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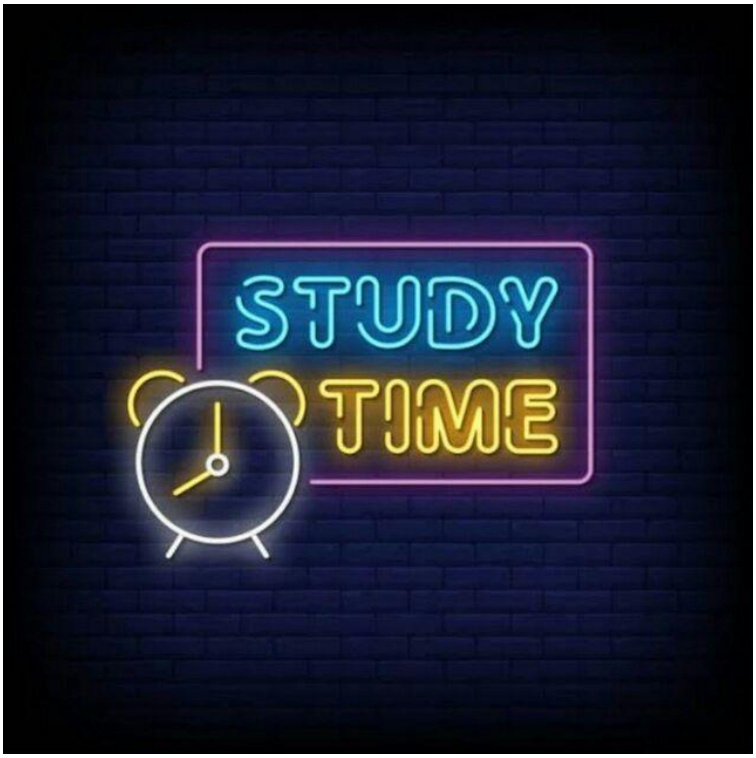

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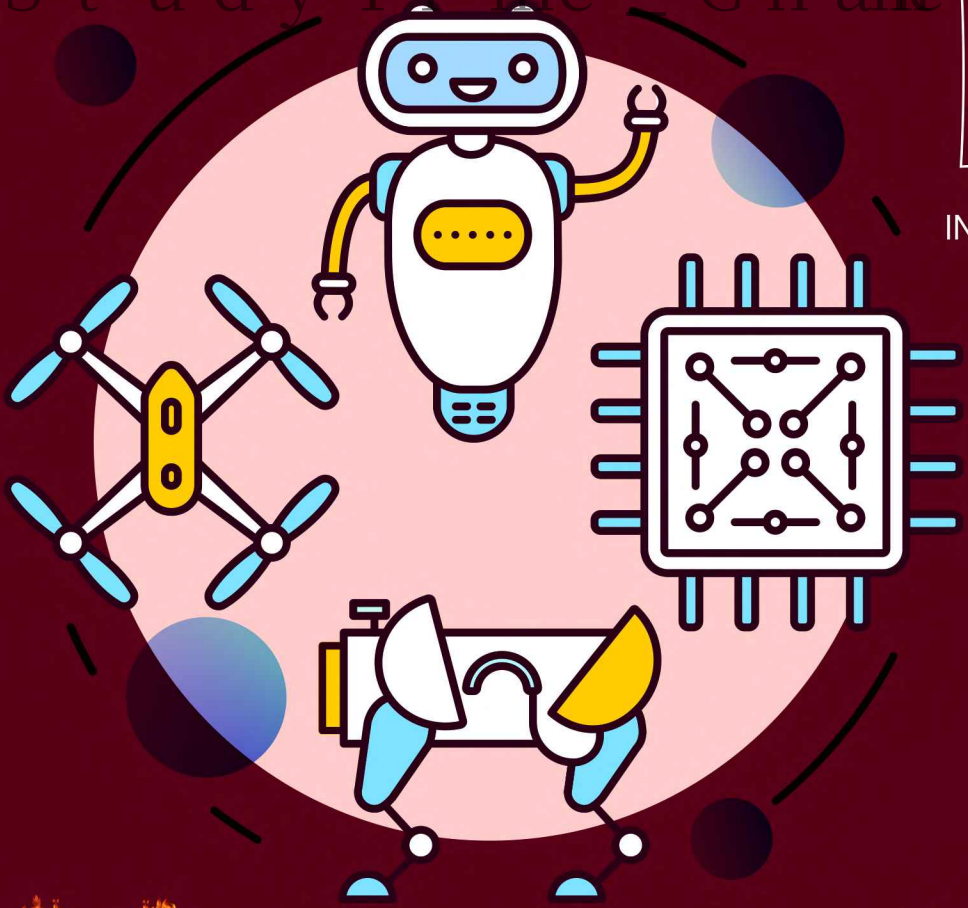

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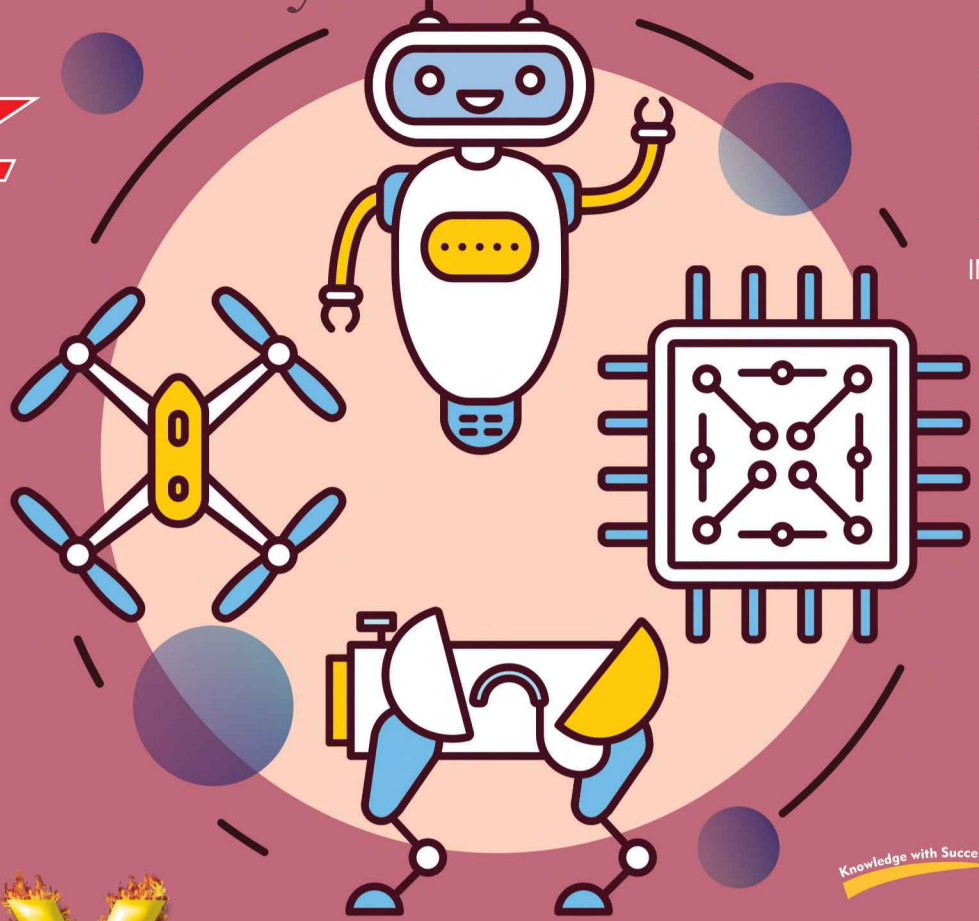

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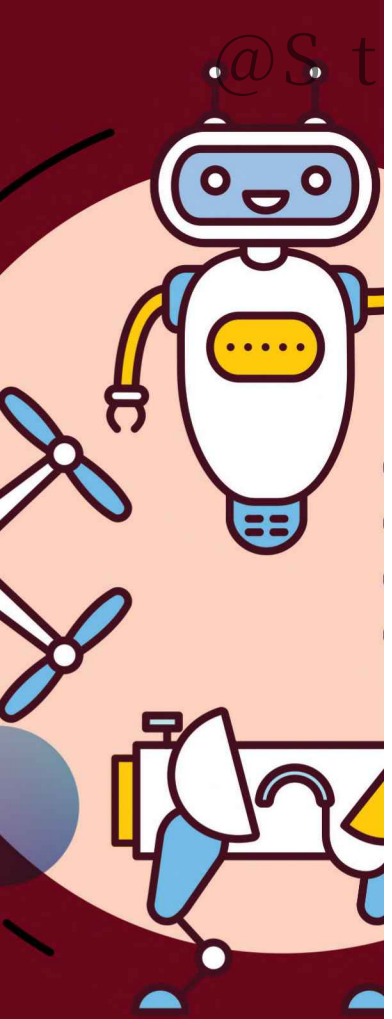

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Contents

PART: A

1. Chemical Reactions and Equations 2
2. Acids, Bases and Salts 30
3. Metals and Non-metals 54
4. Carbon and its Compounds 88
5. Periodic Classification of Elements 123
6. Life Processes 158
7. Control and Coordination 190
8. How do Organisms Reproduce? 214
9. Heredity and Evolution 248
10. Light—Reflection and Refraction 280
11. The Human Eye and the Colourful World 338
12. Electricity 364
13. Magnetic Effects of Electric Current 414
14. Sources of Energy 446
15. Our Environment 468
16. Sustainable Management of Natural Resources 488

PART: B

- Periodic Test – 1 513
  - Pen Paper Test
  - Multiple Assessment
- Periodic Test – 2 517
  - Pen Paper Test
  - Multiple Assessment
- Periodic Test – 3 524
  - Pen Paper Test
  - Multiple Assessment
- CBSE Sample Question Paper–2020 531
- Model Question Papers 1-5 (Unsolved) 545
- CBSE Examination Papers–2020 579

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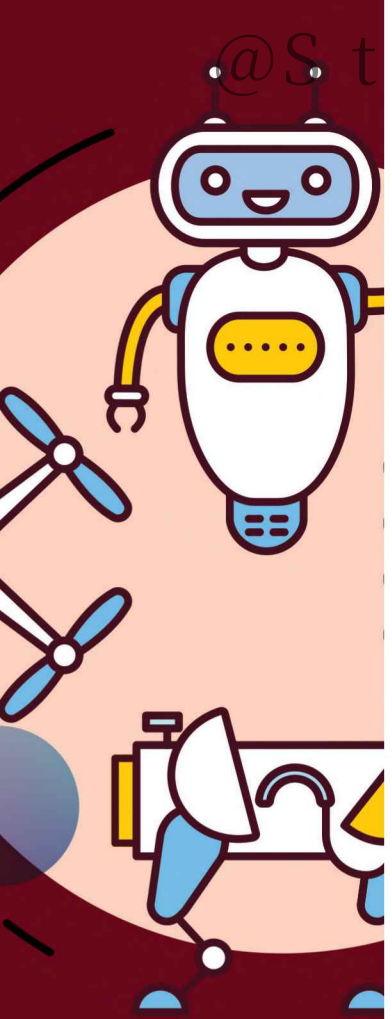

Syllabus

Course Structure Class – X

(Annual Examination)

Marks: 80

Unit No.	Units	Marks	Periods
I	Chemical Substances – Nature and Behaviour	25	55
II	World of Living	23	50
III	Natural Phenomena	12	23
IV	Effects of Current	13	32
V	Natural Resources	07	20
	Total	**80**	
	Internal assessment	**20**	
	Grand Total	**100**	

Theme: Materials **(55 Periods)**

Unit I: Chemical Substances—Nature and Behaviour

Chemical reactions: Chemical equation, Balanced chemical equation, implications of a balanced chemical equation, types of chemical reactions: Combination, decomposition, displacement, double displacement, precipitation, neutralization, oxidation and reduction.

Acids, bases and salts: Their definitions in terms of furnishing of H^+ and OH^- ions, General properties, examples and uses, concept of pH scale (Definition relating to logarithm not required), importance of pH in everyday life; preparation and uses of Sodium Hydroxide, Bleaching powder, Baking soda, Washing soda and Plaster of Paris.

Metals and non-metals: Properties of metals and non-metals; Reactivity series; Formation and properties of ionic compounds; Basic metallurgical processes; Corrosion and its prevention.

Carbon compounds: Covalent bonding in carbon compounds. Versatile nature of carbon. Homologous series. Nomenclature of carbon compounds containing functional groups (halogens, alcohol, ketones, aldehydes, alkanes and alkynes), difference between saturated hydrocarbons and unsaturated hydrocarbons. Chemical properties of carbon compounds (combustion, oxidation, addition and substitution reaction). Ethanol and Ethanoic acid (only properties and uses), soaps and detergents.

Periodic classification of elements: Need for classification, Early attempts at classification of elements (Dobereiner's Triads, Newland's Law of Octaves, Mendeleev's Periodic Table), Modern periodic table, gradation in properties, valency, atomic number, metallic and non-metallic properties.

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Theme: The World of the Living (50 Periods)

Unit II: World of Living

Life processes: 'Living Being'. Basic concept of nutrition, respiration, transport and excretion in plants and animals.

Control and co-ordination in animals and plants: Tropic movements in plants; Introduction of plant hormones; Control and co-ordination in animals; Nervous system; Voluntary, involuntary and reflex action; Chemical co-ordination: animal hormones.

Reproduction: Reproduction in animals and plants (asexual and sexual) reproductive health-need and methods of family planning. Safe sex vs HIV/AIDS. Child bearing and women's health.

Heredity and evolution: Heredity; Mendel's contribution - Laws for inheritance of traits, Sex determination: brief introduction; Basic concepts of evolution.

Theme: Natural Phenomena (23 Periods)

Unit III: Natural Phenomena

Reflection of light by curved surfaces; Images formed by spherical mirrors, centre of curvature, principal axis, principal focus, focal length, mirror formula (Derivation not required), magnification.

Refraction; Laws of refraction, refractive index.

Refraction of light by spherical lens; Image formed by spherical lenses; Lens formula (Derivation not required); Magnification. Power of a lens.

Functioning of a lens in human eye, defects of vision and their corrections, applications of spherical mirrors and lenses.

Refraction of light through a prism, dispersion of light, scattering of light, applications in daily life.

Theme: How Things Work (32 Periods)

Unit IV: Effects of Current

Electric current, potential difference and electric current. Ohm's law; Resistance, resistivity, Factors on which the resistance of a conductor depends. Series combination of resistors, parallel combination of resistors and its applications in daily life. Heating effect of electric current and its applications in daily life. Electric power, Interrelation between P, V, I and R.

Magnetic effects of current: Magnetic field, field lines, field due to a current carrying conductor, field due to current carrying coil or solenoid; Force on current carrying conductor, Fleming's Left Hand Rule, Electric Motor, Electromagnetic induction. Induced potential difference, Induced current. Fleming's Right Hand Rule, Electric Generator, Direct current. Alternating current: frequency of AC. Advantage of AC over DC. Domestic electric circuits.

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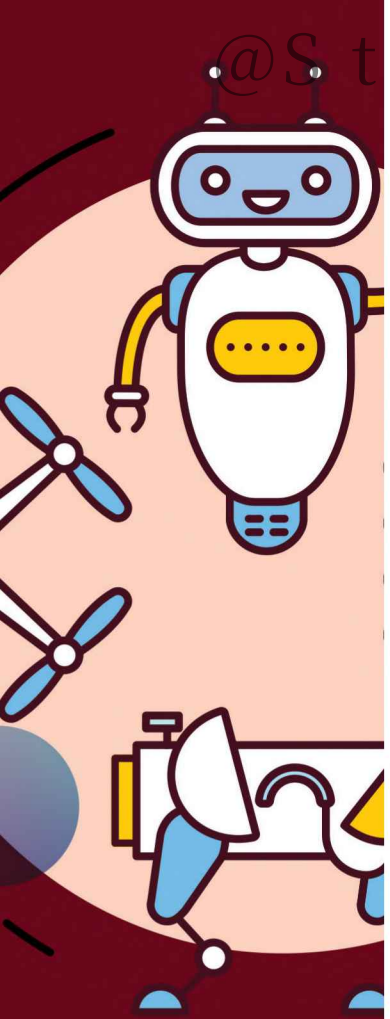

Theme: Natural Resources **(20 Periods)**

Unit V: Natural Resources

Sources of energy: Different forms of energy, conventional and non-conventional sources of energy: Fossil fuels, solar energy; biogas; wind, water and tidal energy; Nuclear energy. Renewable versus non-renewable sources of Energy.

Our environment: Eco-system, Environmental problems, Ozone depletion, waste production and their solutions. Biodegradable and non-biodegradable substances.

Management of natural resources: Conservation and judicious use of natural resources. Forest and wild life; Coal and Petroleum conservation. Examples of people's participation for conservation of natural resources. Big dams: advantages and limitations; alternatives, if any. Water harvesting. Sustainability of natural resources.

Practicals

Practicals should be conducted alongside the concepts taught in theory classes.

(List of Experiments)

1. A. Finding the pH of the following samples by using pH paper / universal indicator: **Unit-I**

   i) Dilute Hydrochloric Acid ii) Dilute NaOH solution

   iii) Dilute Ethanoic Acid Solution iv) Lemon juice

   v) Water

   vi) Dilute Hydrogen Carbonate solution

   B. Studying the properties of acids and bases (HCl & NaOH) by their reaction with: **Unit-I**

   a) Litmus solution (Blue/Red) b) Zinc metal

   c) Solid sodium carbonate

2. Performing and observing the following reactions and classifying them into : **Unit-I**

   A. Combination reaction B. Decomposition reaction

   C. Displacement reaction D. Double displacement reaction

   (i) Action of water on quick lime

   (ii) Action of heat on ferrous sulphate crystals

   (iii) Iron nails kept in copper sulphate solution

   (iv) Reaction between sodium sulphate and barium chloride solutions

3. Observing the action of Zn, Fe, Cu and Al metals on the following salt solutions: **Unit-I**

   i) $ZnSO_4$ (aq) ii) $FeSO_4$ (aq)

   iii) $CuSO_4$ (aq) iv) $Al_2(SO_4)_3$ (aq)

   Arranging Zn, Fe, Cu and Al (metals) in the decreasing order of reactivity based on the above result.

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4. Studying the dependence of potential difference (V) across a resistor on the current (I) passing through it and determine its resistance. Also plotting a graph between V and I. **Unit-IV**
5. Determination of the equivalent resistance of two resistors when connected in series and parallel. **Unit-IV**
6. Preparing a temporary mount of a leaf peel to show stomata. **Unit-II**
7. Experimentally show that carbon dioxide is given out during respiration. **Unit-II**
8. Study of the following properties of acetic acid (ethanoic acid): **Unit-I**

   i) odour ii) solubility in water

   iii) effect on litmus iv) reaction with sodium hydrogen carbonate
9. Study of the comparative cleaning capacity of a sample of soap in soft and hard water. **Unit-I**
10. Determination of the focal length of : **Unit-III**

    i) Concave mirror ii) Convex lens

    by obtaining the image of a distant object.
11. Tracing the path of a ray of light passing through a rectangular glass slab for different angles of incidence. Measure the angle of incidence, angle of refraction, angle of emergence and interpret the result. **Unit-III**
12. Studying (a) binary fission in *Amoeba*, and (b) budding in yeast and *Hydra* with the help of prepared slides. **Unit-II**
13. Tracing the path of the rays of light through a glass prism. **Unit-III**
14. Finding the image distance for varying object distances in case of a convex lens and drawing corresponding ray diagrams to show the nature of image formed. **Unit-III**
15. Identification of the different parts of an embryo of a dicot seed (Pea, gram or red kidney bean). **Unit-II**

General Instructions

1. There will be an Annual Examination based on the entire syllabus.
2. The Annual Examination will be of 80 marks and 20 marks weightage shall be for Internal Assessment.
3. For Internal Assessment:

   (a) There will be Periodic Assessment that would include:

   For 5 marks: Three periodic tests to be conducted by the school. Average of the best two tests to be taken that will have a weightage of 05 marks towards the final result.

   For 5 marks: Diverse methods of assessment as per the need of the class dynamics and curriculum transaction. These may include—short tests, oral test, quiz, concept maps, projects, posters, presentations and enquiry based scientific investigations, etc. and use rubrics for arguing them objectively. This will also have a weightage of 05 marks towards the final result.

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(b) Practical/Laboratory work should be done throughout the year and the student should maintain record of the same. Practical Assessment should be continuous. There will be weightage of 5 marks towards the final result. All practicals listed in the syllabus must be completed.

(c) Portfolio to be prepared by the student. This would include classwork and other sample of student work and will carry a weightage of 5 marks towards the final results.

Assessment Areas (Theory) 2020-21

SCIENCE

Time: 3 hours **Maximum Marks: 80**

Competencies	
Demonstrate Knowledge and Understanding	46%
Application of Knowledge/Concepts	22%
Analyze, Evaluate and Create	32%

Note:

- **Typology of questions:** VSA including objective type questions, Assertion-Reasoning type questions; SA; LA; Source-based/Case-based/Passage-based/ Integrated assessment questions.
- An internal choice of approximately 33% would be provided.

Internal Assessment (20 marks)

- Periodic Assessment—(05 marks + 05 marks)
- Subject Enrichment (Practical work)—05 marks
- Portfolio—05 marks

Suggestive verbs for various competencies

- Demonstrate Knowledge and Understanding

  State, name, list, identify, define, suggest, describe, outline, summarize, etc.
- Application of Knowledge/Concepts

  Calculate, illustrate, show, adapt, explain, distinguish, etc.
- Analyze, Evaluate and Create

  Interpret, analyze, compare, contrast, examine, evaluate, discuss, construct, etc.

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PART–A

- BASIC CONCEPTS—A FLOW CHART
- MORE POINTS TO REMEMBER
- OBJECTIVE TYPE QUESTIONS
  - Multiple Choice Questions
  - Assertion–Reason Questions
  - Passage-based Questions
  - Very Short Answer Questions
- SHORT ANSWER QUESTIONS
- LONG ANSWER QUESTIONS
- HOTS [HIGHER ORDER THINKING SKILLS]
- NCERT CORNER
  - NCERT Intext Questions
  - NCERT Exercises
- SELF-ASSESSMENT TEST

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1 Chemical Reactions and Equations

BASIC CONCEPTS—A FLOW CHART

CHEMICAL REACTION

Process in which one or more substances react to form new substances

Representation

CHEMICAL EQUATION

Shorthand notation of chemical reaction in terms of the symbols, formulae and the ratio of the number of various reactants and products involved

BALANCED CHEMICAL EQUATION

A chemical equation in which the number of atoms of each element on reactant side is equal to that of product side.

TYPES

COMBINATION REACTION

Two or more substances (elements or compounds) combine to form a single substance

$CaO(s) + H_2O(l) \rightarrow Ca(OH)_2(aq)$

DECOMPOSITION REACTION

The breaking down of a single compound into two or more simpler substances

$2FeSO_4(s) \xrightarrow{Heat} Fe_2O_3(s) + SO_2(g) + SO_3(g)$

Ferrous sulphate — Ferric oxide

DISPLACEMENT REACTION

One atom or a group of atoms of a compound is replaced by another atom or group of atoms

$CuSO_4(aq) + Fe(s) \rightarrow FeSO_4(aq) + Cu(s)$

Copper sulphate — Iron — Ferrous sulphate — Copper

THERMAL DECOMPOSITION

A single substance breaks down into two or more simpler substances upon heating

$CaCO_3(s) \xrightarrow{Heat} CaO(s) + CO_2(g)$

Calcium carbonate — Calcium oxide — Carbon dioxide

ELECTRIC DECOMPOSITION

A single substance breaks down into simpler substances upon passage of electric current

$2H_2O(l) \xrightarrow{Electricity} 2H_2(g) + O_2(g)$

PHOTO DECOMPOSITION

A single substance breaks down into simpler substances in presence of sunlight

$2AgCl(s) \xrightarrow{Sunlight} 2Ag(s) + Cl_2(g)$

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On the basis of heat transfer

ENDOTHERMIC REACTION

- Reaction in which heat energy is absorbed
- Mostly decomposition reactions are endothermic reactions

$CaCO_3(s) \xrightarrow{Heat} CaO(s) + CO_2(g)$

EXOTHERMIC REACTION

Reaction in which heat energy is released along with the formation of products

$CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(g)$ + Heat energy

DOUBLE DISPLACEMENT REACTION

Two reacting compounds exchange their corresponding ions and form two new compounds

$AgNO_3(aq)$ + $NaCl(aq) \longrightarrow AgCl(s)$ + $NaNO_3(aq)$

Silver nitrate | Sodium chloride | Silver chloride (White ppt.) | Sodium nitrate

A reaction that produces precipitate (insoluble salt) is called a precipitation reaction

OXIDATION–REDUCTION (REDOX) REACTION

OXIDATION

- Gain of oxygen atoms
- Loss of hydrogen atoms

REDUCTION

- Loss of oxygen atoms
- Gain of hydrogen atoms

Reduction: Copper oxide is being reduced, CuO is an oxidising agent

$CuO + H_2 \xrightarrow{Heat} Cu + H_2O$

Oxidation: Hydrogen is being oxidised, H_2 is the reducing agent

EFFECTS IN EVERYDAY LIFE

CORROSION

Slow conversion of metals into their undesirable compounds (sulphides, carbonates, oxides, etc.) by interaction with atmospheric gases and moisture

$2Fe(s) + \frac{3}{2}O_2(g) + xH_2O(l) \longrightarrow Fe_2O_3.xH_2O(s)$

Iron | (from air) | Moisture | Hydrated ferric oxide (Rust)

RANCIDITY

Oxidation of oils or fats in food resulting in bad taste and smell

Methods of Prevention

- By Adding Antioxidants
- Vacuum Packing
- Replacing Air by Nitrogen
- Refrigeration of the Foodstuff

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MORE POINTS TO REMEMBER

❒ **Observations to determine occurrence of a chemical reaction:**

(*i*) Change in state
(*ii*) Change in colour
(*iii*) Evolution of a gas
(*iv*) Change in temperature

❒ **Steps in writing a balanced chemical equation:**

(*i*) The word equation is written in the formula form.
(*ii*) To balance a chemical equation, first draw boxes around each formula. Do not change anything inside the boxes while balancing the equation.
(*iii*) List the number of atoms of different elements present in the unbalanced equation.
(*iv*) Equalise the number of atoms on both the sides of the reaction.
(*v*) The physical states of the reactants and products are mentioned along with their chemical formulae.

❒ **Oxidising agent** is a substance which gives oxygen or gains hydrogen.

Alternatively, oxidising agent is the substance which oxidises other substances and reduces itself.

❒ **Reducing agent** is a substance which gives hydrogen or gains oxygen.

Alternatively, reducing agent is the substance which reduces other substances and oxidises itself.

Multiple Choice Questions [1 mark]

Each question has 4 choices (a), (b), (c) and (d). Choose and write the correct option.

1. In which of the following equations, the mass is not same on both the sides?

(*a*) Word equation (*b*) Skeletal equation (*c*) Balanced equation (*d*) Both (*a*) and (*b*)

2. Which among the following statement(s) is (are) true? Exposure of silver chloride to sunlight for a long duration turns grey due to *[NCERT Exemplar]*

(*i*) the formation of silver by decomposition of silver chloride
(*ii*) sublimation of silver chloride
(*iii*) decomposition of chlorine gas from silver chloride
(*iv*) oxidation of silver chloride

(*a*) (*i*) only (*b*) (*i*) and (*iii*) (*c*) (*ii*) and (*iii*) (*d*) (*iv*) only

3. Three beakers labelled as A, B and C each containing 25 mL of water were taken. A small amount of NaOH, anhydrous $CuSO_4$ and NaCl were added to the beakers A, B and C respectively. It was observed that there was an increase in the temperature of the solutions contained in beakers A and B, whereas in case of beaker C, the temperature of the solution falls. Which one of the following statements(s) is (are) correct? *[NCERT Exemplar]*

(*i*) In beakers A and B, exothermic process has occurred.
(*ii*) In beakers A and B, endothermic process has occurred.
(*iii*) In beaker C exothermic process has occurred.
(*iv*) In beaker C endothermic process has occurred.

(*a*) (*i*) only (*b*) (*ii*) only (*c*) (*i*) and (*iv*) (*d*) (*ii*) and (*iii*)

4. Corrosion of metals can be prevented

(*a*) by coating the metal surface with a paint.
(*b*) by applying film of grease and oil on the surface of the metal.
(*c*) by covering the surface of the metal with another metal which is more electropositive.
(*d*) all of these.

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5. Identify the chemical equation which represents a complete balanced equation for the reaction of barium chloride with sodium sulphate to produce barium sulphate and sodium chloride.

(*a*) $BaCl_2(aq) + Na_2SO_4(aq) \longrightarrow BaSO_4(s) + NaCl(aq)$

(*b*) $BaCl_2(aq) + Na_2SO_4(aq) \longrightarrow 2BaSO_4(s) + 2NaCl(aq)$

(*c*) $2BaCl_2(aq) + Na_2SO_4(aq) \longrightarrow 2BaSO_4(s) + NaCl(aq)$

(*d*) $BaCl_2(aq) + Na_2SO_4(aq) \longrightarrow BaSO_4(s) + 2NaCl(aq)$

6. Which of the following is not a physical change? [*NCERT Exemplar*]

(*a*) Boiling of water to give water vapour

(*b*) Melting of ice to give water

(*c*) Dissolution of salt in water

(*d*) Combustion of Liquefied Petroleum Gas (LPG)

7. Which among the following is (are) double displacement reaction(s)? [*NCERT Exemplar*]

(*i*) $Pb + CuCl_2 \longrightarrow PbCl_2 + Cu$

(*ii*) $Na_2SO_4 + BaCl_2 \longrightarrow BaSO_4 + 2NaCl$

(*iii*) $C + O_2 \longrightarrow CO_2$

(*iv*) $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

(*a*) (*i*) and (*iv*) (*b*) (*ii*) only

(*c*) (*i*) and (*ii*) (*d*) (*iii*) and (*iv*)

8. Which of the following reactions represents a combination reaction?

(*a*) $CaO(s) + H_2O(l) \longrightarrow Ca(OH)_2\ (aq)$

(*b*) $CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$

(*c*) $Zn(s) + CuSO_4(aq) \longrightarrow ZnSO_4(aq) + Cu(s)$

(*d*) $2FeSO_4(s) \longrightarrow Fe_2O_3(s) + SO_2(g) + SO_3(g)$

9. Which of the following observation help(s) us to determine that a chemical change has taken place?

(*a*) Change in temperature. (*b*) Change in colour.

(*c*) Evolution of a gas. (*d*) All of these.

10. A dilute ferrous sulphate solution was gradually added to the beaker containing acidified potassium permanganate solution. The light purple colour of the solution fades and finally disappears. Which of the following is the correct explanation for the observation? [*NCERT Exemplar*]

(*a*) $KMnO_4$ is an oxidising agent, it oxidises $FeSO_4$

(*b*) $FeSO_4$ acts as an oxidising agent and oxidises $KMnO_4$

(*c*) The colour disappears due to dilution; no reaction is involved

(*d*) $KMnO_4$ is an unstable compound and decomposes in presence of $FeSO_4$ to a colourless compound.

11. Which of the following is (are) an endothermic processes?

(*i*) Dilution of sulphuric acid. **(*ii*) Sublimation of dry ice.**

(*iii*) Condensation of water vapours. **(*iv*) Evaporation of water.** [*NCERT Exemplar*]

(*a*) (*i*) and (*iii*) (*b*) (*ii*) only

(*c*) (*iii*) only (*d*) (*ii*) and (*iv*)

12. Which of the following are combination reactions? [*NCERT Exemplar*]

(*i*) $2KClO_3 \longrightarrow 2KCl + 3O_2$ **(*ii*) $MgO + H_2O \longrightarrow Mg(OH)_2$**

(*iii*) $4Al + 3O_2 \longrightarrow 2Al_2O_3$ **(*iv*) $Zn + FeSO_4 \longrightarrow ZnSO_4 + Fe$**

(*a*) (*i*) and(*iii*) (*b*) (*iii*) and (*iv*)

(*c*) (*ii*) and (*iv*) (*d*) (*ii*) and (*iii*)

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13. In which of the following chemical equations, the abbreviations represent the correct states of the reactants and products involved at reaction temperature? [NCERT Exemplar]

(a) $2H_2(l) + O_2(l) \longrightarrow 2H_2O(g)$ (b) $2H_2(g) + O_2(l) \longrightarrow 2H_2O(l)$

(c) $2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$ (d) $2H_2(g) + O_2(g) \longrightarrow 2H_2O(g)$

14. Which of the following are exothermic processes?

(i) Reaction of water with quick lime **(ii) Dilution of an acid**

(iii) Evaporation of water **(iv) Sublimation of camphor (crystals)**

[NCERT Exemplar]

(a) (i) and (ii) (b) (ii) and (iii)

(c) (i) and (iv) (d) (iii) and (iv)

15. Which one of the following processes involve chemical reactions? [NCERT Exemplar]

(a) Storing of oxygen gas under pressure in a gas cylinder

(b) Liquefaction of air

(c) Keeping petrol in a china dish in the open

(d) Heating copper wire in presence of air at high temperature

16. In the double displacement reaction between aqueous potassium iodide and aqueous lead nitrate, a yellow precipitate of lead iodide is formed. While performing the activity if lead nitrate is not available, which of the following can be used in place of lead nitrate?

[NCERT Exemplar]

(a) Lead sulphate (insoluble) (b) Lead acetate

(c) Ammonium nitrate (d) Potassium sulphate

17. Solid calcium oxide reacts vigorously with water to form calcium hydroxide accompanied by liberation of heat. This process is called slaking of lime. Calcium hydroxide dissolves in water to form its solution called lime water. Which among the following is (are) true about slaking of lime and the solution formed? [NCERT Exemplar]

(i) It is an endothermic reaction

(ii) It is an exothermic reaction

(iii) The pH of the resulting solution will be more than seven

(iv) The pH of the resulting solution will be less than seven

(a) (i) and(ii) (b) (ii) and (iii) (c) (i) and (iv) (d) (iii) and (iv)

18. What happens when dilute hydrochloric acid is added to iron filings?

(a) Hydrogen gas and iron (II) chloride are produced.

(b) Chlorine gas and ferric hydroxide are produced.

(c) Heat is absorbed, *i.e.*, test tubes becomes cold.

(d) Iron salt and water are produced.

19. The following reaction is used for preparation of oxygen gas in the laboratory:

$$2KClO_3(s) \xrightarrow[\text{Catalyst}]{\text{Heat}} 2KCl(s) + 3O_2(g)$$

Which of the following statements is correct about the reaction? [NCERT Exemplar]

(a) It is a decomposition reaction and endothermic in nature.

(b) It is a combination reaction.

(c) It is a decomposition reaction and is accompanied by release of heat.

(d) It is a photo chemical decomposition reaction and exothermic in nature.

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20. The following reaction is an example of a

$4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O(g)$

(*i*) displacement reaction **(*ii*) combination reaction**

(*iii*) redox reaction **(*iv*) neutralisation reaction** *[NCERT Exemplar]*

(*a*) (*i*) and (*iv*) (*b*) (*ii*) and (*iii*) (*c*) (*i*) and (*iii*) (*d*) (*iii*) and (*iv*)

21. Chemically rust is

(*a*) ferric sulphate (*b*) ferric oxide

(*c*) hydrated ferrous oxide (*d*) hydrated ferric oxide

Answers

1. (*d*)	**2.** (*a*)	**3.** (*c*)	**4.** (*d*)	**5.** (*d*)	**6.** (*d*)	**7.** (*b*)
8. (*a*)	**9.** (*d*)	**10.** (*a*)	**11.** (*d*)	**12.** (*d*)	**13.** (*d*)	**14.** (*a*)
15. (*d*)	**16.** (*b*)	**17.** (*b*)	**18.** (*a*)	**19.** (*a*)	**20.** (*c*)	**21.** (*d*)

Assertion-Reason Questions [1 mark]

The following questions consist of two statements — Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

1. Assertion (*A*) : Decomposition of vegetable matter into compost is an example of exothermic reactions.

Reason (*R*) : Exothermic reaction are those reactions in which heat is evolved.

2. Assertion (*A*) : When HCl is added to zinc granules, a chemical reaction occurs.

Reason (*R*) : Evolution of a gas and change in colour indicate that the chemical reaction is taking place.

3. Assertion (*A*) : Calcium carbonate when heated gives calcium oxide and water.

Reason (*R*) : On heating calcium carbonate, decomposition reaction takes place.

4. Assertion (*A*) : Brown fumes are produced when lead nitrate is heated.

Reason (*R*) : Nitrogen dioxide gas is produced as a by product due to the decomposition of lead nitrate.

5. Assertion (*A*) : White silver chloride turns grey in sunlight.

Reason (*R*) : Decomposition of silver chloride in presence of sunlight takes place to form silver metal and chlorine gas.

6. Assertion (*A*) : Pungent smelling gas is produced when sulphur burns in air.

Reason (*R*) : Sulphur trioxide is formed on reaction of sulphur with oxygen.

7. Assertion (*A*) : In a reaction of copper with oxygen, copper serves as a reducing agent.

Reason (*R*) : The substance which gains oxygen in a chemical reaction acts as a reducing agent.

Answers

1. (*a*)	**2.** (*b*)	**3.** (*d*)	**4.** (*a*)	**5.** (*a*)	**6.** (*c*)	**7.** (*a*)

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Passage-based Questions

Answer the questions below each passage on the basis of your understanding of the paragraph and the related studied concepts.

1 Oxidation is the process of gaining of oxygen, or losing of hydrogen. Reduction is the process of losing of oxygen or gaining of hydrogen. The substance which undergoes oxidation is the reducing agent while the substance which undergoes reduction is known as the oxidising agent. Oxidation and reduction always take place together and these type of reactions are known as redox reactions. Some of the examples of redox reactions are given below:

I.	$Pb_3O_4 + 8HCl \longrightarrow 3PbCl_2 + Cl_2 + 4H_2O$
II.	$2Mg + O_2 \longrightarrow 2MgO$
III.	$CuSO_4 + Zn \longrightarrow Cu + ZnSO_4$
IV.	$V_2O_5 + 5Ca \longrightarrow 2V + 5CaO$
V.	$3Fe + 4H_2O \longrightarrow Fe_3O_4 + 4H_2$
VI.	$CuO + H_2 \longrightarrow Cu + H_2O$

(*i*) Give two examples of oxidation reaction from your everyday life.

(*ii*) Write the oxidising agent in the reaction III and VI.

(*iii*) Which of the following is an oxidising agent?

(*a*) $LiAlH_4$ (*b*) Alkaline $KMnO_4$

(*c*) Acidified $K_2Cr_2O_7$ (*d*) Both (*b*) and (*c*)

(*iv*) Out of oxidation and reduction, which reaction takes place at anode?

2. Corrosion is the phenomenon of deterioration of surface of metal in presence of air and moisture. It is a natural process and in the presence of a moist atmosphere, chemically active metals get corroded. This is an oxidation reaction. Rusting is the process where iron corrodes due to exposure to the atmosphere. The main circumstance of corrosion occurs with iron because it is a structural material in construction, bridges, buildings, rail transport, ships, etc. Aluminium is also an important structural metal, but even aluminium undergoes oxidation reactions. However, aluminium doesn't corrode or oxidize as rapidly as its reactivity suggests.
Copper (Cu) corrodes and forms a basic green carbonate.

(*i*) What is rusting?

(*ii*) Which two metals do not corrode easily?

(*iii*) Write the chemical name of the compound formed on corrosion of silver.

(*iv*) Corrosion is

(*a*) a redox reaction (*b*) a reduction reaction

(*c*) a displacement reaction (*d*) an oxidation reaction

Answers

1. (*i*) Corrosion and rancidity (*ii*) $CuSO_4$ in (III) and CuO in (VI)

(*iii*) (*d*) (*iv*) Oxidation takes place at anode.

2. (*i*) The deterioration of surface of iron in presence of air and moisture is called rusting.

(*ii*) Gold and platinum.

(*iii*) Silver sulphide, Ag_2S

(*iv*) (*d*)

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Very Short Answer Questions [1 mark]

Each of the following questions are of 1 mark and have to be answered in one word or one sentence.

Q. 1. What does the word aqueous (*aq*) represent in a chemical reaction?

Ans. It represents that the compound is present as a solution in water.

Q. 2. Why is combustion of Liquified Petroleum Gas (LPG) a chemical change?

Ans. Combustion of Liquified Petroleum Gas (LPG) is a chemical change because after its combustion, a new substance is formed and cannot be turned back into LPG.

Q. 3. What is wrong with the following equation?

$$\mathbf{Mg + O \longrightarrow MgO}$$

Identify the mistake and balance the equation.

Ans. In this equation, oxygen should be in molecular form (O_2).

$$2Mg + O_2 \longrightarrow 2MgO$$

Q. 4. What is meant by skeletal equation?

Ans. The equation where the number of atoms of each element on both the sides of a chemical equation are not equal is called skeletal equation.

Q. 5. Potassium chlorate ($KClO_3$) on heating forms potassium chloride and oxygen. Write a balanced equation for this reaction.

Ans. $2KClO_3(s) \longrightarrow 2KCl(s) + 3O_2(g)$

Q. 6. What do you observe when magnesium ribbon is burnt?

Ans. When magnesium ribbon is burnt, formation of white powder is observed along with white dazzling flame.

Q. 7. Convey the following information in the form of a balanced chemical equation:
"An aqueous solution of ferrous sulphate reacts with an aqueous solution of sodium hydroxide to form a precipitate of ferrous hydroxide and sodium sulphate remains in solution."

Ans. $FeSO_4(aq) + 2NaOH\ (aq) \longrightarrow Fe(OH)_2(s) + Na_2SO_4(aq)$

Q. 8. Balance the following chemical equation:

$$\mathbf{Pb(NO_3)_2(s) \xrightarrow{Heat} PbO(s) + NO_2(g) + O_2(g)}$$

Ans. $2Pb(NO_3)_2(s) \xrightarrow{Heat} 2PbO(s) + 4NO_2(g) + O_2(g)$

Q. 9. Give one example of a combination reaction which is also exothermic.

Ans. When quicklime or calcium oxide (CaO) reacts with water, slaked lime [$Ca(OH)_2$] is formed. During this reaction a large amount of heat is released. So, this reaction is an exothermic reaction.

$$\underset{\text{(Quick lime)}}{CaO(s)} + \underset{\text{Water}}{H_2O(l)} \longrightarrow \underset{\text{(Slaked lime)}}{Ca(OH)_2(aq)} + \text{Heat}$$

Q. 10. What is the difference between the following two types of reactions?

$$\mathbf{AgNO_3 + HCl \longrightarrow AgCl + HNO_3}$$

$$\mathbf{Mg + 2HCl \longrightarrow MgCl_2 + H_2}$$

Ans. The first reaction is a double displacement reaction whereas second reaction is a single displacement reaction.

Q. 11. Why is hydrogen peroxide kept in coloured bottles?

Ans. This is done in order to cut off light because hydrogen peroxide decomposes into water and oxygen in the presence of light.

$$2H_2O_2 \xrightarrow{Light} 2H_2O + O_2$$

Q. 12. Give one example of a reaction which is a double displacement reaction as well as a precipitation reaction.

Ans. $\underset{\text{Silver nitrate}}{AgNO_3(aq)} + \underset{\text{Sodium chloride}}{NaCl(aq)} \longrightarrow \underset{\text{Silver chloride (ppt.)}}{AgCl(s)\downarrow} + \underset{\text{Sodium nitrate}}{NaNO_3(aq)}$

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Q. 13. Why is photosynthesis considered an endothermic reaction?

Ans. Photosynthesis is an endothermic reaction because energy, in the form of sunlight is absorbed during the process of photosynthesis by green plants.

Q. 14. What type of reaction is represented by the digestion of food in our body?

Ans. Decomposition reaction.

Q. 15. How will you test for the gas which is liberated when hydrochloric acid reacts with an active metal?

Ans. When an active metal like Zn reacts with HCl, the gas produced burns with a pop sound which indicates that it is a hydrogen gas.

$$Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(s) + H_2(g)$$

Q. 16. Can a double displacement reaction take place when the products are highly soluble or highly ionised?

Ans. No, double displacement reaction takes place when there is a formation of a slightly soluble salt.

Q. 17. What changes in the colour of iron nails and copper sulphate solution do you observe after keeping the iron nails dipped in copper sulphate solution for about 30 minutes?

Ans. Iron nails become brownish in colour and the blue colour of copper sulphate solution fades. This is because iron displaces copper from copper sulphate solution and forms ferrous sulphate which is light green in colour.

Q. 18. Name the oxidising and reducing agent in the following reaction:

$$\mathbf{2H_2S + SO_2 \longrightarrow 2H_2O + 3S\downarrow}$$

Ans. H_2S is the reducing agent while SO_2 is the oxidising agent.

Q. 19. A dilute ferrous sulphate solution was gradually added to the beaker containing acidified potassium permanganate solution. The light purple colour of the solution fades and finally disappears. Write the correct explanation for this observation.

Ans. Potassium permanganate solution ($KMnO_4$) is an oxidising agent. It oxidises ferrous sulphate ($FeSO_4$) to ferric sulphate [$Fe_2(SO_4)_3$].

Q. 20. Define rancidity.

Ans. The oxidation of oils or fats in food resulting in a bad taste and smell is called rancidity.

Q. 21. Name one synthetic antioxidant.

Ans. Butylated hydroxyanisole (BHA).

Short Answer Questions [3 marks]

Each of the following questions are of 3 marks and have to be answered in about 50-60 words.

Q. 1. (i) 1 g of ammonium chloride is added to a test tube containing 2 g barium hydroxide. What happens when you touch the bottom of the test tube? Give reason.

(ii) Write the chemical equation for the reaction.

Ans. (i) The bottom of the test tube becomes cold. The reaction is an endothermic reaction.

(ii) $Ba(OH)_2 + 2NH_4Cl \longrightarrow BaCl_2 + 2NH_3 + 2H_2O$

Q. 2. Which among the following are physical or chemical changes?

(i) Evaporation of petrol

(ii) Burning of Liquefied Petroleum Gas (LPG)

(iii) Heating of an iron rod to red hot

(iv) Curdling of milk

(v) Sublimation of solid ammonium chloride [*NCERT Exemplar*]

Ans. (i) Physical change (ii) Chemical change

(iii) Physical change (iv) Chemical change

(v) Physical change

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Q. 3. How do we come to know that a chemical reaction has taken place?

Ans. The presence of any of the following changes helps us to determine that a chemical reaction has taken place.

(*i*) Formation of new substance(s) (*ii*) Change in state

(*iii*) Change in colour (*iv*) Change in temperature

(*v*) Formation of a precipitate (*vi*) Evolution of a gas

For example, if on mixing two substances a gas is evolved, then we can say that a chemical reaction has taken place.

Q. 4. Which among the following changes are exothermic or endothermic in nature?

(*i*) Decomposition of ferrous sulphate

(*ii*) Dilution of sulphuric acid

(*iii*) Dissolution of sodium hydroxide in water

(*iv*) Dissolution of ammonium chloride in water [*NCERT Exemplar*]

Ans. (*i*) is endothermic as heat is absorbed in these changes.

(*ii*) is exothermic as heat is released in these changes.

(*iii*) is exothermic as heat is released in these changes.

(*iv*) is endothermic as heat is absorbed in these changes.

Q. 5. What is an oxidation reaction? Give an example of oxidation reaction. Is oxidation an exothermic or an endothermic reaction?

Ans. The reaction in which oxygen combines with other elements or compounds is known as an oxidation reaction. For example, burning of hydrogen is an oxidation process in which hydrogen combines with oxygen to form water.

$$2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$$

Oxidation reactions are exothermic.

Q. 6. Give reasons:

(*i*) Aluminium is a reactive metal but is still used for packing food articles.

(*ii*) Red litmus paper turns blue when touched with aqueous solution of magnesium oxide.

(*iii*) Fire flies glow at night. [*NCERT Exemplar*]

Ans. (*i*) On exposure to air, aluminium forms a hard protective layer of aluminium oxide (Al_2O_3) which prevent further oxidation.

(*ii*) Magnesium oxide is an oxide of a metal, so, it is basic in nature. Due to its basic character it turns red litmus paper blue when touched with its aqueous solution.

(*iii*) Fire flies have a protein which in the presence of enzyme undergoes aerial oxidation. This is a chemical reaction which involves emission of visible light. Therefore, fire flies glow at night.

Q. 7. Complete the missing components/variables given as *x* and *y* in the following reactions:

(*i*) $\mathbf{Pb(NO_3)_2(aq) + 2KI(aq) \longrightarrow PbI_2(x) + 2KNO_3(y)}$

(*ii*) $\mathbf{Cu(s) + 2AgNO_3(aq) \longrightarrow Cu(NO_3)_2(aq) + x(s)}$

(*iii*) $\mathbf{Zn(s) + H_2SO_4(aq) \longrightarrow ZnSO_4(x) + H_2(y)}$

(*iv*) $\mathbf{CaCO_3(s) \xrightarrow{x} CaO(s) + CO_2(g)}$ [*NCERT Exemplar*]

Ans. (*i*) *x* — (*s*); *y* — (*aq*)

(*ii*) *x* — 2Ag

(*iii*) *x* — (*aq*); *y* — (*g*)

(*iv*) *x* — Heat

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Q. 8. Explain why

(*i*) zinc liberates hydrogen gas when reacted with dilute hydrochloric acid, whereas copper does not? [*NCERT Exemplar*]

(*ii*) we store silver chloride in dark coloured bottles? [*NCERT Exemplar*]

Ans. (*i*) Zinc is above hydrogen whereas copper is below hydrogen in the activity series of metals. That is why zinc displaces hydrogen from dilute hydrochloric acid, while copper does not.

$$Zn + HCl \longrightarrow ZnCl_2 + H_2$$
$$Cu + HCl \longrightarrow \text{No reaction}$$

(*ii*) Silver chloride on exposure to sunlight may decompose as per the following reaction.

$$2AgCl(s) \longrightarrow 2Ag(s) + Cl_2(g)$$

Therefore, it is stored in dark coloured bottles.

Q. 9. On adding dilute HCl to copper oxide powder, the solution formed is blue-green. Predict the new compound formed which imparts a blue-green colour to the solution.

Ans. The new compound formed is copper(II) chloride ($CuCl_2$), which imparts blue-green colour to the solution.

$$\underset{\text{Copper oxide}}{CuO} + 2HCl \longrightarrow \underset{\substack{\text{Copper(II) chloride}\\ \text{(Blue-green)}}}{CuCl_2} + H_2O$$

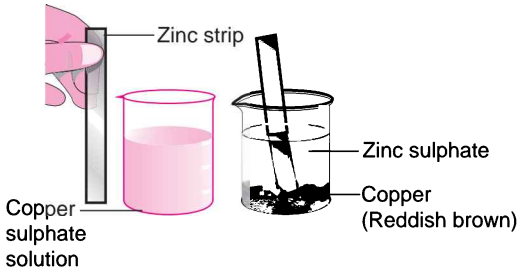
Q. 10. A solution of potassium chloride when mixed with silver nitrate solution, an insoluble white substance is formed. Write the chemical reaction involved and also mention the type of the chemical reaction. [*NCERT Exemplar*]

Ans. $KCl(aq) + AgNO_3(aq) \longrightarrow AgCl(s) + KNO_3(aq)$

It is a double displacement and precipitation reaction.

Q. 11. Draw a labelled diagram to show displacement reaction between copper and zinc. Also write the chemical equation for the reaction.

Ans.



$$CuSO_4 + Zn \longrightarrow ZnSO_4 + Cu$$

Q. 12. Identify the substance oxidised, substance reduced, oxidising agent and reducing agent:

$$\mathbf{MnO_2 + 4HCl \longrightarrow MnCl_2 + 2H_2O + Cl_2}$$

Ans.
Substance oxidised : HCl
Substance reduced : MnO_2
Oxidising agent : MnO_2
Reducing agent : HCl

Q. 13. Grapes hanging on the plant do not ferment but after being plucked from the plant can be fermented. Under what conditions do these grapes ferment? Is it a chemical or a physical change? [*NCERT Exemplar*]

Ans. Grapes when attached to the plants are living and therefore, their own immune system prevents fermentation. The microbes can grow in the plucked grapes and under anaerobic conditions these can be fermented. This is a chemical change.

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Q. 14. A copper coin was kept dipped in silver nitrate solution for a few hours/days. What will happen to the copper coin? What will happen to the colour of the solution?

Ans. Copper is more reactive than silver. Hence, it displaces silver from the silver nitrate solution according to the given reaction.

$$\underset{\text{Copper}}{Cu(s)} + \underset{\text{Silver nitrate}}{2AgNO_3(aq)} \longrightarrow \underset{\text{Copper(II) nitrate}}{Cu(NO_3)_2(aq)} + \underset{\text{Silver}}{2Ag(s)}$$

The silver thus formed is deposited on the surface of copper, thereby giving it a white shining appearance.

The solution becomes blue due to the formation of copper nitrate.

Q. 15. Identify the reducing agent in the following reactions.

(*i*) $\mathbf{4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O}$

(*ii*) $\mathbf{H_2O + F_2 \longrightarrow HF + HOF}$

(*iii*) $\mathbf{Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2}$

(*iv*) $\mathbf{2H_2 + O_2 \longrightarrow 2H_2O}$ [*NCERT Exemplar*]

Ans. (*i*) Ammonia (NH_3)

(*ii*) Water (H_2O) as F_2 is getting reduced to HF

(*iii*) Carbon monoxide (CO)

(*iv*) Hydrogen (H_2)

Q. 16. Translate the following statements into chemical equations and balance them:

(*i*) Lead nitrate reacts with sulphuric acid to form a precipitate of lead sulphate and nitric acid.

(*ii*) Calcium carbonate reacts with hydrochloric acid to produce calcium chloride, water and carbon dioxide.

(*iii*) Aluminium metal strip is added in hydrochloric acid to produce aluminium chloride and hydrogen gas.

Ans. (*i*) $Pb(NO_3)_2(aq) + H_2SO_4(aq) \longrightarrow PbSO_4(s) + 2HNO_3(aq)$

(*ii*) $CaCO_3(s) + 2HCl(aq) \longrightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$

(*iii*) $2Al(s) + 6HCl(aq) \longrightarrow 2AlCl_3(aq) + 3H_2(g)$

Q. 17. Write the balanced chemical equations for the following reactions:

(*i*) Sodium carbonate on reaction with hydrochloric acid in equal molar concentrations gives sodium chloride and sodium hydrogen carbonate.

(*ii*) Sodium hydrogen carbonate on reaction with hydrochloric acid gives sodium chloride, water and liberates carbon dioxide.

(*iii*) Copper sulphate on treatment with potassium iodide precipitates cuprous iodide (Cu_2I_2), liberates iodine gas and also forms potassium sulphate. [*NCERT Exemplar*]

Ans. (*i*) $Na_2CO_3(s) + HCl(aq) \longrightarrow NaCl(aq) + NaHCO_3(s)$

(*ii*) $NaHCO_3(s) + HCl(aq) \longrightarrow NaCl(s) + H_2O(l) + CO_2(g)$

(*iii*) $2CuSO_4(aq) + 4KI(s) \longrightarrow Cu_2I_2(s) + 2K_2SO_4(aq) + I_2(s)$

Q. 18. Write the balanced chemical equations for the following reactions and identify the type of reaction in each case.

(*i*) Nitrogen gas is treated with hydrogen gas in the presence of a catalyst at 773 K to form ammonia gas.

(*ii*) Sodium hydroxide solution is treated with acetic acid to form sodium acetate and water.

(*iii*) Ethanol is warmed with ethanoic acid to form ethyl acetate in the presence of concentrated H_2SO_4.

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(iv) Ethene is burnt in the presence of oxygen to form carbon dioxide, water and releases heat and light. [*NCERT Exemplar*]

Ans. (*i*) $N_2(g) + 3H_2(g) \xrightarrow[773\ K]{\text{Catalyst}} 2NH_3(g)$

Combination reaction

(*ii*) $NaOH(aq) + CH_3COOH(aq) \longrightarrow CH_3COONa(aq) + H_2O(l)$

Double displacement reaction/Neutralisation reaction

(*iii*) $C_2H_5OH(l) + CH_3COOH(l) \xrightarrow{H^+} CH_3COOC_2H_5(l) + H_2O(l)$

Double displacement reaction/Esterification reaction

(*iv*) $C_2H_4(g) + 3O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(g) + \text{Heat} + \text{Light}$

Redox reaction/Combustion reaction

Q. 19. Write the balanced chemical equations for the following reactions and identify the type of reaction in each case.

(i) Thermit reaction, iron (III) oxide reacts with aluminium and gives molten iron and aluminium oxide.

(ii) Magnesium ribbon is burnt in an atmosphere of nitrogen gas to form solid magnesium nitride.

(iii) Chlorine gas is passed in an aqueous potassium iodide solution to form potassium chloride solution and solid iodine.

(iv) Ethanol is burnt in air to form carbon dioxide, water and releases heat. [*NCERT Exemplar*]

Ans. (*i*) $Fe_2O_3(s) + 2Al(s) \longrightarrow Al_2O_3(s) + 2Fe(l) + \text{Heat}$ — Displacement reaction

(*ii*) $3Mg(s) + N_2(g) \longrightarrow Mg_3N_2(s)$ — Combination reaction

(*iii*) $2KI(aq) + Cl_2(g) \longrightarrow 2KCl(aq) + I_2(s)$ — Displacement reaction

(*iv*) $C_2H_5OH(l) + 3O_2(g) \longrightarrow 2CO_2(g) + 3H_2O(l) + \text{Heat}$ — Combustion reaction

Q. 20. (i) Classify the following reactions into different types:

(a) $\mathbf{AgNO_3(aq) + NaCl(aq) \longrightarrow AgCl(s) + NaNO_3(aq)}$

(b) $\mathbf{CaO(s) + H_2O(l) \longrightarrow Ca(OH)_2(aq)}$

(c) $\mathbf{2KClO_3(s) \xrightarrow{\Delta} 2KCl(aq) + 3O_2(g)}$

(d) $\mathbf{Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu}$ [*CBSE 2019 (31/4/1)*]

(ii) Translate the following statement into a balanced chemical equation:

"Barium chloride reacts with aluminum sulphate to give aluminium chloride and barium sulphate."

Ans. (*i*) (*a*) Double displacement reaction, precipitation reaction

(*b*) Combination reaction

(*c*) Thermal decomposition reaction

(*d*) Displacement reaction

(*ii*) $3BaCl_2(aq) + Al_2(SO_4)_3(aq) \longrightarrow 2AlCl_3(aq) + 3BaSO_4(s)$

Q. 21. Name the type of chemical reaction represented by the following equation:

(i) $\mathbf{CaO + H_2O \longrightarrow Ca(OH)_2}$

(ii) $\mathbf{3BaCl_2 + Al_2(SO_4)_3 \longrightarrow 2AlCl_3 + 3BaSO_4}$

(iii) $\mathbf{2FeSO_4 \xrightarrow{Heat} Fe_2O_3 + SO_2 + SO_3}$ [*CCE 2016*]

Ans. (*i*) Combination reaction

(*ii*) Double displacement reaction

(*iii*) Thermal decomposition reaction

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Q. 22. Translate the following statements into chemical equations and then balance the equations:

(*i*) Phosphorus burns in oxygen to give phosphorus pentoxide.

(*ii*) Aluminium metal replaces iron from ferric oxide, Fe_2O_3, giving aluminium oxide and iron.

(*iii*) Carbon disulphide burns in air to give carbon dioxide and sulphur dioxide.

(*iv*) Barium chloride reacts with zinc sulphate to give zinc chloride and barium sulphate.

Ans. (*i*) $P_4(s) + 5O_2(g) \longrightarrow 2P_2O_5(s)$

(*ii*) $2Al(s) + Fe_2O_3(s) \longrightarrow Al_2O_3(s) + 2Fe(l)$

(*iii*) $CS_2(s) + 3O_2(g) \longrightarrow CO_2(g) + 2SO_2(g)$

(*iv*) $BaCl_2(s) + ZnSO_4(aq) \longrightarrow ZnCl_2(s) + BaSO_4(aq)$

Q. 23. When potassium iodide solution is added to a solution of lead (II) nitrate in a test tube, a precipitate is formed.

(*i*) What is the colour of this precipitate? Name the compound precipitated.

(*ii*) Write the balanced chemical equation for this reaction.

(*iii*) List two types of reactions in which this reaction can be placed. [*CBSE* 2019 (31/4/1)]

Ans. (*i*) The colour of the precipitate is yellow. The compound precipitated is PbI_2.

(*ii*) $Pb(NO_3)_2 + 2KI \longrightarrow PbI_2 + 2KNO_3$

(*iii*) Double displacement reaction, precipitation reaction

Q. 24. 2 g of silver chloride is taken in a china dish and the china dish is placed in sunlight for sometime. What will be your observation in this case? Write the chemical reaction involved in the form of a balanced chemical equation. Identify the type of chemical reaction.

[*CBSE* 2019 (31/1/1)]

Ans. The white silver chloride turns grey in sunlight. This is because silver chloride decomposes to form silver and chlorine gas.

$$2AgCl(s) \xrightarrow{\text{Sunlight}} 2Ag(s) + Cl_2(g)$$

It is a photodecomposition reaction.

Q. 25. (*i*) What happens when silver nitrate solution is added to sodium chloride solution? Write the equation for the reaction which takes place.

(*ii*) Name the type of reaction involved.

Ans. (*i*) When silver nitrate solution is added to sodium chloride solution, a white precipitate of silver chloride is formed along with sodium nitrate solution.

$$AgNO_3(aq) + NaCl(aq) \longrightarrow \underset{\text{(White ppt.)}}{AgCl(s)} + NaNO_3(aq)$$

(*ii*) This is double displacement reaction and precipitation reaction.

Q. 26. 2 g of ferrous sulphate crystals are heated in a dry boiling tube.

(*i*) List any two observations.

(*ii*) Name the type of chemical reaction taking place.

(*iii*) Write balanced chemical equation for the reaction and name the products formed.

[*CBSE 2019 (31/5/1)*]

Ans. (*i*) (*a*) The colour of ferrous sulphate crystals changes from green to white then turn into brown due to formation of Fe_2O_3.

(*b*) The smell of burning sulphur due to the evolution of SO_2 gas is observed.

(*ii*) Thermal decomposition reaction

(*iii*) $2FeSO_4(s) \xrightarrow{Heat} \underset{\text{(Ferric oxide)}}{Fe_2O_3(s)} + \underset{\text{(Sulphur dioxide)}}{SO_2(g)} + \underset{\text{(Sulphur trioxide)}}{SO_3(g)}$

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Q. 27. Identify the oxidising agent (oxidant) in the following reactions.

(*i*) $Pb_3O_4 + 8HCl \longrightarrow 3PbCl_2 + Cl_2 + 4H_2O$

(*ii*) $2Mg + O_2 \longrightarrow 2MgO$

(*iii*) $CuSO_4 + Zn \longrightarrow Cu + ZnSO_4$

(*iv*) $V_2O_5 + 5Ca \longrightarrow 2V + 5CaO$

(*v*) $3Fe + 4H_2O \longrightarrow Fe_3O_4 + 4H_2$

(*vi*) $CuO + H_2 \longrightarrow Cu + H_2O$ [*NCERT Exemplar*]

Ans. (*i*) Pb_3O_4 (*ii*) O_2 (*iii*) $CuSO_4$

(*iv*) V_2O_5 (*v*) H_2O (*vi*) CuO

Q. 28. A substance X, which is an oxide of a group 2 element, is used intensively in the cement industry. This element is present in bones also. On treatment with water it forms a solution which turns red litmus blue. Identify X and also write the chemical reactions involved. [*NCERT Exemplar*]

Ans. X is calcium oxide, also called quick lime. It reacts with water to form calcium hydroxide which is basic in nature. So, it turns red litmus blue.

$$CaO(s) + H_2O(l) \longrightarrow Ca(OH)_2(aq)$$

Q. 29. A magnesium ribbon is burnt in oxygen to give a white compound X accompanied by emission of light. If the burning ribbon is now placed in an atmosphere of nitrogen, it continues to burn and forms a compound Y.

(*i*) Write the chemical formulae of X and Y.

(*ii*) Write the balanced chemical equation when X is dissolved in water. [*NCERT Exemplar*]

Ans. $2Mg(s) + O_2(g) \longrightarrow 2MgO(s) + \text{Light}$

$3Mg(s) + N_2(g) \longrightarrow Mg_3N_2(s)$

(*i*) X is MgO; Y is Mg_3N_2

(*ii*) $MgO(s) + H_2O(l) \longrightarrow Mg(OH)_2(aq)$

Q. 30. Identify the type of reaction in the following examples:

(*i*) $Na_2SO_4(aq) + BaCl_2(aq) \longrightarrow BaSO_4(s) + NaCl(aq)$

(*ii*) $Fe(s) + CuSO_4(aq) \longrightarrow FeSO_4(aq) + Cu(s)$

(*iii*) $2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$

Ans. (*i*) Double displacement reaction

(*ii*) Displacement reaction

(*iii*) Combination reaction

Q. 31. During the reaction of some metals with dilute hydrochloric acid, following observations were made.

(*i*) Silver metal does not show any change.

(*ii*) The temperature of the reaction mixture rises when aluminium (Al) is added.

(*iii*) The reaction of sodium metal is found to be highly explosive.

(*iv*) Some bubbles of a gas are seen when lead (Pb) is reacted with the acid.

Explain these observations giving suitable reasons. [*NCERT Exemplar*]

Ans. (*i*) Silver being a less reactive metal than hydrogen does not displace hydrogen from HCl. Hence, it does not react with dilute HCl.

(*ii*) The temperature of the reaction mixture rises when aluminium is added because it is an exothermic reaction.

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(*iii*) Reaction of sodium metal is found to be highly explosive because it is an exothermic reaction.

(*iv*) When lead is treated with hydrochloric acid, bubbles of hydrogen gas are evolved.

$$Pb(s) + 2HCl(aq) \longrightarrow PbCl_2(aq) + H_2(g)$$

Q. 32. A silver article generally turns black when kept in the open for a few days. The article when rubbed with toothpaste again starts shining.

(*i*) Why do silver articles turn black when kept in the open for a few days? Name the phenomenon involved.

(*ii*) Name the black substance formed and give its chemical formula. [*NCERT Exemplar*]

Ans. (*i*) Metals such as silver when attacked by substances around it such as moisture, acids, gases, etc, are said to corrode and this phenomenon is called corrosion.

(*ii*) The black substance is formed because silver (Ag) reacts with H_2S present in air. It forms thin black coating of silver sulphide (Ag_2S).

$$2Ag(s) + H_2S(g) \longrightarrow \underset{\text{Black}}{Ag_2S(s)} + H_2(g)$$

Long Answer Questions [5 marks]

Each of the following questions are of 5 marks and have to be answered in about 80-90 words.

Q. 1. (*i*) What is a double displacement reaction? Explain with an example.

(*ii*) A small amount of quick lime is added to water in a beaker.

(*a*) Name and define the type of reaction that has taken place.

(*b*) Write balanced chemical equation for the above reaction and the chemical name of the product formed.

(*c*) List two main observations of this reaction. [*CBSE 2019 (31/3/3)*]

Ans. (*i*) In double displacement reaction, two compounds react by exchanging their ions and form two new compounds.

For example, silver nitrate and sodium chloride exchange their ions, NO_3^- and Cl^- respectively and form two new compounds in the following reaction.

$$AgNO_3(aq) + NaCl(aq) \longrightarrow \underset{\text{(White ppt.)}}{AgCl(s)} + NaNO_3(aq)$$

(*ii*) (*a*) Combination reaction. The reaction in which two or more reactants combine to form a single product is known as combination reaction.

(*b*) The product formed is slaked lime for which the chemical formula is $Ca(OH)_2$.

$$\underset{\substack{\text{Calcium oxide}\\\text{(Quick lime)}}}{CaO(s)} + \underset{\text{Water}}{H_2O(l)} \longrightarrow \underset{\substack{\text{Calcium hydroxide}\\\text{(Slaked lime)}}}{Ca(OH)_2(aq)} + \text{Heat}$$

(*c*) Following are the two observations:

- Calcium oxide (CaO) reacts vigorously with water to form slaked lime.
- The container becomes hot because a large amount of heat is released during this reaction.

Q. 2. Consider the chemical equation given below and answer the questions that follow:

$$\mathbf{CuO + H_2 \xrightarrow{Heat} Cu + H_2O}$$

(*i*) Name the substance which is getting oxidised.

(*ii*) Name the substance which is getting reduced.

(*iii*) Name the oxidising agent.

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(iv) Name the reducing agent.

(v) What type of a reaction does this equation represent?

Ans. (i) The substance getting oxidised is H_2.

(ii) The substance getting reduced is CuO.

(iii) CuO is the oxidising agent.

(iv) H_2 is the reducing agent.

(v) Since oxidation and reduction is taking place simultaneously, this reaction is an example of redox reaction.

Q. 3. Give the characteristic tests for the following gases:

(i) CO_2 (ii) SO_2 (iii) O_2 (iv) H_2 *[NCERT Exemplar]*

Ans. The characteristic test for the given gases are as follows:

(i) Carbon dioxide (CO_2) gas turns lime water milky when passed through it due to the formation of insoluble calcium carbonate.

$$\underset{\text{Lime water}}{Ca(OH)_2(aq)} + \underset{\text{Carbon dioxide}}{CO_2(g)} \longrightarrow \underset{\text{Calcium carbonate}}{CaCO_3(s)} + H_2O(l)$$

When CO_2 gas is passed in excess through lime water, milkiness disappears due to formation of soluble calcium hydrogen carbonate.

$$CaCO_3(s) + H_2O(l) + CO_2(g) \longrightarrow \underset{\text{Calcium hydrogen carbonate}}{Ca(HCO_3)_2(s)}$$

(ii) Sulphur dioxide (SO_2) gas when passed through acidic potassium permanganate solution (purple in colour) turns it colourless because SO_2 is a strong reducing agent.

$$\underset{\substack{\text{Potassium}\\\text{permanganate}\\\text{(Purple)}}}{2KMnO_4(s)} + 2H_2O(l) + \underset{\substack{\text{Sulphur}\\\text{dioxide}}}{5SO_2(g)} \longrightarrow \underset{\substack{\text{Potassium}\\\text{sulphate}\\\text{(Colourless)}}}{K_2SO_4(aq)} + \underset{\substack{\text{Manganese}\\\text{sulphate}\\\text{(Colourless)}}}{2MnSO_4(aq)} + 2H_2SO_4(aq)$$

(iii) The evolution of oxygen (O_2) gas during a reaction can be confirmed by bringing a burning candle near the mouth of the test tube containing the reaction mixture. The intensity of the flame increases because oxygen supports burning.

(iv) Hydrogen (H_2) gas burns with a pop sound when a burning candle is brought near it.

Q. 4. With the help of an activity explain that hydrogen and oxygen are released when an electric current is passed through water.

Ans. (i) Take a plastic vessel. Drill two holes at its bottom and set rubber stoppers in these holes.

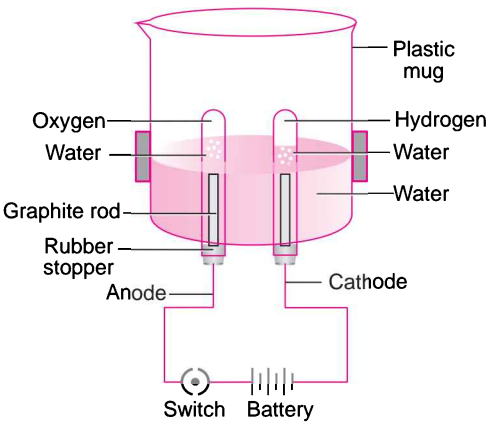
(ii) Insert carbon electrodes in these rubber stoppers and connect these electrodes to a 6 volt battery and a switch.

(iii) Fill the vessel with water such that the electrodes are immersed. Add a few drops of dilute sulphuric acid to the water in the vessel.

(iv) Take two graduated test tubes filled with water and invert them over the two carbon electrodes.

(v) Switch on the current.

(vi) After sometime, you will observe the formation of bubbles at both the electrodes. These bubbles displace water in the graduated tubes.



Electrolysis of water

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(*vii*) Once the test tubes are filled with the respective gases, remove them carefully.

(*viii*) Test these gases one by one by bringing a burning splinter of wood close to the mouth of test tubes.

When the glowing splinter of wood is brought close to the mouth of one test tube, it relights and when it is brought close to the mouth of other test tube, the gas burns with a pop sound. Oxygen is the only common gas that relights the splinter and hydrogen gas burns with a pop sound.

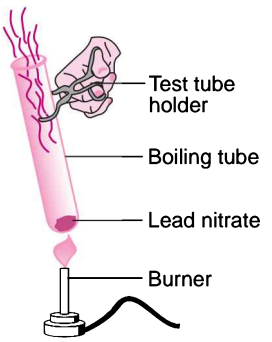
Q. 5. (*i*) Design an activity to demonstrate the decomposition reaction of lead nitrate.

(*ii*) Draw labelled diagram of the experimental set up. List two main observations.

(*iii*) Write balanced chemical equation for the reaction stating the physical state of the reactant and the products. *[CBSE 2019 (31/3/3)]*

Ans. (*i*) **Activity:**

- Take a boiling tube and put about 3 g lead nitrate powder in it.
- Hold the boiling tube carefully with a pair of tongs.
- Now, heat the tube over a flame.



(*ii*) **Observations:**

- Brown fumes of nitrogen dioxide gas is observed.
- Lead oxide, a yellow compound is formed.

(*iii*) $\underset{\text{Lead nitrate}}{2Pb(NO_3)_2(s)} \xrightarrow{\text{Heat}} \underset{\substack{\text{Lead oxide}\\(\text{yellow})}}{2PbO(s)} + \underset{\substack{\text{Nitrogen dioxide}\\(\text{brown})}}{4NO_2(g)} + \underset{\text{Oxygen}}{O_2(g)}$

Q. 6. What happens when a piece of

(*i*) zinc metal is added to copper sulphate solution?

(*ii*) aluminium metal is added to dilute hydrochloric acid?

(*iii*) silver metal is added to copper sulphate solution?

Also, write the balanced chemical equation if the reaction occurs. *[NCERT Exemplar]*

Ans. (*i*) Zinc being more reactive than copper displaces copper from its solution and a solution of zinc sulphate is obtained.

$$\underset{\text{Blue}}{Zn(s) + CuSO_4(aq)} \longrightarrow \underset{\text{Colourless}}{ZnSO_4(aq)} + Cu(s)$$

(*ii*) Aluminium being more reactive displaces hydrogen from dilute hydrochloric acid solution and hydrogen gas is evolved.

$$2Al(s) + 6HCl(aq) \longrightarrow \underset{\substack{\text{Aluminium}\\\text{Chloride}}}{2AlCl_3(aq)} + 3H_2(g)$$

(*iii*) Silver metal being less reactive than copper cannot displace copper from its salt solution. Therefore, no reaction occurs.

$Ag(s) + CuSO_4(aq) \longrightarrow$ No reaction

Q. 7. What happens when zinc granules are treated with dilute solution of H_2SO_4, HCl, HNO_3, NaCl and NaOH? Also write the chemical equations if reaction occurs. *[NCERT Exemplar]*

Ans. The reaction of Zn granules with

(*i*) dilute H_2SO_4

$$Zn(s) + H_2SO_4(aq) \longrightarrow ZnSO_4(aq) + H_2(g)$$

(*ii*) dilute HCl

$$Zn(s) + 2HCl(aq) \longrightarrow ZnCl_2(aq) + H_2(g)$$

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(*iii*) dilute HNO_3

Reaction with dilute HNO_3 is different as compared to other acids because nitric acid is an oxidising agent and it oxidises H_2 gas evolved to H_2O.

$$4Zn(s) + 10HNO_3(aq) \longrightarrow 4Zn(NO_3)_2(aq) + 5H_2O(l) + N_2O(g)$$

(*iv*) NaCl solution

$$Zn(s) + NaCl(aq) \longrightarrow \text{No reaction}$$

(*v*) NaOH solution

$$Zn(s) + 2NaOH(aq) \longrightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_2(aq)} + H_2(g)$$

Q. 8. (*i*) Crystals of copper sulphate are heated in a test tube for some time.

(*a*) What is the colour of copper sulphate crystals before heating, and after heating?

(*b*) What is the source of liquid droplets seen on the inner upper side of the test tube during the heating process?

(*ii*) A metal 'X' when dipped in aqueous solution of aluminium sulphate, no reaction is observed whereas when it is dipped in an aqueous solution of ferrous sulphate, the pale green solution turns colourless. Identify metal 'X' with reason.

Ans. (*i*) (*a*) The colour of copper sulphate crystals before heating is blue and turns white after heating.

(*b*) The liquid droplets are actually the water droplets. The source of water droplets is the water of crystallisation of hydrated copper sulphate crystals ($CuSO_4.5H_2O$).

(*ii*) When metal 'X' is dipped in aqueous solution of aluminium sulphate no reaction is observed, it means it is less reactive than aluminium. But when it is dipped in ferrous sulphate solution, the solution turns from pale green to colourless, so 'X' is more reactive than iron and thus displaces it from its solution.

Therefore, 'X' must be zinc. It reacts with ferrous sulphate to form colourless zinc sulphate solution by displacing iron.

$$Zn(s) + FeSO_4(aq) \longrightarrow ZnSO_4(aq) + Fe(s)$$

HOTS [Higher Order Thinking Skills]

Q. 1. Samuel had a silver coin which turned black. He kept the coin in a bowl lined with aluminium foil. Then he filled the bowl with water and boiled it. After sometime, he found that the coin has become new. Its blackness disappeared. How did it happen?

Ans. The blackness of silver coin is due to the formation of silver sulphide on its surface due to its exposure to air. On boiling, the aluminium foil reacts with the layer of silver sulphide and displaces silver from silver sulphide to form aluminium sulphide and silver. This makes the coin shiny.

$$3Ag_2S(s) + 2Al(s) \longrightarrow 6Ag(s) + Al_2S_3(s)$$

Q. 2. During electrolysis of water a few drops of sulphuric acid is added into water. Why?

Ans. Pure water is a bad conductor of electricity. By adding a few drops of sulphuric acid, it becomes a good conductor of electricity.

Q. 3. Justify with the help of an example that displacement reaction is also a redox reaction.

Ans. Consider the following displacement reaction in which Fe displaces Cu from $CuSO_4$ to form $FeSO_4$:

$$\underset{\text{Iron}}{Fe(s)} + \underset{\substack{\text{Copper sulphate}\\\text{(Blue)}}}{CuSO_4(aq)} \longrightarrow \underset{\substack{\text{Iron(II) sulphate}\\\text{(Green)}}}{FeSO_4(aq)} + \underset{\substack{\text{Copper}\\\text{(Reddish brown)}}}{Cu(s)}$$

In the above reaction, Fe is gaining oxygen. Hence, Fe is oxidised. $CuSO_4$ is loosing oxygen. Hence, it is reduced. So, it is a redox reaction.

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Q. 4. Compound 'A' when dissolved in water gives compound 'B' which is used in whitewashing. Compound 'B' reacts with CO_2 to form a white precipitate of compound 'C'. Identify compounds 'A', 'B' and 'C'. Also write the equations involved.

Ans. $$\text{'A'} \xrightarrow[\text{Exothermic reaction}]{+H_2O} \underset{\text{Used for whitewashing}}{\text{'B'}} + CO_2 \longrightarrow \underset{\text{White ppt}}{\text{'C'}}$$

Slaked lime [$(Ca(OH)_2$] is used for whitewashing. It is obtained when quicklime, CaO reacts with water.

$$\underset{\substack{\text{Calcium oxide}\\\text{(Quick lime)}}}{CaO(s)} + H_2O(l) \longrightarrow \underset{\substack{\text{Calcium hydroxide}\\\text{(Slaked lime)}}}{Ca(OH)_2(aq)} + \text{Heat}$$

So 'A' is CaO and 'B' is $Ca(OH)_2$.

$$Ca(OH)_2(aq) + CO_2(g) \longrightarrow \underset{\substack{\text{Calcium carbonate}\\\text{(White ppt.)}}}{CaCO_3(s)} + H_2O(l)$$

'C' is $CaCO_3$.

Q. 5. On heating blue coloured powder of copper (II) nitrate in a boiling tube, copper oxide (black), oxygen gas and a brown gas X is formed.

(*i*) Write a balanced chemical equation of the reaction.

(*ii*) Identify the brown gas X evolved.

(*iii*) Identify the type of reaction.

(*iv*) What could be the pH range of aqueous solution of the gas X? *[NCERT Exemplar]*

[CBSE 2019 (31/2/1)]

Ans. (*i*) $2Cu(NO_3)_2(s) \xrightarrow{\text{Heat}} 2CuO(s) + O_2(g) + 4NO_2(g)$

(*ii*) The brown gas X evolved is nitrogen dioxide (NO_2).

(*iii*) This is a decomposition reaction.

(*iv*) Nitrogen dioxide dissolves in water to form acidic solution because it is an oxide of non-metal. Therefore, pH of this solution is less than 7.

Q. 6. On adding a drop of barium chloride solution to an aqueous solution of sodium sulphite, white precipitate is obtained.

(*i*) Write a balanced chemical equation of the reaction involved.

(*ii*) What other name can be given to this precipitation reaction?

(*iii*) On adding dilute hydrochloric acid to the reaction mixture, white precipitate disappears. Why? *[NCERT Exemplar]*

Ans. (*i*) $$\underset{\text{Sodium sulphite}}{Na_2SO_3(aq)} + \underset{\text{Barium chloride}}{BaCl_2(aq)} \longrightarrow \underset{\substack{\text{Barium sulphite}\\\text{(White precipitate)}}}{BaSO_3(s)} + \underset{\text{Sodium chloride}}{2NaCl(aq)}$$

(*ii*) This reaction is also known as double displacement reaction.

(*iii*) $BaSO_3$ is a salt of a weak acid (H_2SO_3), therefore dilute acid such as HCl decomposes barium sulphite to produce sulphur dioxide gas which has the smell of burning sulphur.

$$\underset{\text{White ppt.}}{BaSO_3(s)} + 2HCl(aq) \longrightarrow BaCl_2(aq) + H_2O(l) + SO_2(g)$$

$BaCl_2$ is soluble in water, hence white precipitate disappears.

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Q. 7. A brown substance 'X' on heating in air forms a substance 'Y'. When hydrogen gas is passed over heated 'Y', it again changes back into 'X'.

(*i*) Name the substance 'X' and 'Y'.

(*ii*) Name the type of chemical reactions occurring during both the changes.

(*iii*) Write the chemical equations of the reactions. *[CCE 2016]*

Ans. (*i*) X—Cu ; Y—CuO.

(*ii*) When copper is heated in air, oxidation takes place. When hydrogen gas is passed over heated copper oxide, reduction takes place.

(*iii*) $2Cu(s) + O_2(g) \xrightarrow{\Delta} 2CuO(s)$ (Oxidation)

$CuO(s) + H_2(g) \xrightarrow{\Delta} Cu(s) + H_2O(l)$ (Reduction)

NCERT Corner

NCERT Intext Questions

Q. 1. Why should a magnesium ribbon be cleaned before burning in air?

Ans. The magnesium ribbon which we use usually has a coating of a white layer of magnesium oxide on its surface. It is formed by the slow reaction of moist air on it. This hinders the burning of magnesium. So, this layer is removed by rubbing with sandpaper before burning.

Q. 2. Write the balanced equation for the following chemical reactions:

(*i*) Hydrogen + Chlorine ⟶ Hydrogen chloride

(*ii*) Barium chloride + Aluminium sulphate ⟶ Barium sulphate + Aluminium chloride

(*iii*) Sodium + Water ⟶ Sodium hydroxide + Hydrogen

Ans. (*i*) $H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$

(*ii*) $3BaCl_2(aq) + Al_2(SO_4)_3(aq) \longrightarrow 3BaSO_4(s) + 2AlCl_3(aq)$

(*iii*) $2Na(s) + 2H_2O(l) \longrightarrow 2NaOH\ (aq) + H_2(g)$

Q. 3. Write a balanced chemical equation with state symbols for the following reactions:

(*i*) Solutions of barium chloride and sodium sulphate in water react to give insoluble barium sulphate and the solution of sodium chloride.

(*ii*) Sodium hydroxide solution (in water) reacts with hydrochloric acid solution (in water) to produce sodium chloride solution and water.

Ans. (*i*) $BaCl_2(aq) + Na_2SO_4(aq) \longrightarrow BaSO_4(s) + 2NaCl(aq)$

(*ii*) $NaOH(aq) + HCl(aq) \longrightarrow NaCl(aq) + H_2O(l)$

Q. 4. A solution of a substance 'X' is used for whitewashing.

(*i*) Name the substance 'X' and write its formula.

(*ii*) Write the reaction of the substance 'X' named in (*i*) above with water.

Ans. (*i*) The substance 'X' used for whitewashing is quick lime (calcium oxide). Its formula is CaO.

(*ii*) When quick lime is mixed with water, the following reaction takes place:

$$\underset{\text{Quick lime (Calcium oxide)}}{CaO(s)} + \underset{\text{Water}}{H_2O(l)} \longrightarrow \underset{\text{Calcium hydroxide (Slaked lime)}}{Ca(OH)_2(aq)} + \text{Heat}$$

Q. 5. Why is the amount of gas collected in one of the test tubes double of the amount collected in the other in electrolysis of water experiment? Name this gas.

Ans. The gas which is collected in double the amount in the electrolysis of water experiment is hydrogen. This is because water (H_2O) contains two parts of hydrogen element as compared to one part of oxygen element by volume.

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Q. 6. Why does the colour of copper sulphate solution change when an iron nail is dipped in it?

Ans. Iron is more reactive than copper. It displaces copper from copper sulphate solution according to the following reaction:

$$\underset{\text{Iron}}{Fe(s)} + \underset{\text{Copper sulphate}}{CuSO_4(aq)} \longrightarrow \underset{\text{Iron (II) sulphate}}{FeSO_4(aq)} + \underset{\text{Copper}}{Cu(s)}$$

Thus, as copper sulphate reacts to form iron(II) sulphate, the blue colour of copper sulphate solution fades and the solution turns green due to iron (II) sulphate.

Q. 7. Give an example of a double displacement reaction other than the one between barium chloride and sodium sulphate solutions.

Ans. $\underset{\text{Silver nitrate}}{AgNO_3(aq)} + \underset{\text{Sodium chloride}}{NaCl(aq)} \longrightarrow \underset{\text{Silver chloride}}{AgCl(s)} + \underset{\text{Sodium nitrate}}{NaNO_3(aq)}$

Q. 8. Identify the substances oxidised and the substances reduced in the following reactions:

(*i*) $4Na(s) + O_2(g) \longrightarrow 2Na_2O(s)$

(*ii*) $CuO(s) + H_2(g) \longrightarrow Cu(s) + H_2O(l)$

Ans. (*i*) In this reaction, sodium (Na) is changed into sodium oxide (Na_2O) by the addition of oxygen to sodium. Since addition of oxygen is called oxidation, therefore, the substance sodium (Na) is oxidised.

Oxygen (O_2) is changed into Na_2O. Here, the addition of metal to oxygen takes place. So, the substance reduced is oxygen.

(*ii*) Here, copper oxide is reduced to copper metal whereas hydrogen is oxidised to water.

NCERT Exercises

Q. 1. Which of the statements about the reaction below are incorrect?

$2PbO(s) + C(s) \longrightarrow 2Pb(s) + CO_2(g)$

(*a*) Lead is getting reduced. **(*b*) Carbon dioxide is getting oxidised.**

(*c*) Carbon is getting oxidised. **(*d*) Lead oxide is getting reduced.**

(*i*) (*a*) and (*b*) **(*ii*) (*a*) and (*c*)** **(*iii*) (*a*), (*b*) and (*c*)** **(*iv*) all**

Ans. The incorrect statements are:

(*a*) Lead is getting reduced and

(*b*) Carbon dioxide is getting oxidised.

Hence, (*i*) is the correct answer.

Q. 2. $Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe$

The above reaction is an example of

(*a*) combination reaction **(*b*) double displacement reaction**

(*c*) decomposition reaction **(*d*) displacement reaction**

Ans. The given equation is a displacement reaction in which Fe of Fe_2O_3 has been displaced by Al. Hence, (*d*) is the correct answer.

Q. 3. What happens when dilute hydrochloric acid is added to iron filings? Choose the correct answer.

(*a*) Hydrogen gas and iron chloride are produced.

(*b*) Chlorine gas and iron hydroxide are produced.

(*c*) No reaction takes place.

(*d*) Iron salt and water are produced.

Ans. The following reaction takes place:

$$\underset{\text{Iron}}{Fe(s)} + \underset{\text{Hydrochloric acid}}{2HCl(aq)} \longrightarrow \underset{\text{Iron (II) chloride}}{FeCl_2(s)} + \underset{\text{Hydrogen}}{H_2(g)}$$

Thus, hydrogen and iron chloride are produced. Therefore, (*a*) is the correct answer.

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Q. 4. What is a balanced chemical equation? Why should the chemical equations be balanced?

Ans. A balanced chemical equation is one which contains an equal number of atoms of each element on both sides of the equation. For example,

$$2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$$

According to the law of conservation of mass, matter can neither be created nor destroyed in a chemical reaction. During a chemical reaction, the total mass of reactants and products remain the same. Hence, in a chemical reaction, the number of atoms of the various elements on both sides should be equal. Therefore, a chemical equation is to be balanced in accordance with the law of conservation of mass.

Q. 5. Translate the following statements into chemical equations and then balance them.

(*a*) Hydrogen gas combines with nitrogen to form ammonia.

(*b*) Hydrogen sulphide gas burns in air to give water and sulphur dioxide.

(*c*) Barium chloride reacts with aluminium sulphate to give aluminium chloride and a precipitate of barium sulphate.

(*d*) Potassium metal reacts with water to give potassium hydroxide and hydrogen gas.

Ans. (*a*) $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$

(*b*) $2H_2S(g) + 3O_2(g) \longrightarrow 2H_2O(l) + 2SO_2(g)$

(*c*) $3BaCl_2 + Al_2(SO_4)_3 \longrightarrow 2AlCl_3 + 3BaSO_4\downarrow$

(*d*) $2K(s) + 2H_2O(l) \longrightarrow 2KOH(aq) + H_2(g)$

Q. 6. Balance the following chemical equations:

(*a*) $HNO_3 + Ca(OH)_2 \longrightarrow Ca(NO_3)_2 + H_2O$

(*b*) $NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$

(*c*) $NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$

(*d*) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + HCl$

Ans. (*a*) $2HNO_3 + Ca(OH)_2 \longrightarrow Ca(NO_3)_2 + 2H_2O$

(*b*) $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$

(*c*) $NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$

(*d*) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + 2HCl$

Q. 7. Write the balanced chemical equations for the following reactions.

(*a*) Calcium hydroxide + Carbon dioxide $\longrightarrow$ Calcium carbonate + Water

(*b*) Zinc + Silver nitrate $\longrightarrow$ Zinc nitrate + Silver

(*c*) Aluminium + Copper chloride $\longrightarrow$ Aluminium chloride + Copper

(*d*) Barium chloride + Potassium sulphate $\longrightarrow$ Barium sulphate + Potassium chloride

Ans. (*a*) $Ca(OH)_2(aq) + CO_2(g) \longrightarrow CaCO_3(s) + H_2O(l)$

(*b*) $Zn(s) + 2AgNO_3(aq) \longrightarrow Zn(NO_3)_2(aq) + 2Ag(s)$

(*c*) $2Al(s) + 3CuCl_2(aq) \longrightarrow 2AlCl_3(aq) + 3Cu(s)$

(*d*) $BaCl_2(s) + K_2SO_4(aq) \longrightarrow BaSO_4(s) + 2KCl(aq)$

Q. 8. Write the balanced chemical equation for the following and identify the type of reaction in each case.

(*a*) Potassium bromide(*aq*) + Barium iodide(*aq*) $\longrightarrow$ Potassium iodide(*aq*) + Barium bromide(*s*)

(*b*) Zinc carbonate(*s*) $\longrightarrow$ Zinc oxide(*s*) + Carbon dioxide(*g*)

(*c*) Hydrogen(*g*) + Chlorine(*g*) $\longrightarrow$ Hydrogen chloride(*g*)

(*d*) Magnesium(*s*) + Hydrochloric acid(*aq*) $\longrightarrow$ Magnesium chloride(*aq*) + Hydrogen(*g*)

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Ans. (*a*) $2KBr(aq) + BaI_2(aq) \longrightarrow 2KI(aq) + BaBr_2(s)$; Double displacement reaction

(*b*) $ZnCO_3(s) \longrightarrow ZnO(s) + CO_2(g)$; Decomposition reaction

(*c*) $H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$; Combination reaction

(*d*) $Mg(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + H_2(g)$; Displacement reaction

Q. 9. What does one mean by exothermic and endothermic reactions? Give examples.

Ans. Exothermic reaction: In exothermic reaction, heat is evolved during the reaction which is indicated by '+ heat' sign on the right hand side of the equation.

For example:

$$CaO(s) + H_2O(l) \longrightarrow Ca(OH)_2(aq) + \text{Heat}$$

Endothermic reaction: In this reaction, heat is absorbed which is indicated by putting '+ heat' sign on the left hand side of the equation.

For example:

$$N_2(g) + O_2(g) + \text{Heat} \longrightarrow 2NO(g)$$

Q. 10. Why is respiration considered as an exothermic reaction? Explain.

Ans. During respiration, the glucose combines with oxygen in the cells of our body and provides energy. Thus, respiration is an exothermic process because energy is produced during this process.

$$\underset{\text{Glucose}}{C_6H_{12}O_6(aq)} + 6O_2(g) + 6H_2O(l) \longrightarrow 6CO_2(g) + 12H_2O(l) + \text{Energy}$$

Q. 11. Why are decomposition reactions called the opposite of combination reactions? Write equations for these reactions.

Ans. In a combination reaction, two or more substances combine to form a single product. Also, a large amount of heat is evolved.

The decomposition reactions require energy either in the form of heat, light or electricity for breaking down one substance into two or more substances.

$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g) + \text{Heat}$; Combination reaction

$2NH_3(g) + \text{Heat} \longrightarrow N_2(g) + 3H_2(g)$; Decomposition reaction

Q. 12. Write one equation each for decomposition reactions where energy is supplied in the form of heat, light or electricity.

Ans. Decomposition reaction involving absorption of heat:

$$\underset{\text{Calcium carbonate}}{CaCO_3(s)} \longrightarrow \underset{\text{Calcium oxide}}{CaO(s)} + \underset{\text{Carbon dioxide}}{CO_2(g)}$$

Decomposition reaction involving absorption of light:

$$\underset{\text{Silver chloride}}{2AgCl(s)} \xrightarrow{\text{Sunlight}} \underset{\text{Silver}}{2Ag(s)} + \underset{\text{Chlorine}}{Cl_2(g)}$$

Decomposition reaction involving absorption of electrical energy:

$$\underset{\text{Water}}{2H_2O(l)} \xrightarrow[\text{current}]{\text{Electric}} \underset{\text{Hydrogen}}{2H_2(g)} + \underset{\text{Oxygen}}{O_2(g)}$$

Q. 13. What is the difference between displacement and double displacement reactions? Write equations for these reactions.

Ans. In a displacement reaction, a more reactive element displaces or removes another element from its compound.

For example, zinc being more reactive, displaces copper from its compound.

$$Zn(s) + CuSO_4(aq) \longrightarrow ZnSO_4(aq) + Cu(s)$$

In case of double displacement reactions, two compounds react by exchanging their ions and form two new compounds.

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For example, silver nitrate and sodium chloride exchange their ions, NO_3^- and Cl^- respectively and form two new compounds in the following reaction

$$AgNO_3(aq) + NaCl(aq) \longrightarrow \underset{\text{(White ppt.)}}{AgCl(s)} + NaNO_3(aq)$$

Q. 14. In the refining of silver, the recovery of silver from silver nitrate solution involved displacement by copper metal. Write down the reaction involved.

Ans. $\underset{\text{Copper}}{Cu(s)} + \underset{\text{Silver nitrate}}{2AgNO_3(aq)} \longrightarrow \underset{\text{Copper (II) nitrate}}{Cu(NO_3)_2(aq)} + \underset{\text{Silver}}{2Ag(s)}$

Q. 15. What do you mean by precipitation reactions? Explain giving examples.

Ans. On mixing the clear solutions of two ionic compounds, a substance which is insoluble in water, is formed. This insoluble substance formed is known as precipitate. Any reaction that produces a precipitate is called a precipitation reaction.

When sodium sulphate solution is mixed with barium chloride solution, a white precipitate of $BaSO_4$ is formed by the reaction of SO_4^{2-} and Ba^{2+}.

$$Na_2SO_4(aq) + BaCl_2(aq) \longrightarrow BaSO_4(s)\downarrow + 2NaCl(aq)$$

The other product formed is sodium chloride which remains in the solution.

Q. 16. Explain the following in terms of gain or loss of oxygen with two examples each:
(*a*) Oxidation (*b*) Reduction.

Ans. **(*a*) Oxidation:** It is defined as a process which involves gain of oxygen. For example,

(*i*) $\underset{\text{Magnesium}}{2Mg(s)} + \underset{\text{Oxygen}}{O_2(g)} \longrightarrow \underset{\text{Magnesium oxide}}{2MgO(s)}$

Here, Mg has gained oxygen to form MgO. Hence, Mg has been oxidised to MgO.

(*ii*) $\underset{\text{Copper}}{2Cu(s)} + \underset{\text{Oxygen}}{O_2(g)} \xrightarrow{\text{Heat}} \underset{\text{Copper oxide}}{2CuO(s)}$

In this reaction, Cu has gained oxygen to form CuO. Thus, Cu is oxidised to copper oxide (CuO).

(*b*) Reduction: It is defined as the process which involves loss of oxygen. For example,

(*i*) $\underset{\text{Copper oxide}}{CuO(s)} + \underset{\text{Hydrogen}}{H_2(g)} \xrightarrow{\text{Heat}} \underset{\text{Copper}}{Cu(s)} + \underset{\text{Water}}{H_2O(l)}$

In this reaction, copper oxide is losing oxygen. So, it is being reduced to copper.

(*ii*) $\underset{\text{Zinc oxide}}{ZnO(s)} + \underset{\text{Carbon}}{C(s)} \xrightarrow{\text{Heat}} \underset{\text{Zinc}}{Zn(s)} + \underset{\text{Carbon monoxide}}{CO(g)}$

In this reaction, zinc oxide is losing oxygen. So it is being reduced to zinc.

Q. 17. A shiny brown coloured element 'X' on heating in air becomes black in colour. Name the element 'X' and the black coloured compound formed.

Ans. Element X is copper. The black coloured compound formed is copper (II) oxide.

$$\underset{\substack{\text{Copper}\\\text{(Brown)}}}{2Cu(s)} + \underset{\text{Oxygen}}{O_2(g)} \xrightarrow{\text{Heat}} \underset{\substack{\text{Copper (II) oxide}\\\text{(Black)}}}{2CuO(s)}$$

Q. 18. Why do we apply paint on iron articles?

Ans. By coating paint over iron articles, the contact of moist air with iron is cut off. So, moist air cannot attack on the surface of iron articles and there is no risk of rusting (corrosion of iron). Thus, iron articles can be protected from damage for many years.

Q. 19. Oil and fat containing food items are flushed with nitrogen. Why?

Ans. In the presence of oxygen in the air, the fats present in the fatty food are oxidised to compounds which have a bad smell, *i.e.,* the food becomes rancid. Flushing with nitrogen cuts off the contact of food with oxygen and protects the food from rancidity.

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Q. 20. Explain the following terms with one example each.

(*a*) Corrosion **(*b*) Rancidity**

Ans. **(*a*) Corrosion:** It is a process of slow and gradual conversion of a metal into its undesirable compounds (sulphides, carbonates, oxides, *etc.*) by the attack of air and moisture (water) present in the atmosphere.

For example, reddish brown coating on iron, black coating on silver and green coating on copper are some examples of corrosion of iron, silver and copper respectively. Corrosion of iron is known as rusting.

(*b*) Rancidity: When the food items are kept for a long period, the fats and oils present in them get oxidised and their smell and taste change. They become rancid and so the process is called rancidity.

For example, rancid (decaying) flavour or smell in old cooking oil.

SELF-ASSESSMENT TEST

Time allowed: 1 hour **Max. marks: 40**

SECTION–A

Choose and write the correct answer for each of the following. (4 × 1 = 4)

1. Barium chloride on reacting with ammonium sulphate, forms barium sulphate and ammonium chloride. Which of the following correctly represents the type of the reaction involved?

(*i*) Displacement reaction **(*ii*) Precipitation reaction**

(*iii*) Combination reaction **(*iv*) Double displacement reaction**

(*a*) (*i*) only (*b*) (*ii*) only

(*c*) (*iii*) only (*d*) (*ii*) and (*iv*)

2. Which of the following statements is not true?

(*a*) Corrosion is a chemical change.

(*b*) Corrosion of iron is called rusting.

(*c*) Corrosion is enhanced by stains on metallic surface.

(*d*) Corrosion can take place in vacuum.

3. To prevent chips from getting oxidised, the bags of chips are flushed with

(*a*) hydrogen (*b*) oxygen

(*c*) carbon dioxide (*d*) nitrogen

4. Which of the following statements about the given reaction are correct?

$$3Fe(s) + 4H_2O(g) \longrightarrow Fe_3O_4(s) + 4H_2(g)$$

(*i*) Iron metal is getting oxidised.

(*ii*) Water is getting reduced.

(*iii*) Water is acting as a reducing agent.

(*iv*) Water is acting as an oxidising agent.

(*a*) (*i*), (*ii*) and (*iii*) (*b*) (*iii*) and (*iv*)

(*c*) (*i*), (*ii*) and (*iv*) (*d*) (*ii*) and (*iv*)

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The following questions consist of two statements—Assertion(A) and Reason(R). Answer these questions selecting the appropriate option given below:

(*a*) **Both *A* and *R* are true and *R* is the correct explanation for *A*.**

(*b*) **Both *A* and *R* are true but *R* is not the correct explanation for *A*.**

(*c*) ***A* is true but *R* is false.**

(*d*) ***A* is false but *R* is true.** **(3 × 1 = 3)**

5. Assertion (*A*) : In electrolysis of water, the volume of hydrogen liberated is twice the volume of oxygen formed.

Reason (*R*) : Water (H_2O) has hydrogen and oxygen in the ratio of 1:2 by volume.

6. Assertion (*A*) : Corrosion of iron is commonly known as rusting.

Reason (*R*) : Corrosion of iron occurs in presence of water and air.

7. Assertion (*A*) : The balancing of chemical equations is based on law of conservation of mass.

Reason (*R*) : Total mass of reactants is equal to total mass of products.

Answer the following questions in one word or one sentence. **(3 × 1 = 3)**

8. Name the reaction which takes place when ferrous sulphate is heated.

9. Give an example of displacement reaction.

10. Name the substance which is getting oxidised in the reaction, $H_2S + Cl_2 \longrightarrow 2HCl + S$.

SECTION–B

Answer the following questions in about 50-60 words each. **(5 × 3 = 15)**

11. Balance the following chemical equations and identify the type of chemical reaction.

(*i*) $Mg(s) + Cl_2(g) \longrightarrow MgCl_2(s)$

(*ii*) $HgO(s) \xrightarrow{\text{Heat}} Hg(l) + O_2(g)$

(*iii*) $Na(s) + S(s) \xrightarrow{\text{Fuse}} Na_2S(s)$

(*iv*) $TiCl_4(l) + Mg(s) \longrightarrow Ti(s) + MgCl_2(s)$

(*v*) $CaO(s) + SiO_2(s) \longrightarrow CaSiO_3(s)$

(*vi*) $H_2O_2(l) \xrightarrow{\text{U V}} H_2O(l) + O_2(g)$ *[NCERT Exemplar]*

12. *A*, *B* and *C* are three elements which undergo chemical reactions according to the following equations.

$A_2O_3 + 2B \longrightarrow B_2O_3 + 2A$

$3CSO_4 + 2B \longrightarrow B_2(SO_4)_3 + 3C$

$3CO + 2A \longrightarrow A_2O_3 + 3C$

Answer the following questions with reasons.

(*i*) Which element is the most reactive?

(*ii*) Which element is the least reactive?

(*iii*) What is the type of reactions listed above?

13. Illustrate an activity to show a double displacement reaction. Give the chemical equation of the reaction that takes place.

14. When a green iron salt is heated strongly, its colour finally changes to black and odour of burning sulphur is given out.

(*i*) Name the iron salt.

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(*ii*) Name the type of reaction that takes place during the heating of iron salt.

(*iii*) Write the balanced chemical equation for the reaction involved.

15. What is a redox reaction? Identify the substance oxidised and the substance reduced in the following reactions.

(*i*) $Pb_3O_4 + 8HCl \longrightarrow 3PbCl_2 + Cl_2 + 4H_2O$

(*ii*) $CuO + H_2 \longrightarrow Cu + H_2O$

SECTION–C

Answer the following questions in about 80–90 words each. **(3 × 5 = 15)**

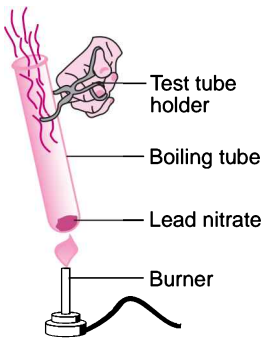
16. You are provided with two containers made up of copper and aluminium. You are also provided with solutions of dilute HCl, dilute HNO_3, $ZnCl_2$ and H_2O. In which of the above containers these solutions can be kept? *[NCERT Exemplar]*

17. (*i*) (*a*) Define corrosion. Under what conditions does corrosion take place?

(*b*) Give the formula and the chemical name of rust.

(*ii*) Give two methods to slow down rancidity.

18. Observe the diagram given below and answer the following questions:



(*i*) What do you observe when lead nitrate is heated?

(*ii*) Mention the two gases evolved during heating.

(*iii*) Write the balanced chemical equation for it.

(*iv*) What is the type of chemical reaction called?

(*v*) Give one more example of this type of reaction.

Answers

1. (*d*) **2.** (*d*) **3.** (*d*) **4.** (*c*)

5. (*c*) **6.** (*b*) **7.** (*a*)

8. Decomposition reaction

9. $Fe(s) + CuSO_4(aq) \longrightarrow FeSO_4(aq) + Cu(s)$

10. H_2S

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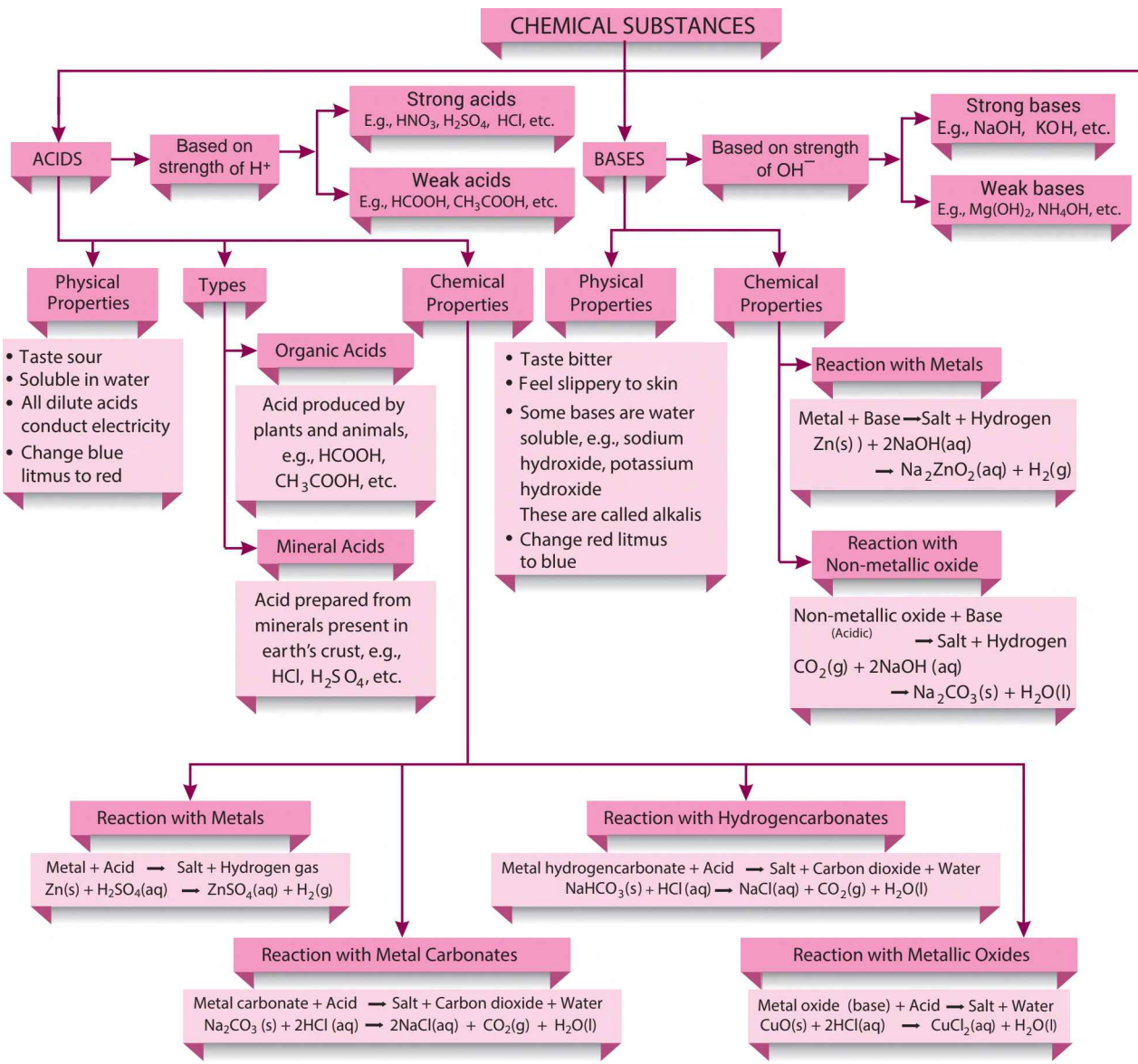
2 Acids, Bases and Salts

BASIC CONCEPTS— A FLOW CHART



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INDICATORS

- **Natural** E.g, litmus
- **Olfactory** E.g, onion
- **Synthetic** E.g, phenolphthalein

Indicator	Colour in Acid	Colour in Alkali
Litmus	Red	Blue
Methyl orange	Pinkish red	Yellow
Phenolphthalein	Colourless	Pink

pH Scale

- Scale for measuring hydrogen ion concentration in a solution
- For acidic solution, pH < 7
  For neutral solution, pH = 7
  For basic solution, pH > 7

Salts

Formed by neutralisation reaction

Acid + Base ⟶ Salt + Water

HA + MOH ⟶ MA + HOH

$NaOH(aq) + HCl(aq) \longrightarrow NaCl(aq) + H_2O(l)$

$HNO_3(aq) + KOH(aq) \longrightarrow KNO_3(aq) + H_2O(l)$

Important Compounds	Chemical name	Chemical formula	Preparation	Uses
Common Salt	Sodium chloride	NaCl	By combination reaction of sodium hydroxide and hydrochloric acid $NaOH(aq) + HCl(aq) \downarrow NaCl(aq) + H_2O(l)$	(i) As raw material for making many chemicals (ii) In cooking food
Caustic Soda	Sodium hydroxide	NaOH	By passing electricity through concentrated sodium chloride (brine) solution $2NaCl(aq) + 2H_2O(l) \downarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$	(i) In detergents and soaps (ii) In paper making (iii) In bleach manufacture (iv) In bauxite purification to extract aluminium
Washing Soda	Sodium carbonate decahydrate	$Na_2CO_3.10H_2O$	By recrystallisation of sodium carbonate in water $Na_2CO_3 + 10H_2O \downarrow Na_2CO_3.10H_2O$	(i) Softening hard water (ii) In washing clothes (iii) In paper, paint and textile industry (iv) Manufacturing glass, borax and caustic soda extract
Baking Soda	Sodium hydrogen carbonate	$NaHCO_3$	On reacting cold concentrated sodium chloride (brine) solution with ammonia and carbon dioxide $NaCl + NH_3 + CO_2 + H_2O \downarrow NaHCO_3 + NH_4Cl$	(i) Preparing baking powder (ii) Manufacture of soda water (iii) In fire extinguishers (iv) As an antacid in medicine
Bleaching Powder	Calcium oxychloride	$CaOCl_2$	By passing chlorine gas over dry slaked lime $Ca(OH)_2 + Cl_2 \downarrow CaOCl_2 + H_2O$	(i) For bleaching cotton textile (ii) For disinfecting drinking water (iii) As an oxidising agent in chemical industry (iv) Manufacturing chloroform
Plaster of Paris	Calcium sulphate hemihydrate	$CaSO_4 \cdot \frac{1}{2}H_2O$	By heating gypsum at 373K $CaSO_4.2H_2O$ (Gypsum) $\xrightarrow{373K} CaSO_4 \cdot \frac{1}{2}H_2O + 1\frac{1}{2}H_2O$	(i) For making statues, models, toys, etc (ii) For making fireproof materials (iii) For setting fractured bones

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MORE POINTS TO REMEMBER

- **Indicators:** These are substances that tell us whether a substance is acidic or basic by the change in their colour. There are some substances whose odour changes in acidic or basic medium. These are called **olfactory indicators**.
- An alkali is a base that dissolves in water. They are soapy to touch, bitter and corrosive.
- When acids dissolve in water, the hydrogen is released into the solution as $H^+(aq)$ or H_3O^+ ions. It is $H^+(aq)$ or H_3O^+ ions that make a solution acidic. Formation of $OH^-(aq)$ ions in solution is responsible for the basic nature of a substance.

Water and neutral solutions	Equal concentrations of H^+ and OH^-.
Acidic solutions	Greater concentration of H^+ than water.
Alkaline solutions	Greater concentration of OH^- than water.

- **Water of Crystallisation:** The fixed number of water molecules chemically attached to each formula unit of a salt in its crystalline form is called water of crystallisation. The salts which contain water of crystallisation are called hydrated salts, *e.g.*, $CuSO_4.5H_2O$.
- The acid must always be added slowly to water with constant stirring. If water is added to a concentrated acid, the heat generated may cause the mixture to splash out and cause burns. The glass container may also break due to excessive local heating.
- Strength of acids and bases can be compared by:

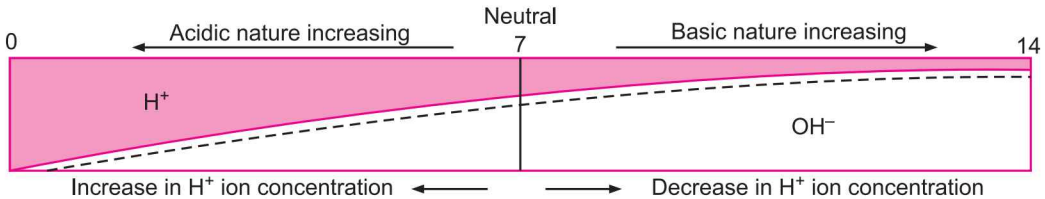

Fig. Variation of pH with the change in concentration of $H^+(aq)$ and $OH^-(aq)$ ions

- Salts of a strong acid and a strong base are neutral with pH value of 7. On the other hand, salts of a strong acid and weak base are acidic with pH value less than 7 and those of a strong base and weak acid are basic in nature, with pH value more than 7.

Multiple Choice Questions [1 mark]

Each question has 4 choices (a), (b), (c) and (d). Choose and write the correct option.

1. **Calcium carbonate is the chemical formula of**
   (*a*) limestone (*b*) chalk (*c*) marble (*d*) all (*a*), (*b*) and (*c*)
2. **On adding dilute HCl to copper oxide in a beaker, the solution turns blue-green due to formation of**
   (*a*) copper(II) hydroxide (*b*) copper nitrate
   (*c*) copper (II) chloride (*d*) copper sulphate
3. **Human body works within the pH range of**
   (*a*) 7.0 to 7.8 (*b*) 4.5 to 5.6 (*c*) 13.0 to 14.0 (*d*) 1.2 to 2.2

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4. A basic solution could have a pH of

(*a*) 1 (*b*) 11 (*c*) 7 (*d*) 2

5. Which of the following gives the correct increasing order of acidic strength? [NCERT Exemplar]

(*a*) Water < Acetic acid < Hydrochloric acid (*b*) Water < Hydrochloric acid < Acetic acid

(*c*) Acetic acid < Water < Hydrochloric acid (*d*) Hydrochloric acid < Water < Acetic acid

6. Fruit juices, such as orange juice, contain

(*a*) boric acid (*b*) citric acid (*c*) sulphuric acid (*d*) nitric acid

7. Common salt, besides being used in kitchen, can also be used as the raw material for making

(*i*) washing soda **(*ii*) bleaching powder**

(*iii*) baking soda **(*iv*) slaked lime** [NCERT Exemplar]

(*a*) (*i*) and (*ii*) (*b*) (*i*), (*ii*) and (*iv*) (*c*) (*i*) and (*iii*) (*d*) (*i*), (*iii*) and (*iv*)

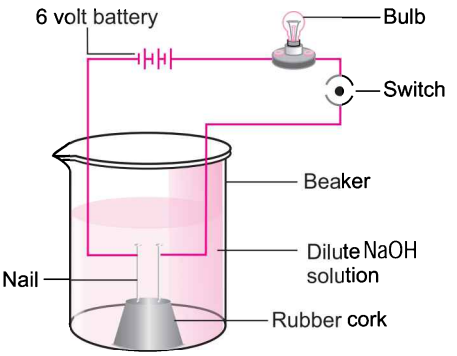
8. Which of the following salts does not contain water of crystallisation? [NCERT Exemplar]

(*a*) Blue vitriol (*b*) Baking soda (*c*) Washing soda (*d*) Gypsum

9. A sample of soil is mixed with water and allowed to settle. The clear supernatant solution turns the pH paper yellowish-orange. Which of the following would change the colour of this pH paper to greenish-blue? [NCERT Exemplar]

(*a*) Lemon juice (*b*) Vinegar (*c*) Common salt (*d*) An antacid

10. In an attempt to demonstrate electrical conductivity through an electrolyte, the alongside apparatus was set up. Which among the following statement(s) is(are) correct? [NCERT Exemplar]



(*i*) Bulb will not glow because electrolyte is not acidic

(*ii*) Bulb will glow because NaOH is a strong base and furnishes ions for conduction.

(*iii*) Bulb will not glow because circuit is incomplete.

(*iv*) Bulb will not glow because it depends upon the type of electrolytic solution.

(*a*) (*i*) and (*iii*) (*b*) (*ii*) and (*iv*)

(*c*) (*ii*) only (*d*) (*iv*) only

11. Which of the following solutions will turn phenolphthalein pink?

(*a*) HCl(*aq*) (*b*) $CO_2(aq)$ (*c*) KOH(*aq*) (*d*) $H_2SO_4(aq)$

12. Identify the correct representation of reaction occurring during chlor-alkali process. [NCERT Exemplar]

(*a*) $2NaCl(l) + 2H_2O(l) \longrightarrow 2NaOH(l) + Cl_2(g) + H_2(g)$

(*b*) $2NaCl(aq) + 2H_2O(aq) \longrightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$

(*c*) $2NaCl(aq) + 2H_2O(l) \longrightarrow 2NaOH(aq) + Cl_2(aq) + H_2(aq)$

(*d*) $2NaCl\ (aq) + 2H_2O\ (l) \longrightarrow 2NaOH\ (aq) + Cl_2(g) + H_2(g)$

13. Which of the following statements is true for acids? [NCERT Exemplar]

(*a*) Bitter and change red litmus to blue (*b*) Sour and change red litmus to blue

(*c*) Sour and change blue litmus to red (*d*) Bitter and change blue litmus to red

14. The acid having highest hydrogen ion concentration is one with

(*a*) pH = 2.5 (*b*) pH = 1.8 (*c*) pH = 7 (*d*) pH = 10

15. The pH of the gastric juices released during digestion is: [NCERT Exemplar]

(*a*) less than 7 (*b*) more than 7 (*c*) equal to 7 (*d*) equal to 0

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16. **If a few drops of a concentrated acid accidentally spills over the hand of a student, what should be done?** [*NCERT Exemplar*]

(*a*) Wash the hand with saline solution.

(*b*) Wash the hand immediately with plenty of water and apply a paste of sodium hydrogencarbonate.

(*c*) After washing with plenty of water, apply solution of sodium hydroxide on the hand.

(*d*) Neutralise the acid with a strong alkali.

17. **Sodium hydrogencarbonate when added to acetic acid evolves a gas. Which of the following statements is true about the gas evolved?** [*NCERT Exemplar*]

(*i*) It turns lime water milky.

(*ii*) It extinguishes a burning splinter.

(*iii*) It dissolves in a solution of sodium hydroxide.

(*iv*) It has a pungent odour.

(*a*) (*i*) and (*ii*)
(*b*) (*i*), (*ii*) and (*iii*)
(*c*) (*ii*), (*iii*) and (*iv*)
(*d*) (*i*) and (*iv*)

18. **Which solution will change blue litmus to red?**

(*a*) NaOH(*aq*)
(*b*) H_2SO_4(*aq*)
(*c*) KCl(*aq*)
(*d*) NH_4OH(*aq*)

19. **Which is a soluble base in water?**

(*a*) $Cu(OH)_2$
(*b*) $Fe(OH)_3$
(*c*) $Zn(OH)_2$
(*d*) KOH

20. **In general, salts**

(*a*) are ionic compounds.
(*b*) contain hydrogen ions.
(*c*) contain hydroxide ions.
(*d*) turn blue litmus red.

21. **Which of the following properties is closely related to acids?**

(*a*) Contain the hydroxide ion
(*b*) Bitter taste
(*c*) Salty taste
(*d*) Sour taste

22. **A base can be prepared by the reaction between**

(*a*) an active non-metal and water.
(*b*) a gas and water.
(*c*) a sulphide and water.
(*d*) an active metal and water.

23. **Which of the following is (are) true when HCl (g) is passed through water?** [*NCERT Exemplar*]

(*i*) It does not ionise in the solution as it is a covalent compound.

(*ii*) It ionises in the solution.

(*iii*) It gives both hydrogen and hydroxyl ion in the solution.

(*iv*) It forms hydronium ion in the solution due to the combination of hydrogen ion with water molecule.

(*a*) (*i*) only
(*b*) (*iii*) only
(*c*) (*ii*) and (*iv*)
(*d*) (*iii*) and (*iv*)

Answers

1. (*d*)	**2.** (*c*)	**3.** (*a*)	**4.** (*b*)	**5.** (*a*)	**6.** (*b*)	**7.** (*c*)
8. (*b*)	**9.** (*d*)	**10.** (*c*)	**11.** (*c*)	**12.** (*d*)	**13.** (*c*)	**14.** (*b*)
15. (*a*)	**16.** (*b*)	**17.** (*b*)	**18.** (*b*)	**19.** (*d*)	**20.** (*a*)	**21.** (*d*)
22. (*d*)	**23.** (*c*)					

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Assertion-Reason Questions [1 mark]

The following questions consist of two statements — Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(*a*) *Both A and R are true and R is the correct explanation of A.*
(*b*) *Both A and R are true but R is not the correct explanation of A.*
(*c*) *A is true but R is false.*
(*d*) *A is false but R is true.*

1. **Assertion (*A*) :** The acid must always be added to water with constant stirring.
   Reason (*R*) : Mixing of an acid with water decreases the concentration of H^+ ions per unit volume.
2. **Assertion (*A*) :** Copper sulphate crystals are wet because it contains water of crystallisation.
   Reason (*R*) : Water of crystallisation is the fixed number of molecules of water present in one formula unit of salt.
3. **Assertion (*A*) :** The aqueous solutions of glucose and alcohol do not show acidic character.
   Reason (*R*) : Aqueous solutions of glucose and alcohol do not give H^+ ions.
4. **Assertion (*A*) :** HCl gas does not change the colour of dry blue litmus paper.
   Reason (*R*) : HCl gas dissolves in the water present in wet litmus paper to form H^+ ions.
5. **Assertion (*A*) :** Weak acids have low electrical conductivity.
   Reason (*R*) : Strong acids and weak acids have equal concentration of hydrogen ions in their solutions.
6. **Assertion (*A*) :** Pure water is neither acidic nor basic.
   Reason (*R*) : The pH of a solution is inversely proportional to the concentration of hydrogen ions in it.
7. **Assertion (*A*) :** During electrolysis of concentrated aqueous solution of sodium chloride, hydrogen is produced at anode and chlorine gas is produced at cathode.
   Reason (*R*) : Ions get attracted to oppositely charged electrodes.

Answers

1. (*b*) **2.** (*d*) **3.** (*a*) **4.** (*a*) **5.** (*c*) **6.** (*b*) **7.** (*d*)

Passage-based Questions

Answer the questions below each passage on the basis of your understanding of the paragraph and the related studied concepts.

1. The pH of a solution is a measure of its hydrogen ion (H^+) concentration. It is measured generally using pH scale. The values on pH scale ranges from 0 to 14.

   A pH of 1 is very acidic and corresponds to a high concentration of H^+ ions. A pH of 14 is very basic and corresponds to a low concentration of H^+ ions. The pH of a neutral solution is 7. The Table given below shows the pH and H^+ ion concentration of some common aqueous solutions. The leftmost column shows the number of moles of H^+ ions in 1 mole of liquid.

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The pH and Hydrogen ion (H^+) Concentration of Some Solutions

H^+ Concentration (moles)	pH	Solution
10^{-1}	1	
10^{-2}	2	Gastric (stomach) juice, cola, lemon juice
10^{-3}	3	Vinegar
10^{-4}	4	Tomato juice
10^{-5}	5	Black coffee, rain water
10^{-6}	6	Urine
10^{-7}	7	Pure water
10^{-8}	8	Sea water
10^{-9}	9	Baking soda
10^{-10}	10	
10^{-11}	11	Milk of magnesia
10^{-12}	12	Household bleach
10^{-13}	13	Oven cleaner
10^{-14}	14	

(*i*) What is the relationship between pH and hydrogen ion concentration?

(*ii*) From Table, write the most acidic and the most basic solution.

(*iii*) A solution has a pH 9. How can you increase its pH?

(*iv*) Which of the following acids is used in making of vinegar?

(*a*) Nitric acid (*b*) Sulphuric acid

(*c*) Formic acid (*d*) Acetic acid

2. Acids, bases and salts are three main categories of chemical compounds. These have certain definite properties which distinguish one class from the other.

The acids are sour in taste while bases are bitter in taste. Tasting a substance is not a good way of finding out if it is an acid or a base. Acids and bases can be better distinguished with the help of indicators. Indicators are substances that undergo a change of colour with a change of acidic, neutral or basic medium. Many of these indicators are derived from natural substances such as extracts from flower petals and barrier. Litmus, a purple dye is extracted from the lichen plant. Some indicators are prepared artificially. For example, methyl orange and phenolphthalein. Given below is a table of indicators and their colour change in acidic and basic medium.

Indicator	Colour in Acid	Colour in Alkali
Litmus	Red	Blue
Methyl orange	Pinkish red	Yellow
Phenolphtalein	Colourless	Pink

(*i*) Give two examples each of natural and artificial indicators.

(*ii*) An aqueous solution turns red litmus solution blue. Excess addition of which solution would reverse the change—ammonium hydroxide solution or hydrochloric acid?

(*iii*) What will be the change in colour when a few drops of phenolphthalein is added to a solution having pH 8.5?

(*iv*) What is universal indicator?

Answers

1. (*i*) pH is inversely proportional to the hydrogen ion concentration.

(*ii*) Gastric juice/cola/lemon juice is most acidic solution and oven cleaner is most basic.

(*iii*) On dissolving excess base in a solution, pH can be increased.

(*iv*) (*d*)

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2. (*i*) Natural Indicators: Turmeric and red cabbage.
   Artificial Indicators: Methyl red and methyl orange
   (*ii*) Hydrochloric acid because adding excess acid to the base would turn blue litmus solution red.
   (*iii*) It changes into pink.
   (*iv*) Universal indicator is a mixture of dyes that changes colour gradually over a range of pH and is used in testing for acids and alkalis.

Very Short Answer Questions [1 mark]

Each of the following questions are of 1 mark and have to be answered in one word or one sentence.

Q. 1. Which acid is injected by the stinging hair of nettle leaf?
Ans. Methanoic acid.

Q. 2. Show that non-metallic oxides are acidic in nature with the help of a chemical equation.
Ans. $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$
Calcium hydroxide is a base. So, to form salt and water it must react with an acid. It means CO_2 is acidic in nature.

Q. 3. Two solutions A and B have pH values of 5 and 8 respectively. Which solution will be basic in nature?
Ans. Solution B

Q. 4. HCl is a stronger acid than acetic acid. Explain.
Ans. HCl is a stronger acid than acetic acid because it ionises completely in aqueous solution while acetic acid is only partially ionised in aqueous solution.

Q. 5. If someone is suffering from the problem of acidity after overeating; which of the following would you suggest as a remedy?
Lemon juice, Baking soda solution or Vinegar.
Ans. Baking soda solution because it is basic in nature and hence neutralises the excess acid present in the stomach.

Q. 6. Arrange the following in the increasing order of acidic strength.
Gastric juice, milk, lemon juice.
Ans. Milk < Lemon juice < Gastric juice.

Q. 7. Why does tooth decay start when the pH of mouth is lower than 5.5?
Ans. Tooth starts decaying when the pH of our mouth is lower than 5.5. This is because below this pH value, the medium of the mouth becomes more acidic due to which tooth enamel corrodes at a faster rate.

Q. 8. Two solutions X and Y have pH values of 3.0 and 9.5 respectively. Which of these will turn litmus solution from blue to red and which will turn phenolphthalein from colourless to pink?
Ans. X will turn blue litmus to red because it is acidic in nature having pH value less than 7. Y will turn phenolphthalein from colourless to pink because it is basic in nature having pH value greater than 7.

Q. 9. Why aqueous ammonia solution considered a base although ammonia does not contain hydroxyl (OH^-) ion?

Ans. Ammonia dissolves in water as follows:

$$NH_3 + H_2O \longrightarrow NH_4^+ + OH^-$$

The hydroxyl ions produced in the solution are responsible for basic character of ammonia.

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Q. 10. A knife, which is used to cut a fruit, was immediately dipped into water containing drops of blue litmus solution. The colour of the solution changes to red, what is the nature of the fruit?

Ans. The fruit is acidic as it turns blue litmus solution to red.

Q. 11. Explain why an aqueous solution of ammonium chloride is acidic in nature.

Ans. Ammonium chloride (NH_4Cl) is the salt of a strong acid, hydrochloric acid (HCl), and a weak base ammonium hydroxide (NH_4OH), so an aqueous solution of ammonium chloride is acidic in nature.

Q. 12. A white chemical compound becomes hard on mixing proper quantity of water. It is also used in surgery to maintain joints in a fixed position. Name the chemical compound.

Ans. Plaster of Paris (Calcium sulphate hemihydrate).

Q. 13. Which one of these has a higher concentration of H^+ ions?

1M HCl or 1M CH_3COOH

Ans. 1 M HCl has a higher concentration of H^+ ions because it is a stronger acid than CH_3COOH.

Q. 14. In addition to sodium hydrogencarbonate, baking powder contains a substance 'X'. Name the substance 'X'.

Ans. Tartaric acid.

Q. 15. What is the commercial name of calcium sulphate hemihydrate?

Ans. Plaster of Paris.

Q. 16. Name the substance obtained by the action of chlorine on dry slaked lime.

Ans. Bleaching powder.

Q. 17. How many molecules of water of crystallisation are there in

(*i*) Plaster of Paris

(*ii*) washing soda crystals? *[CCE 2013]*

Ans. (*i*) $\frac{1}{2}$ (*ii*) 10.

Q. 18. An aqueous solution turns red litmus solution blue. Excess addition of which solution would reverse the change—ammonium hydroxide solution or hydrochloric acid?

Ans. Hydrochloric acid because adding excess acid to the base would turn blue litmus solution red.

Q. 19. (*i*) What do you think will be the pH in the stomach of a person suffering from indigestion?

(*ii*) What do you think will be the pH of an antacid solution?

Ans. (*i*) Less than 7

(*ii*) More than 7

Q. 20. Why is the electrolysis of a concentrated solution of sodium chloride known as chlor-alkali process?

Ans. It is because of the products formed: chlor for chlorine and alkali for sodium hydroxide.

Short Answer Questions [3 marks]

Each of the following questions are of 3 marks and have to be answered in about 50-60 words.

Q. 1. A stain of curry on a white cloth becomes reddish-brown when soap is scrubbed on it.

(*i*) Which indicator can be used here? What type of indicator is it?

(*ii*) Why did the stain become reddish-brown when soap is scrubbed on it?

(*iii*) What happens when the cloth is washed with plenty of water?

Ans. (*i*) Turmeric indicator has been used. It is a natural indicator.

(*ii*) The stain becomes reddish-brown when soap is scrubbed on it because soap is basic in nature and turmeric gives reddish-brown colour in basic medium.

(*iii*) When the cloth is washed with plenty of water, the stain turns yellow again.

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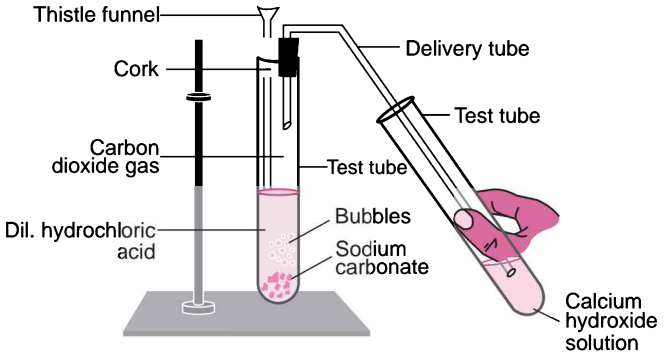
Q. 2. Draw a well-labelled diagram to show the reaction of sodium carbonate with dilute hydrochloric acid. Write the balanced chemical reaction also.

Ans.



$$Na_2CO_3(s) + 2HCl(aq) \longrightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$$

Q. 3. Name the acid present in the following: [*CBSE Delhi 2015*]

(*i*) Tomato **(*ii*) Vinegar** **(*iii*) Tamarind**

Ans. (*i*) Citric acid (*ii*) Acetic acid (*iii*) Tartaric acid

Q. 4. List in tabular form two differences between an acid and a base based on their chemical properties. [*CCE 2015*]

Ans.

Acids	Bases
1. H^+ ions are released in aqueous solution.	1. OH^- ions are released in aqueous solution.
2. Reacts with metal carbonates to liberate CO_2 gas.	2. No reaction takes place with metal carbonates.

Q. 5. What happens when a cold and concentrated solution of sodium chloride reacts with ammonia and carbon dioxide? Write the equation of the reaction which takes place.

Ans. When a cold and concentrated solution of sodium chloride reacts with ammonia and carbon dioxide, sodium hydrogencarbonate (baking soda) and ammonium chloride is formed.

$$NaCl + NH_3 + H_2O + CO_2 \longrightarrow \underset{\text{Baking soda}}{NaHCO_3} + NH_4Cl$$

Q. 6. Name the gas evolved when dilute HCl reacts with sodium hydrogen carbonate. How is it recognised?

Ans. CO_2 gas is evolved. The reaction is as follows:

$$\underset{\substack{\text{Sodium}\\\text{hydrogencarbonate}}}{NaHCO_3(s)} + \underset{\substack{\text{Hydrogen}\\\text{chloride}}}{HCl(aq)} \longrightarrow \underset{\substack{\text{Sodium}\\\text{chloride}}}{NaCl(aq)} + \underset{\text{Water}}{H_2O(l)} + \underset{\substack{\text{Carbon}\\\text{dioxide}}}{CO_2\uparrow}$$

When the produced gas is passed through lime water, lime water turns milky which confirms that the evolved gas is CO_2.

$$\underset{\substack{\text{Calcium hydroxide}\\\text{(Lime water)}}}{Ca(OH)_2(aq)} + CO_2(g) \longrightarrow \underset{\substack{\text{White}\\\text{precipitate}}}{CaCO_3(s)} + H_2O(l)$$

Q. 7. What is 'baking powder'? How does it make the cake soft and spongy?

Ans. Baking powder is a mixture of baking soda ($NaHCO_3$) and an edible acid like tartaric acid.

Baking powder on heating produces carbon dioxide gas which causes bread or cake to rise making it soft and spongy.

$$\underset{\substack{\text{Sodium}\\\text{hydrogencarbonate}\\\text{(Baking soda)}}}{NaHCO_3} + \underset{\substack{\text{(From tartaric}\\\text{acid)}}}{H^+} \xrightarrow{\text{Heat}} CO_2 + H_2O + \text{Sodium salt of tartaric acid}$$

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Q. 8. The conditions preferred by some plants are shown in the table below:

Plant	Apple	Potato	Black currant	Mint	Onion	Strawberry	Lettuce
pH	5.0–6.5	4.5–6.0	6.0–8.0	7.0–8.0	6.0–7.0	5.0–7.0	6.0–7.0

(*i*) Which plants grow well over the largest range of pH values?
(*ii*) Which plant can grow in the most acidic soil?
(*iii*) Which plant can grow in the basic soil only?
(*iv*) What is the pH range for onion to grow well?

Ans. (*i*) Black currant and strawberry (*ii*) Potato (4.5 – 6.0)
(*iii*) Mint (7.0 – 8.0) (*iv*) 6.0 – 7.0

Q. 9. (*i*) Name a sodium compound used for softening hard water.
(*ii*) Which compound of calcium is used for disinfecting drinking water supply?
(*iii*) Name a metal compound which has detergent properties.
(*iv*) State a peculiar property of Plaster of Paris.

Ans. (*i*) Sodium carbonate (*ii*) Bleaching powder
(*iii*) Sodium carbonate (*iv*) It sets into hard mass on mixing with water.

Q. 10. Name the acid present in an ant sting and give its chemical formula. Also give the common method to get relief from the discomfort caused by the ant sting. [*NCERT Exemplar*]

Ans. The acid present in an ant sting is methanoic acid (formic acid). The chemical formula is HCOOH. To get relief, one should apply any available basic salt, *e.g.*, baking soda ($NaHCO_3$) on it.

Q. 11. What happens when nitric acid is added to an egg-shell? [*NCERT Exemplar*]

Ans. Egg-shells contain calcium carbonate. When nitric acid is added to it, carbon dioxide gas is evolved. The reaction can be given as

$$CaCO_3 + 2HNO_3 \longrightarrow Ca(NO_3)_2 + H_2O + CO_2$$

Q. 12. What will be the action of the following substances on litmus paper?
Dry HCl gas, Moistened NH_3 gas, Lemon juice, Carbonated soft drink, Curd, Soap solution.
[*NCERT Exemplar*]

Ans.

Substance	Action on Litmus Paper
Dry HCl gas	No change
Moistened NH_3 gas	Turns red to blue as it is basic.
Lemon juice	Turns blue to red because it contains citric acid.
Carbonated soft drink	Turns blue to red because it contains carbonic acid.
Curd	Turns blue to red because it contains lactic acid.
Soap solution	Turns red to blue as it is basic.

Q. 13. A student prepared solutions of (*i*) an acid and (*ii*) a base in two separate beakers. She forgot to label the solutions and litmus paper is not available in the laboratory. Since both the solutions are colourless, how will she distinguish between the two? [*NCERT Exemplar*]

Ans. In the absence of litmus paper, any indicator like methyl orange, phenolphthalein can be used. Natural indicator like turmeric can also be used.

Indicator	Colour in acidic solution	Colour in basic solution
Methyl Orange	Pinkish red	Yellow
Phenolphthalein	Colourless	Pink
Turmeric	Yellow	Reddish brown

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Q. 14. When zinc metal is treated with a dilute solution of a strong acid, a gas is evolved, which is utilised in the hydrogenation of oil. Name the gas evolved. Write the chemical equation of the reaction and also write a test to detect the gas formed. *[NCERT Exemplar]*

Ans. When zinc reacts with dilute solution of strong acid, it forms salt and hydrogen gas is evolved.

$$Zn + 2HCl \longrightarrow ZnCl_2 + H_2$$

When a burning splinter is brought near the mouth of the test tube, the gas burns with a pop sound.

Q. 15. Which acid is produced in our stomach? What happens if there is an excess of acid in the stomach? How can its effect be cured? *[CCE 2014]*

Ans. Hydrochloric acid is produced in our stomach. The excess acid in the stomach causes indigestion which produces pain and irritation. This effect can be cured by using antacids. Antacids (a group of mild bases) react with excess acid in the stomach and neutralise it.

Q. 16. To the three solutions listed below, a few drops of phenolphthalein and blue litmus were added separately. Specify the colour change in each case, if any:

Name of the solution	Colour change with phenolphthalein	Colour change with blue litmus
(*a*) Sodium carbonate		
(*b*) Hydrochloric acid		
(*c*) Sodium chloride		

Ans.

Name of the solution	Colour change with phenolphthalein	Colour change with blue litmus
(*a*) Sodium carbonate	Turns pink	No change
(*b*) Hydrochloric acid	No change	Turns red
(*c*) Sodium chloride	No change	No change

Q. 17. Identify the acid and the base from which sodium chloride is obtained. Which type of salt is it? When is it called rock salt? How is rock salt formed? *[CBSE 2019 (31/1/1)]*

Ans. Sodium chloride is obtained by the reaction of sodium hydroxide (base) and hydrochloric acid. It is a neutral salt as it is formed by the reaction of a strong acid and a strong base. The salt obtained from seas contains impurities thus appear brown in colour. This is known as rock salt.

Beds of rock salt formed when seas of bygone ages dried up. It is mined like coal.

Q. 18. A salt X when dissolved in distilled water gives a clear solution which turns red litmus blue. Explain this phenomenon.

Ans. Basic solutions turn red litmus paper blue. The salt of a weak acid and a strong base gives a basic solution. So, the given salt X is the salt of a weak acid and a strong base.

Example: When sodium carbonate is dissolved in water, it gets hydrolysed to some extent and forms sodium hydroxide and carbonic acid.

$$\underset{\substack{\text{Sodium carbonate}\\\text{(Basic salt)}}}{Na_2CO_3(s)} + \underset{\text{Water}}{2H_2O(l)} \overset{\text{Hydrolysis}}{\rightleftharpoons} \underset{\substack{\text{Sodium hydroxide}\\\text{(Strong base)}}}{2NaOH(aq)} + \underset{\substack{\text{Carbonic acid}\\\text{(Weak acid)}}}{H_2CO_3\ (aq)}$$

Being a strong base, sodium hydroxide is fully ionised and gives a large amount of hydroxide ions (OH^-). Carbonic acid is a weak acid which is only slightly ionised and hence, gives a small amount of hydrogen ions (H^+). The H^+ ions produced by carbonic acid neutralises only a small amount of OH^- ions produced by sodium hydroxide and the rest amount of OH^- ions are present in the solution. Hence, the Na_2CO_3 solution is basic in nature. It turns red litmus blue.

Q. 19. Write the chemical formula of washing soda. How can it be obtained from baking soda? List two industries in which washing soda is used for other purposes than washing clothes. *[CBSE 2019 (31/3/3)]*

Ans. The chemical formula of washing soda is $Na_2CO_3.10H_2O$. It is obtained by heating baking soda and then recrystallising it.

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$$\underset{\text{Baking soda}}{2NaHCO_3} \xrightarrow{\text{Heat}} \underset{\text{Sodium carbonate}}{Na_2CO_3} + H_2O + CO_2$$

$$Na_2CO_3 + 10H_2O \longrightarrow \underset{\text{Washing soda}}{Na_2CO_3.10H_2O}$$

Uses: (*i*) Washing soda is used in glass and soap industries.

(*ii*) Washing soda is used in paper industry.

Q. 20. With the help of a chemical equation, explain how a soda–acid fire extinguisher helps in putting out a fire.

Ans. Soda-acid fire extinguisher contains sodium bicarbonate and sulphuric acid, which are in separate containers. When knob of the fire extinguisher is pressed, then sulphuric acid mixes with sodium bicarbonate solution and produces a lot of CO_2 gas, which forms a blanket over the fire and cuts it off from the supply of the air to the burning substance and the fire stops.

$$\underset{\substack{\text{Sodium}\\\text{hydrogencarbonate}}}{2NaHCO_3} + \underset{\text{Sulphuric acid}}{H_2SO_4} \longrightarrow \underset{\substack{\text{Sodium}\\\text{sulphate}}}{Na_2SO_4} + \underset{\text{Water}}{2H_2O} + \underset{\substack{\text{Carbon}\\\text{dioxide}}}{2CO_2}$$

Q. 21. A compound which is prepared from gypsum has the property of hardening when mixed with a proper quantity of water. Identify the compound. Write the chemical equation for its preparation. For what purpose is it used in hospitals?

Ans. The compound prepared from gypsum on heating it at 100°C, is known as Plaster of Paris. Its chemical formula is $CaSO_4.\frac{1}{2}H_2O$. Hence, its chemical name is calcium sulphate hemihydrate.

The chemical equation for its preparation is as follows:

$$\underset{\text{Gypsum}}{CaSO_4.2H_2O} \xrightarrow{100°C} \underset{\text{Plaster of Paris}}{CaSO_4.\frac{1}{2}H_2O} + \underset{\text{Water}}{1\frac{1}{2}H_2O}$$

Plaster of Paris is used in hospitals mainly as plaster for supporting fractured bones in the right position. In dentistry, it is used for making casts.

Q. 22. What is meant by water of crystallisation? Explain that the crystalline salts contain water of crystallisation. *[CBSE Delhi 2016]*

Ans. Water of crystallisation is a fixed number of water molecules present in one formula unit of a salt. One formula unit of copper sulphate contains five water molecules ($5H_2O$). The water molecules which form part of the structure of a crystal are called water of crystallisation. When hydrated salts are heated strongly, they lose their water of crystallisation.

On strong heating, blue copper sulphate crystals turn white (due to the loss of water of crystallisation).

$$\underset{\substack{\text{Hydrated}\\\text{copper sulphate}\\\text{(Blue)}}}{CuSO_4.5H_2O} \xrightarrow{\text{Heat}} \underset{\substack{\text{Anhydrous}\\\text{copper sulphate}\\\text{(White)}}}{CuSO_4} + \underset{\substack{\text{Water}\\\text{(Goes away)}}}{5H_2O}$$

Anhydrous copper sulphate turns blue on adding water.

$$\underset{\substack{\text{Anhydrous}\\\text{copper sulphate}\\\text{(White)}}}{CuSO_4} + \underset{\text{Water}}{5H_2O} \longrightarrow \underset{\substack{\text{Hydrated}\\\text{copper sulphate}\\\text{(Blue)}}}{CuSO_4.5H_2O}$$

Q. 23. (*i*) Write the formula and chemical name of bleaching powder.

(*ii*) Write the chemical equation to represent the action of atmospheric CO_2 gas on bleaching powder when left exposed in open.

(*iii*) State for what purpose is bleaching powder used in water treatment plants.

Ans. (*i*) Chemical formula: $CaOCl_2$

Chemical name: Calcium oxychloride

(*ii*) $\underset{\substack{\text{Bleaching}\\\text{powder}}}{CaOCl_2(s)} + \underset{\substack{\text{Carbon}\\\text{dioxide}}}{CO_2(g)} \longrightarrow \underset{\substack{\text{Calcium}\\\text{carbonate}}}{CaCO_3(s)} + \underset{\text{Chlorine}}{Cl_2(g)}$

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(*iii*) Bleaching powder is used in water treatment plants for disinfecting drinking water to make it free of germs.

Q. 24. How would you distinguish between baking powder and washing soda by heating? [*NCERT Exemplar*]

Ans. The chemical formula of baking powder is sodium hydrogencarbonate ($NaHCO_3$); whereas, that of washing soda is sodium carbonate ($Na_2CO_3.10H_2O$).

Sodium hydrogencarbonate on heating gives CO_2 gas which will turn lime water milky whereas no such gas is obtained from sodium carbonate.

$$2NaHCO_3 \xrightarrow{\text{Heat}} Na_2CO_3 + H_2O + CO_2$$

$$Na_2CO_3.10H_2O \xrightarrow{\text{Heat}} Na_2CO_3 + 10H_2O$$

Q. 25. Salt A commonly used in bakery products on heating gets converted into another salt B which itself is used for removal of hardness of water and a gas C is evolved. The gas C when passed through lime water, turns it milky. Identify A, B and C. [*NCERT Exemplar, CBSE 2019 (31/4/2)*]

Ans. Baking powder ($NaHCO_3$), salt A is commonly used in bakery products. On heating, it forms sodium carbonate (Na_2CO_3), B and CO_2 gas, C is evolved. When CO_2 gas is passed through lime water it forms calcium carbonate ($CaCO_3$), which is slightly soluble in water making it milky.

A — $NaHCO_3$; B — Na_2CO_3; C — CO_2 gas

Q. 26. What are strong and weak acids? In the following list of acids, separate strong acids from weak acids: Hydrochloric acid, citric acid, acetic acid, nitric acid, formic acid, sulphuric acid. [*NCERT Exemplar*]

Ans. In aqueous solutions, strong acids ionise completely and provide high concentration of hydronium ions. On the other hand, weak acids are partially ionised and an aqueous solution of same molar concentration provides a much smaller concentration of H_3O^+ ions.

Strong acids—Hydrochloric acid, sulphuric acid, nitric acid.

Weak acids—Citric acid, acetic acid, formic acid.

Q. 27. Explain the formation of

(*i*) acidic (*ii*) basic and (*iii*) neutral salts. [*CBSE 2019 (31/1/3)*]

Ans. (*i*) Acidic salt is formed by the reaction of a strong acid and weak base.

$$HCl + NH_4OH \longrightarrow NH_4Cl + H_2O$$

(*ii*) Basic salt is formed by the reaction of weak acid and strong base

$$NaOH + CH_3COOH \longrightarrow CH_3COONa + H_2O$$

(*iii*) Neutral salt is formed by the reaction of strong acid and strong base.

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

Q. 28. What happens when dilute hydrochloric acid is added to the following and write balanced chemical equations

(*i*) Bleaching powder (*ii*) Zinc granules (*iii*) Baking soda [*CCE 2016*]

Ans. (*i*) Calcium chloride and chlorine gas are formed.

$$\underset{\text{Bleaching powder}}{CaOCl_2(s)} + 2HCl(aq) \longrightarrow \underset{\text{Calcium chloride}}{CaCl_2(s)} + H_2O(l) + Cl_2(g)$$

(*ii*) Hydrogen gas is evolved.

$$\underset{\text{Zinc granules}}{Zn(s)} + 2HCl(aq) \longrightarrow \underset{\text{Zinc chloride}}{ZnCl_2(aq)} + H_2(g)$$

(*iii*) Sodium chloride and carbon dioxide gas are formed.

$$\underset{\text{Baking soda}}{NaHCO_3(s)} + HCl(aq) \longrightarrow \underset{\text{Sodium chloride}}{NaCl(aq)} + H_2O(l) + \underset{\text{Carbon dioxide}}{CO_2(g)}$$

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Q. 29. Give suitable reason for the following statements:

(*i*) We feel burning sensation in the stomach when we overeat.

(*ii*) The crystals of washing soda change to white powder on exposure to air.

(*iii*) An aqueous solution of sodium chloride is neutral but an aqueous solution of sodium carbonate is basic. *[CCE 2016]*

Ans. (*i*) When we overeat excess of acid is produced in the stomach which causes burning sensation.

(*ii*) Washing soda is sodium carbonate decahydrate which when exposed to air loses 10 molecules of water and changes to white powder.

(*iii*) Sodium chloride is a salt of strong acid HCl and strong base NaOH, so it is neutral.
Sodium carbonate is a salt of weak acid H_2CO_3 and strong base NaOH, so it is basic.

Long Answer Questions [5 marks]

Each of the following questions are of 5 marks and have to be answered in about 80-90 words.

Q. 1. 'X' is an indicator added to a dilute NaOH solution. The colour of the solution turns pink. When a substance 'Y' is added to this solution, the solution becomes colourless. 'Y' also combines with sodium hydroxide to form salt that we use in food in everyday life.

(*i*) Identify 'X' and 'Y'.

(*ii*) Give the reaction of 'Y' with sodium hydroxide.

(*iii*) Name the type of reaction happened above.

(*iv*) What is the pH of 'Y'?

Ans. (*i*) 'X' is phenolphthalein.
'Y' is hydrochloric acid.

(*ii*) $HCl + NaOH \longrightarrow NaCl + H_2O$
'Y'

(*iii*) Neutralisation reaction

(*iv*) The pH of 'Y' is less than 7.

Q. 2. (*i*) In the following schematic diagram for the preparation of hydrogen gas as shown in figure, what would happen if following changes are made?

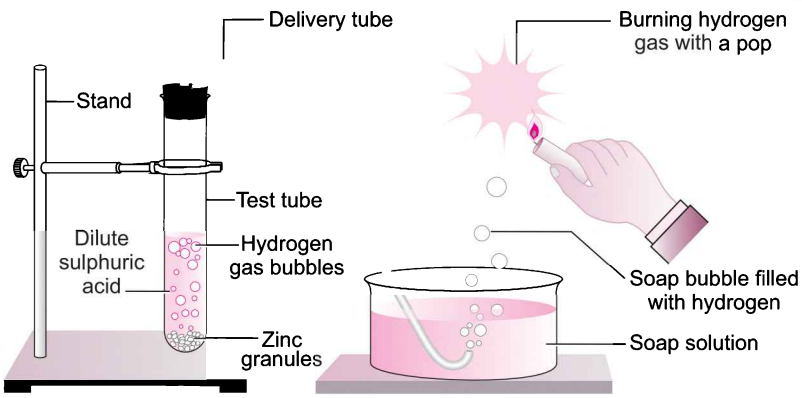
(*a*) In place of zinc granules, same amount of zinc dust is taken in the test tube.

(*b*) Instead of dilute sulphuric acid, dilute hydrochloric acid is taken.

(*c*) Sodium hydroxide is taken in place of dilute sulphuric acid and the tube is heated.

(*ii*) How do metal carbonates and metal hydrogencarbonates react with acids?

[NCERT Exemplar]



Ans. (*i*) (*a*) Hydrogen gas will evolve with greater speed.

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(*b*) Almost same amount of gas is evolved.

(*c*) If sodium hydroxide is taken, hydrogen gas will be evolved.

$$Zn + 2NaOH \longrightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_2} + H_2\uparrow$$

(*ii*) All metal carbonates and hydrogencarbonates react with acids to form a corresponding salt, carbon dioxide and water.

Metal carbonate + Acid ⟶ Salt + Carbon dioxide + Water

Metal hydrogencarbonate + Acid ⟶ Salt + Carbon dioxide + Water

For example, sodium carbonate reacts with dilute hydrochloric acid as follows:

$$Na_2CO_3(s) + 2HCl(aq) \longrightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$$

Sodium hydrogencarbonate reacts with dilute hydrochloric acid as follows:

$$NaHCO_3(s) + HCl(aq) \longrightarrow NaCl(aq) + H_2O(l) + CO_2(g)$$

Q. 3. A metal carbonate X on reacting with an acid gives a gas which when passed through a solution Y gives the carbonate back. On the other hand, a gas G that is obtained at anode during electrolysis of brine is passed on dry Y, it gives a compound Z, used for disinfecting drinking water. Identify X, Y, G and Z. *[NCERT Exemplar]*

Ans. The gas evolved at anode during electrolysis of brine is chlorine (G).

When chlorine gas is passed through dry $Ca(OH)_2$ (Y) produces bleaching powder (Z) used for disinfecting drinking water.

$$\underset{\substack{\text{Slaked lime}\\(Y)}}{Ca(OH)_2} + Cl_2 \longrightarrow \underset{\substack{\text{Bleaching powder}\\Z}}{CaOCl_2} + H_2O$$

Since Y and Z are calcium salts, therefore X is also a calcium salt and is calcium carbonate.

$$\underset{\substack{\text{Calcium carbonate}\\(X)}}{CaCO_3} + 2HCl \longrightarrow CaCl_2 + CO_2 + H_2O$$

$$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$$

Q. 4. Write the formulae of the salts given below:

Potassium sulphate, sodium sulphate, calcium sulphate, magnesium sulphate, copper sulphate, sodium chloride, sodium nitrate, sodium carbonate and ammonium chloride.

Identify the acids and bases from which the above salts may be obtained. How many families can you identify among these salts?

Ans. The formulae of the given salts and the acids and bases from which these salts may be obtained are given in the following table:

S.No.	Salts	Formula	Family	Acid and Base
1.	Potassium sulphate	K_2SO_4	Potassium salts	H_2SO_4 and KOH
2.	Sodium sulphate	Na_2SO_4	Sodium salts	H_2SO_4 and NaOH
3.	Calcium sulphate	$CaSO_4$	Calcium salts	H_2SO_4 and $Ca(OH)_2$
4.	Magnesium sulphate	$MgSO_4$	Magnesium salts	H_2SO_4 and $Mg(OH)_2$
5.	Copper sulphate	$CuSO_4$	Copper salts	H_2SO_4 and $Cu(OH)_2$
6.	Sodium chloride	NaCl	Chloride salts	HCl and NaOH
7.	Sodium nitrate	$NaNO_3$	Nitrate salts	HNO_3 and NaOH
8.	Sodium carbonate	Na_2CO_3	Carbonate salts	H_2CO_3 and NaOH
9.	Ammonium chloride	NH_4Cl	Chloride salts	HCl and NH_4OH

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Q. 5. A sulphate salt of Group 2 element of the Periodic Table is a white, soft substance, which can be moulded into different shapes by making its dough. When this compound is left in open for some time, it becomes a solid mass and cannot be used for moulding purposes. Identify the sulphate salt and state why does it show such a behaviour. Give the reaction involved.

[NCERT Exemplar]

Ans. The substance which is used for making different shapes is Plaster of Paris. Its chemical name is calcium sulphate hemihydrate ($CaSO_4.\frac{1}{2}H_2O$). The two formula unit of $CaSO_4$ share one molecule of water. As a result, it is soft.

When it is left open for some time, it absorbs moisture from the atmosphere and forms gypsum, which is a hard solid mass.

$$\underset{\substack{\text{Plaster of Paris}\\\text{(Soft)}\\\text{(Sulphate salt)}}}{CaSO_4.\frac{1}{2}H_2O} + 1\frac{1}{2}H_2O \longrightarrow \underset{\substack{\text{Gypsum}\\\text{(Hard mass)}}}{CaSO_4.2H_2O}$$

HOTS [Higher Order Thinking Skills]

Q. 1. Why is acetic acid called a weak acid though there are four hydrogen atoms in the molecule?

Ans. Though acetic acid has four hydrogen atoms, only one of the four hydrogen atoms is released as H^+ ion in solution. So, it is a weak acid.

Q. 2. In one of the industrial processes used for manufacture of sodium hydroxide, a gas X is formed as by-product. The gas X reacts with lime water to give a compound Y which is used as a bleaching agent in chemical industry. Identify X and Y giving the chemical equation of the reactions involved. *[NCERT Exemplar, CBSE 2019 (31/5/3)]*

Ans. In the manufacture of sodium hydroxide, hydrogen gas and chlorine gas (X) are formed as by-products. When chlorine gas (X) reacts with lime water, it forms calcium oxychloride (bleaching powder) Y. The reactions are

$$2NaCl(aq) + 2H_2O(l) \longrightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$$

X — Cl_2 (Chlorine gas)

$$\underset{\text{Lime water}}{Ca(OH)_2(s)} + Cl_2(g) \longrightarrow CaOCl_2(s) + H_2O(l)$$

Y — Calcium oxychloride (bleaching powder)

Q. 3. A baker found that the cake prepared by him is hard and small in size. Which ingredient do you think that he might have forgotten to add that would have caused the cake to rise and become light? Give reason.

Ans. The baker might have forgotten to add baking powder. Baking powder is a mixture of baking soda (sodium hydrogencarbonate) and a mild edible acid such as tartaric acid. When this baking powder is added with water, then sodium hydrogencarbonate ($NaHCO_3$) reacts with tartaric acid to evolve carbon dioxide gas. This CO_2 gas causes the cake to rise and become soft and spongy.

Q. 4. A dry pellet of a common base B, when kept in open absorbs moisture and turns sticky. The compound is also a by-product of chlor-alkali process. Identify B. What type of reaction occurs when B is treated with an acidic oxide? Write a balanced chemical equation for one such solution. *[NCERT Exemplar, CBSE 2019 (31/3/2)]*

Ans. Sodium hydroxide (NaOH) is a commonly used base and is hygroscopic, that is, it absorbs moisture from the atmosphere and becomes sticky. Moreover, it is also a by-product of chlor-alkali process. Thus, 'B' is NaOH.

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The acidic oxides react with base to give salt and water. The reaction between NaOH and SO_2 can be given as

$$2NaOH + \underset{\text{Acidic oxide}}{SO_2} \longrightarrow Na_2SO_3 + H_2O$$

Q. 5. A compound 'A' is used in fire extinguishers, as an antacid and its small amount is also used in making bakery items. Identify the compound and also explain the reason for above mentioned uses of the compound 'A'.

Ans. Compound 'A' is sodium hydrogencarbonate—$NaHCO_3$.

(*i*) It is used in fire extinguishers because it produces CO_2 gas on reaction with acid.

$$H_2SO_4 + 2NaHCO_3 \longrightarrow Na_2SO_4 + 2H_2O + 2CO_2$$

(*ii*) It is used as an antacid because it neutralises excess acid (HCl) present in stomach.

$$HCl + NaHCO_3 \longrightarrow NaCl + H_2O + CO_2$$

(*iii*) It is used in making bakery items because on reaction with acid it produces CO_2 gas which makes bread, cakes, etc., soft and spongy.

$$NaHCO_3 + H^+ \longrightarrow H_2O + CO_2\uparrow + \text{Na-salt of acid}$$

NCERT Corner

NCERT Intext Questions

Q. 1. You have been provided with three test tubes. One of them contains distilled water and the other two contain an acidic solution and a basic solution, respectively. If you are given only red litmus paper, how will you identify the contents of each test tube?

Ans. (*a*) Put the red litmus paper turn by turn in each of the three test tubes. The solution which turns the red litmus paper to blue will be a basic solution. Here, the blue litmus paper formed can now be used to test the acidic solution.

(*b*) Put this blue litmus paper in the remaining two test tubes, one by one. The solution which turns the blue litmus paper to red will be the acidic solution.

(*c*) The solution which has no effect on any litmus paper will be neutral and hence, it will be distilled water.

Q. 2. Why should curd and sour substances not be kept in brass and copper vessels?

Ans. Curd and other sour substances should not be kept in brass and copper vessels. This is because curd and other sour substances contain acids which can react with these vessels to form poisonous compounds that can cause food poisoning and damage health.

Q. 3. Which gas is usually liberated when an acid reacts with a metal? Illustrate with an example. How will you test the presence of this gas?

Ans. When a metal reacts with an acid, usually hydrogen gas is liberated. For example, zinc reacts with dilute sulphuric acid as follows:

$$\underset{\text{Zinc}}{Zn} + \underset{\text{Sulphuric acid}}{H_2SO_4} \longrightarrow \underset{\text{Zinc sulphate}}{ZnSO_4} + \underset{\text{Hydrogen}}{H_2\uparrow}$$

The hydrogen gas evolved can be tested by passing the gas through soap solution and then bringing a burning candle near the soap bubble filled with the gas. The soap bubble bursts and the hydrogen gas burns with a pop sound.

Q. 4. A metal compound A reacts with dilute hydrochloric acid to produce effervescence. The gas evolved extinguishes a burning candle. Write a balanced chemical equation for the reaction if one of the compounds formed is calcium chloride.

Ans. The gas that extinguishes a burning candle is carbon dioxide. It is formed by the action of dilute hydrochloric acid on a metal carbonate or metal hydrogencarbonate and produces effervescence.

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Since one of the compounds formed is calcium chloride, this shows that the metal compound is calcium carbonate. It cannot be calcium hydrogencarbonate because calcium hydrogencarbonate is found in solution.

Thus, the metal compound A is calcium carbonate ($CaCO_3$).

Calcium carbonate reacts with dilute hydrochloric acid to form calcium chloride, carbon dioxide and water.

$$CaCO_3(s) + 2HCl(aq) \longrightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$$

Q. 5. Why do HCl, HNO_3, etc., show acidic character in aqueous solutions while solutions of compounds like C_2H_5OH and glucose do not show acidic character?

Ans. HCl, HNO_3, etc., ionise in the aqueous solution to produce H_3O^+ ions. Hence, they show acidic character. Compounds like C_2H_5OH and glucose do not ionise in the aqueous solution to give H_3O^+ ions, *i.e.*, hydrogen present in them is non-ionisable. Hence, they do not show acidic character.

Q. 6. Why does an aqueous solution of an acid conduct electricity?

Ans. An acid in the aqueous solution ionises to produce H_3O^+ ions and the corresponding negative ions. For example, HCl gives H^+ and Cl^- ions. Due to the presence of ions in the solution, it conducts electricity.

Q. 7. Why does dry HCl gas not change the colour of the dry litmus paper? *[CBSE 2019 (31/2/1)]*

Ans. Dry HCl gas does not change the colour of dry litmus paper because it does not produce H_3O^+ ion.

Q. 8. While diluting an acid, why is it recommended that the acid should be added to water and not water to the acid? *[CBSE 2019 (31/2/1)]*

Ans. Dilution of concentrated acid with water is a highly exothermic process. If water is added into acid, the heat produced is so large that the solution may splash out and the beaker in which it is carried out may break due to excessive heating. Hence, dilution is done by adding acid into water.

Q. 9. How is the concentration of hydronium ions (H_3O^+) affected, when a solution of an acid is diluted?

Ans. When a solution of an acid is diluted, the concentration of hydronium ions (H_3O^+) per unit volume decreases.

Q. 10. How is the concentration of hydroxide ions (OH^-) affected, when excess base is dissolved in a solution of sodium hydroxide?

Ans. On dissolving excess base in a solution of sodium hydroxide, concentration of OH^- ions per unit volume in the solution increases.

Q. 11. You have two solutions A and B. The pH of the solution A is 6 and pH of solution B is 8. Which solution has more hydrogen ion concentration? Which of these is acidic and which one is basic?

Ans. The pH of a solution is inversely proportional to its hydrogen ion concentration. This means that the solution having lower pH will have more hydrogen ion concentration. Thus, solution A will have more hydrogen ion concentration.

A solution with pH < 7 is acidic. Hence, solution A is acidic.

A solution with pH > 7 is basic. Hence, solution B is basic.

Q. 12. What effect does the concentration of $H^+(aq)$ ions have on the acidic nature of the solution?

Ans. Water contains exactly the same number of H^+ and OH^- ions. Acidic solution contains more hydrogen ions than water. Higher the concentration of H^+ ions in a solution, more acidic is the solution.

Q. 13. Do basic solutions also have $H^+(aq)$ ions? If yes, then why are these basic?

Ans. Basic solutions also have H^+ ions in addition to OH^- ions. They are basic because in these solutions, OH^- ion concentration is greater than H^+ ion concentration.

Q. 14. Under what soil condition do you think a farmer would treat the soil of his field with quick lime (calcium oxide) or slaked lime (calcium hydroxide) or chalk (calcium carbonate)?

Ans. Most of the plants grow best when the pH of the soil is close to 7. If the soil is too acidic or too basic, the plants grow badly or do not grow at all. As quick lime, slaked lime or chalk are all alkaline substances, these would be added to the soil by the farmer when the soil is highly acidic.

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Q. 15. What is the common name of the compound $CaOCl_2$?

Ans. Bleaching powder.

Q. 16. Name the substances which on treatment with chlorine yields bleaching powder.

Ans. Dry slaked lime $Ca(OH)_2$.

Q. 17. Name the sodium compound which is used for softening hard water.

Ans. Washing soda (sodium carbonate decahydrate).

Q. 18. What will happen if a solution of sodium hydrogencarbonate is heated? Give the equation of the reaction involved.

Ans. Sodium hydrogencarbonate on heating decomposes to give sodium carbonate, carbon dioxide and water.

$$\underset{\text{Sodium hydrogencarbonate}}{2NaHCO_3} \longrightarrow \underset{\text{Sodium carbonate}}{Na_2CO_3} + \underset{\text{Carbon dioxide}}{CO_2\uparrow} + \underset{\text{Water}}{H_2O}$$

Q. 19. Write an equation to show the reaction between Plaster of Paris and water.

Ans. Plaster of Paris ($CaSO_4.1/2H_2O$) on mixing with water, changes into gypsum ($CaSO_4.2H_2O$) which sets to a hard mass in about half an hour.

$$\underset{\text{Plaster of Paris}}{CaSO_4.\frac{1}{2}H_2O} + 1\underset{\text{Water}}{\frac{1}{2}H_2O} \longrightarrow \underset{\text{Gypsum}}{CaSO_4.2H_2O}$$

NCERT Exercises

Q. 1. A solution turns red litmus blue, its pH is likely to be

(*a*) 1 (*b*) 4 (*c*) 5 (*d*) 10

Ans. The solution which turns red litmus blue is basic. Its pH should be greater than 7. Therefore, the correct answer is (*d*).

Q. 2. A solution reacts with crushed egg-shells to give a gas that turns lime water milky. The solution contains

(*a*) NaCl (*b*) HCl (*c*) LiCl (*d*) KCl

Ans. Egg-shells contain calcium carbonate which reacts with HCl to give out CO_2 which turns lime water milky. Hence, the correct answer is (*b*).

Q. 3. 10 mL of a solution of NaOH is found to be completely neutralised by 8 mL of a given solution of HCl. If we take 20 mL of the same solution of NaOH, the amount of HCl solution (the same solution as before) is required to be neutralised. It will be

(*a*) 4 mL (*b*) 8 mL (*c*) 12 mL (*d*) 16 mL

Ans. If we take double the amount of the NaOH solution, the amount of the HCl solution required to neutralise it, is also double. Hence, the correct answer is (*d*).

Q. 4. Which one of the following type of medicines is used for treating indigestion?

(*a*) Antibiotic (*b*) Analgesic (*c*) Antacid (*d*) Antiseptic

Ans. The indigestion is due to excess of acid produced in the stomach. The medicine used to neutralise it is called antacid. Hence, the correct answer is (*c*).

Q. 5. Write word–equations and then balanced equations for the reactions taking place when

(*a*) dilute sulphuric acid reacts with zinc granules.

(*b*) dilute hydrochloric acid reacts with magnesium ribbon.

(*c*) dilute sulphuric acid reacts with aluminium powder.

(*d*) dilute hydrochloric acid reacts with iron filings.

Ans. (*a*) Sulphuric acid(*aq*) + Zinc(*s*) $\longrightarrow$ Zinc sulphate(*aq*) + Hydrogen(*g*)

$$H_2SO_4(aq) + Zn(s) \longrightarrow ZnSO_4(aq) + H_2(g)$$

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(*b*) Hydrochloric acid(*aq*) + Magnesium(*s*) ⟶ Magnesium chloride(*aq*) + Hydrogen(*g*)

$2HCl(aq) + Mg(s) \longrightarrow MgCl_2(aq) + H_2(g)$

(*c*) Sulphuric acid(*aq*) + Aluminium(*s*) ⟶ Aluminium sulphate(*aq*) + Hydrogen(*g*)

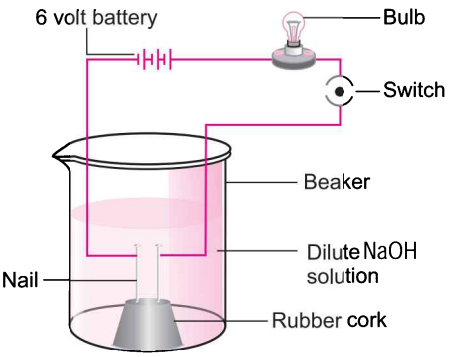
$3H_2SO_4(aq) + 2Al(s) \longrightarrow Al_2(SO_4)_3(aq) + 3H_2(g)$

(*d*) Hydrochloric acid(*aq*) + Iron(*s*) ⟶ Iron(II) chloride(*aq*) + Hydrogen(*g*)

$2HCl(aq) + Fe(s) \longrightarrow FeCl_2(aq) + H_2(g)$

Q. 6. Compounds such as alcohols and glucose also contain hydrogen but are not categorised as acids. Describe an activity to prove it.

Ans. Although alcohols and glucose contain hydrogen, they are not ionised to give H^+ ions in solution. So, they are not considered as acid.



Activity:

- Collect solutions of hydrochloric acid, sulphuric acid, glucose and alcohol.
- Take a beaker of 100 mL.
- Now, take a cork and fix two nails on it as shown in figure.
- Place this cork in the beaker.
- Connect the nails to the two terminals of a 6 volt battery through a bulb and a switch.
- Now, pour dilute H_2SO_4 in the beaker so that the nails are immersed in the acid. Switch on the current.
- Repeat the experiment with dilute hydrochloric acid, glucose and alcohol solutions.
- What do you observe?
- Does the bulb glow in all cases?

It is observed that the bulb will glow in case of hydrochloric acid and sulphuric acid, but not in the case of alcohol and glucose.

Q. 7. Why does distilled water not conduct electricity, whereas rain water does?

Ans. Distilled water does not conduct electricity because it does not contain any ionic compounds like acids, bases or salts, dissolved in it. Rain water, while falling to the earth through the atmosphere, dissolves acidic gases like CO_2, SO_2, etc., from the air and form acids like carbonic acid (H_2CO_3), sulphurous acid (H_2SO_3), etc. These acids provide hydrogen ions (H^+) to rain water. So, due to the presence of these acids, the rain water conducts electricity.

Q. 8. Why do acids not show acidic behaviour in the absence of water?

Ans. Acidic nature of a substance is due to the formation of $H^+(aq)$ ions in solution. Hydrogen ions are produced in the presence of water. The separation of H^+ ions from acid like HCl molecule cannot occur in the absence of water. So, acids do not show acidic behaviour in the absence of water.

Q. 9. Five solutions A, B, C, D and E when tested with universal indicator showed pH as 4, 1, 11, 7 and 9 respectively. Which solution is

(*a*) neutral? **(*b*) strongly alkaline?**

(*c*) strongly acidic? **(*d*) weakly acidic?**

(*e*) weakly alkaline?

Arrange the pH in increasing order of hydrogen ion concentration.

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Ans.

	Nature	pH	Solution
(*a*)	Neutral	7	D
(*b*)	Strongly alkaline	11	C
(*c*)	Strongly acidic	1	B
(*d*)	Weakly acidic	4	A
(*e*)	Weakly alkaline	9	E

Arrangement of the pH in increasing order of hydrogen ion concentration is as follows:

$$11 < 9 < 7 < 4 < 1$$

Q. 10. Equal lengths of magnesium ribbons are taken in test tubes A and B. Hydrochloric acid (HCl) is added to test tube A while acetic acid (CH_3COOH) is added to test tube B. In which test tube, will the fizzing occur more vigorously and why?

Ans. We know that hydrochloric acid (HCl) is a strong acid and acetic acid (CH_3COOH) is a weak acid. Being a strong acid, HCl solution contains a much greater amount of hydrogen ions in it. Due to this, the fizzing will occur more vigorously in test tube A. The fizzing is due to the evolution of H_2 gas which is formed by the action of acid on the magnesium ribbon.

Q. 11. Fresh milk has a pH of 6. How do you think the pH will change as it turns into curd? Explain your answer.

Ans. The pH will fall below 6. This is because lactic acid (an acid) is produced when milk sets into curd.

Q. 12. A milkman adds a very small amount of baking soda to fresh milk.

(*a*) Why does he shift the pH of the fresh milk from 6 to slightly alkaline?

(*b*) Why does this milk take a long time to set as curd?

Ans. (*a*) Milk is made slightly alkaline so that it may not get sour easily due to the formation of lactic acid in it.

(*b*) The alkaline milk takes a longer time to set into curd because the lactic acid formed has to first neutralise the alkali present in it.

Q. 13. Plaster of Paris should be stored in a moisture-proof container. Explain why.

Ans. Plaster of Paris is a white powder and on mixing with water, it changes to gypsum giving a hard solid mass.

$$\underset{\text{Plaster of Paris}}{CaSO_4.\tfrac{1}{2}H_2O} + 1\tfrac{1}{2}H_2O \longrightarrow \underset{\text{Gypsum}}{CaSO_4.2H_2O}$$

Hence, it should be stored in a moisture-proof container.

Q. 14. What is a neutralisation reaction? Give two examples of such type of reactions.

Ans. All bases react with acids to form salt and water. Such type of reactions are called neutralisation reactions.

$$\underset{\substack{\text{Sodium hydroxide}\\(\text{Base})}}{NaOH} + \underset{\substack{\text{Hydrochloric acid}\\(\text{Acid})}}{HCl} \longrightarrow \underset{\substack{\text{Sodium chloride}\\(\text{Salt})}}{NaCl} + \underset{\text{Water}}{H_2O}$$

$$\underset{\substack{\text{Potassium hydroxide}\\(\text{Base})}}{KOH} + \underset{\substack{\text{Nitric acid}\\(\text{Acid})}}{HNO_3} \longrightarrow \underset{\substack{\text{Potassium nitrate}\\(\text{Salt})}}{KNO_3} + \underset{\text{Water}}{H_2O}$$

Q. 15. Give two important uses of washing soda and baking soda.

Ans. (*i*) Washing soda ($Na_2CO_3.10H_2O$)

Uses: (*a*) Softening hard water.

(*b*) In paper, paints and textile industries.

(*ii*) Baking soda ($NaHCO_3$)

Uses: (*a*) Preparation of baking powder and soda water.

(*b*) In fire extinguishers.

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SELF-ASSESSMENT TEST

Time allowed: 1 hour **Max. marks: 40**

SECTION–A

Choose and write the correct answer for each of the following. **(4 × 1 = 4)**

1. Which of the following statements is correct about an aqueous solution of an acid and of a base? *[NCERT Exemplar]*

(*i*) Higher the pH, stronger the acid **(*ii*) Higher the pH, weaker the acid**

(*iii*) Lower the pH, stronger the base **(*iv*) Lower the pH, weaker the base**

(*a*) (*i*) and (*iii*) (*b*) (*ii*) and (*iii*) (*c*) (*i*) and (*iv*) (*d*) (*ii*) and (*iv*)

2. Which of the following is not a mineral acid? *[NCERT Exemplar]*

(*a*) Hydrochloric acid (*b*) Citric acid

(*c*) Sulphuric acid (*d*) Nitric acid

3. During the preparation of hydrogen chloride gas on a humid day, the gas is usually passed through the guard tube containing calcium chloride. The role of calcium chloride taken in the guard tube is to: *[NCERT Exemplar]*

(*a*) absorb the evolved gas (*b*) moisten the gas

(*c*) absorb moisture from the gas (*d*) absorb Cl^- ions from the evolved gas

4. When HCl(*aq*) is exactly neutralised by NaOH(*aq*), the hydrogen ion concentration in the resulting mixture is

(*a*) always less than the concentration of the hydroxide ions.

(*b*) always greater than the concentration of the hydroxide ions.

(*c*) always equal to the concentration of the hydroxide ions.

(*d*) None of these

The following questions consist of two statements—Assertion(A) and Reason(R). Answer these questions selecting the appropriate option given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation for *A*.

(*b*) Both *A* and *R* are true but *R* is not the correct explanation for *A*.

(*c*) *A* is true but *R* is false.

(*d*) *A* is false but *R* is true. **(3 × 1 = 3)**

5. Assertion(*A*) : Baking powder is used in making cake instead of using only baking soda.
Reason (*R*) : Baking powder contains tartaric acid which reacts with sodium carbonate and removes bitter taste.

6. Assertion(*A*) : The chemical formula of bleaching powder is $CaOCl_2$.
Reason (*R*) : Calcium oxide reacts with chlorine to form bleaching powder.

7. Assertion(*A*) : Plaster of Paris is stored in a moisture proof container.
Reason (*R*) : Plaster of Paris sets into a hard mass on wetting with water to form anhydrous calcium sulphate.

Answer the following questions in one word or one sentence. **(3 × 1 = 3)**

8. Name two synthetic indicators.

9. Define pH.

10. Give an example of salt of a strong acid and weak base.

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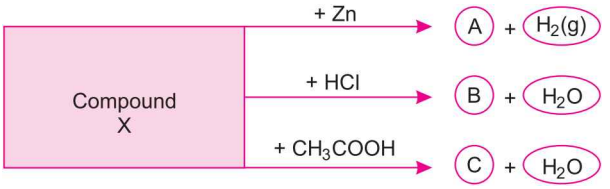
SECTION–B

Answer the following questions in about 50-60 words each. **(5 × 3 = 15)**

11. Identify the compound X on the basis of the reactions given below. Also, write the name and chemical formulae of A, B and C.



[NCERT Exemplar]

12. A gas X reacts with lime water and forms a compound Y which is used as a bleaching agent in chemical industry. Identify X and Y. Give the chemical equation of the reaction involved.

13. Identify the acid and base which form sodium hydrogen carbonate. Write chemical equation in support of your answer. State whether this compound is acidic, basic or neutral. Also write its pH value. *[CBSE 2019 (31/1/2)]*

14. State the effect of concentration of $H^+(aq)$ ions on the nature of the solution. Do basic solution also have $H^+(aq)$ ions? If yes, then why are these basic? *[CBSE 2019 (31/3/1)]*

15. A white powder is added while baking cakes to make it soft and spongy. Name its main ingredients. Explain the function of each ingredient. Write the chemical reaction taking place when the powder is heated during baking. *[CBSE 2019 (31/5/1)]*

SECTION–C

Answer the following questions in about 80–90 words each. **(3 × 5 = 15)**

16. A compound 'X' is bitter to taste. It is a compound of washing powder and reacts with dilute HCl to produce brisk effervescence due to a colourless and odourless gas 'Y' which turns lime water milky due to the formation of 'Z' when excess of CO_2 is passed, milkiness disappears due to formation of 'P'. Identify 'X', 'Y', 'Z' and 'P'. Write the equations involved in the formation of Y, Z and P.

17. For making cake, baking powder is taken. If at home your mother uses baking soda instead of baking powder in cake.

(*i*) How will it affect the taste of the cake and why?

(*ii*) How can baking soda be converted into baking powder?

(*iii*) What is the role of tartaric acid added to baking soda? *[NCERT Exemplar]*

18. What happens when:

(*i*) gypsum is heated at 373 K?

(*ii*) electricity is passed through an aqueous solution of sodium chloride?

(*iii*) dry chlorine gas is passed over slaked lime?

(*iv*) excess of CO_2 is passed through lime water?

(*v*) marble is treated with hydrochloric acid?

Answers

1. (*d*) **2.** (*b*) **3.** (*c*) **4.** (*c*) **5.** (*a*) **6.** (*c*) **7.** (*c*)

8. Phenolphthalein and methyl orange

9. pH is the negative logarithm of hydrogen ion concentration in moles/litre.

10. NH_4Cl

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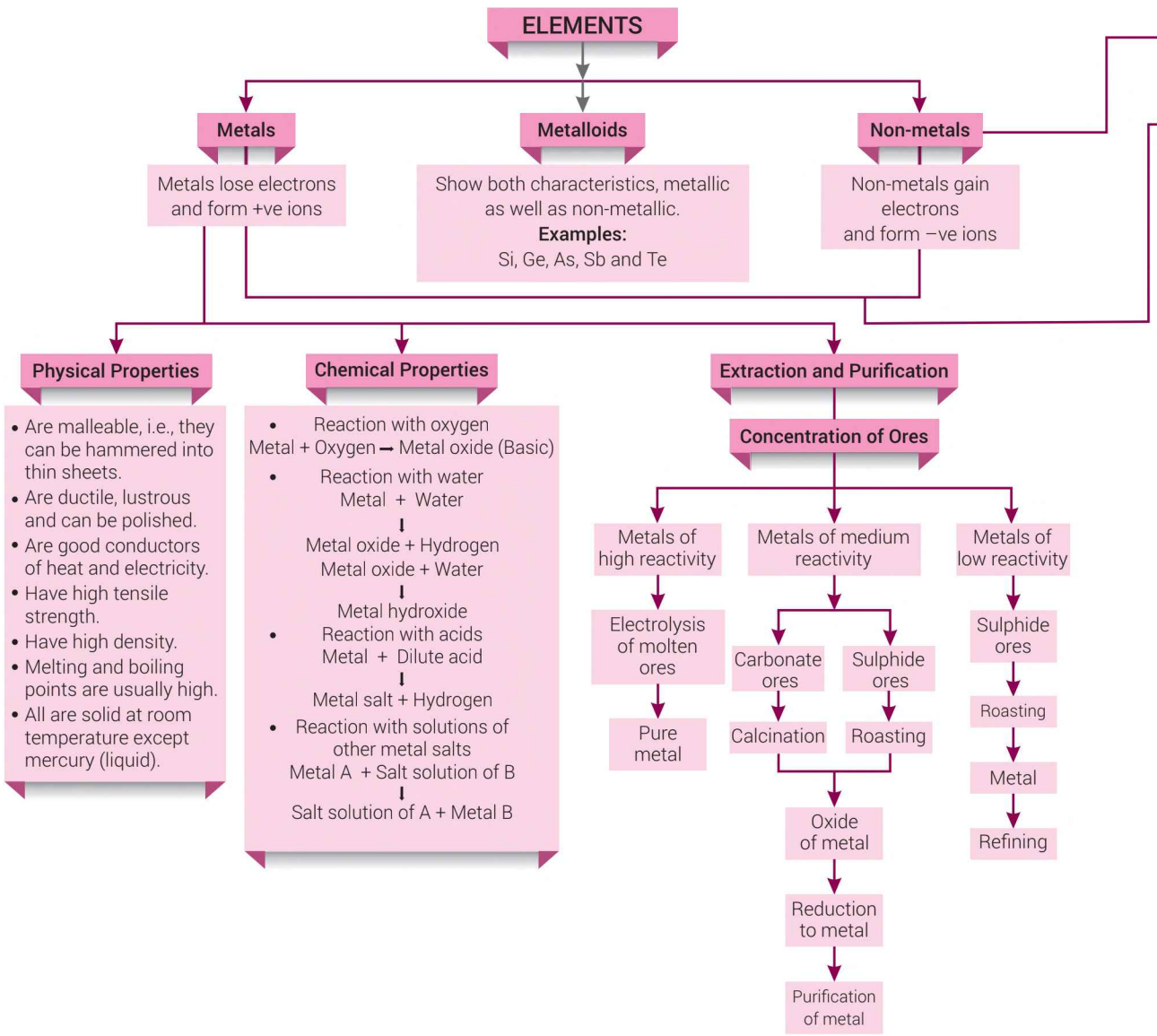
3 Metals and Non-metals

BASIC CONCEPTS—A FLOW CHART



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Corrosion

Gradual destruction of metal by air, water or any other substance around it.

Methods of Prevention

- Painting
- Oiling and greasing
- Plastic coating
- Chromium plating
- Galvanising (zinc plating)
- Alloying

Ionic Compounds

Physical Properties

- Are solids or gases except bromine (liquid)
- Are brittle, i.e., they break down when hammered or stretched
- Are non-malleable
- Are non-ductile
- Except graphite, all are bad conductors of heat and electricity
- Have very low tensile strength
- Have low melting and boiling points

Chemical Properties

- Reaction with oxygen
  Non-metal + oxygen → Non-metallic oxide (Acidic)
  $C(s) + O_2(g) \rightarrow CO_2(g)$
  $CO_2(g) + H_2O(l) \rightarrow H_2CO_3(aq)$ (Carbonic acid)
- Reaction with acids
  Non-metals do not displace H_2

Properties

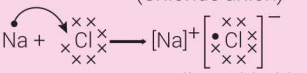
- Solid and crystalline in nature.
- Made up of positive and negative ions.
- Soluble in water and insoluble in solvents such as kerosene, petrol.
- Good conductors of electricity in aqueous solutions and molten state but do not conduct in the solid state.
- Melting and boiling points are high.

Formation

Compounds are formed by a give-and-take relation between the elements as shown below:

$Na \rightarrow Na^+ + e^-$
2,8,1 2,8
(Sodium cation)

$Cl + e^- \rightarrow Cl^-$
2,8,7 2,8,8
(Chloride anion)



Sodium chloride

Activity Series: Relative reactivities of metals

K	Potassium	Most reactive
Na	Sodium	
Ca	Calcium	
Mg	Magnesium	
Al	Aluminium	
Zn	Zinc	Reactivity decreases
Fe	Iron	
Pb	Lead	
H	Hydrogen	
Cu	Copper	
Hg	Mercury	
Ag	Silver	
Au	Gold	Least reactive

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MORE POINTS TO REMEMBER

❒ Comparison of Chemical Properties:

Metals	Non-metals
1. Metals lose electrons and form +ve ions. $Na \longrightarrow Na^+ + e^-$ Metals are electropositive elements.	**Non-metals gain electrons** and form –ve ions. $Cl + e^- \longrightarrow Cl^-$ Non-metals are electronegative elements.
2. Metals combine with oxygen and form basic oxides. $2Mg(s) + O_2(g) \longrightarrow 2MgO(s)$	**Non-metals combine with oxygen** and form acidic oxides or neutral oxides. $C(s) + O_2(g) \longrightarrow CO_2(g)$
3. Basic oxides + Water → Bases $Na_2O(s) + H_2O(l) \longrightarrow \underset{\text{Sodium hydroxide}}{2NaOH(aq)}$ In litmus test, the bases formed turn red litmus paper blue.	**Acidic oxides + Water → Acids** $CO_2(g) + H_2O(l) \longrightarrow \underset{\text{Carbonic acid}}{H_2CO_3(aq)}$ In litmus test, the acids formed turn blue litmus paper red.
4. Oxidation (*i*) K and Na catch fire in oxygen. To prevent oxidation they are kept immersed in kerosene. (*ii*) The surfaces of metals like Mg, Al, Zn, Pb, etc., are covered with a thin layer of their oxides. So, no further oxidation takes place. (*iii*) Magnesium on heating burns forming magnesium oxide. (*iv*) Copper on heating becomes coated with black coloured copper oxide (CuO). (*v*) Silver and gold do not react with oxygen.	(*i*) CO_2 and SO_2 are acidic oxides (turn blue litmus paper red). (*ii*) Carbon monoxide (CO), water (H_2O) and nitrous oxide (N_2O) are neutral oxides (no action on litmus paper). (*iii*) A jet of hydrogen gas burns in air with a pale blue flame. Steam produced can be condensed to water. $2H_2(g) + O_2(g) \longrightarrow 2H_2O(g)$
5. Reaction with Water (*i*) Na and K react violently with **cold water.** Evolved H_2 gas catches fire. $2K(s) + 2H_2O(l) \longrightarrow 2KOH(aq) + H_2(g)$ $2Na(s) + 2H_2O(l) \longrightarrow 2NaOH(aq) + H_2(g)$ (*ii*) Magnesium reacts with **hot water**. $Mg(s) + \underset{\text{(Hot)}}{2H_2O(l)} \longrightarrow Mg(OH)_2(aq) + H_2(g)$ (*iii*) Al, Zn and Fe react with **steam.** $2Al(s) + 3H_2O(g) \longrightarrow Al_2O_3(s) + 3H_2(g)$ $3Fe(s) + 4H_2O(g) \longrightarrow Fe_3O_4(s) + 4H_2(g)$ $Zn(s) + H_2O(g) \longrightarrow ZnO(s) + H_2(g)$ (*iv*) Lead(Pb), Copper(Cu), Silver(Ag) and Gold (Au) **do not react** with water.	Non-metals do not react with water to evolve hydrogen gas.

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6. Reactions with Acids (*i*) Metals react with dil. HCl and H_2SO_4 to liberate H_2 gas. Metal + dil. Acid ⟶ Salt + Hydrogen (*ii*) When metals react with dilute HNO_3, H_2 gas is not evolved but H_2O (water) is formed. Metal + dil. Nitric acid ⟶ Metal salt + Water + Oxides of nitrogen. (**Exceptions:** Mg and Mn evolve H_2 gas with dil. HNO_3)	Non-metals do not displace H_2 from acids because non-metals are electron acceptor, and they cannot supply electron to hydrogen.
7. Reaction with Hydrogen Hydrogen can share or lose electrons. But active metals like Na, K and Ca can force hydrogen atom to accept the electrons to form hydrides. $2Na(s) + H_2(g) \rightarrow 2NaH(s)$ $Ca(s) + H_2(g) \rightarrow CaH_2(s)$	Hydrides of non-metals are stable compounds and are formed by sharing electrons. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ $H_2(g) + S(s) \rightarrow H_2S(g)$

❒ Alloy:

An alloy is a homogeneous mixture of two or more metals or a metal and a non-metal. The electrical conductivity and melting point of an alloy is less than that of pure metals.

A.	**Alloys of Iron:**		
	1. Steel	Iron, Carbon	Hard, tough and strong. Used in construction of ships, bridges, vehicles, etc.
	2. Stainless steel	Iron, Nickel, Chromium	Hard, does not rust. Used in surgical instruments, cutlery, utensils, etc.
B.	**Alloys of Copper:**		
	1. Brass	Copper and Zinc	Malleable, strong, resistant to corrosion. Used in screws, nuts, bolts, utensils, etc.
	2. Bronze	Copper and Tin	Very strong, highly resistant to corrosion. Used for statues, coins, metals, ship propellers, etc.
C.	**Solder**	Lead and Tin	Used for welding electrical wires together.

Multiple Choice Questions [1 mark]

Each question has 4 choices (a), (b), (c) and (d). Choose and write the correct option.

1. Which of the following metals does not burn on heating?
(*a*) Magnesium (*b*) Copper (*c*) Lithium (*d*) Sodium

2. Four metals Al, Zn, Cu and Fe are added in different test tubes containing dilute hydrochloric acid. No bubbles are seen in the case of
(*a*) Al (*b*) Zn (*c*) Cu (*d*) Fe

3. Na^+ has
(*a*) 11 protons, 10 electrons (*b*) 10 protons, 11 electrons
(*c*) 12 protons, 11 electrons (*d*) 11 protons, 12 electrons

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4. Which of the following property is generally not shown by metals? [NCERT Exemplar]

(a) Electrical conduction (b) Sonorous in nature
(c) Dullness (d) Ductility

5. The ability of metals to be drawn into thin wire is known as [NCERT Exemplar]

(a) ductility (b) malleability (c) sonorousity (d) conductivity

6. Which one of the following metals do not react with cold as well as hot water? [NCERT Exemplar]

(a) Na (b) Ca (c) Mg (d) Fe

7. What happens when calcium is treated with water? [NCERT Exemplar]

(i) It does not react with water.
(ii) It reacts violently with water.
(iii) It reacts less violently with water.
(iv) Bubble of hydrogen gas formed stick to the surface of calcium.

(a) (i) and (iv) (b) (ii) and (iii) (c) (i) and (ii) (d) (iii) and (iv)

8. Generally metals react with acids to give salt and hydrogen gas. Which of the following acids does not give hydrogen gas on reacting with metals (except Mn and Mg)? [NCERT Exemplar]

(a) H_2SO_4 (b) HCl (c) HNO_3 (d) All of these

9. The composition of aqua regia is: [NCERT Exemplar]

(a) Dil. HCl : Conc. HNO_3 = 3 : 1 (b) Conc. HCl : Dil. HNO_3 = 3 : 1
(c) Conc. HCl : Conc. HNO_3 = 3 : 1 (d) Dil. HCl : Dil. HNO_3 = 3 : 1

10. Metals are refined by using different methods. Which of the following metals are refined by electrolytic refining? [NCERT Exemplar]

(i) Au **(ii) Cu**
(iii) Na **(iv) K**

(a) (i) and (ii) (b) (i) and (iii) (c) (ii) and (iii) (d) (iii) and (iv)

11. Galvanisation is a method of protecting iron from rusting by coating with a thin layer of: [NCERT Exemplar]

(a) Gallium (b) Aluminium (c) Zinc (d) Silver

12. Stainless steel is very useful material for our life. In stainless steel, iron is mixed with: [NCERT Exemplar]

(a) Ni and Cr (b) Cu and Cr (c) Ni and Cu (d) Cu and Au

13. If copper is kept open in air, it slowly loses its shining brown surface and gains a green coating. It is due to the formation of: [NCERT Exemplar]

(a) $CuSO_4$ (b) $CuCO_3$ (c) $Cu(NO_3)_2$ (d) CuO

14. Generally, metals are solid in nature. Which one of the following metals is found in liquid state at room temperature?

(a) Na (b) Fe (c) Cr (d) Hg

15. Generally, non-metals are not lustrous. Which of the following non-metal is lustrous? [NCERT Exemplar]

(a) Sulphur (b) Oxygen (c) Nitrogen (d) Iodine

16. Which one of the following four metals would be displaced from the solution of its salts by other three metals? [NCERT Exemplar]

(a) Mg (b) Ag (c) Zn (d) Cu

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17. **2 mL each of concentrated HCl, HNO_3 and a mixture of concentrated HCl and concentrated HNO_3 in the ratio of 3 : 1 were taken in test tubes labelled as *A*, *B* and *C*. A small piece of metal was put in each test tube. No change occurred in test tubes A and B but the metal got dissolved in test tube C respectively. The metal could be:** [*NCERT Exemplar*]

(*a*) Al (*b*) Au (*c*) Cu (*d*) Pt

18. **An alloy is :** [*NCERT Exemplar*]

(*a*) an element (*b*) a compound

(*c*) a homogeneous mixture (*d*) a heterogeneous mixture

19. **An electrolyte cell consists of:** [*NCERT Exemplar*]

(*i*) positively charged cathode **(*ii*) negatively charged anode**

(*iii*) positively charged anode **(*iv*) negatively charged cathode**

(*a*) (*i*) and (*ii*) (*b*) (*iii*) and (*iv*) (*c*) (*i*) and (*iii*) (*d*) (*ii*) and (*iv*)

20. **Alloys are homogeneous mixtures of a metal with a metal or non-metal. Which among the following alloys contain non-metal as one of its constituents?** [*NCERT Exemplar*]

(*a*) Brass (*b*) Bronze (*c*) Amalgam (*d*) Steel

21. **Which among the following statements is incorrect for magnesium metal?** [*NCERT Exemplar*]

(*a*) It burns in oxygen with a dazzling white flame.

(*b*) It reacts with cold water to form magnesium oxide and evolves hydrogen gas.

(*c*) It reacts with hot water to form magnesium hydroxide and evolves hydrogen gas.

(*d*) It reacts with steam to form magnesium hydroxide and evolves hydrogen gas.

22. **Which among the following alloys contain mercury as one of its constituents?** [*NCERT Exemplar*]

(*a*) Stainless steel (*b*) Alnico (*c*) Solder (*d*) Zinc amalgam

23. **Reaction between X and Y, forms compound Z. X loses electron and Y gains electron. Which of the following properties is not shown by Z?** [*NCERT Exemplar*]

(*a*) Has high melting point (*b*) Has low melting point

(*c*) Conducts electricity in molten state (*d*) Occurs as solid

24. **Although metals form basic oxides, which of the following metals form an amphoteric oxide?** [*NCERT Exemplar*]

(*a*) Na (*b*) Ca (*c*) Al (*d*) Cu

25. **Generally, non-metals are not conductors of electricity. Which of the following is a good conductor of electricity?** [*NCERT Exemplar*]

(*a*) Diamond (*b*) Graphite (*c*) Sulphur (*d*) Fullerene

26. **Electrical wires have a coating of an insulating material. The material, generally used is:** [*NCERT Exemplar*]

(*a*) Sulphur (*b*) Graphite (*c*) PVC (*d*) All can be used

27. **Which of the following non-metals is a liquid?** [*NCERT Exemplar*]

(*a*) Carbon (*b*) Bromine (*c*) Phosphorus (*d*) Sulphur

28. **Which of the following can undergo a chemical reaction?** [*NCERT Exemplar*]

(*a*) $MgSO_4 + Fe$ (*b*) $ZnSO_4 + Fe$ (*c*) $MgSO_4 + Pb$ (*d*) $CuSO_4 + Fe$

Answers

1. (*b*)	**2.** (*c*)	**3.** (*a*)	**4.** (*c*)	**5.** (*a*)	**6.** (*d*)	**7.** (*d*)
8. (*c*)	**9.** (*c*)	**10.** (*a*)	**11.** (*c*)	**12.** (*a*)	**13.** (*b*)	**14.** (*d*)
15. (*d*)	**16.** (*b*)	**17.** (*b*)	**18.** (*c*)	**19.** (*b*)	**20.** (*d*)	**21.** (*b*)
22. (*d*)	**23.** (*b*)	**24.** (*c*)	**25.** (*b*)	**26.** (*c*)	**27.** (*b*)	**28.** (*d*)

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Assertion-Reason Questions [1 mark]

The following questions consist of two statements — Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

1. **Assertion (A) :** Hydrogen gas is not evolved when a metal reacts with nitric acid.
   Reason (R) : Nitric acid is a strong oxidising agent.
2. **Assertion (A) :** Highly reactive metals are obtained by electrolytic reduction.
   Reason (R) : In the electrolytic reduction, metal is deposited at the cathode.
3. **Assertion (A) :** Bronze is an alloy of copper and tin.
   Reason (R) : Alloys are heterogeneous mixture of metals with other metals and non-metals.
4. **Assertion (A) :** Zinc oxide is amphoteric in nature.
   Reason (R) : Zinc oxide reacts with both acids and bases.
5. **Assertion (A) :** Magnesium chloride is an ionic compound.
   Reason (R) : Metals and non-metals react by mutual transfer of electrons.
6. **Assertion (A) :** Zinc can easily displace copper on reacting with a solution of copper sulphate.
   Reason (R) : Copper is more reactive metal as compared to Zinc.
7. **Assertion (A) :** Zinc carbonate is heated strongly in presence of air to form zinc oxide and carbon dioxide.
   Reason (R) : Calcination is the process in which a carbonate ore is heated strongly in the absence of air to convert into metal oxide.

Answers

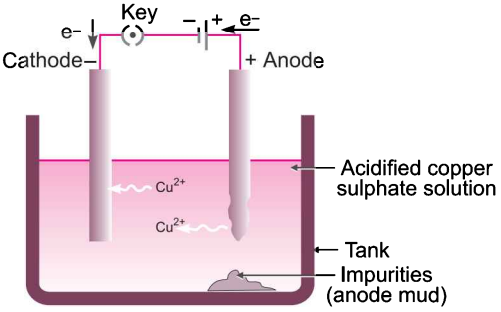
1. (*a*) **2.** (*b*) **3.** (*c*) **4.** (*a*) **5.** (*a*) **6.** (*c*) **7.** (*d*)

Passage-based Questions

Answer the questions below each passage on the basis of your understanding of the paragraph and the related studied concepts.

1. Refining is the process of purification of metals. One of the important method of refining is electrolysis. In electrolysis, electrical energy is used to bring about a non-spontaneous redox reaction. This is done by passing an electric current through a liquid containing ions, known as an electrolyte. In contrast to metals, the current in electrolytes is carried by the movement of ions rather than the movement of electrons. The solid conductors inserted into the liquid are called electrodes, the one with a positive charge is called the anode (because it attracts anions) and the one with the negative charge is called the cathode.

   A diagrammatic representation of electrolysis of copper is shown alongside.

   (*i*) Name the electrolyte used in refining of copper.

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(*ii*) (*a*) $Cu \rightarrow Cu^{2+} + 2e^-$

(*b*) $Cu^{2+} + 2e^- \rightarrow Cu$

Which of these two reactions occur at cathode and anode?

(*iii*) What is anode mud?

(*iv*) Name two metals which can be refined by electrolytic method.

2. The reactivity series is a list of metals arranged in the order of their decreasing activities. The metal at the top of the reactivity series is the most reactive and metal at the bottom is the least reactive. The more reactive metal displaces less reactive metal from its salt solution.

K	Potassium	Most reactive
Na	Sodium	
Ca	Calcium	
Mg	Magnesium	
Al	Aluminium	
Zn	Zinc	Reactivity decreases
Fe	Iron	
Pb	Lead	
[H]	[Hydrogen]	
Cu	Copper	
Hg	Mercury	
Ag	Silver	
Au	Gold	Least reactive

(*i*) Name the metals which react with steam but not with hot water.

(*ii*) What happen when calcium react with nitric acid?

(*iii*) Which method is used to extract metal present at the top of the reactivity series?

(*iv*) Which of the following metals exist in their native states in nature?

I. Cu II. Au

III. Zn IV. Ag

(*a*) I and II (*b*) II and III

(*c*) II and IV (*d*) III and IV

Answers

1. (*i*) Acidified copper sulphate

(*ii*) Reaction (*a*) occurs at Anode

Reaction (*b*) occurs at Cathode

(*iii*) The impurities which settle at the bottom of anode as a result of electrolysis is called anode mud.

(*iv*) Nickel and Zinc

2. (*i*) Aluminium., iron and zinc

(*ii*) Calcium reacts with nitric acid to form calcium nitrate, dinitrogen monoxide and water.

(*iii*) Electrolytic reduction

(*iv*) (*c*)

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Very Short Answer Questions [1 mark]

Each of the following questions are of 1 mark and have to be answered in one word or one sentence.

Q. 1. Name the most ductile metal.
Ans. Gold

Q. 2. Name any two metals that have low densities.
Ans. Lithium, sodium

Q. 3. How can the pure iron which is very soft be made useful?
Ans. Iron is mixed with about 0.05% carbon to make it hard and strong. Thus, it can be made useful.

Q. 4. Why are metals good conductors of electricity? [*CBSE* 2019 (31/1/1)]
Ans. Metals are good conductors of electricity because they contain free electrons. These free electrons move easily through the metal and conduct electric current.

Q. 5. Which property of graphite is utilised in making electrodes?
Ans. Graphite is a good conductor of electricity. Due to this property, graphite is utilised in making electrodes.

Q. 6. Which of the following metals will melt at body temperature?
Gallium, Magnesium, Caesium, Aluminium
Ans. Gallium and caesium will melt at 37°C (body temperature).

Q. 7. Name two metals that do not react with water at all.
Ans. Lead and copper.

Q. 8. What happens when calcium is treated with water?
Ans. Calcium reacts less violently with water and bubbles of hydrogen gas stick to its surface.

Q. 9. Generally, non-metals are not lustrous. Name a non-metal which is lustrous.
Ans. Iodine

Q. 10. What is the nature of non-metal oxide?
Ans. Non-metal oxides are acidic or neutral in nature.

Q. 11. What is the nature of metal oxides?
Ans. Metal oxides are basic in nature.

Q. 12. Why does calcium float in water? [*CBSE Delhi 2011*]
Ans. When calcium reacts with water, hydrogen gas is produced which sticks to the surface of calcium, so it floats in water.

Q. 13. What is flux?
Ans. Flux is a substance which is added to the ore, during reduction, for removing the non-fusible impurities.

Q. 14. Which oxide of iron could be obtained on prolonged reaction of iron with steam?
Ans. Fe_3O_4

$$3Fe(s) + 4H_2O(g) \longrightarrow Fe_3O_4(s) + 4H_2(g)$$

Q. 15. Why are ionic compounds usually hard?
Ans. In all ionic compounds, their positive and negative ions are attached to each other by a strong ionic bond. So, they are rigid and hard solids.

Q. 16. Why does aluminium not react with water under ordinary conditions?
Ans. Aluminium does not react with water under ordinary conditions because of the presence of a thin layer of aluminium oxide on its surface.

Q. 17. In nature, metal A is found in a free state while metal B is found in the form of its compounds. Which of these two will be nearer to the top of the activity series of metals?
Ans. Metal B will be nearer to the top of the activity series of metals as it is so reactive that it is found in combined state.

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Q. 18. Arrange the following metals in decreasing order of their reactivity:
Fe, Zn, Na, Cu, Ag

Ans. Na > Zn > Fe > Cu > Ag.

Q. 19. Why cannot aluminium be obtained by reduction of its oxide with carbon?

Ans. Aluminium has more affinity for oxygen than carbon.

Q. 20. Why does a little addition of carbon in iron make it more useful?

Ans. Pure iron is very soft and stretches easily when hot. When it is mixed with a small quantity of carbon (0.05%), it becomes hard and strong and hence becomes more useful.

Q. 21. Metals are refined by using different methods. Name two metals refined by electrolytic refining.

Ans. Copper and gold.

Q. 22. What is rust?

Ans. The coating of brown, flaky substance on the surface of iron when it is kept exposed in moist air is called rust.

Q. 23. What is corrosion?

Ans. When the surface of a metal is attacked by air, water and some other substances, it is said to be corroded. This phenomenon is known as corrosion.

Q. 24. What is aqua regia?

Ans. It is a freshly prepared mixture of concentrated hydrochloric acid and concentrated nitric acid in the ratio of 3 : 1. It can dissolve gold. It is a highly corrosive liquid.

Q. 25. Which metals are mixed with iron to get stainless steel?

Ans. Nickel and chromium.

Q. 26. Why is stainless steel preferred for making household utensils?

Ans. Stainless steel is preferred as it is non-reactive and so the milk or food is not spoiled in it.

Q. 27. What is galvanisation?

Ans. Galvanisation is a method of protecting steel and iron from rusting by coating them with a thin layer of zinc.

Q. 28. Name an alloy of
(*i*) aluminium used in the construction of aircraft.
(*ii*) lead used in joining metals for electrical work.

Ans. (*i*) Duralumin (*ii*) Solder

Short Answer Questions [3 marks]

Each of the following questions are of 3 marks and have to be answered in about 50-60 words.

Q. 1. 'X' is an amphoteric oxide. It is reduced to metal by using suitable reducing agents such as carbon. Identify 'X'. Write its reaction with acid as well as base.

Ans. 'X' is Zinc oxide (ZnO).

$$ZnO + \underset{\text{(acid)}}{2HCl} \longrightarrow ZnCl_2 + H_2O$$

$$ZnO + \underset{\text{(base)}}{2NaOH} \longrightarrow Na_2ZnO_2 + H_2O$$

Q. 2. A metal 'X' when added to a solution containing $ZnSO_4$ shows no change in the colour of the solution. The metal 'X' is also used to join railway tracks.
(*i*) Identify the metal 'X'.
(*ii*) What is the other reactant used in the reaction with 'X' to join railway tracks?
(*iii*) Name the metal to extract the metal 'X'.

Ans. (*i*) X is aluminium.
(*ii*) Fe_2O_3
(*iii*) Electrolytic reduction.

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Q. 3. **(*i*) Give two examples each of the metals that are good conductors and poor conductors of heat respectively.** *[NCERT Exemplar]*

(*ii*) Name one metal and one non-metal that exist in liquid state at room temperature. Also name two metals having melting point less than 310 K (37°C). *[NCERT Exemplar]*

Ans. (*i*) (*a*) Good conductors: Ag and Cu

(*b*) Poor conductors: Pb and Hg

(*ii*) **Metal:** Mercury (Hg); **Non-metal:** Bromine (Br)

Two metals with melting points less than 310K are Cesium (Cs) and Gallium (Ga).

Q. 4. **The following reaction takes place when aluminium powder is heated with MnO_2.**

$$3MnO_2(s) + 4Al(s) \longrightarrow 3Mn(l) + 2Al_2O_3(l) + Heat$$

(*i*) Is aluminium getting reduced?

(*ii*) Is MnO_2 getting oxidised? *[NCERT Exemplar]*

Ans. (*i*) No, because oxygen is added to aluminium therefore, it is getting oxidised.

(*ii*) No, since manganese has lost oxygen therefore, it is getting reduced.

Q. 5. **A solution of $CuSO_4$ was kept in an iron pot. After few days the iron pot was found to have a number of holes in it. Explain the reason in terms of reactivity. Write the equation of the reaction involved.** *[NCERT Exemplar]*

Ans. Iron is more reactive than copper. Hence, when a solution of $CuSO_4$ is kept in an iron pot, iron slowly displaces copper from the solution and blue colour of the solution keeps fading away. Because of iron going into solution as iron sulphate, a number of holes are seen in the iron pot. The reaction is

$$CuSO_4(aq) + Fe(s) \longrightarrow FeSO_4(aq) + Cu(s)$$

Q. 6. **Generally, when metals are treated with mineral acids, hydrogen gas is liberated but when metals (except Mn and Mg) are treated with HNO_3, hydrogen is not liberated, why?** *[NCERT Exemplar]*

Ans. It is because HNO_3 is a strong oxidising agent. It oxidises the H_2 produced to H_2O and itself get reduced to any of the oxides of the nitrogen, like NO_2, NO, etc.

Q. 7. **Metals replace hydrogen from dilute acids, whereas non-metals do not. Why?**

Ans. Hydrogen from dilute acids can only be replaced if electrons are supplied to H^+ ions of the acid.

$$H_2SO_4(aq) \longrightarrow 2H^+(aq) + SO_4^{2-}(aq)$$

$$2H^+ + 2e^- \longrightarrow H_2(g)$$

$$HCl(aq) \longrightarrow H^+(aq) + Cl^-(aq)$$

$$H^+ + e^- \longrightarrow H$$

$$2H \longrightarrow H_2(g) \uparrow$$

Metals have a tendency to lose electrons and hence they supply electrons, *i.e.*, they are electron donors. That is why metals displace hydrogen from dilute acids.

On the other hand, non-metal is an electron acceptor. It cannot supply electrons to H^+ and hence, it does not displace hydrogen from dilute acids.

Q. 8. **A metal *M* does not liberate hydrogen from acids but reacts with oxygen to give a black colour product. Identify *M* and black coloured product and also explain the reaction of *M* with oxygen.** *[NCERT Exemplar]*

Ans. *M* is copper. It reacts with oxygen to form black coloured compound, CuO.

$$2Cu + O_2 \longrightarrow \underset{\text{(Black)}}{2CuO}$$

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Q. 9. **(*i*) Name a metal for each case:**

(*a*) It does not react with cold as well as hot water but reacts with steam.

(*b*) It does not react with any physical state of water.

(*ii*) When calcium metal is added to water the gas evolved does not catch fire but the same gas evolved on adding sodium metal to water catches fire. Why is it so?

Ans. (*i*) (*a*) Aluminium, (*b*) Copper

(*ii*) In both cases, the gas evolved is H_2. When calcium reacts with water the heat evolved is not sufficient for hydrogen to catch fire. On the other hand, sodium metal reacts with water violently and in this case a lot of heat is evolved which is sufficient for hydrogen to catch fire.

Q. 10. **Which of the following reactions will not occur? Give reasons.**

(*i*) $\mathbf{MgSO_4(aq) + Fe(s) \longrightarrow FeSO_4(aq) + Mg(s)}$

(*ii*) $\mathbf{MgSO_4(aq) + Cu(s) \longrightarrow CuSO_4(aq) + Mg(s)}$

(*iii*) $\mathbf{CuSO_4(aq) + Fe(s) \longrightarrow FeSO_4(aq) + Cu(s)}$

Ans. Reaction (*i*) will not occur because Fe is less reactive than Mg. Reaction (*ii*) will not occur because Cu is less reactive than Mg.

Q. 11. **State the reason for the following behaviour of zinc metal:**

On placing a piece of zinc metal in a solution of mercuric chloride, it acquires a shining silvery surface but when it is placed in a solution of magnesium sulphate no change is observed.

Ans. When a piece of zinc metal is placed in a solution of mercuric chloride ($HgCl_2$), a white layer of mercury is deposited on zinc metal to give it silvery shining look. This is because mercury is lower to zinc in reactivity series and hence, zinc can displace mercury from $HgCl_2$.

But when zinc is placed in a solution of magnesium sulphate, there is no change. This is because magnesium is above zinc in the reactivity series and hence, zinc cannot displace magnesium from its salt solution.

Q. 12. **An ore on treatment with dilute hydrochloric acid produces brisk effervescence. Name the type of ore with one example. What steps will be required to obtain metal from the enriched ore? Also write the chemical equations for the reactions involved in the process.**

[CBSE 2019 (31/5/1)]

Ans. A metal carbonate reacts with dilute hydrochloric acid to form carbon dioxide. Therefore, this ore is a carbonate ore. Carbonate ore is converted into free metal in the following two steps:

(*i*) Calcination: The carbonate ore is strongly heated in the absence of air to get the metal oxide.

$$\text{Metal carbonate} \xrightarrow{\text{Calcination}} \text{Metal oxide} + \text{Carbon dioxide}$$

(*ii*) Reduction: The metal oxide is reduced with carbon to get free metal.

$$\text{Metal oxide} + \underset{\text{(Coke)}}{\text{Carbon}} \xrightarrow{\text{Reduction}} \text{Metal} + \text{Carbon monoxide}$$

Q. 13. **What happens when:**

(*i*) $ZnCO_3$ is heated in the absence of oxygen?

(*ii*) a mixture of Cu_2O and Cu_2S is heated? *[NCERT Exemplar]*

Ans. (*i*) It undergoes calcination. The chemical reaction can be given as:

$$ZnCO_3 \xrightarrow{\text{Heat}} ZnO + CO_2$$

(*ii*) It undergoes auto reduction forming copper and sulphur dioxide.

$$2Cu_2O + Cu_2S \xrightarrow{\text{Heat}} 6Cu + SO_2$$

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Q. 14. Give the reaction involved during extraction of zinc from its ore by:

(*i*) roasting of zinc ore

(*ii*) calcination of zinc ore [*NCERT Exemplar*]

Ans. (*i*) $2ZnS(s) + 3O_2(g) \xrightarrow{\text{Heat}} 2ZnO(s) + 2SO_2(g)$

(*ii*) $ZnCO_3(s) \xrightarrow{\text{Heat}} ZnO(s) + CO_2(g)$

Q. 15. What is a thermite reaction? State one use of this reaction.

Ans. The reaction between iron(III) oxide (Fe_2O_3) and aluminium gives out lots of heat.

It is called the thermite reaction.

$$\underset{\text{Iron(III) oxide}}{Fe_2O_3(s)} + \underset{\text{Aluminium}}{2Al(s)} \longrightarrow \underset{\text{Iron}}{2Fe(l)} + \underset{\text{Aluminium oxide}}{Al_2O_3(s)} + \text{Heat}$$

This displacement reaction is used to join railway tracks or cracked machine parts.

The heat given out in the reaction melts the iron formed. The molten iron runs down between the tracks and welds them together.

Q. 16. What is 24-carat gold? How will you convert it into 18-carat gold?

Ans. 24-carat gold is pure gold. Pure gold is very soft and not suitable for making jewellery.

Therefore, to increase its hardness, it is alloyed either with copper or silver.

18-carat gold is prepared by alloying 18 parts pure gold with 6 parts of either copper or silver.

Q. 17. What would happen to iron railings on the road side if they are not painted? Why does it happen so?

Ans. If the iron railing on the road side is not painted, a brown rust would form on its surface because the moist air of the atmosphere reacts with iron to form brown flaky substance on its surface. The rust is hydrated iron (III) oxide, $Fe_2O_3.xH_2O$.

Q. 18. Explain why, the galvanised iron article is protected against rusting even if the zinc layer is broken.

Ans. The galvanised iron article is protected against rusting even if the zinc layer is broken because zinc is more easily oxidised than iron. So when zinc layer on the surface of galvanised iron article is broken, then zinc continues to corrode but iron article does not corrode or rust.

Q. 19. Why is aluminium oxide considered an amphoteric oxide?

Ans. Aluminium oxide (Al_2O_3) shows basic as well as acidic behaviour because it reacts with both acids and bases. Thus, it is considered as an amphoteric oxide. The two types of reactions given by Al_2O_3 are as follows:

(*i*) $\underset{\substack{\text{Aluminium}\\\text{oxide}}}{Al_2O_3(s)} + \underset{\substack{\text{Hydrochloric}\\\text{acid (Acid)}}}{6HCl(aq)} \longrightarrow \underset{\substack{\text{Aluminium chloride}\\\text{(Salt)}}}{2AlCl_3(aq)} + 3H_2O(l)$

In this reaction, Al_2O_3 behaves as a basic oxide because it reacts with an acid to form salt and water.

(*ii*) $Al_2O_3(s) + \underset{\substack{\text{Sodium hydroxide}\\\text{(Base)}}}{2NaOH(aq)} \longrightarrow \underset{\substack{\text{Sodium aluminate}\\\text{(Salt)}}}{2NaAlO_2(aq)} + H_2O(l)$

In this reaction, Al_2O_3 behaves as an acidic oxide because it reacts with a base to form salt and water.

Q. 20. Why are food cans tin-plated instead of zinc plated though zinc is cheaper than tin?

Ans. Tin is less reactive than zinc. It is less likely to dissolve in the liquid stored in the food cans. Tin reacts only with powerful acids whereas zinc can easily react even with tomatoes, so it is not safe to store food in zinc-plated cans.

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Q. 21. Name two metals which react violently with cold water. Write any observation you would make when such a metal is dropped into water. How would you identify the gas evolved, if any, during the reactions?

Ans. Metals which react violently with cold water are potassium (K) and sodium (Na).

$$2K + 2H_2O \longrightarrow 2KOH + H_2 + \text{Heat energy}$$

$$2Na + 2H_2O \longrightarrow 2NaOH + H_2 + \text{Heat energy}$$

The hydrogen gas produced during the reactions of these two metals with water immediately catches fire. Thus, these reactions are violent and exothermic.

The gas evolved during these reactions burns with a popping sound which confirms that the gas is hydrogen (H_2).

Q. 22. Explain the following statements:

(*i*) Most metal oxides are insoluble in water but some of these dissolve in water. What are these oxides and their solutions in water called?

(*ii*) At ordinary temperature, the surface of metals such as magnesium, aluminium and zinc, etc., is covered with a thin layer. What is the composition of this layer? State its importance.

(*iii*) Some alkali metals can be cut with a knife. [*CCE 2016*]

Ans. (*i*) These oxides are called basic oxides and their solutions in water are called alkalis.

(*ii*) This layer formed is protective oxide layer which prevents the metal from further oxidation.

(*iii*) Some alkali metals can be cut with a knife because they are very soft and have low densities.

Q. 23. When a metal X is treated with cold water, it gives a basic salt Y with molecular formula XOH (Molecular mass = 40) and liberates a gas Z which easily catches fire. Identify X, Y and Z and also write the reaction involved. [*NCERT Exemplar*]

Ans. Sodium (Na) and potassium (K) react with cold water to form basic salt NaOH and KOH respectively. The molecular mass of NaOH is 40. So, X is Na and Y is NaOH. The gas liberated during the reaction is hydrogen (H_2). So Z is H_2.

$$2Na + 2H_2O \longrightarrow 2NaOH + H_2 + \text{Heat energy}$$

Q. 24. Of the three metals X, Y and Z, X reacts with cold water, Y with hot water and Z with steam only. Identify X, Y and Z and also arrange them in order of increasing reactivity. [*NCERT Exemplar*]

Ans. X is an alkali metal, Na or K.

Y is an alkaline earth metal, Mg or Ca.

Z is Fe, Al or Zn.

Therefore, increasing order of reactivity: Fe < Mg < Na.

Q. 25. Out of three metals P, Q and R, P is less reactive than Q and R is more reactive than P and Q both. Suggest an activity to arrange P, Q and R in order of their decreasing reactivity. [*CBSE 2019 (31/3/3)*]

Ans. (*i*) Take salt solutions of P, Q and R in three separate test tubes.

(*ii*) Now, put a piece of metal R in the test tubes containing salt solutions of P and Q.

(*iii*) Repeat the above process for metals Q and P also.

You will observe that when metal R is placed in salt solutions of P and Q, displacement reaction takes place in both the test tubes. It means R is the most reactive metal. When metal Q is placed in test tubes containing salt solutions of P and R, displacement reaction occurs only in the test tube containing salt solution of P. It means Q is more reactive than P but less reactive than R.

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When metal P is placed in the test tubes containing salt solutions of Q and R, no reaction occurs in both the test tubes. It means P is the least reactive metal. So, the decreasing order of reactivity is R > Q > P.

Q. 26. An element A burns with golden flame in air. It reacts with another element B, atomic number 17 to give a product C. An aqueous solution of product C on electrolysis gives a compound D and liberates hydrogen. Identify A, B, C and D. Also write down the equations for the reactions involved. *[NCERT Exemplar]*

Ans. A – Na; B – Cl_2; C – NaCl; D – NaOH

$$2Na + Cl_2 \longrightarrow 2NaCl$$

$$2NaCl(aq) + 2H_2O(l) \longrightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$$

Q. 27. Iqbal treated a lustrous, divalent element M with sodium hydroxide. He observed the formation of bubbles in reaction mixture. He made the same observations when this element was treated with hydrochloric acid. Suggest how can he identify the produced gas. Write chemical equations for both the reactions. *[NCERT Exemplar]*

Ans. The element is a metal.

$$M + 2NaOH \longrightarrow Na_2MO_2 + H_2\uparrow$$

$$M + 2HCl \longrightarrow MCl_2 + H_2\uparrow$$

The produced gas can be identified by bringing a burning matchstick near the reaction vessel. The gas burns with a pop sound. This confirms that the gas is H_2.

Q. 28. Compound X and aluminium are used to join railway tracks.

(*i*) Identify the compound X.

(*ii*) Name the reaction.

(*iii*) Write down its reaction. *[NCERT Exemplar]*

Ans. (*i*) The compound, X is Fe_2O_3.

(*ii*) Thermite reaction

(*iii*) $Fe_2O_3(s) + 2Al(s) \longrightarrow 2Fe(l) + Al_2O_3(s) + Heat$

Q. 29. Name two metals which reacts violently with cold water. Write the observations you would make when such a metal is dropped into water. How would you identify the gas evolved, if any, during the reaction?

Ans. Sodium and Potassium react violently with cold water.

When such a metal is dropped into water, metal moves over the surface of water causing little explosion and ultimately catches fire and starts burning.

The gas burns producing a 'pop' sound indicating that it is hydrogen.

Q. 30. Give the differences between electrolytic reduction and reduction with carbon.

Ans.

Reduction with carbon	Electrolytic reduction
1. Carbon is used as a reducing agent.	1. Electrolysis process is used for reduction.
2. Oxides of moderately reactive metals (*e.g.*, Zn, Fe, Cu, Ni) are reduced by carbon.	2. Oxides (and chlorides) of highly reactive metals (*e.g.*, Al, Na, K, Mg, Ca) are reduced by this process.
3. In this process, the metal oxide is mixed with carbon (coke) and heated in a furnace. $ZnO + C \longrightarrow Zn + CO$ (Zinc oxide, Carbon, Zinc, Carbon monoxide)	3. In this process, molten metal oxide is electrolysed in an electrolytic cell where the cathode acts as a powerful reducing agent by supplying electrons to reduce metal ions into metal. $Al^{3+} + 3e^- \xrightarrow{\text{Electrolytic reduction}} Al$ (Aluminium ion (from molten Al_2O_3), Electron (from cathode), Aluminium metal)

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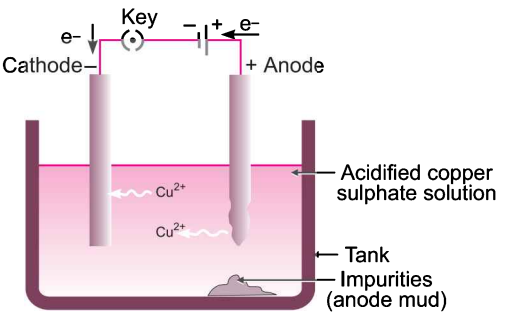
Q. 31. Silver articles become black when kept in open for some time, whereas copper vessels lose their shiny brown surfaces and gain a green coat when kept in open. Name the substances present in air with which these metals react and write the name of the products formed.

[CBSE 2019 (31/2/1)]

Ans. Silver articles reacts with SO_2 (Sulphur dioxide) whereas copper vessels reacts with CO_2 (Carbon dioxide) gas present in air. Products formed are Silver sulphide and Copper carbonate respectively.

Q. 32. What is meant by refining of metals? Describe the electrolytic refining of copper with a neat labelled diagram.

Ans. In electrolytic refining process, the impure metal is made as anode and a thin strip of pure metal is made as cathode. A solution of the metal salt is made as an electrolyte. On passing the current through the electrolyte, the pure metal from the anode dissolves into the electrolyte. An equivalent amount of pure metal from the electrolyte is deposited on the cathode. The soluble impurities go into the solution, whereas, the insoluble impurities settle down at the bottom of the anode and are known as anode mud.



At anode: $Cu \longrightarrow Cu^{2+} + 2e^-$

At cathode: $Cu^{2+} + 2e^- \longrightarrow Cu$

Q. 33. An ore on heating in air produces sulphur dioxide. Which process would you suggest for its concentration? Describe briefly any two steps involved in the conversion of this concentrated ore into related metal.

Ans. The ore on heating produces sulphur dioxide gas so it is a sulphide ore. The method used for its concentration is "froth floatation process". After concentration of the ore following two steps would be followed to convert it into metal.

(*i*) Roasting: The sulphide ore is converted into its oxide by heating it in the presence of air.

$$MS + O_2 \longrightarrow MO + SO_2\uparrow$$

(*ii*) Reduction of metal oxide to metal: The oxide formed by roasting is then reduced to metal by using a suitable reducing agent like carbon (coke).

$$MO + \underset{(Coke)}{C} \xrightarrow{\text{Reduction}} M + CO$$

Q. 34. During extraction of metals, electrolytic refining is used to obtain pure metals.

(*i*) Which material will be used as anode and cathode for refining of silver metal by this process?

(*ii*) Suggest a suitable electrolyte also.

(*iii*) In this electrolytic cell, where do we get pure silver after passing electric current?

[NCERT Exemplar]

Ans. (*i*) Anode: Impure silver
Cathode: Pure silver

(*ii*) Electrolyte: Silver salt, such as $AgNO_3$, AgCl, etc.

(*iii*) We get pure silver at cathode.

Q. 35. A metal that exists as a liquid at room temperature is obtained by heating its sulphide in the presence of air. Identify the metal and its ore and give the reaction involved.

[NCERT Exemplar] [CBSE 2019 (31/3/3)]

Ans. Metals low in activity series can be obtained by reducing their sulphides or oxides by heating. Mercury is the only metal that exists as liquid at room temperature. It can be obtained by heating cinnabar (HgS), the sulphide ore of mercury.

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The reactions are as follows:

$$2HgS(s) + 3O_2(g) \xrightarrow{Heat} 2HgO(s) + 2SO_2(g)$$

$$2HgO(s) \xrightarrow{Heat} 2Hg(l) + O_2(g)$$

Q. 36. How is copper obtained from sulphide ore? Give equation of the reactions.

[CBSE 2018, Delhi 2017]

Ans. (*i*) Sulphide ore of copper *i.e.*, Cu_2S is concentrated by froth floatation process.

(*ii*) Ore is then roasted.

$$2Cu_2S + 3O_2(g) \xrightarrow{Heat} 2Cu_2O(s) + 2SO_2(g)$$

(*iii*) Self reduction

$$Cu_2S + 2Cu_2O \xrightarrow{Heat} \underset{\text{Blister copper}}{6Cu} + SO_2$$

(*iv*) Electrolytic refining of Blister copper is done to obtain pure copper.

Q. 37. How is the method of extraction of metals high up in the reactivity series different from that for the metals in the middle? Why can the same process not be applied for them? Name the process used for the extraction of these metals. *[CBSE 2019 (31/4/1)]*

Ans. The metals in the middle of the reactivity series usually present as sulphides or carbonates in nature. The sulphide ores are converted into oxides by heating strongly in the presence of excess air known a **roasting.**

$$2ZnS(s) + 3O_2(g) \xrightarrow{Heat} 2ZnO(s) + 2SO_2(g)$$

The carbonate ores are changed into oxides by heating strongly in the limited air known as **calcination.**

$$ZnCO_3(s) \xrightarrow{Heat} ZnO(s) + CO_2(g)$$

The metal oxide obtained is then reduced to metal by using suitable reducing agents such as carbon or highly reactive metals such as sodium, calcium, aluminium, etc.

$$ZnO(s) + C(s) \xrightarrow{Heat} Zn(s) + CO(g)$$

The metals high up in the reactivity series are obtained by **electrolytic reduction.** They cannot be obtained by heating with carbon because these metals have more affinity for oxygen than carbon.

Electrolytic reduction: Sodium, calcium and magnesium are obtained by the electrolysis of their molten chlorides. The metals are deposited at the cathode and chlorine gas is liberated at the anode.

At cathode $\quad Na^+ + e^- \longrightarrow Na$

At anode $\quad 2Cl^- \longrightarrow Cl_2 + 2e^-$

Q. 38. How can a layer of aluminium oxide on an aluminium object be made thicker? What is this process called?

Ans. Aluminium develops a thin oxide layer when exposed to air. This aluminium oxide coat makes it resistant to further corrosion. The resistance can be improved further by making the oxide layer thicker. This process is called **anodising**.

During anodising, a clean aluminium article is made the anode and is electrolysed with dilute sulphuric acid. The oxygen gas evolved at the anode reacts with aluminium to make a thicker protective oxide layer. This oxide layer can be dyed easily to give aluminium articles an attractive finish.

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Q. 39. **(*i*) A metal M is found in nature as MCO_3. It is used in galvanising iron articles. Name the metal.**

(*ii*) How can the metal be obtained from its carbonate ore?

Ans. (*i*) The metal is zinc (Zn).

(*ii*) The carbonate ore is first heated strongly in limited supply of oxygen and changed into its oxide. This process is called **calcination.**

$$ZnCO_3(s) \xrightarrow{\text{Heat}} ZnO(s) + CO_2(g)$$

Zinc oxide is then reduced to zinc metal by heating it with carbon. This process is called **reduction.**

$$ZnO(s) + C(s) \xrightarrow{\text{Heat}} Zn(s) + CO(g)$$

Q. 40. **Which two metals do not corrode easily? Give an example in each case to support that**

(*i*) corrosion of some metals is an advantage.

(*ii*) corrosion of some metals is a serious problem.

Ans. Gold and platinum.

(*i*) A thin impervious layer of aluminium oxide forms a protective layer which protects the aluminium metals underneath from further damage.

(*ii*) Corrosion of iron is a serious problem. Every year enormous amount of money is spent to replace damaged iron and steel structures.

Q. 41. **In the formation of the compound XY, atoms of X lost one electron each while atoms of Y gained one electron each. What is the nature of bond in XY? Predict the two properties of XY.**

Ans. The atoms of X lose electrons whereas the atoms of Y gain electrons. Thus, there is transfer of electrons from atoms of X to atoms of Y. The bond formed by the transfer of electrons is called ionic bond. Therefore, the nature of bond in the compound XY is ionic.

Properties of ionic compound XY:

(*i*) The compound will be soluble in water.

(*ii*) The compound will conduct electricity when dissolved in water or in molten state.

Q. 42. **(*i*) Name two physical properties each of sodium and carbon in which their behaviour is not as expected from their classification as metal and non-metal respectively.**

(*ii*) Name two metals whose melting points are low that they melt when held in hand.

Ans. (*i*) Sodium metal : Soft, Low melting point

Carbon non-metal : Graphite conducts electricity, Diamond has a very high melting point.

(*ii*) Gallium and Cesium.

Long Answer Questions [5 marks]

Each of the following questions are of 5 marks and have to be answered in about 80-90 words.

Q. 1. **(*i*) Explain the formation of Mg_3N_2 by the transfer of electrons.**

(*ii*) Name the ions present in the compound.

(*iii*) Write about the solubility of these compounds.

Ans. (*i*) The atomic number of magnesium is 12. Its electronic configuration is 2, 8, 2. So, it has a tendency to donate 2 valence electrons and forms Mg^{2+} ion. The atomic number of nitrogen is 7. Its electronic configuration is 2, 5. So it has a tendency to gain 3 electrons to complete its octet and form N^{3-} ion.

When magnesium and nitrogen are brought together, three magnesium atoms donate 2 electrons each to two nitrogen atoms and in this way they acquire the nearest stable noble gas configuration.

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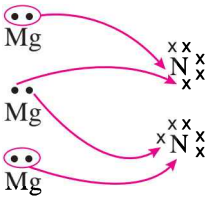


$Mg_3^{2+}\ \ddot{N}^{3-}_2$; Mg_3N_2

(*ii*) The ions present are Mg^{2+} and N^{3-}.

(*iii*) Mg_3N_2 is an ionic compound. It is soluble in water but insoluble in solvents such as kerosene, petrol, etc.

Q. 2. What are ionic or electrovalent compounds? Give an example of ionic compound. Explain with reason four properties of these compounds. *[CBSE 2019 (31/3/1)]*

Ans. Ionic compounds are those compounds which are formed by the transfer of electrons from a metal to a non-metal. For example, NaCl.

Properties:

(*i*) Physical nature: Ionic compounds are hard and solid due to strong force of attraction between oppositely charged ions.

(*ii*) Melting point and boiling point: As more amount of energy is required to break strong bonds. So, they have high melting point and boiling point.

(*iii*) Solubility: These are soluble in water (polar solvent) but insoluble in organic solvent.

(*iv*) Conduction of electricity: They conduct electricity in solution or molten state as ions move towards opposite electrodes.

Q. 3. Two ores *A* and *B* were taken. On heating ore *A* gives CO_2 whereas, ore *B* gives SO_2. What steps will you take to convert them into metals? *[NCERT Exemplar]*

Ans. Since ore *A* gives CO_2 and ore *B* gives SO_2. Therefore, ores are MCO_3 and MS.

As *A* is a carbonate ore, it is first subjected to calcination followed by reduction.

$$MCO_3 \xrightarrow{\text{Calcination}} MO + CO_2$$

$$MO + C \xrightarrow{\text{Reduction}} M + CO$$

As *B* is a sulphide ore, it is first subjected to roasting followed by reduction.

$$2MS + 3O_2 \xrightarrow{\text{Roasting}} 2MO + 2SO_2$$

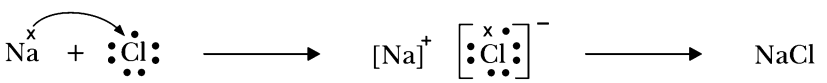
$$MO + C \xrightarrow{\text{Reduction}} M + CO$$

Q. 4. Write the names and symbols of two most reactive metals. Explain by drawing electronic structure how any one of them reacts with a halogen. Explain any two physical properties of the compound formed. *[CCE 2016]*

Ans. Most reactive metals are Na (sodium) and K (potassium)

$$Na \longrightarrow Na^+ + e^-$$

$$Cl + e^- \longrightarrow Cl^-$$



Physical properties:

(*i*) Hard and solid due to strong attractive forces between oppositely charged ions.

(*ii*) High melting point and boiling point because more amount of energy is required to break strong force of attraction.

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Q. 5. (*i*) Hydrogen is not a metal but it has been assigned a place in the reactivity series of metals. Explain.

(*ii*) How would you show that silver is chemically less reactive than copper?

Ans. (*i*) Though hydrogen is not a metal but even then it has been assigned a place in the activity series. The reason is that like metals, hydrogen also has a tendency to lose electron and forms a positive ion H^+.

The metals which lose electrons less readily than hydrogen are placed below it and the metals which lose electrons more readily than hydrogen are placed above it in the reactivity series of metals.

(*ii*) By displacement reaction, silver can be shown to be chemically less reactive than copper or copper is more reactive than silver. If a piece of silver is immersed in a solution of copper sulphate, no reaction will take place because silver is less reactive than copper and will not displace copper from the copper sulphate solution.

$$CuSO_4(aq) + Ag(s) \longrightarrow \text{No reaction}$$

On the other hand, if a copper plate is placed in a solution of silver nitrate, copper will slowly displace silver from the solution and blue solution of copper nitrate is formed.

$$\underset{\text{Colourless}}{2AgNO_3(aq)} + Cu(s) \longrightarrow \underset{\text{Blue}}{Cu(NO_3)_2(aq)} + 2Ag(s)$$

This shows that copper is more reactive than silver.

Q. 6. (*i*) What is an ionic bond?

(*ii*) How is an ionic bond formed?

(*iii*) Write the formation of magnesium chloride.

Ans. (*i*) The chemical bond formed by the transfer of electrons from one atom to another is known as an ionic bond.

(*ii*) An ionic bond is formed when one of the atoms can donate electrons to achieve the inert gas electronic configuration and other atom needs electrons to achieve the inert gas electronic configuration.

When a metal (usually 1, 2 or 3 electrons in outermost shell) reacts with a non-metal (usually 5, 6 or 7 electrons in outermost shell), transfer of electrons takes place from metal atoms to the non-metal atoms and an ionic bond is formed. There is a strong force of electrostatic attraction between metallic cation and non-metallic anion which is responsible for the formation of ionic bond.

(*iii*) **Formation of magnesium chloride ($MgCl_2$):** The atomic number of magnesium is 12. It has two electrons in its valence shell as shown below:

$$_{12}Mg — 2, 8, 2$$

Magnesium, therefore, has a tendency to lose the 2 valence electrons and in the process attains the electronic configuration of neon.

$$\underset{2,8,2}{Mg} \longrightarrow \underset{2,8}{Mg^{2+}} + 2e^-$$

Chlorine (atomic number 17) has 7 electrons in the valence shell. It has a tendency to gain one electron to complete its octet.

$$\underset{2,8,7}{Cl} + e^- \longrightarrow \underset{2,8,8}{Cl^-}$$

Thus, when magnesium and chlorine are brought together, the magnesium atom transfers its two valence electrons to two chlorine atoms. In the process, both the atoms acquire the stable electronic configuration of nearest inert gases. The positively charged magnesium ion Mg^{2+} and negatively charged chloride ions (Cl^-) are now held together by the electrostatic force of attraction and form ionic bond.

$$Mg^{2+} + 2Cl^- \longrightarrow Mg^{2+}2Cl^- \text{ or } MgCl_2$$

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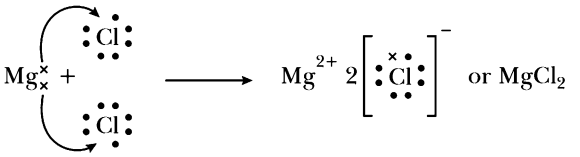
This process can also be shown as below:



Q. 7. **(*i*) Distinguish between ionic and covalent compounds under the following properties:**

(*a*) Strength of forces between constituent elements

(*b*) Solubility of compounds in water

(*c*) Electrical conduction in substances

(*ii*) Explain how the following metals are obtained from their compounds by the reduction process:

(*a*) Metal M which is in the middle of the reactivity series

(*b*) Metal N which is high up in the reactivity series

Give one example of each type.

Ans. (*i*) (*a*) Ionic compounds have strong force of attraction between the oppositely charged ions (*e.g.*, Na^+ and Cl^-), so they are solids. Covalent compounds have weak force of attraction between their molecules, so they are usually liquids or gases.

(*b*) Ionic compounds are soluble in water but covalent compounds are insoluble in water.

(*c*) Ionic compounds conduct electricity when dissolved in water or when melted because they contain ions (charged particles). But, covalent compounds like glucose do not conduct electricity because they do not contain ions.

(*ii*) (*a*) The metal M which is in the middle of the reactivity series (such as iron, zinc, lead, copper, etc.) is moderately reactive. So, for obtaining such metals from their compounds, their sulphides and carbonates (in which they are present in nature) are first converted into their oxides by the process of roasting and calcination respectively.

For example,

$$\underset{\text{Zinc sulphide (Sulphide ore)}}{2ZnS(s)} + 3O_2(g) \xrightarrow{\text{Heat}} 2ZnO(s) + 2SO_2(g)$$

$$\underset{\text{Zinc carbonate (Carbonate ore)}}{ZnCO_3(s)} \xrightarrow{\text{Heat}} ZnO(s) + CO_2(g)$$

The metal oxides (MO) are then reduced to the corresponding metals by using suitable reducing agents such as carbon. For example, zinc metal from its oxide is obtained as follow:

$$\underset{\text{Zinc oxide}}{ZnO(s)} + C(s) \longrightarrow \underset{\text{Zinc}}{Zn(s)} + CO(g)$$

(*b*) The metal N which is high up in the reactivity series (such as sodium, magnesium, calcium, aluminium, etc.), is very reactive and cannot be obtained from its compound by heating with carbon.

Therefore, such metals are obtained by electrolytic reduction of their molten salt. For example, sodium is obtained by the electrolysis of molten sodium chloride (NaCl).

At cathode: $Na^+ + e^- \longrightarrow Na$

At anode: $2Cl^- \longrightarrow Cl_2 + 2e^-$

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Q. 8. **(*i*) Distinguish between 'roasting' and 'calcination'. Which of these two is used for sulphide ores and why?**

(*ii*) Write a chemical equation to illustrate the use of aluminium for joining cracked railway lines.

(*iii*) Name the anode, the cathode and the electrolyte used in the electrolytic refining of impure copper.

Ans. (*i*) **Roasting:** It is the process in which sulphide ores of the metals are converted into oxides by heating them in the presence of excess air. For example, zinc sulphide is converted into zinc oxide by roasting.

$$2ZnS(s) + 3O_2(g) \xrightarrow[\text{Roasting}]{\text{Heat}} 2ZnO(s) + 2SO_2(g)$$

Calcination: It is the process in which carbonate ores of the metals are decomposed into oxides by heating them in the absence or limited air. For example, zinc carbonate is decomposed into zinc oxide and carbon dioxide by calcination.

$$ZnCO_3 \xrightarrow[\text{Calcination}]{\text{Heat}} ZnO(s) + CO_2(g)$$

Out of roasting and calcination, only roasting is used for sulphide ores. This is because it is easier to obtain metal from its oxide as compared to its sulphide.

(*ii*) $\underset{\text{Iron(III)oxide}}{Fe_2O_3(s)} + \underset{\substack{\text{Aluminium}\\\text{powder}}}{2Al(s)} \xrightarrow{\text{Heat}} \underset{\text{Iron metal}}{2Fe(l)} + \underset{\substack{\text{Aluminium}\\\text{oxide}}}{Al_2O_3(s)} + \text{Heat}$

(*iii*) Anode — Impure copper

Cathode — Strip of pure copper

Electrolyte — Acidified copper sulphate solution.

Q. 9. **(*i*) How do you classify elements into metals and non-metals on the basis of their electronic configuration? Choose metal and non-metal out of the following:**

$^{23}_{11}\mathbf{A}$, $^{19}_{9}\mathbf{B}$, $^{24}_{12}\mathbf{C}$, $^{31}_{15}\mathbf{D}$, $^{35}_{17}\mathbf{E}$

(*ii*) What type of bond will be formed if

(*a*) 'A' combines with 'B'? **(*b*) 'A' combines with 'E'?**

(*c*) 'C' combines with 'E'? **(*d*) 'D' combines with 'E'?**

Ans. (*i*) Elements which contain 1 to 3 electrons in their outermost shell are metals.

Elements containing 4 to 7 electrons in their valence shell are non-metals.

Electronic configurations:

$^{23}_{11}A(Z = 11) = 2, 8, 1$ $^{19}_{9}B(Z = 9) = 2, 7$

$^{24}_{12}C(Z = 12) = 2, 8, 2$ $^{31}_{15}D(Z = 15) = 2, 8, 5$

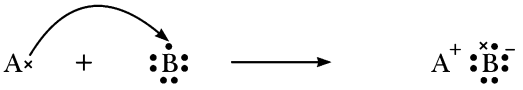
$^{35}_{17}E(Z = 17) = 2, 8, 7$

Hence A and C are metals whereas, B, D and E are non-metals.

(*ii*) **Type of bonds**

(*a*) 'A' is metal and 'B' is non-metal, so the bond formed will be ionic.

A = 2, 8, 1 B = 2, 7



Ionic bond

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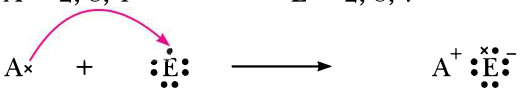
(*b*) 'A' is metal and 'E' is non-metal, so the bond formed is ionic.

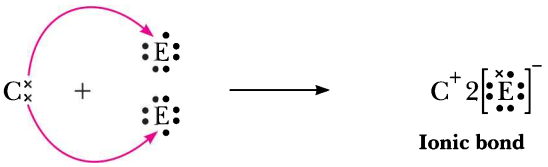
A = 2, 8, 1 E = 2, 8, 7



Ionic bond

(*c*) 'C' is metal and 'E' is non-metal, so the bond formed is ionic.

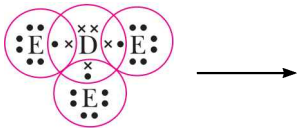
C = 2, 8, 2 E = 2, 8, 7



Ionic bond

(*d*) 'D' is a non-metal and E is also a non-metal, so the bond formed will be covalent.

D = 2, 8, 5 E = 2, 8, 7



DE_3

Covalent bond

Q. 10. Give reasons:

(*i*) Reactivity of Al decreases if it is dipped in HNO_3. *[CBSE 2019 (31/1/3)]*

(*ii*) Carbon cannot reduce the oxides of Na or Mg.

(*iii*) NaCl is not a conductor of electricity in solid state whereas it does conduct electricity in aqueous solution as well as in molten state. *[CBSE 2019 (31/1/3)]*

(*iv*) Iron articles are galvanised.

(*v*) Metals like Na, K, Ca and Mg are never found in their free state in nature.

[NCERT Exemplar] [CBSE 2019 (31/1/3)]

Ans. (*i*) Due to the formation of a layer of oxide, *i.e.*, Al_2O_3 it becomes less reactive.

(*ii*) Na or Mg are more reactive metals as compared to carbon. So, their oxides are more stable.

(*iii*) In solid NaCl, the movement of ions is not possible due to its rigid structure but in aqueous solution or molten state, the ions can move freely. These free ions are responsible for conduction of electricity.

(*iv*) Iron articles are galvanised to protect them from corrosion.

(*v*) Na, K, Ca and Mg are highly reactive metals and thus never found in their free state in nature.

Q. 11. (*i*) Write chemical equations for the following reactions:

(*a*) Calcium metal reacts with water.

(*b*) Cinnabar is heated in the presence of air.

(*c*) Manganese dioxide is heated with aluminium powder.

(*ii*) What are alloys? List two properties of alloys. *[CBSE 2019 (31/1/2)]*

Ans. (*i*) (*a*) $Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2$

(*b*) $2HgS + 3O_2 \xrightarrow{Heat} 2HgO + 2SO_2$

(*c*) $3MnO_2 + 4Al \longrightarrow 2Al_2O_3 + 3Mn + Heat$

(*ii*) Alloys are the homogeneous mixture of two or more metals or one metal and a non-metal.

Properties of alloys:

- The electrical conductivity and melting point of alloys are less than pure metals.
- Alloys are more resistant to corrosion.

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HOTS [Higher Order Thinking Skills]

Q. 1. There are 3 unknown metals—A, B and C. C displaces B from its oxide while with oxide of A, there is no reaction. Give the reactivity order of A, B and C.

Ans. C displaces B from its oxide, therefore, C is more reactive than B.

There is no reaction when C is treated with oxide of A or C does not displace A from its oxide. So, A is more reactive than C. Thus, the reactivity order is B < C < A.

Q. 2. A copper coin is kept immersed in a solution of silver nitrate for some time. What will happen to the coin and the colour of solution?

Ans. Copper is placed above the silver in the reactivity series which indicates that copper is more reactive than silver. When a copper coin or strip is kept immersed in a solution of silver nitrate ($AgNO_3$), silver from its solution will deposit on copper coin.

$$\underset{\text{Colourless}}{2AgNO_3(aq)} + Cu(s) \longrightarrow 2Ag(s) + \underset{\text{Blue}}{Cu(NO_3)_2(aq)}$$

Copper slowly displaces silver from the $AgNO_3$ solution and the colour of solution changes from colourless to blue due to formation of copper nitrate [$Cu(NO_3)_2$]. The copper coin will disappear and silver will precipitate out.

Q. 3. An element A reacts with water to form a compound B which is used in white-washing. The compound B on heating forms an oxide C which on treatment with water gives back B. Identify A, B and C and give the reactions involved. *[NCERT Exemplar]*

Ans. A is calcium, it reacts with water to form calcium hydroxide which is used in white washing. So, B is $Ca(OH)_2$.

$$Ca(s) + 2H_2O(l) \longrightarrow \underset{(B)}{Ca(OH)_2(aq)} + H_2(g)$$

On heating compound *B*, *i.e.*, calcium hydroxide, it forms calcium oxide, *i.e.*, C.

$$Ca(OH)_2 \xrightarrow{\text{Heat}} \underset{(C)}{CaO} + H_2O$$

Q. 4. 'M' is an element which is out of Cu, Fe, Al, Na. It shows the following properties:

(*i*) One of its ore is rich in M_2O_3.

(*ii*) M_2O_3 is not affected by water.

(*iii*) It corrodes easily.

(*iv*) It forms two chlorides MCl_2 and MCl_3. Identify 'M'.

Ans. As the metal 'M' forms oxide M_2O_3, it is trivalent. Out of the metals listed, only Fe and Al are trivalent.

M_2O_3 is not affected by water, so 'M' can be out of Fe or Al.

Fe and Al both corrode easily.

Out of Al and Fe, only Fe can form divalent chloride, so the element 'M' is Fe.

Q. 5. Carbon can reduce copper oxide to copper but not CaO to Ca. Why?

Ans. C is a strong reducing agent and can reduce CuO as follows:

$$CuO + C \longrightarrow Cu + CO\uparrow$$

Ca is much more reactive than Cu and has greater affinity for oxygen than C. So, carbon cannot reduce CaO to Ca.

Q. 6. A metal A, which is used in thermite process, when heated with oxygen gives an oxide B, which is amphoteric in nature. Identify A and B. Write down the reactions of oxide B with HCl and NaOH. *[NCERT Exemplar] [CBSE 2019 (31/4/3)]*

Ans. A is aluminium (Al). It reacts with oxygen to form aluminium oxide, Al_2O_3.

$$4Al(s) + 3O_2(g) \longrightarrow 2Al_2O_3(s)$$

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So, B is Al_2O_3.

$$Al_2O_3 + 6HCl \longrightarrow 2AlCl_3 + 3H_2O$$

$$Al_2O_3 + 2NaOH \longrightarrow 2NaAlO_2 + H_2O$$

Q. 7. A non-metal A which is the largest constituent of air, when heated with H_2 in 1: 3 ratio in the presence of catalyst (Fe) gives a gas B. On heating with O_2 it gives an oxide C. If this oxide is passed into water in the presence of air it gives an acid D which acts as a strong oxidising agent.

(*i*) Identify A, B, C and D.

(*ii*) To which group of periodic table does this non-metal belong? *[NCERT Exemplar]*

Ans. (*i*) 'A' is N_2, nitrogen gas.

When N_2 is heated with H_2 in 1 : 3 ratio in the presence of catalyst (Fe), ammonia gas is produced.

So, 'B' is NH_3.

$$N_2 + 3H_2 \xrightarrow[Fe]{Heat} 2NH_3$$

When N_2 reacts with O_2, it forms an oxide, NO.

$$N_2 + O_2 \xrightarrow{Heat} 2NO$$

So, 'C' is NO.

When this oxide of nitrogen is passed into water in the presence of air, it forms HNO_3 *i.e.*, nitric acid which is a strong oxidising agent.

So, 'D' is HNO_3.

(*ii*) It belongs to group 15 of the periodic table.

Q. 8. A non-metal A, is an important constituent of our food and forms two oxides B and C. Oxide B is toxic whereas C causes global warming.

(*i*) Identify A, B and C

(*ii*) To which group of Periodic Table does A belong? *[NCERT Exemplar]*

Ans. (*i*) 'A' is carbon. Its two oxides are carbon monoxide, CO and carbon dioxide, CO_2. CO is toxic so 'B' is carbon monoxide and carbon dioxide causes global warming, so 'C' is carbon dioxide *i.e.*, CO_2.

(*ii*) 'A' belongs to group 14 of the Periodic Table.

NCERT Corner

NCERT Intext Questions

Q. 1. Give an example of a metal which

(*i*) is a liquid at room temperature;

(*ii*) can be easily cut with a knife;

(*iii*) is the best conductor of heat;

(*iv*) is a poor conductor of heat.

Ans. (*i*) Mercury (*ii*) Sodium

(*iii*) Silver (*iv*) Lead.

Q. 2. Explain the meanings of malleable and ductile.

Ans. Metals can be hammered into thin sheets. This property of metal is called malleability and the metals showing this property are called malleable. Gold, silver, copper, aluminium etc., are malleable metals.

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Metals can be drawn into wires. The ability of metals to be drawn into thin wires is called ductility. Gold is the most ductile metal. It is interesting to know that a wire of about 2 km length can be drawn from one gram of gold.

Q. 3. Why is sodium kept immersed in kerosene oil?

Ans. Sodium is a very reactive metal. It reacts vigorously with the water and oxygen present in air and even catches fire. Hence, to protect sodium, it is kept immersed in kerosene oil.

Q. 4. Write equation for the reactions of

(*i*) iron with steam

(*ii*) calcium and potassium with water

Ans. (*i*) $3Fe(s) + 4H_2O(g) \longrightarrow Fe_3O_4(s) + 4H_2(g)$

(*ii*) $Ca(s) + 2H_2O(l) \longrightarrow Ca(OH)_2(aq) + H_2(g)$

$2K(s) + 2H_2O(l) \longrightarrow 2KOH(aq) + H_2(g)$

Q. 5. Samples of four metals A, B, C and D were taken and added to the following solution one by one. The results obtained have been tabulated as follows:

Metal	Iron(II) sulphate	Copper(II) sulphate	Zinc sulphate	Silver nitrate
A	No reaction	Displacement	—	—
B	Displacement	—	No reaction	—
C	No reaction	No reaction	No reaction	Displacement
D	No reaction	No reaction	No reaction	No reaction

Use the table above to answer the following questions about metals A, B, C and D.

(*i*) Which is the most reactive metal?

(*ii*) What would you observe, if B is added to a solution of copper(II) sulphate?

(*iii*) Arrange the metals A, B, C and D in the order of decreasing reactivity.

Ans. (*i*) B is most reactive.

(*ii*) B will displace copper from copper(II) sulphate.

(*iii*) B > A > C > D.

Q. 6. Which gas is produced, when dilute hydrochloric acid is added to a reactive metal? Write the chemical equation, when iron reacts with dilute H_2SO_4.

Ans. Hydrogen gas is produced, when a metal reacts with dilute hydrochloric acid.

$$\underset{\text{Metal}}{M(s)} + \underset{\substack{\text{Hydrochloric acid}\\(\text{Dilute})}}{2HCl(aq)} \longrightarrow \underset{\text{Metal chloride}}{MCl_2(s)} + \underset{\text{Hydrogen}}{H_2(g)}$$

Chemical equation for the reaction of iron with dilute H_2SO_4 is

$$\underset{\text{Iron}}{Fe(s)} + \underset{\substack{\text{Dilute Sulphuric}\\\text{acid}}}{H_2SO_4(aq)} \longrightarrow \underset{\text{Iron (II) sulphate}}{FeSO_4(aq)} + \underset{\text{Hydrogen}}{H_2(g)}$$

Q. 7. What would you observe, when zinc is added to a solution of iron(II) sulphate? Write the chemical reaction that takes place.

Ans. When zinc is added to a solution of iron(II) sulphate, the greenish colour of iron(II) sulphate solution fades away gradually, due to the formation of colourless zinc sulphate solution. Iron metal is deposited on zinc.

$$\underset{\text{Zinc}}{Zn(s)} + \underset{\substack{\text{Iron (II) sulphate}\\(\text{Greenish solution})}}{FeSO_4(aq)} \longrightarrow \underset{\substack{\text{Zinc sulphate}\\(\text{Colourless solution})}}{ZnSO_4(aq)} + \underset{\text{Iron}}{Fe(s)}$$

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Q. 8. **(*i*) Write the electron dot structures of sodium, oxygen and magnesium.**

(*ii*) Show the formation of Na_2O and MgO by the transfer of electrons. [*CBSE* 2019 (31/3/2)]

(*iii*) What are the ions present in these compounds?

Ans. **(*i*)**

Metal	Symbol	Atomic Number	Electronic Configuration K, L, M, N	Number of Outermost Electrons	Electron dot structures
Sodium	Na	11	2, 8, 1	1	$\dot{N}a$
Oxygen	O	8	2, 6	6	$:\ddot{O}:$
Magnesium	Mg	12	2, 8, 2	2	$Mg:$

(*ii*) Formation of Na_2O:

The atomic number of sodium is 11 and it has only one valence electron.

Hence, electronic configuration of $_{11}Na$ is $\begin{matrix}K & L & M\\ 2, & 8, & 1\end{matrix}$.

The atomic number of oxygen is 8 and it has 6 electrons in its valence shell.

Hence, electronic configuration of $_8O$ is $\begin{matrix}K & L\\ 2, & 6\end{matrix}$.

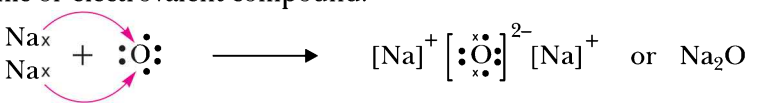
Sodium has a tendency to lose the valence electron and oxygen has a tendency to gain the electron lost by sodium. Since, sodium can lose only one electron of the valence shell and oxygen atom needs two electrons to complete its octet in the valence shell, two atoms of sodium combine with one atom of oxygen. By losing valence electron, sodium is changed into Na^+ cation and by gaining two electrons lost by two sodium atoms, oxygen atom is changed into an oxide anion, O^{2-}. In this process, both the atoms, sodium and oxygen, obtain the stable electronic configuration of the noble gas neon.

$$\underset{2,8,1}{Na} \longrightarrow \underset{2,8}{Na^+} + e^-$$

$$\underset{2,6}{O} + 2e^- \longrightarrow \underset{2,8}{O^{2-}}$$

$$2Na^+ + O^{2-} \longrightarrow 2Na^+O^{2-} \quad \text{or} \quad Na_2O$$

The oppositely charged sodium ion, Na^+ and oxide ion, O^{2-} are now held together by electrostatic forces of attraction or by ionic or electrovalent bond. Na_2O is, therefore, an ionic or electrovalent compound.



or Na_2O

Formation of MgO:

The atomic number of magnesium = 12

Its electronic configuration is $\begin{matrix}K & L & M\\ 2, & 8, & 2\end{matrix}$

It has two electrons in its outermost shell. So, the magnesium atom donates its 2 valence electrons and forms a stable magnesium ion, Mg^{2+}, to attain the electronic arrangement of neon gas.

$$\underset{2,8,2}{Mg} \longrightarrow \underset{2,8}{Mg^{2+}} + 2e^-$$

The atomic number of oxygen = 8

Electronic configuration = $\begin{matrix}K & L\\ 2, & 6\end{matrix}$

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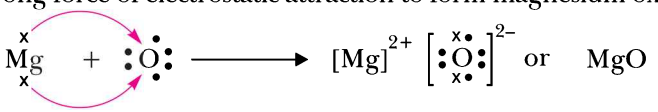
It has six electrons in its valence shell. Therefore, it requires two more electrons to attain the stable electronic arrangement of neon gas. Thus, oxygen accepts two electrons donated by magnesium atom and forms a stable oxide ion, O^{2-}.

$$\underset{2,6}{O} + 2e^- \longrightarrow \underset{2,8}{O^{2-}}$$

The oppositely charged magnesium ions, Mg^{2+} and oxide ions, O^{2-}, are held together by a strong force of electrostatic attraction to form magnesium oxide compound $Mg^{2+}O^{2-}$ or MgO.



MgO is an ionic compound.

(*iii*) The ions present in Na_2O are sodium ions ($2Na^+$) and oxide ion O^{2-}.

The ions present in MgO are magnesium ion (Mg^{2+}) and oxide ion O^{2-}.

Q. 9. Why do ionic compounds have high melting points?

Ans. The ionic compounds are made up of positive and negative ions. There is a strong force of attraction between the oppositely charged ions. Therefore, a lot of energy is required to break this force of attraction and melt this ionic compound. That is why ionic compounds have high melting points.

Q. 10. Define the terms: (*a*) Mineral (*b*) Ore (*c*) Gangue

Ans. (*a*) **Mineral:** The inorganic element or compound, which occurs naturally in the earth's crust is called mineral. For example, copper pyrites ($CuFeS_2$), cuprite (Cu_2O), etc., are the minerals of copper.

(*b*) **Ore:** The mineral from which a metal can be extracted profitably and conveniently is called an ore. For example, bauxite ($Al_2O_3.2H_2O$) and clay ($Al_2O_3.2SiO_2.2H_2O$) are the minerals of aluminium. But, extraction of aluminium is cheaper and easier from bauxite. Hence, bauxite is the ore of aluminium.

Thus, "every ore is a mineral but every mineral is not an ore."

(*c*) **Gangue or Matrix:** The unwanted impurities of sand and rocky materials present in the ore are known as gangue or matrix. We get a concentrated ore by removing the gangue present in it.

Q. 11. Name two metals, which are found in nature in the free state.

Ans. Gold and silver are least reactive and hence these metals occur in nature in the free state.

Q. 12. Which chemical process is used for obtaining a metal from its oxide?

Ans. Reduction.

Q. 13. Metallic oxides of zinc, magnesium and copper were heated with the following metals:

Metal	Zinc	Magnesium	Copper
Zinc oxide			
Magnesium oxide			
Copper oxide			

In which case will you find, displacement reactions taking place?

Ans. As we know, a more reactive metal can displace a less reactive metal from its oxide. Here, magnesium is the most reactive, zinc is less reactive whereas copper is the least reactive metal. Thus, displacement reactions will take place in the following cases:

Metal	Zinc	Magnesium	Copper
Zinc oxide	—	Displacement	—
Magnesium oxide	—	—	—
Copper oxide	Displacement	Displacement	—

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Q. 14. Which metals do not corrode easily?

Ans. Silver, gold, platinum and titanium.

Q. 15. What are alloys?

Ans. Alloys are homogeneous mixtures of two or more metals, or a metal and a non-metal. For example, brass is an alloy of two metals—copper and zinc, whereas steel is an alloy of a metal, iron and a small amount of a non-metal, carbon.

NCERT Exercises

Q. 1. Which of the following pairs will give displacement reactions?

(*a*) NaCl solution and copper metal **(*b*) $MgCl_2$ solution and aluminium metal**

(*c*) $FeSO_4$ solution and silver metal **(*d*) $AgNO_3$ solution and copper metal**

Ans. (*a*) No displacement reaction will occur between NaCl solution and copper metal, as copper metal is less reactive than sodium metal.

(*b*) Al is less reactive than Mg. So, no displacement reaction will take place.

(*c*) Ag is less reactive than Fe. So, no displacement reaction will take place.

(*d*) Cu (copper metal) is more reactive than silver (Ag), so the displacement reaction will take place between $AgNO_3$ solution and copper metal.

Q. 2. Which of the following methods is suitable for preventing an iron frying pan from rusting?

(*a*) Applying grease **(*b*) Applying paint**

(*c*) Applying a coating of zinc **(*d*) All of the above**

Ans. The suitable method for preventing an iron frying pan from rusting is (*c*) applying a coating of zinc.

Applying grease will spoil the food to be cooked in frying pan. Also, we cannot apply paint because it will gradually come out when the frying pan is heated on a gas stove while cooking.

Q. 3. An element reacts with oxygen to give a compound with a high melting point. This compound is also soluble in water. The element is likely to be:

(*a*) calcium **(*b*) carbon**

(*c*) silicon **(*d*) iron**

Ans. Pure calcium oxide or lime, is an amorphous white solid, having a high melting point (2273K). When lime is added to water, a hissing sound is produced and a large amount of heat is generated.

$$CaO + H_2O \longrightarrow \underset{\text{Slaked lime}}{Ca(OH)_2} + \text{Heat}$$

Therefore, the correct answer is (*a*).

Q. 4. Food cans are coated with tin and not with zinc because

(*a*) zinc is costlier than tin.

(*b*) zinc has a higher melting point than tin.

(*c*) zinc is more reactive than tin.

(*d*) zinc is less reactive than tin.

Ans. (*c*) Zinc is more reactive than tin.

Q. 5. You are given a hammer, a battery, a bulb, wires and a switch.

(*a*) How could you use them to distinguish between samples of metals and non-metals?

(*b*) Assess the usefulness of these tests in distinguishing between metals and non-metals.

Ans. (*a*) (*i*) We use the hammer to break the sample. If the sample breaks, this means that it is brittle and hence it is a non-metal. On the other hand, if the sample flattens to form a sheet, this means that the sample is malleable and hence is metal.

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(*ii*) We set up the electric circuit and place the sample in between clips A and B and put the switch 'on'. If the bulb glows, the sample is a good conductor of electricity and hence, it must be a metal. If, on the other hand, the bulb does not glow, the sample is a poor conductor of electricity and hence, it must be a non-metal.

(*b*) Because of malleability of iron and many other metals, we can cast them into sheets, which can be used for various purposes. For example, iron sheets are used for roofing and for making trunks, boxes etc.

Metals are good conductors of electricity. It is because of this property that metal wires made up of copper and aluminium are used for carrying electricity.

These tests of distinguishing metals and non-metals are widely applicable in industries and its validity has been scientifically proved.

Q. 6. What are amphoteric oxides? Give two examples of amphoteric oxides. *[CBSE 2019 (31/2/1)]*

Ans. Some metal oxides show both acidic as well as basic character. Such oxides are called amphoteric oxides.

For example, (*i*) Aluminium oxide (Al_2O_3) (*ii*) Zinc oxide (ZnO).

Q. 7. Name two metals, which will displace hydrogen from dilute acids and two metals, which will not.

Ans. (*i*) Magnesium and zinc will displace hydrogen from dilute acids.

(*ii*) Copper and silver will not displace hydrogen from dilute acids.

Q. 8. In the electrolytic refining of metal M, what would you take as the anode, the cathode and the electrolyte ?

Ans. **Anode:** A thick block of impure metal M.

Cathode: A thin strip of the pure metal M.

Electrolyte: A water soluble salt of the metal M.

Q. 9. Pratyush took sulphur powder on a spatula and heated it. He collected the gas evolved by inverting a test tube over it.

(*a*) What will be the action of gas on (*i*) dry litmus paper? (*ii*) moist litmus paper?

(*b*) Write a balanced chemical equation for the reaction taking place.

Ans. (*a*) When sulphur is heated in air, sulphur dioxide gas is formed.

(*i*) Sulphur dioxide has no action on dry litmus paper.

(*ii*) Sulphur dioxide turns moist blue litmus paper to red.

(*b*) $\underset{\text{Sulphur}}{S(s)} + \underset{\text{Oxygen}}{O_2(g)} \longrightarrow \underset{\text{Sulphur dioxide}}{SO_2(g)}$

Q. 10. State two ways to prevent the rusting of iron.

Ans. (*i*) Galvanisation

(*ii*) Greasing

Q. 11. What type of oxides are formed, when non-metals combine with oxygen?

Ans. Non-metals react with oxygen to form acidic oxides or neutral oxides. Carbon forms an acidic oxide CO_2, sulphur forms an acidic oxide SO_2 and hydrogen forms a neutral oxide H_2O. Carbon monoxide (CO), nitrous oxide (N_2O) and nitric oxide (NO) are also the examples of neutral oxides.

Q. 12. Give reasons:

(*a*) Platinum, gold and silver are used to make jewellery. *[CBSE 2019 (31/2/1)]*

(*b*) Sodium, potassium and lithium are stored under oil. *[CBSE 2019 (31/2/1)]*

(*c*) Aluminium is a highly reactive metal, yet it is used to make utensils for cooking. *[CBSE 2019 (31/2/1)]*

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(d) Carbonate and sulphide ores are usually converted into oxides during the process of extraction. [CBSE 2019 (31/2/1)]

Ans. (a) Platinum, gold and silver are used to make jewellery because of their bright shiny surface and high resistance to corrosion. Also, they have high malleability and ductility.

(b) Sodium, potassium and lithium are stored under oil to prevent their reaction with oxygen, moisture and carbon dioxide of air so as to protect them because they are very reactive metals.

(c) Aluminium metal forms a thin layer of aluminium oxide all over its surface, under the action of moist air. This layer prevents the metal underneath from further corrosion. It is cheap, easily available, malleable, ductile and a good conductor of heat. Therefore, it is used to make utensils for cooking.

(d) It is easier to obtain a metal from its oxides as compared to its sulphides and carbonates. So, prior to reduction, metal carbonate and sulphides must be converted into metal oxides. A carbonate ore is converted into oxide by **calcination**, whereas a sulphide ore is converted into oxide by **roasting**.

Q. 13. You must have seen tarnished copper vessels being cleaned with lemon or tamarind juice. Explain why these sour substances are effective in cleaning the vessels.

Ans. When copper vessels are exposed to moist air, they form a green coating of basic copper carbonate [$CuCO_3.Cu(OH)_2$].

$$2Cu + \underbrace{CO_2 + O_2 + H_2O}_{\text{(From moist air)}} \longrightarrow \underset{\substack{\text{Basic copper carbonate}\\ \text{(Green)}}}{CuCO_3.Cu(OH)_2}$$

The sour substances such as lemon or tamarind juice contain acids. Lemon juice contains citric acid and tamarind contains tartaric acid. These acids dissolve the coating of copper oxide or basic copper carbonate, present on the surface of tarnished copper vessels and make them shining red brown again.

Q. 14. Differentiate between metals and non-metals on the basis of their chemical properties. [CBSE 2019 (31/1/1)]

Ans.

Metals	Non-metals
1. Metals combine with oxygen and form basic oxides. $4Na(s) + O_2(g) \rightarrow 2Na_2O(s)$ Basic oxides + Water → Bases $Na_2O(s) + H_2O(l) \longrightarrow \underset{\text{Sodium hydroxide}}{2NaOH(aq)}$ Litmus test (turn red litmus blue)	1. Non-metals combine with oxygen and form acidic oxides or neutral oxides. $C(s) + O_2(g) \rightarrow CO_2(g)$ Acidic oxides + Water → Acids $CO_2(g) + H_2O(l) \longrightarrow \underset{\text{Carbonic acid}}{H_2CO_3(aq)}$ Litmus test (turn blue litmus red)
2. Metals react with water to liberate hydrogen gas.	2. Non-metals do not react with water.
3. (a) Metals react with dil. HCl and H_2SO_4 to liberate H_2 gas. Metal + dil. Acid → Salt + Hydrogen (b) Metal + dil. Nitric acid → Metal salt + Water + Oxides of nitrogen. (**Exception:** Mg and Mn evolve H_2 gas with dil. HNO_3)	3. Non-metals do not displace H_2 from acids because non-metals are electron acceptor, they cannot supply electron to hydrogen.

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Q. 15. A man went door to door posing as a goldsmith. He promised to bring back the glitter of old and dull gold ornaments. An unsuspecting lady gave a set of gold bangles to him, which he dipped in a particular solution. The bangles sparkled like new but their weight was reduced drastically. The lady was upset but after a futile argument the man beat a hasty retreat. Can you play the detective to find out the nature of the solution he had used?

Ans. The goldsmith dipped the set of the gold bangles in aqua regia solution. Aqua regia is a freshly prepared mixture of 1 part of conc. HNO_3 and 3 parts of conc. HCl by volume. Aqua regia dissolved a considerable amount of gold from the dipped gold bangles and hence reduced their weight drastically. The dishonest goldsmith can recover the dissolved gold from aqua regia by a suitable treatment.

Q. 16. Give reasons, why copper is used to make hot water tanks but not steel (an alloy of iron).

Ans. Copper is a much better conductor of heat than steel. Also, copper does not react with water at all but steel (an alloy of iron) reacts with steam. So, copper is used to make hot water tanks but not steel (an alloy of iron).

SELF-ASSESSMENT TEST

Time allowed: 1 hour **Max. marks: 40**

SECTION–A

Choose and write the correct answer for each of the following. **(4 × 1 = 4)**

1. X is the product formed when sulphur reacts with oxygen. It dissolves in water to produce Y. Choose the correct option for X and Y.

	X	*Y*
(*a*)	SO_2	Acidic
(*b*)	SO_3	Neutral
(*c*)	SO_2	Basic
(*d*)	SO_3	Basic

2. Aluminium is used for making cooking utensils. Which of the following properties of aluminium is responsible for the same? *[NCERT Exemplar]*

(*i*) Good thermal conductivity **(*ii*) Good electrical conductivity**

(*iii*) Ductility **(*iv*) High melting point**

(*a*) (*i*) and (*ii*) (*b*) (*i*) and (*iii*)

(*c*) (*ii*) and (*iii*) (*d*) (*i*) and (*iv*)

3. Which of the following metals exist in their native states in nature? *[NCERT Exemplar]*

(*i*) Cu **(*ii*) Au**

(*iii*) Zn **(*iv*) Ag**

(*a*) (*i*) and (*ii*) (*b*) (*ii*) and (*iii*)

(*c*) (*ii*) and (*iv*) (*d*) (*iii*) and (*iv*)

4. Which of the following oxide(s) of iron would be obtained, on prolonged reaction of iron with steam? *[NCERT Exemplar]*

(*a*) FeO (*b*) Fe_2O_3

(*c*) Fe_3O_4 (*d*) Fe_2O_3 and Fe_3O_4

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The following questions consist of two statements—Assertion(A) and Reason(R). Answer these questions selecting the appropriate option given below:

(*a*) **Both *A* and *R* are true and *R* is the correct explanation for *A*.**

(*b*) **Both *A* and *R* are true but *R* is not the correct explanation for *A*.**

(*c*) ***A* is true but *R* is false.**

(*d*) ***A* is false but *R* is true.** **(3 × 1 = 3)**

5. **Assertion (*A*) :** Zinc becomes dull in moist air.
Reason (*R*) : Zinc is coated by a thin film of its basic carbonate in moist air.

6. **Assertion (*A*) :** $MgCl_2$ is a covalent compound.
Reason (*R*) : $MgCl_2$ is a good conductor of electricity in molten state.

7. **Assertion (*A*) :** Anodising is a method to prevent metal from corrosion.
Reason (*R*) : Anodising is a process of coating iron with a layer of zinc.

Answer the following questions in one word or one sentence. **(3 × 1 = 3)**

8. Name the constituents of bronze.

9. Name two metals which reacts with nitric acid and produces hydrogen gas.

10. Define malleability.

SECTION–B

Answer the following questions in about 50-60 words each. **(5 × 3 = 15)**

11. An alkali metal A gives a compound B (molecular mass = 40) on reacting with water. The B gives a soluble compound C on treatment with aluminium oxide. Identify A, B and C and give the reaction involved. *[NCERT Exemplar]*

12. Give reasons for the following:
(*i*) Metals conduct electricity
(*ii*) Copper does not liberate hydrogen on reacting with dil. H_2SO_4.
(*iii*) Non-metals in general do not displace hydrogen from dilute acids.

13. Describe ionic compounds on the basis of the following properties:
(*i*) Strong force of attraction between positive and negative ions.
(*ii*) Solubility of compounds in water.
(*iii*) Electrical conductivity.

14. A metal X is so soft that it can be easily cut with a knife. Its oxide, soluble in water, forms compound which turns red litmus solution blue. Identify X. Give your answer with chemical equation.

15. Given below are the steps for the extraction of copper from its ore. Write the chemical equation of the reactions involved in each case. *[CBSE 2019 (31/2/3)]*
(*i*) Roasting of copper (I) sulphide
(*ii*) Reduction of copper (I) oxide from copper (I) sulphide
(*iii*) Electrolytic refining

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SECTION–C

Answer the following questions in about 80–90 words each. **(3 × 5 = 15)**

16. The electronic configuration of four elements are given:

A: 2, 8,1 B: 2, 8, 2

C: 2, 8, 7 D: 2, 6

Answer the following questions:

(*i*) Which one among A, B, C and D forms monovalent cation?

(*ii*) Which one among A, B, C and D forms divalent cation?

(*iii*) Which one among A, B, C and D forms monovalent anion?

(*iv*) Explain the bonding between (*i*) A and C (*ii*) B and C (*iii*) A and D (*iv*) B and D.

17. The electronic configuration of a magnesium atom is 2, 8, 2 and that of a chlorine atom is 2, 8, 7. State the type of bond formed between the two and the formula of the compound formed. Show its formation with the help of electron-dot structure. Also list its two properties.

18. (*i*) What is 'activity series of metals'? Arrange the metals Zn, Mg, Al, Cu and Fe in decreasing order of reactivity.

(*ii*) What would you observe when you put some copper pieces into green ferrous sulphate solution?

(*iii*) Name a metal which combines with hydrogen gas.

Answers

1. (*a*) **2.** (*d*) **3.** (*c*) **4.** (*c*) **5.** (*a*) **6.** (*d*) **7.** (*c*)

8. Copper and tin

9. Magnesium and Manganese

10. The property of metal by virtue of which it can drawn into thin sheets is known as malleability.

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4 Carbon and its Compounds

BASIC CONCEPTS—A FLOW CHART

CARBON AND ITS COMPOUNDS

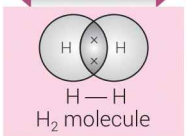
Type of bonding in carbon

Covalent Bond

- Carbon shares its valence electrons with other elements or other carbon atoms.
- Covalent compounds have low melting and boiling points, and are poor conductors of electricity.

Types of covalent bonds

Single Covalent Bond



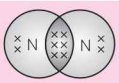
H — H
H_2 molecule

Double Covalent Bond



O = O
O_2 molecule

Triple Covalent Bond



N ≡ N
N_2 molecule

Versatile Nature of Carbon

- *Catenation:* Self-linking property of carbon atoms through covalent bonds to form long chains and rings.
- *Tetravalency:* Since carbon has a valency of four, it is capable of making bonds with four other atoms of carbon or any other element

Types of carbon compounds based on saturation

Saturated Compounds

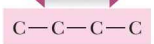
- Carbon compounds having only single bond (called alkane) between the carbon atoms are called saturated carbon compounds.
- *Examples:* Methane, ethane, propane, etc.

Unsaturated Compounds

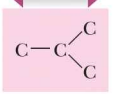
- Carbon compounds having double bond (called alkene) or triple bond (called alkyne) between the carbon atoms.
- *Examples:* Ethene, ethyne, propene, propyne, etc.

Types of carbon compounds based on skeleton

Straight Chain



Branched Chain



Closed Chain (Ring)



Hetero atom	Functional group	Formula of functional group
Cl/Br	Halo– (Chloro/bromo)	–Cl, –Br (substitutes for hydrogen atom)
Oxygen	1. Alcohol	–OH
	2. Aldehyde	
	3. Ketone	
	4. Carboxylic	

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Chemical Properties of Carbon

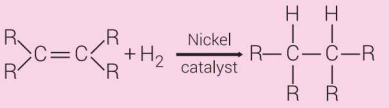
Combustion

Burn in oxygen to give carbon dioxide along with heat and light.

$CH_3CH_2OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$ + Heat and light

Addition Reaction

Unsaturated hydrocarbons add hydrogen in the presence of catalyst to give saturated hydrocarbons,



Oxidation

Oxygen is added to the starting material by oxidising agents.

$CH_3CH_2OH \xrightarrow[\text{or, acidified } K_2Cr_2O_7 + \text{heat}]{\text{Alk. } KMnO_4 + \text{heat}} CH_3COOH$

Substitution Reaction

One or more hydrogen atoms of a hydrocarbon are replaced by some other atoms.

$CH_4 + Cl_2 \xrightarrow{\text{Sunlight}} CH_3Cl + HCl$

Methane — Chlorine — Chloromethane — Hydrogen chloride

Properties of some carbon compounds

Ethanol

- Reaction with sodium

$2Na + 2CH_3CH_2OH \longrightarrow 2CH_3CH_2O^- Na^+ + H_2$

Sodium — Ethanol — Sodium ethoxide — Hydrogen

- Dehydration reaction

$CH_3-CH_2OH \xrightarrow{\text{Hot conc. } H_2SO_4} CH_2=CH_2 + H_2O$

Ethanoic Acid

- Esterification reaction

$CH_3COOH + C_2H_5OH \xrightarrow{H_2SO_4} CH_3COOC_2H_5 + H_2O$

Ethanoic acid — Ethanol — Ethyl ethanoate (ester)

Saponification reaction

$CH_3COOC_2H_5 \xrightarrow{NaOH} CH_3COONa + C_2H_5OH$

Ester — Sodium acetate — Alcohol

- Reaction with carbonates and hydrogencarbonates

$2CH_3COOH + Na_2CO_3 \longrightarrow 2CH_3COONa + H_2O + CO_2$

$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + H_2O + CO_2$

Ethanoic acid — Sodium acetate

- Reaction with a base

$NaOH + CH_3COOH \longrightarrow CH_3COONa + H_2O$

Base — Acid — Salt

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MORE POINTS TO REMEMBER

- **Homologous series:** A series of compounds in which the same functional group substitutes for hydrogen in a carbon chain is called a homologous series.
- The general formula for alkanes can be written as C_nH_{2n+2}, where $n = 1, 2, 3, 4, ...$
- The general formula for alkenes can be written as C_nH_{2n}, where $n = 2, 3, 4, ...$
- The general formula for alkynes can be written as C_nH_{2n-2}, where $n = 2, 3, 4, ...$
- **Naming a carbon compound:**
  - (*i*) Identify the number of carbon atoms in the compound.
  - (*ii*) In case a functional group is present, it is indicated in the name of the compound with either a prefix or a suffix.
  - (*iii*) If the name of the functional group is to be given as a suffix, the name of the carbon chain is modified by deleting the final 'e' and adding the appropriate suffix.
  - (*iv*) If the carbon chain is unsaturated, then the final 'ane' in the name of the carbon chain is substituted by 'ene' or 'yne'.
- **Isomerism:** The compounds which possess the same molecular formula, but different structural formulae, are called isomers and the phenomenon is known as isomerism. For example, butane with a molecular formula C_4H_{10} has two isomers.

$\underset{n\text{-butane}}{CH_3-CH_2-CH_2-CH_3}$ and $\underset{\text{iso-butane}}{CH_3-\underset{\displaystyle CH_3}{\underset{|}{CH}}-CH_3}$

- **Allotropy** is the existence of a chemical element in two or more forms, which may differ in the arrangement of atoms in crystalline solids or in the occurrence of molecules that contain different number of atoms. For example, diamond and graphite are the two allotropes of carbon.
- **Soaps:** The molecules of soap are sodium or potassium salts of long-chain carboxylic acids. The ionic-end of soap dissolves in water while the carbon chain dissolves in oil. The soap molecules, thus form structures called micelles where one end of the molecules is towards the oil droplet while the ionic-end faces outside. This forms an emulsion in water. The soap micelle thus helps in dissolving the dirt in water and we can wash our clothes clean.
- **Detergents:** Detergents are ammonium or sulphonate salts of long chain carboxylic acids. The charged ends of these compounds do not form insoluble precipitates with the calcium and magnesium ions in hard water. Thus, they remain effective in hard water. Detergents are usually used to make shampoos and products for cleaning clothes.

Multiple Choice Questions [1 mark]

Each question has 4 choices (a), (b), (c) and (d). Choose and write the correct option.

1. A curdy solid is formed when

(*a*) soap is added to soft water (*b*) soap is added to hard water
(*c*) detergent is added to soft water (*d*) detergent is added to hard water

2. Which of the following compound contains double bond?

(*a*) H_2O (*b*) CH_4 (*c*) NH_3 (*d*) O_2

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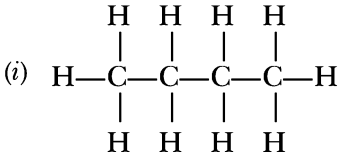
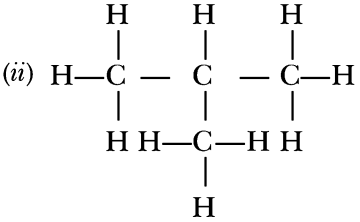
3. A molecule of ammonia (NH_3) has [*NCERT Exemplar*]

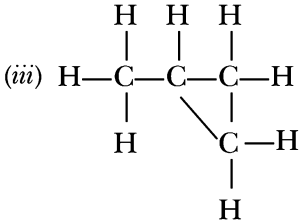
(*a*) only single bonds (*b*) only double bonds

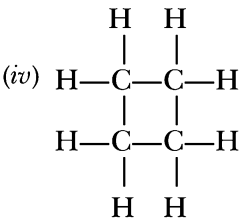
(*c*) only triple bonds (*d*) two double bonds and one single bond

4. Which of the following are correct structural isomers of butane? [*NCERT Exemplar*]

(*i*) 

(*ii*) 

(*iii*) 

(*iv*) 

(*a*) (*i*) and (*iii*) (*b*) (*ii*) and (*iv*) (*c*) (*i*) and (*ii*) (*d*) (*iii*) and (*iv*)

5. Oils on treating with hydrogen in the presence of palladium or nickel catalyst form fats. This is an example of [*NCERT Exemplar*]

(*a*) Addition reaction (*b*) Substitution reaction

(*c*) Displacement reaction (*d*) Oxidation reaction

6. In which of the following compounds, — OH is the functional group? [*NCERT Exemplar*]

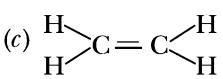
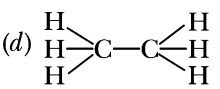
(*a*) Butanone (*b*) Butanol (*c*) Butanoic acid (*d*) Butanal

7. Which of the following is the correct representation of electron dot structure of nitrogen? [*NCERT Exemplar*]

(*a*) $:\dot{\underset{\cdot\cdot}{N}}:\dot{\underset{\cdot\cdot}{N}}:$ (*b*) $:\dot{N}::\dot{N}:$ (*c*) $:\dot{\underset{\cdot\cdot}{N}}:\dot{N}:$ (*d*) $:N:::N:$

8. Structural formula of ethyne is

(*a*) H—C ≡ C—H (*b*) H_3—C ≡ C—H

(*c*)  (*d*) 

9. Identify the unsaturated compounds from the following [*NCERT Exemplar*]

***(i)* Propane** ***(ii)* Propene**

***(iii)* Propyne** ***(iv)* Chloropropane**

(*a*) (*i*) and (*ii*) (*b*) (*ii*) and (*iv*) (*c*) (*iii*) and (*iv*) (*d*) (*ii*) and (*iii*)

10. Chlorine reacts with saturated hydrocarbons at room temperature in the [*NCERT Exemplar*]

(*a*) absence of sunlight (*b*) presence of sunlight

(*c*) presence of water (*d*) presence of hydrochloric acid

11. The fifth member of alcohol homologous series is

(*a*) pentanal (*b*) pentanol (*c*) pentanone (*d*) propanol

12. The property of carbon atom by virtue of which it forms bond with other carbon atoms is called

(*a*) chemical bonding (*b*) polymerisation (*c*) catenation (*d*) carbonisation

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13. Which of the following represents saponification reaction? [NCERT Exemplar]

(*a*) $CH_3COONa + NaOH \xrightarrow{CaO} CH_4 + Na_2CO_3$

(*b*) $CH_3COOH + C_2H_5OH \xrightarrow{H_2SO_4} CH_3COOC_2H_5 + H_2O$

(*c*) $2CH_3COOH + 2Na \longrightarrow 2CH_3COONa + H_2$

(*d*) $CH_3COOC_2H_5 + NaOH \longrightarrow CH_3COONa + C_2H_5OH$

14. The hetero atoms present in $CH_3—CH_2—O—CH_2—CH_2—Cl$ are [NCERT Exemplar]

(*i*) Oxygen **(*ii*) Carbon**

(*iii*) Hydrogen **(*iv*) Chlorine**

(*a*) (*i*) and (*ii*) (*b*) (*ii*) and (*iii*) (*c*) (*iii*) and (*iv*) (*d*) (*i*) and (*iv*)

15. $CH_3 — CH_2 — OH \xrightarrow[\text{Heat}]{\text{Alkaline } KMnO_4} CH_3 — COOH$ [NCERT Exemplar]

In the above given reaction, alkaline $KMnO_4$ acts as

(*a*) reducing agent (*b*) oxidising agent (*c*) catalyst (*d*) dehydrating agent

16. Which of the following statements are usually correct for carbon compounds? These

(*i*) are good conductors of electricity.

(*ii*) are poor conductors of electricity.

(*iii*) have strong forces of attraction between their molecules.

(*iv*) do not have strong forces of attraction between their molecules. [NCERT Exemplar]

(*a*) (*i*) and (*iii*) (*b*) (*ii*) and (*iii*) (*c*) (*i*) and (*iv*) (*d*) (*ii*) and (*iv*)

17. Carbon exists in the atmosphere in the form of [NCERT Exemplar]

(*a*) carbon monoxide only. (*b*) carbon monoxide in traces and carbon dioxide.

(*c*) carbon dioxide only. (*d*) coal.

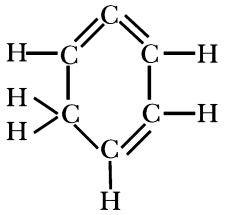
18. Vinegar is a solution of [NCERT Exemplar]

(*a*) 50% – 60% acetic acid in alcohol (*b*) 5% – 8% acetic acid in alcohol

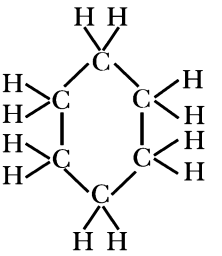
(*c*) 5% – 8% acetic acid in water (*d*) 50% – 60% acetic acid in water

19. Structural formula of benzene is [NCERT Exemplar]

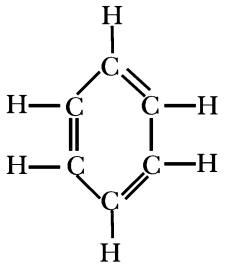
(*a*)



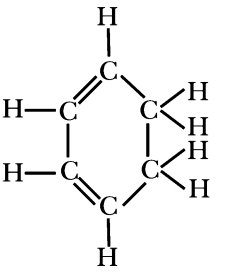
(*b*)



(*c*)



(*d*)



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20. **Pentane has the molecular formula C_5H_{12}. It has** [*NCERT Exemplar*]

(*a*) 5 covalent bonds (*b*) 12 covalent bonds

(*c*) 16 covalent bonds (*d*) 17 covalent bonds

21. **Carbon forms four covalent bonds by sharing its four valence electrons with four univalent atoms, *e.g.*, hydrogen. After the formation of four bonds, carbon attains the electronic configuration of** [*NCERT Exemplar*]

(*a*) helium (*b*) neon (*c*) argon (*d*) krypton

22. **The name of the compound $CH_3—CH_2—CHO$ is** [*NCERT Exemplar*]

(*a*) Propanal (*b*) Propanone (*c*) Ethanol (*d*) Ethanal

Answers

1. (*b*) **2.** (*d*) **3.** (*a*) **4.** (*c*) **5.** (*a*) **6.** (*b*) **7.** (*d*)
8. (*a*) **9.** (*d*) **10.** (*b*) **11.** (*b*) **12.** (*c*) **13.** (*d*) **14.** (*d*)
15. (*b*) **16.** (*d*) **17.** (*b*) **18.** (*c*) **19.** (*c*) **20.** (*c*) **21.** (*b*)
22. (*a*)

Assertion-Reason Questions [1 mark]

The following questions consist of two statements — Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(*a*) *Both A and R are true and R is the correct explanation of A.*

(*b*) *Both A and R are true but R is not the correct explanation of A.*

(*c*) *A is true but R is false.*

(*d*) *A is false but R is true.*

1. **Assertion (*A*) :** Carbon is the only element that can form large number of compounds.
Reason (*R*) : Carbon is tetravalent and shows the property of catenation.

2. **Assertion (*A*) :** If the first member of a homologous series is methanal, its third member will be propanal.
Reason (*R*) : All the members of a homologous series show similar chemical properties.

3. **Assertion (*A*) :** Diamond and graphite are allotropes of carbon.
Reason (*R*) : Some elements can have several different structural forms while in the same physical state. These forms are called allotropes.

4. **Assertion (*A*) :** Soaps are not suitable for washing purpose when water is hard.
Reason (*R*) : Soaps have relatively weak cleansing action.

5. **Assertion (*A*) :** Carbon compounds can form chain, branched and ring structures.
Reason (*R*) : Carbon exhibits the property of catenation.

6. **Assertion (*A*) :** Carbon monoxide is extremely poisonous in nature.
Reason (*R*) : Carbon monoxide is formed by complete combustion of carbon.

7. **Assertion (*A*) :** Cooking oil decolourises bromine water.
Reason (*R*) : Cooking oil is a saturated compound.

Answers

1. (*d*) **2.** (*b*) **3.** (*a*) **4.** (*b*) **5.** (*a*) **6.** (*c*) **7.** (*b*)

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Passage-based Questions

Answer the questions below each passage on the basis of your understanding of the paragraph and the related studied concepts.

1. Ethanol, commonly called as alcohol, is an excellent solvent. It is used in medicines and is also an important starting material in the synthesis of many chemical compounds. However, inspite of its benefits to man, its impact on social behaviour has been questioned as its consumption causes drunkeness. Ethanol is a reactive compound. It reacts with sodium to form sodium ethoxide and hydrogen gas.

(*i*) Write any two properties of ethanol other than those mentioned in the passage.

(*ii*) Which of the following is the correct formula of sodium ethoxide?

(*a*) C_2H_5ONa (*b*) CH_3ONa (*c*) CH_3COONa (*d*) None of these.

(*iii*) Name the product formed when ethanol reacts with ethanoic acid.

(*iv*) What is denatured alcohol?

2. Compounds which contain only carbon and hydrogen are called hydrocarbons. Among these the compounds containing all single covalent bonds are called saturated hydrocarbons while the compounds containing atleast one double or triple bond are called unsaturated hydrocarbons. Saturated hydrocarbons after combustion give a clean flame while unsaturated hydrocarbons give a yellow sooty flame. Unsaturated hydrocarbons are more reactive than saturated hydrocarbons. Unsaturated hydrocarbons add hydrogen in the presence of catalysts such as palladium or nickel to give saturated hydrocarbons. The chemical reaction is as follows:

$$CH_3CH_2CH=CH_2 \xrightarrow[H_2]{\text{nickel catalyst}} CH_3CH_2CH_2CH_3$$

(*i*) Write two differences between saturated and unsaturated hydrocarbons.

(*ii*) Between $CH_3CH_2CH_3$ and $CH_3CH=CH_2$, which is more reactive?

(*iii*) Give the IUPAC names of the reactant and product of the reaction given above.

(*iv*) The reaction given in the passage is known as

(*a*) Combustion (*b*) Oxidation (*c*) Hydrogenation (*d*) Substitution.

Answers

1. (*i*) (*a*) Ethanol is lighter than air.

(*b*) Ethanol is miscible with water.

(*c*) Ethanol has no effect on litmus solution. (*Any two*)

(*ii*) (*a*)

(*iii*) Ethyl ethanoate

(*iv*) Denatured alcohol is ethyl alcohol which has been made unfit for drinking purposes by adding poisonous substances like methanol, pyridine, copper sulphate, etc.

2. (*i*)

Saturated hydrocarbons	Unsaturated hydrocarbons
(1) These are hydrocarbons with only single bonds.	(1) These are hydrocarbons with multiple bonds (double or triple).
(2) Burning in air result in a blue, non-sooty flame.	(2) Burning in air result in a yellow, sooty flame.

(*ii*) $CH_3CH=CH_2$ is more reactive.

(*iii*) Reactant — Butene

Product — Butane

(*iv*) (*c*)

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Very Short Answer Questions [1 mark]

Each of the following questions are of 1 mark and have to be answered in one word or one sentence.

Q. 1. What is heteroatom? Give an example.

Ans. The atom which replace one or more hydrogens in a hydrocarbon chain such that the valency of carbon remains satisfied is called heteroatom. For example, oxygen, nitrogen, etc.

Q. 2. Generate a homologous series containing the functional group '—COOH' up to four carbons.

Ans. HCOOH, CH_3COOH, C_2H_5COOH, C_3H_7COOH.

Q. 3. Out of naphthalene, camphor and alcohol, which will give sooty flame?

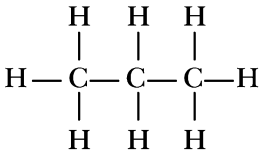
Ans. Naphthalene and camphor are unsaturated compounds so they will give sooty flame.

Q. 4. Draw the electron dot structure of the gas molecule which is liberated when zinc metal is treated with aqueous NaOH solution.

Ans. Hydrogen gas, H:H

Q. 5. Write the number of covalent bonds in the molecule of propane, C_3H_8. *[CBSE (AI) 2015]*

Ans. There are ten covalent bonds:



Q. 6. Which element exhibits the property of catenation to maximum extent and why? *[CBSE (F) 2016]*

Ans. Carbon exhibits the property of catenation due to strong C—C bond.

Q. 7. Write the molecular formula of first two members of homologous series having functional group –Cl. *[CBSE Delhi 2017]*

Ans. (*i*) CH_3Cl (*ii*) C_2H_5Cl

Q. 8. Give the names of the functional groups:

(*i*) —OH **(*ii*) —C(=O)—** *[CBSE (F) 2015]*

Ans. (*i*) Alcoholic group (*ii*) Ketonic group

Q. 9. Write the molecular formula of (*i*) Methane and (*ii*) Ethanol. *[CBSE Delhi (C) 2015]*

Ans. (*i*) CH_4 (*ii*) C_2H_5OH

Q. 10. Which functional groups always occur at the terminal position of a carbon chain?

Ans. Aldehydic group R—CHO and carboxyl group R—COOH (R = alkyl group).

Q. 11. Name the functional group which always occurs in the middle of a carbon chain.

Ans. Ketonic group always occurs in the middle of a carbon chain.

Q. 12. In an organic compound, which parts largely determine its physical and chemical properties?

Ans. The alkyl part (carbon chain) of an organic compound determines its physical properties whereas the functional group determines its chemical properties.

Q. 13. An organic compound 'X' of molecular formula $C_2H_4O_2$ gives brisk effervescence with sodium bicarbonate. Give the name and formula of X.

Ans. 'X' is ethanoic acid (an organic acid). 'X' $\rightarrow CH_3COOH$

$$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + CO_2\uparrow + H_2O$$

Organic acid decomposes sodium bicarbonate and gives brisk effervescence of carbon dioxide gas.

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Q. 14. Why is pure ethanoic acid called glacial ethanoic acid (or glacial acetic acid)?

Ans. The melting point of pure ethanoic acid is 290 K and hence it often freezes in cold climate to form a colourless, ice-like liquid. This has given it the name glacial acetic acid.

Q. 15. What is vinegar?

Ans. A 5–8% solution of acetic acid in water is called vinegar and is used widely as a preservative in pickles.

Q. 16. Which of the following formulae represents a saturated hydrocarbon?

C_nH_{2n+2}, C_nH_{2n+1}, C_nH_{2n}, C_nH_{2n-2}

Ans. C_nH_{2n+2}, represents a saturated hydrocarbon.

Q. 17. Which of the following are alkenes?

CH_4, C_2H_6, C_2H_4, C_3H_6 and C_3H_8.

Ans. C_2H_4 and C_3H_6 are alkenes.

Q. 18. What happens when methane is burnt in air?

Ans. Methane burns in air to give carbon dioxide and water.

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O + \text{Heat energy}$$

Q. 19. A test tube contains a brown coloured liquid. The colour of the liquid in test tube remains unchanged when methane is passed through it, but disappears when ethene is passed. Which element is present in the liquid?

Ans. The element present in the liquid is bromine.

Q. 20. What is the next homologue of C_3H_7OH called?

Ans. The next homologue of C_3H_7OH is called butanol (C_4H_9OH).

Q. 21. Write the name and formula of the 2nd member of homologous series having general formula C_nH_{2n}. *[CBSE Delhi 2015]*

Ans. The 2nd member is propene, C_3H_6.

Q. 22. Write the name and formula of the 2nd member of homologous series having general formula C_nH_{2n+2}. *[CBSE Delhi 2015]*

Ans. The second member is ethane, C_2H_6.

Q. 23. Write the name and formula of the 2nd member of homologous series having general formula C_nH_{2n-2}. *[CBSE Delhi 2015]*

Ans. The 2nd member is propyne, C_3H_4.

Q. 24. Define allotropy. *[CBSE Delhi 2017]*

Ans. Allotropy is the property of an element to exist in different physical forms but have similar chemical properties.

Q. 25. Write the molecular formula of the 2nd and the 3rd member of the homologous series whose first member is methane. *[CBSE (AI) 2017]*

Ans. C_2H_6, C_3H_8

Q. 26. Which two of the following organic compounds belong to the same homologous series?

C_2H_6, C_2H_6O, $C_2H_6O_2$, CH_4O

Ans. CH_4O and C_2H_6O belong to the same homologous series.

Q. 27. Write the name and molecular formula of the first member of the homologous series of alkynes. *[CBSE (F) 2015]*

Ans. The first member is ethyne, C_2H_2.

Q. 28. Write the name and molecular formula of the fourth member of alkane series. *[CBSE (F) 2016]*

Ans. The fourth member of the alkane series is butane C_4H_{10}.

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Q. 29. Write the next homologue of each of the following:

(*i*) C_2H_4 **(*ii*) C_4H_6** [CBSE Delhi 2016]

Ans. (*i*) C_3H_6 (*ii*) C_5H_8

Q. 30. Name the following compounds:

(*i*) $CH_3—CH_2—OH$ **(*ii*) $CH_3—\overset{\overset{O}{\|}}{C}=O$** [CBSE Delhi 2016]

Ans. (*i*) Ethanol (*ii*) Ethanal

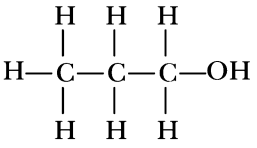
Q. 31. Select saturated hydrocarbons from the following:

C_3H_6; C_5H_{10}; C_4H_{10}; C_6H_{14}; C_2H_4 [CBSE Delhi 2016]

Ans. C_4H_{10} and C_6H_{14} are saturated hydrocarbons.

Q. 32. Write the name and structure of an alcohol with three carbon atoms in its molecule. [CBSE (AI) 2016]

Ans. The compound is propanol.

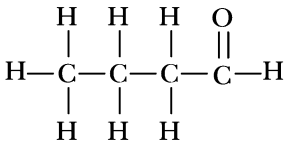


or $CH_3CH_2CH_2OH$

Q. 33. Write the name and structure of an aldehyde with four carbon atoms in its molecule. [CBSE (AI) 2016]

Ans. Butanal; $CH_3—CH_2—CH_2—CHO$

or



Q. 34. Name the process by which unsaturated fats are changed to saturated fats. [CBSE (F) 2015]

Ans. Hydrogenation

Short Answer Questions [3 marks]

Each of the following questions are of 3 marks and have to be answered in about 50 -60 words.

Q. 1. Write any two similarities and differences between cyclohexane and benzene. Also draw their structures.

Ans. Similarities:

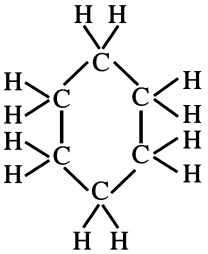
(*i*) Both are cyclic compounds.

(*ii*) Both contain 6 carbon atoms.

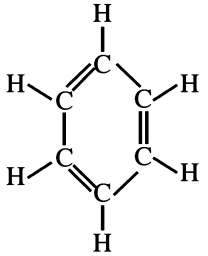
Differences

(*i*) Cyclohexane is a saturated compound whereas benzene is an unsaturated compound.

(*ii*) Cyclohexane is less reactive than benzene as double bond is weaker than single bond.



Cyclohexane



Benzene

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Q. 2. What is a covalent bond? What type of bond exists in (*i*) CCl_4 (*ii*) $CaCl_2$?

Ans. The chemical bonds formed between two atoms by the sharing of electrons between them is known as a covalent bond. The sharing of electrons between the two atoms takes place in such a way that both the atoms acquire stable electronic configuration of their nearest noble gas.

(*i*) CCl_4 – Covalent bond

(*ii*) $CaCl_2$ – Ionic bond

Q. 3. Catenation is the ability of an atom to form bonds with other atoms of the same element. It is exhibited by both carbon and silicon. Compare the ability of catenation of the two elements. Give reasons. *[NCERT Exemplar]*

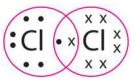
Ans. Carbon exhibits catenation much more than silicon or any other element due to its smaller size which makes the C—C bonds strong while the Si—Si bonds are comparatively weaker due to its large size.

Q. 4. In electron dot structure, the valence shell electrons are represented by crosses or dots.

(*i*) The atomic number of chlorine is 17. Write its electronic configuration.

(*ii*) Draw the electron dot structure of chlorine molecule. *[NCERT Exemplar]*

Ans. (*i*) K, L, M
2, 8, 7

(*ii*) 

Q. 5. Select the hydrocarbons which are members of the same homologous series. Give the name of each series.

C_3H_8, C_4H_{10}, C_5H_{10}, C_6H_{10}, C_7H_{12} and C_8H_{16}.

Ans. C_3H_8, C_4H_{10} → Alkanes

C_5H_{10}, C_8H_{16} → Alkenes

C_6H_{10}, C_7H_{12} → Alkynes

Q. 6. Name the functional groups present in the following compounds

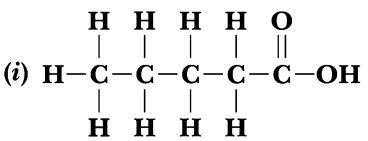
(*i*) $CH_3COCH_2CH_2CH_2CH_3$ **(*ii*) $CH_3CH_2CH_2COOH$**

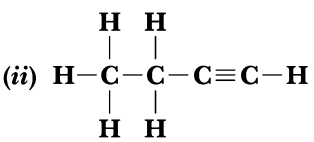
(*iii*) $CH_3CH_2CH_2CH_2CHO$ **(*iv*) CH_3CH_2OH** *[NCERT Exemplar]*

Ans. (*i*) Ketone (*ii*) Carboxylic acid

(*iii*) Aldehyde (*iv*) Alcohol

Q. 7. Write the names of the following compounds.

(*i*)


(*ii*)


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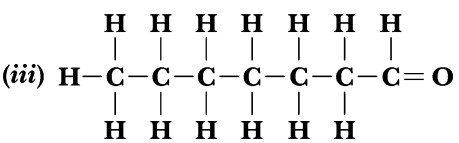

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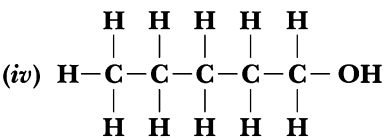

[NCERT Exemplar]

Ans. (*i*) Pentanoic acid (*ii*) Butyne

(*iii*) Heptanal (*iv*) Pentanol

Q. 8. Why are unsaturated hydrocarbons more reactive than saturated hydrocarbons?

Ans. Unsaturated hydrocarbons are more reactive due to the presence of C=C and C ≡ C bonds which are weaker than the single bond in saturated hydrocarbons. These double and triple bonds are the reactive sites in the unsaturated hydrocarbons which easily give addition reactions.

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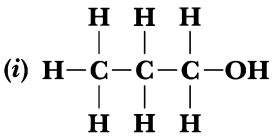
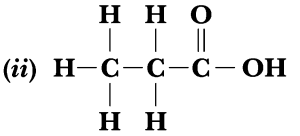
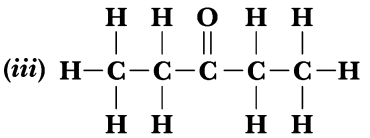
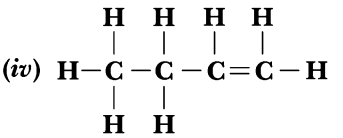
Q. 9. Identify and name the functional groups present in the following compounds.

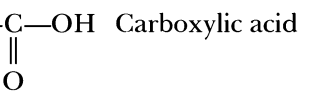
(*i*) 

(*ii*) 

(*iii*) 

(*iv*)  *[NCERT Exemplar]*

Ans. (*i*) —OH Hydroxyl/Alcohol

(*ii*)  Carboxylic acid

(*iii*)  Ketone

(*iv*)  Alkene

Q. 10. Write the name and molecular formula of an organic compound having its name suffixed with '–ol' and having two carbon atoms in the molecule. With the help of a balanced equation indicate what happens when it is heated with excess of conc. H_2SO_4. *[CBSE Sample Paper 2016]*

Ans. The organic compound is ethanol. Its molecular formula is C_2H_6O and structural formula is C_2H_5OH or CH_3CH_2OH.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[\text{Heat}]{\text{conc. } H_2SO_4} \underset{\text{Ethene}}{CH_2{=}CH_2} + H_2O$$

Q. 11. Complete the reaction(s) given below and classify them as Combustion/Oxidation/ Addition/ Substitution reaction.

(*i*) $CH_3CH_2CH_2OH \xrightarrow[\text{Heat}]{\text{alk. } KMnO_4}$ (*ii*) $C_2H_4 + H_2 \xrightarrow{\text{Ni catalyst}}$

Ans. (*i*) CH_3CH_2COOH, Oxidation (*ii*) C_2H_6, Addition.

Q. 12. Carbon, Group (14) element in the Periodic Table, is known to form compounds with many elements. *[NCERT Exemplar]*

Write an example of a compound formed with

(*i*) Chlorine (Group 17 of Periodic Table)

(*ii*) Oxygen (Group 16 of Periodic Table)

Ans. (*i*) Carbon tetrachloride (CCl_4)

(*ii*) Carbon dioxide (CO_2)

Q. 13. Name the gas evolved when ethanoic acid reacts with sodium carbonate. How would you identify this gas?

Ans. The gas evolved is carbon dioxide (CO_2). The reaction is as follows:

$$\underset{\text{Ethanoic acid}}{2CH_3COOH} + \underset{\substack{\text{Sodium}\\\text{carbonate}}}{Na_2CO_3} \longrightarrow \underset{\substack{\text{Sodium}\\\text{ethanoate}}}{2CH_3COONa} + \underset{\substack{\text{Carbon}\\\text{dioxide}}}{CO_2\uparrow} + \underset{\text{Water}}{H_2O}$$

When this gas is passed through lime water, it turns milky. The milky colour of lime water confirms that the gas is carbon dioxide (CO_2).

Q. 14. Write four uses of ethyl alcohol. *[CBSE Sample Paper 2016]*

Ans. (*i*) It is used in the manufacture of paints, medicines, dyes, soaps, etc.

(*ii*) It is used in the preparation of organic compounds like ether, chloroform and iodoform.

(*iii*) It is used as a fuel in internal combustion engines.

(*iv*) It is used in low temperature thermometers.

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Q. 15. Mention the physical properties of ethanoic acid.

Ans. (*i*) It is a colourless liquid. (*ii*) It is sour in taste.
(*iii*) It has a characteristic smell. (*iv*) It is soluble in water.

Q. 16. How will you convert ethanoic acid into methane? Explain with the help of equations of the reactions involved.

Ans. $\underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\substack{\text{Sodium}\\\text{hydroxide}}}{NaOH} \longrightarrow \underset{\text{Sodium ethanoate}}{CH_3COONa} + \underset{\text{Water}}{H_2O}$

Then, sodium ethanoate is heated with sodalime to get methane.

$$\underset{\text{Sodium ethanoate}}{CH_3COONa} + \underset{\substack{\text{Sodium hydroxide}\\\text{(from sodalime)}}}{NaOH} \longrightarrow \underset{\text{Methane}}{CH_4} + \underset{\substack{\text{Sodium}\\\text{carbonate}}}{Na_2CO_3}$$

Q. 17. (*i*) What is meant by denatured alcohol? What is the need to denature alcohol?
(*ii*) Intake of small quantity of methanol can be lethal. Comment. *[NCERT Exemplar]*

Ans. (*i*) Denatured alcohol is ethyl alcohol which has been made unfit for drinking purposes by adding poisonous substances like methanol, pyridine, copper sulphate, etc.

Ethanol is an important chemical. It is supplied at concessional rates to industries. It is therefore, made unfit for drinking purposes to prevent its misuse.

(*ii*) Methanol is oxidised to methanal in the liver. Methanal reacts rapidly with the components of cells. It causes the protoplasm to coagulate. It also affects the optic nerve, causes blindness.

Q. 18. A gas is evolved when ethanol reacts with sodium. Name the gas evolved and also write the balanced chemical equation of the reaction involved. *[NCERT Exemplar]*

Ans. Gas evolved is hydrogen.

$$\underset{\text{Ethanol}}{2CH_3CH_2OH} + 2Na \longrightarrow \underset{\text{Sodium ethoxide}}{2CH_3CH_2O^-Na^+} + H_2\uparrow$$

Q. 19. Why are detergents better cleansing agents than soaps? *[NCERT Exemplar]*

Ans. Detergents work as cleansing agent in hard and soft water both because the charged ends of detergents do not form insoluble precipitates with calcium and magnesium ions in hard water.

Q. 20. Two carbon compounds A and B have the molecular formula C_3H_8 and C_3H_6 respectively. Which one of the two is most likely to show addition reaction? Justify your answer.

Ans. Compound A (C_3H_8) is a saturated and compound B (C_3H_6) is an unsaturated hydrocarbon (with a double bond). As we know that addition reactions are a characteristic property of unsaturated hydrocarbons, thus the compound B (C_3H_6) is most likely to show addition reaction.

Q. 21. How would you bring about the following conversions? Name the process and write the reaction involved.
(*i*) Ethanol to ethene
(*ii*) Propanol to propanoic acid *[NCERT Exemplar, CBSE 2019 (31/5/1))]*

Ans. (*i*) By the dehydration of ethanol in the presence of concentrated H_2SO_4.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[\text{Heat}]{\text{conc. } H_2SO_4} \underset{\text{Ethene}}{CH_2{=}CH_2} + H_2O$$

(*ii*) By the oxidation of propanol using oxidising agent such as alkaline $KMnO_4$.

$$\underset{\text{Propanol}}{CH_3CH_2CH_2OH} \xrightarrow[\text{Heat}]{\text{Alk. } KMnO_4} \underset{\text{Propanoic acid}}{CH_3CH_2COOH} + H_2O$$

Q. 22. Ethene is formed when ethanol at 443 K is heated with excess of concentrated sulphuric acid. What is the role of sulphuric acid in this reaction? Write the balanced chemical equation of this reaction. *[NCERT Exemplar, CBSE Delhi 2015, (F) 2015]*

Ans. Sulphuric acid acts as a dehydrating agent.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[443\text{ K}]{\text{Hot conc. } H_2SO_4} \underset{\text{Ethene}}{CH_2{=}CH_2} + H_2O$$

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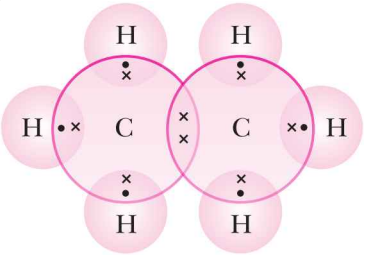
Q. 23. Write the molecular formula of the following compounds and draw their electron-dot structures:
(*i*) Ethane (*ii*) Ethene (*iii*) Ethyne [*CBSE (F) 2015*]

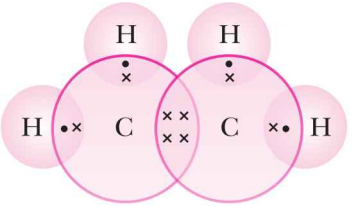
Ans. (*i*) **Ethane:** The molecular formula is C_2H_6.

Electron-dot structure:



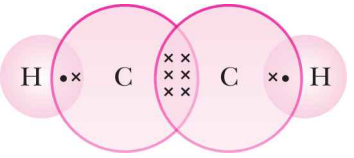
(*ii*) **Ethene:** The molecular formula is C_2H_4.

Electron-dot structure:



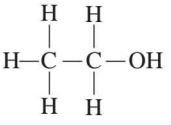
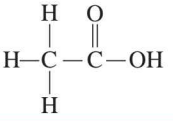
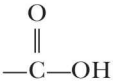
(*iii*) **Ethyne:** The molecular formula is C_2H_2.

Electron-dot structure:



Q. 24. What is meant by functional group in carbon compounds? Write in tabular form the structural formula and the functional group present in the following compounds:
(*i*) Ethanol (*ii*) Ethanoic acid [*CBSE (F) 2015*]

Ans. An atom or a group of atoms which determine the chemical properties of an organic compound is called a functional group.

Name of Compound	Structural Formula	Functional Group
Ethanol		—OH
Ethanoic acid		

Q. 25. Draw the electron-dot structure for ethyne. A mixture of ethyne and oxygen is burnt for welding. In your opinion, why cannot we use a mixture of ethyne and air for this purpose? [*CBSE (AI) 2015*]

Ans. For structure of ethyne, Refer to Q. 23 part (*iii*)

Ethyne burns in air with a sooty flame because of incomplete combustion caused by the limited supply of air. But when burnt at 3000°C in oxygen it gives a clean flame because of complete combustion. This oxy-acetylene flame is used for welding.

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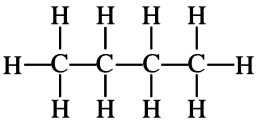
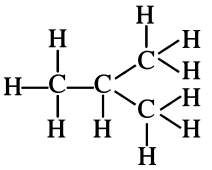
Such a high temperature cannot be achieved without mixing oxygen.
Therefore, a mixture of ethyne and air is not used for welding.

Q. 26. What is meant by isomers? Draw the structures of two isomers of butane, C_4H_{10}. Explain why we cannot have isomers of first three members of alkane series. *[CBSE Delhi 2015]*

Ans. Isomers are compounds having the same molecular formula but different structures.
The two isomers of butane, C_4H_{10} are:





Since branching is not possible, isomers are not possible for the first three members of alkane series.

Q. 27. What is meant by homologous series of carbon compounds? Classify the following carbon compounds into two homologous series and name them.
C_3H_4, C_3H_6, C_4H_6, C_4H_8, C_5H_8, C_5H_{10} *[CBSE (AI) 2015]*

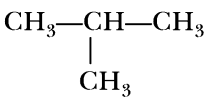
Ans. A group of organic compounds having the same functional group and similar structures in which the successive members differ by CH_2 group is called homologous series.
Alkynes: C_3H_4, C_4H_6, C_5H_8
Alkenes: C_3H_6, C_4H_8, C_5H_{10}

Q. 28. Give an example each of (*i*) open chain (*ii*) branched chain and (*iii*) ring compounds.

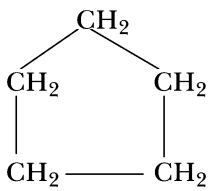
Ans. (*i*) **Open chain compound (*n*-pentane)**



(*ii*) **Branched chain compound (isobutane)**



(*iii*) **Ring (cyclopentane)**



Q. 29. (*i*) How does the supply of air affect combustion of saturated hydrocarbons?
(*ii*) What is indicated by:
(*a*) sooty flame
(*b*) blue flame of a bunsen burner?
(*iii*) Why are holes provided at the bottom of a bunsen burner?

Ans. (*i*) If air supply is not sufficient, saturated hydrocarbons give yellow sooty flame.
(*ii*) (*a*) Yellow sooty flame–Burning of unsaturated hydrocarbons such as ethene and ethyne/ incomplete combustion (any one).
(*b*) Blue flame–Burning of saturated hydrocarbons/complete combustion.
(*iii*) Holes let the supply of air to be adjusted for complete combustion.

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Q. 30. Explain the given reactions with examples:

(*i*) Combustion reaction **(*ii*) Oxidation reaction**

(*iii*) Substitution reaction [*NCERT Exemplar*]

Ans. (*i*) **Combustion reaction:** Carbon compounds burns in oxygen to produce carbon dioxide along with release of large amount of heat and light.

$$\underset{\text{Methane}}{CH_4} + 2O_2 \longrightarrow \underset{\substack{\text{Carbon}\\\text{dioxide}}}{CO_2} + 2H_2O + \text{Heat and light}$$

(*ii*) **Oxidation reaction:** Ethanol is oxidised to ethanoic acid in the presence of alkaline $KMnO_4$ (oxidising agent) on heating.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[\text{Heat}]{\text{Alk. } KMnO_4} \underset{\text{Ethanoic acid}}{CH_3COOH}$$

(*iii*) **Substitution reaction:** In the presence of sunlight, chlorine replaces the hydrogen atom of hydrocarbons.

$$\underset{\text{Methane}}{CH_4} + Cl_2 \xrightarrow{h\nu} \underset{\text{Chloromethane}}{CH_3Cl} + HCl$$

Q. 31. List two tests for experimentally distinguishing between an alcohol and a carboxylic acid and describe how these tests are performed. [*CBSE (AI) 2015*]

Ans. (*i*) **Test with $NaHCO_3$ solution in water.**

On adding carboxylic acid to baking soda, carbon dioxide is liberated with brisk effervescence.

On adding a solution of baking soda to alcohol, no brisk effervescence occurs.

(*ii*) **Test with blue litmus solution.**

Carboxylic acid turns blue litmus red.

There is no change in colour when a blue litmus solution is added to alcohol.

Q. 32. Write physical properties of ethanol.

Ans. Physical properties of ethanol are:

(*i*) Ethanol is a colourless liquid having a pleasant smell and a burning taste.

(*ii*) Ethanol is a liquid at room temperature.

(*iii*) Ethanol is lighter than air.

(*iv*) Ethanol is miscible with water.

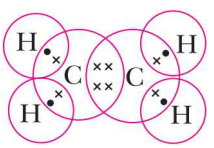
(*v*) Ethanol is a covalent compound.

(*vi*) Ethanol has no effect on litmus solution.

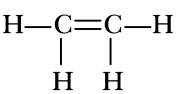
Q. 33. Write molecular, electronic and structural formulae of ethene. [*CBSE 2019 (31/2/1)*]

Ans. Molecular formula: C_2H_4

Electronic formula:



Structural formula:



Q. 34. What is a homologous series of carbon compounds ? List its any two characteristics. Write the name and formula of next higher homologous of HCOOH.

[*CBSE 2019 (31/2/1), CBSE Delhi (C) 2017*]

Ans. (*i*) A series of compounds in which the same functional group substitutes for hydrogen in a carbon chain is called homologous series.

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Characteristics of homologous series:

(*a*) The molecular formulae of any two successive members of a homologous series differ by $—CH_2$.

(*b*) There is a regular gradation in physical properties of members of a homologous series.

(*ii*) The name of next homologous of HCOOH is ethanoic acid. Its formula is CH_3COOH.

Q. 35. Two carbon compounds X and Y have the molecular formula C_4H_8 and C_5H_{12} respectively. Which one of these is most likely to show addition reaction? Justify your answer. Also give the chemical equation to explain the process of addition reaction in this case. [*CBSE Delhi* 2017]

Ans. C_4H_8 will show addition reaction because it is an unsaturated hydrocarbon due to the presence of a double bond.

$$\underset{\text{Butene}}{C_4H_8} + H_2 \xrightarrow{Ni/Pd} \underset{\text{Butane}}{C_4H_{10}}$$

Q. 36. Complete the following chemical equations : [*CBSE Delhi* 2017]

(*i*) $CH_3COOH + Na_2CO_3 \longrightarrow$ (*ii*) $CH_4 + O_2 \longrightarrow$

(*iii*) $C_2H_5OH + Na \longrightarrow$

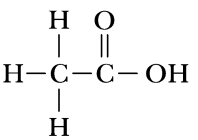
Ans. (*i*) $\underset{\text{Ethanoic acid}}{2CH_3COOH} + Na_2CO_3 \longrightarrow \underset{\text{Sodium ethanoate}}{2CH_3COONa} + H_2O + CO_2\uparrow$

(*ii*) $\underset{\text{Methane}}{CH_4} + 2O_2 \longrightarrow \underset{\text{Carbon dioxide}}{CO_2\uparrow} + 2H_2O$

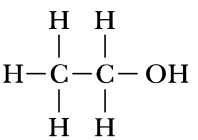
(*iii*) $\underset{\text{Ethanol}}{2C_2H_5OH} + 2Na \longrightarrow \underset{\text{Sodium ethoxide}}{2C_2H_5ONa} + H_2\uparrow$

Q. 37. A compound X is formed by the reaction of a carboxylic acid $C_2H_4O_2$ and an alcohol in presence of a few drops of H_2SO_4. The alcohol on oxidation with alkaline $KMnO_4$ followed by acidification gives the same carboxylic acid as used in this reaction. Give the names and structures of (*i*) carboxylic acid, (*ii*) alcohol and (*iii*) the compound X. Also write the reaction. [*NCERT Exemplar*]

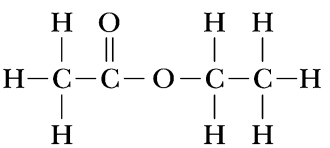
Ans. (*i*) Carboxylic acid is ethanoic acid



(*ii*) Alcohol is ethanol



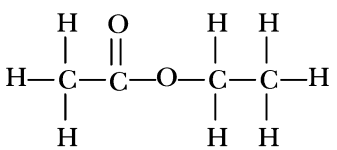
(*iii*) X is ethyl ethanoate



$$\underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow{H_2SO_4} \underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} + H_2O$$

Q. 38. An ester has the molecular formula $C_4H_8O_2$. Write its structural formula. What happens when this ester is heated in the presence of sodium hydroxide solution? Write the balanced chemical equation for the reaction and name the products. What is a saponification reaction?

Ans. Structural formula:



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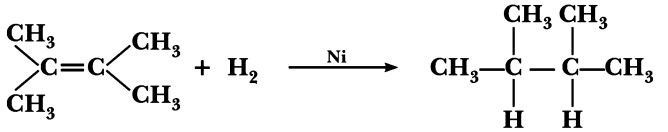
When this ester is heated in the presence of sodium hydroxide solution, it changes into an alcohol and sodium salt of carboxylic acid.

$$\underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} \xrightarrow{NaOH} CH_3COONa + C_2H_5OH$$

Products: Ethanol and sodium ethanoate

Saponification: Reaction of an ester with a base to give an alcohol and sodium salt of carboxylic acid. This reaction is known as saponification because it is used in the preparation of soap.

Q. 39. What is the role of metal or reagents written on arrows in the given chemical reactions?

(*i*) 

(*ii*) $\mathbf{CH_3COOH + CH_3CH_2OH \xrightarrow{Conc.\ H_2SO_4} CH_3COOC_2H_5 + H_2O}$

(*iii*) $\mathbf{CH_3CH_2OH \xrightarrow[Heat]{Alk.\ KMnO_4} CH_3COOH}$ [*NCERT Exemplar*]

Ans. (*i*) Ni acts as a catalyst.

(*ii*) Concentrated H_2SO_4 acts as a catalyst and as a dehydrating agent.

(*iii*) Alkaline $KMnO_4$ acts as an oxidising agent.

Q. 40. Name two oxidising agents that are used for the conversion of alcohols to acids. Distinguish between ethanol and ethanoic acid on the basis of (*i*) litmus test, and (*ii*) reaction with sodium hydrogen carbonate. [*CBSE (F) 2017*]

Ans. The two oxidising agents are alkaline $KMnO_4$ and acidified $K_2Cr_2O_7$.

(*i*) Ethanol does not affect litmus paper whereas ethanoic acid turns blue litmus red.

(*ii*) Ethanol does not react with $NaHCO_3$ whereas ethanoic acid gives brisk effervesence with the evolution of colourless gas, CO_2.

$$\underset{\text{Ethanoic acid}}{CH_3COOH} + NaHCO_3 \longrightarrow \underset{\text{Sodium ethanoate}}{CH_3COONa} + H_2O + CO_2$$

Q. 41. Write chemical equation of the reaction of ethanoic acid with the following: (*i*) Sodium; (*ii*) Sodium hydroxide; (*iii*) Ethanol.

Write the name of one main product of each reaction. [*CBSE (AI) 2016*]

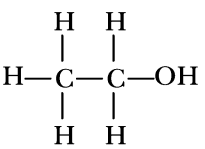
Ans. (*i*) $\underset{\text{Ethanoic acid}}{2CH_3COOH} + 2Na \longrightarrow \underset{\substack{\text{Sodium ethanoate/}\\ \text{Sodium acetate}}}{2CH_3COONa} + H_2$

(*ii*) $CH_3COOH + NaOH \longrightarrow \underset{\substack{\text{Sodium ethanoate/}\\ \text{Sodium acetate}}}{CH_3COONa} + H_2O$

(*iii*) $CH_3COOH + C_2H_5OH \longrightarrow \underset{\text{Ethyl ethanoate/ester}}{CH_3COOC_2H_5} + H_2O$

Q. 42. Write the structural formula of ethanol. What happens when it is heated with excess of conc. H_2SO_4 at 443 K? Write the chemical equation for the reaction stating the role of conc. H_2SO_4 in this reaction. [*CBSE (AI) 2017*]

Ans. Structural formula of ethanol :



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When ethanol is heated with excess of conc. H_2SO_4 at 443K, ethene is formed.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[443\,K]{\text{Conc. } H_2SO_4} \underset{\text{Ethene}}{C_2H_4} + H_2O$$

Conc. H_2SO_4 acts as a dehydrating agent.

Q. 43. Complete the following chemical equations : *[CBSE Delhi 2017]*

(*i*) $CH_3COOC_2H_5 + NaOH \longrightarrow$

(*ii*) $CH_3COOH + NaOH \longrightarrow$

(*iii*) $C_2H_5OH + CH_3COOH \xrightarrow{\text{Conc. } H_2SO_4}$

Ans. (*i*) $\underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} + NaOH \longrightarrow \underset{\text{Sodium ethanoate}}{CH_3COONa} + \underset{\text{Ethanol}}{C_2H_5OH}$

(*ii*) $\underset{\text{Ethanoic acid}}{CH_3COOH} + NaOH \longrightarrow \underset{\text{Sodium ethanoate}}{CH_3COONa} + H_2O$

(*iii*) $\underset{\text{Ethanol}}{C_2H_5OH} + \underset{\text{Ethanoic acid}}{CH_3COOH} \longrightarrow \underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} + H_2O$

Q. 44. When ethanol reacts with ethanoic acid in the presence of conc. H_2SO_4, a substance with fruity smell is produced. Answer the following:

(*i*) State the class of compounds to which the fruity smelling compounds belong. Write the chemical equation for the reaction and write the chemical name of the product formed.

(*ii*) State the role of conc. H_2SO_4 in this reaction. *[CBSE Delhi 2016]*

Ans. (*i*) The fruity smelling compounds are esters.

Chemical equation:

$$\underset{\text{Ethanoic acid}}{CH_3-\overset{\overset{O}{\|}}{C}-OH} + \underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow{\text{Conc. } H_2SO_4} CH_3-\overset{\overset{O}{\|}}{C}-O-CH_2-CH_3 + H_2O$$

Product's chemical name: Ethyl ethanoate.

(*ii*) Conc. H_2SO_4 acts as a dehydrating agent.

Q. 45. Distinguish between esterification and saponification reactions with the help of the chemical equations for each. State one use of each (*i*) esters, and (*ii*) saponification process.

[CBSE (AI) 2017, CBSE 2019 (31/2/1)]

Ans. Esterification: A process in which an alcohol and a carboxylic acid react in the presence of conc. H_2SO_4 to form an ester.

$$\underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow{\text{Conc. } H_2SO_4} \underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} + H_2O$$

Saponification: A process in which an ester reacts with sodium hydroxide to form sodium salt of an acid and alcohol.

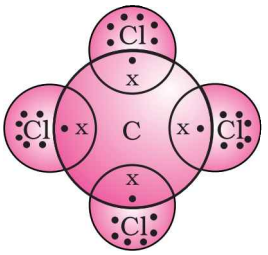
$$CH_3COOC_2H_5 + NaOH \longrightarrow \underset{\text{Sodium ethanoate}}{CH_3COONa} + C_2H_5OH$$

(*i*) Esters are used in ice creams and perfumes.

(*ii*) Saponification process is used in the preparation of soap.

Q. 46. Write the formula and draw electron dot structure of carbon tetrachloride.

Ans. CCl_4



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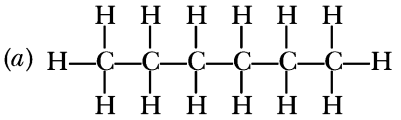
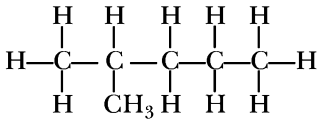
Q. 47. Write the structural formulae of all the isomers of hexane. *[NCERT Exemplar]*

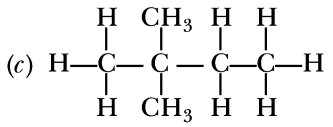
Ans. (*a*)



(*b*)



(*c*)



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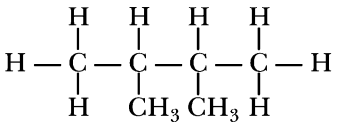
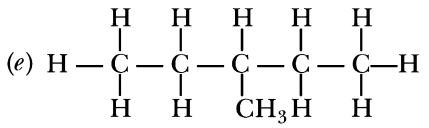


(*e*)



Q. 48. Explain esterification reaction with the help of a chemical equation. Describe an activity to show esterification. *[CBSE 2019 (31/3/1), CBSE (AI) 2017]*

Ans. Esterification : Refer to Q. 45, page-112.

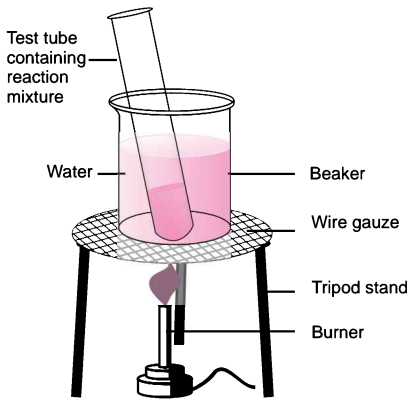
Activity

(*i*) Take 1 ml of ethanol mixed with 1 ml of acetic acid along with few drops of conc. H_2SO_4 in a test tube.

(*ii*) Warm it for 5 minutes in a water bath.

(*iii*) Pour the contents in a beaker containing 20 – 50 mL of water and smell the resulting mixture.

(*iv*) It will give a fruity smell indicating the formation of an ester.



Formation of ester

Long Answer Questions [5 marks]

Each of the following questions are of 5 marks and have to be answered in about 80-90 words.

Q. 1. What is the difference between soaps and detergents? State in brief the cleansing action of soaps in removing an oily spot from a fabric. Why are soaps not very effective when a fabric is washed in hard water? How is this problem resolved? *[CBSE 2019 (31/4/1)]*

Ans. Soaps are sodium or potassium salts of long-chain carboxylic acids. Detergents are generally ammonium or sulphonate salts of long chain carboxylic acids.

Cleansing action of soaps:

A soap molecule contains a hydrophilic polar end ($COO^- Na^+$) and a hydrophobic non-polar carbon chain. The hydrophobic part is soluble in oil whereas hydrophilic part is soluble in water. The non-polar end gets attached to oily or greasy particle on the cloth and the polar end remains in the water. This results in the formation of cluster. When the cloth is agitated, the grease or dirt gets removed along with the soap molecules.

Soaps do not form lather in hard water because hard water contains calcium and magnesium salts. Soap molecules react with calcium and magnesium salts to form an insoluble precipitate called scum.

This problem is resolved by using detergents. The charged ends of detergents do not form insoluble precipitates with the calcium and magnesium ions present in hard water. Thus, they remain effective in hard water.

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Q. 2. Write the chemical formula and name of the compound which is the active ingredient of all alcoholic drinks. List its two uses. Write chemical equation and name of the product formed when this compound reacts with [CBSE 2019 (31/1/1)]

(i) sodium metal

(ii) hot concentrated sulphuric acid

Ans. The chemical name of the compound is ethanol. Its chemical formula is CH_3CH_2OH.

Uses:

1. It is used in medicines as a solvent.
2. It is used in paints, vanishes, etc.

(i) The product formed is sodium ethoxide and hydrogen gas.

$$\underset{\text{Ethanol}}{2C_2H_5OH} + 2Na \longrightarrow \underset{\text{Sodium ethoxide}}{2C_2H_5ONa} + H_2\uparrow$$

(ii) The product formed is ethene.

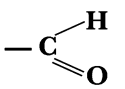
$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[\text{Heat}]{\text{conc. } H_2SO_4} \underset{\text{Ethene}}{CH_2{=}CH_2} + H_2O$$

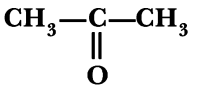
Q. 3. (i) What is a hydrocarbon? Give its one example.

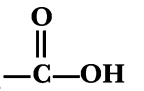
(ii) Give the structural difference between saturated and unsaturated hydrocarbons with two examples each. [CBSE 2019 (31/3/3)]

(iii) Name the following compounds:

(a) $CH_3—OH$

(b) 

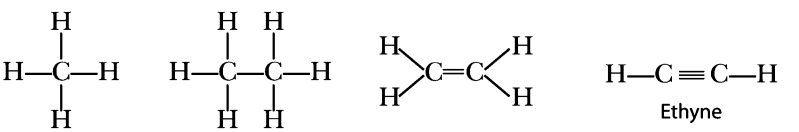
(c) 

(d) 

Ans. (i) Compounds of carbon and hydrogen are called hydrocarbons. For example, methane, ethane, etc.

(ii) Saturated hydrocarbons contain carbon-carbon single bonds.

Unsaturated hydrocarbons contain at least one carbon-carbon double or triple bond.



(iii) (a) Methanol (b) Ethanal

(c) Propanone (d) Ethanoic acid

Q. 4. Why are certain compounds called hydrocarbons ? Write the general formula for homologous series of alkanes, alkenes and alkynes and also draw the structure of the first member of each series. Write the name of the reaction that converts alkenes into alkanes and also write a chemical equation to show the necessary conditions for the reaction to occur. [CBSE (AI) 2017]

Ans. Hydrocarbons are the compounds of hydrogen and carbon.

General formula for homologous series of:

Alkanes – C_nH_{2n+2}

Alkenes – C_nH_{2n}

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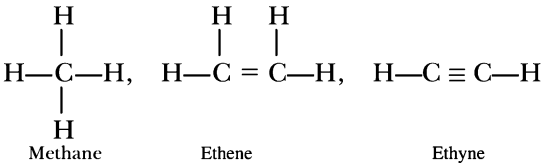
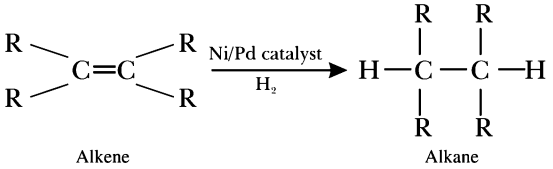
Alkynes – C_nH_{2n-2}



Addition reaction or hydrogenation converts alkenes into alkanes.



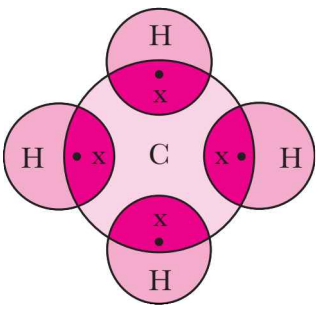
Q. 5. What is methane? Draw its electron dot structure. Name the type of bonds formed in this compound. Why are such compounds: [*CBSE 2019 (31/1/1)*]

(*i*) Poor conductors of electricity? and

(*ii*) Have low melting and boiling points? What happens when this compound burns in oxygen?

Ans. Methane is a carbon compound which is widely used as a fuel and is a major component of Compressed Natural Gas (CNG) and biogas. Its formula is CH_4.

Electron dot structure of methane:



The type of bonds formed in methane is covalent bond.

(*i*) The bond is formed by sharing of electrons so no charged particles are formed. As no charged particles are present to conduct electric current, they are poor conductors of electricity.

(*ii*) Covalently bonded molecules have weak intermolecular forces of attraction. So, they have low melting and boiling points.

When methane burns in oxygen, carbon dioxide and water are produced along with the release of large amount of heat and light.

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O + \text{Heat and light}$$

Q. 6. Explain why carbon forms compounds mainly by covalent bond. Explain in brief two main reasons for carbon forming a large number of compounds. Why does carbon form strong bonds with most other elements? [*CBSE Delhi* 2015]

Ans. Carbon has 4 electrons in its outermost shell, and needs to gain or lose 4 electrons to attain noble gas configuration. Losing or gaining 4 electrons is not possible due to energy considerations, hence it shares electrons to form covalent bonds.

Two reasons for large number of carbon compounds:

(*i*) **Catenation:** The unique ability of carbon to form bonds with other atoms of carbon giving rise to long chains of different types of compounds.

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(*ii*) **Tetravalency:** Since carbon has a valency of 4, it is capable of bonding with four other atoms of carbon or atoms of elements like oxygen, hydrogen, nitrogen, sulphur, chlorine, etc.

Carbon forms strong bonds with most other elements because of its small size which enables the nucleus to hold on to the shared pairs of electrons strongly.

Q. 7. What are esters ? How are esters prepared ? Write the chemical equation for the reaction involved. What happens when an ester reacts with sodium hydroxide ? Write the chemical equation for the reaction and also state the name and use of this reaction. *[CBSE (F) 2017]*

Ans. Esters are pleasant smelling organic compounds. They are formed by the reaction of carboxylic acids and alcohols in the presence of acid.

$$\underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow{\text{acid}} \underset{\text{Ethyl ethanoate (Ester)}}{CH_3COOC_2H_5} + H_2O$$

When an ester reacts with sodium hydroxide, sodium salt of acid is formed.

$$CH_3COOC_2H_5 + NaOH \longrightarrow CH_3COONa + C_2H_5OH$$

Name of the reaction is saponification. It is used in the preparation of soap.

Q. 8. A compound C (molecular formula, $C_2H_4O_2$) reacts with Na-metal to form a compound R and evolves a gas which burns with a pop sound. Compound C on treatment with an alcohol A in presence of an acid forms a sweet smelling compound S (molecular formula $C_3H_6O_2$). On addition of NaOH to C, it also gives R and water. S on treatment with NaOH solution gives back R and A.

Identify C, R, A, S and write down the reactions involved. *[NCERT Exemplar]*

Ans. C — Ethanoic acid

R — Sodium salt of ethanoic acid (sodium acetate) and gas evolved is hydrogen

A — Methanol

S — Ester (Methyl acetate)

(*i*) $\underset{(C)}{2CH_3COOH} + 2Na \longrightarrow \underset{(R)}{2CH_3COONa} + H_2$

(*ii*) $\underset{(C)}{CH_3COOH} + \underset{(A)}{CH_3OH} \xrightarrow{\text{conc. } H_2SO_4} \underset{(S)}{CH_3COOCH_3} + H_2O$

(*iii*) $\underset{(C)}{CH_3COOH} + NaOH \xrightarrow{\text{conc. } H_2SO_4} \underset{(R)}{CH_3COONa} + H_2O$

(*iv*) $\underset{(S)}{CH_3COOCH_3} + NaOH \longrightarrow \underset{(R)}{CH_3COONa} + \underset{(A)}{CH_3OH}$

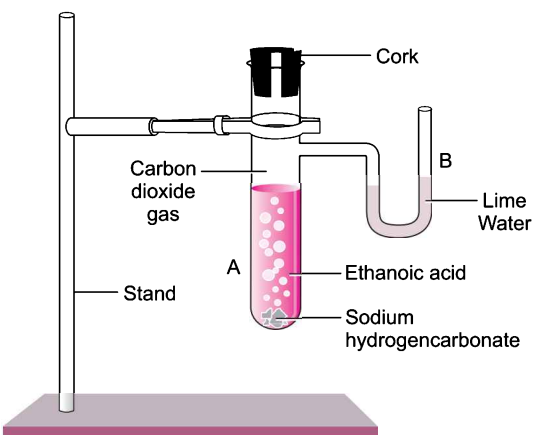
Q. 9. Look at the figure and answer the following questions:

(*i*) What change would you observe in the calcium hydroxide solution taken in tube B?

(*ii*) Write the reaction involved in A and B respectively.

(*iii*) If ethanol is given instead of ethanoic acid, would you expect the same change?

(*iv*) How can a solution of lime water be prepared in the laboratory? *[NCERT Exemplar]*



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Ans. (*i*) It will turn milky.

(*ii*) $CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + H_2O + CO_2\uparrow$ (in A)

$Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$ (in B)

With excess CO_2, milkiness disappears.

(*iii*) As C_2H_5OH and $NaHCO_3$ do not react, a similar change is not expected

$C_2H_5OH + NaHCO_3 \longrightarrow$ No change

(*iv*) The lime water is prepared by dissolving calcium oxide in water and decanting the supernatant liquid.

Q. 10. (*i*) Write a chemical equation of each of the following types of chemical reactions of organic compounds. [*CBSE Delhi (C)* 2017]

(*a*) Oxidation reaction **(*b*) Addition reaction**

(*c*) Substitution reaction

(*ii*) What is ethanol ? What happens when it is heated with excess conc. H_2SO_4 at 443 K? Write the role of conc. H_2SO_4 in this reaction.

Ans. (*i*) (*a*) $\underset{\text{Ethanol}}{CH_3-CH_2OH} \xrightarrow[\text{Or acidified } K_2Cr_2O_7 + \text{Heat}]{\text{Alkaline } KMnO_4 + \text{Heat}} \underset{\text{Ethanoic acid}}{CH_3COOH}$

(*b*) $H_2C=CH_2 \xrightarrow[H_2]{Ni/Pd} H_3C-CH_3$

Ethene — Ethane

(*c*) $\underset{\text{Methane}}{CH_4} + Cl_2 \xrightarrow{\text{Sunlight}} \underset{\text{Chloromethane}}{CH_3Cl} + HCl$

(*ii*) Ethanol is an alcohol having two carbon atoms in its molecule. Its chemical formula is C_2H_5OH.

When ethanol is heated with excess conc. H_2SO_4 at 443K, ethene is formed

$$\underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow[\text{Heat}]{\text{Conc.}H_2SO_4} \underset{\text{Ethene}}{CH_2=CH_2} + H_2O$$

Conc. H_2SO_4 acts as a dehydrating agent.

Q. 11. A salt X is formed and a gas is evolved when ethanoic acid reacts with sodium hydrogen-carbonate. Name the salt X and the gas evolved. Describe an activity and draw the diagram of the apparatus to prove that the evolved gas is the one which you have named. Also, write chemical equation of the reaction involved. [*NCERT Exemplar*]

Ans. X is sodium ethanoate.

Gas evolved is carbon dioxide.

Activity:

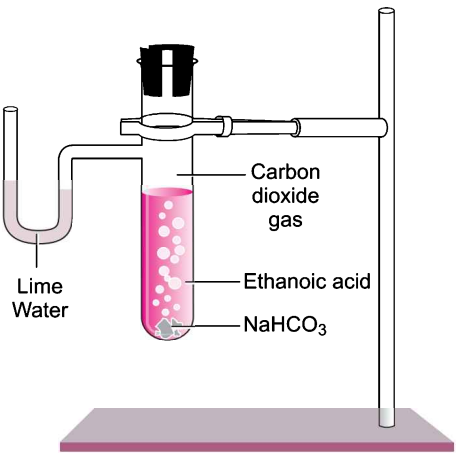
(*i*) Set up the apparatus as shown in the figure.

(*ii*) Take a spatula, full of sodium hydrogen carbonate in a test tube and add 2 mL of dilute ethanoic acid.

(*iii*) We observe that brisk effervescence of a gas is produced in the test tube.

(*iv*) Now pass the gas produced through freshly prepared lime water.

It is observed that lime water turns milky. Only carbon dioxide gas can turn lime water milky. So,



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this activity proves that when ethanoic acid reacts with sodium hydrogencarbonate, then carbon dioxide is evolved.

$$CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + H_2O + CO_2\uparrow$$

Q. 12. (*i*) Give a chemical test to distinguish between saturated and unsaturated hydrocarbons.

(*ii*) Name the products formed when ethane burns in air. Write the balanced chemical equation for the reaction showing the types of energies liberated.

(*iii*) Why is reaction between methane and chlorine in the presence of sunlight considered a substitution reaction? *[CBSE Delhi 2016]*

Ans. (*i*) Br_2-water test: Br_2-water is a brown coloured liquid.

Unsaturated hydrocarbons give addition reaction with Br_2, so the colour of Br_2-water gets decolourised.

Saturated hydrocarbons do not react with Br_2-water, so the colour of Br_2-water does not get decolourised.

(*ii*) On burning ethane in air, the products obtained are carbon dioxide and water, along with heat and light.

$$2C_2H_6(g) + 7O_2(g) \longrightarrow 4CO_2(g) + 6H_2O(l) + \text{Heat} + \text{Light}$$

(*iii*) Methane reacts with chlorine in the presence of sunlight to form chloromethane and hydrogen chloride.

$$\underset{\text{Methane}}{CH_4} + \underset{\text{Chlorine}}{Cl_2} \xrightarrow{\text{Sunlight}} \underset{\text{Chloromethane}}{CH_3Cl} + \underset{\text{Hydrogen chloride}}{HCl}$$

With the excess of chlorine, all the four hydrogen atoms of methane are replaced by chlorine atoms to form carbon tetrachloride (CCl_4). This reaction is considered as substitution reaction because hydrogen of methane is substituted by chlorine.

Q. 13. (*i*) State the reason why carbon can neither form C^{4+} cation nor C^{4-} anions, but forms covalent bonds. Also state reasons to explain why covalent compounds

(*a*) are bad conductors of electricity.

(*b*) have low melting and boiling points.

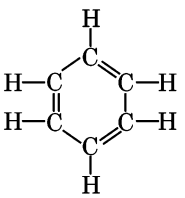
(*ii*) Write the structural formula of benzene, C_6H_6. *[CBSE 2019 (31/5/1)]*

Ans. (*i*) Carbon has 4 electrons in its outermost shell. It cannot lose 4 electrons to form C^{4+} cation because very high energy is required to remove 4 electrons leaving behind a carbon cation with 6 protons in its nucleus holding onto just 2 electrons. It also cannot gain 4 electrons to form C^{4-} anion because it is difficult for 6 protons to hold onto 10 electrons.

(*a*) Since the electrons are shared, there are no charged particles in carbon compounds and hence they are poor conductors of electricity.

(*b*) The molecules in covalent compounds are held by weak van der Waal's forces, hence they have low melting points and boiling points.

(*ii*)



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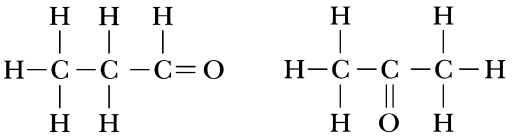
HOTS [Higher Order Thinking Skills]

Q. 1. Two compounds have same molecular formula C_3H_6O. Write the name of these compounds and their structural formula. *[CBSE 2019 (31/5/1)]*

Ans. Propanal (aldehyde); Propanone (ketone);



These two compounds are called isomers *i.e.*, compounds having same molecular formula but different structural formula.

Q. 2. An organic acid 'X' is a liquid which often freezes during winter time in cold countries, has the molecular formula $C_2H_4O_2$. On warming it with ethanol in the presence of a few drops of conc. H_2SO_4, a compound 'Y' with a sweet smell is formed.

(*i*) Identify 'X' and 'Y'.

(*ii*) Write chemical equation for the reaction involved.

Ans. (*i*) X = Ethanoic acid (CH_3COOH)

Y = Ethyl ethanoate ($CH_3COOC_2H_5$)

(*ii*) $\underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow[\Delta]{\text{Conc. } H_2SO_4} \underset{\text{Ethyl ethanoate}}{CH_3COOC_2H_5} + H_2O$

Q. 3. Give reasons for the following observations:

(*i*) Air holes of a gas burner have to be adjusted when the heated vessels get blackened by the flame.

(*ii*) Use of synthetic detergents causes pollution of water.

Ans. (*i*) We need to adjust air holes of gas burner so that sufficient oxygen-rich mixture is burnt to give a clean blue flame for complete combustion.

(*ii*) Synthetic detergents are generally non-biodegradable, that is, they are not decomposed by microorganisms like bacteria. Hence, use of synthetic detergents causes water pollution in lakes and rivers.

Q. 4. An organic compound 'A' is a constituent of wine and beer and is also used as fuel in spirit lamp. Compound 'A' on heating with alkaline potassium permanganate gives another compound 'B' which turns blue litmus to red. Compound 'A' and 'B' combine in the presence of conc. H_2SO_4 to give a sweet smelling compound 'C'. Identify compounds 'A', 'B' and 'C'. Also write the equations involved in the reaction.

Ans. As compound 'A' is a constituent of wine and beer and is used in spirit lamp it is ethanol.

$$\underset{\text{A(Ethanol)}}{CH_3CH_2OH} \xrightarrow[\text{Heat}]{\text{Alk. } KMnO_4} \underset{\substack{\text{B(Ethanoic acid)}\\ \text{Turns blue litmus red}}}{CH_3COOH}$$

$$A + B \xrightarrow{\text{conc. } H_2SO_4} C$$

$$CH_3CH_2OH + CH_3COOH \xrightarrow{\text{conc. } H_2SO_4} \underset{\substack{\text{Ethyl ethanoate}\\ \text{(Ester)}}}{CH_3COOCH_2CH_3} + H_2O$$

Q. 5. An element of group 14 has two common allotropes, A and B. A is very hard and is bad conductor of electricity while B is soft to touch and good conductor of electricity. Identify the element and its allotropes. Explain reasons for their different properties.

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Ans. The element is carbon and the two allotropes are diamond and graphite. Diamond has three-dimensional rigid structure and does not have any free electrons. Hence, it is hard and bad conductor of electricity. Graphite forms hexagonal sheet-like structure and one valency (one electron) with carbon is free. Hence, graphite is soft and a good conductor of electricity.

Q. 6. An organic compound A on heating with concentrated H_2SO_4 forms a compound B which on addition of one mole of hydrogen in presence of Ni forms a compound C. One mole of compound C on combustion forms two moles of CO_2 and 3 moles of H_2O. Identify the compounds A, B and C and write the chemical equations of the reactions involved.

[NCERT Exemplar]

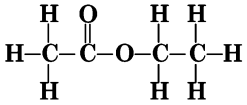
Ans. Since compound C gives 2 moles of CO_2 and 3 moles of H_2O, it shows that it has the molecular formula C_2H_6 (Ethane). C is obtained by the addition of one mole of hydrogen to compound B so the molecular formula of B should be C_2H_4(Ethene). Compound B is obtained by heating compound A with concentrated H_2SO_4 which shows it to be an alcohol. So compound A could be C_2H_5OH (Ethanol).

$$\underset{A}{C_2H_5OH} \xrightarrow{\text{Hot conc. } H_2SO_4} \underset{B}{C_2H_4} + H_2O$$

$$\underset{B}{C_2H_4} + H_2 \xrightarrow{Ni} \underset{C}{C_2H_6}$$

$$2\underset{C}{C_2H_6} + 7O_2 \longrightarrow 4CO_2 + 6H_2O + \text{Heat and light}$$

Q. 7. The structural formula of an ester is:



Write the molecular formula of alcohol and acid from which it would have been formed.

Ans. Alcohol $\longrightarrow$ CH_3CH_2OH/C_2H_5OH

Carboxylic acid $\longrightarrow$ CH_3COOH

Q. 8. An organic compound A of molecular formula C_2H_6O on heating with excess of conc. H_2SO_4 gives compound B of molecular formula C_2H_4. Compound B on reduction gives compound C of molecular formula C_2H_6.

(*i*) Name A, B and C.

(*ii*) Write chemical equation for the conversion of A to B.

(*iii*) What is the role of conc. H_2SO_4 in the above equation?

Ans. (*i*) A – Ethanol, B – Ethene, C – Ethane

(*ii*) $CH_3CH_2OH \xrightarrow[\text{Heat}]{\text{conc. } H_2SO_4} CH_2{=}CH_2 + H_2O$

(*iii*) Conc. H_2SO_4 acts as a dehydrating agent.

Q. 9. An organic compound 'A' of molecular formula C_2H_6O on oxidation with dilute alkaline $KMnO_4$ solution gives an acid 'B' with the same number of carbon atoms. Compound 'A' is often used for sterilisation of skin by doctors.

(*i*) Name the compounds 'A' and 'B'.

(*ii*) Write the chemical equation involved in the formation of 'B' from 'A'.

Ans. (*i*) Compound A – Ethanol (ethyl alcohol)

Compound B – Ethanoic acid (acetic acid)

(*ii*) $C_2H_5OH \xrightarrow{\text{Alk. } KMnO_4} CH_3COOH$

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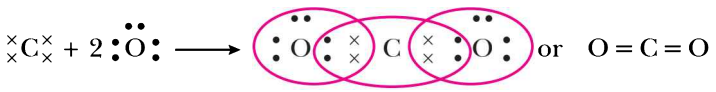
NCERT Corner

NCERT Intext Questions

Q. 1. What would be the electron dot structure of carbon dioxide which has the formula CO_2? *[CBSE 2019 (31/2/2)]*

Ans. In carbon dioxide molecule, the two oxygen atoms are bonded on either side with carbon atom by double bonds. Thus, there are 2 double bonds in CO_2.

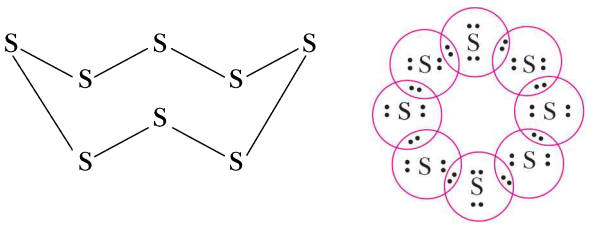
Carbon shares its two electrons in the formation of a double bond with one oxygen atom and another two electrons with another oxygen atom. In this process, both the oxygen atoms and the carbon atom acquire the stable electronic configuration of the noble gas neon. The formation of CO_2 molecule is shown below:



Valencies of C and O are 4 and 2 respectively.

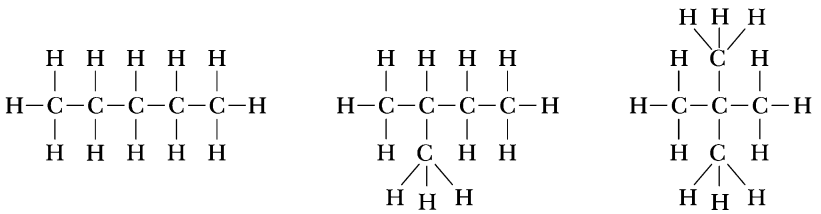
Q. 2. What would be the electron dot structure of a molecule of sulphur which is made up of eight atoms of sulphur? *[CBSE 2019 (31/2/2)]*

Ans. The eight atoms of sulphur are joined together in the form of a ring.



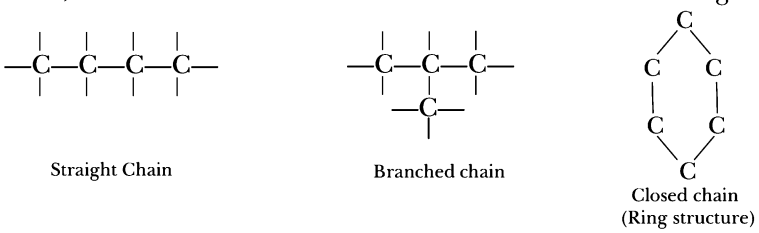
Q. 3. How many structural isomers can you draw for pentane?

Ans. The five carbon atoms in pentane, C_5H_{12} can be arranged in three different ways to give three structural isomers:



Q. 4. What are the two properties of carbon which lead to the huge number of carbon compounds we see around us? *[CBSE 2019 (31/2/2)]*

Ans. (*i*) **Catenation:** Carbon has the unique ability to form bonds with other atoms of carbon, giving rise to large molecules. This property is called catenation. These compounds may have long chains of carbon, branched chains of carbon or even carbon atoms arranged in rings.



In addition, carbon atoms may be linked by single, double or triple bonds.

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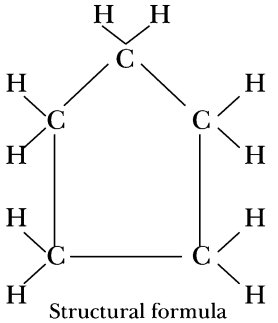
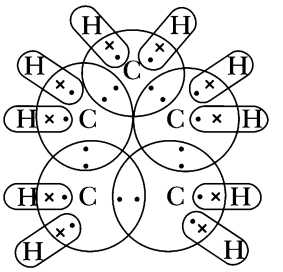
(*ii*) **Tetravalency:** Since carbon has a valency of four, it is capable of bonding with four other atoms of carbon or atoms of some other monovalent elements. In order to satisfy its tetravalency, carbon can form double or triple bonds with other C-atoms or with oxygen, nitrogen also. Compounds of carbon are formed with oxygen, hydrogen, nitrogen, sulphur, chlorine and many other elements giving rise to compounds with specific properties which depend on the elements other than carbon present in the molecule.

Q. 5. What will be the formula and electron dot structure of cyclopentane?

Ans. The molecular formula of cyclopentane is C_5H_{10}. Five carbon atoms of cyclopentane are connected by single bonds in a cyclic form. Following are the structural formula and electron dot structure of cyclopentane.



Structural formula of cyclopentane (C_5H_{10})



Electron dot structure of cyclopentane (C_5H_{10})

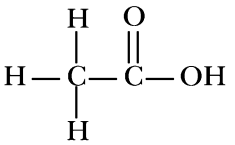
Q. 6. Draw the structures for the following compounds:

(*i*) Ethanoic acid **(*ii*) Bromopentane**

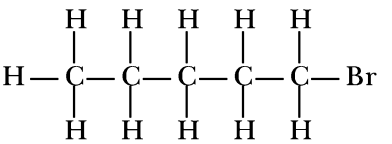
(*iii*) Butanone **(*iv*) Hexanal**

Are structural isomers possible for bromopentane?

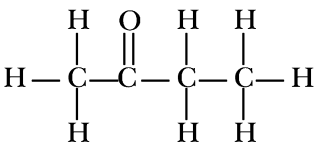
Ans. (*i*) Ethanoic acid



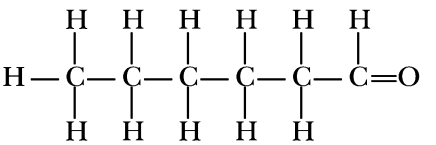
(*ii*) Bromopentane



(*iii*) Butanone

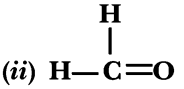
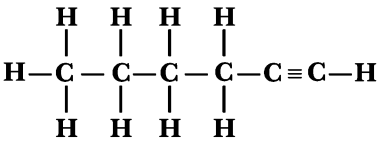


(*iv*) Hexanal



Yes, structural isomers are possible for bromopentane.

Q. 7. How would you name the following compounds ?

(*i*) $CH_3—CH_2—Br$ **(*ii*)**  **(*iii*)** 

Ans. (*i*) Bromoethane or ethyl bromide

(*ii*) Methanal or formaldehyde

(*iii*) Hexyne

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Q. 8. Why is the conversion of ethanol to ethanoic acid an oxidation reaction?

Ans. The conversion of ethanol into ethanoic acid is called an oxidation reaction because oxygen is added to it during this conversion.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} + \underset{\substack{\text{Nascent oxygen}\\ \text{(From oxidising agent)}}}{2[O]} \xrightarrow[\text{Or Acidified } K_2Cr_2O_7 + \text{Heat}]{\text{Alkaline } KMnO_4 + \text{Heat}} \underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Water}}{H_2O}$$

Note: *A substance which gives oxygen for oxidation is called an oxidising agent. Alkaline potassium permanganate and acidified potassium dichromate oxidise alcohols to acids, that is, adding oxygen to the starting material. Hence, they are known as oxidising agents.*

Q. 9. A mixture of oxygen and ethyne is burnt for welding. Can you tell why a mixture of ethyne and air is not used?

Ans. If a mixture of oxygen and ethyne is burnt, then ethyne burns completely producing a blue flame. The oxygen-ethyne flame is extremely hot and produces a very high temperature which is used for welding metals. A mixture of ethyne and air is not used for welding because burning of ethyne in air produces a sooty flame due to incomplete combustion, which is not hot enough to melt metals for welding.

Q. 10. How would you distinguish experimentally between an alcohol and a carboxylic acid?

Ans. All the carboxylic acids decompose sodium hydrogencarbonate giving brisk effervescence of carbon dioxide gas whereas ethanol does not react with sodium hydrogencarbonate.

Experiment:

(*i*) Take two test tubes, label them as A and B.

(*ii*) Take about 0.5 g of sodium hydrogencarbonate ($NaHCO_3$) in each test tube.

(*iii*) Add 2 mL of ethanol in test tube A and 2 mL of ethanoic acid in test tube B.

(*iv*) We can observe the gas bubbles in test tube B. No such bubbles are seen in test tube A. Pass the gas produced in test tube B through lime water taken in another test tube.

(*v*) We will find that lime water turns milky. It is a test for carbon dioxide.

Hence, this experiment proves that when ethanoic acid reacts with sodium hydrogencarbonate then carbon dioxide gas is produced with an effervescence (a rapid evolution of gas bubbles). Ethanol does not react with $NaHCO_3$.

Q. 11. What are oxidising agents?

Ans. A substance which gives oxygen for oxidation is called an oxidising agent. Alkaline potassium permanganate and acidified potassium dichromate are strong oxidising agents.

Q. 12. Would you be able to check if water is hard by using a detergent?

Ans. No, we would not be able to check whether a sample of water is hard by using a detergent because a detergent forms lather easily even in hard water.

Q. 13. People use a variety of methods to wash clothes. Usually after adding the soap, they 'beat' the clothes on a stone, or beat it with a paddle, scrub with a brush or the mixture is agitated in a washing machine. Why is agitation necessary to get clean clothes?

Ans. Agitation is necessary to get clean clothes because the soap micelles which entrap oily or greasy particles on the surface of dirty cloth have to be removed from its surface. When the wetted cloth in soap solution is agitated, the micelles containing oily or greasy dirt particles get removed from the surface of dirty cloth and go into the water and the dirty cloth gets cleaned.

NCERT Exercises

Q. 1. Ethane, with the molecular formula C_2H_6 has: *[CBSE (AI) 2015]*

(*a*) 6 covalent bonds **(*b*) 7 covalent bonds**

(*c*) 8 covalent bonds **(*d*) 9 covalent bonds**

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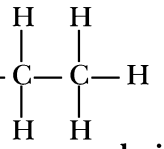
Ans. (*b*) 7 covalent bonds: 

Q. 2. Butanone is a four carbon compound with the functional group:

(*a*) carboxylic acid **(*b*) aldehyde**

(*c*) ketone **(*d*) alcohol**

Ans. (*c*) ketone

Q. 3. While cooking, if the bottom of the vessel is getting blackend on the outside, it means that:

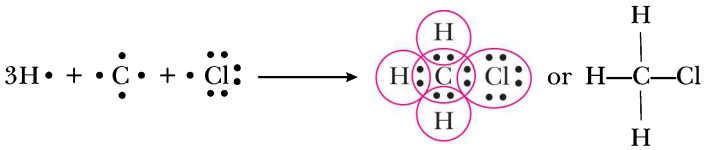
(*a*) the food is not cooked completely. **(*b*) the fuel is not burning completely.**

(*c*) the fuel is wet. **(*d*) the fuel is burning completely.**

Ans. (*b*) the fuel is not burning completely.

Q. 4. Explain the nature of the covalent bond using the bond formation in CH_3Cl.

Ans. CH_3Cl is chloromethane. It is made up of one carbon atom, three hydrogen atoms and one chlorine atom. Carbon atom has 4 outermost electrons, each hydrogen atom has 1 electron and chlorine has 7 outermost electrons. Carbon shares its four outermost electrons with three hydrogen atoms and one chlorine atom to form CH_3Cl as follows:

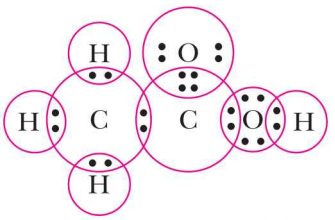


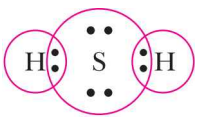
Each atom in CH_3Cl has a noble gas electron arrangement. Carbon attains the nearest noble gas configuration of neon, hydrogen acquires the configuration of helium while chlorine achieves the configuration of argon. Chloromethane contains three C—H and one C—Cl covalent bonds.

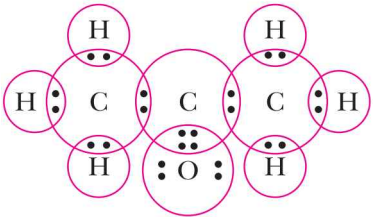
Q. 5. Draw the electron dot structures for:

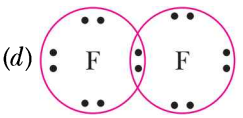
(*a*) ethanoic acid **(*b*) H_2S**

(*c*) propanone **(*d*) F_2**

Ans. (*a*) 

(*b*) 

(*c*) 

(*d*) 

Q. 6. What is a homologous series? Explain with an example.

Ans. A homologous series is a group of organic compounds having same functional group and similar chemical properties in which the successive compounds differ by CH_2 group. They can be represented by same general formula.

Homologous Series of Alkanes: All the alkanes have similar structures with single covalent bonds and show similar chemical properties. Therefore, alkanes can be grouped together in the form of a homologous series. The first six members of the homologous series of alkanes are given in the following table:

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Table: Homologous Series

Compound	Molecular Formula	Difference
Alkanes	C_nH_{2n+2} (General formula)	
1. Methane	CH_4	
2. Ethane	C_2H_6	
3. Propane	C_3H_8	$—CH_2—$
4. Butane	C_4H_{10}	
5. Pentane	C_5H_{12}	
6. Hexane	C_6H_{14}	

Q. 7. How can ethanol and ethanoic acid be differentiated on the basis of their physical and chemical properties? *[CBSE 2019 (31/2/3)]*

Ans.

Ethanol	Ethanoic Acid
1. Ethanol has a pleasant smell.	1. Ethanoic acid has the smell of vinegar.
2. The boiling point of ethanol is 351 K.	2. The boiling point of ethanoic acid is 391 K.
3. Ethanol reacts with alkaline $KMnO_4$ to give ethanoic acid.	3. Ethanoic acid does not react with alkaline $KMnO_4$.
4. Ethanol does not react with sodium hydrogencarbonate.	4. It gives brisk effervescence with sodium hydrogencarbonate: $CH_3COOH + NaHCO_3 \longrightarrow CH_3COONa + H_2O + CO_2\uparrow$

Q. 8. Why does micelle formation take place when soap is added to water? Will a micelle be formed in other solvents such as ethanol also?

Ans. When soap is added to water, micelle formation takes place. This is because the hydrocarbon chains of soap molecules are hydrophobic which are insoluble in water, but the ionic ends of soap molecules are hydrophilic and hence soluble in water. Since soap is soluble in ethanol, so micelle formation does not occur.

Q. 9. Why are carbon and its compounds used as fuels for most applications?

Ans. Carbon and its compounds are used as fuels because they burn in air releasing a large amount of heat energy.

$$C + O_2 \longrightarrow CO_2 + \text{Heat}$$

$$CH_4 + 2O_2 \longrightarrow CO_2 + H_2O + \text{Heat}$$

Q. 10. Explain the formation of scum when hard water is treated with soap.

Ans. Soap does not give foam easily with hard water. Hard water contains calcium and magnesium salts. Soap first reacts with the calcium ions and magnesium ions to form insoluble precipitates of calcium and magnesium salts of fatty acid.

$$\underset{\text{(soap)}}{\text{Sodium stearate}} + \text{Hard water} \longrightarrow \text{Calcium stearate} + \underset{\text{(Scum)}}{\text{Magnesium stearate}}$$

Q. 11. What change will you observe if you test soap with litmus paper (red or blue)?

Ans. A soap is the salt of a strong base (sodium hydroxide) and a weak acid (carboxylic acid), so a solution of soap in water is basic in nature. Being basic, a soap solution will turn red litmus paper blue.

Q. 12. What is hydrogenation? What is its industrial application?

Ans. The addition of hydrogen to an unsaturated hydrocarbon to get a saturated hydrocarbon is called hydrogenation. This process takes place in the presence of nickel or palladium metals as catalyst.

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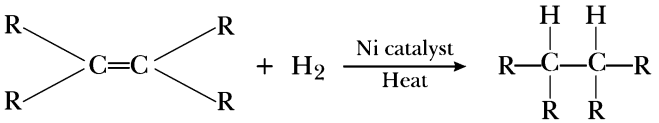
It has an important industrial application. It is used to prepare vegetable ghee from vegetable oils. Vegetable oils such as groundnut oils, cottonseed oils and mustard oils are unsaturated and also contain double bonds (C=C). On hydrogenation (addition of hydrogen), in the presence of nickel as catalyst, vegetable oil produces *vanaspati ghee*.



Vegetable oil (liquid state) — Vanaspati ghee (solid state)

Q. 13. Which of the following hydrocarbons undergo addition reactions?

C_2H_6, C_3H_8, C_3H_6, C_2H_2 and CH_4

Ans. The unsaturated hydrocarbons undergo addition reactions. Out of the given hydrocarbons, C_3H_6 (alkene) and C_2H_2 (alkyne) are unsaturated. Therefore, C_3H_6 and C_2H_2 will undergo addition reactions.

Q. 14. Give a test that can be used to differentiate between butter and cooking oil.

Ans. If a carbon compound decolourises bromine water, it will be an unsaturated compound. Thus, we can distinguish between a cooking oil and butter by the bromine water test.

(*i*) Cooking oil decolourises bromine water. This shows that it is an unsaturated compound.

(*ii*) Butter does not decolourise bromine water. This shows that it is a saturated compound.

Q. 15. Explain the mechanism of the cleaning action of soaps.

Ans. **Cleaning Action of Soap:** A soap molecule consists of two dissimilar parts:

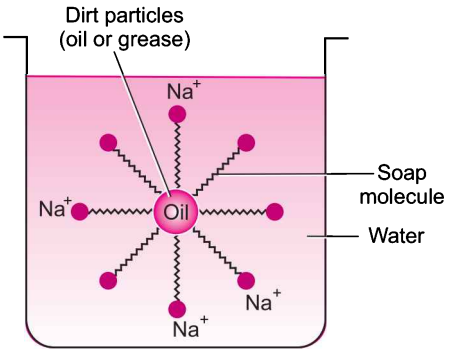
(*i*) A short ionic part comprising the carboxylate salt, —COO^-Na^+.This is the polar end. This is water soluble (*i.e.*, hydrophilic or water attracting) and, therefore, remains attached to water.

(*ii*) A long hydrocarbon chain which is the non-polar end. This end is hydrophobic *i.e.*, water repelling) and is soluble in oil and grease.



Non-polar end (Hydrophobic) Oil soluble end — $C_{17}H_{35}$ Soap molecule — Polar end (Hydrophilic) Water soluble end

When soap is dissolved in water, it forms a colloidal suspension. In this colloidal suspension, the soap molecules cluster together to form micelles and remain radially suspended in water with the hydrocarbon end towards the centre and the ionic end directed outward. This is shown in the figure.



The dirt particles always adhere to the oily or greasy layer present on the skin or clothes. When a dirty cloth is dipped into a soap solution, its non-polar hydrocarbon end of micelles attach to the grease or oil present in dirt and polar end remains in water layer. The mechanical action of rubbing subsequently, dislodges the oily layer from the dirty surface shaping it into small globules. A stable emulsion of oil in water is formed. The emulsified oil or grease globules bearing the dirt can now be readily washed with water.

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SELF-ASSESSMENT TEST

Time allowed: 1 hour **Max. marks: 40**

SECTION–A

Choose and write the correct answer for each of the following. **(4 × 1 = 4)**

1. The correct electron dot structure of a water molecule is *[NCERT Exemplar]*

(*a*) H•O•H (*b*) H:O•H

(*c*) H:O:H (*d*) H:O:H

2. The IUPAC name of the compound $CH_3—\overset{\overset{O}{\|}}{C}—O—CH_2—CH_3$ is

(*a*) Propyl methanoate (*b*) Ethyl formate

(*c*) Ethyl ethanoate (*d*) Ethyl methanoate

3. Ethanol reacts with sodium and forms two products. These are *[NCERT Exemplar]*

(*a*) sodium ethanoate and hydrogen (*b*) sodium ethanoate and oxygen

(*c*) sodium ethoxide and hydrogen (*d*) sodium ethoxide and oxygen

4. The soap molecule has a *[NCERT Exemplar]*

(*a*) hydrophilic head and a hydrophobic tail.

(*b*) hydrophobic head and a hydrophilic tail.

(*c*) hydrophobic head and a hydrophobic tail.

(*d*) hydrophilic head and a hydrophilic tail.

The following questions consist of two statements—Assertion(A) and Reason(R). Answer these questions selecting the appropriate option given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation for *A*.

(*b*) Both *A* and *R* are true but *R* is not the correct explanation for *A*.

(*c*) *A* is true but *R* is false.

(*d*) *A* is false but *R* is true. **(3 × 1 = 3)**

5. Assertion (*A*) : In a candle, wax vapours burn in sufficient supply of oxygen, which leads to blue flame.

Reason (*R*) : When the oxygen supply is sufficient, then fuels burn completely producing a blue flame.

6. Assertion (*A*) : Alkanes give addition reaction.

Reason (*R*) : Addition reactions are a characteristic property of unsaturated hydrocarbons.

7. Assertion (*A*) : *n*-butane and iso-butane are examples of isomers.

Reason (*R*) : Isomerism is possible only with hydrocarbons having 4 or more carbon atoms.

Answer the following questions in one word or one sentence. **(3 × 1 = 3)**

8. What is a functional group?

9. Complete the reaction: $CH_4 + O_2 \longrightarrow$

10. What type of compound burns with a sooty flame?

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SECTION–B

Answer the following questions in about 50-60 words each. **(5 × 3 = 15)**

11. Two carbon compounds X and Y have the molecular formula C_3H_6 and C_4H_{10} respectively. Which one of the two is most likely to show addition reaction ? Justify your answer. Also give the chemical equation to explain the process of addition reaction in this case. *[CBSE Delhi 2017]*

12. State any three points of differences between ionic and covalent compounds.

13. Complete the following chemical equations :

(*i*) $C_2H_5OH + O_2 \longrightarrow$

(*ii*) $C_2H_5OH \xrightarrow[443\ K]{\text{Conc. } H_2SO_4}$

(*iii*) $CH_3COOH + NaHCO_3 \longrightarrow$ *[CBSE Delhi 2017]*

14. Give the IUPAC name of the following organic compounds:

(*i*) CH_3CH_2COOH (*ii*) $CH_3CH_2C \equiv CH$

(*iii*) CH_3Cl (*iv*) CH_3CHO

(*v*) $CH_3CH_2CH=CH_2$ (*vi*) $CH_3CH_2COCH_2CH_3$

15. (*i*) Name the products obtained on complete combustion of hydrocarbons? How is the gas evolved during combustion tested in the laboratory? Explain in brief.

(*ii*) Write the next higher homologue of:

(*a*) C_3H_6 (*b*) C_5H_8

SECTION–C

Answer the following questions in about 80–90 words each. **(3 × 5 = 15)**

16. What is meant by "structural isomers"? Give reason why propane (C_3H_8) cannot exhibit this characteristic. Draw the structures of possible isomers of butane (C_4H_{10}).

17. What are hydrocarbons? Distinguish alkanes from alkenes and each of them from alkynes, giving one example of each. Draw the structure of each compound cited as example to justify your answer.

18. (*i*) You have three unlabelled test tubes containing ethanol, ethanoic acid and soap solution. Explain the method you would use to identify the compounds in different test tubes by chemical tests using litmus paper and sodium metal.

(*ii*) Give the reason of formation of scum when soaps are used with hard water.

Answers

1. (*c*) **2.** (*c*) **3.** (*c*) **4.** (*a*) **5.** (*a*) **6.** (*d*) **7.** (*b*)

8. An atom or group of atoms which determine the chemical properties of an organic compound is called functional group.

9. $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

10. Unsaturated compounds

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Periodic Classification of Elements

5

BASIC CONCEPTS—A FLOW CHART

PERIODIC CLASSIFICATION OF ELEMENTS

Earlier Attempts of Element Classification

Döbereiner's Triads (1817)

- Elements with similar properties were arranged into groups of three elements called **triads**.
- He could identify only three triads from the elements known.

Newlands' Law of Octaves (1866)

- Elements were arranged in the order of increasing atomic masses such that properties of the eighth element was the repetition of the properties of first element.
- This law worked well with lighter elements only.

Mendeléev's Periodic Table (1869)

States that the properties of elements are the periodic function of their atomic masses.

Achievements

- Accommodated noble gases which were discovered very late.
- Some gaps were left to accommodate elements to be discovered later.

Limitations

- Could not assign a correct position to hydrogen.
- Position of isotopes could not be explained.
- Wrong order of atomic masses of some elements could not be explained.

Henry Moseley (1913)

Showed that anomalies in arrangement of elements could be removed when the elements were arranged in order of increasing atomic number.

Modern Classification of Elements/Modern Periodic Table

- States that the properties of elements are periodic function of their atomic number.
- Consists of 18 vertical columns called **groups**.
- Consists of 7 horizontal rows called **periods**.
- Atoms of different elements with same number of occupied outer-shells are placed in same period.
- Position of an element tells us about its chemical properties.

Trends in Modern Periodic Table

	Across the period	Down the group
Atomic size	Decreases	Increases
Valency	First increases from 1 to 4 and then decreases to 0.	Remains same
Metallic character (or electropositive character)	Decreases	Increases
Non-metallic character (or electronegative character)	Increases	Decreases

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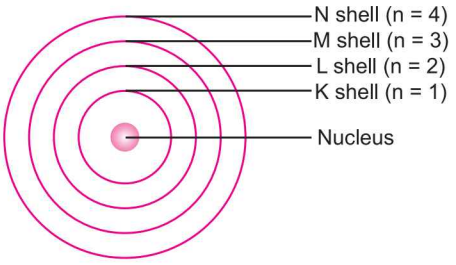
MORE POINTS TO REMEMBER

- Elements with the same number of valence electrons are placed in the same group.
- Elements with the same number of occupied shells are placed in the same period.
- **Electron Distribution in Orbits:** Arrangement of electrons in atomic orbitals is called electronic distribution.



- Electrons that can be accommodated in a shell depends on the formula $2n^2$ where 'n' is the number of the given shell from the nucleus.
- Number of elements in periods of periodic table are calculated as:

  K Shell – $2 \times (1)^2 = 2$, hence the first period has 2 elements.

  L Shell – $2 \times (2)^2 = 8$, hence the second period has 8 elements.

  M Shell – $2 \times (3)^2 = 18$, but the outermost shell can have only 8 electrons, so the third period also has only 8 elements.
- **Atomic Size:** It refers to the radius of an atom. It is the distance between the centre of the nucleus and the outermost shell of an isolated atom.
- **Valency:** It is the combining capacity of an element. It depends on the number of valence electrons of the element.

Multiple Choice Questions [1 mark]

Each question has 4 choices (a), (b), (c) and (d). Choose and write the correct option.

1. Which of the following statements about the Modern Periodic Table is correct? *[NCERT Exemplar]*

(*a*) It has 18 horizontal rows known as Periods
(*b*) It has 7 vertical columns known as Periods
(*c*) It has 18 vertical columns known as Groups
(*d*) It has 7 horizontal rows known as Groups

2. Which of the given elements A, B, C, D and E with atomic number 2, 3, 7, 10 and 30 respectively belong to the same period? *[NCERT Exemplar]*

(*a*) A, B, C
(*b*) B, C, D
(*c*) A, D, E
(*d*) B, D, E

3. The elements A, B, C, D and E have atomic number 9, 11, 17, 12 and 13 respectively. Which pair of elements belong to the same group? *[NCERT Exemplar]*

(*a*) A and B
(*b*) B and D
(*c*) A and C
(*d*) D and E

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4. Where would you locate the element with electronic configuration 2,8 in the Modern Periodic Table? [NCERT Exemplar]

(a) Group 8 (b) Group 2 (c) Group 18 (d) Group 10

5. An element which is an essential constituent of all organic compounds belongs to [NCERT Exemplar]

(a) group 1 (b) group 14 (c) group 15 (d) group 16

6. Which among the following elements has the largest atomic radius? [NCERT Exemplar]

(a) Na (b) Mg (c) K (d) Ca

7. Which of the following elements would lose an electron easily? [NCERT Exemplar]

(a) Mg (b) Na (c) K (d) Ca

8. Which of the following elements does not lose an electron easily? [NCERT Exemplar]

(a) Na (b) F (c) Mg (d) Al

9. Which of the following are the characteristics of isotopes of an element? [NCERT Exemplar]

(i) Isotopes of an element have same atomic masses

(ii) Isotopes of an element have same atomic number

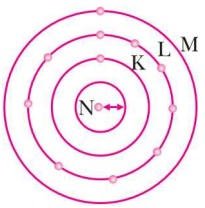
(iii) Isotopes of an element show same physical properties

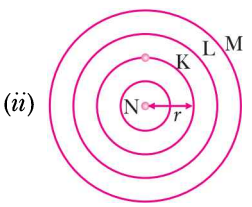
(iv) Isotopes of an element show same chemical properties

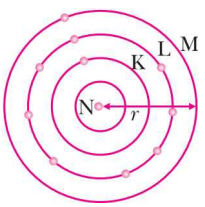
(a) (i), (iii) and (iv) (b) (ii), (iii) and (iv)

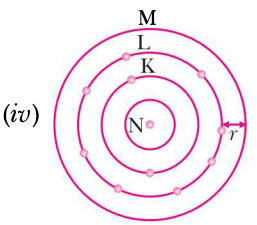
(c) (ii) and (iii) (d) (ii) and (iv)

10. Which one of the following depict the correct representation of atomic radius(r) of an atom? [NCERT Exemplar]

(i) 

(ii) 

(iii) 

(iv) 

(a) (i) and (ii) (b) (ii) and (iii) (c) (iii) and (iv) (d) (i) and (iv)

11. Which one of the following does not increase while moving down the group of the periodic table? [NCERT Exemplar]

(a) Atomic radius (b) Metallic character

(c) Valency (d) Number of shells in an element

12. Which of the following set of elements is written in order of their increasing metallic character? [NCERT Exemplar]

(a) Be, Mg, Ca (b) Na, Li, K (c) Mg, Al, Si (d) C, O, N

13. Up to which element was the Law of Octaves found to be applicable? [NCERT Exemplar]

(a) Oxygen (b) Calcium (c) Cobalt (d) Potassium

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14. Which of the following is the outermost shell for elements of period 2? [NCERT Exemplar]
(a) K shell (b) L shell (c) M shell (d) N shell

15. In Mendeléev's Periodic Table, gaps were left for the elements to be discovered later. Which of the following elements found place in the Periodic Table later? [NCERT Exemplar]
(a) Germanium (b) Chlorine (c) Oxygen (d) Silicon

16. If the two members of a Döbereiner triad are calcium and strontium, the third member of the triad is
(a) Magnesium (b) Barium (c) Cesium (d) Sodium

17. Which of the following statement(s) about the Modern Periodic Table are incorrect?
(i) The elements in the Modern Periodic Table are arranged on the basis of their decreasing atomic numbers.
(ii) The elements in the Modern Periodic Table are arranged on the basis of their increasing atomic masses.
(iii) Isotopes are placed in adjoining group(s) in the Periodic Table.
(iv) The elements in the Modern Periodic Table are arranged on the basis of their increasing atomic numbers. [NCERT Exemplar]
(a) (i) only (b) (i), (ii) and (iii)
(c) (i), (ii) and (iv) (d) (iv) only

18. The Modern Periodic Table contains
(a) 18 periods and 7 groups. (b) 7 periods and 18 groups.
(c) 7 periods and 7 groups. (d) 18 periods and 18 groups

19. Which of the following gives the correct increasing order of the atomic radii of O, F and N? [NCERT Exemplar]
(a) O, F, N (b) N, F, O (c) O, N, F (d) F, O, N

20. The electronic configuration of an element is 2, 8, 8, 2. This element belongs to
(a) 1st group. (b) 2nd group. (c) 3rd group. (d) 4th group.

21. Arrange the following elements in the order of their decreasing metallic character
Na, Si, Cl, Mg, Al [NCERT Exemplar]
(a) Cl > Si > Al> Mg> Na (b) Na > Mg> Al > Si> Cl
(c) Na > Al > Mg> Cl> Si (d) Al > Na> Si> Cl> Mg

22. Three elements B, Si and Ge are [NCERT Exemplar]
(a) metals (b) non-metals
(c) metalloids (d) metal, non-metal and metalloid respectively

23. The element with atomic number 14 is hard and forms acidic oxide and a covalent halide. To which of the following categories does the element belong? [NCERT Exemplar]
(a) Metal (b) Metalloid
(c) Non-metal (d) Left hand side element

24. Arrange the following elements in the order of their increasing non-metallic character—Li, O, C, Be, F. [NCERT Exemplar]
(a) F < O < C < Be < Li (b) Li < Be < C < O < F
(c) F < C < O < Be < Li (d) F < O < Be < C < Li

25. Which of the following elements will form an acidic oxide? [NCERT Exemplar]
(a) An element with atomic number 7 (b) An element with atomic number 3
(c) An element with atomic number 12 (d) An element with atomic number 19

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26. What type of oxide would Eka-aluminium form? *[NCERT Exemplar]*

(*a*) EO_3 (*b*) E_3O_2 (*c*) E_2O_3 (*d*) EO

Answers

1. (*c*)	**2.** (*b*)	**3.** (*c*)	**4.** (*c*)	**5.** (*b*)	**6.** (*c*)	**7.** (*c*)
8. (*b*)	**9.** (*d*)	**10.** (*b*)	**11.** (*c*)	**12.** (*a*)	**13.** (*b*)	**14.** (*b*)
15. (*a*)	**16.** (*b*)	**17.** (*b*)	**18.** (*b*)	**19.** (*d*)	**20.** (*b*)	**21.** (*b*)
22. (*c*)	**23.** (*b*)	**24.** (*b*)	**25.** (*a*)	**26.** (*c*)		

Assertion-Reason Questions [1 mark]

The following questions consist of two statements — Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

1. Assertion (*A*) : Mendeléev concentrated on the compounds formed by elements with oxygen and hydrogen in his periodic table.
Reason (*R*) : Hydrogen and oxygen are very reactive and form compounds with most elements.

2. Assertion (*A*) : In Mendeléev Periodic Table, cobalt was placed before nickel.
Reason (*R*) : The atomic mass of cobalt is less than nickel.

3. Assertion (*A*) : According to Mendeléev, the properties of elements are a periodic function of their atomic masses.
Reason (*R*) : Atomic number is equal to the number of protons.

4. Assertion (*A*) : Noble gases have zero valency.
Reason (*R*) : Noble gases have stable electronic configuration.

5. Assertion (*A*) : Elements in the same vertical column have similar properties.
Reason (*R*) : Elements have periodic dependence upon the atomic number.

6. Assertion (*A*) : Silicon is a metalloid.
Reason (*R*) : Silicon shows only properties of non-metals.

7. Assertion (*A*) : Fluorine has greater atomic radius than nitrogen.
Reason (*R*) : Atomic radius decreases along a period.

Answers

1. (*a*)	**2.** (*c*)	**3.** (*b*)	**4.** (*a*)	**5.** (*b*)	**6.** (*c*)	**7.** (*d*)

Passage-based Questions

Answer the questions below each passage on the basis of your understanding of the paragraph and the related studied concepts.

1. Modern periodic table is based on increasing order of atomic number. There are 18 groups and 7 periods in the modern periodic table.

Group 1 called Alkali metals contains elements Lithium (Li), Sodium (Na), Potassium (K), Rubidium (Rb), Caesium (Cs) and Francium (Fr).

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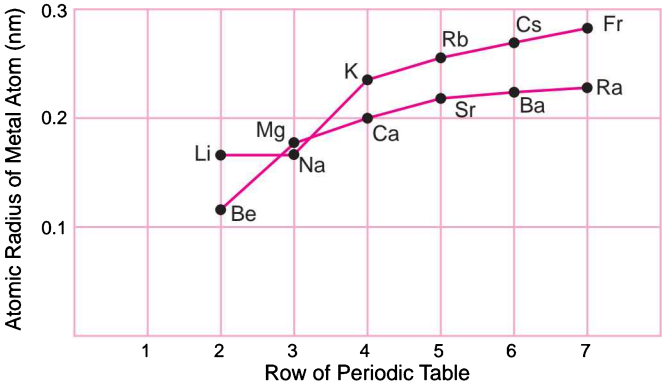
Group 2 called Alkaline earth metals contains elements Beryllium (Be), Magnesium (Mg), Calcium (Ca), Strontium (Sr), Barium (Ba), Radium (Ra).

Modern periodic law states that "the physical and chemical properties of all the elements are the periodic function of their atomic number.

With increase in atomic number the number of shells increases, so the atomic radii increases.

Graph of atomic radii of Group 1 and Group 2 elements is shown here.



(*i*) Write the increasing order of atomic radii of Group 1 elements.

(*ii*) Compare the atomic radii of Ca and K. Justify your answer.

(*iii*) Why does the atomic radii increases down the group?

(*iv*) The valency of Group 1 elements:

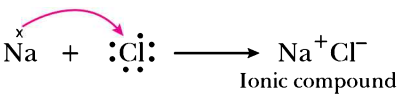
(*a*) increases with increase in atomic radii

(*b*) decreases with increase in atomic radii

(*c*) remain constant with increase in atomic radii

(*d*) first increases then decreases with increase in atomic radii

2. Atoms of eight elements of third period $_{11}Na$, $_{12}Mg$, $_{13}Al$, $_{14}Si$, $_{15}P$, $_{16}S$, $_{17}Cl$, $_{18}Ar$, have the same number of electronic shells but different number of electrons in their outermost shell. It was found that elements Na and Cl combine to form ionic compound by transfer of electrons. Sodium donates its one outermost shell electron to chlorine and forms monopositive ion (Na^+). On the other hand, chlorine after gaining one electron forms mononegative ion (Cl^-).



The number of electrons gained or lost by the elements are their valencies.

(*i*) To which group of the periodic table do the listed elements belong?

(*ii*) How are ionic compounds different from covalent compounds?

(*iii*) What is the valency of $_{16}S$ and $_{18}Ar$?

(*iv*) Which of the following is an ionic compound?

(*a*) PCl_5 (*b*) SCl_6 (*c*) $SiCl_4$ (*d*) $MgCl_2$

Answers

1. (*i*) Li <Na < K < Rb < Cs < Fr

(*ii*) K > Ca; because both the elements are in same period and atomic radii decreases with increase in number of protons.

(*iii*) Atomic radii increases down the group due to increase in number of shells.

(*iv*) (*c*)

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2. (*i*) Na– group 1, Mg–group 2, Al–group 13, Si–group 14, P–group 15, S–group 16, Cl–group 17, Ar–group 18.

(*ii*) Ionic compounds are formed by transfer of electrons while covalent compounds are formed by sharing of electrons.

(*iii*) Valency of S = 2 and valency Ar = 0.

(*iv*) (*d*)

Very Short Answer Questions [1 mark]

Each of the following questions are of 1 mark and have to be answered in one word or one sentence.

Q. 1. Write the pair of elements that were placed in same slot in Newland's Periodic Table.
Ans. Co and Ni, Ce and La

Q. 2. What was Döbereiner's basis of classifying elements?
Ans. According to Döbereiner, elements having similar properties can be arranged in triads in which atomic mass of the middle element is the mean of the atomic masses of the other two elements.

Q. 3. State Mendeléev's Periodic Law. *[CBSE 2019 (31/4/3)]*
Ans. Mendeléev's Periodic Law states that, "The properties of the elements are periodic function of their atomic masses."

Q. 4. State Newlands' Law of Octaves.
Ans. Newlands' Law of Octaves states that "when elements are arranged in order of increasing atomic weights, then every eighth element has properties similar to that of the first element."

Q. 5. What was the drawback of the Law of Octaves?
Ans. Law of Octaves failed to assign the position to the elements with large atomic weights.

Q. 6. Who classified the elements on the basis of fundamental properties of elements like atomic mass?
Ans. Mendeléev.

Q. 7. Define groups.
Ans. The vertical columns in the long form of the Periodic Table are called groups.

Q. 8. In how many groups and periods, the Modern Periodic Table of elements is divided?
Ans. 18 groups and 7 periods.

Q. 9. How many vertical columns are there in the Modern Periodic Table?
Ans. In the Modern Periodic Table, there are 18 vertical columns of elements called groups.

Q. 10. Out of Li, C and N, which forms the most basic oxide and which forms the most acidic oxide?
Ans. Lithium forms the most basic oxide as it is a metal and nitrogen forms the most acidic oxide as it is a non-metal.

Q. 11. A metal M belongs to 13th group in the Modern Periodic Table. Write the valency of the metal.
Ans. Atomic number = 13 (Al)
Electronic configuration = 2, 8, 3
Valency = 3

Q. 12. Find the period and group of the element whose atomic number is 12.
Ans. 3rd period, 2nd group.

Q. 13. Write two reasons responsible for late discovery of noble gases. *[CBSE Delhi 2013]*
Ans. (*i*) They are very less reactive.
(*ii*) They are less abundant in nature.

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Q. 14. Name two elements whose properties were predicted on the basis of their positions in Mendeleev's periodic table.

Ans. Gallium and Scandium

Q. 15. Write the formulae of chlorides of *Eka*-silicon and *Eka*-aluminium, the elements predicted by Mendeléev. *[NCERT Exemplar]*

Ans. $GeCl_4$, $GaCl_3$

Q. 16. If an element X is placed in group 14, what will be the formula and the nature of bonding of its chloride? *[NCERT Exemplar] [CBSE 2019 (31/5/1)]*

Ans. The formula will be XCl_4. The element X of group 14 will have 4 valence electrons. So, it shares its 4 electrons and forms covalent bond with 4 chlorine atoms.

Q. 17. Arrange the following elements in the increasing order of their metallic character
Mg, Ca, K, Ge, Ga *[NCERT Exemplar]*

Ans. Ge < Ga < Mg < Ca < K

Q. 18. Name the element which is in
(*i*) First group and third period
(*ii*) Seventeenth group and second period.

Ans. (*i*) Sodium
(*ii*) Fluorine

Q. 19. The three elements A, B and C with similar properties have atomic masses X, Y and Z respectively. The mass of Y is approximately equal to the average mass of X and Z. What is such an arrangement of elements called as? Give one example of such a set of elements. *[NCERT Exemplar]*

Ans. The arrangement of these elements is known as Döbereiner triad. Example: lithium, sodium and potassium.

Q. 20. Why did Mendeléev leave some gaps in his Periodic Table?

Ans. Mendeléev left some gaps in his Periodic Table for the elements yet to be discovered. He even predicted the properties of these elements by studying the properties of the neighbouring elements.

Short Answer Questions [3 marks]

Each of the following questions are of 3 marks and have to be answered in about 50-60 words.

Q. 1. Elements have been arranged in the following sequence on the basis of their increasing atomic masses.
F, Na, Mg, Al, Si, P, S, Cl, Ar, K
(*i*) Pick two sets of elements which have similar properties.
(*ii*) The given sequence represents which law of classification of elements? *[NCERT Exemplar]*

Ans. (*i*) (*a*) F and Cl
(*b*) Na and K
(*ii*) Newlands' Law of Octaves

Q. 2. State Modern Periodic Law. What is number of groups and periods in the Modern Periodic Table? *[CBSE Delhi (C) 2017]*

Ans. Modern Periodic Law states that the properties of elements are a periodic function of their atomic number.

There are 18 groups and 7 periods in the Modern Periodic Table.

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Q. 3. What do you understand by the term periodicity? Does the periodicity in properties is a function of valence electrons? Illustrate.

Ans. When the elements are arranged in order of increasing atomic numbers, elements with similar chemical properties are repeated at definite intervals. This is known as periodicity. Yes, this periodicity is due to the periodicity in the number of electrons in the outermost shell of the atoms of the elements. If elements having the same number of valence electrons are grouped together, the elements falling within each group are similar in chemical properties.

Q. 4. (*i*) What does each group in the Periodic Table signify?

(*ii*) Why do elements in any given group have similar properties?

Ans. (*i*) Each group in the Periodic Table signifies identical outer shell electronic configuration for the elements constituting that group. For example, each element of group 1 has one electron in its outermost shell.

(*ii*) The chemical properties of an atom are largely determined by its valence electrons. In a given group, the number of valence electrons are same, hence they have similar properties.

Q. 5. Why do group 1 elements form unipositive ions?

Ans. Group 1 elements contain 1 electron in their outermost shells. These elements lose this electron easily to attain the 8 electrons in their outermost shell. Hence, they form unipositive ion.

For example,

	K	L	M			K	L
Sodium (Na)	2,	8,	1	$\xrightarrow{-1e^-}$	Na^+	2,	8

Q. 6. Which is smaller?

(*i*) Na^+ or Na **(*ii*) Cl or Cl^-**

Ans. (*i*) Na $\rightarrow$ 2, 8, 1 $Na^+ \rightarrow$ 2, 8

Na^+ is smaller as it has lesser number of shells than Na.

(*ii*) Cl $\rightarrow$ 2, 8, 7 $Cl^- \rightarrow$ 2, 8, 8

Cl has greater effective nuclear charge. So, it is smaller than Cl^-.

Q. 7. Give reasons:

(*i*) The elements of group 18 are called zero valent.

(*ii*) Group 17 elements form uninegative anions.

Ans. (*i*) Group 18 elements have their outermost shells completely filled and the atoms of these elements have no tendency to gain or lose electrons. Thus, the elements of this group are zero valent and almost unreactive.

(*ii*) Group 17 elements have 7 valence electrons, one electron less than the maximum number of electrons that can be accommodated in the outermost shell. Therefore, it is easier for these elements to gain an electron and form uninegative anions, so as to attain noble gas configuration.

For example,

	K	L			K	L
Fluorine (F)	2,	7	$\xrightarrow{+1e^-}$	F^-	2,	8

Q. 8. Would you place the two isotopes of chlorine, Cl-35 and Cl-37 in different slots because of their different atomic masses or in the same because their chemical properties are the same? Justify your answer.

Ans. In Mendeléev's Periodic Table the two isotopes of chlorine, Cl-35 and Cl-37 would be placed in different slots because they have different atomic masses. But because of their similar chemical properties which is a more reliable property as it is based on the number of valence electrons, they would be placed in the same slot.

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Q. 9. How does the metallic character change along the period?

Ans. As we go from left to right in a period, the metallic character decreases, because of the addition of an electron in the same energy shell each time. So, attraction between the nucleus and the electrons in the outermost shell increases. Thus, tendency to lose an electron decreases and metallic character decreases.

Q. 10. What is atomic radius? Why does atomic radius decrease across a period?

Ans. Atomic radius is defined as the distance from the centre of the nucleus of an atom to the outermost shell of electrons. The atomic radius decreases along a period. In moving from left to right across the period, the charge on the nucleus increases by one unit (due to increase in atomic number), but the additional electron goes to the same shell. As a result, outer electrons are pulled in closer to the nucleus. This causes the decrease of atomic size.

Q. 11. Why does the size of the atom increase down the group?

Ans. In moving down a group, the charge on the nucleus increases with increase in atomic number, but at the same time, there is an increase in the energy levels. The number of electrons in the outermost shell, however, remains the same. Since the effect of additional energy levels outweighs the effect of increased nuclear charge and thus the distance of the outermost electron from the nucleus increases on going down the group.

Q. 12. Can the following groups of elements be classified as Döbereiner's triad?

(*i*) Na, Si, Cl

(*ii*) Be, Mg, Ca

[Atomic mass of Be (9); Na (23); Mg (24); Si (28); Cl (35); Ca (40)]

Explain by giving reason. *[NCERT Exemplar]* *[CBSE 2019 (31/1/2)]*

Ans. (*i*) No, because all these elements do not have similar properties although the atomic mass of silicon is average of atomic masses of sodium (Na) and chlorine (Cl).

(*ii*) Yes, because they have similar properties and the mass of magnesium (Mg) is roughly the average of the atomic masses of Be and Ca.

Q. 13. The atomic number of an element is 17. To which group and period does this element belong? Determine its valency. *[CBSE Delhi (C) 2017]*

Ans. Electronic configuration: 2, 8, 7

Group: 17

Period: 3

Valency: 8 – 7 = 1

Q. 14. Arrange the following elements in increasing order of their atomic radii:

(*i*) Li, Be, F, N

(*ii*) Cl, At, Br, I *[NCERT Exemplar]*

Ans. (*i*) F < N < Be < Li as the atomic radii decreases along a period.

(*ii*) Cl < Br < I < At as the atomic radii increases down a group.

Q. 15. Identify and name the metals out of the following elements whose electronic configurations are given below.

(*i*) 2, 8, 2 **(*ii*) 2, 8, 1**

(*iii*) 2, 8, 7 **(*iv*) 2, 1** *[NCERT Exemplar]*

Ans. (*i*), (*ii*) and (*iv*) are metals.

(*i*) Magnesium (*ii*) Sodium (*iv*) Lithium

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Q. 16. Which group of elements could be placed in Mendeléev's Periodic Table without disturbing the original order? Give reason. [*NCERT Exemplar*]

Ans. Noble gases.

According to the Mendeléev's classification, the properties of elements are the periodic function of their atomic masses and there is a periodic recurrence of elements with similar physical and chemical properties. Noble gases being inert, could be placed in a separate group without disturbing the original order.

Q. 17. (*i*) Why do we classify elements?

(*ii*) In Mendeléev's Periodic Table, why was there no mention of noble gases like Helium, Neon and Argon?

Ans. (*i*) Different elements discovered in different times were found to possess different physical and chemical properties. But, it was difficult to study all the information or properties of these elements. Scientists started discovering some pattern in their properties to classify all the known elements in order to make their study easier. So, elements are classified on the basis of their similarities and dissimilarities in properties.

(*ii*) Noble gases like He, Ne, Ar, etc. were not discovered at the time of Mendeléev. They were discovered later as they are inert and present in extremely low concentrations in our atmosphere. So, after their discovery they were placed in a new group (18) in Modern Periodic Table.

Q. 18. Explain why sodium is more reactive than lithium.

Ans. Sodium is more reactive than lithium because sodium is larger in size. Outermost electrons are less tightly held in sodium than in lithium. As a result, sodium loses its outermost electron more easily than lithium. Hence, it is more reactive than lithium.

Q. 19. Choose from the following. [*CBSE (AI) 2012*]

$_{6}C$, $_{8}O$, $_{10}Ne$, $_{11}Na$, $_{14}Si$

(*i*) Elements that should be in the same period.

(*ii*) Elements that should be in the same group.

Ans. (*i*) C, O, Ne should be in the same period as these elements contain same number of shells.

Similarly, Na and Si should be in the same period.

(*ii*) C and Si should be in the same group as these elements have same number of valence electrons.

Q. 20. (*i*) How it can be proved that the basic structure of the Modern Periodic Table is based on the electronic configuration of atoms of different elements? [*CBSE* 2019 (31/1/1)]

(*ii*) The electronic configuration of an element is 2, 8, 4. State its:

(*a*) group and period in the Modern Periodic Table.

(*b*) name and write its one physical property. [*CBSE* 2019 (31/1/1)]

Ans. (*i*) The elements in the Modern Periodic Table are arranged in increasing order of atomic numbers and atomic number is equal to number of protons or electrons which gives the electronic configuration. The group number of an element depends upon the number of valence electrons and the period number of an element is equal to the number of shells.

(*ii*) (*a*) Group number – 14

Period number – 3

(*b*) Silicon. It is a metalloid with lustre.

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Q. 21. Write the main aim of classifying elements. Name the basic property of elements used in the development of Modern Periodic Table. State the Modern Periodic Law. On which side (part) of the Modern Periodic Table do you find metals, metalloids and non-metals?

[CBSE (F)2016, 2015]

Ans. Elements are classified for systematic and simplified study of elements and their compounds. The basic property of elements used in the Modern Periodic Table is the atomic number of the elements.

Modern Periodic Law states that "the properties of elements are a periodic function of their atomic number."

Metals are found on the left side and centre of the Modern Periodic Table.

Non-metals are found on the right side of the Modern Periodic Table.

Metalloids are found in a zig-zag manner between the metals and the non-metals.

Q. 22. How does the atomic radius of the elements change on going

(*i*) from left to right in a period, and

(*ii*) down a group

in the Modern Periodic Table? Give reason in support of your answer. *[CBSE 2019 (31/4/3)]*

[CBSE Delhi (C) 2017]

Ans. (*i*) Atomic radius decreases along a period. This is because nuclear charge increases from left to right in a period which tends to pull the electrons closer to the nucleus.

(*ii*) Atomic radius increases down the group because number of shells increases on going down the group.

Q. 23. How many groups and periods are there in the Modern Periodic Table? How do the atomic size and metallic character of elements vary as we move:

(*i*) down a group and

(*ii*) from left to right in a period *[CBSE Delhi 2015]*

Ans. There are 18 groups and 7 periods in the Modern Periodic Table.

(*i*)
- Atomic size increases
- Metallic character increases

(*ii*)
- Atomic size decreases
- Metallic character decreases

Q. 24. What is periodicity in properties of elements with reference to the Modern Periodic Table ? Why do all the elements of the same group have similar properties ? How does the tendency of elements to gain electrons change as we move from left to right in a period ? State the reason of this change. *[CBSE (AI) 2017]*

Ans. According to the Modern Periodic Table, similar properties of elements are repeated after regular intervals.

All elements in a group have similar properties because of the same number of valence electrons.

Tendency of elements to gain electrons increases along a period due to increase in effective nuclear charge which pulls the electrons towards it.

Q. 25. From the following elements:

$_4$Be; $_9$F; $_{19}$K; $_{20}$Ca

(*i*) Select the element having one electron in the outermost shell.

(*ii*) Two elements of the same group.

(*iii*) Write the formula and mention the nature of the compound formed by the union of $_{19}$K and element X (2, 8, 7). *[CBSE Delhi 2015]*

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Ans.

Element	Electronic configuration
Be	2, 2
F	2, 7
K	2, 8, 8, 1
Ca	2, 8, 8, 2

(*i*) K

(*ii*) Be and Ca, as both have same number of valence electrons, *i.e.*, 2.

(*iii*) K (2, 8, 8, 1) X (2, 8, 7)

$K^+ + X^- \longrightarrow KX$

Ionic or electrovalent bond is formed.

Q. 26. Name any two elements of group one and write their electronic configurations. What similarity do you observe in their electronic configurations? Write the formula of oxide of any of the aforesaid element. *[CBSE Delhi 2016]*

Ans. Two elements of group 1 are Sodium (Na) and potassium (K).

Their electronic configurations: Na = 2,8,1; K = 2,8,8,1

Similarity: Both have one valence electron.

Formula of their oxides: Na_2O; K_2O.

Q. 27. An element *P* (atomic number 20) reacts with an element *Q* (atomic number 17) to form a compound. Answer the following questions giving reason :

Write the position of *P* and *Q* in the Modern Periodic Table and the molecular formula of the compound formed when *P* reacts with *Q*. *[CBSE Delhi 2017]*

Ans. The electronic configuration of *P* is 2, 8, 8, 2.

Group – 2 because it has 2 valence electrons.

Period – 4 because it has 4 shells.

The electronic configuration of *Q* is 2, 8, 7.

Group – 17 because it has 7 valence electrons so group number is 7 + 10 *i.e.*, 17.

Period – 3 because it has 3 shells.

Formula is PQ_2 because valency of *P* is 2 and that of *Q* is 1.

Q. 28. Write the number of periods the Modern Periodic Table has. State the changes in valency and metallic character of elements as we move from left to right in a period. Also state the changes, if any, in the valency and atomic size of elements as we move down a group. *[CBSE Delhi 2015]*

Ans. The Modern Periodic Table has 7 periods. Valency across a period increases from 1 to 4, then decreases from 4 to zero.

Metallic character of elements across a period decreases.

Valency down a group remains the same. Atomic size of elements down a group increases.

Q. 29. The elements $_4$Be, $_{12}$Mg and $_{20}$Ca, each having two valence electrons in their valence shells, are in periods 2, 3 and 4 respectively of the Modern Periodic Table. Answer the following questions associated with these elements, giving reason in each case:

(*i*) In which group should they be?

(*ii*) Which one of them is least reactive?

(*iii*) Which one of them has the largest atomic size? *[CBSE (AI) 2015]*

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Ans. (*i*) In group 2, as each element has two valence electrons.

(*ii*) Be is least reactive because Be has the least tendency to lose electrons.

(*iii*) Ca has the largest atomic size as Ca has the maximum number of shells and atomic size increases down the group.

Q. 30. Nitrogen (atomic no. 7) and phosphorous (atomic no. 15) belong to group 15 of the Periodic Table. Write the electronic configuration of these two elements in terms of K, L, M, N shell. Predict whether these are metallic or non-metallic.

Ans.

Element	K	L	M
N (7)	2	5	
P (15)	2	8	5

Both are non-metals as they tend to form bonds by gaining electrons.

Q. 31. Na, Mg and Al are the elements of the same period of Modern Periodic Table having one, two and three valence electrons respectively. Which of these elements (*i*) has the largest atomic radius, (*ii*) is least reactive? Justify your answer stating reason for each case.

[CBSE Delhi 2015]

Ans. (*i*) Na has the largest atomic size because the atomic size decreases from left to right due to the increase in the nuclear charge.

(*ii*) Al is least reactive because the tendency to lose electrons decreases from left to right.

Q. 32. Two elements 'P' and 'Q' belong to the same period of the Modern Periodic Table and are in Group-1 and Group-2 respectively. Compare their following characteristics in tabular form:

(*i*) The number of electrons in their atoms

(*ii*) The sizes of their atoms

(*iii*) Their metallic characters

(*iv*) Their tendencies to lose electrons

(*v*) The formula of their oxides

(*vi*) The formula of their chlorides *[CBSE (AI) 2015]*

Ans.

Characteristic	P	Q
(*i*) Number of electrons in their atoms	Number of electrons is less.	Number of electrons is more.
(*ii*) Sizes of their atoms	P is bigger in size.	Q is smaller in size.
(*iii*) Metallic character	P is more metallic than Q.	Q is less metallic.
(*iv*) Tendencies to lose electrons	P will lose electrons more easily.	Q does not lose electrons easily.
(*v*) Formula of their oxides	P_2O	QO
(*vi*) Formula of their chlorides	PCl	QCl_2

Q. 33. The position of three elements A, B and C in the Periodic Table is shown below:

Groups → / Periods ↓	1	2	3	4	5	6	7	8
1								
2			B					
3	A	C						

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Giving reasons, explain the following:

(*i*) Element A is a metal.

(*ii*) Element C has larger size than element B.

(*iii*) Element B has a valency of 3.

Ans. (*i*) Element A belongs to group 1 of the Periodic Table. So, it has 1 valence electron and it forms unipositive ion by losing its valence electron. Hence, A is a metal.

(*ii*) This is because element C is in third period while element B is in second period. We know that the atomic size increases down the group and decreases along a period.

(*iii*) Element B is in 2nd period and 3rd group hence it has 3 valence electrons. It loses 3 electrons to achieve nearest inert gas configuration. So, its valency is 3.

Q. 34. Identify the elements with the following property and arrange them in increasing order of their reactivity.

(*i*) An element which is a soft and reactive metal.

(*ii*) The metal which is an important constituent of limestone.

(*iii*) The metal which exists in liquid state at room temperature. *[NCERT Exemplar]*

Ans. (*i*) Na or K (*ii*) Ca (*iii*) Hg

Reactivity order: Hg < Ca < Na < K

Q. 35. Properties of the elements are given below. Where would you locate the following elements in the Periodic Table?

(*i*) A soft metal stored under kerosene.

(*ii*) An element with variable (more than one) valency stored under water.

(*iii*) An element which is tetravalent and forms the basis of organic chemistry.

(*iv*) An element which is an inert gas with atomic number 2.

(*v*) An element whose thin oxide layer is used to make other elements corrosion resistant by the process of "anodising". *[NCERT Exemplar]*

Ans. (*i*) Sodium (Na) Group 1 and Period 3 or Potassium (K) Group 1 and Period 4

(*ii*) Phosphorus (P) Group 15 and Period 3

(*iii*) Carbon (C) Group 14 and Period 2

(*iv*) Helium (He) Group 18 and Period 1

(*v*) Aluminium (Al) Group 13 and Period 3

Q. 36. The atomic number of an element 'X' is 20.

(*i*) Determine the position of the element 'X' in the periodic table.

(*ii*) Write the formula of the compound formed when 'X' reacts/combines with another element 'Y' (atomic number 8).

(*iii*) What would be the nature (acidic or basic) of the compound formed? Justify your answer. *[CBSE (F) 2015]*

Ans. Electronic configuration : K L M N
2, 8, 8, 2

(*i*) 'X' is in the 2nd group and 4th period of the periodic table.

(*ii*) $\underset{(2,8,8,2)}{X} + \underset{(2,6)}{Y} \longrightarrow XY$

(*iii*) The nature of the compound formed is basic because X is a metal and Y is oxygen. The oxides of metals are basic in nature.

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Q. 37. The following table shows the position of six elements A, B, C, D, E and F in the Periodic Table.

Groups → / Periods ↓	1	2	3 to 12	13	14	15	16	17	18
2	A					B			C
3		D			E				F

Using the above table answer the following questions:

(*i*) Which element will form only covalent compounds?

(*ii*) Which element is a metal with valency 2?

(*iii*) Which element is a non-metal with valency 3?

(*iv*) Write a common name for the family of elements C and F.

(*v*) Out of D and E, which one has a bigger atomic radius and why?

Ans. (*i*) E

(*ii*) D

(*iii*) B

(*iv*) The noble gases.

(*v*) D has bigger atomic radius. The atomic radius decreases in moving from left to right along a period. This is due to an increase in nuclear charge which tends to pull the electrons closer to the nucleus and reduces the size of the atom.

Q. 38. The atomic radii of first group elements of the Periodic Table are as follows:

Group 1 elements	Na	Li	Rb	Cs	K
Atomic radius (pm)	186	152	244	262	231

(*i*) Arrange these elements in the increasing order of their atomic radii.

(*ii*) Name the elements which have the smallest and the largest atoms.

(*iii*) How does the atomic size vary as you go down a group?

Ans. (*i*)

Group 1 elements	Li	Na	K	Rb	Cs
Atomic radius (pm)	152	186	231	244	262

(*ii*) The element Li has the smallest atom (atomic radius 152 pm) whereas the element Cs has the largest atom (atomic radius 262 pm).

(*iii*) From this arrangement, we find that the atomic size (or radius) increases down the group.

Q. 39. The elements of the second period of the Periodic Table are given below:

Li, Be, B, C, N, O, F

(*i*) Explain why atomic radius decreases from Li to F.

(*ii*) Identify the most metallic and non-metallic elements among the above elements.

Ans. (*i*) On moving from left to right along a period of the Periodic Table, atomic number increases, *i.e.*, number of protons and electrons increases which ultimately increases the nuclear charge. Hence, the electrons are pulled in closer to the nucleus which leads to contraction of the atom and thus atomic radius decreases.

(*ii*) On moving from left to right in a Periodic Table, metallic character decreases and non-metallic character increases. This is because the capacity to lose electrons from the outermost orbit of an atom (called ionisation energy) decreases. Hence, among the above elements Li being placed on the extreme left side is most metallic and F being placed on the extreme right side is the most non-metallic element.

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Q. 40. The atomic numbers of nitrogen, oxygen and fluorine are 7, 8 and 9 respectively. Write the electronic configuration of each element and answer the following questions:

(*i*) Which one of N, O and F is most electronegative and which one is least electronegative?

(*ii*) What is the number of valence electrons of F?

(*iii*) What is valency of each one of N, O and F?

Ans. Electronic configuration of

Nitrogen	:	K L 2, 5
Oxygen	:	K L 2, 6
Fluorine	:	K L 2, 7

(*i*) Fluorine (F) is the most electronegative and nitrogen (N) is the least electronegative.

(*ii*) Fluorine (F) has 7 valence electrons.

(*iii*) Valency of nitrogen is 3 and 5, valency of oxygen is 2, valency of fluorine is 1.

Q. 41. Consider the following elements:

Li, Cl, Br, Na, K, I

(*i*) Arrange the elements according to the groups to which they belong in the Periodic Table.

(*ii*) What are the common properties on the basis of which the elements have been grouped together?

Ans. (*i*) Li, Na and K are grouped together in the periodic table and belong to group 1. They are grouped together because all of them have one electron in their valence shell. Rest of the elements Cl, Br and I are grouped together in the periodic table and belong to group 17.

(*ii*) The elements of group 1 are called alkali metals because they react with water to liberate H_2 gas and form alkalis. The elements of group 17 are monovalent non-metals. They form acidic oxides and are called halogens.

Q. 42. Write the names given to the vertical columns and horizontal rows in the Modern Periodic Table. How does the metallic character of elements vary on moving down a vertical column? How does the size of atomic radius vary on moving left to right in a horizontal row ? Give reason in support of your answer in the above two cases. *[CBSE (Delhi) 2017]*

Ans. Vertical columns – Groups

Horizontal rows – Period

Metallic character increases on moving down a vertical column. This is because ability to lose electrons increases on moving down the group due to increase in distance between the nucleus and the valence electrons.

Atomic radius decreases on moving left to right across a period because the nuclear charge increases on moving from left to right across a period resulting in increase in the attraction between the nucleus and the valence electrons.

Q. 43. Two elements with symbol X (atomic no. 16) and Y (atomic no. 12) are placed in the III period of the Modern Periodic Table.

(*i*) Which amongst the two has more metallic character?

(*ii*) Calculate the valency of each element.

(*iii*) Element 'Y' is smaller than 'X' in terms of atomic size. Is the statement true, justify?

Ans. (*i*) Y (*ii*) 2 each

(*iii*) False, both are in same period but Y lies in group 2 and X in group 16. So, as we move from left to right size decreases with increase in nuclear charge.

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Q. 44. Taking the example of an element of atomic number 16, explain how the electronic configuration of the atom of an element relates to its position in the Modern Periodic Table and how valency of an element is calculated on the basis of its atomic number. *[CBSE (AI) 2015]*

Ans. Atomic number of the element = 16

Electronic configuration = K L M
2, 8, 6

Period number = Number of shells

The atom of the element has three shells. So, the period number is 3.

The atom of the element has six valence electrons. So, the group number of the element will be 16 (6 + 10).

Valency = Number of valence electrons (< 5) or 8 – number of valence electrons (> 5)

Q. 45. Calcium is an element with atomic number 20. Stating reason answer each of the following questions:

(*i*) Is calcium a metal or non-metal?

(*ii*) Will its atomic radius be larger or smaller than that of potassium with atomic number 19?

(*iii*) Write the formula of its oxide. *[CBSE Delhi 2016]*

Ans. (*i*) Calcium is a metal since it has two electrons in its outermost shell which it can lose easily.

(*ii*) K(19) is placed before Ca(20) in the same period (fourth period). Since the atomic radius decreases along a period, the atomic radius of calcium is smaller than that of potassium.

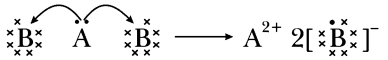
(*iii*) The formula of oxide of calcium is CaO, because the valency of calcium as well as that of oxygen is 2.

Q. 46. Write the electronic configuration of two elements A and B whose atomic numbers are 20 and 17 respectively. Write the molecular formula of the compound formed when element A reacts with element B. State whether this compound is acidic, basic or neutral. Give reason to justify your answer. *[CBSE 2019 (31/4/2)]*

Ans. A(20) – K L M N
2, 8, 8, 2

B(17) – K L M
2, 8, 7

The molecular formula of the compound is AB_2.



A is calcium and B is chlorine. The compound formed is calcium chloride, $CaCl_2$. It is a salt of strong base $Ca(OH)_2$ and strong acid HCl, so it is neutral in nature.

Q. 47. Based on the group valency of elements write the molecular formula of the following compounds giving justification for each:

(*i*) Oxide of first group elements.

(*ii*) Halide of the elements of group thirteen, and

(*iii*) Compound formed when an element, A of group 2 combines with an element, B of group seventeen. *[CBSE 2019 (31/1/1)]*

Ans. (*i*) Valency of first group elements is 1 and oxygen is 2. So, the molecular formula of the oxide is X_2O where X is the first group element.

(*ii*) Valency of group thirteen elements is 3 and halogens is 1. So, the molecular formula of the halide is XY_3 where X is the group thirteen element and Y is halogen.

(*iii*) Valency of element A is 2 and element B is 1. So, the compound formed is AB_2.

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Long Answer Questions [5 marks]

Each of the following questions are of 5 marks and have to be answered in about 80-90 words.

Q. 1. (i) How do you calculate the valency of an element from its electronic configuration?
(ii) What is the valency of magnesium with atomic number 12 and sulphur with atomic number 16?
(iii) How does the valency vary in a period on going from left to right?
(iv) How does the valency vary in going down a group?

Ans. (*i*) The valency of an element is determined by the number of valence electrons present in the outermost shell of its atom. The number of electrons lost or gained (or shared) by one atom of an element to achieve the nearest inert gas electron configuration, gives us the valency of the element.

(*ii*) (*a*) Atomic number of magnesium = 12

Electronic configuration is K L M
2, 8, 2

A magnesium atom can lose its 2 valence electrons to achieve the inert gas electronic configuration of neon (2, 8).

Therefore, valency of magnesium = 2.

(*b*) The atomic number of sulphur = 16.

Electronic configuration = K L M
2, 8, 6

A sulphur atom cannot lose 6 electrons to achieve inert gas electronic configuration due to energy consideration. It can gain 2 electrons to achieve the nearest inert gas electronic configuration of argon (2, 8, 8).

Thus, the valency of sulphur = 2.

(*iii*) On going from left to right along a period (short period), the valency of elements increases from 1 to 4 and then decreases to 0 (zero).

Third period	Na	Mg	Al	Si	P	S	Cl	Ar
Valency	1	2	3	4	3	2	1	0

(*iv*) All the elements in a group have the same valency.

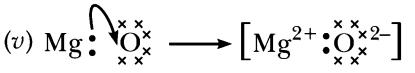
Q. 2. An element placed in 2nd Group and 3rd Period of the Periodic Table, burns in presence of oxygen to form a basic oxide.
(i) Identify the element.
(ii) Write the electronic configuration.
(iii) Write a balanced equation when it burns in the presence of air.
(iv) Write a balanced equation when this oxide is dissolved in water.
(v) Draw the electron dot structure for the formation of this oxide. *[NCERT Exemplar]*

Ans. (*i*) Magnesium (Mg)

(*ii*) K L M
2, 8, 2

(*iii*) $2Mg(s) + O_2(g) \longrightarrow 2MgO(s)$

(*iv*) $MgO(s) + H_2O(l) \longrightarrow Mg(OH)_2\ (aq)$

(*v*) 

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Q. 3. Atomic number of a few elements are given below:

10, 20, 7, 14

(*i*) Identify the elements.

(*ii*) Identify the Group number of these elements in the Periodic Table.

(*iii*) Identify the Periods of these elements in the Periodic Table.

(*iv*) What would be the electronic configuration for each of these elements?

(*v*) Determine the valency of these elements. [*NCERT Exemplar*]

Ans. (*i*) Elements — Neon (Ne), Calcium (Ca), Nitrogen (N), Silicon (Si)

(*ii*) Group — 18, 2, 15, 14

(*iii*) Period — 2, 4, 2, 3

(*iv*) Electronic configuration— (2, 8); (2, 8, 8, 2); (2, 5); (2, 8, 4)

(*v*) Valency — 0, 2, 3, 4

Q. 4. Mendeléev predicted the existence of certain elements not known at that time and named two of them as *Eka*-silicon and *Eka*-aluminium.

(*i*) Name the elements which have taken the place of these elements.

(*ii*) Mention the Group and the Period of these elements in the Modern Periodic Table.

(*iii*) Classify these elements as metals, non-metals or metalloids.

(*iv*) How many valence electrons are present in each one of them? [*NCERT Exemplar*]

Ans. (*i*) Germanium (Ge) and Gallium (Ga)

(*ii*) Group 14; Period 4 and Group 13; Period 4

(*iii*) Ge — Metalloid; Ga — Metal

(*iv*) Ga — 3; Ge — 4

Q. 5. An element X which is a yellow solid at room temperature shows catenation and allotropy. X forms two oxides which are also formed during the thermal decomposition of ferrous sulphate crystals and are the major air pollutants.

(*i*) Identify the element X.

(*ii*) Write the electronic configuration of X.

(*iii*) Write the balanced chemical equation for the thermal decomposition of ferrous sulphate crystals.

(*iv*) What would be the nature (acidic/basic) of oxides formed?

(*v*) Locate the position of the element in the Modern Periodic Table. [*NCERT Exemplar*]

Ans. (*i*) Element X is sulphur (atomic no. 16)

(*ii*) K L M

2, 8, 6

(*iii*) $2FeSO_4 \xrightarrow{\text{Heat}} Fe_2O_3(s) + SO_2(g) + SO_3(g)$

(*iv*) Acidic

(*v*) 3rd period, group 16

Q. 6. An element X of group 15 exists as diatomic molecule and combines with hydrogen at 773 K in presence of the catalyst to form a compound, ammonia which has a characteristic pungent smell.

(*i*) Identify the element X. How many valence electrons does it have?

(*ii*) Draw the electron dot structure of the diatomic molecule of X. What type of bond is formed in it?

(*iii*) Draw the electron dot structure for ammonia. What type of bond is formed in it?

[*NCERT Exemplar*]

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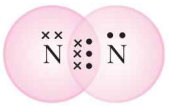
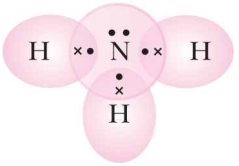
Ans. (*i*) Nitrogen (atomic no. 7)

Electronic configuration: 2, 5; it has 5 valence electrons.

(*ii*)  Triple covalent bonds

(*iii*)  3 Single covalent bonds

Q. 7. Give an account of the process adopted by Mendeléev for the classification of elements. How did he arrive at "Periodic Law"? *[NCERT Exemplar]*

Ans. (*i*) When Mendeléev started his work, 63 elements were known. He studied the compounds of these elements with oxygen and hydrogen. He selected hydrogen and oxygen as they are very reactive and formed compounds with most elements. The formulae of the hydrides and oxides formed by an element were treated as one of the basic properties of an element for its classification.

(*ii*) Elements with similar properties were arranged in a group.

(*iii*) Mendeléev observed that elements were automatically arranged in the order of increasing atomic masses.

Q. 8. The atomic number of an element 'X' is 19.

(*i*) Write its electronic configuration.

(*ii*) To which period of the Modern Periodic Table does it belong and what is its valency?

(*iii*) If 'X' burns in oxygen to form its oxide, what will be its nature – acidic, basic or neutral?

(*iv*) Write balanced chemical equation for the reaction when this oxide is dissolved in water.

[CBSE (F) 2016]

Ans. (*i*) Configuration of X (19) = K L M N
2, 8, 8, 1

(*ii*) It belongs to fourth period and its valency is 1.

(*iii*) Basic oxide (X_2O)

(*iv*) $X_2O + H_2O \longrightarrow 2XOH$

Q. 9. (*i*) How does the atomic radius change as you go

(*a*) from left to right in a period?

(*b*) down a group in the periodic table?

(*ii*) Two elements X and Y have atomic numbers 12 and 16 respectively. Write the electronic configuration for these elements. To which period of the Modern Periodic Table do these two elements belong? What type of bond will be formed between them and why?

Ans. (*i*) (*a*) Atomic radius decreases.

(*b*) Atomic radius increases.

(*ii*) Atomic number of element X = 12

Electronic configuration = K L M
2, 8, 2

Atomic number of element Y = 16

Electronic configuration = K L M
2, 8, 6

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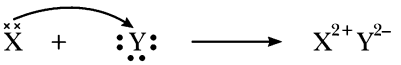
The period number of an element is equal to the number of electron shells in its atom. These two elements have 3 electron shells, therefore they belong to 3rd period.



They will form ionic bond because X is a metal and Y is a non-metal. X loses two electrons which will be gained by Y.

Q. 10. (*i*) How would the tendency to lose electrons change as you go

(*a*) from left to right across a period?

(*b*) down a group?

(*ii*) An element X (2, 8, 2) combines separately with $(NO_3)^-$, $(SO_4)^{2-}$ and $(PO_4)^{3-}$ radicals. Write the formulae of the three compounds so formed. To which group of the periodic table does the element 'X' belong? Will it form covalent or ionic compound? Why?

[*CBSE Delhi 2016*]

Ans. (*i*) (*a*) Tendency to lose electrons decreases.

(*b*) Increases.

(*ii*) The three compounds are $X(NO_3)_2$, XSO_4 and $X_3(PO_4)_2$.

Valence electrons of element X is 2. Therefore, element X belongs to group 2. It will form ionic compounds because X loses 2 electrons to achieve the electronic configuration of inert gas and forms a positively charged ion.

Q. 11. The position of eight elements in the Modern Periodic Table is given below where atomic numbers of elements are given in the parenthesis.

Period No.		
2	Li (3)	Be (4)
3	Na (11)	Mg (12)
4	K (19)	Ca (20)
5	Rb (37)	Sr (38)

(*i*) Write the electronic configuration of Ca.

(*ii*) Predict the number of valence electrons in Rb.

(*iii*) What is the number of shells in Sr?

(*iv*) Predict whether K is a metal or a non-metal.

(*v*) Which one of these elements has the largest atom in size?

(*vi*) Arrange Be, Ca, Mg and Rb in the increasing order of the size of their respective atoms.

[*CBSE (AI) 2016*]

Ans. (*i*) Electronic configuration of Ca –

K	L	M	N
2,	8,	8,	2

(*ii*) Valence electrons in Rb is 1.

(*iii*) Five

(*iv*) Metal

(*v*) Rb is biggest in size.

(*vi*) Be < Mg < Ca < Rb

Q. 12. (*i*) How is the valency of an element determined if its electronic configuration is known? Determine the valency of an element of atomic no. 9.

(*ii*) Given below are some elements of the Modern Periodic Table. Atomic numbers of the elements are given in parentheses:

A(4), B(9), C(14), D(19), E(20)

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(a) With the help of the electronic configuration, find out which one of the above elements will have one electron in its outermost shell.

(b) Which two elements belong to the same group? Give reasons for your answer.

(c) Which one of the above elements belonging to the fourth period has bigger atomic radius and why? *[CBSE 2019 (31/4/1)]*

Ans. (*i*) Valency is determined by the number of valence electrons *i.e.* electrons present in the outermost shell.

The number of electrons lost or gained (or shared) by one atom of an element to achieve the nearest noble gas configuration gives the valency of the element.

If number of valence electrons is less than or equal to 4, valency = number of valence electrons

If number of valence electrons is greater than 4, valency = 8 – number of valence electrons

The electronic configuration of the given element is 2, 7. It needs 1 more electron to achieve the configuration of noble gas, neon. So, its valency is 1.

Also, number of valence electrons is greater than 4, so valency = 8 – number of valence electrons *i.e.* 8 – 7 = 1

(*ii*) (*a*) D; the electronic configuration of D(19) is K L M N .
2, 8, 8, 1

(*b*) A and E belong to the same group as both have the same number of valence electrons, *i.e.*, 2.

(*c*) D and E belong to the fourth period. D has a bigger atomic radius than E because atomic radius decreases from left to right along the period due to increase in the nuclear charge.

Q. 13. Atoms of eight elements A, B, C, D, E, F, G and H have the same number of electronic shells but different number of electrons in their outermost shell. It was found that elements A and G combine to form an ionic compound which can also be extracted from sea water. This compound is added in a small amount to almost all vegetable dishes during cooking. Oxides of elements A and B are basic in nature while those of E and F are acidic. The oxide of D is almost neutral. Based on the above information, answer the following questions:

(*i*) To which group or period of the periodic table do the listed elements belong?

(*ii*) What would be the nature of compounds formed by a combination of elements B and F?

(*iii*) Which two of these elements could definitely be metals and which are likely to be non-metals?

(*iv*) Which one of the eight elements is most likely to be found in gaseous state at room temperature?

(*v*) If the number of electrons in the outermost shell of elements C and G be 3 and 7 respectively, write the formula of the compound formed by the combination of C and G.

(*vi*) Which one of the eight elements is likely to be a noble gas?

(*vii*) Which one of the eight elements would have the largest atomic radius?

(*viii*) Which one of these eight elements is likely to be a semi-metal or metalloid?

Ans. (*i*) Third period

Group—1, 2, 13, 14, 15, 16, 17, 18 respectively.

(*ii*) Nature of compound: Electrovalent/ionic

(*iii*) Metals—A and B; Non-metals—E, F, G

(*iv*) G/H

(*v*) CG_3

(*vi*) H

(*vii*) A

(*viii*) D

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Q. 14. Atoms of seven elements A, B, C, D, E, F and G have a different number of electronic shells but have the same number of electrons in their outermost shells. The elements A and C combine with chlorine to form an acid and common salt respectively. The oxide of element A is liquid at room temperature and is a neutral substance, while the oxides of the remaining six elements are basic in nature. Based on the above information answer the following questions:

(*i*) What could the element A be?

(*ii*) Will elements A to G belong to the same period or same group of the periodic table?

(*iii*) Write the formula of the compound formed by the reaction of the element A with oxygen.

(*iv*) Show the formation of the compound by a combination of element C with chlorine with the help of electronic structure.

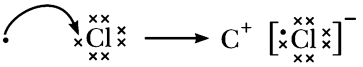
(*v*) What would be the ratio of number of combining atoms in a compound formed by the combination of element A with carbon?

(*vi*) Which one of the given elements is likely to have the smallest atomic radius?

Ans. (*i*) Hydrogen

(*ii*) Same group

(*iii*) A_2O/H_2O

(*iv*) 

(*v*) 4 : 1

(*vi*) A

Q. 15. In the following table, six elements A, B, C, D, E and F of the modern periodic table with atomic numbers 3 to 18 are given:

3	4	5	6	7	8	9	10
A					E		G
11	12	13	14	15	16	17	18
B	C		D			F	

(*i*) Which of these is (*i*) Noble gas (*ii*) halogen?

(*ii*) Which of these is the most active metal in 3rd period?

(*iii*) Identify the most electronegative element in the third period.

(*iv*) In the compound between B and F what type of bond will be formed?

(*v*) What would be the nature of oxide formed by C? *[CBSE Sample Paper 2016]*

Ans. (*i*) Noble gas – G

Halogen – F

(*ii*) Most active metal – B

(*iii*) Most electronegative in 3rd period – F

(*iv*) Ionic bond

(*v*) Oxide formed by C would be basic.

Q. 16. The electrons in the atoms of four elements A, B, C and D are distributed in three shells having 1, 3, 5 and 7 electrons respectively in their outermost shells. Write the group numbers in which these elements are placed in the Modern Periodic Table. Write the electronic configuration of the atoms of B and D and the molecular formula of the compound formed when B and D combine. *[CBSE 2019 (31/2/1)]*

Ans. A — Group 1 B — Group 13

C — Group 15 D — Group 17

The electronic configuration of B is K L M.
2, 8, 3

The electronic configuration of D is K L M.
2, 8, 7

When B and D combine, B donates its 3 valence electrons to three D atoms each acquiring the stable configuration of nearest noble gas neon and D obtains the stable configuration of nearest noble gas argon. The formula of the compound is BD_3.

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Q. 17. **(*i*) List any three observations which posed a challenge to Mendeleev's Periodic Law.**

(*ii*) How does the metallic character of elements vary on moving from

(*a*) left to right in a period,

(*b*) from top to bottom in a group of the Modern Periodic Table? Give reason for your answer. *[CBSE 2019 (31/2/1)]*

Ans. (*i*) (*a*) No fixed position was given to hydrogen.

(*b*) The position of isotopes was not fixed.

(*c*) The atomic masses do not increase in a regular manner in going from one element to another especially in case of heavier elements. So it was not possible to predict how many elements could be discovered between two elements.

(*ii*) (*a*) As we go from left to right in a period, the metallic character decreases, because of the addition of an electron in the same energy shell each time. So, attraction between the nucleus and the electrons in the outermost shell increases. Thus, tendency to lose an electron decreases and metallic character decreases.

(*b*) On moving from top to bottom in a group, metallic character increases. This is because new shells are being added as we go down the group. This increases the distance between the valence shell and the nucleus. Thus, tendency to lose an electron, increases and hence metallic character increases.

HOTS [Higher Order Thinking Skills]

Q. 1. **Using the part of the Periodic Table given below, answer the questions that follow:**

Groups → / Periods ↓	1	2	13	14	15	16	17	18
1	H							He
2	Li	Be	B	C	N	O	F	Ne
3	Na	Mg	Al	Si	P	S	Cl	Ar
4	K	Ca						

(*i*) Na has physical and chemical properties similar to which element (s) and why?

(*ii*) Write the electronic configuration of N and P. Which one of these will be more electronegative and why?

(*iii*) State a chemical property common to fluorine and chlorine.

Ans. (*i*) Lithium and potassium, due to same number of valence electrons.

(*ii*) $N \longrightarrow \begin{matrix} K\ L \\ 2,\ 5 \end{matrix}$ $\qquad P \longrightarrow \begin{matrix} K\ L\ M \\ 2,\ 8,\ 7 \end{matrix}$

N is more electronegative element as electronegativity decreases on moving down the group.

(*iii*) Both fluorine and chlorine form their hydracids on reacting with hydrogen.

$$H_2 + F_2 \longrightarrow 2HF$$

$$H_2 + Cl_2 \longrightarrow 2HCl$$

Q. 2. **Is it possible to have an element with atomic number 2.5?**

Ans. No, because the atomic numbers of elements are always in whole numbers.

Q. 3. **An element 'X' has mass number 35 and number of neutrons 18. Write atomic number and electronic configuration of 'X'. Also write group number, period number and valency of 'X'.** *[CBSE (AI) 2016]* *[CBSE 2019 (31/5/1)]*

Ans. Atomic number of X = Mass number of X – Number of neutrons

= 35 – 18 = 17

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Therefore, electronic configuration of X = K L M
2, 8, 7

Group number = 17

Period number = 3

Valency = 8 – 7 = 1

Q. 4. Three elements A, B and C have 3, 4 and 2 electrons respectively in their outermost shell. Give the group number to which they belong in the Modern Periodic Table. Also, give their valencies. [*NCERT Exemplar*]

Ans.

Element	Group Number	Valency
A	13	3
B	14	4
C	2	2

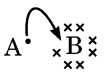
Q. 5. Compare the radii of two species X and Y. Give reasons for your answer.

(*i*) X has 12 protons and 12 electrons

(*ii*) Y has 12 protons and 10 electrons [*NCERT Exemplar*]

Ans. Radii of Y is less than X because Y is a cation of X.

Q. 6. Write the formula of the product formed when the element A (atomic number 19) combines with the element B (atomic number 17). Draw its electronic dot structure. What is the nature of the bond formed? [*NCERT Exemplar*]

Ans. AB  $\longrightarrow A^+ - B^-$

Ionic Bond

A = K (Potassium) B = Cl (Chlorine)

Q. 7. An element X (atomic number 17) reacts with an element Y (atomic number 20) to form a divalent halide.

(*i*) Where in the Periodic Table are elements X and Y placed?

(*ii*) Classify X and Y as metal (s), non-metal (s) or metalloid (s).

(*iii*) What will be the nature of oxide of element Y? Identify the nature of bonding in the compound formed.

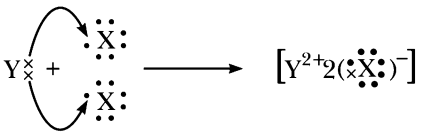
(*iv*) Draw the electron dot structure of the divalent halide. [*NCERT Exemplar*]

Ans. (*i*) X belongs to Group 17 and 3rd period

Y belongs to Group 2 and 4th period

(*ii*) X—Non-metal and Y—Metal

(*iii*) Basic oxide; Ionic bonding

(*iv*) 

Q. 8. (*i*) Electropositive nature of the element(s) increases down the group and decreases across the period.

(*ii*) Electronegativity of the element decreases down the group and increases across the period.

(*iii*) Atomic size increases down the group and decreases across a period (left to right).

(*iv*) Metallic character increases down the group and decreases across a period.

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On the basis of the above trends of the Periodic Table, answer the following about the elements with atomic numbers 3 to 9.

(*a*) Name the most electropositive element among them.

(*b*) Name the most electronegative element.

(*c*) Name the element with smallest atomic size.

(*d*) Name the element which is a metalloid.

(*e*) Name the element which shows maximum valency. *[NCERT Exemplar]*

Ans. (*a*) Lithium (*b*) Fluorine
(*c*) Fluorine (*d*) Boron
(*e*) Carbon

Q. 9. In the following table, the positions of six elements A, B, C, D, E and F are given as they are in the Modern Periodic Table:

Groups → / Periods ↓	1	2	3–12	13	14	15	16	17	18
2	A			B		C			D
3					E				F

On the basis of the above table, answer the following questions:

(*i*) Name the element which forms only covalent compounds.

(*ii*) Name the element which is a metal with valency three.

(*iii*) Name the element which is a non-metal with valency three.

(*iv*) Out of B and C, whose atomic radius is bigger and why?

(*v*) Write the common name for the family to which the elements D and F belong.

[CBSE (F) 2015]

Ans. (*i*) E
(*ii*) B
(*iii*) C
(*iv*) B, because atomic radius decreases from left to right due to increase in the nuclear charge.
(*v*) Noble gases

Q. 10. Two elements 'A' and 'B' belong to the 3rd period of Modern periodic table and are in group 2 and 13 respectively. Compare their following characteristics in tabular form :

(*i*) Number of electrons in their atoms **(*ii*) Size of their atoms**

(*iii*) Their tendencies to lose electrons **(*iv*) The formula of their oxides**

(*v*) Their metallic character **(*vi*) The formula of their chlorides**

[CBSE Delhi 2016]

Ans.

Characteristic		A	B
(*i*)	Number of electrons in their atoms	12	13
(*ii*)	Size of their atoms	Bigger	Smaller
(*iii*)	Their tendencies to lose electrons	More	Less
(*iv*)	The formula of their oxides	AO	B_2O_3
(*v*)	Their metallic character	More metallic	Less metallic
(*vi*)	The formula of their chlorides	ACl_2	BCl_3

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NCERT Corner

NCERT Intext Questions

Q. 1. Did Döbereiner's Triads also exist in the columns of Newlands' Octaves?

Ans. Döbereiner's Triads:

Li	Ca	Cl
Na	Sr	Br
K	Ba	I

Döbereiner's Triads also exist in the columns of Newlands' Octaves. For example, Lithium (Li), Sodium (Na), Potassium (K) constitute a Döbereiner's triad. Also, the second column of Newlands' classification has the elements Lithium (Li), Sodium (Na) and Potassium (K).

Q. 2. What were the limitations of Döbereiner's classification?

Ans. Döbereiner's system of classification failed to arrange all the elements in the form of triads having similar chemical properties. Döbereiner could identify only three triads from the elements known at that time.

Q. 3. What were the limitations of Newlands' Law of Octaves? *[CBSE 2019 (31/4/2)]*

Ans. (*i*) The Law of Octaves was applicable only up to calcium (*i.e.*, lighter elements) as after calcium, every eighth element did not possess properties similar to that of the first.

(*ii*) Newlands assumed that only 56 elements existed in nature and no more elements would be discovered in the future. After sometime, several new elements were discovered whose properties did not fit into the Law of Octaves.

(*iii*) Newlands adjusted two elements in the same slot, but also put some unlike elements under the same slot. For example, cobalt and nickel are in the same slot and these are placed in the same column as fluorine, chlorine and bromine which have very different properties than these elements. Iron, which resembles cobalt and nickel in properties, has been placed far away from these elements.

Q. 4. Use Mendeléev's Periodic Table to predict the formulae for the oxides of the following elements:

(*i*) K (*ii*) C (*iii*) Al (*iv*) Si (*v*) Ba

Ans. (*i*) The element K is in group I of Mendeléev's Periodic Table in which the general formula of the oxides of elements is R_2O, therefore, the formula of oxide of K will be K_2O.

(*ii*) The element C is in group IV of Mendeléev's periodic table in which the general formula of the oxides of elements is RO_2, therefore, the formula of oxide of C will be CO_2.

(*iii*) The element Al is in group III of Mendeléev's Periodic Table in which the general formula of the oxides of elements is R_2O_3, therefore, the formula of oxide of Al will be Al_2O_3.

(*iv*) The element Si is in group IV of Mendeléev's Periodic Table in which the general formula of the oxides of elements is RO_2, therefore, the formula of oxide of Si will be SiO_2.

(*v*) The element Ba is in group II of Mendeléev's Periodic Table in which the general formula of the oxides of elements is RO, therefore, the formula of oxide of Ba will be BaO.

Q. 5. Besides gallium, which other elements have since been discovered that were left by Mendeléev in his Periodic Table? **(*Any two*)**

Ans. Scandium and Germanium

Q. 6. What were the criteria used by Mendeléev in creating his Periodic Table? *[CBSE 2019 (31/4/3)]*

Ans. When Mendeléev started his work, 63 elements were known. He tried putting the elements in order of their atomic masses. He also examined the relationship between the atomic masses

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of the elements and their physical and chemical properties. Among chemical properties, Mendeléev focused on the compounds formed by elements with oxygen and hydrogen. He selected hydrogen and oxygen as they are very reactive and formed compounds with most elements. The formulae of the oxides and hydrides formed by an element were treated as one of the basic properties of an element for its classification. He then took 63 cards and on each card he wrote down the properties of one element. He selected the elements with similar properties and pinned the cards together on a wall. He observed that most of the elements got a place in a Periodic Table and were arranged in the order of their increasing atomic masses.

Q. 7. Why do you think the noble gases are placed in a separate group?

Ans. Noble gases are very unreactive. So, they are placed in a separate group, *i.e.*, zero group.

Q. 8. How could the Modern Periodic Table remove various anomalies of Mendeléev's Periodic Table?

Ans. With the adoption of atomic number as the basis of classification of elements, some of the anomalies in the Mendeléev's Periodic Table now disappear. These are:

(*i*) Position of hydrogen: The atomic number of hydrogen is 1 and hence, it should occupy the first position in group 1 of the Periodic Table. But, because of its chemical similarity with elements of group 1 and group 17, the position of hydrogen in the Periodic Table is still debated.

(*ii*) Position of isotopes: As the isotopes of an element have the same atomic number, they should occupy the same place in the Periodic Table.

(*iii*) Position of anomalous pair: The position of anomalous pair of elements, *i.e.*, pair of elements in which the element with higher atomic mass precedes the element with lower atomic mass is also decided. When these elements are arranged in order of their atomic numbers, they occupy their natural places in the Periodic Table as shown in the following table.

Anomalous Pair of Elements

	Pair of elements	Atomic weight	Atomic number	Group
(*i*)	Cobalt	58.9	27	9
	Nickel	58.7	28	10
(*ii*)	Tellurium	127.6	52	16
	Iodine	126.9	53	17

Q. 9. Name two elements you would expect to show chemical reactions similar to magnesium. What is the basis of your choice?

Ans. Beryllium (Be) and Calcium (Ca) are the two elements which will show chemical reactions similar to magnesium because Be and Ca belong to the same group (group 2) of the Periodic Table as magnesium (group 2). All of these have same number of electrons (*i.e.*, 2) in their outermost shell.

Q. 10. Name:

(*i*) three elements that have only a single electron in their outermost shells.

(*ii*) two elements that have two electrons in their valence shells.

(*iii*) three elements with completely filled outermost shells.

Ans. (*i*)

Element	Atomic Number	Electronic Configuration
Lithium (Li)	3	2, 1
Sodium (Na)	11	2, 8, 1
Potassium (K)	19	2, 8, 8, 1

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(*ii*)

Element	Atomic Number	Electronic Configuration
Beryllium (Be)	4	2, 2
Magnesium (Mg)	12	2, 8, 2

(*iii*)

Element	Atomic Number	Electronic Configuration
Helium (He)	2	2
Neon (Ne)	10	2, 8
Argon (Ar)	18	2, 8, 8

Q. 11. **(*i*) Lithium, sodium, potassium are all metals that react with water to liberate hydrogen gas. Is there any similarity in the atoms of these elements?**

(*ii*) Helium is an unreactive gas and neon is a gas of extremely low reactivity. What, if anything, do their atoms have in common?

Ans. (*i*) All these metals have one electron in their respective outermost shells.

Also, all these elements of group 1 form basic oxides.

(*ii*) The outermost shells of the atoms of helium and neon are completely filled with electrons.

Q. 12. **In the Modern Periodic Table, which are metals among the first ten elements?**

Ans. The first ten elements are : H, He, Li, Be, B, C, N, O, F, Ne. Among these, only two elements Li (lithium) and Be (beryllium) are metals.

Q. 13. **By considering their position in the Periodic Table, which one of the following elements would you expect to have maximum metallic characteristic?**

Ga Ge As Se Be

Ans. Maximum metallic characteristic is found in elements on the extreme left side of the Periodic Table. Out of the above given elements, Beryllium (Be) will have the maximum metallic characteristic because it is on the extreme left side in the Periodic Table (group 2).

NCERT Exercises

Q. 1. **Which of the following statements is not a correct statement about the trends when going from left to right across the periods of Periodic Table?**

(*a*) The elements become less metallic in nature.

(*b*) The number of valence electrons increases.

(*c*) The atoms lose their electrons more easily.

(*d*) The oxides become more acidic.

Ans. (*c*) The atoms lose their electrons more easily.

Q. 2. **Element X forms a chloride with the formula XCl_2, which is a solid with a high melting point. X would most likely be in the same group of the Periodic Table as**

(*a*) Na (*b*) Mg (*c*) Al (*d*) Si

Ans. The element X forms a chloride XCl_2, therefore, its valency is 2. Out of the given elements Na, Mg, Al and Si, the element of valency 2 is Mg. So, X would most likely be in the same group of the Periodic Table as Mg.

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Q. 3. Which element has:

(*a*) two shells, both of which are completely filled with electrons?

(*b*) the electronic configuration 2, 8, 2?

(*c*) a total of three shells, with four electrons in its valence shell?

(*d*) a total of two shells, with three electrons in its valence shell?

(*e*) twice as many electrons in its second shell as in its first shell?

Ans. (*a*) Ne (2, 8) (*b*) Mg (*c*) Si (2, 8, 4)

(*d*) B (2, 3) (*e*) C (2, 4)

Q. 4. (*a*) What property do all elements in the same column of the Periodic Table as boron have in common?

(*b*) What property do all elements in the same column of the Periodic Table as fluorine have in common?

Ans. (*a*) They all have a valency of 3.

(*b*) They all have a valency of 1 because all have 7 valence electrons.

Q. 5. An atom has electronic configuration 2, 8, 7.

(*a*) What is the atomic number of this element?

(*b*) To which of the following elements would it be chemically similar?

(Atomic numbers are given in parentheses)

N (7) F (9) P (15) Ar (18)

Ans. (*a*) The atomic number of this element is obtained by adding all the electrons present in its electronic configuration.

$\therefore$ Atomic number = 2 + 8 + 7 = 17

(*b*) The electronic configuration of the given element = $\begin{matrix} \text{K} & \text{L} & \text{M} \\ 2, & 8, & 7 \end{matrix}$

Valence electron in its atom = 7

This element will be chemically similar to that element which has the same valence electron (7). The electronic configuration of the above elements are:

(*i*) N (7) : $\begin{matrix} \text{K} & \text{L} \\ 2, & 5 \end{matrix}$ (5 valence electrons)

(*ii*) F (9) : $\begin{matrix} \text{K} & \text{L} \\ 2, & 7 \end{matrix}$ (7 valence electrons)

(*iii*) P (15) : $\begin{matrix} \text{K} & \text{L} & \text{M} \\ 2, & 8, & 5 \end{matrix}$ (5 valence electrons)

(*iv*) Ar (18) : $\begin{matrix} \text{K} & \text{L} & \text{M} \\ 2, & 8, & 8 \end{matrix}$ (8 valence electrons)

Clearly, F (9) has 7 valence electrons just like that of the given element. Hence, the given element of atomic number 17 will be chemically similar to the element fluorine (F) of atomic number 9.

Q. 6. The position of three elements A, B and C in the Periodic Table are shown below:

Group 16	Group 17
—	—
—	A
—	—
B	C

(*a*) State whether A is a metal or a non-metal.

(*b*) State whether C is more reactive or less reactive than A.

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(c) Will C be larger or smaller in size than B?

(d) Which type of ion—cation or anion, will be formed by element A?

Ans. (a) Metals lie on the left-hand side of the Periodic Table whereas non-metals are found on the right-hand side. The element A is in group 17. Group 17 is on the right side of the Periodic Table. Thus, element A is a non-metal (called halogen).

(b) The chemical reactivity of non-metals decreases on going down in a group. In group 17, the chemical reactivity decreases on going down in a group. So, element C is less reactive than A.

(c) The atomic size decreases in moving from left to right along a period. So, atom C will be smaller in size than B.

(d) The element A of group 17 has 7 valence electrons. So, it will gain one electron to form a negatively charged ion (A^-). The negatively charged ion is called an anion. So, element A will form an anion.

Q. 7. Nitrogen (atomic number 7) and phosphorus (atomic number 15) belong to group 15 of the Periodic Table. Write the electronic configuration of these two elements. Which of these will be more electronegative? Why?

Ans. (a) Nitrogen (N) — At. No. = 7

Electronic configuration = K L
2, 5

(b) Phosphorous (P) — At. No = 15

Electronic configuration = K L M
2, 8, 5

Thus, nitrogen will be more electronegative because its atom has small size due to which the attraction of its nucleus for the incoming electron is more.

Q. 8. How does the electronic configuration of an atom relate to its position in the Modern Periodic Table?

Ans. The group number of elements having upto two valence electrons is equal to the number of valence electrons.

The group number of elements having more than two valence electrons is equal to the number of valence electrons plus 10.

For example,

No. of valence electrons	Group number in the Periodic Table
1 2	Group number = Number of valence electrons
3	3 + 10 = 13
4	4 + 10 = 14
5	5 + 10 = 15
6	6 + 10 = 16
7	7 + 10 = 17
8 (or 2 valence electrons in K shell)	8 + 10 = 18

The number of electron shells in the atom of an element is equal to the period to which that element belongs in the Periodic Table. Also, the number of valence shell electrons increases by one unit as the atomic number increases by one unit on moving from left to right in a period.

Li	Be	B	C	N	O	F	Ne
2,1	2,2	2,3	2,4	2,5	2,6	2,7	2,8

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Q. 9. In the Modern Periodic Table, calcium (atomic number 20) is surrounded by elements with atomic numbers 12, 19, 21 and 38. Which of these have physical and chemical properties resembling calcium?

Ans. The atomic numbers of three elements which lie in the same group are 12, 20 and 38. So, the elements having atomic numbers 12 and 38 have physical and chemical properties resembling with calcium.

Atomic number	Electronic configuration
12	K L M 2, 8, 2
20	K L M N 2, 8, 8, 2
38	K L M N O 2, 8, 18, 8, 2

Q. 10. Compare and contrast the arrangement of elements in Mendeléev's Periodic Table and the Modern Periodic Table.

Ans.

Mendeléev's Periodic Table	Modern Periodic Table
(*i*) Elements have been arranged in order of their increasing atomic masses.	(*i*) Elements have been arranged in the order of their increasing atomic numbers.
(*ii*) There are only eight vertical columns called groups.	(*ii*) There are eighteen vertical columns, called groups.
(*iii*) Transition elements are arbitrarily placed together in a single group VIII.	(*iii*) Transition elements are placed in the middle of the table.
(*iv*) The inert gases were not known at the time of Mendeléev.	(*iv*) The inert gases have been placed at the end of Periodic Table *i.e.*, Group 18.
(*v*) No proper places are assigned to isotopes of elements.	(*v*) Isotopes of elements are assigned the same place as they have same atomic number.
(*vi*) There are misfit anomalous pair on the basis of atomic masses.	(*vi*) When atomic number is taken as the basis of classification, the misfit anomalous pair have been removed.

SELF-ASSESSMENT TEST

Time allowed: 1 hour **Max. marks: 40**

SECTION–A

Choose and write the correct answer for each of the following. **(4 × 1 = 4)**

1. Which one of the following elements exhibits maximum number of valence electrons? *[NCERT Exemplar]*

(*a*) Na (*b*) Al (*c*) Si (*d*) P

2. Which of the following elements is most electronegative?

(*a*) N (*b*) O (*c*) Cl (*d*) F

3. On moving from left to right in a period in the periodic table, the size of the atom *[NCERT Exemplar]*

(*a*) increases. (*b*) decreases.

(*c*) does not change appreciably. (*d*) first decreases and then increases.

4. The electronic configuration of an element is 2, 8, 8, 1. This element belongs to

(*a*) 3rd period. (*b*) 4th period. (*c*) 5th period. (*d*) 6th period.

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The following questions consist of two statements—Assertion(A) and Reason(R). Answer these questions selecting the appropriate option given below:

(*a*) **Both *A* and *R* are true and *R* is the correct explanation for *A*.**

(*b*) **Both *A* and *R* are true but *R* is not the correct explanation for *A*.**

(*c*) ***A* is true but *R* is false.**

(*d*) ***A* is false but *R* is true.** **(3 × 1 = 3)**

5. **Assertion (*A*) :** Li, Na, K form Döbereiner's triads.
Reason (*R*) : Atomic mass of Na is roughly the average of atomic masses of Li and K.

6. **Assertion (*A*) :** Magnesium belongs to 3rd period of modern periodic table.
Reason (*R*) : The valence electrons of magnesium is 2.

7. **Assertion (*A*) :** Isotopes are placed together in the modern periodic table.
Reason (*R*) : Isotopes have same atomic number.

Answer the following questions in one word or one sentence. **(3 × 1 = 3)**

8. Why no fixed position was assigned to hydrogen in Mendeléev's Periodic Table. *[CBSE 2019 (31/4/3)]*

9. Name the chemist, who arranged the known elements in order of their increasing atomic weight in the form of a table called Periodic table.

10. Name the law, according to which eighth element, starting from a given one, is a kind of repetition of the first, like the eighth note of an octave in music.

SECTION–B

Answer the following questions in about 50-60 words each. **(5 × 3 = 15)**

11. How does the tendency of the elements to lose electrons change in the Modern Periodic Table in (*i*) a group, (*ii*) a period and why? *[CBSE (F) 2016]*

12. Four elements A, B, C and D have atomic numbers 12, 13, 14 and 15 respectively.
Answer the following questions giving reasons:
(*i*) What is the number of valence electrons and valency of D?
(*ii*) Which of them will have largest atomic radii?
(*iii*) Which of these elements will form the most basic oxide? *[CBSE Sample Paper 2016]*

13. "Atomic number of an element is considered to be a more appropriate parameter than its atomic mass for a chemist." Take the example of the element X (atomic number 13) to justify this statement. *[CBSE 2019 (31/3/1)]*

14. An element 'X' (Atomic number = 20) burns in the presence of oxygen to form a basic oxide.
(*i*) Identify the element and write its electronic configuration.
(*ii*) State its group number and period number in the Modern Periodic Table.
(*iii*) Write a balanced chemical equation for the reaction when this oxide is dissolved in water. *[CBSE (F) 2016]*

15. An element 'X' belongs to 3rd period and group 16 of the Modern Periodic Table.
(*i*) Determine the number of valence electrons and the valency of 'X'.
(*ii*) Molecular formula of the compound when 'X' reacts with hydrogen and write its electron dot structure.
(*iii*) Name the element 'X' and state whether it is metallic or non-metallic. *[CBSE (AI) 2016]*

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SECTION–C

Answer the following questions in about 80–90 words each. **(3 × 5 = 15)**

16. The elements of a period of the periodic table are given below in order from left to right with one of its element missing:

Na Mg Al Si S Cl Ar

(*i*) To which period do these elements belong?

(*ii*) One element of this period is missing. Which is the missing element and where should it be placed?

(*iii*) Which one of these elements in this period shows the property of catenation?

(*iv*) Which one of these elements is least reactive?

(*v*) Identify the halogen from this period.

17. Answer the following questions based on the elements with atomic number 3 to 9:

[CBSE 2019 (31/5/3)]

(*i*) Name the element with smallest atomic radius.

(*ii*) Name the element which shows maximum valency.

(*iii*) Name the element which is a metalloid.

(*iv*) Name the element which is most electropositive.

(*v*) Write the chemical formula of the compound formed when the elements of atomic number 6 and 8 react together.

18. (*i*) The following is a list of the electronic distributions of atoms of unknown elements.

Element	**Electronic distribution**
A	2, 5
B	2, 8, 4
C	2, 8, 8, 2
D	2, 8, 18, 8
E	2, 8, 18, 8, 1
F	2, 8, 18, 18, 7

Choose an element from the list for each of the following descriptions.

(*a*) It is a noble gas.

(*b*) It is a soft metal with a low density.

(*c*) It has a giant covalent structure similar to diamond.

(*d*) It can form a negative ion of the type X^{3-}.

(*ii*) How does electronic configurations of atoms change in a period with increase in atomic number?

Answers

1. (*d*) **2.** (*d*) **3.** (*b*) **4.** (*b*) **5.** (*a*) **6.** (*b*) **7.** (*a*)

8. The properties of hydrogen are similar to both alkali metals and halogens. So, no fixed position was assigned to hydrogen in Mendeléev Periodic Table.

9. Mendeléev

10. Newland's law of octaves

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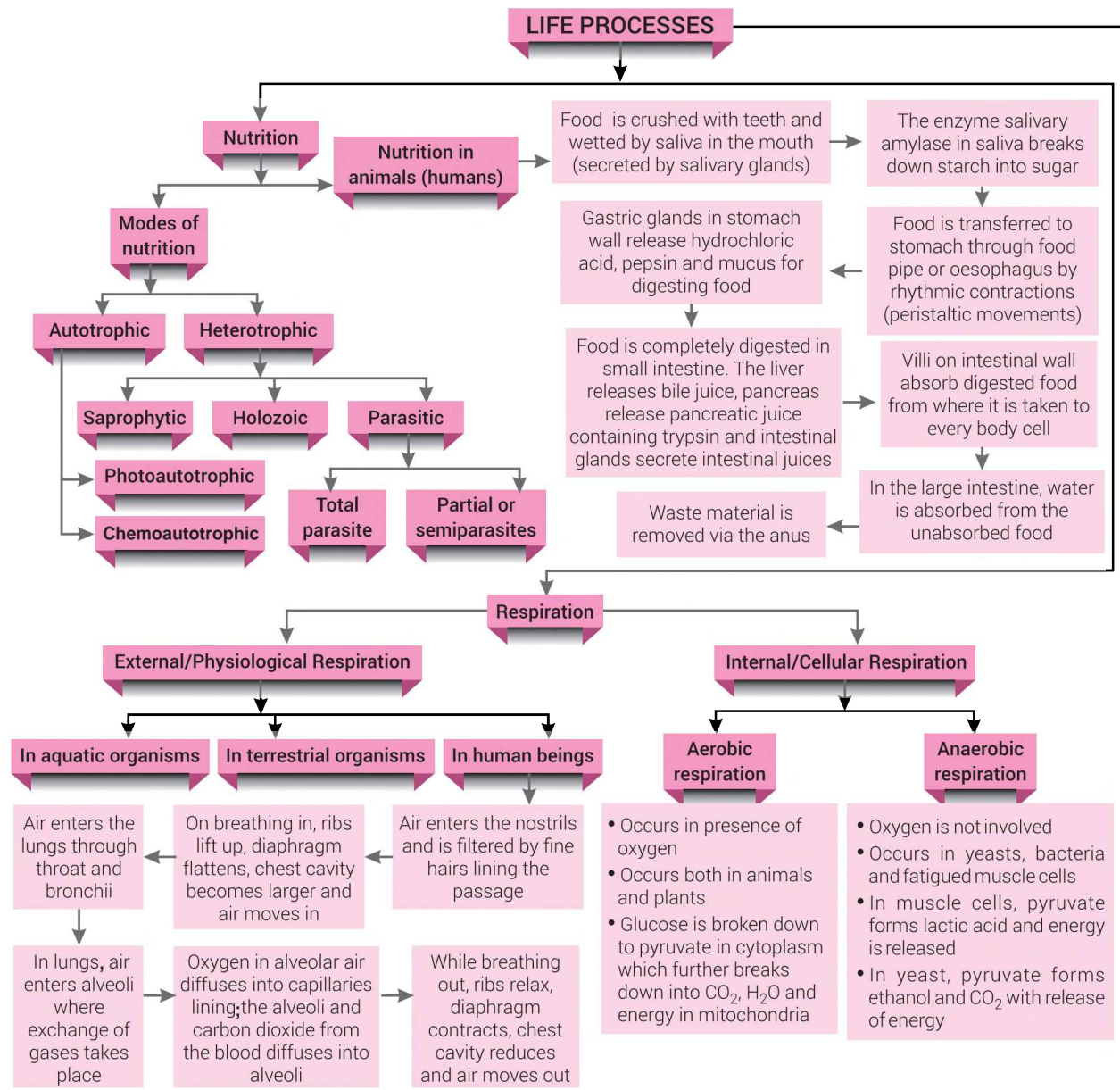
6 Life Processes

BASIC CONCEPTS—A FLOW CHART



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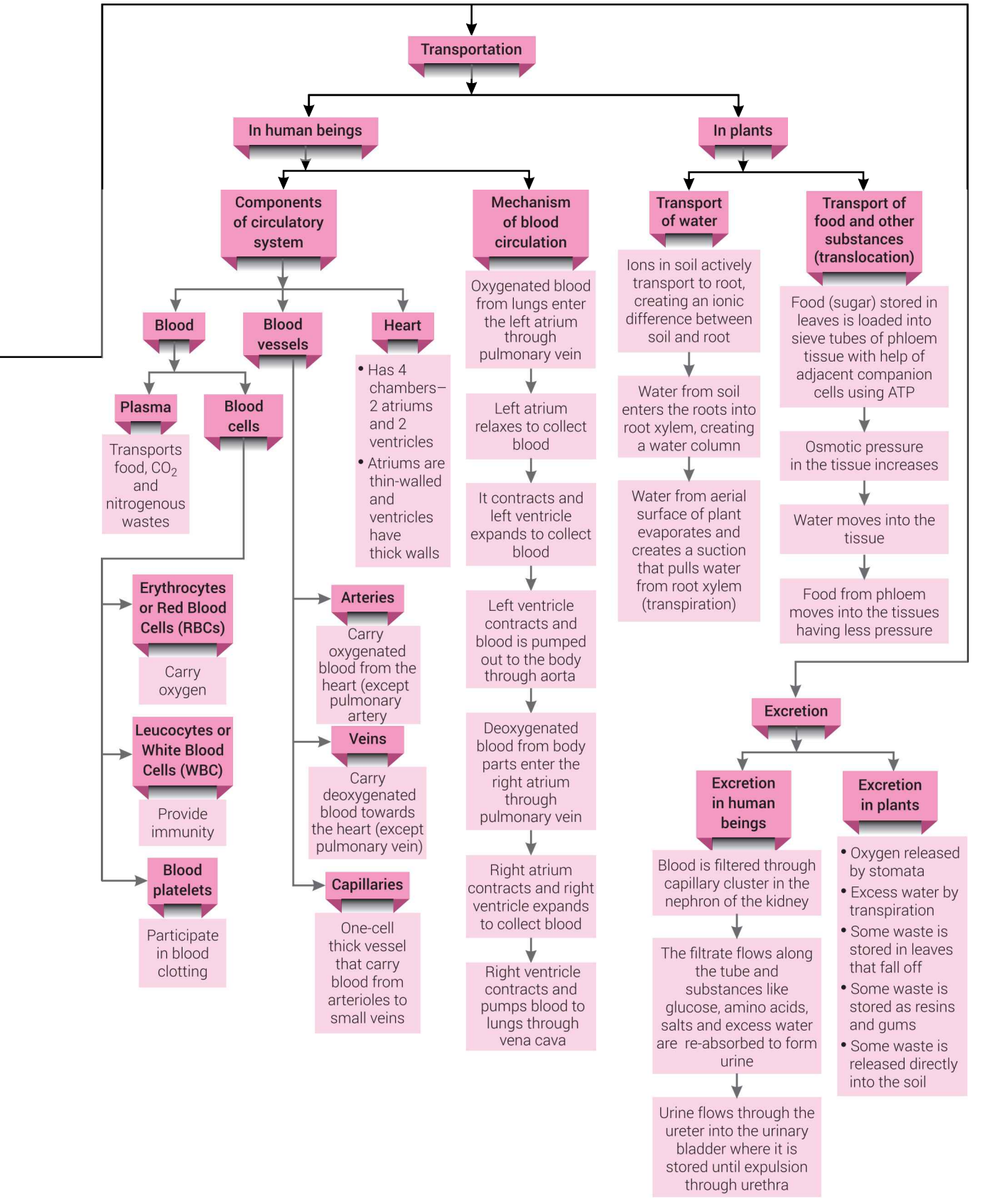

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MORE POINTS TO REMEMBER

- The ability to perform the basic life processes distinguishes a living organism from a non-living one.
- Life processes are the vital processes carried out by living organisms in order to maintain and sustain life. Molecular movements are essential to carry out the various life processes.
- Energy required to carry out the different life processes, is obtained from carbon-based food sources through nutrition.
- In the light reaction of photosynthesis, light energy is absorbed and converted to chemical energy in the form of ATP. Also water molecules split into hydrogen and oxygen. Carbon dioxide is reduced to carbohydrates in the dark phase of photosynthesis.
- In *Amoeba*, digestion occurs in the food vacuole, formed by the engulfing of food by its pseudopodia.
- In humans, digestion of food takes place in the alimentary canal, made up of various organs and glands.
- During respiration, the digested food materials are broken down to release energy in the form of ATP.
- In humans, air takes the following path after entering the nostrils.

  Nostrils ⟶ Nasal passage ⟶ Pharynx ⟶ Larynx ⟶ Trachea ⟶ Bronchus ⟶ Bronchiole ⟶ Alveolus
- Humans show double circulation and complete separation of oxygenated and deoxygenated blood.
- Lymphatic system consists of lymph, lymph nodes, lymphatic capillaries and lymph vessels which drain into larger veins. Lymph is also important in the process of transportation.
- During excretion, the harmful metabolic nitrogenous wastes generated are removed from the body.
- Plants do not have an excretory system and carries out excretion in various ways like transpiration, releasing wastes into surrounding soil, storing wastes in cell vacuoles and old xylem, and losing the leaves containing waste.

Multiple Choice Questions [1 mark]

Each question has 4 choices (a), (b), (c) and (d). Choose and write the correct option.

1. The green colour of plants is due to the presence of

(*a*) chlorophyll (*b*) carotene (*c*) xanthophyll (*d*) starch

2. During respiration exchange of gases take place in [*NCERT Exemplar*]

(*a*) trachea and larynx (*b*) alveoli of lungs

(*c*) alveoli and throat (*d*) throat and larynx

3. The correct sequence of anaerobic reactions in yeast is [*NCERT Exemplar*]

(*a*) Glucose $\xrightarrow{\text{Cytoplasm}}$ Pyruvate $\xrightarrow{\text{Mitochondria}}$ Ethanol + Carbon dioxide

(*b*) Glucose $\xrightarrow{\text{Cytoplasm}}$ Pyruvate $\xrightarrow{\text{Cytoplasm}}$ Lactic acid

(*c*) Glucose $\xrightarrow{\text{Cytoplasm}}$ Pyruvate $\xrightarrow{\text{Mitochondria}}$ Lactic acid

(*d*) Glucose $\xrightarrow{\text{Cytoplasm}}$ Pyruvate $\xrightarrow{\text{Cytoplasm}}$ Ethanol + Carbon dioxide

4. In which of the following vertebrate group/groups, heart does not pump oxygenated blood to different parts of the body? [*NCERT Exemplar*]

(*a*) Pisces and amphibians (*b*) Amphibians and reptiles

(*c*) Amphibians only (*d*) Pisces only

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5. **Blood from superior vena cava flows into**
(*a*) right atrium (*b*) right ventricle (*c*) left atrium (*d*) left ventricle

6. **Which is the first enzyme to mix with food in the digestive tract?** [*NCERT Exemplar*]
(*a*) Pepsin (*b*) Cellulase (*c*) Amylase (*d*) Trypsin

7. **In which part of the alimentary canal food is finally digested?** [*NCERT Exemplar*]
(*a*) Stomach (*b*) Mouth cavity (*c*) Large intestine (*d*) Small intestine

8. **When air is blown from mouth into a test-tube containing lime water, the lime water turned milky due to the presence of** [*NCERT Exemplar*]
(*a*) oxygen (*b*) carbon dioxide (*c*) nitrogen (*d*) water vapour

9. **Choose the correct path of urine in our body.** [*NCERT Exemplar*]
(*a*) Kidney → ureter → urethra → urinary bladder
(*b*) Kidney → urinary bladder → urethra → ureter
(*c*) Kidney → ureter → urinary bladder → urethra
(*d*) Urinary bladder → kidney → ureter → urethra

10. **The internal (cellular) energy reserve in autotrophs is** [*NCERT Exemplar*]
(*a*) glycogen (*b*) protein (*c*) starch (*d*) fatty acid

11. **Which is the correct sequence of parts in human alimentary canal?** [*NCERT Exemplar*]
(*a*) Mouth → stomach → small intestine → oesophagus → large intestine
(*b*) Mouth → oesophagus → stomach → large intestine → small intestine
(*c*) Mouth → stomach → oesophagus → small intestine → large intestine
(*d*) Mouth → oesophagus → stomach → small intestine → large intestine

12. **If salivary amylase is lacking in the saliva, which of the following events in the mouth cavity will be affected?** [*NCERT Exemplar*]
(*a*) Proteins breaking down into amino acids
(*b*) Starch breaking down into sugars
(*c*) Fats breaking down into fatty acids and glycerol
(*d*) Absorption of vitamins

13. **A few drops of iodine solution were added to rice water. The solution turned blue-black in colour. This indicates that rice water contains** [*NCERT Exemplar*]
(*a*) complex proteins (*b*) simple proteins
(*c*) fats (*d*) starch

14. **Which of the following is most appropriate for aerobic respiration?** [*NCERT Exemplar*]
(*a*) Glucose $\xrightarrow{\text{Mitochondria}}$ Pyruvate $\xrightarrow{\text{Cytoplasm}}$ $CO_2 + H_2O$ + Energy
(*b*) Glucose $\xrightarrow{\text{Cytoplasm}}$ Pyruvate $\xrightarrow{\text{Mitochondria}}$ $CO_2 + H_2O$ + Energy
(*c*) Glucose $\xrightarrow{\text{Cytoplasm}}$ Pyruvate + Energy $\xrightarrow{\text{Mitochondria}}$ $CO_2 + H_2O$
(*d*) Glucose $\xrightarrow{\text{Cytoplasm}}$ Pyruvate + Energy $\xrightarrow{\text{Mitochondria}}$ $CO_2 + H_2O$ + Energy

15. **Single circulation, *i.e.*, blood flows through the heart only once during one cycle of passage through the body, is exhibited by** [*NCERT Exemplar*]
(*a*) *Labeo*, Chameleon, Salamander (*b*) Hippocampus, Exocoetus, *Anabas*
(*c*) *Hyla, Rana, Draco* (*d*) Whale, Dolphin, Turtle

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16. Lack of oxygen in muscles often leads to cramps among cricketers. This results due to [NCERT Exemplar]

(a) conversion of pyruvate to ethanol (b) conversion of pyruvate to glucose
(c) non conversion of glucose to pyruvate (d) conversion of pyruvate to lactic acid

17. The opening and closing of the stomatal pore depends upon [NCERT Exemplar]

(a) oxygen (b) temperature
(c) water in guard cells (d) concentration of CO_2 in stomata

18. The inner lining of stomach is protected by one of the following from hydrochloric acid. Choose the correct one. [NCERT Exemplar]

(a) Pepsin (b) Mucus (c) Salivary amylase (d) Bile

19. Rings of cartilage present in the throat ensure that

(a) air is filtered (b) air is at room temperature
(c) air passage does not collapse (d) air is free of microbes

20. Which of the following organisms absorbs nutrition with haustoria?

(a) A carnivore (b) A herbivore (c) A parasite (d) A saprophyte

21. The process by which *Amoeba* obtains food is called

(a) phagocytosis (b) assimilation (c) diffusion (d) absorption

Answers

1. (a)	**2.** (b)	**3.** (d)	**4.** (d)	**5.** (a)	**6.** (c)	**7.** (d)
8. (b)	**9.** (c)	**10.** (c)	**11.** (d)	**12.** (b)	**13.** (d)	**14.** (d)
15. (b)	**16.** (d)	**17.** (c)	**18.** (b)	**19.** (c)	**20.** (c)	**21.** (a)

Assertion-Reason Questions

The following questions consist of two statements — Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

1. Assertion (A) : Plants lack excretory organs.
Reason (R) : Plants usually absorb essential nutrients.

2. Assertion (A) : In anaerobic respiration, one of the end product is alcohol.
Reason (R) : There is an incomplete breakdown of glucose.

3. Assertion (A) : In plants there is no need of specialised respiratory organs.
Reason (R) : Plants do not have great demands of gaseous exchange.

4. Assertion (A) : Bile is essential for digestion of lipids.
Reason (R) : Bile juice contains enzymes.

5. Assertion (A) : Carbohydrate digestion mainly takes place in small intestine.
Reason (R) : Pancreatic juice contains the enzyme lactase.

Answers

1. (b) **2.** (a) **3.** (a) **4.** (c) **5.** (c)

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Passage-based Questions

Answer the questions given below each passage on the basis of your understanding of the paragraph and the related studied concepts.

1. Tobacco is smoked in cigarettes, cigars, and pipes. Research shows that tobacco-related diseases kill nearly 13,500 people worldwide every day. It is predicted that, by 2020, tobacco-related diseases will cause 12% of all deaths globally.

Tobacco smoke contains many harmful substances. The most damaging substances are tar, nicotine and carbon monoxide. Tobacco smoke is inhaled into the lungs. Tar from the smoke is deposited in the lungs and this prevents the lungs from working properly. Some people use nicotine patches to help them to give up smoking. The patches are put on skin and they release nicotine into the blood. This helps to relieve cravings and withdrawal symptoms when people have stopped smoking.

(*i*) What is the important function of the lungs?

(*ii*) Name any one disease which is not caused by the increased tobacco smoking.

(*iii*) To study the effectiveness of nicotine patches, a group of 50 smokers is chosen randomly. The group is to be studied for six months. The effectiveness of the nicotine patches is to be measured by finding out how many people in the group have not resumed smoking by the end of the study. Which one of the following represents the appropriate experimental design?

(*a*) All the people in the group use the patches.

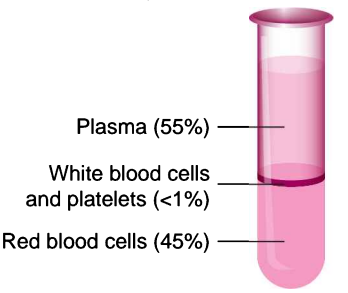
(*b*) All use patches except one person who tries to give up smoking without them.

(*c*) People choose whether or not they will use patches to help give up smoking.

(*d*) Half are randomly chosen to use patches and the other half do not use them.

(*iv*) What methods can be adopted to deal with the problem based on technology?

2. Blood is a fluid connective tissue that circulates throughout our body and delivers essential substances like oxygen to the body cells. It also transports metabolic waste products away from the cells. Figure alongside depicts the percentage composition of different components of blood.



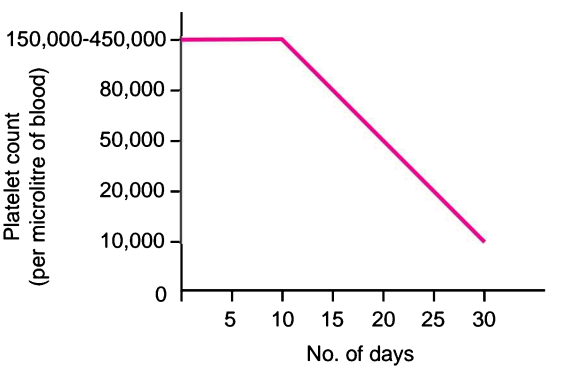
Blood cannot be made or manufactured outside the body. Blood donation is the only source of blood for patients that need blood transfusion.

(*i*) Why do you think donating blood isn't harmful even though red blood cells carry oxygen to the body cells?

(*ii*) Which component is deficient in your blood if you lose too much of blood from a cut?

(*iii*) Name the pigment present in red blood cells that carries oxygen from the lungs to all the body tissues.

(*iv*) Based on the information shown by the bar graph, what could be the possible cause for reduced platelet count?



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Answers

1. (*i*) To transfer the oxygen that you breathe to the blood is one of the important function of the lungs.

(*ii*) Chicken Pox

(*iii*) (*d*)

(*iv*) Increase production of nicotine patches to help people give up smoking.

2. (*i*) Red blood cells make up about 40% of our blood and are constantly being replaced in our body.

(*ii*) Platelets, as they help in clotting of blood.

(*iii*) Haemoglobin

(*iv*) Dengue, which is caused by the dengue virus, reduces the blood platelet count of a person drastically.

Very Short Answer Questions [1 mark]

Each of the following questions are of 1 mark and have to be answered in one word or one sentence.

Q. 1. Why is energy required by an organism even during sleep?

Ans. This is because even when an organism is asleep, various biological processes keep on occurring in its body which requires energy.

Q. 2. Give the energy transformation that takes place in the process of photosynthesis.

Ans. Solar energy is converted into chemical energy during photosynthesis.

Q. 3. Define photolysis.

Ans. The phenomenon of breaking down of water molecule using solar energy absorbed by chlorophyll molecules is known as photolysis.

Q. 4. Which is the largest gland in the human body?

Ans. Liver

Q. 5. Give an example of an organism whose digestion is intracellular.

Ans. *Amoeba*

Q. 6. Name the various cells through which water moves upward to reach the leaves.

Ans. Water absorbed by root hairs moves through epidermis → root cortex → endodermis → root xylem (*i.e.*, tracheids and vessels) → stem xylem → xylem in the leaf.

Q. 7. What will happen to a plant if its xylem is removed? *[CBSE Delhi 2009]*

Ans. The xylem tissue transports water and minerals from the soil to the leaves of a plant for photosynthesis. If xylem is removed, upward movement of water will stop leading to wilting of leaves and ultimately causes death of a plant.

Q. 8. In which chamber of heart is oxygenated and deoxygenated blood found?

Ans. Oxygenated blood: It is found in left auricle and left ventricle.

Deoxygenated blood: It is found in right auricle and right ventricle.

Q. 9. What makes red blood corpuscles red?

Ans. Haemoglobin

Q. 10. What will happen if platelets were absent in the blood? *[NCERT Exemplar]*

Ans. In the absence of platelets, the process of clotting will be affected.

Q. 11. What is the main function of kidneys in humans?

Ans. Kidneys excrete water and dissolve metabolic wastes, *e.g.*, urea and other dissolved solids like uric acid, creatinine and inorganic salts.

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Q. 12. In which part of nephron is water reabsorbed?

Ans. Proximal and distal convoluted tubules.

Q. 13. Which is the major nitrogenous waste product in human beings? How is it removed from the body?

Ans. The major nitrogenous waste product in human beings is urea. Urea is removed/ eliminated from the body through urine.

Q. 14. What is osmoregulation?

Ans. Osmoregulation is the maintenance of optimum concentration of water and salts in the body fluids.

Q. 15. In which form

(*i*) oxygen is carried to the tissues?

(*ii*) CO_2 moves out of the blood?

Ans. (*i*) Oxyhaemoglobin

(*ii*) Carboxyhaemoglobin and as carbonic acid (CO_2 dissolved in blood plasma).

Q. 16. Why do the walls of trachea not collapse when there is less air in it?

Ans. Tracheal walls do not collapse when there is less air in it because it is supported by rings of cartilage.

Q. 17. Which part of root is involved in the exchange of respiratory gases in plants?

Ans. Root hairs are involved in the exchange of respiratory gases in plants.

Q. 18. Name two organisms in which food material is broken down outside the body and absorbed.

Ans. Yeast, mushroom.

Q. 19. What prevents backflow of blood inside the heart during contraction?

Ans. Valves in heart prevent backflow of blood inside the heart during contraction.

Q. 20. Which is the first enzyme to mix with food in the digestive system?

Ans. Salivary amylase

Q. 21. Why does lack of oxygen in muscles often lead to cramps among cricketers?

Ans. This is due to the conversion of pyruvate to lactic acid in the absence of oxygen.

Q. 22. What is the internal (cellular) energy reserve in autotrophs?

Ans. Starch

Q. 23. In which forms do most plants absorb nitrogen?

Ans. Nitrates and nitrites

Q. 24. What is common for *Cuscuta*, ticks and leeches?

Ans. All are parasites. They derive their nutrition from plants or animals without killing them.

Q. 25. If salivary amylase is lacking in the saliva, which event in the mouth cavity will be affected?

Ans. Starch breaking down into sugars.

Q. 26. What protects the inner lining of stomach from hydrochloric acid?

Ans. The inner lining of stomach is protected from hydrochloric acid by mucus.

Q. 27. What is chyme?

Ans. The slightly digested food, enters into the stomach through the alimentary canal. In the stomach, this food is churned along with gastric juices converting this food into a semi-solid paste called chyme.

Q. 28. Name the enzyme which is present in infants but may be absent in adults.

Ans. Renin

Q. 29. What is ascent of sap?

Ans. Absorbed water from the soil also contains dissolved minerals (nitrates, phosphates, etc.) and hence it is called sap. This sap moves upwards due to the 'transpiration pull' developed in the xylem elements. Thus, transportation of sap from roots to the leaves at the top is called ascent of sap.

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Short Answer Questions [3 marks]

Each of the following questions are of 3 marks and have to be answered in about 50-60 words.

Q. 1. (i) What is compensation point?

(ii) "All plants give out oxygen during day and carbon dioxide during night". Do you agree with this statement? Give reason. *[NCERT Exemplar]*

Ans. (i) When the rate of photosynthesis is equal to rate of respiration, it is called as compensation point. The rate of liberation of O_2 during photosynthesis is equal to the rate of liberation of CO_2 during respiration. Thus, there is no net uptake of gases from the environment. Compensation point is usually reached at dusk and dawn and on a cloudy day.

(ii) During day time, as the rate of photosynthesis is more than the rate of respiration, the net result is evolution of oxygen. At night there is no photosynthesis, so they give out carbon dioxide due to respiration.

Q. 2. What happens to visible light of the Sun when it falls on chlorophyll?

Ans. Visible light of the Sun consists of seven colours—violet, indigo, blue, green, yellow, orange and red. Out of these lights of different wavelengths, chlorophyll absorbs mainly blue, violet, red and orange lights but does not absorb the green light. It is due to the reflection of green light by chlorophyll of the plants that the plants look green in colour.

Q. 3. (i) What is chlorophyll?

(ii) How does water affect the rate of photosynthesis in plants?

Ans. (i) Chlorophyll is a green coloured pigment found in the green leaves or green parts of the plant which traps solar energy for photosynthesis. Chlorophyll is present in cell organelles called chloroplasts.

(ii) Water controls the opening and closing of stomata. The deficiency of water causes stomata to open very little or it may even remain closed. Therefore, carbon dioxide (required as a raw material for photosynthesis) cannot enter into the leaves and thus lack of water slows down the rate of photosynthesis.

Q. 4. (i) What is peptic ulcer? How is peptic ulcer caused?

(ii) List two different functions performed by pancreas in our body. *[CBSE 2019 (31/1/3)]*

Ans. (i) An ulcer on the inner membrane lining of the stomach is called peptic ulcer. Peptic ulcer is caused by the high acidity of gastric juice secretions.

(ii) (a) Pancreas secrete digestive enzymes which help in the digestion process.

(b) The endocrine part of pancreas (Langerhans cells) produce hormones like glucagon, insulin, etc.

Q. 5. (i) What is root pressure?

(ii) What is transpiration pull?

Ans. (i) It is a pressure developed in the xylem due to metabolic activity of the root cells. It is a hydrostatic pressure developed in the root system that pumps the water or sap in the root xylem.

(ii) Water in the mesophyll cells of leaves (cells located below the stomata) is in contact with water or sap in xylem of leaf petiole, stem and root. This water evaporates by the process of transpiration. Thus, due to transpiration water is pulled upward which creates an upward suction force called 'transpiration pull'.

Q. 6. What is transpiration? List its two functions. *[CBSE 2019 (31/2/1)]*

Ans. The release of water in the form of vapour from the aerial parts of the plant through the pores called stomata, is called transpiration.

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Functions:

(*i*) It helps in the absorption and upward movement of water and minerals dissolved in it from roots to leaves.

(*ii*) It also helps in temperature regulation.

Q. 7. (*i*) What is translocation? Why is it essential for plants?

(*ii*) Where do the substances in plants reach as a result to translocation? [*CBSE 2019 (31/2/1)*]

Ans. (*i*) The transport of food from the leaves to other parts of the plant is called translocation. Leaves of the plants perform photosynthesis and produce carbohydrates (sugar) in the form of food which are translocated to the other parts of the plant through phloem. This allow plants to have access to raw materials needed during photosynthesis by leaves.

(*ii*) Non-photosynthetic parts of the plant like roots, flowers, fruits.

Q. 8. Plants have low energy needs as compared to animals. Explain. [*NCERT Exemplar*]

Ans. Plants do not move. In a large plant body there are many dead cells like sclerenchyma which provide strength to the plant but do not perform any cellular function. As a result they require less energy. Animals, on the other hand, need energy for different activities like movement or search of food. So, they require more energy.

Q. 9. Answer the following:

(*i*) Name the membrane covering the lungs.

(*ii*) What is the role of intercostal muscles in respiration and where are these found?

(*iii*) State the function of epiglottis.

Ans. (*i*) Pleura

(*ii*) Intercostal muscles are found in between the ribs. Their contraction and relaxation changes the volume of thoracic cavity so that air can enter and leave the lungs.

(*iii*) At the top of the trachea (or wind pipe) there is a flap of cartilage called epiglottis. The function of epiglottis is to cover the mouth of trachea (or wind pipe) when we swallow food so that the food may not enter the trachea (or wind pipe).

Q. 10. State the function of Bowman's capsule and glomerulus.

Ans. Bowman's capsule and glomerulus have semipermeable walls. The glomerulus, is a tuft of capillaries contained in Bowman's capsule. The water and dissolved substances (wastes and useful) are filtered into the Bowman's capsule and from here they are filtered into the tubule. Thus, both the structures act as filtering apparatus.

Q. 11. (*i*) Name the parts of the body responsible for excretion in

(*a*) *Amoeba*

(*b*) Earthworm.

(*ii*) What happens to glucose which enters the nephron along with the filtrate?

Ans. (*i*) (*a*) *Amoeba*: Contractile vacuole

(*b*) Earthworm: Nephridia

(*ii*) Glucose along with filtrate runs down through the long renal tubule by the action of cilia. Glucose, amino acids, salts, etc., are reabsorbed by the tubular cells and then secreted into the capillary blood cells by diffusion.

Q. 12. Write down the functions of lymph nodes.

Ans. Functions of lymph nodes are:

(*i*) Lymph nodes produce and maintain the lymphocytes of blood. These are only found in the mammals.

(*ii*) Lymph nodes filter the blood and remove poisonous and foreign substances, *e.g.*, bacteria, debris, etc.

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Q. 13. Why are white blood corpuscles called soldiers of the body?

Ans. White blood corpuscles engulf (phagocytose) the foreign matter (bacteria, dust and other foreign material) entering the body, and are hence called soldiers. They produce antibodies against antigens, and antitoxins against toxins.

Q. 14. How do the guard cells regulate opening and closing of stomatal pores? [*NCERT Exemplar*]

Ans. The swelling of guard cells due to absorption of water causes opening of stomatal pores while shrinking of guard cells closes the pores. Opening and closing of stomata occurs due to turgor changes in guard cells. When guard cells are turgid, stomatal pore is open while in flaccid conditions, the stomatal aperture closes.

Q. 15. (*i*) Define light reaction.

(*ii*) Define dark reaction.

(*iii*) Two green plants are kept separately in oxygen-free containers, one in the dark and the other in continuous light. Which one will live longer? Give reasons. [*NCERT Exemplar*]

Ans. (*i*) A chemical reaction, which take place only in the presence of light, is called light reaction or light dependent reaction. It takes place in grana of chloroplast.

(*ii*) A chemical reaction, which can take place even in the absence of light, is called a dark reaction or light independent reaction. It takes place in stroma of chloroplast.

(*iii*) Plant kept in continuous light will live longer because it will be able to produce oxygen required for its respiration by the process of photosynthesis.

Q. 16. In each of the following situations what happens to the rate of photosynthesis?

(*i*) Cloudy days **(*ii*) No rainfall in the area**

(*iii*) Good manuring in the area **(*iv*) Stomata get blocked due to dust** [*NCERT Exemplar*]

Ans. (*i*) Decreases (*ii*) Decreases

(*iii*) Increases (*iv*) Decreases

Q. 17. (*i*) Name the energy currency in the living organisms. When and where is it produced? [*NCERT Exemplar*]

(*ii*) What happens to the rate of breathing during vigorous exercise and why?

Ans. (*i*) Adenosine triphosphate (ATP) is the energy currency in the living organisms. It is produced in the mitochondria during respiration in living organisms and also during photosynthesis in plants.

(*ii*) During vigorous exercise, our body requires more energy and for this purpose more oxygen is needed, so the rate of breathing is increased. Oxygen intake rate increases by about 20 to 25 times.

Q. 18. Match the terms in Column (A) with those in Column (B): [*NCERT Exemplar*]

Column A	Column B
(*i*) Trypsin	(*a*) Pancreas
(*ii*) Amylase	(*b*) Liver
(*iii*) Bile	(*c*) Gastric glands
(*iv*) Pepsin	(*d*) Saliva

Ans. (*i*) — (*a*); (*ii*) — (*d*); (*iii*) — (*b*); (*iv*) — (*c*)

Q. 19. (*i*) Name the correct substrates for the following enzymes. [*NCERT Exemplar*]

(*a*) Trypsin **(*b*) Amylase**

(*c*) Pepsin **(*d*) Lipase**

(*ii*) Explain the role of mouth in digestion of food. [*NCERT Exemplar*]

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Ans. (*i*) (*a*) Protein (*b*) Starch (*c*) Protein (*iv*) Fats
(*ii*) (*a*) Food is crushed into small pieces by the teeth.
(*b*) It mixes with saliva and the enzyme amylase (found in saliva) breaks down starch into sugars.
(*c*) Tongue helps in thorough mixing of food with saliva.

Q. 20. Explain the statement, 'Bile does not contain any enzyme but it is essential for digestion.'

Ans. Bile does not contain any enzyme but it is essential for digestion because bile is alkaline and contain salts which helps to emulsify the fat present in the food. So, the bile perform two functions:
(*i*) The food coming from the stomach is acidic and has to be made alkaline for the pancreatic enzymes to act.
(*ii*) The bile salts breakdown the fat present in the food into smaller globules. This increases the efficiency of enzymes in the small intestine to digest the food effectively.

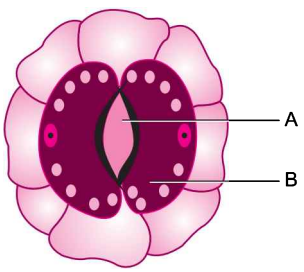
Q. 21. Why is blood circulation in human heart called double circulation? [*NCERT Exemplar*]

Ans. The blood circulation in human heart is called double circulation because the blood passes through the heart twice in one complete cycle of the body *i.e.*, once through the right half in the form of deoxygenated blood and once through the left half in the form of oxygenated blood.

Q. 22. What are the adaptations of leaf for photosynthesis? [*NCERT Exemplar*]

Ans. (*i*) Leaves provide large surface area for maximum light absorption.
(*ii*) Leaves are arranged at right angles to the light source in a way that causes overlapping.
(*iii*) The extensive network of veins enables quick transport of substances to and from the mesophyll cells.
(*iv*) Presence of numerous stomata for gaseous exchange.
(*v*) The chloroplasts are more in number on the upper surface of leaves.

Q. 23. Study the given diagram:



Name the parts 'A' and 'B' and state one function of each.

Ans. **A** → Stomatal pore
Function: Massive amounts of gaseous exchange takes place in the leaves through these pores for the purpose of photosynthesis.
B → Guard cell
Function: The opening and closing of the stomatal pore is a function of the guard cell.

Q. 24. Define the term transpiration. Design an experiment to demonstrate this process.
[*CBSE 2019 (31/1/2)*]

Ans. The loss of water in the form of vapour from the aerial parts of the plants is known as transpiration.
(*i*) Take a healthy potted plant.
(*ii*) Cover its leaves by a plastic sheet.
(*iii*) Place the plant in bright sunshine for an hour or so and observe it.
You will observe droplets of water on the inner surface of the plastic sheet. This shows that water is lost by leaves through stomata as a result of transpiration.

Q. 25. Why does absorption of digested food occur mainly in the small intestine? [*NCERT Exemplar*]

Ans. Maximum absorption occurs in small intestine because
(*i*) digestion is completed in small intestine.
(*ii*) inner lining of small intestine is provided with villi which increases the surface area for absorption.

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(*iii*) wall of intestine is richly supplied with blood vessels which take the absorbed food to each and every cell of the body.

Q. 26. What substances are contained in the gastric juice? What are their functions?

Ans. Gastric juice contains three substances: hydrochloric acid, enzyme pepsin and mucus.

Their functions are:

(*i*) Hydrochloric acid in the stomach is used to make the medium acidic to facilitate the action of the enzyme pepsin and to kill germs if any.

(*ii*) Enzyme pepsin digests proteins to convert them into peptones.

(*iii*) The mucus helps to protect the stomach wall from its own secretions of hydrochloric acid.

Q. 27. (*i*) Write the function of the following in the human alimentary canal:

(*a*) Saliva **(*b*) HCl in stomach**

(*c*) Bile juice **(*d*) Villi**

(*ii*) Write one function of each of the following enzymes:

(*a*) Pepsin **(*b*) Lipase** *[CBSE 2019 (31/4/2)]*

Ans. (*i*) (*a*) Saliva contains an enzyme, salivary amylase which digests the starch present in food into sugar.

(*b*) HCl in stomach creates an acidic medium which facilitates the action of pepsin. It also kills many kinds of bacteria in the food.

(*c*) Bile juice makes the medium alkaline and break down the fat present in the food into smaller globules.

(*d*) Villi increase the surface area for efficient absorption of food.

(*ii*) (*a*) Pepsin helps in breaking down or digestion of proteins.

(*b*) Lipase breaks down emulsified fats.

Q. 28. What are the various processes that take place in the duodenum?

Ans. Processes that take place in the duodenum are:

(*i*) Bile emulsifies the fat molecules present in the food into small globules.

(*ii*) The pancreatic enzyme trypsin starts digesting the proteins and the pancreatic amylase breaks down the starch.

(*iii*) Bile juice secreted by the liver and bicarbonate ions secreted by the duodenal wall makes the medium alkaline.

Q. 29. How does respiration occur in the roots of the plant?

Ans. Air is present in between the particles of the soil. The roots take the oxygen by the process of diffusion. Oxygen first diffuses into the root hairs and reaches all other cells of the root for respiration. CO_2 produced in the cells moves out through the root hairs by the process of diffusion. For respiration, in older roots, where root hair is not present, the exchange of gases takes place through lenticels (tiny openings in the protective layer) by the process of diffusion.

Q. 30. (*i*) Explain why the rate of photosynthesis in plants is low both at lower and higher temperatures.

(*ii*) Is green light most or least useful in photosynthesis and why?

Ans. (*i*) Photosynthesis is an enzymatic process. The enzymes function within an optimum range of temperature which is neither very low nor very high. At low temperature the activity of enzymes is lowered due to which the rate of photosynthesis is also low. Again when the temperature is very high, the activity of enzymes decreases which leads to low rate of photosynthesis.

(*ii*) Green light is least useful in photosynthesis, because chlorophyll does not absorb green light.

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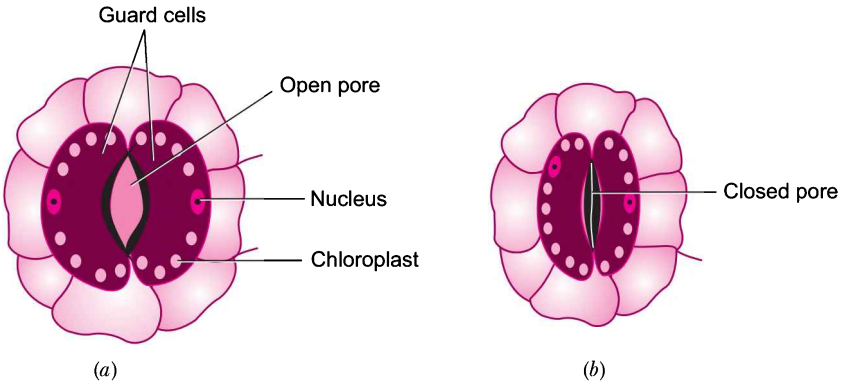
Q. 31. How does respiration occur in the following:

(*i*) Stem of the plant? (*ii*) In the leaves?

Ans. (*i*) In the stem of herbaceous plants, stomatas are present. So, the exchange of gases takes place through stomata by the process of diffusion. In the woody and hard stems of big plants, the exchange of gases takes place through lenticels which are present on the bark of the stem.

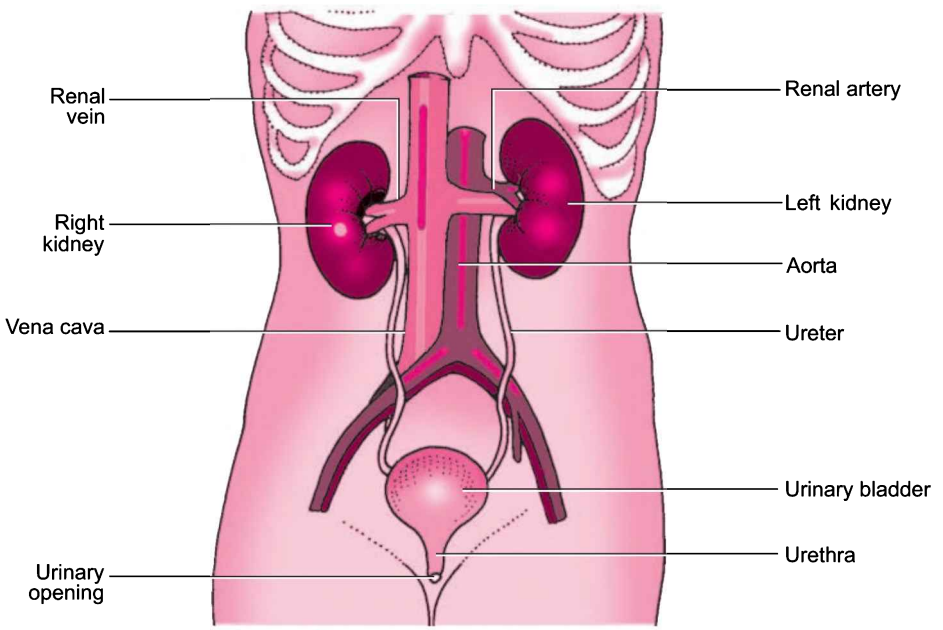


Open and closed stomata

(*ii*) Leaves have tiny openings on their lower surface called stomata. The exchange of gases takes place through the stomata by the process of diffusion.

Q. 32. Draw and label the parts of the human excretory system. *[CBSE 2019 (31/4/3)]*

Ans.



Human excretory system

Q. 33. Give reasons:

(*i*) Plants look green.

(*ii*) The respiratory surface of earthworm is its skin.

(*iii*) Nutrition is necessary for an organism.

(*iv*) We boil the leaf in alcohol when we are testing it for starch.

Ans. (*i*) The leaves of plants contain green pigments called chlorophyll which is necessary for photosynthesis. Plants reflect green light of sunlight, so they look green.

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(*ii*) The skin of earthworm is quite thin and moist and has rich blood supply. So, it respires through its skin.

(*iii*) An organism requires nutrients like carbohydrates, fats, proteins, minerals and vitamins for the growth, reproduction and metabolic activities, so nutrition is necessary for an organism.

(*iv*) We boil the leaf in alcohol to remove chlorophyll from green leaf.

Q. 34. List two types of the transport system in human beings and write the functions of any one of these.

Ans. The two types of transport system in humans are:

(*i*) Blood

(*ii*) Lymph

The following are the important functions of blood:

(*a*) It transports the digestive components of food to all the body cells.

(*b*) It also transports respiratory gases to body cells.

(*c*) It carries waste product for excretion.

(*d*) It acts as carrier of hormones.

Q. 35. (*i*) What is the advantage of having four chambered heart? [*NCERT Exemplar*]

(*ii*) Why is cigarette smoking injurious to health?

Ans. (*i*) In four chambered heart, left half is completely separated from right half by septa. This prevents oxygenated and deoxygenated blood from mixing. This allows a highly efficient supply of oxygenated blood to all parts of the body. This is useful in animals that have high energy needs, such as birds and mammals.

(*ii*) During smoking, the cigarette fumes make the walls of alveoli very thin which causes rupturing of alveoli. This reduces the surface area for gaseous exchange in lungs. To make up for the reduced gaseous exchange, the heart has to pump more blood. This over-burdening of the heart may cause heart failure.

Q. 36. Differentiate between an artery and a vein. [*NCERT Exemplar*]

Ans.

Artery	Vein
1. Thick-walled.	1. Thin-walled.
2. Carries blood from the heart to other parts of the body.	2. Carries blood from different organs to the heart.
3. Situated deeper under the skin.	3. Situated just under the skin.

Q. 37. Is 'nutrition' a necessity for an organism? Discuss. [*NCERT Exemplar*]

Ans. Food is required for the following purposes:

(*i*) It provides energy for the various metabolic processes in the body.

(*ii*) It is essential for the growth of new cells and repair or replacement of worn out cells.

(*iii*) It is needed to develop resistance against various diseases.

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Long Answer Questions [5 marks]

Each of the following questions are of 5 marks and have to be answered in about 80-90 words.

Q. 1. Describe the glands involved in the digestive system.

Ans.

S. No.	Organ	Gland	Secretion	Enzymes	Substrate	End product
1.	Mouth	Salivary	Saliva	Salivary amylase	Starch	Maltose
2.	Stomach	Gastric	Gastric juice	1. Pepsin 2. Lipase	Proteins Lipids	Peptones Glycerides
3.	Duodenum	1. Liver 2. Pancreas	Bile juice Pancreatic juice	No enzyme 1. Amylase 2. Trypsin 3. Lipase	Fat Starch Proteins Fats (emulsified)	Emulsification of fats (alkaline medium) Maltose Peptones, and peptides Fatty acids and glycerol
4.	Small intestine	Intestinal glands	Intestinal juice or Succus entericus	1. Erepsin 2. Enzyme for sugar digestion 3. Lipase	Peptones, and peptides Sugars Triglycerides	Amino acids Glucose Monoglycerides and fatty acids

Q. 2. What are the common features between all the respiratory organs? Explain the mechanism of gaseous exchange between tissues and blood.

Ans. Common features between all the respiratory organs are:

(*i*) All the respiratory organs have large surface areas to get enough oxygen.

(*ii*) All the respiratory organs are thin-walled for easy diffusion of gases and substances.

(*iii*) All the respiratory organs (like skin, lungs, gills) have a rich supply of blood for transporting respiratory gases.

The mechanism of gaseous exchange between tissues and blood is as follows:

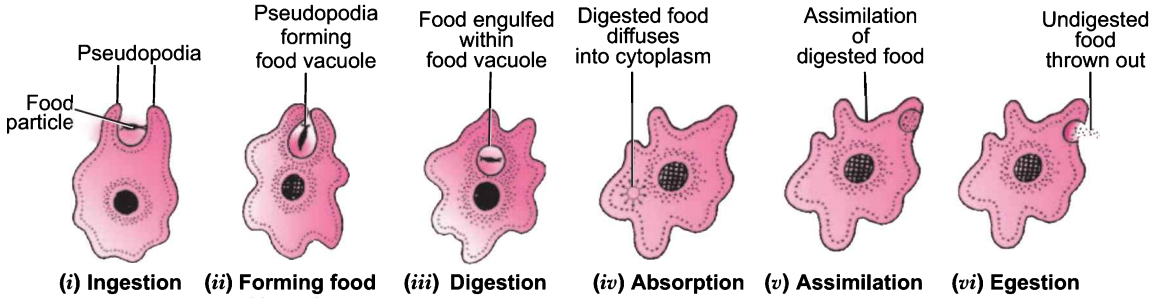
(*i*) The blood reaching the tissues has higher concentration of oxygen than in the cells so it gets diffused into the cells.

(*ii*) The carbon dioxide, which is formed in the cells, gets accumulated in higher concentration as compared in the blood, so it easily diffuses into the blood.

(*iii*) The blood with CO_2 takes this gas to the lungs, from where it is expelled out during exhalation.

Q. 3. Explain the nutrition process in an *Amoeba*. *[NCERT Exemplar]*

Ans. The mode of nutrition in *Amoeba* is holozoic.



Different stages in the nutrition of *Amoeba*

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The various steps involved in the process of nutrition are:

(*i*) **Ingestion:** *Amoeba* ingests food with the help of its finger-like extensions, called pseudopodia. When a food particle approaches *Amoeba*, it forms pseudopodia around it and forms a food vacuole inside the *Amoeba*.

(*ii*) **Digestion:** Various enzymes from the cytoplasm enter into the food vacuole and break them down into simple soluble molecules.

(*iii*) **Absorption:** The simple soluble food is absorbed by cytoplasm of *Amoeba* from food vacuoles through the process of diffusion.

(*iv*) **Assimilation:** *Amoeba* cell obtains energy from the absorbed food through respiration. This energy is utilised by *Amoeba* for its growth and repair of the body.

(*v*) **Egestion:** When a considerable amount of undigested food gets collected inside *Amoeba*, its cell membrane ruptures and throws out the undigested food.

Q. 4. Give the role of liver in the human beings.

Ans. Liver is the largest gland in human beings.

Its main functions are as follows:

(*i*) It secretes bile juice which makes the medium of the food alkaline and also emulsifies fat.

(*ii*) It stores the excess of glucose in the form of glycogen.

(*iii*) Old worn-out RBCs are broken down in liver cells.

(*iv*) The ammonia is produced as a result of metabolism of amino acids. It is highly toxic. The ammonia combines with CO_2 and is converted into urea (less toxic).

(*v*) It stores vitamins, iron and copper.

(*vi*) It produces fibrinogen and helps in blood-clotting.

(*vii*) It produces heparin which does not allow the clotting of blood inside the blood vessels.

(*viii*) It regulates the volume of blood to some extent.

(*ix*) RBCs are produced at the foetal stage by the liver.

Q. 5. (*i*) Describe aerobic respiration.

(*ii*) Describe the process of anaerobic respiration.

Ans. (*i*) The respiration which needs oxygen or occurs in the presence of oxygen is called aerobic respiration. During this type of respiration, glucose is broken down into carbon dioxide and water with the release of considerable amount of energy. The energy is stored in the form of ATP.

It consists of two steps:

(*a*) **Glycolysis:** The conversion of glucose into pyruvate (or pyruvic acid) is called glycolysis. It occurs in the cytoplasm.

(*b*) **Kreb's Cycle:** It is the process of converting pyruvate into CO_2 and H_2O along with the release of considerable amount of energy. It occurs in the mitochondria. One molecule of glucose liberates 38 ATP of energy during aerobic respiration.

$$\underset{\text{(1 molecule)}}{\text{Glucose}} \xrightarrow[\text{(Occurs in the cytoplasm)}]{\text{Glycolysis}} \underset{\substack{\text{(Pyruvate)}\\\text{(2 molecules)}}}{\text{Pyruvic acid}} \xrightarrow[\substack{\text{(Kreb's cycle occurs}\\\text{in mitochondria)}}]{\text{Oxygen}} 6CO_2 + 6H_2O + \underset{\text{Energy}}{38\ ATP}$$

(*ii*) The respiration which takes place in the absence of oxygen is called anaerobic respiration. During this respiration glucose is broken down into ethyl alcohol and CO_2 with the release of very small amount of energy. In anaerobic respiration, one molecule of oxygen produces only 2 ATP of energy. This type of respiration occurs in microscopic organisms like yeast, etc.

$$\underset{\substack{\text{(Pyruvate)}\\\text{(2 molecules)}}}{\text{Pyruvic acid}} \xrightarrow{\text{In the absence of oxygen}} \underset{\text{Ethyl alcohol}}{2C_2H_5OH} + 2CO_2 + \underset{\text{Energy}}{2ATP}$$

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In human beings, the energy is obtained by aerobic respiration but sometimes anaerobic respiration occurs in muscles during vigorous exercise when oxygen gets consumed faster than its supply by the blood. During the anaerobic respiration in the muscles the glucose is converted into lactic acid with the release of 2 ATP of energy.

Anaerobic respiration in human beings:

$$\underset{\text{(1 molecule)}}{\text{Glucose}} \xrightarrow[\text{(In cytoplasm)}]{\text{Glycolysis}} \underset{\substack{\text{(Pyruvate)}\\\text{(2 molecules)}}}{\text{Pyruvic acid}} \xrightarrow[\text{(Occurs in human muscles)}]{\text{In the absence of oxygen}} \underset{\text{(2 molecules)}}{\text{Lactic acid}} + \underset{\text{Energy}}{\text{2ATP}}$$

Q. 6. Distinguish between breathing and respiration.

Ans.

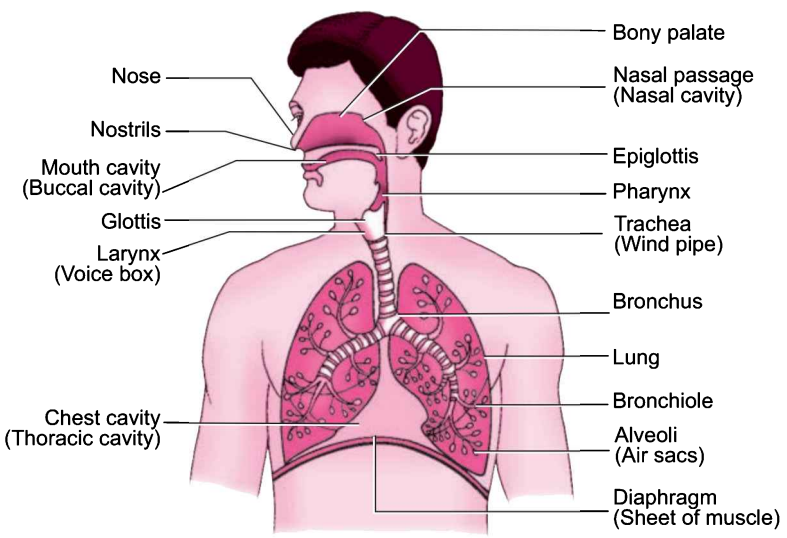
Breathing	Respiration
1. The process of obtaining oxygen and releasing carbon dioxide is called breathing.	1. The process of releasing energy from food is called respiration.
2. It is a physical process.	2. It is a chemical process.
3. It takes place in the lungs.	3. It takes place in the lungs as well as in mitochondria.
4. It utilises energy from the food.	4. It releases energy from the oxidation of simple food.

Q. 7. Explain process of breathing in man. *[NCERT Exemplar]*

Ans. Human respiratory system: The human respiratory system begins from nose cavities called nostrils. The air from cavity enters into the pharynx and then into the trachea (or wind pipe). The trachea runs down the neck and divides into two tubes called bronchi. Each bronchi is connected to a lung. In the lungs each bronchi divides into a large number of thin tubes called bronchioles. The bronchioles have a tiny air sac at their ends called alveoli. It is in the alveoli where exchange of gases takes place.

Mechanism of breathing:

(*i*) When we breathe in air, the diaphragm contracts which results in the increase in volume of chest cavity. Due to this expansion of chest cavity, the air pressure in the lungs decreases. Thus, air from outside rushes into the lungs through nostrils, trachea and bronchi. Therefore, air sacs of lungs get filled with air when we breathe in. The exchange of gases between alveoli and blood takes place by the process of diffusion.



Human respiratory system

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(*ii*) Now, the air present in air sacs of the lungs is rich in CO_2. When we breathe out air, the diaphragm relaxes which results in the decrease in volume of chest cavity. This contraction pushes the air from the lungs into the trachea, nostrils and then out of the body into air.

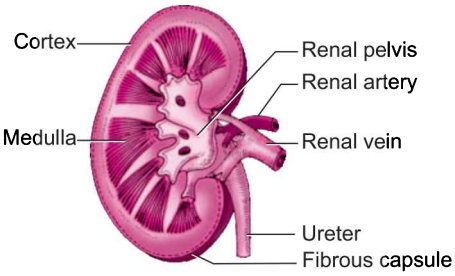
Breathing in air is called inhalation and breathing out air is called exhalation.

Mechanism of gaseous exchange during respiration: The oxygen is carried by blood to all the parts of the body. As the blood passes through the tissues of the body, the oxygen from the blood diffuses into the cell, whereas the CO_2 which is produced during respiration diffuses into the blood and is carried to the lungs.

Q. 8. Describe the structure of human kidney.

Ans. Kidneys are bean-shaped and located at the back of abdomen, one on either side of backbone.

Its inner concave surface has a depression called hilum through which renal artery enters and renal vein leaves the kidney. Kidney has two regions: outer cortex and inner medulla. Each kidney has a large number of filtering units called nephrons.



Longitudinal section of kidney

Q. 9. Describe the process of digestion of food in human beings.

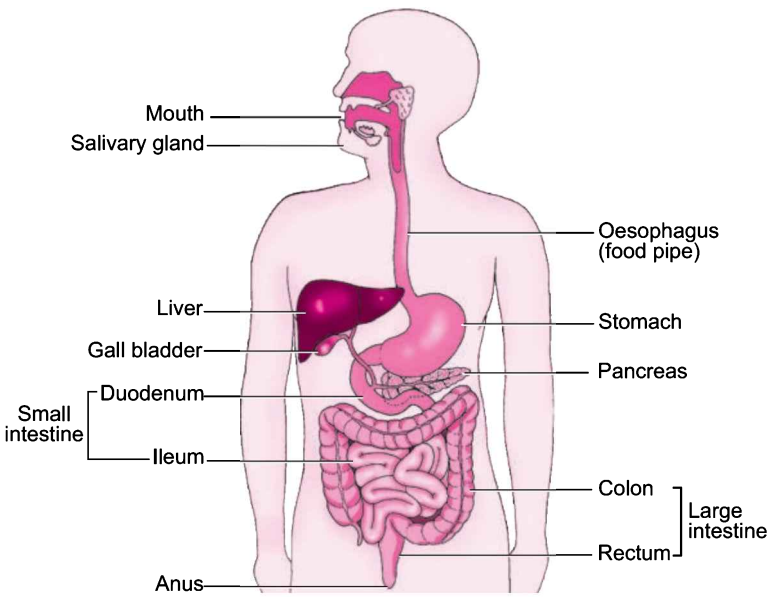
OR

Draw the diagram of alimentary canal of man and label the following parts: [*NCERT Exemplar*]
Mouth, Oesophagus, Stomach, Intestine

OR

How do carbohydrates, proteins and fats get digested in human beings? [*NCERT Exemplar*]

Ans.



Human digestive system

The various processes involved in the digestion of human beings are:

(*i*) **Ingestion:** Through the help of mouth human beings ingest food.

(*ii*) **Digestion:** The teeth helps in physical digestion of food. In mouth there are salivary glands, which secrete saliva, in which salivary amylase enzyme is present which digest the starch present in food into maltose sugar, *i.e.*, the digestion of carbohydrate starts from mouth itself. Mouth opens into a small funnel-shaped area called pharynx which leads to a long tube called **oesophagus,** whose wall is highly muscular. When the slightly digested food enters into oesophagus the contraction and expansion movement of its wall, takes place, which is known as **peristaltic movement**. This movement helps the food to move towards

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the stomach. Usually, in oesophagus there is no digestion of food. From the oesophagus the food enters into the stomach. In the stomach there is secretion of gastric juices which is a mixture of hydrochloric acid, pepsin (protein digesting enzyme) and mucus. Now, the partially digested food enters from stomach into the small intestine's wider part which is known as **duodenum** and the remaining part of the small intestine is termed as **ileum**. The duodenum, receives secretions of two glands, i.e., liver and pancreas. Liver secretes bile pigments and pancreas secretes pancreatic juice which digestes the proteins, carbohydrates and emulsified fats. Here the digestive enzymes are **amylase**, **maltose** and **invertase** for digesting the carbohydrates, trypsin for proteins and lipase for fats. Thus, food is completely digested in ileum part of small intestine.

(*iii*) **Absorption:** Now, the food enters from duodenum into ileum part of small intestine where millions of finger-like projections known as villi are present which absorb the food.

(*iv*) **Assimilation:** The blood carries the digested and dissolved food to all parts of the body, where it is assimilated into the cells which is used for obtaining energy as well as for growth and repair of the body.

(*v*) **Egestion:** The undigested food enters into the large intestine's wider part, where water is absorbed from the undigested food and the food becomes solid. Now, this solid undigested food enters the last part of large intestine known as rectum through which it moves out from the body.

Q. 10. Define the terms, 'nutrition' and 'nutrients'. List two differences between 'holozoic nutrition' and 'saprophytic nutrition'. Give two examples of each of these two types of nutrition.

Ans. **Nutrition:** The process by which the living organisms receive and utilise the food materials necessary for their survival, growth and repair of worn-out tissues is called nutrition.

Nutrients: Those substances which supply nourishment to living organisms from its surroundings and use it as an energy source or for biosynthesis of body constituents.

Holozoic nutrition	Saprophytic nutrition
1. In this type of nutrition solid and complex organic food is directly taken into the body.	1. In saprophytic nutrition, the organism obtains nutrients from the dead and decaying organic matter. The food is digested outside the body of the organism and then absorbed.
2. This type of nutrition takes place in 5 steps namely ingestion, digestion, absorption, assimilation and egestion.	2. Saprophytic nutrition takes place by absorption of break-down products.
3. Example: *Amoeba*, different vertebrates.	3. Example: Bacteria, fungi, *Rhizopus*, yeast.

Q. 11. Differentiate between blood and lymph.

Ans.

Blood	Lymph
1. Red in colour.	1. Colourless.
2. Red blood corpuscles are present.	2. Red blood corpuscles are absent.
3. Lymphocytes are present.	3. Lymphocytes are present more in number than the blood.
4. Nutritive substances are more.	4. Nutritive substances are less in amount.
5. Oxygen is more.	5. Oxygen is relatively less.
6. Metabolic wastes and CO_2 are in normal amount.	6. Both are more than in the blood.
7. Soluble proteins are more than insoluble proteins.	7. Insoluble proteins are more than soluble ones.
8. Fibrinogen in large amount.	8. Fibrinogen in less amount.

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Q. 12. **(*i*) Mention any two components of blood.**
(*ii*) Trace the movement of oxygenated blood in the body.
(*iii*) Write the function of valves present in between atria and ventricles.
(*iv*) Write one structural difference between the composition of artery and veins. *[CBSE 2018]*

Ans. (*i*) Components of blood are plasma, red blood cells, white blood cells, blood platelets. *[Any two]*

(*ii*) Path of movement of oxygenated blood in the body is as follows:

Lungs
↓
Left side of the heart
↓
Aorta
↓
Body organs

(*iii*) The valves allow blood to flow in only one direction and prevent backflow from the ventricles into the atria during systole.

(*iv*) Arteries have thick, elastic, muscular walls whereas veins have thin walls with few elastic fibers.

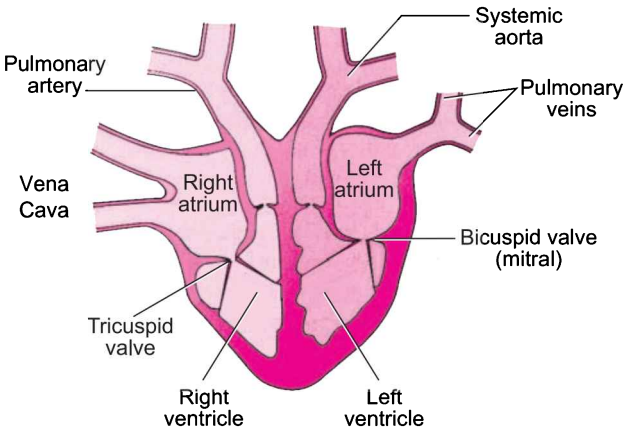
Q. 13. **Describe internal structure of a human heart.**

OR

Describe the flow of blood through the heart of human beings. *[NCERT Exemplar]*

Ans. The two auricles or atria are thin-walled and are separated from each other by a thin inter-atrial septum. The right atrium receives venous (deoxygenated blood having very little O_2) from the entire body through a superior and inferior vena cava. The left smaller atrium receives oxygenated blood from the lungs through four pulmonary veins.

The two auricles (atria) are separated from the ventricles by two apertures guarded by membranous valves. The valve separating right atrium from right ventricle is called right atrio-ventricular valve or tricuspid valve made up of three flaps. The valve separating left atrium from left ventricle is called left atrio-ventricular valve or mitral valve, formed of two flaps. These valves are attached with fine cords with the papillary muscles of the ventricular wall. These valves only allow blood flow from auricles into ventricles and not in opposite direction.



Longitudinal section of human heart

Both the ventricles are separated from each other by a thick inter-ventricular septum. The wall of left ventricle is much thicker than that of right ventricle. The left ventricle pushes blood into aorta which supplies blood to entire body. The opening of aorta is also guarded by a valve formed of 3 semilunar flaps. The right ventricle pumps venous blood into lungs by a pulmonary aorta. Its opening is also guarded by a valve, having 3 semilunar flaps. These valves allow the flow of blood from ventricles into the aorta and not back. Heart is formed of cardiac muscle fibres, which rhythmically contract the heart without feeling fatigue.

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Q. 14. **(*i*) Define excretion.**

(*ii*) Name the basic filtration unit present in the kidney.

(*iii*) Draw excretory system in human beings and label the following organs of excretory system which perform following functions:

(*a*) Form urine.

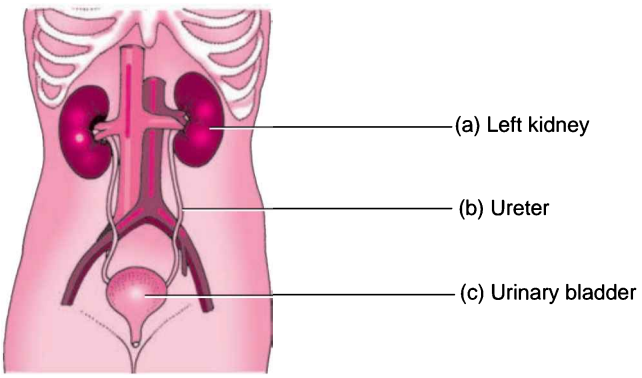
(*b*) Is a long tube which collects urine from kidney.

(*c*) Store urine until it is passed out. *[CBSE 2018]*

Ans. (*i*) Excretion is the process by which metabolic wastes and other non-useful materials, such as faeces, are eliminated from an organism.

(*ii*) Nephron is the basic filtration unit of the kidney.

(*iii*)



HOTS [Higher Order Thinking Skills]

Q. 1. **If a plant is releasing carbon dioxide and taking in oxygen during the day, does it mean that there is no photosynthesis occurring? Justify your answer.** *[NCERT Exemplar]*

Ans. Release of CO_2 and intake of O_2 gives evidence that either photosynthesis is not taking place or its rate is too low. Normally during day time, the rate of photosynthesis is much more than the rate of respiration. So, CO_2 produced during respiration is used up for photosynthesis hence CO_2 is not released.

Q. 2. **The leaves of a plant first prepare food A by photosynthesis then food A gets converted into food B. What are A and B?**

Ans. Food A → glucose; food B → starch

Q. 3. **Why do fish die when taken out of water?** *[NCERT Exemplar]*

Ans. Fish respire with the help of gills. Gills are richly supplied with blood capillaries and can readily absorb oxygen dissolved in water. Since fish cannot absorb gaseous oxygen they die soon after they are taken out of water.

Q. 4. **What would happen if green plants disappear from the Earth?** *[NCERT Exemplar]*

Ans. Green plants are the sources of energy for all organisms. If all green plants disappear from the Earth, all the herbivores will die due to starvation and so will the carnivores.

Q. 5. **Why is small intestine in herbivores longer than in carnivores?** *[NCERT Exemplar]*

Ans. Digestion of cellulose takes a longer time. Hence, herbivores eating grass need a longer small intestine to allow complete digestion of cellulose. Carnivorous animals cannot digest cellulose, hence they have a shorter intestine.

Q. 6. **What will happen if mucus is not secreted by the gastric glands?** *[NCERT Exemplar]*

Ans. Gastric glands in stomach release hydrochloric acid, enzyme pepsin and mucus. Mucus protects the inner lining of stomach from the action of hydrochloric acid and enzyme pepsin. If mucus is not released, it will lead to erosion of inner lining of stomach, leading to acidity and ulcers.

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Q. 7. Why is the rate of breathing in aquatic organisms much faster than in terrestrial organisms? [*NCERT Exemplar*]

Ans. Aquatic organisms like fishes obtain oxygen from water present in dissolved state through their gills. Since the amount of dissolved oxygen is fairly low compared to the amount of oxygen in the air, the rate of breathing in aquatic organisms is much faster than that seen in terrestrial organisms.

Q. 8. Why do veins have thin walls as compared to arteries? [*NCERT Exemplar*]

Ans. Arteries carry blood from the heart to various organs of the body under high pressure so they have thick and elastic walls. Veins collect the blood from different organs and bring it back to the heart. The blood is no longer under pressure so the walls are thin with valves to ensure that blood flows only in one direction.

Q. 9. Why and how does water enter continuously into the root xylem? [*NCERT Exemplar*]

Ans. Cells of root are in close contact with soil and so actively take up ions. The ion concentration increases inside the root and hence osmotic pressure increases the movement of water from the soil into the root which occurs continuously.

Q. 10. Why is more concentrated yellowish urine excreted in summers?

Ans. In summers consumption of water is increased and inspite of that excretory amount of urine is less. Because most of the water is excreted in the form of sweat which is evaporated soon due to high environmental temperature. It keeps our body cool and hence concentrated yellowish urine is excreted.

Q. 11. Leaves of a healthy potted plant were coated with vaseline to block the stomata. Will this plant remain healthy for long? State three reasons for your answer. [*NCERT Exemplar*]

Ans. If waxy coating is made on the surface of leaf, loss of water in the form of water vapour does not take place. Even the gaseous exchange will not take place. So, photosynthesis will either be reduced or will not take place.

The plant will not remain healthy for long because:

(*i*) Exchange of gases will not take place.

(*ii*) Photosynthesis will either be reduced or will not take place due to lack of CO_2.

(*iii*) Transpiration will not take place, so there will be no mechanism of cooling in hot weather.

NCERT Corner

NCERT Intext Questions

Q. 1. Why is diffusion insufficient to meet the oxygen requirements of multicellular organisms like humans?

Ans. In the case of a single-celled organism, no specific organs for exchange of gases are needed because the entire surface of the organism is in contact with the environment. But in multicellular organism, all the cells may not be in direct contact with the surrounding environment. Thus, diffusion is insufficient to meet the oxygen requirements of large multicellular organisms (human beings) because the volume of human body is so big that oxygen cannot diffuse into all the cells of the human body quickly enough.

Q. 2. What criteria do we use to decide whether something is alive?

Ans. Following are the standards that decide whether something is alive:

(*i*) The major criterion is movement. Movement may be incurred through locomotion (running, walking, *etc.*), action of body parts (*e.g.*, chewing of cud by cow), breathing, growth (in plants), maintenance and repair of cellular structures and molecular movement in metabolic reactions.

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(*ii*) Requirement of food for performing life processes.
(*iii*) Respiration and utilisation of the inhaled oxygen for oxidation of food.
(*iv*) Display of growth and development.
(*v*) Expulsion of metabolic wastes (Excretion).

Q. 3. What are outside raw materials used for by an organism?

Ans. Outside raw materials provide energy to organisms to maintain their body processes. They are needed to prevent damage and breakdown in the body.

Q. 4. What processes would you consider essential for maintaining life?

Ans. The important processes essential for maintaining life are: nutrition, respiration, transportation and excretion, and control and coordination.

Q. 5. What are the differences between autotrophic nutrition and heterotrophic nutrition?

[CBSE 2019 (31/2/1)]

Ans.

Autotrophic Nutrition	Heterotrophic Nutrition
1. The organisms that make their food from simple inorganic substances are called autotrophs, *e.g.*, most green plants. Therefore, autotrophic nutrition refers to the process of nourishing, namely photosynthesis, that organisms adopt for growth and maintenance.	1. The organisms which cannot make their own food and depend directly or indirectly on autotrophs for their survival are called heterotrophs, *e.g.*, animals and fungi. Heterotrophic nutrition refers to the process of nourishing, namely by obtaining food from other organisms, for their own growth and maintenance.
2. The raw materials required for preparation of food are CO_2 and H_2O.	2. Heterotrophs are directly or indirectly dependent on autotrophs.
3. Chlorophyll and sunlight are essential for photosynthesis and thus nutrition to occur.	3. Chlorophyll and sunlight are not required.

Q. 6. Where do plants get each of the raw materials required for photosynthesis?

Ans. The raw materials required for photosynthesis are carbon dioxide and water. Terrestrial plants get carbon dioxide from atmosphere and water from the soil. Aquatic plants take up CO_2 that is present in dissolved form in water. Water is simply absorbed by the parts of the aquatic plant submerged in water.

Q. 7. What is the role of the acid in our stomach?

Ans. (*i*) The acid (hydrochloric acid) secreted inside the stomach makes the medium acidic which is necessary for the activation of the enzyme pepsin. It converts inactive propepsin into active pepsin.
(*ii*) Hydrochloric acid kills any bacteria which may enter the stomach along with food.

Q. 8. What is the function of digestive enzymes?

Ans. Digestive enzymes convert the large and insoluble food molecules into small water soluble molecules in the process of digestion for their absorption into the cell. For example, pancreas secretes enzymes like amylase, trypsin and lipase. The enzyme amylase breaks down the starch, trypsin breaks down the proteins and lipase breaks down the emulsified fats into simple sugars, amino acids and fatty acids, respectively.

Q. 9. How is the small intestine designed to absorb digested food?

Ans. The small intestine is the main region for the absorption of digested food. The inner lining of small intestine has millions of tiny finger-like projections called villi. The presence of villi gives the inner walls of the small intestine a very large surface area for absorption of digested food. The villi are richly supplied with blood vessels which take the absorbed food to each and every cell of the body.

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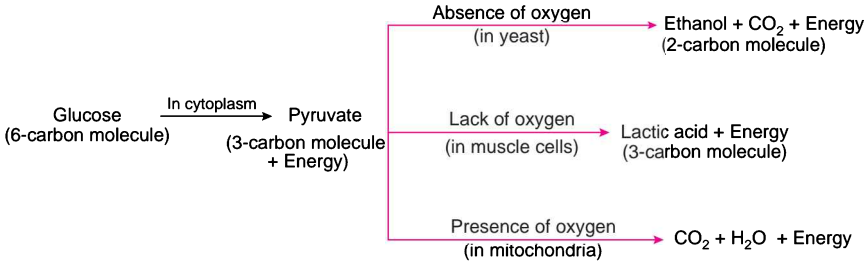
Q. 10. What advantage over an aquatic organism does a terrestrial organism have with regard to obtaining oxygen for respiration?

Ans. The organism that lives in water such as a fish obtains oxygen for respiration which is dissolved in water whereas the terrestrial organisms take in oxygen directly from the air. Since, the amount of oxygen dissolved in water is fairly low as compared to the amount of oxygen in the air, breathing rate in aquatic organisms is much faster than terrestrial organisms.

Q. 11. What are the different ways in which glucose is oxidised to provide energy in various organisms?

Ans. Breakdown of glucose takes place by various pathways as given below:



Q. 12. How is oxygen and carbon dioxide transported in human beings? *[CBSE 2019 (31/1/2)]*

Ans. During inhalation, oxygen enters alveoli of the lungs. The alveoli is surrounded by very thin blood vessels called capillaries. Oxygen diffuses out from the alveoli walls to the blood in capillaries. The oxygen is carried by blood to all the parts of body by binding it with haemoglobin present in blood.

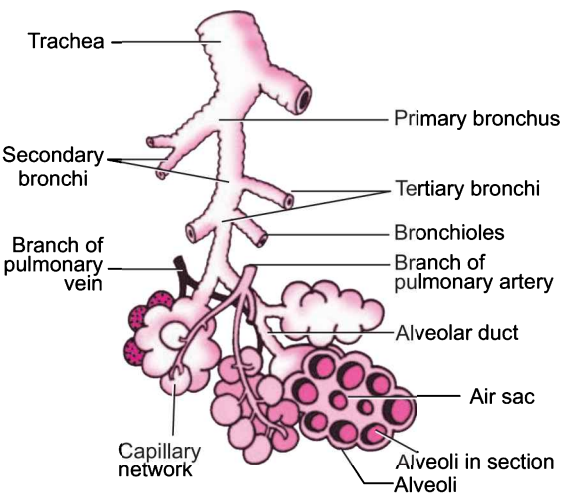
The blood passes through the tissues of the body and the oxygen present in it diffuses into the cells (due to its higher concentration in the blood). This oxygen combines with the digested food present in the cells to release energy. Carbon dioxide is produced as a waste product during respiration in the cells of the body tissues. This CO_2 diffuses into the blood (due to its higher concentration in body tissues). Blood carries CO_2 back to the lungs where it diffuses into its alveoli, then into the trachea, nostrils and then out of the body into air. CO_2 is more soluble in water than oxygen and hence mostly transported in the dissolved form in our blood.

$$\text{Air} \underset{CO_2}{\overset{O_2}{\rightleftharpoons}} \text{Nostril} \underset{CO_2}{\overset{O_2}{\rightleftharpoons}} \text{Pharynx} \underset{CO_2}{\overset{O_2}{\rightleftharpoons}} \text{Wind pipe} \rightleftharpoons \text{Bronchi}$$

$$\underset{CO_2}{\overset{O_2}{\rightleftharpoons}} \text{Lungs} \underset{CO_2}{\overset{O_2}{\rightleftharpoons}} \text{Alveoli} \underset{CO_2}{\overset{O_2}{\rightleftharpoons}} \text{Blood} \underset{CO_2}{\overset{O_2}{\rightleftharpoons}} \text{Tissue}$$

Q. 13. How are the lungs designed in human beings to maximise the area for exchange of gases?

Ans. Lungs are two soft spongy structures lodged in the thoracic cavity. Each lung is enclosed in a double-walled sac called pleura. In the lungs, the air passage (wind pipe) divides into smaller tubes, called bronchi which in turn form bronchioles. The bronchioles later terminate in balloon-like structures, called alveoli. The presence of alveoli in the lungs provides a very large area for the exchange of gases and this availability of large surface area maximises the exchange of gases. The alveoli have very thin walls and contain an extensive network of blood vessels to facilitate exchange of gases.



Alveoli and associated capillaries in the lung

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Q. 14. What are the components of the transport system in human beings? What are the functions of these components?

Ans. Transport system in human beings consists of heart, blood and blood vessels.

(*i*) **Heart:** The muscular organ which pumps and receives the blood.

(*ii*) **Blood:** It is a fluid connective tissue. It consists of plasma, RBC, WBC and blood platelets. Plasma transports food, CO_2 as nitrogenous wastes in dissolved form. RBCs transport respiratory gases and hormones. WBCs protect the body from infections and platelets prevent the loss of blood at the time of injury by forming blood clots.

(*iii*) **Vessels:** They are subdivided into:

(*a*) **Arteries:** Carries blood from heart to different body parts.

(*b*) **Veins:** Transport blood towards heart from various body parts.

(*c*) **Capillaries:** Site of exchange of materials between blood and living cells through tissue fluid.

Q. 15. Why is it necessary to separate oxygenated and deoxygenated blood in mammals and birds?

Ans. Mammals and birds are warm-blooded animals. They constantly use energy to maintain their body temperature. They have higher energy needs and so they require more oxygen to produce energy. Thus, it is important that their oxygenated blood does not get mixed up with deoxygenated blood.

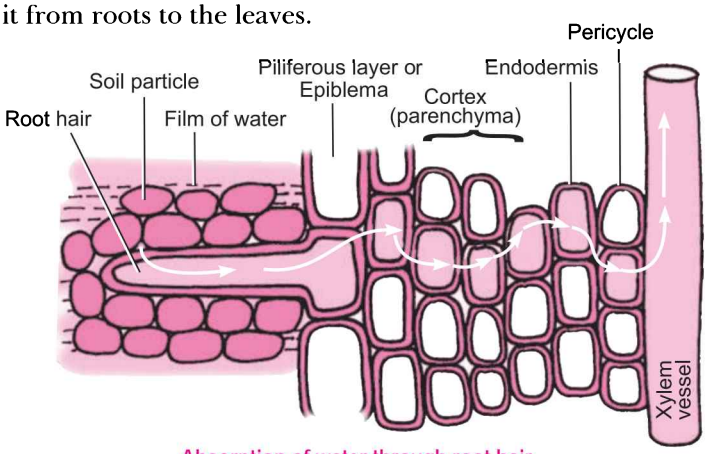
Q. 16. What are the components of the transport system in highly organised plants?

Ans. The components of the transport system of highly organised plants consist of xylem and phloem. Xylem consists of tracheids, vessels, xylem parenchyma and xylem fibres. Phloem consists of sieve tubes, companion cells, phloem fibres and phloem parenchyma.

Q. 17. How are water and minerals transported in plants?

Ans. In xylem tissue, vessels and tracheids of the roots, stem and leaves are interconnected to form a continuous system of water-conducting channels reaching all parts of the plant. The root hairs are directly in contact with the film of water in between the soil particles. Water gets into the root hairs by the process of diffusion. At the roots, cells in contact with the soil actively take up ions. This creates a difference in concentration of these ions between the root and the soil. Water, therefore, moves into the root from the soil. Hence, there is steady movement of water into root xylem, creating a column of water that is steadily pushed upwards. Also, water is lost from the aerial parts of plant (transpiration). Evaporation of water molecules from the cells of the leaf creates a suction which pulls water from the xylem cell of roots (the transpiration pull).

Thus, transpiration helps in the absorption and upward movement of water and minerals dissolved in it from roots to the leaves.



Absorption of water through root hair

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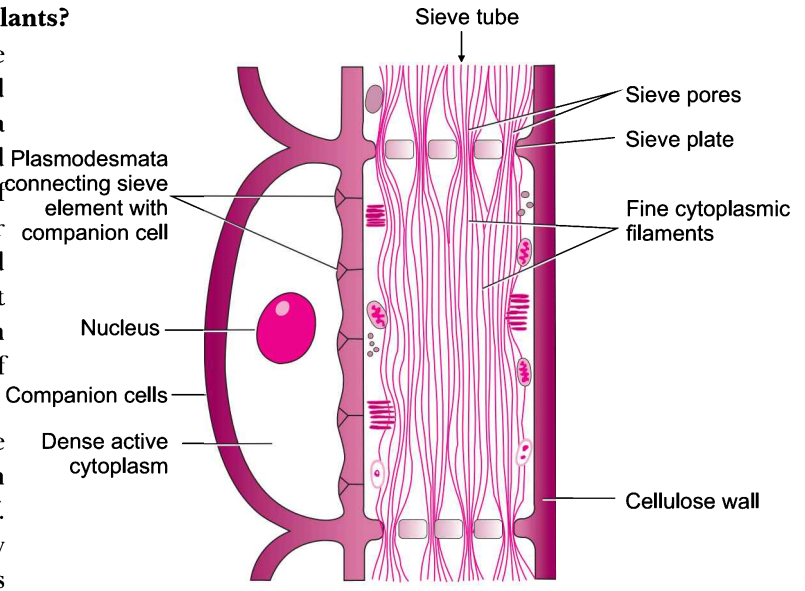
Q. 18. How is food transported in plants?

Ans. The food manufactured by the leaves of a plant is transported to its other parts through a kind of tube system called phloem. The transport of food from the leaves to other parts of the plant is called translocation. The movement of material through phloem depends on the action of living cells called sieve tubes.



A part of phloem tissue

Food molecules enter the phloem elements or cells from mesophyll cells of the leaf. Once they enter phloem, they can be transported upwards or downwards to all parts of a plant, including roots.

This food is transported to different parts of plant in the form of solution through sieve tubes. The end walls of sieve tubes are connected with each other by perforated sieve plates, forming a continuous passage from root tips to stem tips through which dissolved food substances move freely.

The translocation in phloem is achieved by utilising energy. Material like sucrose is transferred into phloem tissue using energy from ATP. This increases the osmotic pressure of the tissue causing water to move into it. This pressure moves the material in the phloem to tissues which have less pressure. This allows the phloem to move material according to plant's need.

Q. 19. Describe the structure and functioning of nephrons.

Ans. **Structure of Nephron:** Nephron is the structural and functional unit of kidney.

It consists of a long coiled tubule differentiated into proximal tubule, loop of Henle and distal tubule. The distal tubule opens into the collecting tubule. At the proximal end of the nephron lies a double-walled cup-shaped structure called Bowman's capsule. The Bowman's capsule contains a bundle of blood capillaries which is called glomerulus. In the glomerulus, the blood that comes in through afferent arteriole is drained out through.

Functions of Nephron:

(*i*) **Filtration:** Filtration of blood takes place in Bowman's capsule from the capillaries of glomerulus. This takes place under high pressure. The filtrate passes into the tubular part of the nephron. This filtrate contains glucose, amino acids, urea, uric acid, salts and major amount of water.

(*ii*) **Reabsorption:** As the filtrate flows along the tubule useful substances such as glucose, amino acids, salts and water are selectively reabsorbed into the blood by capillaries surrounding the nephron tubule.

(*iii*) **Tubular secretion:** Certain substances which are harmful and not needed by the body like ammonia, potassium, creatinine and hydrogen ions are secreted from the capillary blood into the lumen of distal tubule. This is called tubular secretion.

The fluid entering the collecting tubule is called urine. It flows through the ureters into urinary bladder, where it is stored and discharged from time to time through urethra.

Q. 20. What are the methods used by plants to get rid of excretory products?

Ans. To get rid of excretory products, plants use the following ways:

(*i*) The plants get rid of gaseous waste products through stomata on leaves and lenticels in stems.

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(*ii*) The plants get rid of stored solid and liquid wastes by shedding of leaves, peeling of bark and felling of fruits.

(*iii*) The plants also secrete wastes in the form of gums and resins.

(*iv*) Some waste substances are excreted through roots into the soil around them.

(*v*) Excess of water is eliminated by the process of transpiration.

(*vi*) In living cells, many cytoplasmic wastes are shifted to cellular vacuoles.

Q. 21. How is the amount of urine produced regulated?

Ans. The amount of urine produced depends on how much of excess water is there in the body, and on how much of dissolved waste is there to be excreted. More water and dissolved waste in the body will produce more urine and on the other hand, less water and less dissolved waste will therefore, produce less urine.

NCERT Exercises

Q. 1. The kidneys in human beings are a part of the system for

(*a*) nutrition **(*b*) respiration** **(*c*) excretion** **(*d*) transportation**

Ans. (*c*)

Q. 2. The xylem in plants are responsible for

(*a*) transport of water **(*b*) transport of food**

(*c*) transport of amino acids **(*d*) transport of oxygen**

Ans. (*a*)

Q. 3. The autotrophic mode of nutrition requires

(*a*) carbon dioxide and water **(*b*) chlorophyll**

(*c*) sunlight **(*d*) all of the above**

Ans. (*d*)

Q. 4. The breakdown of pyruvate to give carbon dioxide, water and energy takes place in

(*a*) cytoplasm **(*b*) mitochondria** **(*c*) chloroplast** **(*d*) nucleus**

Ans. (*b*)

Q. 5. How are fats digested in our bodies? Where does this process take place?

Ans. The small intestine is the site of the complete digestion of fats. The food coming from the stomach is acidic and has to be made alkaline for the pancreatic enzymes to act. It is made alkaline by bile juice secreted by the liver. The upper part of small intestine, also called duodenum, receives bile juice from the liver and the enzyme lipase from pancreas. Bile salts break them down into smaller globules thereby increasing the efficiency of enzyme action and lipase breaks down the emulsified fats. The wall of the small intestine contain glands which secrete intestinal juice. The enzymes present in it finally convert the fats into fatty acids and glycerol. These are absorbed by villi and passed to every cell for obtaining energy.

Q. 6. What is the role of saliva in the digestion of food?

Ans. Saliva contains an enzyme called salivary amylase which digests the starch (complex molecule) present in food into sugar (maltose).

Q. 7. What are the necessary conditions for autotrophic nutrition and what are its byproducts?

Ans. The conditions necessary for autotrophic nutrition are sunlight, chlorophyll, carbon dioxide and water.

The byproducts of autotrophic nutrition are water and oxygen.

$$\underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Water}}{H_2O} \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} \underset{\text{Glucose}}{C_6H_{12}O_6} + \underset{\text{Oxygen}}{O_2} + \underset{\text{Water}}{H_2O}$$

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Q. 8. What are the differences between aerobic and anaerobic respiration? Name some organisms that use the anaerobic mode of respiration.

Ans.

Aerobic Respiration	Anaerobic Respiration
1. Aerobic respiration takes place in the presence of oxygen.	1. Anaerobic respiration takes place in the absence of oxygen.
2. Complete break down of food occurs in it.	2. Incomplete oxidation of food occurs.
3. The end products are carbon dioxide (CO_2) and water (H_2O).	3. The end products may be ethyl alcohol and carbon dioxide or lactic acid.
4. It produces a considerable amount of energy, due to complete oxidation of food molecules.	4. Much less energy is produced, due to incomplete oxidation of food.

Organisms that use the anaerobic mode of respiration are yeast, some bacteria and some parasitic worms.

Q. 9. How are the alveoli designed to maximise the exchange of gases?

Ans. Alveoli are small pouches or sac-like structure. They are surrounded by blood capillaries. More than millions of alveoli are present in the lungs. The presence of millions of alveoli in the lungs provides a very large surface area for the exchange of gases. When we breathe in, the alveoli expand and maximise the exchange of gases.

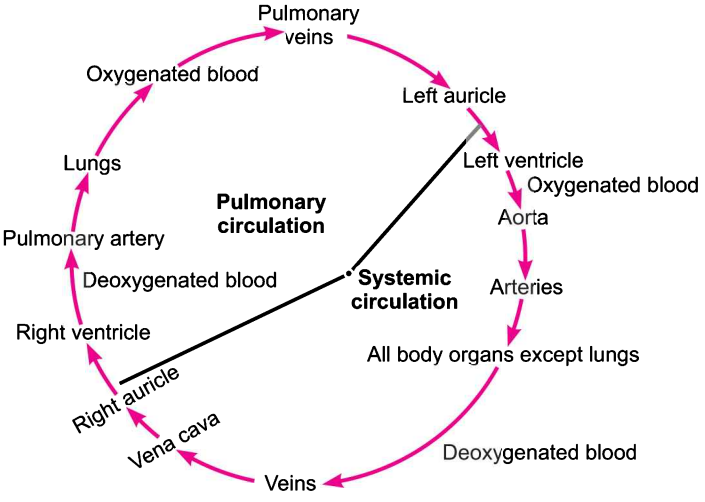
Q. 10. What would be the consequence of a deficiency of haemoglobin in our body?

[CBSE 2019 (31/3/3)]

Ans. The deficiency of haemoglobin in our body is called anaemia. In anaemia, the blood is unable to carry the sufficient amount of oxygen required by the body. So, respiration would be less and less energy will be available to the body. The haemoglobin deficient person will feel weak, pale, lethargic and will be unable to perform heavy physical work.

Q. 11. Describe double circulation in human beings. Why is it necessary?

Ans. The blood passes through the heart twice through separate pathways for completing one cycle. This type of circulation is called double circulation.



The double circulation of blood includes:

(*i*) Systemic circulation (*ii*) Pulmonary circulations.

(*i*) **Systemic circulation:** It supplies oxygenated blood from left auricle to left ventricle, which is pumped to aorta to distribute blood to various body parts. The deoxygenated blood is collected from the various body organs by the veins to pour into vena cava and finally into the right atrium (auricle). Right atrium transfers this blood into the right ventricle.

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(*ii*) **Pulmonary circulation:** The deoxygenated blood is pushed by the right ventricle into the lungs for oxygenation through pulmonary artery. The oxygenated blood is brought back to left atrium of the human heart through pulmonary vein. From left atrium, the oxygenated blood is pushed into the left ventricle. The left ventricle pumps oxygenated blood into aorta for systemic circulation.

Necessity of double circulation: In humans, having four-chambered heart (which consists of two auricles and two ventricles) the left side and right side of heart are completely separated to prevent the oxygenated blood from mixing with deoxygenated blood. Such a separation allows a highly efficient supply of oxygen to the body cells which is necessary for producing a lot of energy. This energy is useful in case of human beings that have high energy need because they constantly require energy to maintain their body temperature.

Q. 12. What are the differences between the transport of materials in xylem and phloem?

Ans.

Transport in Xylem	Transport in Phloem
1. It transports water and minerals.	1. It transports organic nutrients.
2. The movement is generally unidirectional.	2. The movement is multidirectional.
3. It is not influenced by metabolic inhibitors.	3. Phloem transport is inhibited by metabolic inhibitors.
4. It is carried out by xylem vessels and tracheids.	4. Takes place in sieve tubes with the help of adjacent companion cells.
5. Major operating forces are diffusion and transpiration pull.	5. Energy (ATP) is required for translocation.

Q. 13. Compare the functioning of alveoli in the lungs and nephrons in the kidneys with respect to their structure and functioning.

Ans.

Alveoli	Nephron
1. Its structure is that of a pouch-like air sac.	1. They are elongated tubules.
2. The walls of alveoli are very thin.	2. Each nephron has two components—Bowman's capsule and tubules.
3. Alveoli's are surrounded by the thin blood capillaries.	3. Blood capillaries form two patches—glomerulus and peritubular capillaries.
4. The presence of millions of alveoli in the lungs provides a very large surface area for the exchange of gases between blood and inhaled air.	4. The function of tubular part of nephron is to allow the selective reabsorption of the useful substances into the blood capillaries.

SELF-ASSESSMENT TEST

Time allowed: 1 hour **Max. marks: 40**

SECTION–A

Choose and write the correct answer for each of the following. (4 × 1 = 4)

1. Which of the following equations is the summary of photosynthesis?

(*a*) $6CO_2 + 12H_2O \rightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$

(*b*) $6CO_2 + H_2O$ + Sunlight $\rightarrow C_6H_{12}O_6 + O_2 + 6H_2O$

(*c*) $6CO_2 + 12H_2O$ + Chlorophyll + Sunlight $\rightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$

(*d*) $6CO_2 + 12H_2O$ Chlorophyll + Sunlight $\rightarrow C_6H_{12}O_6 + 6CO_2 + 6H_2O$

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2. **Products of anaerobic respiration in muscles are**
   (*a*) lactic acid and energy
   (*b*) lactic acid, carbon dioxide and energy
   (*c*) lactic acid, water, carbon dioxide and energy
   (*d*) lactic acid, water, and energy

3. **Which of the following statement(s) is (are) true about respiration?**
   (*i*) During inhalation, ribs move inward and diaphragm is raised.
   (*ii*) In the alveoli, exchange of gases takes place, *i.e.*, oxygen from blood into alveolar air.
   (*iii*) Haemoglobin has greater affinity for carbon dioxide than oxygen.
   (*iv*) Alveoli increase surface area for exchange of gases.
   (*a*) (*i*) and (*iv*) (*b*) (*ii*) and (*iii*) (*c*) (*i*) and (*iii*) (*d*) (*ii*) and (*iv*)

4. **The main function of the ureter is to**
   (*a*) control the pressure of urine in urinary bladder.
   (*b*) take urine from kidneys to urinary bladder.
   (*c*) filter blood and remove it to urine.
   (*d*) connect the parts of excretory system.

The following questions consist of two statements—Assertion(A) and Reason(R). Answer these questions selecting the appropriate option given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation for *A*.
(*b*) Both *A* and *R* are true but *R* is not the correct explanation for *A*.
(*c*) *A* is true but *R* is false.
(*d*) *A* is false but *R* is true. **(3 × 1 = 3)**

5. **Assertion (*A*) :** Aerobic respiration requires less energy as compared to anaerobic respiration.
   Reason (*R*) : Mitochondria is the powerhouse of the cell.
6. **Assertion (*A*) :** Human heart is four-chambered.
   Reason (*R*) : Vena cava is the only artery that supplies deoxygenated blood to the heart.
7. **Assertion (*A*) :** Energy is required to carry out different life processes.
   Reason (*R*) : Energy is obtained in the form of ATP in the mitochondria.

Answer the following questions in one word or one sentence. **(3 × 1 = 3)**

8. Define blood vessels.
9. Which is the largest gland in the human body?
10. List in tabular form two differences between pepsin and trypsin. *[CBSE 2019 (31/3/3)]*

SECTION–B

Answer the following questions in about 50-60 words each. **(5 × 3 = 15)**

11. Name the following:
    (*i*) The process in plants that links light energy with chemical energy.
    (*ii*) Organism that can prepare their own food.
    (*iii*) The cell organelle where photosynthesis occurs.
    (*iv*) Cells that surround a stomatal pore.
    (*v*) Organisms that cannot prepare their own food.
    (*vi*) An enzyme secreted from gastric glands in stomach that acts on proteins. *[NCERT Exemplar]*

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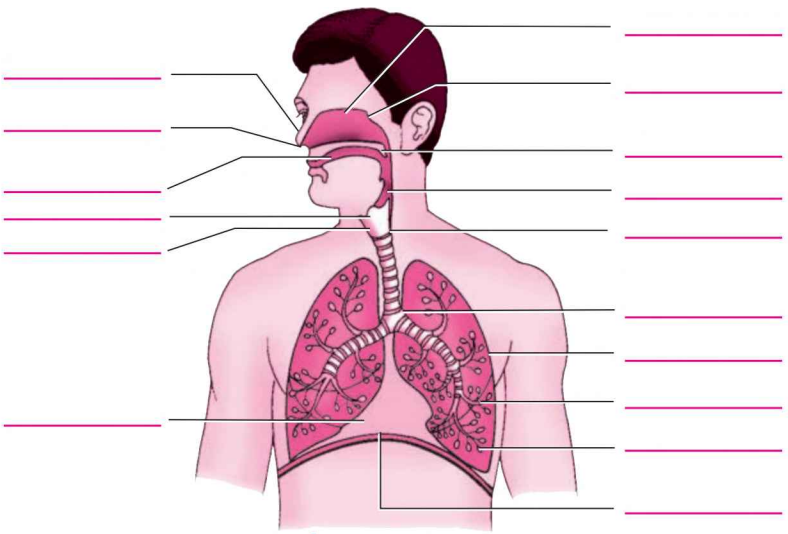
12. How are the alveoli designed to maximise the exchange of gases?
13. (*i*) Write two water conducting tissues present in plants. How does water enter continuously into the root xylem?
    (*ii*) Explain why plants have low energy needs as compared to animals. [*CBSE 2019 (31/5/1)*]
14. (*i*) What is peristalsis?
    (*ii*) What will happen if diaphragm of a person gets ruptured in an accident?
15. How does aerobic respiration differ from anaerobic respiration? [*NCERT Exemplar*]

SECTION–C

Answer the following questions in about 80–90 words each. **(3 × 5 = 15)**

16. Describe the process of urine formation in kidneys.
17. Draw the diagram of sectional view of human heart and label the following parts:
    (*i*) The chamber of the heart that pumps out deoxygenated blood.
    (*ii*) The blood vessel that carries away oxygenated blood from the heart.
    (*iii*) The blood vessel that receives deoxygenated blood from the lower part of our body.
    (*iv*) Part which prevents the backward flow of blood. [*NCERT Exemplar*]
18. Observe the diagram showing respiratory system of a man and answer the questions that follow:
    (*i*) Label the diagram.
    (*ii*) Which organ is called the voice box?
    (*iii*) What is 'Adam's apple'?
    (*iv*) How is the entry of dust and bacteria prevented during respiration?
    (*v*) What prevents trachea from collapsing?



Answers

1. (*c*) **2.** (*a*) **3.** (*d*) **4.** (*b*) **5.** (*d*) **6.** (*c*) **7.** (*a*)

8. Blood vessels are elastic tubes which carry blood.

9. Liver

10.

Pepsin	Trypsin
(*i*) Produced in stomach.	(*i*) Produced by pancreas.
(*ii*) Acts in acidic medium.	(*ii*) Acts in basic medium.

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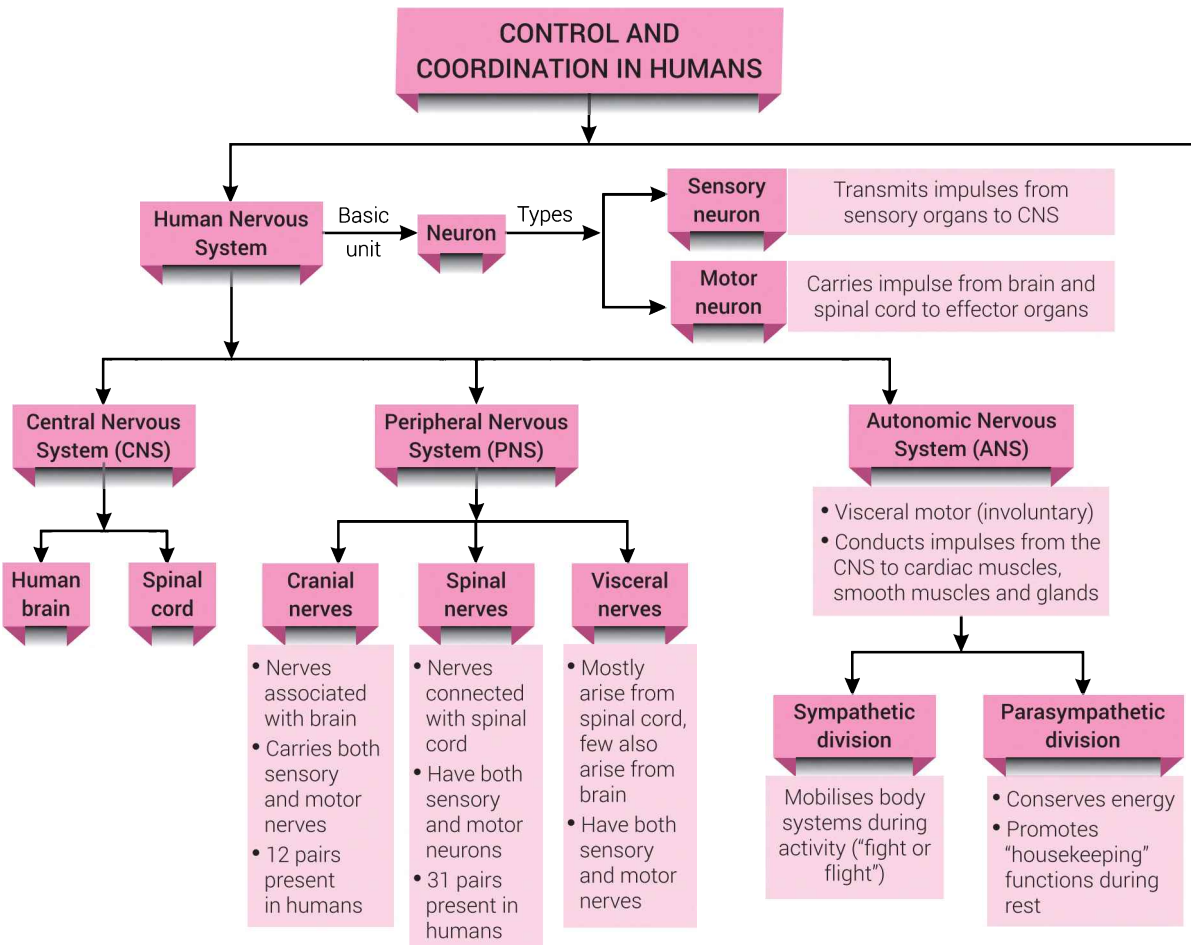
7 Control and Coordination

BASIC CONCEPTS—A FLOW CHART



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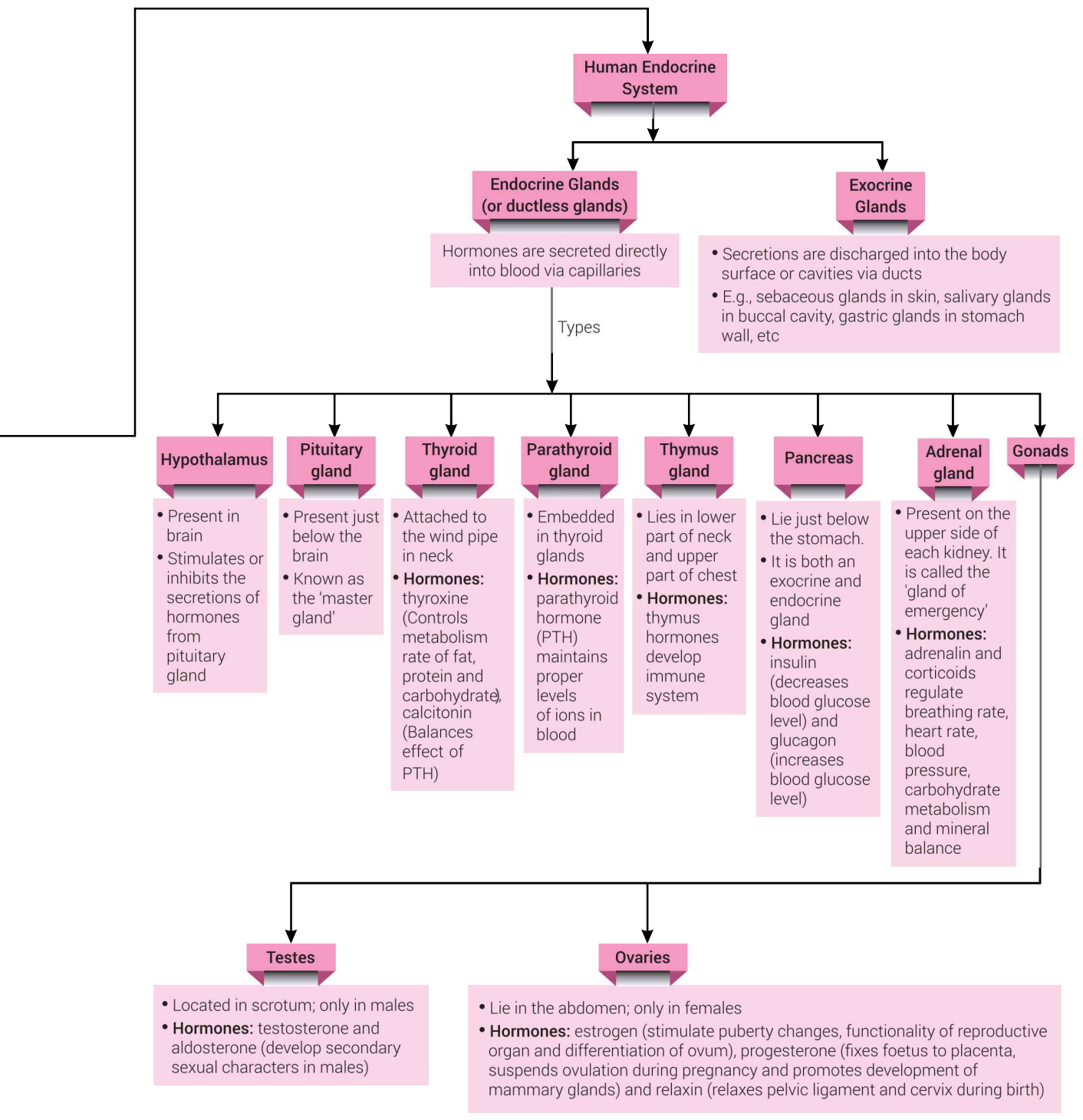

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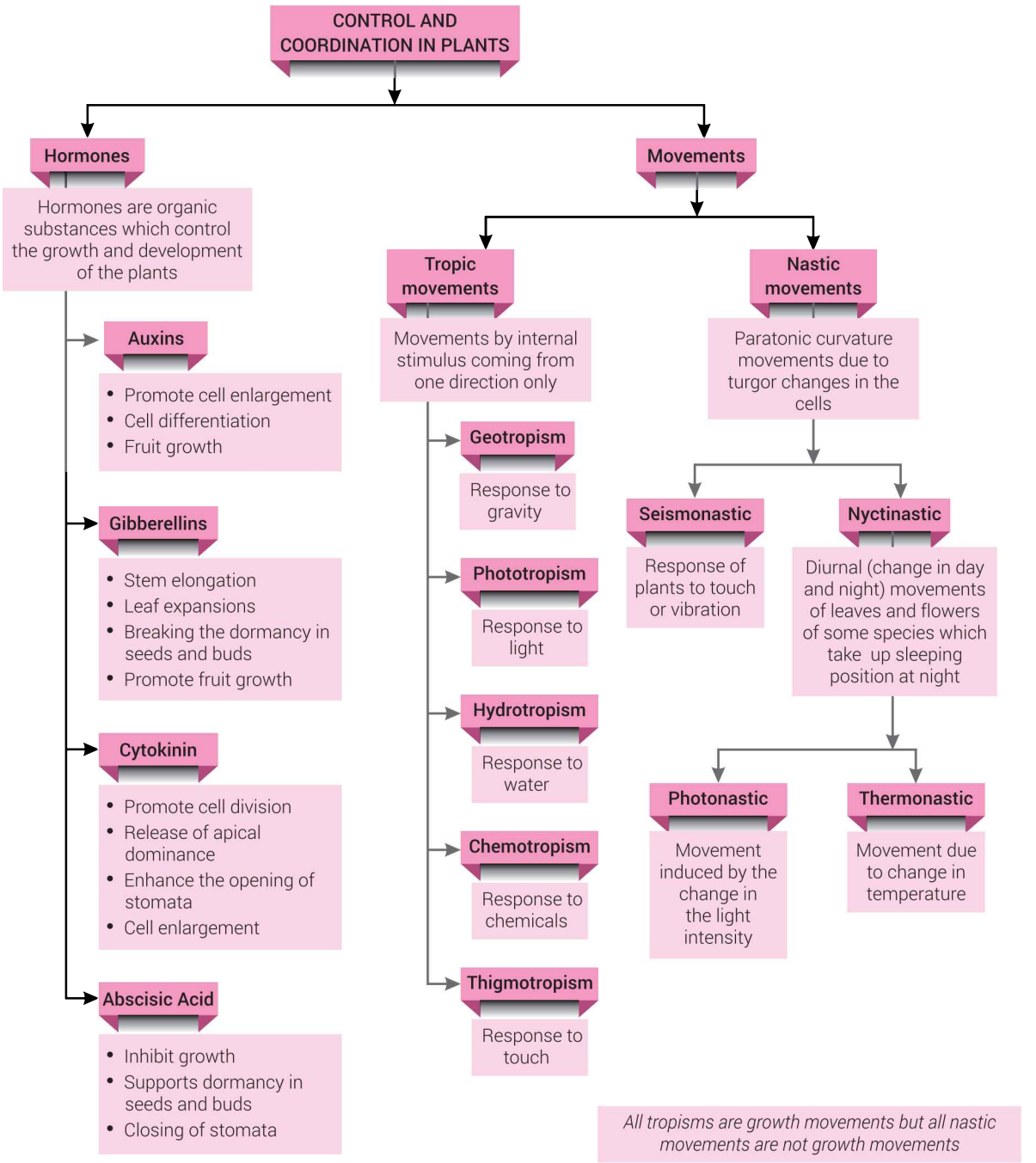

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MORE POINTS TO REMEMBER

- In animals, the nervous system and hormonal system are responsible for control and coordination.
- **Neurons** are specialised cells of the nervous system. They use electrical and chemical signals for transferring information.
- **Receptors** are specialised tips of the nerve fibres that collect the information to be conducted by the nerves. Olfactory receptors are present in the nose, gustatory receptors are found in tongue.
- **Nerve** impulses travel in the following manner from one neuron to the next

  Dendrites ⟶ Cell body ⟶ Axon ⟶ Nerve endings at the tip of axon ⟶ Synapse ⟶ Dendrite of next neuron
- **Chemicals** released from axon tip of one neuron, cross the synapse or neuromuscular junction to reach the next cell (neuron or muscle fibre).
- **Reflex action** is an automatic, rapid and immediate reaction to a stimulus and is below the level of consciousness. No thinking is involved in reflex action.
- **Reflex arc** is the neural pathway that mediates a reflex action.

  Pathway of reflex arc:

  Receptor ⟶ Sensory neuron ⟶ Relay neuron ⟶ Motor neuron ⟶ Effector
- **Brain** is protected by a bony box called cranium, within which are present 3 layers of fluid-filled membranes for absorbing shock.
- **Plants** respond to stimuli by showing two types of movements—growth independent and growth dependent.
- **Growth independent movements or nastic movements** are usually quicker than growth dependent ones, and involve the use of electrochemical signals by the plant. To achieve this movement, the plant cells change shape by altering their water content.
- **Growth dependent movements** or tropic movements are slow, occurring either towards or away from the stimulus.

Multiple Choice Questions [1 mark]

Each question has 4 choices (a), (b), (c) and (d). Choose and write the correct option.

1. **Choose the incorrect statement about insulin.** *[NCERT Exemplar]*
   (*a*) It is produced from pancreas.
   (*b*) It regulates growth and development of the body.
   (*c*) It regulates blood sugar level.
   (*d*) Insufficient secretion of insulin will cause diabetes.
2. **Upon receiving a signal, the dendrite tip of a nerve cell sets off a chemical reaction that**
   (*a*) creates an electrical impulse in the dendrite.
   (*b*) creates an electrical impulse in the next neuron.
   (*c*) releases some chemicals in the cell body of the neuron.
   (*d*) creates a stimulus.

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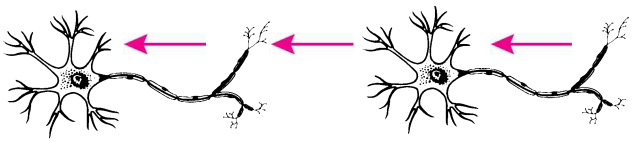
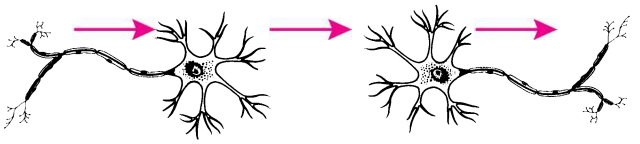
3. **Which is the correct sequence of the components of a reflex arc?** [*NCERT Exemplar*]
   (*a*) Receptors → Muscles → Sensory neuron → Motor neuron → Spinal cord
   (*b*) Receptors → Motor neuron → Spinal cord → Sensory neuron → Muscle
   (*c*) Receptors → Spinal cord → Sensory neuron → Motor neuron → Muscle
   (*d*) Receptors → Sensory neuron → Spinal cord → Motor neuron → Muscle
4. **Gibberellins promote**
   (*a*) cell division (*b*) cell elongation (*c*) growth of the stem (*d*) all of these
5. **The directional movement or orientation of part of plant in response to light is termed as**
   (*a*) chemotropism (*b*) phototropism (*c*) phototaxis (*d*) photoperiodism
6. **Dramatic changes of body features associated with puberty are mainly because of the secretion of** [*NCERT Exemplar*]
   (*a*) oestrogen from testes and testosterone from ovary.
   (*b*) estrogen from adrenal gland and testosterone from pituitary gland.
   (*c*) testosterone from testes and estrogen from ovary.
   (*d*) testosterone from thyroid gland and estrogen from pituitary gland.
7. **Dwarfism in human beings is caused due to deficiency of**
   (*a*) thyroxin (*b*) growth hormone (*c*) adrenalin (*d*) insulin
8. **Spinal cord originates from** [*NCERT Exemplar*]
   (*a*) cerebrum (*b*) medulla (*c*) pons (*d*) cerebellum
9. **Diabetes mellitus is caused due to deficiency of**
   (*a*) glucagon (*b*) thyroxin (*c*) insulin (*d*) prolactin
10. **Which of the following statements is correct about receptors?** [*NCERT Exemplar*]
    (*a*) Gustatory receptors detect taste while olfactory receptors detect smell.
    (*b*) Both gustatory and olfactory receptors detect smell.
    (*c*) Auditory receptors detect smell and olfactory receptors detect test.
    (*d*) Olfactory receptors detect taste and gustatory receptors smell.
11. **What is the correct direction of flow of electrical impulses?** [*NCERT Exemplar*]

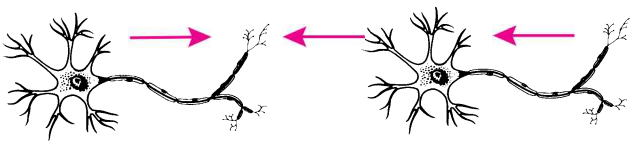
(*a*)



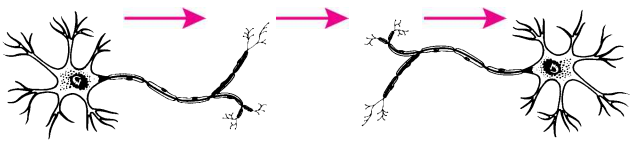
(*b*)



(*c*)



(*d*)



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12. In a synapse, chemical signal is transmitted from [NCERT Exemplar]

(*a*) dendritic end of one neuron to axonal end of another neuron

(*b*) axon to cell body of the same neuron

(*c*) cell body to axonal end of the same neuron

(*d*) axonal end of one neuron to dendritic end of another neuron

13. Posture and balance of the body is controlled by [NCERT Exemplar]

(*a*) cerebrum (*b*) cerebellum (*c*) medulla (*d*) pons

14. The growth of pollen tubes towards ovules is due to [NCERT Exemplar]

(*a*) hydrotropism (*b*) chemotropism (*c*) geotropism (*d*) phototropism

15. The substance that triggers the fall of mature leaves and fruits from plants is due to [NCERT Exemplar]

(*a*) auxin (*b*) gibberellin (*c*) abscisic acid (*d*) cytokinin

16. Involuntary actions in the body are controlled by [NCERT Exemplar]

(*a*) medulla in fore brain (*b*) medulla in mid brain

(*c*) medulla in hind brain (*d*) medulla in spinal cord

17. Which statement is not true about thyroxin? [NCERT Exemplar]

(*a*) Iron is essential for the synthesis of thyroxin.

(*b*) It regulates carbohydrate, protein and fat metabolism in the body.

(*c*) Thyroid gland requires iodine to synthesise thyroxin.

(*d*) Thyroxin is also called thyroid hormone.

18. A doctor advised a person to take an injection of insulin because [NCERT Exemplar]

(*a*) his blood pressure was low. (*b*) his heart was beating slowly.

(*c*) he was suffering from goitre. (*d*) his sugar level in blood was high.

19. The hormone which increases the fertility in males is called [NCERT Exemplar]

(*a*) oestrogen (*b*) testosterone (*c*) insulin (*d*) growth hormone

Answers

1. (*b*)	**2.** (*a*)	**3.** (*d*)	**4.** (*c*)	**5.** (*b*)	**6.** (*c*)	**7.** (*b*)
8. (*b*)	**9.** (*c*)	**10.** (*a*)	**11.** (*c*)	**12.** (*d*)	**13.** (*b*)	**14.** (*b*)
15. (*c*)	**16.** (*c*)	**17.** (*a*)	**18.** (*d*)	**19.** (*b*)		

Assertion-Reason Questions [1 mark]

The following questions consist of two statements — Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

1. Assertion (*A*) : Insulin regulates blood sugar level.
Reason (*R*) : Insufficient secretion of insulin will cause diabetes.

2. Assertion (*A*) : Animals can react to stimuli in different ways.
Reason (*R*) : All animals have a nervous system and an endocrine system involving hormones.

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3. **Assertion (*A*) :** The effect of auxin hormone on the growth of root is exactly opposite to that on a stem.
   Reason (*R*) : Auxin hormone increases the rate of growth in root and decreases the rate of growth in stem.
4. **Assertion (*A*) :** A receptor is a specialized group of cells in a sense organ that perceive a particular type of stimulus.
   Reason (*R*) : Different sense organs have different receptors for detecting stimuli.
5. **Assertion (*A*) :** Cyton region of nerve fibre collects information for the brain.
   Reason (*R*) : Nerve fibres can either have or lack myelin sheath.

Answers

1. (*a*) **2.** (*a*) **3.** (*c*) **4.** (*b*) **5.** (*d*)

Passage-based Questions

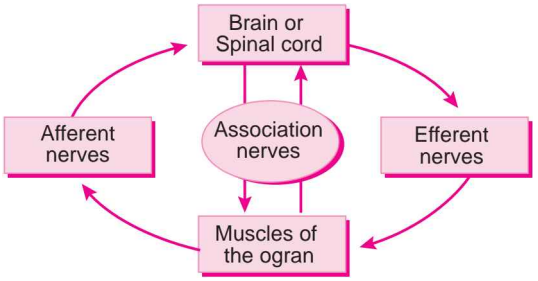
Answer the questions given below each passage on the basis of your understanding of the paragraph and the related studied concepts.

1. To carry out a simple function such as eating food there has to be coordination of the eyes, hands and the mouth. The eyes have to focus on the food, the hands have to pick it up and take it to the mouth where it will be chewed. All these actions have to be coordinated in such a manner that they follow a particular sequence and the action is completed. A similar mechanism is also needed for internal functions of the body. This function is carried out by the nervous system. It is composed of

(*a*) Specialised cells which can detect, receive and transmit different kinds of stimuli. These are called neurons.

(*b*) Nerve fibres which are certain bundles of extended processes of nerve cells.

The individuals also have to adjust to the changing conditions around them and vary their responses. At the same time, the internal conditions of the body should be maintained constant. This is called homeostasis. The internal conditions of the body are maintained at a constant by controlling the physiology of the organisms.



(*i*) What will the correct sequence in which conduction of information through nerves take place?

(*ii*) How homeostasis is said to maintain the equilibrium of the body?

(*iii*) What function does the central nervous system perform?

(*iv*) What happens when the dendrite tip of a nerve cell receives a signal?

2. Movement in plants are in the form of bending, twisting and elongation of certain parts or organs. These movements are related to some external stimuli such as light, force of gravity, chemical substances, water, touch, etc. Action of plant hormones, under the influence of stimulus play an important role in the growth of stems and branches.

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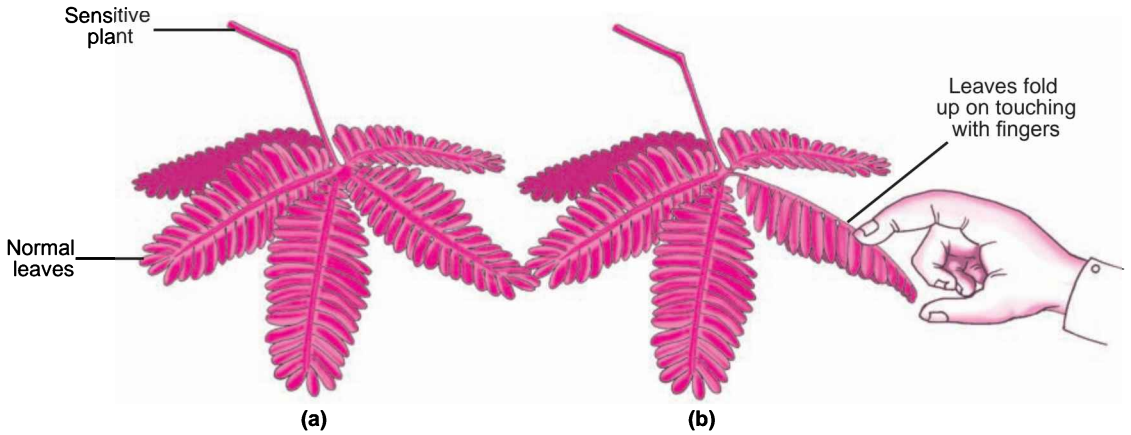
Tropic movements are caused by external stimulus coming from one direction only. The growth of a plant part in response to a stimulus can be towards the stimulus (in the direction of the stimulus) as positive tropism or away from the stimulus (against the direction of the stimulus), as negative tropism. Nastic movements are paratonic movements due to turgor changes in the cells. These may be growth movements which are elastic and permanent, or these may be turgor or variation movements, which are elastic and reversible. Such movements are due to the stimulus of light, temperature or contact but the direction of response is prefix and inherent in the tissues.



(*i*) What is the directional movement or orientation of part of plant in response to light known as?

(*ii*) The growth of tendril in pea plants is due to

(*a*) effect of light

(*b*) effect of gravity

(*c*) rapid cell divisions in tendrillar cells that are away from the support

(*d*) rapid cell divisions in tendrillar cells in contact with the support

(*iii*) Write an example of plant showing seismonastic movement.

(*iv*) Why are roots called positively geotropic?

Answers

1. (*i*) Dendrites → Cell body → Axon → Nerve endings at the tip of axon → Synapse → Dendrite of next neuron

(*ii*) Homeostasis helps in keeping the constant internal environment within a cell or a body and hence maintains the equilibrium of the body.

(*iii*) The central nervous system is comprised of the brain and the spinal cord which process the information received from the receptors on/in the body.

(*iv*) Upon receiving a signal, the dendrite tip of a nerve cell sets off a chemical reaction which creates an electrical impulse in the them.

2. (*i*) Phototropism

(*ii*) (*c*)

(*iii*) 'Touch-me-not' plant (*Mimosa pudica*).

(*iv*) This is because the roots always grow towards the gravity of the Earth.

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Very Short Answer Questions [1 mark]

Each of the following questions are of 1 mark and have to be answered in one word or one sentence.

Q. 1. Mention the receptors for light and sound in animals.

Ans. Sense organs are called receptors. The receptor of light in animals is called photoreceptor. The receptor of sound in animals is called phonoreceptor.

Q. 2. Which hormone regulates the concentration of sugar in the blood?

Ans. Insulin secreted by islets of Langerhans of pancreas.

Q. 3. Define 'reflex action.'

Ans. Reflex action is a rapid, automatic response to a stimulus which is not under the voluntary control of the brain.

Q. 4. Name few involuntary actions controlled by the hindbrain.

Ans. Involuntary actions controlled by hindbrain are vomiting, salivation and blood pressure.

Q. 5. What is an axon?

Ans. It is a large, single, unbranched nerve fibre arising from the cyton. It carries impulses from cyton located in CNS to effectors.

Q. 6. What is the number of cranial nerves and spinal nerves in human beings?

Ans. There are 12 pairs of cranial nerves and 31 pairs of spinal nerves in human beings.

Q. 7. Name the largest cell present in the human body.

Ans. Neuron

Q. 8. Which part of central nervous system controls reflexes?

Ans. Spinal cord

Q. 9. Name the part of neuron

(*i*) where information is acquired.

(*ii*) through which information travels as an electrical impulse.

Ans. (*i*) Dendrite (*ii*) Axon

Q. 10. Which hormone controls the metabolism of calcium and phosphorus in human beings?

Ans. Parathyroid hormone (parathormone)

Q. 11. Name the hormone, the secretion of which is responsible for dramatic changes in appearance in girls and boys when they approach 10-12 years of age.

Ans. Oestrogen from the ovaries of girls and testosterone from testes of boys.

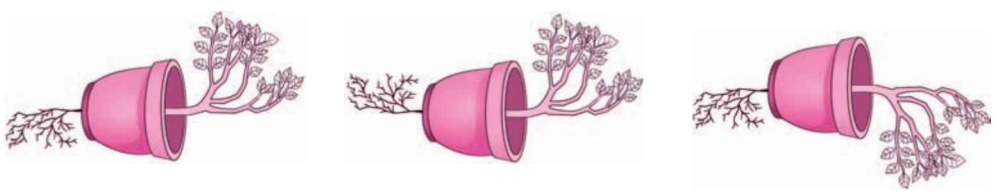
Q. 12. Name two tissues that provide control and coordination in multicellular animals.

Ans. The two tissues that provide control and coordination in multicellular animals are nervous tissue and muscular tissue.

Q. 13. Which hormone helps in lowering the level of blood glucose in human beings?

Ans. Insulin

Q. 14. In the figure below (*a*), (*b*) and (*c*), which appears more accurate and why? *[NCERT Exemplar]*



(*a*) (*b*) (*c*)

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Ans. Figure (*a*) is more appropriate because in a plant, shoots are negatively geotropic. Hence, they grow upwards and roots are positively geotropic so they grow downwards.

Q. 15. State the main function of abscisic acid in plants.

Ans. Abscisic acid slows plant growth and inhibits division of cells.

Q. 16. What is hydrotropism? *[CBSE 2019 (31/2/1)]*

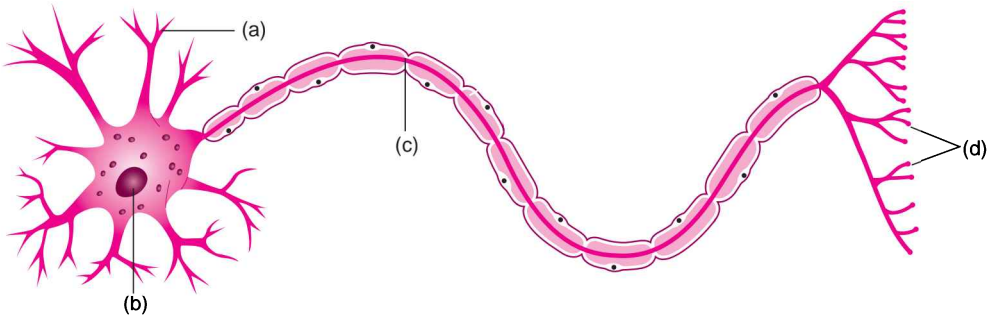
Ans. Hydrotropism is the movement or growth of a plant in response to water.

Short Answer Questions [3 marks]

Each of the following questions are of 3 marks and have to be answered in about 50-60 words.

Q. 1. (*i*) Define a synapse.

(*ii*) Label the marked parts of a neuron in the given figure. *[NCERT Exemplar]*



Ans. (*i*) Synapse is a very fine gap between telodendria of axon of one neuron and dendrites of another neuron. These two structures do not unite with each other but remain separated by a fine gap.

(*ii*) (*a*) Dendrite (*b*) Nucleus (*c*) Axon (*d*) Nerve endings

Q. 2. (*i*) Name one gustatory receptor and one olfactory receptor present in human beings.

(*ii*) Write a and b in the given flow chart of neuron through which information travels as an electrical impulse. *[CBSE 2018]*

Dendrite → a → b → End point of Neuron

Ans. (*i*) **Gustatory receptors:** Taste buds on tongue.

Olfactory receptors: Receptors in nose.

(*ii*) a is Cyton/Cell body

b is Axon

Q. 3. Mention the functions of forebrain.

Ans. The forebrain performs the following functions:

(*i*) It is responsible for intelligence, memory, consciousness, will power and voluntary actions.

(*ii*) It has the centres for visual reception, hearing reception, touch, smell and temperature reception.

Q. 4. Trace the sequence of events which occur when a bright light is focused on your eyes. *[CBSE 2019 (31/1/1)]*

Ans. Receptor cells of Eyes/Retina → Sensory Neuron → Brain/Central Nervous System (CNS) → Motor Neuron → Eye Muscles → Pupil contracts/Eye lids close/Blink

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Q. 5. Answer the following:

(*i*) Which hormone is responsible for the changes noticed in females at puberty?

(*ii*) Dwarfism results due to deficiency of which hormone?

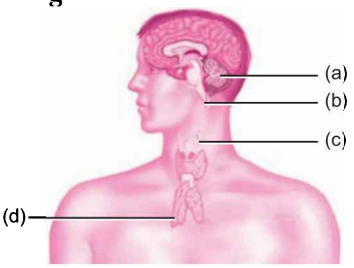
(*iii*) Blood sugar level rises due to deficiency of which hormone?

(*iv*) Iodine is necessary for the synthesis of which hormone? *[NCERT Exemplar]*

Ans. (*i*) Oestrogen (*ii*) Growth hormone

(*iii*) Insulin (*iv*) Thyroxine

Q. 6. Label the endocrine glands in figure. *[NCERT Exemplar]*



Ans. The endocrine glands are as follow:

(*a*) Pineal gland (*b*) Pituitary gland

(*c*) Thyroid gland (*d*) Thymus

Q. 7. Name the hormones responsible for the regulation of

(*i*) metabolism of carbohydrates, fats and proteins.

(*ii*) balance of calcium and phosphate.

(*iii*) blood pressure.

(*iv*) water and electrolyte balance.

Ans. (*i*) Thyroxin (*ii*) Parathormone

(*iii*) Adrenaline (*iv*) Vasopressin

Q. 8. (*i*) What is a tropic movement? Explain with an example. *[NCERT Exemplar]*

(*ii*) Why *Mimosa pudica* (touch-me-not) leaves droop down when touched?

Ans. (*i*) The directional growth movement of plants due to external stimuli is called a tropic movement. It can be either towards the stimulus, or away from it. For example, in case of phototropic movement, shoots respond by bending towards light while roots respond by bending away from it.

(*ii*) It is due to turgor pressure difference between the upper and lower halves of the base of petiole (pulvinus). Lower half cells lose water and upper half cells of pulvinus become turgid due to transfer of water from lower cells. Thus, the entire leaf droops down when touched.

Q. 9. Why are the electrical–chemical signals not an efficient means of communication in plants?

Ans. Unlike animals, where there is a nervous system for conduction of nerve impulses and circulatory system for conduction of hormones, there are no specialised tissues in plants. So, the electrical-chemical signals are not an effective means of communication in plants.

Q. 10. (*i*) What will happen if intake of iodine in our diet is low? *[NCERT Exemplar]*

(*ii*) If a ripened fruit is kept in a basket of raw fruits, then what will happen? What causes it?

Ans. (*i*) (*a*) When iodine intake is low, release of thyroxine from thyroid gland will be less by which protein, carbohydrate and fat metabolisms will be affected.

(*b*) A person might suffer from goitre in case of iodine deficiency in the body.

(*ii*) The ripened fruit will release ethylene (hormone) which causes ripening of other raw fruits kept in a basket.

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Q. 11. What is cerebrospinal fluid? What is its function?

Ans. Cerebrospinal fluid is the fluid found in the cavities of brain and central canal of spinal cord and in between arachnoid and pia mater.

Function: It prevents the brain and spinal cord from mechanical shocks.

Q. 12. Answer the following:

(*i*) Name the endocrine gland associated with brain.

(*ii*) Which gland secretes digestive enzymes as well as hormones?

(*iii*) Name the endocrine gland associated with kidneys.

(*iv*) Which endocrine gland is present in males but not in females? [*NCERT Exemplar*]

Ans. (*i*) Pituitary (*ii*) Pancreas

(*iii*) Adrenal (*iv*) Testes

Q. 13. What are the advantages of the fact that most reflex actions are governed by spinal cord?

Ans. The advantages are:

(*i*) This enables the body to give quick responses to harmful stimuli thus protecting the body.

(*ii*) It minimises overloading of brain.

(*iii*) In many animals, reflex arcs have evolved as efficient ways of functioning in the absence of true thought processes.

Q. 14. (*i*) Name the part of human brain which controls (*a*) voluntary actions, and (*b*) involuntary actions.

(*ii*) Write the function of peripheral nervous system. Name the components of this system stating their origin.

Ans. (*i*) (*a*) Voluntary actions: Cerebellum

(*b*) Involuntary actions: Medulla

(*ii*) Peripheral nervous system connects the central nervous system to various parts of the body.

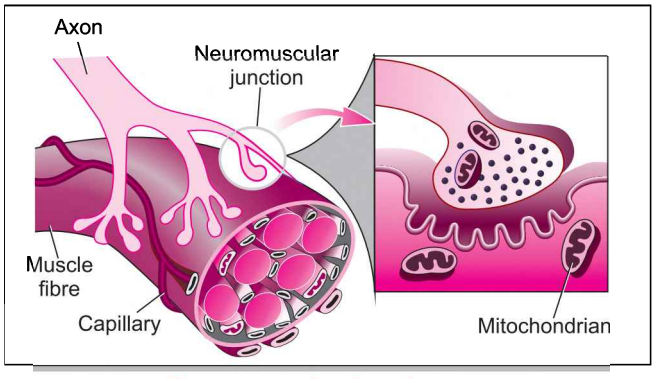
The main components of the PNS are

(*a*) Spinal nerves — These nerves arise from spinal cord.

(*b*) Cranial nerves — These nerves arise from brain.

Q. 15. How do animal muscles move?

Ans. The nerve fibres at the end of a neuron are attached to muscles. This area is called neuro-muscular junction. When nerve impulses are conducted to this area, the special proteins present in the muscle cells change their shape and arrangement in the cell in response to nervous electrical impulses. New arrangement of these proteins give the muscle cells a shorter form thus bringing about movement of muscles.



Neuromuscular junction

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Q. 16. What is turgor movement?

Ans. Turgor movement is the movement due to the difference of turgidity of the cells in the lower half and upper half of pulvinus (petiole of leaf). When leaf of 'touch-me-not' plant (*Mimosa pudica*) is touched, the electrical signal send chemical signals from leaflets to pulvinus (petiole) of leaf. Cells in the lower half of pulvinus lose water and become flaccid, while cells in the upper half of pulvinus become turgid due to accumulation of more water. Hence, leaf droops down for a short time.

Q. 17. Why do tendrils coil around hard rough objects?

Ans. The growth movement of tendril in response to unilateral stimulus of touch is called thigmotropism. Tendrils of louki, tori, karela, and sweet pea plants coil around hard objects when they come in their contact. It occurs due to unequal growth of two sides of a tendril. The growth of the surface which comes in contact of the support is retarded, while it remains normal or increased on the other side, due to which tendril coils around the support.

Q. 18. (*i*) Plants do not have any nervous system but yet, if we touch a sensitive plant, some observable changes take place in its leaves. Explain how could this plant respond to the external stimuli and how it is communicated.

(*ii*) Name the hormone that needs to be administered to

(*a*) increase the height of a dwarf plant.

(*b*) cause rapid cell division in fruits and seeds. *[CBSE 2019 (31/4/2)]*

Ans. (*i*) The changes in the leaves of the sensitive plant when touched is due to the difference in the turgor pressure. When leaf of the sensitive plant is touched, the electrical-chemical signal conveys the information from cell to cell. Plants lack specialised tissues for conduction of information and thus change the shape by changing the amount of water. Cells in the lower half of the leaf lose water and become flaccid while cells in the upper half gains water and become turgid.

(*ii*) (*a*) Auxin (*b*) Cytokinin

Q. 19. Why is pancreas called a 'dual function' gland? Write the names of its hormones.

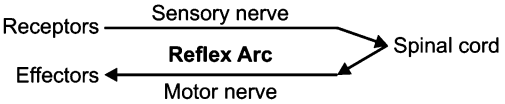
Ans. Pancreas is an exocrine gland as well as an endocrine gland. Exocrine part of the gland secretes digestive enzymes and the endocrine part (Langerhan's cells) produce hormones.

Hormones secreted by pancreas are insulin and glucagon.

Q. 20. (*i*) How is reflex arc formed?

(*ii*) What do you understand by the sleep movement of plant organs?

Ans. (*i*) A message or stimulus from receptor is relayed by sensory nerve to the spinal cord. It sends response through motor nerve to effectors for necessary action. This pathway is the reflex arc.



(*ii*) Sleep movement in plants *e.g.*, in flowers is to protect the reproductive organs from the cold. Hence, sepals and petals of saffron flower close at sunset and open up in the morning.

Q. 21. How is the endocrine system able to maintain hormonal concentration in the body?

Ans. Hypothalamus is responsible for maintaining the balance of hormones in the body. When any hormone is secreted in large amounts, a signal is sent by the hypothalamus to the secreting gland to lower its secretion.

Whereas when the amount of any hormone is less, hypothalamus sends a signal to the respective gland to increase its functioning.

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Q. 22. What is feedback mechanism of hormonic regulation? Take the example of insulin to explain this phenomenon. *[CBSE 2019 (31/1/2)]*

Ans. Normal functioning of endocrine glands and regulation of level of hormones in the body is the feedback mechanism. For example, after a meal, the glucose level of the blood rises which stimulates the pancreas to secrete insulin to act on it. Insulin stimulates target cells to take up extra glucose which is either utilised in respiration or is stored as glycogen. In this way, glucose level of blood is brought back to normal. When there is a fall in glucose level in blood, a decrease of insulin level takes place, insulin secretion by pancreas decreases. This checks further fall in the blood glucose level. In this way insulin maintains the blood-glucose homeostatis.

Q. 23. Define 'nerve impulse'. Which structure in a neuron helps to conduct a nerve impulse

(*i*) towards the cell body?

(*ii*) away from the cell body?

Ans. The information passing through neurons is in the form of chemical and electrical signals, called nerve impulse.

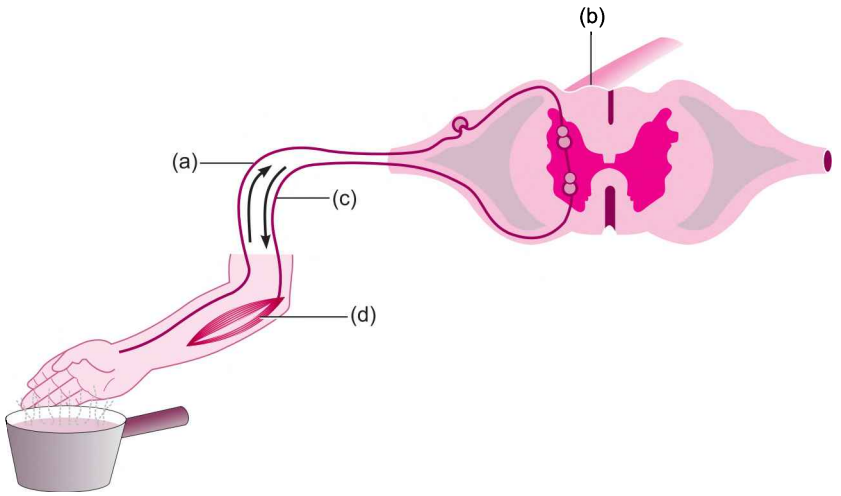
(*i*) Towards the cell body: Dendrites.

(*ii*) Away from the cell body: Axon.

Q. 24. Nervous and hormonal system together perform the function of control and coordination in human beings. Justify the statement. *[NCERT Exemplar]* *[CBSE 2019 (31/1/3, 31/5/3)]*

Ans. Nervous and hormonal system together perform the function of control and coordination in human beings. Let us take an example, in the case of any emergency, stimulus is being perceived by CNS (Central nervous system). The stimulus is analysed and the response is sent to the effectors. Simultaneously, sympathetic nerves stimulate adrenal gland to release adrenaline which regulates blood pressure, increases heartbeat, constricts blood vessels and dilates pupil, etc. So, both nervous and endocrine systems interact and overcome the crisis together.

Q. 25. Label the parts (*a*), (*b*), (*c*) and (*d*) and show the direction of flow of electrical signals in the figure.



[NCERT Exemplar]

Ans. (*a*) Sensory neuron

(*b*) Spinal cord (CNS)

(*c*) Motor neuron

(*d*) Effector—muscle in arm

Flow of electrical signals: Receptors in hand ⇒ Sensory neurons ⇒ Spinal cord (CNS) ⇒ Motor neurons ⇒ Effector – muscles in arm.

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Q. 26. List in tabular form three distinguishing features between cerebrum and cerebellum.

[CBSE 2019 (31/3/1)]

Ans.

Cerebrum	Cerebellum
1. It forms the part of forebrain.	1. It forms the part of hindbrain.
2. It is composed of two cerebral hemispheres, each consisting of four lobes, namely temporal, parietal, occipital and frontal.	2. It has two cerebellar hemispheres and the presence of a medial vermis.
3. It controls the muscular movements, interprets sensory impulses and is concerned with emotions and intelligence.	3. It maintains the body equilibrium, muscle coordination and muscle tone.

Q. 27. How are the brain and spinal cord protected?

Ans. **(*i*) Brain:** It is protected by the bony box called cranium. It is also called as skull.

Also the membranes that surround the brain (meninges) are filled with cerebrospinal fluid that act as shock absorbers protecting the brain.

(*ii*) Spinal cord: The vertebral column, commonly called backbone, protects the spinal cord.

Q. 28. Name the hormones secreted by the following endocrine glands and specify one function of each:

(*i*) Thyroid (*ii*) Pituitary (*iii*) Pancreas *[CBSE 2018]*

Ans. (*i*) **Thyroid**

Hormones secreted: Thyroxine, triiodothyronine, and calcitonin.

Function: It regulates carbohydrate, protein and fat metabolism.

(*ii*) **Pituitary:**

Hormone secreted: Growth hormone

Function: It regulates growth and development of body.

(*iii*) **Pancreas**

Hormone secreted: Insulin and glucagon

Functions:

- Insulin regulates or decreases blood sugar level.
- Glucagon regulates or increases blood sugar level.

Long Answer Questions [5 marks]

Each of the following questions are of 5 marks and have to be answered in about 80-90 words.

Q. 1. Differentiate between tropic and nastic movements in plants.

Ans.

Tropic Movements	Nastic Movements
1. It can be easily observed in stems and roots.	1. It is clearly observed in bilaterally symmetrical organs such as leaves and petals of flowers.
2. It is due to unilateral stimulus which causes unequal growth on the two sides of a stem, root and tendril.	2. The movements occur due to stimulus of light and temperature. It is not a growth movement.
3. Movement is related to stimulus, *i.e.*, plant organs either move towards source of stimulus or away from it. Stimuli which causes movements in plants are gravity, light, touch, water and chemical substances.	3. It does not depend on the direction of stimulus applied.
4. Example: Bending of root towards gravity and shoot towards light.	4. Example: Leaves of 'touch-me-not' plant bend and droop on touching.

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Q. 2. **(*i*) What are cranial and spinal nerves? Describe a spinal nerve.**

(*ii*) Draw a diagram of the human brain and label the following parts:

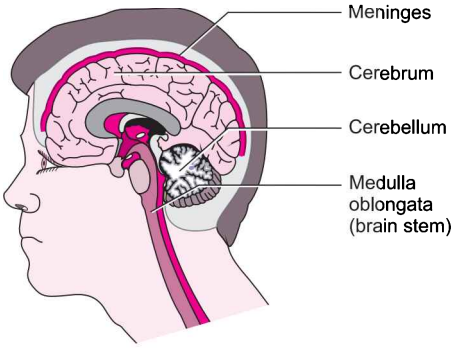
(*a*) Cerebrum (*b*) Meninges (*c*) Medulla oblongata (*d*) Cerebellum

Ans. (*i*) Cranial nerves are the nerves associated with the brain. These are 12 pairs in number and carries both sensory and motor nerves.

Spinal nerves are the nerves connected with the spinal cord. These are 31 pairs in number.

Spinal nerve arises in the form of dorsal root and ventral root and both unite in the neural canal to form a single branch. It comes out of the vertebral column through intervertebral canal and then divides into dorsal, ventral and visceral branches.

(*ii*)



Structure of Human Brain

Q. 3. **Which hormone is released into the blood when its sugar level rises? Name the organ which produces the hormone and describe its effect on blood sugar level. Also name one digestive enzyme that this organ secretes and the function of this enzyme.**

Ans. Insulin hormone is released into the blood when its sugar level rises. Pancreas secretes the insulin hormone. The function of insulin hormone is to lower the blood sugar level. Deficiency of insulin hormone in the body causes a disease known as diabetes. Diabetes is characterised by large quantities of sugar in the blood. The insulin hormone controls the metabolism of sugar. If due to some reason pancreas does not produce and secrete sufficient amount of insulin into blood, then the sugar level in the blood rises. The high sugar level in the blood can cause many harmful effects to the body of person. The person having severe diabetes are treated by giving injection of insulin.

The pancreas secretes pancreatic juice which contains enzymes like trypsin for digesting proteins, lipase for breakdown of emulsified fats and amylase for breakdown of starch.

Q. 4. **Describe the central nervous system in human beings.**

Ans. The central nervous system in human beings consists of brain and spinal cord.

(*i*) Brain: Brain is the highest coordinating centre in the body. It is covered by meninges, which is made up of three layers. It is protected by cranium. Brain is broadly divided into:

(*a*) Forebrain: The forebrain includes cerebrum and olfactory lobes. Cerebrum is the largest part of the brain. It consists of two cerebral hemispheres. Sensory and motor receptors are present in the brain. There are various regions for reception of vision (occipital lobe), reception of sound (temporal lobe), touch, smell, temperature (parietal lobe) and muscular activities (frontal lobe). Olfactory lobes are one in pair and receives olfactory nerves.

(*b*) Midbrain: It is the small portion of the brain that connects cerebrum with the other parts of the brain and spinal cord.

(*c*) Hindbrain: It consists of cerebellum, pons and medulla oblongata. Cerebellum is responsible for coordination and adjustment of movement and posture. Pons regulate respiration. Medulla oblongata regulates swallowing, coughing, sneezing and vomiting.

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(*ii*) **Spinal cord:** Medulla oblongata extends downwards, enclosed in vertebral column to form a cylindrical structure known as spinal cord. It is also covered by meninges. It is the reflex centre of the body.

Q. 5. Give the various functions performed by the plant hormones.

OR

Name various plant hormones. Also give their physiological effects on plant growth and development. *[NCERT Exemplar]*

Ans. The various functions performed by the plant hormones are:

(*i*) Auxins promote cell enlargement and cell differentiation. They also promote growth.

(*ii*) Gibberellins promote cell enlargement and cell differentiation in the presence of auxin. It also help in breaking the dormancy in seeds and buds. It promote the growth in fruits.

(*iii*) Cytokinins promote cell division and help in breaking the dormancy of seeds and buds. It delays the ageing in leaves. It promotes the opening of stomata and also fruit growth.

(*iv*) Abscisic acid promotes the dormancy in seeds and buds. It promotes the closing of stomata and falling of leaves. It also inhibits growth, reverses the growth promoting effects of auxins and gibberellins. Its effects include wilting of leaves.

(*v*) Ethylene promotes the falling of leaves, ripening of fruits and helps in breaking bud dormancy.

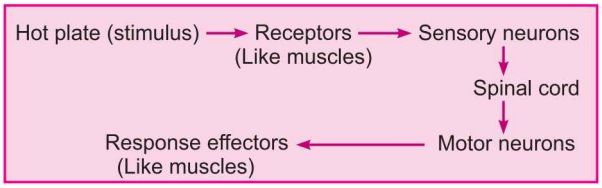
Q. 6. What is reflex action? Explain with the help of examples.

OR

What are reflex actions? Give two examples. Explain a reflex arc. *[NCERT Exemplar]*

Ans. A reflex action is defined as a spontaneous, automatic and mechanical response to a stimuli without the will of an individual. In such actions there is no involvement of the brain. All reflex actions are conveyed through the spinal cord by a path called reflex arc.

The reflex action travels in the following sequence:



The reflex arc constitutes the following components:

(*i*) A receptor to perceive the stimulus.

(*ii*) A sensory or afferent nerve which carries the message from the receptor to the spinal cord.

(*iii*) The neurons of spinal cord transmit the impulse from afferent neurons to efferent neurons.

(*iv*) The motor or efferent nerve carries messages from spinal cord to the muscles (effectors) that show the response.

Some examples of reflex actions are:

(*i*) Blinking of eyes when a foreign particle gets in them.

(*ii*) Sneezing if an unwanted particle enters the nose.

(*iii*) Watering of mouth at the sight or smell of good food.

(*iv*) Withdrawal of foot if a nail comes in the way while walking and pricks the foot.

(*v*) Immediate withdrawal of hand on touching some hot thing.

Q. 7. With the help of an activity demonstrate geotropism in plants.

Ans. 1. Soak some seeds of gram or *moong* in water for one day.

2. Pierce slightly big holes (2 mm diameter) at the bottom of the cup.

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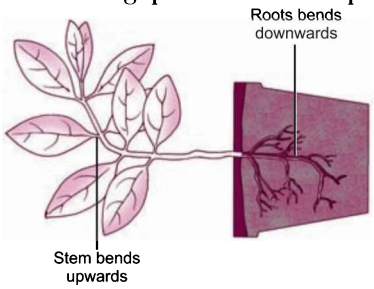
3. Fill it with 1 cm thick layer of garden soil.
4. Sprinkle soaked seeds (*moong*/gram) over the soil. Water the seeds.
5. Put the cup on 2 pieces of wooden or stone slabs so that there is a little gap between the top of the table and bottom of the cup.
6. Cover the lower part of the set-up with black paper.
7. Water the seeds regularly with little water.
8. You will observe that the roots come out from the holes and grow towards the Earth showing positive geotropism.



HOTS [Higher Order Thinking Skills]

Q. 1. Why do stem and root move (grow) towards light and the centre of gravity of the Earth respectively?

Ans. It is due to auxins (plant hormones) produced by the shoot apex and root tip. In stem, growth is more on the shaded side (lower side of apex) due to accumulation of auxins. In root, growth is more on the illuminated side as auxins accumulated on the lower side (shaded side) of root tip inhibits the growth of that side. Thus, there is greater growth on the upper side (illuminated side), resulting in the growth of root apex towards gravity of Earth.

Q. 2. What is association neuron?

Ans. It is found in the cortex part of spinal cord in between the sensory neuron and motor neuron. It forms synapse with the axon of sensory neuron and dendrites of motor neuron.

Q. 3. Why is the flow of signals in a synapse from axonal end of one neuron to dendritic end of another neuron but not the reverse? *[NCERT Exemplar]*

Ans. When an electrical signal reaches the axonal end of a neuron, it releases a chemical substance. This chemical diffuses towards the dendrite end of next neuron where it generates an electrical impulse or signal. Hence, the electrical signal is converted into a chemical signal at the axonal end. Since these chemicals are absent at the dendritic end of the neuron, the electrical signal cannot be converted into chemical signal.

Q. 4. Sameer was studying in his room. Suddenly he smells something burning and sees smoke in the room. He rushes out of the room immediately. Was Sameer's action voluntary or involuntary? Why?

Ans. Sameer's action was voluntary because rushing out of the room was under his conscious control. The smoke and smell were perceived by the receptors in the sense organs and signals are sent to the brain. The brain, then sent signals to the effector organs, *i.e.*, the muscles, to move out of the room.

NCERT Corner

NCERT Intext Questions

Q. 1. What are the differences between a reflex action and walking? *[CBSE (2019) 31/3/3]*

Ans.

Reflex action	Walking
1. Reflex action is the immediate response of the spinal cord to a sudden impulse.	1. Walking is a voluntary action which is controlled.
2. It is conducted by the spinal cord.	2. It is controlled by hind-brain (by cerebellum).
3. It occurs in a fraction of seconds.	3. It takes longer time.

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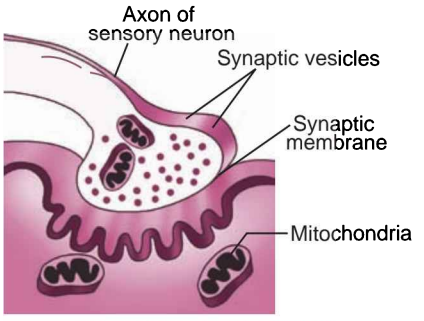
Q. 2. What happens at the synapse between two neurons?

Ans. The neurons lie end-to-end in a chain to transmit the impulses in an animal body. There occurs a very minute gap between terminal portion of axon of one neuron and dendron of the other neuron. This gap is called synapse. At the end of the axon, the electrical impulse sets off the release of some chemicals. These chemicals cross the gap (synapse), and start a similar electrical impulse in the dendrite of the next neuron.



Synaptic transmission

Synapses actually act like one way valves. This is because the chemical substance is present at only one side of the gap. In this way synapses ensure that nerve impulse travels only in one direction.

Q. 3. Which part of the brain maintains posture and equilibrium of the body?

Ans. Cerebellum in the hind-brain maintains posture and equilibrium of the body.

Q. 4. How do we detect the smell of an *agarbatti* (incense stick)?

Ans. The olfactory receptors in our nose detect the smell of *agarbatti*. The information in the form of nerve impulse is transmitted to olfactory lobes of fore brain. The message is interpreted there.

Q. 5. What is the role of the brain in reflex action?

Ans. The reflexes which involve only the spinal cord are called spinal reflexes. The spinal reflexes are produced in the spinal cord but the message of reflex action taken also goes on to reach the brain where the thinking process occurs. Some reflex arcs involve the brain, rather than the spinal cord only. They are called cerebral reflexes. Closing of eyes when exposed to flash of light and salivation at the sight of tempting food are the examples of cerebral reflexes.

Q. 6. What are plant hormones? *[CBSE 2019 (31/1/1)]*

Ans. In plants, certain chemical substances are necessary for proper growth and development. These chemical substances are called plant hormones or phytohormones. Different plant hormones help to coordinate growth, development and responses to the environment. For example, auxins, gibberellins, cytokinins, ethylene and abscisic acid are plant hormones.

Q. 7. How is the movement of leaves of a sensitive plant different from the movement of a shoot towards light? *[CBSE 2019 (31/3/2)]*

Ans. Movement in the leaves of a sensitive plant (*Mimosa pudica*) occurs due to turgor changes in the cells which causes drooping of leaves/leaflets. Movement of a shoot towards light is a phototropic movement which is caused due to differential growth that occurs due to more concentration of auxins in one side.

Q. 8. Give an example of a plant hormone that promotes growth.

Ans. Auxin is the plant hormone that helps in cell elongation and growth.

Q. 9. How do auxins promote the growth of a tendril around a support? *[CBSE 2019 (31/3/1)]*

Ans. The movement of tendril around the support is caused by the hormone auxin. Less auxin occurs on the side of contact as compared to the free side. Auxin promotes the growth on the free side. As a result of growth on the free side, the tendril coils around the support.

Q. 10. Design an experiment to demonstrate hydrotropism. *[CBSE 2019 (31/2/1)]*

Ans. Experiment to demonstrate hydrotropism:

(*i*) Take a wire mesh and cover it with moist saw dust.

(*ii*) Place some germinated seedling (pea or gram) on the moist saw dust.

(*iii*) Keep the saw dust moist by sprinkling water at regular intervals. Observe after 2-3 days.

(*iv*) As the radicals come out of the seeds, they are seen to move towards the perforation. After some growth they bend back and enter the perforations to reach the moist saw dust in complete disregard of gravity (positive hydrotropism).

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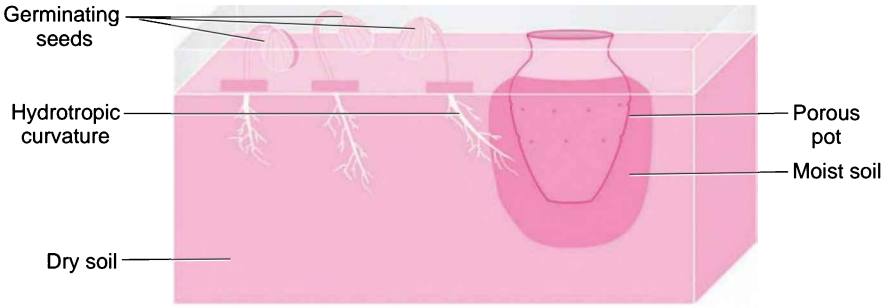

Positive hydrotropic response shown by roots

Conclusion: Bending of radicals back into moist saw dust is a hydrotrophic movement. It occurs despite being against the force of gravity.

Q. 11. How does chemical coordination take place in animals? *[NCERT Exemplar]*

Ans. In animals, chemical coordination is achieved through the agency of hormones which function as chemical messengers or informational molecules. Hormones are secreted in a very small amount by specialised tissues in the body called endocrine glands. These glands are ductless and pour their secretions directly into blood. Blood transports them to the target tissues/organs. Hormones coordinate the activities of living organisms and also their growth. For example, pancreas secretes two hormones—insulin and glucagon.

Q. 12. Why is the use of iodised salt advisable? *[CBSE 2019 (31/2/1)]*

Ans. Iodine is necessary for the thyroid gland to make the hormone thyroxine. Thyroxin regulates carbohydrate, protein and fat metabolism in the body to provide balance for growth. Deficiency of iodine can lead to goitre.

Q. 13. How does our body respond when adrenaline is secreted into the blood?

Ans. Adrenaline hormone is secreted in small amounts all the time but in large amounts it is secreted when a person is frightened. It then prepares our body for action. It increases the rate of heartbeat and breathing, raises blood pressure and allows more glucose to go into the blood to give us a lot of energy so as to quickly fight or run away from the frightening situation. Adrenaline is termed as 'hormone of emergency'.

Q. 14. Why are some diabetes patients treated by giving insulin injections? *[CBSE 2019 (31/3/2)]*

Ans. The insulin hormone controls the metabolism of sugar. When pancreas does not produce or secrete sufficient amount of insulin into blood, then the sugar level in the blood rises. Therefore, the patient excretes sugar (glucose) in urine, feels excessive thirst and also urinates excessively. The people having severe diabetes are treated by giving injections of insulin.

NCERT Exercises

Q. 1. Which of the following is a plant hormone?

(*a*) Insulin **(*b*) Thyroxine**

(*c*) Oestrogen **(*d*) Cytokinin**

Ans. (*d*)

Q. 2. The gap between two neurons is called a

(*a*) dendrite **(*b*) synapse**

(*c*) axon **(*d*) impulse**

Ans. (*b*)

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Q. 3. The brain is responsible for

(*a*) thinking **(*b*) regulating the heartbeat**

(*c*) balancing the body **(*d*) all of the above**

Ans. (*d*)

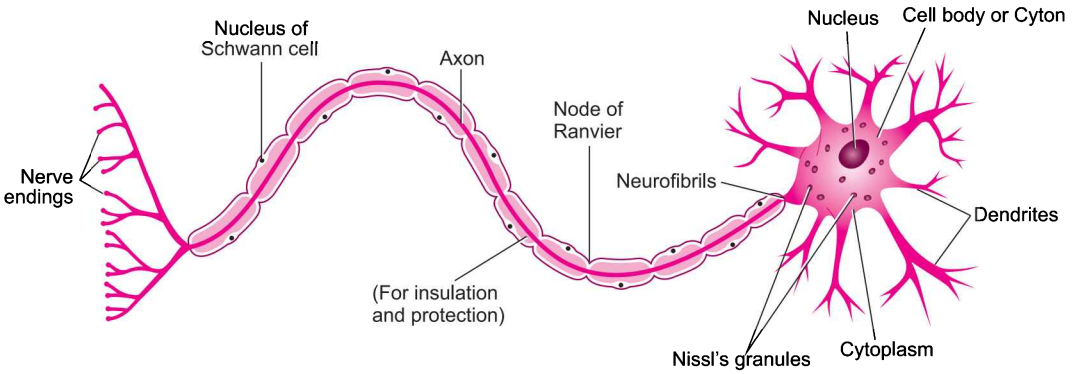
Q. 4. What is the function of receptors in our body? Think of situations where receptors do not work properly. What problems are likely to arise?

Ans. The receptors in our body collect information about changes in the environment around us in the form of stimuli, *e.g.,* photoreceptors, gustatoreceptors, olfactory receptors. These receptors then passes the information in the form of nerve impulses to central nervous system (spinal cord and/or brain) where message is interpreted and appropriate instructions are sent to effectors (glands or muscles) which reveal responses. When receptors do not function normally, the environmental stimuli are not able to create nerve impulses and body does not respond. For example, if our gustatory receptors located in the tongue do not work properly we will not perceive the taste of food such as sour, sweet, salty or bitter.

Q. 5. Draw the structure of a neuron and explain its function. *[NCERT Exemplar]*

Ans. Neuron or nerve cell is a structural and functional unit of the nervous system that is specialised to receive, conduct and transmit nerve impulses.

A neuron (nerve cell) has three components: (*i*) Cell body (cyton), (*ii*) Dendrites, (*iii*) Axon



A neuron (nerve cell)

Functions: The information acquired at the end of the dendritic tip of a neuron sets off a chemical reaction which creates an electrical impulse. This impulse travels from the dendrite to the cyton along the axon of its end. At the end of axon, the electrical impulse sets off the release of some chemicals, which cross the synapse and start a similar electrical impulse in a dendrite of the next neuron. In this way, nerve impulses travel in the body, from one neuron to another till it reaches the brain or the target organ. Thus, a nervous tissue is made up of an organised network of nerve cells or neurons which are specialised in conducting information via electrical impulse from one part of the body to another.

Q. 6. How does phototropism occur in plants?

Ans. The directional movement of a plant part/plant in response to light is called phototropism. The shoot responds by bending towards light while roots respond by bending away from the light. We know that the plant stem responds to light and bend towards it due to the action of auxin hormone. This happens as follows:

(*i*) When sunlight falls on the plant, the auxin hormone present at the tip of the stem spreads uniformly down the stem. Due to the equal presence of auxin, both the sides of the stem grow straight and with same rapidity.

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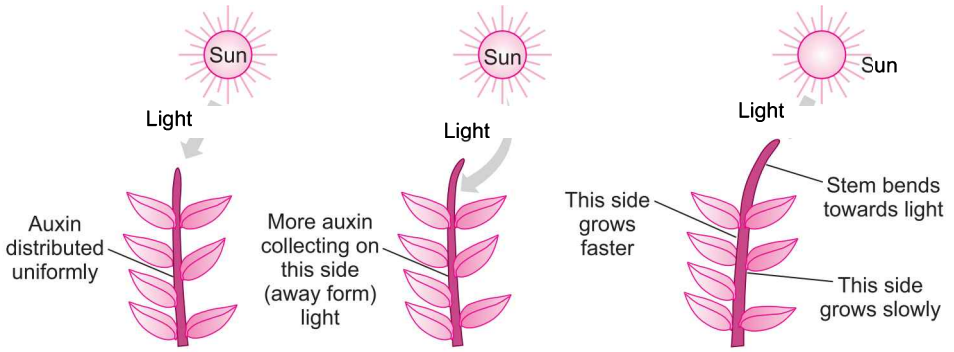

Experiment to show the effect of auxin on the growth of a plant in response to light (Phototropism)

(*ii*) When the light falls only on the right side of the stem, then the auxin hormone collects in the left side of the stem, away from the light. This is because auxin hormone prefers to stay in shade, *i.e.,* moves away from the light. Thus, more auxin hormone is present in the left side of stem as compared to the right. The left side of stem, grows faster than its right side and therefore, the stem bends towards the right side (direction of light).

The effect of auxin on the growth of a root is exactly opposite to that on a stem. Auxin hormone increases the rate of growth in stem but it decreases the rate of growth in a root. The side of root away from light will have all the auxin concentrated in it. Due to this, the side of root which is away from light will grow slower than the other side and make the root bends away from light.

Q. 7. Which signals will get disrupted in case of a spinal cord injury?

Ans. In case of a spinal cord injury, reflex actions and involuntary actions will get disrupted.

Q. 8. How does chemical coordination occur in plants?

Ans. In plants, chemical coordination occurs with the help of plant hormones (phytohormones). Different plant hormones help to coordinate growth, development and responses to the environment. They are synthesised at places away from where they act and simply diffuse to the area of action, for example, auxin. Another example of plant hormones are gibberellins which help in growth of the stem. Cytokinins promote cell division. Abscisic acid is a plant hormone which inhibits growth and its effects include wilting of leaves.

Q. 9. What is the need for a system of control and coordination in an organism?

Ans. The body of a multicellular organism consists of a number of components and sub-components and each is specialised to perform a particular function. Therefore, it is necessary that various organs of the body of an organism work together in a proper manner to carry out various functions and respond to stimuli. In human beings, nervous system and endocrine system work together to control and coordinate.

Q. 10. Compare and contrast nervous and hormonal mechanisms for control and coordination in animals.

Ans.

Nervous Control	Hormonal Control
1. Information is passed as electrochemical conduction.	1. Information is sent as a chemical substance through the blood stream.
2. Information travels rapidly; in milliseconds.	2. Information travels slowly.
3. Response is immediate.	3. Response is usually slow.
4. Its effects are short-lived.	4. Its effects are generally more prolonged.

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Q. 11. How are involuntary actions and reflex actions different from each other?

Ans.

Involuntary Actions	Reflex Actions
1. They involve autonomic nervous system.	1. They involve all parts of voluntary nervous system.
2. They usually occur in response to internal stimuli.	2. They operate against harmful stimuli which are generally external and may cause injury.
3. They are connected with functioning of internal body parts.	3. They are connected with emergency.
4. These are regulated by medulla (hind-brain).	4. Reflex action is controlled by spinal cord.
5. The speed of response is slower.	5. The speed of response is very fast.
6. Example: Beating of heart muscle.	6. Example: Removal of hand with jerk when someone touches a hot object accidently.

Q. 12. What is the difference between the manner in which movement takes place in a sensitive plant and the movement in our legs?

Ans.

Movement in Sensitive Plant	Movement in Legs
1. It occurs in response to an external stimulus like touch and shock.	1. It occurs in response to our requirement and is determined by will.
2. Plant cells change shape by changing the amount of water (turgor changes).	2. Movement in our legs is a voluntary action which is controlled by cerebellum in hind-brain.
3. No nerves are involved.	3. Nerves carry the message for movement of legs.
4. It is controlled by plant hormones.	4. It is controlled by nerves and cerebellum in hind-brain.

SELF-ASSESSMENT TEST

Time allowed: 1 hour **Max. marks: 40**

SECTION–A

Choose and write the correct answer for each of the following. (4 × 1 = 4)

1. Functions of the forebrain are

(*a*) sensation of feeling full, control of voluntary muscles, hearing, sight.
(*b*) control of voluntary muscles, control of blood pressure, hearing, sight.
(*c*) control of voluntary muscles, hearing, sight, posture of the body.
(*d*) sensation of feeling full, control of involuntary muscles, hearing, sight.

2. The shape of guard cells changes due to change in the

(*a*) protein composition of cells. (*b*) temperature of cells.
(*c*) amount of water in cells. (*d*) position of nucleus in the cells.

3. In a neuron, conversion of electrical signal to a chemical signal occurs at/in

(*a*) cell body. (*b*) axonal end.
(*c*) dendritic end. (*d*) axon.

4. Junction between two neurons is called

(*a*) cell junction. (*b*) neuro muscular junction.
(*c*) neural joint. (*d*) synapse.

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The following questions consist of two statements—Assertion(A) and Reason(R). Answer these questions selecting the appropriate option given below:

(*a*) **Both *A* and *R* are true and *R* is the correct explanation for *A*.**

(*b*) **Both *A* and *R* are true but *R* is not the correct explanation for *A*.**

(*c*) ***A* is true but *R* is false.**

(*d*) ***A* is false but *R* is true.** **(3 × 1 = 3)**

5. Assertion(*A*) : A nerve impulse is an electrochemical event.
Reason (*R*) : In a nerve impulse there are changes in the resting potential which spreads down the nerve fibre.

6. Assertion(*A*) : The brain is also known as the central nervous system.
Reason (*R*) : Central nervous system controls and regulates the voluntary actions.

7. Assertion(*A*) : The spinal nerves are 31 in number.
Reason (*R*) : Spinal nerves only have sensory neurons in them.

Answer the following questions in one word or one sentence. **(3 × 1 = 3)**

8. Name the movements which are also known as sleep movements.

9. Name the hormone which increases heartbeat rate when we get frightened.

10. What is insulin?

SECTION–B

Answer the following questions in about 50-60 words each. **(5 × 3 = 15)**

11. Explain how the human body responds when adrenaline is secreted into blood.

12. Why does the flow of signals in a synapse from axonal end of one neuron to dendritic end of another neuron take place but not in the reverse direction? Explain. *[CBSE 2019 (31/5/1)]*

13. Nervous and hormonal system together perform the function of control and coordination in human beings. Justify the statement. *[CBSE Delhi 2017]*

14. (*i*) Define reflex arc.
(*ii*) What happens at the synapse between two neurons? *[NCERT Exemplar]*

15. Name the plant hormones responsible for the following:
(*i*) Elongation of cells (*ii*) Growth of stem
(*iii*) Promotion of cell division (*iv*) Falling of senescent leaves

SECTION–C

Answer the following questions in about 80–90 words each. **(3 × 5 = 15)**

16. (*i*) What is (*a*) phototropism and (*b*) geotropism? With labelled diagrams describe an activity to show that light and gravity change the direction that plant parts grow in.
(*ii*) Mention the role of each of the following plant hormones: (*a*) Auxin, (*b*) Abscisic acid.

17. (*i*) Why is the use of iodised salt advisable? Name the disease caused due to deficiency of iodine in our diet and state its one symptom. *[CBSE 2019 (31/2/1)]*
(*ii*) How do nerve impulses travel in the body? Explain.

18. What are the major parts of the brain? Mention the functions of different parts. *[NCERT Exemplar]*

Answers

1. (*a*) **2.** (*c*) **3.** (*b*) **4.** (*d*) **5.** (*a*) **6.** (*d*) **7.** (*c*)

8. Nyctinastic **9.** Adrenalin

10. Insulin is a hormone secreted by the beta cells of islets of Langerhans in the pancreas.

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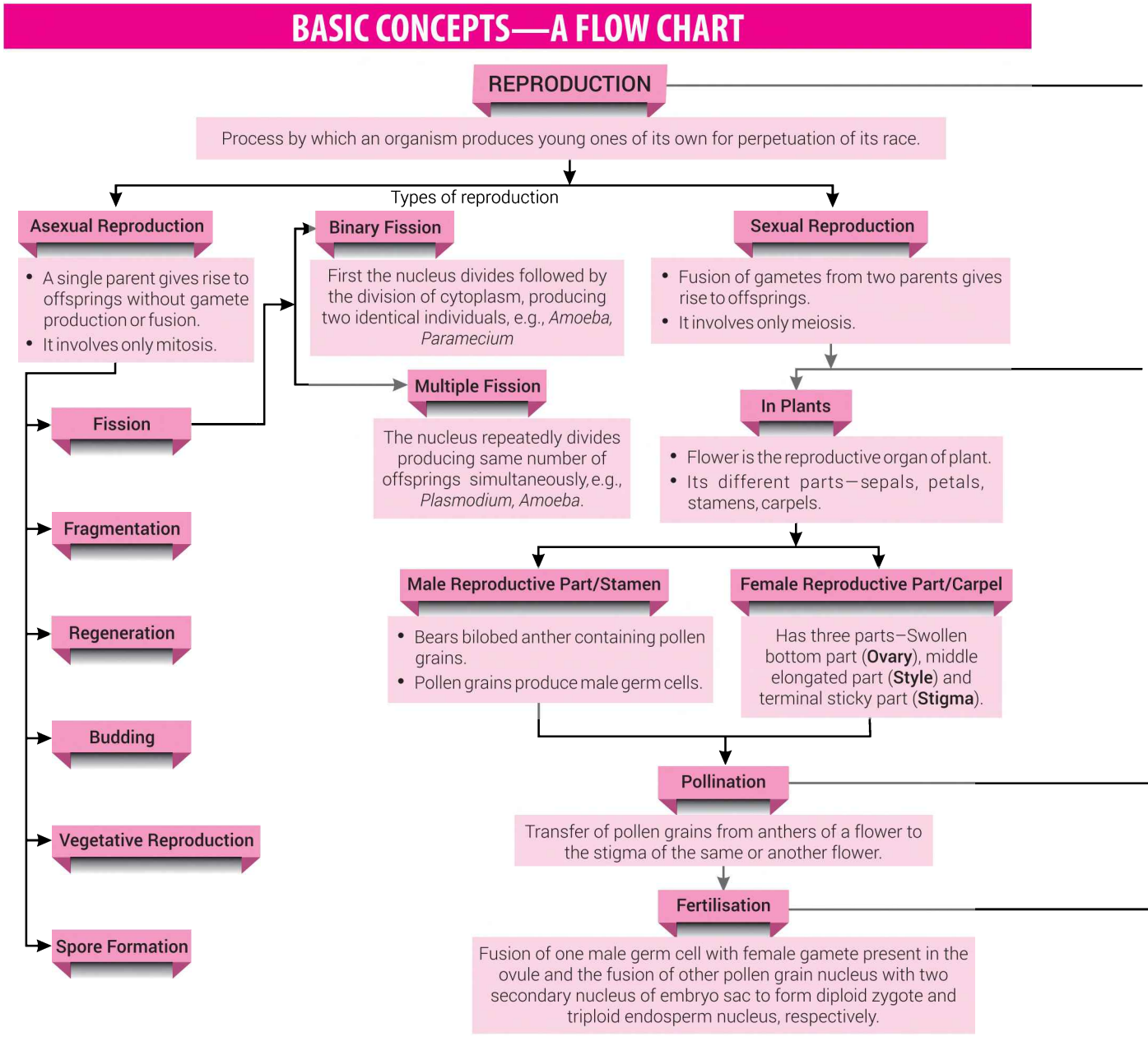
8 How Do Organisms Reproduce?

BASIC CONCEPTS—A FLOW CHART



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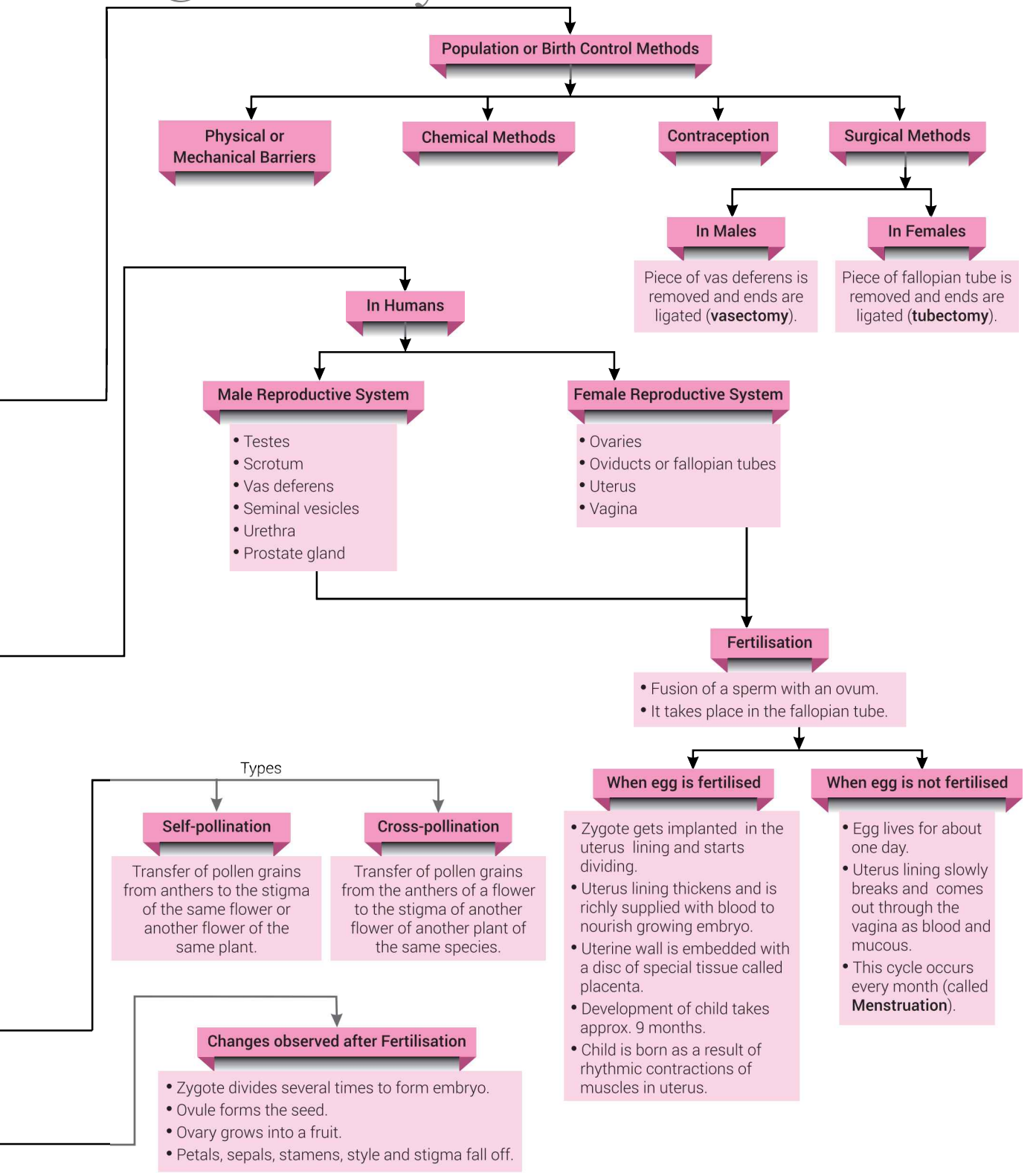

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MORE POINTS TO REMEMBER

- **DNA copying mechanisms** creates variations which are useful for ensuring the survival of the species. Modes of sexual reproduction allow for greater variation to be generated.
- **Organisms** such as *Hydra* can regenerate if they are broken into pieces. They can also give out buds which mature into new individuals.
- When the cell divides into two, each new cell gets a copy of parental DNA or chromosomes.
- **In tissue culture,** new plants are grown by removing tissue or separating cells from the growing tip of a plant. The cells are then placed in an artificial medium where they divide rapidly to form a small group of cells or callus. The callus is transferred to another medium containing hormones for growth and differentiation. The plantlets are then placed in the soil so that they can grow into mature plants.
- **Pollen grains** are tiny, spherical cells having outer thick wall (exine) and inner thin wall (intine) and nucleus in the centre.
- The period during adolescence when the reproductive organs become functional is termed as puberty. It is attained in males between the age of 13-16 years and in females between 11-14 years.
- **Reproductive health is** — To have awareness about STDs (sexually transmitted disease).

  Some common STDs are gonorrhea, syphilis & HIV-AIDS.

Multiple Choice Questions [1 mark]

Each question has 4 choices (a), (b), (c) and (d). Choose and write the correct option.

1. In the list of organisms given below, those that reproduce by the asexual method are

(*i*) banana (*ii*) dog (*iii*) yeast (*iv*) *Amoeba*

[*NCERT Exemplar*]

(*a*) (*ii*) and (*iv*) (*b*) (*i*), (*iii*) and (*iv*) (*c*) (*i*) and (*iv*) (*d*) (*ii*), (*iii*) and (*iv*)

2. In a flower, the parts that produce male and female gametes (germ cells) are [*NCERT Exemplar*]

(*a*) stamen and anther (*b*) filament and stigma

(*c*) anther and ovary (*d*) stamen and style

3. Which of the following is the correct sequence of events of sexual reproduction in a flower?

[*NCERT Exemplar*]

(*a*) pollination, fertilisation, seedling, embryo

(*b*) seedling, embryo, fertilisation, pollination

(*c*) pollination, fertilisation, embryo, seedling

(*d*) embryo, seedling, pollination, fertilisation

4. Offsprings formed by asexual method of reproduction have greater similarity among themselves because

(*i*) asexual reproduction involves only one parent

(*ii*) asexual reproduction does not involve gametes

(*iii*) asexual reproduction occurs before sexual reproduction

(*iv*) asexual reproduction occurs after sexual reproduction [*NCERT Exemplar*]

(*a*) (*i*) and (*ii*) (*b*) (*i*) and (*iii*)

(*c*) (*ii*) and (*iv*) (*d*) (*iii*) and (*iv*)

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5. **A feature of reproduction that is common to *Amoeba*, *Spirogyra* and yeast is that** [*NCERT Exemplar*]
   (*a*) they reproduce asexually. (*b*) they are all unicellular.
   (*c*) they reproduce only sexually. (*d*) they are all multicellular.
6. **In *Spirogyra*, asexual reproduction takes place by** [*NCERT Exemplar*]
   (*a*) breaking up of filaments into smaller bits (*b*) division of a cell into two cells
   (*c*) division of a cell into many cells (*d*) formation of young cells from older cells
7. **The number of chromosomes in parents and offsprings of a particular species remains constant due to** [*NCERT Exemplar*]
   (*a*) doubling of chromosomes after zygote formation
   (*b*) halving of chromosomes during gamete formation
   (*c*) doubling of chromosomes after gamete formation
   (*d*) halving of chromosomes after gamete formation
8. **In *Rhizopus*, tubular, thread-like structures bearing sporangia at their tips are called** [*NCERT Exemplar*]
   (*a*) filaments (*b*) hyphae (*c*) rhizoids (*d*) roots
9. **Vegetative propagation refers to the formation of new plants from** [*NCERT Exemplar*]
   (*a*) stem, roots and flowers (*b*) stem, roots and leaves
   (*c*) stem, flowers and fruits (*d*) stem, leaves and flowers
10. **Factors responsible for the rapid spread of bread mould on slices of bread are**
    (*i*) large number of spores
    (*ii*) availability of moisture and nutrients in bread
    (*iii*) presence of tubular branched hyphae
    (*iv*) formation of round shaped sporangia [*NCERT Exemplar*]
    (*a*) (*i*) and (*iii*) (*b*) (*ii*) and (*iv*) (*c*) (*i*) and (*ii*) (*d*) (*iii*) and (*iv*)
11. **Which among the following statements are true for sexual reproduction in flowering plants?**
    (*i*) It requires two types of gametes.
    (*ii*) Fertilisation is a compulsory event.
    (*iii*) It always results in formation of zygote.
    (*iv*) Offspring formed are clones. [*NCERT Exemplar*]
    (*a*) (*i*) and (*iv*) (*b*) (*i*), (*iii*) and (*iv*) (*c*) (*i*), (*ii*) and (*iii*) (*d*) (*i*), (*ii*) and (*iv*)
12. **In human females an event that reflects onset of reproductive phase is** [*NCERT Exemplar*]
    (*a*) growth of body (*b*) changes in hair pattern
    (*c*) change in voice (*d*) menstruation
13. **The correct sequence of organs in the male reproductive system for transport of sperms is** [*NCERT Exemplar*]
    (*a*) testis → vas deferens → urethra (*b*) testis → ureter → urethra
    (*c*) testis → urethra → ureter (*d*) testis → vas deferens → ureter
14. **The plants that have lost their capacity to produce seeds, reproduce by**
    (*a*) spore formation (*b*) budding
    (*c*) regeneration (*d*) vegetative propagation
15. **Callus is a cellular mass that is formed during**
    (*a*) micropropagation (*b*) grafting (*c*) budding (*d*) layering

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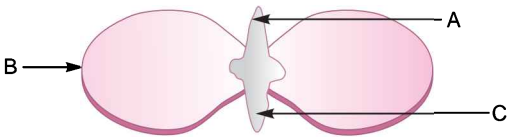
16. **Fertilisation in human beings takes place in**
(*a*) uterus (*b*) vagina
(*c*) fallopian tube (*d*) vas deferens

17. **The function of testes is to**
(*a*) produce testosterone (*b*) produce sperms
(*c*) produce male sperms and testosterone (*d*) produce sperms and urine

18. **In Figure, the parts A, B and C are sequentially**



(*a*) cotyledon, plumule and radicle (*b*) plumule, radicle and cotyledon
(*c*) plumule, cotyledon and radicle (*d*) radicle, cotyledon and plumule

19. **Which of the following is not a function of ovaries?**
(*a*) They produce and release eggs.
(*b*) They produce estrogen and progesterone.
(*c*) They stimulate the start of labour contraction.
(*d*) They store eggs.

20. **Which of the following glands produce sugars to provide energy for sperm?**
(*a*) Cowper's glands (*b*) Prostate gland
(*c*) Seminal vesicles (*d*) Epididymis

Answers

1. (*b*)	**2.** (*c*)	**3.** (*c*)	**4.** (*a*)	**5.** (*a*)	**6.** (*a*)	**7.** (*b*)
8. (*b*)	**9.** (*b*)	**10.** (*c*)	**11.** (*c*)	**12.** (*d*)	**13.** (*a*)	**14.** (*d*)
15. (*a*)	**16.** (*c*)	**17.** (*c*)	**18.** (*c*)	**19.** (*c*)	**20.** (*c*)	

Assertion-Reason Questions [1 mark]

The following questions consist of two statements — Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

1. **Assertion (*A*) :** Asexual reproduction is a primitive type of reproduction.
Reason (*R*) : Asexual reproduction involves only mitotic cell division.
2. **Assertion (*A*) :** Spores are unicellular bodies.
Reason (*R*) : The parent body simply breaks up into smaller pieces on maturation.
3. **Assertion (*A*) :** Clones are offspring of an organism formed by asexual reproduction.
Reason (*R*) : Clones have exact copies of DNA as their parent.
4. **Assertion (*A*) :** Colonies of yeast multiply in sugar solution.
Reason (*R*) : Sugar is made of sucrose which provides energy for sustaining all life activities.

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5. **Assertion (*A*) :** Pollen grains from the carpel stick to the stigma of stamen.
   Reason (*R*) : The fertilised egg cells grow inside the ovules and become seeds.

Answers

1. (*a*) **2.** (*c*) **3.** (*b*) **4.** (*a*) **5.** (*d*)

Passage-based Questions

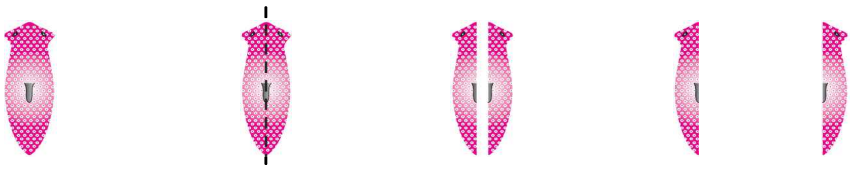
Answer the questions given below each passage on the basis of your understanding of the paragraph and the related studied concepts.

1. Asexual reproduction can be seen in protozoans, sponges, coelenterates, certain worms and tunicate. It is not found in higher invertebrates and vertebrates.

Leishmania is a unicellular protozoan. It is a parasite which causes the disease known as kala-azar. It has whip-like structure called flagellum at its one end of the cell. It reproduces by the process of binary fission. In such organisms, the splitting of the parent cell during fission (or cell division) takes place in a definite plane with respect to the flagellum at its end.

(*i*) What are clones?

(*ii*) Would a *Planaria* cut vertically into two halves regenerate into two individuals? Complete Figure D and E by indicating the regenerated regions.



(*a*) (*b*) (*c*) (*d*) (*e*)

(*iii*) Can you consider cell division as a type of reproduction in unicellular organism? Give one reason.

(*iv*) Name two simple organisms having the ability of regeneration.

2. Acquired Immunodeficiency Syndrome (AIDS) is a chronic life-threatening disorder. It is also a sexually transmitted disease, caused by a virus called HIV (Human Immunodeficiency Virus). AIDS damages the body's immune system, so that the body cannot protect itself against infection. So, AIDS is a very dangerous disease which leads to death.

Early symptoms of AIDS are weight loss, fever, diarrhoea, oral thrush and enlargement of lymph glands. In severe conditions, a patient may develop pneumonia, cancer of skin and lymph system. The patient dies within a year.

AIDS is transmitted by blood transfusion, hypodermic needles used by addicts, homosexual or heterosexual intercourse.

Treatment: No definite cure has been found for the AIDS disease so far. The best method of prevention is to avoid drug abuse and intercourse with affected persons.

(*i*) What are sexually transmitted diseases?

(*ii*) Contraceptive methods can be used to prevent STDs. Name any three.

(*iii*) How are general growth and sexual maturation different from each other?

(*iv*) How can people be made aware of STDs?

Answers

1. (*i*) Clone refers to offspring of an organism formed by asexual method of reproduction.

(*ii*) Yes, shaded part in Figures D and E represent the regenerated halves.

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(D)


(E)

(*iii*) Yes, because it results in the formation of two daughter cells, *i.e.*, it results in the production of more individuals of the organism.

(*iv*) *Planaria*/*Hydra*/Earthworm. (*Any two*)

2. (*i*) Sexually transmitted diseases (STDs) are a group of communicable diseases that are transmitted predominantly by sexual contact and caused by a wide range of bacterial, viral, protozoan and fungal agents and ectoparasites.

(*ii*) Contraceptive methods that are used to prevent STDs are (*a*) Barrier method (condoms), (*b*) drugs (as pills), (*c*) loop or copper T, and (*d*) surgical method (vasectomy/tubectomy).

(*iii*) General growth refers to different types of developmental processes in the body like increase in height, weight gain, changes in shape and size of the body. But sexual maturation is specific to changes reflected at puberty like cracking of voice, new hair patterns in males, development of breasts in females, etc.

(*iv*) (*a*) Educating people about STDs through campaigns and advertisements in television and newspapers.

(*b*) Teaching adolescents about complications of STDs through classroom activities and books.

Very Short Answer Questions [1 mark]

Each of the following questions are of 1 mark and have to be answered in one word or one sentence.

Q. 1. What is reproduction? List its two types. *[CBSE 2019 (31/3/1)]*

Ans. Reproduction is the process by which an organism produces a copy of its own type for perpetuation of its race.

On the basis of different modes of reproduction, reproduction is classified as:

(*i*) Asexual reproduction

(*ii*) Sexual reproduction.

Q. 2. What is the effect of DNA copying which is not perfectly accurate in the reproduction process?

Ans. The DNA copying which is not perfectly accurate in the reproduction process results in variations in populations for better survival of the species.

Q. 3. What methods will you use for growing jasmine and rose plants?

Ans. For growing jasmine plants, layering method will be used and for growing rose plants, cutting and grafting methods will be used.

Q. 4. Can you consider cell division as a type of reproduction in unicellular organism? Give one reason. *[NCERT Exemplar]*

Ans. Yes, because it results in the formation of two daughter cells, *i.e.,* it results in the production of more individuals of the organism.

Q. 5. What is the function of pollen grains in flowers?

Ans. Pollen grains are the male gametes which fertilise the egg cell present in the ovule of a flower.

Q. 6. Write the various methods of cross-pollination.

Ans. Various methods of cross-pollination are **entomophily** (insect pollination), **anemophily** (wind pollination), **hydrophily** (water pollination) and **zoophily** (animal pollination).

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Q. 7. Why cannot fertilisation take place in flowers if pollination does not occur? [*NCERT Exemplar*]

OR

Why is fertilisation not possible without pollination? [*CBSE (F) 2016*]

Ans. In a flower, fertilisation requires both male and female gametes. If pollination does not occur, male gametes will not be available hence fertilisation cannot take place.

Q. 8. Explain the role of cotyledon and plumule in germination.

Ans. Cotyledon stores food and the plumule acts as future shoot.

Q. 9. Is the chromosome number of zygote, embryonal cells and adult of a particular organism always constant? How is the constancy maintained in these three stages? [*NCERT Exemplar*]

Ans. Yes, the constancy is maintained because cells in all these three structures undergo only mitotic divisions.

Q. 10. In a bisexual flower inspite of the young stamens being removed artificially, the flower produces fruit. How is it possible? [*NCERT Exemplar*]

Ans. This is because the pistil is intact due to which cross-pollination takes place leading to fertilisation and formation of fruit.

Q. 11. What is gametogenesis?

Ans. Formation of sperms in testes and ova in ovary is called gametogenesis.

Q. 12. In tobacco plant, the male gametes have twenty four chromosomes. What is the number of chromosomes in the female gamete? What is the number of chromosomes in the zygote? [*NCERT Exemplar*]

Ans. Number of chromosomes in female gamete is 24 and in zygote it is 48.

Q. 13. What would be the ratio of chromosome number between an egg and its zygote? How is the sperm genetically different from the egg? [*NCERT Exemplar*]

Ans. The ratio is 1 : 2. Sperms contain either X or Y chromosome whereas an egg will always have an X chromosome.

Q. 14. Name the method by which *Hydra* reproduces. Is this method sexual or asexual? [*CBSE (F) 2016*]

Ans. *Hydra* reproduces by budding or regeneration.

It is a method of asexual reproduction.

Q. 15. Name the method by which *Spirogyra* reproduces under favourable conditions. Is this method sexual or asexual? [*CBSE Delhi 2017*]

Ans. *Spirogyra* reproduces by fragmentation. It is an asexual method.

Q. 16. How does *Plasmodium* reproduce? Is this method sexual or asexual? [*CBSE Delhi 2017*]

Ans. *Plasmodium* reproduces by multiple fission. This method is an asexual means of reproduction.

Q. 17. Name the male and female gametes in animals.

Ans. In animals, male gametes are called sperms while female gametes are called eggs or ova.

Q. 18. Why are testes placed outside the abdominal cavity in the scrotal sac?

Ans. Testes are placed outside the body cavity in the scrotal sac because it requires a temperature 2°C lower than the normal body temperature for production of sperms.

Q. 19. What is hymen?

Ans. It is a thin fold of membrane which surrounds or partly closes the external vaginal opening.

Q. 20. What is funeral of unfertilised egg?

Ans. Menstruation is also called funeral of egg since it is not fertilised.

Q. 21. What is gestation?

Ans. The period of development of foetus in the uterus till birth is called gestation. It is of 9 months duration (*i.e.*, 280 days or 40 weeks from the first day of the last menstrual cycle) in human beings.

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Q. 22. Define parturition.

Ans. The birth of the fully developed foetus (childbirth) is called parturition.

Q. 23. Name the causative agent of the disease '*Kala-azar*' and its mode of asexual reproduction. *[CBSE (F) 2015]*

Ans. The causative agent of *Kala-azar* is *Leishmania* and the mode of asexual reproduction is binary fission.

Q. 24. Name the parts of a bisexual flower that are not directly involved in reproduction. *[CBSE (F) 2015]*

Ans. (*i*) Sepals/Calyx
(*ii*) Petals/Corolla
(*iii*) Thalamus

Q. 25. List two unisexual flowers. *[CBSE (F) 2016]*

Ans. Watermelon and papaya are unisexual flowers.

Q. 26. Write names of one male and one female sex hormone.

Ans. Male sex hormone is testosterone and female sex hormone is oestrogen.

Q. 27. What is syngamy?

Ans. One male gamete fuses with one female gamete or egg. This process of fusion of male and female nuclei is called syngamy.

Q. 28. What are those organisms called which bear both the sex organs in the same individiual? Give one example of such organism. *[CBSE (AI) 2016]*

Ans. Organisms bearing both the sex organs in the same individual are called bisexual. Example, *Hydra*, Mustard.

Q. 29. Give an example of a unisexual and bisexual flower. *[CBSE (AI) 2014]*

Ans. Cucumber is a unisexual flower and hibiscus is a bisexual flower.

Q. 30. Where is the zygote located in the flower after fertilisation? *[NCERT Exemplar]*

Ans. Zygote is located inside the ovule which is present in the ovary.

Q. 31 What changes are observed in the uterus if fertilisation does not occur? *[NCERT Exemplar]*

Ans. If fertilisation does not occur, the thick and spongy lining of the uterus slowly breaks and comes out through the vagina as blood and mucus.

Q. 32. Give reason for the statement- Since the ovary releases one egg every month, the uterus also prepares itself every month by making its lining thick and spongy. *[CBSE Sample Paper 2016]*

Ans. The lining of uterus becomes thick for nourishing the embryo if fertilisation takes place and egg reaches the uterus.

Q. 33. What is menopause?

Ans. The period of permanent cessation of menstruation in females, usually occurring between the age of 45 and 50 is called as menopause.

Q. 34. What is fertilisation? Where does it occur in a human female? *[CBSE (F) 2017]*

Ans. Fertilisation is the fusion of sperm or male gamete and female gamete. It takes place in oviduct or fallopian tube of human female.

Q. 36. List two bacterial diseases which are transmitted sexually. *[CBSE 2019 (31/5/3)]*

Ans. Syphilis, Gonorrhea

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Short Answer Questions [3 marks]

Each of the following questions are of 3 marks and have to be answered in about 50-60 words.

Q. 1. Define the terms unisexual and bisexual giving one example of each.

Ans. **Unisexual:** In most of the animals including humans, male and female reproductive organs are in different individuals. Such animals are called unisexual.

Bisexual: In some animals like tapeworm, liver fluke, earthworm, leech, etc., the male and female reproductive organs are found in a single individual. Such organisms are called bisexual (hermaphrodite).

The flower may be unisexual (*e.g.*, papaya, watermelon) when it contains either stamens or carpels and bisexual (*e.g.*, Hibiscus, mustard) when it contains both stamens and carpels.

Q. 2. (*i*) What is a clone? Why do offsprings formed by asexual reproduction exhibit remarkable similarity? *[NCERT Exemplar]*

(*ii*) Give two reasons for the appearance of variations among the progeny formed by sexual reproduction. *[NCERT Exemplar]*

Ans. (*i*) Clone refers to offspring of an organism formed by asexual method of reproduction. Since they possess exact copies of the DNA of their parent, clones exhibit remarkable similarity.

(*ii*) (*a*) Sexual reproduction involves two parents with different sets of characters.

(*b*) The gene combinations are different in gametes.

Q. 3. Why does bread mould grow profusely on a moist slice of bread rather than on a dry slice of bread? *[NCERT Exemplar]*

Ans. Moisture is an important factor for the growth of hyphae. Moistened bread slice offers both moisture and nutrients to the bread mould, hence it grows profusely. Dry slice of bread offers nutrients but not moisture hence hyphae fail to grow.

Q. 4. Explain the roles of gametes and zygote in sexual reproduction.

Ans. The two fusing gametes possess characters of their parents in their DNA. Fertilisation brings characters of both parents into one zygote cell.

Zygote is the first cell of the next generation. It divides to form an embryo which subsequently grows into a new individual.

Male gamete forming part – anther/stamen.

Female gamete forming part – pistil/ovary/ovule.

Q. 5. (*i*) Describe the structure of a pollen grain.

(*ii*) In a germinating seed, which parts are known as future shoot and future root? Mention the function of cotyledon. *[CBSE Sample Paper 2016]*

Ans. (*i*) Stamens produce pollen grains that are yellowish in colour. Pollen grain is unicellular and haploid. It has two layers, the thicker outer one is called exine, which is thin at places called germ pores and inner thin layer is called intine.

(*ii*) In a germinating seed, plumule is known as future shoot and radicle is known as future root.

The function of cotyledon is to store food for the future plant or embryo.

Q. 6. Identify the following parts of a flower:

(*i*) Part that produces pollen grain. **(*ii*) Part that transfers male gametes.**

(*iii*) Part that is sticky to trap pollen grains. **(*iv*) Part that develops into a fruit.**

Ans. (*i*) Anther (*ii*) Style

(*iii*) Stigma (*iv*) Ovary

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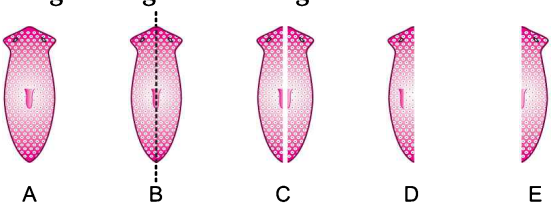
Q. 7. Differentiate between self-pollination and cross-pollination. *[CBSE 2019 (31/5/3)]*

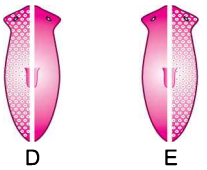
Ans.

Self-pollination	Cross-pollination
1. Transfer of pollen grains from anthers to the stigma of the same flower or another flower of the same plant.	1. Transfer of pollen grains from anthers of a flower to the stigma of another flower borne on another plant of the same species.
2. It occurs in bisexual flowers, *e.g.*, wheat, rice, potato, pea, etc.	2. It occurs in unisexual as well as in bisexual flowers, *e.g.*, maize.

Q. 8. Would a *Planaria* cut vertically into two halves regenerate into two individuals? Complete Figure D and E by indicating the regenerated regions. *[NCERT Exemplar]*



Ans. Yes, shaded part in Figures D and E represent the regenerated halves.



Q. 9. Write one main difference between asexual and sexual mode of reproduction. Which species is likely to have comparatively better chances of survival—the one reproducing asexually or the one reproducing sexually? Justify your answer. *[CBSE 2018, (F) 2015]*

Ans. Asexual reproduction does not involve genetic fusion while sexual reproduction involves fusion of male and female gametes to form a zygote.

Species reproducing sexually have better chances of survival. This is because sexual reproduction gives rise to more variations which are essential for evolution as well as for the survival of species under unfavourable conditions.

Q. 10. Why is DNA copying an essential part of the process of reproduction? What are the advantages of sexual reproduction over asexual reproduction? *[CBSE (F) 2015]*

Ans. DNA copying is essential because it makes the transmission of characters from parents to the next generation possible.

Advantages of sexual reproduction over asexual reproduction:

Sexual reproduction gives rise to variations, which are essential for evolution as well as for the survival of species under unfavourable conditions.

Q. 11. (*i*) Trace the path of sperm during ejaculation and mention the gland and their functions associated with the male reproductive system. *[NCERT Exemplar]*

(*ii*) What changes are observed in the uterus subsequent to implantation of young embryo? *[NCERT Exemplar]*

Ans. (*i*) Sperm comes out from testis into the vas deferens and then passes through urethra before ejaculation. The secretions of seminal vesicle and prostrate glands provide nutrition to the sperms and also facilitate their transport.

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(*ii*) The uterine wall thickens that is richly supplied with blood. A special tissue called placenta develops which connects embryo to the uterine wall that provides nutrients and oxygen to it.

Q. 12. (*i*) What are sexually transmitted diseases (STD)? List two viral and two bacterial STDs. [*CBSE 2019 (31/3/1)*]

(*ii*) Give two reasons for avoiding frequent pregnancies by women.

Ans. (*i*) Sexually transmitted diseases (STD) are a group of communicable diseases that are transmitted predominantly by sexual contact and are caused by a wide range of bacterial, viral, protozoan and fungal agents and ectoparasites.

Viral STDs — Aids, Hepatitis

Bacterial STDs — Syphilis, Gonorrhea

(*ii*) Frequent pregnancies by women are avoided due to the following reasons:

(*a*) It has adverse effect on the health of women.

(*b*) It increases the rate of the population of our country.

Q. 13. Reproduction is one of the most important characteristics of living beings. Give three reasons in support of the statement. [*CBSE (AI) 2017*]

Ans. (*i*) Reproduction is important for continuation of species or perpetuation of species.

(*ii*) It promotes diversity of characters or helps to show the variations which enhances the survival chances.

(*iii*) It increases population of a species.

Q. 14. Suggest three contraceptive methods to control the size of human population which is essential for the health and prosperity of a country. State the basic principle involved in each. [*CBSE Delhi 2016*]

Ans. The methods of contraception are:

(*i*) Barrier method or mechanical method (Condom/Diaphragm): Prevents the meeting of sperms and ova.

(*ii*) Chemical method (Oral pills): Changes the hormonal balance of the female partner so that the eggs are not released.

(*iii*) Surgical method: The vas deferens in males is blocked (vasectomy) or the fallopian tube (oviduct) in females is blocked (tubectomy) to prevent the transfer of sperms or egg and hence no fertilisation takes place.

(*iv*) IUCDs/ Loop or the copper-T is placed in the uterus to prevent pregnancy. (*Any three*)

Q. 15. List three techniques that have been developed to prevent pregnancy. Which one of these techniques is not meant for males? How does the use of these techniques have a direct impact on the health and prosperity of a family? [*CBSE (AI) 2017*]

Ans. Three techniques to prevent pregnancy are barrier method, chemical method and surgical method.

Chemical method is not meant for males.

Use of these techniques helps in maintaining health of the woman. Also, parents can provide more attention and quality resources to the children.

Q. 16. List four points of significance of reproductive health in a society. Name any two areas related to reproductive health which have improved over the past 50 years in our country. [*CBSE (AI) 2015*]

Ans. Significance of reproductive health in a society:

(*i*) It prevents the spread of various sexually transmitted diseases such as AIDS, syphilis, etc.

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(*ii*) Individuals with sound reproductive health produce better offspring which have better chances of survival.

(*iii*) Better sex education and awareness helps to maintain the population and prevent population explosion.

(*iv*) Unwanted and teen pregnancies can be avoided.

The reproductive health in India has improved tremendously over the past 50 years.

The areas in which reproductive health have improved are:

(*i*) Family planning (*ii*) Mortality rate

Q. 17. List four categories of contraceptive methods. State in brief two advantages of adopting such preventive methods. [*CBSE Delhi 2015; (AI) 2015*]

Ans. The categories of contraceptive methods are:

(*i*) Barrier method (Condoms) (*ii*) Surgical method

(*iii*) Withdrawal method (*iv*) Calendar method

(*v*) Hormonal method (*vi*) IUCD/Copper–T/Loop (*Any four*)

Two advantages of adopting preventive methods are:

(*i*) It helps in maintaining health of women.

(*ii*) It helps in preventing STDs especially AIDS.

(*iii*) It helps in birth control.

(*iv*) Parents can give more attention to children. (*Any two*)

Q. 18. Name the reproductive parts of an angiosperm. Where are these parts located? Explain in brief the structure of its female reproductive parts. [*CBSE (F) 2016*]

Ans. In an angiosperm, the male reproductive part is androecium or stamen and the female reproductive part is the gynoecium or carpel. These parts are located in the flower.

The gynoecium (carpel) has three parts:

(*i*) **Stigma –** It is the upper most part which has sticky surface to which pollen grain stick during pollination.

(*ii*) **Style –** It is the middle elongated part which connects the stigma to the ovary.

(*iii*) **Ovary –** It is the bottom swollen part in which female gametes are formed.

Q. 19. (*i*) Name the following:

(*a*) Thread like non-reproductive structures present in *Rhizopus*.

(*b*) 'Blobs' that develop at the tips of the non-reproductive threads in *Rhizopus*.

(*ii*) Explain how these structures protect themselves and what is the function of the structures released from the 'blobs' in *Rhizopus*. [*CBSE Delhi 2015*]

Ans. (*i*) (*a*) Hyphae/mycelium, (*b*) *Sporangia*

(*ii*) These structures are protected by thick walls.

These structures germinate into new individuals under favourable conditions.

Q. 20. (*i*) Name the part of *Bryophyllum* where the buds are produced for vegetative propagation. [*CBSE Delhi 2016*]

(*ii*) Which parts of plants can grow vegetatively?

Ans. (*i*) In *Bryophyllum*, the buds are produced in leaf notches.

(*ii*) Modified stems like onion bulbs, runners of doob grass, ginger rhizomes, potato tubers, root tubers of sweet potato and dahlia, stem cutting of plants like rose and leaves of plants like *Bryophyllum* can be grown vegetatively.

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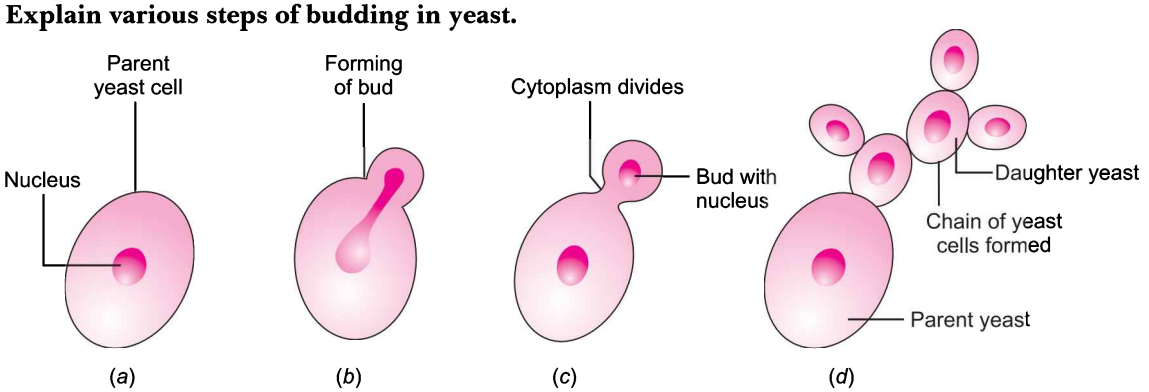
Q. 21. What is asexual reproduction? Write the process of budding in *Hydra*. [*CBSE Delhi (C) 2017*]

Ans. Asexual reproduction is the mode of reproduction used by single organisms or parent without the gamete production or fusion. In the process of budding in *Hydra*, a bud develops as an outgrowth due to repeated cell division of reproductive cells at one specific site. These buds develop into tiny individuals, and when fully mature, detach from the parent body as new independent individuals.

Q. 22. Explain various steps of budding in yeast.

Ans.



Yeast is a unicellular organism. Budding usually occurs when food is available in plenty. In budding, one or more outgrowths appear on one side, which enlarges in size. The nucleus divides mitotically, one daughter nucleus passes into the bud and the other remains in the parent cell. The bud either separates off from the parent cell or new bud appears before its separation from the parent cell resulting in the formation of branched or unbranched chain of buds.

Q. 23. What is regeneration? Give one example of an organism that shows this process and one organism that does not. Why does regeneration not occur in the latter? [*CBSE (F) 2017*]

Ans. Regeneration is the ability of organisms to give rise to new individual organisms from their body parts.

Planaria shows this process and *Amoeba* does not.

Regenertion does not occur is *Amoeba* because regeneration is carried out by specialised cells which are not present in non-regenerating organisms like *Amoeba*.

Q. 24. Explain the process of regeneration in *Planaria*. How is this process different from reproduction? [*CBSE (F) 2015*]

Ans. When *Planaria* is cut into many pieces, each piece grows into a complete organism. This regeneration process is carried out by specialised cells, which proliferate, develop and differentiate into various cell types and tissues.

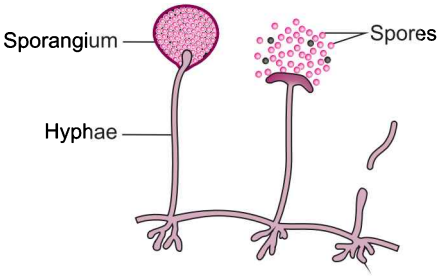
Regeneration is not same as reproduction as most of the organisms would not normally depend on being cut up to be able to reproduce.

Q. 25. Illustrate the following with the help of suitable diagrams:

(*i*) Spore formation in *Rhizopus*.

(*ii*) Multiple fission in *Plasmodium*.

Ans. **(*i*) Spore formation in *Rhizopus*:** This is an asexual method of reproduction in bacteria and fungi. Spores are unicellular bodies formed by cell division in a parent organism. After detaching from the parent, and if conditions are suitable, they germinate directly or indirectly into a new individual.



Spore formation in *Rhizopus*

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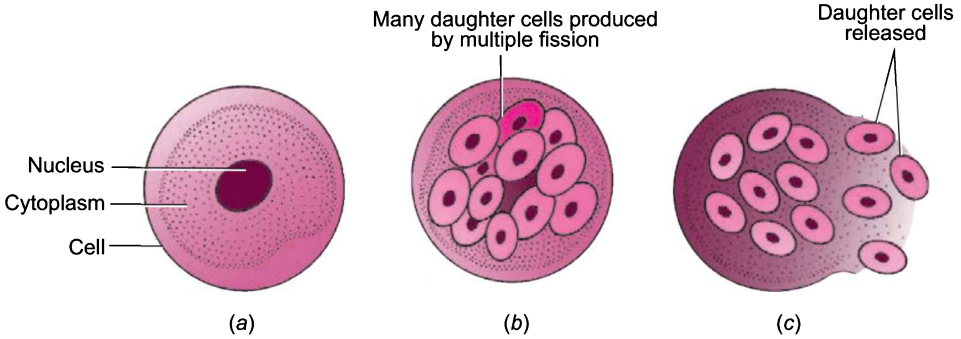
(*ii*) **Multiple fission in *Plasmodium*:** It is an asexual mode of reproduction in organisms. Here, the nucleus of the organism divides repeatedly to form a number of equal sized daughter nuclei and each daughter nuclei breaks away together with a small portion of the cytoplasm.



Multiple fission in *Plasmodium*

Q. 26. (*i*) **List two reasons for the appearance of variations among the progeny formed by sexual reproduction.**

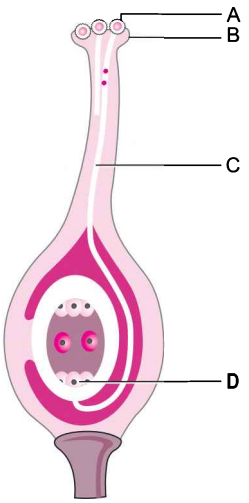
(*ii*) **(*a*) Name the part marked 'A' in the diagram given.**

(*b*) How does 'A' reaches part 'B' ?

(*c*) State the importance of the part 'C'.

(*d*) What happens to the part marked 'D' after fertilisation is over?

[CBSE (AI) 2016]



Ans. (*i*) Variation is seen among progeny formed by sexual reproduction because of:

(*a*) Involvement of two different individuals.

(*b*) Creation of new combination of variants.

(*ii*) (*a*) A – pollen or pollen grain.

(*b*) A reaches the B (stigma) by agents of pollination.

(*c*) C (pollen tube) helps male gamete to reach the egg (ovule).

(*d*) After fertilisation it converts into embryo.

Q. 27. What is carpel? Write the function of its various parts. *[CBSE 2019 (31/2/1)]*

Ans. Carpel is the female reproductive part of the flower. It consists of three parts:

(*i*) **Stigma:** It is the uppermost part which has sticky surface to which pollen grains stick during pollination.

(*ii*) **Style:** It connects the stigma to the ovary.

(*iii*) **Ovary:** It is responsible for the production of female gametes.

Q. 28. How does natural vegetative propagation occur?

Ans. Natural vegetative propagation occurs from modified stems, roots, leaves and bulbs. Modified short stems of onion bear **bulbs** which when grown in soil develop into a new plant. **Runners** – stems of doob grass have nodes and internodes. From nodes, roots are developed that form a new plant. **Rhizome** of ginger is a horizontal underground stem. If kept in soil with adequate moisture, it develops into a new plant. **Tuber** of potato bears eyes (buds), which when sown (entire or in pieces) in soil develops into a new plant.

Modified root **tubers** of sweet potato also grows into a new plant.

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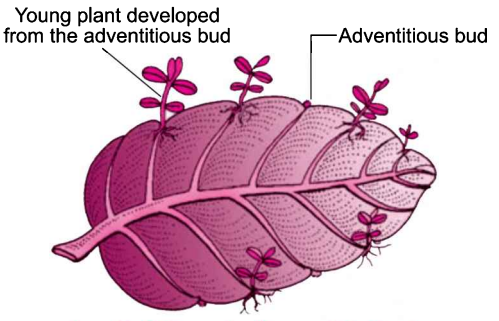
Buds produced in the notches along the leaf margin of *Bryophyllum* fall on the soil and develop into new plants.

Q. 29. Illustrate the following with the help of suitable diagrams:
Leaf of *Bryophyllum* with buds.

Ans. Leaf of *Bryophyllum* shows vegetative propagation in plants where a part of the body becomes detached and develops into a new supporting plant. Here, leaves of *Bryophyllum pinnatum* having plantlets along the leaf margins when grown in soil develops into a new plant.



Leaf of Bryophyllum with Buds

Q. 30. Differentiate between natural and artificial vegetative propagation in plants.

Ans.

Natural Propagation	Artificial Propagation
Vegetative parts of plants such as modified stems like onion **bulbs, runners** of doob grass, rhizomes of ginger, **tuber** of potato all possess buds. When sown in soil they develop into a new plant. Sweet potato (*shakarkandi*) is a root tuber that also develops into a new plant when sown in soil.	It includes growing plants by man-made methods. For example, (*i*) **Cuttings** of stem of sugar cane, grapes, etc., which when grown in soil develop into a new plant. (*ii*) **Grafting** is a process in which branches of two similar plants, one potted plant and the other of a good quality plant are obliquely cut and placed over each other and tied by a tape and left for a month or so. A new plant thus develops. (*iii*) In **layering,** the roots are induced to develop in the branch of a rooted plant buried in the soil.

Q. 31. In the context of reproduction of species, state the main difference between fission and fragmentation. Also give one example of each. [*CBSE (AI) 2016*]

Ans. Fission is the method of asexual reproduction in unicellular forms of life. In this process the parent organism splits to form two or more daughter cells. Example, *Ameoba* and *Plasmodium*.

Fragmentation is the process found in multicellular organisms. The filament breaks up into two or more pieces upon maturation. These pieces then grow into new individuals. Example, *Spirogyra*.

Q. 32. What are the various methods of vegetative propagation? Discuss any one method with example.

Ans. The various methods of vegetative propagation are:

(*i*) cutting, (*ii*) layering, (*iii*) grafting, (*iv*) tissue culture.

Layering: In layering, roots are induced on the stem of a rooted plant. When roots develop, that part of stem is detached from the parent plant and grown in the soil. Layering is of two types:

(*i*) Mound layering: A lower branch of a rooted plant is bent and buried into the moist soil. The tip of the branch should remain above the ground. In a few days, the buried part of the branch develops roots. It is now cut off from the parent plant and grown in the soil as a new plant. This method is used in the propagation of grapevine, strawberry, raspberry, jasmine, etc.

(*ii*) Air layering: This method is used in plants like crotons whose branches cannot be bent and buried in the soil. The stem is girdled, *i.e.*, a ring of bark is removed and then it is covered with a moist moss or cotton and enclosed in a polythene bag. After a few days, roots emerge from this region and branch is cut off from the parent plant. It can now be planted in the soil as a new plant. This method is used in rose, rubber plant, guavas, pear, apple, mangoes, etc.

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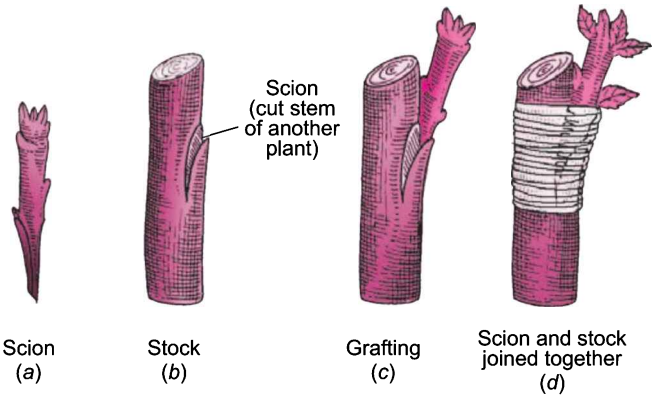
Q. 33. State the process of grafting.

Ans. In grafting, stem parts of two different plants are joined to produce a new plant. One part is of *in situ* rooted plant called stock and another part from superior quality plant called scion. Both are obliquely cut and placed over each other and tied with the tape. Part of stock remain rooted but scion is separated from the mother plant. After a month or so, both parts unite with each other and a new plant develops from the scion. Stock provides water and minerals from the soil to the developing plant.



Q. 34. Explain the term 'Regeneration' as used in relation to reproduction of organisms. Describe briefly how regeneration is carried out in multicellular organisms like *Hydra*. [*CBSE (AI) 2016*]

Ans. Regeneration is the ability of an organism to give rise to a new organism or individual from their body parts.

Each part of *Hydra* contains specialised cells which have the ability to proliferate.

When the body of *Hydra* by any means is cut into number of pieces, these pieces proliferate and make large number of cells. From this mass of cells, different cells undergo changes to become various cell types and tissues finally developing into a new organism.

Q. 35. (*i*) Why are budding, fragmentation and regeneration all considered as asexual types of reproduction?

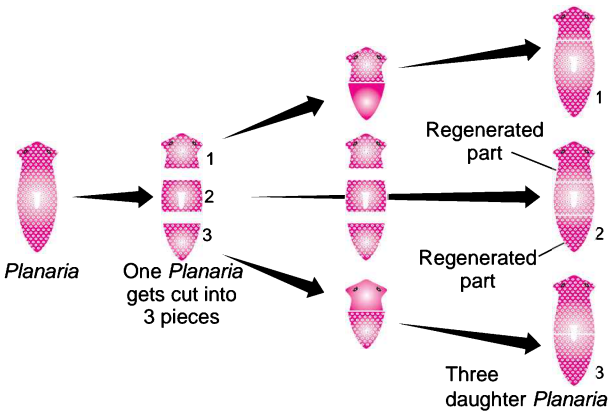
(*ii*) With neat diagrams explain the process of regeneration in *Planaria*.

[*NCERT Exemplar*] [*CBSE (AI) 2015*][*CBSE 2019 (31/2/3)*]

Ans. (*i*) Budding, fragmentation and regeneration are considered as asexual types of reproduction because all of them involve only one parent and gametes are not involved in reproduction.

(*ii*) Regeneration is the ability of an organisms to give rise to new individual organisms from their body part.

When *Planaria* is cut into many pieces, each piece grows into a complete organism. This regeneration process is carried out by specialised cells, which proliferate, develop and differentiate into various cell types and tissues.



Q. 36. Explain four advantages of vegetative propagation. [*CBSE (F) 2015*]

Ans. (*i*) New plants produced by vegetative propagation maintain the desirable characters of the parents. These plants are genetically identical.

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(*ii*) Certain plants like banana, grapes, pineapple, roses, jasmine, etc., do not form seeds. Thus, this is the only method of reproduction and continuation of such species.

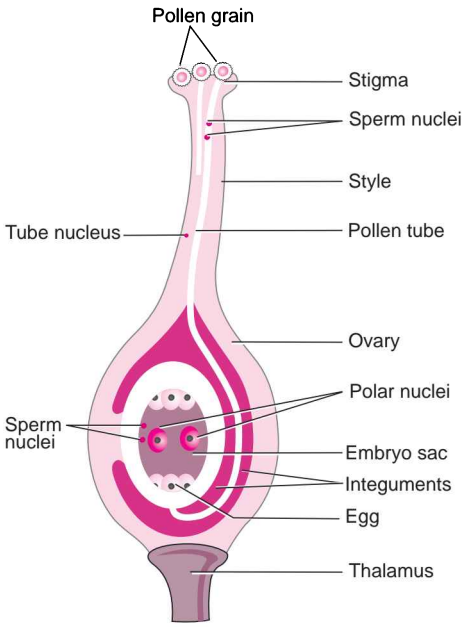
(*iii*) This method is cheap and can be easily employed to reproduce plants, especially fruit plants.

(*iv*) Only one parent is required for reproduction.

Q. 37. Describe double fertilisation in plants.

Ans. Soon after pollination the pollen grains start germinating and form a pollen tube. The pollen tube grows within the style till it reaches the ovary.

On reaching the ovary it enters the ovule through an opening called micropyle. In the meantime, two male gametes are formed in the pollen tube. One of the male gametes fuses with the egg, the process is called syngamy. The product formed is termed as zygote. The other male gamete fuses with the two polar nuclei, one from each end of embryo sac, to form endosperm nucleus. This process is called triple fusion. In this process three nuclei, two polar nuclei and one male gamete is involved, so it is called triple fusion. Thus, inside each embryo sac two fusions, *i.e.*, syngamy and triple fusion take place. This mechanism of two fusions occurring in an embryonal sac is called double fertilisation. After fertilisation, the ovule develops into seed and the ovary develops into a fruit.



Fertilisation showing pollen tube growth

Q. 38. (*i*) State the basic requirement for sexual reproduction. Write the importance of such reproductions in nature. [*CBSE Delhi 2017*]

(*ii*) What are the benefits of using mechanical barriers during sexual act? [*NCERT Exemplar*]

Ans. (*i*) Formation of male and female gametes and fusion of gametes or syngamy is the basic requirement for sexual reproduction.

Importance: Combination of DNA from two different individuals lead to increase in genetic variation in the organism. This leads to diversity in the population which helps in natural selection.

(*ii*) Mechanical barriers like condom prevent the sperms from reaching the egg. Thus it is an effective method to avoid pregnancy. It also prevents transmission of infections during sexual act.

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Q. 39. List any four steps involved in sexual reproduction and write its two advantages.

[CBSE Delhi 2017]

Ans. Steps involved in sexual reproduction are as follows:

(*i*) Formation of male and female gametes.

(*ii*) Transfer of male gamete to female gamete.

(*iii*) Fusion of gametes resulting in zygote formation.

(*iv*) Zygote grows into an embryo forming a new individual.

Its advantages are:

(*i*) It increases genetic variation.

(*ii*) It plays an important role in the origin of new species.

(*iii*) It promotes diversity in the offsprings. (*Any two*)

Q. 40. Write one main difference between asexual and sexual mode of reproduction. Which species is likely to have comparatively better chances of survival – the one reproducing asexually or the one reproducing sexually? Give reason to justify your answer.

Ans. (*i*) In sexual reproduction two opposite sexes are involved whereas in asexual reproduction only one individual is involved.

(*ii*) In sexual reproduction male and female gamete formation takes place whereas in asexual no gamete formation occurs.

Sexually reproducing organisms have better chances of survival because more variations are generated.

Q. 41. Mention secondary sexual characters in human male and female.

Ans. Secondary sexual characters in male :

(*i*) Hair growth on face, chest, armpit (axillae) and over pubis.

(*ii*) Voice becomes deep and hoarse due to growth of larynx called Adam's apple.

(*iii*) Body becomes muscular.

Secondary sexual characters in female:

(*i*) Growth of breasts and hair in axillae and over pubis.

(*ii*) Pelvis region becomes broad and buttocks become heavy due to deposition of fat.

(*iii*) Development of accessory sex organs.

Q. 42. (*i*) Mention the role of the following organs of human male reproductive system:

(*a*) Testis; (*b*) Scrotum;

(*c*) Vas deferens; (*d*) Prostate glands.

(*ii*) What are the two roles of testosterone? *[CBSE (F) 2016]*

Ans. (*i*) **(*a*) Testis:** To produce male gametes.

(*b*) Scrotum: To provide optimal temperature to testis for the formation of sperm.

(*c*) Vas deferens: To deliver the sperms to the urinary bladder.

(*d*) Prostrate glands: To secrete the fluid which provides nutrition and medium for transport of sperms.

(*ii*) Testosterone has following roles:

(*a*) It regulates the formation of sperms.

(*b*) It brings about the changes in boys during adolescence.

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Q. 43. Explain how, offspring and parents of organisms reproducing sexually have the same number of chromosomes. *[NCERT Exemplar]*

OR

How do organisms, whether reproduced asexually or sexually maintain a constant chromosome number through several generations? Explain with the help of suitable example.

[CBSE Delhi 2016]

Ans. During asexual reproduction organisms undergo only mitotic divisions. The DNA (in the chromosomes) of the cells involved are copied and then equally divided among the two daughter cells formed. Thus, chromosome number remains unchanged.

In sexual reproduction, organisms produce gametes through meiosis, which is called reductional division, in which the original number of chromosomes becomes half. These two gametes combine to form the zygote and the original number of chromosomes is restored.

For example, in humans, the parents (father and mother) have 46 or 23 pairs of chromosomes. In the gametes, the sperm has half the number of chromosomes, *i.e.*, 23 and the egg also has 23 chromosomes in each. When the sperm and the egg fuse, the zygote has 46 or 23 pairs of chromosomes.

Thus, the chromosome number remains constant.

Q. 44. What are the male and female gonads in human beings? Mention their functions.

Ans. The male gonads in human beings are a pair of testes. The testis lies in a sac outside the abodominal cavity called scrotum. The function of testis is to regulate the production of sperms and secretion of male hormone, testosterone. The female gonads in human beings are pair of ovaries located in the abdominal cavity near the kidneys. The ovaries perform dual functions of production of female hormones–oestrogen and progesterone and the production of female gamete (ovum/ova).

Q. 45. Name the two types of mammalian gametes. How are these different from each other ? Name the type of reproduction they are involved in. Write the advantage of this type of reproduction.

[CBSE (F) 2017]

Ans. Two types of mammalian gametes are sperm and ovum or egg.

Sperms are motile and are produced by male individuals whereas ova or eggs are non-motile and produced by female individuals. They are involved in sexual reproduction.

Advantage: Sexual reproduction generates more variations among organisms.

Q. 46. From the internet, gather information about the chromosome numbers of five animals and five plants. Correlate the number with the size of organism and answer the following questions.

(*i*) Do larger organisms have more number of chromosomes/cells?

(*ii*) Can organism with fewer chromosomes reproduce more easily than organisms with more number of chromosomes?

(*iii*) More the number of chromosomes/cells greater is the DNA content. Justify.

[NCERT Exemplar]

Ans. (*i*) No, there is no relationship between size of organism and its chromosome number.

(*ii*) No, process of reproduction follows a common pattern and is not dependent on the number of chromosomes.

(*iii*) Yes, since the major component of chromosome is DNA, if there are more chromosomes in a cell, the quantity of DNA will also be more.

Q. 47. What happens when

(*i*) *Planaria* gets cut into two pieces?

(*ii*) a mature *Spirogyra* filament attains considerable length?

(*iii*) on maturation sporangia burst? *[CBSE (F) 2016]*

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Ans. (*i*) Each piece regenerates into a new *Planaria*.

(*ii*) Its filaments break into smaller pieces or fragments and each fragment gives rise to a new filament.

(*iii*) It releases spores which germinate into new mycelium in moist conditions.

Q. 48. Mention the information source for making proteins in the cell. What is the basic event in reproduction?

Ans. The DNA in the nucleus of a cell is the information source for making proteins. If the information is changed, different proteins will be made. The basic event in reproduction is the creation of a DNA copy. Cells use chemical reactions to build copies of their DNA. This creates two copies of the DNA in a reproducing cell and they need to get separated from each other. DNA copying is accompanied by the creation of an additional cellular apparatus, and then the DNA copies separate, each with its own cellular apparatus.

Q. 49. (*i*) Write the names of those parts of a flower which serve the same function as the following do in the animals.

(*a*) Testis **(*b*) Sperm**

(*c*) Ovary **(*d*) Egg**

(*ii*) State the function of flowers in the flowering plants.

Ans. (*i*) (*a*) Testis — anther (*b*) Sperm — pollen grains

(*c*) Ovary — ovary (*d*) Egg — ovum

(*ii*) Flowers are responsible for sexual reproduction as they contain the reproductive organs of the plant.

Q. 50. (*i*) What is pollination ? Give its two types.

(*ii*) Draw a longitudinal section of female reproductive part of a flower showing germination of pollen grain. Label on it the following:

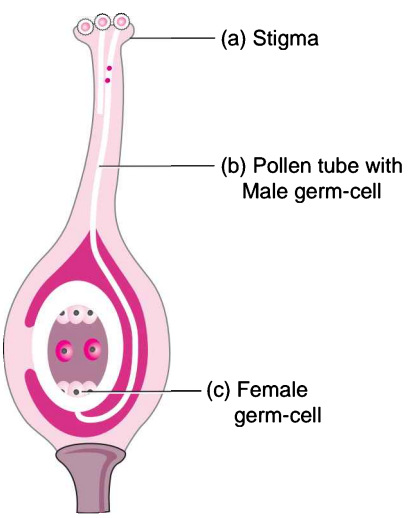
(*a*) Stigma;

(*b*) Pollen tube with a male germ cell;

(*c*) Female germ cell. *[CBSE Delhi (C) 2017]*

Ans. (*i*) Pollination is the process of transfer of pollen grains from the anther to the stigma of the flower. Two types of pollination are self-pollination and cross pollination.

(*ii*)



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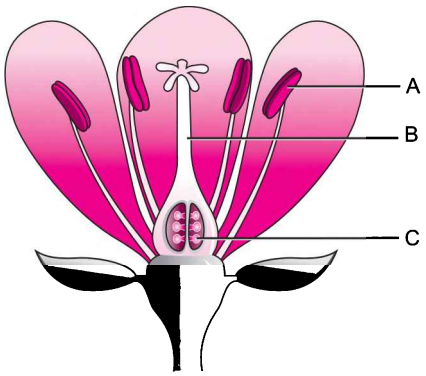
Q. 51. Name the parts A, B and C shown in the following diagram and state one function of each.



[CBSE Delhi 2016]

Ans.

	Part	Functions
A	Anther	It produces pollen grains.
B	Style	It provides the path through which the pollen tube grows and reaches the ovary.
C	Ovary	It contains ovules and each ovule has an egg cell. It develops into fruit after fertilisation.

Q. 52. (*i*) How do sexually transmitted diseases spread from one person to another? Give two symptoms of STDs.

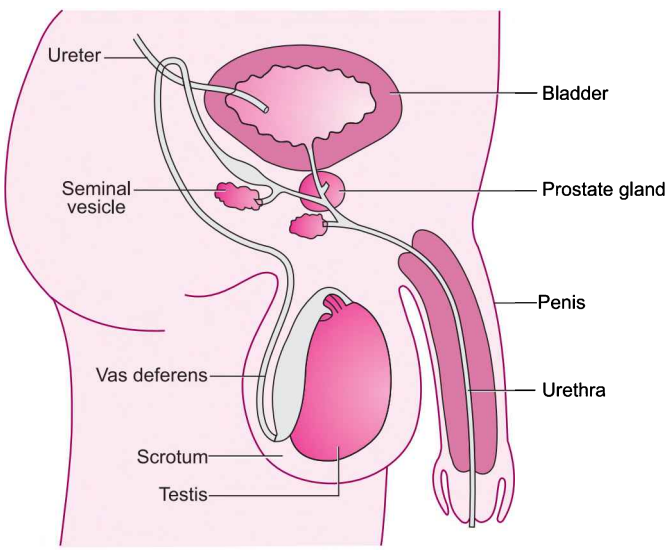
(*ii*) Explain why fertilisation is possible if copulation takes place during the middle of menstrual cycle.

Ans. (*i*) The two sexually transmitted diseases (STDs) are gonorrhoea and syphilis. These infectious diseases spread from one person to another by sexual contact with an infected person. Two symptoms of STDs are burning sensation at urination and urethral discharge and sores in the genitals.

(*ii*) Since ovulation, *i.e.*, the release of ovum occurs on the 14th day of the menstrual cycle, *i.e.*, in its middle, chances are more for the sperms to fertilise the egg or ovum during this time.

Q. 54. Draw a labelled diagram of a human male reproductive system.

Ans.



Human male reproductive system

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Q. 53. Write the full form of IUCD, AIDS, HIV, OC.

Ans. IUCD = Intra-Uterine Contraceptive Device
AIDS = Acquired Immune Deficiency Syndrome
HIV = Human Immunodeficiency Virus
OC = Oral Contraceptive

Q. 55. What is placenta? Mention its role during pregnancy. *[NCERT Exemplar]*

OR

What is placenta? Explain its function in humans. *[CBSE (F) 2015, 2017]*

Ans. Placenta is a special tissue connection between embryo and uterine wall. It acts as an endocrine gland.

Role of placenta:

(*i*) It possesses villi that increase the surface area for absorption of nutrients.

(*ii*) It facilitates the passage of nutrition and oxygen to embryo from mother through blood.

(*iii*) Waste substances produced by embryo are removed through placenta into mother's blood.

Q. 56. State the changes that take place in the uterus when:

(*i*) Implantation of embryo has occurred.

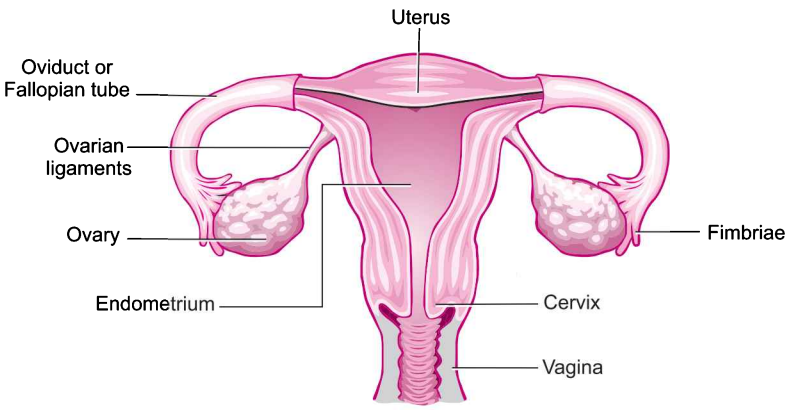
(*ii*) Female gamete/egg is not fertilised. *[CBSE Delhi 2017]*

Ans. (*i*) When implantation of embryo has occurred the uterine wall thickens and is richly supplied with blood to nourish the growing embryo.

(*ii*) The thick and spongy lining of the uterus slowly breaks and comes out through the vagina as blood and mucus.

Q. 57. Draw a labelled diagram of a human female reproductive system.

Ans.



Human female reproductive system

Q. 58. What are the functions of testis in the human male reproductive system? Why are these located outside the abdominal cavity? Who is responsible for bringing about changes in appearance seen in boys at the time of puberty? *[CBSE Delhi 2016]*

Ans. Functions of testis:

(*i*) Production of sperms.

(*ii*) Production of male hormone/testosterone.

These are located outside the human body, as sperms need lower temperature than the normal body temperature to mature.

Testosterone is responsible for bringing changes at the time of puberty in boys.

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Q. 59. What is contraception? Name any two methods. How does the use of these methods have a direct effect on the health and prosperity of a family? State any three points. [*CBSE (F) 2017*]

Ans. Any method which prevents conception or pregnancy is called contraception.
Barrier method, chemical method and surgical method are the different contraceptive methods.
Use of these methods have direct effect on the health and prosperity of a family because:

(*i*) Health of women (mother) is maintained.

(*ii*) Parents can give more attention to their children.

(*iii*) More resources may be made available for improvement of standard of living.

Q. 60. State briefly the changes that take place in a fertilised egg till birth of the child in the human female reproductive system. What happens to the egg when it is not fertilised?

[*CBSE Delhi (C) 2017*]

Ans. Following changes takes place in fertilised egg:

(*i*) Zygote or the fertilized egg starts dividing.

(*ii*) Implantation of zygote in the inner uterine wall.

(*iii*) Embryo starts growing with the help of the placenta which results in the development of the child.

(*iv*) Birth of a child as a result of rhythmic contraction of the muscles in the uterus.

When egg is not fertilised, the inner lining of the uterus slowly breaks and comes out through the vagina as blood and mucous (Menstruation).

Long Answer Questions [5 marks]

Each of the following questions are of 5 marks and have to be answered in about 80-90 words.

Q. 1. Write two points of difference between asexual and sexual types of reproduction. Describe why variations are observed in the offspring formed by sexual reproduction.

[*NCERT Exemplar, CBSE (AI) 2015*]

Ans.

Asexual Reproduction	Sexual Reproduction
1. Involves only one parent.	1. Often involves two parents.
2. Gametes are not produced.	2. Gametes are produced.
3. No fertilisation and zygote formation.	3. Fertilisation and zygote formation is observed.
4. Meiosis does not occur at anytime during reproduction.	4. Meiosis occurs at the time of gamete formation.

[*Any two*]

During sexual reproduction two types of gametes fuse. Although the gametes contain the same number of chromosomes, their DNA is not identical. The difference in the genetic make up of DNA generate variations among the offsprings.

Q. 2. What is multiple fission? How does it occur in an organism? Explain briefly. Name one organism which exhibits this type of reproduction. [*CBSE Delhi 2016*]

Ans. Multiple fission is the process of reproduction in which many daughter individuals are formed or produced from the parent cell. In this process, the nucleus divides repeatedly to produce large number of nuclei. Each nucleus gathers a bit of cytoplasm around itself and develops a membrane around each structure. Many daughter cells develop which on liberation grow into adult organisms.

Plasmodium exhibits multiple of fission.

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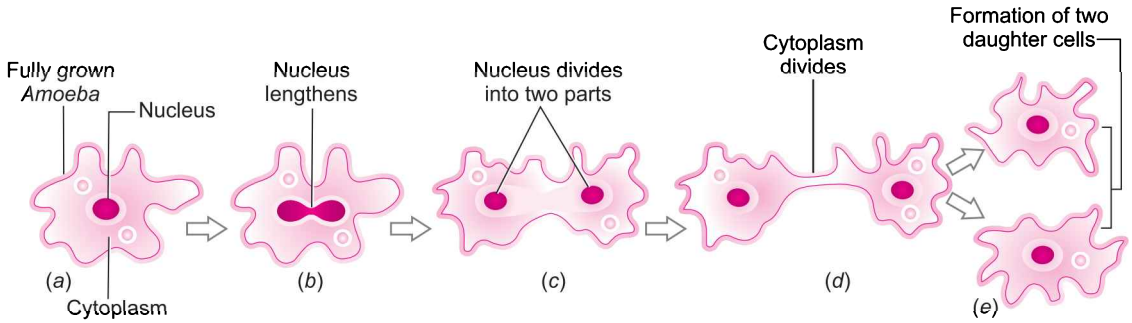
Q. 3. (*i*) Describe asexual reproduction in *Amoeba*.

(*ii*) How does sexual reproduction in plants takes place?

Ans. (*i*) In *Amoeba*, asexual reproduction occurs by fission (binary and multiple). In *Amoeba*, nucleus first divides into two daughter nuclei by mitosis and then body along with the cytoplasm constricts from the middle, which gradually deepens and eventually divides into two individual parts, each part has one nucleus. Thus, two daughter *Amoebae* develop from one. This is called binary fission.

In multiple fission, nucleus repeatedly divides to form a large number of nuclei, which reach at the periphery. Later cytoplasm gathers around each nucleus to form a daughter *Amoeba*. In this process, several individuals (equal to number of nuclei) develop from a single *Amoeba*.



(*ii*) Sexual reproduction in plants takes place in the following steps:

(*a*) The male reproductive organ 'stamen' makes the male gametes.

(*b*) The female reproductive organ 'carpel' makes the female gametes.

(*c*) The male gametes fertilise the female gametes.

(*d*) The fertilised ovules grow and become seeds.

(*e*) The seeds produce new plants under favourable conditions like presence of water, warmth, air, light, etc.

Q. 4. (*i*) Define vegetative propagation. List its two methods. *[CBSE 2019 (31/4/2)]*

(*ii*) Why is this mode practised for growing some types of plants?

(*iii*) Explain the process of budding in *Hydra* with the help of labelled diagrams.

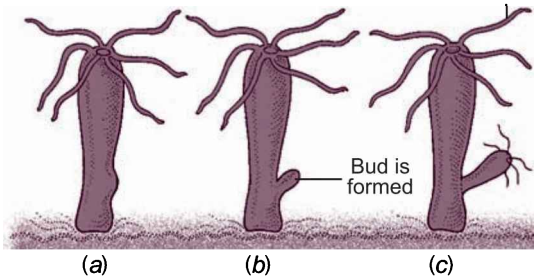
Ans. (*i*) Vegetative propagation is the asexual mode of reproduction which involves the production of new individuals from the vegetative parts such as buds, tubers, rhizomes, etc.

The two methods are cutting and layering.

(*ii*) Vegetative mode is practised for growing some types of plants because:

(*a*) It is used for growing plants which do not produce viable seeds.

(*b*) It is a short cut method for rapid multiplication.



(*c*) It helps to grow plants bearing superior traits, because they produce genetically identical plants.

(*d*) Plants raised by vegetative means can bear flowers and fruits earlier than those produced from seeds.

(*iii*) In the process of budding in *Hydra*, a bud develops as an outgrowth due to repeated cell division of reproductive cells at one specific site. These buds develop into tiny individuals, and when fully mature, detach from the parent body as new independent individuals.

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Q. 5. **(*i*) Describe the process of fertilisation in a flower.**
(*ii*) Why is the number of sperms produced always much more than the number of eggs produced?

Ans. (*i*) A pollen grain contains two male gametes. When a pollen grain falls on the stigma of the carpel, it grows a pollen tube downwards into the style. One of the male gametes reaches the ovary through pollen tube and fuses with egg to form zygote.

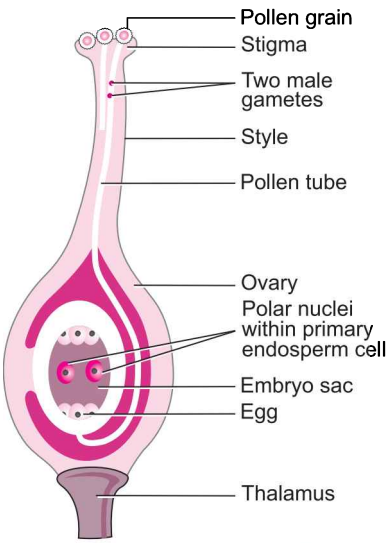
The other male gamete fuses with two polar nuclei one from each end of embryo sac to form endosperm nucleus. This fusion is called triple fusion. The zygote grows into an embryo and an endosperm nucleus grows into endosperm (the food storage tissue of seed).

(*ii*) Sperms are produced much more in number than eggs because:

(*a*) Eggs are non-motile whereas sperms are motile and they may be misdirected while they are travelling towards eggs.

(*b*) Sperms may not be able to survive under external environmental conditions for long.

(*c*) To increase the probability of fertilisation of eggs.



Longitudinal section of a flower showing growth of pollen tube

Q. 6. **Give one example each of unisexual and bisexual flowers. Differentiate between the two types of pollination that occur in flowers. What happens when a pollen lands on a suitable stigma? Write about the events that occur till the seed formation in the ovary.** *[CBSE (F) 2017]*

Ans. **Unisexual Flower:** papaya, watermelon

Bisexual Flower: hibiscus, rose

The two types of pollination are self pollination and cross pollination.

Self pollination: The pollen grains are transferred from the anther to the stigma of the same flower or to the flower of the same plant.

Cross pollination: The pollen grains are transferred from the anther to the stigma of a flower of a different plant.

The following events takes place:

(*i*) After pollen lands on a suitable stigma, a pollen tube grows out of pollen grain and travels through the style to reach the ovary.

(*ii*) The male germ cell fuses with the female germ cell to form a zygote.

(*iii*) Zygote divides several times to form an embryo within the ovule.

(*d*) The ovule develops tough coat and gradually gets converted into a seed.

Q. 7. **(*i*) State in brief the functions of the following organs in the human female reproductive system: Ovary, Fallopian tube, Uterus**

(*ii*) What is menstruation? Why does it occur? *[CBSE (F) 2017]*

Ans. **(*i*) Functions of ovary are:**

(*a*) Production of female gamete.

(*b*) Production of female hormone.

Functions of fallopian tube are:

(*a*) It is the site of fertilisation.

(*b*) Transfer of female gamete from ovary takes place through it.

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Functions of uterus are:

(*a*) Implantation of zygote.

(*b*) Nourishment of developing embryo.

(*ii*) **Menstruation:** It is the periodic breakdown of uterine lining and its removal along with blood and mucous in (post pubertal stage of a) human female.

Uterine lining is required to nourish the embryo that is formed if fertilisation takes place. In absence of fertilisation, the lining is not required and hence it sheds in the form of mensuration.

Q. 8. Write the functions of the following in human female reproductive system:

Ovary, oviduct, uterus

How does the embryo get nourishment inside the mother's body? Explain in brief.

[CBSE Delhi 2015]

OR

(*i*) Write the functions of the following parts in human female reproductive system:

(*a*) Ovary (*b*) Oviduct (*c*) Uterus *[CBSE 2018]*

(*ii*) Describe the structure and function of placenta. *[CBSE 2018, Delhi 2016]*

OR

List two functions of ovary of human female reproductive system. *[CBSE (AI) 2016]*

Ans. Ovary:

(*i*) Production of female hormone (oestrogen and progesterone).

(*ii*) Production of female gamete or egg.

Oviduct:

(*i*) Transfer of female gamete from the ovary.

(*ii*) Site of fertilisation.

Uterus:

(*i*) Implantation of zygote or embryo.

(*ii*) Nourishment of developing embryo.

The embryo inside the mother's body gets nourishment through the placenta.

Placenta is a special disc-like tissue embedded in the mother's uterine wall and connected to the embryo. Placenta provides a large surface area for glucose and oxygen, and nutrients to pass from the mother's blood to the embryo.

Q. 9. (*i*) Name the human male reproductive organ that produces sperms and also secretes a hormone. Write the functions of the secreted hormone.

(*ii*) Name the parts of the human female reproductive system where

(*a*) fertilisation takes place,

(*b*) implantation of the fertilised egg occurs.

(*iii*) Explain how the embryo gets nourishment inside the mother's body. *[CBSE (AI) 2015]*

OR

(*i*) Name the organ that produces sperms as well as secretes a hormone in human males. Name the hormone it secretes and write its functions.

(*ii*) Name the parts of the human female reproductive system where fertilisation occurs.

(*iii*) Explain how the developing embryo gets nourishment inside the mother's body.

[CBSE Delhi 2017]

Ans. (*i*) Testes produce sperms and secrete a hormone called testosterone.

The function of testosterone is to control the development of male sex organs and secondary sexual features.

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(*ii*) (*a*) Oviduct or fallopian tubes
(*b*) Uterus

(*iii*) After implantation, a disc-like special tissue called placenta develops between the uterus wall and the embryo which helps in the exchange of nutrients, oxygen and waste products between the embryo and the mother.

Q. 10. Reproduction is essentially a phenomenon that is not for survival of an individual but for the stability of a species. Justify. [*NCERT Exemplar*]

Ans. (*i*) Organisms need energy for survival which they obtain from life processes such as nutrition and respiration.

(*ii*) Reproduction needs a lot of energy.

(*iii*) Genetic material is transferred from one generation to the next as a result of reproduction through DNA copying.

(*iv*) DNA copying takes place with high constancy and considerable variations, that is, advantageous to the species for stability in the changing environment.

HOTS [Higher Order Thinking Skills]

Q. 1. What is self sterility mechanism in flowers which allows only cross-pollination?

Ans. In self sterility, pollen grains of the same flower are not capable to fertilise that flower, potato, tobacco, tea, etc. Hence, cross-pollination is the rule applied.

Q. 2. What are the basic differences between male and female germ cell?

Ans.

Male Germ Cell	Female Germ Cell
1. Produced by male reproductive organ (testes in animals, anther in plants)	1. Produced by female reproductive organ (ovary in animals and plants)
2. Usually smaller in size and motile.	2. Usually larger in size and stores food.

Q. 3. How are general growth and sexual maturation different from each other? [*NCERT Exemplar*]

Ans. General growth refers to different types of developmental process in the body like increase in height, weight gain, changes in shape and size of the body but sexual maturation is specific to changes reflected at puberty like cracking of voice, new hair patterns, development of breast in female, etc.

Q. 4. Colonies of yeast fail to multiply in water, but multiply in sugar solution. Give one reason for this. [*NCERT Exemplar*]

Ans. Sugar provides energy for sustaining all life activities in yeasts. In water, it fails to reproduce because of inadequate energy in its cells.

NCERT Corner

NCERT Intext Questions

Q. 1. Why is DNA copying an essential part of the process of reproduction?

OR

What is the importance of DNA copying in reproduction?

Ans. The process of reproduction results in the production of offsprings which are exactly similar to the parents. DNA copying is accompanied by cell division that gives rise to two cells. The exact blueprint of body design is inherited in the offsprings due to DNA replication in parent cell. Therefore, DNA copying is an essential part of the process of reproduction.

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Q. 2. Why is variation beneficial to the species but not necessarily for the individual?

Ans. The importance of variation in organism introduced during reproduction is that it helps the species of various organisms to survive and flourish even in adverse environment. If all the organisms of a population living in that habitat are exactly identical, then there is a danger that all of them may die and no one would survive under those conditions. This will eliminate the species from the habitat completely. However, if some variations are present in some individual organism to tolerate excessive heat or cold, then there is a chance for them to survive and flourish even in adverse excessive heat or cold. Thus, variation is useful for the survival of a species over time.

Q. 3. How does binary fission differ from multiple fission? *[CBSE Delhi 2015]*

Ans.

Binary fission	Multiple fission
1. In binary fission, the parent organism splits into two daughter nuclei, followed by division of cytoplasm, thus resulting into two identical individuals (daughter cells).	1. Multiple fission is the simultaneous division of the parent body into many daughter individuals.
2. It occurs during favourable conditions.	2. It occurs when an organism faces unfavourable environmental conditions.
3. Nucleus divides only once in this form of reproduction.	3. Nucleus divides repeatedly to form large number of nuclei.
4. Protective covering is not formed around an organism.	4. Protective covering, *i.e.*, a cyst is formed around the organism during multiple fission.
5. Example: *Amoeba, Paramecium*.	5. Example: *Plasmodium*.

Q. 4. How will an organism be benefitted if it reproduces through spores?

Ans. An organism will be benefitted if it reproduces through spores because:

(*i*) It is a simpler and faster mode of reproduction.

(*ii*) Spores being small and light, get easily dispersed through wind, water and animals. Thus, its dispersal becomes easier.

(*iii*) Spores bear thick resistant covering to enable them to survive even in unfavourable conditions.

Q. 5. Can you think of reasons why more complex organisms cannot give rise to new individuals through regeneration?

Ans. More complex organisms cannot reproduce by regeneration process because

(*i*) their body is highly complicated,

(*ii*) there are specific organs to do specific functions,

(*iii*) there is a division of labour in the body of complex organisms,

(*iv*) regeneration is carried out by specialised cells, which are not present in complex organisms.

Q. 6. Why is vegetative propagation practised for growing some types of plants?

Ans. Vegetative propagation is practised for growing some types of plants because:

(*i*) Characters of the plants can be preserved through successive generation.

(*ii*) Seedless plants can be grown through vegetative reproduction.

(*iii*) Through cutting and grafting methods, flowers and fruits can be grown in a shorter time.

(*iv*) It is a cheaper, easier and more rapid method of plant propagation.

Q. 7. How is the process of pollination different from fertilisation? *[CBSE 2019 (31/2/2)]*

Ans. Pollination is the transfer of pollen grains from the anther of a stamen to the stigma of a carpel. The pollen grains are transferred by agents, such as insects, birds, man, wind and water. It

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occurs only in plants. However, fertilisation in plants is the fusion of pollen grains, nuclei (male gamete with the egg cell) and secondary nucleus of embryo sac to form diploid zygote and triploid endosperm nucleus, respectively.

Fertilisation in animals is defined as the fusion of a male gamete (sperm) with a female gamete (ova) to form a zygote during sexual reproduction.

Q. 8. What is the role of the seminal vesicles and the prostate gland?

Ans. Seminal vesicles are a pair of thin-walled muscular elongated sacs which secrete fluid for nourishment of sperms.

Prostate glands also produce fluid which is released in the urethra along with secretion of seminal vesicle and helps in sperm mobility. The secretion of these accessory glands together with sperm is called semen. It affects the vaginal pH so that sperms move smoothly inside the vagina.

Q. 9. What are the changes seen in girls at the time of puberty?

Ans. Various changes that take place in a girl's body at the time of puberty are:

(*i*) Thick hair growth in armpits and genital area between the thighs.

(*ii*) Thinner hair on legs, arms and face.

(*iii*) Oily skin and appearance of pimples.

(*iv*) Breast size begins to increase.

(*v*) Darkening of the skin of the nipples at the tips of the breasts.

(*vi*) Start of menstrual cycle.

Q. 10. How does the embryo get nourishment inside the mother's body?

Ans. The embryo gets nourishment from the mother's blood through placenta. The placenta is a disc-shaped tissue which is embedded in the uterine wall. It contains villi on the embryo's side of the tissue. On the mother's side are blood spaces, which surround the villi. This provides a large surface area for glucose and oxygen to pass from the mother to the embryo. In this way, embryo gets its nutrition.

Q. 11. If a woman is using a copper-T, will it help in protecting her from sexually transmitted diseases?

Ans. No, because sexually transmitted diseases occur due to fluid to fluid contact that takes place in the vagina.

NCERT Exercises

Q. 1. Asexual reproduction takes place through budding in

(*a*) *Amoeba* **(*b*) Yeast**

(*c*) *Plasmodium* **(*d*) *Leishmania***

Ans. (*b*)

Q. 2. Which of the following is not a part of the female reproductive system in human beings?

(*a*) Ovary **(*b*) Uterus**

(*c*) Vas deferens **(*d*) Fallopian tube**

Ans. (*c*)

Q. 3. The anther contains

(*a*) Sepals **(*b*) Ovules**

(*c*) Carpel **(*d*) Pollen grains**

Ans. (*d*)

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Q. 4. What are the advantages of sexual reproduction over asexual reproduction?

Ans. In asexual reproduction, the offsprings are almost identical to their parents because they have the same genes as of their parents. Thus, genetic variation is not possible or is slow in asexual reproduction.

Sexual reproduction involves fusion of male and female gametes coming from both the parents. Therefore, the offsprings receive some genes from the mother and some from the father. The mixing of these genes of mother and father in various different combinations, results in the offsprings having genetic variations.

Thus, we conclude that sexual reproduction promotes diversity of characters in the offsprings by providing genetic variations. This genetic variation leads to the continuous evolution of various species to form better and better organisms.

Q. 5. What are the functions performed by the testis in human beings?

Ans. The function of testis is to produce sperm and male sex hormone called testosterone. The scrotum provides the optimal temperature for formation of sperms.

Q. 6. Why does menstruation occur?

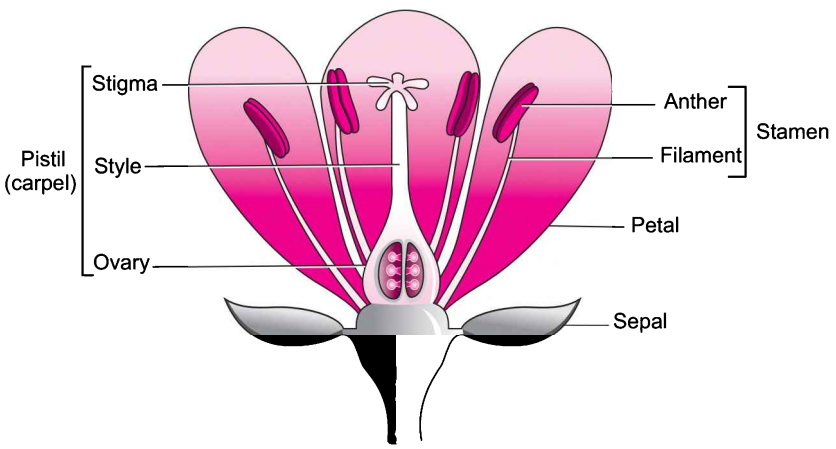
Ans. Menstruation occurs in human females only when the egg is not fertilised by the male sperm. Since the egg is not fertilised so, the thick and soft uterus lining having a lot of blood capillaries in it is not required. Thus, the unfertilised ovum disintegrates within a day and the uterus lining also breaks down. As the uterus lining contains a lot of blood vessels, so when it is shed, blood alongwith other tissues is released. This comes out of the vagina in the form of bleeding.

Q. 7. Draw a labelled diagram of the longitudinal section of a flower.

OR

Draw the diagram of a flower and label the four whorls. Write the names of gamete producing organs in the flower. [*NCERT Exemplar*]

Ans.



Male gamete forming organ – Anther/Stamen

Female gamete forming organ – Pistil/Ovary/Ovule

Q. 8. What are the different methods of contraception?

OR

What are the various ways to avoid pregnancy? Elaborate any one method. [*NCERT Exemplar*]

Ans. A number of preventive methods or devices have been developed to prevent unwanted pregnancy. These methods are broadly categorised as:

(*i*) Barrier methods, (*ii*) Chemical methods, (*iii*) Surgical methods.

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(*i*) **Barrier methods:** In these methods, physical devices such as condoms, diaphragms and cervical caps are used. These devices prevent the entry of sperm into the female genital tract, thus acting as a barrier between them.

(*ii*) **Chemical methods:** This category of contraceptives acts by changing the hormonal balance of the body so that eggs are not released and fertilisation cannot occur. Females use two types of pills for preventing pregnancies: oral pills and vaginal pills.

The oral pills contain hormones which stop the ovaries from releasing ovum into the fallopian tube. This is also called oral contraceptives (OC).

Other contraceptive devices such as loop or the copper-T are placed in the uterus to prevent pregnancy.

(*iii*) **Surgical methods:** In males, a small portion of the sperm duct (vas deferens) is blocked by surgical operation. This prevents the sperms from coming out. Whereas in females, a small portion of the fallopian tubes (oviducts) is blocked by surgical operation. It prevents the egg to reach uterus. In both the cases, fertilisation will not take place.

Q. 9. How are the modes of reproduction different in unicellular and multicellular organisms?

[*CBSE* 2019 (31/3/1)]

Ans. The unicellular organisms have only one cell. There is no separate tissue for reproduction. So, they can reproduce asexually by the process of fission (binary or multiple) or budding as in yeast.

On the other hand, the multicellular organisms, contain various cells and have separate systems for reproduction. So, they can reproduce by both sexual and asexual reproduction.

Q. 10. How does reproduction help in providing stability to the populations of species?

Ans. The consistency of DNA copying during reproduction is important for maintenance of body design features that allow the organism to live in a particular area. This consistency of DNA copying provides stability to the populations of species. Reproduction is responsible for continuation of a species. Stability to populations of species is attained by equalising the birth and death ratio of individuals. Birth is possible only due to reproduction.

Q. 11. What could be the reasons for adopting contraceptive methods?

Ans. The reasons for adopting contraceptive methods are:

(*i*) Protection from sexually transmitted diseases.

(*ii*) Restricting the number of children in a family.

(*iii*) Sufficient gap between successive births.

(*iv*) Enjoying a good reproductive health.

(*v*) Controlling population.

SELF-ASSESSMENT TEST

Time allowed: 1 hour **Max. marks: 40**

SECTION–A

Choose and write the correct answer for each of the following. **(4 × 1 = 4)**

1. Characters that are transmitted from parents to offspring during reproduction show

(*a*) only similarities with parents.

(*b*) only variations with parents.

(*c*) both similarities and variations with parents.

(*d*) neither similarities nor variations.

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2. **The correct sequence of reproductive stages seen in flowering plants is**
   (*a*) gametes, zygote, embryo, seedling (*b*) zygote, gametes, embryo, seedling
   (*c*) seedling, embryo, zygote, gametes (*d*) gametes, embryo, zygote, seedling
3. **Offspring formed as a result of sexual reproduction exhibit more variations because**
   (*a*) sexual reproduction is a lengthy process.
   (*b*) genetic material comes from two parents of the same species.
   (*c*) genetic material comes from two parents of different species.
   (*d*) genetic material comes from many parents.
4. **The part of the flower that forms a seed is**
   (*a*) ovule (*b*) carpel (*c*) ovary (*d*) egg cell

The following questions consist of two statements—Assertion(A) and Reason(R). Answer these questions selecting the appropriate option given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation for *A*.
(*b*) Both *A* and *R* are true but *R* is not the correct explanation for *A*.
(*c*) *A* is true but *R* is false.
(*d*) *A* is false but *R* is true. **(3 × 1 = 3)**

5. **Assertion (*A*) :** The offspring produced by sexual reproduction is likely to adjust better in environmental fluctuation.
   Reason (*R*) : During the fusion of gametes there is mixing of genetic material from two parents.
6. **Assertion (*A*) :** Growth hormone stimulates the growth of different body parts.
   Reason (*R*) : Gonadotropins stimulate the production of sex hormones.
7. **Assertion (*A*) :** Testes lie in penis outside the body.
   Reason (*R*) : Sperms require temperature lower than the body temperature for development.

Answer the following questions in one word or one sentence. **(3 × 1 = 3)**

8. Name the thread like non-reproductive structures in *Rhizopus*.
9. Mention the site and the product of fertilisation in a flower.
10. What is puberty?

SECTION–B

Answer the following questions in about 50-60 words each. **(5 × 3 = 15)**

11. Explain the phenomenon of regeneration with the help of a diagram. How is regeneration different from reproduction?
12. (*i*) How do organisms reproduce by fission? Write names of any two organisms which reproduce by this method.
    (*ii*) Differentiate between the fission of *Leishmania* and *Plasmodium*.
13. What is reproduction? Explain two advantages of sexual reproduction over asexual reproduction. *[CBSE Delhi (C) 2017]*
14. Write two points of differences between asexual and sexual types of reproduction. Describe why variations are observed in the offspring formed by sexual reproduction.
    [NCERT Exemplar, CBSE (AI) 2015]
15. (*i*) Name the following:
    (*a*) Thread like non-reproductive structures present in *Rhizopus*.
    (*b*) 'Blobs' that develop at the tips of the non-reproductive threads in *Rhizopus*.

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(*ii*) Explain how these structures protect themselves and what is the function of the structures released from the 'blobs' in *Rhizopus*.

SECTION–C

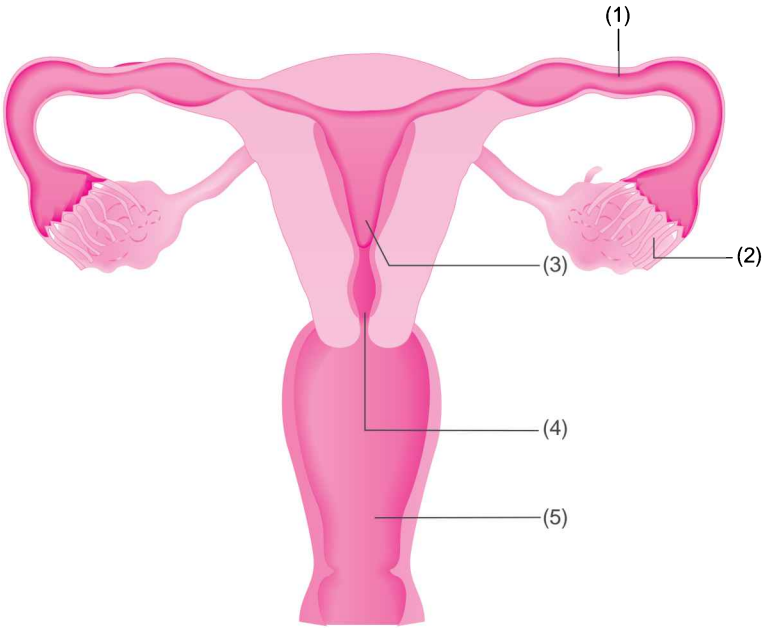
Answer the following questions in about 80–90 words each. **(3 × 5 = 15)**

16. Distinguish between pollination and fertilisation. Mention the site and product of fertilisation in a flower.

Draw a neat, labelled diagram of a pistil showing pollen tube growth and its entry into the ovule. [*NCERT Exemplar*]

17. What is menstrual cycle? Describe different changes during the menstrual cycle occurring in a woman.

18. (*i*) Identify the given diagram. Name the parts 1 to 5.



(*b*) What is contraception? List three advantages of adopting contraceptive measures. [*CBSE 2019 (31/1/1)*]

Answers

1. (*c*) **2.** (*a*) **3.** (*b*) **4.** (*d*) **5.** (*a*) **6.** (*b*) **7.** (*d*)

8. Hyphae

9. Site : Ovule/Ovary

Product : Zygote

10. The period of adolescence when the reproductive organs become functional, is termed as puberty. It is accompanied by development of secondary sexual characters both in males and females.

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9 Heredity and Evolution

BASIC CONCEPTS—A FLOW CHART

HEREDITY

Transmission of characters (or traits) from the parents to their offsprings.

Variations

- Differences in the characters (or traits) among the individuals of a species.
- It helps in adaptation of organisms to the changing environment.

Inherited Traits

Traits and characteristics are reliably inherited to next generation to provide a common basic body design.

Rules for Inheritance of Traits

- Gregor Johann Mendel first studied inheritance of characters.
- He did his study on pea plant.

Monohybrid Cross

- He concluded:
  —Characters were controlled by factors or genes which occur in pairs (alleles).
  —When two different alleles are present together, the dominant one is expressed.
  —Alleles segregated so that each gamete gets only one of the alleles.
- The traits are always inherited in the phenotypic ratio of 3:1.

Dihybrid Cross

- He concluded:
  —Pairs of contrasting characters behave independently of the other pairs.
  —At the time of gamete formation all genes assort independently of each other.
- The traits are always inherited in the phenotypic ratio of 9:3:3:1

How are Traits Expressed

- Cellular DNA is the information source for making proteins in the cell.
- A section of DNA that provides information for one protein is called the gene for that protein.
- Each gene set is present as separate independent pieces called chromosomes.
- Each cell has two copies of each chromosome, one each from male and female parents.
- Every germ cell takes one pair from each pair.
- When two germ cells combine, the normal number of chromosomes is restored.

Sex Determination

- Process by which the sex of a person is determined.
- The female has two X-chromosomes (XX) in the germ cell or egg and the male has one X-chromosome and one Y-chromosome (XY) in the germ cell or sperm.
- When a sperm bearing X-chromosome unites with egg or ovum, female (XX) child is born.
- When a sperm bearing Y-chromosome unites with ovum, male (XY) child is born.

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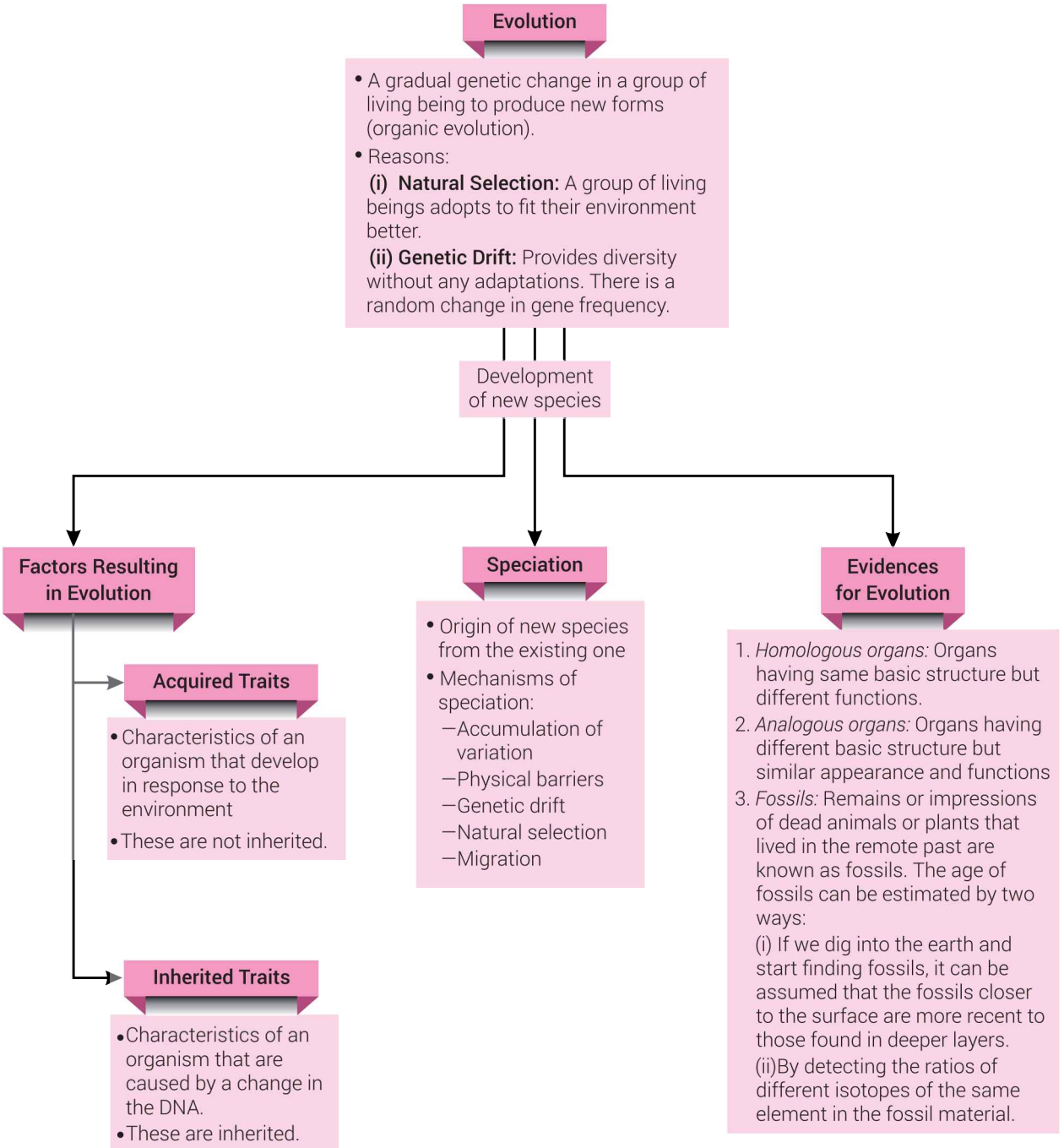

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MORE POINTS TO REMEMBER

- **Sexually reproducing** individuals have two copies of genes for the same trait. If the copies are not identical, the trait that gets expressed is called the dominant trait and the other is called the recessive trait.
- **Variations** in the species may confer survival advantages or merely contribute to the genetic drift.
- **Allele:** Alleles are alternate forms of a gene. Different alleles of a gene give rise to different expressions of a character. Hence, alleles for 'green' and 'yellow' are alternative expressions of a gene governing the characteristics for seed colour.
- **Organic evolution:** All the existing complex plants and animals are developed from simple ancient plants and animals.
  - According to **Lamarck**, new organ develops in an organism due to its special needs. Its continuous use develop the organ and its disuse makes it extinct. This acquired character is inherited to its offsprings, *e.g.,* neck of a giraffe. Thus, new race or species were developed. Present horses also developed similarly.
  - **Darwin's** evolution theory is based on natural selection.
  - Mutation refers to the sudden change in the genetic material (chromosomes) of an organism/ individual and their inheritance to the next generation, resulting in a new species.
  - **Isolation** of groups of same animals by physical barriers or reproductive barrier developed new species.
- **Evolution** cannot be said to 'progress' from 'lower' forms to 'higher' forms. Rather, evolution seems to have given rise to more complex body designs even while the simpler body designs continue to flourish.
- **Human evolution:** The study of human evolution indicates that all of us belong to a single species that evolved in Africa. The earliest members of the human species, *Homo sapiens* can be traced there.
  - (*i*) Determining DNA sequences that have been used for studying human evolution.
  - (*ii*) Due to the diversified human forms and features, skin colour is the most common way for identifying the races.
  - (*iii*) All human beings (white, black, yellow or brown) are a single species called *Homo sapiens*.
  - (*iv*) In other words, our genetic footprints can be traced that indicate we have African roots.
  - (*v*) A couple of hundred thousand years ago, some of our ancestors left Africa while others stayed on.
  - (*vi*) The residents spread across Africa and the migrants spread across the planet from Africa to West Asia, Central Asia, Eurasia, South Asia, East Asia, Indonesia, Philippines, Australia and America.
  - (*vii*) They went forward and backward with groups sometimes separating from each other or sometimes coming together.
  - (*viii*) Like all other species on the planet, they had come into being as an accident of evolution, and were trying to live their lives the best way they could.

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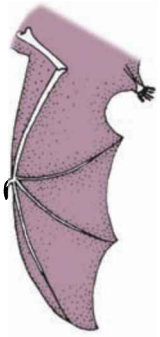
Multiple Choice Questions [1 mark]

Each question has 4 choices (a), (b), (c) and (d). Choose and write the correct option.

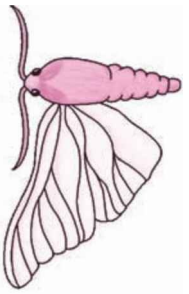
1. Given below are some structural organs of animals.



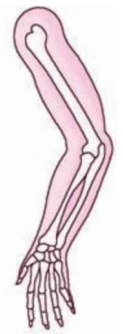
Wing of bat
I



Flipper of penguin
II



Wing of butterfly
III



Human hand
IV

Which structures are analogous?

(*a*) I and III (*b*) I and II (*c*) II and IV (*d*) III and IV

2. Analogy refers to similarity in

(*a*) morphology (*b*) origin (*c*) function (*d*) size

3. The difference between homologous and analogous organs is that

(*a*) homologous organs perform similar functions but analogous organs perform different functions.

(*b*) homologous organs have different origin but analogous organs have similar origin.

(*c*) homologous organs are evidence of convergent evolution but analogous organs are evidence of divergent evolution.

(*d*) homologous organs have different structures but analogous organs have similar structures.

4. In the following pairs identify the homologous organs.

(*a*) Tendrils of *Pisum* and spines of *Opuntia* (*b*) Wings of insects and wings of birds

(*c*) Spines of cactus and thorns of euphorbia (*d*) All the above

5. In a test, the students were given sweet potato, potato tuber, cactus phylloclade and tendril of pea. They were then asked to identify the homologous organs among the given samples. The teacher while checking their answers got four different answers.

(*i*) Sweet potato and potato tuber are homologous.

(*ii*) Cactus phylloclade and sweet potato are homologous.

(*iii*) Tendril of pea and potato tuber are homologous.

(*iv*) Potato tuber, cactus phylloclade and tendril of pea are homologous.

Which answer is correct?

(*a*) (*i*) (*b*) (*ii*) (*c*) (*iii*) (*d*) (*iv*)

6. Read the following statements.

(*i*) Wings of birds and forelimbs of horse are homologous organs.

(*ii*) Wings of bird and wings of insect are analogous organs.

(*iii*) Wings of bird and wings of insect are modified forelimbs.

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Select the right choice.

(*a*) (*i*) and (*ii*) are correct (*b*) (*ii*) and (*iii*) are correct
(*c*) (*i*) and (*iii*) are correct (*d*) (*i*), (*ii*) and (*iii*) are correct

7. Exchange of genetic material takes place in [*NCERT Exemplar*]

(*a*) vegetative reproduction (*b*) asexual reproduction
(*c*) sexual reproduction (*d*) budding

8. Two pink coloured flowers on crossing resulted in 1 red, 2 pink and 1 white flower progeny. The nature of the cross will be [*NCERT Exemplar*]

(*a*) double fertilisation (*b*) self pollination (*c*) cross fertilisation (*d*) no fertilisation

9. Which of the following statement is incorrect? [*NCERT Exemplar*]

(*a*) For every hormone there is a gene.
(*b*) For every protein there is a gene.
(*c*) For production of every enzyme there is a gene.
(*d*) For every molecule of fat there is a gene

10. In human males all the chromosomes are paired perfectly except one. This/these unpaired chromosome is/are

(*i*) large chromosome **(*ii*) small chromosome**
(*iii*) Y-chromosome **(*iv*) X-chromosome** [*NCERT Exemplar*]

(*a*) (*i*) and (*ii*) (*b*) (*iii*) only (*c*) (*iii*) and (*iv*) (*d*) (*ii*) and (*iv*)

11. The maleness of a child is determined by [*NCERT Exemplar*]

(*a*) the X chromosome in the zygote.
(*b*) the Y chromosome in zygote.
(*c*) the cytoplasm of germ cell which determines the sex.
(*d*) sex is determined by chance.

12. New species may be formed if

(*i*) DNA undergoes significant changes in germ cells.
(*ii*) chromosome number changes in the gamete.
(*iii*) there is no change in the genetic material.
(*iv*) mating does not take place. [*NCERT Exemplar*]

(*a*) (*i*) and (*ii*) (*b*) (*i*) and (*iii*) (*c*) (*ii*), (*iii*) and (*iv*) (*d*) (*i*), (*ii*) and (*iii*)

13. Two pea plants one with round green seeds (RRyy) and another with wrinkled yellow (rrYY) seeds produce F_1 progeny that have round yellow (RrYy) seeds. When F_1 plants are self-pollinated, the F_2 progeny will have new combination of characters. Choose the new combination from the following

(*i*) Round, yellow **(*ii*) Round, green**
(*iii*) Wrinkled, yellow **(*iv*) Wrinkled, green** [*NCERT Exemplar*]

(*a*) (*i*) and (*ii*) (*c*) (*ii*) and (*iii*)
(*b*) (*i*) and (*iv*) (*d*) (*i*) and (*iii*)

14. If the fossil of an organism is found in the deeper layers of Earth, then we can predict that [*NCERT Exemplar*]

(*a*) the extinction of organism has occurred recently.
(*b*) the extinction of organism has occurred thousands of years ago.
(*c*) the fossil position in the layers of earth is not related to its time of extinction.
(*d*) time of extinction cannot be determined.

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15. **Select the group which shares maximum number of common characters.** [NCERT Exemplar]
(a) Two individuals of a species (b) Two species of a genus
(c) Two genera of a family (d) Two genera of two families

16. **According to the evolutionary theory, formation of a new species is generally due to** [NCERT Exemplar]
(a) sudden creation by nature.
(b) accumulation of variations over several generations.
(c) clones formed during asexual reproduction.
(d) movement of individuals from one habitat to another.

17. **From the list given below, select the character which can be acquired but not inherited.** [NCERT Exemplar]
(a) Colour of eye (b) Colour of skin (c) Size of body (d) Nature of hair

18. **The two versions of a trait (character) which are brought in by the male and female gametes are situated on** [NCERT Exemplar]
(a) copies of the same chromosome (b) two different chromosomes
(c) sex chromosomes (d) any chromosome

19. **Select the statements that describe characteristics of genes.** [NCERT Exemplar]
(i) Genes are specific sequence of bases in a DNA molecule.
(ii) A gene does not code for proteins.
(iii) In individuals of a given species, a specific gene is located on a particular chromosome.
(iv) Each chromosome has only one gene. [NCERT Exemplar]
(a) (i) and (ii) (b) (i) and (iii) (c) (i) and (iv) (d) (ii) and (iv)

20. **In peas, a pure tall plant (TT) is crossed with a short plant (tt). The ratio of pure tall plants to short plants in F_2 is** [NCERT Exemplar]
(a) 1 : 3 (b) 3 : 1 (c) 1 : 1 (d) 2 : 1

Answers

1. (a)	**2.** (c)	**3.** (c)	**4.** (a)	**5.** (d)	**6.** (a)	**7.** (c)
8. (b)	**9.** (d)	**10.** (c)	**11.** (b)	**12.** (a)	**13.** (b)	**14.** (b)
15. (a)	**16.** (b)	**17.** (c)	**18.** (a)	**19.** (b)	**20.** (c)	

Assertion-Reason Questions [1 mark]

The following questions consist of two statements — Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

1. **Assertion (A) :** A geneticist crossed two pea plants and got 50% tall and 50% dwarf in the progeny.
Reason (R) : One plant was heterozygous tall and the other was dwarf.
2. **Assertion (A) :** Variations are seen in offspring produced by sexual reproduction.
Reason (R) : DNA molecule generated by replication is not exactly identical to original DNA.
3. **Assertion (A) :** Mutation is sudden change in the genetic material.
Reason (R) : Variation is useful for the survival of species over time.

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4. **Assertion (*A*) :** Mendel selected the pea plant for his experiments.
   Reason (*R*) : Pea plant is cross-pollinating and has unisexual flowers.
5. **Assertion (*A*) :** The sex of a child is determined by the mother.
   Reason (*R*) : Humans have two types of sex chromosomes: XX and XY.

Answers

1. (*a*) **2.** (*a*) **3.** (*b*) **4.** (*a*) **5.** (*d*)

Passage-based Questions

Answer the questions below each passage on the basis of your understanding of the paragraph and the related studied concepts.

1. A species is defined as a group of organism that are similar in structure and behaviour and are capable of interbreeding to reproduce fertile hybrids but are reproductively isolated from members of other species. Wheat, paddy, sunflower, lotus, mango, neem, human being, tiger, dog and cat, etc. are some examples of various types of species. In simple term, the formation of a new species is called speciation.

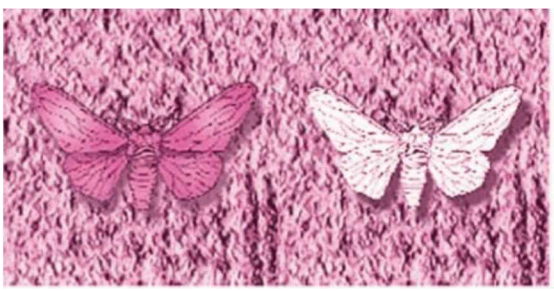
(*i*) Define the term speciation.

(*ii*) List any two mechanism of speciation.

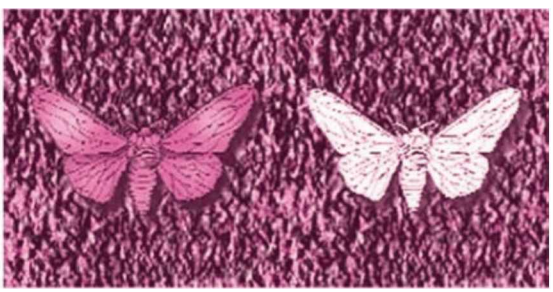
(*iii*) What is the role of natural selection in speciation?

(*iv*) Why geographical isolation is the major factor in the speciation of asexually reproducing animals?

2. Industrial melanism is a term used to describe the adaptation of a population in response to pollution. One example of rapid industrial melanism occurred in populations of peppered moths in the area of Manchester, England from 1845 to 1890. Before the industrial revolution, the trunks of the trees in the forests around Manchester were light greyish-green due to the presence of lichens. Most of the peppered moths in the area were light coloured with dark spots. As the industrial revolution progressed, the tree trunks became covered with soot and turned dark. Over a period of 45 years, the dark variety of the peppered moth became more common.



(*a*)



(*b*)

(*i*) Which coloured moth would be dominating the population after three generations?

(*ii*) When we say "survival of the fittest", does it mean that (*a*) those which are fit only survive, or (*b*) those that survive are called fit. Comment.

(*iii*) What is fossil?

(*iv*) How do we compute the age of a fossil?

Answers

1. (*i*) The process by which an existing species give rise to new species is called speciation.

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(*ii*) Accumulation of variation; Migration, Physical barries. (*Any two*)

(*iii*) Natural selection favours individuals with certain genotypes which proves to be more beneficial for survival in a given environment.

(*iv*) Geographical isolation cannot be a major factor in the speciation of asexually reproducing organisms because it does not require any other organisms for reproduction.

2. (*i*) The dark variety of moth would be dominating because the light coloured moth would disappear slowly.

(*ii*) Those individuals which survive and reproduce in their respective environment are called fit.

(*iii*) Fossils are the remains or impressions of ancient organisms preserved in sedimentary rocks or other media.

(*iv*) By radiocarbon dating.

Very Short Answer Questions [1 mark]

Each of the following questions are of 1 mark and have to be answered in one word or one sentence.

Q. 1. Who is known as the father of genetics?

Ans. Gregor Johann Mendel is known as the father of genetics.

Q. 2. Define chromosome.

Ans. Chromosome is a thread-like structure that bears genes and are enclosed within a nucleus. It is composed of DNA and protein.

Q. 3. Define variation.

Ans. The occurrence of differences among the individuals of a species is called variation.

Q. 4. Define a gene.

Ans. Gene is a segment of a DNA molecule which carries the code for the synthesis of a specific protein.

Q. 5. Define alleles.

Ans. Genes which code for a pair of contrasting traits are known as alleles, *i.e.,* they are the different forms of the same gene.

Q. 6. Where is DNA found in a cell? [*CBSE (AI) 2015*]

Ans. DNA is found in genes or chromosomes.

Q. 7. What is the function of a gene?

Ans. Gene is the carrier of the genetic information from one generation to the next.

Q. 8. Who proposed the theory of natural selection?

Ans. Charles Darwin proposed the theory of natural selection.

Q. 9. Which of the following traits are recessive in pea plant?

Dwarfness, violet flower, wrinkled seed.

Ans. Dwarfness and wrinkled seeds are the recessive characters.

Q. 10. How many pairs of chromosomes are found in human beings?

Ans. 23 pairs of chromosomes are found in human beings.

Q. 11. In humans, the gene for black hair colour is B and gene for brown hair colour is b. What will be the hair colour of person having the genetic constitution

(*a*) BB (*b*) bb (*c*) Bb?

Ans. (*a*) Black hair, (*b*) Brown hair, (*c*) Black hair (Heterozygous)

Q. 12. What is a sex chromosome?

Ans. The chromosomes which are associated with sex determination of an organism are called sex chromosomes.

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Q. 13. Who gave the theory of inheritance of acquired characters?

Ans. Lamarck

Q. 14. Define mutation.

Ans. Sudden changes in the genetic form of an organism which are passed on to the next generation are called mutations. Mutations lead to variations in an organism.

Q. 15. What is the significance of *Archaeopteryx* in evolution?

Ans. *Archaeopteryx* provides evidence of evolution of birds from reptiles and its study shows that

(*i*) birds and reptiles had a common ancestor.

(*ii*) birds have evolved from reptiles.

Q. 16. Why are acquired characters not inheritable?

Ans. Acquired characters are not inherited because they affect the somatic cells and these changes are not incorporated in the chromosomes of cells that will form germ cells.

Q. 17. What is genetic drift?

Ans. The elimination of the genes of certain traits when a section of a species population migrates or dies due to natural calamity. It alters the gene frequency of the remaining population.

Q. 18. What is organic evolution?

Ans. Evolution is the sequence of gradual changes of the living organisms, which takes place in the primitive organisms over millions of years resulting in the formation of new species.

Q. 19. What are the basic events in evolution?

Ans. A gradual genetic change in a group of living beings to produce new forms brought about by changes in DNA during reproduction are the basic events in evolution.

Q. 20. Newly formed DNA copies may not be identical at times. Give one reason. *[CBSE (AI) 2017]*

Ans. Newly formed DNA copies may not be identical at times if there is error or inaccuracies in DNA copying.

Q. 21. Do genetic combination of mothers play a significant role in determining the sex of a new born? *[NCERT Exemplar]*

Ans. No, because mothers have a pair of X-chromosomes. All children will inherit an 'X' chromosome from their mother regardless of whether they are boys or girls.

Short Answer Questions [3 marks]

Each of the following questions are of 3 marks and have to be answered in about 50–60 words each.

Q. 1. Why offsprings differ from parents in certain characters?

Ans. It is due to biparental percentage. The genes on chromosomes which pass over to the next generation is partly derived from both the parents (mother and father). During fertilisation of egg by the sperm, new combination of chromosomes enter the zygote, due to which certain variations occur in the offsprings. Thus, brothers and sisters show variations in their complexion, habits and behaviour.

Q. 2. (*i*) Why is variation important for a species?

(*ii*) What are the causes of variations? *[CBSE (AI) 2017]*

Ans. (*i*) Variation is important for species to survive.

(*ii*) Following are the causes of variations:

(*a*) **Dual percentage:** Offsprings inherit some features from mother and some from father, hence no offspring will exactly resemble to either of the parent or each other.

(*b*) Mutation in gene or chromosomal pattern also causes variations.

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Q. 3. Give the pair of contrasting traits of the following characters in pea plant and mention which is dominant and recessive

(*i*) yellow seed

(*ii*) round seed [*NCERT Exemplar*]

Ans. (*i*) yellow — dominant
green — recessive
(*ii*) round — dominant
wrinkled — recessive

Q. 4. What is the contribution of Mendel to genetics?

Ans. Mendel observed the occurrence of contrasting characters of garden pea in various generations. On this basis, he interpreted that these contrasting characters are controlled by factors. He considered each and every character as a unit, which is controlled by a 'factor'. Factors are carriers of hereditary information. Now, factors are known as genes.

Q. 5. How does use and disuse of an organ help in evolution of a new species?

Ans. According to Lamarck, those organs which are used regularly become strong and more developed. On the other hand, those organs which are not used regularly become weak and degenerate. Such characters are inherited to the offsprings and so on. In the due course of time, such characters become permanent in later generations and become quite different from their ancestors, resulting in the formation of a new species.

Q. 6. A very small population of a species faces a greater threat of extinction than a larger population. Provide a suitable genetic explanation. [*NCERT Exemplar*]

Ans. Fewer individuals in a species impose extensive inbreeding among them. This limits the appearance of variations and puts the species at a disadvantage if there are changes in the environment. Since the individuals fail to cope up with the environmental changes, they may become extinct.

Q. 7. Does the occurrence of diversity of animals on earth suggest their diverse ancestry also? Discuss this point in the light of evolution. [*NCERT Exemplar*]

Ans. Though animals have a vast diversity in structures they probably do not have a common ancestry, because common ancestry may greatly limit the extent of diversity. As many of these diverse animals are inhabiting the same habitat, their evolution by geographical isolation and speciation is also not likely. Thus, a common ancestry for all the animals is not the likely theory.

Q. 8. All the human races like Africans, Asians, Europeans, Americans and others might have evolved from a common ancestor. Provide a few evidences in support of this view. [*NCERT Exemplar*]

Ans. All human races have evolved from a common ancestor because everybody has:

(*i*) Common body design, structure, physiology and metabolism.

(*ii*) Constant chromosome number.

(*iii*) Common genetic blue print.

(*iv*) Freely inter-breeding species.

Q. 9. A change in DNA that is useful for one property to start with, can become useful later for a different function. Explain.

Ans. A change/feature/property of an organism that may have helped it to adopt to an environmental condition can also become useful for a completely different function in the future. For example, feathers in birds, a character developed and selected during natural selection for providing insulation in cold weather, became useful in later stages for flight.

Some dinosaurs had feathers, but they could not fly. Birds later adapted the feathers to fly.

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Q. 10. List two differences in tabular form between dominant trait and recessive trait. What percentage/proportion of the plants in the F_2 generation/progeny were round, in Mendel's cross between round and wrinkled pea plants? *[CBSE (F) 2015]*

Ans.

Dominant trait	Recessive trait
1. The trait which appears in the F_1 progeny is dominant.	1. The trait which remains hidden or which does not appear in the F_1 progeny is the recessive trait.
2. It appears in more numbers.	2. It appears in less number.

75% of the plants were with round seeds.

Q. 11. (*i*) How many pairs of chromosomes are present in human beings? Out of these how many are sex chromosomes? How many types of sex chromosomes are found in human beings?

(*ii*) A woman has only daughters, analyse the situation genetically and provide a suitable explanation. *[NCERT Exemplar]*

Ans. (*i*) 23 pairs of chromosomes are present in human beings. One pair of these are sex chromosomes. Two types of sex chromosomes are there: XX and XY.

(*ii*) The woman produces ova with 'X' chromosome. The man produces sperms with 'X' and 'Y' chromosome which actually determines the sex of the baby. In this case, everytime the male X chromosome only fuses with the female X chromosome thus producing XX combination.

Q. 12. What is DNA copying? State its importance. *[CBSE Delhi 2015]*

Ans. A process where a DNA molecule produces two similar copies of itself in a reproducing cell is called DNA copying.

Its importance are:

(*i*) It makes the transmission of characters from parents to the next generation possible.

(*ii*) It causes variation in the population.

Q. 13. "We cannot pass on to our progeny the experiences and qualifications earned during our life time". Justify the statement giving reason and examples. *[CBSE Delhi 2015]*

OR

With the help of two suitable examples, explain why certain experiences and traits earned by people during their lifetime are not passed on to their next generations. When can such traits be passed on? *[CBSE (AI) 2017]*

Ans. We acquire knowledge and skills in our lifetime such as learning dance, music, physical fitness, etc.

But these skills cannot be passed to our progenies because

(*i*) Such characters or experiences acquired during one's lifetime do not bring any change in the DNA of the germ cell.

(*ii*) Only germ cells are responsible for passing on the characters from the parents to the progeny.

These traits can be passed to the next generation when the changes are in the DNA of the germ cell.

Q. 14. 'Different species use different strategies to determine sex of a newborn individual. It can be environmental cues or genetically determined'. Explain the statement by giving example for each strategy. *[CBSE Sample Paper 2016]*

Ans. Environmental cue:

In some animals, the temperature at which fertilised eggs are kept determines whether the developing animal in egg is male or female.

In some animals like snail, individual can change sex.

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Genetical cue:

A child who inherits an X chromosome from the father will be a girl and one who inherits a Y chromosome from the father will be a boy.

Q. 15. List the two types of reproduction. Which one of the two is responsible for bringing in more variations in its progeny and how? [*CBSE (AI) 2017*]

Ans. The two types of reproduction are sexual reproduction and asexual reproduction. Sexual reproduction is responsible for bringing in more variations because of the process of DNA copying which may result in some error in it. Also, it involves fusion of male and female gametes from two different parents.

Q. 16. How do variations occur in an offspring?

Ans. Dissimilarities between members of the same species is called variations. Two offsprings of the same parents show certain variations. Variations occur due to sex chromosomes. Variations arising in germplasm (genes) of the organism are heritable. Mother and father contribute to the gene pattern of the offsprings through their chromosomes, in which recombination occurs at the time of gametogenesis. In zygote formation, gene pattern of both parents come together, that causes some variations between parents and offsprings and amongst offsprings also.

Q. 17. Why is variation beneficial to the species but not necessary for the individual?

Ans. The importance of variation in organism introduced during reproduction is that it helps the species of various organisms to survive and flourish even in adverse environment. If all the organisms of a population living in that habitat are exactly identical, then there is a danger that all of them may die and no one would survive under those conditions. This will eliminate the species from the habitat completely. However, if some variations are present in some individual organism to tolerate excessive heat or cold, then there is a chance for them to survive and flourish even in adverse excessive heat or cold. Thus, variation is useful for the survival of a species over time.

Q. 18. What is speciation? List four factors responsible for speciation. [*CBSE Delhi 2015*]

Ans. Speciation is the formation of new species from the pre-existing population.

Factors responsible for speciation:

(*i*) Genetic drift
(*ii*) Natural selection
(*iii*) Geographical isolation
(*iv*) Mutation

Q. 19. List in tabular form, two distinguishing features between the acquired traits and the inherited traits with one example of each. [*CBSE Delhi 2015*]

OR

List three distinguishing features, in tabular form, between acquired traits and the inherited traits. [*CBSE Delhi 2015*]

OR

Distinguish between the acquired traits and the inherited traits in tabular form, giving one example for each. [*CBSE Delhi 2017*]

OR

Differentiate between inherited and acquired characters. Give one example for each type. [*NCERT Exemplar*]

OR

List two differences between acquired traits and inherited traits by giving an example of each. [*CBSE* 2019 (31/1/1)]

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Ans.

Acquired Traits	Inherited Traits
1. Does not bring about change in the DNA of the germ cell.	1. Brings about change in the DNA of the germ cell.
2. Cannot be passed on to the progeny.	2. Can be passed on to the progeny.
3. Cannot direct evolution.	3. Can direct evolution.
Examples: Acquiring knowledge, loss of weight, etc.	**Examples:** Skin colour, colour of the eye, etc.

Q. 20. In one of his experiments with pea plants Mendel observed that when a pure tall pea plant is crossed with a pure dwarf pea plant, in the first generation, F_1 only tall plants appear.

(*i*) What happens to the traits of the dwarf plants in this case?

(*ii*) When the F_1 generation plants were self-fertilised, he observed that in the plants of second generation, F_2 both tall plants and dwarf plants were present. Why it happened? Explain briefly. *[CBSE Delhi 2016]*

Ans. (*i*) The dwarf traits of the plants is not expressed in the presence of the dominant tall trait.

(*ii*) In the F_2 generation, both the tall and dwarf traits are present in the ratio of 3 : 1. This showed that the traits for tallness and dwarfness are present in the F_1 generation, but the dwarfness, being the recessive trait does not express itself in the presence of tallness, the dominant trait.

Q. 21. What are chromosomes? Explain how in sexually reproducing organisms the number of chromosomes in the progeny is maintained. *[CBSE (AI) 2015, Delhi (C) 2017]*

Ans. Chromosomes are thread-like structures, made of proteins and DNA, found in the nucleus at the time of cell division.

In sexually reproducing organisms, the gametes undergo meiosis, and hence, each gamete contains only half a set of chromosomes. When two gametes fuse, the zygote formed contains the full set of chromosomes. Hence, the formation of gametes by meiosis helps to maintain the number of chromosomes in the progeny.

Q. 22. Mention the total number of chromosomes along with the sex chromosomes that are present in a human female and a human male. Explain how in sexually producing organisms the number of chromosomes in the progeny remains the same as that of the parents. *[CBSE Delhi 2017]*

Ans. Human male has 22 pairs of chromosomes along with XY sex chromosome.

Human female has 22 pairs of chromosomes along with XX sex chromosomes.

The original number of chromosomes (the amount of DNA) becomes half during gamete formation. When the gametes fuse, the original number of chromosomes (the amount of DNA) is restored in the progeny.

Q. 23. "Two areas of study namely 'evolution' and 'classification' are interlinked". Justify this statement. *[CBSE (AI) 2015]*

OR

"Evolution and classification of organisms are interlinked." Give reasons to justify this statement. *[CBSE (AI) 2017]*

Ans. Different forms of organisms have evolved during the course of evolution. Classification deals with grouping of these organisms into groups and subgroups based on their similarities and

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differences. The more characteristics any two species have in common more closely they are related. In other words, they will have a more recent ancestor.

Thus, classification helps is tracing the evolutionary relationships between the two organisms. Hence classification and evolution are interlinked.

Q. 24. A pea plant with blue colour flower denoted by BB is cross-bred with a pea plant with white flower denoted by ww.

(*i*) What is the expected colour of the flowers in their F_1 progeny?

(*ii*) What will be the percentage of plants bearing white flower in F_2 generation, when the flowers F_1 plants were selfed?

(*iii*) State the expected ratio of the genotype BB and Bw in the F_2 progeny. *[CBSE (AI) 2015]*

Ans. **Parents** BB Blue × ww White

Gametes B, w

F_1 generation Bw (blue)

Bw × Bw

Selfing

F_2 generation

♀ \ ♂	B	w
B	BB Blue	Bw Blue
w	Bw Blue	ww White

(*i*) Blue

(*ii*) 25%

(*iii*) BB : Bw = 1 : 2

Q. 25. Explain the following:

(*i*) Speciation *[CBSE 2019 (31/1/1)]*

(*ii*) Natural Selection *[CBSE (AI) 2015]*

Ans. (*i*) The process by which new species develop from the existing species is known as speciation. The factors which could lead to speciation are:

(*a*) Geographical isolation of population caused by various types of barriers such as mountain ranges, rivers and seas. This leads to reproductive isolation because of which there is no flow of genes between separated groups of population.

(*b*) Genetic drift caused by drastic changes in the frequencies of particular genes by chance alone.

(*c*) Variations caused in individuals because of natural selection.

(*ii*) According to Darwin's theory of natural selection, the individuals who are most suitable and fit are successful in struggle for existence for food, space, mate, etc. Their offsprings are also better developed and adapted to the environment. Whereas one who are less adapted to the environment may die. Thus, nature selects better adapted organisms. This is called **natural selection** of the well adapted, better developed individuals of species.

Q. 26. "Natural selection and speciation leads to evolution." Justify this statement. *[CBSE Delhi 2017]*

Ans. Natural selection is defined as the change in frequency of some genes in a population, which gives survival advantage to a species. Whereas speciation is the development of a new species from pre-existing ones.

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This leads to a sequence of gradual change in the primitive organisms over millions of years, to form newer species which are very different from older ones. This is called evolution.

Q. 27. "Fossils are related to evolution", justify this statement. Give the two ways by which age of the fossils can be estimated.

Ans. Fossils are the remains of the organisms that once existed on earth, *i.e.*, they are the preserved traces of living organisms. They provide evidence of evolution by revealing the characteristics of the past organisms and the changes that have occurred in these organisms to give rise to the present organisms.

Two ways of determining age of fossils are:

(*i*) Relative method—fossils closer to the surface are more recent.

(*ii*) Dating—finding the ratio of different isotopes of the same element.

Q. 28. (*i*) *Planaria*, insects, octopus and vertebrates all have eyes. Can we group eyes of these animals together to establish a common evolutionary origin? Justify your answer.

(*ii*) "Birds have evolved from reptiles". State evidence to prove the statement.

[CBSE Delhi 2015; (F) 2015]

Ans. (*i*) No we cannot group them together because the structure of the eye in each of the organisms is different.

(*ii*) Fossils of certain dinosaurs and reptiles show imprints of feathers along with their bones but they could not fly presumably, using the feathers for insulation only. Later they evolved and adapted feathers for flight, thus becoming the ancestors of present day birds.

Q. 29. Mention three important features of fossils which help in the study of evolution.

[NCERT Exemplar]

Ans. (*i*) Fossils represent modes of preservation of ancient species.

(*ii*) Fossils help in establishing evolutionary traits among organisms and their ancestors.

(*iii*) Fossils help in establishing the time period in which organisms lived.

Q. 30. Explain analogous organs and homologous organs. Identify the analogous and homologous organs amongst the following:

Wings of an insect, wings of a bat, forelimbs of frog, forelimbs of a human.

Ans. Analogous organs are those organs which have different structural designs and origin but perform similar functions.

Homologous organs are those which have the same basic structural design and origin but perform different functions.

Analogous organs: Wings of an insect, wings of a bat.

Homologous organs: Forelimbs of a frog, forelimbs of a human.

Q. 31. Explain with the help of an example each, how the following provide evidences in favour of evolution: *[CBSE Delhi 2017]*

(*i*) Homologous organs (*ii*) Analogous organs (*iii*) Fossils

Ans. **(*i*) Homologous organs:** The study of these organs suggests that these organisms with organs having same structure but performing different functions have evolved from a common ancestor, *e.g.*, forelimbs of different vertebrates.

(*ii*) Analogous organs: The study of these apparently similar organs suggests that the organisms with apparently similar organs do not share common ancestory. Similarity in these organs is superficial or design and the structure of these organs are very different, *e.g.*, wings of bird and wings of butterfly.

(*iii*) Fossils: They provide the missing link between the species, *e.g.*, Fossils of dinosaurs with feathers or fossils of prehistoric horse, etc.

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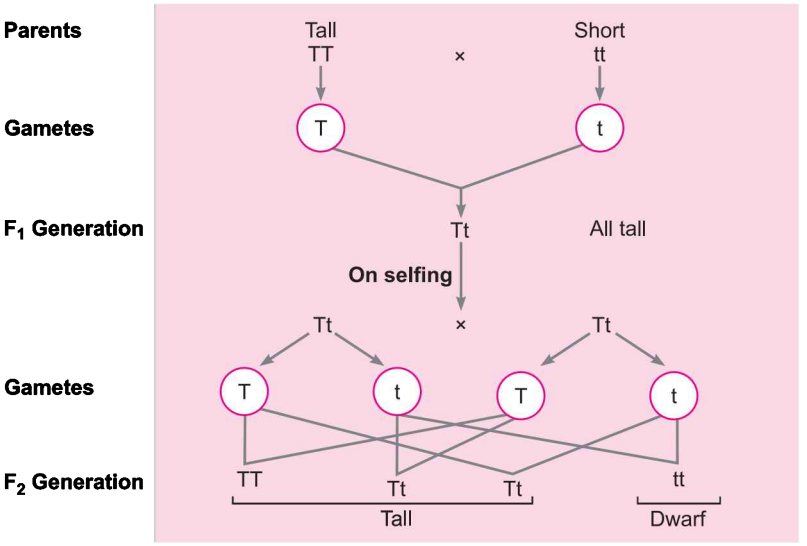
Q. 32. Describe the contribution of Lamarck.

Ans. The gradual unfolding of organisms from pre-existing organisms through changes since the beginning of life is called evolution. The theory proposed by J.B. Lamarck is known as the theory of inheritance of acquired characters. According to this theory, the use and disuse of an organ leads to acquiring of change in that organ. These changes or variations can be passed on from one generation to the next but this idea of inheritance of acquired characters was soon discarded.

Q. 33. Name the plant Mendel used for his experiment. What type of progeny was obtained by Mendel in F_1 and F_2 generations when he crossed the tall and short plants? Write the ratio he obtained in F_2 generation plants. [*CBSE* 2019 (31/1/1)]

Ans. Mendel used garden pea (*Pisum Sativum*) for his experiment.

When Mendel crossed a pure tall plant (TT) with a dwarf plant (tt), the progeny thus obtained was called F_1 progeny/generation.



Then he self-pollinated F_1 generation and found out 75% tall plants and 25% dwarf.

F_2 generation ratio:–

1	:	2	:	1
Pure tall	:	Hybrid tall	:	Pure dwarf
(T T)		(Tt)		(tt)

Q. 34. How did Mendel's experiments show that different traits are inherited independently? Explain. [*CBSE Delhi 2017*]

Ans. Mendel conducted a dihybrid cross; and observed that though he started with two types of parents, he obtained four types of individuals in F_2. The appearance of new recombination in F_2 generations along with parental type characters show that traits are inherited independently of each other.

Q. 35. Name two homologous structures in vertebrates. Why are they so called? How do such organs help in understanding an evolutionary relationship?

Ans. Two homologous structures in vertebrates are:

(*i*) Limbs of birds and reptiles.

(*ii*) Limbs of reptiles and amphibians.

These are called so because the organs have similar structure to perform different functions in various vertebrates.

The homologous characteristics of such organs indicate common ancestory. Thus these exist an evolutionary relationship.

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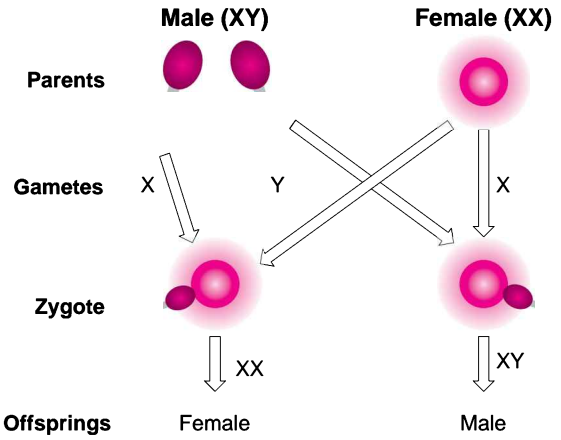
Q. 36. "The sex of a newborn child is a number matter of chance and none of the parents may be considered responsible for it." Justify this statement with the help of a flow chart showing sex-determination in human beings. *[CBSE 2019 (31/2/1)]*

Ans. In human beings, sex of the child depends upon which kind of male gamete fertilises with the female gamete. If sperm carrying X chromosome fertilises the ovum carrying X chromosome, then the child born will be a girl.

If a sperm carrying Y chromosome fertilises the ovum which carries X chromosome, then the child born will be a boy.

So, it is the male who is responsible for the sex of the child.

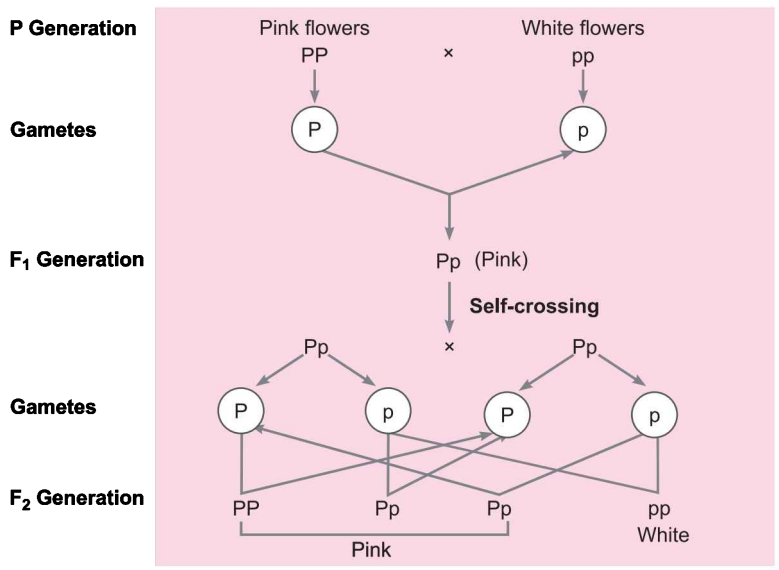


Q. 37. In a cross between plants with pink flowers and plants with white flowers the offsprings of F_1 generation all had pink flowers. When the F_1 generation was self-crossed, it was observed in the F_2 generation that out of 100, 75 flowers were pink. Make a cross and answer the following:

(*i*) What are the genotypes of the F_1 progeny?

(*ii*) What is the ratio of Pink: White flowers in the F_2 generation?

Ans.



(*i*) **Genotype of F_1 progeny** is Pp (Pink)

(*ii*) **Phenotypic ratio in F_2 generation** Pink : White

3 : 1

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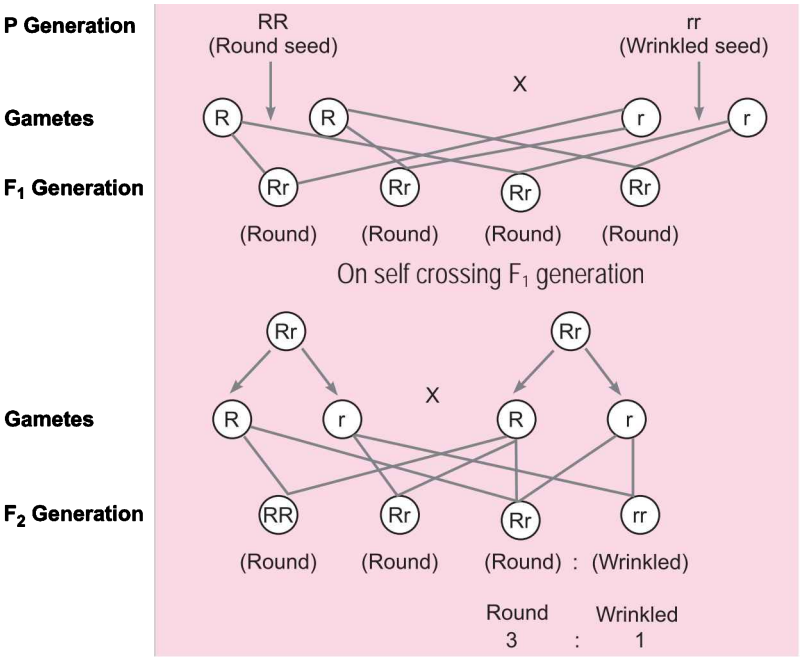
Q. 38. Mendel, in one of his experiments with pea plants, crossed a variety of pea plant having round seeds with one having wrinkled seeds. State Mendel's observations giving reasons of F_1 and F_2 progeny of this cross. Also, list any two contrasting characters, other than round seeds of pea plants that Mendel used in his experiments. *[CBSE 2019 (31/3/1)]*

Ans. Mendel crossbred round seed plants with wrinkled seed plants.

The F_1 progeny so obtained had heterozygous round seed plants and no wrinkled seed plants. When he self crossed the F_1 generation, both round and wrinkled seed plants were obtained in the ratio of 3 : 1.



Q. 39. List three factors that provide evidences in favour of evolution in organisms and state the role of each in brief. *[CBSE (F) 2016]*

Ans. Three factors that provide evidences are:

(*i*) Analogous organs—organisms with similar looking organs may have different origin.

(*ii*) Homologous organs—organisms with apparently different looking organs may have similar origin.

(*iii*) Fossils—allow us to make estimates of how far back evolutionary relationships go. Fossils when chronologically arranged help in tracing the evolutionary history of an organism.

Q. 40. Does geographical isolation of individuals of a species lead to formation of a new species? Provide a suitable explanation. *[NCERT Exemplar]*

Ans. Yes, geographical isolation gradually leads to genetic drift. This may impose limitations to sexual reproduction of the separated population. Slowly the separated individuals will reproduce among themselves and generate new variations. Continuous accumulation of those new variations through a few generations may ultimately lead to the formation of a new species.

Q. 41. What is an organic evolution? It cannot be equated with progress. Explain with the help of a suitable example. *[CBSE (AI) 2017]*

Ans. Organic evolution is a sequence of gradual changes which take place in the organism over millions of years resulting in the formation of new organisms or species.

Evolution is not the progress from lower form of life to higher. It has given rise to more complex body design even while simpler body designs continue to flourish.

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For example, human beings who have not evolved from chimpanzees, but both have common ancestors.

Q. 42. (*i*) What is meant by characteristics?

(*ii*) Give an example of the characteristics being used to determine how close two species are in evolutionary terms. *[CBSE 2019 (31/4/3)] [CBSE (F) 2017]*

Ans. (*i*) It is the detail of appearance or behaviour; in other words, a particular form or a particular function.

(*ii*) Study of homologous organs such as forelimbs of mammals, birds, reptiles and amphibians shows that though they perform different functions but they have similar basic or internal structure. This is because they have evolved from common ancestor and help us in determining the closeness between two species in evolutionary terms.

Long Answer Questions [5 marks]

Each of the following questions are of 5 marks and have to be answered in about 80-90 words each.

Q. 1. Explain with reason why giraffe has long neck.

Ans. According to Lamarck's theory of use and disuse, giraffes had to stretch their necks and forelimbs for feeding on leaves of tall trees because of which these organs were elongated. But this theory has been completely discarded. It is now proposed that, the giraffe's neck evolved with time because of 'necking' battle with time and natural selection. Only giraffes with long necks survived.

Q. 2. Give the basic features of the mechanism of inheritance. *[NCERT Exemplar]*

Ans. (*i*) Characters are controlled by genes.

(*ii*) Each gene controls one character.

(*iii*) There may be two or more forms of gene.

(*iv*) One form may be dominant over the other.

(*v*) Genes are present on chromosomes.

(*vi*) An individual has two forms of gene whether similar or dissimilar.

(*vii*) The two forms separate from each other at the time of gamete formation.

(*viii*) The two forms are brought together in the zygote.

Q. 3. "It is possible that a trait is inherited but may not be expressed." Give a suitable example to justify this statement. *[CBSE (F) 2015]*

OR

With the help of an example justify the following statement: "A trait may be inherited, but may not be expressed". *[CBSE (AI) 2016]*

OR

How did Mendel explain that it is possible that a trait is inherited but not expressed in an organism? *[CBSE (AI) 2017]*

OR

(*i*) What are dominant and recessive traits?

(*ii*) "Is it possible that a trait is inherited but may not be expressed in the next generation?" Give a suitable example to justify this statement. *[CBSE 2019 (31/2/2)]*

Ans. (*i*) Dominant traits are those which expresses itself in the F_1 generation.

Recessive teaits are those traits which remains hidden or does not express itself in the F_1 generation.

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(*ii*) Yes, it is possible that a trait is inherited but may not be expressed.

For example, when pure tall pea plants are crossed with pure dwarf pea plants, only tall pea plants are obtained in F_1 generation.

On selfing tall plants of F_1, both tall and dwarf plants are obtained in F_2 generation in the ratio 3 : 1.

Reappearance of the dwarf character, a recessive trait in F_2 generation shows that the dwarf trait was present in individuals of F_1 but it did not express.

Q. 4. (*i*) Mention any two points of difference between acquired and inherited traits.

[CBSE 2019 (31/4/3)]

(*ii*) If the tail of a mouse is cut for twenty one generations, will the tail occur in the twenty second generation of that mouse? Give reason to support your answer.

(*iii*) Define the term natural selection. *[CBSE Sample Paper 2016]*

Ans. (*i*)

Acquired Traits	Inherited Traits
1. These are traits acquired during one's lifetime.	1. These are traits inherited from one's predecessors.
2. These are not inheritable.	2. These are inheritable.
3. Not present in the genetic make up.	3. Present in the genetic makeup.
4. Change in DNA will not result in any change in such traits.	4. Change is DNA will bring about change in such traits.

(Any two)

(*ii*) The mouse will continue to have information for presence of tail in its DNA. So, it will continue to have tail because absence of tail is an acquired trait and not an inherited trait.

(*iii*) Natural selection means that nature selects the best trait in a species, leading to survival of fittest and evolution of species.

Q. 5. In the following crosses write the characteristics of the progeny.

Cross	Progeny
(*i*) RR YY × RR YY	_____
Round, yellow and round, yellow	
(*ii*) Rr Yy × Rr Yy	_____
Round, yellow and round, yellow	
(*iii*) rr yy × rr yy	_____
Wrinkled, green and wrinkled, green	
(*iv*) RR YY × rr yy	_____
Round, yellow and wrinkled, green	

[NCERT Exemplar]

Ans. (*i*) Round, yellow

(*ii*) Round, yellow
Round, green
Wrinkled, yellow
Wrinkled, green

(*iii*) Wrinkled, green

(*iv*) Round, yellow

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Q. 6. How do Mendel's experiments show that the

(*i*) traits may be dominant or recessive,

(*ii*) traits are inherited independently? *[CBSE (AI) 2015, Delhi (C) 2017]*

OR

How do Mendel's experiments show that

(*i*) traits may be dominant or recessive?

(*ii*) inheritance of two traits is independent of each other? *[CBSE Delhi 2017]*

Ans. (*i*) When Mendel cross–pollinated pure tall pea plants with pure dwarf pea plants, only tall plants were obtained in F_1 generation. On self pollinating the F_1 progeny, both tall and dwarf plants appeared in F_2 generation in the ratio 3 : 1.

Appearance of tall character in both the F_1 and F_2 shows that it is a dominant character. The absence of dwarf character in F_1 generation and its reappearance in F_2 shows dwarfness is the recessive character.

(*ii*) When Mendel first crossed pure-breed pea plants having round-yellow seeds with pure-breed pea plants having wrinkled-green seeds, he found that only round-yellow seeds were produced in the first-generation. No wrinkled-green seeds were obtained in the generation. From this, it was concluded that round shape and yellow colour of the seeds were dominant traits over the wrinkled shape and green colour of the seeds.

When the F_1 generation pea plants having round-yellow seeds were cross-bred by self-pollination, then four types of seeds having different combinations of shape and colour were obtained in second generation (F_2). These were round-yellow, round-green, wrinkled-yellow and wrinkled-green seeds.

Such a cross is known as dihybrid cross as two sets of corresponding characters are considered.

Mendel observed that along with round-yellow and wrinkled-green, two new combinations of characteristics, round-green and wrinkled-yellow, had appeared in the F_2 generation. On the basis of this observation, Mendel concluded that though the two pairs of original characteristics (seed colour and shape) combine in the F_1 generation, they get separated and behave independently in the subsequent generation.

Q. 7. What are the various evidences in favour of evolution?

OR

Explain with an example for each, how the following provides evidences in favour of evolution in organisms:

(*i*) Homologous organs **(*ii*) Analogous organs**

(*iii*) Fossils *[CBSE (AI) 2015]*

OR

List three factors that provide evidences in favour of evolution in organisms and state the role of each in brief. *[CBSE (F) 2016, 2017]*

OR

How do the following provide evidences in favour of evolution in organisms? Explain with an example for each.

(*i*) Homologous organs **(*ii*) Analogous organs**

(*iii*) Fossils *[CBSE 2019 (31/5/1)]*

Ans. The following are the various evidences in favour of evolution:

(*i*) Homologous organs: Organs with a common basic structural design but with different functions are said to be homologous organ. For example, forelimbs of a frog, lizard, bird and man.

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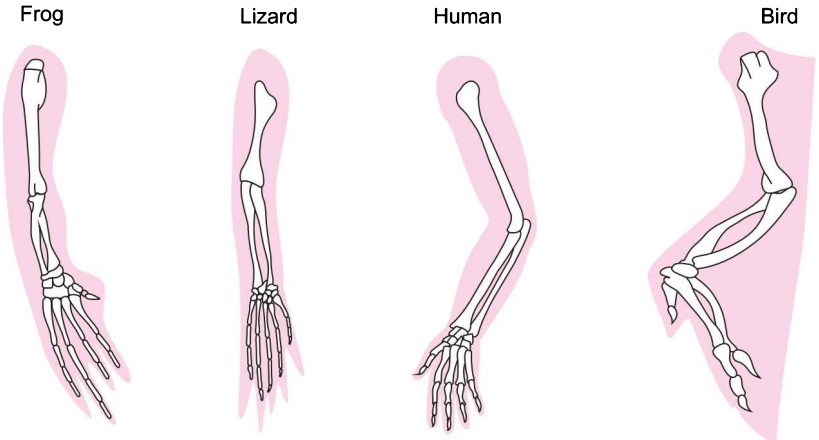
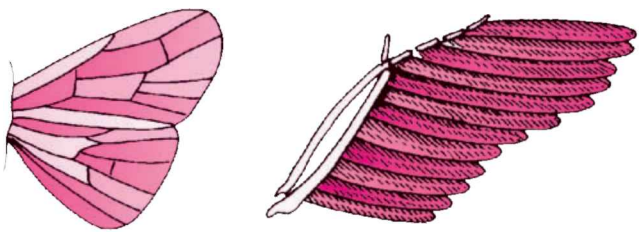
The forelimbs of man are used for grasping, of lizard for running, of frog for propping up and bird for flying. They have different functions but have same structural pattern.



Homologous organs

(*ii*) **Analogous organs:** The analogous organs have different basic structure but perform similar functions. For example, the wing of insects and the wing of birds, have a totally different anatomy and origin but they perform the same function of flying in air.



(a) Wing of an insect

(b) Wing of bird

Analogous organs

(*iii*) **Evidences from fossils:** The fossils also provide evidences for evolution. For example, the fossil of *Archaeopteryx* looks like a bird but it bears a number of other features, which are found in reptiles. This observation provides a clue that birds have evolved from reptiles.

Q. 8. Explain the ways in which evolutionary relationships can be traced.

Ans. Evolutionary relationships can be traced in the following ways:

(*i*) **Study of homologous organs:** Some organs in different organisms are similar in structure and design because they are inherited from a common ancestor. For example, forelimbs of horse, wings of bird and arms of man may be functionally different, but because of their similarity in structure, origin and design, they indicate that horse, birds and man are closely linked and had a common ancestor.

(*ii*) **Study of fossils:** Fossils are the remains or impressions of organisms that existed in the past, allow us to study organ structure of organisms that are no longer alive. Comparing their organ structure with organ structure of present day organisms also enable us to trace evolutionary relationships.

(*iii*) **Comparing DNA of different species:** This will give us a direct estimate of how much the DNA has changed during the formation of these species. This, too, can also be used as a criterion to trace evolutionary relationships.

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Q. 9. Describe Darwin's theory of evolution.

Ans. Following are the points of Darwin's theory of natural selection:

(i) **Over-production:** Every organism has enormous potential to reproduce.

(ii) **Struggle for existence:** Population size of an organism is limited due to struggle between the members of same species as well as the members of different species. It is due to struggle for food, space and mate.

(iii) **Variation:** Due to struggle, the fit organisms possess some variations which are favourable, and they can leave the progeny to continue the favourable variations.

(iv) **Survival of the fittest:** The fittest organism survive to continue the favourable variations.

(v) **Formation of a new species:** These variations when accumulated for a long time, leads to the origin of a new species.

Q. 10. Explain Mendel's experiment with peas on inheritance of characters considering only one visible contrasting character. *[CBSE (F) 2015]*

Ans. Mendel conducted breeding experiments with garden peas:

(*i*) He studied plants (pure) of a tall/short varieties.

(*ii*) He crossed them and obtained F_1 progeny.

(*iii*) He found that F_1 progeny was all tall plants.

(*iv*) He selfed the (hybrid) plants of F_1 progeny.

(*v*) He found that in F_2 progeny there were tall as well as short plants.

(*vi*) The three quarter plants were tall and one quarter was short .

(or any other contrasting character may be taken.)

Q. 11. What are fossils? How are they formed? Describe in brief two methods of determining the age of fossils. State any one role of fossils in the study of the process of evolution. *[CBSE (AI) 2015]*

OR

What are fossils? How are they formed? List two methods of determining the age of fossils. Explain in brief the importance of fossils in deciding the evolutionary relationships.

[CBSE (F) 2016, 2017]

OR

What are fossils? Describe briefly two methods of determining the age of fossils.

[CBSE 2019 (31/4/1)]

Ans. Fossils are dead remains of animals and plants from remote past.

Fossils are formed when dead organisms are not completely decomposed. The organisms may get trapped in resins of tree, lava of volcanoes or hot mud, which when hardens retains the animal's parts thus forming fossils.

Two methods of determining the age of fossils are:

(i) **Relative method:** By estimating the age of the layer of Earth's crust where the fossil is found. Fossils near the surface are recent and those in the deeper layers are more ancient.

(ii) **Radio-carbon dating method:** By detecting the ratios of different isotopes of carbon in the fossils.

Fossils play the following roles:

(*i*) By determining the age of fossils we come to know the type of Earth strata present at that time.

(*ii*) We can also know the type of animals and plants present on the earth at that time.

(*iii*) They help in establishing evolutionary relationship by providing connecting links. (*Any one*)

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Q. 12. What is speciation? List four factors that could lead to speciation. Which of these cannot be a major factor in the speciation of a self-pollinating plant species? Explain. Give reason to justify your answer. *[CBSE Delhi 2016, (F) 2015]*

Ans. Speciation is the formation of new species from the pre-existing population.

Factors responsible for speciation:

(*i*) Genetic drift (*ii*) Natural selection

(*iii*) Geographical isolation (*iv*) Mutation

Geographical isolation cannot be a major factor in the speciation of a self pollinating plant species because physical barrier cannot be created in self-pollinating plants.

Q. 13. (*i*) How does speciation take place?

(*ii*) Define the term gene.

(*iii*) The gene for red hair is recessive to the gene for black hair. What will be the hair colour of a child if he inherits a gene for red colour from his mother and a gene for black hair from his father? Express with the help of flow chart. *[CBSE Sample Paper 2016]*

Ans. (*i*) Speciation may take place by

(*a*) Migration (*b*) Natural selection

(*c*) Mutation (*d*) Genetic drift (*Any two*)

(*ii*) The segment of DNA which is functional and is made of nucleic acids and protein is called gene.

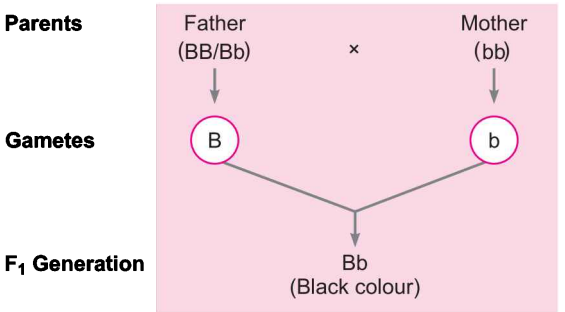
(*iii*) Given,

Mother has red hair which is recessive, *i.e.*, bb

Father has black hair which is dominant, *i.e.*, BB or Bb.

The inheritance pattern can be shown as follows:

Thus, the child will have black hair.



Q. 14. How has the method of 'artificial selection' by humans helped in the evolution of different vegetables?

Ans. A wild variety of a plant may show different variations. Humans have selected some such variants and grown them for generations and during the course of time, they have become totally different species.

For example, variants in wild cabbage were selected on the basis of certain features to generate different vegetables.

(*i*) Short distances between leaves, led to formation of green leaf buds—the common cabbage.

(*ii*) Arrested flower development has bred broccoli.

(*iii*) The variant with sterile flowers has made the cauliflower.

(*iv*) Variant with swollen leaf parts—kohlrabi.

(*v*) Variant with larger leaves—kale.

HOTS [Higher Order Thinking Skills]

Q. 1. Why do all the gametes formed in human females have X chromosome? *[NCERT Exemplar]*

Ans. Human females have two X chromosomes called sex chromosomes. During meiosis at the time of gamete formation, one X chromosome enters each gamete. Hence all the gametes possess an X chromosome.

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Q. 2. In human beings, the statistical probability of getting either a male or female child is 50 : 50. Give a suitable explanation. *[NCERT Exemplar]*

Ans. The sex of an infant is determined by the type of sex chromosome contributed by the male gamete. Since the ratio of male gametes containing X chromosome and those containing Y chromosome is 50 : 50, the statistical probability of male or a female infant is also 50 : 50.

Q. 3. Why did Mendel choose pea plant for his experiments? *[NCERT Exemplar]*

Ans. (*i*) Easy to grow (*ii*) Short lifespan
(*iii*) Easily distinguishable characters (*iv*) Larger size of flower
(*v*) Self-pollinated

Q. 4. Give reasons for the appearance of new combinations of characters in the F_2 progeny. *[NCERT Exemplar]*

Ans. The tall/short and round/wrinkled seed trait are independently inherited.

Q. 5. Why is making anti-viral drugs more difficult than making anti-bacterial medicines?

Ans. Since viruses have very few biochemical mechanisms of their own, anti-viral drugs can't be made so easily.

Q. 6. Evolution has exhibited a greater stability of molecular structure when compared with morphological structures. Comment on the statement and justify your opinion. *[NCERT Exemplar]*

Ans. We see immense diversity in size, form, structure and morphological features in the living world. But at the molecular level these diverse types of organisms exhibit unbelievable similarity. For instance, the basic biomolecules like DNA, RNA, carbohydrates, proteins, etc., exhibit remarkable similarity in all organisms.

NCERT Corner

NCERT Intext Questions

Q. 1. If a trait A exists in 10% of a population of an asexually reproducing species and a trait B exists in 60% of the same population, which trait is likely to have arisen earlier?

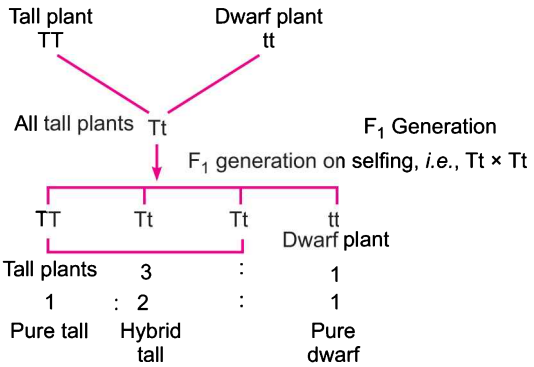
Ans. Trait B is likely to have arisen earlier in a population of an asexually reproducing species.

Q. 2. How does the creation of variations in a species promote survival?

Ans. Variations in a species arise due to errors in DNA copying. Force of natural selection selects individuals with useful variations in the prevailing environment so as to ensure their survival. The individuals with useful variations increase in numbers through differential reproduction in the population.

Q. 3. How do Mendel's experiments show that traits may be dominant or recessive? *[CBSE 2019 (31/4/1)]*

Ans. When Mendel first crossed pure tall pea plants with pure dwarf pea plants, he found that only tall plants were produced in the first generation(F_1 generation). No dwarf pea plants were obtained in the first-generation of progeny. When F_1 tall plants were self-pollinated, Mendel got both tall and dwarf plants in F_2 generation in 3 : 1 ratio. In other words, in the F_2 generation three-fourth plants were tall and one-fourth were dwarf. Mendel called this tall character as dominant trait and dwarf character as recessive trait.



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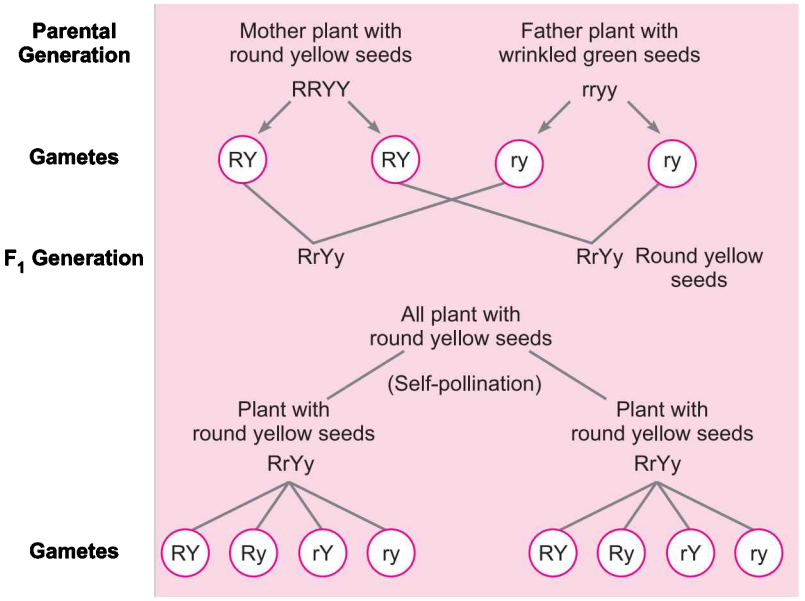
Q. 4. How do Mendel's experiments show that traits are inherited independently?

Ans. When Mendel first crossed pure-bred pea plants having round-yellow seeds with pure-bred pea plants having wrinkled–green seeds, he found that only round-yellow seeds were produced in the first generation. No wrinkled–green seeds were obtained in the F_1 generation. From this, it was concluded that round shape and yellow colour of the seeds were dominant traits over the wrinkled shape and green colour of the seeds.



When the F_1 generation pea plants having round yellow seeds were cross-bred by self-pollination, then four types of seeds having different combinations of shape and colour were obtained in second generation (F_2). These were round yellow, round green, wrinkled yellow and wrinkled green seeds.

Such a cross is known as dihybrid cross as two sets of corresponding characters are considered.

Gametes ♂

Gametes ♀	RY	Ry	rY	ry
RY	RRYY Round yellow	RRYy Round yellow	RrYY Round yellow	RrYy Round yellow
Ry	RRYy Round yellow	RRyy Round green	RrYy Round yellow	Rryy Round green
rY	RrYY Round yellow	RrYy Round yellow	rrYY Wrinkled yellow	rrYy Wrinkled yellow
ry	RrYy Round yellow	Rryy Round green	rrYy Wrinkled yellow	rryy Wrinkled green

F_2 generation

Independent inheritance of two contrasting traits: Shape and colour of the seeds

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Thus, ratio of F_2 generation is

Round yellow	:	Round green	:	Wrinkled yellow	:	Wrinkled green
9	:	3	:	3	:	1

Thus, the ratio of each phenotype (or appearance) of the seeds in the F_2 generation is 9 : 3 : 3 : 1.

Mendel observed that round yellow and wrinkled green, and two new combinations of characteristics had appeared in the generation. These were round green and wrinkled yellow. On the basis of this observation, Mendel concluded that though the two pairs of original characteristics (seed colour and shape) combine in the F_1 generation, they get separated and behave independently in the subsequent generation.

Q. 5. A man with blood group A marries a woman with blood group O and their daughter has blood group O. Is this information enough to tell you which of the traits blood group A or O is dominant? Why or why not?

Ans. The information is insufficient to tell whether the trait - 'A' or 'O' is dominant.

In Case I, let us assume that trait 'A' is dominant. Then father may have I^AI^A or I^AI^O and mother I^OI^O.

In this case, 50 per cent of the progeny will have blood group A and 50 percent of the progeny will have blood group O, when father's blood group is A and mother's is O.

	I^A	I^A
I^O	I^AI^O	I^AI^O
I^O	I^AI^O	I^AI^O

In case II, let us assume that trait 'O' is dominant. In this case also, we see that child may have blood group O.

	I^A	I^O
I^O	I^AI^O	I^OI^O
I^O	I^AI^O	I^OI^O

Since, in both the assumptions the child can have blood group O, so we cannot establish which trait is dominant.

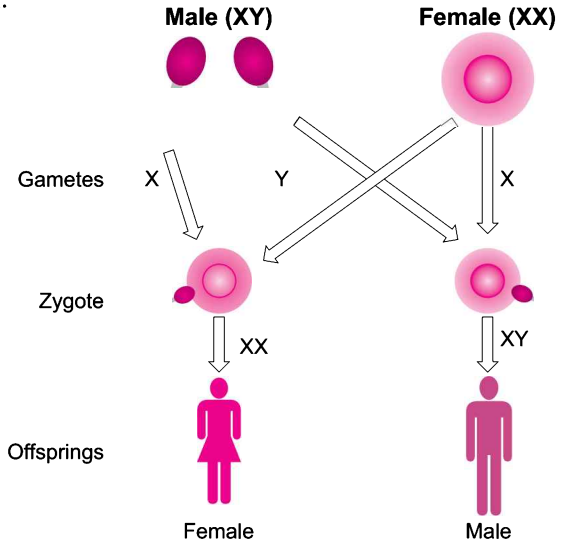
Q. 6. What are the different ways in which individuals with a particular trait may increase in a population?

Ans. Individuals with particular trait may increase in a population in the following ways:

(*i*) By natural selection (*ii*) By genetic drift

Q. 7. How is the sex of the child determined in human beings?

Ans. In human beings, sex of the child depends upon which kind of male gamete fertilises the female gamete. If sperm carrying X chromosome fertilises the ovum carrying X chromosome, then the child born will be a girl.



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If a sperm carrying Y chromosome fertilises the ovum which carries X chromosome, then the child born will be a boy.

Q. 8. Why are traits acquired during the lifetime of an individual not inherited?

Ans. The changes in the non-reproductive body cells, *i.e.*, somatic cells of an organism cannot be inherited by its offsprings, because only those traits can be transmitted to future generations in which changes have occurred in the DNA present in the reproductive cells of parent organism.

Q. 9. Why are small numbers of surviving tigers a cause of worry from the point of view of genetics? *[CBSE 2019 (31/5/1)]*

Ans. The small numbers of surviving tigers are a cause of worry from the point of view of genetics because if they all die and become extinct, their genes will be lost forever and coming generations will not be able to see tigers at all. Also, small number of tigers means less chances of variations. Variations are important for stability of a species by natural selection.

Q. 10. What factors could lead to the rise of a new species?

Ans. Genetic variation, natural selection and reproductive isolation are factors that could lead to the rise of a new species.

Q. 11. Will geographical isolation be a major factor in the speciation of a self-pollinating plant species? Why or why not?

Ans. Geographical isolation will not be a major factor for the speciation of a self-pollinating plant species because it does not have to look for other plants for its process of reproduction to be carried out.

Q. 12. Will geographical isolation be a major factor in the speciation of an organism that reproduces asexually? Why or why not?

Ans. Geographical isolation will not be a major factor in the speciation of an organism that reproduces asexually, because it does not require any other organism to carry out reproduction.

Q. 13. Give an example of characteristics being used to determine how close two species are in evolutionary terms.

Ans. Forelimbs of humans and wings of birds show the closeness between these two species. Since, the forelimbs of a human and wings of birds have similar structure but perform different functions. Thus, the presence of homologous organs in different animals provides evidence for evolution by telling us that they have evolved from the same ancestor who had the basic design of the organ on which all the homologous organs are based.

Q. 14. Can the wings of butterfly and the wings of a bat be considered homologous organs? Why or why not?

Ans. The wings of a butterfly and the wings of a bat cannot be considered as homologous organs because they have different basic designs even though they perform similar functions. They are therefore regarded as analogous organs.

Q. 15. What are fossils? What do they tell us about the process of evolution?

Ans. When organisms die, their bodies decay and decompose. But every once in a while, the body or at least some parts may be in an environment that does not let it decompose completely. If a dead insect gets caught in hot mud, for example, it will not decompose quickly, and the mud will eventually harden and retain the impression of the body parts of the insect. All such preserved traces of living organisms are called fossils.

The fossils tell us the following:

(*i*) It helps to identify an evolutionary relationship between apparently different species.

(*ii*) The fossils present in the bottom rocks are simple while the most recent fossil found in the upper strata are highly complex. This geographical succession completely agrees with the concept of evolution.

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Q. 16. Why are human beings who look so different from each other in terms of size, colour and looks said to belong to the same species?

Ans. The human beings are different from each other in terms of size, colour and looks but are said to be of the same species (*Homo sapiens*) because they can interbreed to produce fertile offsprings (son and daughter). The earliest members of *Homo sapiens* have been traced back to Africa. Some of our ancestors stayed back in Africa and spread across these continents; other left Africa and slowly spread across the whole Earth. They moved forward and backward in groups, separately or in mixed groups at times. These groups of ancestors, like other species, lived their lives in then prevailing environment and developed genetic variation to become differently coloured with specific features of different geographical regions in modern times.

Q. 17. In evolutionary terms, can we say which among bacteria, spiders, fish and chimpanzees have a 'better' body design? Why or why not?

Ans. There is no real 'progress' in the idea of evolution. Evolution is simply the generation of diversity by environmental selection. The only progressive trend in evolution seems to be that more and more complex body designs have emerged over time. However, again, it is not as if the older designs are inefficient. So many of the older and simpler designs still survive. In fact, one of the simplest life forms, *i.e.*, bacteria inhabit the most inhospitable habitats like hot springs, deep-sea thermal vents and ice in Antarctica. In other words, human beings are not the pinnacle of evolution, but simply yet another species in the teeming spectrum of evolving life.

NCERT Exercises

Q. 1. A Mendelian experiment consisted of breeding tall pea plants bearing violet flowers with short pea plants bearing white flowers. The progeny all bore violet flowers, but almost half of them were short. This suggest that the genetic make-up of the tall parent can be depicted as

(*a*) TTWW (*b*) Ttww (*c*) TtWW (*d*) TtWw

Ans. (*c*)

Q. 2. An example of homologous organs is

(*a*) our arm and dog's foreleg (*b*) our teeth and an elephant's tusks

(*c*) potato and runners of grass (*d*) all of the above

Ans. (*d*)

Q. 3. In evolutionary terms, we have more in common with

(*a*) a chinese school-boy (*b*) a chimpanzee

(*c*) a spider (*d*) a bacterium

Ans. (*a*)

Q. 4. A study found that children with light-coloured eyes are likely to have parents with light-coloured eyes. On this basis, can we say anything about whether the light eye colour trait is dominant or recessive? Why or why not?

Ans. From this study, we can say light-coloured eye is a dominant trait because children born from parents having light-coloured eyes also had light-coloured eyes.

Q. 5. How are the areas of study—evolution and classification interlinked?

Ans. Characteristics of organisms refer to the details of their external and internal appearance or behaviour that distinguish them from one another. These characteristics of organisms also form the basis for the classification of organisms. The more characteristics two species have in common, the more closely they are related. And the more closely they are related the more recently they will have had a common ancestor. By identifying hierarchies of characteristics between species, we can work out the evolutionary relationships of the species we see around us. Thus, we can appreciate that classification of species is in fact reflection of their evolutionary relationship.

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Q. 6. Explain the terms analogous and homologous organs with examples.

Ans. **Homologous organs:** Those organs which have the same basic structural design and developmental origin but may have different functions.

Example: The forelimb of a frog, a lizard, a bird and a man have been built from the same basic design of bones, but they perform different functions.

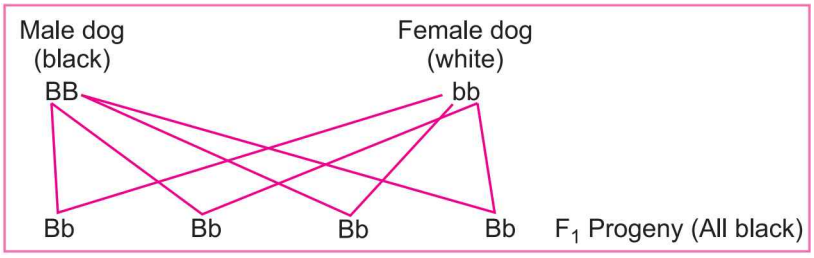
Analogous organs: Those organs which have different basic structural design and developmental origin but have similar functions.

Example: The wings of birds and insects.

Q. 7. Outline a project which aims to find the dominant coat colour in dogs.

Ans. Select a homozygous black (BB) male dog and a homozygous white (bb) female dog. Cross breed them to produce offsprings (F_1 generation).

If all the offsprings are black, we can conclude that black coat colour is dominant over white coat in dogs.



Q. 8. Explain the importance of fossils in deciding evolutionary relationship.

Ans. Fossils are the remains or impressions of dead plants or animals which died millions of years ago. The study of fossils helps us to know about the evolution or links between two species. Fossils tell us how new species are developed from the old ones. So, fossils have an importance in deciding evolutionary relationships.

Q. 9. What evidence do we have for the origin of life from inanimate matter?

Ans. An experiment conducted by Stanley L. Miller and Harold C. Urey in 1953 proved that origin of life takes place from inanimate matter. They assembled an apparatus to create an early Earth atmosphere which consisted of gases like methane, ammonia and hydrogen sulphide but no oxygen, over water. This was maintained at a temperature just below 100°C and electric sparks were passed through the mixture of gases to stimulate lightning. At the end of a week, 15% of the carbon (from methane) had been converted to simple compounds of carbon including amino acids which make up protein molecules.

Q. 10. Explain how sexual reproduction gives rise to more viable variations than asexual reproduction. How does this affect the evolution of those organisms that reproduce sexually?

[CBSE 2019 (31/2/3)]

Ans. Sexual reproduction gives rise to more viable variations than asexual reproduction. In asexual reproduction, the offsprings are almost identical to their parents because they have the same genes as of their single parent. Thus, much genetic variation is not possible in asexual reproduction. Asexual reproduction inhibits the further evolution of the organism.

In sexual reproduction, the offsprings although similar to their parents, are not identical to them or to one another. This is because the offsprings receive some genes from the mother and some from the father. Because of the mixing of genes of mother and father in different combinations, all the offsprings will exhibit genetic variations. In this way, sexual reproduction leads to a greater variations in the population.

Thus, genetic variation leads to the continuous evolution of various species to form better and still better organisms.

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Q. 11. How is the equal genetic contribution of male and female parents ensured in the progeny?

Ans. In case of human beings, 23 pairs of chromosomes have a maternal and a paternal copy. Out of 23 pairs, 22 pairs are said to be autosomes and one pair is called sex chromosome. At the time of fertilisation, the egg cell fuses with the sperm cell which is haploid (n) to form zygote. Zygote is diploid (2n) which contains 23 chromosomes from mother and 23 from father. In this way, an equal genetic contribution of male and female parents is ensured in the progeny.

Q. 12. Only variations that confer an advantage to an individual organism will survive in a population. Do you agree with this statement? Why or why not?

Ans. We agree with this statement that only variations that confer an advantage will survive in a population.

All the variations do not have an equal chance of surviving in the environment in which they find themselves. The chances of survival depends on the nature of variations. Different individuals would have different kinds of advantages. A bacteria that can withstand heat will survive better in a heat wave. Selection of variants by environmental factors forms the basis for evolutionary processes.

SELF-ASSESSMENT TEST

Time allowed: 1 hour **Max. marks: 40**

SECTION–A

Choose and write the correct answer for each of the following. **(4 × 1 = 4)**

1. **Homology and analogy are helpful in studying and interpreting**
   (*a*) commercial uses of structures (*b*) structural relationship
   (*c*) functional relationship (*d*) evolutionary relationship
2. **A zygote which has an X-chromosome inherited from the father will develop into a**
   (*a*) boy
   (*b*) girl
   (*c*) X-chromosome does not determine the sex of a child
   (*d*) either boy or girl
3. **If a round, green seeded pea plant (RR yy) is crossed with wrinkled, yellow seeded pea plant. (rrYY) the seeds produced in F_1 generation are**
   (*a*) round and yellow (*b*) round and green
   (*c*) wrinkled and green (*d*) wrinkled and yellow
4. **Which of the following pairs is not the correct match?**
   (*a*) Flippers of penguin – human hand
   (*b*) Tendrils of cucurbita – thorns of bougainvillea
   (*c*) Forelimbs of humans – forelimbs of bats
   (*d*) Wings of birds – forelimbs of horse

The following questions consist of two statements—Assertion(A) and Reason(R). Answer these questions selecting the appropriate option given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation for *A*.
(*b*) Both *A* and *R* are true but *R* is not the correct explanation for *A*.
(*c*) *A* is true but *R* is false.
(*d*) *A* is false but *R* is true. **(3 × 1 = 3)**

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5. **Assertion (*A*) :** Evolution is an extremely slow process.
   Reason (*R*) : New characters are accumulated in an organism during its lifetime.
6. **Assertion (*A*) :** According to Darwin, all organisms compete with each other for existence.
   Reason (*R*) : During the struggle for existence there is survival of the fittest.
7. **Assertion (*A*) :** Geographical isolation cannot be a major factor in speciation of an asexually reproducing organism.
   Reason (*R*) : Asexually reproducing organisms do not require any other organism for reproduction.

Answer the following questions in one word or one sentence. **(3 × 1 = 3)**

8. Name the segment of DNA that codes for a specific character.
9. List two visible traits of garden pea that Mendel considered in his experiments.
10. How can we estimate age of fossil?

SECTION–B

Answer the following questions in about 50-60 words each. **(5 × 3 = 15)**

11. Give reasons why acquired characters are not inherited. *[NCERT Exemplar]*
12. What is meant by expression TT and Tt in Mendelian terms?
13. In terms of evolution, what is the significance of homology between a human hand and a wing of a bird?
14. Bacteria have a simpler body plan when compared with human beings. Does it mean that human beings are more evolved than bacteria? Provide a suitable explanation. *[NCERT Exemplar]*
15. Why is variation beneficial to the species but not necessarily for the individual?

SECTION–C

Answer the following questions in about 80–90 words each. **(3 × 5 = 15)**

16. (*i*) How is equal genetic contribution of male and female parents ensured in the progeny? Explain.
    (*ii*) Does the occurrence of diversity of animals on Earth suggest their diverse ancestry also? Discuss this point in the light of evolution. *[CBSE 2019 (31/5/3)]*
17. Explain struggle for existence.
18. Bacteria have a simpler body plan when compared with human beings. Does it mean that human beings are more evolved than bacteria? Provide a suitable explanation.

Answers

1. (*d*) **2.** (*b*) **3.** (*a*) **4.** (*d*) **5.** (*c*) **6.** (*b*) **7.** (*a*)

8. Gene **9.** Tall/Dwarf, Round/Wrinkled seed.

10. Age of fossils can be estimated by the depth of the layer of rocks in which the are found. Age of fossils can also be detected from the ratio of isotopes in the fossils containing rocks.

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10 Light–Reflection and Refraction

BASIC CONCEPTS—A FLOW CHART

LIGHT

Reflection

- Coming back of light rays to the same medium, when they fall on a surface.
- Laws of reflection:

Ist law: The incident ray, the reflected ray and the normal at the point of incidence all lie in the same plane.

IInd law: The angle of incidence is always equal to the angle of reflection.

Reflecting surfaces

Spherical Mirrors

Important terms

- *Pole:* Midpoint or centre of the reflecting surface of a spherical mirror.
- *Centre of curvature:* Centre of the hollow sphere of which the mirror is a part.
- *Radius of curvature:* Radius of that sphere of which the mirror is a part.
- *Principal axis:* Line joining the pole and the centre of curvature.
- *Principal section:* Vertical section of a mirror cut by a plane passing through the principal axis of the mirror.

Types

Concave Mirror

- Reflecting surface is curved inwards.
- Polishing is done on outer surface.

Uses

- Used by dentists to focus light on the patient's teeth.
- Used as shaving mirrors.

Image formation

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At the focus F	Highly diminished, point-sized	Real and inverted
Beyond C	Between F and C	Diminished	Real and inverted
At C	At C	Same size	Real and inverted
Between C and F	Beyond C	Enlarged	Real and inverted
At F	At infinity	Highly enlarged	Real and inverted
Between P and F	Behind the mirror	Enlarged	Virtual and erect

Convex Mirror

- Reflecting surface is curved outwards.
- Polishing is done on inner surface.

Uses

- Used as rear view mirrors in vehicles
- Used as a reflector in street lamps.

Image formation

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At the focus F, behind the mirror	Highly diminished, point sized	Virtual and erect
Between infinity and the pole P of the mirror	Between P and F, behind the mirror	Diminished	Virtual and erect

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Important Formulae

- Mirror formula, $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$
- Magnification produced by mirror, $m=\frac{h'}{h}=-\frac{v}{u}$
- Snell's law $\frac{\sin i}{\sin r}=\frac{n_b}{n_a}=n_{ba}=\frac{v_a}{v_b}=\frac{\lambda_a}{\lambda_b}$
- Absolute refractive index, $n=\frac{c}{v}$
- If C is critical angle, then refractive index $n=\frac{1}{\sin C}$
- Lens formula, $\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$
- Magnification produced by lens, $m=\frac{h'}{h}=\frac{v}{u}$
- Power of a lens, $P=\frac{1}{f\,(\text{in m})}=\frac{100}{f\,(\text{in cm})}$
- Power of combination of lenses, $P=P_1+P_2+P_3+\ldots$
- For combination of lenses, $m=m_1\times m_2\times m_3\times\ldots$

Phenomena of Light

Refraction

- Bending of light when it passes from one medium to another.
- *Laws of refraction:*

First law: The incident ray, the refracted ray, and the normal at the point of incidence all lie in the same plane.

Second law (Snell's law): The ratio of sine of angle of incidence to the sine of angle of refraction is a constant for a given pair of media.

$$i.e.,\ \frac{\sin i}{\sin r}=\text{constant}$$

Expression of extent of change in direction in a pair of media

Refractive Index

- Ratio of the speed of light in vacuum to the speed of light in the medium.

$$\text{Refractive index, } n=\frac{\text{Speed of light in vacuum}}{\text{Speed of light in medium}}=\frac{c}{v}$$

- It is a ratio and has no unit.

Refracting surfaces

Spherical Lenses

Important terms

- *Optical centre:* Centre point of a lens.
- *Principal axis:* Line passing through the optical centre of the lens and perpendicular to both the faces of the lens.
- *Principal focus of a convex lens:* A point on its principal axis to which light rays parallel to principal axis converge after passing through the lens.
- *Principal focus of a concave lens:* A point on its principal axis from which light rays originally parallel to the axis, appear to diverge after passing through the concave lens.

Types

Convex Lens

- Thick at centre, thinner at edges.
- These converge light rays.

Image formation

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At the focus F_2	Highly diminished, point-sized	Real and inverted
Beyond $2F_1$	Between F_2 and $2F_2$	Diminished	Real and inverted
At $2F_1$	At $2F_2$	Same size	Real and inverted
Between F_1 and $2F_1$	Beyond $2F_2$	Enlarged	Real and inverted
At Focus F_1	At infinity	Infintely large or highly enlarged	Real and inverted
Between focus F_1 and optical centre O	On the same side of the lens as the object	Enlarged	Virtual and erect

Concave Lens

- Thin in the middle, thicker at edges.
- These diverge light rays.

Image formation

Position of the object	Position of the image	Size of the image	Nature of the image
At infinity	At the focus F_1	Highly diminished, point-sized	Virtual and erect
Between infinity and optical centre O of the lens	Between F_1 and O	Diminished	Virtual and erect

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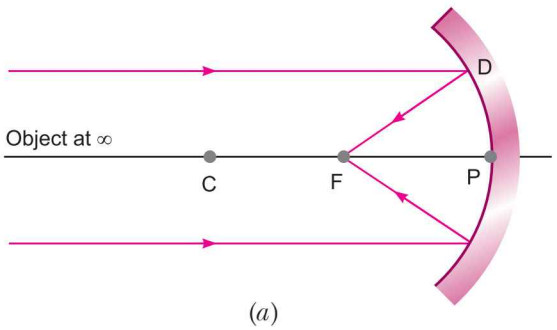
MORE POINTS TO REMEMBER

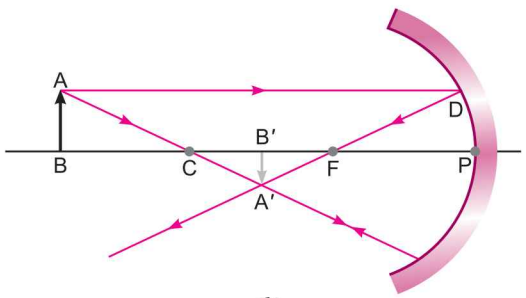
❒ Image formation by spherical mirrors:

- It is more convenient to consider only two rays, for the sake of clarity of the ray diagram.
- A ray parallel to the principal axis, after reflection, will pass through the principal focus in case of a concave mirror or appear to diverge from the principal focus in case of a convex mirror.
- A ray passing through the principal focus of a concave mirror or a ray which is directed towards the principal focus of a convex mirror, after reflection, will emerge parallel to the principal axis.
- A ray passing through the centre of curvature of a concave mirror or directed in the direction of the centre of curvature of a convex mirror, after reflection, is reflected back along the same path.
- A ray incident obliquely to the principal axis, towards a point P (pole of the mirror), on the concave mirror or a convex mirror, is reflected obliquely at the same angle.

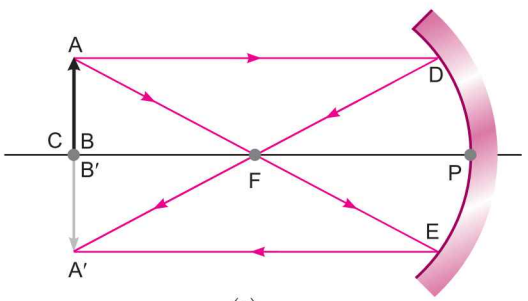
❒ Image formation by concave mirror:



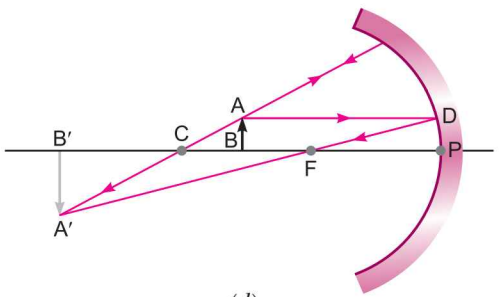
(a)



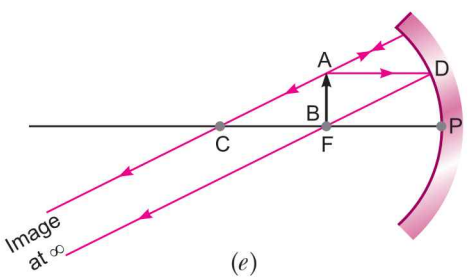
(b)



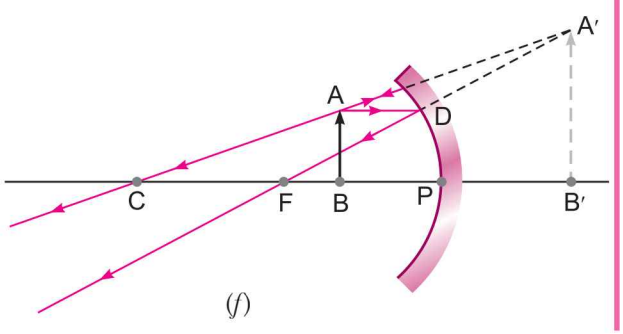
(c)



(d)



(e)



(f)

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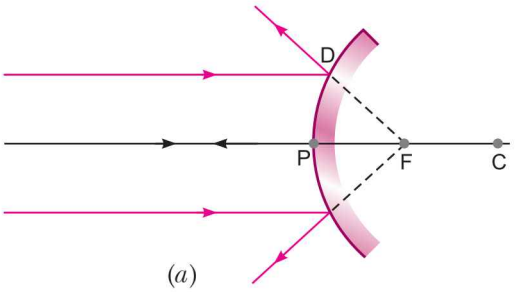
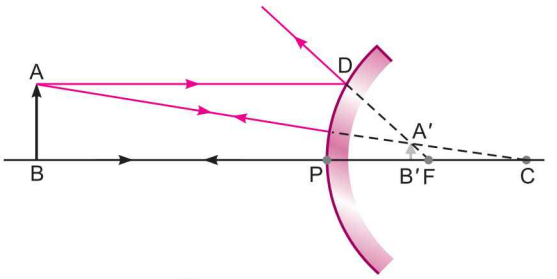
❒ Image formation by convex mirror:

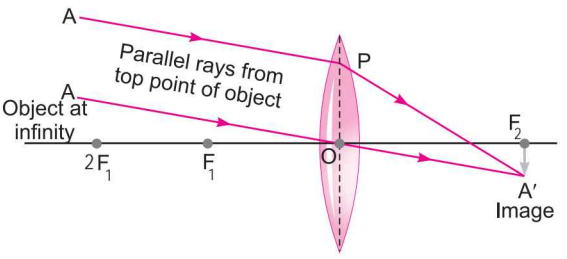


(a)

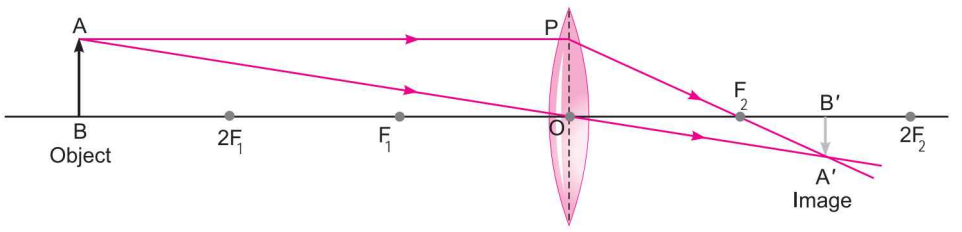


(b)

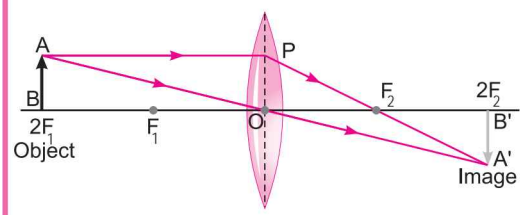
❒ Image formation by convex lens:



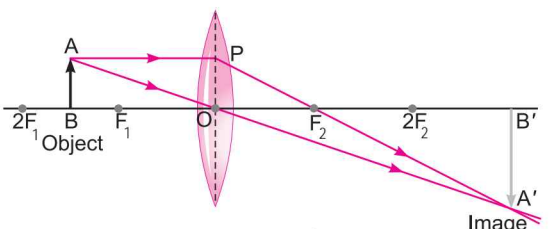
(a)



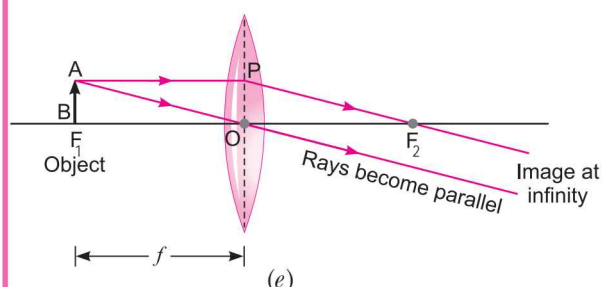
(b)



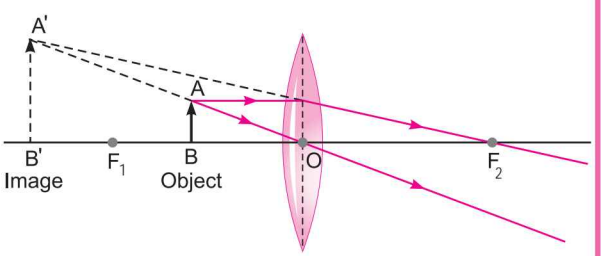
(c)



(d)



(e)



(f)

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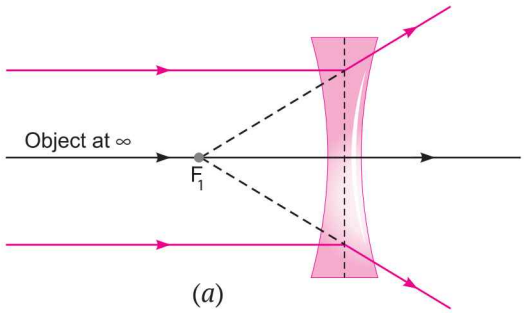
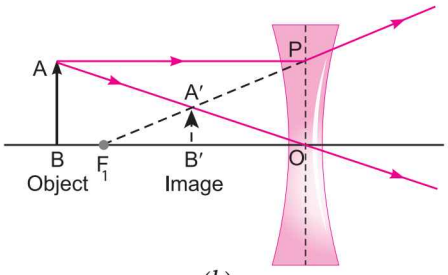
❒ Image formation by concave lens:



(*a*)



(*b*)

❒ Sign conventions for reflection and refraction:

- The object is always placed to the left of the mirror.
- All distances parallel to the principal axis are measured from the pole of the mirror.
- The distances measured in the same direction as that of the incident light are taken as positive, *i.e.*, distances on the right side of pole are positive.
- The distances measured in the direction opposite to the direction of the incident light are taken as negative, *i.e.*, distances on the left side of pole are taken as negative.
- Distances measured perpendicular to and above the principal axis (along + y axis) are taken as positive while those below the principal axis (along –y axis) are taken as negative.

Multiple Choice Questions [1 mark]

Each question has 4 choices (a), (b), (c) and (d). Choose and write the correct option.

1. A ray of light travelling in air falls obliquely on the surface of a calm pond. It will

(*a*) go into the water without deviating from its path
(*b*) deviate away from the normal
(*c*) deviate towards the normal
(*d*) turn back on its original path

2. Which of the following mirror is used by a dentist to examine a small cavity?

(*a*) Concave mirror (*b*) Convex mirror
(*c*) Combination of (*a*) and (*b*) (*d*) None of these

3. The diameter of the reflecting surface of spherical mirror is called its

(*a*) aperture (*b*) focal length
(*c*) radius of curvature (*d*) none of these

4. Which of these mirrors will give the full image of a large object?

(*a*) Plane mirror (*b*) Concave mirror (*c*) Convex mirror (*d*) None of these

5. Choose the incorrect statement.

(*a*) The height of the object is taken to be positive as the object is usually placed above the principal axis.
(*b*) The height of the image should be taken as positive for both virtual and real image.
(*c*) A negative sign in the value of the magnification indicates that the image is real.
(*d*) A positive sign in the value of the magnification indicates that the image is virtual.

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6. **A convex lens is making full image of an object. If half of lens is covered by an opaque object, then**
   (*a*) half image is not seen
   (*b*) full image of same intensity is seen
   (*c*) half image of same intensity is seen
   (*d*) full image of decreased intensity is seen

7. **The power of a lens of focal length 25 cm in diopter is**
   (*a*) 0.25 D (*b*) 2.5 D (*c*) 4.0 D (*d*) 0.4 D

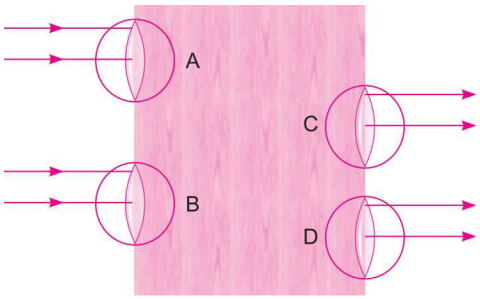
8. **If the magnification of a lens has a positive value, the image is**
   (*a*) real
   (*b*) virtual and erect
   (*c*) inverted
   (*d*) none of these

9. **An object is placed at the centre of curvature of a concave mirror. The distance between the image and the pole is**
   (*a*) equal to f
   (*b*) greater than f but less than $2f$
   (*c*) equal to $2f$
   (*d*) greater than $2f$

10. **An object is placed at a distance of 30 cm from a convex mirror of focal length 15 cm. The image formed is**
    (*a*) 20 cm from the pole
    (*b*) –10 cm from the pole
    (*c*) +10 cm from the pole
    (*d*) +60 cm from the pole

11. **If the magnification of a lens has a negative value, the image is**
    (*a*) real and inverted
    (*b*) virtual
    (*c*) erect
    (*d*) none of these

12. **Beams of light are incident through the holes A and B and emerge out of box through the holes C and D respectively as shown in figure.**



Which of the following could be inside the box? [*NCERT Exemplar*]
   (*a*) A rectangular glass slab
   (*b*) A convex lens
   (*c*) A concave lens
   (*d*) A prism

13. **The focal length, $f = \frac{R}{2}$ is valid**
   (*a*) for convex mirror but not for concave mirror.
   (*b*) for concave mirror but not for convex mirror.
   (*c*) for both convex and concave mirrors.
   (*d*) neither for convex mirror nor for concave mirror.

14. **The image of the distant object is obtained on a screen by using a concave mirror. The focal length of the mirror can be determined by measuring the distance between**
   (*a*) the object and the mirror
   (*b*) the object and the screen
   (*c*) the mirror and the screen
   (*d*) the mirror and the screen as well as that between the object and the screen

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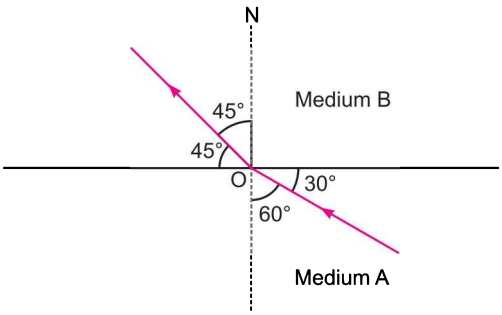
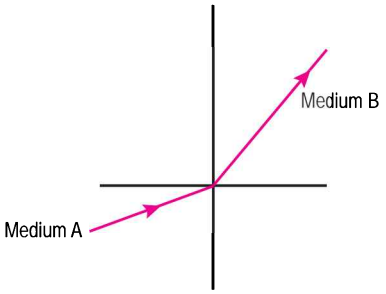
15. Figure shows a ray of light as it travels from medium A to medium B. The refractive index of medium B relative to medium A is [NCERT Exemplar]



(a) $\sqrt{3}/\sqrt{2}$
(b) $\sqrt{2}/\sqrt{3}$
(c) $1/\sqrt{2}$
(d) $\sqrt{2}/1$

16. A light ray enters from medium A to medium B as shown in figure. The refractive index of medium B relative to A will be [NCERT Exemplar]

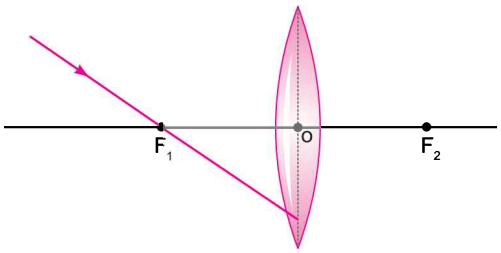


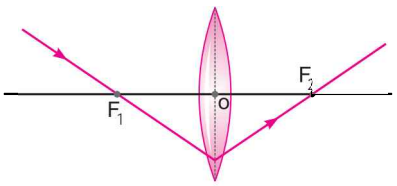
(a) greater than unity
(b) less than unity
(c) equal to unity
(d) zero

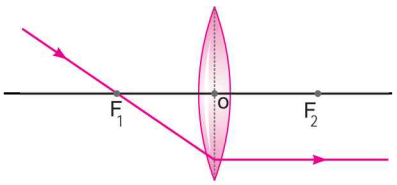
17. The magnification produced by a rear view mirror fitted in vehicles is [NCERT Exemplar]

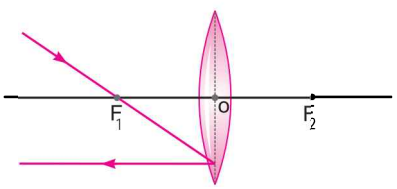
(a) less than 1
(b) more than 1
(c) equal to 1
(d) less than 1 or more than 1 depending on the position of the object in front of it.

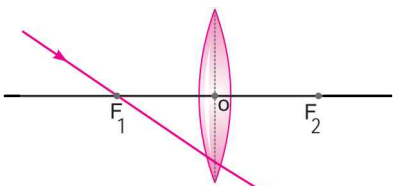
18. Which one of the following ray diagrams is correct for the ray of light incident on a lens as shown in figure? [NCERT Exemplar]



(a)


(b)


(c)


(d)


19. The full length image of a distant tall building can definitely be seen by using [NCERT Exemplar]

(a) a concave mirror
(b) a convex mirror
(c) a plane mirror
(d) both concave as well as plane mirrors

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20. **You are given water, mustard oil, glycerine and kerosene. In which of these media a ray of light incident obliquely at same angle would bend the most?** *[NCERT Exemplar]*

(*a*) Kerosene (*b*) Water (*c*) Mustard oil (*d*) Glycerine

21. **A child is standing in front of a magic mirror. He finds the image of his head bigger, the middle portion of his body to be of same size and that of the legs smaller. Which of the following is the order of combinations for the magic mirror from the top?** *[NCERT Exemplar]*

(*a*) Plane, convex and concave (*b*) Convex, concave and plane

(*c*) Concave, plane and convex (*d*) Convex, plane and concave

22. **Two lenses of power +2.50 D and –3.75 D are combined to form a compound lens. Its focal length in cm will be**

(*a*) 40 (*b*) –40 (*c*) 80 (*d*) –80

23. **A man runs towards the plane mirror at 2 ms^{-1}. The relative speed of his image with respect to him will be**

(*a*) 2 ms^{-1} (*b*) 4 ms^{-1} (*c*) 8 ms^{-1} (*d*) 10 ms^{-1}

Answers

1. (*c*)	**2.** (*a*)	**3.** (*a*)	**4.** (*c*)	**5.** (*b*)	**6.** (*d*)	**7.** (*c*)	**8.** (*b*)
9. (*c*)	**10.** (*c*)	**11.** (*a*)	**12.** (*a*)	**13.** (*c*)	**14.** (*c*)	**15.** (*a*)	**16.** (*a*)
17. (*a*)	**18.** (*b*)	**19.** (*b*)	**20.** (*d*)	**21.** (*c*)	**22.** (*d*)	**23.** (*b*)	

Assertion-Reason Questions [1 mark]

The following questions consist of two statements — Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

1. **Assertion (*A*) :** The centre of curvature is not a part of the mirror. It lies outside its reflecting surface.

Reason (*R*) : The reflecting surface of a spherical mirror forms a part of a sphere. This sphere has a centre.

2. **Assertion (*A*) :** A ray passing through the centre of curvature of a concave mirror after reflection, is reflected back along the same path.

Reason (*R*) : The incident rays fall on the mirror along the normal to the reflecting surface.

3. **Assertion (*A*) :** Light does not travel in the same direction in all the media.

Reason (*R*) : The speed of light does not change as it enters from one transparent medium to another.

4. **Assertion (*A*) :** The emergent ray is parallel to the direction of the incident ray.

Reason (*R*) : The extent of bending of the ray of light at the opposite parallel faces (air-glass interface and glass-air interface) of the rectangular glass slab is equal and opposite.

5. **Assertion (*A*) :** A ray of light travelling from a rarer medium to a denser medium slows down and bends away from the normal. When it travels from a denser medium to a rarer medium, it speeds up and bends towards the normal.

Reason (*R*) : The speed of light is higher in a rarer medium than a denser medium.

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6. **Assertion (*A*) :** The mirrors used in search lights are concave spherical.
   Reason (*R*) : In concave spherical mirror the image formed is always virtual.
7. **Assertion (*A*) :** Light travels faster in glass than in air.
   Reason (*R*) : Glass is denser than air.
8. **Assertion (*A*) :** For observing traffic at back, the driver mirror is convex mirror.
   Reason (*R*) : A convex mirror has much larger field of view than a plane mirror.
9. **Assertion (*A*) :** Mirror formula can be applied to a plane mirror.
   Reason (*R*) : A plane mirror is a spherical mirror of infinite focal length.
10. **Assertion (*A*) :** It is not possible to see a virtual image by eye.
    Reason (*R*) : The rays that seem to emanate from a virtual image do not in fact emanates from the image.
11. **Assertion (*A*) :** When the object moves with a velocity 2 m/s, its image in the plane mirror moves with a velocity of 4 m/s.
    Reason (*R*) : The image formed by a plane mirror is as far behind the mirror as the object is in front of it.
12. **Assertion (*A*) :** The height of an object is always considered positive.
    Reason (*R*) : An object is always placed above the principal axis in this upward direction.
13. **Assertion (*A*) :** Concave mirrors are used as make-up mirrors.
    Reason (*R*) : When the face is held within the focus of a concave mirror, then a diminished image of the face is seen in the concave mirror.
14. **Assertion (*A*) :** Refractive index has no units.
    Reason (*R*) : The refractive index is a ratio of two similar quantities.

Answers

1. (*a*) **2.** (*a*) **3.** (*c*) **4.** (*a*) **5.** (*d*) **6.** (*c*) **7.** (*d*) **8.** (*a*)
9. (*a*) **10.** (*d*) **11.** (*a*) **12.** (*a*) **13.** (*c*) **14.** (*a*)

Passage-based Questions

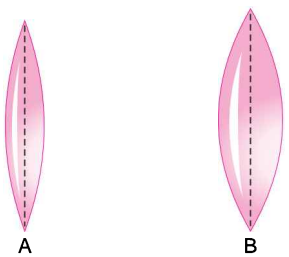
Answer the question below each passage on the basis of your understanding of the following paragraph and the related studied concepts.

1. Lenses are objects made of transparent materials such as glass or clear plastic that has curved surfaces. Diverging lenses are thicker at their edges than at their centres and makes light rays passing through them spread out. Converging lenses are thicker in their middle than at this edges and make light rays passing through them focus at a point. These are used in spectacles to help people with poor vision see better. The converging lenses magnify by bending the rays of light that pass through them to meet at a point called focus. Thicker the converging lens is at its centre, the more it magnifies and closer the focus is to the lens.

   (*i*) Ravi uses two lenses A and B of same size and same material as shown. P_1 and P_2 are the powers of A and B.

   An object is kept at the same distance from the lens between F and 2F of each lens on the principal axis in turn. Let I_1 and I_2 be the image formed by two lenses respectively. Which one of the following statements is correct for the images formed?

   (*a*) Distance of image I_2 will be less than distance of I_1 from the lens.



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(*b*) Distance of image I_2 will be greater than distance of I_1 from the lens.

(*c*) Size of image I_1 will be equal to size I_2.

(*d*) Size of image I_1 will be lesser than size I_2.

(*ii*) For the above two lenses

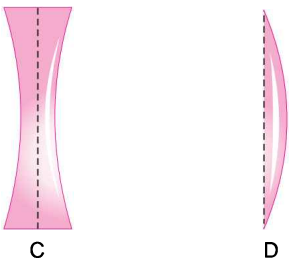
(*a*) $P_1 = P_2$ (*b*) $P_1 < P_2$

(*c*) $P_2 < P_1$ (*d*) P_1 is positive and P_2 is negative

(*iii*) Meenakshi uses above two lenses A and B along with another two lenses C and D, as shown alongside:

She is able to see the subject matter on the black board while sitting in the front row in the classroom but is unable to see the same matter while sitting in the last row.

Which of the above four lenses will she require to correct the defect in her vision? Why?



(*iv*) Natasha places an object on the principal axis of above given lens A. One end of this object coincides with the focus F and the other end with 2F. What will be the nature of the image formed by the lens on the other side?

2. A real image (always inverted) is the one through which the rays of light actually pass after reflection from concave mirror and which can be formed on a screen. A virtual image (always erect) is the one through which the rays do not actually pass, although they appear to come from it. The position, nature and size of the image of an object formed by a concave mirror changes with the position of the object. The size of image may be determined by using a graph paper fixed on the screen.

Object	Image	Nature of the Image
$u = \infty$	$v = f$	Real, inverted and highly diminished
$\infty > u > 2f$	$2f < v < \infty$	Real inverted and diminished
$u = 2f$	$v = 2f$	Real inverted and same size
$2f > u > f$	$2f < v < \infty$	Real inverted and enlarged
$u = f$	$v = \infty$	Real inverted and highly enlarged
$f > u > 0$	Behind the mirror	Virtual, erect and enlarged

(*i*) When an object is placed at 30 cm in front of a concave mirror, image of the same size is formed. What is the focal length of the mirror?

(*ii*) Differentiate between virtual image formed by a concave mirror and of a convex mirror.

(*iii*) A virtual, erect and magnified image of an object is to be produced with a concave mirror of focal length 15 cm. Which of the following object distance should be chosen for this purpose?

(*a*) 13 cm (*b*) 17 cm

(*c*) 21 cm (*d*) 27 cm

(*iv*) Image formed by concave lens, irrespective of the position of the object, is

(*a*) virtual, erect and diminished (*b*) virtual, erect and magnified

(*c*) real, inverted and diminished (*d*) real, inverted and magnified

Answers

1. (*i*) (*a*) (*ii*) (*b*)

(*iii*) She will require lens C. Because, she is suffering from myopia and in myopia concave lens is required to correct it.

(*iv*) The nature of the image formed will be infinite in size.

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2. (*i*) When object is at centre of curvature, the size of image is equal to the size of object.

$\therefore$ R = 30 cm

Hence, focal length, $f = \frac{R}{2} = \frac{30}{2}$ **= 15 cm**

(*ii*) The virtual image formed by a concave mirror is always magnified whereas the virtual image formed by a convex mirror is diminished.

(*iii*) (*a*)

(*iv*) (*a*)

Very Short Answer Questions [1 mark]

Each of the following questions are of 1 mark and have to be answered in one word or one sentence.

Q. 1. What is light?

Ans. Light is a form of energy which gives us the sensation of sight or vision.

Q. 2. What is a ray of light?

Ans. The path along which light travels is called a ray of light.



Q. 3. What is a beam of light?

Ans. A group of light rays originating from a source and travelling in a definite direction is known as a beam of light.

Q. 4. Define the term principal axis of a spherical mirror. *[CBSE Delhi 2017 (C)]*

Ans. Principal axis of a spherical mirror is the line joining the pole and the centre of curvature of a spherical mirror.

Q. 5. Name a communication device which uses light for its working.

Ans. Optical communication uses light for its working. It comprieses of obtical fibres which transmit many telephonic messages at the same time.

Q. 6. What kind of image can be obtained on the screen?

Ans. Real image

Q. 7. What type of image is formed in a plane mirror?

Ans. Virtual image

Q. 8. What type of image is formed on a cinema screen?

Ans. Real image

Q. 9. Write two different uses of concave mirrors. *[CBSE Delhi 2017 (C)]*

Ans. Concave mirror are used in (*a*) torches, (*b*) searchlights, (*c*) headlights of vehicles, etc.

Q. 10. Name the type of mirror which always forms a virtual and diminished image.

Ans. Convex mirror

Q. 11. Which mirror—convex or concave has larger field of view?

Ans. Convex mirror

Q. 12. Why is convex mirror used as a rear view mirror in vehicles? State any one reason. *[CBSE Delhi 2017 (C)]*

Ans. As convex mirror gives a wider field view of the approaching traffic and is used as a rear view mirror in vehicles.

Q. 13. If an object is placed at the focus of a concave mirror, where is the image formed?

Ans. At infinity

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Q. 14. What should be the position of the object when a concave mirror is to be used as a shaving mirror?

Ans. Between pole P and focus F

Q. 15. What should be the position of the object when a concave mirror is to be used as a doctor's mirror?

Ans. At focus F

Q. 16. What sign (+ve or –ve) is given to the focal length of a concave mirror?

Ans. Focal length of a concave mirror is – ve.

Q. 17. What sign (+ve or –ve) is given to the focal length of a convex mirror?

Ans. Focal length of a convex mirror is + ve.

Q. 18. What is the significance of +ve sign of magnification?

Ans. + ve sign of magnification shows that the image is virtual and erect.

Q. 19. A man standing in front of a spherical mirror, finds his image having a very small head, a fat body and legs of normal size. What type of mirrors are used in these three parts?

Ans. A very small head: Convex mirror,

A fat body: Concave mirror, and

Legs of normal size: Plane mirror.

Q. 20. Differentiate between virtual image formed by a concave mirror and of a convex mirror.

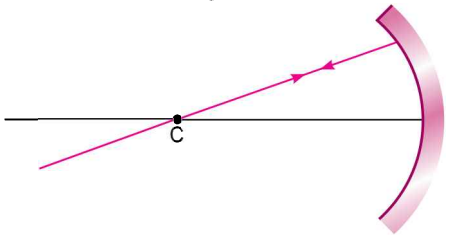
Ans. The virtual image formed by a concave mirror is always magnified whereas the virtual image formed by a convex mirror is diminished.

Q. 21. Why does a convex mirror said to have a virtual principal focus?

Ans. In a convex mirror, a parallel beam after reflection do not actually pass through the focus (*F*) but it appears to come from the back side of the mirror from focus. So, we can say that a convex mirror has a virtual principal focus, which is situated behind the mirror.

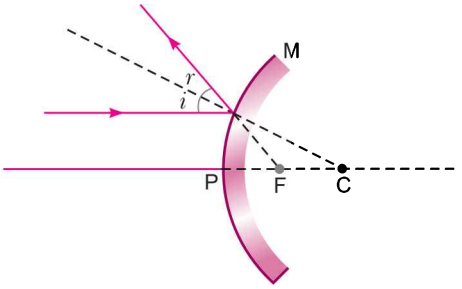
Q. 22. Explain why a ray of light passing through the centre of curvature of a concave mirror gets reflected along the same path after reflection.

Ans. This is because the angle of incidence is 0°. That is the ray passing through the centre of curvature is incident normally to the mirror. The angle of reflection should also be 0°.



Q. 23. Draw a labelled ray diagram to show the path of the reflected ray corresponding to an incident ray of light parallel to the principal axis of a convex mirror. Mark the angle of incidence and angle of reflection on it. *[CBSE (AI) 2015, 2019 (31/5/1)]*

Ans.



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Q. 24. What is the nature of the image formed by a concave mirror if the magnification produced by the mirror is +3?

Ans. Virtual and erect

Q. 25. Between which two points of a concave mirror should an object be placed to obtain a magnification of – 3?

Ans. Between F and C

Q. 26. The outer surface of a hollow sphere of aluminium of radius 50 cm is to be used as a mirror. What will be the focal length of this mirror? Which type of spherical mirror will it provide?

Ans. Focal length, $f = \frac{R}{2} = \frac{50}{2} = 25\text{ cm}$

It will provide a convex mirror.

Q. 27. Which property of concave mirror is utilised for using them as shaving mirrors?

[CBSE Sample Paper 2017]

Ans. When an object is placed between the pole and focus of concave mirror a magnified, erect and virtual image is obtained.

Q. 28. What is an optically rarer medium?

Ans. A medium in which light travels comparatively faster than the other medium is called an optically rarer medium.

Q. 29. What is an optically denser medium?

Ans. A medium in which light travels comparatively slower than the other medium is called an optically denser medium.

Q. 30. Define absolute refractive index. *[CBSE 2019 (31/4/1)]*

Ans. Refractive index of a medium with respect to vacuum is called absolute refractive index.

Q. 31. What is relative refractive index?

Ans. Refractive index of a medium with respect to another medium is called relative refractive index.

Q. 32. What is the unit of refractive index?

Ans. Refractive index has no units as it is a ratio of two similar physical quantities.

Q. 33. Refractive index of two material mediums X and Y are 1.3 and 1.5 respectively. In which of the two, the light would travel faster?

Ans. In medium 'X' because of lower value of refractive index.

Q. 34. What is the cause of refraction of light?

Ans. Refraction of light takes place when it travels from one medium to another because the speed of light is different in the two media.

Q. 35. What is the relationship between the refractive index of two media?

Ans. The refractive index for the light going from medium '1' to medium '2' is equal to the reciprocal of the refractive index for light going from medium '2' to medium '1'.

$$n_{21} = \frac{1}{n_{12}}$$

Q. 36. In which direction a ray of light bends when it goes from water to glass?

Ans. We know that glass is a denser medium than water. Therefore, a ray of light will bend towards the normal when it goes from water to glass.

Q. 37. If refractive indices of water and alcohol are 1.33 and 1.36 respectively, which of the two is optically denser medium?

Ans. The refractive index of alcohol is more than water, therefore, alcohol is optically denser medium.

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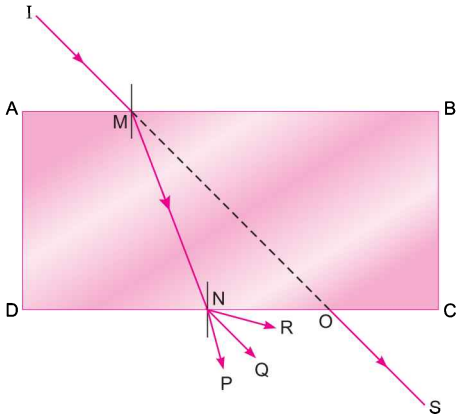
Q. 38. If a light ray IM is incident on the surface AB as shown, identify the correct emergent ray.



Ans. Here, NQ is parallel to OS. Therefore, NQ is the correct emergent ray.

Q. 39. Why does a ray of light bend when it travels from one medium into another?

Ans. When a ray of light travels from one medium to another, its speed changes and this change in speed of light causes the bending of light (refraction of light).

Q. 40. What is a lens?

Ans. A lens is a piece of transparent medium bounded by two surfaces of which at least one surface is curved.

Q. 41. Name the phenomena on which the working of a lens is based.

Ans. The working of a lens is based on the phenomenon of refraction of light.

Q. 42. State two examples of phenomenon of refraction of light in everyday life situations.

Ans. (*a*) A stick partly immersed in water appears to be bent at the water surface.

(*b*) A pool of water appears less deep than it actually is.

Q. 43. What is meant by power of a lens? *[CBSE Delhi 2015]*

Ans. Power of a lens is the degree of convergence or divergence of light rays achieved by a lens, $P = \frac{1}{f}$ (where f = focal length).

Q. 44. Give the SI unit of power of lens. State whether the power of a converging lens is positive or negative.

Ans. The SI unit of power of a lens is dioptre.

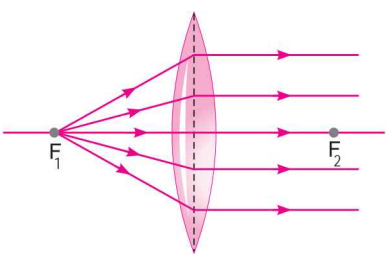
The power of a converging lens is positive as f is +ve.

Q. 45. A spherical mirror and a lens have same focal length of – 20 cm. What type of mirror and lens are these?

Ans. A concave mirror and concave lens have negative focal length. Hence, both mirror and lens are concave.

Q. 46. A small electric lamp is placed at the focus of a convex lens. What is the nature of beam of light produced by the lens?

Ans. The beam of light coming out of lens is a parallel beam of light as shown.



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Q. 47. An object is placed 80 cm from a converging lens of focal length 25 cm. What is the nature of the image?

Ans. The image is real, inverted and diminished as the object is placed beyond $2F_2$.

Q. 48. What is the power of a combination of lenses?

Ans. If a number of lenses are placed in close contact, then the power of the combination of lenses is equal to algebraic sum of the powers of the individual lenses.

$$P = P_1 + P_2 + P_3 + \ldots\ldots\ldots$$

Q. 49. State one advantage of using combination of lenses in optical instruments instead of a single lens.

Ans. The use of a combination of lenses increases the magnification and sharpness of the image.

Q. 50. What is monochromatic light?

Ans. The light of single wavelength is called monochromatic light, *e.g.*, sodium lamp is a source of monochromatic light.

Q. 51 Name the component of white light that has the greatest wavelength.

[CBSE Sample Paper 2016]

Ans. Red.

Q. 52. How does phenomenon of lateral inversion occurs?

Ans. The phenomenon of lateral inversion occurs due to the reflection of light by plane mirror.

Q. 53. Under what condition a lens becomes invisible when placed in a transparent liquid?

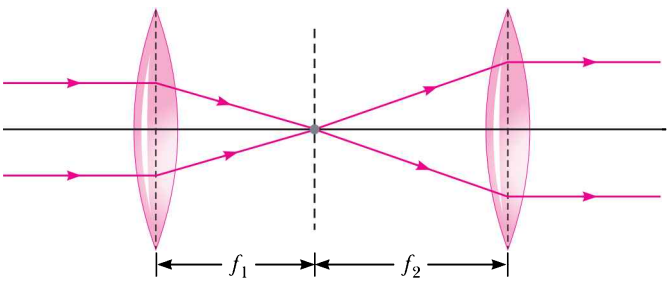
Ans. This happens when the refractive index of the lens becomes equal to that of the liquid.

Q. 54. Define the term magnification.

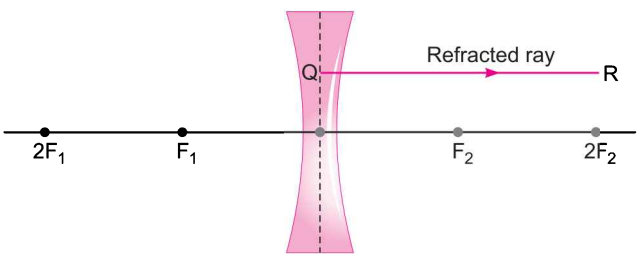
Ans. The ratio of the height of image to the height of object is called magnification.

Q. 55. Show diagrammatically, how should two converging lenses be arranged so that a parallel beam becomes parallel after passing through two lenses.

Ans. If the distance between two lenses becomes equal to sum of their focal lengths, then the parallel beam of light will emerge parallel after passing through the second lens.



Q. 56. The diagram below shows the refracted ray QR through a concave lens. Complete the diagram by drawing the corresponding incident ray.



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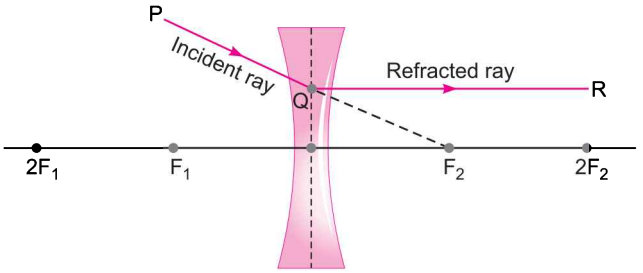
Ans. In figure the refracted ray is parallel to the principal axis. So, the incident ray must be appearing to meet at the principal focus of concave lens. To find the incident ray, F_2 is joined to Q and produced as shown in the figure.



Short Answer Questions [3 marks]

Each of the following questions are of 3 marks and have to be answered in about 50-60 words.

Q. 1. (*i*) What possible phenomenon can happen when light falls on a surface?

(*ii*) State the laws of refraction of light. If the speed of light in vacuum is 3×10^8 m/s, find the absolute refractive index of a medium in which light travels with a speed of 1.4×10^8 m/s. *[CBSE (F) 2015]*

Ans. (*i*) Any of the following phenomenon may happen:

(*a*) A portion of incident light is reflected back into the first medium.

(*b*) Some portion travels through the second medium along a changed path, known as refraction.

(*c*) The remaining part of the light may be absorbed by the second medium.

(*ii*) Laws of refraction of light:

First law: The incident ray, the refracted ray, and the normal at the point of incidence all lie in the same plane.

Second law (Snell's law): The ratio of sine of angle of incidence to the sine of angle of refraction is constant for a given pair of media.

i.e., $$\frac{\sin i}{\sin r} = \text{constant}$$

Speed of light in vacuum, $c = 3 \times 10^8$ m/s

Speed of light in medium, $v = 1.4 \times 10^8$ m/s

$$\text{Absolute refractive index} = \frac{\text{Speed of light in vacuum}}{\text{Speed of light in medium}}$$

$$= \frac{3 \times 10^8 \text{ m/s}}{1.4 \times 10^8 \text{ m/s}} = \mathbf{2.14}$$

Q. 2. (*i*) List four characteristics of the images formed by plane mirrors?

(*ii*) How can you distinguish between a plane mirror, a concave mirror and a convex mirror without touching them? *[CBSE Delhi 2015, 2017 (C), 2019 (31/3/1)]*

Ans. (*i*) (*a*) Image formed by a plane mirror is always virtual and erect.

(*b*) The size of the image is equal to that of the object.

(*c*) The image formed is as far behind the mirror as the object is in front of it.

(*d*) The image is laterally inverted.

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(*ii*) By observing the virtual images formed by the three mirrors, we can distinguish between the mirrors as:

(*a*) Plane mirror will produce an image of the same size,

(*b*) Concave mirror will produce a magnified image, and

(*c*) Convex mirror will produce a diminished image.

Q. 3. (*i*) List four specific characteristics of the images of the objects formed by convex mirrors. [*CBSE Delhi 2015*]

(*ii*) An object is placed at a distance of 30 cm in front of a convex mirror of focal length 15 cm. Write four characteristics of the image formed by the mirror. [*CBSE Delhi 2017*]

Ans. (*i*) (*a*) Virtual

(*b*) Erect

(*c*) Diminished

(*d*) Object distance more than image distance

(*ii*) Virtual, erect, diminished, laterally inverted.

Q. 4. (*i*) An object is placed at a distance of 40 cm in front of a convex mirror of radius of curvature 40 cm. List four characteristics of the image formed by the mirror. [*CBSE Delhi 2017*]

(*ii*) An object is placed at a distance of 12 cm in front of a concave mirror of radius of curvature 30 cm. List four characteristics of the image formed by the mirror. [*CBSE Delhi 2017*]

Ans. (*i*) Virtual, erect, diminished, laterally inverted

(*ii*) Virtual, erect, enlarged, laterally inverted.

Q. 5. (*i*) Explain the term lateral inversion.

(*ii*) In what way is the word AMBULANCE printed in front of the hospital vans? Why is it printed this way?

Ans. (*i*) If an object is placed in front of a plane mirror, then the right side of the object appears to be the left side of the image, and the left side of the object appears to be the right side of its image. This change of sides of an object and its mirror image is called lateral inversion.

(*ii*) The word AMBULANCE on the hospital vans is written in the form of its mirror image as ƎɔИAꞀUꓭMA because any vehicle which is ahead of ambulance van can see the laterally inverted alphabets correctly from his rear-view mirror and make way for it to pass through and enable it to reach the hospital quickly.

Q. 6. (*i*) State two positions in which a concave mirror produces a magnified image of a given object. List two differences between the two images. [*CBSE Delhi 2016*]

(*ii*) An object is placed at a distance of 30 cm from a concave lens of focal length 15 cm. List four characteristics (nature, position, etc.) of the image formed by the lens. [*CBSE (AI) 2017*]

Ans. (*i*) A concave mirror produces a magnified image when the object is placed in front of the mirror:

(*a*) between its pole and focus

(*b*) between the focus and centre of curvature

In case (*a*) the image is virtual and erect, whereas in case (*b*) the image is real and inverted.

(*ii*) (*a*) Virtual

(*b*) Erect

(*c*) Diminished

(*d*) On the same side as the object.

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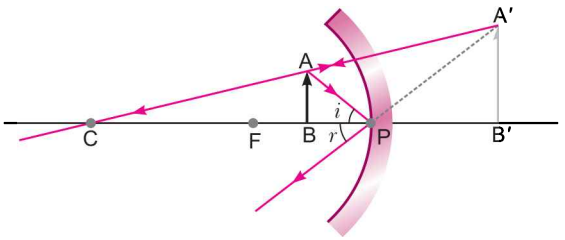
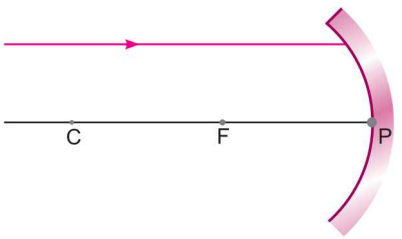
Q. 7. The linear magnification produced by a spherical mirror is +3. Analyse this value and state the (*i*) type of mirror and (*ii*) position of the object with respect to the pole of the mirror. Draw ray diagram to show the formation of image in this case. *[CBSE (F) 2016]*

Ans. (*i*) Concave mirror

(*ii*) Between the pole and focus

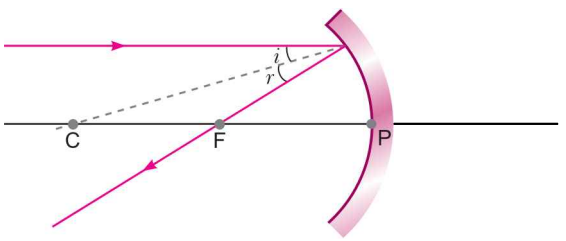


Q. 8. (*i*) Redraw the following diagram on your answer-sheet and show the path of the reflected ray. Also mark the angle of incidence (∠*i*) and the angle of reflection (∠ *r*) on the diagram. *[CBSE (F) 2017]*

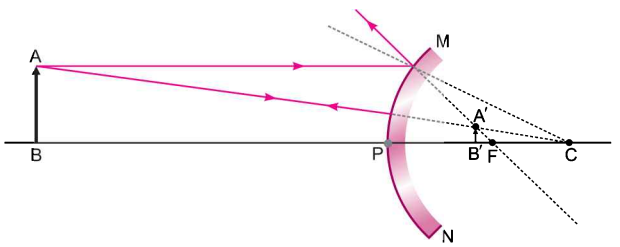


(*ii*) List two properties of the images formed by convex mirrors. Draw ray diagram in support of your answer.

Ans. (*i*)



(*ii*) The images formed by convex mirrors are: Virtual, erect and smaller than the object



Q. 9. (*i*) What will happen to a ray of light when it falls normally on a surface? Show it diagrammatically.

(*ii*) Under what condition in an arrangement of two plane mirrors, incident ray and reflected ray will always be parallel to each other, whatever may be angle of incidence. Show the same with the help of a ray diagram. *[NCERT Exemplar]*

Ans. (*i*) When a ray of light falls normally on the surface of a medium, then, no bending of light ray occurs. It means the light ray goes straight from one medium to another.

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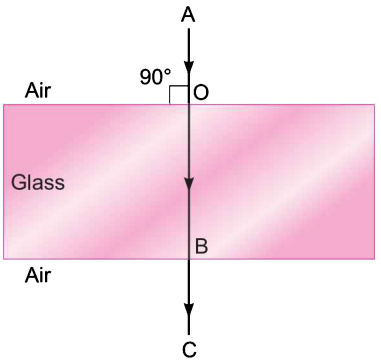
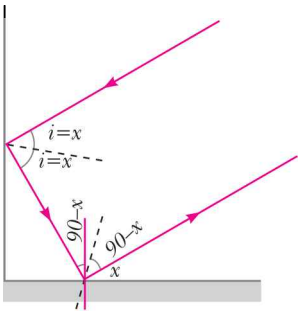


(*ii*) When two plane mirrors are placed at right angle to each other, then the incident and reflected rays will always be parallel to each other.



Q. 10. Identify the device used (a spherical mirror or lens) in following cases, when the image formed is virtual and erect in each case.

(*i*) Object is placed between device and its focus, image formed is enlarged and behind it.

(*ii*) Object is placed between the focus and device, image formed is enlarged and on the same side as that of the object.

(*iii*) Object is placed between infinity and device, image formed is diminished and between focus and optical centre on the same side as that of the object.

(*iv*) Object is placed between infinity and device, image formed is diminished and between pole and focus, behind it. *[NCERT Exemplar]*

Ans. (*i*) Concave mirror (*ii*) Convex lens

(*iii*) Concave lens (*iv*) Convex mirror

Q. 11. (*i*) A convex lens of focal length 20 cm can produce a magnified virtual as well as real image. Is this a correct statement? If yes, where shall the object be placed in each case for obtaining these images? *[NCERT Exemplar]*

(*ii*) How are power and focal length of a lens related? You are provided with two lenses of focal length 20 cm and 40 cm respectively. Which lens will you use to obtain more convergent light? *[NCERT Exemplar]*

Ans. (*i*) Yes, the statement is correct. If the object is placed within 20 cm from the lens *i.e*; between optical centre and focus, it will produce a magnified virtual image; and if the object is placed between 20 cm and 40 cm from the lens *i.e*; between focus and radius of curvature, it will produce a magnified real image.

(*ii*) $P = \frac{1}{f}, P \propto \frac{1}{f}$. Power of a lens is inversely proportional to its focal length therefore lens having focal length of 20 cm will provide more convergence.

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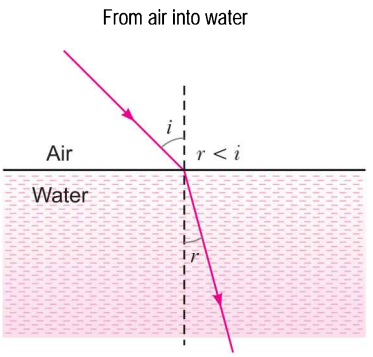
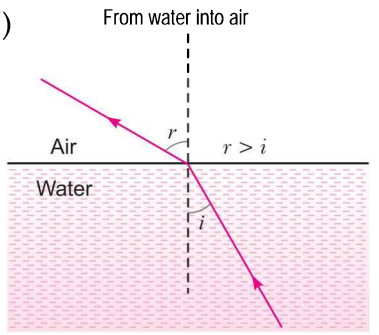
Q. 12. Draw a ray diagram showing the path of rays of light when it enters with oblique incidence (*i*) from air into water; (*ii*) from water into air. *[NCERT Exemplar]*

Ans. (*i*)



(*ii*)

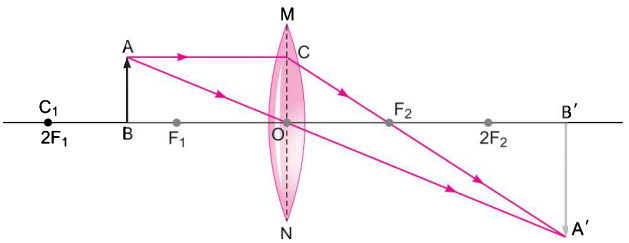


Q. 13. Distinguish between real image and virtual image.

Ans.

	Real Image		Virtual Image
1.	It is formed by the actual meeting of reflected (or refracted) rays.	1.	It is formed when reflected (or refracted) rays appear to meet when produced backwards.
2.	It can be obtained on the screen.	2.	It cannot be obtained on the screen.
3.	It is always inverted.	3.	It is always erect.
4.	It is formed by concave mirror or convex lens.	4.	It is formed by concave, convex and plane mirrors (or concave and convex lenses).

Q. 14. Study the ray diagram given below and answer the following questions:



(*i*) State the type of lens used in the figure.

(*ii*) List two properties of the image formed.

(*iii*) In which position of the object will the magnification be – 1?

Ans. (*i*) Convex lens.

(*ii*) Real, inverted, enlarged.

(*iii*) When object is at $2F_1$.

Q. 15. A student holding a mirror in his hand, directed the reflecting surface of the mirror towards the Sun. He then directed the reflected light on to a sheet of paper held close to the mirror.

(*i*) What should he do to burn the paper?

(*ii*) Which type of mirror does he have?

(*iii*) Will he be able to determine the approximate value of focal length of this mirror from this activity? Give reason and draw ray diagram to justify your answer in this case.

[CBSE 2019 (31/2/1)]

Ans. (*i*) To burn the paper, the student should move the mirror in such a way that paper is positioned at the focus of the mirror.

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(*ii*) The student have concave (converging) mirror. An image of the sun is formed at the focus of the concave mirror.

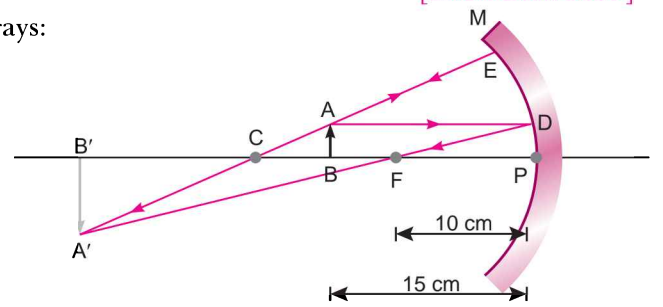
(*iii*) Yes. Since the Sun's image is formed at the focus of the concave mirror, therefore, the distance of Sun's image (piece of paper) from the concave mirror will give the approximate value of focal length of the mirror. For diagram, Refer to Fig. (*a*), Page 286.

Q. 16. To construct a ray diagram we use two rays of light which are so chosen that it is easy to determine their directions after reflection from the mirror. Choose these two rays and state the path of these rays after reflection from a concave mirror. Use these two rays to find the nature and position of the image of an object placed at a distance of 15 cm from a concave mirror of focal length 10 cm. *[CBSE Delhi 2015]*

Ans. The candidate may choose the following rays:

(*i*) A ray parallel to the principal axis, after reflection, will pass through the principal focus of a concave mirror.

(*ii*) A ray passing through the centre of curvature of a concave mirror after reflection is reflected back along the same path.



Object distance, $u = -15$ cm,

focal length, $f = -10$ cm, image distance, v = ?

Apply mirror formula,

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\therefore \quad \frac{1}{v} = \frac{1}{f} - \frac{1}{u}$$

$$\Rightarrow \quad \frac{1}{v} = \frac{1}{-10} - \frac{1}{-15}$$

$$\Rightarrow \quad \frac{1}{v} = -\frac{1}{10} + \frac{1}{15} = \frac{-3+2}{30} = \frac{-1}{30}$$

$$\therefore \quad v = \mathbf{-30\ cm}$$

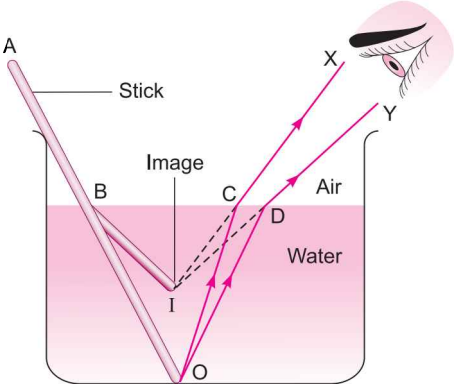
The image is formed at a distance of 30 cm in front of the mirror (negative sign means object and image are on the same side).

$$\text{Magnification, } m = \frac{-(\text{Image distance})}{\text{Object distance}} = \frac{-(-30)}{-15} = \mathbf{-2}$$

The image is real and inverted.

Q. 17. Explain with the help of a ray diagram, why a stick partly immersed in water appears to be bent at the water surface.

Ans. A stick half immersed in water at an angle appears bent due to refraction of light at the air-water interface. Figure shows a straight stick AO whose lower portion BO is immersed in water. It appears to be bent at point B in the direction BI. A ray of light OC coming from the lower end O passes from water into air at C and gets refracted away from the normal in the direction CX. Another ray OD gets refracted in the direction DY.



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The two refracted ray CX and DY, when produced backward, appear to meet at point I, nearer to the water surface above the point O. Similarly each part of the immersed portion of the stick is raised. As a result immersed portion of the stick appears to be bent when viewed at an angle from outside.

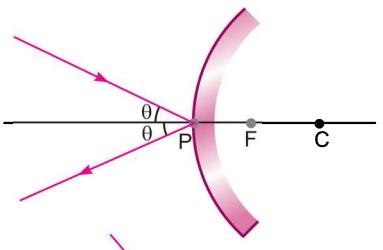
Q. 18. Draw a ray diagram to show the path of the reflected ray in each of the following cases. A ray of light incident on a convex mirror

(*i*) strikes at its pole making an angle θ with the principal axis.

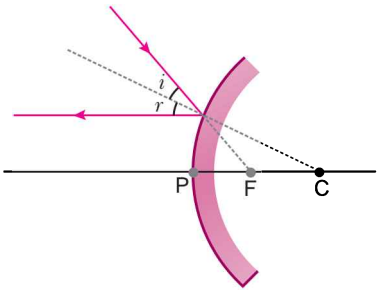
(*ii*) is directed towards its principal focus.

(*iii*) is parallel to its principal axis. [*CBSE (F) 2015*]

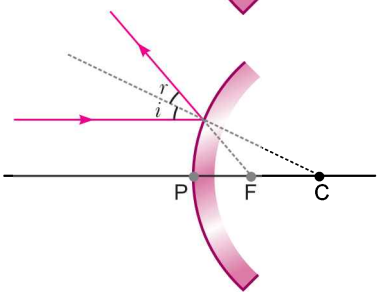
Ans. (*i*)



(*ii*)



(*iii*)



Q. 19. A student wants to project the image of a candle flame on a screen 80 cm in front of a mirror by keeping the candle flame at a distance of 20 cm from its pole.

(*i*) Which type of mirror should the student use?

(*ii*) Find the magnification of the image produced.

(*iii*) Find the distance between the object and its image.

(*iv*) Draw a ray diagram to show the image formation in this case and mark the distance between the object and its image. [*CBSE (F) 2015*]

Ans. (*i*) Concave mirror should be used.

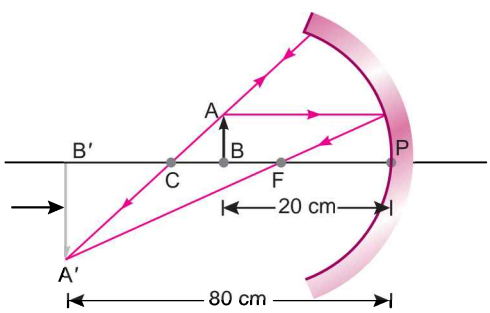
(*ii*) Object distance, $u = -20$ cm; image distance, $v = -80$ cm;

magnification, $m = ?$

$$m = -\frac{v}{u} = \frac{-(-80\text{ cm})}{(-20\text{ cm})} = \mathbf{-4}$$

(*iii*) Distance between object and its image $= v - u =$ **60 cm**

(*iv*)



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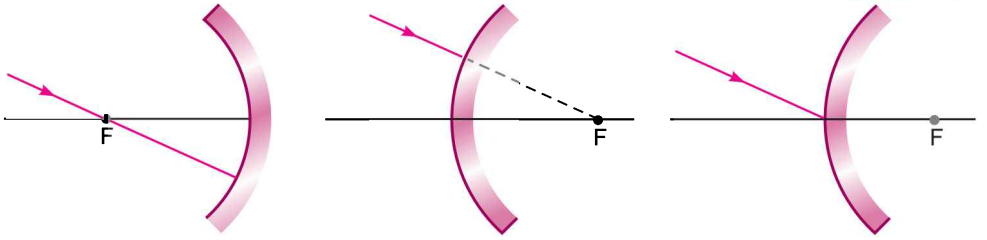
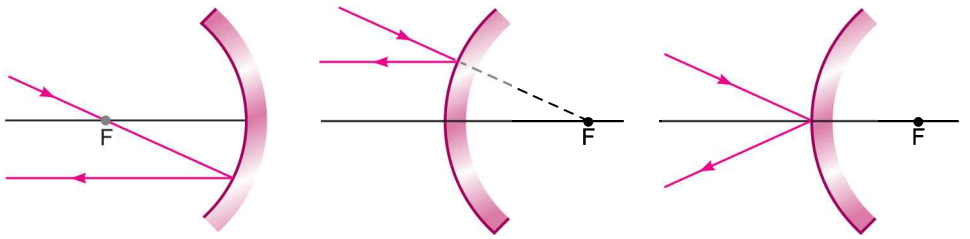
Q. 20. Draw the following diagram, in which a ray of light is incident on a concave/convex mirror, on your answer sheet. Show the path of this ray, after reflection, in each case. *[CBSE Delhi 2016]*

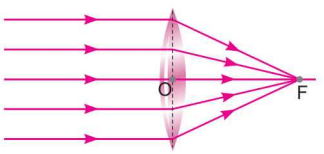
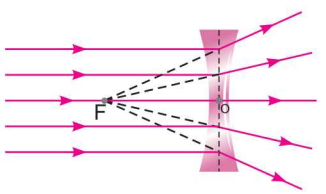


Ans.



Q. 21. Distinguish between a convex lens and a concave lens.

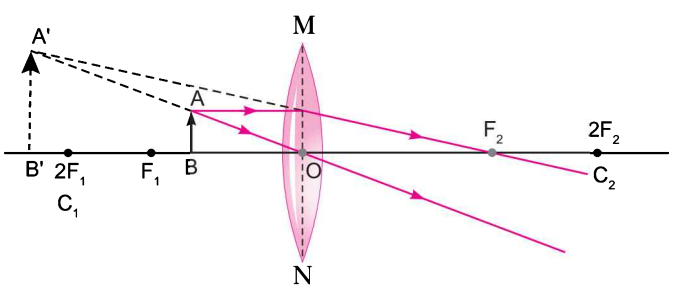
Ans.

Convex Lens		Concave Lens	
1.	It is thicker at the centre than at the edges.	1.	It is thinner at the centre than at the edges.
2.	It has real focus.	2.	It has virtual focus.
3.	It converges a parallel beam of light after refraction through it. 	3.	It diverges a parallel beam of light after refraction through it. 

Q. 22. "A lens can form a magnified erect image as well as magnified inverted image of an object placed in front of it." State the nature of this lens and draw ray diagrams to justify the above statement. Mark the positions of O, F and 2F in the diagram. *[CBSE (AI) 2017]*

Ans. The lens is convex

(*i*) Magnified erect image



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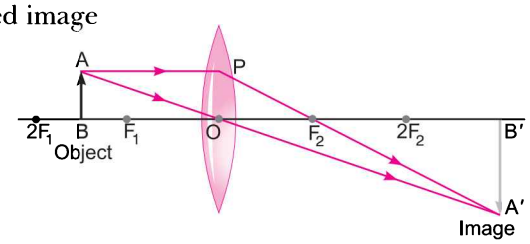
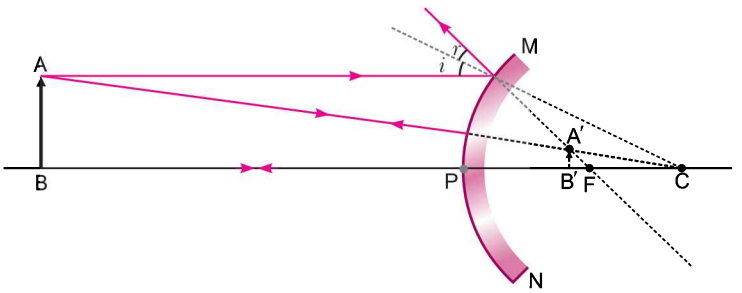
(*ii*) Magnified inverted image



Q. 23. If the image formed by a mirror for all positions of the object placed in front of it is always erect and diminished, what type of mirror is it? Draw a ray diagram to justify your answer. Where and why do we generally use this type of mirror? *[CBSE 2018,(AI) 2015]*

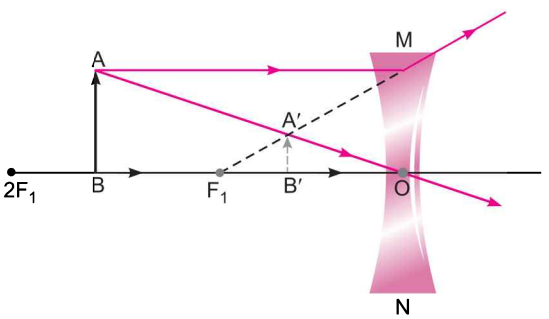
Ans. A convex mirror always produces an erect and diminished image of the object placed in front of it irrespective of the position of the object.



A convex mirror is used as a rear view mirror in vehicles. It enables the driver to view a much larger area of the traffic behind. It forms erect image.

Q. 24. If the image formed by a lens for all positions of an object placed in front of it is always erect and diminished, what is the nature of this lens? Draw a ray diagram to justify your answer. If the numerical value of the power of this lens is 10 D, what is its focal length in the Cartesian system? *[CBSE (AI) 2017]*

Ans. This is Concave or diverging lens.



$$f = \frac{1}{P}$$

As P = – 10 D,

So, focal length $f = \frac{1}{-10\ \text{D}} = -0.1\ \text{m}$ or **–10 cm**

Q. 25. A pencil when dipped in water in a glass tumbler, appears to be bent at the interface of air and water. Will the pencil appear to be bent to the same extent, if instead of water we use liquids like, kerosene or turpentine. Support your answer with reason. *[NCERT Exemplar]*

Ans. No. Bending will be different in different liquids since speed of light in the medium depends on the relative refractive index of the medium. A substance having higher refractive index is optically denser than another substance having lower refractive index. Thus higher the refractive index of a substance, more it will change the direction of a beam of light passing through it.

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Q. 26. How is the refractive index of a medium related to the speed of light? Obtain an expression for refractive index of a medium with respect to another in terms of speed of light in these two media? *[NCERT Exemplar]*

Ans. The refractive index of the medium n_m is given by

$$n_{\mathrm{m}} = \frac{\text{Speed of light in air}}{\text{Speed of light in medium}} = \frac{c}{v}$$

Let v_1 be the speed of light in medium 1 and v_2 be the speed of light in medium 2. The refractive index of medium 2 with respect to medium 1 is given by the ratio of the speed of light in medium 1 and the speed of light in medium 2. This is usually represented by the symbol n_{21}.

$$n_{21} = \frac{\text{Speed of light in medium 1}}{\text{Speed of light in medium 2}} = \frac{v_1}{v_2}$$

Q. 27. Sudha finds out that the sharp image of the window pane of her science laboratory is formed at a distance of 15 cm from the lens. She now tries to focus the building visible to her outside the window instead of the window pane without disturbing the lens. In which direction will she move the screen to obtain a sharp image of the building? What is the approximate focal length of this lens? *[NCERT Exemplar]*

Ans. Sudha should move the screen towards the lens so as to obtain a clear image of the building. The approximate focal length of this lens will be 15 cm. The rays of light coming from distant object such as a tree (or a distant building or electricity pole) can be considered to be parallel to each other. When parallel rays of light are incident on a convex lens, the rays, after refraction, converge at focus on the other side of the lens.

Q. 28. Define refractive index of a transparent medium. The speed of light in a medium of absolute refractive index 1.5 is 2×10^8 ms^{-1}. What is the speed of light in vacuum? *[CBSE 2019 (31/4/3)]*

Ans. Refractive index of a medium is defined as the ratio of speed of light in vacuum to the speed of light in the medium. *i.e.*,

$$\text{Refractive index (of a medium)} = \frac{\text{Speed of light in vacuum}}{\text{Speed of light in medium}}$$

$$n_B = \frac{c}{v_B}$$

Speed of light in vacuum, $c = n_B v_B$

$$= 1.5 \times 2 \times 10^8$$

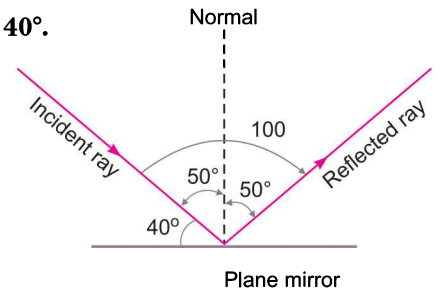
$$= \mathbf{3 \times 10^8\ m/s}$$

Q. 29. (*i*) The angle between an incident ray and the mirror is 40°.

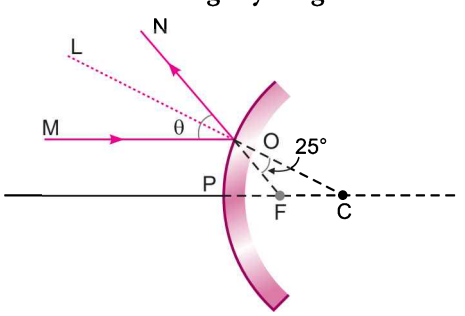
(*a*) What is the angle of incidence?

(*b*) What is the angle of reflection?

(*c*) What is the total angle through which the ray of light turns?



(*ii*) What is the value of θ in the following ray diagram?



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Ans. (*i*) (*a*) 50°

(*b*) 50°

(*c*) 100°

(*ii*) Here, $\angle MON = \angle MOL + \angle LON = \theta$

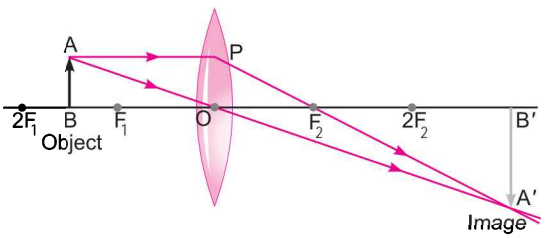
$\angle LON = \angle FOC = 25°$ (Vertically opposite angles)

$\angle LON = \angle MOL = 25°$ (Angle of incidence = Angle of reflection)

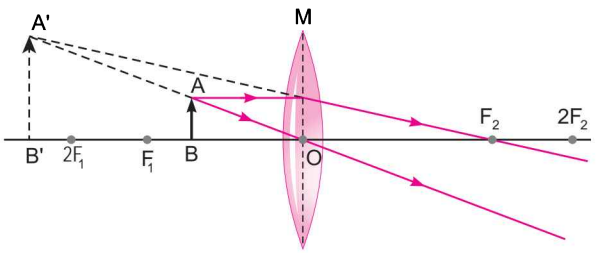
$\angle MON = 25° + 25° = \mathbf{50°}$

Q. 30. Draw ray diagrams to show the formation of three times magnified (*i*) real, and (*ii*) virtual image of an object by a converging lens. Mark the positions of O, F and 2F in each diagram. *[CBSE (AI) 2017]*

Ans. (*i*) Real image



(*ii*) Virtual image



Long Answer Questions [5 marks]

Each of the following questions are of 5 marks and have to be answered in about 80-90 words.

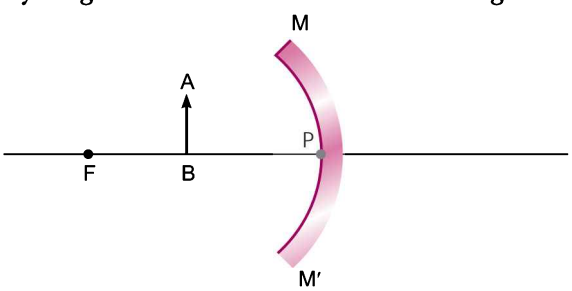
Q. 1. (*i*) Define the following terms in the context of spherical mirrors :

(*a*) Pole **(*b*) Centre of curvature**

(*c*) Radius of curvature **(*d*) Principal axis**

(*ii*) Draw ray diagrams to show the principal focus of (*a*) a concave mirror, and (*b*) a convex mirror.

(*iii*) In the following diagram, MM′ is a concave mirror and AB is an object. Draw on your answer-sheet a ray diagram to show the formation of image of this object. *[CBSE (F) 2017]*



Ans. (*i*) (*a*) Pole: It is the centre of the reflecting surface of the spherical mirror.

(*b*) Centre of curvature: It is the centre of the sphere of which mirror forms a part.

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(*c*) Radius of curvature: It is the radius of the sphere of which mirror forms a part.

(*d*) Principal axis: It is an imaginary straight line passing through the pole and the centre of curvature of the mirror.

(*ii*) (*a*) Refer to diagram (a), Page-286

(*b*) Refer to diagram (a), Page-287

(*iii*) Refer to diagram (*f*), Page-286

Q. 2. It is desired to obtain an erect image of an object, using concave mirror of focal length of 12 cm.

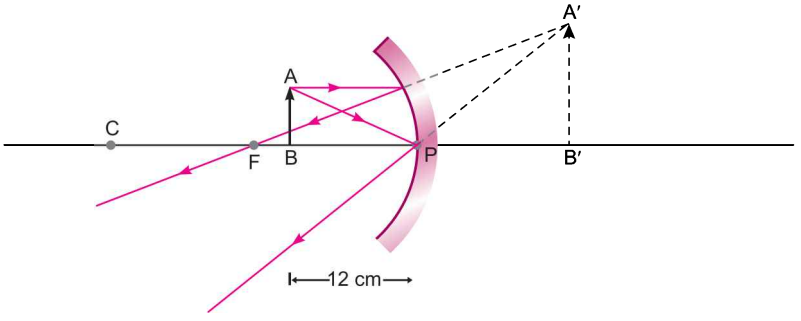
(*i*) What should be the range of distance of an object placed in front of the mirror?

(*ii*) Will the image be smaller or larger than the object. Draw ray diagram to show the formation of image in this case.

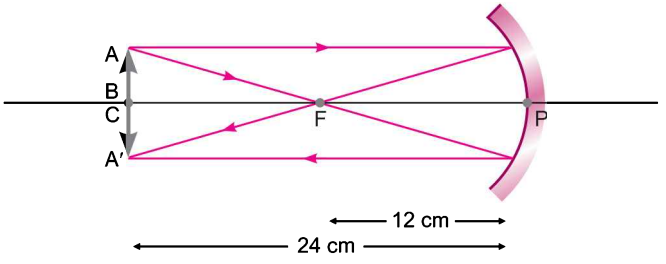
(*iii*) Where will the image of this object be, if it is placed 24 cm in front of the mirror? Draw ray diagram for this situation also to justify your answer. Show the positions of pole, principal focus and the centre of curvature in the above ray diagrams. [*CBSE (AI) 2016*]

Ans. (*i*) Range of distance should be between 0 cm and 12 cm.

(*ii*) The image will be larger than the object.



(*iii*) Image will be 24 cm in front of the mirror.



Q. 3. Suppose you have three concave mirrors A, B and C of focal lengths 10 cm, 15 cm and 20 cm. For each concave mirror you perform the experiment of image formation for three values of object distance of 10 cm, 20 cm and 30 cm. Giving reason answer the following:

(*i*) For the three object distances, identify the mirror/mirrors which will form an image of magnification – 1.

(*ii*) Out of the three mirrors identify the mirror which would be preferred to be used for shaving purposes/makeup.

(*iii*) For the mirror B draw ray diagram for image formation for object distances 10 cm and 20 cm. [*CBSE (F) 2016*]

Ans. Given, $f_a = 10$ cm; $f_b = 15$ cm; $f_c = 20$ cm

$u_1 = 10$ cm; $u_2 = 20$ cm; $u_3 = 30$ cm

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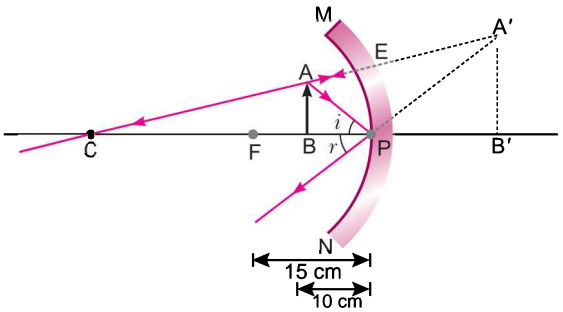
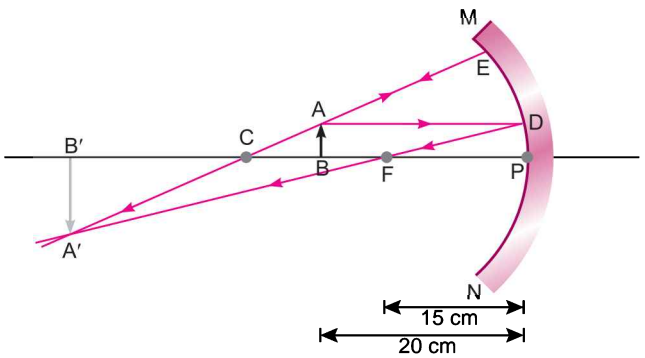
(*i*) $m = -1$ means $u = 2f$. For A it will be u_2 and for B it will be u_3.

(*ii*) Mirror B or C can be used for shaving/makeup purposes because the distance should be less than focal length for erect and magnified image. The face is generally kept at a distance more than 10 cm from the mirror.

(*iii*) When $u = 10$ cm



When $u = 20$ cm



Q. 4. (*i*) Rohit claims to have obtained an image twice the size of object with a concave lens. Is he correct? Give reason for your answer.

(*ii*) Where should an object be placed in case of a convex lens to form an image of same size as of the object? Show with the help of ray diagram the position and the nature of the image formed.

(*iii*) With the help of ray diagram, illustrate the change in position, nature and size of the image formed if the convex lens in case of (*ii*) is replaced by concave lens of same focal length. *[CBSE Sample Paper 2016]*

Ans. (*i*) No, Rohit is incorrect because magnified image of an object cannot be formed by a concave lens ever.

(*ii*) The object should be placed at $2F_1$.

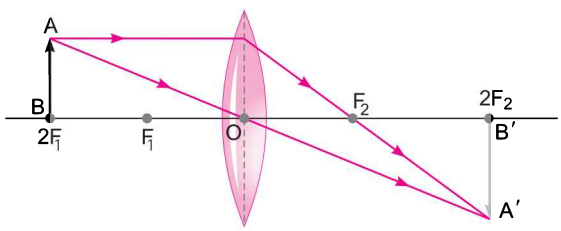


Image obtained is real, inverted and of same size as that of object.

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(*iii*)

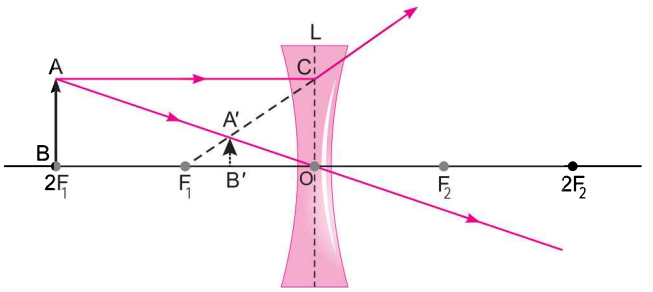


Image obtained is virtual, erect and diminished in case of concave lens.

Q. 5. **(*i*) Draw labelled ray diagrams for each of the following cases to show the position, nature and size of the image formed by a convex lens when the object is placed**

(*a*) between its optical centre (O) and principal focus (F)

(*b*) between F and 2F

(*ii*) How will the nature and size of the image formed in the above two cases, (*a*) and (*b*) change, if the convex lens is replaced by a concave lens of same focal length? *[CBSE Delhi 2017 (C)]*

Ans. (*i*) (*a*)

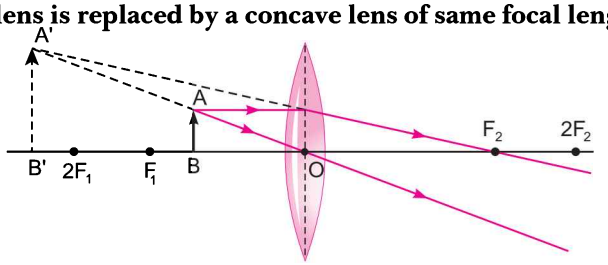


Image formed is virtual, erect and magnified.

(*b*)

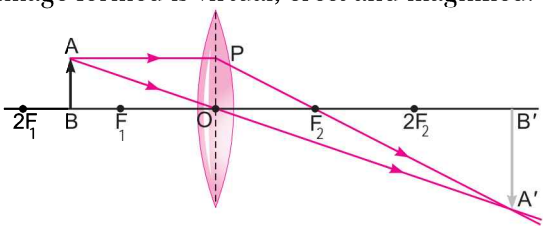


Image formed is real, inverted and magnified.

(*ii*) Image formed is virtual, erect and diminished in both cases.

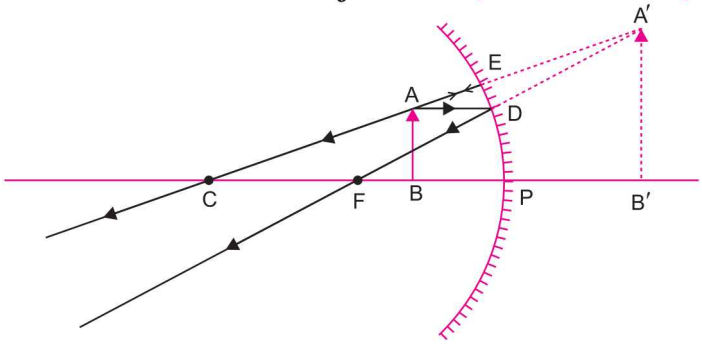
Q. 6. **(*i*) To construct a ray diagram we use two rays which are so chosen that it is easy to know their directions after reflection from the mirror. List two such rays and state the path of these rays after reflection in case of concave mirrors. Use these two rays and draw ray diagram to locate the image of an object placed between pole and focus of a concave mirror.**

(*ii*) A concave mirror produces three times magnified image on a screen. If the object is placed 20 cm in front of the mirror, how far is the screen from the object? *[CBSE Delhi 2017]*

Ans. (*i*) A ray of light incident parallel to the principal axis after reflection passes through the principal focus.

A ray of light which passes through the centre of curvature after reflection retraces its path back.

Ray diagram when the object is in between the pole and the focus of the mirror.



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(*ii*) $u = -20$ cm, $m = -3$

$$m = \frac{v}{-u}$$

$$\therefore \quad v = -m \times u$$

$$= -(-3)\,(-20\text{ cm}) = -60\text{ cm}$$

Distance between the object and the screen $= -60\text{ cm} - (-20\text{ cm}) =$ **-40 cm**

So, the distance between the object and the screen is **40 cm**.

Some Important Numericals

CONCAVE MIRROR

Q. 1. The image of a candle flame placed at a distance of 30 cm from a mirror is formed on a screen placed in front of the mirror at a distance of 60 cm from its pole. What is the nature of the mirror? Find its focal length. If the height of the flame is 2.4 cm, find the height of its image. State whether the image formed is erect or inverted.

Ans. The mirror is concave,

$h = +2.4$ cm, $u = -30$ cm, $v = -60$ cm, $f = ?$

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{1}{-60\text{ cm}} + \frac{1}{-30\text{ cm}}$$

$$\therefore \quad f = -20\text{ cm}$$

$$m = \frac{h'}{h} = -\frac{v}{u}$$

$$\therefore \quad h' = -h \times \frac{v}{u} = -2.4\text{ cm} \times \frac{-60\text{ cm}}{-30\text{ cm}} = \mathbf{-4.8\text{ cm}}$$

–ve sign of h_2 (image size) indicates that the image is inverted.

Q. 2. Find the size, nature and position of image formed when an object of size 1 cm is placed at a distance of 15 cm from a concave mirror of focal length 10 cm.

Ans. Object distance, $u = -15$ cm; Focal length, $f = -10$ cm

Object size, $h = 1$ cm ; Image distance, $v = ?$

Image size, $h' = ?$

(*i*) Position of image

From mirror formula, $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

We have, $\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$

Putting values, we get $\frac{1}{v} = \frac{1}{-10} - \frac{1}{-15} = \frac{-3-(-2)}{30} = -\frac{1}{30}$

$\frac{1}{v} =$ **-30 cm.**

The image is formed at a distance 30 cm on the side of the object. Negative sign indicates that object and image are on the same side.

(*ii*) Nature of image: The image is in front of the mirror, its nature is real and inverted.

(*iii*) Size of image: From the expression for magnification, $m = \frac{h'}{h} = -\frac{v}{u}$

We have $h' = -h \times \frac{v}{u}$

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Putting values, we get $h' = -1 \times \frac{-30}{-15} = -2$

Image size, $h' = \mathbf{-2\ cm}$

The image formed has size 2 cm and negative sign means inverted and real.

Q. 3. The image of an object formed by a mirror is real, inverted and is of magnification –1. If the image is at a distance of 40 cm from the mirror, where is the object placed? Where would the image be if the object is moved 20 cm towards the mirror? State reason and also draw ray diagram for the new position of the object to justify your answer. *[CBSE (AI) 2016]*

Ans. Magnification, $m = -1$

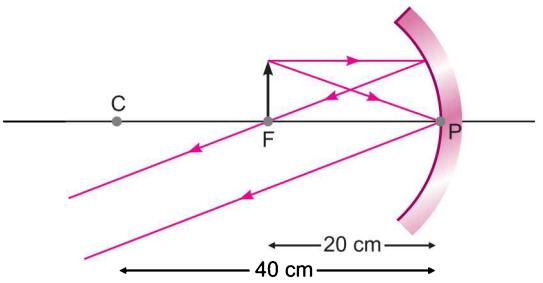
Image distance, $v = -40$ cm

$\therefore \quad m = \frac{-v}{u}$

$\Rightarrow \quad -1 = \frac{-(-40)}{u} \quad \Rightarrow \quad u = \mathbf{-40\ cm}$

So, object and image both are at C.

Such that $f = \frac{40}{2} = 20$ cm.



If the object is moved 20 cm towards the mirror then its new position would be at the focus of the mirror.

$u = -20$ cm, $f = -20$ cm

$\Rightarrow \quad \frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ Such that $v =$ **infinity.**

Q. 4. An object 2 cm high is placed at a distance of 16 cm from a concave mirror which produces a real image 3 cm high.

(*i*) Find the position of the image.

(*ii*) What is the focal length of mirror?

Ans. Object height, $h = +2$ cm

Image height, $h' = -3$ cm (real image hence inverted)

Object distance, $u = -16$ cm; Image distance, $v = ?$

Focal length, $f = ?$

(*i*) Position of image

From the expression for magnification

$$m = \frac{h'}{h} = -\frac{v}{u}$$

We have, $v = -u\frac{h'}{h}$

Putting values, we get $v = -(-16) \times \frac{-3}{2}$

$v = \mathbf{-24\ cm}$

The image is formed at distance of 24 cm in front of the mirror (negative sign means object and image are on the same side).

(*ii*) Focal length of mirror

Using mirror formula, $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

Putting values, we get $\frac{1}{f} = \frac{1}{-16} + \frac{1}{-24} = -\frac{3+2}{48} = -\frac{5}{48}$

or $f = -\frac{48}{5} = \mathbf{-9.6\ cm}$

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Q. 5. A concave mirror of focal length 10 cm is placed at a distance of 35 cm from a wall. How far from the wall an object be placed so that its image formed by the mirror falls on the wall?

Ans. Here, $f = -10$ cm; $v = -35$ cm (since the image is formed on the wall and distance between the wall and mirror is 35 cm). Image is beyond $2f$ so object has to be in between F and C.

Let the distance of the object from the wall be x.

$$\therefore \quad u = -(35 - x)$$

$$\because \quad \frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

$$\therefore \quad \frac{1}{-(35-x)} + \frac{1}{-35} = \frac{1}{-10}$$

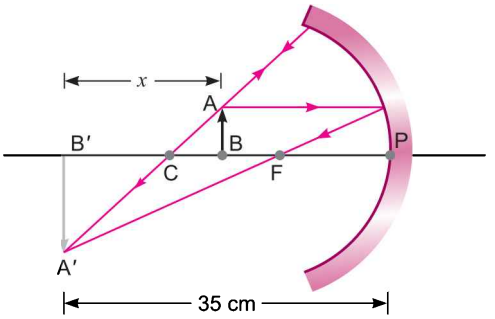
$$\text{or} \quad \frac{1}{35-x} + \frac{1}{35} = \frac{1}{10} \quad \text{or} \quad \frac{1}{35-x} = \frac{1}{10} - \frac{1}{35}$$

$$\text{or} \quad \frac{1}{35-x} = \frac{7-2}{70} \quad \Rightarrow \quad \frac{1}{35-x} = \frac{5}{70}$$

$$\Rightarrow \quad 35 - x = 14$$

$$\therefore \quad x = \mathbf{21\ cm}$$

Therefore, the distance of the object from the wall = 21 cm.



Q. 6. A 2.0 cm tall object is placed perpendicular to the principal axis of a concave mirror of focal length 10 cm. The distance of the object from the mirror is 15 cm. Find the nature, position and size of the image formed. Represent the situation with the help of a ray diagram.

Ans. Given, $f = -10$ cm;

$u = -15$ cm;

$h = +2.0$ cm;

Using the mirror formula,

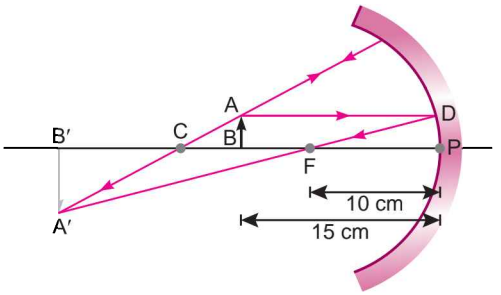
$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{v} + \frac{1}{-15} = \frac{1}{-10}$$

$$\frac{1}{v} = \frac{1}{15} - \frac{1}{10}$$

$$\therefore \quad v = \mathbf{-30.0\ cm}$$

The image is formed at a distance of 30 cm in front of the mirror.



Magnification, $m = \frac{h'}{h} = -\frac{v}{u}$

$$h' = -h \times \frac{v}{u} = -2 \times \frac{-30}{-15}$$

$$h' = \mathbf{-4\ cm}$$

Hence, the size of image is 4 cm. –ve sign shows that image is inverted & real. Thus, image formed is real, inverted and enlarged.

Q. 7. A student has focused the image of a candle flame on a white screen using a concave mirror. The situation is as given below:

Length of the flame = 1.5 cm

Focal length of the mirror = 12 cm

Distance of flame from the mirror = 18 cm

If the flame is perpendicular to the principal axis of the mirror, then calculate the following:

(*i*) Distance of the image from the mirror

(*ii*) Length of the image

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If the distance between the mirror and the flame is reduced to 10 cm, then what would be observed on the screen? Draw ray diagram to justify your answer for this situation. *[CBSE (F) 2015]*

Ans. Given: height of object, $h = +1.5$ cm; focal length, $f = -12$ cm; object distance, $u = -18$ cm; image distance, $v = ?$; height of image, $h' = ?$

(*i*) Applying mirror formula,

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

$$\therefore \quad \frac{1}{v} = \frac{1}{f} - \frac{1}{u}$$

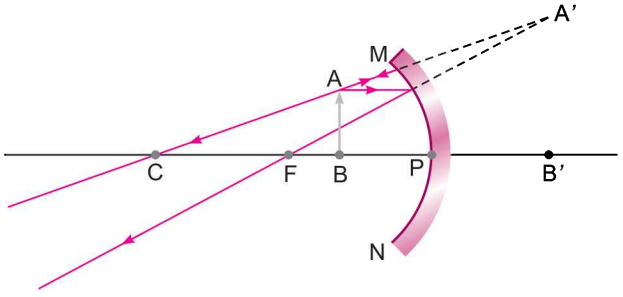
$$= \frac{1}{(-12)} - \frac{1}{(-18)} = \frac{-1}{12} + \frac{1}{18} = \frac{-3+2}{36} = \frac{-1}{36}$$

$$v = \mathbf{-36\ cm}$$

(*ii*) $h' = -\frac{v}{u} \times h = -\frac{-36\ \text{cm}}{-18\ \text{cm}} \times 1.5\ \text{cm}$

$= \mathbf{-3\ cm}$ (Magnified, inverted image)

If $u = -10$ cm, no distinct image would be formed on the screen. In this case the image formed will be virtual.



Q. 8. A 2 cm high object is placed at a distance of 32 cm from a concave mirror. The image is real, inverted and 3 cm in size. Find the focal length of the mirror and the position where the image is formed? *[CBSE Sample Paper 2016]*

Ans. Given:

Object height, $h = 2$ cm

Image height, $h' = -3$ cm

Object distance, $u = -32$ cm

$$m = \frac{-v}{u} = \frac{h'}{h}$$

$$m = \frac{h'}{h} = \frac{-3\ \text{cm}}{2\ \text{cm}} = -1.5$$

$$\Rightarrow \quad \frac{-v}{u} = -1.5$$

$$\therefore \quad v = \mathbf{-48\ cm}$$

Also $\quad \frac{1}{f} = \frac{1}{v} + \frac{1}{u} = \frac{1}{-48} + \frac{1}{-32} = -\frac{5}{96}$

$$\therefore \quad f = \mathbf{-19.2\ cm}$$

$\therefore$ Focal length of concave mirror is 19.2 cm and image is formed 48 cm in front of it.

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Q. 9. An object 4 cm in height, is placed at 15 cm in front of a concave mirror of focal length 10 cm. At what distance from the mirror should a screen be placed to obtain a sharp image of the object. Calculate the height of the image. *[CBSE Delhi 2017]*

Ans. $h = +4$ cm $\quad f = -10$ cm $\quad u = -15$ cm $\quad v = ?$ $\quad h' = ?$

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

$$\Rightarrow \quad \frac{1}{v} = \frac{1}{f} - \frac{1}{u}$$

$$\frac{1}{v} = \frac{1}{-10\text{ cm}} - \frac{1}{-15\text{ cm}}$$

$$\therefore \quad v = -30\text{ cm}$$

$$\frac{h'}{h} = -\frac{v}{u}$$

$$\therefore \quad h' = -\frac{v}{u} \times h = -\frac{-30\text{ cm}}{-15\text{ cm}} \times 4\text{ cm} = \mathbf{-8\ cm}$$

CONVEX MIRROR

Q. 10. A convex mirror used for rear-view on an automobile has a radius of curvature of 3.00 m. If a bus is located at 5.00 m from this mirror, find the position, nature and size of the image.

Ans. Radius of curvature, $R = +3.00$ m;
Object distance, $u = -5.00$ m;
Image distance, $v = ?$
Height of the image, $h' = ?$

Focal length, $f = \frac{R}{2} = +\frac{3.00}{2} = 1.50$ m

Since, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

or $\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = +\frac{1}{1.50} - \frac{1}{-5.00}$

$$= \frac{1}{1.50} + \frac{1}{5.00} = \frac{2}{3} + \frac{1}{5}$$

$$\frac{1}{v} = \frac{13}{15}$$

$$v = \frac{15}{13} = \mathbf{+\ 1.15\ m}\ \text{(approximately)}$$

The image is 1.15 m at the back of the mirror.

Magnification, $m = \frac{h'}{h} = -\frac{v}{u} = -\frac{1.15\text{ m}}{-5.00\text{ m}} = \mathbf{+\ 0.23}$

The image is virtual, erect and smaller in size by a factor of 0.23.

Q. 11. Size of image of an object formed by a mirror having a focal length of 20 cm, is observed to be reduced to $\frac{1}{3}$rd of its size. At what distance the object has been placed from the mirror? What is the nature of the image and the mirror? *[NCERT Exemplar]*

Ans. An image smaller in size can be formed both by a concave mirror as well as a convex mirror.

Case I: When mirror is concave, the image is real.

Hence, $m = -\frac{1}{3}, f = -20$ cm

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As $m = -\frac{v}{u}$ $\therefore$ $-\frac{1}{3} = -\frac{v}{u}$

$\Rightarrow$ $v = \frac{u}{3}$

Using, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

or $\frac{3}{u} + \frac{1}{u} = \frac{1}{-20}$

or $\frac{4}{u} = \frac{1}{-20}$

or $u = \mathbf{-80\ cm}$

Now, $v = \frac{u}{3} = \frac{\mathbf{-80}}{\mathbf{3}}\ \mathbf{cm}$

$\therefore$ Image is real and inverted.

Case II: When mirror is convex, the image is virtual

$m = \frac{1}{3}, f = +20\ \text{cm}$

As $m = -\frac{v}{u} = \frac{1}{3}$

$\Rightarrow$ $v = -\frac{u}{3}$

Using, $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

or $-\frac{3}{u} + \frac{1}{u} = \frac{1}{20}$

$u = \mathbf{-40\ cm}$

and $v = -\frac{(-40)}{3} = \frac{\mathbf{40}}{\mathbf{3}}\mathbf{cm}$

$\therefore$ Image is virtual and erect.

Q. 12. A truck uses a convex mirror as view finder whose radius of curvature is 2.0 m. A maruti car is coming behind the truck at a distance of 10 m. What will be the position of the image of the car and size of the image of the car when observed by the driver of the truck through the convex mirror?

Ans. For convex mirror, we are given, $u = -10$ m, $R = 2.0$ m

So, $f = \frac{R}{2} = \frac{2.0\ \text{m}}{2} = 1.0\ \text{m}$

Using the mirror formula, $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

We get $\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{1.0} + \frac{1}{10} = \frac{11}{10}$ or, $v = \frac{10}{11} = \mathbf{0.9\ m}$

Thus, the car would appear at 0.9 m from the convex mirror. We know that

$$m = -\frac{v}{u} = \frac{\frac{-10}{11}}{-10} = \mathbf{\frac{1}{11}}$$

Thus, size of the image of the car will be a fraction of $\frac{1}{11}$ the actual size of the car through the convex mirror.

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REFRACTIVE INDEX

Q. 13. If the angle of incidence (i) for a light ray in air be 45° and the angle of refraction (r) in glass be 30°, find refractive index of glass with respect to air.

Ans. Refractive index of glass, $n_{ga} = \dfrac{\sin 45°}{\sin 30°} = \dfrac{1}{\sqrt{2}} \times 2 = \sqrt{2}$

Q. 14. Refractive index of water with respect to air is 1.33. What is the value of refractive index of air with respect to water?

Ans. Here, $n_{wa} = 1.33$

We know $n_{aw} = \dfrac{1}{n_{wa}} = \dfrac{1}{1.33} = \mathbf{0.75}$

Q. 15. The absolute refractive indices of glass and water are 3/2 and 4/3 respectively. If the speed of light in glass is 2×10^8 m/s, calculate the speed of light in (i) vacuum, (ii) water. *[CBSE (AI) 2015, 2016]*

Ans. Refractive index of glass, $n_g = \dfrac{3}{2}$

$$\therefore \quad n_g = \frac{\text{Speed of light in vaccum}}{\text{Speed of light in glass}}$$

$$\frac{3}{2} = \frac{\text{Speed of light in vaccum}}{2 \times 10^8}$$

$$\text{Speed of light in vacuum} = \frac{3 \times 2 \times 10^8}{2} = \mathbf{3 \times 10^8\ m/s}$$

Refractive index of water, $n_w = \dfrac{4}{3}$

$$n_w = \frac{\text{Speed of light in vacuum}}{\text{Speed of light in water}}$$

$$\frac{4}{3} = \frac{3 \times 10^8}{\text{Speed of light in water}}$$

Speed of light in water = $\mathbf{2.25 \times 10^8\ m/s}$

Q. 16. Refractive index of water with respect to air is 4/3 and glass is 3/2. What is the refractive index of glass with respect to water?

Ans. When there are three media air, water and glass,
We have

$$n_{wa} \times n_{gw} \times n_{ag} = 1$$

$$\therefore \quad n_{gw} = \frac{1}{n_{wa} \times n_{ag}} = \frac{n_{ga}}{n_{wa}} = \frac{3/2}{4/3} = \mathbf{\frac{9}{8}}$$

$\therefore$ Refractive index of glass with respect to water is 9/8.

Q. 17. Refractive indices of water and benzene with respect to air are 1.33 and 1.50 respectively. Calculate the refractive index of benzene with respect to water.

Ans. For air, water and benzene,

$$n_{wa} \times n_{Bw} \times n_{aB} = 1$$

$$\therefore \quad n_{Bw} = \frac{1}{n_{wa}} \times n_{Ba} = \frac{1.50}{1.33} = \mathbf{1.13}.$$

Q. 18. Refractive index of diamond with respect to glass is 1.6 and absolute refractive index of glass is 1.5. Find out the absolute refractive index of diamond.

Ans. For air, glass and diamond,

$$n_{ga} \times n_{Dg} \times n_{aD} = 1$$

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$$\therefore \quad n_a D = \frac{1}{n_{ga} \times n_{Dg}}$$

$$\Rightarrow \quad n_{Da} = n_{ga} \times n_{Dg} = 1.5 \times 1.6 = \mathbf{2.4}.$$

Q. 19. The absolute refractive indices of two media 'A' and 'B' are 2.0 and 1.5 respectively. If the speed of light in medium 'B' is 2×10^8 m/s, calculate the speed of light in:
(*i*) vacuum (*ii*) medium 'A'. *[CBSE Delhi 2015]*

Ans. $n_A = 2.0$; $n_B = 1.5$; speed of light in medium B, $v_B = 2 \times 10^8$ m/s

(*i*) $$n_B = \frac{c}{v_B}$$

$$\therefore \quad c = n_B v_B$$

$$= 1.5 \times 2 \times 10^8 \text{ m/s} = \mathbf{3 \times 10^8 \text{ m/s}}$$

(*ii*) $$n_A = \frac{c}{v_A}$$

$$v_A = \frac{c}{n_A} = \frac{3 \times 10^8 \text{ m/s}}{2} = \mathbf{1.5 \times 10^8 \text{ m/s}}$$

CONVEX LENS

Q. 20. An object is placed perpendicular to the principal axis of a convex lens of focal length 8 cm. The distance of the object from the lens is 12 cm. Find the position and nature of the image. *[CBSE Delhi 2017 (C)]*

Ans. $u = -12$ cm, $f = +8$ cm, $v = ?$

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}, \quad \Rightarrow \quad \frac{1}{v} - \frac{1}{(-12)} = \frac{1}{8}$$

$v = \mathbf{+24}$ **cm**

The image is real and inverted.

Q. 21. The image of a candle flame formed by a lens is obtained on a screen placed on the other side of the lens. If the image is three times the size of the flame and the distance between lens and image is 80 cm, at what distance should the candle be placed from the lens? What is the nature of the image at a distance of 80 cm from the lens? *[NCERT Exemplar]*

Ans. Since the image is obtained on the screen, it is real. Hence, the lens is convex.

Here, $v = 80$ cm; $m = -3$ [$\because$ Image is real]

Using, $$m = \frac{v}{u} \quad \Rightarrow \quad -3 = \frac{80}{u}$$

$$\Rightarrow \quad u = -\frac{\mathbf{80}}{\mathbf{3}} \textbf{ cm}$$

The lens is convex and the image formed at a distance of 80 cm from the lens is real and inverted.

Q. 22. A 10 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 12 cm. The distance of the object from the lens is 18 cm. Find the nature, position and size of the image formed. *[CBSE 2019 (31/2/1)]*

Ans. Given: $u = -18$ cm, $f = +12$ cm [$\because$ Lens is convex]

$h = +10$ cm

Using lens formula,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

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$$\frac{1}{v} - \frac{1}{-18} = \frac{1}{12}$$

$$\Rightarrow \quad \frac{1}{v} = \frac{1}{12} - \frac{1}{18} = \frac{3-2}{36}$$

$$\Rightarrow \quad \frac{1}{v} = \frac{1}{36} \quad \Rightarrow \quad v = \mathbf{+36\ cm}$$

Thus, image is formed at a distance of 36 cm from the lens.

The positive sign of v indicates that the image is formed on the other side of the lens.

Now, $\quad m = \frac{h'}{h} = \frac{v}{u}$

or, $\quad \frac{h'}{10} = \frac{36}{-18} \quad$ or $\quad h' = \mathbf{-20\ cm}$

Thus, size of the image is 20 cm (magnified). Negative sign shows that the image is in the downward direction. Thus, the image is real and inverted.

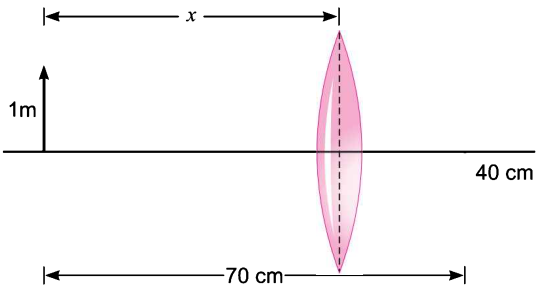
Q. 23. An object 1 m tall is placed on the principal axis of a convex lens and its 40 cm tall image is formed on the screen placed at a distance of 70 cm from the object. What is the focal length of the lens?

Ans. Since, the image is formed on the screen, so the image is real and inverted,

Given: $h = 100$ cm; $h' = -40$ cm;

Let the object be kept at a distance x from the lens.

$\therefore \quad v = +(70 - x); f = ?$



Now $\quad m = \frac{h'}{h} = \frac{v}{u}$

$\therefore \quad \frac{-40}{+100} = \frac{(70-x)}{-x}$

or $\quad 40x = 7000 - 100x$

i.e., $\quad x = 50$ cm

$\therefore \quad u = -x = -50$ cm

and $\quad v = 70 - x = 70 - 50 = 20$ cm

Substituting the values of u and v in the lens formula,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

We have, $\quad \frac{1}{20} - \frac{1}{-50} = \frac{1}{f}$

$$\therefore \quad f = +\frac{100}{7} = \mathbf{+14.3\ cm}$$

Therefore, focal length of the lens = 14.3 cm

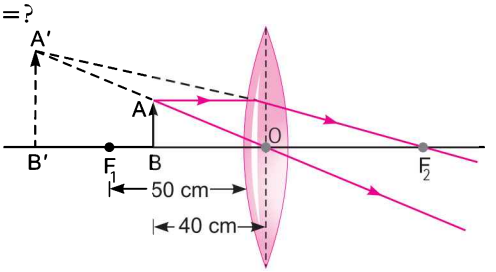
Q. 24. A 5 cm tall object is placed on the principal axis of a convex lens of focal length 50 cm at a distance of 40 cm from it. Find the nature, position and size of the image.

Ans. Here, $u = -40$ cm; $f = +50$ cm; $h = 5$ cm; $v = ?$; $h' = ?$

Using lens formula,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{v} = \frac{1}{u} + \frac{1}{f}$$



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$$\therefore \quad v = \frac{uf}{u+f}$$

$$v = \frac{(-40)\times(+50)}{-40+50} = \frac{-2000}{10} = \mathbf{-200\ cm}$$

Here the negative sign indicates that the image is formed on the same side of the lens as the object. Therefore, the image is virtual.

Now, $m = \frac{h'}{h} = \frac{v}{u} = \frac{-200}{-40} = +5$ or $\frac{h'}{h} = +5$

$$\therefore \quad h' = +5 \times h = +5 \times 5 = \mathbf{+25\ cm}$$

The positive sign of h' shows that the image is erect. Thus in this case, the image is erect, virtual, 25 cm tall, and it is formed at a distance of 200 cm on the same side of the lens as the objects.

Q. 25. A student focussed the image of a candle flame on a white screen using a convex lens. He noted down the position of the candle, screen and the lens as under

Position of candle = 12.0 cm

Position of convex lens = 50.0 cm

Position of the screen = 88.0 cm

(*i*) What is the focal length of the convex lens?

(*ii*) Where will the image be formed if he shifts the candle towards the lens at a position of 31.0 cm?

(*iii*) What will be the nature of the image formed if he further shifts the candle towards the lens?

(*iv*) Draw a ray diagram to show the formation of the image in case (*iii*) as said above.

[NCERT Exemplar]

Ans. (*i*) Here, u = Distance of candle from the lens

= (50 – 12) cm = 38 cm

According to sign convention, $u = -38$ cm

Now, v = Distance of screen from the lens

= (88 – 50) cm = 38 cm

As per sign convention, $v = +38$ cm

Using the lens formula, $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

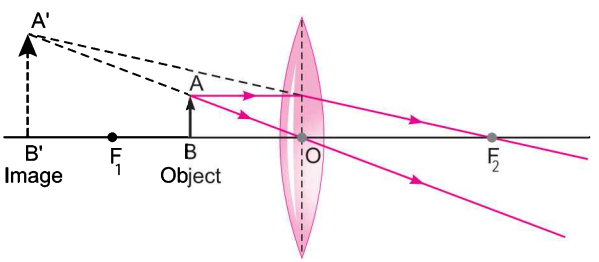
$$\frac{1}{38} + \frac{1}{38} = \frac{1}{f}$$

or $$f = \frac{38}{2} = \mathbf{19\ cm}$$

(*ii*) If the student shifts the candle towards the lens at a position of 31.0 cm, object distance u = (50 – 31) = 19 cm. Thus, candle lies at the focus. Hence, image will be formed at infinity.

(*iii*) If the candle is further shifted towards the lens, the candle lies between the optical centre and focus of the lens. Thus a virtual, erect and magnified image is formed on the same side as the object.

(*iv*)



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Q. 26. A real image, $\frac{4}{5}$ size of the object is formed 18 cm from a lens. Calculate the focal length of the lens.

Ans. Since the image is real and diminished, the lens must be convex and the object must be placed beyond 2F.

Given: $v = +18$ cm

$$\frac{h'}{h} = \frac{-4}{5} \qquad [\because m = \frac{h'}{h} \text{ is negative for real image}]$$

We have, $m = \frac{h'}{h} = \frac{v}{u}$

$\therefore \quad \frac{v}{u} = \frac{-4}{5}$

$\Rightarrow \quad \mathbf{4u = -5v}$

and $\quad 4u = -5 \times 18$ cm

$\therefore \quad u = -22.5$ cm

Also focal length is given by

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$= \frac{1}{18} - \frac{1}{-22.5} = \frac{1}{18} + \frac{1}{22.5} = \frac{9}{90}$$

$f = \mathbf{10}$ cm

Q. 27. Analyse the following observation table showing variation of image distance (v) with object distance (u) in case of a convex lens and answer the questions that follow, without doing any calculations:

S. No.	Object distance u (cm)	Image distance v (cm)
1	– 90	+ 18
2	– 60	+ 20
3	– 30	+ 30
4	– 20	+ 60
5	– 18	+ 90
6	– 10	+ 100

(*i*) What is the focal length of the convex lens ? Give reason in support of your answer.

(*ii*) Write the serial number of that observation which is not correct. How did you arrive at this conclusion?

(*iii*) Take an appropriate scale to draw ray diagram for the observation at S. No. 4 and find the approximate value of magnification. *[CBSE Delhi 2017]*

Ans. (*i*) $f = 15$ cm

Object at S. No. (3) indicates $u = -30$ cm, $v = +30$ cm

Thus, object is at 2F ($2f = 30$ cm)

$\therefore \quad f = 15$ cm

(*ii*) Observation at S. No. (6) is not correct.

The value, $u = -10$ cm, indicates that the object is in between the optical centre and the focus (*i.e.*, less than the focal length) of the lens and hence the image should be on the same side as the object. Thus, the image distance cannot be positive.

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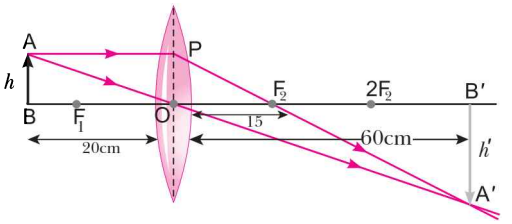
(*iii*) $u = -20$ cm; $v = +60$ cm; $f = +15$ cm



CONCAVE LENS

Q. 28. An object kept at a distance of 60 cm from a lens gives a virtual image at a distance of 20 cm over the same side of the lens. What is the focal length of the lens? Is the lens converging or diverging?

Ans. Here, $u = -60$ cm, $v = -20$ cm

From lens formula,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \qquad \Rightarrow \qquad \frac{1}{-20} - \frac{1}{-60} = \frac{1}{f}$$

$$\Rightarrow \qquad \frac{1}{f} = \frac{1}{60} - \frac{1}{20} = \frac{1-3}{60} = \frac{-2}{60};$$

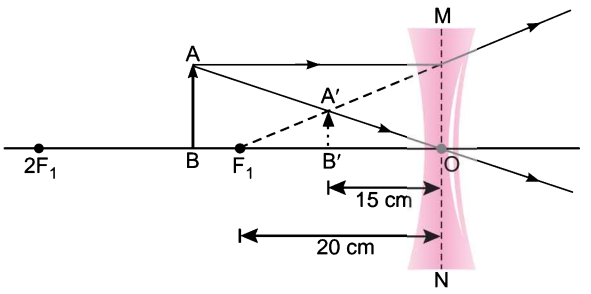
$$\Rightarrow \qquad f = \frac{-60}{2} = \mathbf{-30\ cm}$$

The focal length of the lens is 30 cm. The –ve sign shows that the lens is diverging.

Q. 29. At what distance from a concave lens of focal length 20 cm a 6 cm tall object be placed so as to obtain its image at 15 cm from the lens? Also calculate the size of the image formed.

Draw a ray diagram to justify your answer for the above situation and label it.

Ans. Given, $f = -20$ cm; $h = 6$ cm; $v = -15$ cm; u = ?



Lens formula: $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$$\Rightarrow \quad u = \frac{vf}{f - v} = \frac{-15\ \text{cm} \times -20\ \text{cm}}{-20\ \text{cm} - (-15\ \text{cm})}$$

$$= \mathbf{-60\ cm}$$

$\therefore$ Object is at 60 cm from the lens.

$$h' = \frac{v}{u} \times h = \frac{-15\ \text{cm}}{-60\ \text{cm}} \times 6\ \text{cm} = \mathbf{+1.5\ cm}$$

The image formed is diminished and erect.

Q. 30. An object is placed at a distance of 60 cm from a concave lens of focal length 30 cm.

(*i*) Use lens formula to find the distance of the image from the lens.

(*ii*) List four characteristics of the image (nature, position, size, erect inverted) formed by the lens in this case.

(*iii*) Draw ray diagram to justify your answer of part (*ii*). *[CBSE 2019 (31/1/1)]*

Ans. (*i*) $u = -60$ cm, $f = -30$ cm, v = ?

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\therefore \qquad \frac{1}{v} = \frac{1}{f} + \frac{1}{u}$$

$$= \frac{1}{-30} + \frac{1}{-60} = \frac{-3}{60}$$

$$\therefore \qquad v = \mathbf{-20\ cm}$$

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Magnification, $m = \frac{v}{u} = \frac{-20\text{ cm}}{-60\text{ cm}} = \frac{1}{3}$

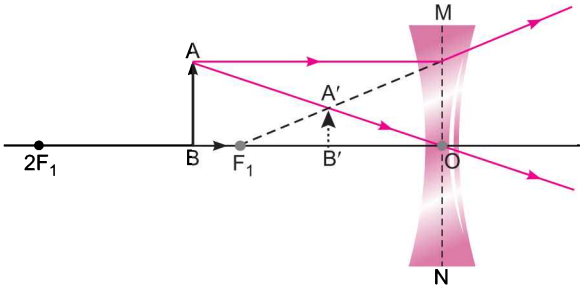
(*ii*) Nature: Virtual

Position: 20 cm from lens on the same side as the object

Size: Diminished

Erect/Inverted: Erect

(*iii*)



POWER OF A LENS

Q. 31. A convex lens has a focal length of 10 cm. What is its power?

Ans. Here, the focal length of the lens is given in 'cm'. We should first convert the focal length into 'm'.

Now, 10 cm $= \frac{10}{100}$ m $= 0.1$ m

So, focal length, $f = 0.1$ m (A convex lens has positive focal length)

Now, $P = \frac{1}{f\text{ (in metres)}}$

We get $P = \frac{1}{0.1}$ or $P = \frac{1 \times 10}{1}$

Thus, power $P = +10$ dioptre (or **+ 10 D**).

Q. 32. A student uses a lens of focal length 50 cm and another of – 50 cm. What is the nature of the lens and its power used by each of them? *[NCERT Exemplar]*

Ans. **Case I:** When $f = 50$ cm $= 0.5$ m

$$P = \frac{1}{f\text{ (in m)}} = \frac{1}{0.5} = \mathbf{2\ D}$$

$\therefore$ Lens is convex.

Case II: When $f = -50$ cm $= -0.5$ m

$$P = \frac{1}{f\text{ (in m)}} = \frac{1}{-0.5} = \mathbf{-2\ D}$$

$\therefore$ Lens is concave.

Q. 33. Two thin lenses of focal lengths + 10 cm and – 5 cm are kept in contact. What is the focal length and power of the combination?

Ans. Here, $f_1 = +10$ cm, $f_2 = -5$ cm,

$\therefore$ Focal length of the combination of lenses is given by

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} \quad \Rightarrow \quad \frac{1}{f} = \frac{1}{10} + \frac{1}{-5} = \frac{1}{10} - \frac{1}{5}$$

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$\Rightarrow \quad \frac{1}{f} = \frac{1-2}{10} \qquad \Rightarrow \quad \frac{1}{f} = -\frac{1}{10}$

$\therefore \quad f = \mathbf{-10\ cm}$

Power of combination,

$$P = \frac{1}{f(\text{in cm})} = \frac{100}{f\ (\text{in cm})}$$

$$P = -\frac{100}{10}\text{D} = \mathbf{-10\ D}.$$

HOTS [Higher Order Thinking Skills]

Q. 1. Which one of the two—glass and water is optically denser and why?

Ans. Glass is denser than water because speed of light in glass is less than that of water.

Q. 2. Can a convergent lens in one medium become divergent in another medium?

Ans. Yes, a convergent lens in one medium becomes divergent in another medium when the refractive index of the medium is greater than the refractive index of the material of the lens.

Q. 3. A man is going away from the plane mirror with a velocity of 3 m/s. With what velocity is he going away from his own image in the mirror?

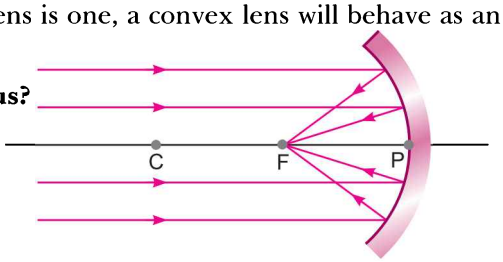
Ans. We know that the image formed by a plane mirror is as much behind the mirror as object is in front. So, the speed of image will be same as object but in opposite direction. Thus, net velocity between man and his image will be 3 – (–3) = 6 m/s.

Q. 4. Under what condition a convex lens when placed in a medium behaves as an ordinary glass plate?

Ans. When the refractive index of a medium relative to lens is one, a convex lens will behave as an ordinary glass plate.

Q. 5. Why does a concave mirror has a real principal focus?

Ans. In a concave mirror, all the incident rays parallel to principal axis actually pass through the focus F after getting reflected from the concave mirror. Thus, concave mirror has a real principal focus.



Q. 6. A concave mirror and convex lens are immersed in water. What change, if any, do you expect in the focal length of the two?

Ans. Focal length of the concave mirror does not change because it is about half its radius of curvature and has nothing to do with the external medium. On the other hand, the focal length of the convex lens will increase because the refractive index of glass with respect to water is less than refractive index of glass with respect to air.

Q. 7. A man is holding a lighted candle in front of a thick glass mirror and on viewing it obliquely he noticed a number of images of the candle why?

Ans. The front surface of a thick glass mirror is both reflecting and refracting. The back surface is silvered and acts as a mirror. Images arise due to reflection of incident light by the front surface then by the back surface, followed by multiple reflection of light within the glass by the front and back surfaces.

Q. 8. A concave mirror of focal length f produces an image n times the size of the object. What would be the object distance for which the image is real?

Ans. We know, $\frac{\text{Size of the image}}{\text{Size of the object}} = n$

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In case of concave mirror, if the image is real then it must be inverted.

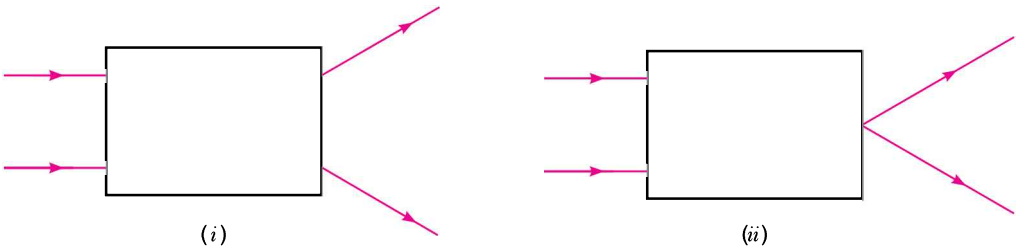
So, $m = -n = \frac{-v}{u}$ or $m = n = \frac{v}{u}$

From mirror formula, we get

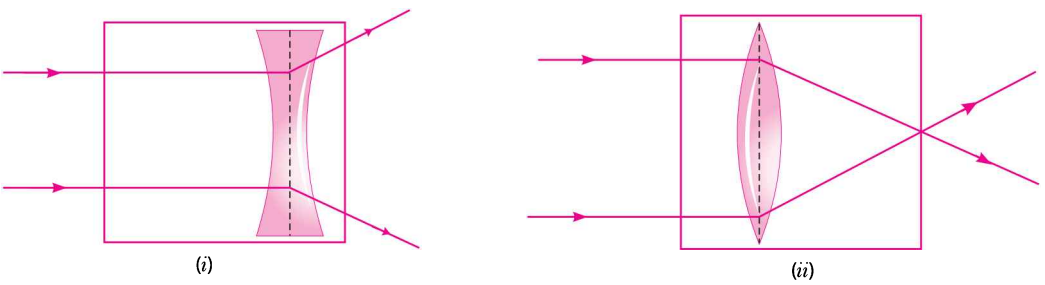
$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f} \quad \text{or} \quad 1 + \frac{u}{v} = \frac{u}{f}$$

or $$1 + \frac{1}{n} = \frac{u}{f} \quad \text{or} \quad u = \left(\frac{n+1}{n}\right) f$$

Q. 9. In the following figures, one lens is placed inside each box. State the nature of the lens. Complete the ray diagrams.



Ans.

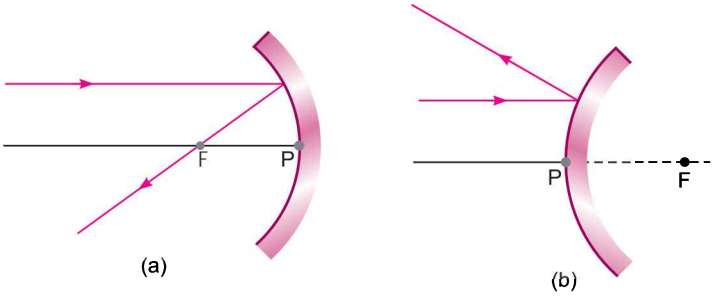


In figure (*i*), the incident rays are diverged after refraction, so the lens is concave.
In figure (*ii*), the incident rays are converged after refraction, so the lens is convex.

Q. 10. A convex lens forms a blurred image of an object on a screen.
Suggest a suitable way to get a sharp image on a screen without disturbing the object, lens or the screen.

Ans. By placing another lens of suitable nature and focal length between the object and the screen.

Q. 11. Why does a ray of light parallel to the principal axis
(*i*) bend towards the principal axis in the case of a concave mirror and
(*ii*) goes away from the principal axis in the case of a convex mirror as shown here?



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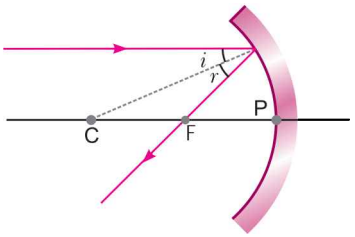
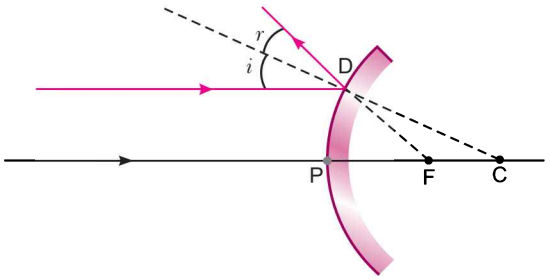
Ans. A ray of light incident on any spherical mirror follows the laws of the reflection.

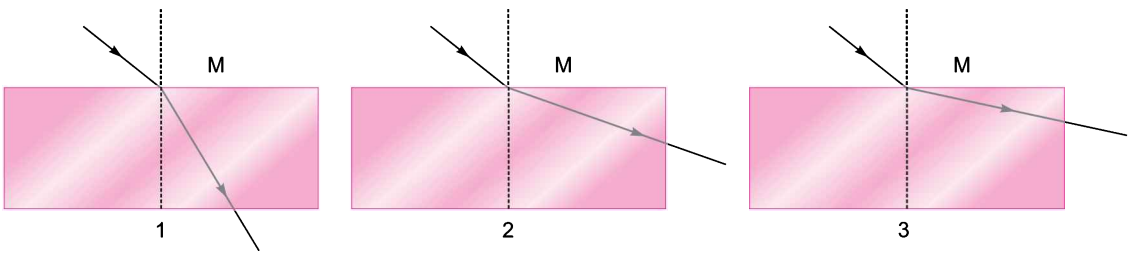
(*i*) In case of a concave mirror, the line joining the point of incidence and the centre of curvature forms the normal as shown. The reflected ray goes on the other side of the normal following laws of reflection.



(*ii*) In the case of convex mirror, the normal at the point of incidence is as shown. The reflected ray goes on the other side of the normal following laws of reflection as shown. Hence, it goes away from the principal axis.



Q. 12. The ray diagrams given below show the paths of a ray of light travelling from a medium M into different media 1, 2 and 3.



(*i*) In which of three media 1, 2 or 3 does light travel: (*a*) faster, (*b*) slower than in medium M?

(*ii*) Arrange the media 1, 2 and 3 in descending order of (*a*) speed of light through them, (*b*) their refractive index.

Ans. (*i*) (*a*) faster—in medium 2 and 3 (*b*) slower—in medium 1

(*ii*) (*a*) $v_3 > v_2 > v_1$ or $3 > 2 > 1$ (*b*) $1 > 2 > 3$ or $n_1 > n_2 > n_3$

Q. 13. If *x*, *y* and *z* denote the object distance, image distance and the radius of curvature respectively of a spherical mirror, which one of the following is the correct relation between them?

(*i*) $z = 2\dfrac{xy}{x+y}$ **(*ii*)** $z = 2\dfrac{x+y}{xy}$

(*iii*) $z = 2\dfrac{xy}{x-y}$ **(*iv*)** $z = 2\dfrac{x-y}{xy}$

Ans. For a spherical mirror,

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

$$\therefore \quad \frac{2}{z} = \frac{1}{x} + \frac{1}{y} = \frac{y+x}{xy} \quad \Rightarrow \quad \frac{z}{2} = \frac{xy}{x+y}$$

$$z = 2\frac{xy}{x+y}$$

Hence, (*i*) is the correct answer.

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Q. 14. You are given lenses with powers + 10 D, + 5 D, – 5 D, – 20 D, and – 10 D. Taking a pair of lenses at a time, which two lenses will you select to have a combination of total focal length when the two lenses are kept in contact in each case.

(*i*) 20 cm (*ii*) – 10 cm (*iii*) – 20 cm (*iv*) $\frac{20}{3}$ cm

Ans. Total power, $P = P_1 + P_2$ and total focal length f is $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$

(*i*) When lenses of 10 D and – 5 D are taken, total power

$$P = P_1 + P_2 = 10 \text{ D} - 5 \text{ D} = 5 \text{ D}$$

Hence, focal length $= \frac{100}{5} =$ **20 cm**

(*ii*) When lenses of 10 D and – 20 D are taken

$$P = 10 \text{ D} - 20 \text{ D} = -10 \text{ D}$$

Focal length $= \frac{100}{-10} =$ **– 10 cm**

(*iii*) When lenses of + 5 D and – 10 D

$$P = -5 \text{ D}$$

$$f = \frac{100}{-5} =$$ **– 20 cm**

(*iv*) When lenses of 10 D and 5 D are taken

$$P = 15 \text{ D}$$

$$f = \frac{100}{15} = \frac{\mathbf{20}}{\mathbf{3}} \textbf{ cm}$$

Q. 15. A student recorded the following data for the values of object distance and corresponding image distance while performing an experiment on real image formation by a convex lens of power + 4 D. Two of these observations are incorrect.

Without making any calculations, identify these observations and give reason for your choice.

Observation	A	B	C	D	E
Object Distance *u* (cm)	30	40	50	60	70
Image Distance *v* (cm)	20	60	50	70	30

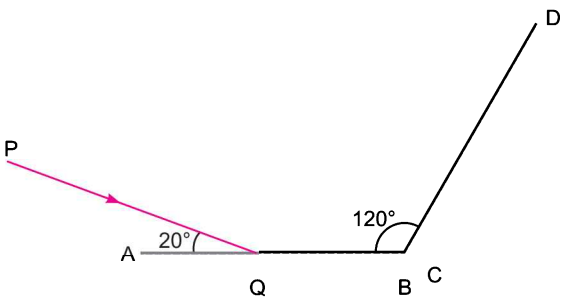
Ans. Readings A and D are incorrect.

Reason: The focal length of the lens is 25 cm.

(*i*) In reading A, the object is kept at 30 cm from the lens, *i.e.*, between F and 2F. The image should be formed beyond 2F (50 cm). However, it is shown to be at 20 cm, which is incorrect.

(*ii*) In reading D, the object is kept beyond 2F, *i.e.*, 60 cm. The image should be formed between F and 2F. However, it is also shown to be formed at 70 cm, *i.e.*, beyond 2F. Hence it is incorrect.

Q. 16. The given ray diagram shows a ray of light PQ striking a mirror AB. The mirror AB and CD are at an angle of 120° with each other. The ray PQ strikes the surface of the mirror AB at point Q.



(*i*) Draw the complete path of reflection of the ray at mirrors AB and CD.

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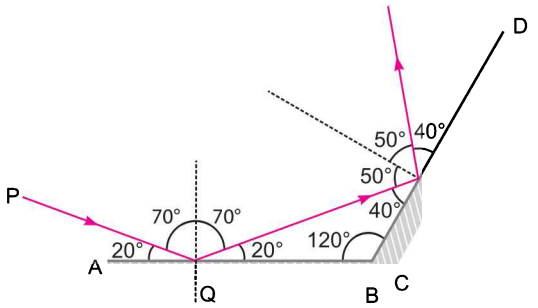
(ii) Calculate the sum of angles which the reflected rays make with the surfaces of mirrors AB and CD.

Ans. (i)



(ii) The sum of the angles, made by reflected rays with mirrors AB and CD is

$20° + 40° = 60°$

Q. 17. Playing with an old lens one morning, Ravi discovers that if he holds the lens 10 cm away from a wall opposite to a window, he can see a sharp but upside-down picture of outside world on the wall. That evening, he covers a lighted lamp with a piece of opaque paper on which he has pierced, a small hole 1 mm in diameter. By placing the lens between the illuminated card and the wall, he manages to produce a sharp image of diameter 5 mm on the wall.

Answer the following questions based on the above information:

(i) What is the power of the lens?

(ii) In the evening experiment, how far away from the opaque paper did he place the lens?

(iii) How far apart were the card and the wall?

Ans. (i) Since the rays from far away object get focussed at the principal focus, distance between lens and wall is equal to focal length 10 cm.

$\therefore$ Power of the lens = **+ 10 D**.

(ii) In the evening experiment,

$$m = \frac{h'}{h} = \frac{-5}{1} \Rightarrow m = -5$$

$$m = \frac{v}{u} \qquad \therefore v = -5u$$

Using , $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$, we get

$$\frac{1}{-5u} - \frac{1}{u} = \frac{1}{10} \Rightarrow u = \mathbf{-12\ cm}$$

(iii) $v = 60$;

Thus $u + v = 60 + 12 =$ **72 cm**.

Some Important Numericals (For Practice)

1. A 3 cm tall object is placed 18 cm in front of a concave mirror of focal length 12 cm. At what distance from the mirror should a screen be placed to see a sharp image of the object on the screen. Also calculate the height of the image formed. *[CBSE Delhi 2017]*
2. An object is placed at a distance of 10 cm from a convex mirror of focal length 5 cm.
   (i) Draw a ray diagram showing the formation of image.
   (ii) State two characteristics of the image formed.
   (iii) Calculate the distance of the image from mirror.

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3. An object placed 20 cm in front of a mirror is found to form an image at 15 cm (*i*) in front of it, (*ii*) behind the mirror. Find the focal length of the mirror and the kind of mirror in each case.
4. An object is placed at a distance of 10 cm from a concave mirror of focal length 20 cm.
   (*i*) Draw a ray diagram for the formation of image.
   (*ii*) Calculate the image distance.
   (*iii*) State two characteristics of the image formed.
5. If an object 10 cm high is placed at a distance of 36 cm from a concave mirror of focal length 12 cm, find the position, nature and height of the image.
6. If the magnification of an object of size 1 m is 2, what is the size of the image?
7. An arrow 2.5 cm high is placed at a distance of 25 cm from a diverging mirror of focal length 20 cm. Find the nature, position and size of the image formed.
8. A converging mirror forms a real image of height 4 cm of an object of height 1 cm placed 20 cm away from the mirror. Calculate
   (*i*) image distance, (*ii*) focal length of the mirror.
9. The speed of light in water is 2.25×10^8 m/s. If the speed of light in vacuum be 3×10^8 m/s, calculate the refractive index of water.
10. The refractive index of water with respect to air is 4/3. What is the refractive index of air with respect to water?
11. In an experiment with a rectangular glass slab, a student observed that a ray of light incident at an angle of 60° with the normal on one face of the slab, after refraction, strikes the opposite face of the slab before emerging out in air making an angle of 42° with the normal. Draw a labelled ray diagram to show the path of this ray. What value would you assign to the angle of refraction and angle of emergence?
12. Three beams of light 1, 2 and 3 of the same wavelength are sent through three different materials of refractive indices 1.60, 1.50 and 1.55. Arrange the speed of these beams in different materials in ascending order.
13. The refractive index of glass with respect to air is 1.65 and that of water w.r.t air is 1.33. Calculate the refractive index of water with respect to glass.
14. A convex lens has a focal length of 10 cm. At what distance from the lens should the object be placed so that it forms a real and inverted image 20 cm away from the lens? What could be the size of the image formed if the object is 2 cm high? With the help of a ray diagram, show the formation of the image by the lens in this case.
15. The image of a candle flame placed at a distance of 30 cm from a spherical lens is formed on a screen placed on the other side of the lens at a distance of 60 cm from the optical centre of the lens. Identify the type of lens and calculate its focal length. If the height of the flame is 3 cm, find the height of its image. *[CBSE Delhi 2015]*
16. An object of height 5 cm is placed perpendicular to the principal axis of a concave lens of focal length 10 cm. If the distance of the object from the optical centre of the lens is 20 cm, determine the position, nature and size of the image formed using the lens formula. *[CBSE (AI) 2015]*
17. A 5 cm tall object is placed at a distance of 20 cm from a concave mirror of focal length 30 cm. Use mirror formula to determine the position and size of the image formed. *[CBSE 2019 (31/3/1)]*
18. The image of an object formed by a lens is of magnification –1. If the distance between the object and its image is 60 cm, what is the focal length of the lens? If the object is moved 20 cm towards the lens, where would the image be formed? State reason and also draw a ray diagram in support of your answer. *[CBSE (AI) 2016]*

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19. A concave lens has focal length of 15 cm. At what distance should the object from the lens be placed so that it forms an image at 10 cm from the lens? Also, find the magnification of the lens.

20. At what distance should an object be placed from a convex lens of focal length 18 cm to obtain an image at 24 cm from it on the other side. What will be the magnification produced in this case?

21. A 2 cm high candle flame is placed at a distance of 80 cm from a white screen. On placing a convex lens exactly at the mid point of the candle and the screen, a distant image of the flame is seen on the screen. What is the focal length of the lens and the size of the candle flame image formed? Draw a ray diagram to show the formation of the image in this case.

22. One half of a convex lens of focal length 10 cm is covered with a black paper. Can such a lens produce an image of a complete object placed at a distance of 30 cm from the lens? Draw a ray diagram to justify your answer.

23. A 4 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 20 cm. The distance of the object from the lens is 15 cm. Find the nature, position and size of the image. *[CBSE (AI) 2015]*

24. The power of a lens is +4 D. What kind of lens is it and what is its focal length?

25. A lens has focal length of 10 cm. What is the power of the lens and what is its nature?

26. The power of a lens is – 2 D. What is its focal length?

27. Focal length of the lens in a photographic camera is 5 centimetres. What is the power of the lens?

28. Two lenses of power 3D and –5D are placed in contact to form a composite lens. An object is placed at a distance 50 cm from this composite lens, find the position of the image.

29. An object 3 cm high is placed 20 cm from convex lens of focal length 12 cm. Find the nature, position and height of the image.

30. Size of the image of an object by a concave lens of focal length 20 cm is observed to be reduced to $\frac{1}{2}$ of its size. Find the distance of the object from the lens.

31. An object 2 cm high is placed at a distance of 64 cm from a white screen. On placing a convex lens at a distance of 32 cm from the object it is found that a distinct image of the object is formed on the screen. What is the focal length of the convex lens and size of the image formed on the screen?

32. The magnification of an image formed by a lens is –1. If the distance of the image from the optical centre of the lens is 25 cm, where is the object placed ? Find the nature and focal length of the lens. If the object is displaced 15 cm towards the optical centre of the lens, where would the image be formed ? Draw a ray diagram to justify your answer. *[CBSE (F) 2017]*

Answers

1. $v = -36$ cm $h' = -6$ cm **2.** (*ii*) virtual and erect; diminished (*iii*) 3.3 cm

3. (*i*) concave mirror of focal length $\frac{60}{7}$ cm, (*ii*) convex mirror of focal length 60 cm

4. (*ii*) 20 cm; (*iii*) virtual and erect; magnified

5. – 18 cm; real and inverted; – 5 cm **6.** 2 m

7. v = 11.1 cm; virtual and erect; 1.1 cm tall **8.** (*i*) – 80 cm (*ii*) – 16 cm

9. 1.33 **10.** 3/4 **11.** Angle of refraction = 42°, Angle of emergence = 60°

12. $v_1 < v_3 < v_2$ **13.** 0.80 **14.** $u = -20$ cm; $h' = -2$ cm

15. Convex lens, $f = +20$ cm, $h' = -6$ cm

16. The image is virtual and erect, $v = -\frac{20}{3}$ cm, and $h' = 1.6$ cm

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17. $v = 60$ cm, $h' = 15$ cm **19.** $u = -30$ cm, $+1/3$ **20.** $m = -1/3$

21. $f = -20$ cm, $h' = -2$ cm

23. The image is virtual, erect and magnified, size of the image is 16 cm.

24. Convex lens; 25 cm **25.** 10 D; convex lens **26.** –50 cm

27. + 20 D **28.** $v = -25$ cm **29.** $v = 30$ cm, $h' = -4.5$ cm **30.** 20 cm

31. $f = 16$ cm, $h' = -2$ cm **32.** $f = 12.5$ cm

NCERT Corner

NCERT Intext Questions

REFLECTION

Q. 1. Define the principal focus of a concave mirror.

Ans. The point on the principal axis at which all the rays parallel and close to the principal axis meet after reflection from the concave mirror is called principal focus.

Q. 2. The radius of curvature of a spherical mirror is 20 cm. What is its focal length?

Ans. Here, radius of curvature, $R = 20$ cm.

Focal length, $f = ?$

We know that, $f = \frac{R}{2} = \frac{20}{2}\text{cm} = \mathbf{10\ cm}$

The focal length of spherical mirror is 10 cm.

Q. 3. Name a mirror that can give an erect and enlarged image of an object.

Ans. Concave mirror can give an erect and enlarged image of an object, when the object is placed between the pole and the focus of the mirror.

Q. 4. Why do we prefer a convex mirror as a rear-view mirror in vehicles?

Ans. Convex mirrors are used as rear-view mirrors in vehicles to see the traffic at the rear side. Convex mirrors are preferred because

(*i*) they always give an erect, though diminished image.

(*ii*) they have a wider field of view as they are curved outwards.

Thus, convex mirrors enable the driver to view much larger area than a plane mirror.

Q. 5. Find the focal length of a convex mirror whose radius of curvature is 32 cm.

Ans. Here, $R = 32$ cm; $f = ?$ [convex mirror]

$$f = \frac{R}{2} = \frac{32}{2} = \mathbf{16\ cm}$$

Q. 6. A concave mirror produces three times magnified (enlarged) real image of an object placed at 10 cm in front of it. Where is the image located?

Ans. Here, in case of concave mirror

$u = -10$ cm [u is always negative]

$v = ?$; $m = -3$ [real image]

Now the magnification formula is

$$m = \frac{-v}{u} \qquad \text{or} \qquad -3 = -\left(\frac{v}{-10}\right)$$

or $v = \mathbf{-30\ cm.}$

Image will be formed at 30 cm from the mirror on the same side of the object.

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REFRACTION

Q. 7. A ray of light travelling in air enters obliquely into water. Does the light ray bend towards the normal or away from the normal? Why?

Ans. Light ray travelling in air and entering obliquely into water is bent towards the normal because the speed of the ray decreases in water.

Q. 8. Light enters from air into glass having refractive index 1.50. What is the speed of light in glass? The speed of light in vacuum is 3×10^8 ms^{-1}.

Ans. Given, $n = 1.5$ and the speed of light in vacuum, $c = 3 \times 10^8$ ms^{-1}. We know that the refractive index is given by the expression $n = \frac{c}{v}$ where c is the speed of light in vacuum and v is the speed of light in the given medium (glass). Hence we have

$$v = \frac{c}{n} = \frac{3\times10^8}{1.5} = \mathbf{2.0\times10^8\ ms^{-1}}$$

Q. 9. Find out, from table given below, the medium having highest optical density. Also find the medium with lowest optical density.

Material medium	Refractive index	Material medium	Refractive index
Air	1.0003	Crown glass	1.52
Ice	1.31	Canada Balsam	1.53
Water	1.33	Rock salt	1.54
Alcohol	1.36	Carbon disulphide	1.63
Kerosene	1.44	Dense flint glass	1.65
Fused quartz	1.46	Ruby	1.71
Turpentine oil	1.47	Sapphire	1.77
Benzene	1.50	Diamond	2.42

Ans. A substance having higher refractive index is optically denser than another substance having lower refractive index. So the medium having highest optical density is diamond. The medium with lowest optical density is air.

Q. 10. You are given kerosene, turpentine and water. In which of these does the light ray travel fastest? Given refractive index of kerosene = 1.44, Refractive index of turpentine 1.47, refractive index of water = 1.33.

Ans. Speed of light in a medium is inversely proportional to refractive index of the medium, *i.e.*, $v \propto \frac{1}{n}$. As refractive index of water is minimum, so light travels fastest in water.

Q. 11. The refractive index of diamond is 2.42. What is the meaning of this statement?

Ans. The refractive index of diamond is 2.42. It means that for a light ray travelling in vacuum and entering diamond, speed is slowed and becomes $\frac{1}{2.42}$ times than that in the vacuum.

Q. 12. Define 1 dioptre of power of a lens.

Ans. 1 dioptre is the power of a lens whose focal length is 1 metre.

Q. 13. A convex lens forms a real and inverted image of a needle at a distance of 50 cm from the lens. Where is the needle placed in front of the convex lens if the image is equal to the size of the object? Also, find the power of the lens.

Ans. When an object is placed, at $2F_1$, of a convex lens, its image is formed at $2F_2$ and is of the same size as object.

Here, it is given that the image of the needle is formed at a distance of 50 cm from the convex lens. Hence, the needle is placed in front of the lens at a distance of 50 cm.

Object distance, $u = -50$ cm

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Image distance $v = 50$ cm

Focal length $= f$

According to lens formula

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{f} = \frac{1}{50} - \frac{1}{(-50)} = \frac{2}{50} = \frac{1}{25}$$

$f = 25$ cm $= 0.25$ m

Power of lens $= \frac{1}{f(\text{in m})} = \frac{1}{0.25} =$ **+ 4D**

Q. 14. Find the power of a concave lens of focal length 2 m.

Ans. Given $f = -2$ m

Power, $P = \frac{1}{f} = \frac{1}{-2} = -0.5$ dioptre.

Thus, the power of concave lens is – 0.5 dioptre.

NCERT Exercises

REFLECTION

Q. 1. The image formed by a concave mirror is observed to be virtual, erect and larger than the object. What should be the position of the object?

(*i*) Between the principal focus and the centre of curvature.

(*ii*) At the centre of curvature.

(*iii*) Beyond the centre of curvature.

(*iv*) Between the pole of the mirror and its principal focus.

Ans. The image formed by a concave mirror is virtual, erect and larger only when the object is placed between the pole of the mirror and its principal focus. So correct choice is (*d*).

Q. 2. No matter how far you stand from a mirror, your image appears erect. The mirror is likely to be

(*i*) only plane. **(*ii*) only concave.**

(*iii*) only convex. **(*iv*) either plane or convex.**

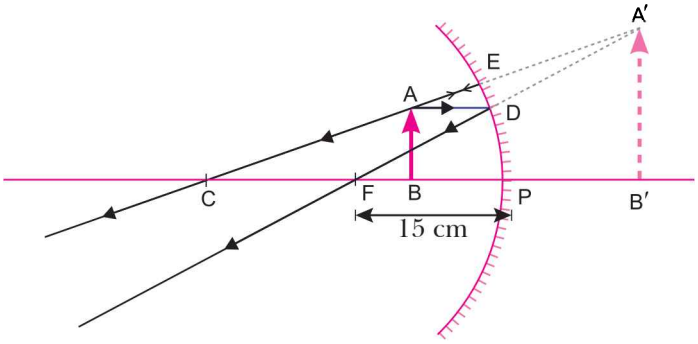
Ans. A plane mirror forms an erect image of equal size; while a convex mirror forms an erect image of smaller size irrespective of the distance of object from the mirror, so correct choice is (*d*).

Q. 3. We wish to obtain an erect image of an object, using a concave mirror of focal length 15 cm. What should be the range of the distance of the object from the mirror? What is the nature of the image? Is the image larger or smaller than the object? Draw a ray diagram to show the image formation in this case.

Ans. An erect image is formed by a concave mirror, only if the object is placed between the pole and the principal focus of the mirror (*i.e.*, range of object distance is between 0 and 15 cm. *i.e.*, $0 < u < 15$ cm.)

Nature: The image is ***virtual***.

Size of Image: The image is larger than the object. The ray diagram is shown in figure.



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Q. 4. Name the type of mirror used in following situations:

(*i*) Headlights of a car. **(*ii*) Side/Rear-view mirror of a vehicle.**

(*iii*) Solar furnace.

Support your answer with reason.

Ans. (*i*) Headlights of a car use a concave mirror.

Concave mirror renders the rays parallel when object is placed at its principal focus. The bulb of headlight is at focus of concave mirror, the rays reflected from the mirror are in the form of a strong parallel beam, which goes straight and makes the distant objects visible for safe driving.

(*ii*) Side/rear view mirror of a vehicle is a convex mirror because of its larger field of view.

(*iii*) Solar furnace uses a concave mirror. The object to be heated is placed at the focus of concave mirror. The parallel rays coming from the sun become incident on the mirror and get reflected at focus. That is sufficient energy is received from the sun and collected at one point (focus) to heat the object.

Q. 5. An object is placed at a distance of 10 cm from a convex mirror of focal length 15 cm. Find the position and nature of the image.

Ans. Given, $u = -10$ cm, $f = +15$ cm, $v = ?$

From mirror formula, $\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$ or $\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$

$\Rightarrow \quad \frac{1}{v} = \frac{1}{15} - \frac{1}{(-10)} = \frac{1}{15} + \frac{1}{10} = \frac{2+3}{30}$

or $\quad v = \frac{30}{5} = \mathbf{+6\ cm}$

That is the image is formed at a distance of 6 cm from the mirror behind it. The image is erect and virtual.

Q. 6. The magnification produced by a plane mirror is + 1. What does this mean?

Ans. The positive (+) sign of magnification (m) indicates that the image is virtual and erect. The magnification, $m = 1$ indicates that the image is of the same size as the object. Thus, the magnification of + 1 produced by a plane mirror means the image formed in a plane mirror is virtual, erect and of the same size as the object.

Q. 7. An object 5 cm in length is placed at a distance of 20 cm in front of a convex mirror of radius of curvature 30 cm. Find the position of the image, its nature and size.

Ans. Radius of curvature of convex mirror, $R = 30$ cm.

$\therefore$ Focal length of convex mirror, $f = \frac{R}{2} = \frac{30\text{ cm}}{2} = 15\text{ cm}$

Now $h = 5$ cm, $u = -20$ cm, $v = ?$, $h' = ?$

Using the mirror formula $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$, we have

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{15} - \frac{1}{-20} = \frac{1}{15} + \frac{1}{20} = \frac{4+3}{60}$$

$$v = \frac{60}{7} = \mathbf{+8.6\ cm}$$

Thus, image is formed at a distance of 8.6 cm behind the convex mirror. The image is virtual and erect.

$$m = \frac{h'}{h} = -\frac{v}{u}$$

$$\frac{h'}{5} = -\frac{8.6}{-20} \quad \Rightarrow \quad h' = \frac{8.6}{20} \times 5 = 2.15\text{ cm}$$

Thus, the size of the image is 2.15 cm which is positive. It indicates that the image formed is erect, virtual and diminished.

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Q. 8. An object of size 7 cm is placed at 27 cm in front of a concave mirror of focal length 18 cm. At what distance from the mirror should a screen be placed, so that a sharp focused image can be obtained? Find the size and the nature of the image.

Ans. Here, $h = 7\text{ cm}, u = -27\text{ cm}, f = -18\text{ cm}, v = ?, h' = ?$

Using the mirror formula $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$, we have

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$$

$$= \frac{1}{-18} - \frac{1}{-27} = \frac{1}{-18} + \frac{1}{27} = \frac{-3+2}{54} = -\frac{1}{54}$$

$$v = \mathbf{-54\text{ cm}}$$

The image is formed at a distance of 54 cm in front of the mirror and '–' sign shows that image is formed on the same side as that of the object. It means image is real and inverted.

Further, we know that $m = \frac{h'}{h} = -\frac{v}{u}$

$$\frac{h'}{7} = \frac{-(-54)}{(-27)}$$

$$h' = \mathbf{-14\text{ cm}}$$

Hence, the size of the image is 14 cm. The negative sign of the image shows that it is inverted. Thus, the nature of the image is real, inverted and enlarged.

REFRACTION

Q. 9. Which one of the following materials cannot be used to make a lens?

(*i*) Water **(*ii*) Glass**

(*iii*) Plastic **(*iv*) Clay**

Ans. Lens is made of a transparent material. Since clay is not transparent.

So, correct choice is (*d*).

Q. 10. Where should an object be placed in front of a convex lens to get a real image of the size of the object?

(*i*) At the principal focus of the lens

(*ii*) At twice the focal length

(*iii*) At infinity

(*iv*) Between the optical centre of the lens and its principal focus.

Ans. For real image of same size, the object must be placed at the distance $2f$ in front of convex lens.

So, correct choice is (*b*).

Q. 11. A spherical mirror and a thin spherical lens have each a focal length of –15 cm. The mirror and lens are likely to be

(*i*) both concave.

(*ii*) both convex.

(*iii*) the mirror is concave and the lens is convex.

(*iv*) the mirror is convex and the lens is concave.

Ans. Concave mirror and concave lens both have negative focal length. So, correct choice is (*a*).

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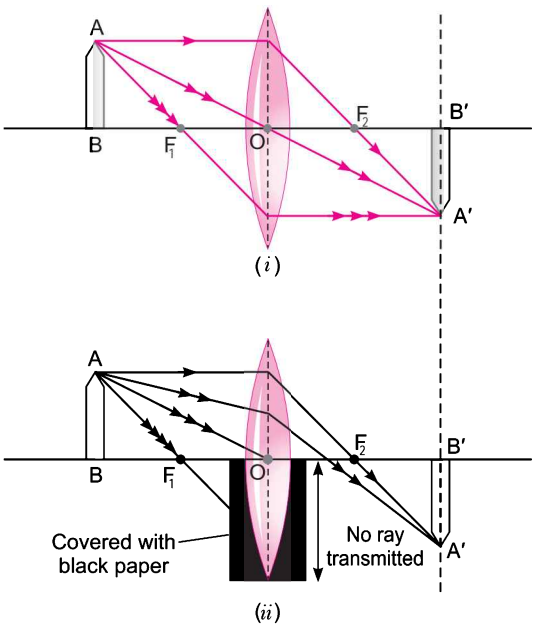
Q. 12. Which of the following lenses would you prefer to use while reading small letters found in a dictionary?

(*i*) A convex lens of focal length 50 cm **(*ii*) A concave lens of focal length 50 cm**

(*iii*) A convex lens of focal length 5 cm **(*iv*) A concave lens of focal length 5 cm**

Ans. Magnifier or a simple microscope consists of a convex lens of small focal length. So, correct choice is (*iii*).

Q. 13. One half of a convex lens is covered with a black paper. Will this lens produce a complete image of the object? Verify your answer experimentally. Explain your observations.



Ans. Take a live candle, put it in front of a convex lens mounted on an optical bench. Move the candle along the axis of the bench and take its full image on a screen fig. (*i*). Now cover the lower half of the lens with a black paper without changing the positions of candle, lens and screen fig. (*ii*).

You will observe that the full image of the candle is still seen on the screen; but the intensity of image is reduced. The reason is that a large number of rays incident on the lens are refracted to form the image when lens is not covered. In the case of covered lower half of lens with black paper, the rays starting from candle and incident on lens are refracted from the upper part only and form the full image, having low intensity.

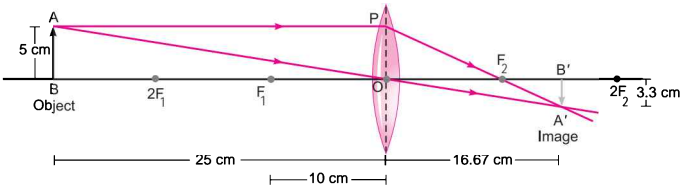
Q. 14. An object 5 cm in length is held 25 cm away from a converging lens of focal length 10 cm. Draw the ray diagram and find the position, size and the nature of the image formed.

Ans. Here,

$u = -25$ cm (u is always negative)

$f = +10$ cm (convex lens)

$h = 5$ cm; $v = ?$ and $h' = ?$



From the lens formula

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\Rightarrow \quad \frac{1}{v} = \frac{1}{f} + \frac{1}{u}$$

$$= \frac{1}{10} + \frac{1}{-25} = \frac{3}{50}$$

or $$v = \frac{50}{3} = \mathbf{16.67\ cm}$$

This image is formed at a distance 16.67 cm behind the lens.

Also, magnification

$$m = \frac{h'}{h} = \frac{v}{u}$$

or $$h' = \frac{v}{u} \times h = \frac{16.67}{-25} \times 5 = \mathbf{-3.33\ cm}$$

Thus, image is inverted, real and of size 3.33 cm.

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Q. 15. A concave lens of focal length 15 cm, forms an image at a distance of 10 cm from the lens. How far is the object placed from the lens? Draw the ray diagram.

Ans. Here, focal length of the concave (diverging) lens is

$f = -15$ cm (negative), $v = -10$ cm (image same side in concave lens)

$u = ?$

By lens formula, we have $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$

or $\frac{1}{u} = \frac{1}{v} - \frac{1}{f} = \frac{1}{(-10)} - \frac{1}{(-15)}$

$= -\frac{1}{10} + \frac{1}{15} = \frac{-3+2}{30} = -\frac{1}{30}$

or $u = \mathbf{-30\ cm}$

The object is placed at a distance of 30 cm away from the lens.

Q. 16. Find the focal length of a lens of power – 2.0 D. What type of lens is this?

Ans. Given Power, $P = -2.0$ D

If f is the focal length of lens, then $P = \frac{1}{f}$ gives

$$f = \frac{1}{P} = \frac{1}{-2.0}\ \text{m} = \mathbf{-50\ cm}$$

Negative sign shows that lens is concave. Thus focal length of lens is 50 cm and it is concave lens.

Q. 17. A doctor has prescribed a corrective lens of power + 1.5 D. Find the focal length of the lens. Is the prescribed lens diverging or converging?

Ans. Given $P = +1.5$ D

As $P = \frac{1}{f(\text{in metre})}$,

Focal length, $f = \frac{1}{P} = \frac{1}{1.5} = 0.667$ m $= \mathbf{66.7\ cm}$

As power of prescribed lens is positive, the lens is converging (or convex) lens.

SELF-ASSESSMENT TEST

Time allowed: 1 hour **Max. marks: 40**

SECTION–A

Choose and write the correct answer for each of the following. **(4 × 1 = 4)**

1. A lens has a power of + 0·5 D. It is

(*a*) a concave lens of focal length 5 m (*b*) a convex lens of focal length 5 m

(*c*) a convex lens of focal length 2 m (*d*) a concave lens of focal length 2 m

2. Which of the following can make a parallel beam of light when light from a point source is incident on it? [*NCERT Exemplar*]

(*a*) Concave mirror as well as convex lens

(*b*) Convex mirror as well as concave lens

(*c*) Two plane mirrors placed at 90° to each other

(*d*) Concave mirror as well as concave lens

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3. **Two convex lens of focal length 20 cm and 25 cm are placed in contract with each other, then power of this combination is**
   (*a*) +1D (*b*) –1D (*c*) +9D (*d*) –9D

4. **Rays from the sun converge at a point 15 cm in front of a concave mirror. Where should an object be placed so that the size of its image is equal to the size of the object?** [*NCERT Exemplar*]
   (*a*) 15 cm in front of the mirror
   (*b*) 30 cm in front of the mirror
   (*c*) between 15 cm and 30 cm in front of the mirror
   (*d*) more than 30 cm in front of the mirror

The following questions consist of two statements—Assertion(A) and Reason(R). Answer these questions selecting the appropriate option given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation for *A*.
(*b*) Both *A* and *R* are true but *R* is not the correct explanation for *A*.
(*c*) *A* is true but *R* is false.
(*d*) *A* is false but *R* is true. **(3 × 1 = 3)**

5. **Assertion (*A*) :** The formula connecting u, v and f for a spherical mirror is valid in all situations for all spherical mirrors for all positions of the object.
   Reason (*R*) : Laws of reflection are strictly valid for plane surfaces.
6. **Assertion (*A*) :** A person cannot see his image in a concave mirror, unless, he is standing beyond the center of curvature of the mirror.
   Reason (*R*) : In a concave mirror, image formed is real provided the object is situated beyond its focus.
7. **Assertion (*A*) :** Virtual images are always erect.
   Reason (*R*) : Virtual images are formed by diverging lenses only.

Answer the following questions in one word or one sentence. **(3 × 1 = 3)**

8. What is the angle of reflection when a ray of light falls normally on a plane mirror?
9. What is the magnification produced by a plane mirror?
10. Can a plane mirror be called spherical mirror?

SECTION–B

Answer the following questions in about 50-60 words each. **(5 × 3 = 15)**

11. (*i*) State the relation between object distance, image distance and focal length of a spherical mirror.
    (*ii*) Draw a ray diagram to show the image formed when an object is placed between pole and focus of the concave mirror.
12. (*i*) A child is standing in front of a magic mirror. She finds the image of her head bigger, the middle portion of her body of the same size and that of the leg smaller. Write the order of combinations for the magic mirror from the top.
    (*ii*) The absolute refractive index of Ruby is 1.7. Find the speed of light in Ruby. The speed of light in vacuum is 3×10^8 m/s. [*CBSE 2019 (31/2/1)*]
13. The refractive index of a medium 'X' with respect to medium 'Y' is $\frac{2}{3}$ and the refractive index of medium 'Y' with respect to medium 'Z' is $\frac{4}{3}$. Find the refractive index of medium 'Z' with respect to medium 'X'.

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14. (*i*) Which property of concave mirror is utilised for using them as shaving mirrors?

(*ii*) The power of a lens is +5 diopters. What is the nature and focal length of this lens? At what distance from this lens should an object be placed so as to get its inverted image of the same size? *[CBSE 2019 (31/2/2)]*

15. If the image formed by a lens for all positions of the object placed in front of it is always virtual, erect and diminished, state the type of the lens. Draw a ray diagram in support of your answer. If the numerical value of focal length of such a lens is 20 cm, find its power in new cartesian sign conventions. *[CBSE (F) 2016]*

SECTION–C

Answer the following questions in about 80–90 words each. **(3 × 5 = 15)**

16. Find the position of an object which when placed in front of a concave mirror of focal length 20 cm produces a virtual image twice the size of the object.

17. You have two lenses A and B of focal lengths +10 cm and –10 cm respectively. State the nature and power of each lens. Which of the two lenses will form a virtual and magnified image of an object placed 8 cm from the lens? Draw a ray diagram to justify your answer. *[CBSE (AI) 2015]*

18. Draw the ray diagram in each case to show the position and nature of the image formed when the object is placed: (*i*) in front of a convex lens at F, (*ii*) at 2F of a convex lens, (*iii*) between the lens and infinity of a concave lens.

Answers

1. (*c*) **2.** (*a*) **3.** (*c*) **4.** (*b*) **5.** (*c*) **6.** (*b*) **7.** (*c*)

8. 0° **9.** 1

10. A plane mirror is a spherical mirror with a focal length equal to infinity.

13. $\frac{9}{8}$ **14.** (*ii*) P = 2 D **15.** $u = 35$ cm $= v$, $f = 17.5$ cm

16. $u = -10$ cm

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11 The Human Eye and the Colourful World

BASIC CONCEPTS—A FLOW CHART

HUMAN EYE AND COLOURFUL WORLD

Human Eye

Main Parts of the Eye

Cornea
Transparent spherical membrane covering front of the eye through which light enters.

Iris
Coloured diaphragm between the cornea and the lens that controls size of pupil.

Pupil
A hole in the middle of the iris that regulates the amount of light entering the eye.

Retina
Screen on which the image is formed by the lens system of human eye.

Eye Lens
Transparent crystalline convex lens converges the light rays and produces a real and inverted image of object on retina.

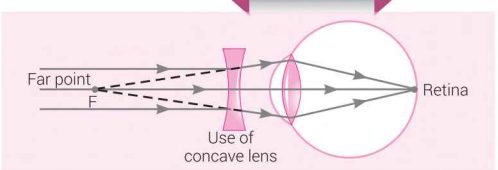
Optic Nerve
Transfers signals from retina to the brain.

Defects of Eye

Myopia or Near-sightedness
- Eye cannot see distant objects clearly.
- Image of distant object forms in front of retina.

Reasons:
(i) Focal length of eye lens is too short
(ii) Elongation of eyeball.

Correction → **Concave Lens**



Types of light sensitive cells

Rods
Respond to the intensity of light and enable vision in dim light.

Cones
Respond to colour so that we perceive objects as they are.

Power of Accommodation
- Ability of the eye lens to adjust its focal length.
- Relaxation of ciliary muscles → lens becomes thin → increase in focal length.
- Contraction of ciliary muscles → lens becomes thick → focal length decreases.

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Phenomena Occurring in Nature

Dispersion of Light

- Splitting of light into its component colours.
- White light disperses into its seven-colour components in the order VIBGYOR (Violet, Indigo, Blue, Green, Yellow, Orange, Red).
- Red light bends least, violet the most.
- Rainbow appears due to dispersion of sunlight by tiny rain droplets.

Atmospheric Refraction

- Refraction of light by the earth's atmosphere.
- The twinkling of stars is due to continuously atmospheric refraction of starlight before it reaches earth.

Scattering of Light

Tyndall Effect

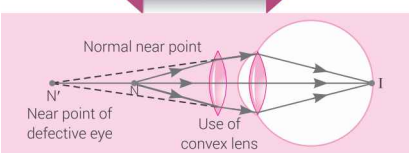
- When a beam of light strikes fine particles in air, path of the beam becomes visible.
- Very fine particles scatter mainly blue light while particles of larger size scatter light of longer wavelengths.

Hypermetropia or Far-Sightedness

- Eye cannot see nearby objects clearly.
- Image of close by object forms behind retina.
- Reasons:
  (i) Focal length of eye lens is too long.
  (ii) Eyeball becomes small.

Correction

Convex Lens



Presbyopia

- Eye suffers from myopia as well as from hypermetropia.
- Due to gradual weakening of ciliary muscles and diminishing flexibility of eye lens.

Correction

Bi-focal Lens (concave + convex lenses)

Calculation of focal length for correcting lenses:

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

(i) For Myopia: $u = \infty$
v = far point of myopic person

(ii) For Hypermetropia: u = normal near point of eye (25 cm)
v = near point of hypermetropic eye.

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MORE POINTS TO REMEMBER

❒ **Working of eye:**

- Light reflects off from the object and enters the eyeball through the cornea.
- The cornea bends the light rays through the pupil.
- The adjusted light passes through the eye's lens.
- The eye lens is convex in nature. The image formed on the retina is real, small and inverted.
- The retina converts the light rays into electrical signals which are sent to the brain via optic nerve.

❒ **Near Point:** The closest distance at which the eye can focus clearly is called the near point or least distance of distinct vision. For young adults with normal vision, it is about 25 cm.

❒ **Far Point:** The farthest distance at which an object can be seen clearly is called far point. It is infinity for a normal eye.

❒ **Persistence of Vision:** The impression or sensation of the image remains on the retina for about 1/16th of a second. It is called persistence of vision. In cinematography the principle of persistence of vision is used. The sequence of still pictures taken by a movie camera is projected on the screen at a rate of 24 images or more per second. The images on the screen appear to blend or merge smoothly into one another.

❒ **How do We See Colours:** The retina of our eye has a larger number of light sensitive cells. The cells on the retina are of two shapes—rod-shaped and cone-shaped. The rod-shaped cells respond to the intensity of light. The cone-shaped cells of our retina respond to colours. Thus, cones make colour perception possible.

❒ **Colour Blindness:** The defect of the eye due to which a person is unable to distinguish between certain colours, is known as colour blindness. The colour blind persons do not possess cone cells that respond to certain colours. Colour blindness is a genetic disorder which occurs by inheritance. It has not been cured so far.

❒ **Calculation of Focal Length and Power of Concave Lens to Correct Myopia:** The focal length of concave lens required to correct myopia is calculated by the lens formula:

$$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$$

In this case, $u = \infty$, (infinity)

v = far point of myopic person

Knowing the focal length, power is calculated by

$$P=\frac{1}{f(\text{in m})}$$

❒ **Calculation of Focal Length and Power of Convex Lens to Correct Hypermetropia:**

Formula used: $$\frac{1}{v}-\frac{1}{u}=\frac{1}{f}$$

Take, u = normal near point of the eye (25 cm)

v = near point of the hypermetropic eye.

Knowing f, power is calculated by

$$P=\frac{1}{f(\text{in m})}$$

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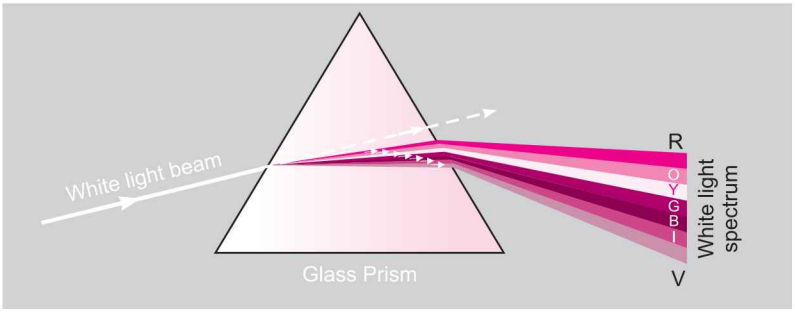
❒ **Dispersion through glass prism:** The prism splits the incident white light into a band of colours. Different colours of light bend through different angles with respect to the incident ray, as they pass through a prism. The red light bends the least while the violet the most.



Multiple Choice Questions [1 mark]

Each question has 4 choices (a), (b), (c) and (d). Choose and write the correct option.

1. **The eyeball is approximately spherical in shape with a diameter of about**
   (a) 2.0 cm (b) 2.3 cm (c) 2.5 cm (d) 2.7 cm
2. **A normal eye can see objects clearly that are between**
   (a) our eye and infinity (b) 25 cm and infinity
   (c) 50 cm and infinity (d) 100 cm and infinity
3. **The crystalline lens of people at old age becomes milky and cloudy. This condition is called**
   (a) myopia (b) hypermetropia (c) presbyopia (d) cataract
4. **We can see a rainbow on a sunny day when you look at the sky through a waterfall or through a water fountain**
   (a) with the Sun in front of you (b) with the Sun behind you
   (c) with the Sun overhead (d) just after the sunset
5. **The time difference between actual sunset and the apparent sunset is about**
   (a) 2 min (b) 3 min (c) 4 min (d) 5 min
6. **The sky would appear red instead of blue if**
   (a) atmospheric particles scatter blue light more than red light
   (b) atmospheric particles scatter all colours equally
   (c) atmospheric particles scatter red light more than blue light
   (d) the Sun was much hotter
7. **For normal vision, what is minimum distance of object from eye?**
   (a) 25 cm (b) 30 cm (c) 40 cm (d) Infinite
8. **The blue colour of the sky is due to the phenomenon of**
   (a) scattering (b) dispersion (c) reflection (d) refraction
9. **Electric signals from retina to brain is conveyed via**
   (a) ciliary muscles (b) blind spot (c) optic nerves (d) pupil
10. **Dispersion of light by glass prism takes place because**
    (a) the lights of different colours have different intensities.
    (b) the lights of different colours have different speed in a medium.

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(*c*) different colours have different frequencies.

(*d*) the lights of different colours have different energies.

11. The colour of light which is deviated the least by a prism in the spectrum of white light is

(*a*) red (*b*) green (*c*) violet (*d*) yellow

12. The colour of light which is deviated the most by a prism in the spectrum of white light is

(*a*) red (*b*) green (*c*) violet (*d*) yellow

13. A person cannot see objects distinctly kept beyond 2 m. This defect can be corrected by using a lens of power [*NCERT Exemplar*]

(*a*) +0.5 D (*b*) –0.5 D (*c*) +0.2 D (*d*) –0.2 D

14. A student sitting on the last bench can read the letters written on the blackboard but is not able to read the letters written in his textbook. Which of the following statements is correct? [*NCERT Exemplar*]

(*a*) The near point of his eyes has receded away

(*b*) The near point of his eyes has come closer to him

(*c*) The far point of his eyes has come closer to him

(*d*) The far point of his eyes has receded away

15. The clear sky appears blue because [*NCERT Exemplar*]

(*a*) blue light gets absorbed in the atmosphere.

(*b*) ultraviolet radiations are absorbed in the atmosphere.

(*c*) violet and blue lights get scattered more than lights of the other colours by the atmosphere.

(*d*) light of all other colours is scattered more than the violet and blue colour lights by the atmosphere.

16. At noon the Sun appears white because [*NCERT Exemplar*]

(*a*) light is least scattered (*b*) all colours get scattered equally

(*c*) blue colour is scattered the most (*d*) red colour is scattered the most

17. Which of the following phenomena of light are involved in the formation of a rainbow? [*NCERT Exemplar*]

(*a*) Reflection, refraction and dispersion

(*b*) Refraction, dispersion and total internal reflection

(*c*) Refraction, dispersion and internal reflection

(*d*) Dispersion, scattering and total internal reflection

18. Which of the following statements is correct regarding the propagation of light of different colours of white light in air? [*NCERT Exemplar*]

(*a*) Red light moves fastest.

(*b*) Blue light travels faster than green light.

(*c*) All colours of white light move with the same speed.

(*d*) Yellow light moves with the mean speed as that of red and violet lights.

19. When light rays enter the eye, most of the refraction occur at the [*NCERT Exemplar*]

(*a*) crystalline lens (*b*) outer surface of cornea

(*c*) iris (*d*) pupil

20. The focal length of eye lens increases when eye muscles [*NCERT Exemplar*]

(*a*) are relaxed and lens becomes thinner (*b*) contract and lens becomes thicker

(*c*) are relaxed and lens becomes thicker (*d*) contract and lens becomes thinner

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21. Which of the following statements is correct? [NCERT Exemplar]

(*a*) A person with myopia can see distinct objects clearly.

(*b*) A person with hypermetropia can see nearby objects clearly.

(*c*) A person with myopia can see nearby objects clearly.

(*d*) A person with hypermetropia cannot see distant objects clearly.

22. The danger signals installed at the top of tall buildings are red in colour. These can be easily seen from a distance because among all other colours, the red light [NCERT Exemplar]

(*a*) is scattered the most by smoke or fog (*b*) is scattered the least by smoke or fog

(*c*) is absorbed the most by smoke or fog (*d*) moves fastest in air

Answers

1. (*b*)	**2.** (*b*)	**3.** (*d*)	**4.** (*b*)	**5.** (*a*)	**6.** (*c*)	**7.** (*a*)	**8.** (*a*)
9. (*c*)	**10.** (*b*)	**11.** (*a*)	**12.** (*c*)	**13.** (*b*)	**14.** (*a*)	**15.** (*c*)	**16.** (*a*)
17. (*c*)	**18.** (*c*)	**19.** (*b*)	**20.** (*a*)	**21.** (*c*)	**22.** (*b*)		

Assertion-Reason Questions [1 mark]

The following questions consist of two statements — Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

1. Assertion (*A*) : White light is dispersed into its seven-colour components by a prism.
Reason (*R*) : Different colours of light bend through different angles with respect to the incident ray as they pass through a prism.

2. Assertion (*A*) : The phenomenon of scattering of light by the colloidal particles gives rise to Tyndall effect.
Reason (*R*) : The colour of the scattered light depends on the size of the scattering particles.

3. Assertion (*A*) : A normal human eye can clearly see all the objects beyond certain minimum distance.
Reason (*R*) : The human eye has capacity of adjusting the focal length of eye lens.

4. Assertion (*A*) : A rainbow is sometimes seen in the sky in rainy season only when observer's back is towards the Sun.
Reason (*R*) : Internal reflection in the water droplets cause dispersion and the final rays are in backward direction.

5. Assertion (*A*) : Myopia is the defect of the eye in which only nearer objects are seen by the eye.
Reason (*R*) : The eye ball is elongated.

6. Assertion (*A*) : Hypermetropia is the defect of the eye in which only farther objects are seen.
Reason (*R*) : Hypermetropia is corrected by using converging lens.

7. Assertion (*A*) : Danger signals are made of red colour.
Reason (*R*) : Velocity of red light in air is maximum, so signals are visible even in dark.

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8. **Assertion (*A*) :** The sky looks dark and black instead of blue in outer space.
   Reason (*R*) : No atmosphere containing air in the outer space to scatter sunlight.

Answers

1. (*a*) **2.** (*b*) **3.** (*a*) **4.** (*a*) **5.** (*a*) **6.** (*b*) **7.** (*c*) **8.** (*a*)

Passage-based Questions

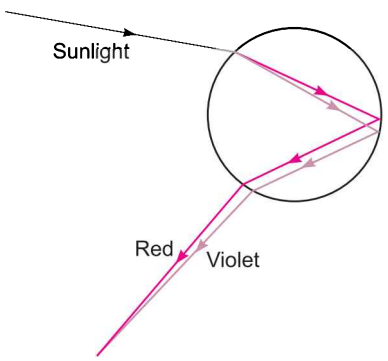
Answer the questions below each passage on the basis of your understanding of the paragraph and the related studied concepts.

1. A beautiful atmospheric phenomenon commonly seen after rain is the rainbow. The colourful arc of a rainbow across the sky is the result of several optical effects: refraction, internal reflection and dispersion. But the conditions must be just right. As we all know, a rainbow is seen after a rain but not after every rain.

Following a rain, there are many tiny water droplets in the air. Sunlight incident on the droplets in the air produces a rainbow. But whether a rainbow is seen or not depends on the relative positions of the Sun and the observer. As you may have noticed, the Sun is generally behind you when you see a rainbow.

To understand the formation and observation of a rainbow, consider what happens when sunlight is incident on a water droplet. On entering the droplet, the light is first refracted and then dispersed into component colors as it travels in the water droplet.

These seven colours strike the inner surface of the water drop and get internally reflected. The reflected light is refracted again as it comes out of the drop as shown in figure.



(*i*) The phenomenon not involved in the formation of a rainbow is

(*a*) refraction (*b*) dispersion

(*c*) scattering (*d*) internal reflection.

(*ii*) What are the two conditions necessary for the formation of a rainbow in the sky?

(*iii*) Write the seven colours seen in a rainbow.

(*iv*) What acts as tiny prisms in the formation of rainbow?

2. The lens of the eye does little of the bending of the light rays. Most of the refraction is done at the front surface of the cornea which also acts as a protective covering. The lens acts as a fine adjustment for focussing at different distances. This is accomplished by the ciliary muscles which change the curvature of the lens so that its focal length is changed. To focus on a distant object, the muscles are relaxed and the lens is thin, and parallel rays focus at the focal point (on the retina). To focus on a nearby object, the muscles contract, causing the center of the lens to be thicker, thus shortening the focal length so that images of nearby objects can be focused on the retina, behind the focal point. This focusing adjustment is called accommodation.

The closest distance at which the eye can focus clearly is called the near point of the eye. A given person's far point is the farthest distance at which an object can be seen clearly. To check your own near point, place this book close to your eye and slowly move it away until the type is sharp.

A large part of the population have eyes that do not accommodate within the normal range of 25 cm to infinity, or have some other defect. Two common defects are near sightedness and far sightedness. Both can be corrected to a large extent with lenses— either eyeglasses or contact lenses.

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(*i*) The ciliary muscles of a normal eye are in their (*a*) most relaxed (*b*) most contracted state. In which of the two cases is the focal length of the eye lens more?

(*ii*) What is the nature of image formed on the retina?

(*iii*) What is far sightedness?

(*iv*) A convex lens is used to correct which type of defect?

(*a*) Myopia (*b*) Hypermetropia

(*c*) Presbyopia (*d*) None of these

Answers

1. (*i*) (*c*)

(*ii*) (*a*) A rain shower should have occurred.

(*b*) The position of the Sun should be behind us.

(*iii*) The seven colours are violet, indigo, blue, green,yellow, orange and red.

(*iv*) Water droplets act like tiny prisms.

2. (*i*) In most relaxed state.

(*ii*) Real and inverted.

(*iii*) Far sightedness is the defect of eye in which a person can see distant objects clearly but cannot see nearby objects distinctly.

(*iv*) (*b*)

Very Short Answer Questions [1 mark]

Each of the following questions are of 1 mark and have to be answered in one word or one sentence.

Q. 1. The ciliary muscles of a normal eye are in their (i) most relaxed (ii) most contracted state. In which of the two cases is the focal length of the eye-lens more?

Ans. In most relaxed state.

Q. 2. Write in one word or at the most in one sentence about the following

(*i*) Mirrors used by dentists to examine teeth.

(*ii*) The smallest distance, at which the eye can see objects clearly without strain.

Ans. (*i*) Concave mirror

(*ii*) Near point or 25 cm

Q. 3. Which defect of the eye can be corrected by using a cylindrical lens?

Ans. Astigmatism

Q. 4. A person is advised to wear spectacles with concave lenses. What type of defect of vision is he suffering from?

Ans. Near-sightedness/Short-sightedness/Myopia.

Q. 5. What is colour blindness?

Ans. Colour blindness is that defect of the eye due to which a person is unable to distinguish certain colours, sometimes even the primary colours.

Q. 6. When a monochromatic light having only one wavelength, passes through a prism, will it show dispersion?

Ans. No, it will not show dispersion. It will only show deviation.

Q. 7. The sun can be seen about two minutes before actual sunrise. Give reason.

Ans. The sun can be seen about two minutes before actual sunrise because of atmospheric refraction.

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Q. 8. Name the component of white light that deviates the least and the component that deviates the most while passing through a glass prism.

Ans. Least deviated component: Red

Most deviated component: Violet

Q. 9. Why does the sky appear dark to astronauts?

Ans. For scattering of light, particles are required. Since there are no particles in space, the sky appears dark to astronauts.

Short Answer Questions [3 marks]

Each of the following questions are of 3 marks and have to be answered in about 50 -60 words.

Q. 1. (i) How do we see colours?

(ii) What is colour-blindness? What kind of retinal cells are lacking in person suffering from this defect?

Ans. (i) The retina of a human eye has a large number of light sensitive cells. These cells are of two types, *i.e.*, rod cells and cone cells. The rod shaped cells show response towards the intensity of light rays, while the cone shaped cells respond to colours. It is these cone cells, which make it possible for a person to see different colours and distinguish between them.

(ii) The defect of the eye due to which a person is unable to distinguish between certain colours, is known as colour blindness. Cone shaped retinal cells are responsible for making a person differentiate between colours. The colour blind persons do not possess cone cells that respond to certain colours.

Q. 2. (i) What is the cause of dispersion?

(ii) A glass prism is able to produce a spectrum when white light passes through it but a rectangular block of same transparent glass does not produce any spectrum. Why? *[CBSE 2019 (31/3/2)]*

Ans. (i) All colours of light travel at the same speed in a vacuum. When these enter a transparent substance like prism, all slow down by different amounts depending on their wavelength. As these slow down by different amounts, different colours are refracted through different angles which causes dispersion.

(ii) After refraction at two parallel faces of a glass slab, a ray of light emerges in a direction parallel to the direction of incidence of white light. As rays of all colours emerge in the same direction, *i.e.*, the direction of the incidence of white light, there is no dispersion. However, there is lateral displacement.

Q. 3. (i) What is meant by dispersion of white light? Name the various colours of spectrum of white light in proper sequence.

(ii) Why are 'danger' signal lights red in colour?

Ans. (i) The splitting of white light into its component colours is called dispersion of light. The band of the coloured components formed due to dispersion of white light is called 'spectrum'. Seven colours of spectrum are violet, indigo, blue, green, yellow, orange and red also known as 'VIBGYOR'.

(ii) Danger signal lights are red in colour because the red coloured light having longer wavelength is scattered the least by fog or smoke. Therefore, it can be seen clearly from a distance.

Q. 4. (i) Why do different rays deviate differently in the prism?

(ii) How will you use two identical prisms so that a narrow beam of white light incident on one prism emerges out of the second prism as white light? *[NCERT Exemplar]*

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Ans. (*i*) Different wavelengths deviate differently in the prism because the angle of refraction for different colours having different wavelengths is different while passing through the glass prism.

(*ii*) By using two identical prisms, one placed inverted with respect to the other we get a narrow beam of white light incident on one prism emerges out of the second prism as white light.

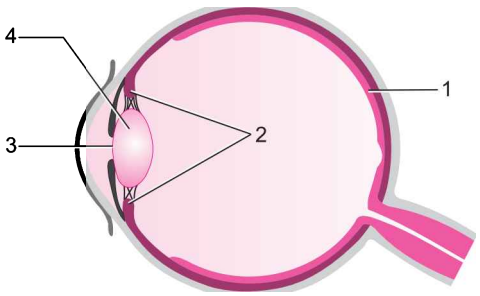
Q. 5. What happens to the image distance in the normal human eye when we decrease the distance of an object, say 10 m to 1 m? Justify your answer. *[CBSE 2019 (31/1/3)]*

Ans. The normal human eye have the ability to adjust focal length of its lens using ciliary muscles. This is called accommodation.

When we decrease the distance of an object from 10m to 1m, our eye changes its focal length so as to form image on retina itself.

So, when we change the object distance within specified limits, image distance remains same due to the ability of accommodation.

Q. 6. (*i*) Name the four parts labelled as 1, 2, 3 and 4 in the given diagram.



(*ii*) At which place is the image of an object formed?

Ans. (*i*) 1. Retina 2. Ciliary muscles
3. Pupil 4. Crystalline lens

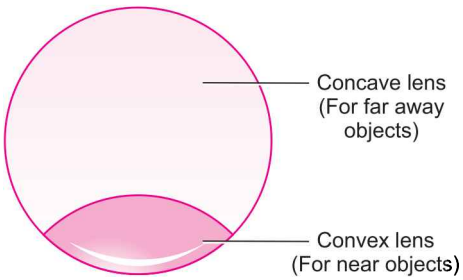
(*ii*) Retina

Q. 7. Write the structure of eye lens and state the role of ciliary muscles in the human eye. *[CBSE 2019 (31/1/2)]*

Ans. The eye lens in a convex lens composed of a transparent, fibrous, jelly-like material. Ciliary muscles hold the eye lens in position and control the focal length of the eye lens. By contracting and expanding they increase and decrease the focal length of the eye lens. Hence these muscles have a great role in focusing the nearby objects as well as far off objects.

Q. 8. List two causes of presbyopia. Draw labelled diagram of a lens used for the correction of this defect of vision. *[CBSE 2019 (31/3/3)]*

Ans. The power of accommodation of the eye decreases with ageing. For most people, the near point gradually recedes and the far point comes closer. This defect is called presbyopia.



It arises due to the gradual weakening of the ciliary muscles and diminishing flexibility of the eye lens. Such a person may suffer from myopia and hypermetropia. This defect is then corrected by using bi-focal lenses of suitable focal lengths. The upper part of the lens is concave lens which corrects myopia to see the distant objects clearly, while the lower part of the lens has convex lens which corrects the hypermetropia to see the nearby objects clearly.

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Q. 9. What is astigmatism? What causes astigmatism? How is astigmatism corrected?

Ans. In this defect, a person cannot focus on both horizontal as well as vertical lines at the same time. So he can see the objects clearly only in one plane.

This defect is mainly due to the cornea that is not perfectly spherical. As a result, the cornea has different curvatures in different directions of the horizontal and vertical planes.

This defect can be corrected by using cylindrical lenses of suitable focal length and suitable axis in the spectacles.

Q. 10. What is meant by 'persistence of vision'? We are able to see the movie picture in a cinema hall. How does this happen?

Ans. The ability of the human eye to continue to see the image of an object for a very short duration even after the removal of that object is called persistence of vision. Infact the sensation produced by the image of an object lasts for nearly $1/16^{th}$ of a second on retina.

It is due to persistence of vision that we are able to see movie pictures in a cinema hall. The pictures in the form of a long film are projected on the screen at a rate of about 24 pictures per second. Under these conditions, the image of one picture persists on the retina of the eye till the image of the next picture falls on the screen, and so on. Due to this, the slightly different images of the successive pictures present on the film merge smoothly with one another and give us the feeling of continuity and moving images.

Q. 11. What is meant by scattering of light? Use this phenomenon to explain why the clear sky appears blue or the sun appears reddish at sunrise.

[CBSE 2019 (31/4/1), CBSE (F) 2017, CBSE Delhi 2017 (C), CBSE (AI) 2015]

Ans. The phenomenon in which a part of the light incident on a particle is redirected in different directions is called the scattering of light.

The blue colour of the sky is due to the scattering of sunlight by the molecules of atmosphere. The light of shorter wavelength (blue) of the visible spectrum is scattered more than the light of longer wavelength by the atmospheric particles. When we look at the sky, the scattered light enters our eyes which majorly contains blue, colour and hence the sky appears blue.

At the time of sunrise and sunset, when the Sun is near the horizon, sunlight travels a greater distance through the atmosphere to reach us. During this, most of the shorter wavelengths present in it are scattered away from our line of sight by the molecules of air and other fine particles in the atmosphere. So, light reaching us directly from the rising or setting Sun consists mainly of the longer wavelength red colour because of which the Sun appears red.

Q. 12. Using the phenomenon of scattering of light, explain why there is a difference in the colour of the Sun as it appears during sunrise and at noon. *[CBSE 2019 (31/4/1), CBSE (F) 2017]*

Ans. At sunrise, light from the Sun near the horizon passes through thicker layers of air and larger distance in the Earth's atmosphere before reaching our eye. Hence shorter waves are scattered away and longer (red) waves reach our eye. Hence the Sun appears red.

However, at noon, sunlight would travel relatively shorter distance due to which only a little blue and violet colours are scattered and it is nearly the white light which reaches our eye.

Q. 13. Why does it take sometime to see objects in a dim room when you enter the room from bright sunlight outside?

Ans. In the bright sunlight, iris causes the pupil to become smaller so that only a small portion of light enters the eye and rods of the retina are also adjusted in the same way. But, when a person enters into a dimly lighted room, each iris takes some time to increase the diameter of the pupil, so that more amount of light can enter the eyes to see the object clearly and rod cells of the retina also take some time to adjust themselves to get the picture of the object in the dim light.

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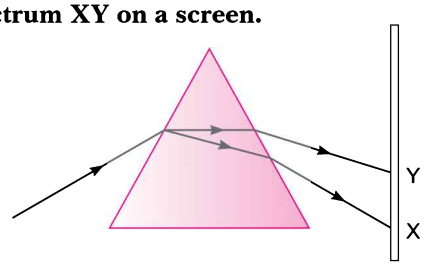
Q. 14. In the given figure, a narrow beam of white light is shown to pass through a triangular glass prism. After passing through the prism it produces a spectrum XY on a screen.

(*i*) State the colour seen at X and Y.

(*ii*) Why do different colours of white light bend through different angles with respect to the incident beam of light?



Ans. (*i*) X — Violet
Y — Red

(*ii*) Different colours of white light bend through different angles with respect to the incident beam of light due to difference in speed of light of different wavelengths.

Q. 15. Explain giving reason why the sky appears blue to an observer from the surface of the Earth. What should the appearance of the sky be during the day for an astronaut staying in the international space station orbiting the Earth? State reason to justify your answer.

[CBSE (F) 2015]

Ans. The fine particles in the atmosphere scatter light of shorter wavelength (blue colour) more strongly than the light of longer wavelength (red colour). Therefore, the sky appears blue from the surface of the Earth.

For an astronaut the sky would appear dark because in space there is no atmosphere to scatter light.

Q. 16. Why is the colour of the clear sky blue? *[CBSE 2019 (31/3/1), NCERT Exemplar]*

Ans. The molecules of air and other fine particles in the atmosphere have size smaller than the wavelength of visible light. These are more effective in scattering light of shorter wavelengths at the blue end than light of longer wavelengths at the red end. When sunlight passes through the atmosphere, the fine particles in air scatter the blue colour more strongly than red. The scattered blue light enters our eyes. Since we see the blue light from everywhere overhead, the clear sky appears blue.

Q. 17. What is Tyndall effect? Explain with an example.

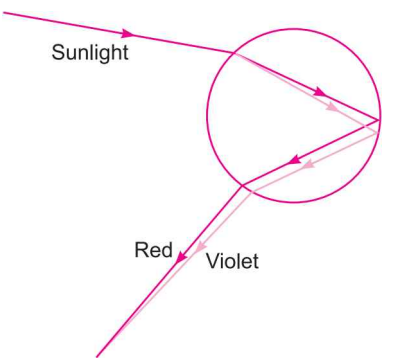
Ans. The scattering of light by particles in its path is called Tyndall effect. When a beam of light enters a smoke-filled dark room through a small hole, then its path becomes visible to us. The tiny dust particles present in the air of room scatter the beam of light all around the room. Thus, scattering of light makes the particles visible. Tyndall effect can also be observed when sunlight passes through a canopy of a dense forest. Here, tiny water droplets in the mist scatter light.

Q. 18. What is a rainbow? Draw a labelled diagram to show the formation of a rainbow.

[CBSE 2019 (31/1/1)]

Ans. A rainbow is a natural spectrum appearing in the sky after a rain. It is produced by dispersion of sunlight by tiny water droplets, present in the atmosphere. The water droplets act like small prisms. When a ray of light falls on water drop (or raindrop) it undergoes refraction and dispersion to form a spectrum. This spectrum undergoes internal reflection (inside the raindrop) and finally refracted again when it comes out of the raindrop. After the dispersion of light and internal reflections, the band of colours reaches observer's eye in the form of a rainbow.

A rainbow is always formed in the direction opposite to that of the Sun.



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Q. 19. What is atmospheric refraction? List two phenomena which can be explained on the basis of atmospheric refraction. *[CBSE 2019 (31/2/3)]*

Ans. Atmospheric refraction-refraction of light caused by the Earth's atmosphere due to change in the refractive indices of different layers. The two phenomena which can be explained on the basis of atmospheric refraction are:

(*i*) Twinkling of star: Stars are distant point sized source of light. The path of the rays of light coming from the star goes on varying due to atmospheric refraction slightly. Thus apparent position of the stars fluctuates and the amount of star light entering the eye flickers giving the twinkling effect.

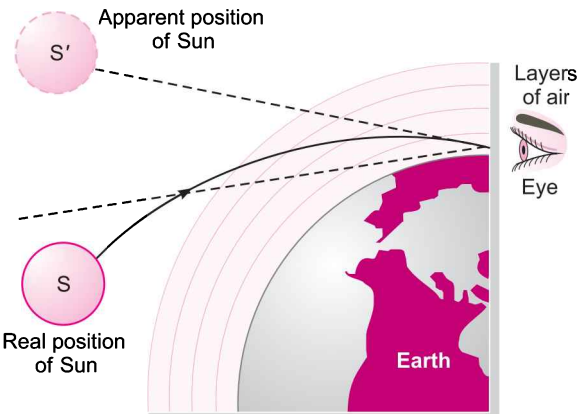
(*ii*) Advanced sunrise: When the Sun is slightly below the horizon, light rays coming from the Sun travel from the rarer to denser layers of air. Because of atmospheric refraction of light, light appears to come from a higher position above the horizon. Thus, the Sun appears earlier than actual sunrise.

Q. 20. How does atmospheric refraction affect sunrise and sunset?

Or

What is meant by advance sunrise and delayed sunset. Draw a labelled diagram to explain. *[CBSE (F) 2015, 2017]*

Ans. The layers of air nearer to the Earth are denser than those above it. At sunrise and sunset when the Sun is below the horizon, the light rays starting from the Sun are incident on these layers. They pass through successively denser layers and thus get bent more and more towards the normal until they fall upon the eye of the observer. To the observer, these rays appear to come from S' which is above horizon. It is for this reason that the Sun is visible to us a little before it rises above the horizon and so also till a little later it sets below the horizon. The difference of time is about 2 minutes each for early rise and late setting of the Sun.



Q. 21. How does refraction of light take place in the atmosphere ? Explain the reason why stars appear to twinkle and the planets do not twinkle. *[CBSE Delhi 2017 (C)]*

Ans. Since the atmosphere consists of varying densities the apparent position of the object, as seen through the hot air fluctuates. This wavering of light is an effect of atmospheric refraction.

The twinkling of a star is due to atmospheric refraction of star light. The atmospheric refraction of light occurs in a medium of gradually changing refractive index.

The planets are much closer to the earth and are thus seen as extended sources. A planet is considered as a collection of large number of point sized sources of light, the total variation in the amount of light entering our eye from all individual point sized sources will average out to zero, thereby nullifying the twinkling effect.

Q. 22. A person needs a lens of power – 4.5 D for correction of her vision.

(*i*) What kind of defect in vision is she suffering from?

(*ii*) What is the focal length of the corrective lens?

(*iii*) What is the nature of the corrective lens? *[NCERT Exemplar]*

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Ans. (*i*) Myopia

(*ii*) $f = \frac{1}{-4.5} = -\frac{2}{9}\text{m} = \mathbf{-0.22\ m}$

(*iii*) Concave lens

Q. 23. Write about power of accommodation of human eye. Explain why the image distance in the eye does not change when we change the distance of an object from the eye? *[CBSE Delhi 2017]*

Ans. Ability of the eye lens to focus nearby as well as distant objects on the retina by changing the curvature or focal length of the eye lens is known as power of accommodation.

Image distance in the eye is the distance between the eye lens and the retina and it is fixed. As the object approaches from infinity towards the eye, the focal length of the eye lens decreases (or vice-versa) so as to maintain the same image distance.

Q. 24. How are we able to see nearby and also the distant objects clearly?

Ans. This is due to the ability of the eye lens to adjust its focal length which is known as accommodation.

When the ciliary muscles are relaxed, the lens becomes thin. Thus, its focal length increases. This enables us to see distant objects clearly. When we are looking at objects closer to the eye, the ciliary muscles contract. This increases the curvature of the eye lens. The eye lens becomes thicker. The focal length of the eye lens decreases. This enables us to see nearby objects clearly.

Q. 25. Due to gradual weakening of ciliary muscles and diminishing flexibility of the eye lens a certain defect of vision arises. Write the name of this defect. Name the type of lens required by such persons to improve the vision. Explain the structure and function of such a lens. *[CBSE Delhi 2017]*

Ans. The name of the defect is Presbyopia. Bifocal lens is required to improve the vision.

In bifocal lens, upper portion is of concave or diverging lens to view far off objects and lower part is of convex or converging lens to view nearby objects.

Q. 26. With the help of ciliary muscles the human eye can change its curvature and thus alter the focal length of its lens. State the changes that occur in the curvature and focal length of the eye lens while viewing (*i*) a distance object, (*ii*) nearby objects.

Explain, why a normal eye is not able to see distinctly the objects placed closer than 25 cm, without putting any strain on the eye. *[CBSE Delhi 2017]*

Ans. (*i*) Lens becomes thin
Curvature decreases.
Focal length increases.

(*ii*) Curvature increases.
Focal length decreases.

This is because focal length of the lens of a normal human eye cannot be decreased below a certain limit *i.e.*, 25 cm.

Long Answer Questions [5 marks]

Each of the following questions are of 5 marks and have to be answered in about 80-90 words.

Q. 1. State the function of each of the following parts of the human eye:

(*i*) Cornea **(*ii*) Iris**

(*iii*) Pupil **(*iv*) Retina**

Millions of people of the developing countries are suffering from corneal blindness. This disease can be cured by replacing the defective cornea with the cornea of a donated eye. Your school has organised a campaign in the school and its neighbourhood in order to create awareness about this fact and motivate people to donate their eyes after death. How can you along with your classmates contribute in this noble cause? State the objectives of organising such campaigns in schools. *[CBSE (F) 2015]*

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Ans. (*i*) **Cornea:** Refraction of the light rays falling on the eye.

(*ii*) **Iris:** To control the size of the pupil.

(*iii*) **Pupil:** To regulate and control the amount of light entering the eye.

(*iv*) **Retina:** To act as a screen to obtain the image of object and generate electrical signals which are sent to the brain via optic nerves.

We can contribute by participating in different ways of motivating people for the noble cause of eye donation such as, street play, banners, poster, door to door campaign, etc.

Objectives of organising such campaigns:

(*i*) To develop the habit of group work,

(*ii*) To work for a common cause,

(*iii*) To understand social issues and problems.

Q. 2. A person is unable to see objects distinctly placed within 50 cm from his eyes.

(*i*) Name the defect of vision the person is suffering from and list its two possible causes.

(*ii*) Draw a ray diagram to show the defect in the above case.

(*iii*) Mention the type of lens used by him for the correction of the defect and calculate its power. Assume that the near point for the normal eye is 25 cm.

(*iv*) Draw labelled diagram for the correction of the defect in the above case.

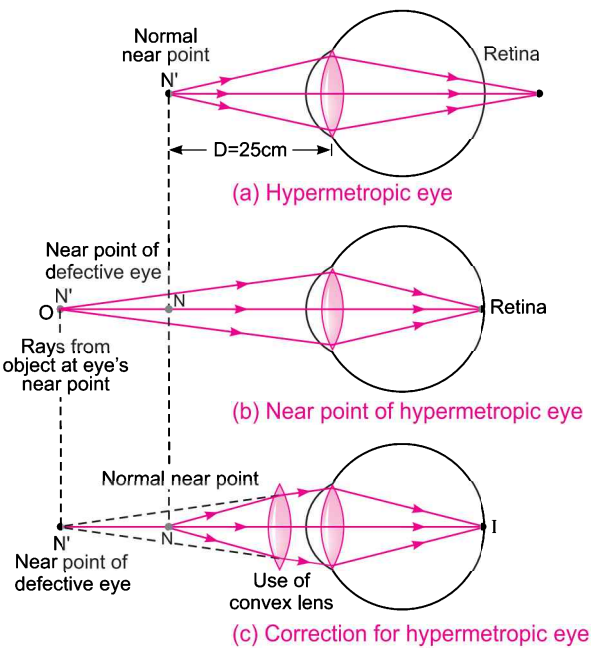
[CBSE 2019 (31/4/1)]

Ans. (*i*) A person can see distant objects distinctly but cannot see nearby objects so clearly in this case, the image is formed behind the retina. This defect of the eye is hypermetropia.

Causes of hypermetropia: This defect arises because either

(*a*) the focal length of the eye lens is too long, or

(*b*) the eyeball becomes too short, so that light rays from the nearby object, say at point N, cannot be brought to focus on the retina to give a distinct image.



(*ii*) Fig. (*a*)

(*iii*) Since object and image are on the same side of convex lens, both the distances u and v are measured from lens and the direction of measurement is opposite to the incident ray.

Hence by sign convention both are negative.

So, $v = -50$ cm and $u = -25$ cm.

Using lens formula,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f} \Rightarrow \frac{1}{-50} + \frac{1}{25} = \frac{1}{f}$$

$$\Rightarrow \frac{-1+2}{50} = \frac{1}{f}$$

$f = 50$ cm

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Hence, power $= \frac{1}{f \text{ (in m)}} = \frac{100 \text{ cm}}{50 \text{ cm}} =$ **+ 2D**

(*iv*) Hypermetropia can be corrected by using convex lens of suitable focal length in spectacles [See Fig. (*b*) and (*c*)].

Q. 3. (*i*) When do we consider a student sitting in the class to be myopic? List two causes of this defect. Explain using a ray diagram how this defect of eye can be corrected. *[CBSE 2019 (31/3/1)]*

(*ii*) Why is the normal eye unable to focus on an object placed within 10 cm from the eye?

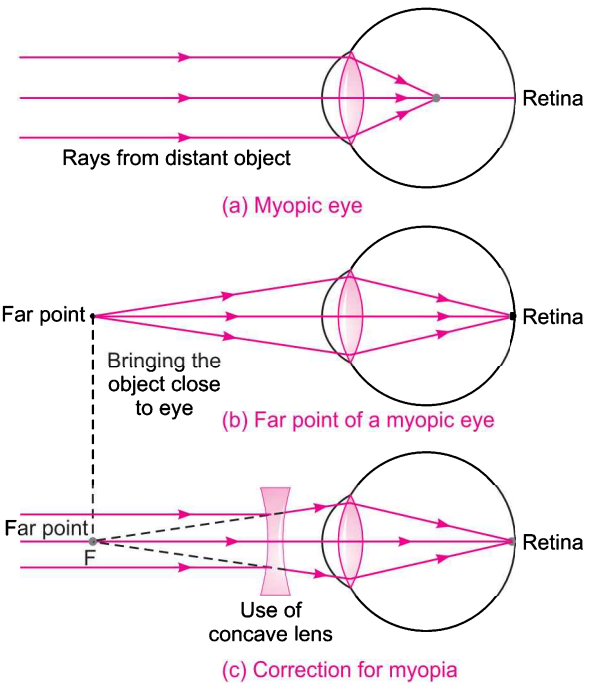
Ans. (*i*) Myopia is the defect of the eye vision due to which a person can see the nearly objects clearly but cannot see the far objects so distinctly.

Causes of myopia: Myopia is caused:

—due to the elongation of the eyeball.

—due to decrease in the focal length of the eye lens.

Myopia can be corrected by using a concave lens of suitable focal length in the spectacles of such a person.



(*ii*) The ability of the eye lens to adjust its focal length is called automatic accommodation. However, the focal length of the eye lens cannot be decreased below a certain limit. The maximum accommodation of a normal eye is reached when the object is at a distance of 25 cm from the eyes. Thus, the normal eye is unable to focus an object placed within 10 cm from the eye because it is beyond its power of accommodation.

Q. 4. What is the cause of dispersion of white light through a glass prism? Draw a ray diagram to show the path of light when two identical glass prisms are arranged together in inverted position with respect to each other and a narrow beam of white light is allowed to fall obliquely on one of the faces of the prisms. *[CBSE 2019 (31/4/1)*

OR

State the cause of dispersion of white light by a glass prism. How did Newton, using two identical glass prisms, show that white light is made of seven colours ? Draw a ray diagram to show the path of a narrow beam of white light, through a combination of two identical prisms arranged together in inverted position with respect to each other, when it is allowed to fall obliquely on one of the faces of the first prism of the combination. *[CBSE (AI) 2017]*

Ans. (*i*) The splitting up of white light into its constituent colours on passing through a refracting medium like a glass prism is called dispersion of light.

The dispersion of white light occurs because different colours of light bend through different angles with respect to the incident ray, as they pass through a prism. The red light bends the least while the violet the most as shown below.

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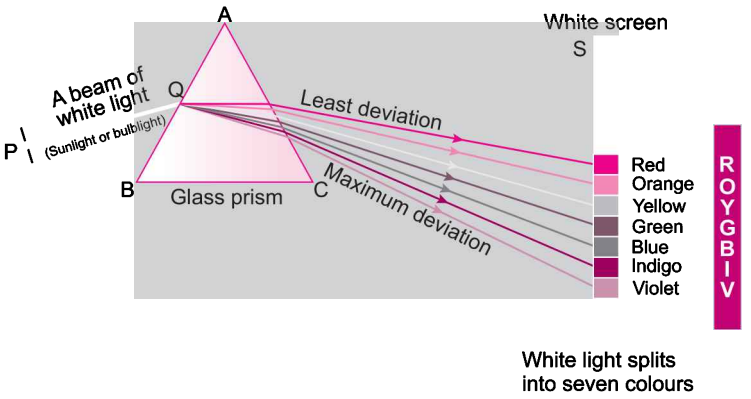
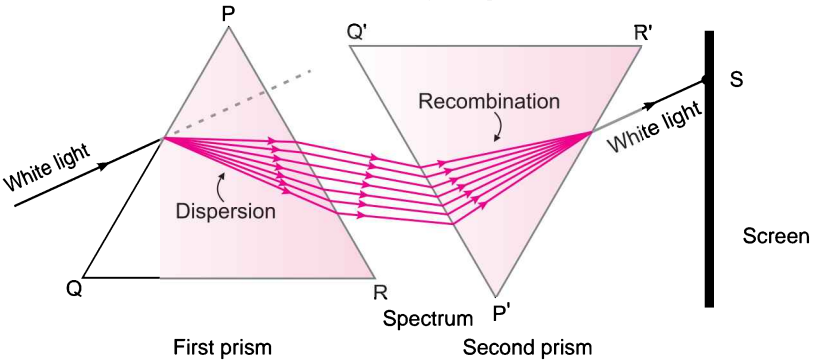


(*ii*) A glass slab acts as a combination of two identical glass prisms.



The second prism can be considered to be placed in an inverted position with respect to the first. The first prism splits the white light into its seven colour components. When these colour components fall on the second prism, it recombines them to form white light.

Q. 5. With the help of an activity show the blue colour of the sky and the reddish appearance of the sun at the sunrise or sunset.

Ans. Activity:

(*i*) Place a source of light S such as an electric bulb at the focus of a converging lens L_1. This lens provides a parallel beam of light.

(*ii*) Allow the light beam to pass through a transparent glass beaker B of capacity 500 mL filled with water.

(*iii*) After passing through the beaker containing about 400 mL of water allow the light beam to pass through a circular hole made in cardboard C. Obtain a sharp image of the hole on a screen MN using another convex lens L_2.

(*iv*) Dissolve about 200 g of sodium thiosulphate (hypo) in water taken in the beaker B. Add about 1 to 2 mL of concentrated sulphuric acid with the help of an injection syringe dropwise in the beaker containing hypo solution.

(*v*) What do you observe?

You will notice fine microscopic sulphur particles precipitating in about 2 to 3 seconds. As the sulphur particles begin to form, you can observe the blue light from the sides of the beaker. This is due to scattering of short wavelengths by minute colloidal sulphur particles. Observe the colour of the light patch on the screen. It is interesting to observe the change in colour of the patch–from orange red colour in the beginning to bright crimson red colour later on the screen.

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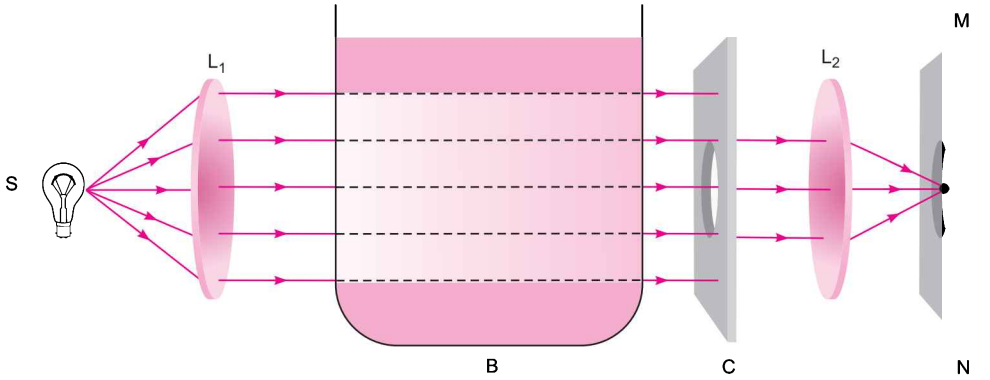


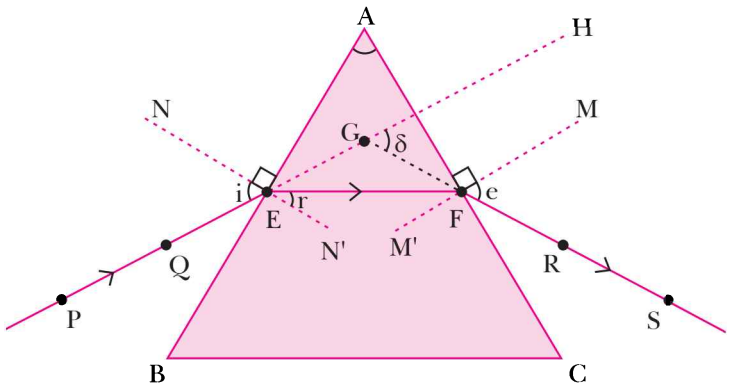
This activity demonstrates the scattering phenomena of light that helps us to understand the bluish colour of the sky in general and the reddish appearance of the Sun at the sunrise or the sunset.

Q. 6. **(*i*) Draw a ray diagram to explain the term angle of deviation.**

(*ii*) Why do the component colours of incident white light split into a spectrum while passing through a glass prism, explain.

(*iii*) Draw a labelled ray diagram to show the formation of a rainbow. [*CBSE Delhi 2017*]

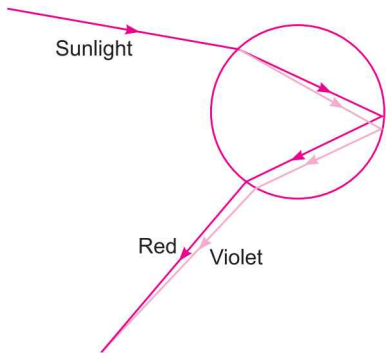
Ans. (*i*)



∠ δ is the angle of deviation.

(*ii*) Different colour of white light bend through different angles with respect to the incident light, as they pass through the glass prism. Thus, each colour emerges along a different path, forming a spectrum.

(*iii*)



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Some Important Numericals

Q. 1. A person cannot see objects nearer than 75 cm from his eyes while a person with normal vision can see objects upto 25 cm from his eyes. Find the nature, the focal length and the power of the correcting lens used for the defective vision.

Ans. The defect of the vision is hypermetropia.

Given, that $u = -25$ cm and $v = -75$ cm.

Using the formula, $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$\therefore \quad \frac{1}{f} = -\frac{1}{75} + \frac{1}{25} = +\frac{2}{75}$

or $f = +\frac{75}{2} = \mathbf{+ 37.5\ cm}$

$$\text{Power of the lens} = \frac{1}{f(\text{in metres})}$$

$$= \frac{100}{75/2} = +\frac{8}{3} = \mathbf{+ 2.67\ D}$$

The + sign with f or the power indicates a convergent lens.

Q. 2. A person cannot see objects beyond 80 cm from his eye while a person with normal eyesight can see object easily placed upto 160 cm from the eye. Find the nature, the focal length and the power of the correcting lens.

Ans. The defect of vision is myopia.

Using the formula $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

Given, $u = -160$ cm and $v = -80$ cm

$\therefore \quad \frac{1}{f} = -\frac{1}{80} + \frac{1}{160} = -\frac{1}{160}$

or $f = \mathbf{-160\ cm}$

$$\text{Power} = \frac{1}{f(\text{in metres})} = -\frac{1}{1.60}$$

$$= \mathbf{-0.625\ D}$$

The –ve sign with f indicates the concave lens.

Q. 3. A person can see clearly only up to 3 metres. Prescribe a lens for spectacles so that he can see clearly up to 12 metres.

Ans. Here, $v = -3$ m, $u = -12$ m, $f = ?$

Using $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ or $-\frac{1}{3} + \frac{1}{12} = \frac{1}{f}$

$f = \mathbf{-4\ m}$

A concave lens of focal length 4 m should be used.

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HOTS [Higher Order Thinking Skills]

Q. 1. Is the position of a star as seen by us in its true position? Justify your answer.

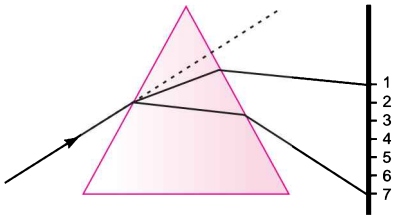
[NCERT Exemplar]

Ans. No, light from stars undergoes atmospheric refraction which occurs in medium of gradually changing refractive index. So, we see the apparent position of the star after refraction by atmosphere.

Q. 2. Does a beam of white light give a spectrum on passing through a hollow prism?

Ans. No, this is because dispersion of light cannot occur through a hollow prism containing air.

Q. 3. A beam of white light falling on a glass prism gets split up into seven colours marked 1 to 7 as shown in the diagram.



A student makes the following statements about the spectrum observed on the screen.

(*i*) The colours at positions marked 3 and 5 are similar to the colour of the sky and the colour of gold metal respectively.

Is the above statement made by the student correct or incorrect? Justify.

(*ii*) Which two positions correspond closely to the colour of

(*a*) brinjal, (*b*) 'danger' or stop signal lights?

Ans. (*i*) The statement made by the student is incorrect.

Positions marked 3 (yellow) and 5 (blue) are similar to the colour of gold metal and the colour of the sky respectively. The student is stating the nature of colours in reverse order.

(*ii*) (*a*) The position marked 7 corresponds closely to the colour of a brinjal *i.e.*, violet.

(*b*) The position marked 1 (red) corresponds closely to the colour of 'danger' or stop signal lights *i.e.*, red.

Q. 4. Why sometimes haloes or rings are observed round the Moon or Sun?

Ans. When the Moon or the Sun is observed through a thin layer of the high clouds, reflection of light from fine icy crystals, present in the clouds, results in the formation of haloes.

Q. 5. Can an observer see a rainbow on the Moon?

Ans. No, since there is no atmosphere on the Moon.

Q. 6. Why does a person suffering from hypermetropia prefer to remove his spectacles while looking at distant objects? Explain.

Ans. A hypermetropic eye can have normal far point. If he uses spectacles of converging lens, he will have more converging power than needed for parallel rays so the distant object may get focused in front of the retina and so distant objects will appear blurred.

NCERT Corner

NCERT Intext Questions

Q. 1. What is meant by power of accommodation of the eye?

Ans. The ability of the eye to focus on the distant objects as well as the nearby objects on the retina by changing the focal length or converging power of its lens is called accommodation.

The normal eye has a power of accommodation which enables the objects as close as 25 cm and as far as infinity to be focused on its retina.

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Q. 2. A person with a myopic eye cannot see objects beyond 1.2 m distinctly. What should be the type of the corrective lens used to restore proper vision?

Ans. In normal eye, the far point is infinity. The lens used should be such that an object at infinity forms virtual image at 1.2 m.

Now, $v = -1.2$ m, $u = -\infty$, $f = ?$

We know $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

$$\frac{1}{f} = \frac{1}{-1.2} - \frac{1}{(-\infty)} = -\frac{1}{1.2}$$

or $f = \mathbf{-1.2\ m}$

Power, $P = \frac{1}{f} = \frac{1}{-1.2}$

$$= \frac{-5}{6} = \mathbf{-0.83\ D}$$

A concave (or divergent) lens of focal length 1.2 m and power – 0.83 D should be used to restore proper vision.

Q. 3. What is the far point and near point of the human eye with normal vision?

Ans. For normal vision, the near point is about 25 cm and far point is infinity. Thus, a normal eye can see objects clearly that are between 25 cm and infinity.

Q. 4. A student has difficulty in reading the blackboard while sitting in the last row. What could be the defect the child is suffering from? How can it be corrected?

Ans. The child is suffering from myopia. It can be corrected by using spectacles containing concave lenses.

NCERT Exercises

Q. 1 The human eye can focus objects at different distances by adjusting the focal length of the eye lens. This is due to

(*a*) presbyopia **(*b*) accommodation**

(*c*) near-sightedness **(*d*) far-sightedness**

Ans. (*b*) accommodation.

Q. 2. The human eye forms the image of an object at its

(*a*) cornea **(*b*) iris**

(*c*) pupil **(*d*) retina**

Ans. (*d*) retina.

Q. 3. The least distance of distinct vision for a young adult with normal vision is about

(*a*) 25 m **(*b*) 2.5 cm**

(*c*) 25 cm **(*d*) 2.5 m**

Ans. (*c*) 25 cm.

Q. 4. The change in focal length of an eye lens is caused by the action of the

(*a*) pupil **(*b*) retina**

(*c*) ciliary muscles **(*d*) iris**

Ans. (*c*) ciliary muscles.

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Q. 5. A person needs a lens of power –5·5 diopters for correcting his distant vision. For correcting his near vision he needs a lens of power + 1·5 diopter. What is the focal length of the lens required for correcting (*i*) distant vision, and (*ii*) near vision?

Ans. (*i*) Power, $P = -5.5$ D, Focal length, f = ?

$$\because \quad P = \frac{1}{f(\text{in m})}$$

$$\text{or} \quad -5.5 = \frac{1}{f}$$

$$\text{or} \quad f = \frac{1}{-5.5} = \mathbf{-0.18\ m}$$

The negative (–) sign indicates that the lens is concave.

(*ii*) Power, $P = +1.5$ D

Focal length, f = ?

$$\because \quad P = \frac{1}{f(\text{in m})}$$

$$\text{or} \quad +1.5 = \frac{1}{f}$$

$$\text{or} \quad f = \frac{1}{+1.5}$$

$$\text{or} \quad f = \mathbf{+0.67\ m}$$

The positive sign indicates that the lens is convex.

Q. 6. The far point of a myopic person is 80 cm in front of the eye. What is the nature and power of the lens required to correct the problem?

Ans. The far point of this myopic person is 80 cm. This means that this person can see the distant object (which is kept at infinity) clearly if the image of this object is formed at his far point (80 cm). Therefore, in this case,

$u = \infty$, $v = -80$ cm, f = ?

Using lens formula

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$\text{or} \quad \frac{1}{-80} - \frac{1}{\infty} = \frac{1}{f}$$

$$\text{or} \quad -\frac{1}{80} - 0 = \frac{1}{f}$$

$$\text{or} \quad f = -80\ \text{cm} = -0.8\ \text{m}$$

The negative (–) sign indicates that the lens is concave.

Now, Power, $P = \dfrac{1}{f(\text{in m})} = \dfrac{1}{-0.8} = \mathbf{-1.25\ D}$

The concave lens of power – 1.25 D is required to correct the problem.

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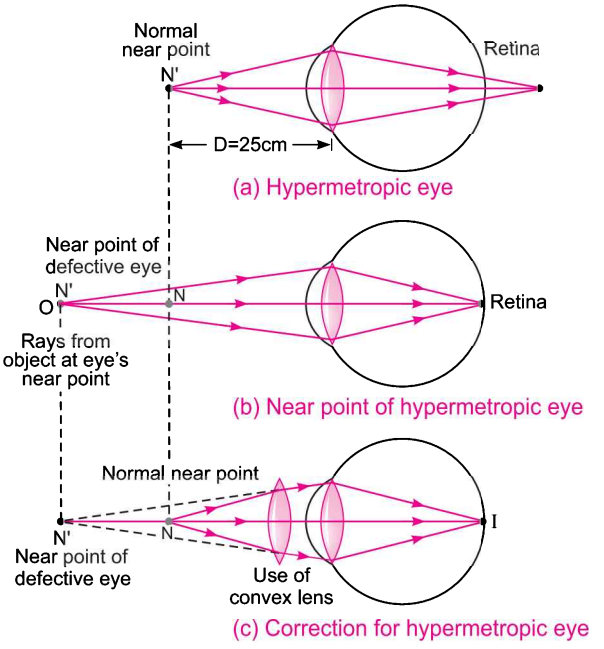
Q. 7. Make a diagram to show how hypermetropia is corrected. The near point of a hypermetropic eye is 1 m. What is the power of the lens required to correct this defect? Assume that the near point of the normal eye is 25 cm.

Ans. The hypermetropic eye is corrected by using a convex lens of appropriate focal length as spectacles in front of the eye.



Here, $u = -25$ cm (Normal near point)

$v = -1$ m $= -100$ cm

(Near point of defective eye)

$f = ?$

Using lens formula,

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

or $$\frac{1}{-100} - \frac{1}{-25} = \frac{1}{f}$$

or $$\frac{1}{-100} + \frac{1}{25} = \frac{1}{f}$$

or $$\frac{-1+4}{100} = \frac{1}{f}$$

or $$f = \frac{100}{3} = 33.3 \text{ cm}$$

Thus, the convex lens of focal length + 33.3 cm is required to correct this defect.

Here, $f = 33.3$ cm $= 0.33$ m

Now, Power $P = \dfrac{1}{f \text{ (in m)}} = \dfrac{1}{+0.33} = \mathbf{3.0\ D}$

Thus, the convex lens of power + 3.0 D is required.

Q. 8. Why is a normal eye not able to see clearly the objects placed closer than 25 cm?

Ans. The maximum accommodation of a normal eye is reached when the object is at a distance of 25 cm from the eye. The focal length of the eye lens cannot be decreased below this minimum limit.

Thus, an object placed closer than 25 cm (or very close to eye) cannot be seen clearly by a normal eye.

Q. 9. What happens to the image distance in the eye when we increase the distance of an object from the eye?

Ans. The distance between eye lens and retina is the image distance inside the eye. The image distance is fixed. It cannot be changed at all. Therefore, when we increase the distance of an object from the eye, there is no change in the image distance, inside the eye.

Q. 10. Why do stars twinkle? *[CBSE 2018,(F) 2015]*

Ans. The twinkling of a star is due to the atmospheric refraction of starlight. The atmospheric refraction occurs in a medium of gradually changing refractive index.

Since the atmosphere bends starlight towards the normal, the apparent position of the star is slightly different from its actual position. This apparent position of the star is not stationary, but keeps on changing slightly, as the physical conditions of the earth's atmosphere are not stationary. Since the stars are very distant, they form approximate point-sized sources of light.

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As the path of rays of light coming from the star goes on varying slightly, the apparent position of the star fluctuates and the amount of starlight entering the eye flickers–the star sometimes appear brighter, and at some other time, fainter, which is the twinkling effect.

Q. 11. Explain why the planets do not twinkle. *[CBSE (F) 2015]*

Ans. The planets are much closer to the Earth, and are thus seen as extended sources. If we consider a planet as a collection of a large number of point-sized sources of light, the total variation in the amount of light entering our eye from all the individual, point-sized sources will average out to zero, thereby nullifying the twinkling effect.

Q. 12. Why does the Sun appear reddish early in the morning? *[CBSE Delhi 2015]*

Ans. In the early morning (at the time of sunrise), when the sun is near the horizon, the sunlight has to travel the greatest distance through the atmosphere to reach us. During this long journey of sunlight, most of the blue colour and shorter wavelength present in it is scattered out and away from our line of sight. So, the light reaching us directly from the rising Sun consists mainly of longer wavelength, red colour due to which the Sun appears reddish early in the morning.

Q. 13. Why does the sky appear dark instead of blue to an astronaut?

Ans. The sky appears dark instead of blue to an astronaut because there is no atmosphere containing air in the outer space to scatter sunlight. As there is no scattered light to reach our eyes in outer space, so, the sky appears dark.

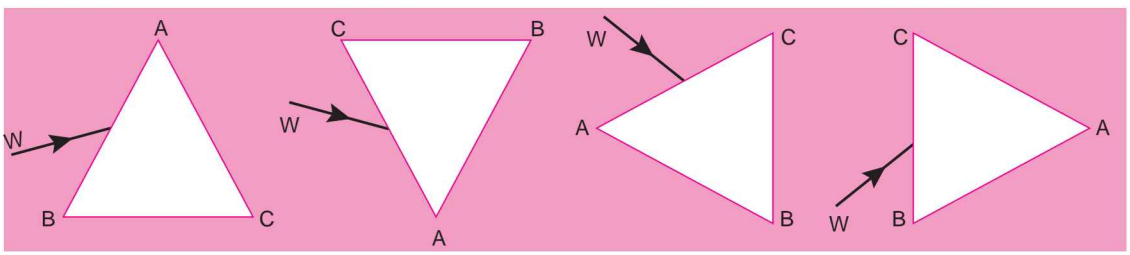
SELF-ASSESSMENT TEST

Time allowed: 1 hour **Max. marks: 40**

SECTION–A

Choose and write the correct answer for each of the following. **(4 × 1 = 4)**

1. A prism ABC (with BC as base) is placed in different orientations. A narrow beam of white light is incident on the prism as shown in fig. In which of the following cases after dispersion does the third colour from the top correspond to the colours of the sky? *[NCERT Exemplar]*



I II III IV

(*a*) I (*b*) II (*c*) III (*d*) IV

2. The human eye forms the image of an object at its

(*a*) cornea (*b*) iris

(*c*) pupil (*d*) retina

3. A person can see objects lying between 0.50 m and 2.0 m. He is suffering from

(*a*) myopia (*b*) hypermetropia

(*c*) presbyopia (*d*) astigmatism

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4. **Which one of the following phenomena contributes significantly to the reddish appearance of the Sun at sunrise or sunset?** *[NCERT Exemplar]*

   (*a*) Dispersion of light

   (*b*) Scattering of light

   (*c*) Total internal reflection of light

   (*d*) Reflection of light from the Earth

The following questions consist of two statements—Assertion(A) and Reason(R). Answer these questions selecting the appropriate option given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation for *A*.

(*b*) Both *A* and *R* are true but *R* is not the correct explanation for *A*.

(*c*) *A* is true but *R* is false.

(*d*) *A* is false but *R* is true. **(3 × 1 = 3)**

5. **Assertion (*A*) :** The stars twinkle, while the planets do not.
   Reason (*R*) : The stars are much bigger in size than the planets.
6. **Assertion (*A*) :** The Sun appears flattened at sunrise and sunset.
   Reason (*R*) : The apparent flattering of the Sun's disc at sunrise and sunset is due to atmospheric refraction.
7. **Assertion (*A*) :** Blue colour of sky appears due to scattering of blue colour.
   Reason (*R*) : Blue light has longer wavelength.

Answer the following questions in one word or one sentence. **(3 × 1 = 3)**

8. Name the muscles responsible for bringing change in focal length of the eye.
9. A person is advised to wear spectacles with convex lenses. What type of defect of vision is he suffering from?
10. What do you understand by spectrum of white light?

SECTION–B

Answer the following questions in about 50-60 words each. **(5 × 3 = 15)**

11. A person with a myopic eye cannot see objects beyond a distance of 1.5 m from it. What would be the nature and power of the corrective lens used to restore proper vision?
12. (*i*) What is the least distance of distinct vision for a normal eye?

    (*ii*) Define the term power of accommodation. Write the modification in the curvature of the eye lens which enables us to see the nearby objects clearly? *[CBSE 2019 (31/1/1)]*
13. What happens to a beam of white light when it gets refracted through a glass prism? Which colour deviates the most and the least after refraction through a prism? What is likely to happen if a second identical prism is placed in an inverted position with respect to the first prism? Justify your answer.
14. Explain with the help of diagram why the sun is visible to us two minutes before the actual sunrise and two minutes after the sunset.
15. What is "dispersion of white light"? Draw a labelled diagram to illustrate the recombination of the spectrum of white light. Why is it essential that the two prisms used for the purpose should be identical and placed in an inverted position with respect to each other? *[CBSE (AI) 2017]*

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SECTION–C

Answer the following questions in about 80–90 words each. **(3 × 5 = 15)**

16. Give reasons for each of the following:

(*i*) The sky appears dark instead of blue to an astronaut in space.

(*ii*) The sky near the horizon appears to have a reddish hue at the time of sunset and sunrise.

(*iii*) The stars appear to twinkle.

17. (*i*) Write the functions of each of the following parts of the human eye:

(*a*) Cornea (*b*) Iris

(*c*) Crystalline (Eye) lens (*d*) Ciliary muscles

(*e*) Retina *[CBSE 2018]*

(*ii*) A person is unable to see distinctly the objects closer than 1 m. Name the defect of vision he is suffering from. Draw ray diagrams to illustrate the cause of the defect and its correction by suitable lens. *[CBSE (F) 2017]*

18. When do we consider a person to be myopic or hypermetropic? Explain using diagrams how the defects associated with myopic and hypermetropic eye can be corrected? *[NCERT Exemplar]*

Answers

1. (*b*) **2.** (*d*) **3.** (*c*) **4.** (*b*)

5. (*b*) **6.** (*a*) **7.** (*c*)

8. Ciliary muscles

9. Far sightedness/long sightedness/hypermetropia

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12 Electricity

BASIC CONCEPTS—A FLOW CHART

ELECTRIC CURRENT (I)

- Rate of flow of electric charges
  $I = \frac{\text{Net charge (Q)}}{\text{Time (t)}}$
- Measured by ammeter

Essential requirement for current flow

Opposition to passage of electric current

Potential difference (V)

- Work done to move a unit charge from one point to other.
  $V = \frac{\text{Work done (W)}}{\text{Charge (Q)}}$ J/C
- Measured by voltmeter.

Unit → **volt (V)**

1 V = 1 JC^{-1}
1 mV = 10^{-3} V

Resistance (R)

Ratio of potential difference across a conductor to current flowing through it.

Unit → **ohm (Ω)**

1 kΩ = 10^3 Ω
1 mΩ = 10^{-3} Ω

Ohm's law

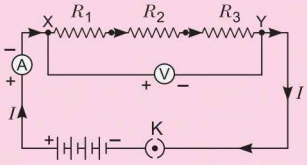
A relationship between V across a conductor and I through it.
$V \propto I$
i.e., $V = IR$

Factors affecting resistance

- Length ($R \propto l$)
- Area of cross-section ($R \propto \frac{1}{A}$)
- Nature of material
- Temperature

Combination of resistors

Resistors in series



- Current remains constant but voltage varies.
  $V = V_1 + V_2 + V_3$
- $R_s = R_1 + R_2 + R_3$

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Measure of current

Electric power (*P*) — Unit → **watt (W)**

Rate at which electric energy is dissipated or consumed in an electric circuit

$P = VI = I^2R = V^2/R$

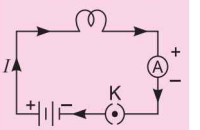
$1\ W = 1\ Js^{-1}$

$1\ kW = 10^3\ W$

Representation of current flow

Electric circuit

Continuous and closed path for an electric current



Unit

ampere (A)

$1\ A = 1\ Cs^{-1}$

$1\ mA = 10^{-3}\ A$

Heating effect

According to Joule's law of heating

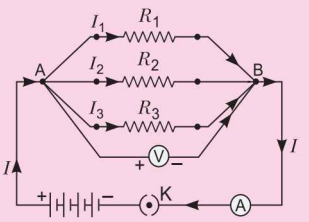
$H \propto I^2$

$H \propto R$

$H \propto t$

$\therefore$ Heat produced, $H = I^2Rt$

Resistors in parallel



- Voltage remains constant but current varies.
- $I = I_1 + I_2 + I_3$
- $\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

Practical applications of heating effect

- To produce light (electric bulb)
- Electric fuse that protects circuits and appliances.
- In electrical heating appliances (electric iron, toaster, room heater, etc.).

Commercial unit of electric energy is kilowatt hour (kWh), commonly known as 'unit'.
$1\ kWh = 3.6 \times 10^6\ J$

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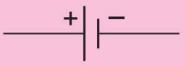
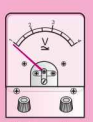
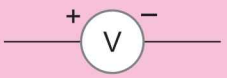
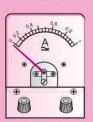
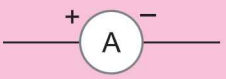
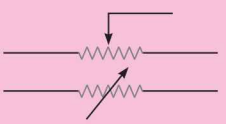
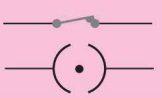
MORE POINTS TO REMEMBER

Commonly used Electrical Components

COMPONENT	CIRCUIT SYMBOL	FUNCTION OF COMPONENT
Wire		To conduct or pass current from one part of a circuit to another.
Wire joined		A 'blob' should be drawn where wires are connected (joined), but it is sometimes omitted. Wires connected to another wire should be staggered slightly to form two T-junctions, as shown.
Wires not joined		In diagrams, it is often necessary to draw wires crossing even though they are not connected. It is preferred to have the 'hump' symbol as shown because the simple crossing of the wire may be misread as a joint where you have forgotten to add a 'blob'.
 Cell		Supplies electrical energy. The larger terminal is marked as '+' to represent the anode and smaller terminal is marked as '–' to represent the cathode. A single cell is often interpreted and called a battery, but a battery is two or more cell joined together.
 Battery		Supplies electrical energy. A battery is a combination of 2 or more cells.
 Fuse		A safety device, which will melt if the current flowing through it exceeds a specified value.
 Voltmeter		A voltmeter is used to measure voltage (potential difference).
 Ammeter		An ammeter is used to measure electric current.
 Bulb		A device, which converts electrical energy to light.
 Resistor		A fixed resistor limits the current in the circuit.
 Variable Resistor		A variable resistor allows the current in a circuit to be varied.
 Open switch		A switch enables current in a circuit to be switched on or off. When the switch is open, the circuit is incomplete and no current flows.
 Closed switch		When the switch is closed, the circuit is complete and current flows.

- **Electrical resistivity:** ρ (rho) is a constant of proportionality. The SI unit of resistivity is Ω m. It is a characteristic property of the material. The conductors have very low resistivity in the range of 10^{-8} Ω m to 10^{-6} Ω m. Insulators have resistivity of the order of 10^{12} to 10^{17} Ω m.
- The unit of power is watt (W). One watt of power is consumed when 1 A of current flows at a potential difference of 1 V.
- The electrical energy dissipated in a resistor is given by $W = V \times I \times t$

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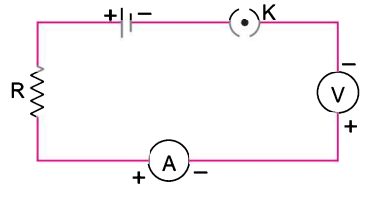
Multiple Choice Questions [1 mark]

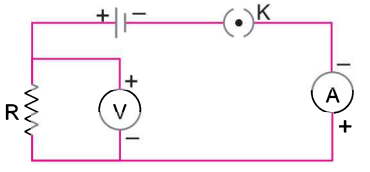
Each question has 4 choices (a), (b), (c) and (d). Choose and write the correct option.

1. **Conventionally, in an electric circuit the direction of electric current is taken as opposite to the direction of the flow of**
   (a) electrons (b) protons (c) neutrons (d) none of these
2. **A wire of resistance R is stretched to twice of its original length. Its new resistance will be**
   (a) $4R$ (b) $\frac{R}{9}$ (c) $3R$ (d) $\frac{R}{3}$
3. **A metallic wire of resistance 12 Ω is bent to form a square. The resistance between the two diagonal points would be**
   (a) 12 Ω (b) 24 Ω (c) 6 Ω (d) 3 Ω
4. **A fuse wire is a wire of**
   (a) low resistance and low melting point (b) high resistance and low melting point
   (c) low resistance and high melting point (d) high resistance and high melting point
5. **One kilowatt hour is equal to**
   (a) 36×10^5 J (b) 36×10^3 J (c) 36×10^{-5} J (d) 36×10^{-3} J
6. **Ten identical wires each having a resistance of 1 Ω are connected in parallel. The combination will have a resistance of**
   (a) 10 Ω (b) 1 Ω (c) 0.1 Ω (d) 0.01 Ω
7. **Ohm's Law states the relationship between**
   (a) electric current and resistance (b) electric current and work
   (c) electric current and potential difference (d) electric current and electric charge
8. **is used exclusively for the filaments of the bulbs.**
   (a) Copper (b) Aluminium (c) Silver (d) Tungsten
9. **The unit of resistivity is**
   (a) ohm (b) ohm metre^2 (c) ohm-metre (d) ohm per metre
10. **The resistivity does not change if** [*NCERT Exemplar*]
    (a) the material is changed (b) the temperature is changed
    (c) the shape of the resistor is changed (d) both material and temperature are changed
11. **An electric iron draws a current 4 A when connected to a 220 V mains. Its resistance must be**
    (a) 1000 Ω (b) 55 Ω (c) 44 Ω (d) none of these
12. **Identify the current in which the electrical components have been properly connected.** [*NCERT Exemplar*]

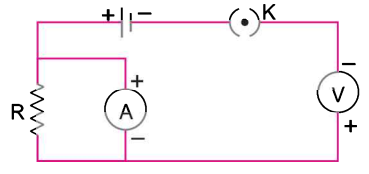
(a)



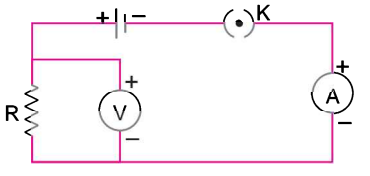
(b)



(c)



(d)



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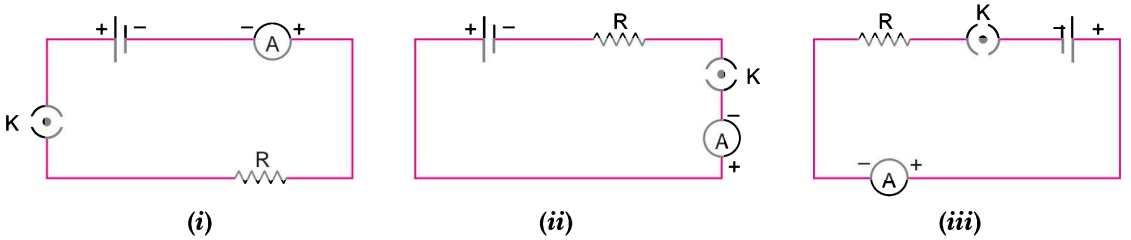
13. **A cylindrical conductor of length l and uniform area of cross-section A has resistance R. Another conductor of length $2l$ and resistance R of the same material must have area of cross-section** [*NCERT Exemplar*]

(*a*) $\frac{A}{2}$ (*b*) $\frac{3A}{2}$ (c) $2A$ (*d*) $3A$

14. **A cell, a resistor, a key and ammeter are arranged as shown in circuit diagrams.**



(*i*) (*ii*) (*iii*)

The current recorded in the ammeter will be [*NCERT Exemplar*]

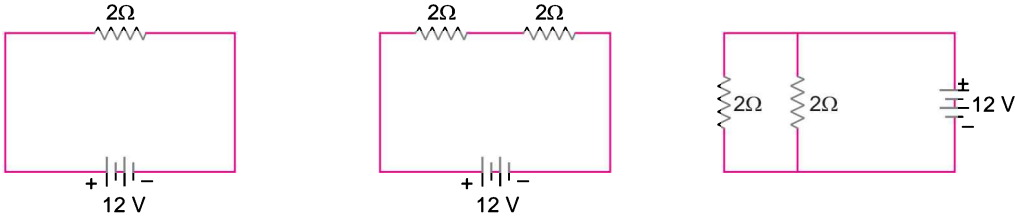
(*a*) maximum in (*i*) (*b*) maximum in (*ii*)

(*c*) maximum in (*iii*) (*d*) same in all three circuits

15. **A current of 1A is drawn by a filament of an electric bulb. Number of electrons passing through a cross-section of the filament in 16 seconds would be roughly** [*NCERT Exemplar*]

(*a*) 10^{20} (*b*) 10^{16} (*c*) 10^{18} (*d*) 10^{23}

16. **In the following circuits, heat produced in the resistor or combination of resistors connected to a 12 V battery will be** [*NCERT Exemplar*]

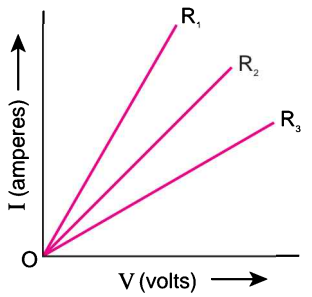


(*i*) (*ii*) (*iii*)

(*a*) same in all the three cases (*b*) minimum in case (*i*)

(*c*) maximum in case (*ii*) (*d*) maximum in case (*iii*)

17. **A student carries out an experiment and plots the V–I graph of three samples of nichrome wire with resistances R_1, R_2 and R_3 respectively. Which of the following is true?** [*NCERT Exemplar*]



(*a*) $R_1 = R_2 = R_3$ (*b*) $R_1 > R_2 > R_3$ (*c*) $R_3 > R_2 > R_1$ (*d*) $R_2 > R_3 > R_1$

18. **Out of the three bulbs: 25 W, 60 W and 100 W, which bulb has least resistance?**

(*a*) 25 W bulb (*b*) 60 W bulb

(c) 100 W bulb (*d*) All bulbs have equal resistances

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19. **In an electrical circuit two resistors 2 Ω and 4 Ω respectively are connected in series to a 6 V battery. The heat dissipated by the 4 Ω resistor in 5 s will be** [*NCERT Exemplar*]

(*a*) 5 J (*b*) 10 J (*c*) 20 J (*d*) 30 J

20. **What is the maximum resistance which can be made using five resistors each of $\frac{1}{5}\Omega$?** [*NCERT Exemplar*]

(*a*) $\frac{1}{5}\Omega$ (*b*) 10 Ω (*c*) 5 Ω (*d*) 1 Ω

21. **Two resistors of resistances 2 Ω and 4 Ω when connected with a battery will have** [*NCERT Exemplar*]

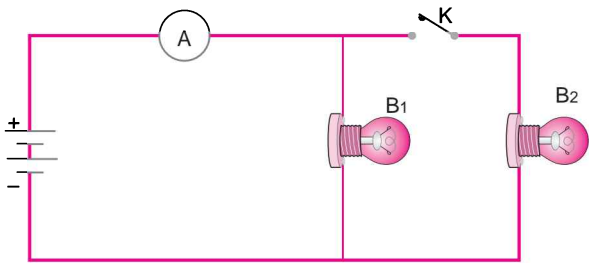
(*a*) same current flowing through them when connected in parallel.

(*b*) same current flowing through them when connected in series.

(*c*) same potential difference across them when connected in series.

(*d*) different potential differences when connected in parallel.

22. **Bulbs B_1 and B_2 are exactly identical. When the key *K* is pressed, the reading of the ammeter will**



(*a*) remain unchanged (*b*) be doubled

(*c*) be halved (*d*) become four times

Answers

1. (*a*)	**2.** (*a*)	**3.** (*d*)	**4.** (*b*)	**5.** (*a*)	**6.** (*c*)	**7.** (*c*)	**8.** (*d*)
9. (*c*)	**10.** (*c*)	**11.** (*b*)	**12.** (*b*)	**13.** (*c*)	**14.** (*d*)	**15.** (*a*)	**16.** (*d*)
17. (*c*)	**18.** (*c*)	**19.** (*c*)	**20.** (*d*)	**21.** (*b*)	**22.** (*b*)		

Assertion-Reason Questions [1 mark]

The following questions consist of two statements — Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

1. **Assertion (*A*) :** Tungsten metal is used for making filaments of incandescent lamps.

Reason (*R*) : The melting point of tungsten is very low.

2. **Assertion (*A*) :** If a graph is plotted between the potential difference and the current flowing, the graph is a straight line passing through the origin.

Reason (*R*) : The current is directly proportional to the potential difference.

3. **Assertion (*A*) :** Longer wires have greater resistance and the smaller wires have lesser resistance.

Reason (*R*) : Resistance is inversely proportional to the length of the wire.

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4. **Assertion (*A*) :** Alloys are commonly used in electrical heating devices, like electrical iron, toasters etc.
   Reason (*R*) : Alloys do not oxidise (burn) readily at high temperatures.
5. **Assertion (*A*) :** When the resistances are connected end-to-end consecutively, they are said to be in series.
   Reason (*R*) : In case the total resistance is to be increased, then the individual resistances are connected in series.
6. **Assertion (*A*) :** When the resistances are connected between the same two points, they are said to be connected in parallel.
   Reason (*R*) : In case the total resistance is to be decreased, then the individual resistances are connected in parallel.
7. **Assertion (*A*) :** A cell is a device which converts chemical energy into electrical energy.
   Reason (*R*) : Cell maintains a constant potential difference between its terminals for a long time.

Answers

1. (*c*) **2.** (*a*) **3.** (*c*) **4.** (*a*) **5.** (*b*) **6.** (*b*) **7.** (*b*)

Passage-based Questions

Answer the questions below each passage on the basis of your understanding of the paragraph and the related studied concepts.

1. In an electrical circuit, the resistance R is defined by the equation $R = \frac{V}{I}$, where the electrical current I is in amperes (A), and the potential difference V is in volts (V). R is measured in ohms (Ω).

   Ohm's law states that for certain conductors, the resistance R is constant. Any resistance device or conductor for which R is constant is said to obey Ohm's law. Not all devices obey this law.

   Students performed two experiments. In Experiment 1, they investigated the resistance of a small resistor device. In Experiment 2, they investigated the resistance of a small lightbulb. In Experiment 1, the students measured current through the resistor at various voltage values between 0 and 20 V. In Experiment 2, the student measured current through the lightbulb at about 10 voltage values between 0 and 20 V. Figures show the symbolic circuit diagrams for Experiment 1 and 2, respectively. The lines connecting the various devices represent wires whose resistance is negligible.

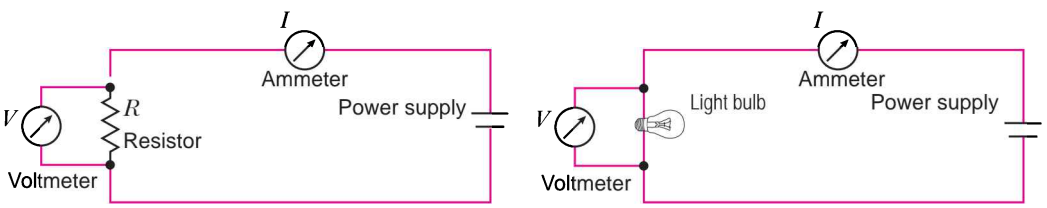

   Figure (A) shows the results of Experiment 1. Current I in milliamperes (mA) is plotted against potential V in volts (V).

   Figure (B) shows the results of Experiment 2. Current I in amperes (A) is plotted against potential V in volts (V).

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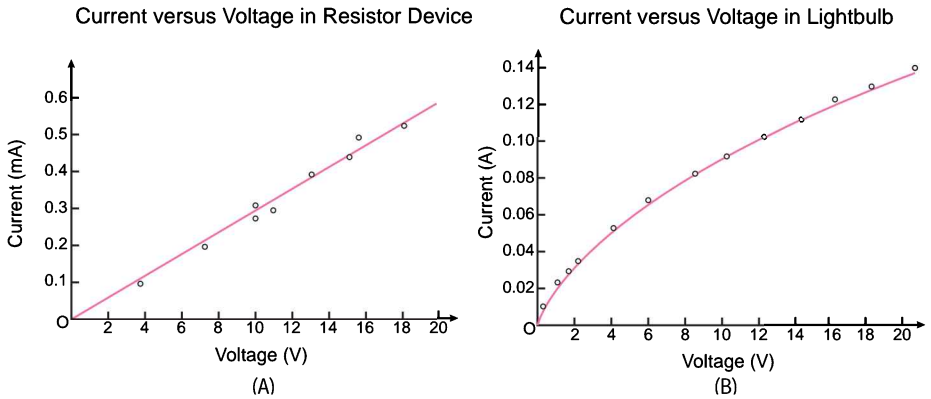


(*i*) According to the results obtained in the experiments, find the resistance of the resistor device.

(*ii*) In experiment 2, on comparing 60 W lightbulb with a 75 W lightbulb, whose resistance is more?

(*iii*) Based on the graphs in figures, what could the students reasonably conclude?

(*a*) The resistor device and the lightbulb both obeyed Ohm's law.

(*b*) Neither the resistor device nor the lightbulb obeyed Ohm's law.

(*c*) The lightbulb obeyed Ohm's law, but the resistor device did not.

(*d*) The resistor device obeyed Ohm's law, but the lightbulb did not.

(*iv*) Based on the data in the graph for Experiment 2, which describes the relationship between voltage through the lightbulb and resistance?

(*a*) There is no pattern in the relationship between voltage and resistance.

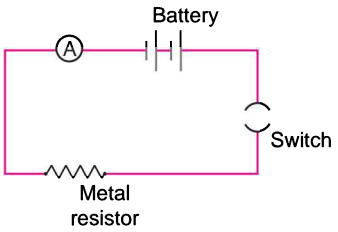
(*b*) As voltage increases, resistance increases.

(*c*) As voltage increases, resistance decreases.

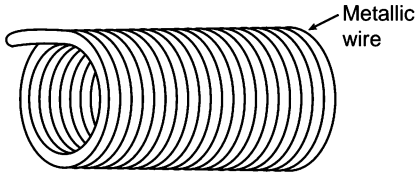
(*d*) As voltage increases, resistance stays constant.

2. Metals differ in their relative abilities to conduct electricity. Resistance is a measurement in ohms (Ω) of how much a metal opposes electric current at a particular voltage.

A scientist performed 3 experiments using the circuit shown in Figure.



The metal resistor consisted of a coil of metallic wire with a known cross-sectional area and length.



A 9-volt battery was used, and when the switch was closed, electrons (negatively charged) flowed away from the negative battery terminal, through the circuit, and back to the positive battery terminal. The magnitude of current (charge per unit time) from this electron flow was measured by an *ammeter*, and was 1.0×10^{-3} coulombs/second for the first trial of each experiment. Resistor was calculated in ohms (Ω) from the resulting values for voltage (V) and current (I).

Experiment 1

Three nickel resistor coils, each with a cross-sectional area of 7.61×10^{-10} m^2 but with different lengths, were attached separately to the circuit. Results were recorded in Table 1.

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Table 1

Resistor length (m)	I (coulombs/second)	R (Ω)
100	1.0×10^{-3}	9,000
50	2.0×10^{-3}	4,500
25	4.0×10^{-3}	2,250

Experiment 2

Three gold resistor coils of varying cross-sectional area were tested. Each resistor coil had a measured length of 100 m. The results were recorded in Table 2.

Table 2

Resistor cross-sectional area (m^2)	I (coulombs/second)	R (Ω)
2.7×10^{-10}	1.0×10^{-3}	9,000
8.0×10^{-10}	3.0×10^{-3}	3,000
2.4×10^{-9}	9.0×10^{-3}	1,000

Experiment 3

Three coils made of different metals were tested. Each resistor had a cross-sectional area of 2.67×10^{-10} m^2 and a length 100 m. The value ρ is related to each metal's inherent resistance to current flow. Results were recorded in Table 3.

Table 3

Metal	ρ (Ω . m)	I (coulombs/second)	R (Ω)
Gold	2.4×10^{-8}	1.0×10^{-3}	9,000
Nickel	6.9×10^{-8}	4.4×10^{-4}	25,690
Tin	1.1×10^{-7}	3.4×10^{-4}	41,250

(*i*) From the above experiments, write the relation between resistance (R), ρ (resistivity), A (area of cross section) and l (length) of a conductor.

(*ii*) Assume that as ρ increases, a metal's ability to conduct current decreases. Based on the results of Experiment 3, Arrange correctly gold, nickel and tin in order of increasing ability to conduct electrons when shaped as a wire coil.

(*iii*) In Experiment 2, the scientist varied which of the following aspects of the metal resistor?

(*a*) Identity of the metal coil
(*b*) Cross-sectional area of the coil
(*c*) Length of the coil
(*d*) Value ρ of the metal composing the coil

(*iv*) In the first trial of Experiments 1–3, once the resistor was attached and the switch was closed, what charge returned to the positive battery terminal each second?

(*a*) -1.0×10^{-3} coulombs
(*b*) -2.0×10^{-3} coulombs
(*c*) -3.0×10^{-3} coulombs
(*d*) -4.0×10^{-3} coulombs

Answers

1. (*i*) Resistance $R = \frac{V}{I}$; where V is in volts and I is in amperes. From the graph in Figure, when voltage V is 8, I = 0.25 mA = 0.25×10^{-3} A.

Therefore, $R = \frac{8}{0.25\times10^{-3}} = \mathbf{32 \times 10^3\ \Omega}$

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(*ii*) In household use, the voltage is kept constant. In the equation $P = VI$, if V is constant, I increases as P increases. This means that for $P = 75$ W, the current I is larger than for $P = 60$ W. In formula, $V = IR$, since V is constant, hence for larger I, R must be smaller. Thus, since current is larger in a 75 W bulb, the resistance is lower than it is in a 60 W bulb.

(*iii*) (*d*) The graph for Experiment 1 is approximately linear. This means that its slope $\frac{I}{V}$ is constant, which means that $\frac{V}{I} = R$ is constant. Therefore, the resistor device obeys Ohm's law. The graph for Exp. 2 is non-linear. This means that R is not constant and that the lightbulb does not obey Ohm's Law.

(*iv*) (*b*) The slope of the graph decreases as V increases. Since slope equals $\frac{1}{R}$, as $\frac{1}{R}$ decreases, R increases.

2. (*i*) $R = \rho\frac{l}{A}$

(*ii*) The results of Experiment 3 shown in Table 3 indicate that as ρ increases, resistance increases and current decreases. Since gold has the lowest ρ value, it should be the best conductor. And tin has greatest ρ value, so it should be the least conductor. Thus, the order is: Tin, nickel, gold.

(*iii*) (*b*) In Experiment 2, all of the metal resistors were gold and 100 m in length, eliminating choices (*a*), (*c*) and (*d*). The description of the experiment and data in Table 2 indicates that cross-sectional area was varied across trials.

(*iv*) (*a*) According to the passage, electrons are negatively charged and return to the positive battery terminal. This explains why each answer choice is negative. The passage introduction states current is charge per unit time measured in coulombs/second, and that the magnitude of this current was 1.0×10^{-3} coulombs every second for the first trial of each experiment. Therefore, a charge of -1.0×10^{-3} coulombs returned to the positive battery terminal each second the switch was closed.

Very Short Answer Questions [1 mark]

Each of the following questions are of 1 mark and have to be answered in one word or one sentence.

Q. 1. Define current. Give its SI unit. *[CBSE 2019 (31/4/2)]*

Ans. Electric current is the rate of flow of electric charges. Its SI unit is ampere abbreviated as A.

$I = \frac{Q}{t}$

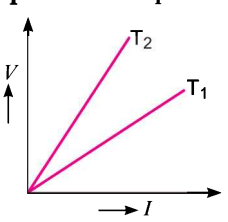
Q. 2. Define the term electrical resistivity of a material. *[CBSE 2019 (31/3/1)]*

Ans. Resistivity of a material is numerically equal to the resistance of a conductor of unit length and unit cross- sectional area of that material at a certain temperature.

Q. 3. Define resistance. Give its SI unit. *[CBSE 2019 (31/4/1)]*

Ans. The hindrance offered by a conductor to the flow of current is called resistance. Its SI unit is ohm (Ω).

Q. 4. The voltage-current (*V-I*) graph of a metallic conductor at two different temperatures T_1 and T_2 is shown in figure. At which temperature is the resistance higher?



Ans. At T_2

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Q. 5. Why is resistance less when resistors are joined in parallel?

Ans. We know that $R \propto \frac{l}{A}$

In parallel combination of resistors, the effective area of cross-section of the conductor increases, so the resistance decreases.

Q. 6. Mention the condition under which a current can flow in a conductor. *[CBSE 2019 (31/4/3)]*

Ans. The condition under which a current can flow in a conductor is that the circuit is closed and there is a potential difference along the conductor.

Q. 7. Why is resistance more in series combination?

Ans. We know R $\propto l$. In series combination of resistors, the effective length of the conductor increases, so the resistance increases.

Q. 8. What are the special features of a heating wire?

Ans. It must have high specific resistance and high melting point.

Q. 9. What is the resistance of an ideal ammeter?

Ans. Zero

Q. 10. What is the resistance of an ideal voltmeter?

Ans. Infinite

Q. 11. Which one has more resistance 100 watt bulb or 60 watt bulb both operating at 220 V?

Ans. The resistance of 60 watt bulb is greater than the resistance of 100 watt bulb.

Q. 12. Write the expression for the heat energy produced in a wire of resistance *R* and carrying current *I*.

Ans. Heat produced, $H = I^2Rt$, where 't' stands for time, for which current I is passed through the conductor.

Q. 13. Name the physical quantity whose unit is J/C.

Ans. Electric potential

Q. 14. When do we say that the potential difference between two points of a circuit is 1 volt? *[CBSE 2019 (31/3/2)]*

Ans. The potential difference between two points of a circuit is 1 volt when 1 joule of work is done to move a charge of 1 coulomb from one point to the other.

Q. 15. What is the resistance of an air gap?

Ans. It is very large, almost infinite.

Q. 16. What is the commercial unit of electric energy?

Ans. The commercial unit of electric energy is kilowatt hour (kWh).

Q. 17. What happens to the resistance of a wire if it is made thinner?

Ans. The resistance of wire increases.

Q. 18. In series combination which remains constant—current or voltage?

Ans. Current

Q. 19. Which substance is used for making resistance coil of electric heater and why?

Ans. Nichrome, due to its high resistivity.

Q. 20. Why does the cord of an electric oven not glow while its heating element does? *[CBSE 2019 (31/2/3)]*

Ans. The cord of the electric heater is made of copper where as the heating element is made of nichrome. Nichrome glows because large amount of heat is produced due to its high resistance when electric current is passed through it.

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Q. 21. Which physical quantity remains constant when resistances are connected in parallel?

Ans. Potential difference (voltage) remains constant.

Q. 22. How is the ammeter connected in the circuit?

Ans. An ammeter is connected in series in the circuit.

Q. 23. Name two devices in which electricity is converted into heat.

Ans. Electric heater and electric iron.

Q. 24. Write the function of voltmeter in an electric circuit. *[CBSE 2019 (31/1/3)]*

Ans. Voltmeter is used for measuring potential difference between two points in an electric circuit.

Q. 25. Name the instrument used for measuring electric current flowing in an electric circuit.

Ans. An ammeter.

Q. 26. The following table gives the value of electrical resistivity of some materials:

Material	Copper	Silver	Constantan
Electrical resistivity (in Ω m)	1.62×10^{-8}	1.6×10^{-8}	49×10^{-6}

Which one of these materials is the best conductor of electricity?

Ans. Out of these three, silver has the lowest resistivity. Hence, silver is the best conductor of electricity.

Q. 27. Should the resistance of a voltmeter be low or high? Give reason. *[CBSE 2019 (31/2/2)]*

Ans. The resistance of a voltmeter should be high so that it takes a negligible current from the circuit.

Q. 28. Define 1 kilowatt hour. *[CBSE 2019 (31/3/3)]*

Ans. One kilowatt hour is the electrical energy consumed when an electrical appliance having 1 kW power rating is used for 1 hour.

Q. 29. Define electric power. *[CBSE 2019 (31/4/1)]*

Ans. Rate at which electrical energy is dissipated in an electric circuit is called as power.

Q. 30. An electrical device of resistance *R* is connected across a source of voltage *V* and draws a current *I*. Derive an expression for power in terms of current and resistance.

[CBSE 2019 (31/4/1)]

Ans. Power, $P = V \times I = IR \times I = I^2R$.

Short Answer Questions [3 marks]

Each of the following questions are of 3 marks and have to be answered in about 50-60 words.

Q. 1. (*i*) Why does resistance of a metallic conductor increase with increase in temperature?

(*ii*) Heat is generated continuously in an electric heater but the temperature of its element becomes constant after some time. Why?

Ans. (*i*) When a metallic conductor is heated, the atoms in the metal vibrate with greater amplitude and frequency. Due to increase in temperature, the thermal velocities of free electrons also increases. Therefore, the number of collisions between free electrons and atoms increases. This increases the opposition to the movement of electrons and hence the resistance of the conductor.

(*ii*) When the temperature of the heater becomes greater than the temperature of the surrounding, some of the heat is lost to the surroundings in the form of thermal radiations. After some time, rate at which heat is being produced becomes equal to the rate at which heat is lost. Hence, the temperature of the element becomes constant.

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Q. 2. **(*i*) Why is it not advisable to handle high voltage electrical circuit with wet hands?**

(*ii*) Though the same current flows through line wires or the filament of a bulb, yet only the latter glows. Why?

Ans. (*i*) The resistance of dry-skin human body is about 50,000 Ω. When the skin is wet, the resistance gets lowered to about 10,000 Ω. If a person with wet hands touches the electrical circuit, high current will flow through the body causing risk to life.

(*ii*) The filament of electric lamp has high resistance whereas the line wires are of negligible resistance. Since amount of heat generated is proportional to the resistance, the filament generates much more heat and it starts glowing.

Q. 3. **(*i*) Should the resistance of an ammeter be low or high? Give reason.** *[NCERT Exemplar]*

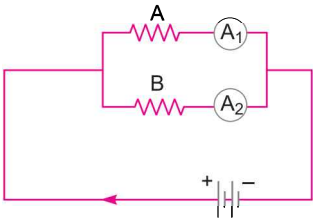
(*ii*) How does use of a fuse wire protect electrical appliances? *[NCERT Exemplar]*

Ans. (*i*) It should be as close to zero as possible. Ideally it should be zero ohm. If it is non-zero and substantial, it will affect the true current.

(*ii*) If a current larger than a specified value flows in a circuit, temperature of fuse wire increases to its melting point. The fuse wire melts and the circuit breaks.

Q. 4. **(*i*) What is electrical resistivity? In a series electrical circuit comprising of a resistor having a metallic wire, the ammeter reads 5 A. The reading of the ammeter decreases to half when the length of the wire is doubled. Why?** *[CBSE 2019 (31/1/2)] [NCERT Exemplar]*

(*ii*) In the given circuit diagram, two resistance wires A and B are of same area of cross–section and same material, but A is longer than B. Which ammeter A_1 or A_2 will indicate higher reading for current? Give reason.



Ans. (*i*) The resistivity of a material is defined as the resistance of a conductor made of that material of unit length and unit cross-sectional area.

Using, $$R = \rho \frac{l}{A}$$

Also, $$V = RI$$

R is doubled while V remains unchanged. Hence, current becomes half.

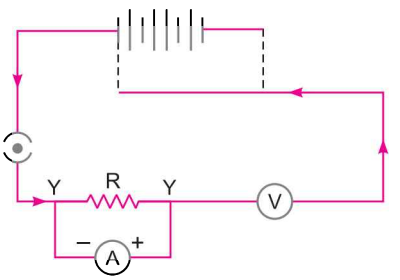
(*ii*) Ammeter A_2 shows higher reading. Since wire A is longer, it has greater resistance and so draws lesser current. So more current flows through B and A_2 shows higher reading.

Q. 5. **Two wires of equal length, one of copper and the other of manganin (an alloy) have the same thickness. Which one can be used for (*i*) electrical transmission lines (*ii*) electrical heating devices? Why?**

Ans. (*i*) Copper wire can be used for electrical transmission lines because copper has very low resistivity and hence it is very good conductor of electricity.

(*ii*) Manganin can be used for electrical heating devices because the resistivity of manganin is about 25 times more than that of copper and hence it produces a lot of heat on passage of current through it.

Q. 6. **A student has drawn the electric circuit to study Ohm's law as shown in figure. His teacher told that the circuit diagram needs correction. Study the circuit diagram and redraw it after making all corrections.** *[NCERT Exemplar]*



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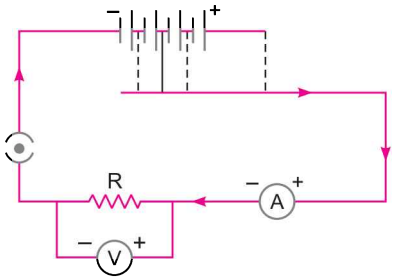
Ans.



Q. 7. Why does an electric bulb become dim when an electric heater in parallel circuit is switched on? Why does dimness decrease after sometime?

Ans. The resistance of a heater coil is less than that of electric bulb filament. When heater is switched on in parallel, more current start flowing through the heater coil and current through the bulb filament decreases making it dim.

After some time, when heater coil becomes hot its resistance increases. As a result, current through the heater coil decreases and the current through the bulb filament increases and thus dimness of the bulb decreases.

Q. 8. A metallic wire of resistance *R* is cut into ten parts of equal length. Two pieces each are joined in series and then five such combinations are joined in parallel. What will be the effective resistance of the combination?

Ans. The resistance of a conductor is directly proportional to the length of the conductor. The resistance of the metallic wire, when it is cut into ten parts of equal length is

$$r = \frac{R}{10}$$

Two such pieces when joined in series, the equivalent resistance of these two parts

$$= r + r = 2r = \frac{2R}{10}.$$

Series resistance of two parts $= 2 \times \frac{R}{10} = \frac{R}{5}$

5 such elements are connected in parallel. Therefore the total resistance R' will be

$$\frac{1}{R'} = \frac{1}{\frac{R}{5}} + \frac{1}{\frac{R}{5}} + \frac{1}{\frac{R}{5}} + \frac{1}{\frac{R}{5}} + \frac{1}{\frac{R}{5}} = \frac{25}{R}$$

Hence $$R' = \boldsymbol{\frac{R}{25}}$$

Q. 9. A wire of length *l* and resistance *R* is stretched so that its length is doubled and the area of cross-section is halved. How will its:

(*i*) resistance change?

(*ii*) resistivity change?

Justify your answer in each case.

Ans. (*i*) Here, length is doubled and area of cross-section is halved. Thus, a wire of length l and area of cross-section A becomes a wire of length $2l$ and area of cross-section $\frac{A}{2}$.

Using $$R = \rho \frac{l}{A}$$

New resistance, $$R_1 = \rho \frac{2l}{A/2}$$

$$= \frac{4\rho l}{A} = 4 \times R$$

i.e., resistance becomes four times

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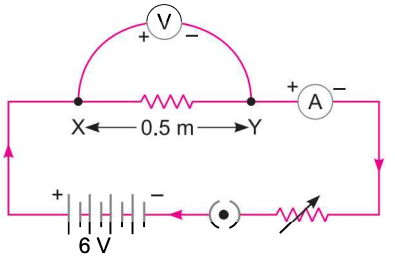
(*ii*) Resistivity of a substance does not depend on its length or area of cross-section. It depends on the nature of the material and temperature. Hence there is no change.

Q. 10. (*i*) The components of an electric circuit are 0.5 m long nichrome wire XY, an ammeter, a voltmeter, four cells of 1.5 V each, rheostat and a plug key. Draw a circuit diagram to study the relation between potential difference across the terminals X and Y of the wire and current flowing through it.

(*ii*) State the law that relates potential difference across a conductor with the current flowing through it.

Ans. (*i*)



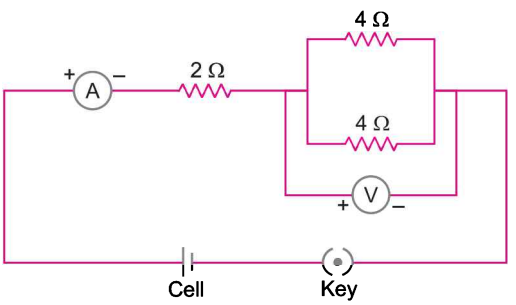
(*ii*) Ohm's law states that the current through a conductor between two points is directly proportional to the potential difference across the two points.

Q. 11. Draw a circuit diagram of an electric circuit containing a cell, a key, an ammeter, a resistor of 2 Ω in series with a combination of two resistors (4 Ω each) in parallel and a voltmeter across the parallel combination. Will the potential difference across the 2 Ω resistor be the same as that across the parallel combination of 4 Ω resistors? Give reason. *[NCERT Exemplar]*

Ans. The circuit is shown in figure. Effective resistance of combination of two resistors (4 Ω each) in parallel is

$$R_{eq} = \frac{4 \times 4}{4 + 4} = 2\ \Omega$$

Since the resistor of 2 Ω and parallel combination of two 4 Ω resistors are in series, same current will flow through these. Hence, the potential difference across 2 Ω resistor is same as that across combination of two resistors.



Q. 12. Three incandescent bulbs of 100 W each are connected in series in an electrical circuit. In another circuit another set of three bulbs of the same wattage are connected in parallel to the same source.

(*i*) Will the bulb in the two circuits glow with the same brightness? Justify your answer.

(*ii*) Now let one bulb in both the circuits get fused. Will the rest of the bulbs continue to glow in each circuit? Give reason. *[NCERT Exemplar]*

Ans. (*i*) No.

Reasons: Let R be the resistance of each bulb, then total resistance in series = $3R$

In series, current in each bulb is same.

So current drawn by each bulb connected in series is one-third as compared to the current in each bulb in parallel arrangement, so the bulbs connected in parallel combination glow more brightly.

(*ii*) In series arrangement, if one bulb is fused; then current in the bulbs connected in series will become zero, so bulbs will stop glowing. In parallel arrangement, if one bulb is fused, the other two bulbs will continue to glow with same brightness.

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Q. 13. What would be the reading of ammeter and voltmeter in the given circuit?

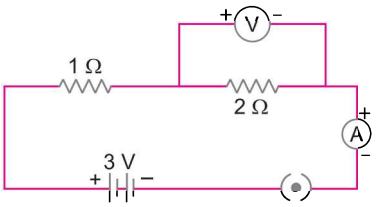
Ans. $R = R_1 + R_2 = 1 + 2 = 3\ \Omega$

$$I = \frac{V}{R} = \frac{3}{3} = 1\ \text{A}$$

Ammeter reading = 1 A

Voltmeter reading = $IR = 1 \times 2 = 2$ V

Voltmeter reading = 2 V



Q. 14. Read the following information:

I. Resistivity of copper is lower than that of aluminium which in turn is lower than that of constantan.

II. Six wires labelled as A, B, C, D, E, F have been designed as per the following parameters:

Wire	Length	Diameter	Material	Resistance
A	l	$2d$	Aluminium	R_1
B	$2l$	$d/2$	Constantan	R_2
C	$3l$	$d/2$	Constantan	R_3
D	$l/2$	$3d$	Copper	R_4
E	$2l$	$2d$	Aluminium	R_5
F	$l/2$	$4d$	Copper	R_6

Answer the following questions using the above data:

(*i*) Which of the wires has maximum resistance and why?

(*ii*) Which of the wires has minimum resistance and why?

(*iii*) Arrange R_1, R_3 and R_5 in ascending order of their values. Justify your answer.

Ans. (*i*) Wire C has maximum resistance because it has maximum length, least thickness and highest resistivity.

(*ii*) Wire F has the minimum resistance since it has least length, maximum thickness and least resistivity. (Using $R = \rho\frac{l}{A}$)

(*iii*) $R_3 > R_5 > R_1$ (Using relation $R = \rho\frac{l}{A}$ and comparing)

Q. 15. (*i*) Write the relation between resistance and electrical resistivity of the material of a conductor in the shape of a cylinder of length '*l*' and area of cross-section 'A'. Hence derive the S.I. unit of electrical resistivity.

(*ii*) Resistance of a metal wire of length 5 m is 100 Ω. If the area of cross-section of the wire is 3×10^{-7} m^2, calculate the resistivity of the metal. *[CBSE 2019 (31/3/1)]*

Ans. (*i*) Resistance, $R = \frac{\rho l}{A}$

where ρ (rho) is resistivity of the material of the conductor.

Also, $\rho = \frac{RA}{l}$

$$\therefore \text{ SI unit of resistivity} = \frac{\text{SI unit of R} \times \text{SI unit of A}}{\text{SI unit of } l}$$

$$= \frac{\text{ohm} \times \text{metre}^2}{\text{metre}}$$

$$= \text{ohm metre } (\Omega\text{m})$$

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(*ii*) Here, $l = 5$ m

$R = 100\ \Omega$

$A = 3 \times 10^{-7}\ m^2$

$\rho = ?$

We know that

$$R = \frac{\rho l}{A}$$

$$\rho = \frac{RA}{l}$$

$$= \frac{100 \times 3 \times 10^{-7}}{5}$$

$$= 60 \times 10^{-7}$$

$$= \mathbf{6 \times 10^{-6}\ \Omega m}$$

Long Answer Questions [5 marks]

Each of the following questions are of 5 marks and have to be answered in about 80-90 words.

Q. 1. **(*i*) The potential difference between two points in an electric circuit is 1 volt. What does it mean? Name a device that helps to measure the potential difference across a conductor.**

(*ii*) Why does the connecting cord of an electric heater not glow while the heating element does?

(*iii*) Electrical resistivities of some substances at 20°C are given below:

Silver	**$1.60 \times 10^{-8}\ \Omega$ m**
Copper	**$1.62 \times 10^{-8}\ \Omega$ m**
Tungsten	**$5.2 \times 10^{-8}\ \Omega$ m**
Iron	**$10.0 \times 10^{-8}\ \Omega$ m**
Mercury	**$94.0 \times 10^{-8}\ \Omega$ m**
Nichrome	**$100 \times 10^{-6}\ \Omega$ m**

Answer the following questions using above data:

(*a*) Among silver and copper, which one is a better conductor? Why?

(*b*) Which material would you advise to be used in electrical heating devices and why?

Ans. (*i*) The potential difference between two points is 1 volt means that if a charge of 1 coulomb is moved from one point to the other, 1 joule of work is required.

The potential difference across a conductor is measured by means of an instrument called voltmeter.

(*ii*) The electric power P is given by

$$P = I^2R$$

The resistance of the heating element is very high. Large amount of heat generates in the heating element and it glows hot.

The resistance of connecting cord is very low. Thus, negligible heat generates in the connecting cord and it does not glow.

(*iii*) (*a*) Silver is a better conductor due to its lower resistivity.

(*b*) Nichrome should be used in electrical heating devices due to very high resistivity.

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Q. 2. **(*i*) Name an instrument that measures electric current in a circuit. Define the unit of electric current.**

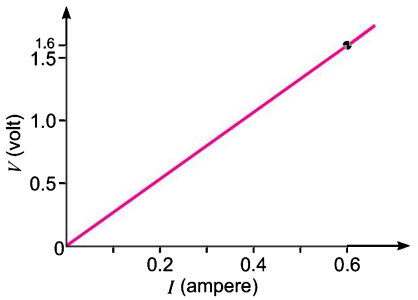
(*ii*) What do the following symbols represent in a circuit diagram?

(*a*)  **(*b*)**

(*iii*) An electric circuit consisting of a 0.5 m long nichrome wire XY, an ammeter, a voltmeter, four cells of 1.5 V each and a plug key was set up.

(*a*) Draw the electric circuit diagram to study the relation between the potential difference maintained between the points 'X' and 'Y' and the electric current flowing through XY.

(*b*) Following graph was plotted between V and I values using above circuit:



What would be the values of $\frac{V}{I}$ ratios when the potential difference is 0.8 V, 1.2 V and 1.6 V respectively? What conclusion do you draw from these values?

Ans. (*i*) An instrument that measures electric current in a circuit is called "ammeter".

The unit of electric current is ampere (A). 1 ampere is constituted by the flow of 1 coulomb of charge through any point in an electric circuit in 1 second.

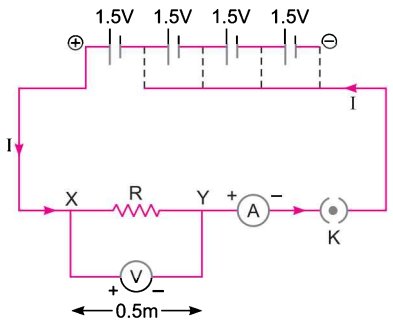
(*ii*) (*a*) 

Variable resistance or rheostat

(*b*)

Plug key or switch (closed)

(*iii*) (*a*)



(*b*) Following graph was plotted between *V* and I values.

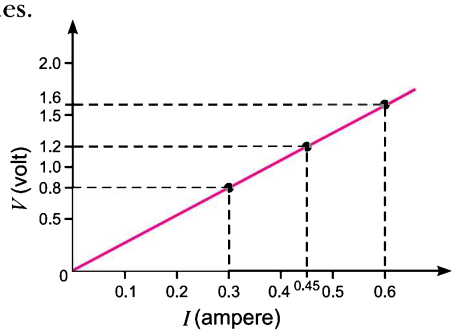
At potential difference 0.8 V,

$$\frac{V}{I} = \frac{0.8}{0.3} = \frac{8}{3}$$

At potential difference 1.2 V,

$$\frac{V}{I} = \frac{1.2}{0.45} = \frac{8}{3}$$

At potential difference 1.6 V, $\frac{V}{I} = \frac{1.6}{0.6} = \frac{8}{3}$ ...(3)



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Conclusion: If I be the current through XY resistor and V be the potential difference across it, then the ratio $\frac{V}{I}$ = constant.

$\Rightarrow$ $V \propto I$ and Ohm's law is obeyed.

Q. 3. Find out the following in the electric circuit given in figure alongside:

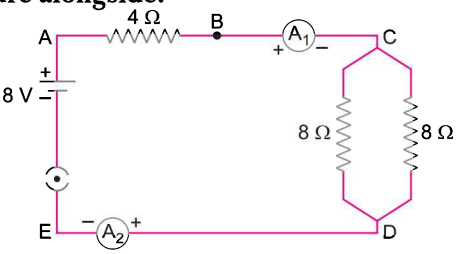
(*i*) Effective resistance of two 8 Ω resistors in the combination

(*ii*) Current flowing through 4 Ω resistor

(*iii*) Potential difference across 4 Ω resistance

(*iv*) Power dissipated in 4 Ω resistor

(*v*) Difference in ammeter readings, if any



[NCERT Exemplar]

Ans. (*i*) $R = \frac{R_1 R_2}{R_1 + R_2} = \left(\frac{8 \times 8}{8+8}\right) = \mathbf{4\ \Omega}$

(*ii*) $I = \frac{V}{R} = \frac{8}{4 + \left(\frac{8 \times 8}{8+8}\right)} = \frac{8}{8} = \mathbf{1A}$

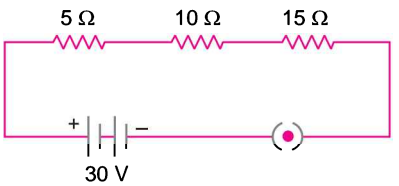
(*iii*) $V = IR = 1 \times 4 = \mathbf{4V}$

(*iv*) $P = I^2R = 1^2 \times 4 = \mathbf{4W}$

(*v*) No difference, same current flows through each ammeter in the given circuit.

Q. 4. (*i*) Three resistors R_1, R_2 and R_3 are connected in series and the combination is connected to a battery, ammeter, voltmeter and key. Draw suitable circuit diagram and obtain an expression for the equivalent resistance of the combination of the resistors.

(*ii*) Consider the given circuit and find the current flowing in the circuit and potential difference across the 15 Ω resistor when the circuit is closed. *[CBSE 2019 (31/2/1)]*



Ans. (*i*) Consider three resistors R_1, R_2 and R_3 are connected in series as shown in figure. A voltage V is applied across the series combination. Applying basic circuit rules we get

(*a*) Current I is same in all points in series.

(*b*) $V = V_1 + V_2 + V_3$ ...(*i*)

Applying ohm's law, we have

$V = IR_{eq}$ (where R_{eq} is the equivalent resistance of the combination)

$V_1 = IR_1$

$V_2 = IR_2$

$V_3 = IR_3$

Putting these values in equation (i), we have

$IR_{eq} = IR_1 + IR_2 + IR_3$

$R_{eq} = R_1 + R_2 + R_3$

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(*ii*) $R_{eq} = R_1 + R_2 + R_3 = 5 + 10 + 15 = 30\ \Omega$

$V = 30$ V

Applying ohm's law

$$I = \frac{V}{R_{eq}} = \frac{30}{30} = \mathbf{1\ A}$$

Now, potential difference across 15 Ω resistor $= IR_3 = 1 \times 15 = \mathbf{15\ V}$.

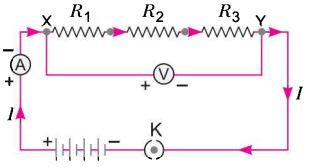
Q. 5. (*i*) How will you infer with the help of an experiment that the same current flows through every part of a circuit containing three resistors in series connected to a battery?

[NCERT Exemplar]

(*ii*) Three resistors R_1, R_2 and R_3 are connected in parallel and the combination is connected to a battery, ammeter, voltmeter and key. Draw suitable circuit diagram and obtain an expression for the equivalent resistance of the combination of the resistors.

[CBSE 2019 (31/2/1)]

Ans. (*i*)



- Join three resistors of different values in series. Connect them with a battery, an ammeter and a plug key, as shown in figure. You may use the resistors of values like 2 Ω, 4 Ω, 6 Ω, etc., and a battery of 6 V for performing this activity.
- Plug the key. Note the ammeter readings.
- Change the position of ammeter to anywhere in between the resistors. Note the ammeter reading each time.
- Do you find any change in the value of current through the ammeter?

Conclusion: In series, current in same at all points.

(*ii*) Consider three resistors R_1, R_2 and R_3 are connected in parallel. A voltage V is applied across the parallel combination.

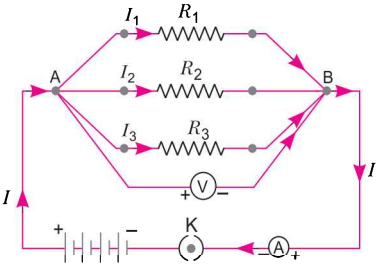
Applying basic circuit rules, we have

(*a*) Potential difference V in same across each resistors R_1, R_2 and R_3 in parallel.

(*b*) $I = I_1 + I_2 + I_3$

Using ohm's law, we have

$$I = \frac{V}{R_{eq}} \qquad \text{(where } R_{eq} \text{ is the equivalent resistance)}$$



$$I_1 = \frac{V}{R_1}$$

$$I_2 = \frac{V}{R_2}$$

$$I_3 = \frac{V}{R_3}$$

Putting these values in (*i*), we have

$$\frac{V}{R_{eq}} = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

$$\Rightarrow \qquad \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

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Numericals

CURRENT AND POTENTIAL DIFFERENCE

Q. 1. A current of 0.5 A is drawn by a filament of an electric bulb for 10 minutes. Find the amount of electric charge that flows through any point of the circuit.

Ans. It is given, I = 0.5 A; t = 10 min = 600 s.

We know that, $Q = I\,t$

$= 0.5\ A \times 600\ s$

$= \mathbf{300\ C}$

Q. 2. A current of 5 A is flowing through a resistor of 15 Ω. Calculate the potential difference between the ends of the resistor.

Ans. Given, Resistance (R) = 15 ohms,

Current (I) = 5 amperes,

Potential difference (V) according to Ohm's law

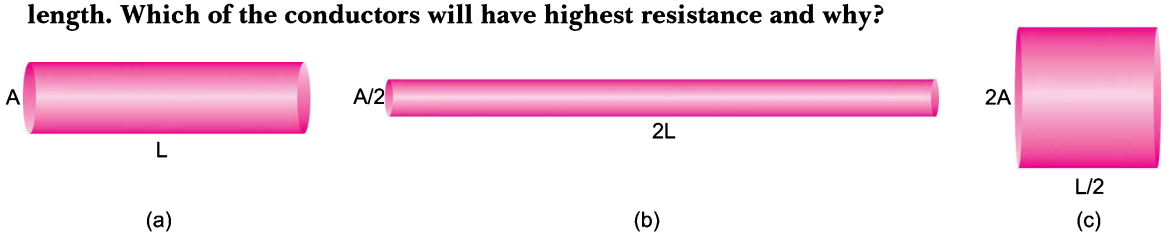
$V = IR$

$\Rightarrow \quad V = 5 \times 15 = 75$ volt

$\therefore \quad V = \mathbf{75\ volt}$

RESISTANCE AND RESISTIVITY

Q. 3. Figure (*a*), (*b*) and (*c*) show three cylindrical copper conductors alongwith their face areas and length. Which of the conductors will have highest resistance and why?



Ans. (*i*) $R_a = \rho\dfrac{L}{A} = \rho\left(\dfrac{L}{A}\right)$

(*ii*) $R_b = \rho\left(\dfrac{2L}{A/2}\right) = \rho\left(\dfrac{4L}{A}\right) = 4\,R_a$

(*iii*) $R_c = \rho\left(\dfrac{L}{2\,(2A)}\right) = \dfrac{1}{4}\rho\left(\dfrac{L}{A}\right) = \dfrac{1}{4}R_a$

Hence, $R_b > R_a > R_c$. Thus, the conductor (*b*) will have the highest resistance.

Q. 4. A piece of wire of resistance 20 Ω is drawn out so that its length is increased to twice its original length. Calculate the resistance of the wire in the new situation.

Ans. Suppose the length of $R_1 = 20\ \Omega$ resistance wire is l, its area of cross-section is A and its resistivity is ρ. Then,

$$R_1 = \frac{\rho l}{A} = 20\ \Omega$$

When length becomes twice ($2l$), then its area of cross-section will become half $\left(\dfrac{A}{2}\right)$. The new resistance

$$R_2 = \frac{\rho \cdot 2l}{A/2} \quad \Rightarrow \quad R_2 = 4\frac{\rho l}{A} = 4 \times 20 = \mathbf{80\ \Omega}$$

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Q. 5. Resistance of a metal wire of length 1 m is 26 Ω at 20°C. If the diameter of the wire is 0.3 mm, what will be the resistivity of the metal at that temperature?

Ans. Given the resistance of the wire $R = 26\ \Omega$ the diameter $d = 0.3\ \text{mm} = 3 \times 10^{-4}$ m and the length of the wire, $l = 1$ m.

The resistivity of the given metallic wire is

$$\rho = \frac{RA}{l} = \frac{R\pi d^2}{4l}$$

$$= \frac{26 \times 22 \times 3 \times 10^{-4} \times 3 \times 10^{-4}}{7 \times 4 \times 1} = 183.857 \times 10^{-8}$$

$$= \mathbf{1.84 \times 10^{-6}\ \Omega\ m}$$

The resistivity of the metal at 20°C is $1.84 \times 10^{-6}\ \Omega$ m.

Q. 6. A 4 Ω resistance wire is doubled on it. Calculate the new resistance of the wire.

Ans. We are given, R = 4 Ω

When a wire is doubled on it, its length would become half and area of cross-section would be doubled. That is, a wire of length l becomes $\frac{l}{2}$ and area of cross-section $2A$.

We know that

$$R = \rho\frac{l}{A}$$

$$R_1 = \rho\frac{l/2}{2A}, \text{ where } R_1 \text{ is the new resistance.}$$

Therefore,
$$\frac{R_1}{R} = \frac{\rho\frac{l/2}{2A}}{\rho\frac{l}{A}} = \frac{1}{4}$$

or
$$R_1 = \frac{R}{4} = \frac{4\Omega}{4} = \mathbf{1\Omega}$$

The new resistance of the wire is 1 Ω.

SERIES AND PARALLEL COMBINATION OF RESISTORS

Q. 7. A current of 1 ampere flows in a series circuit having an electric lamp and a conductor of 5 Ω when connected to a 10 V battery. Calculate the resistance of the electric lamp.

Now if a resistance of 10 Ω is connected in parallel with this series combination, what change (if any) in current flowing through 5 Ω conductor and potential difference across the lamp will take place? Give reason. *[NCERT Exemplar]*

Ans. (*i*) Let the resistance of the lamp = R_1

Resistance of conductor = $R_2 = 5\ \Omega$

Total resistance in series, $R_S = R_1 + R_2$

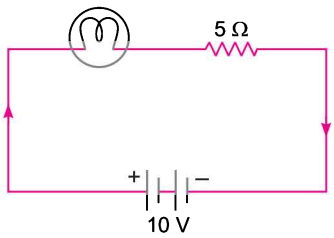
$= R_1 + 5$

Current $I = 1$ A, Voltage, $V = 10$ V

Using Ohm's Law, $V = IR$

$10 = 1(R_1 + 5)$

$\Rightarrow$ $R_1 = \mathbf{5\ \Omega}$



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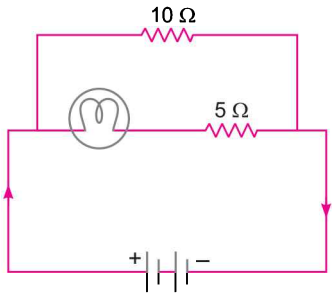
(*ii*) Now, a resistance of 10 Ω is connected in parallel with the series combination. Therefore, the total resistance of the circuit is given by



$$\frac{1}{R_P} = \frac{1}{R_1 + 5} + \frac{1}{10}$$

$$\Rightarrow \quad \frac{1}{R_P} = \frac{1}{10} + \frac{1}{10}$$

$$\Rightarrow \quad R_P = 5\ \Omega$$

Hence, current flowing in the circuit,

$$I = \frac{V}{R} = \frac{10}{5} = \mathbf{2\ A}$$

Thus, 1 A current will flow through 10 Ω resistor and 1 A will flow through the lamp and conductor of 5 Ω resistance. Hence, there will be no change in current flowing through 5 Ω conductor. Also, there will be no change in potential difference across the lamp.

Q. 8. Two resistors, with resistances 5 Ω and 10 Ω respectively are to be connected to a battery of emf 6 V so as to obtain:

(*i*) minimum current

(*ii*) maximum current

(*a*) How will you connect the resistances in each case?

(*b*) Calculate the strength of the total current in the circuit in the two cases.

Ans. (*i*) (*a*) For obtaining minimum current, the two resistors should be connected in series.

(*b*) For obtaining maximum current, the two resistors should be connected in parallel.

(*ii*) (*a*) Given, $R_1 = 5\ \Omega$, $R_2 = 10\ \Omega$ and V = 6 V

For series arrangement, the equivalent resistance,

$$R = R_1 + R_2$$

$$= 5\ \Omega + 10\ \Omega = 15\ \Omega$$

$$I = \frac{V}{R} = \frac{6V}{15\Omega} = \mathbf{0.4\ A}$$

(*b*) For parallel arrangement, the equivalent resistance is given by

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\Rightarrow \quad \frac{1}{R} = \frac{1}{5} + \frac{1}{10} = \frac{2+1}{10} = \frac{3}{10}$$

$$\Rightarrow \quad R = \frac{10}{3}\Omega$$

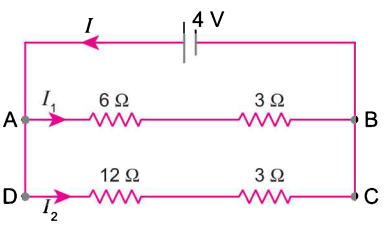
$$\therefore \quad I = \frac{V}{R} = \frac{6 \times 3}{10} = \mathbf{1.8\ A}$$

Q. 9. For the circuit shown in the given diagram:

What is the value of

(*i*) current through 6 Ω resistor?

(*ii*) potential difference across 12 Ω resistor?



Ans. Let the current through the circuit be I which is divided into I_1 and I_2 in the arms AB and CD respectively, then we have

$$I = I_1 + I_2$$

In the arm AB, the total resistance is

$$R_1 = 6\ \Omega + 3\ \Omega = 9\ \Omega$$

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and the total resistance in the arm CD is

$$R_2 = 12\ \Omega + 3\ \Omega = 15\ \Omega$$

(*i*) Then current in the 6 Ω resistor *i.e.*,

$$I_1 = \frac{V}{R_1} = \frac{4}{9} = \mathbf{0.44\ A}$$

(*ii*) Now the current through CD is

$$I_2 = \frac{V}{R_2} = \frac{4}{15} = 0.27\ \text{A}$$

The potential difference across 12 Ω resistor is

$$\Rightarrow \quad V_1 = I_2 \times 12\ \Omega$$

$$\therefore \quad V_1 = 0.27 \times 12$$

$$= \mathbf{3.24\ V}$$

Q. 10. Two resistances when connected in parallel give resultant value of 2 ohm, when connected in series the value becomes 9 ohm. Calculate the value of each resistance.

Ans. We know that two resistances are in parallel and hence

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} \qquad \Rightarrow \qquad R_P = \frac{R_1 R_2}{R_1 + R_2}$$

Given, $R_P = 2\ \Omega$

$$\Rightarrow \quad 2 = \frac{R_1 R_2}{R_1 + R_2}$$

$$2\,(R_1 + R_2) = R_1 R_2 \qquad \ldots(1)$$

Now, same resistances are in series

$$R_S = R_1 + R_2$$

Given, $R_S = 9$ ohm

$$9 = R_1 + R_2 \qquad \ldots(2)$$

From (1) and (2), we get

$$R_1 R_2 = 18$$

Again using (2), we have

$$R_2 = 9 - R_1$$

$$\therefore \quad R_1\,(9 - R_1) = 18$$

$$\Rightarrow \quad R_1^2 - 9R_1 + 18 = 0$$

$$\Rightarrow \quad R_1^2 - 6R_1 - 3R_1 + 18 = 0$$

$$\Rightarrow \quad (R_1 - 6)\,(R_1 - 3) = 0$$

Either $R_1 = \mathbf{6\ \Omega}$ or $R_1 = \mathbf{3\ \Omega}$

$R_2 = \mathbf{3\ \Omega}$ or $R_2 = \mathbf{6\ \Omega}$

Thus two resistances are 3 Ω and 6 Ω.

Q. 11. A piece of wire of resistance *R* is cut into five equal parts. These parts are then connected in parallel. If the equivalent resistance of this combination is R' then find the ratio $\frac{R}{R'}$.

Ans. Resistance of a piece of length $\frac{l}{5} = \frac{R}{5}$

The equivalent resistance of the 5 wires in parallel is R'. Then

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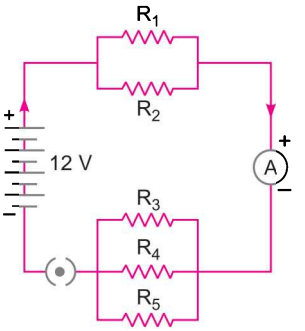
$$\frac{1}{R'} = \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5}$$

$$\frac{1}{R'} = \frac{5}{R} + \frac{5}{R} + \frac{5}{R} + \frac{5}{R} + \frac{5}{R}$$

$$\frac{1}{R'} = \frac{25}{R}$$

$$\therefore \quad \frac{R}{R'} = \mathbf{25}$$

Q. 12. If in the figure $R_1 = 10\ \Omega$, $R_2 = 40\ \Omega$, $R_3 = 30\ \Omega$, $R_4 = 20\ \Omega$, $R_5 = 60\ \Omega$, and a 12 V battery is connected to the arrangement, calculate (*i*) the total resistance in the circuit and (*ii*) the total current flowing in the circuit.



Ans. (*i*) Let the equivalent resistance of parallel resistors R_1 and R_2 = R'

The equivalent resistance of parallel resistors R_3, R_4 and R_5 = R''

Then, we have

$$\frac{1}{R'} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\Rightarrow \quad \frac{1}{R'} = \frac{1}{10} + \frac{1}{40} = \frac{4+1}{40} = \frac{5}{40}$$

$$\Rightarrow \quad R' = 8\ \Omega$$

Similarly,

$$\frac{1}{R''} = \frac{1}{R_3} + \frac{1}{R_4} + \frac{1}{R_5}$$

$$\Rightarrow \quad \frac{1}{R''} = \frac{1}{30} + \frac{1}{20} + \frac{1}{60} = \frac{6}{60}$$

$$\Rightarrow \quad R'' = 10\ \Omega$$

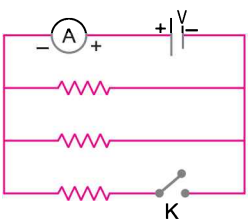
Thus, the total resistance

$$R = R' + R'' = 8\ \Omega + 10\ \Omega = \mathbf{18\ \Omega}$$

(*ii*) According to Ohm's law

$$I = \frac{V}{R} = \frac{12\ \text{V}}{18\ \Omega} = \mathbf{0.67\ A}$$

Q. 13. In the given circuit diagram, the cell and the ammeter, both have negligible resistance. The resistances are identical. With the switch K open, the ammeter reads 0.6 A. What will be the ammeter reading when the switch is closed?

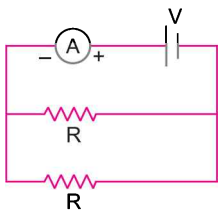


Ans. Let the value of each resistance be 'R'.

(*i*) When key 'K' is open the only two resistance are in circuit so resultant resistance in this case is parallel combination of two resistances.

$$\frac{1}{R_1} = \frac{1}{R} + \frac{1}{R} = \frac{2}{R}$$

$$\Rightarrow \quad R_1 = \frac{R}{2}$$



Let potential difference of cell = V volt

Current I = 0.6 A (given)

$$\therefore \quad V = IR_1 = 0.6 \times \frac{R}{2} = 0.3R$$

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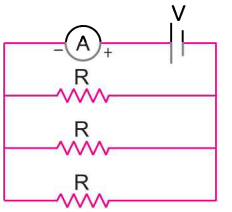
(*ii*) Now, when key 'K' is closed, all three resistances are parallel in the circuit. Therefore,



$$\frac{1}{R_2} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} = \frac{3}{R}$$

$$\Rightarrow \quad R_2 = \frac{R}{3}$$

Using Ohm's law $V = IR_2$

$$0.3R = I\left(\frac{R}{3}\right)$$

$$\Rightarrow \quad I = 0.3\,R \times \frac{3}{R} = \mathbf{0.9\ A}$$

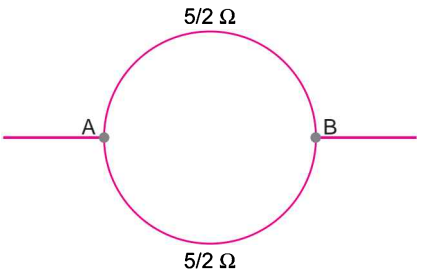
Therefore, the ammeter reads 0.9 A.

Q. 14. A wire of resistance 5 ohms is bent in the form of a closed circle. What is the effective resistance between the two points at ends of any diameter of the circle?

Ans. The length of the wire between two points at the ends of a diameter of a circle is half of the whole wire. The resistance of a conductor is directly proportional to its length.

Thus, the two resistances $\frac{5}{2}\ \Omega$ will be in parallel.

Let R is the effective resistance



$$\frac{1}{R} = \frac{2}{5} + \frac{2}{5}$$

$$\Rightarrow \quad \frac{1}{R} = \frac{4}{5}$$

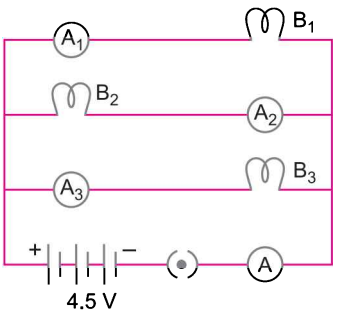
$$\therefore \quad R = \frac{5}{4} = 1.25\ \Omega$$

Q. 15. B_1, B_2, B_3 are three identical bulbs connected as shown in figure. Ammeters A_1, A_2, A_3 are connected as shown. When all the bulbs glow, the current of 3A is recorded by ammeter A.

(*i*) What happens to the glow of the other two bulbs when bulb B_1 gets fused?

(*ii*) What happens to the reading of A_1, A_2, A_3 and A when the bulb B_2 gets fused?

(*iii*) How much power is dissipated in the circuit when all the three bulbs glow together? *[NCERT Exemplar]*



Ans. Resistance of combination of three bulbs in parallel

$$R_{eq} = \frac{V}{I} = \frac{4.5}{3} = 1.5\ \Omega$$

If R is the resistance of each wire, then

$$R_{eq} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R}$$

or $$\frac{1}{R_{eq}} = \frac{3}{R}$$

or, $$R = 3\,R_{eq} = 3 \times 1.5 = 4.5\ \Omega$$

Current in each bulb, $$I = \frac{V}{R} = \frac{4.5\ \text{V}}{4.5\ \Omega} = 1\ \text{A}$$

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(*i*) When bulb B_1 gets fused, the currents in B_2 and B_3 remain same $I_2 = I_3 = 1$ A, so their glow remains unaffected.

(*ii*) When bulb B_2 gets fused, the current in B_2 becomes zero and currents in B_1 and B_3 remains 1 A.

$$\text{Total current } I = I_1 + I_2 + I_3$$
$$= 1 + 0 + 1 = 2 \text{ A}$$

Current in ammeter $A_1 = 1$ A

Current in ammeter $A_2 = 0$

Current in ammeter $A_3 = 1$ A

Current in ammeter $A = 2$ A

(*iii*) When all the three bulbs are connected.

$$\text{Power dissipitated, P} = \frac{V^2}{R_{eq}}$$
$$= \frac{(4.5)^2}{1.5} = \mathbf{13.5\ W}$$

ELECTRIC POWER AND ENERGY

Q. 16. An electric iron has a rating of 750 W, 220 V. Calculate

(*i*) the current passing through it, and

(*ii*) its resistance, when in use.

Ans. (*i*) Power, $P = 750$ W

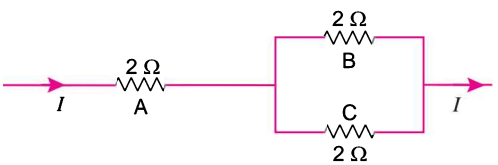
Potential, $V = 220$ V

$$\therefore \quad \text{I} = \frac{P}{V} = \frac{750 \text{ W}}{220 \text{ V}} = \mathbf{3.4\ A}$$

(*ii*) Now $V = IR$ (Ohm's law)

$$\text{R} = \frac{V}{I} = \frac{220\text{V}}{3.4\text{A}} = \mathbf{64.7\ \Omega}$$

Q. 17. Three 2 Ω resistors *A*, *B* and *C* are connected as shown in figure. Each of them dissipates energy and can withstand a maximum power of 18 W without melting. Find the maximum current that can flow through the three resistors.



[*NCERT Exemplar*]

Ans. The current of resistor A is equally divided in resistors B and C; so maximum current can flow in resistor A.

$$\text{Power} = (\text{current})^2 \times \text{resistance}$$

$$\Rightarrow \quad 18 \text{ W} = (I_A^2) \times 2\ \Omega$$

$$\therefore \quad (I_A^2) = 9 \text{ or } I_A = 3 \text{ A}$$

Current in resistance A, $I_A = 3$ A

So current in each of resistor B and C

$$I_B = I_C = \frac{3}{2}\text{A} = \mathbf{1.5\ A}$$

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Q. 18. What is the commercial unit of electrical energy? Represent it in terms of joules.

Ans. The commercial unit of electrical energy is kilowatt hour.

Energy used = Power ×time

$1\ \text{kWh} = 1\ \text{kW} \times 1\ \text{h}$

$= 1000\text{W} \times 60 \times 60\ \text{s}$

$= 1000\ \text{Js}^{-1} \times 60 \times 60\ \text{s}$

$= 3600000\ \text{J}$

$= \mathbf{3.6 \times 10^6\ J}$

Q. 19. A geyser is rated 1500 W, 250 V. It is connected to 250 V mains. Calculate (*i*) the current drawn, (*ii*) the energy consumed in 50 hours, and (*iii*) the cost of energy consumed at ₹ 2.20 per kWh.

Ans. Given, $V = 250$ V, P = 1500 W, t = 50 h = 50 × 60 × 60 s

(*i*) $$I = \frac{P}{V} = \frac{1500}{250} = \mathbf{6\ A}$$

(*ii*) Energy consumed $= VIt$ joule

$= 250 \times 6 \times 50 \times 60 \times 60$

$= 27 \times 10^7\ \text{J}$

$= \frac{27 \times 10^7}{3.6 \times 10^6}\ \text{kWh}$

$= \mathbf{75\ kWh}$

(*iii*) 1 kWh costs = ₹2.20

$\therefore$ 75 kWh cost= 2.20 × 75 = **₹165**

Q. 20. Two resistors of 4 Ω and 6 Ω are connected in parallel. The combination is connected across a 6 volt battery of negligible resistance. Calculate (*i*) the power supplied by the battery, (*ii*) the power dissipated in each resistor.

Ans. Here, $R_1 = 4\ \Omega$ and $R_2 = 6\ \Omega$

Both are in parallel. Hence

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{R_2 + R_1}{R_1 R_2}$$

$$R = \frac{R_1 R_2}{R_1 + R_2}$$

$$= \frac{4 \times 6}{4 + 6}$$

$$= 2.4\ \Omega$$

(*i*) Power dissipated, $P = \frac{V^2}{R} = \frac{36 \times 10}{24} = \mathbf{15\ W}$

(*ii*) For R_1, Power dissipated

$$P_1 = \frac{V^2}{R_1} = \frac{36}{4} = \mathbf{9\ W}$$

For R_2, $$P_2 = \frac{V^2}{R_2} = \frac{6 \times 6}{6} = \mathbf{6\ W}$$

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Q. 21. An electric bulb is rated 220 V and 100 W. Calculate the power consumed when it is operated on 110 V.

Ans. We have, $P = \frac{V^2}{R}$

or $100 = \frac{(220)^2}{R}$ ...(1)

Let power consumed will be P' when operated on 110 V. Then

$$P' = \frac{(110)^2}{R} \quad ...(2)$$

From (1) and (2), we have

$$\frac{P'}{100} = \left(\frac{110}{220}\right)^2$$

or $P' = \frac{1}{4} \times 100$

or $P' = \mathbf{25\ W}$

Q. 22. Two conducting wires of the same material and of equal lengths and equal diameters are first connected in series and then in parallel in a circuit across the same potential difference. Find the ratio of heat produced in series and parallel combination.

Ans. Suppose the resistance of each one of the two wires is R.

The equivalent resistance of the series combination,

$$R_s = R + R = 2R$$

The heat produced in time t,

$$H_1 = \frac{V^2}{2R}\ \mathrm{t} \qquad \left(\because H = \frac{V^2}{R}t\right) \quad ...(1)$$

The equivalent resistance of the parallel combination is

$$R_P = \frac{R \times R}{R + R} = \frac{R^2}{2R} = \frac{R}{2}$$

Heat produced in time t,

$$H_2 = \frac{V^2}{R/2}t = \frac{2V^2t}{R} \quad ...(2)$$

From (1) and (2), we have

$$\frac{H_1}{H_2} = \frac{V^2t}{2R} \times \frac{R}{2V^2t}$$

$\Rightarrow$ $\frac{H_1}{H_2} = \frac{1}{4}$

$$H_1 : H_2 = \mathbf{1 : 4}$$

Q. 23. Which has a higher resistance: a 50 W – 220 V lamp or a 25 W – 220 V lamp ? Calculate the ratio of their resistances.

Ans. Under a constant (fixed) applied voltage (V),

$$\text{Resistance} = \frac{(\text{Voltage})^2}{\text{Power}}$$

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or $$R = \frac{V^2}{P}$$

Resistance of the first bulb, $$R_1 = \frac{V^2}{50}$$

Resistance of the second bulb, $$R_2 = \frac{V^2}{25}$$

$\because$ $$\frac{R_2}{R_1} = 2 \quad \text{or,} \quad R_2 = 2R_1$$

$R_2 > R_1$, 25 W bulb has higher resistance. Resistance of 25 W lamp bulb is twice the resistance of 50 W lamp bulb.

Q. 24. An electric iron consumes energy at a rate of 840 W when heating it at the maximum rate and 360 W when the heating it at the minimum. The applied voltage is 220 V. What is the value of current and the resistance in each case?

Ans. We know that the power input is

Thus the current, $I = \frac{P}{V}$

When heating is at the maximum rate,

$$I = \frac{840 \text{ W}}{220 \text{ V}} = \mathbf{3.82\ A}$$

and the resistance of the electric iron is

$$R = \frac{V}{I} = \frac{220 \text{ V}}{3.82 \text{ A}} = \mathbf{57.59\ \Omega}$$

When heating is at the minimum rate,

$$I = \frac{360 \text{ W}}{220 \text{ V}} = \mathbf{1.64\ A}$$

and the resistance of the electric iron is

$$R = \frac{V}{I} = \frac{220 \text{ V}}{1.64 \text{ A}} = \mathbf{134.15\ \Omega}$$

Q. 25. A heater coil is rated 100 W, 200 V. It is cut into two identical parts. Both parts are connected together in parallel to the same source of 200 V. Calculate the energy liberated per second in the new combination.

Ans. Resistance of heater coil,

$$\text{R} = \frac{V^2}{P} = \frac{(200)^2}{100} = \frac{200 \times 200}{100} = 400\ \Omega$$

After cutting, resistance of each part $= \frac{400}{2} = 200\ \Omega$

When connected in parallel, the net resistance is given by

$$\frac{1}{R_P} = \frac{1}{200} + \frac{1}{200}$$

$\Rightarrow$ $$\frac{1}{R_P} = \frac{2}{200}$$

$\therefore$ $$R_P = 100$$

Energy liberated $= P \times t$

$$= \frac{V^2}{R} \times t = \frac{(200)^2}{100} \times 1 = \mathbf{400\ J}$$

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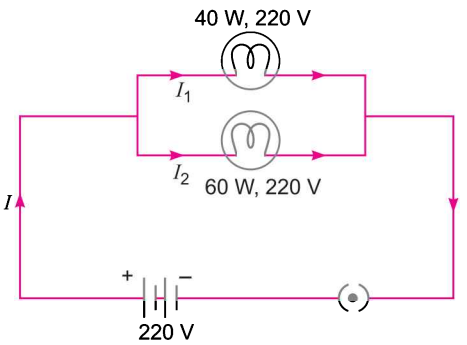
Q. 26. Two lamps, one rated at 40 W – 220 V and the other at 60 W – 220 V, are connected in parallel to the electric supply at 220 V.

(*i*) Draw a circuit diagram to show the connections.

(*ii*) Calculate the current drawn from the electric supply source.

(*iii*) Calculate the total energy consumed by the two lamps together when they operate for one hour.

Ans. (*i*)



(*ii*) Current drawn by 40 W bulb,

$$I_1 = \frac{P}{V} = \frac{40}{220}\ \text{A} = \frac{2}{11}\ \text{A} = 0.18\ \text{A}$$

Current drawn by 60 W bulb,

$$I_2 = \frac{P}{V} = \frac{60}{220}\text{A} = \frac{3}{11}\ \text{A} = 0.27\ \text{A}$$

Total current drawn from circuit,

$$I = I_1 + I_2 = 0.18\ \text{A} + 0.27\ \text{A} = \mathbf{0.45\ A}$$

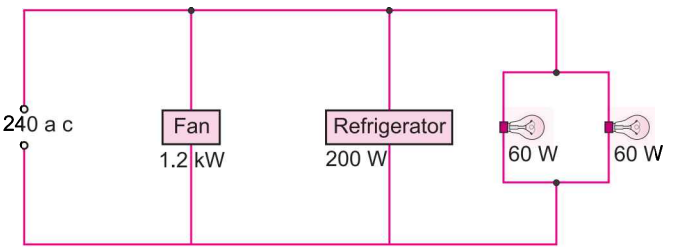
(*iii*) Energy consumed by 40 W bulb in 1 hour $= P \times t$

$$= 40\ \text{W} \times 1\ \text{h} = 40\ \text{Wh}$$

Energy consumed by 60 W bulb in 1 hour = 60 W × 1h = 60 Wh

∴ Total energy consumed = 40 Wh + 60 Wh = 100 Wh= **0.1 kWh**

Q. 27. Figure shows a 240 V ac mains circuit to which a number of appliances are connected and switched on.



(*i*) Calculate the power supplied to the circuit.

(*ii*) Calculate

(*a*) the current in the refrigerator,

(*b*) the energy used by the fan in 3 hours,

(*c*) the resistance of the filament of one lamp.

Ans. (*i*) Power supplied to the circuit

$$= 1.2 \times 1000\ \text{W} + 200\ \text{W} + 60\ \text{W} + 60\text{W}$$

$$= 1200\ \text{W} + 200\ \text{W} + 60\ \text{W} + 60\ \text{W}$$

$$= 1520\ \text{W}$$

$$= \mathbf{1.52\ kW}$$

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(*ii*) (*a*) Current in the refrigerator

$$= \frac{\text{Power}}{\text{Voltage}} = \frac{200\ \text{W}}{240\ \text{V}} = \mathbf{0.83\ A}$$

(*b*) Energy used by the fan in 3 hours = Power × Time

$= 1.2\ \text{kW} \times 3\text{h}$

$= 1.2 \times 1000\ \frac{\text{J}}{\text{s}} \times 3 \times 60 \times 60\text{s}$

$= 1200 \times 3 \times 3600\ \text{J}$

$= 12960000\ \text{J}$

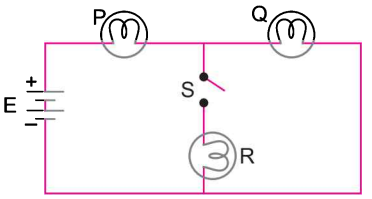
$= \mathbf{1.3 \times 10^7\ J}$

(*c*) Current, $I = \frac{P}{V} = \frac{60}{240} = 0.25\ \text{A}$

Resistance $= \frac{V}{I} = \frac{240}{0.25} = \mathbf{960\ \Omega}$

HOTS [Higher Order Thinking Skills]

Q. 1. A battery E is connected to three identical lamps P, Q and R as shown in figure:



Initially the switch S is kept open and the lamp P and Q are observed to glow with some brightness.

Then switch S is closed.

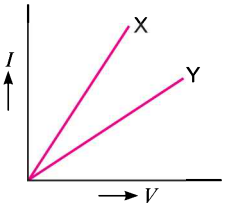
How will the brightness of glow of bulbs P and Q will change? Justify your answer.

Ans. The brightness of glow of bulb P will increase and brightness of glow of bulb Q will decrease.

This is because on closing S, bulbs Q and R will be in parallel and the combination will be in series with bulb P. Hence the total resistance of the circuit will decrease and the current flowing in the circuit will increase. Therefore, the glow of bulb P will increase.

Also since bulbs Q and R will be in parallel in this case, the current gets divided and lesser current flows through Q and hence the glow of bulb Q will decrease.

Q. 2. V-I graph for the metallic wires X and Y at constant temperature are as shown in figure:



Assuming that the two wires have same length and same diameter, explain as to which of the two wires has higher resistivity and why?

Ans. The slope $\frac{I}{V}$ of the graph represents $\frac{1}{R}$. Since the graph marked Y has lesser slope, it represents higher resistance.

Since the length and diameter of the two wires is same, using the relation $R = \rho\frac{l}{A}$ the resistivity of wire Y will be higher.

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Q. 3. Why is an ammeter likely to be burnt out if it is connected in parallel in a circuit?

Ans. The resistance of an ammeter is very low. If an ammeter is connected in parallel, the resultant resistance of the circuit decreases and excessive current passes through the instrument. Hence, the ammeter is likely to be burnt out.

Q. 4. Current *I* flowing through a resistor results in dissipation of power *P*. By what percentage will the power dissipated in the resistor increase if the current through the resistor is increased by 50%? Justify your answer with the help of mathematical calculations.

Ans. The power dissipated in the resistor will increase by 125%.

$$P = I^2Rt$$

When I is increased by 50%, I becomes $\frac{3}{2}I$.

Hence, $$P' = \left(\frac{3}{2}I\right)^2 Rt = \frac{9}{4}I^2\,Rt$$

Increase in power dissipation $= \frac{9}{4}I^2\,Rt - I^2\,Rt$

$$= \frac{5}{4}I^2\,Rt$$

$$\text{Percentage increase} = \frac{\text{Increase}}{\text{Original}} \times 100$$

$$= \frac{5I^2Rt}{4I^2Rt} \times 100$$

$$= \mathbf{125\%}$$

Q. 5. What are the possible values of resistances which one can obtain by using resistors of values 2 Ω, 3 Ω and 6 Ω?

Ans. The following combinations can be obtained:

(*i*) The individual resistances: 2 Ω , 3 Ω , 6 Ω

(*ii*) All in series: 11 Ω

(*iii*) All in parallel: 1 Ω

(*iv*) Different possible mixed grouping of three resistors: 4 Ω , $\frac{9}{2}$ Ω , $\frac{36}{5}$ Ω .

Q. 6. Out of two electric bulbs of 50 W – 220 V and 100 W – 220 V, which one will glow brighter when they are connected (*i*) in series, and (*ii*) in parallel?

Ans. The resistance of the bulb is defined as $R = \frac{V^2}{P}$. So the resistance of 50 W bulb is double than the resistance of 100 W bulb. When they are connected in series the current through both bulbs is same. Hence 50 watt bulb will be brighter because $P = I^2R$. In parallel, the voltage will be same in both bulbs. So, the 100 watt bulb will be brighter because $P = \frac{V^2}{R}$.

Q. 7. Given *n* resistors each of resistance *R*, how will you combine them to get the (*i*) maximum; and (*ii*) minimum effective resistance? What is the ratio of the maximum to minimum resistance?

Ans. (*i*) For maximum effective resistance, the resistors must be connected in series combination.
If there are n resistors each of resistance R, then the maximum effective resistance $= nR$

(*ii*) For minimum effective resistance, the resistors must be connected in parallel combination.
So the minimum effective resistance $= \frac{R}{n}$

Ratio of the maximum to minimum resistance is $\frac{nR}{(R/n)} = n^2{:}1$.

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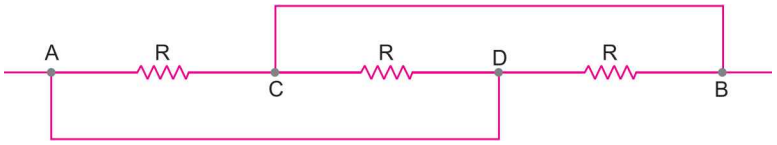
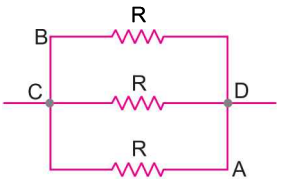
Q. 8. What is the resistance from A to B in the network shown in the figure?



Ans. The point C is connected to B and the point D is connected to A. Therefore, three identical resistors, each having resistance R, are connected in parallel and the equivalent circuit diagram is shown in the figure.



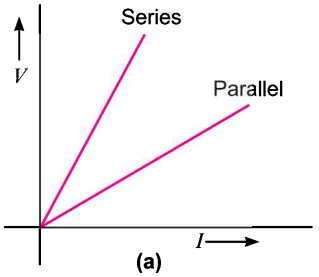
If the equivalent resistance is R' then

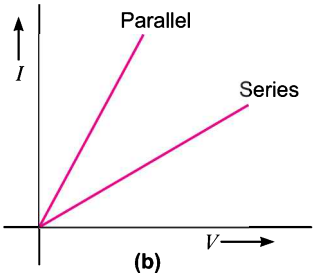
$$\frac{1}{R'} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} = \frac{3}{R}$$

or $$R' = \frac{R}{3}$$

Q. 9. Two students perform the experiment on series and parallel combinations of two given resistors R_1 and R_2 and plot the following V-I graphs (*i*) and (*ii*).

Which of the graphs is (are) correctly labelled in terms of the words 'series' and 'parallel'? Justify your answer.





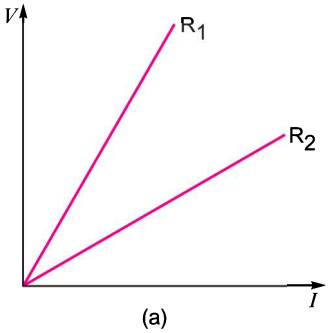
Ans. (*i*) Slope $\frac{V}{I}$ = Resistance R

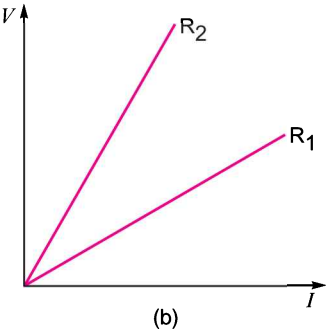
As larger resistance represents series combination and smaller resistance the parallel combination. Therefore, graph of greater slope represents series combination and hence it is correctly labelled.

(*ii*) Slope, $\frac{I}{V} = \frac{1}{R}$

As larger resistance represents series combination, so graph of smaller slope represents series combination and hence it is also correctly labelled.

Q. 10. Two students perform experiments on two given resistors R_1 and R_2 and plot the following V-I graphs. If $R_1 > R_2$ which of the two diagrams correctly represent the situation on the plotted curves? Justify your answer.





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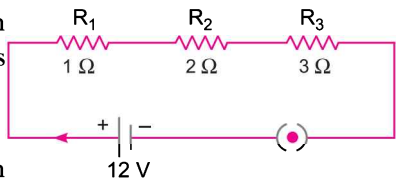
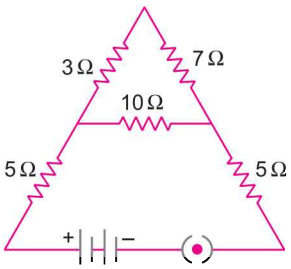
Ans. As $R_1 > R_2$ therefore, figure (*a*) is correct. This is because R_1 is greater so the slope of *V*–*I* graph $\left(\frac{V}{I}\right)$ is greater in figure (*a*) and is correctly represented as R_1.

Some Important Numericals (For Practice)

1. A wire carries a current of 0.1 A and has a resistance of 120 milliohm per metre. What is the p.d. across 1 m of this wire?
2. An electric iron draws a current of 4 A from 220 V supply line. When voltage of supply is changed, then iron draws a current of 2 A, what is the new voltage applied?
3. A copper wire has a diameter 0.5 mm and resistivity 1.6×10^{-8} Ω m.
   (*i*) What will be the length of this wire to make the resistance of 12 Ω?
   (*ii*) How much will be the resistance of another copper wire of same length but half the diameter?
4. Three resistances of 5, 10 and 15 ohms are connected in series and a potential difference of 15 volts is applied across the combination. Calculate the current flowing through the circuit.
5. A voltmeter reads 24 V across a resistor and an ammeter reads a current of 3 A through it. Calculate *R*. What will be the current through the resistor if the voltage changes to 12 V?
6. Three resistances are connected in electrical circuit as shown in the circuit diagram. Determine the potential difference across resistance R_2.



7. Five resistances are connected in the shape of letter A as shown in figure alongside. Determine the total resistance of the circuit.



8. A wire of uniform cross-section and length *l* has a resistance of 4 Ω. The wire is cut into four equal pieces. Each piece is then stretched to length '*l*'. Thereafter, the four wires are joined in parallel. Calculate the net resistance.
9. A cable of resistance 12 Ω carries electric power from a generator producing 250 kW at 10,000 V. Calculate (*i*) the current in the cable, (*ii*) the power lost in the cable during transmission, and (*iii*) the p.d. across the ends of the cable.
10. Calculate the electrical energy produced in 5 minutes when a current of 2 A is sent through a conductor by a potential difference of 500 volts.
11. Two bulbs have the following ratings: (*i*) 40 W at 220 V, and (*ii*) 40 W at 110 V. The filament of which bulb has a higher resistance? What is the ratio of their resistances?
12. A potential difference of 40 V is applied across a resistance of 8 Ω for a period of 2 minutes.
    (*i*) What current is drawn?
    (*ii*) Calculate the charge which passes through the resistor.
13. The specific resistance of the material of a wire is 44×10^{-8} Ω m. If the resistance of the wire is 14 Ω and its diameter is 1 mm, calculate the length of the wire.

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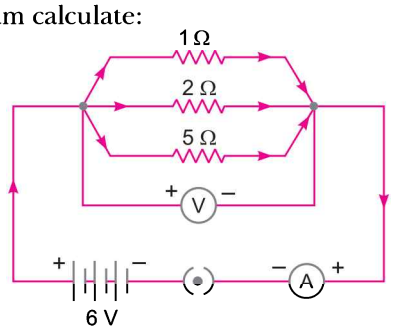
14. For the given circuit diagram calculate:



(*i*) the current through each resistor.

(*ii*) the total current in the circuit.

(*iii*) the total effective resistance of the circuit.

15. An electric iron has a rating of 750 W, 220 V. Calculate

(*i*) the current passing through it.

(*ii*) its resistance, when in use.

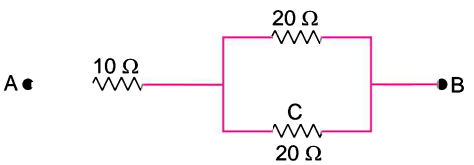
16. An electric heater draws a current of 10 A from a 220 V supply. What is the cost of using the heater 5 hours per day for 30 days if the cost of 1 unit is ₹ 2.50?

17. A torch bulb is rated 3 V and 600 mA. Calculate its resistance if it is lighted for 4 hours.

18. In a household circuit, an electric bulb of 100 W is used for 10 hours and an electric heater of 1000 W for 2 hours everyday. Calculate the cost of using the bulb and the heater of 30 days if the cost of one unit of electrical energy is two rupees.

19. An electric bulb draws a current of 0.2 A when it operates at 220 V. Calculate the amount of electric charge flowing through it in 1 h.

20. Calculate the equivalent resistance of the following network: *[CBSE 2019 (31/2/1)]*



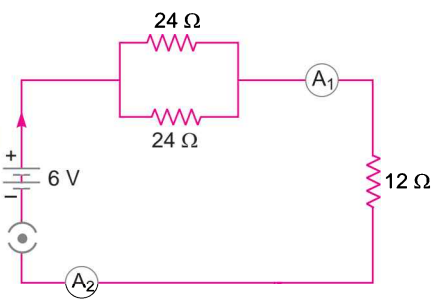
21. Two electric bulbs rated 100 W; 220 V and 60 W; 220 V are connected in parallel to an electric mains of 220 V. Find the current drawn by the bulbs from the mains. *[CBSE 2019 (31/4/1)]*

22. Study the following circuit and find out:

(*i*) Current in 12 Ω resistor.

(*ii*) Difference in the readings of A_1 and A_2, if any.

[CBSE 2019 (31/4/1)]



Answers

1. 12 mV **2.** 110 V **3.** (*i*) 147.3 m (*ii*) 48 Ω **4.** 0.5 A **5.** 8 Ω, 1.5 A **6.** 4 V

7. 15 Ω **8.** Net resistance of combination = 4 Ω **9.** (*i*) 25 A (*ii*) 7.5 kW (*iii*) 300 V

10. 3×10^5 joules **11.** (*i*) First bulb (*ii*) 4 : 1 **12.** (*i*) 5A (*ii*) 600 C **13.** 25 m.

14. (*i*) 6A, 3A, 1.2A (*ii*) 10.2 A (*iii*) 0.588 Ω **15.** (*i*) 3.4 A (*ii*) 64.5 **16.** ₹ 825

17. 5 Ω **18.** ₹ 180 **19.** 720 C **20.** 20 Ω **21.** $\frac{8}{11}$ A **22.** (i) 0.25 A (ii) 0 A

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NCERT Corner

NCERT Intext Questions

Q. 1. What does an electric circuit mean?

Ans. A closed conducting path through which electric current may flow is called an electric circuit.

Q. 2. Define the unit of current.

Ans. The SI unit of electric current is ampere (A). When 1 coulomb of electric charge flows through any cross-section of a conductor in 1 second, the electric current flowing through it is said to be 1 ampere.

$$1\,\text{ampere (A)} = \frac{1\text{ coulomb (C)}}{1\text{ second (s)}}$$

Q. 3. Calculate the number of electrons constituting one coulomb of charge.

Ans. Charge on an electron = 1.6×10^{-19} C.

$\because$ If the value of charge is 1.6×10^{-19} C, then number of electron = 1

$\therefore$ If the value of charge is 1 C, then number of electrons

$$= \frac{1}{1.6\times10^{-19}} = \frac{1}{1.6}\times10^{19}$$

$$= 0.625 \times 10^{19} = \mathbf{6.25 \times 10^{18}}\ \textbf{electrons}$$

Q. 4. Name a device that helps to maintain a potential difference across a conductor.

Ans. A cell or a battery

Q. 5. What is meant by saying that the potential difference between two points is 1 V?

Ans. The potential difference between two points in a current carrying conductor is said to be 1 V when 1 joule of work is done to move a charge of 1 coulomb from one point to the other.

$$\text{Therefore,}\quad 1\text{ volt} = \frac{1\text{ joule}}{1\text{ coulomb}}$$

$$1\text{ V} = 1\text{ JC}^{-1}$$

Q. 6. How much energy is given to each coulomb of charge passing through a 6 V battery?

Ans. Charge, $Q = 1$

Potential difference, $V = 6$ V

Work done, $W = VQ = 6\text{ V} \times 1\text{ C} = 6$ J

The work done on each coulomb = 6 J.

Therefore, the energy given to each coulomb of charge is also **6 J**.

Q. 7. On what factors does the resistance of a conductor depend?

Ans. The resistance of a conductor depends:

(*i*) on its length,

(*ii*) on its area of cross-section,

(*iii*) on the nature of its material and

(*iv*) on temperature of the conductor.

Q. 8. Will current flow more easily through a thick wire or a thin wire of the same material, when connected to the same source? Why?

Ans. Resistance, $R \propto \frac{1}{A}$

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The resistance of a conductor is inversely proportional to its area of cross-section. A thick wire has a greater area of cross-section whereas a thin wire has a smaller area of cross section. Thus, a thick wire has less resistance and a thin wire has more resistance. Therefore, current will flow more easily through a thick wire than a thin wire.

Q. 9. Let the resistance of an electrical component remain constant while the potential difference across the two ends of the component decreases to half of its former value. What change will occur in the current through it?

Ans. We know that, $I = \frac{V}{R}$

Since the resistance remains constant, so the current is directly proportional to potential difference. If the potential difference is halved, the current also gets halved.

Q. 10. Why are coils of electric toasters and electric irons made of an alloy rather than a pure metal? *[CBSE 2019 (31/2/1)]*

Ans. Coils of electric toasters and electric irons are made of an alloy rather than a pure metal because

(*i*) the resistivity of an alloy is much higher than that of pure metal and

(*ii*) an alloy does not undergo oxidation easily even at high temperature.

(*iii*) alloy have high melting point.

Q. 11. Use the data given in table below and answer the following :

(*i*) Which among iron and mercury is a better conductor?

(*ii*) Which material is the best conductor?

	Material	Resistivity (Ω m)
Conductors	Silver	1.60×10^{-8}
	Copper	1.62×10^{-8}
	Aluminium	2.63×10^{-8}
	Tungsten	5.20×10^{-8}
	Nickel	6.84×10^{-8}
	Iron	10.0×10^{-8}
	Chromium	12.9×10^{-8}
	Mercury	94.0×10^{-8}
	Manganese	1.84×10^{-6}
Alloys	Constantan(alloy of Cu and Ni)	49×10^{-6}
	Manganin (alloy of Cu, Mn and Ni)	44×10^{-6}
	Nichrome (alloy of Ni, Cr, Mn and Fe)	100×10^{-6}
Insulators	Glass	$10^{10} - 10^{14}$
	Hard rubber	$10^{13} - 10^{16}$
	Ebonite	$10^{15} - 10^{17}$
	Diamond	$10^{12} - 10^{13}$
	Paper (dry)	10^{12}

Ans. (*i*) Among iron and mercury, iron is better conductor of electricity because resistivity of iron (10.0×10^{-8} Ω m) is less than that of mercury (94.0×10^{-8} Ω m).

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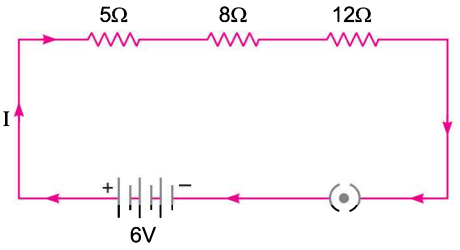
(*ii*) We know that a good conductor of electricity should have a low resistivity and a poor conductor of electricity will have a high resistivity. Silver has the lowest resistivity of 1.60×10^{-8} Ω m, which means that silver offers the least resistance to the flow of current through it. So, silver is the best conductor of electricity.

Q. 12. Draw a schematic diagram of a circuit consisting of a battery of three cells of 2 V each, a 5 Ω resistor, an 8 Ω resistor, and a 12 Ω resistor and a plug key, all connected in series.

Ans.



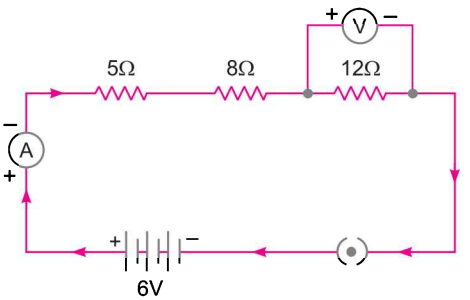
The potential difference of each cell = 2 V

The total potential difference (or voltage) of 3 cells

$= 3 \times 2 \text{ V} = 6 \text{ V}.$

Q. 13. Redraw the circuit of Q. 12, putting in an ammeter to measure the current through the resistors and a voltmeter to measure the potential difference across the 12 Ω resistor. What would be the readings in the ammeter and the voltmeter?

Ans. It is noted that the ammeter has been put in series with the circuit and the voltmeter has been put in parallel with the 12 Ω resistor.



(*i*) Calculation of current reading in the ammeter:

Here, $R_1 = 5\ \Omega$, $R_2 = 8\ \Omega$ and $R_3 = 12\ \Omega$

These three resistors are connected in series.

$\therefore$ Total resistance, $R = R_1 + R_2 + R_3$

$= 5 + 8 + 12 = 25\ \Omega$

Potential difference, $V = 6$ V

Current, $I = ?$

Applying Ohm's law,

$$V = IR$$

$$I = \frac{V}{R} = \frac{6}{25} = \mathbf{0.24\ A}$$

Therefore, ammeter will show a reading of 0.24 A.

(*ii*) Calculation of potential difference reading across 12 Ω resistor.

Current, $I = 0{\cdot}24$ A, Resistance, $R = 12\ \Omega$, Potential difference, $V = ?$

Applying Ohm's law

$$V = IR = 0{\cdot}24 \times 12 = \mathbf{2.88\ V}$$

Therefore, the voltmeter reading is 2.88 V.

Q. 14. Judge the equivalent resistance when the following are connected in parallel (*i*) 1 Ω and 10^6 Ω (*ii*) 1 Ω and 10^3 Ω and 10^6 Ω.

Ans. (*i*) When a number of resistance are connected in parallel, then their combined resistance is less than the smallest individual resistance. Therefore, equivalent resistance will be less than 1 Ω.

(*ii*) In this case, also the equivalent resistance will be less than 1 Ω .

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Q. 15. An electric lamp of 100 Ω, a toaster of resistance 50 Ω, and a water filter of resistance 500 Ω are connected in parallel to a 220 V source. What is the resistance of an electric iron connected to the same source that takes as much current as all three appliances, and what is the current through it?

Ans. Here, $R_1 = 100\ \Omega$, $R_2 = 50\ \Omega$, $R_3 = 500\ \Omega$

Equivalent resistance = R

Resistors are connected in parallel.

$$\therefore \quad \frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\frac{1}{R} = \frac{1}{100} + \frac{1}{50} + \frac{1}{500} \quad \Rightarrow \quad \frac{1}{R} = \frac{5 + 10 + 1}{500}$$

$$\frac{1}{R} = \frac{16}{500} = \frac{4}{125} \quad \Rightarrow \quad R = \mathbf{\frac{125}{4}\ \Omega}$$

Current through all the three appliances, $I = \frac{V}{R} = \frac{220 \times 4}{125} = \mathbf{7.04\ A}$

Since the electric iron connected to the same source that takes as much current as all the three appliances. So

Resistance of the electric iron $= \frac{125}{4}\ \Omega = 31.25\ \Omega$

Current through the electric iron = 7.04 A

Q. 16. What are the advantages of connecting electrical devices in parallel with the battery instead of connecting them in series?

Ans. (*i*) In parallel circuit, if one electrical appliance stops working due to some defect, then all other appliances keep working normally. In series circuit, if one electrical appliance stops working due to some defect, then all other appliances also stop working.

(*ii*) In parallel circuits, each electrical appliance gets the same voltage as that of the power supply line. In series circuit, appliances do not get the same voltage as that of the power supply line.

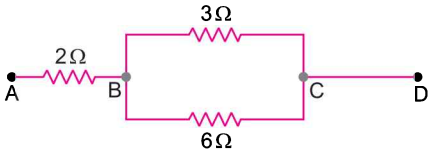
(*iii*) In the parallel connection of electrical appliances, the overall resistance of the household circuit is reduced due to which the current from the power supply is high. In the series connection, the overall resistance of the circuit increases too much due to which the current from the power supply is low.

Q. 17. How can three resistors of resistance 2 Ω, 3 Ω and 6 Ω be connected to give a total resistance of (*i*) 4 Ω, (*ii*) 1 Ω?

Ans. (*i*) As the total resistance (equivalent resistance) is 4 Ω, the 6 Ω resistor cannot be in series. So, it must be in parallel with some other resistors.

In parallel connection, the equivalent resistance (4 Ω) has to be less than all the resistances. So, the resistors of 2 Ω and 3 Ω cannot be in parallel at one time with 6 Ω.

So, the resistors have to be in a mixed combination. Let us consider the combination shown in the figure.



The equivalent resistance between B and C (which are in parallel)

$$\frac{3\ \Omega \times 6\ \Omega}{3\ \Omega + 6\ \Omega} = \frac{18\ \Omega}{9\ \Omega} = 2\ \Omega$$

The resistance between A and D = 2 Ω + 2 Ω = 4 Ω.

So, the combination shown in the figure is true.

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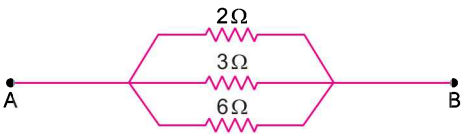
(*ii*) Here, $R_1 = 2\ \Omega$, $R_2 = 3\ \Omega$, $R_3 = 6\ \Omega$ and $R = 1\ \Omega$



Since the equivalent resistance of the combination is of lesser value than any of the resistors of the combination, it is clear that the resistors should be connected in parallel. It can be further confirmed by using the formula

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6} = \frac{3+2+1}{6} = \frac{6}{6} = 1$$

i.e., $R = 1$ ohm.

Therefore, resistors should be connected in parallel.

Q. 18. What is (*i*) the highest, (*ii*) the lowest total resistance that can be secured by combinations of four coils of resistance 4 Ω, 8 Ω, 12 Ω, 24 Ω?

Ans. (*i*) The highest can be secured by series combination and is equal to

$$R = 4\ \Omega + 8\ \Omega + 12\ \Omega + 24\ \Omega = \mathbf{48\ \Omega}$$

(*ii*) The lowest total resistance can be secured by parallel combination, which is given by

$$\frac{1}{R} = \frac{1}{4} + \frac{1}{8} + \frac{1}{12} + \frac{1}{24} \quad \Rightarrow \quad \frac{1}{R} = \frac{6+3+2+1}{24}$$

$$\Rightarrow \quad \frac{1}{R} = \frac{12}{24} = \frac{1}{2} \qquad \therefore \quad R = \mathbf{2\ \Omega}$$

Q. 19. Why does the cord of an electric heater not glow while the heating element does?

Ans. The cord of the electric heater is made of copper. It does not glow because negligible heat is produced in it by the passing current due to its extremely low resistance.

The heating element of an electric heater is made of nichrome. It glows because large amount of heat is produced in it by the passing electric current due to its high resistance.

Q. 20. Compute the heat generated while transferring 96,000 coulombs of charge in one hour through a potential difference of 50 V.

Ans. Here, $Q = 96{,}000$ C, $t = 1$ hour $= 60 \times 60$ s and $V = 50$ V

$$\text{Current, } I = \frac{Q}{t} = \frac{96{,}000}{60 \times 60} = \frac{80}{3}\text{A}$$

$$\text{Resistance, } R = \frac{V}{I} = \frac{50 \times 3}{80} = \frac{15}{8}\Omega$$

Heat produced, $H = I^2Rt$

$$= \frac{80}{3} \times \frac{80}{3} \times \frac{15}{8} \times 60 \times 60$$

$$= 4800000$$

$$= \mathbf{4800\ kJ}$$

Q. 21. An electric iron of resistance 20 Ω takes a current of 5 A. Calculate the heat developed in 30 s.

Ans. Here, $R = 20\ \Omega$, $I = 5$ A, $t = 30$ s

Heat developed $= I^2\,Rt$

$$= 5 \times 5 \times 20 \times 30$$

$$= 15{,}000\ \text{J} = \mathbf{15\ kJ}$$

Q. 22. What determines the rate at which energy is delivered by a current?

Ans. Electric power.

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Q. 23. An electric motor takes 5 A from a 220 V line. Determine the power of the motor and the energy consumed in 2 h.

Ans. Power, $P = VI$

$= 220 \times 5 = 1100 \text{ W} = \mathbf{1.1 \text{ kW}}$

Energy consumed, $E = P \times t$

$= 1.1 \text{ kW} \times 2 \text{ h} = \mathbf{2.2 \text{ kWh}}$

NCERT Exercises

Q. 1. A piece of wire of resistance R is cut into five equal parts. These parts are then connected in parallel. If the equivalent resistance of this combination is R', then the ratio $\frac{R}{R'}$ is:

(a) $\frac{1}{25}$ **(b)** $\frac{1}{5}$ **(c) 15** **(d) 25**

Ans. Resistance of this wire, $R = \rho\frac{l}{A}$

Resistance of a piece of length $\frac{l}{5} = \rho\ \frac{l}{5A} = \frac{R}{5}$ $\left(\because R = \rho\frac{l}{A}\right)$

The equivalent resistance of the 5 wires in parallel is R' Then

$$\frac{1}{R'} = \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5} + \frac{1}{R/5}$$

$$\frac{1}{R'} = \frac{5}{R} + \frac{5}{R} + \frac{5}{R} + \frac{5}{R} + \frac{5}{R}$$

$$\frac{1}{R'} = \frac{25}{R}$$

$$\therefore \quad \frac{R}{R'} = 25$$

Hence, the correct answer is (*d*).

Q. 2. Which of the following terms does not represent electrical power in a circuit?

(a) I^2R **(b)** IR^2 **(c)** VI **(d)** $\frac{V^2}{R}$

Ans. Electric power is given by expression

$P = VI$. According to ohm's law, $V = IR$

$\therefore \quad P = VI = (IR)\, I = I^2R$

or $P = VI = V\left(\frac{V}{R}\right) = \frac{V^2}{R} \Rightarrow P = VI = \frac{V^2}{R} = I^2R$ Hence, the correct answer is (*b*).

Q. 3. An electric bulb is rated 220 V and 100 W. When it is operated on 110 V, the power consumed will be:

(a) 100 W **(b) 75 W** **(c) 50 W** **(d) 25 W**

Ans. We have, $P = \frac{V^2}{R}$

or $100 = \frac{(220)^2}{R}$ ...(1)

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Let power consumed be P' when operated on 110 V. Then

$$P' = \frac{(110)^2}{R} \qquad ...(2)$$

From (1) and (2), we have

$$\frac{P'}{100} = \left(\frac{110}{220}\right)^2 \quad \text{or} \quad P' = \frac{1}{4} \times 100$$

or $P' = 25$ W

Hence, the correct answer is (*d*).

Q. 4. Two conducting wires of the same material and of equal lengths and equal diameters are first connected in series and then in parallel in a circuit across the same potential difference. The ratio of heat produced in series and parallel combination would be:

(*a*) 1 : 2 (*b*) 2 : 1 (*c*) 1 : 4 (*d*) 4 : 1

Ans. Suppose the resistance of each one of the two wires is R.

The equivalent resistance of the series combination,

$$R_s = R + R = 2R$$

The heat produced in time *t*,

$$H_1 = \frac{V^2}{2R}t \qquad \left(\because H = \frac{V^2}{R}t\right) \qquad ...(1)$$

The equivalent resistance of the parallel combination is

$$R_P = \frac{R \times R}{R + R} = \frac{R^2}{2R} = \frac{R}{2}$$

Heat produced in time t,

$$H_2 = \frac{V^2}{R/2}t = \frac{2V^2t}{R} \qquad ...(2)$$

From (1) and (2), we have

$$\frac{H_1}{H_2} = \frac{V^2t}{2R} \times \frac{R}{2V^2t} \Rightarrow \frac{H_1}{H_2} = \frac{1}{4}$$

$$H_1 : H_2 = 1 : 4$$

Thus, the correct answer is (*c*).

Q. 5. How is a voltmeter connected in the circuit to measure the potential difference between two points?

Ans. A voltmeter is always connected in parallel in the circuit to measure the potential difference between two points. Also, the positive terminal of the voltmeter should be connected to the positive terminal of the battery or cell and negative terminal to the negative terminal of the battery or the cell.

Q. 6. A copper wire has diameter 0.5 mm and resistivity of 1.6×10^{-8} Ω m. What will be the length of this wire to make its resistance 10 Ω. How much does the resistance change if the diameter is doubled?

Ans. (*i*) Diameter, $d = 0.5$ mm

$$\text{Radius, } r = \frac{0.5}{2}\text{ mm} = 0.25\text{ mm} = \frac{0.25}{1000}\text{m} = 0.25 \times 10^{-3}\text{ m}$$

$$\text{Area of cross-section, } A = \pi r^2 = \frac{22}{7} \times (0.25 \times 10^{-3})^2 = 0.1964 \times 10^{-6}\text{ m}^2$$

Resistance, $R = 10\ \Omega$, Resistivity, $\rho = 1.6 \times 10^{-8}\ \Omega$ m, Length, l = ?

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We know that $R = \frac{\rho l}{A}$

$$l = \frac{RA}{\rho} = \frac{10 \times 0.1964 \times 10^{-6}}{1.6 \times 10^{-8}} = \frac{1964}{16} = \mathbf{122.75\ m}$$

(*ii*) The area of cross-section, $A_1 = \pi r^2 = \pi\left(\frac{d}{2}\right)^2 = \frac{\pi d^2}{4}$

Its resistance, $R_1 = \frac{\rho l}{A_1} = \frac{4\rho l}{\pi d^2}$ ...(1)

When the diameter is doubled, area of cross-section,

$$A_2 = \pi\left(\frac{2d}{2}\right)^2 = \pi d^2$$

Its resistance, $R_2 = \frac{\rho l}{A_2} = \frac{\rho l}{\pi d^2}$ ...(2)

From (1) and (2), we have

$$\frac{R_2}{R_1} = \frac{\rho l}{\pi d^2} \times \frac{\pi d^2}{4\rho l} = \frac{1}{4}$$

or $R_2 = \mathbf{\frac{1}{4} R_1}$

Thus, on doubling the diameter, the area of cross-section becomes 4 times and the resistance becomes one-fourth.

Q. 7. The values of current *I* flowing in a given resistor for the corresponding values of potential difference V across the resistor are given below:

I (amperes)	0.5	1.0	2.0	3.0	4.0
V (volts)	1.6	3.4	6.7	10.2	13.2

Plot a graph between V and I and calculate the resistance of that resistor.

Ans. Resistance of resistor

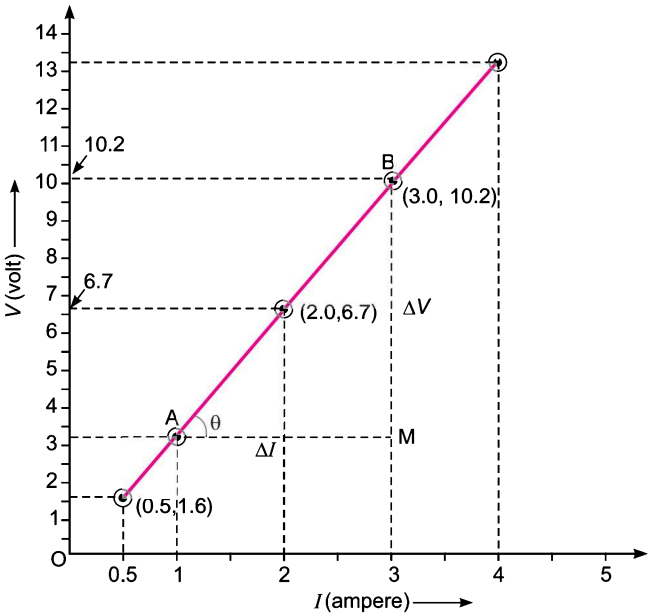
$R = \frac{V}{I}$ = slope of V - I graph

$= \frac{\Delta V}{\Delta I} = \frac{BM}{AM}$

$= \frac{10.2 - 3.4}{3.0 - 1.0}$

$= \frac{6.8}{2.0}$

$= \mathbf{3.4\ \Omega}$



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Q. 8. When a 12 V battery is connected across an unknown resistor, there is a current of 2.5 mA in the circuit. Find the value of the resistance of the resistor.

Ans. Potential difference, $V = 12$ V

Current, $I = 2.5$ mA $= 2.5 \times 10^{-3}$ A

We know that $V = IR$

or, $$R = \frac{V}{I} = \frac{12}{2.5 \times 10^{-3}}$$

$$= 4.8 \times 10^{3}\ \Omega = \mathbf{4.8\ k\Omega}$$

Q. 9. A battery of 9 V is connected in series with resistors of 0.2 Ω, 0.3 Ω, 0.4 Ω, 0.5 Ω and 12 Ω respectively. How much current would flow through the 12 Ω, resistor?

Ans. Resistors are connected in series.

So, equivalent resistance

$$R = 0.2\ \Omega + 0.3\ \Omega + 0.4\ \Omega + 0.5\ \Omega + 12\ \Omega = 13.4\ \Omega$$

Potential difference, $V = 9$ V

Current, through the circuit,

$$I = \frac{V}{R} = \frac{9}{13.4} = \mathbf{0.67\ A}$$

Q. 10. How many 176 Ω resistors (in parallel) are required to carry 5 A on a 220 V line?

Ans. Current, $I = 5$ A

Potential difference, $V = 220$ V

Resistance of parallel circuit, $R = \frac{V}{I} = \frac{220}{5} = 44\ \Omega$

Let no. of resistors $= n$

In parallel, $$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots. + n \text{ times}$$

$$\frac{1}{44} = \frac{1}{176} + \frac{1}{176} + \ldots. n \text{ times}$$

$$\frac{1}{44} = \frac{n}{176}$$

$$n = \frac{176}{44} \text{ or } n = \mathbf{4}$$

Number of required resistors = 4.

Q. 11. Show how you would connect three resistors, each of resistance 6 Ω, so that the combination has a resistance of (*i*) 9 Ω (*ii*) 4 Ω.

Ans. (*i*) In order to get a resistance of 9 Ω, We connect the given resistors (each of resistance of 6 Ω) in the following way.

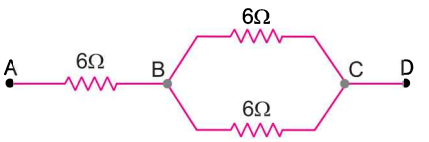
Resistance between B and C

$$\frac{1}{R} = \frac{1}{6} + \frac{1}{6}$$

$$\frac{1}{R} = \frac{2}{6}$$

$$\boldsymbol{R = 3\ \Omega}$$

Resistance of the combination = 6 Ω + 3 Ω = 9 Ω



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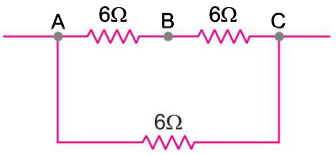
(*ii*) In order to get a resistance of 4 Ω, we connect two resistors in series and third in parallel as shown in figure.



Resistors AB and BC are in series, therefore,

$$R_S = 6\ \Omega + 6\ \Omega = 12\ \Omega$$

Now, R_s is parallel with the third (6Ω).

∴ Equivalent resistance of combination (R_p) is given by

$$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{12} = \frac{2+1}{12}$$

$$\frac{1}{R_p} = \frac{3}{12} = \frac{1}{4}$$

$$\boldsymbol{R_p = 4\ \Omega}$$

Q. 12. Several electric bulbs designed to be used on a 220 V electric supply line, are rated 10 W. How many lamps can be connected in parallel with each other across the two wires of 220 V line if the maximum allowable current is 5 A?

Ans. Potential difference, $V = 220$ V

Power of each bulb, $P = 10$ W

Resistance of each bulb, $R = \frac{V^2}{P} = \frac{220 \times 220}{10} = 4840\ \Omega$

Total resistance in the circuit,

$$R' = \frac{V}{I} = \frac{220}{5} = 44\ \Omega$$

Let n be the number of bulbs to be connected in parallel to obtain resistance R'.

$$\frac{1}{R'} = \frac{1}{R} + \frac{1}{R} + \ldots . n \text{ times}$$

$$\frac{1}{R'} = \frac{n}{R}$$

$$n = \frac{R}{R'} = \frac{4840}{44} = \mathbf{110}$$

Required number of bulbs = 110

Q. 13. A hot plate of an electric oven connected to a 220 V line has two resistance coils A and B, each of 24 Ω resistance, which may be used separately, in series or in parallel. What are the currents in the three cases?

Ans. Potential difference, V = 220 V

Resistance of each coil, R = 24 Ω

Case I: When coils A and B are used separately, current through each coil,

$$\text{I} = \frac{V}{R} = \frac{220}{24} = \mathbf{9.2\ A}$$

Case II: When coils A and B are connected in series, the equivalent resistance in the circuit.

Rs = 24 + 24 = 48 Ω

Current, $\text{I} = \frac{V}{R_S} = \frac{220}{48} = \mathbf{4.6\ A}$

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Case III: When coils A and B are connected in parallel, the equivalent resistance (Rp) is given by

$$\frac{1}{R_p} = \frac{1}{24} + \frac{1}{24} = \frac{2}{24}$$

$$R_p = 12\ \Omega$$

$$\text{Current, } I = \frac{V}{R_p} = \frac{220}{12} = \mathbf{18.3\ A}$$

Q. 14. Compare the power used in the 2 Ω resistor in each of the following circuits:

(*i*) a 6 V battery in series with 1 Ω and 2 Ω resistors, and

(*ii*) a 4 V battery in parallel with 12 Ω and 2 Ω resistors.

Ans. (*i*) Equivalent resistance of 1 Ω and 2 Ω in series, R = 1 Ω + 2 Ω = 3 Ω

Potential difference, V = 6 V

$$\text{Current, } I = \frac{V}{R} = \frac{6}{3} = 2\ \text{A}$$

Current in series circuit is same.

∴ Current in 2 Ω resistor = 2 A

Power in 2 Ω resistor, $P = I^2 R = 2^2 \times 2 = 8$ W

(*ii*) Potential difference across 2 Ω resistor = 4 V

$$\text{Power, } P' = \frac{V^2}{R} = \frac{4^2}{2} = 8\ \text{W}$$

$$P : P' = 8\ \text{W} : 8\ \text{W} = \mathbf{1 : 1}$$

Q. 15. Two lamps, one rated 100 W at 220 V, and the other 60 W at 220 V, are connected in parallel to electric mains supply. What current is drawn from the line if the supply voltage is 220 V?

[CBSE 2018]

Ans. We know that $P = \frac{V^2}{R}$

$$\therefore \quad R = \frac{V^2}{P}$$

Resistance of 1st lamp,

$$R_1 = \frac{V^2}{P} = \frac{220 \times 220}{100} = 484\ \Omega$$

Resistance of 2nd lamp,

$$R_2 = \frac{220 \times 220}{60} = \frac{2420}{3}\ \Omega$$

Since, two lamps are connected in parallel, so its equivalent resistance is given by

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$= \frac{1}{484} + \frac{3}{2420} = \frac{8}{2420}$$

$$R = \frac{2420}{8}\ \Omega$$

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Current drawn from the line

$$I = \frac{V}{R} = \frac{220 \times 8}{2420} = \mathbf{0.73\ A}$$

Q. 16. Which uses more energy, a 250 W TV set in 1 h or a 1200 W toaster in 10 minutes?

Ans. Energy used by TV set

$$E_1 = P \times t$$
$$= 250\ \text{W} \times 1\text{h} = 250\ \text{Wh}$$

Energy used by toaster,

$$E_2 = P \times t$$
$$= 1200 \times \frac{10}{60} = 200\ \text{Wh}$$

Thus, TV set in one hour uses more energy than the toaster uses in 10 minutes.

Q. 17. An electric heater of resistance 8 Ω draws 15 A from the service mains in 2 hours. Calculate the rate at which heat is developed in the heater.

Ans. Here, $R = 8\ \Omega$

$I = 15$ A

The rate at which heat is developed is power, $P = I^2R$

$$\text{Power} = \frac{\text{Heat developed } (I^2Rt)}{\text{Time taken } (t)}$$

$$= 15 \times 15 \times 8 = \mathbf{1800\ J/s}.$$

Q. 18. Explain the following:

(*i*) Why is the tungsten used almost exclusively for filament of electric lamp?

(*ii*) Why are the conductors of electric heating devices, such as bread-toasters and electric irons, made of an alloy rather than a pure metal?

(*iii*) Why is the series arrangement not used for domestic circuits?

(*iv*) How does the resistance of a wire vary with its area of cross-section?

(*v*) Why are copper and aluminium wires usually employed for electricity transmission?

Ans. (*i*) Pure tungsten has a high resistivity and a high melting point (nearly 3000°C). When an electric current is passed through the filament, the electric energy is converted to heat and light energy due to the heating of the filament to a very high temperature. Due to the high melting point of tungsten, the filament does not melt.

(*ii*) The resistivity of an alloy is generally higher than that of its constituent metals. Alloys do not oxidise (burn) readily at higher temperatures. Therefore, conductors of electric heating devices, such as toasters and electric irons, are made of an alloy rather than pure metal.

(*iii*) The series arrangement is not used for domestic circuits because:

(*a*) if connected in series total resistances will increase. Therefore, current flowing through the circuit will be low.

(*b*) if one appliance is switched off or gets damaged than all other appliances will also stop working because their electricity supply will be cut off.

(*iv*) The resistance of a wire is inversely proportional to its cross-sectional area. Thus, a thick wire has less resistance, and a thin wire has more resistance.

(*v*) Copper and aluminium wires are usually employed for electricity transmission because copper and aluminium have very low resistivities.

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SELF-ASSESSMENT TEST

Time allowed: 1 hour **Max. marks: 40**

SECTION–A

Choose and write the correct answer for each of the following. **(4 × 1 = 4)**

1. The fixed resistance is called

(*a*) rheostat (*b*) resistor (*c*) key (*d*) switch

2. A wire is drawn such that its radius changes from *r* to 2*r*. The new resistance is

(*a*) 1 times (*b*) 4 times (*c*) 8 times (*d*) $\frac{1}{16}$ times

3. An electric current of 3 A flows through a circuit for 20 minutes. What is the amount of charges flowing?

(*a*) 60 C (*b*) 1 C (*c*) 3600 C (*d*) None of the above

4. A man has five resistors each of value 1/6 Ω. What is the minimum resistance he can obtain by connecting them?

(*a*) 1/6 Ω (*b*) 1/30 Ω (*c*) 1/10 Ω (*d*) 1/50 Ω

The following questions consist of two statements—Assertion(A) and Reason(R). Answer these questions selecting the appropriate option given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation for *A*.

(*b*) Both *A* and *R* are true but *R* is not the correct explanation for *A*.

(*c*) *A* is true but *R* is false.

(*d*) *A* is false but *R* is true. **(3 × 1 = 3)**

5. Assertion (*A*) : The resistivity of a substance does not depend on the nature of the substance and temperature.

Reason (*R*) : The resistivity of a substance is a characteristic property of the material.

6. Assertion (*A*) : Tungsten metal is used for making filaments of incandescent lamps.

Reason (*R*) : The melting point of tungsten is very low.

7. Assertion (*A*) : The fuse is placed in series with the device.

Reason (*R*) : Fuse consists of a piece of wire made of a metal or an alloy of appropriate melting point.

Answer the following questions in one word or one sentence. **(3 × 1 = 3)**

8. What is a fixed resistance called?

9. Name the alloy which is used for making the filament of bulbs.

10. Why is an ammeter connected in series in an electric circuit?

SECTION–B

Answer the following questions in about 50-60 words each. **(5 × 3 = 15)**

11. (*i*) Table gives the resistivity of three materials in (in Ω m) A, B, C.

Samples	A	B	C
Resistivity	1.6×10^{-8}	7.5×10^{17}	44×10^{-6}

Which one of them is the best conductor? And which is an insulator and why?

(*ii*) A wire of resistivity ρ is stretched to twice its length. What will be its new resistivity?

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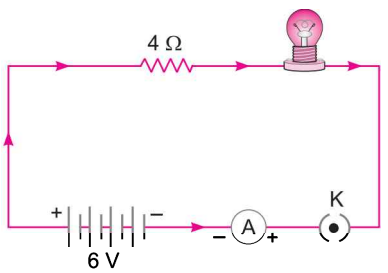
12. How can three resistances of 2, 3 and 6 ohms be connected so as to give a total resistance of 1 ohm?
13. The resistance of a metal wire of length 1 m is 25 Ω at 20°C. If the diameter of the wire is 0.3 mm, what must be the resistivity of metal at that temperature?
14. How is an ammeter and a voltmeter connected in a circuit and why?
15. Why is parallel arrangement used in domestic wiring?

SECTION–C

Answer the following questions in about 80–90 words each. **(3 × 5 = 15)**

16. What is electrical resistivity of a material? What is its unit? Describe an experiment to study the factors on which the resistance of conducting wire depends.
17. Three bulbs each having power P are connected in series in an electric circuit. In another circuit another set of three bulbs of same power are connected in parallel to the same source.
    (*i*) Will the bulbs in both the circuits glow with the same brightness? Justify your answer.
    (*ii*) Now let one bulb in each circuit get fused. Will the rest of the bulbs continue to glow in each circuit? Give reason.
    (*iii*) Representing each bulb by a resistor, draw circuit diagram for each case.
18. An electric lamb of resistance 20 Ω and a conductor of resistance 4 Ω are connected to a 6 V battery as shown in the circuit. Calculate:



    (*i*) the total resistance of the circuit,
    (*ii*) the current through the circuit,
    (*iii*) the potential difference across the (*i*) electric lamp and (*ii*) conductor, and
    (*iv*) power of lamp.

Answers

1. (*b*) **2.** (*d*) **3.** (*c*) **4.** (*b*) **5.** (*d*) **6.** (*c*) **7.** (*b*)
8. Resistor **9.** Tungsten
10. Because the value of current remains same in a series circuit.

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13 Magnetic Effects of Electric Current

BASIC CONCEPTS—A FLOW CHART

MAGNETIC EFFECTS OF ELECTRIC CURRENT

Electric current through a metallic conductor produces a magnetic field around it.

Application

Electric motor

- Electrical energy is converted into mechanical energy.
- Used in electric fans, refrigerators, washing machines, computers, etc.

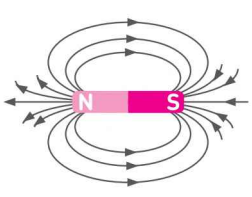
Magnetic field

- Space surrounding a magnet within which a magnetic force is experienced.
- Has both direction and magnitude.
- SI unit is tesla.

Field patterns produced in different shapes by current carrying conductor

Magnetic field lines

- Continuous curve in a magnetic field such that the tangent at any point on it gives the direction of magnetic field at that point.
- If field lines are close, field is stronger.
- If field lines are far apart, field is weak.
- Field lines around a bar magnet:

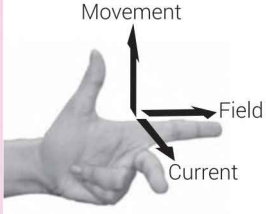


Force on a current-carrying conductor

Force acting on the conductor is perpendicular to the direction of magnetic field.

Direction of force

Fleming's left hand rule

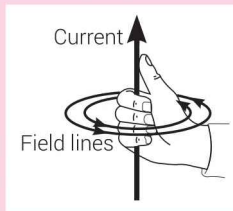


Straight conductor

Magnetic field is represented by concentric circles which become larger and larger as the distance increases.

Direction of magnetic field lines

Right hand thumb rule



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Electromagnetic induction

Phenomenon of induction of emf in a coil when there is a change in magnetic flux linked with the coil.

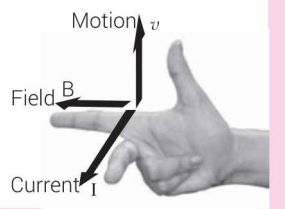
Application

Electric generator

- Mechanical energy is converted into electrical energy.
- An AC generator produces alternating current, which reverses its direction after equal intervals of time. In this case, we use slip rings due to which the direction of current changes.
- DC generator produces direct current *i.e.*, the direction of current remains the same. In this case, we use split rings called commutator, which give current only in one direction.

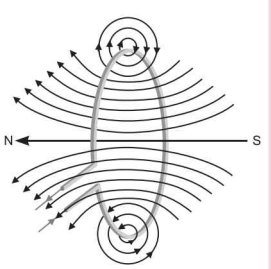
Direction of induced current

Fleming's right hand rule



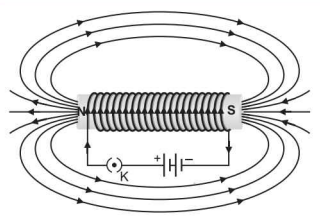
Circular loop

Magnetic field lines are represented by concentric circles near the wire of the loop that flattens as we move towards centre and appear as straight lines at the centre of loop.

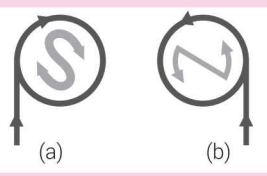


Solenoid

Magnetic field produced is similar to that produced by a bar magnet.



Direction of magnetic field



(a) Clockwise current shows south polarity
(b) Anti-clockwise current shows north polarity

Electromagnet

- A temporary magnet of soft iron core with a coil wound around it which retains magnetism only when current passes through the coil.
- Used in electric bell, telephone, electric motor, etc.

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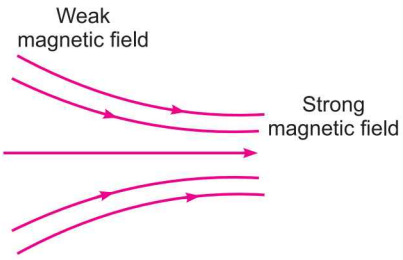
MORE POINTS TO REMEMBER

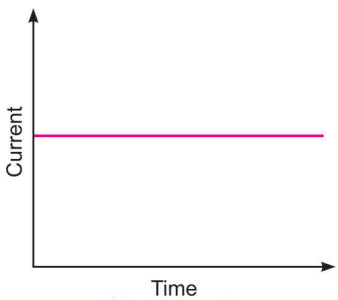
❒ Properties of Magnetic Field Lines



- They travel from north pole to south pole outside the magnet and south pole to north pole inside the magnet.
- They are always in the form of closed and continuous curves.
- The number of field lines per unit area is the measure of the strength of magnetic field. The magnetic field is strong, where the field lines are close together and weak where the lines are far apart.
- Magnetic field lines are closest near the pole of a magnet and become wider as we move away from the pole. This means that the magnetic field is stronger near the poles and it becomes weaker as we move away from the poles.
- The direction of magnetic field at any point is along the tangent on the line of force at that point.
- Two magnetic lines of forces never intersect each other. If the lines intersect, then at the point of intersection there would be two directions (the needle would point towards two directions) for the same magnetic field, which is not possible.
- **Uniform and Non-uniform Magnetic Fields:** If the magnetic field lines are parallel and equidistant, the field is uniform and if they are non parallel and unequally spaced the field is non-uniform.

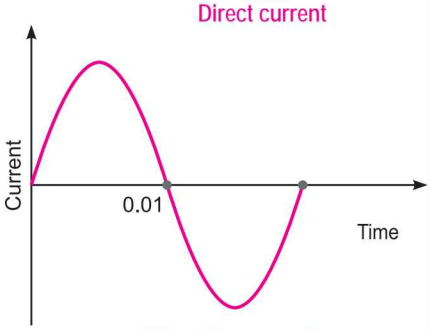
❒ Direct and Alternating Current

- **Direct Current:** A current that always flows in one direction is called a direct current (DC). The current which we get from a battery or a cell is direct current because it always flows in the same direction. It is graphically represented by a straight line parallel to the time axis.



Direct current

- **Alternating Current:** An electric current which flows first in one direction in a circuit, called the positive direction, then in the reverse or negative direction at a regular interval of time is called alternating current (AC). In other words, an electric current that reverses its direction with time is called an alternating current. The symbol for an AC source is ~. The generators (converts mechanical energy into electrical energy based on electromagnetic induction) can produce either DC or AC.



Alternating current

❒ Advantages of AC over DC

(*i*) Electric power can be transmitted over long distances without much loss of energy by an AC.

(*ii*) Alternating current can be controlled by a choke coil at small energy losses but direct current can be controlled by ohmic resistances only and energy losses in the form of heat are very high.

(*iii*) Alternating current equipments are more durable and convenient.

❒ **Fuse:** A fuse in a circuit prevents damage to the appliances and the circuit due to overloading. Overloading can occur when large number of electric devices having low resistances are connected in parallel.

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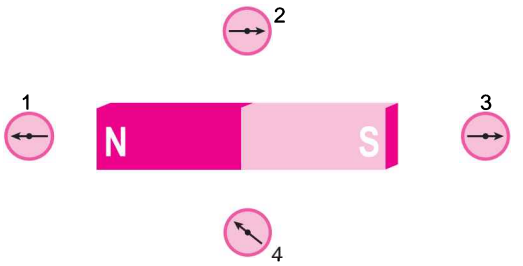
Multiple Choice Questions [1 mark]

Each question has 4 choices (a), (b), (c) and (d). Choose and write the correct option.

1. **The magnetic field lines due to a straight wire carrying a current are**
   (*a*) straight (*b*) circular
   (*c*) parabolic (*d*) elliptical

2. **The magnetic field lines inside a long current carrying solenoid are nearby**
   (*a*) straight (*b*) circular
   (*c*) parabolic (*d*) elliptical

3. **The diagram shows plotting compasses around a bar magnet.**



   Which of the plotting compass needles are drawn pointing in the correct direction?.
   (*a*) 1 and 2 only (*b*) 1 and 3 only
   (*c*) 1, 2 and 3 only (*d*) 4 only

4. **The direction of the force on a current carrying wire placed in a magnetic field depends on**
   (*a*) the direction of the current but not on the direction of the field
   (*b*) the direction of the field but not on the direction of the current
   (*c*) the direction of the current as well as the direction of the field
   (*d*) neither the direction of the current nor the direction of the field

5. **An electric current can be produced in a closed loop**
   (*a*) by connecting it to a battery but not by moving a magnet near it
   (*b*) by moving a magnet near it but not by connecting it to a battery
   (*c*) by connecting it to a battery as well as by moving a magnet near it
   (*d*) neither by connecting it to a battery nor by moving a magnet near it

6. **Commercial electric motors do not use** *[NCERT Exemplar]*
   (*a*) an electromagnet to rotate the armature
   (*b*) effectively large number of turns of conducting wire in the current carrying coil
   (*c*) a permanent magnet to rotate the armature
   (*d*) a soft iron core on which the coil is wound

7. **Which of the following involves electromagnetic induction?**
   (*a*) A rod is charged with electricity
   (*b*) An electric current produced a magnetic field
   (*c*) A magnetic field exerts a force on a current carrying wire
   (*d*) The relative motion between a magnet and a coil produces an electric current

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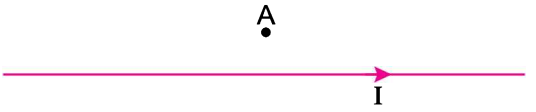
8. What is the direction of magnetic field at a point A above the wire carrying current I as shown in figure?



(*a*) Out of the page
(*b*) Into the page
(*c*) Up the page
(*d*) Down the page

9. According to international convention of colour coding in a wire

(*a*) live is red, neutral is black and earth is green
(*b*) live is brown, neutral is blue and earth is green
(*c*) live is brown, neutral is green and earth is black
(*d*) live is red, neutral is yellow and earth is blue.

10. Which of the following is not associated with Fleming's right-hand rule?

(*a*) Magnetic field
(*b*) Movement
(*c*) Resistance
(*d*) Induced current

11. A current through a horizontal power line flows in east to west direction. The direction of magnetic filed at a point directly below it is from

(*a*) North to South
(*b*) South to North
(*c*) West to East
(*d*) North to West

12. A rectangular coil of copper wires is rotated in a magnetic field. The direction of induced current changes once in each *[NCERT Exemplar]*

(*a*) two revolutions
(*b*) one revolution
(*c*) half revolution
(*d*) one-fourth revolution

13. The strength of magnetic field inside a long current carrying straight solenoids is *[NCERT Exemplar]*

(*a*) more at the ends than at the centre
(*b*) minimum in the middle
(*c*) same at all points
(*d*) found to increase from one end to the other

14. For a current in a long straight solenoid N and S poles are created at the two ends. Among the following statement, the incorrect statement is *[NCERT Exemplar]*

(*a*) The field lines inside the solenoids are in the form of straight lines which indicate that the magnetic field is same at all points in the solenoid.
(*b*) The strong magnetic field produced inside the solenoid can be used to magnetise a piece of magnetic material, when soft iron is placed inside the coil.
(*c*) The pattern of magnetic field associated with the solenoid is different from the pattern of the magnetic field around a bar magnet.
(*d*) The N and S poles exchange positions when the direction of current through the solenoid is reversed.

15. Choose the incorrect statement. *[NCERT Exemplar]*

(*a*) Fleming's right-hand rule is a simple rule to know the direction of induced current.
(*b*) The right-hand thumb rule is used to find the direction of magnetic fields due to current carrying conductors.
(*c*) The difference between the direct and alternating currents is that the direct current always flows in one direction whereas the alternating current reverses the direction periodically.
(*d*) In India the ac changes direction after every $\frac{1}{50}$ second

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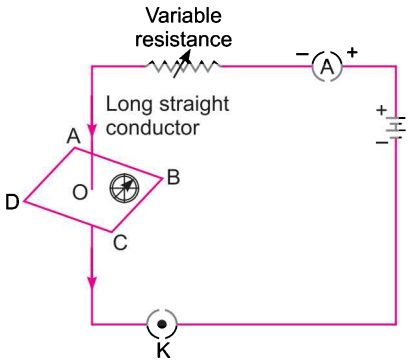
16. **If the key (K) in the arrangement (figure) is taken out (*i.e.*, circuit is made open) and the magnetic field lines are drawn over the horizontal plane ABCD, the lines are** [NCERT Exemplar]

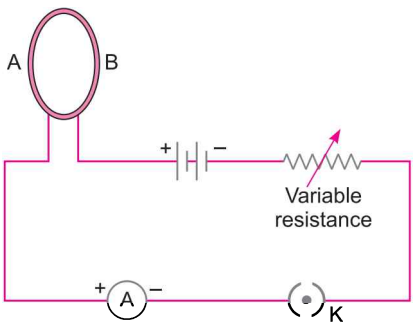


(*a*) concentric circles
(*b*) elliptical in shapes
(*c*) straight lines parallel to each other
(*d*) concentric circles near the point 0, but of elliptical shapes as we go away from it

17. **The most important safety method used for protecting home appliances from short circuiting or overloading is** [NCERT Exemplar]

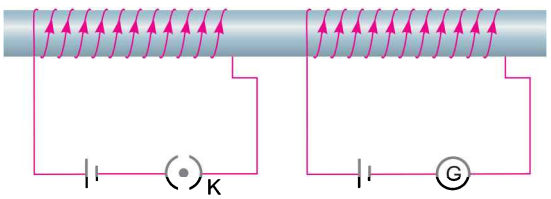
(*a*) earthing (*b*) use of fuse (*c*) use of stabilizers (*d*) use of electric meter

18. **A circular loop placed in a plane perpendicular to O the plane of paper carries a current when the key (K) is ON. The current as seen from points A and B (in the plane of paper and on the axis of the coil) is anticlockwise and clockwise respectively. The magnetic field lines point from B to A. The North pole of the resultant magnet is on the close to**



(*a*) A
(*b*) B
(*c*) A if current is small and B if current is large
(*d*) B if current is small and A if current is large

19. **In the arrangement shown in figure, there are two coils wound on a non-conducting cylindrical rod. Initially the key is not inserted, then the key is inserted and later removed. Then** [NCERT Exemplar]

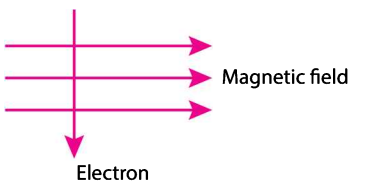


(*a*) the deflection in the galvanometer remains zero throughout.
(*b*) there is a momentary deflection in the galvanometer but it dies out shortly and there is no effect when the key is removed.
(*c*) there are momentary deflections in the galvanometer that die out shortly, the deflections are in the same direction.
(*d*) there are momentary deflections in the galvanometer that die out shortly; the deflections are in opposite directions.

20. **To convert an AC generator into DC generator** [NCERT Exemplar]

(*a*) split-ring type commutator must be used (*b*) slip rings and brushes must be used
(*c*) a stronger magnetic field has to be used (*d*) a rectangular wire loop has to be used

21. **An electron enters a magnetic field at right angles to it, as shown in figure. The direction of force acting on the electron will be**



(*a*) to the right (*b*) to the left
(*c*) out of the page (*d*) into the page

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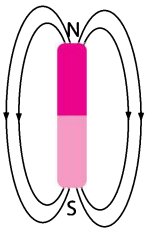
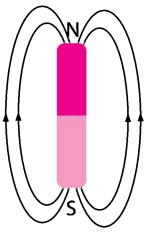
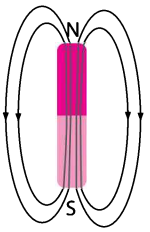
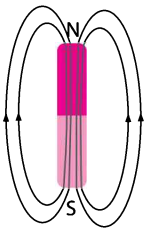
22. The magnetic field lines due to a bar magnet are correctly shown in

(a) 

(b) 

(c) 

(d) 

Answers

1. (*b*)	**2.** (*a*)	**3.** (*a*)	**4.** (*c*)	**5.** (*c*)	**6.** (*c*)	**7.** (*d*)	**8.** (*a*)
9. (*b*)	**10.** (*c*)	**11.** (*a*)	**12.** (*c*)	**13.** (*b*)	**14.** (*a*)	**15.** (*a*)	**16.** (*c*)
17. (*c*)	**18.** (*c*)	**19.** (*d*)	**20.** (*a*)	**21.** (*d*)	**22.** (*c*)		

Assertion-Reason Questions [1 mark]

The following questions consist of two statements — Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.

(b) Both A and R are true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

1. Assertion (*A*) : On changing the direction of flow of current through a straight conductor, the direction of a magnetic field around the conductor is reversed.

Reason (*R*) : The direction of magnetic field around a conductor can be given in accordance with left hand thumb rule.

2. Assertion (*A*) : The magnitude of the magnetic field at a point on the axis of a current carrying solenoid is inversely proportional to the current flowing through the solenoid.

Reason (*R*) : The magnitude of the magnetic field at a point on the axis of a current carrying solenoid is directly proportional to the number of turns per unit length of a solenoid.

3. Assertion (*A*) : A compass needle is placed near a current carrying wire. The deflection of the compass needle decreases when the magnitude of an electric current in the wire is increased.

Reason (*R*) : Strength of a magnetic field at a point near the conductor increases on increasing the current.

4. Assertion (*A*) : A compass needle is placed near a current carrying wire. The deflection of the compass needle decreases when the compass needle is displaced away from the wire.

Reason (*R*) : Strength of a magnetic field decreases as one moves away from a current carrying conductor.

5. Assertion (*A*) : The strength of the magnetic field produced at the centre of a current carrying circular coil increases on increasing the current flowing through the coil.

Reason (*R*) : Magnetic field strength is inversely proportional to the current flowing in the coil.

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6. **Assertion(*A*) :** The strength of the magnetic field produced at the centre of a current carrying circular coil increases on increasing the radius of the circular coil.
   Reason (*R*) : Magnetic field strength is inversely proportional to the radius of the circular coil.
7. **Assertion(*A*) :** The strength of the magnetic field produced at the centre of a current carrying circular coil increases on increasing the number of turns of the circular coil.
   Reason (*R*) : Magnetic field strength is directly proportional to the number of turns of the circular coil.
8. **Assertion(*A*) :** On freely suspending a current-carrying solenoid, it comes to rest in N-S direction just like a bar magnet.
   Reason (*R*) : One end of current carrying straight solenoid behaves as a North pole and the other end as a South pole.
9. **Assertion(*A*) :** Alternating Current is used in household supply.
   Reason (*R*) : AC electric power can be transmitted over long distances without much loss of energy.

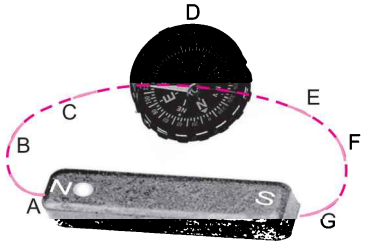
Answers

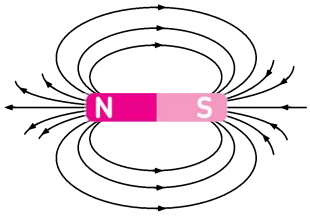
1. (*c*) **2.** (*d*) **3.** (*d*) **4.** (*a*) **5.** (*c*) **6.** (*d*) **7.** (*a*)
8. (*a*) **9.** (*a*)

Passage-based Questions

Answer the questions below the passage on the basis of your understanding of the paragraph and the related studied concepts.

1. There is a magnetic field in the area around a magnet. In this area there is a force on a magnetic object. If the field is strong the force is big. In a weak field the force is small.
   The direction of a magnetic field can be found by using a small plotting compass. The compass needle always lies along the direction of the field. Figure shows how you can investigate the field near to a bar magnet using a compass. We use magnetic field lines to represent a magnetic field. Magnetic field lines always start at a North pole and finish on a South pole. When the field lines are close together then the field is strong. The further apart the lines are, the weaker the field is. (Magnetic field lines are not real, but they make a useful model which helps us to understand magnetic fields).





   The pattern of magnetic field lines close to two (or more) magnets becomes complicated. The magnetic field from the two magnets combine. The field line from the two magnets never cross. If field lines did cross, it would mean that compass would have to point in two directions at once.

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(*i*) Why do two magnetic field lines of force never intersect each other?

(*ii*) The magnetic field in a given region is uniform. Draw a diagram to represent it.

(*iii*) Magnetic field lines determine

(*a*) only the direction of the field

(*b*) the relative strength of the field

(*c*) both the relative strength and the direction of the field

(*d*) only the shape of the field

(*iv*) Magnetic field lines

(*a*) have one direction at a point

(*b*) have no physical reality

(*c*) can be used to indicate the direction of the magnetic field of a point

(*d*) all the above

Answers

1. (*i*) Two magnetic field lines of force never intersect each other. If the lines intersect, then at the point of intersection there would be two directions (the needle would point towards two directions) for the same magnetic field, which is not possible.

(*ii*) A uniform magnetic field in a region is represented by drawing parallel and equidistant straight lines, all pointing in the same direction.



(*iii*) (*c*)

(*iv*) (*d*)

Very Short Answer Questions [1 mark]

Each of the following questions are of 1 mark and have to be answered in one word or one sentence.

Q. 1. What happens if a current carrying conductor is placed in the magnetic field?

Ans. The conductor experiences a force and the direction of this force is given by Fleming's left hand rule.

Q. 2. On what effect of an electric current does an electromagnet work?

Ans. An electromagnet works on the principles of magnetic effect of current.

Q. 3. Name the alloy which is mainly used for making permanent magnets.

Ans. The alloy 'Alnico' is used for making permanent magnets. It is an alloy of aluminium, nickel, cobalt and iron.

Q. 4. Why is electromagnetic induction so called?

Ans. This is due to the reason that electric current can be produced with the help of varying magnetic field without any physical contact of the source of magnetic field and the conductor.

Q. 5. What is the function of a galvanometer in a circuit? *[CBSE 2019 (31/1/1)]*

Ans. A galvanometer can detect the presence or direction of current in the circuit.

Q. 6. Which effect of electric current is utilised in the working of an electric fuse?

Ans. An electric fuse works on the heating effect of current.

Q. 7. What is the frequency of A.C. (alternating current) in India?

Ans. It is 50 Hz.

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Q. 8. What will you do if you see a person coming in contact with a live wire?

Ans. Such a person should be provided with an insulated support like wood, plastic or rubber in order to disconnect the person from wire.

Q. 9. How can it be proved that a magnetic field exists around a current carrying metallic wire?

Ans. When a magnetic compass needle is placed close to the current carrying wire, it will get deflected.

Q. 10. How is the strength of the magnetic field at a point near a wire related to the strength of the electric current flowing in the wire?

Ans. The magnitude of magnetic field is directly proportional to the strength of the electric current flowing in the wire.

Q. 11. How is the fuse connected in an electric circuit?

Ans. Fuse is connected in series in the circuit.

Q. 12. Why is a fuse usually made of tin or tin-copper alloy?

Ans. A fuse is usually made of tin or tin-copper alloy because it has a low melting point.

Q. 13. What is the capacity of a fuse commonly used in domestic electrical fittings?

Ans. Fuses of capacity 5 ampere or 15 ampere are commonly used in domestic electrical fittings.

Q. 14. Name the device used to protect the electric circuits from overloading and short circuiting.

Ans. A fuse is used to protect circuits from overloading and short circuiting.

Q. 15. What kind of magnetic field is produced by a current carrying solenoid?

Ans. The magnetic field produced by a current-carrying solenoid is similar to the magnetic field produced by a bar magnet.

Q. 16. State Faraday's law of electromagnetic induction.

Ans. Whenever the magnetic field lines linked with a coil change due to relative motion of a magnet and the coil, an induced current is produced in the coil. The magnitude of induced current is directly proportional to the rate of change of number of magnetic field lines linked to the coil.

Q. 17. The frequency of alternating current in India is 50 Hz. What does it mean?

Ans. In India, the alternating current changes direction after every $\frac{1}{100}$ second, so the frequency of alternating current is 50 Hz.

Q. 18. Name the scientist who discovered the relationship between electric current and magnetic field.

Ans. Danish physicist, H.C. Oersted established the relation between electricity and magnetism.

Q. 19. What does the closeness of field lines in a magnetic field signify?

Ans. The degree of closeness of the field lines in a magnetic field indicates the strength of magnetic field in the region. The closer the field lines, the stronger is the field.

Q. 20. Name the device which converts mechanical energy into electrical energy.

Ans. Electric generator.

Q. 21. Which type of generator is used at power stations?

Ans. AC generator.

Q. 22. Does the AC generator have any slip ring?

Ans. Yes, the AC generator has two slip rings.

Q. 23. What is the frequency of DC?

Ans. Zero

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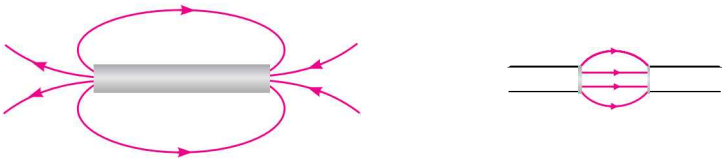
Short Answer Questions [3 marks]

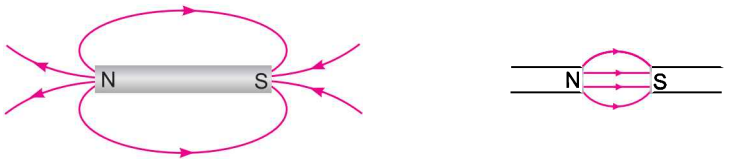
Each of the following questions are of 3 marks and have to be answered in about 50–60 words.

Q. 1. (*i*) Identify the poles of the magnet in the figure (a) and (b) shown below.



(*ii*) How does the strength of the magnetic field at the centre of a circular coil of a wire depend on: (*a*) radius of the coil (*b*) number of turns in the coil.

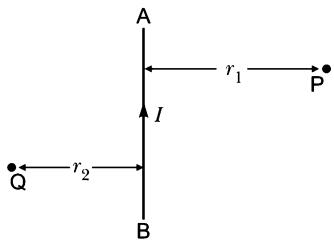
Ans. (*i*) The magnetic field lines emerge from north pole and merge at the south pole.



(*ii*) (*a*) More the radius weaker the field.

(*b*) Field strength is directly proportional to the number of turns in the coil

Q. 2. (*i*) AB is a current-carrying conductor in the plane of the paper as shown in figure. What are the directions of magnetic fields produced by it at points P and Q? Given $r_1 > r_2$, where will the strength of the magnetic field be larger? *[NCERT Exemplar]*



(*ii*) (*a*) How is the direction of magnetic field at a point determined?

(*b*) What is the direction of magnetic field at the centre of a current-carrying circular loop?

Ans. (*i*) Magnetic field at P is into the plane of paper and at Q it is out of the plane of paper. The strength of the magnetic field at Q will be larger as strength of the field $\propto \frac{1}{r}$.

(*ii*) (*a*) The direction of the magnetic field at a point can be found by placing a small magnetic compass at that point. The north end of the needle of a compass indicates the direction of magnetic field at a point where it is placed.

(*b*) The direction of magnetic field at the centre of a current-carrying circular loop is perpendicular to the plane of the loop.

Q. 3. (*i*) What is electromagnetic induction?

(*ii*) A student performs an experiment to study the magnetic effect of current around a current carrying straight conductor with the help of a magnetic compass. He reports that

(*a*) the degree of deflection of the magnetic compass increases when the compass is moved away from the conductor.

(*b*) the degree of deflection of the magnetic compass increases when the current through the conductor is increased.

Which of the above observations of the student appears to be wrong and why?

Ans. (*i*) Whenever the magnetic flux linked with a coil changes, an induced e.m.f. (electromotive force) is produced in the coil. This phenomenon is known as electromagnetic induction and is used to generate electric current in a generator or a dynamo.

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(*ii*) The first observation is wrong. Because as the distance from the conductor increases, the strength of the magnetic field will decrease. So the degree of deflection of the compass should decrease instead of increasing.

Q. 4. Write SI unit of magnetic field. Under what condition does a moving charge experience (*i*) maximum force (*ii*) minimum force?

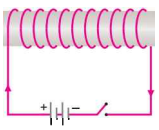
Ans. The SI unit of magnetic field is tesla.

(*i*) **Maximum force:** When the velocity of charge and the magnetic field are perpendicular to each other.

(*ii*) **Minimum force:** When the charge is moving in the direction of the magnetic field.

Q. 5. What is an electromagnet? Draw a circuit diagram and explain how a soft iron piece can be transformed into an electromagnet.

Ans. The magnetic field produced due to current flowing in a coil or a solenoid can be used to magnetise a material like soft iron temporarily. The insulated copper wire is wrapped on a soft iron piece. When current is passed through the coil using a battery and a key, the iron piece behaves like a bar magnet as long as current is being passed. Such a magnet is called an electromagnet.



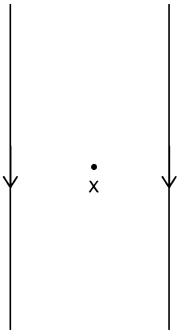
Q. 6. (*i*) A magnetic compass shows a deflection when placed near a current-carrying wire. How will the deflection of the compass get affected if the current in the wire is increased? Support your answer with a reason. *[NCERT Exemplar]*

(*ii*) What does the divergence of magnetic field lines near the ends of a current-carrying straight solenoid indicate? *[NCERT Exemplar]*

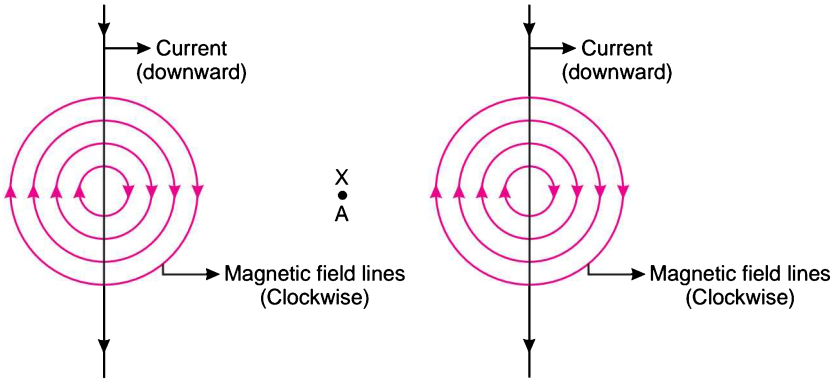
Ans. (*i*) If the current in the wire is increased, the deflection increases. The strength of magnetic field is directly proportional to the magnitude of current passing through the straight conductor.

(*ii*) The divergence, that is, the falling degree of closeness of magnetic field lines indicates the fall in strength of magnetic field near and beyond the ends of the solenoid.

Q. 7. The following diagram shows two parallel straight conductors carrying, same current. Copy the diagram and draw the pattern of the magnetic field lines around them showing their directions. What is the magnitude of magnetic field at a point 'A' which is equidistant from the conductors? Give justification for your answer. *[CBSE 2019 (31/4/2)]*



Ans. The direction of magnetic field in a current carrying wire is given by right hand thumb rule. So, the pattern of the magnetic field around each wire is as such



Direction of magnetic field at A by left wire is out of the page (•) and direction of magnetic field at A by right wire is into the page (×) as shown in figure. Since the magnitude of the magnetic field due to each wire is same, hence the net magnetic field at point A is zero.

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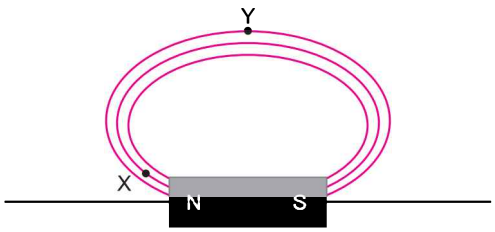
Q. 8. It is established that an electric current through a conductor produces a magnetic field around it. Is there a similar magnetic field produced around a thin beam of moving (*i*) alpha particles, (*ii*) neutrons? Justify your answer in each case. *[CBSE 2019 (31/4/3)]*

Ans. In case of movement of a charged particle, the magnetic field is created around the path on which the charged particle moves.

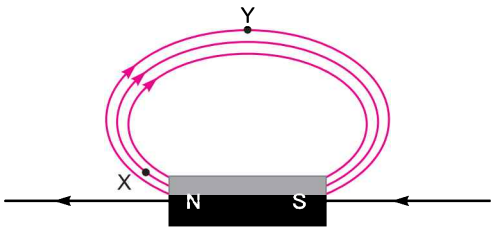
(*i*) Yes, magnetic field is produced as a thin beam of α-particles (which are positively charged) is like a straight conductor carrying current in the direction of motion.

(*ii*) No, magnetic field is not produced as neutrons carry no charge so no magnetic field would be created around its path.

Q. 9. Magnetic field lines are shown in the given diagram. A student makes a statement that magnetic field at X is stronger than at Y. Justify this statement. Also redraw the diagram and mark the direction of magnetic field lines.



Ans. The relative strength of the magnetic field is shown by the degree of closeness of the field lines. The degree of closeness is more at X than at Y. Therefore, the field is stronger at X where the field lines are crowded.



Q. 10. What is the difference between a direct current and an alternating current? How many times does AC used in India change direction in one second? *[NCERT Exemplar]*

Ans. Direct current always flows in one direction but the alternating current reverses its direction periodically. Also the magnitude of current in case of DC is same throughout whereas in case of AC, it changes continuously. The frequency of AC in India is 50 Hz and in each cycle it alters direction twice. Therefore, AC changes direction $2 \times 50 = 100$ times in one second.

Q. 11. How can the magnitude of the induced current in a coil be increased?

Ans. The magnitude of the induced current can be increased by:

(*i*) Increasing the number of turns in the coil.

(*ii*) Increasing the strength of the magnetic field used.

(*iii*) Increasing the rate of change of magnetic flux associated with the coil.

Q. 12. What is the role of fuse used in series with any electrical appliance? Why should a fuse with defined rating not be replaced by one with a larger rating? *[NCERT Exemplar]*

Ans. Fuse is used for protecting appliances due to short-circuiting or overloading. The fuse is rated for a certain maximum current and blows off when a current more than the rated value flows through it. If a fuse is replaced by one with larger ratings, the appliances may get damaged while the protecting fuse does not burn off. This practice of using fuse of improper rating should always be avoided.

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Q. 13. Answer the following questions:

(*i*) What is the direction of magnetic field lines outside a bar-magnet?

(*ii*) The magnetic field lines in a given region are getting crowded. What does it indicate?

(*iii*) State one advantage of AC over DC.

Ans. (*i*) North pole to south pole.

(*ii*) The strength of magnetic field is higher in this region.

(*iii*) AC voltage can be stepped up and transmitted over long distances without much loss of energy.

Q. 14. What are magnetic field lines? How is the direction of a magnetic field at a point determined? Mention two important properties of magnetic field lines.

Ans. The magnetic field lines of force are the lines drawn in a magnetic field along which a hypothetical north magnetic pole would move if it is free to do so.

The direction of a magnetic field at a point is in the direction of the resultant force acting on a hypothetical north pole placed at that point. The tangent at any point on the magnetic field line gives the direction of magnetic field at that point. The direction of the magnetic field at a point can be found by placing a small magnetic compass at that point. The north end of the needle indicates the direction of the field.

Two important properties of the magnetic lines of force are:

(*i*) The magnetic lines of force start from north pole and terminate at south pole. Inside the magnet they travel from south pole to north pole. Thus, they are closed curves.

(*ii*) They do not intersect each other because at the point of intersection there will be two directions of same magnetic field which is impossible.

Q. 15. What is a solenoid? Draw the pattern of magnetic field lines of (*i*) a current carrying solenoid and (*ii*) a bar magnet. List two distinguishing features between the two fields.

[CBSE 2019 (31/1/1)]

Ans. A coil of many circular turns of insulated copper wire wrapped closely in the shape of a cylinder is called a solenoid.

For diagrams Refer to Basic Concepts—A Flow Chart.

Distinguishing features:

Solenoid	Bar Magnet
1. Field disappear on stopping the current.	1. No effect of current on magnetic field.
2. Strength of the field can be changed by changing the current.	2. Strength cannot to changed.
3. Direction can be reversed by changing the direction of current through it.	3. Direction is fixed and cannot be reversed.

Q. 16. What change in the deflection of the compass needle placed at a point near current carrying straight conductor shall be observed if the (*i*) current through the conductor is increased? (*ii*) direction of current in the conductor is reversed? (*iii*) compass is moved away from the conductor?

Ans. (*i*) Deflection increases.

(*ii*) Direction of deflection is reversed.

(*iii*) Deflection decreases.

Q. 17. Name and state the rule used for determination of direction of induced current produced in a conductor due to a changing magnetic field and give one practical application of this phenomenon in everyday life.

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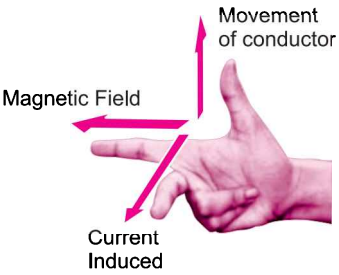
Ans. **Rule:** Fleming's right-hand rule.

It states that if we stretch the thumb, forefinger and middle finger of our right hand such that they are mutually perpendicular to each other. If forefinger indicates direction of magnetic field and the thumb shows the direction of motion of conductor, then middle finger will show direction of induced current.

Application: Electrical generator.



Fleming's right-hand rule

Q. 18. A coil made of insulated copper wire is connected to a galvanometer. What will happen to the deflection of the galvanometer if this coil is moved towards a stationary bar magnet and then moved away from it? Give reason for your answer and name the phenomenon involved.

Ans. When coil is moved towards a stationary magnet, the magnetic field associated with the coil will change and so current will be induced in the coil. This causes galvanometer to show deflection in one direction. Now when coil is moved away, the magnetic field will decrease and so current induces in the opposite direction causing galvanometer to show deflection in opposite direction. The phenomenon is electromagnetic induction.

Q. 19. In what respect does the construction of an AC generator differ from that of a DC generator?

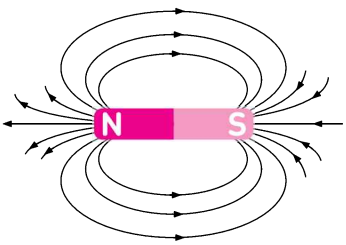
Ans. The only difference between a DC generator and an AC generator is in the way the two ends of the generator coil are connected to the outer circuit. In a DC generator, the two ends of the generator coil are connected to a split ring type commutator consisting of two half rings of copper. In an AC generator, the ends of the coil are connected to two full rings of copper called slip rings. There is no commutator in an AC generator.

Long Answer Questions [5 marks]

Each of the following questions are of 5 marks and have to be answered in about 80–90 words.

Q. 1. Briefly explain an activity to plot the magnetic field lines around a bar magnet. Sketch the field pattern for the same specifying field directions.
A region A has magnetic field lines relatively closer than another region B. Which region has stronger magnetic field. Give reason to support your answer.

Ans.



1. Take a drawing sheet and fix it on a smooth table with adhesive tape.
2. Place a bar magnet in the middle of the drawing sheet and draw its boundary with a sharp pencil.
3. Place a magnetic compass near one end of the magnet (N-pole) and mark the positions of the two ends (N and S-poles) of the compass needle using a sharp pencil.
4. Shift the compass from this position and place it in such a way that S-pole of its needle is on the point you marked in previous step for N-pole.
5. Again mark the position of the other end (N-pole) of the compass needle.
6. Repeat the steps 4 and 5, till you reach the other end (S-pole) of the bar magnet.
7. Join all the points with a sharp pencil to get a smooth curve.
8. Put the compass at some other points near the N-pole of the magnet and draw another magnetic field lines. Similarly, draw many field lines on both the sides of the bar magnet as shown in figure.
9. Observe the pattern of the magnetic field lines.

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Result: Magnetic field lines can be drawn around a bar magnet using a magnetic compass. The field lines do not cross each other.

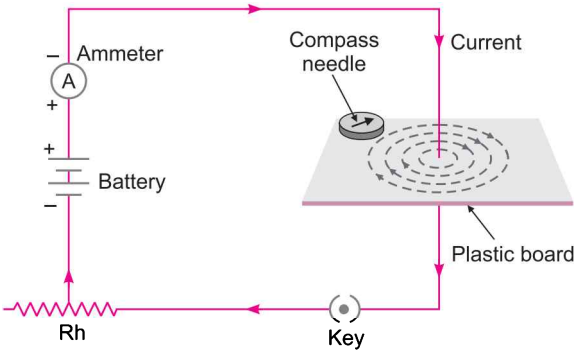
Region A has stronger magnetic field. This is due to the strength of the field is proportional to the relative closeness of field lines.

Q. 2. Briefly explain an activity to plot the magnetic field lines around a straight current carrying conductor. Sketch the field pattern for the same, specifying current and field directions. What happens to the field,

(*a*) if the strength of the current is decreased?

(*b*) if the direction of the current is reversed?

Ans. The pattern of magnetic field lines around a straight conductor carrying current can be described by the following activity.



(*i*) Insert vertically a long straight wire carrying an electric current so that it passes through the centre of a horizontal piece of plastic board as shown in figure.

(*ii*) Take care that the plastic board is fixed and does not move up and down. Now, sprinkle some iron filings onto the plastic board to show the shape of the field.

(*iii*) You will notice that the iron filings get arranged round the wires in the shape of circles. This is due to the reason that the magnetic field lines around the current carrying straight conductor are circular. The iron filings align along these field lines.

(*iv*) On reversing the direction of flow of current, we observe that the iron filings arrange themselves in circles around the wire showing that the magnetic field lines are still circular in nature.

The direction of the magnetic field can be obtained by using a compass. If the current direction is reversed, the direction of the magnetic field is also reversed.

(*a*) When current through the wire is decreased, field also gets reduced.

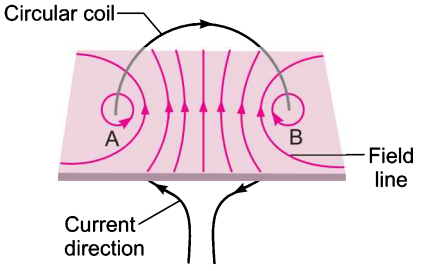
(*b*) When the current is reversed, field also gets reversed in direction.

Q. 3. (*i*) With the help of a labelled diagram, explain the distribution of magnetic field due to a current through a circular loop. Why is it that if a current carrying coil has *n* turns the field produced at any point is *n* times as large as that produced by a single turn?

[NCERT Exemplar]

(*ii*) Draw a pattern of magnetic field formed around a current carrying solenoid. What happens to the magnetic field when the current through the solenoid is reversed?

Ans. (*i*) The pattern of the magnetic field lines near the wires of the coil are concentric circles. The curvature of these curves goes on increasing as we move away from the wire. At the centre of the circular loop, the field lines are nearly straight.



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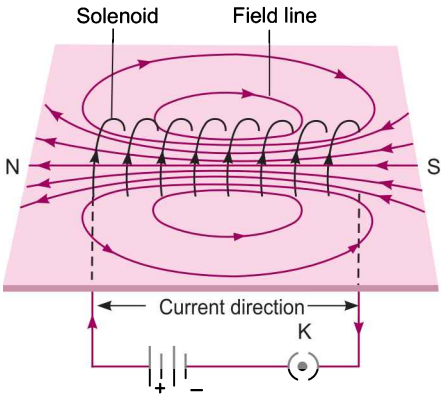
The magnetic field produced by a current carrying wire at a given point depends directly on the current passing through it. Therefore, if there is a circular coil having n turns, the field produced is n-times as large as that produced by a single turn. This is because the current in each circular turn has the same direction, and the field due to each turn then just adds up.

(*ii*)

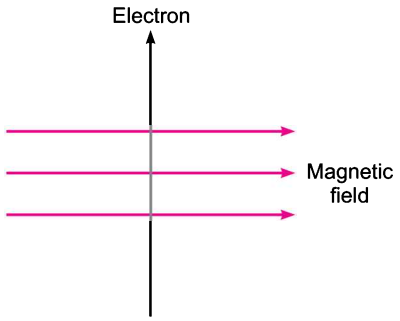


Magnetic field also gets reversed.

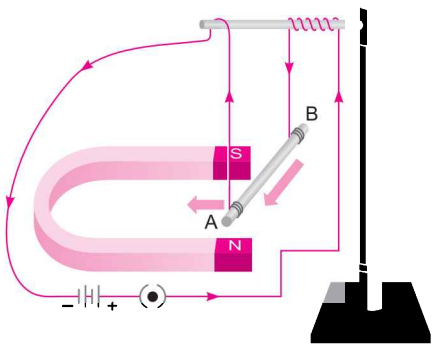
Q. 4. (*i*) Explain an activity to show that a current-carrying conductor experiences a force when placed in a magnetic field. How do you think the displacement of rod AB will be affected if (*a*) current in rod AB is increased; (*b*) a stronger horse-shoe magnet is used; and (*c*) length of the rod AB is increased?

(*ii*) State the rule which gives the direction of force acting on the conductor.

(*iii*) An electron moves perpendicular to a magnetic field as shown in the figure. What would be the direction of force experienced by the electron?



Ans. (*i*) A small aluminium rod is suspended horizontally from a stand using two connecting wires. Place a strong horseshoe magnet in such a way that the rod lies between the two poles with the magnetic field directed upwards. For this, put the north pole of the magnet vertically below and south pole vertically above the aluminium rod. Connect the aluminium rod in series with a battery, a key and a rheostat. Pass a current through the aluminium rod from one end to other (B to A). The rod is displaced towards left. When the direction of current flowing through the rod is reversed, the displacement of rod across towards right.



A current carrying conductor placed in a magnetic field experience a force. This force increases with the amount of current, strength of magnetic field and length of the conductor. The displacement of rod AB will

(*a*) increase (*b*) increase (*c*) increase.

(*ii*) **Fleming's left-hand rule.**

Stretch the thumb, forefinger and middle finger of your left hand such that they are mutually perpendicular to one another. If the forefinger points in the direction of magnetic field and the middle finger in the direction of current, then the thumb will point in the direction of motion or the force acting on the conductor.

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(*iii*) According to Fleming's left hand rule, the direction of force is perpendicular to the direction of magnetic field and current. We know that the direction of current is taken opposite to the direction of motion of electrons. Therefore, the force is directed upwards from the plane of the paper.

Q. 5. Draw a labelled circuit diagram of a simple electric motor and explain its working. In what way these simple electric motor are different from commercial motors? *[CBSE 2019 (31/3/1)]*

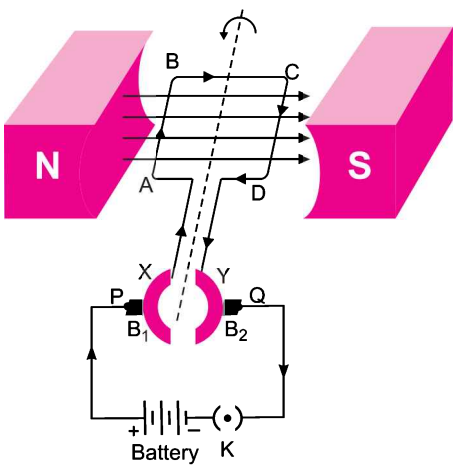
Ans. An electric motor is a device which converts electrical energy into mechanical energy.

Principle

The electric motor works on the magnetic effect of current. Its principle is when a rectangular coil is placed in a magnetic field and current is passed through it, a force acts on the coil, due to which the coil rotates. When the coil rotates the shaft attached to it also rotates. The rotating shaft has mechanical energy. In this way electric energy supplied to motor is converted into mechanical energy.

Construction: An electric motor has the following parts:

1. **Field Magnet:** It is a permanent U-shaped magnet NS; whose north and south poles are N and S respectively.
2. **Armature:** It is a rectangular coil ABCD which contains a large number of turns of insulated copper wire wound on a soft iron core. This coil is free to rotate between the pole pieces of the magnet.
3. **Split Rings and Brushes:** Split rings (X and Y) are simply a brass (or copper) ring which is divided into two parts. These both parts are separated from each other and are soldered to the two ends of the coil. These split rings are mounted on the shaft of the motor and can rotate with the shaft.



The split rings touch the two strips of graphite B_1, B_2; these strips of graphite are called the brushes. These brushes are connected to two connecting screws P and Q. The brushes are fixed to the base of the motor and are in contact with the half rings lightly. The screws are connected to terminals of battery. When current is passed by means of battery, the current enters the coil from one brush and leaves through the other.

Working

Initially let coil ABCD be horizontal as shown in Fig. When key is closed, the current begins to flow in the coil. Initially the sides AD and BC of coil are parallel to magnetic field, so no magnetic force acts on them.

By Fleming's left hand rule, the force on arm AB of coil is vertically downward and on side CD of coil, it is vertically upward. These two forces are equal and opposite and hence form a couple. This tends to rotate the coil in anticlockwise direction. When rotating coil becomes perpendicular to its initial position, then couple becomes zero. But due to inertia the coil continues to rotate along the same direction. As the split rings also rotate with the coil, therefore, the split rings come in contact with other brushes. That is initially B_1 had contact with X and B_2 had contact with Y; now B_1 has contact with Y and B_2 has contact with X. When this happens the direction of current in the coil is reversed.

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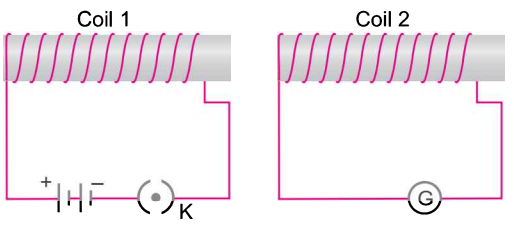
This in turn reverses the direction of forces in AB and CD. The side CD of the coil will be on left hand side with a downward force on it and the side AB of coil will be on right hand side with an upward force on it. Thus a couple acts on the coil which rotates the coil in the same direction (anti-clockwise). This process is repeated again and again and the coil rotates continuously.

Due to rotation of coil, its shaft gains kinetic energy; which may be used to run electric fan, water pump, washing machine, mixer and grinder etc.

Q. 6. With the help of a diagram, describe an experiment to show that a change in current flowing through a coil induces an electric current in a neighbouring coil.

Ans. Take two different coils of insulated copper wire having large number of turns (50 or even more)

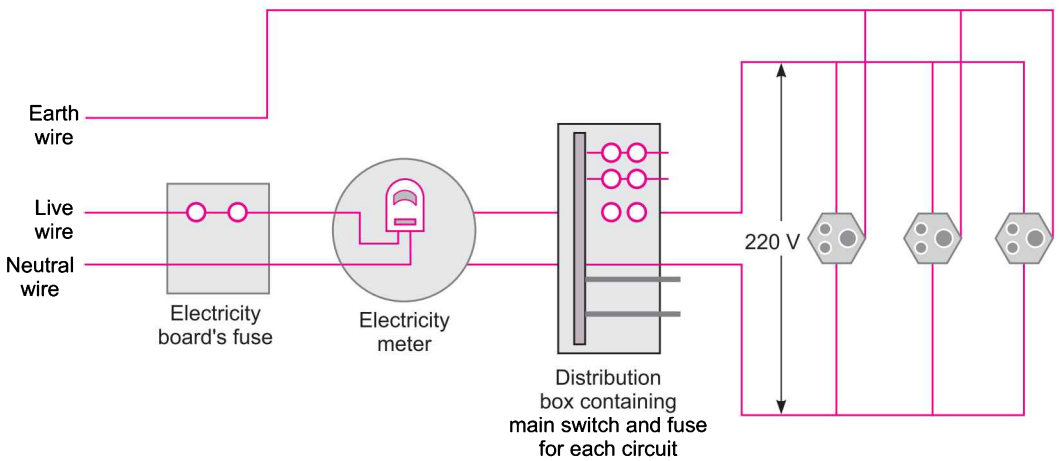


Insert the coils over a non-conducting cylindrical thick paper roll as shown in figure. Connect a battery of 6V, a plug key K in series of coil-1. With coil-2, connect a sensitive galvanometer. Now put the plug in key K. Galvanometer joined with coil-2 also gives a momentary deflection and then pointer quickly returns to its mean position.

On removing plug from key K in coil-1 the needle momentarily moves, but to the opposite side. It means that now the current flows in the opposite direction in coil 2. So we conclude that current is produced in coil-2 whenever the current flowing in the neighouring coil is changing.

Q. 7. Draw an appropriate schematic diagram showing common domestic circuits and discuss the importance of fuse. Why is it that a burnt out fuse should be replaced by another fuse of identical rating? *[NCERT Exemplar]*

Ans.



A fuse in a circuit prevents damage to the appliances and the circuit due to overloading. Otherwise, the appliances or the circuit may be damaged.

When current in the circuit exceeds the value of fuse rating, the fuse wire burns due to overloading. This causes a gap in the circuit and the current stops flowing in the circuit.

This is done due to the reason so that the circuit or the appliances to be connected in the circuit continue functioning without any damage in future.

Q. 8. (*i*) Two circular coils P and Q are kept close to each other, of which coil P carries a current. If coil P is moved towards Q, will some current be induced in coil Q? Give reason for your answer and name the phenomenon involved.

(*ii*) What happens if coil P is moved away from Q?

(*iii*) State any two methods of inducing current in a coil.

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Ans. (*i*) When coil P is moved towards Q, current will be induced in coil Q. This is because on moving P the magnetic field associated with Q increases and so a current is induced. The phenomenon is electromagnetic induction.

(*ii*) If P is moved away from Q, the field associated with Q will decrease and a current will be induced but in the opposite direction.

(*iii*) Current can be induced in a coil by (*a*) moving a magnet towards or away from the coil (*b*) moving a coil towards or away from a magnet (*c*) rotating a coil within a magnetic field.

Q. 9. (*i*) With the help of an activity, explain the method of inducing electric current in a coil with a moving magnet. State the rule used to find the direction of electric current thus generated in the coil.

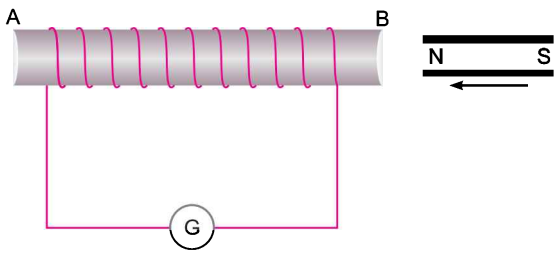
(*ii*) Two circular coils P and Q are kept close to each other, of which coil P carries a current. What will you observe in Q?

(*a*) If current in the coil P is changed?

(*b*) If both the coils are moved in the same direction with the same speed? Give reason.

Ans. (*i*) **Activity:**

(*a*) Take a coil of wire AB having a large number of turns.



(*b*) Connect the ends of the coil to a galvanometer.

(*c*) Take a strong bar magnet and move its north pole towards the end B of the coil.

(*d*) There is a momentary deflection in the needle of the galvanometer, say to the right. This indicates the presence of a current in the coil AB. The deflection becomes zero the moment the motion of the magnet stops.

(*e*) Now withdraw the north pole of the magnet from the coil. Now the galvanometer is deflected toward the left, showing that the current is now set up in the direction opposite to the previous direction.

(*f*) Place the magnet stationary at a point near to the coil, keeping its north pole towards the end B of the coil. We see that the galvanometer needle deflects toward the right when the coil is moved towards the north pole of the magnet. Similarly, the needle moves toward left when the coil is moved away.

When the coil is kept stationary with respect to the magnet, the deflection of the galvanometer drops to zero.

To find the direction of electric current Fleming's right hand rule is applied. According to it, if we stretch the forefinger, middle finger and thumb of our right hand mutually perpendicular in such a way that thumb points along the direction of motion of conductor, forefinger along the direction of magnetic field; then the middle finger points along the direction of induced current.

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(*ii*) (*a*) When current in P is changed, the field associated with Q will vary causing an induced current in Q.

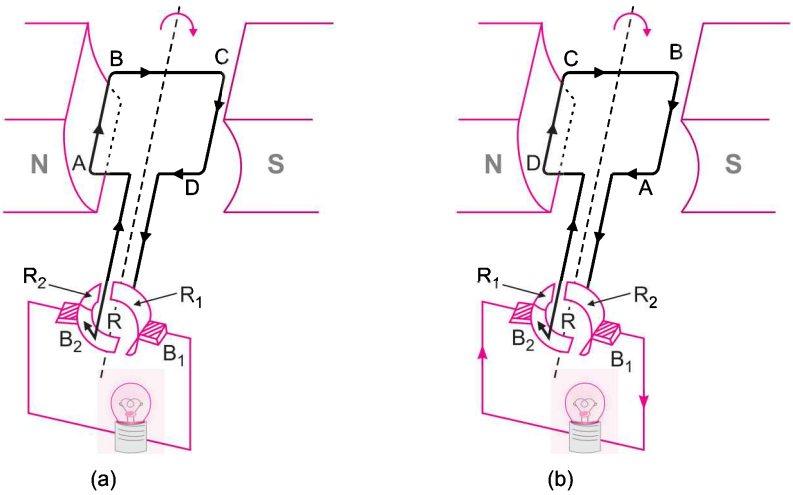
(*b*) If both the coils are moved in the same direction with same speed, there will not be any change in the field associated with Q. Hence no current will be induced in Q.

Q. 10. Explain the underlying principle and working of direct current generator (or DC dynamo) by drawing a labelled diagram.

Ans. A device used to convert mechanical energy into electrical energy is called an electric generator. An armature-coil rotating in a magnetic field develops an alternating emf and sends alternating current in an external circuit. If, however, the connections of the ends of the coil to the external circuit are interchanged every time the emf in the coil reverses, the current in the external circuit flows always in the same direction. This is the principle of a DC dynamo.

The working of a single-coil DC dynamo is shown in the figure. The ends of the armature-coil ABCD are connected to the two separated segments R_1 and R_2 of a single copper ring R, which is called the 'split-ring commutator'. R_1 and R_2 rotate along with the armature between two brushes B_1 and B_2 to which the external circuit is connected.

When the armature-coil ABCD is rotated clockwise (say), an emf is induced in the coil and a current flows in the direction *ABCD* (Fleming's right-hand rule), as shown in Fig (*a*). In the external circuit, the current flows from B_1 to B_2. For half the revolution, R_1 is in contact with B_1 and R_2 with B_2. But as soon as the coil passes the vertical, R_1 comes in contact with B_2 and R_2 with B_1 and remain so during the next half revolution [Fig. (*b*)]. Although the induced emf in the coil is reversed and the current in the coil flows in the direction DCBA, but in the external circuit the current still flows from B_1 to B_2.



Basic principle of operation of DC dynamo

The current generated by such a simple dynamo is uni-directional. As long as the coil is rotating, the direct current flows through the device connected to the terminals of the generator.

HOTS [Higher Order Thinking Skills]

Q. 1. Meena draws magnetic field lines of field close to the axis of a current-carrying circular loop. As she moves away from the centre of the circular loop she observes that the lines keep on diverging. How will you explain her observation? [*NCERT Exemplar*]

Ans. Strength of the magnetic field falls as distance increases. This is indicated by the decrease in degree of closeness of the lines of field.

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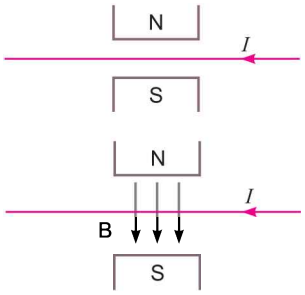
Q. 2. Why does a magnetic compass needle pointing North and South in the absence of a nearby magnet get deflected when a bar magnet or a current carrying loop is brought near it?

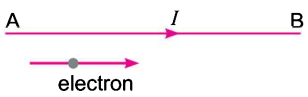
Ans. Current-carrying loops behave like bar magnets and both have their associated field lines. This modifies the already existing earth's magnetic field and a deflection results.

Q. 3. A wire is placed between N and S poles of a magnet as shown in figure. If current flows in the wire as shown, in which direction does the wire tend to move?



Ans. The direction of magnetic field is from N-pole to S-pole; on applying Fleming's left-hand rule, the wire tends to move perpendicular to plane of paper in the upward directions.

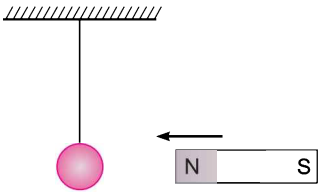
Q. 4. A fixed wire AB carries current *I*. An electron is moving parallel to the wire, in which direction does the electron tend to move?



Ans. By right-hand thumb rule, the magnetic field in the vicinity of wire is downward perpendicular to plane of paper. The conventional direction of electric current is opposite to the direction of motion of electron. By Fleming's left-hand rule, the force on electron is away from wire into the plane of paper; therefore, the electron will be deflected downward (away from wire) into the plane of paper.

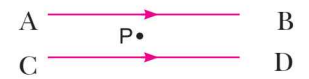
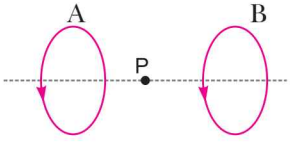
Q. 5. A metallic wire loop is suspended freely and a bar magnet is brought near it as shown in the diagram.

What will be the direction of induced current in the wire loop when the magnet is moved towards it.



Ans. Anticlockwise from the side of a magnet.

Q. 6. Two wires each carrying a steady current i are shown in two different configurations in column I. The magnetic field produced due to current in the wires is described in column II. Match the situations A and B in column I with all the correct statements in column II.

Column I	Column II
 A. Point P is situated midway between the wires above. B. Point P is situated at the mid point of the line joining the centres of the circular wires, which have same radii. 	(*i*) The magnetic fields B at P due to the current in the wires are in the same direction. (*ii*) The magnetic fields B at P due to the current in the wires are in the opposite directions. (*iii*) Magnetic field at P is zero.

Ans. (*a*) A matches with (*ii*) and (*iii*).

Applying Right Hand Thumb rule, the magnetic field at P due to current flowing in AB is perpendicular to the plane of paper pointing vertically downwards. The magnetic field at P due to current flowing in CD is perpendicular to the plane of paper pointing vertically upwards.

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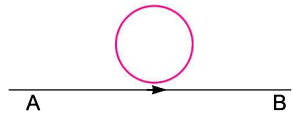
As P is the mid point, the two magnetic fields, cancel out each other. Therefore, magnetic field at P is zero.

(*b*) B matches with only (*i*) in column II.

Applying Right Hand Thumb rule, the magnetic field at P due to current in loop A is along the axial line towards right. The magnetic field at P due to current in loop B is also along the axial line towards right.

Q. 7. A circular metallic loop is kept above the wire AB as shown here.



What is the direction of induced current produced in the loop, if any, when the current flowing in the straight wire

(*i*) is steady, *i.e.*, does not vary.

(*ii*) is increasing in magnitude.

Justify your answer in each case.

Ans. (*i*) No induced current will be produced in the loop since the constant current flowing in the straight wire produces a constant magnetic field. Hence no induced current is produced in the loop.

(*ii*) Since current in the straight wire is changing, the magnetic flux associated with the loop will change and hence induced current will be produced in it.

Applying Lenz' law, the current flowing in the loop will be in clockwise direction.

Q. 8. An electron and a proton, moving parallel to each other, enter a uniform magnetic field with same velocity. The direction of magnetic field and their motion coincides (is same). How will the direction of their paths be affected when they are travelling in

(*i*) same direction

(*ii*) opposite direction.

Justify your answer.

Ans. A magnetic field does not exert any force on a charge moving parallel or antiparallel to the field direction. Since they are travelling in the direction of the magnetic field, there will be no force acting on them. Hence their paths will remain the same after entering the magnetic field.

Q. 9. You are given a galvanometer, an electroplating equipment, a key and two sources of electricity. Give two different experimental set ups to find whether any of the given sources is AC or DC source.

Ans. (*i*) We can connect the galvanometer to any one of the sources using a key in the circuit. If the galvanometer shows definite deflection in a given direction, the source taken is d.c. source. If the given source is a.c. source, the average deflection shown by the galvanometer will be zero.

(*ii*) We can also connect the electroplating equipment to any one of the source using a key in the circuit. If electroplating takes place, the source used is d.c. source. In case of AC source, since the direction of current changes periodically and alternatively, there is no definite shifting of the ions of the electrolyte and hence no electroplating takes place.

Q. 10. A circuit has a fuse of 5 A. What is the maximum number of 100 watt (220 V) bulbs which can be safely used in the circuit?

Ans. Suppose x number of such bulbs can be used.

Power of one bulb = 100 watt

Power of x bulbs (P) = $100x$ watts

Potential difference (V) = 220 volts

I = 5 ampere

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We know $P = VI$

$\Rightarrow \quad 100x = 220 \times 5$

$\therefore \quad x = \frac{220 \times 5}{100} =$ **11 bulbs**

Q. 11. It is established that an electric current through a metallic conductor produces a magnetic field around it. Is there a similar magnetic field produced around a thin beam of moving (*i*) alpha particles, (*ii*) neutrons? Justify your answer. *[NCERT Exemplar]*

Ans. (*i*) Yes, Alpha particles being positively charged constitute a current in the direction of motion.

(*ii*) No. The neutrons being electrically neutral constitute no current.

NCERT Corner

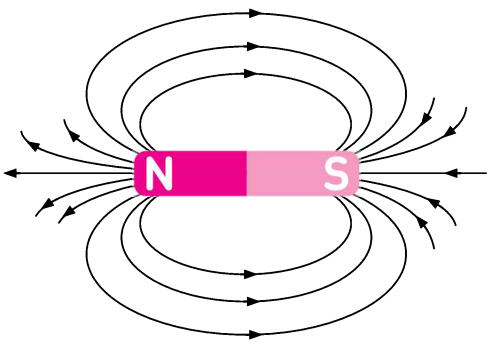
NCERT Intext Questions

Q. 1. Why does a compass needle get deflected when brought near a bar magnet?

Ans. A compass needle gets deflected when brought near a bar magnet because magnetic force is exerted by the bar magnet on the compass needle, which is itself a tiny pivoted magnet.

Q. 2. Draw magnetic field lines around a bar magnet.

Ans.



Q. 3. List the properties of magnetic field lines.

Ans. (*i*) They travel from north pole to south pole outside the magnet and south pole to north pole inside the magnet.

(*ii*) They are closed and continuous curves.

(*iii*) Two magnetic field lines never intersect each other. If the lines intersect, then at the point of intersection there would be two directions (the needle would point towards two directions) for the same magnetic field, which is not possible.

(*iv*) The number of field lines per unit area is the measure of the strength of magnetic field, which is maximum at poles. The magnetic field is strong, where the field lines are close together and weak where the lines are far apart.

Q. 4. Why don't two magnetic field lines never intersect each other?

Ans. Two magnetic field lines of force never intersect each other. If the lines intersect, then at the point of intersection there would be two directions (the needle would point towards two directions) for the same magnetic field, which is not possible.

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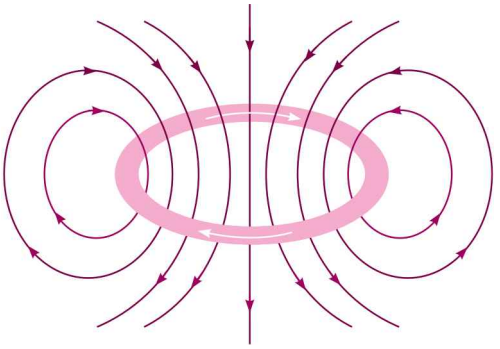
Q. 5. Consider a circular loop of wire lying in the plane of the table. Let the current pass through the loop clockwise. Apply the right-hand rule to find out the direction of the magnetic field inside and outside the loop.

Ans. Since the current passes through the loop in clockwise direction, therefore, the front face of the loop will be the south pole and the back face, *i.e.*, the face touching the table will be north pole. According to right-hand rule, the direction of magnetic field inside the loop will be pointing downward. Outside the loop, the direction of the magnetic field will be upward.



Q. 6. The magnetic field in a given region is uniform. Draw a diagram to represent it.



Ans. A uniform magnetic field in a region is represented by drawing parallel and equidistant straight lines, all pointing in the same direction.

Q. 7. Choose the correct option. The magnetic field inside a long straight solenoid carrying current

(*i*) is zero.

(*ii*) decreases as we move towards its ends.

(*iii*) increases as we move towards its ends.

(*iv*) is the same at all points.

Ans. The field lines inside the solenoid are in the form of parallel straight lines. This indicates that the magnetic field is the same at all points inside the solenoid. Thus, option (*iv*) is correct.

Q. 8. Which of the following property of a proton can change while it moves freely in a magnetic field? (There may be more than one correct answer).

(*i*) mass **(*ii*) speed**

(*iii*) velocity **(*iv*) momentum**

Ans. Whenever a charged particle (in this case a proton) moves in a magnetic field, its velocity changes and as a result of this its momentum change. Thus, (*iii*) and (*iv*) are the properties which change when a proton moves freely in a magnetic field.

Q. 9. A positively charged particle (alpha-particle) projected towards west is deflected towards north by a magnetic field. The direction of magnetic field is

(*i*) towards south **(*ii*) towards east**

(*iii*) downward **(*iv*) upward**

Ans. Since the positively charged particle (alpha-particle) projected towards west, so the direction of current is towards west. Now the deflection is towards north, so the force is towards north.

Now hold the forefinger, centre finger and thumb of our left-hand at right angles to one another. Let us adjust the hand in such a way that our centre finger points towards west and thumb points towards north. If we look at our forefinger, it will be pointing, upward. Thus, the magnetic field is in the upward direction. So, the correct option is (*iv*).

Q. 10. State Fleming's left hand rule. *[CBSE 2018]*

Ans. Stretch the thumb, forefinger and middle finger of your left hand such that they are mutually perpendicular. If the fore finger points in the direction of magnetic field and the middle finger in the direction of current, then the thumb will point in the direction of motion or the force acting on the conductor.

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Q. 11. What is the principle of an electric motor? *[CBSE 2018]*

Ans. The electric motor works on the magnetic effect of current. Its principle is when a rectangular coil is placed in a magnetic field and current is passed through it, a force acts on the coil, due to which the coil rotates. When the coil rotates the shaft attached to it also rotates.

Q. 12. What is the role of the split ring in an electric motor?

Ans. The split ring in electric motor acts as commutator. It reverses the direction of the current flowing through the coil after each half rotation of the coil. Due to this reversal of the current, the coil continues to rotate in the same direction.

Q. 13. Explain different ways to induce current in a coil.

Ans. The current in a coil can be induced by the following ways:

(*i*) By rotating the coil in the magnetic field between the poles of U-shaped magnet.

(*ii*) By keeping the coil stationary and moving a magnet inside it.

(*iii*) By changing the current continuously in an another coil kept near it.

Q. 14. State the principal of an electric generator.

Ans. Electric generator work on the principle of electromagnetic induction which states that whenever there is a change in electric flux linked with the coil, an emf is induced in the coil.

Q. 15. Name some sources of direct current.

Ans. Some of the sources of direct current are dry cell battery, car battery, and dc generator.

Q. 16. Which sources produce alternating current?

Ans. Some of the sources that produce alternating current are bicycle dynamos, car alternators and power house generators.

Q. 17. Choose the correct option.

A rectangular coil of copper wires is rotated in a magnetic field. The direction of the induced current changes once in each

(*i*) two revolutions **(*ii*) one revolution**

(*iii*) half revolution **(*iv*) one-fourth revolution**

Ans. (*iii*) Half revolution

Q. 18. Name two safety measures commonly used in electric circuits and appliances.

Ans. (*i*) Electric fuse

(*ii*) Earthing of metal bodies of electrical appliances

Q. 19. An electric oven of 2 kW power rating is operated in a domestic electric circuit (220 V) that has a current rating of 5 A. What result do you expect? Explain.

Ans. Power, P = 2 kW = 2 × 1000 W = 2000 W

Voltage, V = 220 V

Current drawn, I = ?

Power, $P = V \times I$

$$I = \frac{P}{V} = \frac{2000}{220} = \mathbf{9\ A}\ \text{(approx)}$$

The current drawn by this electric oven is 9 A whereas the fuse in the circuit is only 5 A capacity. When a high current of 9 A flows through the 5 A fuse, the fuse wire will get heated too much, melt and break the circuit. Therefore, when a 2 kW power rating electric oven is operated in a circuit having 5 A fuse, the fuse will blow off cutting off the power supply in this circuit.

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Q. 20. What precautions should be taken to avoid the overloading of domestic electric circuits?

Ans. (*i*) Too many electrical appliances should not be operated on a single socket.

(*ii*) Too many high power rating electrical appliances should not be switched on at the same time.

NCERT Exercises

Q. 1. Which of the following correctly describes the magnetic field near a long straight wire?

(*i*) The field consists of straight lines perpendicular to the wire.

(*ii*) The field consists of straight lines parallel to the wire.

(*iii*) The field consists of radial lines originating from the wire.

(*iv*) The field consists of concentric circles centred on the wire.

Ans. The magnetic field lines near a long straight wire carrying current are concentric circles centred on the wire. So, choice (*iv*) is correct.

Q. 2. The phenomenon of electromagnetic induction is

(*i*) the process of charging a body.

(*ii*) the process of generating magnetic field due to a current passing through a coil.

(*iii*) producing induced current in a coil due to relative motion between a magnet and the coil.

(*iv*) the process of rotating a coil of an electric motor.

Ans. The phenomenon of electromagnetic induction is producing induced current in a coil due to relative motion between a magnet and the coil. So, choice (*iii*) is correct.

Q. 3. The device used for producing current is called a

(*i*) generator **(*ii*) galvanometer**

(*iii*) ammeter **(*iv*) motor**

Ans. Generator is a device for producing electric current. So, choice (*i*) is correct.

Q. 4. The essential difference between an AC generator and a DC generator is that

(*i*) AC generator has an electromagnet while a DC generator has permanent magnet.

(*ii*) DC generator will generate a higher voltage.

(*iii*) AC generator will generate a higher voltage.

(*iv*) AC generator has slip rings while the DC generator has a commutator.

Ans. AC generator has slip rings while DC generator has a commutator. So, choice (*iv*) is correct.

Q. 5. At the time of short circuit, the current in the circuit

(*i*) reduces substantially **(*ii*) does not change**

(*iii*) increases heavily **(*iv*) varies continuously**

Ans. At the time of short circuit, the resistance of circuit becomes nearly zero; so current increases heavily. So, choice (*iii*) is correct.

Q. 6. State whether the following statements are true or false.

(*i*) An electric motor converts mechanical energy into electrical energy.

(*ii*) An electric generator works on the principle of electromagnetic induction.

(*iii*) The field at the centre of a long circular coil carrying current will be parallel straight lines.

(*iv*) A wire with a green insulation is usually the live wire of an electric supply.

Ans. (*i*) False, because an electric motor converts electric energy into mechanical energy.

(*ii*) True (*iii*) True

(*iv*) False, because a live wire has always **red** or **brown** insulation.

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Q. 7. List two methods of producing magnetic field.

Ans. Magnetic field produced by using any of the following:

(*i*) A wire carrying current.

(*ii*) A loop on solenoid carrying current.

(*iii*) Any bar-magnet, horse-shoe magnet or round magnet.

Q. 8. How does a solenoid behave like a magnet? Can you determine the north and south poles of a current-carrying solenoid with the help of a bar magnet? Explain.

Ans. A solenoid has a large number of close, insulated circular turns. The magnet at the centre of current carrying circular wire is along the axis; so when current is passed in a solenoid, the magnetic fields due to all circular turns are added and hence the field line becomes just as for a bar magnet.

Yes, we can determine the north and south poles of a current carrying solenoid with the help of a bar magnet. For this we suspend the bar magnet freely and note its ends pointing along north and south directions and mark on these ends N (north pole) and S (south pole).

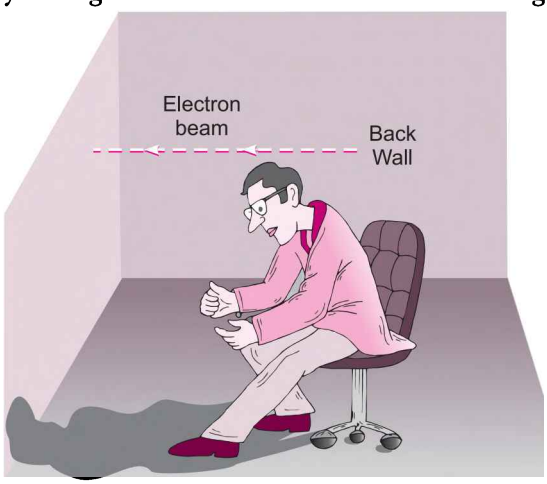
Now we bring N-pole near one end of freely suspended current carrying solenoid; if there is repulsion, then that end of solenoid is N-pole and other S-pole; but if there is attraction, then that end of solenoid is S-pole and the other is N-pole.

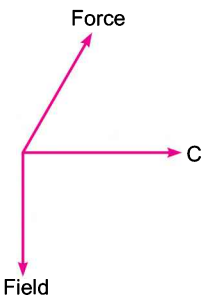
Q. 9. When is the force experienced by a current-carrying conductor placed in a magnetic field largest?

Ans. The force experienced by a current-carrying conductor placed in a magnetic field is largest when the direction of current is at right angles to the direction of the magnetic field.

Q. 10. Imagine that you are sitting in a chamber with your back to one wall. An electron beam, moving horizontally from back wall towards the front wall, is deflected by a strong magnetic field to your right side. What is the direction of magnetic field?

Ans.





The current due to moving electron beam is in a direction opposite to motion. The force on electron is towards right. By Fleming's left hand rule, the direction of magnetic field is vertically downward.

Q. 11. Name some devices in which electric motors are used.

Ans. Electric motors are used in electric fans, refrigerators, mixers, washing machines, etc.

Q. 12. A coil of insulated copper wire is connected to a galvanometer. What will happen if a bar magnet is (*i*) pushed into the coil (*ii*) withdrawn from inside the coil (*iii*) held stationary inside of coil? *[CBSE 2019 (31/4/1)]*

Ans. (*i*) When a bar magnet is pushed into the coil, a momentary deflection is observed in the galvanometer. This deflection indicates that a momentary current is produced in the coil.

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(*ii*) When a bar magnet is withdrawn from the coil, the deflection of galvanometer is in opposite direction. It indicates that a current of an opposite direction is produced.

(*iii*) When a bar magnet is held stationary inside the coil, there is no deflection in the galvanometer. It indicates that no current is produced in the coil.

Q. 13. Two circular coils A and B are placed close to each other. If the current in the coil A is changed, will some current be induced in the coil B? Give reason.

Ans. Yes, by changing current in coil A, some current will be induced in coil B. The reason is that when current in coil A is changed, the magnetic field around A changes, so magnetic flux linked with nearby coil B changes; this gives rise to induced current in coil B.

Q. 14. State the rule to determine the direction of a (*i*) magnetic field produced around a straight conductor-carrying current (*ii*) force experienced by a current-carrying straight conductor placed in a magnetic field which is perpendicular to it, and (*iii*) current induced in a coil due to its rotation in a magnetic field.

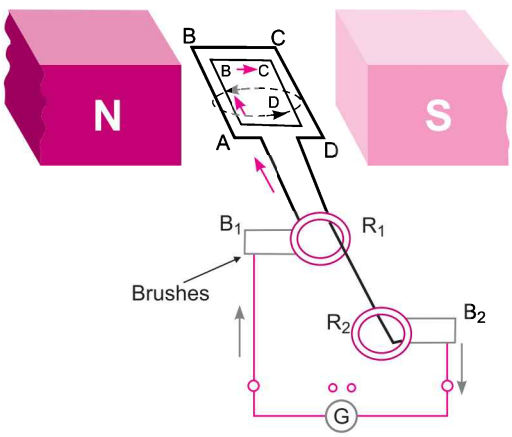
Ans. (*i*) The direction of magnetic field produced around a current-carrying conductor is given by **right hand thumb rule**. If the conductor carrying current is held in the right hand in such a way that the thumb points in the direction of current, then direction of curl of fingers gives the direction of the magnetic field.

(*ii*) The direction of force experienced by a straight conductor carrying current placed in a magnetic field, which is perpendicular to it is determined by **Fleming's left hand rule**. Hold the thumb and first two fingers of the left hand at right angles to each other with the first finger pointing in the direction of the field and the second finger in the direction of the current, then the thumb points in the direction of the motion.

(*iii*) The direction of current induced in a circuit by changing magnetic flux due to motion of a magnet is determined by **Fleming's right hand rule**. If we stretch our right hand in such a way that the thumb, forefinger and central finger remain perpendicular to each other, so that the forefinger indicates the direction of the magnetic field and the thumb in the direction of motion of conductor; then the central finger indicates the direction of induced current.

Q. 15. Explain the underlying principle and working of an electric generator by drawing a labelled diagram. What is the function of brushes?

Ans. An electric generator converts mechanical energy into electrical energy. Alternating current generators or AC generators produce alternating current.



Basic principle of operation of AC generators.

Principle: It works on the principle of electromagnetic induction. Whenever the magnetic flux through a coil changes, induced current is produced.

Construction: Alternating current generator consists of a rectangular coil *ABCD* called armature. The armature coil consists of large number of turns of insulated copper wire wound over a soft iron core. The coil is kept between the poles of a strong magnet. In the figure shown R_1 and R_2 are two slip rings connected to the two ends of the coil and convey the current produced to outside circuit. B_1 and B_2 are two carbon brushes remain in sliding contact with slip rings.

Working: The coil of the generator is rotated with the help of an axel. When coil rotates, it cuts the magnetic lines of force (magnetic field) near the north (N) and south (S) poles of the magnet.

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By electromagnetic induction, a current is induced in the coil. The direction of this current is given by Fleming's right hand rule.

As this coil turns clockwise, arm AB moves up and arm CD goes down. The direction of current is from A to B in AB and C to D in CD. The induced current is taken out through slip rings and carbon brushes. After half this rotation, AB and CD interchange their position. Now CD moves upward and AB downward.

The direction of induced current is from D to C in CD and B to A in AB, during this half rotation. The slip rings R_1 and R_2 also rotate along with the coil ABCD. Thus, their polarities keep changing after every half rotation. Thus, the current changes its direction twice in one complete revolution of the coil. Such a current which changes its polarity after fixed intervals is called alternating current.

Function of Brushes: The brushes B_1 and B_2 remain fixed in their positions and maintain sliding contacts with the rotatable slip rings R_1 and R_2 respectively. It is through these brushes that the current induced in the armature coil is fed to the external circuit by means of live wires.

Q. 16. When does an electric short circuit occur?

Ans. If the insulation of the live wire and neutral wire gets damaged then the two wires touch each other. This touching of the live wire and neutral wire is known as short circuit. In this situation, resistance of a circuit decreases to a very small value. Due to this, current flowing through the wires becomes very large and heats the wires to a very high temperature, and a fire may be started.

Q. 17. What is the function of an earth wire? Why is it necessary to earth the metallic appliances?

Ans. Sometimes, the insulation of live wire is torn and due to this the live wire touches the metallic body of the appliances. This causes the flow of current in metallic body. This current flows to the Earth through the earth wire and does not harm the user of the appliances.

Therefore, to prevent the user getting an electric shock, due to leakage of current to metallic body, earth wire must always be used.

SELF-ASSESSMENT TEST

Time allowed: 1 hour **Max. marks: 40**

SECTION–A

Choose and write the correct answer for each of the following. **(4 × 1 = 4)**

1. The strength of magnetic field inside a long current carrying straight solenoids is

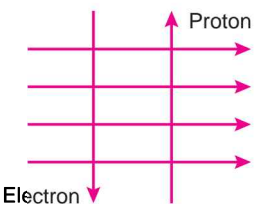
[NCERT Exemplar]

(*a*) more at the ends than at the centre
(*b*) minimum in the middle
(*c*) same at all points
(*d*) found to increase from one end to the other

2. A uniform magnetic field exists in the plane of paper pointing from left to right as shown in figure. In the field, an electron and proton are shown. The electron and proton experience

[NCERT Exemplar]

(*a*) forces both pointing into the plane of paper.
(*b*) forces both pointing out of the plane of paper.
(*c*) forces pointing into the plane of paper and out of the plane of paper respectively.
(*d*) forces pointing opposite and along the direction of uniform magnetic field respectively.



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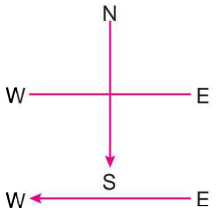
3. **A constant current flows in a horizontal wire in the plane of the paper from East to West as shown in figure alongside. The direction of magnetic field at a point will be North to South** *[NCERT Exemplar]*



(*a*) directly above the wire
(*b*) directly below the wire
(*c*) at a point located in the plane of the paper, on the north side of the wire
(*d*) at a point located in the plane of the paper, on the south side of the wire

4. **The most important safety method used for protecting home appliances from short circuiting or overloading is**
(*a*) earthing (*b*) use of fuse
(*c*) use of stabilizers (*d*) use of electric meter

The following questions consist of two statements—Assertion(A) and Reason(R). Answer these questions selecting the appropriate option given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation for *A*.
(*b*) Both *A* and *R* are true but *R* is not the correct explanation for *A*.
(*c*) *A* is true but *R* is false.
(*d*) *A* is false but *R* is true. **(3 × 1 = 3)**

5. **Assertion (*A*) :** The strength of the magnetic field at the centre of a circular coil of a wire depends on the radius of the coil
Reason (*R*) : The strength of the magnetic field at the centre of a circular coil of a wire depends on the number of turns of the wire in the coil.
6. **Assertion (*A*) :** A current carrying wire deflects a magnetic needle placed near it.
Reason (*R*) : A magnetic field exists around a current carrying wire.
7. **Assertion (*A*) :** Strength of an electromagnet can be increased by increasing the number of turns per unit length in solenoid coil.
Reason (*R*) : Strength of an electromagnet can be increased by increasing the current flowing through the solenoid.

Answer the following questions in one word or one sentence. **(3 × 1 = 3)**

8. State one advantage of alternating current over direct current.
9. Name an instrument in which the directive property of a magnet is used.
10. What is a solenoid?

SECTION–B

Answer the following questions in about 50-60 words each. **(5 × 3 = 15)**

11. (*i*) Draw magnetic field lines produced around a current carrying straight conductor passing through a cardboard. Name state and apply the rule to mark the direction of these field lines.
(*ii*) How will the strength of the magnetic field change when the point where magnetic field is to be determined is moved away from the straight wire carrying constant current? Justify your answer.
12. What is the principle of an electric generator?
13. Two fuse wires of same length are rated 5 A and 20 A. Which of the two fuse wires is thicker and why?

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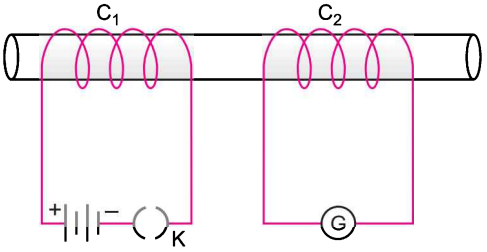
14. Explain why the direction of the induced current in the coil of an AC generator changes after every half revolution of the coil.
15. What is overloading of an electric circuit? State two conditions that can lead to overloading of a circuit. How can it to be prevented?

SECTION–C

Answer the following questions in about 80–90 words each. **(3 × 5 = 15)**

16. A student fixes a sheet of white paper on a drawing board. He places a bar magnet in the centre of it. He sprinkles some iron filings uniformly around the bar magnet. Then he taps the board gently and observes that the iron filings arrange themselves in a particular pattern.
    (*i*) Why do the iron filings arrange in a pattern?
    (*ii*) What does the crowding of iron filings at the end of the magnet indicate?
    (*iii*) What does the lines along which the iron filings align represent?
    (*iv*) Draw a neat diagram to show the magnetic field lines around a bar magnet.
    (*v*) Write any two properties of magnetic field lines.
17. (*i*) A stationary charge is placed in a magnetic field. Will it experience a force? Give reason to justify your answer.
    (*ii*) On what factors does the direction of force experienced by a conductor when placed in a magnetic field depend?
    (*iii*) Under what conditions is the force experienced by a current carrying conductor placed in a uniform magnetic field maximum?
    (*iv*) Name and state the rule which gives the direction of force experienced by a current carrying conductor placed in a magnetic field.
18. Two coils C_1 and C_2 are wrapped around a non conducting cylinder. Coil C_1 is connected to a battery and key and C_2 with galvanometer G. On pressing the key (K), current starts flowing in the coil C_1. State your observation in the galvanometer:



    (*i*) When key K is pressed on.
    (*ii*) When current in the coil C_1 is switched off.
    (*iii*) When the current is passed continuously through coil C_1.
    (*iv*) Name and state the phenomenon responsible for the above observations. Write the name of the rule that is used to determine the direction of current produced in the phenomena.

Answers

1. (*c*) **2.** (*a*) **3.** (*b*) **4.** (*b*) **5.** (*b*) **6.** (*a*) **7.** (*b*)

8. Electric power can be transmitted over long distance without much loss of electrical energy in AC.

9. A compass needle

10. Solenoid is long coil containing a large number of close circular turns.

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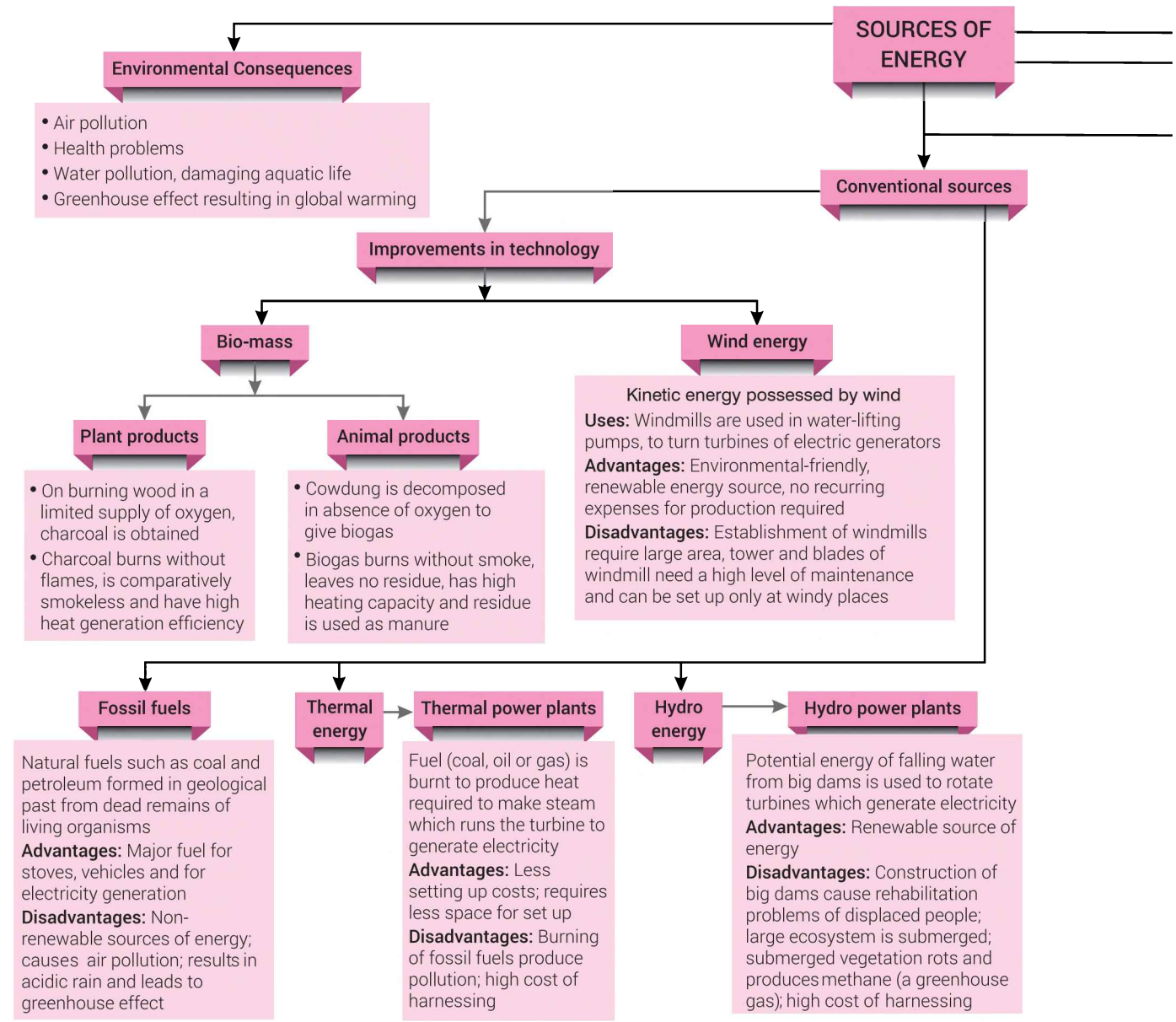
14 Sources of Energy

BASIC CONCEPTS—A FLOW CHART



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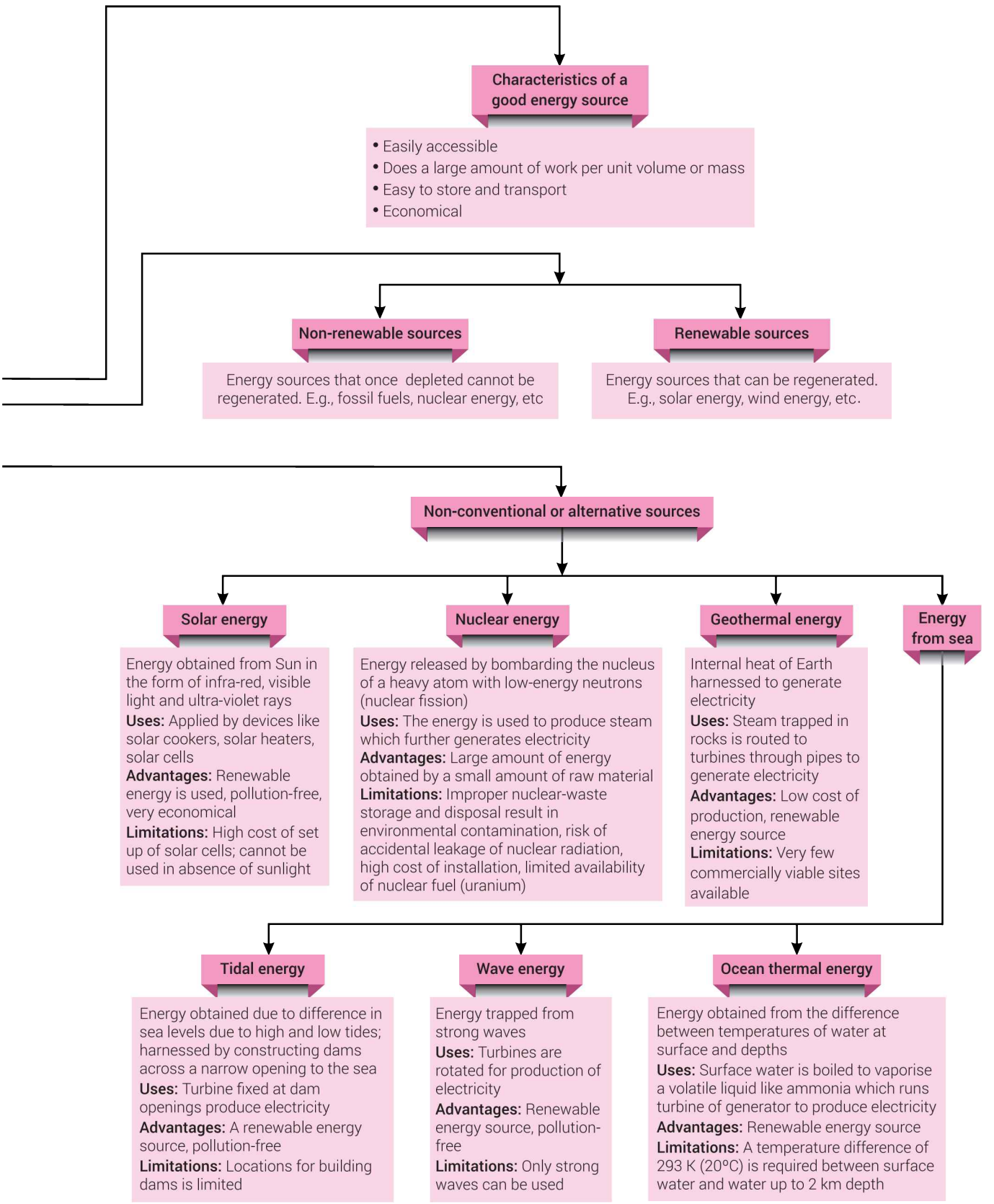

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MORE POINTS TO REMEMBER

❒ **Sources of energy** are of two types:
- **Conventional sources:** Sources which are being used since a long time. *E.g.*, fossil fuels, flowing water, etc.
- **Non-conventional sources:** Sources whose use has recently started. *E.g.*, sun, tides, etc.

❒ **Hydro power plant:** In order to produce hydro electricity, high-rise dams are constructed on the river to obstruct the flow of water and thereby collect water in larger reservoirs.
- The water level rises and in this process the kinetic energy of flowing water gets transformed into potential energy.
- The water from the high level in the dam is carried through pipes, to the turbine, at the bottom of the dam.

❒ **Advantages of biogas:**
- Burns without smoke.
- Leaves no residue.
- Waste left in biogas plant is used as manure.
- It is a renewable source of energy.
- Good way of sewage disposal.

❒ **Solar cells:** Convert solar energy into electricity. A typical cell develops a voltage of 0.5–1 V and can produce about 0.7 W of electricity

❒ **Advantages of solar cells:** They have no moving parts
- They require little maintenance.
- They work quite satisfactorily without the use of any focusing device.
- They can be set up in remote and inaccessible hamlets or very sparsely inhabited areas.

❒ **Disadvantages of solar cells:**
- Availability of the special grade silicon for making solar cells is limited.
- The entire process of manufacturing is still very expensive.
- Silver used for interconnection of the cells in the panel further adds to the cost.

Multiple Choice Questions [1 mark]

Each question has 4 choices (a), (b), (c) and (d). Choose and write the correct option.

1. Which one of the following is a non-renewable source of energy? *[NCERT Exemplar]*
(*a*) Wood (*b*) Sun (*c*) Fossil fuels (*d*) Wind

2. Which is the ultimate source of energy?
(*a*) Water (*b*) Sun (*c*) Uranium (*d*) Fossil fuels

3. Which part of solar cooker is responsible for greenhouse effect? *[NCERT Exemplar]*
(*a*) Coating with black colour inside the box (*b*) Mirror
(*c*) Glass sheet (*d*) Outer cover of the solar cooker

4. Greenhouse gas is
(*a*) oxygen (*b*) carbon dioxide (*c*) methane (*d*) hydrogen

5. Which of the following is a renewable source of energy?
(*a*) Coal (*b*) Natural gas (*c*) Wood (*d*) Petrol

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6. A solar panel is made by combining a large number of

(*a*) solar cookers (*b*) solar cells

(*c*) solar water heaters (*d*) solar concentrators

7. To work properly, wind-electric generators need wind speeds of at least about

(*a*) 1.5 km/h (*b*) 15 km/h (*c*) 150 km/h (*d*) 1,500 km/h

9. To produce biogas in a biogas plant, we need

(*a*) air but not water (*b*) water but not air

(*c*) air and water (*d*) neither air nor water

9. Electricity from the ocean can be generated based on utilising

(*a*) kinetic energy of the waves but not stored thermal energy

(*b*) stored thermal energy but not kinetic energy of the waves

(*c*) kinetic energy of the waves as well as stored thermal energy

(*d*) neither kinetic energy of the waves nor stored thermal energy.

10. The site of a hydroelectric plant should be chosen carefully because it

(*a*) produces a large amount of carbon monoxide and carbon dioxide

(*b*) produces a large amount of electricity

(*c*) affects the organisms of the region

(*d*) is expensive

11. Choose the incorrect statement. *[NCERT Exemplar]*

(*a*) We are encouraged to plant more trees so as to ensure clean environment and also provide biomass fuel.

(*b*) Gobar gas is produced when crops, vegetable wastes, etc., decompose in the absence of oxygen.

(*c*) The main ingredient of biomass is ethane and it gives a lot of smoke and also produces a lot of residual ash.

(*d*) Biomass is a renewable source of energy.

12. Choose the correct statement. *[NCERT Exemplar]*

(*a*) Sun can be taken as an inexhaustible source of energy.

(*b*) There is infinite storage of fossil fuel inside the Earth.

(*c*) Hydro and wind energy plants are non polluting sources of energy.

(*d*) Waste from a nuclear power plant can be easily disposed off.

13. Which one of the following forms of energy leads to least environmental pollution in the process of its harnessing and utilisation? *[NCERT Exemplar]*

(*a*) Nuclear energy (*b*) Thermal energy (*c*) Solar energy (*d*) Geothermal energy

14. Ocean thermal energy is due to *[NCERT Exemplar]*

(*a*) energy stored by waves in the ocean

(*b*) temperature difference at different levels in the ocean

(*c*) pressure difference at different levels in the ocean

(*d*) tides arising out in the ocean

15. The major problem in harnessing nuclear energy is how to *[NCERT Exemplar]*

(*a*) split nuclei (*b*) sustain the reaction

(*c*) dispose off spent fuel safely (*d*) convert nuclear energy into electrical energy

16. Which part of the solar cooker is responsible for green house effect? *[NCERT Exemplar]*

(*a*) Coating with black colour inside the box (*b*) Mirror

(*c*) Glass sheet (*d*) Outer cover of the solar cooker

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17. **The main constituent of biogas is** [NCERT Exemplar]
(a) methane (b) carbon dioxide (c) hydrogen (d) hydrogen sulphide

18. **The power generated in a windmill** [NCERT Exemplar]
(a) is more in rainy season since damp air would mean more air mass hitting the blades
(b) depends on the height of the tower
(c) depends on wind velocity
(d) can be increased by planting tall trees close to the tower

19. **In a hydroelectric power plant more electrical power can be generated if water falls from a greater height because** [NCERT Exemplar]
(a) its temperature increases
(b) larger amount of potential energy is converted into kinetic energy
(c) the electricity content of water increases with height
(d) more water molecules dissociate into ions

20. **Choose the incorrect statement regarding wind power.** [NCERT Exemplar]
(a) It is expected to harness wind power to minimum in open space.
(b) The potential energy content of wind blowing at high altitudes is the source of wind power.
(c) Wind hitting at the blades of a windmill causes them to rotate. The rotation thus achieved can be utilised further.
(d) One possible method of utilising the energy of rotational motion of the blades of a windmill is to run the turbine of an electric generator.

21. **The rise and fall of sea-water during high and low tides is caused by the gravitational pull of the**
(a) Moon (b) Earth (c) Sun (d) Mercury

22. **Which of the following is not a consequence of establishing hydroelectric power plants?**
(a) Occurrence of flood (b) Ecological disturbance
(c) Production of methane (d) Displacement of people

Answers

1. (c)	**2.** (b)	**3.** (c)	**4.** (b)	**5.** (c)	**6.** (b)	**7.** (b)	**8.** (b)
9. (c)	**10.** (c)	**11.** (c)	**12.** (a)	**13.** (c)	**14.** (b)	**15.** (c)	**16.** (c)
17. (b)	**18.** (c)	**19.** (b)	**20.** (c)	**21.** (a)	**22.** (a)		

Assertion-Reason Questions [1 mark]

The following questions consist of two statements — Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

1. **Assertion (A) :** Nuclear fusion is used to generate electricity.
Reason (R) : Nuclear power is used because it cannot be controlled.
2. **Assertion (A) :** Charcoal is a better fuel than wood for domestic purposes.
Reason (R) : Charcoal burns without flames and does not produce smoke during burning.

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3. **Assertion (*A*) :** Biogas is also known as Gobar gas.
   Reason (*R*) : The animal dung is the common material used in the bio gas plant.
4. **Assertion (*A*) :** The slurry left behind in a biogas plant is used as a manure.
   Reason (*R*) : Slurry contains methane and phosphorus as two main nutrients in it.
5. **Assertion (*A*) :** Construction of big dams has lots of problems associated with them.
   Reason (*R*) : Large ecosystems are destroyed when submerged under the water in dams.
6. **Assertion (*A*) :** Solar energy, wind energy and hydro energy are considered to be exhaustible source of energy.
   Reason (*R*) : The rate of depletion of these energy sources, because of extraction of usable energy, is practically negligible.
7. **Assertion (*A*) :** Solar cooker covered with a plane glass plate is more effective than the one which is left open.
   Reason (*R*) : Covered glass plate allows solar radiations of smaller wavelength to pass through it but does not allow heat radiation of longer wavelengths emitted by heated container to pass through it. Thus, heat remains inside the cooker itself and food item is cooked easily.
8. **Assertion (*A*) :** Solar cooker is painted white from inside.
   Reason (*R*) : The black surface of the solar cooker is a better heat absorber than a white surface.
9. **Assertion (*A*) :** Silver metal is used for joining various solar cells in a solar cell panel.
   Reason (*R*) : Silver is a shiny metal.
10. **Assertion (*A*) :** Thermal power plants are set up near coal or gas fields.
    Reason (*R*) : Transmission of electric power is more efficient, convenient and economical than transportation of fossil fuels like coal or natural gas.

Answers

1. (*c*) **2.** (*a*) **3.** (*a*) **4.** (*c*) **5.** (*a*) **6.** (*d*) **7.** (*a*)
8. (*d*) **9.** (*b*) **10.** (*a*)

Passage-based Questions

Answer the questions below each passage on the basis of your understanding of the paragraph and the related studied concepts.

1. Biomass means any organic matter from which we can get energy on a renewable basis. Biomass like plant and animal products do not produce much heat on burning instead produce a lot of smoke when burnt. With improvement in technology, we can convert biomass into charcoal and biogas (gobar gas). So these sources of energy can be exploited at a commercial and large scale level.

Charcoal is an example of improvement in the technology for using conventional sources of energy. When wood is burnt in a limited supply of oxygen, the water and volatile materials present in it get removed and charcoal is left behind as the residue. Charcoal burns without flames, is comparatively smokeless and has a higher heat generation efficiency.

Biogas is another example of improvement in the technology for using conventional sources of energy. Biogas is a combustible mixture of gases produced by the decomposition of biomass, especially animal waste and sewage. Biogas contains about 75% methane, 23% carbon-dioxide

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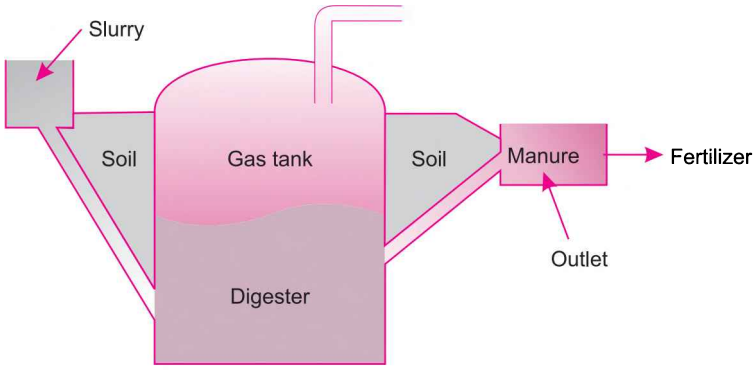
and 2% other gases. When cow dung, various plant materials and sewage are decomposed in the absence of oxygen then biogas is obtained. Biogas is produced in a plant as shown in Figure.



Fixed dome type biogas plant

(*i*) "Biogas is an excellent fuel." List two reasons to justify this statement.

(*ii*) Biogas is considered to be a boon to the farmers. Give reasons.

(*iii*) Biogas contains % of methane.

(*a*) 25% (*b*) 55% (*c*) 75% (*d*) 86.1%

(*iv*) To produce biogas in a biogas plant, we need

(*a*) air but not water (*b*) water but not air

(*c*) air and water (*d*) neither air nor water

2. Solar power generation is a fast developing industry in India and many other advanced countries of the world. India is fortunate to receive large amount of solar radiations for greater part of the year particularly in the Western and Southern regions. This fact puts our country at an advantageous position to explore and utilise this natural abundance. A solar panel is an arrangement to convert solar energy into electric energy.

A solar cell is a comparatively smaller device used to convert solar energy into electricity. Since the voltage developed in a single cell is low, large number of solar cells are combined in an arrangement called solar cell panel. (see figure)



The advanced technology required to fabricate a solar cell for greater output and more conversion of percentage of energy (from solar to electric) in it is quite a daunting task. The availability of special grade silicon for making efficient solar cells is also limited.

Though the domestic use of solar cell is limited due to its high cost, the use of solar panels in artificial satellites, space probes and wireless transmission system is well known.

Neha wanted to investigate the effect of solar radiations on different objects having different material, colour of their surface and type of surface (dull or shiny).

She used different boxes for this purpose. She used a thermometer to measure the temperature of air inside each of these boxes.

The following table lists the result of her measurements:

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Box Number	Box Material	Nature of outside surface (colour)	Type of surface	Temperature at the start (°C)	Temperature after one hour (°C)
1	Plastic	White	Shiny	20	25
2	Plastic	Black	Shiny	20	36
3	Metal	Black	dull	20	52
4	Metal	White	shiny	20	30
5	Metal	White	dull	20	30
6	Metal	Black	shiny	20	49

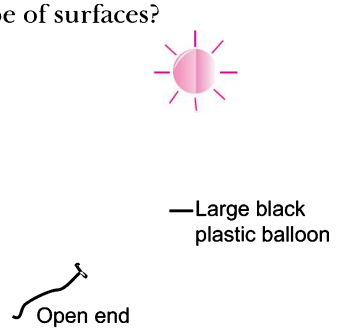
(*i*) The box material and nature of outside surface affects the temperature of air inside the box. Write two such boxes.

(*ii*) What inference can be drawn by Neha regarding nature and type of surfaces?

(*iii*) Neha designed a large balloon using black plastic. She used a fan to fill the balloon with air and left it in the sunlight. After sometime, the balloon rose in the air without Neha having to do anything more to it.

Explain in brief why the balloon rose?

(*iv*) In what sense are the term 'high cost' and 'low efficiency' of the solar cell used in the above paragraph?



Answers

1. (*i*) Biogas is an excellent fuel for domestic use because of the following reasons:

(*a*) It has high calorific value.

(*b*) Its residue is used as manure.

(*ii*) Biogas is considered to be a boon to the farmers because:

(*a*) Farmers can produce clean domestic fuel from the wastes like animal dung, dry leaves, dry plants, etc.

(*b*) Spent slurry can be used in the fields as manure to increase the fertility of the soil.

(*c*) Biogas can be used to generate electricity which can be utilised to run modern machines used in the fields to save time and energy.

(*iii*) (*c*)

(*iv*) (*b*)

2. (*i*) Box (3) and box (6).

(*ii*) The inference that can be drawn by Neha is that black surface absorbs more heat and dull surface radiates less heat.

(*iii*) The air inside the balloon expanded due to absorption of heat radiations by the black balloon. The balloon become lighter than the weight of the air (outside) displaced by it and hence it rose.

(*iv*) **High Cost:**

(*a*) Fabrication of solar cells

(*b*) Non-availability of high grade silicon

Low Efficiency: Very less percentage of solar energy getting converted into electric energy, *i.e.*, low output energy from high input energy.

$$\text{Efficiency} = \frac{\text{Output}}{\text{Input}} \times 100$$

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Very Short Answer Questions [1 mark]

Each of the following questions are of 1 mark and have to be answered in one word or one sentence.

Q. 1. What type of reactions occur inside the Sun which produces solar energy?

Ans. The nuclear fusion reactions taking place inside the Sun produce solar energy.

Q. 2. Which of the following are renewable and which are non-renewable sources of energy? Coal, wind, tides, Sun, petrol, biomass, CNG, hydro energy.

Ans. **Renewable sources:** Wind, tides, Sun, biomass, hydro energy

Non-renewable sources: Coal, petrol, CNG

Q. 3. Which part of Sun's energy is responsible for drying clothes and exposure to which part could be a health hazard?

Ans. Infrared (IR) radiations are responsible for drying clothes and ultraviolet (UV) radiations could be a health hazard.

Q. 4. What type of energy is possessed by wind?

Ans. Kinetic energy

Q. 5. Though a hot iron emits radiations, yet it is not visible in the dark, why?

Ans. Hot iron emits infrared rays. These rays are invisible to the eyes.

Q. 6. What is bagasse?

Ans. Bagasse is the remaining part of the sugarcane from which juice has been extracted.

Q. 7. Define anaerobic degradation.

Ans. The decomposition which takes place in the absence of oxygen by anaerobic bacteria is called anaerobic degradation.

Q. 8. Write the name of the main constituent or biogas. Also state its percentage.

[NCERT Exemplar][CBSE 2019 (31/1/2)]

Ans. The main constituent of biogas is methane (75%).

Q. 9. Why is biogas considered an excellent fuel? *[CBSE 2019 (31/1/1)]*

Ans. Biogas is an excellent fuel as it burns without smoke and leaves no residue like ash in wood, charcoal and coal burning.

Q. 10. What is the minimum wind velocity required for obtaining useful energy with a windmill?

Ans. Minimum velocity required for obtaining useful energy with a windmill is about 15 km/h.

Q. 11. Name two forms of energy in which solar energy manifests itself in oceans.

Ans. (*i*) Tidal energy, and (*ii*) Ocean thermal energy.

Q. 12. Name any two materials that are used for making solar cells.

Ans. (*i*) Silicon, and (*ii*) Gallium or selenium.

Q. 13. What is the range of wavelength of electromagnetic waves that constitute visible radiation?

Ans. The range of electromagnetic waves is about 4000 Å to 7000 Å, which constitute visible radiation.

Q. 14. What steps would you suggest to help minimise environmental pollution caused by burning of fossil fuels? *[NCERT Exemplar]*

Ans. (*i*) Use of smokeless appliances

(*ii*) Afforestation

Q. 15. Although coal and petroleum are produced by the degradation of biomass, yet we need to conserve these resources. Why? *[CBSE 2019 (31/2/3)]*

Ans. Both the energy sources, coal and petroleum, take millions of years for their formation. As these resources are being utilised at a much faster rate than their formation, they will be exhausted in the near future. Hence, they need to be conserved.

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Q. 16. State the two forms of energy in which energy is mainly utilised at our homes.

Ans. (*i*) Heat energy, and (*ii*) light energy.

Q. 17. What are the different types of nuclear reactions?

Ans. There are two types of nuclear reactions:

(*i*) Nuclear fission

(*ii*) Nuclear fusion

Q. 18. Why does acid rain happen?

Ans. Acid rain happens because burning of fossil fuels releases oxides of carbon, nitrogen and sulphur in the atmosphere. These oxides with rain fall as acid rain.

Short Answer Questions [3 marks]

Each of the following questions are of 3 marks and have to be answered in about 50–60 words.

Q. 1. (*i*) What is the use of the black painted surface in solar heating devices?

(*ii*) Why is it not possible to make use of solar cells to meet all our energy needs? State at least two reasons to support your answer.

Ans. (*i*) Black colour is a very good absorber of heat but a very poor reflector. So, it is used to absorb the maximum amount of heat from the sunlight. It is used in solar heating devices to maximise the absorption of heat and to minimise heat loss due to reflection.

(*ii*) (*a*) In the solar cells, the energy is obtained only during the day, when the Sun shines.

(*b*) In the solar cells, the solar panel convert solar energy into electricity, which is stored in storage battery. The storage battery give the direct current but all the appliances are working by the alternating current, so first of all direct current is converted into alternating current by any suitable appliances before it can be used to run various devices. So, it increases the cost of using solar panels as the source of energy.

So, the solar cell is not used to meet all our energy needs.

Q. 2. (*i*) Give an example of indirect harnessing of solar energy.

(*ii*) State the important uses of wind energy.

Ans. (*i*) All green plants prepare carbohydrates from carbon dioxide and water in the presence of sunlight by the process of photosynthesis. All non-green plants and animals directly or indirectly consume food from the green plants (producers) and store this food in their bodies in the form of chemical energy. In other words, solar energy is transformed into chemical energy.

(*ii*) The wind energy is used:

(*a*) To generate electricity.

(*b*) To grind the wheat in flour mills.

(*c*) To run a pump to draw water from the ground.

Q. 3. (*i*) Write two advantages of classifying energy sources as renewable and non-renewable.

(*ii*) Why is tidal energy not likely to be a potential source of energy?

Ans. (*i*) (*a*) The classification helps us to decide which of the available energy sources need to be conserved to ensure their availability for future generations.

(*b*) The classification helps us to look for alternative sources of energy like solar and wind energy. It has, therefore, accelerated the pace of development of technologies suitable for harnessing new sources of energy.

(*ii*) The tidal energy is not likely to be a potential source of energy because:

(*a*) Only few sites are available around the world which are suitable for building field barrages, and

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(*b*) The rise and fall of sea water during high and low tides is not enough to generate electricity on a large scale.

Q. 4. Name the process used to harness nuclear energy these days. Explain it briefly. List two advantages of using nuclear energy in place of fossil fuels. *[CBSE 2019 (31/3/3)]*

Ans. The process used to harness nuclear energy these days is nuclear fission.

When the nucleus of heavy atom is bombarded with low energy neutrons, it will split apart into lighter nuclei. When this is done, a tremendous amount of energy is released.

(*i*) It releases 10 millions times/tremendous amount of energy produced by other fossil fuels.

(*ii*) It can be used to generate clean electricity.

(*iii*) Self sustainable chain reaction.

Q. 5. Firewood is a conventional fuel. List any four reasons for replacing it with alternate sources of energy.

Ans. (*i*) Wood has low calorific value as compared to other sources of fuel.

(*ii*) It causes air pollution on burning.

(*iii*) Cutting down of trees causes depletion of forest leading to imbalance in nature.

(*iv*) Only 8-10% energy of burning firewood is utilised and the remaining is wasted.

Q. 6. State two advantages and two disadvantages of geothermal energy.

Ans. Advantages:

(*i*) The use of geothermal energy does not cause any pollution.

(*ii*) The use of geothermal energy is quite economical.

Disadvantages:

(*i*) It is not available everywhere.

(*ii*) Deep drilling in the Earth to obtain geothermal energy is very difficult.

Q. 7. "Biogas is an excellent fuel." List four reasons to justify this statement. Write the main constituent of this gas and state its percentage. *[CBSE 2019 (31/3/2)]*

Ans. Biogas is an excellent fuel for domestic use because of the following reasons:

(*i*) It has high calorific value.

(*ii*) It does not produce smoke.

(*iii*) It leaves no residue.

(*iv*) Its residue is used as manure.

The main constituent of biogas is methane. Its percentage is 75%.

Q. 8. Why is biogas a better fuel than animal dung cakes?

Ans. Biogas is a better fuel than animal dung cakes because:

(*i*) Burning of animal dung cake causes lot of pollution whereas biogas is a smokeless fuel.

(*ii*) The calorific value of animal dung cake is much lower than that of biogas.

(*iii*) Animal dung cakes leave residue after burning whereas biogas leaves no residue.

Q. 9. What causes the wind to blow?

Ans. The Sun rays fall on the equatorial region more intensively than on any other part of the Earth. Thus, the hot air of equatorial region, being lighter, rises upwards and cooler air from polar region starts blowing towards the equator to fill the space vacated by hot air. This moving air is called wind. Therefore, Sun's energy causes winds on the Earth.

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Q. 10. What are solar cells? Explain the structure of solar panel. List two principal advantages associated with solar cells.

Ans. **Solar cell:** A solar cells is device which converts solar energy directly into electricity.

Solar panel: A group of solar cells is called a solar cell panel. It consists of a large number of solar cells joined together in a different pattern.

Advantages:

(*i*) Solar cells directly utilise solar energy.

(*ii*) They can work satisfactorily even in the presence of diffused radiations.

(*iii*) They do not produce any pollution.

(*iv*) They do not require maintenance.

Q. 11. Give some uses and advantages of solar energy.

Ans. **Uses:**

(*i*) For cooking food in a solar cooker.

(*ii*) For heating water in solar geysers.

(*iii*) For generating electricity in space satellites, calculators, watches, etc., by solar cells.

(*iv*) For generating electricity on a large scale by a solar power plant.

(*v*) To melt metals in solar furnaces.

Advantages:

(*i*) It does not cause any pollution.

(*ii*) It is a renewable source of energy.

(*iii*) It is free of cost.

Q. 12. Explain why only a small part of the solar energy that strikes the upper regions of atmosphere reaches the surface of the Earth.

Ans. When the solar energy falls on the top surface of the atmosphere then the following happens:

(*i*) Some solar energy is reflected back into the space by the atmosphere, and

(*ii*) The atmosphere also absorbs a lot of solar energy; for example, most of the ultraviolet rays are absorbed by the ozone layer.

So, the solar energy which reaches us through the Earth's atmosphere are mainly in the form of heat rays (infra red rays) and visible light, which is a small part of the solar energy.

Q. 13. Why is charcoal considered a better fuel than wood? What are the disadvantages of converting wood into charcoal?

Ans. Charcoal is considered a better fuel than wood because:

(*i*) It has high calorific value.

(*ii*) It does not produce any smoke.

Disadvantages:

(*i*) 1 kg of wood on destructive distillation produces only 0.25 kg of charcoal making it an expensive fuel.

(*ii*) For production of charcoal, more and more trees would have to be cut down which causes deforestation and disturbs the ecological balance of the Earth.

Q. 14. Explain how the energy of flowing water is related to solar energy.

Ans. When solar energy falls on the water surface then evaporation of water from water surfaces like oceans, rivers and other water bodies takes place to form clouds. The clouds are then taken to distant places by air currents, and ultimately water comes back to the surface in the form of rain and snow. During evaporation, a part of solar energy gets converted into potential energy

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of water molecules. The potential energy of water molecules gets converted into kinetic energy during rain and snowfall.

Thus, energy of water flowing in a river is considered to be an indirect form of solar energy.

Q. 15. Mention any two advantages and two disadvantages of producing hydroelectricity by building dams on rivers.

Ans. Advantages:

(*i*) The generation of electricity from water does not produce any environmental pollution.

(*ii*) Water energy is a renewable source of electric energy which will never get exhausted.

Disadvantages:

(*i*) A vast variety of flora and fauna (plants and animals) get affected.

(*ii*) Dams can be constructed only at a limited number of places.

Q. 16. What is the importance of hydro power plants in India? Describe how electric energy is generated in such plants.

Ans. Importance: Hydro power plants are of prime importance as about 25 per cent of our energy requirement in India is met by hydro power plants.

(*i*) A high rise dam is constructed at a suitable place on the river to obstruct the flow of water and thereby, collect water in larger reservoirs. Due to rise in water level the kinetic energy of flowing water is transformed into potential energy of stored water.

(*ii*) The water from the high level in the dam is carried through sluice gates and pipes to the turbine of electric generator, which is fitted at the bottom of the dam. Due to flowing water, turbine is rotated at a fast rate and hydel electricity is produced.

(*iii*) A hydro power plant converts the potential energy of falling/stored water into electricity.

Q. 17. (*i*) Name the device used to convert

(*a*) solar energy into heat, and

(*b*) solar energy into electricity.

(*ii*) Explain the principle of working of a windmill.

Ans. (*i*) (*a*) Solar energy into heat: Solar cooker.

(*b*) Solar energy into electricity: Solar cell.

(*ii*) The wind rotates the blades of the windmill. This, in turn, rotates the connecting rod (shaft) and the crank (u-bend) moves up and down. Since the pump rod is connected to the crank, the pump rod of the water pump also moves up and down and lifts the water from the well or flooded mine. Thus, the rotational movement of the blades of the windmill is used to drive a large number of machines.

Q. 18. Describe the steps involved in obtaining biogas and explain what is meant by anaerobic decomposition.

Ans. Following steps are involved in obtaining biogas:

(*i*) Mixing (slurry of cattle-dung and water).

(*ii*) Digesting (cattle-dung undergoing decomposition by anaerobic bacteria).

(*iii*) Formation of biogas (mixture of methane, CO_2, H_2 and H_2S).

(*iv*) Spent slurry (residue left after the formation of biogas).

The process by which the biomass changes into biogas in the absence of air due to an anaerobic microorganisms is termed as an anaerobic decomposition.

Q. 19. Biogas is considered to be a boon to the farmers. Give reasons.

Ans. Biogas is considered to be a boon to the farmers because:

(*i*) Farmers can produce clean domestic fuel from the wastes like animal dung, dry leaves, dry plants, etc.

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(*ii*) Spent slurry can be used in the fields as manure to increase the fertility of the soil.

(*iii*) Biogas can be used to generate electricity which can be utilised to run modern machines used in the fields to save time and energy.

Q. 20. What are solar cells? Explain the structure of solar panel. List two principal advantages associated with solar cells. *[CBSE 2019 (31/2/1)]*

Ans. A solar cell is a device which converts solar energy directly into electricity. A group of solar cells is called a solar cell panel. It consists of a large number of solar cells joined together in a definite pattern. It provides a lot of electric energy required by artificial satellites, water pumps, street lighting, etc.

For joining the various solar cells in a solar panel, silver wires are used because silver metal is the best conductor of electricity having a very low resistance and which also increases efficiency.

Solar cells are used

(*i*) for providing electricity in artificial satellites.

(*ii*) for lighting the street lights, traffic signals, running television sets and radio sets in remote areas.

(*iii*) for providing electricity in lighthouses.

(*iv*) for operating electronic watches and calculators.

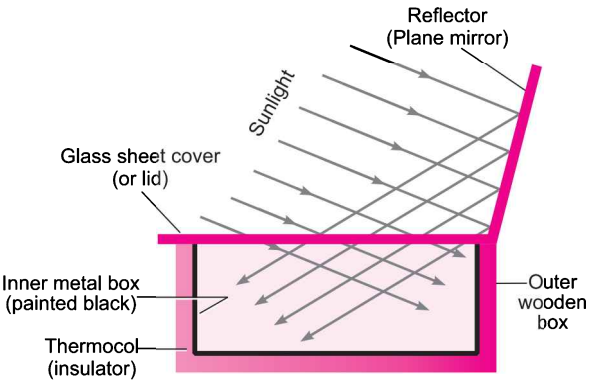
Long Answer Questions [5 marks]

Each of the following questions are of 5 marks and have to be answered in about 80–90 words.

Q. 1. Give the construction and working of a solar cooker.

Ans. A device that utilises solar energy for cooking purposes is called a solar cooker. The most commonly used form of solar cooker is known as box-type solar cooker.

A box-type solar cooker is shown in the figure.



Construction of a box-type solar cooker: A box-type solar cooker consists of the following components:

(*i*) **Box (B):** This is an insulated metal or a wooden box. It is painted black from inside because black surface absorbs more heat. The box may be provided with four roll-wheels. There is a thermocol layer between the wooden box and the inner metal box.

(*ii*) **Glass cover (G):** A cover made of two sheets of toughened glass held together in an aluminium frame is used as a cover of the box B.

(*iii*) **Plane mirror reflector (R):** A plane mirror reflector fixed in a frame is fixed to the box B with the help of hinges. The mirror reflector can be positioned at any desired angle to the box. The mirror is positioned so as to allow the reflected sunlight fall on the glass cover of the box.

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(*iv*) **Cooking containers (C):** A set of containers made of aluminium and blackened from outside are kept in the box B. These containers are also painted black because black surface absorbs more heat.

Working: The food is cooked in a shallow vessel of the container. The box has a transparent covering of glass sheet over it. The solar cooker is placed in sunlight and reflector (plane mirror) is adjusted in such a way that a strong beam of sunlight enters the box through the glass sheet. The blackened metal surfaces in the wooden box absorb infra-red radiations from the beam of sunlight and heat produced raises the temperature of blackened metal surface to about 100°C.

The food absorbs heat from the black surface and gets cooked. The thick glass sheet does not allow the heat produced to escape and thus, helps in raising the temperature in the box to a sufficiently high degree to cook the food. The thermocol layer also does not allow the heat to escape and thus the temperature inside is maintained.

Q. 2. **(*i*) Distinguish between renewable and non-renewable sources of energy.**
(*ii*) Choose the renewable sources of energy from the following list.
Coal, biogas, Sun, natural gas

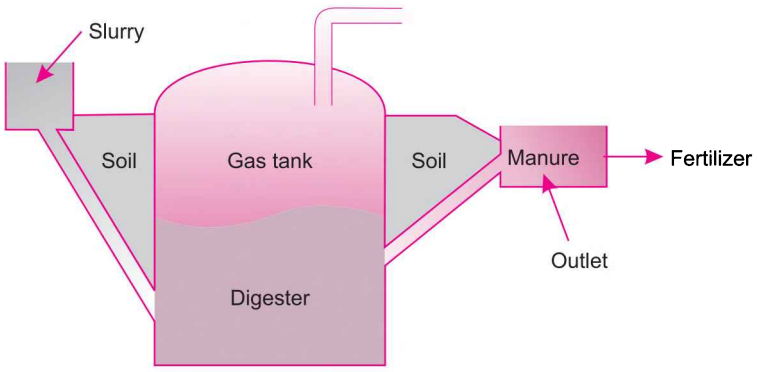
Ans. (*i*)

Renewable sources of energy	Non-renewable sources of energy
1. These sources of energy can be used again and again.	1. These sources of energy cannot be used again and again.
2. These type of sources are inexhaustible.	2. These type of sources are exhaustible and cannot be renewed.
3. It does not pollute atmosphere.	3. It causes atmospheric pollution.
4. Example: Solar energy, wind energy, etc.	4. Example: Coal, petroleum, etc.

(*i*) Sun and biogas.

Q. 3. **What is biogas? Describe the working of a biogas plant with the help of a labelled diagram.**

Ans. Biogas is a mixture of methane, carbon dioxide, hydrogen and hydrogen sulphide. The major constituent of biogas is methane. Biogas is produced by the anaerobic degradation of animal wastes like cow-dung or plant wastes in the presence of water.



Fixed dome type biogas plant

The biogas plant has a dome-like structure built with bricks. A slurry of cow-dung and water is made in the mixing tank from where it is fed into the digester. The digester is a sealed chamber in which there is no oxygen. Anaerobic micro-organisms that do not require oxygen, decompose or break down complex compounds of the cow-dung slurry. It takes a few days for the decomposition process to be complete and generate gases. The biogas is stored in the gas tank above the digester from which they are drawn through pipes for use.

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Q. 4. What are the environmental consequences of using fossil fuels? Suggest the steps to minimise the pollution caused by various sources of energy including non-conventional sources of energy. *[NCERT Exemplar]*

Ans. Fossil fuels have the following environmental effects:

(*i*) Air pollution: Burning of fossil fuels release oxides and sulphides in the air and many other harmful gases like carbon monoxide, sulphur dioxide, etc. These cause various health problems and also lead to acid rain which further affects water and soil resources.

(*ii*) Greenhouse effect: On burning fossil fuels, a large amount of carbon dioxide is released into the atmosphere. This is a greenhouse gas and does not allow the sun rays reflected from the earth surface to escape into the atmosphere. Thus, increasing the temperature of the atmosphere. This is called greenhouse effect which results in global warming.

Following steps can be taken to minimise pollution:

(*i*) Use of smokeless appliances.

(*ii*) Use of refined technology to increase the efficiency of combustion process and to reduce escape of harmful gases into the atmosphere.

(*iii*) Judicious use of energy.

Q. 5. Differentiate between box-type solar cooker and spherical reflector type solar cooker.

Ans.

Box-type solar cooker	Spherical reflector type solar cooker
1. Plane mirror is used as a reflector.	1. Concave or parabolic reflector is used.
2. It does not concentrate solar energy at a point.	2. It concentrates the solar energy at a point called focus.
3. Comparatively low temperature is produced in it.	3. Very high temperature is produced.
4. It is used to cook the food materials which require slow heating.	4. It can cook food materials which require strong heating.
5. Baking and frying is not possible in it.	5. Baking and frying can be done in it.

HOTS [Higher Order Thinking Skills]

Q. 1. Which part of the solar cooker is responsible for greenhouse effect?

Ans. The glass sheet in the solar cooker creates a greenhouse effect. Glass sheet has a property that allows the infra-red rays of shorter wavelength from the Sun to get in the device but does not allow the infra-red rays of longer wavelength to leave the solar heating device. Therefore, heat energy is trapped inside the heating device.

Q. 2. Though wood is a renewable source of energy, but the use of wood as a fuel is not a wise decision. Explain.

Ans. Wood is a renewable source of energy. It is obtained by cutting trees. A new plant sapling usually takes more than 15 years to grow and mature into a tree. Therefore, replenishment of cut down trees takes a very long time. Cutting down of trees causes depletion of the forests leading to imbalance in nature. Burning of wood also causes air pollution. Due to the above reasons, usage of wood as a source of energy is not a wise decision.

Q. 3. Wavelength of radiation incident on a surface is 850 nm. Will the surface become visible when exposed to this radiation? Explain.

Ans. No, the surface will not be visible as the range of wavelength of visible radiation is from 400 nm to 700 nm. The radiation having wavelength greater than 700 nm is termed as infra-red radiations which are heat radiations, so the radiations of wavelength 850 nm are not visible to us.

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NCERT Corner

NCERT Intext Questions

Q. 1. What is a good source of energy?

Ans. A good source of energy is

(*i*) one which would do a large amount of work per unit volume or mass.

(*ii*) which is easily accessible.

(*iii*) which is easy to store and transport; and

(*iv*) perhaps most importantly, economical.

Q. 2. What is a good fuel?

Ans. A good fuel is one which

(*i*) produces more heat per unit mass. It has high calorific value.

(*ii*) produces less harmful gases on combustion.

(*iii*) is cheap and easily available.

(*iv*) is easy to handle, safe to transport, and convenient to store.

Q. 3. If you could use any source of energy for heating your food, which one would you use and why? *[CBSE 2019 (31/1/3)]*

Ans. Natural gas can be used as a source of energy for heating the food. This is because

(*a*) it is clean source of energy.

(*b*) it does not produce huge among of smoke on burning.

(*c*) it is easy to use, transport and it produces a huge amount of heat on burning.

Q. 4. What are the disadvantages of fossil fuels?

Ans. (*i*) The fossil fuels are non-renewable sources of energy. If we were to continue consuming these sources at such an alarming rate, we would soon run out of energy.

(*ii*) Air pollution is caused by burning fossil fuels.

(*iii*) The oxides of carbon, nitrogen and sulphur that are released on burning fossil fuels are acidic oxides. These lead to acid rain which affects our water and soil resources.

(*iv*) Carbon dioxide produced by burning these fuels produces greenhouse effect.

Q. 5. Why are we looking at alternate sources of energy?

Ans. We are looking at alternate sources of energy because

(*i*) the fossil fuel reserves in the Earth are limited which may get exhausted soon, if continued to be used at the current rate.

(*ii*) the use of alternate sources of energy will reduce the pressure on fossil fuels making them last for a much longer time.

(*iii*) the pollution being caused by the burning of fossil fuels can be avoided by using alternate sources of energy.

Q. 6. How has the traditional use of wind and water energy been modified for our convenience?

Ans. The traditional use of wind has been modified by using windmills and that of water by constructing hydroelectric power plants.

Q. 7. What kind of mirror—concave, convex or plain would be best suited for use in a solar cooker? Why?

Ans. A concave mirror would be best suited for use in a solar cooker. When a concave mirror reflector is attached to a solar cooker, it converges a large amount of Sun's heat radiations at its focus due to which a high temperature is produced around the focus area.

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Q. 8. What are the limitations of the energy that can be obtained from the oceans?

Ans. The limitations of the energy that can be obtained from the oceans (tidal energy, wave energy and ocean thermal energy).

(*i*) Tidal energy is not likely to be a potential source of energy in the future because there are very few sites around the world which are suitable for building tidal dams.

(*ii*) Wave energy would be a viable proposition only where waves are very strong.

(*iii*) The energy potential from the sea (tidal energy, wave energy and ocean thermal energy) is quite large, but efficient commercial exploitation is difficult.

Q. 9. What is geothermal energy?

Ans. Heat energy from hot molten rocks present inside the Earth under certain favourable conditions created by natural process is known as geothermal energy. This form of energy is the only type of energy which do not use solar energy.

Q. 10. What are the advantages of nuclear energy?

Ans. (*i*) It produces huge amount of energy from very small amount of a nuclear fuel.

(*ii*) It does not produce gases like carbon dioxide which contribute to greenhouse effect or sulphur dioxide which causes acid rain.

(*iii*) Once the nuclear fuel is loaded into the reactor, the nuclear power plant can go on producing electricity for two to three years at a stretch. Hence, there is no need for putting in the nuclear fuel again and again.

Q. 11. Can any source of energy be pollution-free? Why or why not?

Ans. No, any source of energy cannot be pollution-free. Exploiting any source of energy disturbs the environment in some way or the other. Only the degree and manner of pollution varies. In some cases, the actual operation of a device like the solar cell may be pollution-free, but the assembly of the device would have caused some environmental damage.

Q. 12. Hydrogen has been used as a rocket fuel. Would you consider it a cleaner fuel than CNG? Why or why not?

Ans. Hydrogen is a cleaner fuel than CNG because the burning of hydrogen produces only water, which is completely harmless. The burning of CNG produces carbon dioxide and water. This CO_2 can produce greenhouse effect in the atmosphere and lead to the excessive heating of the environment in the long-run.

Q. 13. Name two energy sources that you would consider to be renewable. Give reasons for your choices.

Ans. (*i*) Wind energy

(*ii*) Solar energy

These sources of energy can be used again and again, endlessly. They will never get exhausted.

Q. 14. Give the names of two energy sources that you would consider to be exhaustible. Give reasons for your choices.

Ans. (*i*) Fossil fuels

(*ii*) Nuclear fuels

Fossil fuels are present in a limited amount in the Earth. Once exhausted, they will not be available to us again. It takes millions of years for fossil fuel to be formed.

The nuclear materials which can be conveniently extracted from the Earth are limited and hence, they will get exhausted one day.

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NCERT Exercises

Q. 1. A solar water heater cannot be used to get hot water on

(*a*) a sunny day. **(*b*) a cloudy day.**

(*c*) a hot day. **(*d*) a windy day.**

Ans. (*b*) **a cloudy day**

Q. 2. Which of the following is not an example of a bio-mass energy source?

(*a*) Wood **(*b*) Gobar-gas**

(*c*) Nuclear energy **(*d*) Coal**

Ans. (*c*) Nuclear energy

Q. 3. Most of the sources of energy we use represent stored solar energy. Which of the following is not ultimately derived from the Sun's energy?

(*a*) Geothermal energy **(*b*) Wind energy**

(*c*) Fossil fuel **(*d*) Bio-mass**

Ans. (*a*) Geothermal energy

Q. 4. Compare and contrast fossil fuels and the Sun as direct sources of energy.

Ans. (*i*) The reserves of fossil fuels are limited, *i.e.*, exhaustible whereas solar energy is available in abundance (and that too without cost), *i.e.*, inexhaustible.

(*ii*) Fossils fuels cause pollution on burning whereas solar energy is pollution-free.

(*iii*) Fossil fuels can provide energy at any required time whereas solar energy becomes unavailable when the sky is covered with clouds.

Q. 5. Compare and contrast biomass and hydroelectricity as sources of energy.

Ans. (*i*) Biomass is a renewable source of energy only if we plant trees in a planned manner which is not the case with hydroelectricity.

(*ii*) The energy from bio-mass can be obtained by using a *chulha* or a *gobar gas* plant whereas hydroelectricity requires construction of dams on rivers.

(*iii*) Biomass provides pollution-free energy only when converted into bio-gas whereas hydroelectricity is totally pollution-free.

Q. 6. What are the limitations of extracting energy from

(*i*) the wind **(*ii*) waves**

(*iii*) tides

Ans. (*i*) (*a*) It is not available at all times.

(*b*) It requires a very large area of land.

(*c*) It is not possible to have a windmill everywhere as to run it, the minimum wind speed of 15 km/hr is required (only possible in open areas like the seaside).

(*ii*) (*a*) Wave energy would be a viable proposition only where waves are very strong.

(*b*) It is costly to set up devices to trap wave energy.

(*iii*) (*a*) Very few sea coasts in the world have suitable sites for the purpose of harnessing tidal energy.

(*b*) The rise and fall of tides happen only twice in a day and is not sufficient to generate electricity continuously.

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Q. 7. On what basis would you classify energy sources?

(*i*) Renewable and non-renewable

(*ii*) Exhaustible and inexhaustible

Are the options given in (*i*) and (*ii*) the same?

Ans. We would classify energy sources as (*i*) renewable and non-renewable.

Renewable sources of energy are **inexhaustible;** whereas **non-renewable sources** of energy are **exhaustible**. Thus, the options in (*i*) and (*ii*) are the same.

Q. 8. What are the qualities of an ideal source of energy?

Ans. An ideal source of energy has the following qualities:

(*i*) It gives us more heat per unit mass.

(*ii*) It does not pollute the air on burning by giving out smoke or harmful gases.

(*iii*) It should be cheap and easily available.

(*iv*) It should be easy to handle and safe to transport.

Q. 9. What are the advantages and disadvantages of using a solar cooker? Are there places where solar cookers would have limited utility?

Ans. Solar cookers have limited utility at places which remain cloudy or have longer winters; *e.g.*, hilly areas.

Advantages of using a solar cooker:

(*i*) It cooks food without causing any kind of pollution.

(*ii*) It is economical to use solar cooker because nothing is to be paid for using solar energy.

(*iii*) It is easy to handle solar cooker and there is no chance of any kind of accident.

(*iv*) The nutrients in the food do not get destroyed.

Disadvantages of using a solar cooker:

(*i*) Solar cooker cannot be used at night and during cloudy weather.

(*ii*) It takes more time to cook food.

(*iii*) The direction of solar cooker is to be changed continuously towards the direction of the Sun.

(*iv*) Solar energy is not available uniformly all the time and at all the places.

(*v*) It cannot be used for making *chapatis* and for frying purposes.

Q. 10. What are the environmental consequences of the increasing demand for energy? What steps would you suggest to reduce energy consumption?

Ans. (*i*) Burning of fossil fuels to meet the increasing demand for energy causes *air pollution*.

(*ii*) Construction of dams on rivers to generate hydroelectricity destroys large ecosystems which get submerged under water in the dams. Further, large amounts of methane (which is a greenhouse gas) is produced when submerged vegetation rots under anaerobic conditions.

In order to reduce energy consumption:

(*i*) Fossil fuels should be used with care and caution to derive maximum benefit out of them.

(*ii*) Fuel saving devices such as pressure cookers, *etc.*, should be used.

(*iii*) Efficiency of energy sources should be maintained by getting them regularly serviced.

(*iv*) And last of all, we should be economical in our energy consumption as energy saved is energy produced.

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SELF-ASSESSMENT TEST

Time allowed: 1 hour **Max. marks: 40**

SECTION–A

Choose and write the correct answer for each of the following. **(4 × 1 = 4)**

1. Which one of the following is not required in the formation of biogas in a biogas plant?

(*a*) Anaerobic bacteria (*b*) water

(*c*) cow-dung (*d*) oxygen

2. Fuel used in thermal power plant is *[NCERT Exemplar]*

(*a*) water (*b*) uranium

(*c*) biomass (*d*) fossil fuels

3. Acid rain occurs because *[NCERT Exemplar]*

(*a*) Sun leads to heating of the upper layer of atmosphere

(*b*) burning of fossil fuels release oxides of carbon, nitrogen and sulphur in the atmosphere

(*c*) electrical charges are produced due to friction among clouds

(*d*) Earth's atmosphere contains acids.

4. In a hydro power plant *[NCERT Exemplar]*

(*a*) potential energy possessed by stored water is converted into electricity

(*b*) kinetic energy possessed by stored water is converted into potential energy

(*c*) electricity is extracted from water

(*d*) water is converted into steam to produce electricity.

The following questions consist of two statements—Assertion(A) and Reason(R). Answer these questions selecting the appropriate option given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation for *A*.

(*b*) Both *A* and *R* are true but *R* is not the correct explanation for *A*.

(*c*) *A* is true but *R* is false.

(*d*) *A* is false but *R* is true. **(3 × 1 = 3)**

5. Assertion (*A*) : Fossil Fuels will get depleted some day.
Reason (*R*) : Fossil fuels are exhaustible sources of energy.

6. Assertion (*A*) : Hydrogen has been used as a rocket fuel.
Reason (*R*) : Hydrogen is considered as a lighter fuel than CNG.

7. Assertion (*A*) : The use of dry wood as a domestic fuel is considered as good.
Reason (*R*) : Dry wood on burning produces a lot of smoke.

Answer the following questions in one word or one sentence. **(3 × 1 = 3)**

8. Which of the energy content of wind blowing at high altitudes is the source of wind power?

9. Name the main constituent of biogas.

10. Give an example of direct harnessing of solar energy.

SECTION–B

Answer the following questions in about 50-60 words each. **(5 × 3 = 15)**

11. List any four reasons why we need to look for alternate sources of energy.

12. List three environmental consequences of using fossil fuels. Suggest three steps to minimise the pollution caused by various energy sources.

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13. What is biomass? What can be done to obtain bio-energy using biomass? [*NCERT Exemplar*]
14. Nuclear power is an excellent non-conventional source of energy still it is not used commonly for power generation. Why? State three reasons.
15. Name two energy sources that you would consider to be renewable. Give justification for your choices. Can these energy sources be pollution free? List two reasons in support of your answer. [*CBSE 2019 (31/3/1)*]

SECTION–C

Answer the following questions in about 80–90 words each. **(3 × 5 = 15)**

16. Why is it not possible to make use of solar cells to meet all our energy needs? State at least three reasons to support your answer.
17. Name the various forms in which energy is available from the sea. For any two types give one limitation in harnessing.
18. What are the factors that should be taken into consideration for selecting a source of energy? List any three.

Answers

1. (*d*) **2.** (*d*) **3.** (*b*) **4.** (*a*) **5.** (*a*) **6.** (*c*) **7.** (*d*)

8. Potential **9.** Methane (75%)

10. Solar water heating

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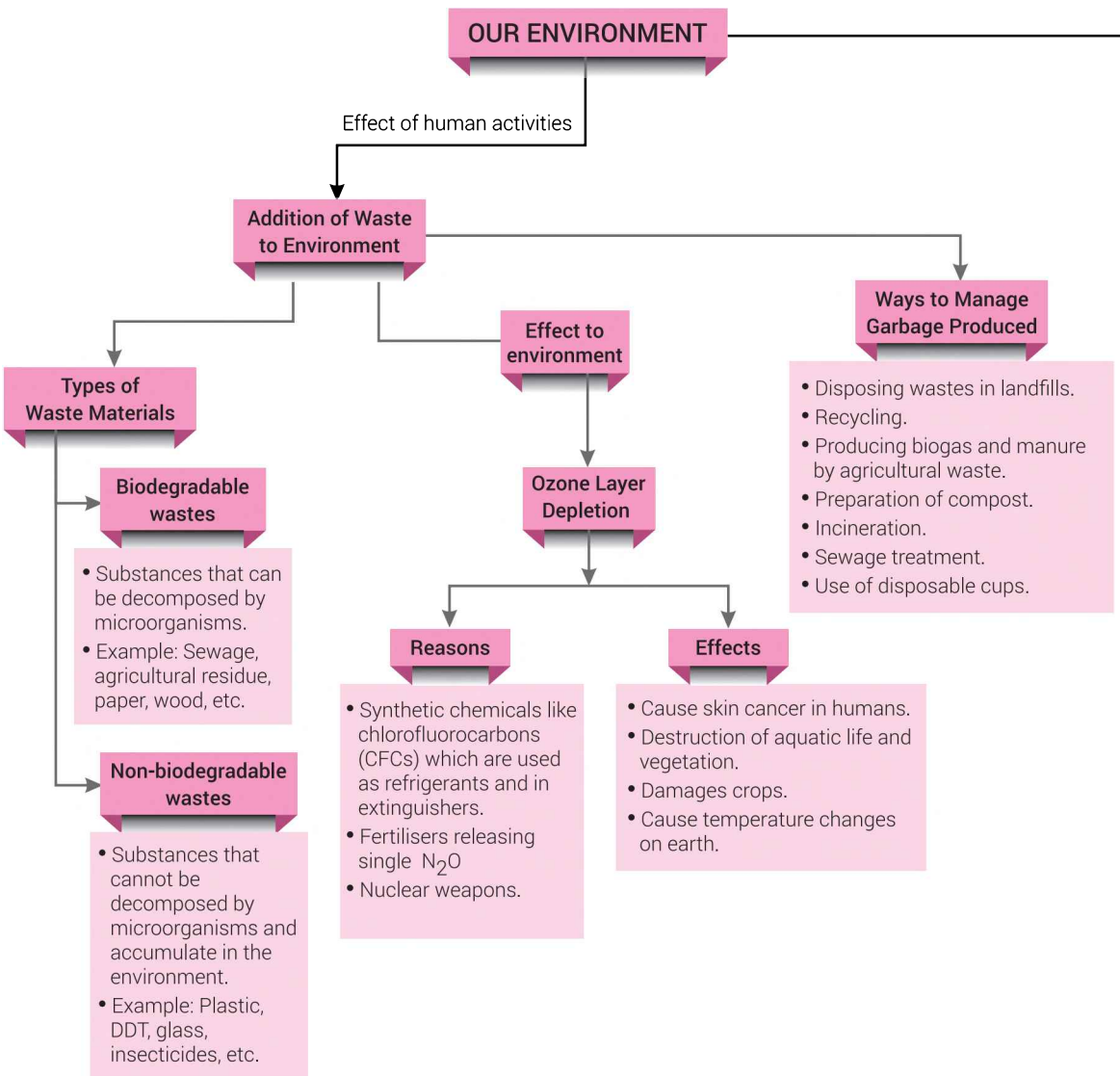
15 Our Environment

BASIC CONCEPTS—A FLOW CHART



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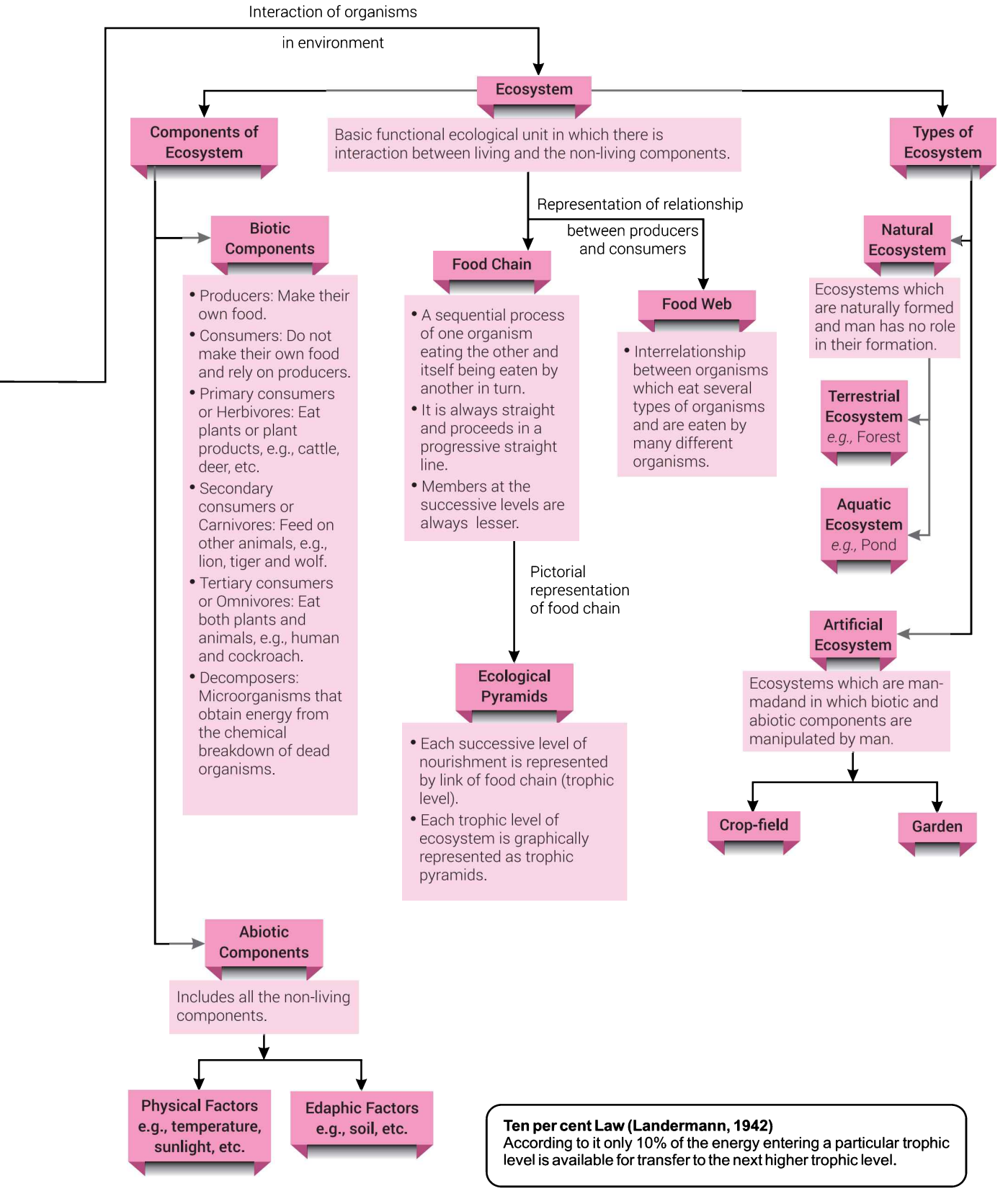

Ten per cent Law (Landermann, 1942)
According to it only 10% of the energy entering a particular trophic level is available for transfer to the next higher trophic level.

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MORE POINTS TO REMEMBER

- The **environment** includes everything that may affect the organism (plant or animal) in any way. All the external, physical and biological factors that directly influence the survival, growth, development and reproduction of organisms are collectively called the environment.
- There is a loss of energy as we go from one trophic level to the next, this limits the number of trophic levels in a food-chain.
- **Ozone** at the higher levels of the atmosphere is a product of UV radiation acting on oxygen (O_2) molecule. The higher energy UV radiations split apart some molecular oxygen (O_2) into free oxygen (O) atoms. These atoms then combine with the molecular oxygen to form ozone as shown:

$$O_2 \xrightarrow{UV} O + O$$

$$O + O_2 \longrightarrow \underset{\text{(Ozone)}}{O_3}$$

- **In stratosphere,** the ultraviolet rays (UV) are absorbed by the ozone layer which protects all forms of life on the Earth. Ozone is being depleted by air pollutants such as chlorofluorocarbons (CFCs) and nitrogen monoxide (NO). Chlorofluorocarbons are mainly responsible for ozone depletion. These are harmful, synthetic chemicals widely used in refrigerators and air conditioners as coolants.
- **Biological magnification:** Pesticides and other chemicals used to protect our crops are either washed down into the soil or into the water bodies. From there these are absorbed by the plants and taken up by aquatic plants and animals. As these chemicals are not degradable, these get accumulated progressively at each trophic level. As human beings occupy the top level in any food chain, the maximum concentration of these chemicals get accumulated in our bodies. This phenomenon is known as biological magnification.
- **Eutrophication:** It is the natural aging of a lake by biological enrichment of its mater.

Multiple Choice Questions [1 mark]

Each question has 4 choices (a), (b), (c) and (d). Choose and write the correct option.

1. Which one of the following is an artificial ecosystem? *[NCERT Exemplar]*

(a) Pond (b) Crop field (c) Lake (d) Forest

2. An ecosystem includes *[NCERT Exemplar]*

(a) all living organisms.

(b) non-living objects.

(c) both living organisms and non-living objects.

(d) sometimes living organisms and sometimes non-living objects.

3. In the given food chain, suppose the amount of energy at fourth trophic level is 5 kJ, what will be the energy available at the producer level?

Grass → Grasshopper → Frog → Snake → Hawk *[NCERT Exemplar]*

(a) 5 k J (b) 50 kJ

(c) 500 k J (d) 5000 k J

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4. **In an ecosystem, the 10% of energy available for transfer from one trophic level to the next is in the form of** [NCERT Exemplar]
   (a) heat energy (b) light energy
   (c) chemical energy (d) mechanical energy

5. **Organisms of a higher trophic level which feed on several types of organisms belonging to a lower trophic level constitute the** [NCERT Exemplar]
   (a) food web (b) ecological pyramid
   (c) ecosystem (d) food chain

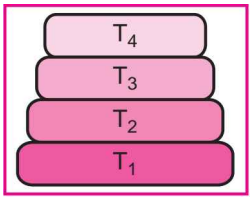
6. **Flow of energy in an ecosystem is always** [NCERT Exemplar]
   (a) unidirectional (b) bidirectional
   (c) multi directional (d) no specific direction

7. **Excessive exposure of humans to UV-rays results in**
   (i) damage to immune system **(ii) damage to lungs**
   (iii) skin cancer **(iv) peptic ulcers** [NCERT Exemplar]
   (a) (i) and (ii) (b) (ii) and (iv)
   (c) (i) and (iii) (d) (iii) and (iv)

8. **In the following groups of materials, which group(s) contains only non-biodegradable items?**
   (i) Wood, paper, leather **(ii) Polythene, detergent, PVC**
   (iii) Plastic, detergent, grass **(iv) Plastic, bakelite, DDT** [NCERT Exemplar]
   (a) (iii) (b) (iv)
   (c) (i) and (iii) (d) (ii) and (iv)

9. **Which of the following limits the number of trophic levels in a food chain?** [NCERT Exemplar]
   (a) Decrease in energy at higher trophic levels
   (b) Deficient food supply
   (c) Polluted air
   (d) Water

10. **In the given figure alongside the various trophic levels are shown in a pyramid. At which trophic level is maximum energy available?** [NCERT Exemplar]



   (a) T_4 (b) T_2
   (c) T_1 (d) T_3

11. **What will happen if deer is missing in the food chain given below?**
   Grass → Deer → Tiger [NCERT Exemplar]
   (a) The population of tiger increases.
   (b) The population of grass decreases.
   (c) Tiger will start eating grass.
   (d) The population of tiger decreases and the population of grass increases.

12. **The decomposers in an ecosystem** [NCERT Exemplar]
   (a) convert inorganic material to simpler forms.
   (b) convert organic material to inorganic forms.
   (c) convert inorganic materials into organic compounds.
   (d) do not breakdown organic compounds.

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13. **If a grasshopper is eaten by a frog, then the energy transfer will be from** [*NCERT Exemplar*]
   (*a*) producer to decomposer.
   (*b*) producer to primary consumer.
   (*c*) primary consumer to secondary consumer.
   (*d*) secondary consumer to primary consumer.

14. **Disposable plastic plates should not be used because** [*NCERT Exemplar*]
   (*a*) they are made of materials with light weight.
   (*b*) they are made of toxic materials.
   (*c*) they are made of biodegradable materials.
   (*d*) they are made of non-biodegradable materials.

Answers

1. (*b*) **2.** (*c*) **3.** (*d*) **4.** (*c*) **5.** (*a*) **6.** (*a*) **7.** (*c*)
8. (*d*) **9.** (*a*) **10.** (*c*) **11.** (*d*) **12.** (*b*) **13.** (*c*) **14.** (*d*)

Assertion-Reason Questions [1 mark]

The following questions consist of two statements — Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

1. **Assertion (*A*) :** Green plants of the ecosystem are the transducers.
   Reason (*R*) : Producers trap the radiant energy of the Sun and change it into chemical energy.
2. **Assertion (*A*) :** Man is a herbivore.
   Reason (*R*) : Omnivores eat both plant food and meat of animals.
3. **Assertion (*A*) :** Garden is an artificial ecosystem.
   Reason (*R*) : Biotic and abiotic components are manipulated by humans.
4. **Assertion (*A*) :** Biotic components of ecosystem continuously require energy to carry on life processes.
   Reason (*R*) : Abiotic components are the non-living factors of the ecosystem.
5. **Assertion (*A*) :** Decomposers act as cleaning agents of the environment.
   Reason (*R*) : The decomposers recycle waste material in the hydrosphere.

Answers

1. (*a*) **2.** (*d*) **3.** (*a*) **4.** (*b*) **5.** (*c*)

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Passage-based Questions

Answer the questions given below each passage on the basis of your understanding of the paragraph and the related studied concepts.

1. The atmosphere is a blanket of air and a precious natural resource for sustaining life on the Earth. Unfortunately, human activities based on national/personal interests are causing harm to this common resource, notably by depleting the fragile ozone layer, which acts as a protective shield for life on the Earth.

Ozone molecules consist of three oxygen atoms. Ozone molecules are exceeding rare: fewer than ten in every million molecules of air. However, for nearly a billion years, their presence in the atmosphere has played a vital role in safeguarding life on Earth. The ozone in the troposphere (up to 110 kilometres above the Earth's surface) is 'bad' ozone which can damage lung tissues and plants. But about 90 per cent of ozone found in the stratosphere (between 10 and 40 kilometres above the Earth's surface) is "good" ozone which plays a beneficial role by absorbing dangerous ultraviolet (UV-B) radiations from the Sun.

Without this beneficial ozone layer, humans would be more susceptible to certain diseases due to the increased incidence of ultraviolet rays from the Sun.

(*i*) Ozone is also formed during thunderstorms. It causes the typical smell after such a storm. Is the ozone formed during thunderstorm 'bad ozone' or 'good ozone'? Choose the answer and the explanation.

Ozone	Explanation
(*a*) Bad	It is formed during bad weather.
(*b*) Bad	It is formed in the troposphere.
(*c*) Good	It is formed in the stratosphere
(*d*) Good	It smells good.

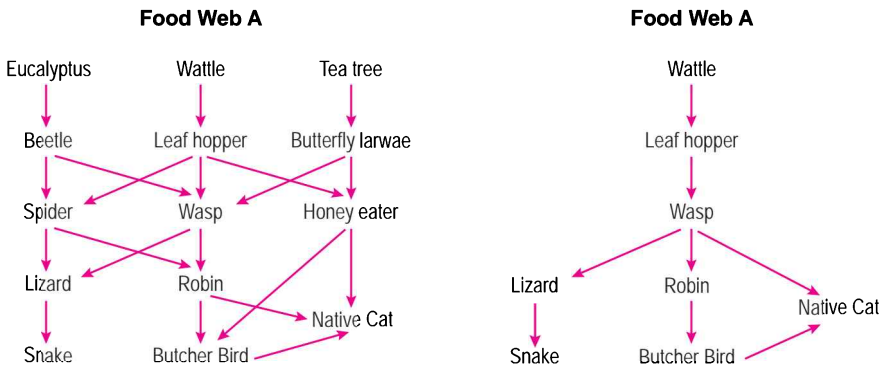
(*ii*) How can increased incidence of ultra-violet rays harm humans?

(*iii*) What destructive effect do chlorofluorocarbons bring about in the atmosphere?

(*iv*) Name any two sources of chemicals that are said to deplete ozone.

2. An ecosystem that retains a high biodiversity is much more likely to adapt to human caused environment change than in one that has little.

Consider the two food webs shown below.



Food web B represents a situation with very low biodiversity, where at some levels the food path involves only a single type of organism. Food web A represents a more diverse ecosystem, as a result, there are many more alternative feeding pathways. Generally, loss of biodiversity should

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be regarded a serious issue, not only because the organisms that have become extinct represent a big loss but also because the organisms that remain have become more exposed to extinction in the future.

(*i*) Food webs A and B are in different locations. If leaf hoppers died out in both locations, what would be the effect on the food webs?

(*ii*) The first trophic level in a food chain is always a green plant. Why?

(*iii*) In food web A, only two animals have three immediate food sources. Which two animals are they?

(*iv*) Flow of energy in an ecosystem is always

(*a*) unidirectional (*b*) bidirectional

(*c*) multi directional (*d*) no specific direction

Answers

1. (*i*) (*b*)

(*ii*) It can cause skin cancer and snow-blindness.

(*iii*) CFCs deplete ozone from ozone shield, resulting in increasing the passage of harmful ultraviolet radiation to the Earth.

(*iv*) Nuclear weapons; fertilizers releasing nitrous oxides (N_2O).

2. (*i*) Both the food webs would be disrupted to some extent because leaf hoppers occupy the first trophic level but that effect would be greater in food web B because the wasp has only one food source in this web.

(*ii*) The first trophic level is always a green plant because only plants can utilise the radiant energy of the Sun and transform it to chemical form during photosynthesis.

(*iii*) Native cat and wasps.

(*iv*) (*a*)

Very Short Answer Questions [1 mark]

Each of the following questions are of 1 mark and have to be answered in one word or one sentence.

Q. 1. Why is it necessary to conserve our environment?

Ans. It is necessary to conserve our environment in order to maintain ecological balance.

Q. 2. What is a biodegradable substance? *[CBSE (C) 2017]*

Ans. Biodegradable substances are the substances that are broken down by biological processes.

Q. 3. Name any two biodegradable and two non–biodegradable pollutants.

Ans. Biodegradable: domestic sewage and wood.

Non–biodegradable: Plastic and DDT.

Q. 4. We often use the word environment. What does it mean? *[CBSE (F) 2016]*

Ans. Environment is the physical, chemical and biological conditions of the region.

Q. 5. Which two of the following are biodegradable?

Tomato leaves, aluminium wire, synthetic fibre and wool

Ans. Tomato leaves and wool.

Q. 6. Which of the following are non-biodegradable?

Wool, glass, silver foil and leather

Ans. Glass and silver foil.

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Q. 7. What is the function of ozone in the upper atmosphere? [*CBSE Delhi 2015*]

Ans. Ozone shields the surface of the Earth from ultraviolet rays of the Sun.

Q. 8. Why should biodegradable and non-biodegradable wastes be discarded in two separate dustbins? [*CBSE Delhi 2015*]

Ans. Biodegradable and non-biodegradable wastes should be discarded in two separate dustbins so that the time and energy required in segregation may be saved and waste may be disposed off quickly.

Q. 9. List the two main components of an ecosystem. [*CBSE 2019 (31/3/1)*]

Ans. The two components of an ecosystem are biotic or living and abiotic or non-living component.

Q. 10. List two biotic components of a biosphere. [*CBSE Delhi 2016*]

Ans. Producers, consumers and decomposers are the biotic components of a biosphere. (*Any two*)

Q. 11. Name any two abiotic components of an environment.

Ans. Abiotic components of an environment include soil and water.

Q. 12. Write an aquatic food chain.

Ans. Phytoplankton $\longrightarrow$ Zooplankton $\longrightarrow$ Fish $\longrightarrow$ Seal
(Small fish) (Big fish)

Q. 13. What is the percentage of solar energy trapped and utilised?

Ans. 1% in terrestrial habitats and 0.2% in aquatic ecosystems is the percentage solar energy trapped and utilised.

Q. 14. What will be the amount of energy available to the organisms of the 2nd trophic level of a food chain, if the energy available at the first trophic level is 10,000 joules? [*CBSE (AI) 2015*]

Ans. On applying the 10% law to the food chain, the organisms of the 2nd trophic level of the food chain will have $\frac{10}{100} \times 10{,}000 = 1{,}000$ joules of energy.

Q. 15. Draw a food chain with four trophic levels.

Ans. Plants $\longrightarrow$ Rats $\longrightarrow$ Snakes $\longrightarrow$ Hawks

Q. 16. Write the common food chain of a pond ecosystem. [*NCERT Exemplar*]

Ans. Phytoplanktons and aquatic plants $\longrightarrow$ small aquatic animal (larvae and insects) $\longrightarrow$ fishes $\longrightarrow$ birds.

Q. 17. The first trophic level in a food chain is always a green plant. Why? [*CBSE (AI) 2015*]

OR

Why do producers always occupy the first trophic level on every food chain? [*CBSE (F) 2016*]

Ans. The first trophic level is always a green plant because only plants can utilise the radiant energy of the Sun and transform it to chemical form during photosynthesis.

Q. 18. Which of the following are always at the second trophic level of food chains?

Carnivores, Autotrophs, Herbivores [*CBSE (AI) 2015*]

Ans. Herbivores are always at the second trophic level of food chains.

Q. 19. The following organisms form a food chain. Which of these will have the highest concentration of non-biodegradable chemicals? Name the phenomenon associated with it.

Insects, Hawk, Grass, Snake, Frog [*CBSE (F) 2015*]

Ans. Hawk will have the highest concentration of non-biodegradable chemicals. The phenomenon associated is biomagnification.

Q. 20. State the essential function performed by ozone at the higher levels of the atmosphere. [*CBSE Delhi (C) 2017*]

Ans. It shields the surface of the Earth from ultraviolet (UV) radiation of the Sun.

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Q. 21. Write the full name of the group of compounds mainly responsible for the depletion of ozone layer. *[CBSE (F) 2015]*

Ans. Chlorofluorocarbons

Q. 22. What is an ecosystem ? *[CBSE Delhi 2017)*

Ans. A unit of biosphere in which biotic and abiotic components interact with each other is an ecosystem.

Q. 23. Why is forest considered a natural ecosystem ? *[CBSE Delhi 2017)*

Ans. A forest is a self-sustaining system, so it is considered as a natural ecosystem.

Q. 24. List two examples of natural ecosystem. *[CBSE (F) 2017, 2015, Delhi 2016]*

Ans. Forests, ponds, lakes are examples of natural ecosystem. (*Any two*)

Q. 25. Name any two man-made ecosystems. *[CBSE (F) 2017]*

Ans. Crop fields, gardens, aquarium, parks (*Any two*)

Q. 26. Why are green plants called producers? *[CBSE Delhi 2016]*

Ans. Green plants are called producers because they prepare food by photosynthesis using solar energy.

Q. 27. List four common waste disposal methods.

Ans. Compost, recycling of wastes, landfills and incineration.

Q. 28. What is incineration?

Ans. Incineration means 'reducing to ashes'. The burning of substances at high temperature to form ash is called incineration.

Q. 29. Why is improper disposal of waste a curse to environment? *[NCERT Exemplar]*

Ans. Wastes pollute our environment, air, soil and water, and cause harmful effects on all living organisms.

Q. 30. Write one negative effect, on the environment, of affluent lifestyle of few persons of a society. *[CBSE (AI) 2016]*

Ans. Affluent lifestyle results in:

(*i*) Generation of excessive waste materials.

(*ii*) Excessive use of natural resources like coal and petroleum which causes pollution.

(*iii*) Use of excessive non-biodegradable material in packaging. (*Any one*)

Short Answer Questions [3 marks]

Each of the following questions are of 3 marks and have to be answered in about 50-60 words.

Q. 1. Why are crop fields known as artificial ecosystems? *[NCERT Exemplar]*

Ans. Crop fields are man-made and some biotic and abiotic components are manipulated by humans. Therefore, they are known as artificial ecosystems.

Q. 2. Suggest one word for each of the following statements/definitions:

(*i*) The physical and biological world where we live in.

(*ii*) Each level of food chain where transfer of energy takes place.

(*iii*) The physical factors like temperature, rainfall, wind and soil of an ecosystem.

(*iv*) Organisms which depend on the producers either directly or indirectly for food.

[NCERT Exemplar]

Ans. (*i*) Environment/biosphere (*ii*) Trophic level

(*iii*) Abiotic factors (*iv*) Consumers/heterotrophs

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Q. 3. What are decomposers? What will be the consequence of their absence in an ecosystem?
[NCERT Exemplar, CBSE 2019 (31/4/2)]

Ans. Decomposers break down the complex organic substances of garbage, dead animals and plants into simpler inorganic substances that go into the soil and are used up again by the plants. In the absence of decomposers, recycling of material in the biosphere will not take place.

Q. 4. Give two examples of decomposers. State their important role in nature. *[CBSE Delhi (C) 2017]*

Ans. Bacteria and fungi are decomposers because bacteria and fungi break down the dead and decaying organic matter into simpler substances and provide the nutrients back to the soil.

Importance of decomposers in nature are:

(*i*) They act as natural scavengers.

(*ii*) They help in recycling of nutrients.

Q. 5. Consider the food chain: Grass ⟶ Deer ⟶ Lion. What will happen if lions are removed from the above food chain?

Ans. Removal of lions from the above food chain will increase the number of deer to such an extent that they will eat up the whole grass. The density of producer like grass will be very much reduced and this will turn the area into a desert.

Q. 6. Which of the following belongs to the same trophic level?

Grass, Hawk, Rabbit, Frog, Deer

Ans. Grass is producer, hawk and frog are carnivores (top and lower), rabbit and deer are herbivores.

Since rabbit and deer are both herbivores, they belong to the same trophic level.

Q. 7. In the following food chain, plants provide 500 J of energy to rats. How much energy will be available to hawks from snakes ? *[CBSE (AI) 2017]*

Plants ⟶ Rats ⟶ Snakes ⟶ Hawks

Ans. On applying the 10% law to the food chain,

Energy available to snakes from rats = 10% of 500

$$= \frac{10}{100} \times 500 = 50 \text{ J}$$

So, energy available to hawks from snakes = 10% of 50 J

$$= \frac{10}{100} \times 50 = 5 \text{ J}$$

Q. 8. In a lake contaminated with pesticides, which one of the following organism living in the lake will contain the maximum amount of pesticide?

Small fish, zooplankton, big fish, phytoplankton.

Ans. The concentration of pesticide will increase with the rise of trophic level in the food chain.

Phytoplankton ⟶ Zooplankton ⟶ Small fish ⟶ Big fish (maximum pesticide)

Therefore, big fishes will have maximum amount of pesticides.

Q. 9. Why does a food chain consist of only three to four steps?

Ans. On an average, only 10% of the food available to a trophic level is transferred to the next trophic level. Since, the amount of available energy keeps on becoming less as we move to higher trophic levels, so very little usable energy remains after four trophic levels. That is why a food chain consists of only three to four steps.

Q. 10. (*i*) With the help of an example explain how indiscriminate use of pesticides may result in the degradation of the environment.

(*ii*) What are the by-products of fertiliser industries? How do they affect the environment?
[NCERT Exemplar]

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Ans. (*i*) Indiscriminate use of pesticides may result in the degradation of the environment. For example, DDT is an organic pesticide which is used to kill pests in crop fields. When it is used in large quantity it can be passed along the food chain from crops to man or other animals and birds and can harm them.

(*ii*) The harmful by-products are gases such as SO_2 and NO. They cause extensive air pollution and are responsible for acid rain.

Q. 11. State any two practices which can help in the protection of our environment.

Ans. Two practices which can help in the protection of our environment are:

(*i*) Disposal of the waste after its separation as biodegradable and non-biodegradable material.

(*ii*) Judicious use of unleaded petrol and alternate sources of energy.

Q. 12. The number of malarial patients in a village increased tremendously when large number of frogs were exported from the village. What could be the cause for this?

Ans. The food chain in the given situation will be:

Phytoplankton ⟶ Zooplankton ⟶ Mosquito larva ⟶ Frogs

In the absence of frogs (as they were exported), more mosquito larvae survived giving rise to large number of mosquitoes. The large number of mosquitoes caused increased incidences of malaria.

Q. 13. Mention three harmful effects of using polythene bags on the environment. Suggest an effective alternative to these bags. *[CBSE (F) 2017]*

Ans. Harmful effects of using polythene bags are :

(*i*) Increases soil temperature or adversely effect agricultural products.

(*ii*) Land and animals die after consumption of these bags.

(*iii*) It causes clogging of drains and may even cause flood like situation. Alternatives are the use of jute bags, paper bags, cloth bags.

Q. 14. Suggest any two ways by which the balance between the environment and industrial development is maintained so as to help undisturbed survival of the organisms on the Earth. *[CBSE (F) 2017]*

Ans. (*i*) Judicious use of forest resources for industrial development.

(*ii*) Waste water generated by industries should be recycled.

(*iii*) Alternative resources to conserve natural resources. *(Any two)*

Q. 15. Differentiate between biodegradable and non-biodegradable substances with the help of one example each. List two changes in habit that people must adopt to dispose non-biodegradable waste, for saving the environment. *[NCERT Exemplar, CBSE (AI) 2015]*

Ans.

S.No.	Biodegradable wastes	Non-biodegradable wastes
(*i*)	Waste materials which can be broken down into harmless substances in nature in due course of time by the action of microorganisms such as certain bacteria are called biodegradable wastes.	Waste materials which cannot be broken down into harmless substances by the action of microorganisms in nature are called non-biodegradable wastes.
(*ii*)	**Examples:** Cattle dung, wool, paper, compost.	**Examples:** Plastics, polythene bags, metal articles, glass objects.

People should adopt following changes in habit:

(*i*) Dispose household waste, chemical waste and hospital waste in a landfill.

(*ii*) Broken plastic articles such as buckets, bowls, cups, plates, etc., should be sent to plastic processing factories.

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Q. 16. Give reason to justify the following : [CBSE (Delhi) 2016]

(*i*) The existence of decomposers is essential in a biosphere.

(*ii*) Flow of energy in a food chain is unidirectional.

Ans. (*i*) The existence of decomposers is essential in a biosphere because they breakdown complex organic substances into simple inorganic substances that can be absorbed by the plants. Thus, decomposers:

- Replenish the soil naturally.
- Helps in removing the biodegradable waste.

(*ii*) In a food chain the energy moves progressively through the various trophic levels, it is no longer available to the previous level (*i.e.*, autotrophs) and the energy captured by the autotrophs does not go back to the solar input.

Hence, the flow of energy is unidirectional.

Q. 17. What is an ecosystem? List its two main components. We do not clean natural ponds or lakes but an aquarium needs to be cleaned regularly. Why is it so? Explain. [CBSE (AI) 2015]

Ans. An ecosystem is defined as a dynamic system of biotic and abiotic components and there is a continuous flow of energy between the different components.

Its two main components are:

(*i*) Biotic component/living organisms

(*ii*) Abiotic component/physical factors

An aquarium needs to be cleaned regularly because it is an artificial and incomplete ecosystem in which natural decomposers are absent and the water is stagnant. Thus, water do not clean itself in an aquarium.

Q. 18. "Energy flow in food chains is always unidirectional." Justify this statement. Explain how the pesticides enter a food chain and subsequently get into our body. [CBSE (F) 2015]

OR

Indicate the flow of energy is an ecosystem. Why is it unidirectional? Justify. [NCERT Exemplar]

OR

What is a food chain? Why is the flow of energy in an ecosystem unidirectional? Explain briefly. [CBSE 2019 (31/5/1)]

Ans. In a food chain the energy moves progressively through the various trophic levels and is no longer available to the organisms of the previous trophic level. The energy captured by the autotrophs does not revert back to the solar input. Thus, energy flow in food chains are said to be unidirectional.

Pesticides used for crop protection when washed away go down into the soil. These pesticides are absorbed by plants which are the producers. On consumption of these plants, the pesticides enter our food chain and being non-biodegradable, these chemicals get accumulated progressively and enter our body.

Q. 19. Give two differences between food chain and food web. [NCERT Exemplar]

Ans.

Food Chain	Food Web
1. Food chain is a series of organisms feeding on one another.	1. Food web consists of a number of interlinked food chains.
2. Members of higher trophic level feed upon a single type of organism of the lower trophic level.	2. Members of higher trophic level can feed upon organisms of the lower trophic levels of other food chain.

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Q. 20. Why does vegetarian habit help us in getting more energy? In terms of energy who is at an advantageous position (vegetarian or a non- vegetarian)? Why?

Ans. We know that, vegetarians obtain food directly from plants while non- vegetarians get the food from animals. Animals (herbivores) contain 10% of food energy as compared to plants (producers). For example; the same amount of producer which supplies say 1000 J of food energy to a vegetarian will provide only 100 J of food energy to a non-vegetarian. Hence, a vegetarian will be at an advantageous position.

Q. 21. Calculate the amount of energy available to tiger in the following food chain if plants have 30,000 J of energy available from the Sun:

Plant ⟶ Deer ⟶ Tiger

Ans. Plants can trap only 1% of the Sun's energy falling on them. Now, 1% of 30,000 J is 300 J which is the energy available to plants.

The plants are eaten up by deer. According to 10% law, 10% of 300 J, *i.e.,* 30 J of energy will be available to deer as food.

The deer will transfer 10% of its 30 J energy to the tiger. Thus, the food energy available to the tiger will be 10% of 30 J which is 3 J.

$$\underset{(30{,}000\ J)}{\text{Sun}} \xrightarrow{1\%\ \text{absorbed}} \underset{(300\ J)}{\text{Plants}} \xrightarrow{10\%} \underset{(30\ J)}{\text{Deer}} \xrightarrow{10\%} \underset{(3\ J)}{\text{Tiger}}$$

Q. 22. Define a food chain. Design a terrestrial food chain of four trophic levels. If a pollutant enters at the producers level, the organisms of which trophic level will have the maximum concentration of the pollutant in their bodies? What is this phenomenon called?

[CBSE 2019 (31/2/3)]

Ans. Food chain is defined as an arrangement of a one-way flow of food energy from the source of solar energy to top consumer through a series of organisms by a continuous process of eating and being eaten.

$$\text{Grass} \longrightarrow \text{Mice} \longrightarrow \text{Snake} \longrightarrow \text{Hawk}$$

If a pollutant enters at the producer level the organism at the top or highest level of food chain will have maximum concentration of the pollutant

This phenomenon is called as biological magnification.

Q. 23. Give three characteristics of food chain.

Ans. (*i*) A food chain is always straight and proceeds in a progressive straight line.

(*ii*) A food chain helps in understanding the food relationship and interactions among various organisms in an ecosystem.

(*iii*) It also helps to understand the movement of toxic substances in an ecosystem and the problem of their biological magnification.

Q. 24. Write the essential function performed by ozone at the higher levels of the Earth's atmosphere. How is it produced? Name the synthetic chemicals mainly responsible for the drop of amount of ozone in the atmosphere. How can the use of these chemicals be reduced? [CBSE 2019 (31/2/1)]

Ans. At the higher levels of the atmosphere, ozone shields the surface of the Earth from ultraviolet radiations from the Sun. Ozone at the higher levels of the atmosphere is a product of UV radiation acting on oxygen molecule. The high energy UV radiations split apart molecular oxygen into free oxygen (O) atoms. These atoms then combine with molecular oxygen to from ozone.

$$O_2 + O \rightleftharpoons O_3$$

CFCs (chlorofluorocarbons) accumulate in the upper atmosphere and react with ozone resulting in its reduction.

To reduce the use of CFCs, it is now mandatory to make CFC-free refrigerators throughout the world.

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Q. 25. Describe any four modes of disposal of waste.

OR

How can we help in reducing the problem of waste disposal? Suggest any three methods.

[CBSE 2019 (31/1/1)]

Ans. (*i*) Disposing of biodegradable wastes in biogas plants so that it can help in the preparation of biogas and manure.

(*ii*) Solid wastes should be buried in urban areas as landfills.

(*iii*) Some solid wastes (plastic, paper and metals) should be recycled.

(*iv*) Large amount of waste must be burnt at high temperature (incineration).

Q. 26. What are the advantages of cloth bags over plastic bags during shopping? *[NCERT Exemplar]*

Ans. Advantages of cloth bags are as follows:

(*i*) They are capable of carrying more items.

(*ii*) They are made of biodegradable material.

(*iii*) Do not pollute our environment.

(*iv*) They can be reused.

Q. 27. How is ozone formed in the upper atmosphere? What causes its damage?

Ans.

$$O_2 \xrightarrow{UV} O + O$$

$$O + O_2 \longrightarrow O_3 \text{(ozone)}$$

Certain harmful chemicals such as chlorofluorocarbons (CFCs), are released into the air. These accumulate in the upper atmosphere and react with ozone resulting in reduction of the ozone layer by forming a hole. Thus, ozone layer becomes thinner and gets depleted allowing more ultraviolet rays to pass through the Earth's atmosphere. These radiations are highly damaging to organisms and cause skin cancer, damage to eyes including increased incidence of cataract and damage to immune system of human beings and other animals.

Q. 28. (*i*) The depletion of ozone layer is a cause of concern. Why? *[CBSE (AI) 2016]*

(*ii*) What destructive effect do chlorofluorocarbons bring about in the atmosphere?

Ans. (*i*) Ozone layer is very important for the existence of life on Earth because it prevents harmful ultraviolet (UV) radiations coming from the Sun to reach the Earth.

(*ii*) CFCs deplete ozone from ozone shield, resulting in increasing the passage of harmful ultraviolet radiation to the Earth.

Long Answer Questions [5 marks]

Each of the following questions are of 5 marks and have to be answered in about 80-90 words.

Q. 1. Suggest any five activities in daily life which are eco-friendly.

Ans. (*i*) Separation of biodegradable and non-biodegradable substances

(*ii*) Gardening

(*iii*) Use of gunny bags/paper bags in place of polythene/plastic bags

(*iv*) Use of compost and vermicompost in place of fertilisers

(*v*) Harvesting rainwater

Q. 2. Name the wastes which are generated in your house daily. What measures would you take for their disposal? *[NCERT Exemplar]*

Ans. (*i*) Kitchen wastes

(*ii*) Paper wastes like newspapers, bags, envelopes

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(*iii*) Plastic bags

(*iv*) Vegetable/fruit peels/rind

Measures for disposal

(*i*) Segregation of biodegradable and non-biodegradable wastes.

(*ii*) Safe disposal of plastic bags.

(*iii*) Vegetable/fruit peels can be placed near trees/plants, which on decomposition will enrich the soil with nutrients.

(*iv*) Give paper wastes for recycling.

(*v*) Prepare a compost pit for kitchen wastes.

Q. 3. Explain some harmful effects of agricultural practices on environment. *[NCERT Exemplar]*

Ans. (*i*) Excessive use of fertilisers changes the chemistry of soil and kills useful microbes.

(*ii*) Excessive use of non-biodegradable chemical pesticides leads to biological magnification.

(*iii*) Extensive cropping causes loss of soil fertility.

(*iv*) Excess use of ground water for agriculture lowers the water table.

(*v*) Damage to natural ecosystem/habitat.

HOTS [Higher Order Thinking Skills]

Q. 1. Select the mis-matched pair in the following and correct it.

(*i*) Biomagnification — Accumulation of chemicals at the successive trophic levels of a food chain

(*ii*) Ecosystem — Biotic components of environment

(*iii*) Aquarium — A man-made ecosystem

(*iv*) Parasites — Organisms which obtain food from other living organisms

[NCERT Exemplar]

Ans. Option (*ii*) is not a matching pair.

This is because both biotic and abiotic components of environment constitute an ecosystem.

Q. 3. What will be the direction of energy transfer in each of the following cases?

(*i*) Grasshopper is eaten by a frog.

(*ii*) A deer feeds on grass.

(*iii*) A deer is eaten by a lion.

Ans. (*i*) Primary consumer to secondary consumer.

(*ii*) Producer to primary consumer.

(*iii*) Secondary consumer to tertiary consumer.

NCERT Corner

NCERT Intext Questions

Q. 1. What are trophic levels? Give an example of a food chain and state the different trophic levels in it.

Ans. Each step or level of a food chain where transfer of energy occurs are called trophic levels.

Let us consider the following food chain:

Grass (Producer) ⟶ Insect (Herbivore, Primary consumer) ⟶ Frog (Carnivore, Secondary consumer) ⟶ Snake (Carnivore, Tertiary consumer) ⟶ Peacock (Top carnivore)

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In this food chain, grass is a producer (first trophic level). Insect is a herbivore and eats grass. Thus, insect is at second trophic level. Insect, in turn, is eaten by frog (carnivores I). Thus, frog is at third trophic level. Frog, is eaten by snake (carnivores II). Thus, snake is at fourth trophic level. Snake, in turn is eaten by peacock (carnivores III). Thus, peacock is at fifth trophic level.

Q. 2. What is the role of decomposers in the ecosystem or environment? *[NCERT Exemplar]*

Ans. Decomposers break down the complex organic substances in the dead remains and waste products of organisms into simple inorganic substances that go into the soil and are used up once more by plants.

Q. 3. Why are some substances biodegradable and some non-biodegradable?

Ans. The substances that we use in our daily life are either biodegradable and non- biodegradable. In our environment, microorganisms such as bacteria and fungi secrete enzymes to degrade substances. Organic compounds, present in the dead remains of plants and animals and their waste products can be degraded into simpler harmless substances by biological processes and microorganisms. These substances are termed as biodegradable. On the other hand, certain category of substances like plastics, glass, etc., cannot be degraded by microorganisms or biological processes. These substances persist in the environment and are termed as non-biodegradable.

Q. 4. Give any two ways in which biodegradable substances would affect the environment.

Ans. Two ways in which biodegradable substances would affect the environment are:

(*i*) Decomposition of biodegradable wastes produces foul smell which spreads in the environment and makes the life of people miserable.

(*ii*) Flies breed at huge heaps of biodegradable wastes carrying the germs and spread diseases such as typhoid, diarrhoea, tuberculosis, cholera, etc.

Q. 5. Give any two ways in which non-biodegradable substances would affect the environment.

Ans. Two ways in which non-biodegradable substances would affect the environment are:

(*i*) Some of the non-biodegradable wastes (pesticides and heavy metals) convert the land into barren land and enter the food chain thus, effecting human beings and other biotic components of the environment.

(*ii*) Pesticides and other chemicals enter water and food chains. They affect the fertility of soil and harm all kind of living organisms. Human beings are harmed the most because they are at the top of the food chain.

Q. 6. What is ozone and how does it affect any ecosystem? *[CBSE (F) 2015]*

Ans. Ozone is an allotrope of oxygen. It is formed by three atoms of oxygen . Ozone, is a deadly poison. Very little of it is present in lower part of the atmosphere called troposphere. In the stratosphere, ozone layer comprises high concentration of ozone some 18–26 km above. Ozone performs an essential function. It shields the surface of the Earth from ultraviolet (UV) radiations of the Sun.

Synthetic chemicals such as chlorofluorocarbons (CFCs) released into the air accumulate in the upper atmosphere and react with ozone resulting in reduction of the ozone layer. Thus, ozone layer becomes thinner and gets depleted allowing more ultraviolet rays to pass through the Earth's, atmosphere. This radiation is highly damaging to organisms. It produces skin cancer, damage eyes including increased incidence of cataract and damage the immune system of human beings and other animals.

Q. 7. How can you help in reducing the problem of waste disposing? Give any two methods.

Ans. We can help reducing the waste disposal problem by changing our lifestyle and attitude. If we minimise the use of disposable articles and start using only those articles which can easily be recycled, the quantity of waste can be reduced.

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(*i*) Non-biodegradable waste: Most often the non-biodegradable waste is recycled. It is taken away by rag-pickers.

(*ii*) Biodegradable waste: Biodegradable waste is putrescible. It can be composted or vermicomposted to prepare compost for our kitchen gardens.

Some prominent methods of waste disposal are land fills, production of bio-gas and manure, and incineration.

NCERT Exercises

Q. 1. Which of the following groups contain only biodegradable items?

(*i*) Grass, flowers and leather **(*ii*) Grass, wood and plastic**

(*iii*) Fruit-peels, cake and lime-juice **(*iv*) Cake, wood and grass.**

Ans. (*i*), (*iii*) and (*iv*)

Q. 2. Which of the following constitute a food chain?

(*i*) Grass, wheat and mango **(*ii*) Grass, goat and human**

(*iii*) Goat, cow and elephant **(*iv*) Grass, fish and goat**

Ans. (*ii*)

Q. 3. Which of the following are environment-friendly practices?

(*i*) Carrying cloth-bags to put purchases in while shopping.

(*ii*) Switching off unnecessary lights and fans.

(*iii*) Walking to school instead of getting your mother to drop you on her scooter.

(*iv*) All of the above.

Ans. (*iv*)

Q. 4. What will happen if we kill all the organisms in one trophic level?

Ans. If we kill all the organisms in one trophic level, the transfer of food energy to next level will stop. Also, there will be overpopulation of individuals belonging to the previous trophic level. The organisms of higher tropic level will also die. Hence, it will result in imbalance in the ecosystem.

Q. 5. Will the impact of removing all the organisms in a trophic level be different for different trophic levels? Can the organisms of any trophic level be removed without causing any damage to the ecosystem?

Ans. Removal of all the organisms in a trophic level will cause the same type of disturbance in an ecosystem, *i.e.*, killing of higher trophic level and explosion in population of the lower level organisms. If all producers are killed, there will be no food available for herbivores present in the ecosystem. In the absence of herbivores, various categories of carnivores will be affected. Since, all categories of organisms are linked through a food chain, removal of organisms of any trophic level will ultimately affect the ecosystem.

Q. 6. What is biological magnification? Will the levels of this magnification be different at different levels of the ecosystem?

Ans. The increase in concentration of harmful chemical substances (pesticides) in the body of living organisms at each trophic level of a food chain is called biological magnification.

The concentration of harmful chemicals will be different at different trophic level, because the animals at the highest trophic level or at the extreme right side of the food chain will have the maximum concentration of harmful chemicals in the body, and grass which is at the lowest trophic level will have minimum concentration of harmful chemicals.

Grass (Absorbs chemicals from soil) ⟶ Goat (Receives chemicals along with fodder) ⟶ Human (Receives chemicals with milk and meat)

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Q. 7. What are the problems caused by the non-biodegradable wastes that we generate?

Ans. The problems caused by the non-biodegradable wastes that we generate are:

(*i*) The non-biodegradable wastes cannot be decomposed by microorganisms like bacteria. So, the volume of these wastes will not decrease creating the problem of their disposal.

(*ii*) They have to be dumped on land. Hence, the land becomes unfit for other purposes.

(*iii*) Heavy metals present in industrial waste like copper, lead, nickel, mercury remain in the soil indefinitely. Slowly, they pass into vegetation and crops and thus harm both humans and animals.

(*iv*) Pesticides and other toxins pollute underground water, surface water and soil. The chemicals enter food chain thereby harming animals and humans, and the soil may become acidic or alkaline.

(*v*) In the process of removing recyclable materials from solid wastes, the rag-pickers are exposed to many diseases and toxins.

Q. 8. If all the waste we generate is biodegradable, will this have no impact on the environment?

Ans. If all the waste we generate is biodegradable, it will have impact on the environment. Biodegradable wastes pollute the environment only when the amount is large which cannot be degraded (or decomposed) into harmless substances in nature at the right time. Thus, the impact on the environment will depend upon the system of collecting, transporting and disposal of biodegradable waste.

Q. 9. Why is damage to the ozone layer a cause for concern? What steps are being taken to limit this damage?

Ans. Ozone layer is very important for the existence of life on Earth because it absorbs most of the harmful ultraviolet radiation coming from the Sun and prevents them from reaching the Earth. The ultraviolet radiations have extremely harmful effects on human beings, other animals as well as plants. For example, ultraviolet rays can cause skin cancer. They also damage the eyes by causing an eye disease called cataract. Ultraviolet rays damage immune system by lowering the body's resistance to diseases. Thus, ozone layer in upper atmosphere protect us from these diseases by absorbing ultraviolet rays coming from the Sun.

This decrease has been linked to synthetic chemicals like chlorofluorocarbons (CFCs) which are used as refrigerants and in fire extinguishers. In 1987, the United Nations Environment Programme (UNEP) succeeded in forging an agreement to freeze CFC production at 1986 levels. By developing substitutes to freeze CFCs; scientists have already developed some substitutes which are ozone friendly.

SELF-ASSESSMENT TEST

Time allowed: 1 hour **Max. marks: 40**

SECTION–A

Choose and write the correct answer for each of the following. **(4 × 1 = 4)**

1. Accumulation of non-biodegradable pesticides in the food chain in increasing amount at each higher trophic level is known as

(*a*) eutrophication (*b*) pollution

(*c*) biomagnification (*d*) accumulation

2. Depletion of ozone is mainly due to

(*a*) chlorofluorocarbon compounds (*b*) carbon monoxide

(*c*) methane (*d*) pesticides

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3. **Which group of organisms are not constituents of a food chain?**
   (*i*) Grass, rabbit, wolf **(*ii*) Plankton, man, fish, grasshopper**
   (*iii*) Wolf, grass, snake, tiger **(*iv*) Frog, snake, eagle, grass, grasshopper**
   (*a*) (*i*) and (*iii*) (*b*) (*iii*) and (*iv*)
   (*c*) (*ii*) and (*iii*) (*d*) (*i*) and (*iv*)

4. **The percentage of solar radiation absorbed by all the green plants for the process of photosynthesis is about**
   (*a*) 1 % (*b*) 5 %
   (*c*) 8 % (*d*) 10 %

The following questions consist of two statements—Assertion(A) and Reason(R). Answer these questions selecting the appropriate option given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation for *A*.
(*b*) Both *A* and *R* are true but *R* is not the correct explanation for *A*.
(*c*) *A* is true but *R* is false.
(*d*) *A* is false but *R* is true. **(3 × 1 = 3)**

5. **Assertion (*A*) :** The food in the ecosystem is preserved in a linear fashion.
   Reason (*R*) : Plants use the solar energy in reducing carbon dioxide to carbon.
6. **Assertion (*A*) :** Microorganisms decompose organic waste into harmless substances.
   Reason (*R*) : Biodegradable substances have a harmful effect on human life.
7. **Assertion (*A*) :** All energy from the producers is utilised by the consumers.
   Reason (*R*) : Organisms store chemical energy in the form of food.

Answer the following questions in one word or one sentence. **(3 × 1 = 3)**

8. Name of the habitat provided by water.
9. Name the compound responsible for depletion of ozone layer.
10. Write various steps of a terrestrial food chain of four tropic levels. *[CBSE 2019 (31/3/2)]*

SECTION–B

Answer the following questions in about 50-60 words each. **(5 × 3 = 15)**

11. (*i*) Why should National Parks be allowed to remain in their pristine form?
    (*ii*) Why is reuse of material better than recycling? *[CBSE 2019 (31/5/1)]*
12. Define an ecosystem. Draw a block diagram to show the flow of energy in an ecosystem. *[CBSE 2019 (31/1/1)]*
13. Name the wastes which are generated in your house daily. What measures would you take for their disposal? *[NCERT Exemplar]*
14. What is ten per cent law? How do our activities affect the environment?
15. In a village of South India people started cultivating crops all around a lake. They added fertiliser of their field in order to enhance the yield. Soon after it was discovered that the water body was completely covered with green floating plants and the aquatic animals started dying in large number.
    Analyse the situation and state reasons for the excessive growth of plants and death of aquatic animals in the lake. *[CBSE 2019 (31/3/2)]*

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SECTION–C

Answer the following questions in about 80–90 words each. **(3 × 5 = 15)**

16. Differentiate between food chain and food web.

17. (*i*) Draw a line diagram to show flow of solar energy in ecosystem.

(*ii*) Why is the government stressing upon the use of jute/cloth carry bags?

(*iii*) List any two artificial ecosystems.

18. (*i*) Which gas shields the surface of the Earth from the harmful UV-radiations from the Sun?

(*ii*) Mention one example each of biotic and abiotic components of ecosystem.

(*iii*) Identify which one of the following would have hazardous impact if it persists in the environment for a longtime.

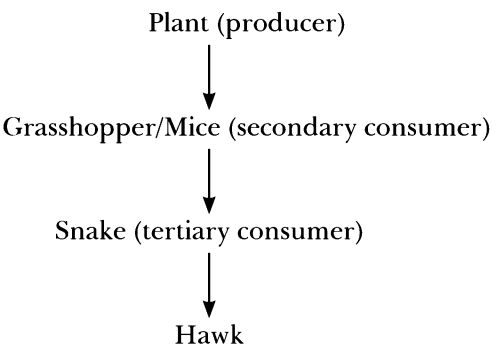
Plastic, vegetable waste, steel utensils.

Answers

1. (*c*) **2.** (*a*) **3.** (*c*) **4.** (*a*) **5.** (*b*) **6.** (*c*) **7.** (*d*)

8. Aquatic ecosystem **9.** Chlorofluorocarbons

10. **Terrestrial food chain**



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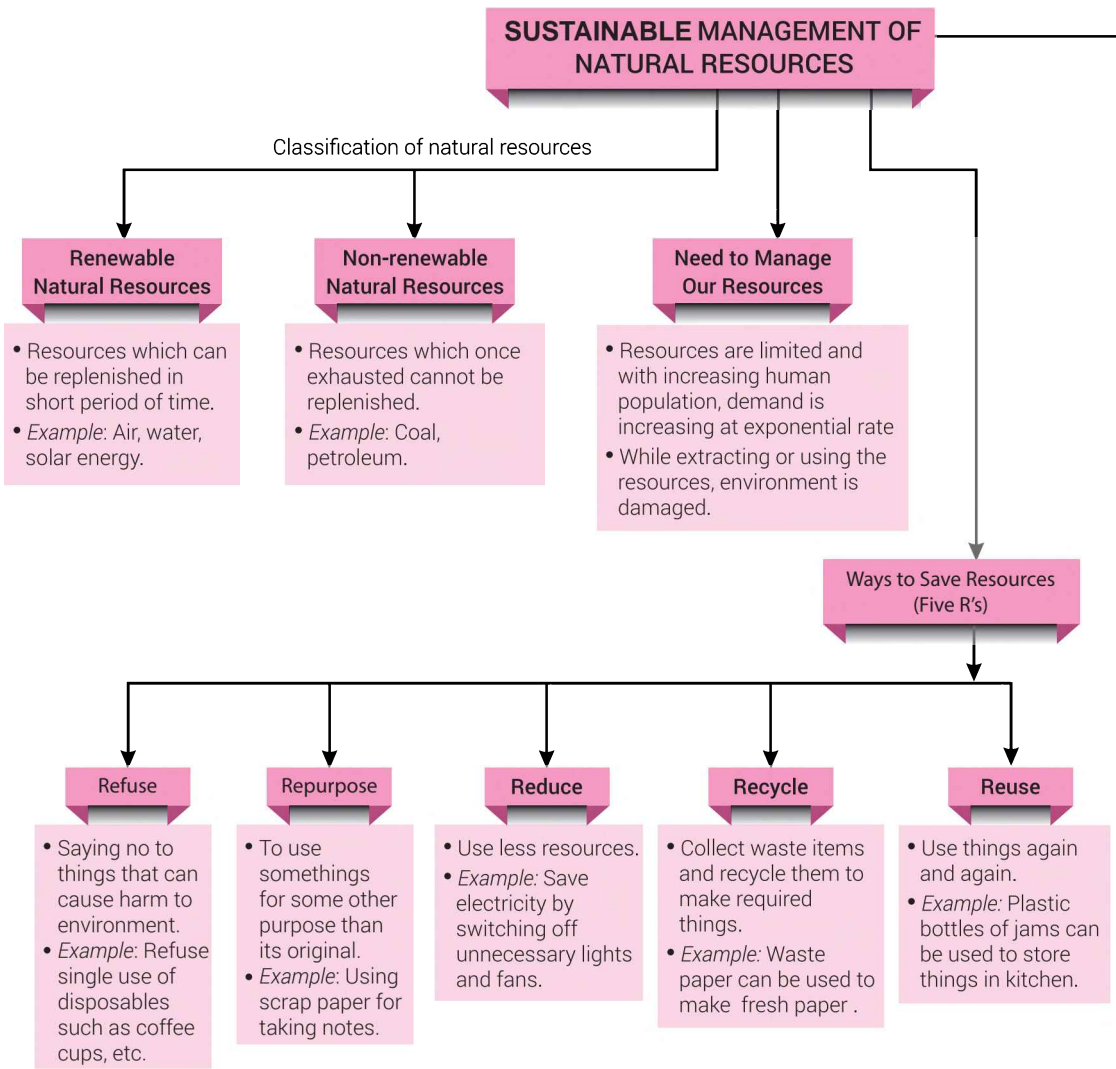
16 Sustainable Management of Natural Resources

BASIC CONCEPTS—A FLOW CHART



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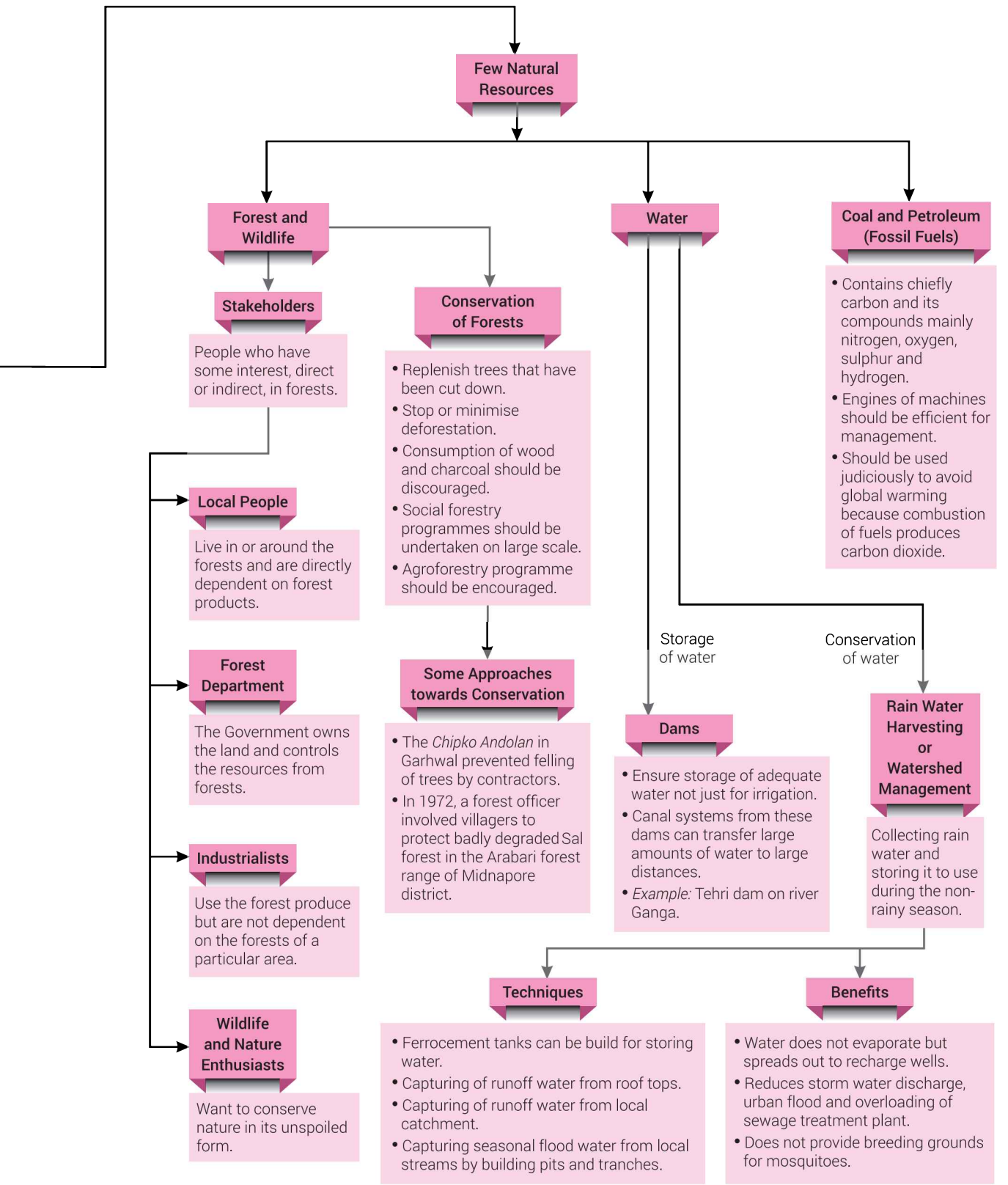

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MORE POINTS TO REMEMBER

- Pollution: It is an undesirable change in physical, chemical and biological characteristics of air, land and water which harmfully affects human lives or the lives of other species.
- **Coliform:** It is a group of bacteria, found in human intestines. Their presence in water is an indicator of contamination by disease-causing microorganisms.
- Criticism about large dams:
  - **Social problems:** They displace large number of farmers and tribals without adequate compensation.
  - **Economic problems:** They consume huge amount of public money without proportionate benefits.
  - **Environmental problems:** They cause deforestation and loss of biological diversity.
- The harnessing of water resources by building dams has social, economic and environmental implications. Alternatives to large dams exist. These are locale-specific and may be developed so as to give local people control over their local resources.
- **Fossil fuels:** The fossil fuels are obtained from the remains of plants and animals which got buried beneath the Earth millions of years ago and changed into coal, petroleum and natural gas due to excessive heat and high pressure inside the Earth.

Multiple Choice Questions [1 mark]

Each question has 4 choices (a), (b), (c) and (d). Choose and write the correct option.

1. **The most rapidly dwindling natural resource in the world is** [*NCERT Exemplar*]
   (*a*) water (*b*) forests (*c*) wind (*d*) sunlight
2. **The most appropriate definition of a natural resource is that it is a substance/commodity that is** [*NCERT Exemplar*]
   (*a*) present only on land.
   (*b*) a gift of nature which is very useful to mankind.
   (*c*) a man-made substance placed in nature.
   (*d*) available only in the forest.
3. **The pH of water sample collected from a river was found to be acidic in the range of 3.5 – 4.5, on the banks of the river were several factories that were discharging effluents into the river. The effluents of which one of the following factories is the most likely cause for lowering the pH of river water?** [*NCERT Exemplar*]
   (*a*) Soap and detergent factory (*b*) Lead battery manufacturing factory
   (*c*) Plastic cup manufacturing factory (*d*) Alcohol distillery
4. **The pH range most conducive for life of fresh water plants and animals is** [*NCERT Exemplar*]
   (*a*) 6.5–7.5 (*b*) 2.0–3.5 (*c*) 3.5–5.0 (*d*) 9.0–10.5
5. **Given below are a few statements related to biodiversity. Pick those that correctly describe the concept of biodiversity.**
   (*i*) Biodiversity refers to the different species of flora and fauna present in an area.
   (*ii*) Biodiversity refers to only the flora of a given area.
   (*iii*) Biodiversity is greater in a forest.

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(*iv*) **Biodiversity refers to the total number of individuals of a particular species living in an area.** [*NCERT Exemplar*]

(*a*) (*i*) and (*ii*) (*b*) (*ii*) and (*iv*) (*c*) (*i*) and (*iii*) (*d*) (*ii*) and (*iii*)

6. **Among the statements given below select the ones that correctly describe the concept of sustainable development.**
   (*i*) Planned growth with minimum damage to the environment.
   (*ii*) Growth irrespective of the extent of damage caused to the environment.
   (*iii*) Stopping all developmental work to conserve the environment.
   (*iv*) Growth that is acceptable to all the stakeholders. [*NCERT Exemplar*]
   (*a*) (*i*) and (*iv*) (*b*) (*ii*) and (*iii*) (*c*) (*ii*) and (*iv*) (*d*) (*iii*) only

7. **A successful forest conservation strategy should involve** [*NCERT Exemplar*]
   (*a*) protection of animals at the highest trophic level.
   (*b*) protection of only consumers.
   (*c*) protection of only herbivores.
   (*d*) comprehensive programme to protect all the physical and biological components.

8. **In our country, there are attempts to increase the height of several existing dams like Tehri and Almatti, dams, across Narmada. Choose the correct statements among the following that are a consequence of raising the height of dams**
   (*i*) Terrestrial flora and fauna of the area is destroyed completely.
   (*ii*) Dislocation of people and domestic animals living in the area.
   (*iii*) Valuable agricultural land may be permanently lost.
   (*iv*) It will generate permanent employment for people. [*NCERT Exemplar*]
   (*a*) (*i*) and (*ii*) (*b*) (*i*), (*ii*) and (*iii*) (*c*) (*ii*) and (*iv*) (*d*) (*i*), (*iii*) and (*iv*)

9. **Expand the abbreviation GAP.** [*NCERT Exemplar*]
   (*a*) Governmental Agency for Pollution Control (*b*) Gross Assimilation by Photosynthesis
   (*c*) Ganga Action Plan (*d*) Governmental Agency for Animal Protection

10. **Which of the following is not a natural resource?** [*NCERT Exemplar*]
    (*a*) Mango tree (*b*) Snake (*c*) Wind (*d*) Wooden house

11. **Select the wrong statement.** [*NCERT Exemplar*]
    (*a*) Forests provide variety of products. (*b*) Forests have greater plant diversity.
    (*c*) Forests do not conserve soil. (*d*) Forests conserve water.

12. **Arabari forests of Bengal is dominated by** [*NCERT Exemplar*]
    (*a*) Tea (*b*) Sal
    (*c*) Bamboo (*d*) Mangroove

13. **Opposition to the construction of large dams is due to** [*NCERT Exemplar*]
    (*a*) social reasons (*b*) economic reasons
    (*c*) environmental reasons (*d*) all the above

14. ***Khadins, Bundhis, Ahars* and *Kattas* are ancient structures that are examples for** [*NCERT Exemplar*]
    (*a*) grain storage (*b*) wood storage
    (*c*) water harvesting (*d*) soil conservation

15. **Pick the right combination of terms which has no fossil fuel.** [*NCERT Exemplar*]
    (*a*) Wind, ocean and coal (*b*) Kerosene, wind and tide
    (*c*) Wind, wood, Sun (*d*) Petroleum, wood, Sun

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16. **Select the eco-friendly activity among the following.** [NCERT Exemplar]
   (*a*) Using car for transportation.
   (*b*) Using polybags for shopping.
   (*c*) Using dyes for colouring clothes.
   (*d*) Using windmills to generate power for irrigation.

17. **It is important to make small check dams across the flooded gullies because they**
   (*i*) hold water for irrigation. (*ii*)hold water and prevent soil erosion.
   (*iii*) recharge ground water. (*iv*)hold water permanently. [NCERT Exemplar]
   (*a*) (*i*) and (*iv*) (*b*) (*iii*) and (*iv*) (*c*) (*ii*) and (*iii*) (*d*) (*ii*) and (*iv*)

18. **Which famous movement was started by women of Reni village in Garhwal?**
   (*a*) Bishnoi movement (*b*) Chipko movement
   (*c*) Appiko movement (*d*) Bahuguna movement

19. **Tehri dam is build over which of the following river?**
   (*a*) Kaveri (*b*) Narmada (*c*) Ganga (*d*) Bhagirathi

Answers

1. (*b*)	**2.** (*b*)	**3.** (*b*)	**4.** (*a*)	**5.** (*c*)	**6.** (*a*)	**7.** (*d*)
8. (*b*)	**9.** (*c*)	**10.** (*d*)	**11.** (*c*)	**12.** (*b*)	**13.** (*d*)	**14.** (*c*)
15. (*c*)	**16.** (*d*)	**17.** (*c*)	**18.** (*a*)	**19.** (*d*)		

Assertion-Reason Questions [1 mark]

The following questions consist of two statements — Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

1. **Assertion (*A*) :** Natural resources need to be used carefully.
   Reason (*R*) : Resources are finite in supply and human population is tremendously increasing.
2. **Assertion (*A*) :** Local people are the major stakeholders of the forest.
   Reason (*R*) : Actions of local masses do not result in depletion of natural resources.
3. **Assertion (*A*) :** Forest cover balances the temperature level of the area.
   Reason (*R*) : Forests reduce atmospheric pollution by absorbing carbon dioxide from the atmosphere.
4. **Assertion (*A*) :** Deforestation should be stopped or reduced to minimum.
   Reason (*R*) : Afforestation damages the top soil and lead to desertification.
5. **Assertion (*A*) :** Dams cause discontentment among people.
   Reason (*R*) : Local people are alienated from their land without adequate compensation.

Answers

1. (*a*)	**2.** (*d*)	**3.** (*b*)	**4.** (*c*)	**5.** (*a*)

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Passage-based Questions

Answer the questions below each passage on the basis of your understanding of the paragraph and the related studied concepts.

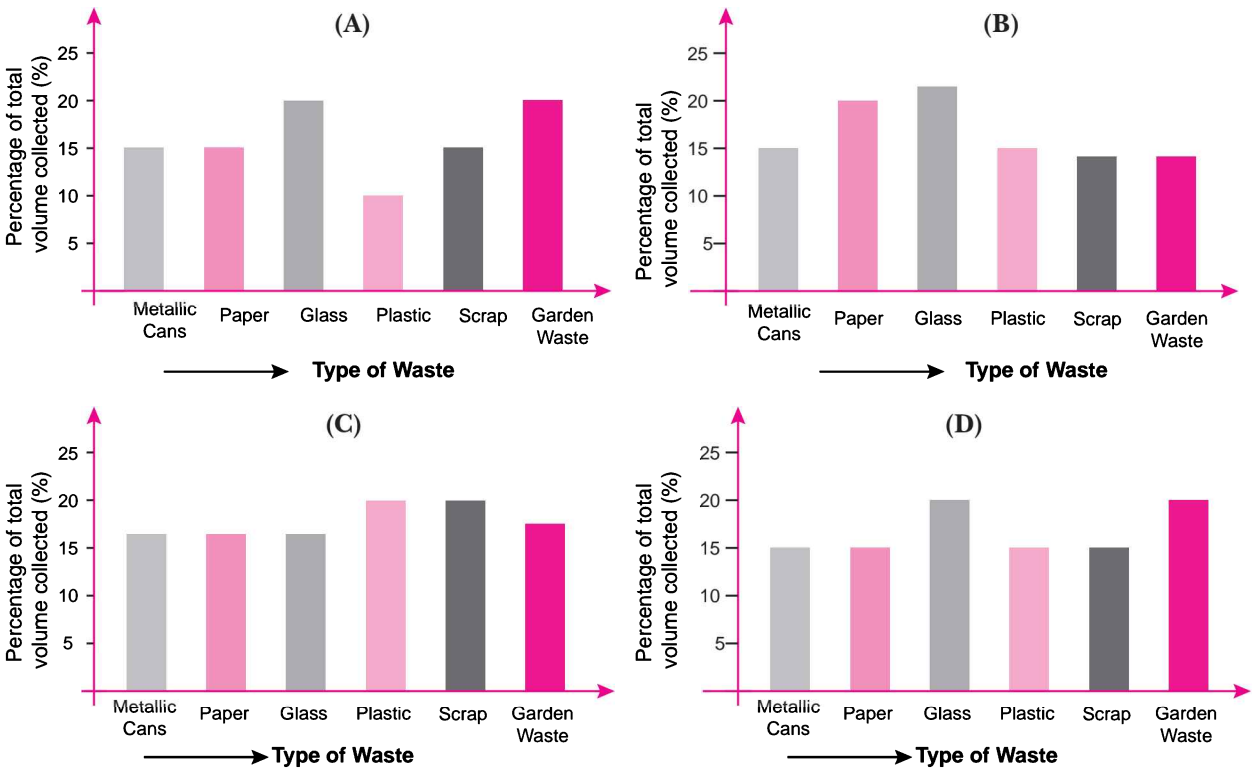
1. Disposal of solid waste materials has become one of the key environmental challenges in almost all major cities of the world. Changes in lifestyles and attitude of humans have resulted in greater amount of waste material particularly in urban areas. Municipal corporations and other local authorities have adopted different mechanisms to meet the emerging challenges.

A particular municipal council waste recycling depot collects various materials. They sort the metallic cans, glass, plastic and scrap metal and send them to other places for recycling. They recycle all other wastes at their own depot. The following table shows the waste material of different types out of the total waste of 20 kg collected at the depot.

No.	Type of Waste Material	Amount
1.	Metallic can	3 kg
2.	Paper	3 kg
3.	Glass	4 kg
4.	Plastic	3 kg
5.	Scrap Metal	3 kg
6.	Garden Waste	4 kg

(*i*) What percentage of metallic can, garden waste, paper and scrap metal wastes are collected at the depot itself?

(*ii*) Which one of the following corresponds to the correct bar graph for the above data?



(*a*) A

(*b*) B

(*c*) C

(*d*) D

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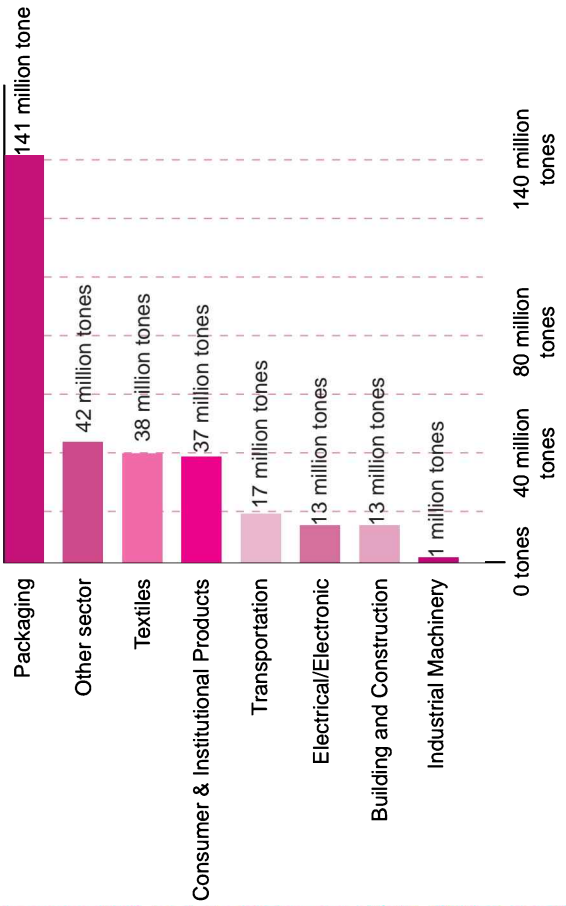
(*iii*) List any four items of waste from your household that can be used for composting.

(*iv*) Why are decomposers (*e.g.*, worms) important in composting? Explain briefly.

2. Wherever we look, we find plastics-be it a food packet, a toy, storage packing, any furniture or an electronic item. According to UN estimates, every year the world uses 500 billion plastic bags and half of this plastic is single-use plastic such as plastic bags, straws, cups, plates and bottles. Plastic is currently the biggest environmental concern. Plastic waste takes a lot of time to decompose naturally. It is harmful for animals who might eat it and can cause severe air pollution on burning. In oceans, pollution is mainly caused due to plastic wastes. Each year, at least eight million tonnes of plastic wastes are released into the oceans which means a full garbage truck every minute. This is damaging the marine life and also threatening human health.



Plastic waste generation by industrial sector, 2015. Global plastic waste generation by industrial sector, measured in tonnes per year

(*i*) Why has there been huge hue and cry against the use of single-use plastics?

(*ii*) The pH of ocean water as measured using pH paper is found to be 5. What does this pH tell us about the ocean water?

(*iii*) Based on the data shown in the graph that follows, which industrial sector produces the most plastic waste? Suggest the alternative that can be used in place of plastic in this sector?

(*iv*) Expand the five R's that help in reducing plastic wastes.

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Answers

1. (*i*) The total of different wastes collected at depot =

$$\underset{\text{(Metallic can)}}{3\text{ kg}} + \underset{\text{(Garden waste)}}{4\text{ kg}} + \underset{\text{(Paper)}}{3\text{ kg}} + \underset{\text{(Scrap metal)}}{3\text{ kg}} = 13\text{ kg}$$

Total waste collected at depot = 20 kg

Percentage of collected materials = $\frac{13}{20} \times 100 = 65\%$

(*ii*) (*d*)

(*iii*)
- Vegetable peels
- Tea bags
- Egg shell
- Fruit scraps

(*iv*) Worms eat food scraps which become compost as they pass through worm's body. This compost is used for growing plants.

2. (*i*) Non-biodegradable nature;

(*ii*) The pH 5 tells us that ocean water has become highly acidic.

(*iii*) Packaging sector produces the maximum plastic waste. Paper and cardboard can be used in place of plastic in this sector as these are reusable, recyclable and biodegradable.

(*iv*) **Refuse:** To say NO to single use plastic bags; **Reduce:** To reduce the use of plastic bags; **Reuse:** To use plastic bottles, container etc. again and again; **Repurpose:** To use the already used plastic object for any other useful purpose; **Recycle:** To collect plastic waste and make new things instead of synthesising fresh plastic.

Very Short Answer Questions [1 mark]

Each of the following questions are of 1 mark and have to be answered in one word or one sentence.

Q. 1. Define biodiversity.

Ans. The occurrence of different types of genes and species from all the habitat and ecosystem in a particular place and various parts of the Earth is called biodiversity.

Q. 2. Why maintaining a biodiversity is important?

Ans. Maintaining biodiversity is important because experiments and field studies suggest that a loss of biodiversity may lead to a loss of ecological stability.

Q. 3. List any two industries based on forest produce. *[CBSE 2019 (31/2/1)]*

Ans. Paper, timber, lac, sports equipments. *(Any two)*

Q. 4. A person lives near a forest. Make a list of four items which he can get from the forest to meet his daily needs.

Ans. Firewood, timber, thatch, bamboo, fruits, nuts, medicines. *(Any four)*

Q. 5. Name the award given in the memory of Amrita Devi Bishnoi.

Ans. Amrita Devi Bishnoi award for wildlife conservation.

Q. 6. Name the prominent ecologist who is responsible for *Chipko* movement.

Ans. Shri Sundarlal Bahuguna

Q. 7. Give one criticism about large dams.

Ans. Large dams consume large amount of public money without the generation of proportionate benefits.

Q. 8. What are biodiversity hotspots?

Ans. Biodiversity hotspots are regions rich in biodiversity.

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Q. 9. Give an example of a community for whom conservation of forest and wildlife has been a religious tenet.

Ans. For Bishnoi community in Rajasthan, conservation of forest and wildlife has been a religious tenet.

Short Answer Questions [3 marks]

Each of the following questions are of 3 marks and have to be answered in about 50-60 words each.

Q. 1. What are natural resources? State two factors that work against an equitable distribution of these resources.

Ans. Natural resources are the stocks of nature whether living or non-living, such as air, water, soil, animals and plants which are useful to the mankind.

Two factors that work against an equitable distribution of these resources are

(*i*) money and (*ii*) power.

Q. 2. How do advantages of exploiting natural resources with short term gains in mind differ from the advantages of managing our resources with a long-term perspective? *[CBSE Delhi 2017]*

Ans. Former leads to huge immediate profits or selfish gains while latter leads to sustainable approach so that the resource may last for future generations too.

Q. 3. What is meant by five types of 'R' (5-R's) to save the environment? Explain with examples how would you follow the 5-R's in your school to save the environment.

Ans. The five types of 'R' (5-R's) are Reduce, Reuse, Recycle, Repurpose, Reform. The 5-R's can be followed in the following ways:

—Switch off the fans and bulbs when not in use,

—Reuse of paper, polythene bags, etc.,

—Reduce the wastage of water/paper or any other item.

Q. 4. Write two advantages of sustainable management of natural resources. Out of the two – reuse and recycle – which is better and why? *[CBSE (F), (AI) 2015]*

Ans. Advantages:

(*i*) Provides the resources for the present generation.

(*ii*) Preserves the resources for the future generation as well.

Reuse is better than recycling because it does not involve use of energy.

Q. 5. Prepare a list of five items that you use daily in the school. Identify from the list such items that can be recycled. *[NCERT Exemplar]*

Ans. Paper, rexin bag, blade, pen, plastic box, scale, eraser, compass and dividers (metallic), steel lunch box and steel spoon are used in the school.

Paper, blade, plastic box, eraser, compass, steel lunch box and steel spoon can be recycled.

Q. 6. What is meant by wildlife? How is it important for us? *[CBSE Delhi 2017)*

Ans. Wildlife is naturally occurring plants, animals and their species which are not cultivated, domesticated or trained.

Its importance are :

(*i*) Helps in maintaining the ecological balance.

(*ii*) Provides great aesthetic value for human beings.

(*iii*) Have economical importance also.

Q. 7. What legislative measures are taken in India to conserve wildlife?

Ans. In India, several laws and acts have been passed from time to time in order to protect the degrading wildlife. Out of all, the Wildlife Protection Act of 1972 has been the most effective. Under this

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act, possession, trapping, shooting of wild animals alive or dead; serving their meat for eating in houses, using them as transport, etc., are completely under strict control or prohibited.

Q. 8. Mention two ways in which water harvesting can be undertaken.

Ans. The two ways by which water harvesting can be undertaken are:

(*i*) Capturing run-off water from roof tops.

(*ii*) Capturing run-off water from local catchments.

Q. 9. What is the impact of excessive irrigation and intensification of agriculture?

Ans. It has resulted in environmental degradation and creation of few waste lands. Water logging has ultimately caused development of saline soil.

Q. 10. Building of big dams gives rise to some problems. List three main problems that may arise. Suggest a solution to any one of these problems. [*CBSE (F) 2015*]

Ans. Problem that may arise would be :

(*i*) Social problems

(*ii*) Economic problems

(*iii*) Environmental problems.

Solution to these problems would be adequate rehabilitation, compensation to the displaced persons and afforestation.

Q. 11. What measures would you take to conserve electricity in your house? [*NCERT Exemplar*]

Ans. (*a*) Put off the fans and lights when they are not required.

(*b*) Maximum use of solar radiation.

(*c*) Use of solar water heating system during winters.

(*d*) Use of fluorescent tubes or CFL.

Q. 12. What is *Narmada Bachao Andolan*?

Ans. *Narmada Bachao Andolan* (Save the Narmada Movement) is a movement to protest about the height of Sardar Sarovar Dam on the river Narmada, thereby criticising large dams for addressing problems.

Q. 13. (*i*) Why do we need to manage our resources carefully?

(*ii*) Why management of natural resources requires a long term perspective? [*CBSE Delhi 2015*]

Ans. (*i*) The resources are limited and with a tremendous increase in human population, the demand for resources is increasing at an exponential rate. Therefore, we need to manage them carefully.

(*ii*) Long term perspective is required to meet the needs of the present as well as for the generations to come.

Q. 14. Why are coal and petroleum categorised as natural resources ? Give a reason as to why they should be used judiciously. [*CBSE (AI) 2017*]

Ans. Coal and petroleum are obtained from nature so they are categorised as natural resources.

They should be used judiciously because they are non-renewable resources which cannot be renewed within a short period of time.

Q. 15. Name any two endangered plant and animal species.

Ans. Endangered plant species—*Nepenthes khasiana* (Pitcher plant) and Snow orchid.

Endangered animal species—Indian Wild Ass and Great Indian Rhinoceros.

Q. 16. Name the river with which the following dams are associated.

(*i*) Tehri dam, **(*ii*) Sardar Sarovar dam**

Ans. (*i*) Tehri dam on the river Ganga.

(*ii*) Sardar Sarovar dam on the river Narmada.

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Q. 17. Although coal and petroleum are produced by degradation of biomass, yet we need to conserve them. Why? *[NCERT Exemplar][CBSE 2019 (31/2/3)]*

Ans. Both the energy sources, coal and petroleum, take millions of years for their formation. As these resources are being utilised at a much faster rate than their formation, they will be exhausted in the near future. Hence, they need to be conserved.

Q. 18. Name a greenhouse gas produced due to combustion of fossil fuels. Mention its bad effect to the environment.

Ans. The greenhouse gases produced are CO_2 and oxides of nitrogen and sulphur. These cause global warming.

Q. 19. List two problems that may arise by planting trees of single variety over vast tracts of a forest. *[CBSE (F) 2015]*

Ans. (*i*) Loss of biodiversity

(*ii*) Varied needs of the local people can no longer be met.

(*iii*) Degradation of soil. (*Any two*)

Q. 20. Why must we conserve our forests? List two factors responsible for causing deforestation. *[CBSE (AI) 2017]*

Ans. We must conserve forests because of the following reasons:

(*i*) Forests help in preventing soil erosion.

(*ii*) They protect biodiversity.

(*iii*) They maintain ground water level.

(*iv*) They help in rainfall.

(*v*) They provide raw materials.

(*vi*) They prevent floods. (*Any two*)

Deforestation is caused by:

(*i*) Exploitation by industries,

(*ii*) increase in population,

(*iii*) urbanization,

(*iv*) cattle grazing. (*Any two*)

Q. 21. What is water harvesting? How can this technique help in the conservation of water?

Ans. Water harvesting is a technique of capturing rain water when it falls and taking measures to keep the water clean.

This water is stored underground that remains unpolluted, it recharges wells and provides moisture for vegetation over a wide area.

Q. 22. List two advantages associated with water harvesting at the community level. *[NCERT Exemplar, CBSE 2019 (31/2/2), CBSE (AI) 2017, CBSE Delhi 2015, (F) 2015]*

Ans. Advantages of water harvesting at community level:

(*i*) Recharges ground water. (*ii*) Mitigates floods and droughts.

(*iii*) Brings rivers and wells back to life and makes more water available. (*Any two*)

Q. 23. List any two advantages associated with water stored in the ground. *[CBSE (AI) 2015]*

Ans. Advantages of water stored in the ground are:

(*i*) Recharges the ground water.

(*ii*) Prevents evaporation of water.

(*iii*) Prevents breeding of mosquitoes.

(*iv*) Prevents contamination.

(*v*) Mitigates flood and drought. (*Any two*)

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Q. 24. What is meant by "sustainable management"? Why is reuse considered better than recycling? *[CBSE Delhi 2015]*

OR

What is sustainable management ? Why is reuse considered better in comparison to recycle? *[CBSE Delhi 2017]*

Ans. A type of management which encourages utilisation of resources that meet current basic human needs while preserving the resources for the needs of future generations is called sustainable management.

Reuse is better as it does not consume energy.

Q. 25. List any two causes for the failure of sustained availability of ground water.

Ans. (*i*) Loss of vegetation cover. (*ii*) Diversion for high water demanding crops.
(*iii*) Pollution from industrial effluents. (*iv*) Dumping of urban waste. (*Any two*)

Q. 27. Management of forest and wild life resources is a very challenging task. Why ? Give any two reasons. *[CBSE Delhi 2017]*

Ans. (*i*) Space (Clearing forests) is needed for developmental activities.
(*ii*) Our selfish attitude/ No respect for natural resources.

Q. 28. State two advantages of conserving (*i*) forests, and (*ii*) wildlife. *[CBSE (AI) 2017]*

Ans. (*i*) Conserving forests helps in (*a*) retaining subsoil water and (*b*) checking floods. (*any other*)
(*ii*) Conserving wildlife helps in (*a*) maintaining ecological balance and (*b*) protecting the nature. *(or any other)*

Q. 29. Why is an equitable distribution of resources essential in a society ? List three forces which are against such distribution. *[CBSE (AI) 2017][CBSE 2019 (31/1/2)]*

Ans. Equitable distribution of resources is essential in a society so that the resources reach every individual or has equal rights on usage of resources. It also avoids division of society.

Forces against it are:

(*i*) More exploitation by industrialists for developmental activities.

(*ii*) Overuse of resources by greedy people, black marketers.

(*iii*) Improper management which has lead to access of natural raw materials to certain groups of people only.

Q. 30. You being an environmentalist are interested in contributing towards the conservation of natural resources. List four activities that you can do on your own. *[CBSE (AI) 2017]*

Ans. (*i*) Using public transport (*ii*) Limited use of fossil fuels
(*iii*) Using bicycles to go to short distances (*iv*) Rain water harvesting.

Q. 31. (*i*) Distinguish between renewable and non-renewable sources of energy.

(*ii*) Choose the renewable sources of energy from the following list:

Coal, biogas, Sun, natural gas

Ans. (*i*)

Renewable Sources of Energy	Non-renewable Sources of Energy
1. Those sources of energy which are being produced continuously in nature and are inexhaustible are called renewable sources of energy.	1. Those sources of energy which have been accumulated in nature over a long time and cannot be quickly replaced if once exhausted are called non-renewable sources of energy.
2. Renewable sources of energy are available in unlimited quantities. Example: Air, water, solar radiation, etc.	2. Non-renewable sources of energy are available in limited quantity. Example: Coal, petroleum, natural gas, etc.

(*ii*) Renewable sources of energy from the above list are Sun and biogas.

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Q. 32. Why are forests considered 'biodiversity hotspots'? List two ways in which an individual can contribute effectively to the management of forests and wildlife.

[CBSE (F) 2017, Delhi 2015] [CBSE 2019 (31/3/1)]

Ans. Forests are considered 'biodiversity hotspots' because large number of life forms (such as bacteria, fungi, fern, nematodes, insects, birds, reptiles, mammals, gymnosperms and angiosperms) are found there. These are the regions with large biodiversity of endangered species, many of them being highly endemic. Such regions are being subjected to large scale destruction and hence are called 'hotspots' by ecologists.

Ways in which an individual can contribute:

(*i*) Not allowing cutting of trees.

(*ii*) Promoting or making people aware about the importance of forests and wildlife.

(*iii*) Not using wildlife products like fur coat or any other named product. (*Any two*)

Q. 33. Why is replenishment of forest necessary? State four reasons.

Ans. The replenishment of forest is necessary because of the following reasons:

(*i*) It is used to conserve soil.

(*ii*) It provides shelter to wild animals.

(*iii*) It reduces atmospheric pollution.

(*iv*) It controls flood and increases frequency of rainfall.

Q. 34. Explain giving example where active involvement of local people lead to efficient management of forest. *[CBSE Delhi 2016]*

Ans. In West Bengal, the Sal forests had been very badly degraded. A forest officer involved villagers in protection of Sal forest and gave them employment in silviculture and harvesting operations. Villagers were allowed to collect firewood and fodder on a nominal payment. Within a period of 10 years the previously worthless forests became valuable.

Q. 35. List two main causes of the pollution of water of the river Ganga. State how pollution and contamination of river water prove harmful for the health of the people of neighbouring areas. *[CBSE (AI) 2015]*

Ans. Causes for pollution of water of river Ganga:

(*i*) Dumping of untreated sewage

(*ii*) Industrial wastes

Effects:

(*a*) Growth of disease-causing microorganisms in the river water.

(*b*) The river water becomes more acidic which makes the soil acidic and affects the productivity of crops.

Q. 36. Why must we conserve our forests? List any two causes for deforestation taking place.

Ans. We must conserve our forests for the following reasons:

(*i*) Forests produce a large number of products of commercial use such as timber, raw materials for the manufacture of paper, bidi leaves, gums, resins, essential oils. Thus, forests helps in economic development.

(*ii*) One of the main aims of conservations is to try and preserve the biodiversity we have inherited because loss of biodiversity may lead to a loss of ecological stability.

Two causes of deforestation are:

(*i*) Indiscriminate felling (*i.e.*, cutting) of trees for the purpose of timber, fuel and individual demand of wood.

(*ii*) Overgrazing by a large livestock population.

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Q. 37. List any four measures for conserving forests.

OR

List four measures that can be taken to conserve forests. *[CBSE Delhi 2015]*

Ans. (*i*) Replenish the trees cut down for timber by planting more trees so that there is no scarcity.

(*ii*) Consumption of wood and charcoal should be discouraged. Instead, use conventional sources of energy such as biogas.

(*iii*) Deforestation should either be stopped or reduced to minimum and should be followed by reforestation.

(*iv*) Acute participation of local people need to be taken for the conservation of forests.

Q. 38. Explain the role of forests in conserving the environment. How do the forests get depleted? State two consequences of deforestation on the environment? *[CBSE 2019 (31/4/3)]*

Ans. Role of forests in conservation of environment:

(*i*) Prevent soil erosion and help in maintaining fertility of soil.

(*ii*) They provide shelter to wild animals and are areas that sustain biodiversity.

(*iii*) They reduce atmospheric pollution.

(*iv*) They increase humidity and frequency of rainfall.

The forests get depleted due to forest fires, urbanisation, industrialisation, overgrazing by animals, etc.

The consequences of deforestation will be:

(*i*) Change in climate and global warming.

(*ii*) Soil erosion and floods.

(*iii*) Extinction of wildlife, etc.

Q. 39. Suggest a few measures for controlling carbon dioxide levels in the atmosphere. *[NCERT Exemplar]*

Ans. (*i*) Reduce the consumption of petrol in the automobiles.

(*ii*) Use of CNG or clean fuel.

(*iii*) Instead of burning litter prepare manure out of it.

(*iv*) Treatment of smoke to remove harmful gases before discharging into the atmosphere.

(*v*) Plant more trees.

Q. 40. (*i*) Locate and name the water reservoirs in Figure (a) and (b).

(*ii*) Which has an advantage over the other and why? *[NCERT Exemplar]*

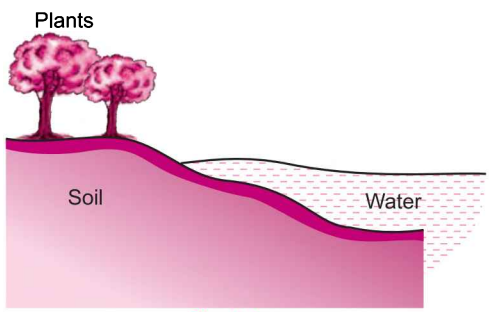

Fig. (a)

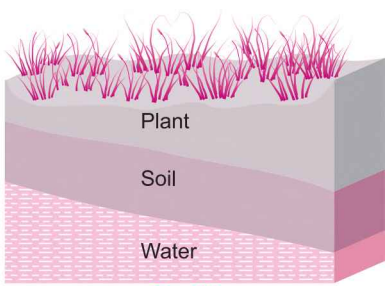

Fig. (b)

Ans. (*i*) The water reservoir is a pond in Figure (*a*) and underground water body in Figure (*b*).

(*ii*) Figure (*b*) has more advantage than Figure (*a*) because the advantages of water stored in the ground is more than water stored in a pond. For example:

(*a*) It does not evaporate.

(*b*) It spreads out to recharge wells.

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(*c*) Provides moisture for vegetation over a wide area.
(*d*) It is protected from contamination by animal and human wastes.
(*e*) It prevents breeding of insects.

Q. 41. List four stakeholders which may be helpful in the conservation of forests. [*CBSE (AI) 2016*]

Ans. The four stakeholders are:
(*i*) Local people living in villages near the forest.
(*ii*) Industrialists who use forest produce as raw materials.
(*iii*) Wild life and nature enthusiasts.
(*iv*) Forest department of the government.

Q. 42. List any four changes you would like to incorporate in your lifestyle in a move towards a sustainable use of available resources in our country.

Ans. (*i*) Save electricity by switching off unnecessary lights and fans.
(*ii*) Reuse of used envelopes, plastic bottles.
(*iii*) Opt for carpool.
(*iv*) Cycling to school.

Q. 43. In a village in Karnataka, people started cultivating crops all around a lake which was always filled with water. They added fertilisers to their field in order to enhance the yield. Soon they discovered that the water body was completely covered with green floating plants and fishes started dying in large numbers.

Analyse the situation and give reasons for excessive growth of plants and death of fish in the lake. [*NCERT Exemplar*]

Ans. Since people used excessive fertilisers in the fields, they were carried down to the lake during rains. As many fertilisers contain phosphates and nitrates, the water body became enriched with these chemicals. These chemicals promote excessive growth of aquatic plants and the surface of water was completely covered with plants (eutrophication).

Depletion of light in the water body and insufficient availability of dissolved oxygen and nutrients resulted in the death of fish.

Q. 44. We often observe domestic waste decomposing in the bylanes of our homes. List four ways to make the residents aware that the improper disposal of wastes is harmful to the environment and also for their own health. [*CBSE (AI) 2015*]

Ans. Residents can be made aware by following ways:
(*i*) Organising street plays,
(*ii*) Distributing pamphlets to the residents,
(*iii*) Reuse/recycle of the waste products,
(*iv*) Calling meeting of residents, welfare society/association of the locality,
(*v*) Advertisements through TV/radio,
(*vi*) Putting posters/hoardings,
(*vii*) Segregation of the wastes as per the nature of the waste.

Q. 45. What is biodiversity? What will happen if biodiversity of an area is not preserved? Mention one effect of it. [*CBSE (AI) 2015*]

Ans. The variety of life forms found in a particular region forms its biodiversity.
If biodiversity of an area is not preserved, it will result in:
(*i*) Natural calamities such as floods, forest fires and hurricanes.
(*ii*) Soil erosion and desertification because of deforestation.

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(*iii*) Large-scale habitat losses and extinction of vulnerable animal and plant species.
(*iv*) Sudden climatic changes and instability in the functioning of the ecosystem.
The effect of biodiversity loss would be disturbance of ecosystem balance.

Q. 46. What was *Chipko Andolan* ? How did this *Andolan* ultimately benefit the local people and the environment? [*CBSE (F) 2017, CBSE (AI) 2016*]

Ans. '*Chipko Andolan*' (Hug the Trees Movement) was a movement started by women of Reni village in Garhwal, who hugged the tree trunks preventing the contractors from felling the trees.

This *Andolan* quickly spread to other parts of the country and forced the government to rethink their priorities in the use of forest produce. Consequently, the local people were benefitted.

The environment was saved from permanent damage. It affected the quality of soil and the sources of water were affected in a good way.

Q. 47. List three advantages each of [*CBSE 2019 (31/1/3)*]

(*i*) exploiting resources with short term aims, and

(*ii*) using a long term perspective in managing our natural resources.

Ans. (*i*) Advantages of exploiting resources with short term aims:

(*a*) It fulfills the requirements of present generation only.
(*b*) It provides industrial growth.
(*c*) It improves lifestyle of people.

(*ii*) Advantages of using long-term perspective in managing our natural resources are:

(*a*) Resources will last for future generations.
(*b*) Equal distribution of resources.
(*c*) Prevention of ecological imbalance, thus no damage to the environment will be caused.

Long Answer Questions [5 marks]

Each of the following questions are of 5 marks and have to be answered in about 80-90 words each.

Q. 1. Prepare a list of five activities that you perform daily in which natural resources can be conserved or energy utilisation can be minimised. [*NCERT Exemplar*]

Ans. (*i*) Unused water in the water bottle may be used for watering plants.
(*ii*) Close all the taps before you go to sleep.
(*iii*) Avoid using a hose pipe for watering plants and instead use a mug.
(*iv*) Wash vehicles only when they are dirty.
(*v*) Use fan and light only when required.
(*vi*) Use solar water heating devices.
(*vii*) Use CFL in place of conventional bulbs/tubes. (*Any five*)

Q. 2. What is the importance of forest as a resource? [*NCERT Exemplar*]

Ans. Forests are renewable resources which

(*i*) provide habitat, food and protection to wildlife.
(*ii*) help in balancing CO_2 and O_2 of atmosphere.
(*iii*) improve water holding capacity of soil.
(*iv*) regulate water cycle.

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(*v*) are the source for all essential commodities like fuel wood, timber, pulp and paper, etc., for human beings.

(*vi*) provide useful products like fruits, resins, gums, essential oils, etc.

Q. 3. Suggest a few useful ways of utilising waste water. *[NCERT Exemplar]*

Ans. Waste water can be used for the following ways:

(*i*) For recharging the ground water.

(*ii*) Can be used for irrigation.

(*iii*) Treated municipal water can be used for washing cars or watering the gardens.

(*iv*) Certain pollutants in sewage water can become fertiliser for various crops.

Q. 4. Explain some harmful effects of agricultural practices on the environment.

Ans. (*i*) Excessive use of fertilisers changes the chemistry of soil and kills useful microbes.

(*ii*) Excessive use of non-biodegradable chemical pesticides leads to biological magnification.

(*iii*) Extensive cropping causes loss of soil fertility.

(*iv*) Damage to natural ecosystem or habitat.

(*v*) Excessive use of ground water for agriculture lowers the water table.

Q. 5. (*i*) What is sustainable development ? Why is it necessary ?

(*ii*) What is water harvesting ? List its four benefits. *[CBSE Delhi (Comp.) 2017]*

Ans. (*i*) Sustainable development is the practice of using natural resources in such a manner that environment is not harmed and energy is saved for future generations.

It is necessary to provide and preserve the resources for future generation. In the process of exploiting the resources, man has generated problems for the present and future generations in the form of pollution, global warming and climate change. To reduce the effects sustainable development is important.

(*ii*) Water harvesting is the method of collecting rain water and storing it to use during the non-rainy season.

Four advantages of water harvesting are:

(*a*) Water collected in ground does not evaporate, but spreads out to recharge wells and provides moisture for vegetation over a wide area.

(*b*) The groundwater is also relatively protected from contamination by human and animal waste.

(*c*) It provides year round supply of drinking water.

(*d*) It does not provide breeding grounds for mosquitoes like stagnant water collected in ponds or artificial lakes.

Q. 6. In the context of conservation of natural resources, explain the terms reduce, recycle and reuse. From among the materials that we use in daily life, identify two materials for each category. *[NCERT Exemplar]*

Ans. **Reduce** means to use a material or commodity in lesser quantity, e.g., electricity and water.

Recycle means a material that is used once is collected and set back to a manufacturer so that they can make some other useful material from it.

E.g., plastic cups and buckets, glass tumbler, paper, metal objects.

Reuse means using a thing over and over again instead of throwing it away. It does not involve the process of recycling either in small or in large scale. *E.g.*, used envelopes, plastic carry bags, bottles of jam.

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HOTS [Higher Order Thinking Skills]

Q. 1. What is the slogan of *Chipko* movement?

Ans. The slogan of *Chipko* movement is 'ecology is permanent economy'.

Q. 2. List any four changes you would like to incorporate in your lifestyle in a move towards a sustainable use of available resources in our country.

Ans. Four changes I would like to incorporate in my lifestyle in a move towards a sustainable use of available resources are:

(*i*) I will collect plastic, paper, glass and metal items and recycle them to use again.

(*ii*) I will save electricity by switching off unnecessary lights and fans.

(*iii*) I will prefer walking or cycling than using vehicles.

(*iv*) I will use potable water for drinking purpose only.

Q. 3. Prejudice against traditional use of forest areas has no basis. Explain giving an example.

Ans. In many forests, the local population may not be allowed to use forests in the manner they have been using them for generations.

This may sometimes be harmful for the sustainability of forests.

When the nomadic shepherds were not allowed in the alpine meadows of The Great Himalayan National Park to graze their sheep, it had an adverse affect on the growth of grass. Without regular grazing by sheep, the grass grew very tall and then fell over preventing fresh growth.

Q. 4. Why are local needs and local knowledge of forest dwellers important for maintaining forests?

Ans. Needs and knowledge of the local people needs to be given due consideration for maintaining forests. This gives an insight on how the resources can be used in a sustainable manner.

When vast area of forest land was converted to monocultures of pine, teak, eucalyptus, etc., a large amount of biodiversity was destroyed and needs of local people (leaves for fodder, herbs for medicines, fruits and nuts for food) could no longer be met from such forests.

Q. 5. Is water conservation necessary? Give reasons. *[NCERT Exemplar]*

Ans. The total amount of fresh water is more than enough to meet the needs of human beings. But its uneven distribution, wide seasonal as well as yearly fluctuation in rainfalls and water shortage are chronic problems in most parts of the world. To overcome these issues, water conservation is a necessity.

Q. 6. Why are the Arabari forests of Bengal known to be a good example of conserved forest? *[NCERT Exemplar]*

Ans. The forest department developed a strategy in which the villagers were involved in the protection of the forest. In return for the labour, the villagers were paid and also had some benefit in harvesting operations. They were allowed to collect wood and fodder on payment of nominal fee. In this way, by the active and willing participation of the local people, the Sal forests of Arabari were conserved.

Q. 7. "Reuse is better than recycling of materials". Give reason to justify this statement. *[CBSE Delhi 2016]*

Ans. Reuse refers to the use of the same material again and again.

In reuse of materials no energy is consumed and the resources are saved.

In recycling certain used materials are converted into other useful materials.

In recycling of materials, energy is consumed and the resources may be wasted.

Thus, it can be said that reuse is better than recycling.

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NCERT Corner

NCERT Intext Questions

Q. 1. What changes can you make in your habits to become more environment friendly?

Ans. We can make the following changes in our habits to become more environment friendly:

(*i*) We must collect plastic, paper, glass and metal items and recycle and reuse them to make the required things instead of synthesising fresh plastic, paper, glass or metals.

(*ii*) By closing the taps when water is not needed.

(*iii*) By planting trees.

(*iv*) Save the energy by switching off unnecessary lights and fans.

(*v*) Reducing the use of non-renewable energy sources like petrol, diesel, etc.

Q. 2. What would be the advantage of exploiting resources with short-term aims?

Ans. Exploiting resources with short-term aims provide immediate advantages that meet current basic human needs.

Q. 3. How would these advantages differ from the advantages of using a long-term perspective in managing our resources?

Ans. Exploiting resources with short-term aim is beneficial for the present generation to meet current basic human needs while using with a long-term perspective aims to fulfil the need of future generation. A long-term perspective in managing our resources is a sustainable practice that enables the present generation to use natural resources judiciously so that their availability is ensured for the future generations too.

Q. 4. Why do you think there should be equitable distribution of resources? What forces would be working against an equitable distribution of our resources?

Ans. The management should ensure equitable distribution of resources, so that both rich and poor are benefitted. Powerful and rich people take advantage of their influence and get more benefit as compared to poor people. The money and power are important factors which work against the distributions of our resources.

Q. 5. Why should we conserve forests and wildlife?

Ans. There are large number of species of both plants and animals that are found in the forests. However, the range of different life forms (bacteria, fungi, ferns, flowering plants, nematodes, insects, birds, reptiles and so on) is also important. One of the main aims of conservation is to try and preserve the biodiversity we have inherited. Experiments and field studies suggest that a loss of diversity may lead to a loss of ecological stability.

Q. 6. Suggest some approaches towards the conservation of forests. *[CBSE 2019 (31/3/1)]*

Ans. The following measures are suggested for the conservation of forests:

(*i*) Plantation of indigenous or exotic species to develop forests in all the available land.

(*ii*) Indiscriminate felling of trees for the purpose of timber must be reduced.

(*iii*) The forest reserves must be protected from fuel-starved villagers, fodder-starved cattles and commercial exploitation.

(*iv*) Participation of local people and villagers must be taken in conservation of forests and they should be given proper employment.

Q. 7. Find out about the traditional systems of water harvesting/management in your region.

Ans. The traditional system of water harvesting/management in our region are ponds, pits and lakes where rainwater is stored.

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Q. 8. Compare the above system with the probable systems in hilly/mountainous areas or plains or plateau regions.

Ans. Water harvesting system in the hilly areas are quite different from those of plain areas. Parts of Himachal Pradesh had evolved the local system of canal irrigation called kulhs over four hundred years ago. The water flowing in the streams was diverted into man-made channels which took this water to numerous villages down the hillside. The management of the water flowing in these kulhs was done by a common agreement between all the villages. Interestingly, during the planting season, water was first used by the village farthest away from the source of the kulh, then by villages progressively higher up. These kulhs were managed by two or three people who were paid by the villagers. In addition to irrigation, water from these kulhs also percolated into the soil and fed springs at various points.

Q. 9. Find out the source of water in your region/locality. Is water from this source available to all people living in that area?

Ans. The sources of water in my locality is groundwater through handpump and the municipality supply. Sometimes, especially in summer season, water from these sources becomes scant. In my locality, water is available to all the people.

NCERT Exercises

Q. 1. What changes would you suggest in your home in order to be environment friendly?

Ans. By persuing the five 5R's, *i.e.*, Refuse, Reduce, Recycle, Repurpose, Reuse.

(*i*) **Refuse:** It means to say 'No' to waste or to things that cause harm to environment. For example, saying no to the use of any plastic kitchenware at home, not using fluorescent bulbs and lights, etc.

(*ii*) **Reduce:** It means to use less. I would save electricity by switching off unnecessary lights and fans, prefer walking on cycling than using an automobile, turn off the engine of car at red light, repair leaky taps, and would not waste food etc.

(*iii*) **Recycle:** Means to collect used things like plastic, paper, glass and metal items and recycle these materials to make required things instead of synthesising or extracting fresh plastic, paper, glass or metal.

(*iv*) **Reuse:** Refers to use things again and again. For example, instead of throwing away used envelopes, they can be used by reversing.

(*v*) **Repurpose:** It means to upcycle *i.e.*, altering something you already have. So to use it for something different. Like turning old clothes into cleaning rags, using cartoons, containers for storing, etc.

Q. 2. Can you suggest some changes in your school which would make it environment friendly?

Ans. The changes that would make my school environment friendly are:

(*i*) Saving energy by turning off lights that we are not using.

(*ii*) I will suggest to buy recycled paper for decoration and other purposes instead of plastic materials.

(*iii*) Use writing paper on both the sides.

(*iv*) To grow plant and trees all around the playground.

Q. 3. We saw in this chapter that there are four main stakeholders when it comes to forests and wildlife. Which among these should have the authority to decide the management of forest produce? Why do you think so?

Ans. The local people who live in or around forests should have the authority to decide the management of forest produce. These people know the practices to use the resources in sustainable manner.

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These people have been using the forest and wildlife resources since the ancient times without harming or causing any environment damage. However, they should be constantly checked and guided by environmentalists and ecologists.

Q. 4. How can you say that an individual can contribute or make a difference to the management of
(*i*) Forests and wildlife, (*ii*) Water resources, and
(*iii*) Coal and petroleum?

Ans. (*i*) Forests and wildlife:

(*a*) I will stress on the conservation of biodiversity.

(*b*) I will prevent cutting down of trees in forest, this will itself protect the habitat of wild animals.

(*c*) I will try to educate people on the importance of forests and their role in our life.

(*ii*) Water resources:

(*a*) I will stress on the conservation of water by turning off the tap while brushing or shaving.

(*b*) I will use potable water for drinking purpose only and not for cleaning car, or giving water to plant.

(*c*) The judicious use of water is essential to avoid undue wastage of water.

(*d*) I will adopt rainwater harvesting system.

(*iii*) Coal and Petroleum: These are the main sources of energy today. We can save them in many ways. For example :

(*a*) Using fluorescent tubes instead of lamps using fossil fuels.

(*b*) Using solar devices instead of fossil fuels.

(*c*) Prefer walking or cycling rather than using vehicles or using public transport to save petrol.

(*d*) I will get my car properly tuned to improve fuel efficiency.

Q. 5. What can you as an individual do to reduce your consumption of the various natural resources?

Ans. As an individual, I will try my best to use or consume only minimum and the required amount of food, clothes, toys, books and electricity.

Q. 6. List five things you have done over the last one week to:
(*i*) Conserve our natural resources.
(*ii*) Increase the pressure on our natural resources.

Ans. (*i*) Five things that I have done over the last one week to conserve our natural resources are:

(*a*) Saved electricity by switching off unnecessary lights.

(*b*) Repaired leaky taps for saving water.

(*c*) Used empty glass bottles of jams for storing purpose.

(*d*) Used empty plastic bottles of jams for storing purpose.

(*e*) I have not purchased plastic toys.

(*f*) I have not used petroleum products. (*Any five*)

(*ii*) Five things which I have done over the last week to increase the pressure on our natural resources:

(*a*) I did not switch off my room's light last night.

(*b*) Wasted food.

(*c*) Wasted water during bathing.

(*d*) Frequently used heating devices.

(*e*) Visited my friends house in a car.

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Q. 7. On the basis of the issues raised in this chapter, what changes would you incorporate in your lifestyle in a move towards a sustainable use of our resources?

Ans. I would incorporate the maximum use of the Five R's, *i.e.*, refuse, repurpose, reduce, recycle and reuse in my lifestyle in a move towards sustainable use of our resources.

SELF-ASSESSMENT TEST

Time allowed: 1 hour **Max. marks: 40**

SECTION–A

Choose and write the correct answer for each of the following. (4 × 1 = 4)

1. The main cause for abundant coliform bacteria in the river Ganga is

(*a*) disposal of unburnt corpses into water.

(*b*) discharge of effluents from electroplating industries.

(*c*) washing of clothes.

(*d*) immersion of ashes.

2. In our country, vast tracts of forests are cleared and a single species of plant is cultivated. This practice promotes

(*a*) biodiversity in the area.

(*b*) monoculture in the area.

(*c*) growth of natural forest.

(*d*) preserves the natural ecosystem in the area.

3. The important message conveyed by the 'Chipko Movement' is

(*a*) to involve the community in forest conservation efforts.

(*b*) to ignore the community in forest conservation efforts.

(*c*) to cut down forest trees for developmental activities.

(*d*) government agencies have the unquestionable right to order destruction of trees in forests.

4. Ground water will not be depleted due to

(*a*) afforestation.

(*b*) thermal power plants.

(*c*) loss of forest, and decreased rainfall.

(*d*) cropping of high water demanding crops.

The following questions consist of two statements—Assertion(A) and Reason(R). Answer these questions selecting the appropriate option given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation for *A*.

(*b*) Both *A* and *R* are true but *R* is not the correct explanation for *A*.

(*c*) *A* is true but *R* is false.

(*d*) *A* is false but *R* is true. (3 × 1 = 3)

5. Assertion (*A*) : In Ancient days, people did not have knowledge about water conservation.
Reason (*R*) : Water harvesting techniques have applications in urban as well as rural areas.

6. Assertion (*A*) : Fossil fuels have chemical energy stored in them.
Reason (*R*) : Coal and petroleum are inexhaustible resources.

7. Assertion (*A*) : Avoid using car for short distances, instead either walk or use a bicycle.
Reason (*R*) : Non-renewable energy sources should be conserved by reducing their use.

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Answer the following questions in one word or one sentence. **(3 × 1 = 3)**

8. Name the only source of timber, wood, fuel , etc.

9. How can floods be prevented?

10. Name the two elements which are present both in CNG and petroleum.

SECTION–B

Answer the following questions in about 50-60 words each. **(5 × 3 = 15)**

11. List four advantages of properly managed watershed management. *[CBSE Delhi 2016]*

12. Why do you think there should be equitable distribution of resources? What forces would be working against an equitable distribution of our resources?

13. Why are the Arabari forests of Bengal known to be a good example of conserved forest?

14. What is a dam? Why do we seek to build large dams? While building large dams, which three main problems should particularly be addressed to maintain peace among local people? Mention them. *[CBSE 2018]*

15. What is the importance of forest as a resource? *[NCERT Exemplar]*

SECTION–C

Answer the following questions in about 80–90 words each. **(3 × 5 = 15)**

16. Explain the five R's for conserving the environment.

17. (*i*) Which natural resource are the 'biodiversity hotspots'? Suggest what happens when there is a loss of biodiversity.

(*ii*) Why is sustainable management of natural resources necessary? Why is reuse better as compared to recycle ?

18. (*i*) Is water conservation necessary? Give reasons.

(*ii*) List two advantages associated with water harvesting at the community level.

Answers

1. (*a*) **2.** (*b*) **3.** (*a*) **4.** (*a*)

5. (*d*) **6.** (*c*) **7.** (*a*)

8. Forests

9. Afforestation

10. Hydrogen and Carbon

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PART–B

PERIODIC TEST – 1

- PEN PAPER TEST
- MULTIPLE ASSESSMENT

PERIODIC TEST – 2

- PEN PAPER TEST
- MULTIPLE ASSESSMENT

PERIODIC TEST – 3

- PEN PAPER TEST
- MULTIPLE ASSESSMENT

CBSE SAMPLE QUESTION PAPER–2020

MODEL QUESTION PAPERS–1 to 5 [FOR PRACTICE]

CBSE EXAMINATION PAPERS–2020 [31/1/1; 31/1/2; 31/1/3]

SCIENCE

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Periodic Test 1

CHAPTERS COVERED

● Chemical Reactions and Equations ● Life Processes ● Electricity

PEN PAPER TEST

Time allowed: 45 minutes **Maximum Marks: 20**

General Instructions:

(*i*) *Question numbers **1** to **3** are objective type questions and question numbers **4** to **7** are subjective type questions.*

(*ii*) *Question numbers **4** to **6** are to be answered in about 50–60 words each.*

(*iii*) *Question number **7** is to be answered in about 80–90 words.*

(*iv*) *Weightage of marks is given along with the questions.*

1. Multiple Choice Questions **(3 × 1 = 3)**

Choose and write the correct answer for each of the following.

(*i*) SI unit of resistivity is

(*a*) ohm (*b*) ohm-metre

(*c*) ohm/metre (*d*) mho

(*ii*) In the equation $MnO_2 + 4HCl \xrightarrow{\Delta} MnCl_2 + 2H_2O + Cl_2$, the substance being oxidised is

(*a*) MnO_2 (*b*) HCl

(*c*) $MnCl_2$ (*d*) H_2O

(*iii*) The enzyme amylase acts on the substrate

(*a*) starch (*b*) protein

(*c*) fat (*d*) carbohydrate

2. Answer the following questions in one word or one sentence. **(2 × 1 = 2)**

(*a*) Which pigment help to transport oxygen and carbon dioxide in human body?

(*b*) Define rancidity.

3. The following question consists of two statements—Assertion (*A*) and Reason (*R*). Select the correct option. **(1)**

Assertion (*A*) : Hydrogen gas is not evolved when a metal reacts with nitric acid.

Reason (*R*) : Nitric acid is a strong oxidising agent.

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(*a*) Both *A* and *R* are true and *R* is the correct explanation of *A*.

(*b*) Both *A* and *R* are true but *R* is not the correct explanation of *A*.

(*c*) *A* is true but *R* is false.

(*d*) *A* is false but *R* is true.

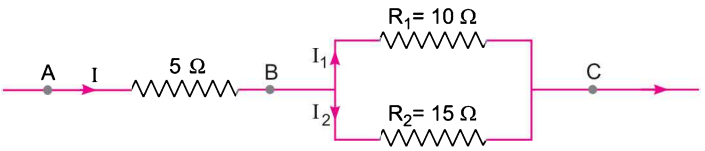
4. Identify the reducing and oxidising agent in the following reactions. **(3 × 1 = 3)**

(*i*) $4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$

(*ii*) $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$

(*iii*) $2H_2 + O_2 \longrightarrow 2H_2O$

5. Three resistors are connected as shown in the figure. Through the resistor of 5 ohms a constant current of 1 ampere is flowing.



(*a*) What is the current through the other two resistors?

(*b*) What is the potential difference across AB and across AC?

(*c*) What is the total resistance? **3**

6. State reason for the following:

(*a*) In human heart, the walls of the ventricles are thicker than the auricles.

(*b*) During the breathing cycle, even after forceful exhalation, the exchange of gases continues.

(*c*) In green plants during the day carbon dioxide is generated in respiration but is not released out. **3**

7. (*a*) Give reasons for the following:

(*i*) Tungsten used almost exclusively for filament of electric lamp.

(*ii*) Copper and aluminium wires are usually employed for electricity transmission.

(*b*) Describe an activity with the help of circuit diagram to show that potential difference across each resistor connected in parallel is same. **5**

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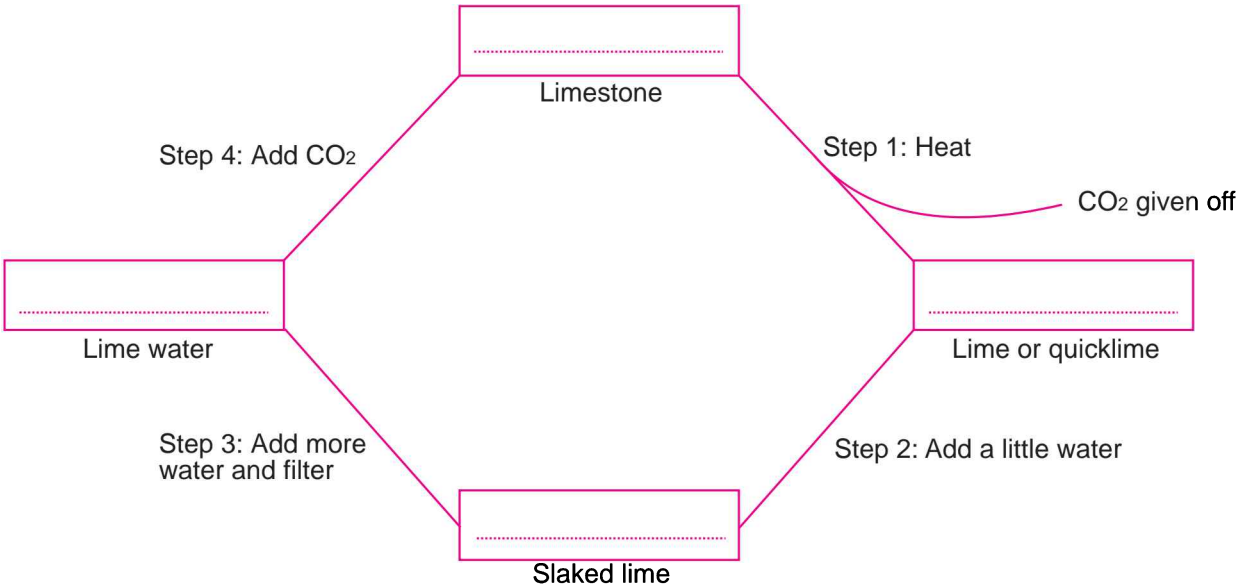
MULTIPLE ASSESSMENT

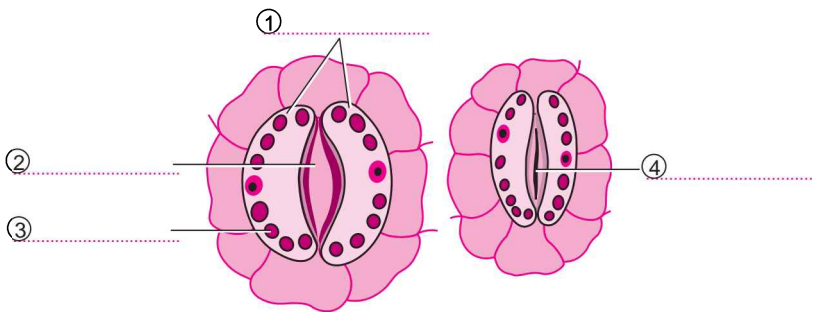
Time allowed: 45 minutes **Maximum Marks: 20**

1. Concept Map **4**

Fill in the blanks with Chemical formula.



2. Label the parts 1 to 4 in the given figure of open and closed stomatal pore. **4**



3. Vocabulary Quiz.

Match the words given in column A with the definitions given in column B. **(6 × 1 = 6)**

Column A	Column B
(*i*) Endothermic	(*a*) Reactions which can take place in both the directions under similar conditions of temperature and pressure.
(*ii*) Reversible	(*b*) The work done by a source of electricity to maintain a current in an electrical circuit.
(*iii*) Precipitation	(*c*) The property of a conductor due to which it opposes the flow of current through it.
(*iv*) Power	(*d*) Reactions which are accompanied with absorption of heat.
(*v*) Resistance	(*e*) Reaction in which one of the products formed is an insoluble substance and is thrown out of the solution as solid.
(*vi*) Electric energy	(*f*) Rate at which electric energy is dissipated or consumed in an electric circuit.

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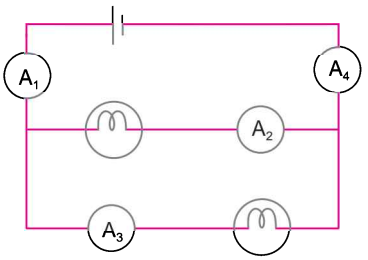
4. Diagram based Questions

(*a*) In the diagram, the lamps are identical and ammeter A_2 reads 0.5 A. **3**

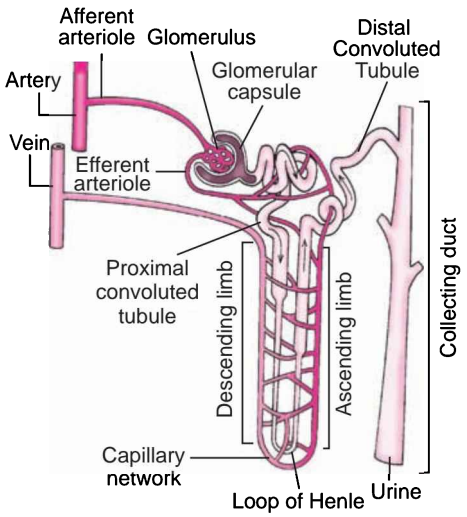


(*i*) What are the readings on A_1, A_3, A_4?

(*ii*) Redraw the diagram to include a switch to control both lamps together.

(*iii*) Redraw the diagram to include two switches to control the lamps separately.

(*b*) Observe the diagram given below and answer the questions that follow. **3**



(*i*) What is the fluid entering the collecting tubule called?

(*ii*) Where is blood filtered in the nephron?

(*iii*) Where does the reabsorption of useful substance takes place?

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Periodic Test 2

CHAPTERS COVERED

● Chemical Reactions and Equations ● Acids, Bases and Salts ● Metals and Non-metals
● Life Processes ● Control and Coordination ● Electricity
● Magnetic Effects of Electric Current ● Sources of Energy

PEN PAPER TEST

Time allowed: 1½ hours **Maximum Marks: 40**

***General Instructions*:**

(*i*) *Question numbers **1** to **3** are objective type questions and question numbers **4** to **11** are subjective type questions.*

(*ii*) *Question numbers **4** to **9** are to be answered in about 50–60 words each.*

(*iii*) *Question numbers **10** and **11** are to be answered in about 80–90 words each.*

(*iv*) *Weightage of marks is given along with the questions.*

1. Multiple Choice Questions **(5 × 1 = 5)**

Choose and write the correct answer for each of the following.

(*i*) The correct decreasing order of the metals in the activity series is

(*a*) Ca, Mg, Ni, Fe (*b*) Ni, Ca, Mg, Fe

(*c*) Ca, Mg, Fe, Ni (*d*) Mg, Ca, Fe, Ni

(*ii*) Which of the following are present in a dilute aqueous solution of hydrochloric acid?

(*a*) $H_3O^+ + Cl^-$ (*b*) $H_3O^+ + OH^-$

(*c*) $Cl^- + OH^-$ (*d*) Unionised HCl

(*iii*) The direction of the force on a current carrying wire placed in a magnetic field depends on

(*a*) the direction of the current but not on the direction of the field

(*b*) the direction of the field but not on the direction of the current

(*c*) the direction of the current as well as the direction of the field

(*d*) neither the direction of the current nor the direction of the field

(*iv*) The tendrils of pea plant are sensitive to

(*a*) electrical impulse (*b*) heat

(*c*) touch (*d*) moisture

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(*v*) Most of the carbon dioxide is transported in dissolved form in blood while oxygen is carried by haemoglobin because

(*a*) CO_2 is more soluble in water than oxygen and haemoglobin has very high affinity for oxygen

(*b*) haemoglobin is unable to carry CO_2

(*c*) O_2 is more soluble in water than CO_2 and haemoglobin has high affinity for oxygen

(*d*) water is unable to carry O_2.

2. Answer the following questions in one word or one sentence. **(4 × 1 = 4)**

(*i*) Write chemical formula of washing soda.

(*ii*) Which mirror would be best suited for use in a solar cooker?

(*iii*) What is synapse?

(*iv*) What is the role of glass wool soaked in water in the experiment to study the reaction of metal with steam?

3. For following questions, consist of two statements are given—one labelled Assertion (*A*) and the other labelled Reason (*R*). Select the correct answer to these questions from the codes (*a*), (*b*), (*c*) and (*d*) as given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation of the *Assertion*.

(*b*) Both *A* and *R* are true but *R* is not the correct explanation of the *Assertion*.

(*c*) *A* is true but *R* is false.

(*d*) *A* is false but *R* is true. **(3 × 1 = 3)**

(*i*) **Assertion (*A*) :** Two magnetic field lines of force can intersect each other.
Reason (*R*) : At the point of intersection there would be two directions for the same magnetic field, which is not possible.

(*ii*) **Assertion (*A*) :** The rate of photosynthesis in plants is low both at lower and higher temperature.
Reason (*R*) : Photosynthesis is an enzymatic process.

(*iii*) **Assertion (*A*) :** After decomposition of calcium carbonate, CO_2 gas is released.
Reason (*R*) : CO_2 gas turns lime water milky.

4. (*i*) Select a metal out of the following which reacts with hot water but not with cold water: Iron, sodium, magnesium.

(*ii*) Write the chemical equation of the reaction and name the main product formed during the reaction. **3**

5. Write one function of the following plant growth hormones:

(*a*) Auxins

(*b*) Gibberellins

(*c*) Cytokinins **3**

6. (*a*) Write two points of difference between cerebrum and cerebellum.

(*b*) Name the nerves that arise from spinal cord and brain respectively. **3**

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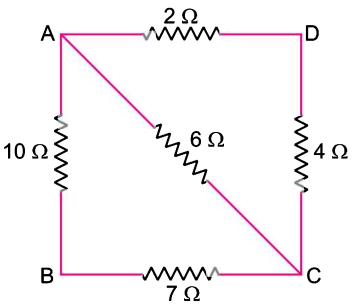
7. Determine the equivalent resistance between A and B in the following circuit. **3**



8. A uniform magnetic field is directed vertically upwards. In which direction in this field should an α–particle be projected so that it is deflected southward? Name and state the rule you have used to find the direction in this case. **3**

9. Describe briefly the method to obtain mercury from cinnabar. Write the chemical equation for the reactions involved in the process. **3**

10. (*a*) (*i*) A white powder is an active ingredient of antacids and is used in preparation of cakes. Name the compound and state how it is manufactured. Give chemical equation.

(*ii*) Write an equation to show the effect of heat on this compound.

(*b*) A milkman added a small amount of baking soda to fresh milk.

(*i*) Why does he shift the pH of fresh milk to slightly alkaline?

(*ii*) Why does this milk take a longer time to set as a curd? **5**

11. What is Joule's heating effect? How can it be demonstrated experimentally? List its four applications in daily life. **5**

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MULTIPLE ASSESSMENT

Time Allowed: 1½ hours **Maximum Marks: 40**

1. Match the columns. **(5 × 1 = 5)**

Match the acids and bases given in column A with their nature given in column B.

Column A	Column B
(*i*) $HClO_4$	(*a*) Weak acid
(*ii*) $B(OH)_3$	(*b*) Strong base
(*iii*) KOH	(*c*) Weak base
(*iv*) NH_4OH	(*d*) Strong acid
(*v*) CH_3COOH	

Match the words (or group of words) on the left with correct information on the right. **(4 × 1 = 4)**

Column A	Column B
(*i*) Thermal power plant	(*a*) Converts potential energy of falling water into electricity.
(*ii*) Hydro power plant	(*b*) Heat energy of molten rocks under the earth's crust.
(*iii*) Geothermal energy	(*c*) Chemical energy of fossil fuel is converted into electrical energy.
(*iv*) Tidal energy	(*d*) A rotary motor or engine driven by a flow of water, steam, gas, wind, etc., specially to produce electrical energy

2. Concept based Question **(10 × ½ = 5)**

Given below is a worksheet in which certain steps related to the conduction of information through neurons are given in a tabular form. They have not been placed in the correct order. Allot a number to each step in order to put them in the correct sequence.

Step Number	Description of the Step
	The electrical impulse travels along the dendrite.
	An electrical impulse is created at the dendrite.
	Stimulus provides the information.
	Information is acquired at the end of the dendrite tip of the nerve cell.
	The electrical impulse travels from cell body to axon to the end of axon.
	The chemicals cross the synapse and reach the dendrite of the next neuron.
	The information sets off a chemical reaction.
	The electrical impulse travels from dendrite to the cell body.
	The chemicals start a similar electrical impulse in the dendrite of the next neuron.
	At the end of the axon, the electrical impulse sets off the release of some chemicals.

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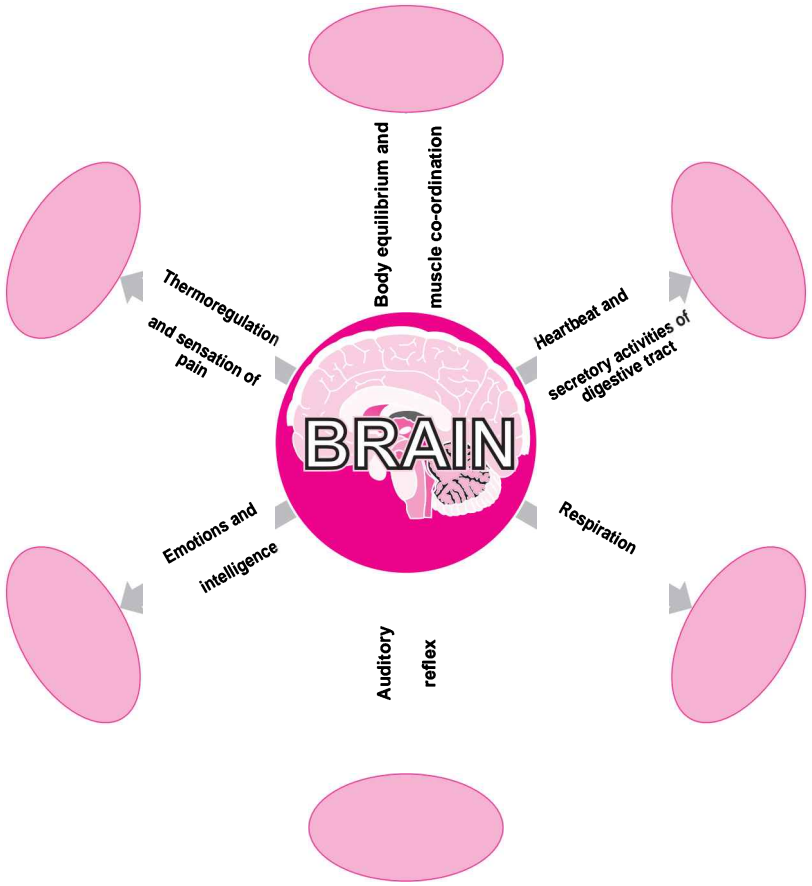
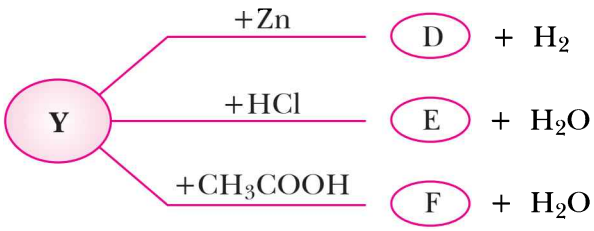
3. Mapping based question **6**

Complete the following map showing the functions of different parts of the brain.



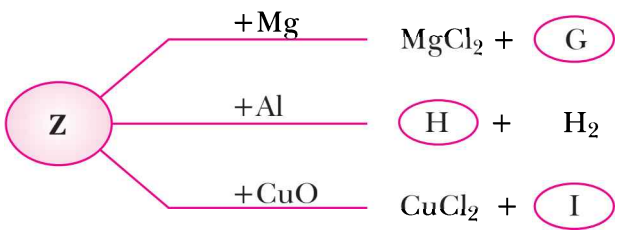
4. (*a*) Identify the compound Y and also write the formulae of D, E and F **4**

Y =



(*b*) Identify the component Z on the basis of reactions given below. Also write the formulae of their respective products. **4**

Z =



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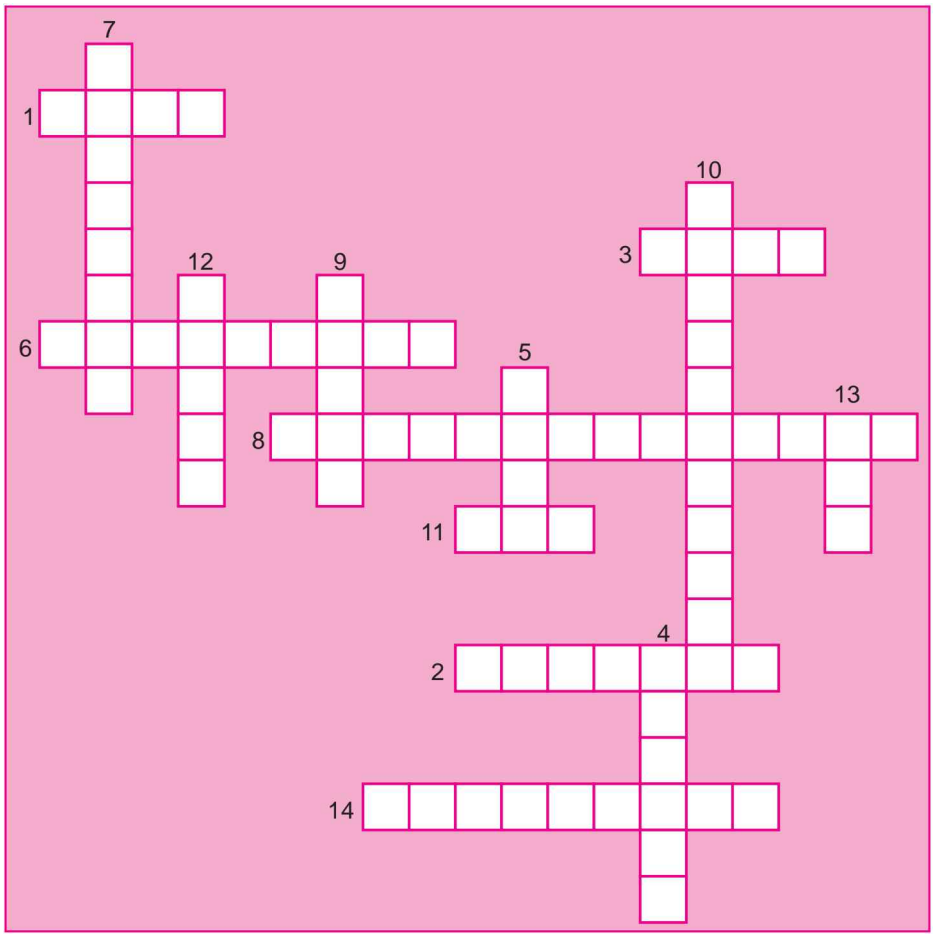
5. Crossword Puzzle **(14 × ½ = 7)**

Solve the crossword puzzle with the help of the clues provided.



Across:

1. If a magnet is strongly heated, knocked or hammered then its magnetism can be .
2. Unlike magnetic poles each other.
3. magnetic materials lose their magnetism if they are removed from a magnetic field.
6. If the thumb of the right hand points in the direction of current flow (from positive to negative) then the fingers curl in the of the magnetic field produced by the straight wire.
8. Temporary magnets produced by electric currents.
11. If a magnet is broken or cut in half, each piece has a north south magnetic pole.
14. Natural permanent magnet.

Down:

4. Most permanent magnets are made from .
5. A metal which can be magnetized .
7. A coil of wire that has an electric current flowing through it.
9. The space around a magnet where its magnetic force is exerted.

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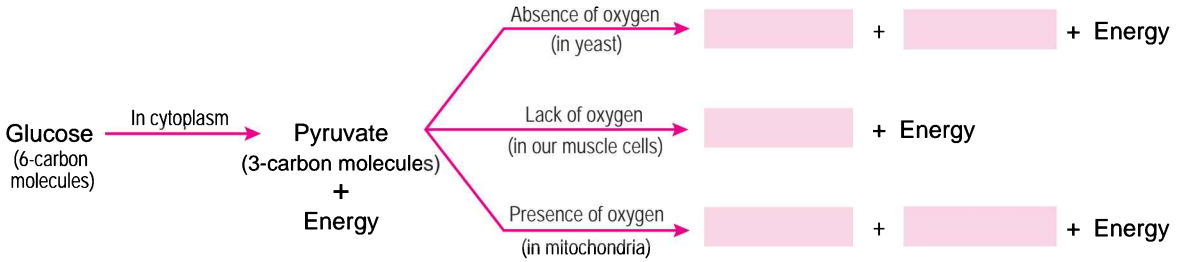
10. Magnets can act through materials such as paper, plastic and glass.
12. Two north poles each other.
13. Magnets are called dipoles because they have poles.

6. Directions: Given below are various pathways for breakdown of glucose in different conditions. Complete it by giving appropriate answer. 5



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3 Periodic Test

CHAPTERS COVERED

● Chemical Reactions and Equations ● Acids, Bases and Salts ● Metals and Non-metals
● Life Processes ● Control and Coordination ● Electricity
● Magnetic Effects of Electric Current ● Sources of Energy ● Carbon and its Compounds
● How do Organisms Reproduce? ● Our Environment ● Light – Reflection and Refraction

PEN PAPER TEST

Time allowed: 1½ hours **Maximum Marks: 40**

General Instructions: *Same as Periodic Test-2.*

1. Multiple Choice Questions **(5 × 1 = 5)**

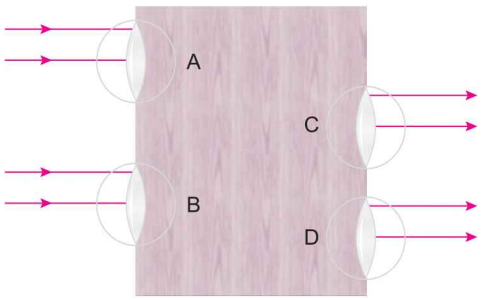
Choose and write the correct answer for each of the following.

(*i*) When length of a conductor is increased, the resistivity of material of conductor
(*a*) increases (*b*) decreases
(*c*) remains unchanged (*d*) uncertain

(*ii*) The correct IUPAC name of the compound with molecular formula $CH_3CH_2CH_2CHO$ is
(*a*) butane (*b*) butanal
(*c*) butanol (*d*) butanone

(*iii*) Which of the following salts is not obtained from sodium chloride?
(*a*) Washing soda (*b*) Baking soda
(*c*) Sodium hydroxide (*d*) Plaster of Paris

(*iv*) Beams of light are incident through the holes, A and B and emerge out of box through the holes C and D respectively as shown in figure.



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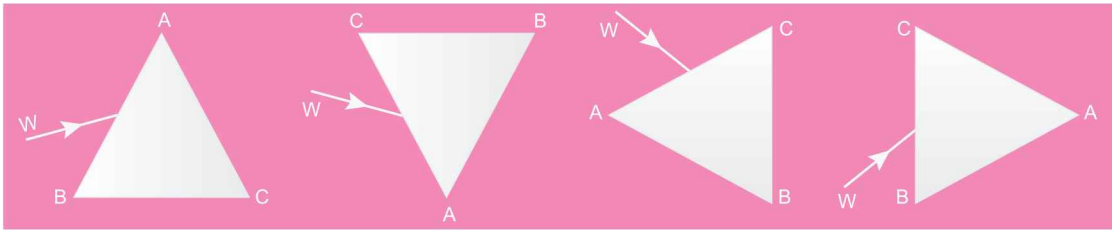
Which of the following could be inside the box?

(*a*) A rectangular glass slab (*b*) A convex lens

(*c*) A concave lens (*d*) A prism

(*v*) A prism ABC (with BC as base) is placed in different orientations. A narrow beam of white light is incident on the prism as shown in fig. In which of the following cases after dispersion does the third colour from the top correspond to the colours of the sky?



(*i*) (*ii*) (*iii*) (*iv*)

(*a*) (*i*) (*b*) (*iii*)

(*c*) (*ii*) (*d*) (*iv*)

2. Answer the following questions in one word or one sentence. **(4 × 1 = 4)**

(*i*) If in tobacco the male gamete has 24 chromosomes, female gamete will have how many chromosomes?

(*ii*) Name the hormone which promotes cell division.

(*iii*) Give an example of a redox reaction.

(*iv*) What is sustainable development?

3. For following questions, consist of two statements are given—one labelled Assertion (*A*) and the other labelled Reason (*R*). Select the correct answer to these questions from the codes (*a*), (*b*), (*c*) and (*d*) as given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation of the *Assertion*.

(*b*) Both *A* and *R* are true but *R* is not the correct explanation of the *Assertion*.

(*c*) *A* is true but *R* is false.

(*d*) *A* is false but *R* is true. **(3 × 1 = 3)**

(*i*) **Assertion (*A*) :** We should conserve forests and wildlife.
Reason (*R*) : Conservation is to try and preserve the biodiversity we have inherited.

(*ii*) **Assertion (*A*) :** CO_2 is a covalent compound.
Reason (*R*) : Covalent compounds are formed by transfer of electrons.

(*iii*) **Assertion (*A*) :** There is a need to harness non-conventional sources of energy.
Reason (*R*) : Fossil fuel reserves in the earth are limited.

4. An organic compound 'A' has a molecular formula C_2H_6O. 'A' on addition of oxygen gives compound 'B' which gives effervescence with baking soda. **3**

(*i*) Identify 'A' and 'B'.

(*ii*) Write the reaction of B with baking soda.

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5. State the factors on which the heat produced in a current carrying conductor depends. Give one practical application of this effect. **3**

6. Give reason to justify the following: **3**

(*a*) The existence of decomposers is essential in a biosphere.

(*b*) Flow of energy in a food chain is unidirectional.

(*c*) Damage to the ozone layer is a cause for concern.

7. A 2 cm high object is placed at a distance of 32 cm from a concave mirror. The image is real, inverted and 3 cm in size. Find the focal length of the mirror and the position where the image is formed. **3**

[**Ans.** 19.2 cm]

8. Explain the action of dilute hydrochloric acid on the following with chemical equations: **3**

(*a*) Magnesium ribbon

(*b*) Sodium hydroxide

(*c*) Crushed egg shells.

9. A silver article generally turns black when kept in the open for a few days. The article when rubbed with toothpaste again starts shining. **3**

(*a*) Why do silver articles turn black when kept in the open for a few days? Name the phenomenon involved.

(*b*) Name the black substance formed and give its chemical formula.

10. (*a*) Draw the diagram of heart and label its four chambers.

(*b*) Construct a table to show the functions of these four chambers. **5**

11. Distinguish between pollination and fertilisation. Mention the site and product of fertilisation in a flower.

Draw a neat, labelled diagram of a pistil showing pollen tube growth and its entry into the ovule. **5**

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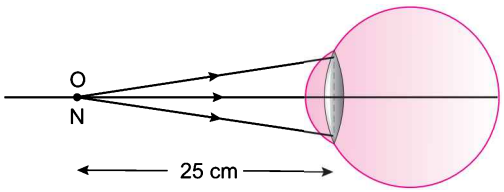
MULTIPLE ASSESSMENT

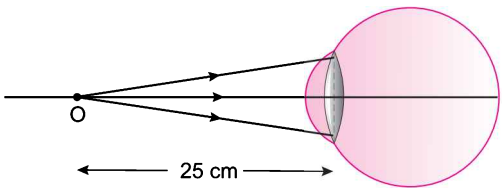
Time Allowed: 1½ hours **Maximum Marks: 40**

1. Complete the following diagrams to show the image formation. The nature of eye, normal/ myopic/hypermetropic is indicated with each diagram. **(5×2 = 10)**

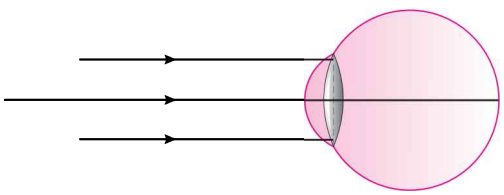
(*a*) Normal eye, object 25 cm from the eye lens



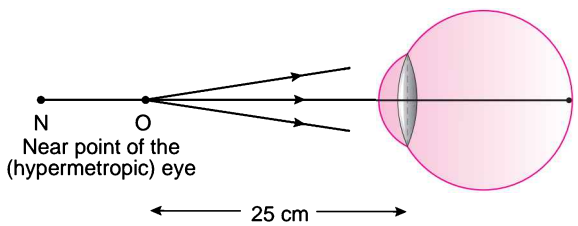
(*b*) Hypermetropic eye, object at 25 cm from the eye lens



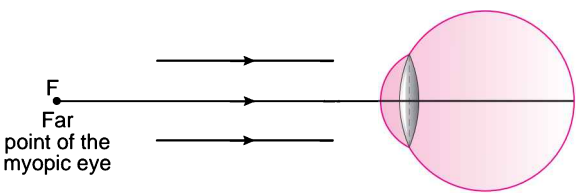
(*c*) Myopic eye, object at infinity



(*d*) Hypermetropic eye



(*e*) Myopic eye



2. Study the diagram given and answer the following questions. **5**

(*a*) Name the phenomenon responsible for the change in the path of rays.

(*b*) Identify the device X.

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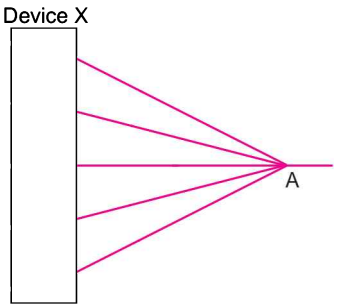
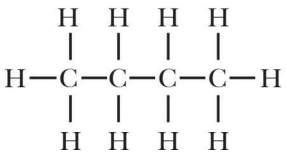
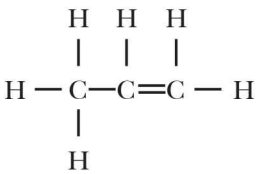
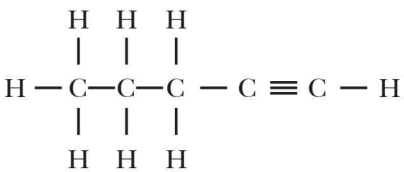
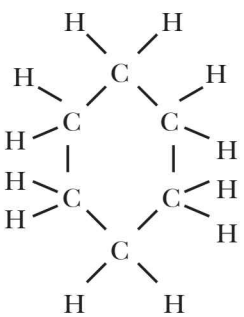
(*c*) What is point A called?

(*d*) Which physical quantity does the reciprocal of the distance between the device and point A denote?

(*e*) Write SI unit of quantity named in point (*d*) above.



3. Match the structures of organic compounds given in column A with their IUPAC names in column B. **10**

Column A	Column B
(*i*) 	(*a*) Pentyne
(*ii*) 	(*b*) Butanone
(*iii*) 	(*c*) Chloropropane
(*iv*) 	(*d*) Benzene

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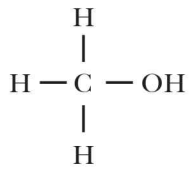
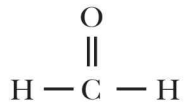
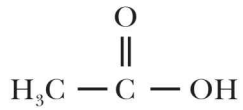
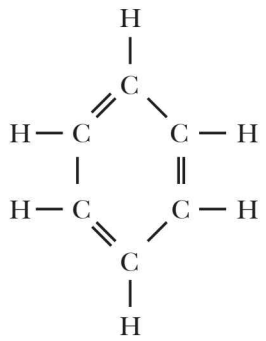
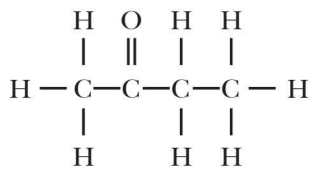
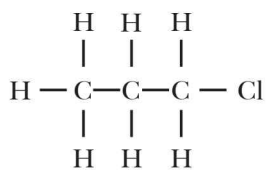
(v) 	(e) Ethanoic acid
(vi) 	(f) Methanol
(vii) 	(g) Propene
(viii) 	(h) Cyclohexane
(ix) 	(i) Butane
(x) 	(j) Methanal

4. There are three columns, *i.e.*, I, II and III. In column I, there is a list of position of objects while column II provides position of image and column III gives the nature and size of the image formed by a concave mirror. Match them correctly. 5

I. Position of the object	II. Position of the image	III. Nature and size of the object
(A) Beyond the centre of curvature	(*a*) at the centre of curvature	(*i*) real, inverted and diminished
(B) At the centre of curvature	(*b*) beyond the centre of curvature	(*ii*) real, inverted and magnified

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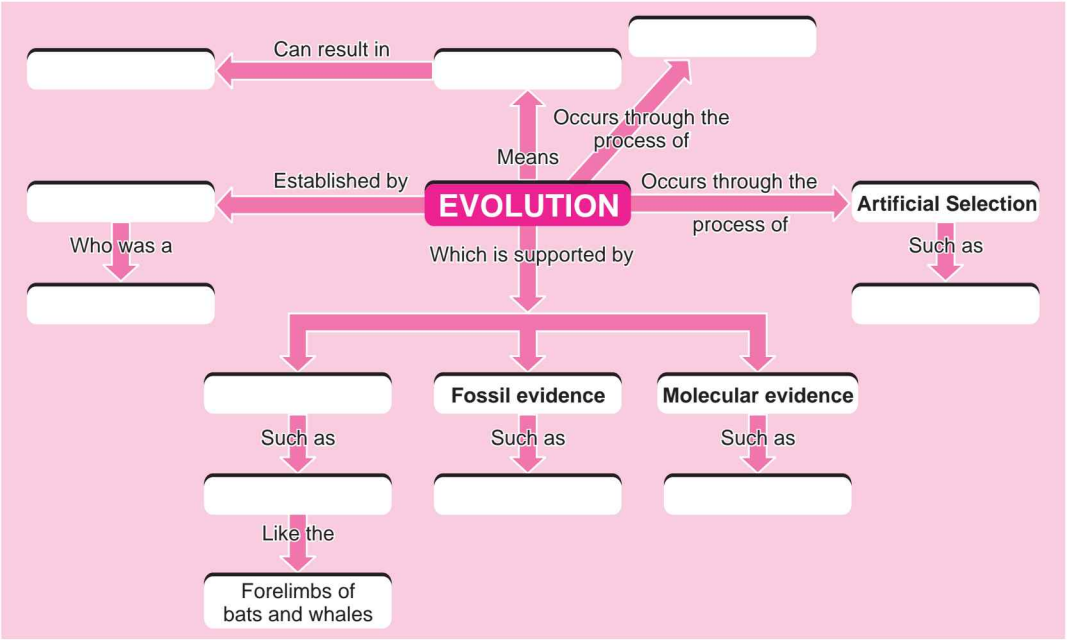
(C) Between the centre of curvature and focus	(*c*) behind the mirror	(*iii*) virtual, erect and magnified
(D) At the focus	(*d*) between the focus and the centre of curvature	(*iv*) real, inverted and of the same size
(E) Between the focus and the pole	(*e*) at infinity	(*v*) real, inverted and highly magnified

5. Given below is a concept map about evolution. Fill up the gaps in the concept map.

(10 × 1 = 10)



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CBSE Sample Question Paper–2020

Time Allowed: 3 hours **Max. Marks: 80**

***General Instructions*:**

(i) *The question paper comprises three* ***Sections—A, B*** *and* ***C****. Attempt all the sections.*

(ii) *All questions are compulsory.*

(iii) *Internal choice is given in each section.*

(iv) *All questions in* ***Section A*** *are* ***one****-mark questions comprising MCQ, VSA type and assertion-reason type questions. They are to be answered in one word or in one sentence.*

(v) *All questions in* ***Section B*** *are* ***three****-mark, short-answer type questions. These are to be answered in about* **50–60** *words each.*

(vi) *All questions in* ***Section C*** *are* ***five****-mark, long-answer type questions. These are to be answered in about* **80–90** *words each.*

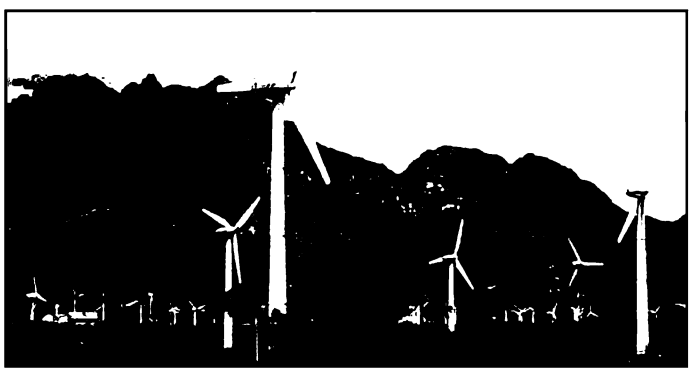
(vii) *This question paper consists of a total of* **30** *questions.*

SECTION–A

1. Define catenation. 1

2. How does valency of an element vary across a period? 1

3. Answer question numbers 3(*a*) – 3(*d*) on the basis of your understanding of the following paragraph and the related studied concepts.



Renewable energy sources such as wind energy are vital for the Indian economy, not only from the point of view of supply, but also from the perspective of environmental and social benefits. India is the world's fifth largest wind-power producer and the largest windmill facilities in India are installed in Tamil Nadu. Muppandal is a small village of Tamil Nadu and one of the most important sites of wind-farm in the state. It uses wind from the Arabian Sea to produce renewable energy. The suitability of Muppandal as a site for wind farms stems from its geographical location as it has access to the seasonal monsoon winds.

The electrical generators used on wind turbines in sites like Muppandal, produce an output AC of 240 V and a frequency of 50 Hz even when the wind speed is fluctuating. A transformer may be required to increase or decrease the voltage so it is compatible with the end usage, distribution or transmission voltage, depending on the type of interconnection.

3(*a*) State the principle behind electric generator. 1

3(*b*) The output frequency of wind turbine is 50 Hz. What is meant by this statement? 1

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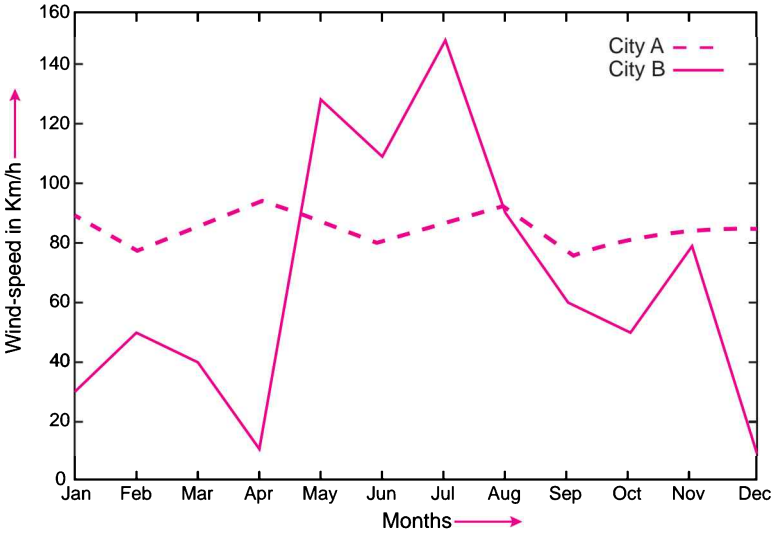
3(c) Why do you think Muppandal is at an advantageous position for this project? **1**

3(d) Based on the data represented in the graph below, which of the two cities A or B would be an ideal location for establishing a wind-farm and why? **1**



4. Question numbers 4(*a*)–4(*d*) are based on the two tables given below. Study these tables related to blood sugar levels and answer the questions that follow.

Table A (Blood glucose chart)

	Mean Blood Glucose Level (mg/dL)
Doctor's advice needed	380 350 315 280 250 215
Good	180 150
Excellent	115 80 50

Table B (Blood Report of Patient X and Y)

Time of check	Blood Glucose ranges (mg/dL)	
	Patient X	Patient Y
Before breakfast (Fasting)	< 100	70 – 130
Before lunch, supper and snack	< 110	70 – 130
Two hours after meals	< 140	< 180
Bedtime	< 120	90 – 150

4(a) Refer to Table B showing the blood report of the levels of glucose of patients X and Y. Infer the disease which can be diagnosed from the given data. **1**

4(b) Identify the hormone whose level in the blood is responsible for the above disease. **1**

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4(c) Which one of the following diets would you recommended to the affected patient? **1**

(*i*) High sugar and low fat diet. (*ii*) Low sugar and high protein diet.

(*iii*) High Fat and low fiber diet. (*iv*) Low sugar and high fiber diet.

4(d) Refer to the Table A and suggest the value of the mean blood glucose level beyond which doctor's advice is necessary: **1**

(*i*) 180 mg/dL (*ii*) 115 mg/dL (*iii*) 50 mg/dL (*iv*) 80 mg/dL

5. When we enter a dark room coming from outside, immediately the things inside the room do not appear clear to our eyes. This is because **1**

(*a*) pupils do not open at all in the dark. (*b*) pupils take time to adjust.

(*c*) light travels slower in a dark room. (*d*) pupils open very quickly in the dark.

OR

The phenomena of light responsible for the working of the human eye is

(*a*) reflection (*b*) refraction

(*c*) power of accommodation (*d*) persistence of vision

6. When a 4V battery is connected across an unknown resistor there is a current of 100 mA in the circuit. The value of the resistance of the resistor is: **1**

(*a*) 4 Ω (*b*) 40 Ω (*c*) 400 Ω (*d*) 0.4 Ω

7. Unit of electric power may also be expressed as: **1**

(*a*) volt-ampere (*b*) kilowatt-hour (*c*) watt-second (*d*) joule-second

8. It was found that water from a river was contaminated with Coliform bacteria. Which one of the following pollutant might have got mixed with the water? **1**

(*a*) Fertilizer run off (*b*) Industrial waste (*c*) Pesticides (*d*) Human faecal matter

OR

Which one of the following stakeholders of forests causes the maximum damage to forest?

(*a*) People who live in or around the forest (*b*) The forest department of the government

(*c*) The wildlife and native enthusiasts (*d*) The industrialists

9. Which one of the following greenhouse gases is a contributor due to incomplete combustion of coal and petroleum? **1**

(*a*) Oxides of nitrogen (*b*) Methane (*c*) Carbon monoxide (*d*) Carbon dioxide

10. Which of the following reactions is an endothermic reaction? **1**

(*a*) Burning of coal.

(*b*) Decomposition of vegetable matter into compost.

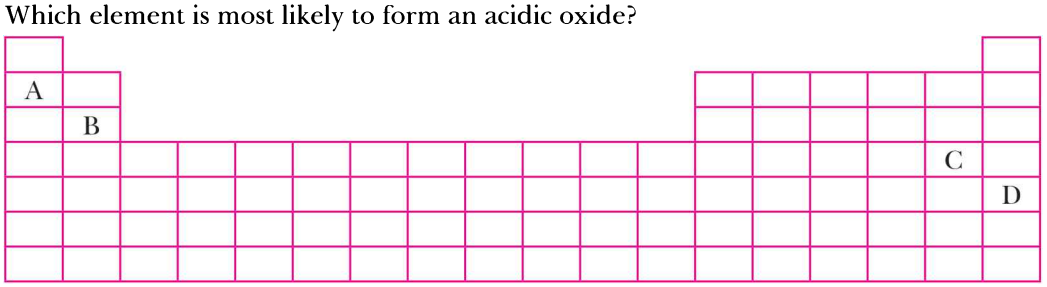
(*c*) Process of respiration.

(*d*) Decomposition of calcium carbonate to form quick lime and carbon dioxide.

11. Identify the basic salt from the following salts: **1**

(*a*) Na_2CO_3 (*b*) NH_4Cl (*c*) $NaNO_3$ (*d*) KCl

12. The positions of four elements A, B, C and D in the Modern Periodic Table are shown below. Which element is most likely to form an acidic oxide? **1**



(*a*) A (*b*) B (*c*) C (*d*) D

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OR

Elements P, Q, R and S have atomic numbers 11, 15, 17 and 18 respectively. Which of them are reactive non-metals?

(*a*) P and Q (*b*) P and R (*c*) Q and R (*d*) R and S

For question numbers 13 and 14, two statements are given—one labeled Assertion (*A*) and the other labeled Reason (*R*). Select the correct answer to these questions from the codes (*i*), (*ii*), (*iii*) and (*iv*) as given below:

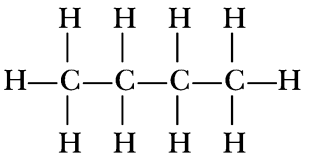
(*i*) ***Both A and R are true and R is the correct explanation of A.***

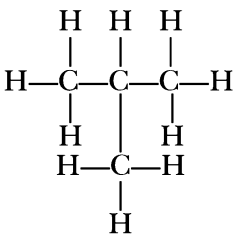
(*ii*) ***Both A and R are true but R is not the correct explanation of A.***

(*iii*) ***A is true but R is false.***

(*iv*) ***A is false but R is true.***

13. **Assertion (*A*)** : Following are the structural isomers of butane. **1**





Reason (*R*) : Structural isomers have the same molecular formula but they differ in their structures.

14. **Assertion (*A*)** : A fuse wire is always connected in parallel with the mainline. **1**

Reason (*R*) : If a current larger than the specified value flows through the circuit, fuse wire melts.

SECTION–B

15. (*i*) Write two observations when lead nitrate is heated in a test tube. **3**

(*ii*) Name the type of reaction.

(*iii*) Write a balanced chemical equation to represent the above reaction.

16. A compound 'X' of sodium is used as an antacid and it decomposes on strong heating. **3**

(*i*) Name the compound 'X' and give its chemical formula.

(*ii*) Write a balanced chemical equation to represent the decomposition of 'X'.

(*iii*) Give one use of compound 'X' besides an antacid.

OR

You are provided with 90 mL of distilled water and 10 mL of concentrated sulphuric acid to prepare dilute sulphuric acid.

(*i*) What is the correct way of preparing dilute sulphuric acid? Give reason.

(*ii*) How will the concentration of H_3O^+ ions change on dilution?

17. Two elements X and Y have atomic numbers 12 and 16 respectively. To which period of the Modern Periodic Table do these two elements belong? What type of bond will be formed between them and why? Also give the chemical formula of the compound formed. **3**

18. (*i*) Create a terrestrial food chain depicting four trophic levels.

(*ii*) Why do we not find food chains of more than four trophic levels in nature? **3**

OR

How will you create an artificial aquatic ecosystem, which is self-sustainable?

19. Explain the processes of aerobic respiration in mitochondria of a cell and anaerobic respiration in yeast and muscle with the help of word equations. **3**

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20. In a pea plant, the trait of flowers bearing purple colour (PP) is dominant over white colour (pp). Explain the inheritance pattern of F_1 and F_2 generations with the help of a cross following the rules of inheritance of traits. State the visible characters of F_1 and F_2 progenies. **3**

21. Explain giving reasons the bending of the shoot tip of a plant towards light source coming from one side of the plant. **3**

22. It is desired to obtain an erect image of an object, using concave mirror of focal length of 12 cm.

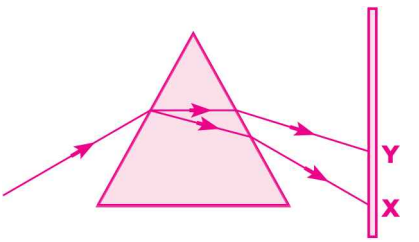
(*i*) What should be the range of the object distance in the above case?

(*ii*) Will the image be smaller or larger than the object? Draw a ray diagram to show the formation of image in this case.

(*iii*) Where will the image of this object be, if it is placed 24 cm in front of the mirror? **3**

23. Suppose your parents have constructed a two room house and you want that in the living room there should be a provision of one electric bulb, one electric fan, a refrigerator and a plug point for appliances of power up to 2 kilowatt. Draw a circuit diagram showing electric fuse and earthing as safety devices. **3**

24. In the figure given below, a narrow beam of white light is shown to pass through a triangular glass prism. After passing through the prism, it produces a spectrum XY on the screen.



(*i*) Name the phenomenon.

(*ii*) State the colours seen at X and Y.

(*iii*) Why do different colours of white light bend at different angles through a prism? **3**

OR

(*i*) What is visible spectrum?

(*ii*) Why is red used as the stopping light at traffic signals?

(*iii*) Two triangular glass prisms are kept together connected through their rectangular side. A light beam is passed through one side of the combination. Will there be any dispersion? Justify your answer.

SECTION–C

25. Metal X is found in nature as its sulphide XS. It is used in the galvanisation of iron articles. Identify the metal X. How will you convert this sulphide ore into the metal? Explain with equations. **5**

OR

State the reason for the following:

(*i*) Aluminium oxide is called an amphoteric oxide.

(*ii*) An iron strip dipped in a blue copper sulphate solution turns the blue solution pale green.

(*iii*) Hydrogen gas is not evolved when most metals react with nitric acid.

(*iv*) Calcium does not occur in free state in nature.

(*v*) Sodium or potassium metals are kept immersed under kerosene.

26. The formulae of four organic compounds are given below:

A	B	C	D
C_2H_4	CH_3COOH	C_2H_5OH	C_2H_6

(*i*) Which one of these compounds A, B, C or D is a saturated hydrocarbon?

(*ii*) Identify the organic acid and give its structural formula.

(*iii*) Which of the above compounds when heated at 443K in the presence of concentrated H_2SO_4 forms ethene as the major product? What is the role played by concentrated H_2SO_4 in this reaction? Also write the chemical equation involved.

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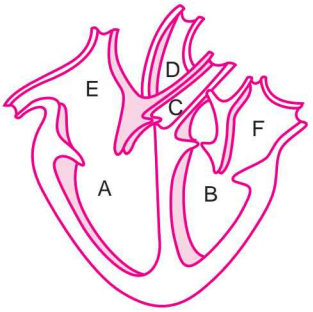
(*iv*) Give a chemical equation when B and C react with each other in presence of concentrated H_2SO_4. Name the major product formed and mention one of its important use. **5**

27.



(*i*) Identify any two parts from the above diagram which carry oxygenated and deoxygenated blood.

(*ii*) Explain the process of double circulation with the help of a flow chart. **5**

28. (*i*) Describe the various steps involved in the process of binary fission with the help of a diagram.

(*ii*) Why do multicellular organisms use complex way of reproduction? **5**

OR

(*i*) Describe the role of prostate gland, seminal vesicle and testes in the human male reproductive system.

(*ii*) How is the surgical removal of unwanted pregnancies misused?

(*iii*) Explain the role of oral contraceptive pills in preventing conception.

29. (*i*) Consider a conductor of resistance 'R', length 'L', thickness 'd' and resistivity 'ρ'.

Now this conductor is cut into four equal parts. What will be the new resistivity of each of these parts? Why?

(*ii*) Find the resistance if all of these parts are connected in:

(*a*) Parallel (*b*) Series

(*iii*) Out of the combinations of resistors mentioned above in the previous part, for a given voltage which combination will consume more power and why? **5**

30. (*i*) A lens produces a magnification of –0.5. Is this a converging or diverging lens? If the focal length of the lens is 6 cm, draw a ray diagram showing the image formation in this case.

(*ii*) A girl was playing with a thin beam of light from a laser torch by directing it from different directions on a convex lens held vertically. She was surprised to see that in a particular direction, the beam of light continues to move along the same direction after passing through the lens. State the reason for her observation. Draw a ray diagram to support your answer. **5**

OR

(*i*) On entering in a medium from air, the speed of light becomes half of its value in air. Find the refractive index of that medium with respect to air?

(*ii*) A glass slab made of a material of refractive index n_1 is kept in a medium of refractive index n_2.

A light ray is incident on the slab. Draw the path of the rays of light emerging from the glass slab, if (*i*) $n_1 > n_2$ (*ii*) $n_1 = n_2$ (*iii*) $n_1 < n_2$

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Answers

1. The property of self-linking of atoms of an element through covalent bonds in order to form straight chain, branched chains or cyclic chains of different sizes is called catenation. **1**

2. The valency of an element first increases and then decreases across a period. **1**

3. (*a*) The principle behind electric generator is Electromagnetic Induction- the phenomenon of producing current in a coil by changing the magnetic field associated with it. **1**

(*b*) The polarity of the output alternating current changes every 1/100 seconds. Alternately: In 1 second the output (AC) completes 50 cycles. **1**

(*c*) The suitability of Muppandal as a site for wind farms stems from its geographical location as it has access to the seasonal monsoon winds. **1**

(*d*) City A **0.5**

It is more suitable for a wind-farm as there is consistently high wind-speed in that city throughout the year. **0.5**

4. (*a*) Diabetes **1**

(*b*) Insulin **1**

(*c*) (*iv*) Low sugar and high fibre diet **1**

(*d*) (*i*) 180 mg/dL **1**

5. (*b*) **OR** (*b*) **1**

6. (*b*) Since $V = IR$, $V = 4$ V, $I = 100$ mA $= 0.1$ A **1**

Hence, $R = V/I = 4/0.1\ \Omega = 40\ \Omega$

7. (*a*) Power = Voltage × Current **1**

8. (*d*) **OR** (*d*) **1**

9. (*c*) **1**

10. (*d*) **1**

11. (*a*) **1**

12. (*c*) **OR** (*c*) **1**

13. (*i*) **1**

14. (*iv*) **1**

15. (*i*) It turns yellow due to formation of lead oxide and reddish brown fumes evolve due to formation of nitrogen dioxide. **0.5+0.5**

(*ii*) Thermal decomposition reaction. **1**

(*iii*) $\underset{\text{Lead nitrate}}{2Pb(NO_3)_2(s)} \xrightarrow{\text{Heat}} \underset{\text{Lead oxide}}{2PbO(s)} + \underset{\text{Nitrogen oxide}}{4NO_2(g)} + \underset{\text{Oxygen}}{O_2(g)}$ **1**

16. (*i*) Sodium bicarbonate or Sodium hydrogencarbonate or baking soda and its chemical formula is $NaHCO_3$. **0.5+0.5**

(*ii*) $\underset{\text{Sodium hydrogen carbonate}}{2NaHCO_3(s)} \xrightarrow{\text{Heat}} \underset{\text{Sodium carbonate}}{Na_2CO_3(s)} + \underset{\text{Carbon dioxide}}{CO_2(g)} + \underset{\text{Water}}{H_2O(s)}$ **1**

(*iii*) It is used in fire extinguisher and for baking. (*Any one*) **1**

OR

(*i*) Add 10 mL of concentrated sulphuric acid slowly to 90 mL of water with constant stirring. **1**

Dilution of acid is a highly exothermic process. If water is added to concentrated sulphuric acid, heat generated causes the mixture to splash leading to burns and the glass container can break. **1**

(*ii*) The concentration of H_3O^+ ions decreases per unit volume. **1**

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17. Electronic configuration of X is 2, 8, 2 and Y and 2, 8, 6. **0.5+0.5**

Both X and Y belong to 3rd period. **0.5**

Ionic bond will be formed between them because X will lose 2 electrons and Y will gain 2 electrons to complete their octet and become stable. **1**

The chemical formula of the compound is XY. **0.5**

18. (*i*) A terrestrial food chain with four trophic levels would be: **2**

Producer (Plants) ⟶ Primary Consumer (Mouse) ⟶ Secondary Consumer (Snake) ⟶ Tertiary Consumer (Hawk)

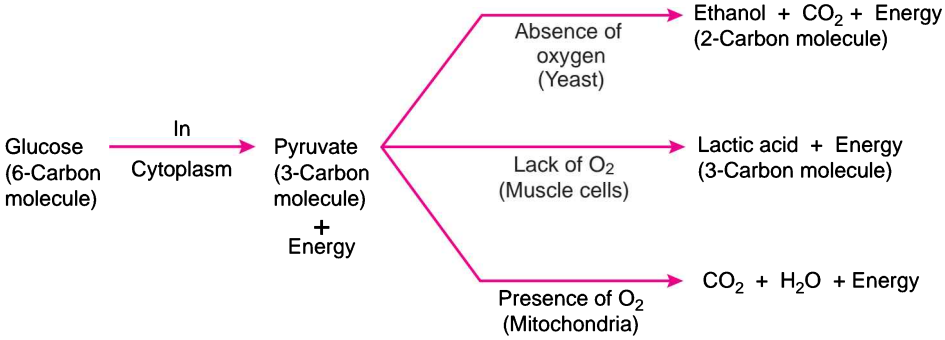
(*ii*) According to the 10% law, the amount of energy available will not be sufficient for the survival of the organism in the fifth trophic level. **1**

OR

Following are the requirements for self-sustainable artificial aquatic ecosystem:

- Large jar filled with water, oxygen, food and aquatic plants and animals,
- Oxygen/oxygen pump,
- Fish food,
- Aquatic plants/producers to provide O_2 during photosynthesis,
- Aquatic animals/consumers to release CO_2 for the process of photosynthesis, and
- Decomposers for natural cleaning of the aquarium. **3**

19. **1+1+1**



20. **0.5+1+0.5**

Parents PP (Purple flower) × pp (White flower)

Gametes P, p

F_1 generation Pp (Purple flower)

Pp × Pp

Selfing

F_2 generation

♀ \ ♂	P	p
P	PP (Purple)	Pp (Purple)
p	Pp (Purple)	pp (White)

0.5+0.5

Visible characters of all F_1 progeny are purple coloured flowers and in F_2 progeny, three of the progenies have purple coloured flower and one has white coloured flower (3 : 1 ratio).

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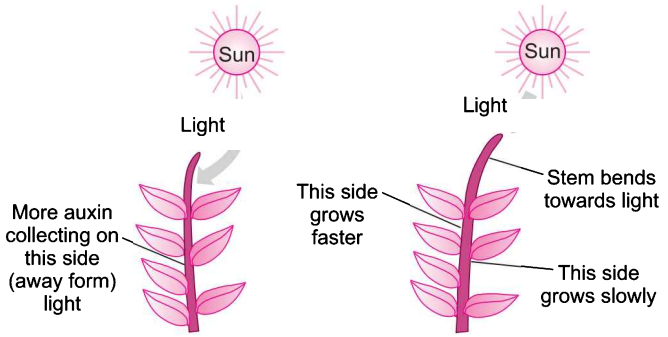
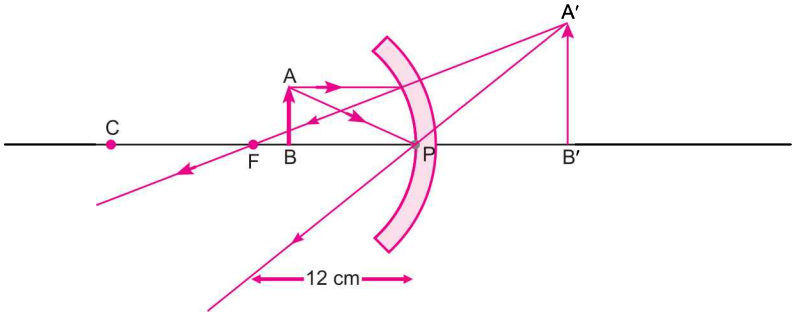
21. When growing plant shoot tip detects light, a hormone called auxin is synthesised in the shoot tip which is sensitive to light. The plant responds by bending towards light. **1**

When the light falls only on the right side of the stem, then the auxin hormone collects in the left side of the stem, away from the light. This is because auxin hormone prefers to stay in shade, *i.e.*, moves away from the light. Thus, more auxin hormone is present in the left side of the stem as compared to the right. The left side of the stem, grows faster than its right side and therefore, the stem bends towards the right side (direction of light). **2**



22. (*i*) Range of distance should be 0 cm to < 12 cm for the concave mirror to form erect image. **0.5**

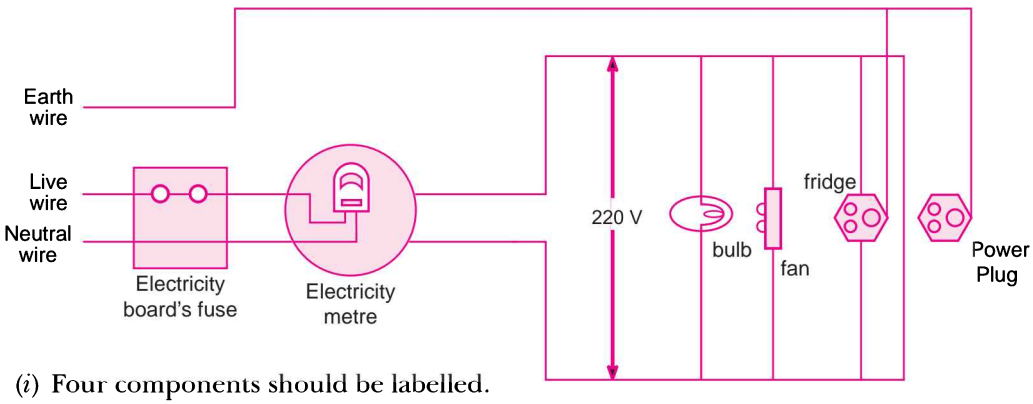
(*ii*) The image will larger than the object.



1.5

(*iii*) Image will formed of the object be at 24 cm in front of the mirror or the image is formed at C. **1**

23.



(*i*) Four components should be labelled. **1**

(*ii*) All of them should be in parallel and there should be a fuse for safety. **0.5+0.5**

(*iii*) Live and earth wires should be there. **1**

24. (*i*) The phenomenon is called dispersion. **1**

(*ii*) X—Violet Y—Red **0.5+0.5**

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(*iii*) Different colours of white light bend through different angles with respect to the incident beam of light due to difference in speed of light of different wavelengths. **1**

OR

(*i*) Visible spectrum is the band of coloured components of a white light beam. **1**

(*ii*) Red light is scattered the least by air molecules and has longer wavelength. It travels the longest distance. **1**

(*iii*) The given setup will behave like a glass slab, resulting in recombination of the seven colours to produce white light. **1**

25. Metal X is Zinc. **1**

The sulphide ore is first heated strongly in supply of oxygen and changed into its oxide. This process is called roasting. **1**

$$2ZnS + 3O_2 \xrightarrow{\text{heat}} 2ZnO + 2SO_2$$ **1**

Zinc oxide is then reduced to zinc metal by heating it with carbon. This process is called reduction. **1**

$$2ZnO + C \longrightarrow 2Zn + CO_2$$ **1**

OR

(*i*) Aluminium oxide is an amphoteric oxide as it reacts with both acids as well as bases to form salts. **1**

(*ii*) Iron being more reactive than copper displaces copper from copper sulphate to form green ferrous sulphate solution. **1**

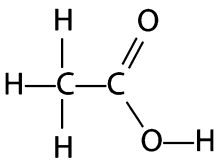
(*iii*) Nitric acid is a strong oxidising agent. So, hydrogen gas produced gets oxidised to H_2O. **1**

(*iv*) Calcium is a very reactive metal. So, it readily reacts with the chemicals present in surroundings and occurs in combined state. **1**

(*v*) Sodium and potassium are highly reactive metals and react vigorously with oxygen in air and may even catch fire also. They do not react with kerosene. Hence, to protect sodium and potassium, they are kept in kerosene oil. **1**

26. (*i*) D is a saturated hydrocarbon. **0.5**

(*ii*) B is an organic acid. **0.5**

Structural formula  **0.5**

(*iii*) C is the compound. **0.5**

In this reaction, H_2SO_4 acts as a dehydrating agent and removes a water molecule from ethanol. **0.5**

$$\underset{\text{Ethanol}}{C_2H_5OH} \xrightarrow{\text{hot conc. } H_2SO_4} \underset{\text{Ethene}}{C_2H_4} + H_2O$$ **1**

(*iv*) $CH_3COOH + C_2H_5OH \xrightarrow{\text{conc. } H_2SO_4} CH_3COOC_2H_5 + H_2O$ **1**

Major product is Ester and it is used in making perfumes or flavouring agents. **0.5**

27. (*i*) Oxygenated blood is carried by B = left ventricle/D = aorta/F = left auricle/pulmonary vein. **0.5+0.5**

Deoxygenated blood blood is carried by A = right ventricle/C=pulmonary artery/E=right auricle/vena cava. **0.5+0.5**

(*ii*) The blood passes through the heart twice through separate pathways for completing one cycle. This type of circulation is called double circulation. **3**

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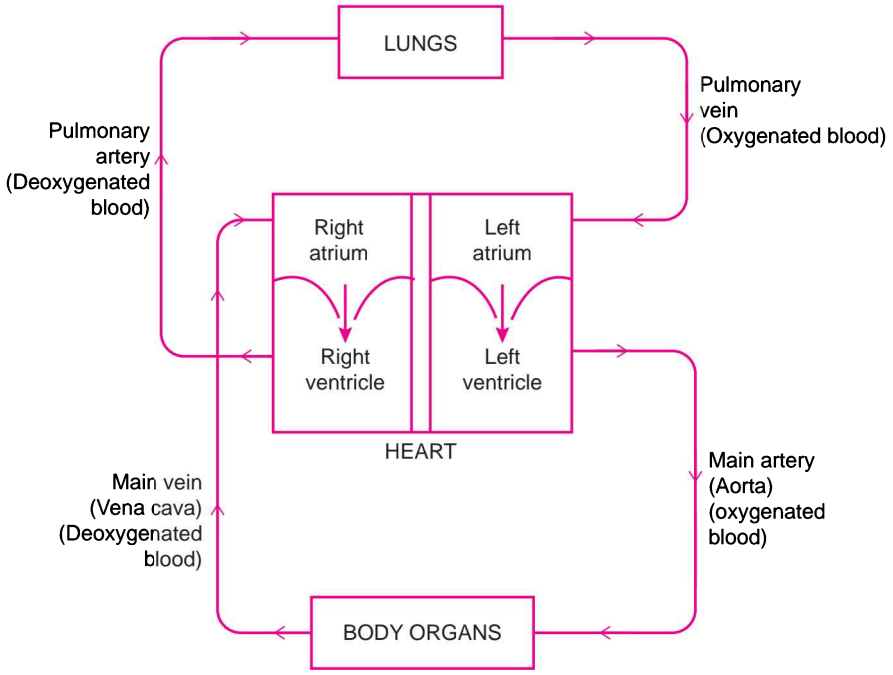
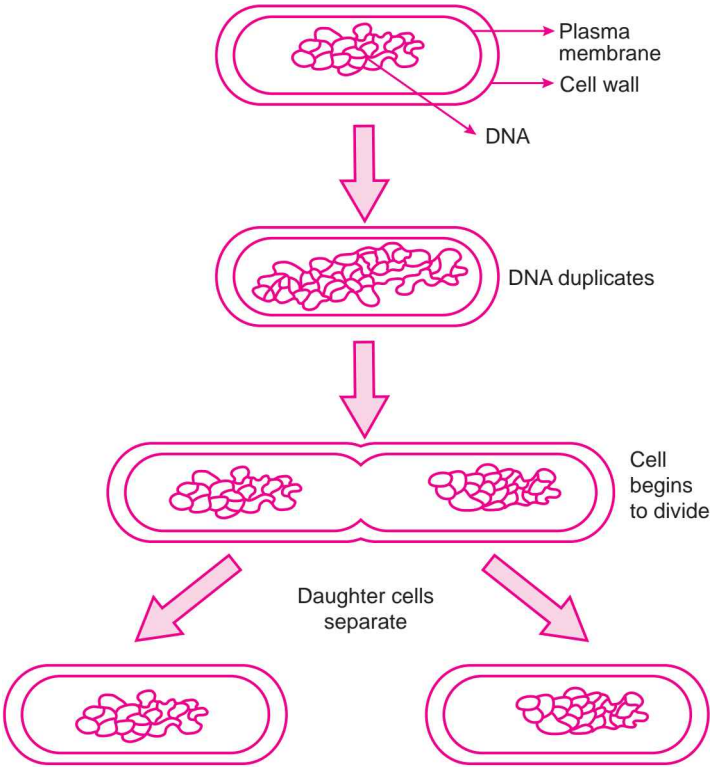


28. (*i*) **3**



(*ii*) Multicellular organisms cannot reproduce by cell because they are not a random collection of cells. In them, specialized cells are organised as tissues which are further organised into organs and organ systems. In such an organised condition, cell-by-cell division would not be possible. Multicellular organisms, therefore, require to use more complex ways of reproduction. **2**

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OR

(*i*) Prostate glands and seminal vesicle: These secrete fluid which helps in the mobility of sperm and their nourishment.

Testes secrete testosterone which brings about changes in the appearances in boys at the time of puberty. It also regulates the production of sperms. **3**

(*ii*) Surgical removal of unwanted pregnancies can be misused for female foeticides or illegal sex selected abortion of girl child. **1**

(*iii*) Oral contraceptives interfere in release of egg into the fallopian tube. **1**

29. (*i*) Resistivity will not change as it depends on the nature of the material of the conductor. **1**

(*ii*) The length of each part becomes L/4, since ρ, A are constant. **0.5**

$$R = \frac{\rho L}{A}$$

Resistance of each part = $R_{part} = (\rho L/4)/A = R/4$.

(*a*) In parallel,

$$\frac{1}{R_{eqv}} = \frac{1}{R_{part}} + \frac{1}{R_{part}} + \frac{1}{R_{part}} + \frac{1}{R_{part}} \quad \textbf{0.5}$$

$$= \frac{4}{R_{part}} = \frac{16}{R} \rightarrow R_{eqv} = \frac{R}{16}\Omega \quad \textbf{0.5}$$

(*b*) In series,

$$R_{eqv} = \frac{R}{4} + \frac{R}{4} + \frac{R}{4} + \frac{R}{4} = R\,\Omega \quad \textbf{1}$$

($R_{eqv} = r_1 + r_2 + r_3 + r_4$)

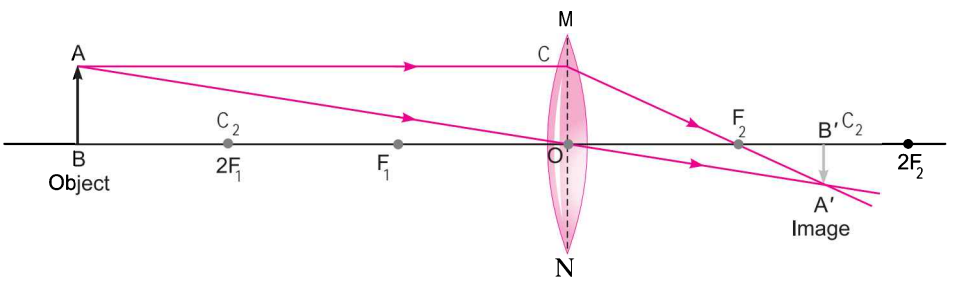
(*iii*) $P = \frac{V^2}{R}$ **1**

If R_{eqv} is less, power consumed will be more.

In the given cases, R_{eqv} is lesser in the parallel and hence power consumed will be more. **0.5**

30. (*i*) The image will be real and inverted, since the magnification has negative value. **1**

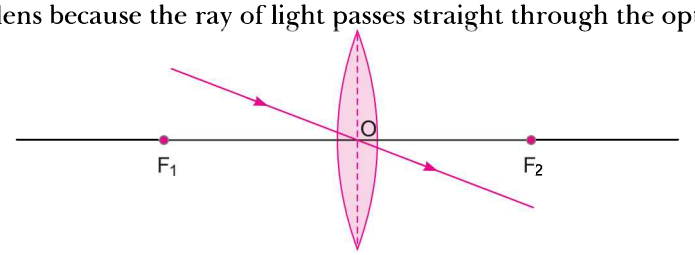
The lens that can produce a real and inverted image is a converging/ convex lens.



2

In the figure $OF_1 = OF_2 = 6$ cm.

(*ii*) The girl must have directed the ray of light along the direction of the optical centre of the lens because the ray of light passes straight through the optical centre of the lens. **1**



1

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OR

(i) Refractive Index of a medium (μ) = $\frac{\text{Velocity of light in vacuum}}{\text{Velocity of light in the medium}}$ **0.5**

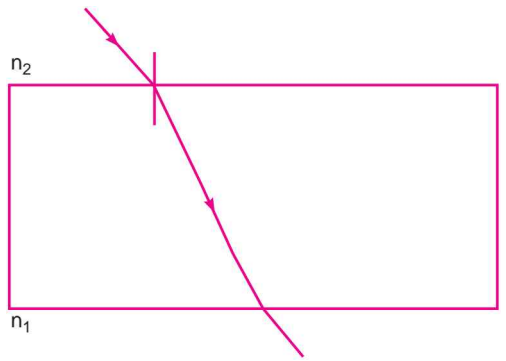
Let the velocity of light in vacuum be v_1 and velocity of light in the medium be v_2.

$$v_2 = \frac{v_1}{2}$$

Hence $n = \frac{v_1}{v_2} = \frac{v_1}{\frac{v_1}{2}}$ **1**

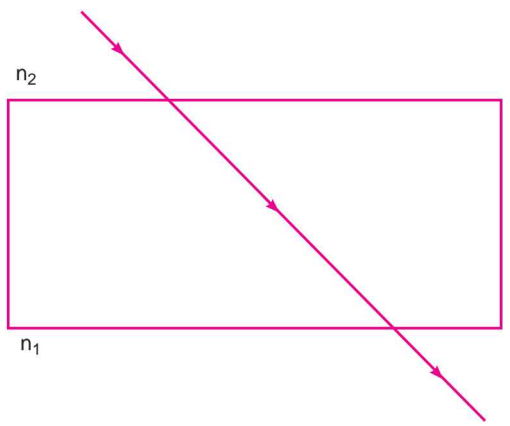
$= 2$ **0.5**

(*ii*) (*a*) The ray bends towards the normal.



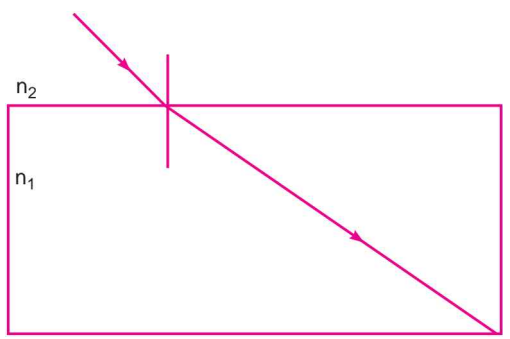
1

(*b*) The ray moves undeviated.



1

(*c*) The ray moves away from the normal.



1

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Blue Print Science-X

Based on CBSE Sample Question Paper–2020

Unit	Chapters / Form of Questions	Objective Type Questions				SAQ (3 marks)	LAQ (5 marks)	Total
		VSA	Passage-based	MCQ	A/R			
Chemical Substances	1. Chemical Reactions and Equations			1(1)		3(1)		25(11)
	2. Acids, Bases and Salts			1(1)		3(1)		
	3. Metals and Non-metals						5(1)	
	4. Carbon and its Compounds	1(1)			1(1)		5(1)	
	5. Periodic Classification of Elements	1(1)		1(1)		3(1)		
World of Living	6. Life Processes					3(1)	5(1)	23(6)
	7. Control and Coordination		4(1)			3(1)		
	8. How do Organisms Reproduce?						5(1)	
	9. Heredity and Evolution					3(1)		
Natural Phenomena	10. Light—Reflection and Refraction					3(1)	5(1)	12(4)
	11. The Human Eye and the Colourful World			1(1)		3(1)		
Effects of Current	12. Electricity			2(2)	1(1)	3(1)	5(1)	11(5)
	13. Magnetic Effects of Electric Current							
Natural Resources	14. Sources of Energy		4(1)					9(4)
	15. Our Environment			1(1)		3(1)		
	16. Management of Natural Resources			1(1)				
	Total	**2(2)**	**8(2)**	**8(8)**	**2(2)**	**30(10)**	**30(6)**	**80(30)**

Note: 1. Number of question(s) is/are given in the brackets.

2. Passage-based Questions contain both Very Short Answer Questions (VSAQ) and Multiple Choice Questions (MCQ).

3. The above Blue Print is only a sample. Suitable internal variations may be made for generating similar Blue Prints keeping the overall weightage to different form of questions and typology of questions same.

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Model Question Paper 1

Time Allowed: 3 hours **Maximum Marks: 80**

***General Instructions*:**

(i) *The question paper comprises three* ***Sections—A, B*** *and* ***C****. Attempt all the sections.*

(ii) *All questions are compulsory.*

(iii) *Internal choice is given in each section.*

(iv) *All questions in* ***Section A*** *are* ***one****-mark questions comprising MCQ, VSA type and assertion-reason type questions. They are to be answered in one word or in one sentence.*

(v) *All questions in* ***Section B*** *are* ***three****-marks, short-answer type questions. These are to be answered in about* **50–60** *words each.*

(vi) *All questions in* ***Section C*** *are* ***five****-marks, long-answer type questions. These are to be answered in about* **80–90** *words each.*

(vii) *This question paper consists of a total of* **30** *questions.*

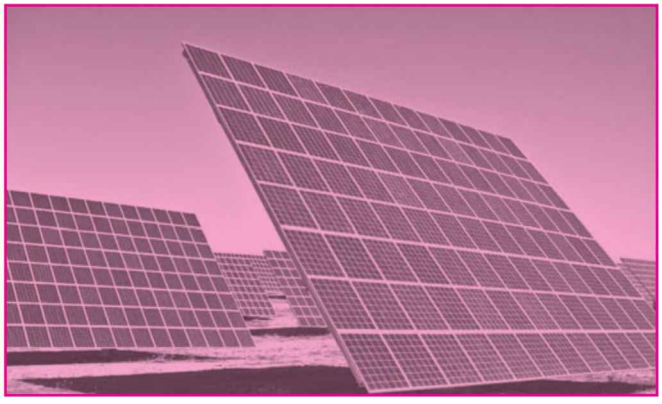
SECTION–A

1. What is methane?

2. If an element X is placed in group 14, what will be the formula and the nature of bonding of its chloride?

3. **Answer the question numbers 3(*a*)–3(*d*) on the basis of your understanding of the following paragraph and the related studied concepts.**

Solar power generation is a fast developing industry in India and many other advanced countries of the world. India is fortunate to receive large amount of solar radiations for greater part of the year particularly in the Western and Southern regions. This fact puts our country at an advantageous position to explore and utilise this natural abundance. A solar panel is an arrangement to convert solar energy into electric energy.



A solar cell is a comparatively smaller device used to convert solar energy into electricity. Since the voltage developed in a single cell is low, large number of solar cells are combined in an arrangement called solar cell panel. (see figure)

The advanced technology required to fabricate a solar cell for greater output and more conversion of percentage of energy (from solar to electric) in it is quite a daunting task. The availability of special grade silicon for making efficient solar cells is also limited.

Though the domestic use of solar cell is limited due to its high cost, the use of solar panels in artificial satellites, space probes and wireless transmission system is well known.

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Neha wanted to investigate the effect of solar radiations on different objects having different material, colour of their surface and type of surface (dull or shiny).

She used different boxes for this purpose. She used a thermometer to measure the temperature of air inside each of these boxes.

The following table lists the result of her measurements:

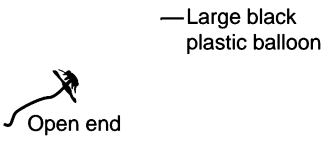
Box Number	Box Material	Nature of outside surface (colour)	Type of surface	Temperature at the start (°C)	Temperature after one hour (°C)
1	Plastic	White	Shiny	20	25
2	Plastic	Black	Shiny	20	36
3	Metal	Black	dull	20	52
4	Metal	White	shiny	20	30
5	Metal	White	dull	20	30
6	Metal	Black	shiny	20	49

(*a*) The box material and nature of outside surface affects the temperature of air inside the box. Write two such boxes.

(*b*) What inference can be drawn by Neha regarding nature and type of surfaces?

(*c*) Neha designed a large balloon using black plastic. She used a fan to fill the balloon with air and left it in the sunlight. After sometime, the balloon rose in the air without Neha having to do anything more to it.

Explain in brief why the balloon rose?



(*d*) In what sense are the term 'high cost' and 'low efficiency' of the solar cell used in the above paragraph?

4. Answer question numbers 4(*a*)–4(*d*) on the basis of your understanding of the following paragraph and the related studied concepts.

A receptor is a specialised cell or a group of cells in a sense organ that perceive a particular type of stimulus in the environment like light, heat, pressure, etc. Different sense organs have different receptors for detecting different stimuli.

Name of Receptors	Stimulus	Location in our body
Photoreceptors	Light	Eyes
Phonoreceptors	Sound	Inner Ears
Olfactory receptors	Smell	Nose
Gustory receptors	Taste	Tongue
Thermoreceptors	Heat/Cold	Skin
Tangoreceptors	Touch	Skin

Receptors are either neuron endings or specialised cells that are in close contact with neuron endings to perceive information about their external or internal environments. The receptor cells receive stimuli from the environment and transform these excitations into electro-chemical impulse. Therefore, all the receptors in various sense organs receive stimuli from the surrounding environment and send messages to the spinal cord and brain through sensory nerves. Another type of nerve cells called motor nerves transmit the response from the sensory organs to central nervous system towards effectors, in the form of electrical impulse.

(*a*) What is a nerve impulse?

(*b*) What will be the path followed by a nerve impulse on hearing a sound?

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(*c*) Upon receiving a signal the dendrite tip of a nerve cell sets off a chemical reaction that
- (*i*) creates an electrical impulse in the dendrite
- (*ii*) creates an electrical impulse in the next neuron
- (*iii*) releases some chemicals in the cell body of the neuron
- (*iv*) creates a stimulus

(*d*) When stimulated by a stimuli, the nerve impulses are
- (*i*) continuously discharged
- (*ii*) discharged for a short time
- (*iii*) discharged at different rates depending on the type of receptor
- (*iv*) discharged at a high rate initially and declines later

5. The amount of light entering the eye is controlled by the

(*a*) iris (*b*) cornea (*c*) pupil (*d*) crystalline lens

OR

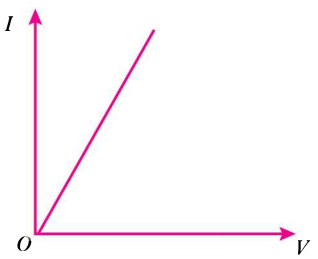
The screen behind the eye lens is called the

(*a*) iris (*b*) ciliary muscle (*c*) retina (*d*) pupil

6. SI unit of specific resistance is

(*a*) Ω (*b*) Ω m (*c*) $\Omega\,m^{-1}$ (*d*) $\Omega\,m^{-2}$

7. *I-V* characteristic of a copper wire of length *L* and area of cross-section *A* is shown in figure. The slope of the curve becomes



(*a*) less if the length of the wire is increased
(*b*) more if the length of the wire is increased
(*c*) more if the experiment is performed at higher temperature
(*d*) more if a wire of steel of same dimensions is used

8. It is important to build dams across the flooded gullies to
- I. hold water for irrigation
- II. hold water thereby preventing soil erosion
- III. recharge the ground water
- IV. hold permeability of water

Select the correct alternative from the following:

(*a*) I and IV (*b*) III and IV
(*c*) I, II and III (*d*) II and IV

OR

There are five R's to save our environment which are:

(*a*) Reduce, recycle, reform, redefine and restructure
(*b*) Reuse, refuse, redefine, restructure and reform
(*c*) Refuse, Reduce, reuse, repurpose and recycle
(*d*) Redesign, reduce, recycle, repurpose and restructure

9. In the given food chain, suppose the amount of energy at fourth trophic level is 5 kJ, what will be the energy available at the producer level?

Grass → Grasshopper → Frog → Snake → Hawk

(*a*) 5 kJ (*b*) 50 kJ
(*c*) 500 kJ (*d*) 5000 kJ

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10. Which of the following are combination reactions?

(*i*) $2KClO_3 \xrightarrow{Heat} 2KCl + 3O_2$ (*ii*) $MgO + H_2O \longrightarrow Mg(OH)_2$

(*iii*) $4Al + 3O_2 \longrightarrow 2Al_2O_3$ (*iv*) $Zn + FeSO_4 \longrightarrow ZnSO_4 + Fe$

(*a*) (*i*) and (*iii*) (*b*) (*iii*) and (*iv*) (*c*) (*ii*) and (*iv*) (*d*) (*ii*) and (*iii*)

11. Identify the acidic salt from the following:

(*a*) NaCl (*b*) KC (*c*) NH_4Cl (*d*) Na_2CO_3

12. An element which is tetravalent and forms the basis of organic chemistry is:

(*a*) P (*b*) K (*c*) O (*d*) C

OR

The element with atomic number 14 is hard and forms acidic oxide and a covalent halide. To which of the following categories does the element belong?

(*a*) Metal (*b*) Metalloid (*c*) Non-metal (*d*) Left-hand side element

For question numbers 13 and 14, two statements are given—one labeled Assertion (*A*) and the other labeled Reason (*R*). Select the correct answer to these questions from the codes (*a*), (*b*), (*c*) and (*d*) as given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation of *A*.

(*b*) Both *A* and *R* are true but *R* is not the correct explanation of *A*.

(*c*) *A* is true but *R* is false.

(*d*) *A* is false but *R* is true.

13. Assertion (*A*) : Sodium metal and ethanol should be dry when they are made to react.

Reason (*R*) : The reaction between sodium and water is more exothermic than between sodium and ethanol.

14. Assertion (*A*) : Longer wires have greater resistance and the smaller wires have lesser resistance.

Reason (*R*) : Resistance is inversely proportional to the length of the wire.

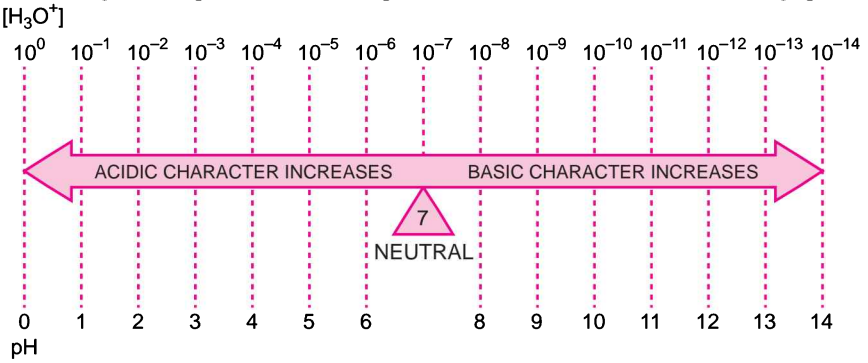
SECTION–B

15. 2 g of silver chloride is taken in a china dish and the china dish is placed in sunlight for sometime. What will be your observation in this case? Write the chemical reaction involved in the form of a balanced chemical equation. Identify the type of chemical reaction.

16. Salt A commonly used in bakery products on heating gets converted into another salt B which itself is used for removal of hardness of water and a gas C is evolved. The gas C when passed through lime water, turns it milky. Identify A, B and C.

OR

Refer the given representation of pH scale and answer the following questions:



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(*i*) What would be the H_3O^+ conc. of a substance having pH of 3?

(*ii*) What would be the nature of the substance having a pH of 11?

(*iii*) Mention the pH below which milk goes sour by lactobacillus bacteria.

17. An element 'X' has mass number 35 and number of neutrons 18. Write atomic number and electronic configuration of 'X'. Also write group number, period number and valency of 'X'.

18. How can we help in reducing the problem of waste disposal? Suggest any three methods.

OR

Mention three harmful effects of using polythene bags on the environment. Suggest an effective alternative to these bags.

19. Write three types of blood vessels. Give one important feature of each.

20. Name the plant Mendel used for his experiment. What type of progeny was obtained by Mendel in F_1 and F_2 generations when he crossed the tall and short plants? Write the ratio he obtained in F_2 generation plants.

21. Look at the picture and answer the given questions:



The gland shown in the picture is a small butterfly-shaped gland found at the base of the neck. This gland makes a hormone that travels in blood to all parts of our body and regulates carbohydrate, protein and fat metabolism in the body so as to provide the best balance for growth. This hormone also controls body's metabolism in many ways.

(*i*) Which gland is referred to in the given picture? What type of a gland is this?

(*ii*) What does this gland secrete?

(*iii*) Name the disease caused due to the deficiency of the hormone secreted by this gland.

22. (*i*) List four characteristics of the images formed by plane mirrors.

(*ii*) How can you distinguish between a plane mirror, a concave mirror and a convex mirror without touching them?

23. (*i*) Can copper wire be used as a fuse wire? Give a brief reason in support of your answer.

(*ii*) An electric oven of 2 kW power rating is operated in a domestic electrical circuit at 220 V that has a current rating of 5 A. What result do you expect? Explain.

24. State the cause of dispersion, when white light enters a glass prism. Explain with a diagram.

OR

What is atmospheric refraction? Use this phenomenon to explain the following natural events:

(*i*) Twinkling of stars

(*ii*) Advanced sunrise and delayed sunset.

Draw diagrams to illustrate your answers.

SECTION–C

25. (*i*) How do you classify elements into metals and non-metals on the basis of their electronic configuration? Choose metal and non-metal out of the following:

$$^{23}_{11}A, \quad ^{19}_{9}B, \quad ^{24}_{12}C, \quad ^{31}_{15}D, \quad ^{35}_{17}E$$

(*ii*) What type of bond will be formed if

(*a*) 'A' combines with 'B'?

(*b*) 'A' combines with 'E'?

(*c*) 'C' combines with 'E'?

(*d*) 'D' combines with 'E'?

OR

An element *A* burns with golden flame in air. It reacts with another element *B*, atomic number 17 to give a product *C*. An aqueous solution of product *C* on electrolysis gives a compound *D* and liberates hydrogen. Identify *A*, *B*, *C* and *D*. Also write down the equations for the reactions involved.

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26. (*i*) Write a chemical equation of each of the following types of chemical reactions of organic compounds.

(*a*) Oxidation reaction (*b*) Addition reaction

(*c*) Substitution reaction

(*ii*) What is ethanol? What happens when it is heated with excess conc. H_2SO_4 at 443 K? Write the role of conc. H_2SO_4 in this reaction.

27. (*i*) Define excretion.

(*ii*) Name the basic filtration unit present in the kidney.

(*iii*) Draw excretory system in human beings and label the following organs of excretory system which perform following functions:

(*a*) Form urine

(*b*) Is a long tube which collects urine from kidney

(*c*) Store urine until it is passed out

28. (*i*) What is reproduction? List its two types.

(*ii*) How are the modes of reproduction different in unicellular and multicellular organisms?

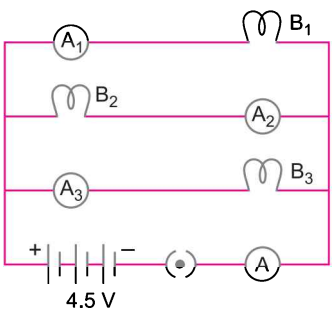
OR

(*i*) Define vegetative propagation. List its two methods.

(*ii*) Why is this mode practised for growing some types of plants ?

(*iii*) Explain the process of budding in *Hydra* with the help of labelled diagrams.

29. B_1, B_2, B_3 are three identical bulbs connected as shown in figure. Ammeters A_1, A_2, A_3 are connected as shown. When all the bulbs glow, the current of 3 A is recorded by ammeter A.



(*i*) What happens to the glow of the other two bulbs when bulb B_1 gets fused?

(*ii*) What happens to the reading of A_1, A_2, A_3 and A when the bulb B_2 gets fused?

(*iii*) How much power is dissipated in the circuit when all the three bulbs glow together?

30. (*i*) Rohit claims to have obtained an image twice the size of object with a concave lens. Is he correct? Give reason for your answer.

(*ii*) Where should an object be placed in case of a convex lens to form an image of same size as of the object? Show with the help of ray diagram the position and the nature of the image formed.

(*iii*) With the help of ray diagram, illustrate the change in position, nature and size of the image formed if the convex lens in case of (*b*) is replaced by concave lens of same focal length.

OR

(*i*) Draw labelled ray diagrams for each of the following cases to show the position, nature and size of the image formed by a convex lens when the object is placed

(*a*) between its optical centre (O) and principal focus (F)

(*b*) between F and 2F.

(*ii*) How will the nature and size of the image formed in the above two cases, (*a*) and (*b*) change, if the convex lens is replaced by a concave lens of same focal length?

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Answers

1. Methane is a carbon compound which is widely used as a fuel and as a major component of Compressed Natural Gas and Biogas.
2. The formula will be XCl_4. The element X of group 14 will have 4 valence electrons. So, it shares its 4 electrons and forms covalent bond with 4 chlorine atoms.
3. (*a*) Box (3) and box (6).
   (*b*) The inference that can be drawn by Neha is that black surface absorbs more heat and dull surface radiates less heat.
   (*c*) The air inside the balloon expanded due to absorption of heat radiations by the black balloon. The balloon become lighter than the weight of the air (outside) displaced by it and hence it rose.
   (*d*) **High Cost:**
   (*i*) Fabrication of solar cells
   (*ii*) Non-availability of high grade silicon
   Low Efficiency: Very less percentage of solar energy getting converted into electric energy, *i.e.*, low output energy from high input energy.
   $$\text{Efficiency} = \frac{\text{Output}}{\text{Input}} \times 100$$
4. (*a*) The information passing through neurons is in the form of chemical and electrical signals called nerve impulse.
   (*b*) Nerve impulses travel in the following manner from one neuron to the next:
   Dendrites ⟶ Cell body ⟶ Axon ⟶ Nerve endings at the tip of axon ⟶ Synapse ⟶ Dendrite of next neuron.
   (*c*) (*i*)
   (*d*) (*iv*)
5. (*c*) **OR** (*c*)
6. (*b*) We have, $R = \rho\frac{l}{A}$
   or $\rho = \frac{RA}{l}$, where ρ is specific resistance
   SI unit is $\frac{\Omega m^2}{m}$, *i.e.*, Ωm.
7. (*a*) Slope of the graph $= \frac{I}{V} = \frac{1}{R}$
   If the length of the wire is increased, R increases and the slope becomes less.
8. (*c*) **OR** (*c*)
9. (*d*)
10. (*d*)
11. (*c*)
12. (*d*) **OR** (*b*)
13. (*a*)
14. (*c*)

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2 Model Question Paper

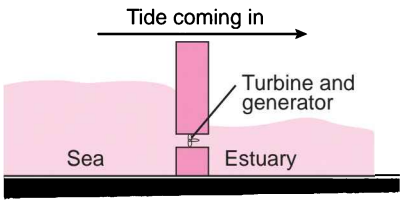
Time Allowed: 3 hours **Maximum Marks: 80**

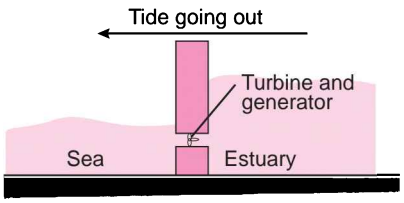
General Instructions: *Same as Model Question Paper–1.*

SECTION–A

1. Draw the structure of ethanol molecule.
2. In how many groups and periods, the Modern Periodic Table of elements is divided?
3. **Answer the question numbers 3(*a*)–3(*d*) on the basis of your understanding of the following paragraph and the related studied concepts.**

Oceans are huge reservoirs of water and energy. The energy from the oceans is available in different forms. Tides arise due to the gravitational pull of mainly the moon on the spinning Earth. The rise of ocean water as a result of moon's attraction is called 'high tide' and the fall of water is called 'low tide'. The rise and fall of tidal waves takes place twice in a day. The daily rise and fall of the tides can be used to drive turbines for generating electricity. The tidal energy can be harnessed by constructing a dam (of a barrage) across a narrow opening to the sea. During high tide, sea-water flows into the reservoir of the dam and turns the turbines and generates electricity (fig). During the low tide, stored water flows out from the reservoir into the sea and turns the turbine to generate electricity.





Energy from the sea is also available in the form of sea waves. The waves are generated by strong winds blowing across the sea. The kinetic energy of moving sea-waves can be used to generate electricity.

There is always some significant temperature difference between the water at the surface of ocean and at deeper levels. This difference in temperature is exploited to obtain energy in ocean-thermal energy conversion plants.

The warm surface-water is used to boil a volatile liquid. The vapours of the liquid are then used to run the turbine of generator. The cold water from the depth of the ocean is pumped up and condense vapour again to liquid.

(*a*) Write the full form of OTE.

(*b*) Write two forms in which solar energy manifests itself in sea.

(*c*) What is the minimum temperature difference in water at the surface of ocean and its deeper level which is required to operate power plants based on this energy?

(*d*) The generation of electricity from water energy

(*i*) is renewable source of energy (*ii*) will not produce environmental pollution

(*iii*) will never get exhausted (*iv*) all the above are correct

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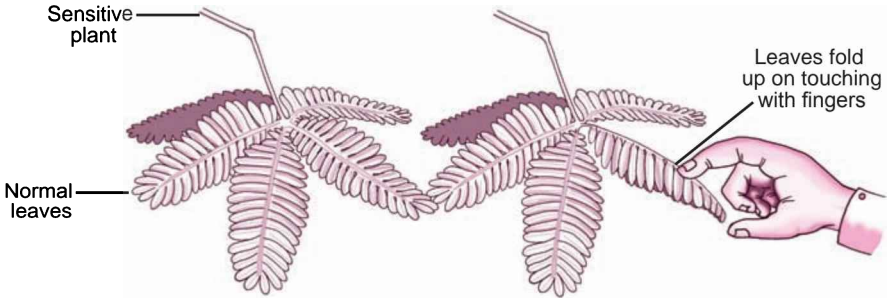
4. Answer the question numbers 4(*a*)–4(*d*) on the basis of your understanding of the following paragraph and the related studied concepts.

Movement in plants are in the form of bending, twisting and elongation of certain parts or organs. These movements are related to some external stimuli such as light, force of gravity, chemical substances, water, touch, etc. Action of plant hormones, under the influence of stimulus play an important role in the growth of stems and branches.

Tropic movements are caused by external stimulus coming from one direction only. The growth of a plant part in response to a stimulus can be towards the stimulus (in the direction of the stimulus) as positive tropism or away from the stimulus (against the direction of the stimulus), as negative tropism. Nastic movements are paratonic movements due to turgor changes in the cells. These may be growth movements which are elastic and permanent, or these may be turgor or variation movements, which are elastic and reversible. Such movements are due to the stimulus of light, temperature or contact but the direction of response is prefix and inherent in the tissues.



(*a*) What is the directional movement or orientation of part of plant in response to light known as?

(*b*) The growth of tendril in pea plants is due to

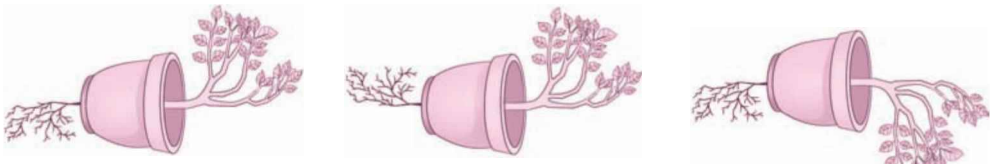
(*i*) effect of light

(*ii*) effect of gravity

(*iii*) rapid cell divisions in tendrillar cells that are away from the support

(*iv*) rapid cell divisions in tendrillar cells in contact with the support

(*c*) In the figure below (*i*), (*ii*) and (*iii*), which appears more accurate and why?



(*d*) Why are roots called positively geotropic?

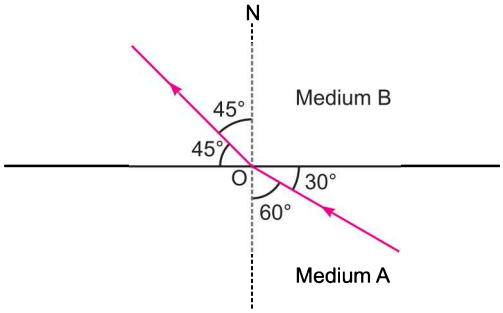
5. A light ray enters from medium A to medium B as shown in figure. The refractive index of medium B relative to A will be

(*a*) greater than unity

(*b*) less than unity

(*c*) equal to unity

(*d*) zero



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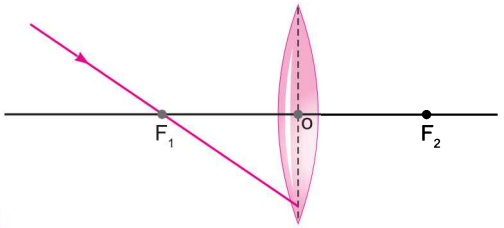
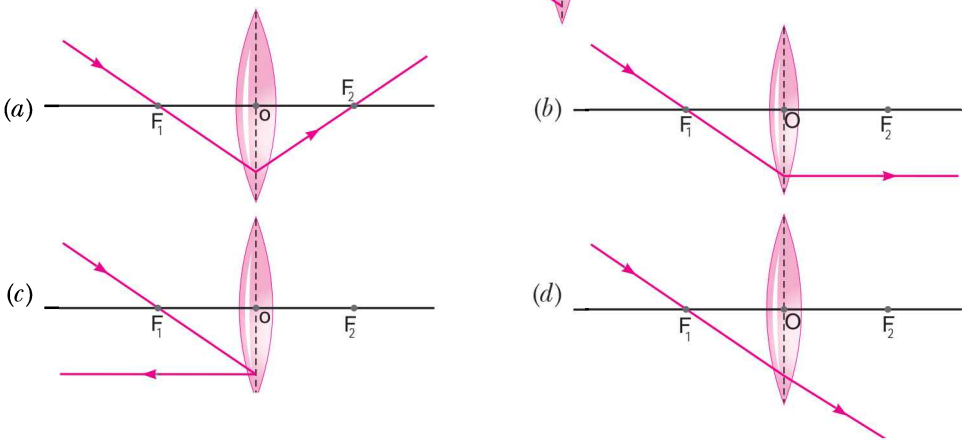
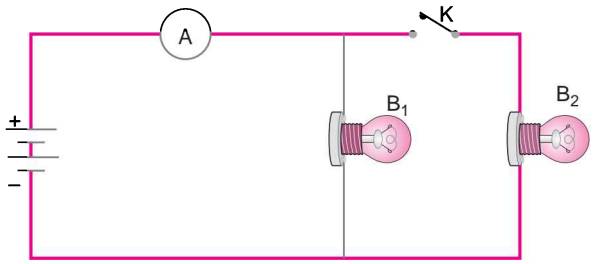
OR

Which one of the following ray diagrams is correct for the ray of light incident on a lens as shown in figure?





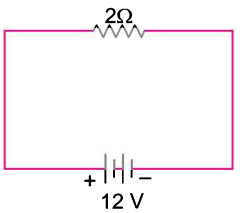
6. Bulbs B_1 and B_2 are exactly identical. When the key *K* is pressed, the reading of the ammeter will



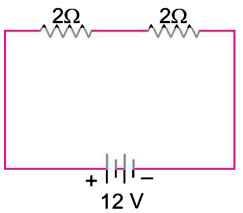
(*a*) remain unchanged (*b*) be doubled

(*c*) be halved (*d*) become four times

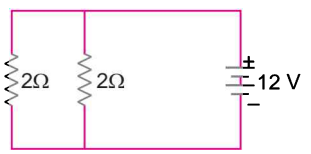
7. In the following circuits, heat produced in the resistor or combination of resistors connected to a 12 V battery will be



(*i*)



(*ii*)



(*iii*)

(*a*) same in all the three cases (*b*) minimum in case (*i*)

(*c*) maximum in case (*ii*) (*d*) maximum in case (*iii*)

8. Given below are a few statements related to biodiversity. Pick those that correctly describe the concept of biodiversity.

(*i*) Biodiversity refers to the different species of flora and fauna present in an area.

(*ii*) Biodiversity refers to only the flora of a given area.

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(*iii*) Biodiversity is greater in a forest.

(*iv*) Biodiversity refers to the total number of individuals of a particular species living in an area.

(*a*) (*i*) and (*ii*) (*b*) (*ii*) and (*iv*) (*c*) (*i*) and (*iii*) (*d*) (*ii*) and (*iii*)

OR

The most appropriate definition of a natural resource is that it is a substance/commodity that is

(*a*) present only on land

(*b*) a gift of nature which is very useful to mankind

(*c*) a man-made substance placed in nature

(*d*) available only in the forest

9. In a highly pesticide polluted pond, which of the following aquatic organisms will have the maximum amount of pesticide per gram of body mass?

(*a*) Lotus (*b*) Fishes (*c*) *Spirogyra* (*d*) Zooplanktons

10. Which of the following are exothermic processes?

(*i*) Reaction of water with quick lime (*ii*) Dilution of an acid

(*iii*) Evaporation of water (*iv*) Sublimation of camphor (crystals)

(*a*) (*i*) and (*ii*) (*b*) (*ii*) and (*iii*) (*c*) (*i*) and (*iv*) (*d*) (*iii*) and (*iv*)

11. Which of the following salts does not contain water of crystallisation?

(*a*) Blue vitriol (*b*) Baking soda (*c*) Washing soda (*d*) Gypsum

12. Which one of the following elements exhibits maximum number of valence electrons?

(*a*) Na (*b*) Al (*c*) Si (*d*) P

OR

Which of the following gives the correct increasing order of the atomic radii of O, F and N ?

(*a*) O, F, N (*b*) N, F, O (*c*) O, N, F (*d*) F, O, N

For question numbers 13 and 14, two statements are given—one labeled Assertion (*A*) and the other labeled Reason (*R*). Select the correct answer to these questions from the codes (*a*), (*b*), (*c*) and (*d*) as given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation of *A*.

(*b*) Both *A* and *R* are true but *R* is not the correct explanation of *A*.

(*c*) *A* is true but *R* is false.

(*d*) *A* is false but *R* is true.

13. **Assertion (*A*)** : Carbon is able to form millions of compounds.

Reason (*R*) : The property of self combination of carbon atom to form long chain is called catenation.

14. **Assertion (*A*)** : When the resistances are connected end-to-end consecutively, they are said to be in series.

Reason (*R*) : In case the total resistance is to be increased, then the individual resistances are connected in series.

SECTION–B

15. A magnesium ribbon is burnt in oxygen to give a white compound X accompanied by emission of light. If the burning ribbon is now placed in an atmosphere of nitrogen, it continues to burn and forms a compound Y.

(*i*) Write the chemical formulae of X and Y.

(*ii*) Write the balanced chemical equation when X is dissolved in water.

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16. A dry pellet of a common base B, when kept in open absorbs moisture and turns sticky. The compound is also a by-product of chlor-alkali process. Identify B. What type of reaction occurs when B is treated with an acidic oxide? Write a balanced chemical equation for one such solution.

OR

In one of the industrial processes used for manufacture of sodium hydroxide, a gas X is formed as by-product. The gas X reacts with lime water to give a compound Y which is used as a bleaching agent in chemical industry. Identify X and Y giving the chemical equation of the reactions involved.

17. Elements have been arranged in the following sequence on the basis of their increasing atomic masses.

F, Na, Mg, Al, Si, P, S, Cl, Ar, K

(*i*) Pick two sets of elements which have similar properties.

(*ii*) The given sequence represents which law of classification of elements?

18. How is ozone both beneficial and damaging? How can we prevent the damaging effect of ozone?

OR

The flow of energy between various components of the environment has been extensively studied. Give an outline of the findings.

19. Name the hormones secreted by the following endocrine glands and specify one function of each:

(*i*) Thyroid (*ii*) Pituitary (*iii*) Pancreas

20. What are plant hormones? Name the plant hormones responsible for the following:

(*i*) Growth of stem (*ii*) Promotion of cell division

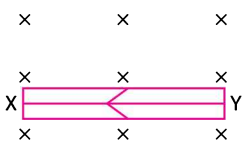
(*iii*) Inhibition of growth (*iv*) Elongation of cells

21. List two differences between acquired traits and inherited traits by giving an example of each.

22. (*i*) Why are the danger signals on the cross roads red in colour?

(*ii*) What is scattering of light? The colour of Sun looks different at different times of the day. Why?

23. Crosses X represent a uniform magnetic field directed into the paper. A conductor XY placed in the field carries current in Y to X direction. Find the direction of the force experienced by the conductor. Name the rule you applied. What will happen to the direction of force if the direction of field and direction of current both are reversed?



24. Due to gradual weakening of ciliary muscles and diminishing flexibility of the eye lens, a certain defect of vision arises. Write the name of this defect. Name the type of lens required by such persons to improve the vision. Explain the structure and function of such a lens.

OR

With the help of ciliary muscles, the human eye can change its curvature and thus alter the focal length of its lens. State the changes that occur in the curvature and focal length of the eye lens while viewing (*a*) a distant object, (*b*) nearby objects.

Explain, why a normal eye is not able to see distinctly the objects placed closer than 25 cm, without putting any strain on the eye.

SECTION–C

25. Give reasons:

(*i*) Platinum, gold and silver are used to make jewellery.

(*ii*) Sodium, potassium and lithium are stored under oil.

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(*iii*) Aluminium is a highly reactive metal, yet it is used to make utensils for cooking.

(*iv*) Carbonate and sulphide ores are usually converted into oxides during the process of extraction.

(*v*) Copper is used to make hot water tanks but not steel (an alloy of iron).

OR

Write chemical equations for the following reactions:

(*i*) Calcium metal reacts with water.

(*ii*) Cinnabar is heated in the presence of air.

(*iii*) Manganese dioxide is heated with aluminium powder.

(*iv*) A mixture of Cu_2O and Cu_2S is heated.

(*v*) $ZnCO_3$ is heated in the absence of oxygen.

26. A compound C (molecular formula, $C_2H_4O_2$) reacts with Na-metal to form a compound R and evolves a gas which burns with a pop sound. Compound C on treatment with an alcohol A in presence of an acid forms a sweet smelling compound S (molecular formula $C_3H_6O_2$). On addition of NaOH to C, it also gives R and water. S on treatment with NaOH solution gives back R and A.

Identify C, R, A, S and write down the reactions involved.

27. (*i*) Draw the diagram of female reproductive system and match and mark the part(s):

(*a*) Where block is created surgically to prevent fertilization.

(*b*) Where CuT is inserted.

(*c*) Inside which condom can be placed.

(*ii*) Why do more and more people prefer to use condoms? What is the principle behind use of condoms?

OR

(*i*) What are sexually transmitted diseases (STD)? List two viral and two bacterial STDs.

(*ii*) State briefly the changes that take place in a fertilised egg till birth of the child in the human female reproductive system. What happens to the egg when it is not fertilised?

28. (*i*) Write the reaction that occurs when glucose breaks down anaerobically in yeast.

(*ii*) Write the mechanism by which fishes breathe in water.

(*iii*) Name the balloon like structures present in lungs. List its two functions.

(*iv*) Name the respiratory pigment and write its role in human beings.

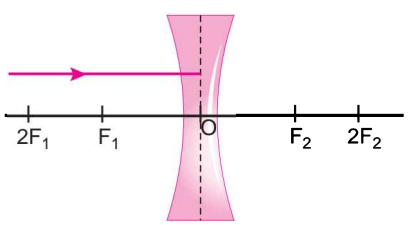
29. A current of 1 ampere flows in a series circuit having an electric lamp and a conductor of 5 Ω when connected to a 10 V battery. Calculate the resistance of the electric lamp.

Now if a resistance of 10 Ω is connected in parallel with this series combination, what change (if any) in current flowing through 5 Ω conductor and potential difference across the lamp will take place? Give reason.

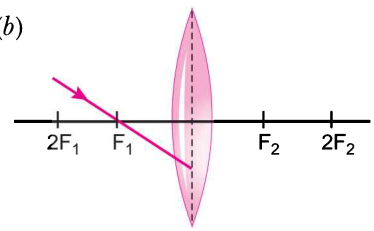
30. (*i*) The refractive index of diamond is 2.42. What is the meaning of this statement?

(*ii*) Redraw the diagram given below in your answer book and complete the path of ray.

(*a*)



(*b*)



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(*iii*) What is the difference between virtual images produced by concave, plane and convex mirrors?

(*iv*) What does the negative sign in the value of magnification produced by a mirror indicates about the image?

OR

A student focussed the image of a candle flame on a white screen using a convex lens. He noted down the position of the candle, screen and the lens as under:

Position of candle = 12.0 cm

Position of convex lens = 50.0 cm

Position of the screen = 88.0 cm

(*i*) What is the focal length of the convex lens?

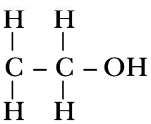
(*ii*) Where will the image be formed if he shifts the candle towards the lens at a position of 31.0 cm?

(*iii*) What will be the nature of the image formed if he further shifts the candle towards the lens?

(*iv*) Draw a ray diagram to show the formation of the image in case (*c*) as said above.

Answers

1.



2. 18 groups and 7 periods.

3. (*a*) Ocean Thermal Energy

(*b*) Sea-waves energy and ocean thermal energy

(*c*) 20°C

(*d*) (*iv*)

4. (*a*) Phototropism

(*b*) (*iii*)

(*c*) Figure (*i*) is more appropriate because in a plant, shoots are negatively geotropic. Hence, they grow upwards and roots are positively geotropic so they grow downwards.

(*d*) This is because the roots always grow towards the gravity of the Earth.

5. (*a*) **OR** (*b*)

6. (*b*)

7. (*d*)

8. (*c*) **OR** (*b*)

9. (*b*)

10. (*a*)

11. (*b*)

12. (*d*) **OR** (*d*)

13. (*a*)

14. (*b*)

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Model Question Paper 3

Time Allowed: 3 hours **Maximum Marks: 80**

General Instructions: *Same as Model Question Paper–1.*

SECTION–A

1. What is hydrotropism?
2. Write the function of voltmeter in an electric circuit.
3. **Answer question numbers 3(*a*) – 3(*d*) on the basis of your understanding of the following paragraph and the related studied concepts.**

   Ionic bonding occurs between elements that have a large difference in electronegativity. In ionic bonding a metal atom with a low electronegativity loses electrons to form a positively charged ion, or cation and a non-metal atom with a high electronegativity gains electrons to form a negatively charged ion, or anion. As a result there is an electrostatic attraction between these ions which results in ionic bonding. These type of compounds formed are ionic compounds. The table below gives the electronic structure of pairs of elements, A and B.

S.No.	Element A	Element B
(1)	2, 1	2, 8, 7
(2)	2, 6	2, 8, 8, 2
(3)	2, 8, 1	2, 8, 6
(4)	2, 8, 3	2, 7
(5)	2, 5	2, 8, 2

   (*a*) Find out the metals from the table.

   (*b*) Write the formula of the compound formed in (1) and (3).

   (*c*) Write any two properties of ionic compounds.

   (*d*) Which of the following statements is incorrect about ionic compounds?

   (*i*) Ionic compounds are aggregates of oppositively charged ions.

   (*ii*) Ionic compounds are formed by transfer of electrons.

   (*iii*) Ionic compounds are formed by sharing of electrons.

   (*iv*) Ionic compounds are formed between elements having difference in electronegativity.

4. **Answer question numbers 4(*a*)–4(*d*) on the basis of your understanding of the following paragraph and the related studied concepts.**

   An ecosystem that retains a high biodiversity is much more likely to adapt to human-caused environment change than in one that has little.

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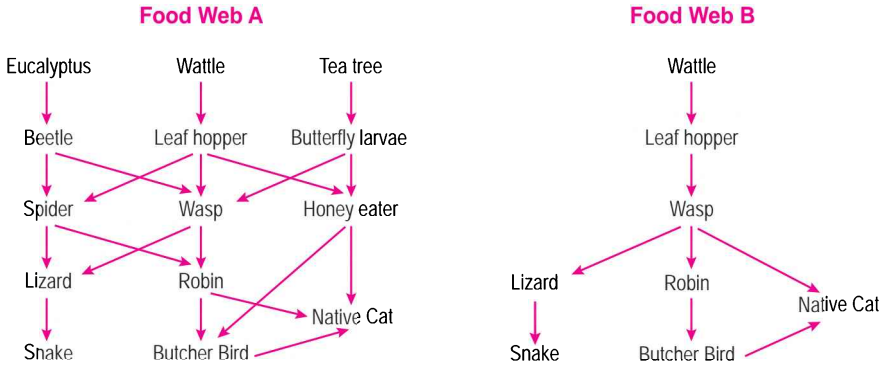
Consider the two food webs shown below.



Food web B represents a situation with very low biodiversity, where at some levels the food path involves only a single type of organism. Food web A represents a more diverse ecosystem, as a result, there are many more alternative feeding pathways. Generally, loss of biodiversity should be regarded as a serious issue, not only because the organisms that have become extinct represent a big loss but also because the organisms that remain have become more exposed to extinction in the future.

(*a*) Food webs A and B are in different locations. If leaf hoppers died out in both locations, what would be the effect on the food webs?

(*b*) The first trophic level in a food chain is always a green plant. Why?

(*c*) In food web A only two animals have three immediate food sources. Which two animals are they?

(*d*) Flow of energy in an ecosystem is always

(*i*) unidirectional (*ii*) bidirectional

(*iii*) multi directional (*iv*) no specific direction

5. Which statement is correct about the following reaction?

$$ZnO + CO \longrightarrow Zn + CO_2$$

(*a*) ZnO is being oxidised (*b*) CO is being reduced

(*c*) CO_2 is being oxidised (*d*) ZnO is being reduced

6. An organic compound which contains a —OH functional group is called

(*a*) aldehyde (*b*) alcohol (*c*) carboxylic acid (*d*) ester

OR

How many isomers are possible for an alkane having molecular formula C_6H_{14}

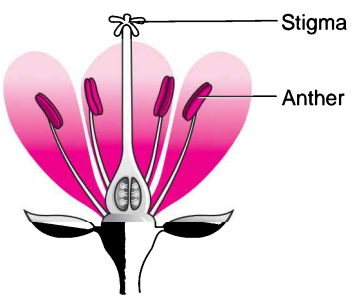
(*a*) 3 (*b*) 4 (*c*) 5 (*d*) 6

7. The process by which *Amoeba* obtains food is called

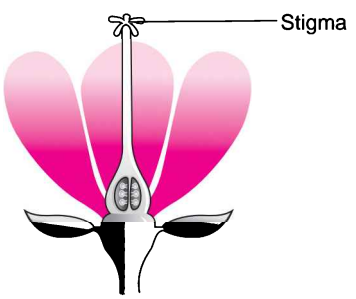
(*a*) phagocytosis (*b*) assimilation (*c*) diffusion (*d*) absorption

8. Identify the flower which will self pollinate.

(*a*)



(*b*)



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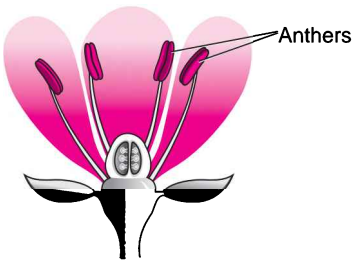
(c)



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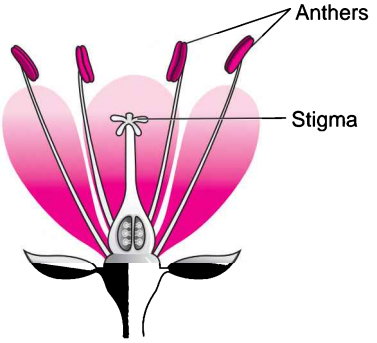


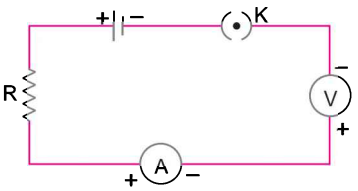
OR

The correct sequence of reproductive stages in flowering plants is

(a) gamete, zygote, embryo, seedling
(b) zygote, gametes, embryo, seedling
(c) seedling, zygote, embryo, gamete
(d) embryo, zygote, gamete, seedling

9. Identify the circuit in which the electrical components have been properly connected.

(a)



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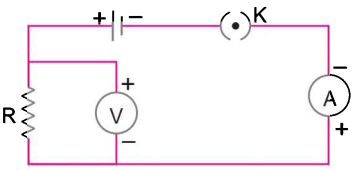

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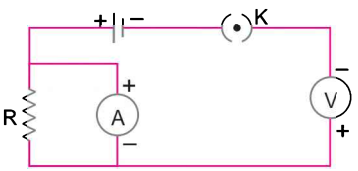

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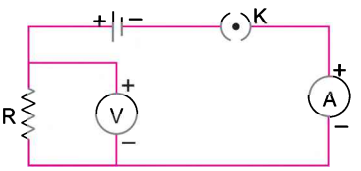
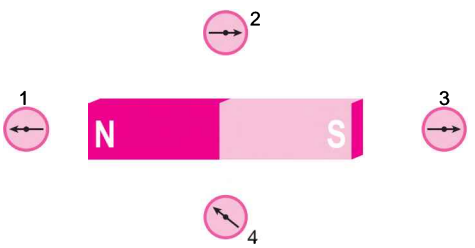


10. The direction of the force on a current carrying wire placed in a magnetic field depends on

(a) the direction of the current but not on the direction of the field.
(b) the direction of the field but not on the direction of the current.
(c) the direction of the current as well as the direction of the field.
(d) neither the direction of the current nor the direction of the field.

OR

The diagram shows plotting compasses around a bar magnet.



Which of the plotting compass needles are drawn pointing in the correct direction?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 1, 2 and 3 only
(d) 4 only

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11. Which part of solar cooker is responsible for greenhouse effect?

(*a*) Coating with black colour inside the box (*b*) Mirror

(*c*) Glass sheet (*d*) Outer cover of the solar cooker

12. Select the group which contains only non-biodegradable items.

(*a*) Wood, paper, leather (*b*) Polythene, glass, PVC

(*c*) Plastic, glass, grass (*d*) Plastic, nylon, cardboard

For question numbers 13 and 14, two statements are given—one labeled Assertion (*A*) and the other labeled Reason (*R*). Select the correct answer to these questions from the codes (*a*), (*b*), (*c*) and (*d*) as given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation of *A*.

(*b*) Both *A* and *R* are true but *R* is not the correct explanation of *A*.

(*c*) *A* is true but *R* is false.

(*d*) *A* is false but *R* is true.

13. Assertion (*A*) : Genetic variation is disadvantageous to a population.

Reason (*R*) : It enables individuals to adapt to environment.

14. Assertion (*A*) : Virtual images are always erect.

Reason (*R*) : Virtual images are formed by diverging lenses only.

SECTION–B

15. Give reasons:

(*i*) Aluminium is a reactive metal but is still used for packing food articles.

(*ii*) Red litmus paper turns blue when touched with aqueous solution of magnesium oxide.

(*iii*) Fire flies glow at night.

OR

What is an oxidation reaction? Give an example of oxidation reaction. Is oxidation an exothermic or an endothermic reaction?

16. Distinguish between ionic and covalent compounds under the following properties:

(*i*) Strength of forces between constituent elements

(*ii*) Solubility of compounds in water

(*iii*) Electrical conduction in substances

17. An organic compound 'A' of molecular formula C_2H_6O on oxidation with dilute alkaline $KMnO_4$ solution gives an acid 'B' with the same number of carbon atoms. Compound 'A' is often used for sterilisation of skin by doctors.

(*i*) Name the compounds 'A' and 'B'.

(*ii*) Write the chemical equation involved in the formation of 'B' from 'A'.

18. What is transpiration? List its two functions.

OR

(*i*) What is translocation? Why is it essential for plants?

(*ii*) Where do the substances in plants reach as a result of translocation?

19. Distinguish between pollination and fertilisation. Mention the site and the product of fertilisation in a flower.

20. What are fossils? Describe briefly two methods of determining the age of fossils.

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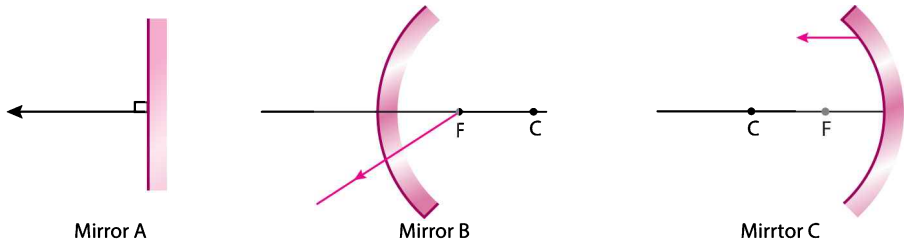
21. Study the diagram given below and answer the questions that follow:



(*i*) Which of the three mirrors is a convex mirror?

(*ii*) For the reflected rays shown in the above diagrams draw the corresponding incident ray.

(*ii*) Out of the three mirrors A, B and C, identify the one used by dentist to observe cavities in the teeth.

(*ii*) Identify the mirror which reflects a parallel beam of light as a converging beam.

22. Make a diagram to show how hypermetropia is corrected. The near point of a hypermetropic eye is 1 m. What is the power of the lens required to correct this defect? Assume that the near point of the normal eye is 25 cm.

23. There are nine wires labelled as A, B, C, D, E, F, G, H, I that have been designed as per the tabular details given below:

Wires	Lengths	Diameters	Material	Resistance
A	l	d	Constantan	R_1
B	$2l$	d	Constantan	R_2
C	$3l$	d	Constantan	R_3
D	l	d	Copper	R_4
E	l	$2d$	Copper	R_5
F	l	$3d$	Copper	R_6
G	l	$d/2$	Copper	R_7
H	l	$d/2$	Constantan	R_8
I	l	$d/2$	Aluminium	R_9

(*i*) Arrange three values R_1, R_2, R_3 in increasing order.

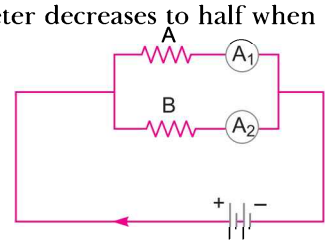
(*ii*) Arrange three values R_1, R_2, R_3 in decreasing order.

(*iii*) Will the graph between R_1, R_2 and R_3 (on the Y-axis) and their corresponding length (on the X-axis) be a straight line?

OR

(*i*) What is electrical resistivity? In a series electrical circuit comprising of a resistor having a metallic wire, the ammeter reads 5 A. The reading of the ammeter decreases to half when the length of the wire is doubled. Why?

(*ii*) In the given circuit diagram, two resistance wires A and B are of same area of cross–section and same material, but A is longer than B. Which ammeter A_1 or A_2 will indicate higher reading for current? Give reason.



24. Describe the steps involved in obtaining biogas and explain what is meant by anaerobic decomposition.

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SECTION–C

25. Equal length of magnesium ribbon are taken in two test tubes 'A' and 'B'. H_2SO_4 is added to test tube 'A' and H_2CO_3 in the test tube 'B' in equal amounts.

(*i*) Identify the test tube showing vigorous reaction.

(*ii*) Give reason to support your answer.

(*iii*) Name the gas liberated in both the tubes. How will you prove its liberation?

(*iv*) Write chemical equations for both the reactions.

(*v*) Out of the acids taken above, which one will have

(*a*) lower pH value?

(*b*) lower H^+ ion concentration respectively?

26. (*i*) How is the valency of an element determined if its electronic configuration is known? Determine the valency of an element of atomic no. 9.

(*ii*) Given below are some elements of the Modern Periodic Table. Atomic numbers of the elements are given in parentheses:

A(4), B(9), C(14), D(19), E(20)

(*a*) With the help of the electronic configuration, find out which one of the above elements will have one electron in its outermost shell.

(*b*) Which two elements belong to the same group? Give reasons for your answer.

(*c*) Which one of the above elements belonging to the fourth period has bigger atomic radius and why?

OR

The electrons in the atoms of four elements A, B, C and D are distributed in three shells having 1, 3, 5 and 7 electrons respectively in their outermost shells. Write the group numbers in which these elements are placed in the Modern Periodic Table. Write the electronic configuration of the atoms of B and D and the molecular formula of the compound formed when B and D combine.

27. What is feedback mechanism of hormonic regulation? Take the example of insulin to explain this phenomenon.

OR

State the function of each of the following plant hormones :

(*i*) Gibberellins (*ii*) Auxins (*iii*) Abscisic acid

28. (*i*) What is variation? How is variation created in a population? How does the creation of variation in a species promote survival?

(*ii*) Explain how, offspring and parents of organisms reproducing sexually have the same number of chromosomes.

29. (*i*) When do we consider a student sitting in the class to be myopic? List two causes of this defect. Explain using a ray diagram how this defect of eye can be corrected.

(*ii*) Why is the normal eye unable to focus on an object placed within 10 cm from the eye?

OR

(*i*) Draw a ray diagram to explain the term angle of deviation.

(*ii*) Why do the component colours of incident white light split into a spectrum while passing through a glass prism, explain.

(*iii*) Draw a labelled ray diagram to show the formation of a rainbow.

30. (*i*) With the help of an activity, explain the method of inducing electric current in a coil with a moving magnet. State the rule used to find the direction of electric current thus generated in the coil.

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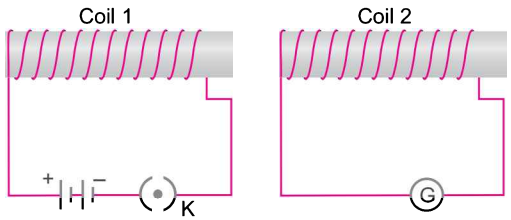
(*ii*) Two circular coils-1 and coil-2 are kept close to each other as shown in the diagram. Coil-1 is connected to a battery and key and coil-2 with a galvanometer. State your observation in the galvanometer:

(*a*) When key K is closed;

(*b*) When key K is opened;

Give reason for your observations.



Answers

1. The movement of growth of a plant in response to water is called hydrotropism.
2. Voltmeter is used for measuring potential difference between two points in an electric circuit.
3. (*a*) Element A → (1), (3), (4)
   Element B → (2), (5)
   (*b*) Compounds formed in (1) and (3) are AB and A_2B respectively.
   (*c*) (*i*) Ionic compounds have high melting point and boiling point.
   (*ii*) Ionic compounds are soluble in water.
   (*d*) (*iii*)
4. (*a*) Both the food webs would be disrupted to some extent because leaf hoppers occupy the second trophic level but that effect would be greater in food web B because the wasp has only one food source in this web.
   (*b*) The first trophic level is always a green plant because only plants can utilise the radiant energy of the Sun and transform it to chemical form during photosynthesis.
   (*c*) Native cat and wasps.
   (*d*) (*i*)
5. (*d*)
6. (*b*) **OR** (*c*)
7. (*a*)
8. (*d*) **OR** (*a*)
9. (*b*)
10. (*c*) **OR** (*a*)
11. (*c*)
12. (*b*)
13. (*d*)
14. (*c*)

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4 Model Question Paper

Time Allowed: 3 hours **Maximum Marks: 80**

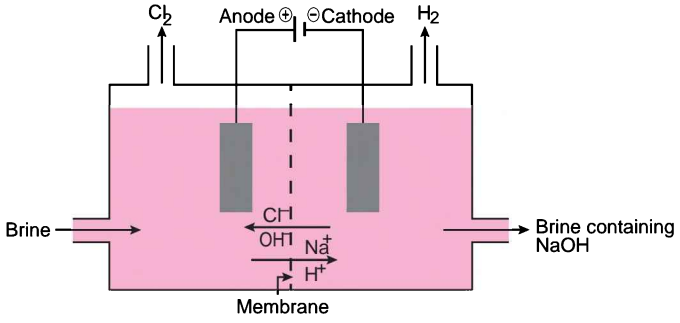
General Instructions: *Same as Model Question Paper–1.*

SECTION–A

1. Which hormone increases heartbeat rate when we get a fright?
2. What are solar cells?
3. **Answer the question numbers 3(*a*)–3(*d*) on the basis of your understanding of the following paragraph and the related studied concepts.**

   'Salts' refer to the compound formed when an acid reacts with a base. These reactions are known as neutralisation reactions. These reactions are often used in the laboratories to calculate the exact concentration of an acid or an alkali when the other is known. The familiar example of salt is sodium chloride (NaCl), which we use in our food on daily basis and is known as rock salt.

   It is prepared by the reaction of hydrochloric acid and sodium hydroxide solution. This salt is used to prepare various compounds. When electricity is passed through an aqueous solution of sodium chloride (called brine), it decomposes to form sodium hydroxide. The process is called the chlor-alkali process because of the products formed –chlor for chlorine and alkali for sodium hydroxide.



   (*a*) Write the chemical reaction of chlor-alkali process.

   (*b*) Name the gases formed at the anode and the cathode.

   (*c*) Write one use each of chlorine and hydrogen gas.

   (*d*) How will you prepare baking soda from sodium chloride?

4. **Answer question numbers 4(*a*)–4(*d*) on the basis of your understanding of the following paragraph and the related studied concepts.**

   The image formed by a convex lens depends on the position of the object in front of the lens. When the object is placed anywhere between focus and infinity, the image formed by convex lens is real and inverted. The image is not obtained on the screen when the object is placed between the focus and the lens.

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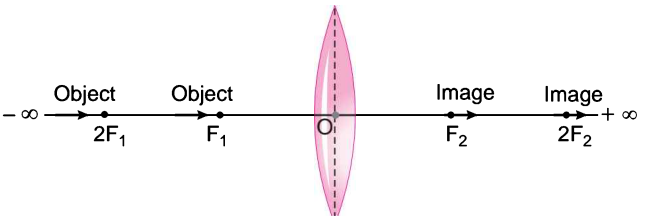
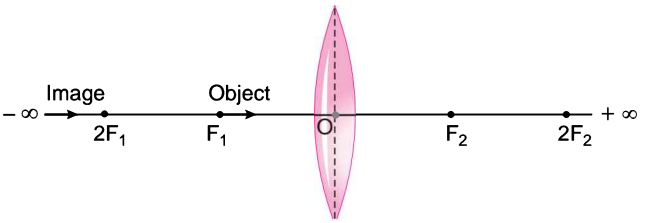
The distance between the optical centre O of the convex lens and the focus point F_1 or F_2 is its focal length.

When the object shifts from $-\infty$ to F_1, the image moves from F_2 to $+\infty$.



When the object shifts from F_1 to O, the image moves from $-\infty$ to O.



A student did an experiment with a convex lens. He put an object at different distances from the lens. In each case he measured the distance of the image from the lens. The results were recorded in the following table.

Object distance (in cm)	25	30	40	60	120
Image distance (in cm)	100	24	60	30	40

Unfortunately his results are written in the wrong order.

(*a*) What is the focal length of this lens?

(*b*) Rewrite the image distances in the correct order.

(c) Which of the object distances gives the biggest image?

(*i*) 30 cm (*ii*) 25 cm (*iii*) 40 cm (*iv*) 60 cm

(*d*) The minimum distance between an object and its real image formed by a convex lens is

(*i*) $2f$ (*ii*) $3f$ (*iii*) $4f$ (*iv*) zero

5. A greenish coating develops on copper utensils due to formation of

(*a*) $CuCO_3$ (*b*) $Cu(OH)_2$

(*c*) $CuCO_3 . Cu(OH)_2$ (*d*) CuO

OR

Although metals form basic oxides, which of the following metals form an amphoteric oxide?

(*a*) Na (*b*) Ca (*c*) Al (*d*) Cu

6. Identify the group which is not a Dobereiner Triad.

(*a*) Li, Na, K (*b*) Be, Mg, Ca (*c*) Ca, Sr, Ba (*d*) Cl, Br, I

7. Living cells of xylem tissue are

(*a*) xylem parenchyma (*b*) xylem fibres

(*c*) xylem vessels (*d*) tracheids

OR

When a blood vessel becomes damaged in body, the type of blood corpuscles that quickly increases in number at that site is

(*a*) lymphocyte (*b*) monocyte (*c*) platelets (*d*) eosinophils

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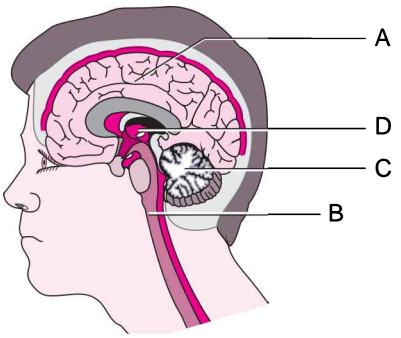
8. From the given figure identify the part of human brain controlling most of the involuntary actions.



(*a*) A & B (*b*) B & C (*c*) C & D (*d*) D & A

9. A pollen tube produced from pollen grain contains _____ male gametes.

(*a*) one (*b*) two (*c*) seven (*d*) eight

10. Which of the following represents voltage?

(*a*) $\frac{\text{Work done}}{\text{Current} \times \text{Time}}$ (*b*) Work done × Charge

(*c*) Work done × Charge × Time (*d*) $\frac{\text{Work done} \times \text{Time}}{\text{Current}}$

OR

The unit of electric power may also be expressed as

(*a*) volt × ampere (*b*) kilowatt × hour (*c*) watt × second (*d*) joule × second

11. A rectangular coil of copper wire is rotated in a magnetic field. The direction of induced current changes once in each

(*a*) two revolutions (*b*) one revolution (*c*) half revolution (*d*) one-fourth revolution

12. Select the incorrect statement.

(*a*) Economic development is linked to environmental conservation.

(*b*) Sustainable development encourages development for current generation and conservation of resources for future generations.

(*c*) Sustainable development does not consider the view points of stakeholders.

(*d*) Sustainable development is a long planned and persistent development.

For question numbers 13 and 14, two statements are given—one labeled Assertion (*A*) and the other labeled Reason (*R*). Select the correct answer to these questions from the codes (*a*), (*b*), (*c*) and (*d*) as given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation of *A*.

(*b*) Both *A* and *R* are true but *R* is not the correct explanation of *A*.

(*c*) *A* is true but *R* is false.

(*d*) *A* is false but *R* is true.

13. Assertion (*A*) : If a graph is plotted between the potential difference and the current flowing, the graph is a straight line passing through the origin.

Reason (*R*) : The current is directly proportional to the potential difference.

14. Assertion (*A*) : Supersonic jets cause thinning of ozone layer.

Reason (*R*) : Depletion of ozone layer causes greenhouse effect.

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SECTION–B

15. Write the balanced chemical equations for the following reactions:

(*i*) Calcium hydroxide + Carbon dioxide ⟶ Calcium carbonate + Water

(*ii*) Aluminium + Copper chloride ⟶ Aluminium chloride + Copper

(*iii*) Calcium carbonate + Hydrochloric acid ⟶ Calcium chloride + Water + Carbon dioxide

16. The pH of a salt used to make tasty and crispy *pakoras* is 14. Identify the salt and write a chemical equation for its formation. List its two uses.

17. What happens when hydrogen is added to a vegetable oil in the presence of nickel? Name the reaction and write one difference between the physical property of the vegetable oil and the product obtained in this reaction. Write the role of nickel in this reaction.

OR

(*i*) Complete the following equations:

(*a*) $CH_4 + O_2 \longrightarrow$ (*b*) $CH_3COOH + C_2H_5OH \xrightarrow{\text{Acid}}$

(*c*) $CH_3CH_2OH \xrightarrow[443K]{\text{Conc. } H_2SO_4}$

(*ii*) Write the name of the next homologue of CH_3OH and HCOOH.

(*iii*) How does boiling point and melting point of hydrocarbons change with increase in molecular mass?

18. List two types of the transport system in human beings and write the functions of any one of these.

19. What happens when a pollen lands on a suitable stigma? Write about the events that occur till the seed formation in the ovary.

OR

Draw a longitudinal section of female reproductive part of a flower showing germination of pollen grain. Label on it the following:

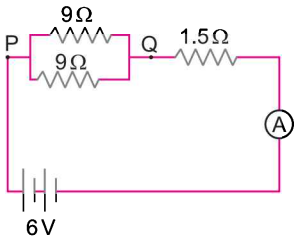
(*i*) Stigma; (*ii*) Pollen tube with a male germ cell;

(*iii*) Female germ cell.

20. What is DNA copying? State its importance.

21. What is Tyndall effect? Explain with an example.

22. In the circuit diagram, calculate:



(*i*) Effective resistance

(*ii*) Current read by ammeter

(*iii*) Potential difference across points P and Q

23. (*i*) Name the device used to convert

(*a*) solar energy into heat, and (*b*) solar energy into electricity.

(*ii*) Explain the principle of working of a windmill.

OR

Explain the steps involved in obtaining biogas. What is meant by anaerobic decomposition?

24. Why are forests considered "biodiversity hotspots"? Suggest four approaches towards the conservation of forests.

SECTION–C

25. (*i*) How will you show experimentally that metals are good conductors of heat?

(*ii*) Describe the extraction of mercury metal from its ore cinnabar (HgS).

OR

(*i*) List in tabular form any three chemical properties on the basis of which metals and non-metals are differentiated.

(*ii*) State two ways to prevent the rusting of iron.

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26. (*i*) How do you calculate the valency of an element from its electronic configuration?

(*ii*) What is the valency of magnesium with atomic number 12 and sulphur with atomic number 16?

(*iii*) How does the valency vary in a period on going from left to right?

(*iv*) How does the valency vary in going down a group?

27. (*i*) Mention any two components of blood.

(*ii*) Trace the movement of oxygenated blood in the body.

(*iii*) Write the function of valves present in between atria and ventricles.

(*iv*) Write one structural difference between the composition of artery and veins.

28. (*i*) How does chemical coordination occur in plants?

(*ii*) State the role of cerebellum.

OR

(*i*) Name those parts of the flower which serve the same function as the following do in the animals:

(*a*) Testis (*b*) Ovary (*c*) Sperms

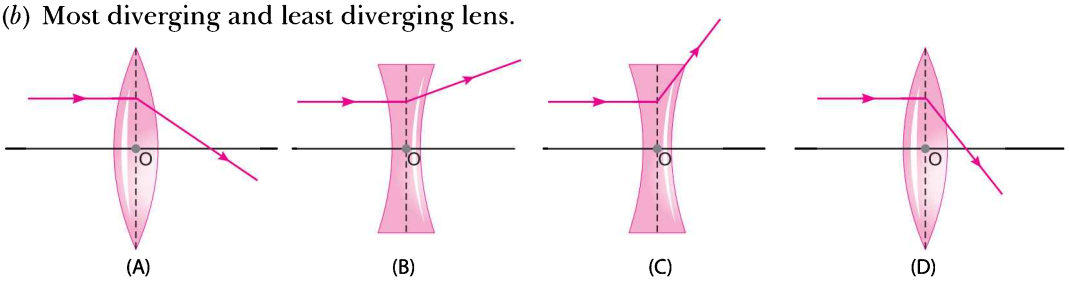
(*ii*) Draw the structure of a neuron and label the nucleus and cell body.

29. (*i*) How far should one hold an object from a concave mirror of focal length 40 cm so as to get a virtual image twice the size of the object?

(*ii*) From the diagrams given below identify the:

(*a*) Most converging and least converging lens.

(*b*) Most diverging and least diverging lens.



Hence infer how the power of a lens is related to focal length of a lens?

OR

(*i*) Rohit claims to have obtained an image twice the size of object with a concave lens. Is he correct? Give reason for your answer.

(*ii*) Where should an object be placed in case of a convex lens to form an image of same size as of the object? Show with the help of ray diagram the position and the nature of the image formed.

(*iii*) With the help of ray diagram, illustrate the change in position, nature and size of the image formed if the convex lens in case of (*b*) is replaced by concave lens of same focal length.

30. (*i*) What are magnetic field lines? How is the direction of magnetic field at a point in a magnetic field determined using field lines?

(*ii*) Two circular coils 'X' and 'Y' are placed close to each other. If the current in the coil 'X' is changed, will some current be induced in the coil 'Y'? Give reason.

(*iii*) State 'Fleming's right hand rule".

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Answers

1. Adrenalin
2. Solar cell is a device which converts solar energy directly into electricity.
3. (*a*) $2NaCl + 2H_2O \longrightarrow 2NaOH + Cl_2\uparrow + H_2\uparrow$
   (*b*) Anode: Chlorine gas
   Cathode: Hydrogen gas
   (*c*) Chlorine is used to purify water.
   Hydrogen gas is used as a fuel.
   (*d*) When a cold and concentrated solution of sodium chloride reacts with ammonia and carbon dioxide, sodium hydrogencarbonate (baking soda) and ammonium chloride is formed.
   $NaCl + NH_3 + H_2O + CO_2 \longrightarrow \underset{\text{Baking soda}}{NaHCO_3} + NH_4Cl$
4. (*a*) When the object distance equals the image distance, they are at twice the focal length from the lens.
   When $2F = 60$ cm
   $F = 30$ cm
   When an object is placed at focus ($F = 30$ cm) of a convex lens, the image formed is at infinity. But infinity is not an observation in the given table.
   Hence, $F = 30$ cm is not possible.
   Now, when $2F = 40$ cm
   $\therefore$ $F = 20$ cm
   (*b*) Correct order: 100, 60, 40, 30, 24
   (*c*) (*ii*)
   (*d*) (*iii*)
5. (*c*) **OR** (*c*)
6. (*b*)
7. (*a*) **OR** (*c*)
8. (*b*)
9. (*b*)
10. (*a*) **OR** (*a*)
11. (*c*)
12. (*c*)
13. (*a*)
14. (*b*)

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5 Model Question Paper

Time Allowed: 3 hours **Maximum Marks: 80**

General Instructions: *Same as Model Question Paper–1.*

SECTION–A

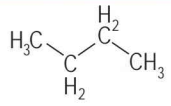
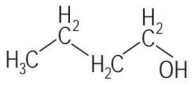
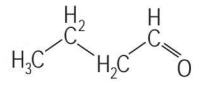
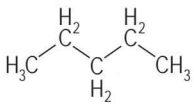
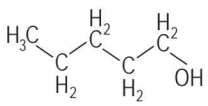
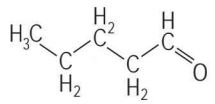
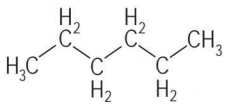
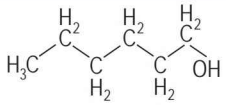
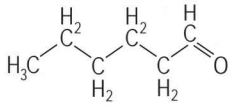
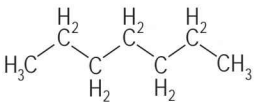
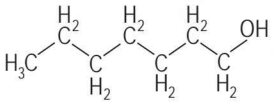
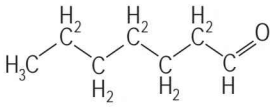
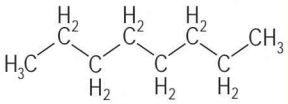
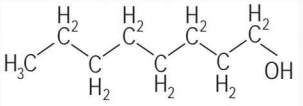
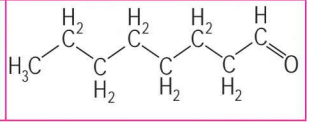
1. What is the role of ciliary muscles in the human eye?
2. If a pollutant enters at the producer level, the organisms of which trophic level will have the maximum concentration of the pollutant in their bodies?
3. **Answer the question numbers 3(*a*)–3(*d*) on the basis of your understanding of the following paragraph and the related studied concepts.**

   Organic compounds are molecules that frequently contain carbon (C), hydrogen (H), and oxygen (O) joined together by covalent bonds.

   Due to tetravalency and catenation property of carbon, it forms chains of different lengths. Hydrogen atom or other atoms on these carbon chains can be replaced by the functional groups. A series of compounds in which the same functional group substitute for hydrogen in a carbon chain is called a homologous series.

   Homologous series of alkane, alcohol and aldehyde is given in table 1.

Table 1

Carbons in the Chain	Name prefix	Structure		
		Alkane (suffix-ane)	Alcohol (suffix-anol)	Aldehyde (suffix-analdehyde)
4	but			
5	pent			
6	hex			
7	hept			
8	oct			

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The melting points of homologous series given above is given in table 2.

Table 2

Carbons in the Chain	Melting Point (K)		
	Alkane	Alcohol	Aldehyde
4	135	183	174
5	143	194	213
6	178	221	217
7	182	239	231
8	216	257	285

(*a*) Which organic compounds in Table 2 are solids at 215 K?

(*i*) All alkanes, alcohols, and aldehydes with 5 carbons or fewer.

(*ii*) Alcohols and aldehydes with 6 or more carbons and octane.

(*iii*) The 4 and 5-carbon alcohols and aldehydes, and all alkanes with 7 or fewer carbons.

(*iv*) The 5-carbon pentane and pentanol compounds and the 4-carbon butane, butanol, and butanal.

(*b*) Write the IUPAC name of $CH_3CH_2CH_2CHO$.

(*c*) Draw the structure of an alcohol having 14 covalent bonds.

(*d*) What will be the 8th member of the homologous series whose fifth member is pentanal?

4. Answer question numbers 4(*a*)–4(*d*) on the basis of your understanding of the following paragraph and the related studied concepts.

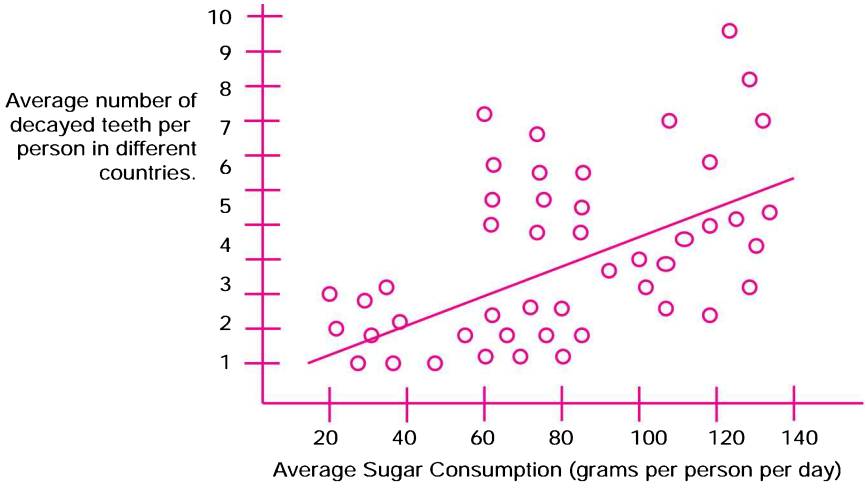
Bacteria that live in our mouths cause dental caries (tooth decay). Caries has been a problem since the 1700s when sugar became available from the expanding sugarcane industry.

Today, we know a lot about caries. For example:

- Bacteria that cause caries feed on sugar.
- The sugar is transformed to acid.
- Acid damages the surface of teeth.
- Brushing teeth helps to prevent caries.

(*a*) What is the role of bacteria in dental caries?

(*b*) The given graph shows the consumption of sugar and the amount of caries in different countries. Each country is represented by a dot in the graph.



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Which of the following statements is supported by the data given in the graph?

(*i*) In some countries, people brush their teeth more frequently than in other countries.

(*ii*) The more sugar people eat, the more likely they are to get caries.

(*iii*) In recent years, the rate of caries has increased in many countries.

(*iv*) In recent years, the consumption of sugar has increased in many countries.

(*c*) How can tooth decay be prevented?

(*d*) What role does mouth play in digestion of food?

5. $NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$ is an example of

(*a*) neutralisation reaction (*b*) redox reaction

(*c*) double displacement reaction (*d*) decomposition reaction

OR

Fatty foods become rancid due to the process of

(*a*) oxidation (*b*) corrosion

(*c*) reduction (*d*) hydrogenation

6. The image formed by a concave mirror is observed to be virtual, erect and larger than the object. Where should be the position of object?

(*a*) Between the pole of mirror and its principal focus.

(*b*) At the centre of curvature.

(*c*) Between the principal focus and the centre of curvature.

(*d*) Beyond the centre of curvature.

7. A concave spherical mirror has a radius of curvature of 100 cm. What is its focal length?

(*a*) 50 cm (*b*) 300 cm (*c*) 100 cm (*d*) 25 cm

8. Which one of the following phenomena contributes significantly to the reddish appearance of the Sun at sunrise or sunset?

(*a*) Dispersion of light (*b*) Scattering of light

(*c*) Total internal reflection of light (*d*) Reflection of light from the Earth

OR

The focal length of eye lens increases when eye muscles

(*a*) are relaxed and lens becomes thinner.

(*b*) contract and lens becomes thicker.

(*c*) are relaxed and lens becomes thicker.

(*d*) contract and lens becomes thinner.

9. Which of the following is a renewable source of energy?

(*a*) Coal (*b*) Natural gas

(*c*) Wood (*d*) Petrol

10. To work properly, wind-electric generators need wind speeds of at least about

(*a*) 1.5 km/h (*b*) 15 km/h (*c*) 150 km/h (*d*) 1,500 km/h

11. Which of the following is a result of biological magnification?

(*a*) Top level predators may be most harmed by toxic chemicals in environment.

(*b*) Increase in carbon dioxide.

(*c*) The green-house effect will be most significant at the poles.

(*d*) Energy is lost at each trophic level of a food chain.

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OR

If a grasshopper is eaten by a frog, then the energy transfer will be from

(*a*) primary consumer to secondary consumer

(*b*) secondary consumer to primary consumer

(*c*) producer to primary consumer

(*d*) producer to decomposer

12. *Khadins, Bundhis, Ahars* and *Kattas* are ancient structures that are examples for

(*a*) grain storage (*b*) wood storage

(*c*) water harvesting (*d*) soil conservation

For question numbers 13 and 14, two statements are given—one labeled Assertion (*A*) and the other labeled Reason (*R*). Select the correct answer to these questions from the codes (*a*), (*b*), (*c*) and (*d*) as given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation of *A*.

(*b*) Both *A* and *R* are true but *R* is not the correct explanation of *A*.

(*c*) *A* is true but *R* is false.

(*d*) *A* is false but *R* is true.

13. Assertion (*A*) : Zinc oxide is amphoteric in nature.

Reason (*R*) : Zinc oxide reacts with both acids and bases.

14. Assertion (*A*) : Natural resources need to be used carefully.

Reason (*R*) : Resources are finite in supply and human population is tremendously increasing.

SECTION–B

15. What is the difference between the displacement and double displacement reactions? Write equations for these reactions.

16. What is cinnabar? How is metal extracted from Cinnabar? Explain briefly.

OR

You are given samples of three metals sodium, magnesium and copper. Suggest any two activities to arrange them in order of decreasing activity.

17. The electronic configuration of an element is 2, 8, 4.

(*i*) State its group and period in the Modern Periodic Table.

(*ii*) Name and write its one physical property.

(*iii*) Find out its valency.

18. (*i*) Define the term excretion. Why should animals excrete waste matter?

(*ii*) Name the main excretory organ of human beings and state the form in which the excretory matter is thrown out of the body.

19. (*i*) Name the part of human brain which controls (*i*) voluntary actions, and (*ii*) involuntary actions.

(*ii*) Write the function of peripheral nervous system. Name the components of this system stating their origin.

20. (*i*) Testes are located outside the abdominal cavity. Why?

(*ii*) Fertilisation is possible if copulation has taken place during middle of menstrual cycle. Give reason.

(*iii*) What happens when the egg is not fertilised?

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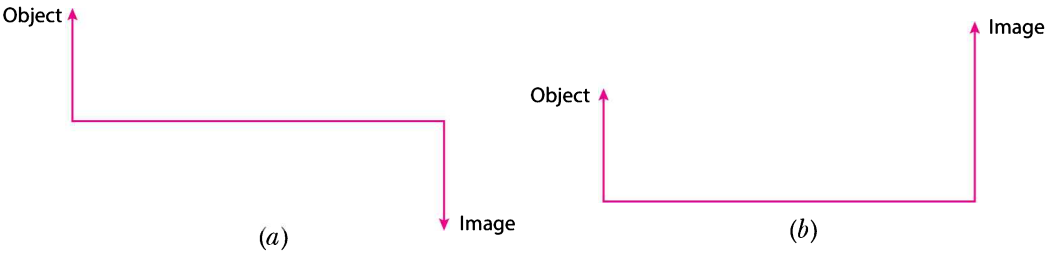
21. The nature, size and position of image of an object produced by a lens or mirror are as shown below. Identify the lens/mirror used in each case and draw the corresponding complete ray diagram.

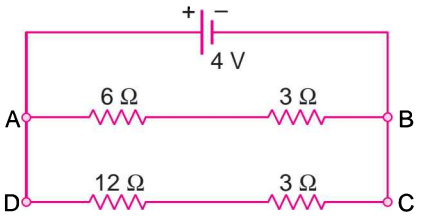


22. For the circuit shown in the following diagram.

What is the value of:

(*i*) Current through 6 Ω resistor?

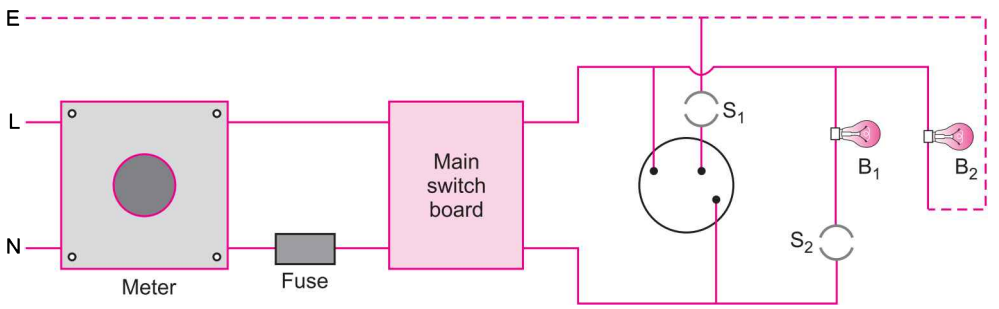
(*ii*) Potential difference across 12 Ω resistor?



23. Can a freely suspended current carrying solenoid stay in any direction? Justify your answer. What will happen when the direction of current in the solenoid is reversed? Explain.

OR

(*i*) The given figure shows a domestic electric circuit. Study this circuit carefully. List any two errors in the circuit and justify your answer.



(*ii*) Give one difference between the wires used in the element of an electric heater and in a fuse.

(*iii*) List two advantages of parallel connection over series connections.

24. What is "sustainable management of natural resources"? Why is it necessary? Which one out of reuse and recycle, would you practise in your daily life and why?

OR

How can you say that an individual can contribute or make a difference to the management of

(*i*) forests and wildlife (*ii*) water resources, and

(*iii*) coal and petroleum?

SECTION–C

25. A road tanker carrying an acid was involved in an accident and its contents spilled on the road. At the side of the road, iron drain cover began melting and fizzing as the acid ran over them. A specialist was called to see if acid actually leaked into the nearby river.

(*i*) Explain how specialist could carry out sample test to see if the river water contains some acid or not.

(*ii*) Suggest a better report name for the word 'melting'.

(*iii*) Explain why the drain covers began fizzing as the acid ran over them.

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OR

A metal carbonate X on reacting with an acid gives a gas which when passed through a solution Y gives the carbonate back. On the other hand, a gas G that is obtained at anode during electrolysis of brine is passed on dry Y, it gives a compound Z, used for disinfecting drinking water. Identify X, Y, G and Z.

26. Give reasons for the following:

(*i*) Element carbon forms compounds mainly by covalent bonding.

(*ii*) Diamond has a high melting point.

(*iii*) Graphite is a good conductor of electricity.

(*iv*) Acetylene burns with a sooty flame.

(*v*) Kerosene does not decolourise bromine water while cooking oils do.

27. Explain the process of breathing in man.

28. (*i*) With the help of Mendel's experiments show that

(*a*) traits may be dominant or recessive, and

(*b*) traits are inherited independently.

(*ii*) Birds and bats are more closely related to each other than to squirrels or lizards. Comment.

OR

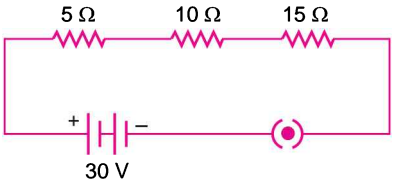
(*i*) List two reasons in favour of Mendel's choice of pea plants for his experiments.

(*ii*) "The geographical isolation of individuals of a species can lead to the formation of a new species." Provide suitable explanation to justify this statement.

29. What is the cause of dispersion of white light through a glass prism? Draw a ray diagram to show the path of light when two identical glass prisms are arranged together in inverted position with respect to each other and a narrow beam of white light is allowed to fall obliquely on one of the faces of the prisms. *[CBSE 2019 (31/4/1)]*

30. (*i*) Three resistors R_1, R_2 and R_3 are connected in series and the combination is connected to a battery, ammeter, voltmeter and key. Draw suitable circuit diagram and obtain an expression for the equivalent resistance of the combination of the resistors.

(*ii*) Consider the given circuit and find the current flowing in the circuit and potential difference across the 15 Ω resistor when the circuit is closed.



OR

Find out the following in the electric circuit given in figure alongside:

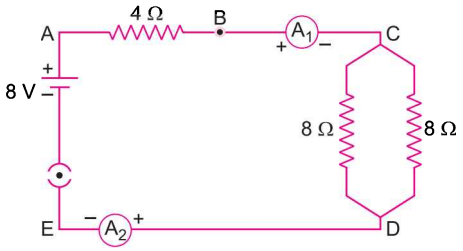
(*i*) Effective resistance of two 8 Ω resistors in the combination.

(*ii*) Current flowing through 4 Ω resistor.

(*iii*) Potential difference across 4 Ω resistance.

(*iv*) Power dissipated in 4 Ω resistor.

(*v*) Difference in ammeter readings, if any.



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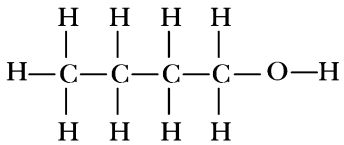
Answers

1. Ciliary muscles hold the eye lens in position and control the focal length of the eye lens by contracting and expanding.
2. Organisms at the top or highest level of food chain will have maximum concentration of the pollutant.
3. (*a*) (*ii*)

   (*b*) Butanal

   (*c*)



   (*d*) Octanal
4. (*a*) Bacteria produces acid which cause caries and degrade the tooth enamel.

   (*b*) (*ii*)

   (*c*) Tooth decay can be prevented by brushing and flossing the teeth and by regular visits to the dentist.

   (*d*) In mouth, food is crushed into small pieces by teeth and saliva is mixed. Saliva contains the enzyme salivary amylase which digests starch.
5. (*c*) **OR** (*a*)
6. (*a*)
7. (*a*)
8. (*b*) **OR** (*a*)
9. (*c*)
10. (*b*)
11. (*a*) **OR** (*a*)
12. (*c*)
13. (*a*)
14. (*a*)

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CBSE Examination Papers—2020

[31/1/1] [31/1/2] [31/1/3]

Time Allowed: 3 hours **Maximum Marks: 80**

General Instructions:

Read the following instructions very carefully and strictly follow them.

(i) Question paper comprises three sections – A, B and C.
There are 30 questions in the question paper. All questions are compulsory.

*(ii) **Section A**–question no. 1 to 14 – all questions or part thereof are of one mark each. These questions comprise multiple choice questions (MCQ), very short answer (VSA), and Assertion-Reason type questions. Answer to these questions should be given in one word or one sentence.*

*(iii) **Section B**–question no. 15 to 24 are short answer type questions, carrying 3 marks each. Answer to these questions should not exceed 50 to 60 words.*

*(iv) **Section C**–question no. 25 to 30 are long answer type questions, carrying 5 marks each. Answer to these questions should not exceed 80 to 90 words.*

(v) Answer should be brief and to the point. Also the above mentioned word limit be adhered to as far as possible.

(vi) There is no overall choice in the question paper. However, an internal choice has been provided in some questions in each Section. Only one of the choices in such questions have to be attempted.

(vii) In addition to this, separate instructions are given with each section and question, wherever necessary.

SET–1 (31/1/1)

SECTION–A

1. Name a cyclic unsaturated carbon compound.
2. The change in magnetic field lines in a coil is the cause of induced electric current in it. Name the underlying phenomenon.

Answer question numbers 3(*a*) to 3(*d*) and 4(*a*) to 4(*d*) on the basis or your understanding of the following paragraphs and the related studied concepts.

3. The growing size of the human population is a cause of concern for all people. The rate of birth and death in a given population will determine its size. Reproduction is the process by which organisms increase their population. The process of sexual maturation for reproduction is gradual and takes place while general body growth is still going on. Some degree of sexual maturation does not necessarily mean that the mind or body is ready for sexual acts or for having and bringing up children. Various contraceptive devices are being used by human beings to control the size of population.

(*a*) List two common signs of sexual maturation in boys and girls.

(*b*) What is the result of reckless female foeticide?

(*c*) Which contraceptive method changes the hormonal balance of the body?

(*d*) Write two factors that determine the size of a population.

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4. Human body is made up of five important components, of which water is the main component. Food as well as potable water are essential for every human being. The food is obtained from plant through agriculture. Pesticides are being used extensively for a high yield in the fields. These pesticides are absorbed by the plants from the soil along with water and minerals and from the water bodies these pesticides are taken up by the aquatic animals and plants. As these chemicals are not biodegradable, they get accumulated progressively at each trophic level. The maximum concentration of these chemicals gets accumulated in our bodies and greatly affects the health of our mind and body.

(*a*) Why is the maximum concentration of pesticides found in human beings?

(*b*) Give one method which could be applied to reduce our intake of pesticides through food to some extent.

(*c*) Various steps in food chain represents:

(*i*) Food web (*ii*) Trophic level

(*iii*) Ecosystem (*iv*) Biomagnification

(*d*) With regard to various food chains operating in an ecosystem, man is a:

(*i*) Consumer (*ii*) Producer

(*iii*) Producer and consumer (*iv*) Producer and decomposer

5. Calcium oxide reacts vigorously with water to produce slaked lime.

$$CaO\,(s) + H_2O\,(l) \rightarrow Ca(OH)_2\,(aq)$$

This reaction can be classified as:

(A) Combination reaction (B) Exothermic reaction

(C) Endothermic reaction (D) Oxidation reaction

Which of the following is a correct option ?

(*a*) (A) and (C) (*b*) (C) and (D)

(*c*) (A), (C) and (D) (*d*) (A) and (B)

OR

When hydrogen sulphide gas is passed through a blue solution of copper sulphate, a black precipitate or copper sulphide is obtained and the sulphuric acid so formed remains in the solution. The reaction is an example of a :

(*a*) Combination reaction (*b*) Displacement reaction

(*c*) Decomposition reaction (*d*) Double displacement reaction

6. In a double displacement reaction such as the reaction between sodium sulphate solution and barium chloride solution:

(A) exchange of atoms takes place (B) exchange of ions takes place

(C) a precipitate is produced (D) an insoluble salt is produced

The correct option is :

(*a*) (B) and (D) (*b*) (A) and (C)

(*c*) only (B) (*d*) (B), (C) and (D)

7. Baking soda is a mixture of:

(*a*) Sodium carbonate and acetic acid

(*b*) Sodium carbonate and tartaric acid

(*c*) Sodium hydrogen carbonate and tartaric acid

(*d*) Sodium hydrogen carbonate and acetic acid

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8. The chemical formula for plaster of Paris is:

(*a*) $CaSO_4.2H_2O$ (*b*) $CaSO_4.H_2O$ (*c*) $CaSO_4.\frac{1}{2}H_2O$ (*d*) $2CaSO_4.H_2O$

9. The laws of reflection hold true for:

(*a*) plane mirrors only (*b*) concave mirrors only

(*c*) convex mirrors only (*d*) all reflecting surfaces

OR

When object is kept within the focus of a concave mirror, an enlarged image is formed behind the mirror. This image is:

(*a*) real (*b*) inverted

(*c*) virtual and inverted (*d*) virtual and erect

10. At the time of short circuit, the electric current in the circuit :

(*a*) vary continuously (*b*) docs not change

(*c*) reduces substantially (*d*) increases heavily

OR

Two bulbs of 100 W and 40 W are connected in series. The current through the 100 W bulb is l A. The current through the 40 W bulb will be:

(*a*) 0.4 A (*b*) 0.6 A (*c*) 0.8 A (*d*) l A

11. Which one of the following is responsible for the sustenance of underground water?

(*a*) Loss of vegetation cover (*b*) Diversion for high water demanding crops

(*c*) Pollution from urban wastes (*d*) Afforestation.

12. Incomplete combustion of coal and petroleum:

(A) increases air pollution. (B) increases efficiency of machines.

(C) reduces global warming. (D) produce poisonous gases.

The correct option is :

(*a*) (A) and (B) (*b*) (A) and (D) (*c*) (B) and (C) (*d*) (C) and (D).

For question numbers 13 and 14, two statements are given—one labelled Assertion (*A*) and the other labelled Reason (*R*). Select the correct answer to these questions from the codes (*a*), (*b*), (*c*) and (*d*) as given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation of the Assertion.

(*b*) Both *A* and *R* are true but *R* is not the correct explanation of the Assertion.

(*c*) *A* is true but *R* is false.

(*d*) *A* is false but *R* is true.

13. **Assertion (*A*) :** Esterification is a process in which a sweet smelling substance is produced.

Reason (*R*) : When esters react with sodium hydroxide an alcohol and sodium salt of carboxylic acid are obtained.

14. **Assertion (*A*) :** In the process of nuclear fission, the amount of nuclear energy generated by the fission of an atom of uranium is so tremendous that it produces 10 million times the energy produced by the combustion of an atom of carbon from coal.

Reason (*R*) : The nucleus of a heavy atom such as uranium, when bombarded with low energy neutrons, splits apart into lighter nuclei. The mass difference between the original nucleus and the product nuclei gets converted to tremendous energy.

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SECTION–B

15. 1 g of copper powder was taken in a China dish and heated. What change takes place on heating? When hydrogen gas is passed over this heated substance, a visible change is seen in it. Give the chemical equations of reactions, the name and the color of the products formed in each case.

16. List the important products of the Chlor-alkali process. Write one important use of each.

OR

How is washing soda prepared from sodium carbonate? Give its chemical equation. State the type of this salt. Name the type of hardness of water which can be removed by it?

17. 3 mL of ethanol is taken in a test tube and warmed gently in a water bath. A 5% solution of alkaline potassium permanganate is added first drop by drop to this solution, then in excess.

(*a*) How is 5% solution of $KMnO_4$ prepared?

(*b*) State the role of alkaline potassium permanganate in this reaction. What happens on adding it in excess?

(*c*) Write chemical equation of this reaction.

18. A squirrel is in a scary situation. Its body has to prepare for either fighting or running away. State the immediate changes that take place in its body so that the squirrel is able to either fight or run?

OR

Why is chemical communication better than electrical impulses as a means of communication between cells in a multi-cellular organism?

19. Define the term pollination. Differentiate between self pollination and cross pollination. What is the significance of pollination?

20. What are homologous structures? Give an example. Is it necessary that homologous structures always have a common ancestor. Justify your answer.

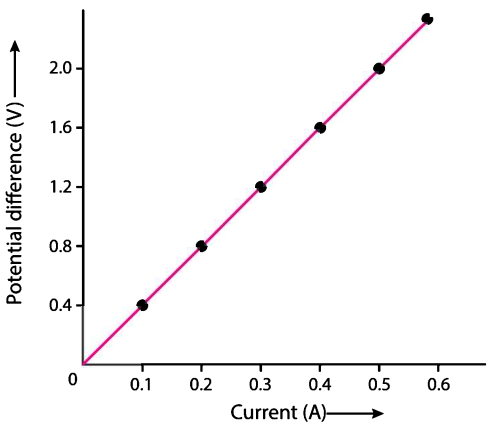
21. Why is Tyndall effect shown by colloidal particles? State four instances of observing the Tyndall effect.

OR

Differentiate between a glass slab and a glass prism. What happens when a narrow beam of (*i*) a monochromatic light, and (*ii*) white light passes through (*a*) glass slab and (*b*) glass prism?

22. Draw labelled diagram to show (*i*) reddish appearance of the sun at the sunrise or the sunset and (*ii*) white appearance of the sun at noon when it is overhead.

23. A V-I graph for a nichrome wire is given below. What do you infer from this graph? Draw a labelled circuit diagram to obtain such a graph.



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24. (*a*) Write the mathematical expression for Joule's law of heating.

(*b*) Compute the heat generated while transferring 96000 coulomb of charge in two hours through a potential difference of 40 V.

SECTION–C

25. Carbon cannot reduce the oxides of sodium, magnesium and aluminium to their respective metals. Why? Where are these metals placed in the reactivity series? How are these metals obtained from their ores? Take an example to explain the process of extraction along with chemical equations.

26. The position of certain elements in the Modern Periodic Table are shown below.

Group → / ↓ Period	1	2	3 to 12	13	14	15	16	17	18
1	G								H
2	A			I			B		C
3		D			E				F

Using the above table answer the following questions giving reasons in each case :

(*a*) Which element will form only covalent compounds?

(*b*) Which element is a non-metal with valency 2 ?

(*c*) Which element is a metal with valency 2?

(*d*) Out of H,C and F which has largest atomic size?

(*e*) To which family does H, C and F belong?

OR

Define atomic size. Give its unit of measurement. In the modern periodic table what trend is observed in the atomic radius in a group and a period and why is it so?

27. (*a*) Why is there a difference in the rate of breathing between aquatic organisms and terrestrial organisms? Explain.

(*b*) Draw a diagram of human respiratory system and label – pharynx, trachea, lungs, diaphragm and alveolar sac on it.

OR

(*a*) Name the organs that form the excretory system in human beings.

(*b*) Describe in brief how urine is produced in human body.

28. (*a*) What is the law of dominance of traits ? Explain with an example.

(*b*) Why are traits acquired during the life time of an individual not inherited? Explain.

29. Draw a ray diagram in each of the following cases to show the formation of image, when the object is placed:

(*a*) between optical centre and principal focus of a convex lens.

(*b*) anywhere in front of a concave lens.

(*c*) at 2F of a convex lens.

State the signs and values of magnifications in the above mentioned cases (*a*) and (*b*).

OR

An object 4.0 cm in size, is placed 25.0 cm in front of a concave mirror of focal length 15.0 cm.

(*a*) At what distance from the mirror should a screen be placed in order to obtain a sharp image?

(*b*) Find the size of the image.

(*c*) Draw a ray diagram to show the formation of image in this case.

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30. (*a*) What is an electromagnet? List any two uses.
(*b*) Draw a labelled diagram to show how an electromagnet is made.
(*c*) State the purpose of son iron core used in making an electromagnet.
(*d*) List two ways of increasing the strength of an electromagnet if the material of the electromagnet is fixed.

SET–2 (31/1/2) [Uncommon Questions of SET–1]

1. Name the functional group present in propanone.

5. The compound obtained on reaction of iron with steam is /are:

(*a*) Fe_2O_3 (*b*) Fe_3O_4
(*c*) FeO (*d*) Fe_2O_3 and Fe_3O_4

OR

An element 'X' reacts with O_2 to give a compound with a high melting point. This compound is also soluble in water. The element 'X' is likely to be:

(*a*) iron (*b*) calcium
(*c*) carbon (*d*) silicon

11. In an ecosystem, 10% of energy available for transfer from one trophic level to the next is in the form of:

(*a*) heat energy (*b*) chemical energy
(*c*) mechanical energy (*d*) light energy

12. Soil fertility is determined by its ability to:

(*a*) Decay organic matter (*b*) Hold organic matter
(*c*) Hold water (*d*) Support life

For question number 13, two statements are given—one labelled Assertion (*A*) and the other labelled Reason (*R*). Select the correct answer to these questions from the codes (*a*), (*b*), (*c*) and (*d*) as given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation of *A*.
(*b*) Both *A* and *R* are true but *R* is not the correct explanation of *A*.
(*c*) *A* is true but *R* is false.
(*d*) *A* is false but *R* is true.

13. Assertion (*A*) : In a homologous series of alcohols, the formula for the second member is C_2H_5OH and the third member is C_3H_7OH.
Reason (*R*) : The difference between the molecular masses of the two consecutive members of a homologous series is 144.

15. What is 'rusting'? Describe with a labelled diagram an activity to investigate the conditions under which iron rusts.

19. (*a*) List in tabular form two differences between binary fission and multiple fission.
(*b*) What happens when a mature Spirogyra filament attains considerable length.

23. (*a*) State the relation correlating the electric current flowing in a conductor and the voltage applied across it. Also draw a graph to show this relationship.
(*b*) Find the resistance of a conductor if the electric current flowing through it is 0.35 A when the potential difference across it is 1.4 V.

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25. (*a*) What is thermit process? Where is this process used? Write balanced chemical equation for the reaction involved.

(*b*) Where does the metal aluminium, used in the process, occurs in the reactivity series of metals?

(*c*) Name the substances that are getting oxidised and reduced in the process.

28. (*a*) What is genetics?

(*b*) What are genes? Where are the genes located?

(*c*) State and define three factors responsible for the rise of a new species.

SET–3 (31/1/3) [Uncommon Questions of SET–1 and SET–2]

2. State an important advantage of using alternating current (a.c.) over direct current (d.c.).

7. When sodium hydrogen carbonate is added to ethanoic acid, a gas evolves. Consider the following statements about the gas evolved?

I. It turns lime water milky. II. It is evolved with a brisk effervescence.

III. It has a smell of burning sulphur IV. It is also a by- product of respiration.

The correct statements are:

(*a*) I. and II. only (*b*) II. and IV only (*c*) I. III. and IV. (*d*) I. II and IV

8. When a small amount of acid is added to water, the phenomena which occur are:

I. Dilution II. Neutralisation

III. Formation of H_3O ions IV. Salt formation

The correct statements are:

(*a*) I and III (*b*) II and IV (*c*) I and II (*d*) III and IV

9. A real image is formed by the light rays after reflection or refraction when they:

I. actually meet or intersect with each other.

II. actually converge at a point.

III. appear to meet when they are produced in the backward direction.

IV. appear to diverge from a point.

Which of the above statements are correct?

(*a*) I and IV (*b*) II and IV (*c*) I and II (*d*) II and III

OR

Consider the following properties of virtual images:

I. cannot be projected on the screen II. are formed by both concave and convex lens

III. are always erect IV. are always inverted

The correct properties are:

(*a*) I and IV (*b*) I and II (*c*) I, II and III (*d*) I, II and IV

For question number 14, two statements are given—one labelled Assertion (*A*) and the other labelled Reason (*R*). Select the correct answer to these questions from the codes (*a*), (*b*), (*c*) and (*d*) as given below:

(*a*) Both *A* and *R* are true and *R* is the correct explanation of *A*.

(*b*) Both *A* and *R* are true but *R* is not the correct explanation of *A*.

(*c*) *A* is true but *R* is false.

(*d*) *A* is false but *R* is true.

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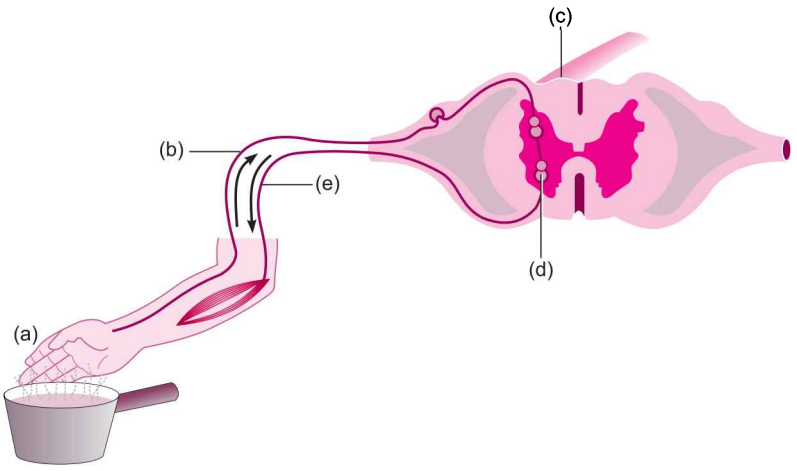
14. **Assertion (*A*) :** A solar cooker cooks the meal due to green house effect.
Reason (*R*) : The plane mirror is responsible for producing the green house effect.

17. (*a*) Draw the structure for (*i*) ethanol, (*ii*) ethanoic acid.

(*b*) Why is the conversion of ethanol to ethanoic acid considered an oxidation reaction? Write the oxidising agent used in the reaction involved.

18. Name the parts (a) to (c) in the following diagram



What is the term given to the sequence of events occurring in the diagram?

OR

(*a*) What is tropism?

(*b*) How do auxins promote the growth of a tendril around a support?

23. The near point of the eye of a person is 50 cm. Find the nature and power of the corrective lens required by the person to enable him to see clearly the objects placed at 25 cm from the eye.

27. (*a*) A gas is released during photosynthesis. Name the gas and also state the way by which the gas is evolved.

(*b*) What are stomata? What governs the opening and closing of stomata?

OR

(*a*) Draw a diagram of human alimentary canal and label – gall bladder, pancreas, liver and small intestine on it.

(*b*) Give two reasons to explain why absorption of digested food occurs mainly in the small intestine.

30. (*a*) Explain with the help of the pattern of magnetic field lines the distribution of magnetic field due to a current carrying a circular loop.

(*b*) Why is it that the magnetic field of a current carrying coil having *n* turns, is '*n*' times as large as that produced by a single turn (loop)?

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Answers

SET–1 (31/1/1)

1. Benzene
2. Electromagnetic induction
3. (*a*) **Common signs of sexual maturation in boys:** new facial hair growth, voice begins to crack.
   Common signs of sexual maturation in girls: increase in breast size, menstruation begins.
   (*b*) Because of reckless female foeticides, child sex ratio is declining at an alarming rate in some sections of our society.
   (*c*) Oral pills change the hormonal balance of the body.
   (*d*) The rates of births and deaths in a given population determine its size.
4. (*a*) Pesticides are not degradable and as human beings occupy the top level in any food chain, the maximum concentration of these chemicals get accumulated in our bodies.
   (*b*) Pesticides can be removed to some extent by washing the food properly before cooking and eating.
   (*c*) (*ii*)
   (*d*) (*i*)
5. (*d*) **OR** (*d*)
6. (*d*)
7. (*c*)
8. (*c*)
9. (*d*) **OR** (*d*)
10. (*d*) **OR** (*d*)
11. (*d*)
12. (*b*)
13. Option (*b*) is correct.
14. Option (*a*) is correct.
15. When copper powder is heated, its surface acquires a black coating. This is because oxygen is added to copper and copper oxide is formed.

$$2Cu(s) + O_2(g) \xrightarrow{\text{Heat}} 2CuO(s)$$

Now, if hydrogen gas is passed over CuO, the opposite reaction takes place. The black coating turns brown and copper is obtained.

$$CuO(s) + H_2(g) \xrightarrow{\text{Heat}} Cu(s) + H_2O(l)$$

16. When electricity is passed through an aqueous solution of sodium chloride (brine), it decomposes to form sodium hydroxide, chlorine gas and hydrogen gas. The process is called the **chlor-alkali process** because of the products formed—chlor for chlorine and alkali for sodium hydroxide.

$$2NaCl\,(aq) + 2H_2O\,(l) \longrightarrow 2NaOH\,(aq) + Cl_2\,(g) + H_2\,(g)$$

Important use of:

Hydrogen: It is used in the manufacture of ammonia for fertilisers.

Chlorine: It is used in killing bacteria in drinking water and in swimming pools.

Sodium Hydroxide : It is used in detergents and soaps to remove grease.

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OR

The chemical formula of washing soda is $Na_2CO_3.10H_2O$. It is obtained by heating baking soda and then recrystallising it.

$$\underset{\text{Baking soda}}{2NaHCO_3(s)} \xrightarrow{\text{Heat}} \underset{\text{Sodium carbonate}}{Na_2CO_3(s)} + H_2O(l) + CO_2(g)$$

$$Na_2CO_3(s) + 10H_2O(l) \xrightarrow{\text{Heat}} \underset{\text{Washing soda}}{Na_2CO_3.10H_2O(aq)}$$

The salt Na_2CO_3 is formed by strong base and weak acid. So, it is a basic salt. It is used for removing permanent hardness of water.

17. (*a*) 5% solution of $KMnO_4$ is prepared by dissolving 5 g of $KMnO_4$ in 95 gram of water.

(*b*) Alkaline potassium permanganate is used as an oxidising agent in this reaction. When alkaline potassium permanganate is added to ethanol, its purple colour disappears. When it is added is excess, the purple colour persists.

(*c*) $\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[\text{Heat}]{\text{Alk. } KMnO_4} \underset{\text{Ethanoic acid}}{CH_3COOH}$

18. Adrenaline is secreted directly into the blood and carried to different parts of the body. As a result, the heart beats faster, resulting in supply of more oxygen to the muscles. The blood to the digestive system and skin is reduced due to contraction of muscles around small arteries in these organs. This diverts the blood to the skeletal muscles. The breathing rate also increases because of the contractions of the diaphragm and the rib muscles. All these responses together enable the animal body to be ready to deal with the situation.

OR

There are limitations to the use of electrical impulses in multicellular organisms. Firstly, they will reach only those cells that are connected by nervous tissue, not each and every cell in the body. Secondly, cells cannot continuously create and transmit electrical impulses. On the other hand, chemical compounds reach all the cells of the body, regardless of nervous connections, and it can be done steadily and persistently.

19. Pollination is the process of transfer of pollen grains from the anther to the stigma of the flower.

Self-pollination	Cross-pollination
(*a*) Transfer of pollen grains from anthers to the stigma of the same flower or another flower of the same plant.	(*a*) Transfer of pollen grains from anthers of a flower to the stigma of another flower born on another plant of the same species.
(*b*) It occurs in bisexual flowers, *e.g.*, wheat, rice, potato, pea, etc.	(*b*) It occurs in unisexual as well as in bisexual flowers, *e.g.*, maize.

For fertilization to take place the pollen grain needs to be transferred to the stigma.

20. Homologous structures are structures with a common origin but with a different function. For example, five-digit limbs are found in all the four classes of terrestrial vertebrates, amphibians, reptiles, birds and mammals.

Yes, it is necessary that homologous structures have a common ancestor because otherwise they will not have any similarity in internal body structure.

21. Tyndall effect is the effect under which scattering of light takes place when it passes through a colloidal or suspension particle. It is shown by colloidal particles because the size of colloidal particles are fairly large to scatter light falling on them in all the directions.

Four instances of observing Tyndall effect are:

1. It can be observed when sunlight passes through the canopy of a dense forest.
2. It can be observed in fog.
3. It can be observed when light passes through the milk.
4. It explains the reason behind blue colour of the sky.

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OR

Glass slab: It is a rectangular shaped glass in which incident ray and emergent ray are parallel to each other.

Glass prism: It is a transparent object made of glass having two triangular ends and three rectangular sides.

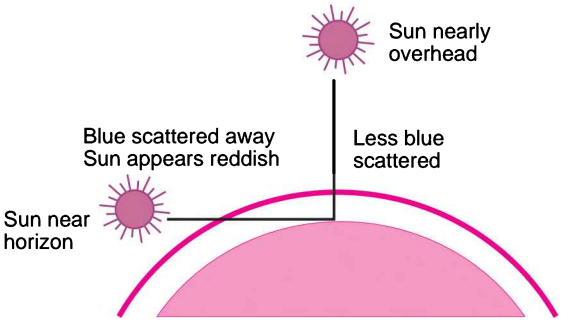
When a narrow beam of a monochromatic light passes through glass slab, it gets deviated from the normal path but the direction of incident ray and emergent ray are parallel to each other whereas when it passes through a glass prism, it gets deviated from the actual path but the direction of incident ray and emergent ray are not parallel to each other.

When a narrow beam of white light is passed through a glass slab, no splitting of light takes place whereas when it passes through a glass prism, splitting of light into seven colours takes place.

22. At sunrise, light from the Sun near the horizon passes through thicker layers of air and at larger distance in the Earth's atmosphere before reaching our eye. Hence shorter waves are scattered away and longer (red) waves reach our eye. Thus, Sun appears red.

However, at noon, sunlight would travel relatively at shorter distance due to which only a little blue and violet colours are scattered and it is nearly the white light which reaches our eye.

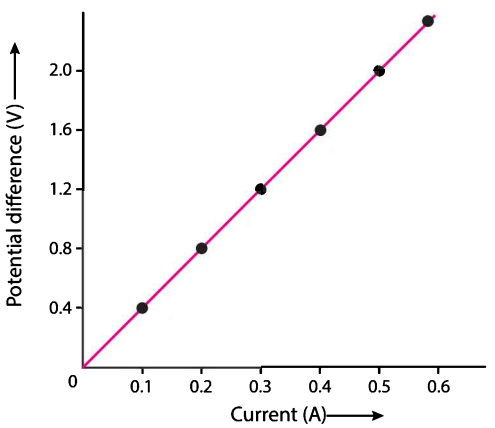




23. As graph between V and I is a straight line, so current flowing through the wire is directly proportional to the potential difference applied across it. The slope of this graph is the resistance of the nichrome wire.

$$\text{Resistance} = \frac{V}{I} = \frac{0.4}{0.1} = 4\ \Omega$$

The circuit diagram corresponding to the given graph is shown below:



24. (*a*) The mathematical expression for Joule's law of heating is

$$H \propto I^2Rt$$

where, H is heating effect produced, I is current flowing and t is the time taken.

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(*b*) Given $Q = 96000$ C, $t = 2$ h, $V = 40$ V

Then heat generated, $H = VIt$

$$= V \times \frac{Q}{t} \times t$$

$$= 40 \times 96000$$

$$= 3840000 \text{ J}$$

25. Carbon cannot reduce the oxides of sodium, magnesium and aluminium, because carbon is below in reactivity series as compared to these metals. These metals are placed forwards the top of the reactivity series.

Such metals are obtained by electrolytic reduction of their molten salt. For example, sodium is obtained by the electrolysis of molten sodium chloride (NaCl).

At cathode: $Na^+ + e^- \longrightarrow Na$

At anode: $2Cl^- \longrightarrow Cl_2 + 2e^-$

26. (*a*) E (*b*) B

(*c*) D (*d*) F

(*e*) Noble gases

OR

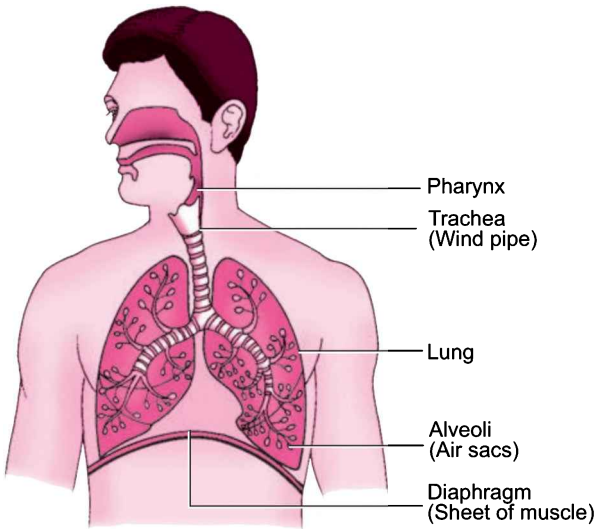
Atomic size refers to the radius of an atom. It is the distance between the centre of the nucleus and the outermost shell of an isolated atom. Its unit of measurement is **Angstroms (Å)**.

In moving down a group, the charge on the nucleus increases with increase in atomic number, but at the same time, there is an increase in the energy levels. The number of electrons in the outermost shell, however, remains the same. Since the effect of additional energy levels outweighs the effect of increased nuclear charge and thus the distance of the outermost electron from the nucleus increases on going down the group.

The atomic radius decreases along a period. In moving from left to right across the period, the charge on the nucleus increases by one unit (due to increase in atomic number), but the additional electron goes to the same shell. As a result, outer electrons are pulled in closer to the nucleus. This causes the decrease of atomic size.

27. (*a*) Since the amount of dissolved oxygen is fairly low in water as compared to the amount of oxygen in the air, the rate of breathing in aquatic organisms is much faster than that in terrestrial organisms.

(*b*)



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OR

(*a*) The excretory system in humans is composed of kidneys, ureters, urinary bladder and urethra.

(*b*) Urine formation takes place in the following steps:

(*i*) **Filtration:** Filtration of blood takes place in Bowman's capsule from the capillaries of glomerulus. This takes place under high pressure. The filtrate passes into the tubular part of the nephron. This filtrate contains glucose, amino acids, urea, uric acid, salts and major amount of water.

(*ii*) **Reabsorption:** As the filtrate flows along the tubule, useful substances such as glucose, amino acids, salts and water are selectively reabsorbed into the blood by capillaries surrounding the nephron tubule.

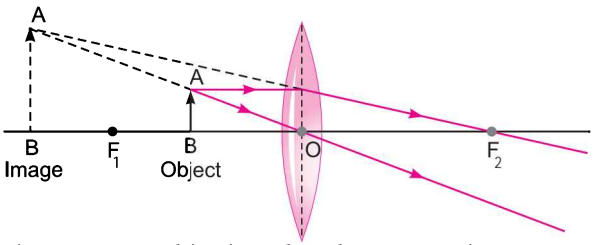
(*iii*) **Tubular secretion:** Certain substances which are harmful and not needed by the body like ammonia, potassium, creatinine and hydrogen ions are secreted from the capillary blood into the lumen of distal tubule. This is called tubular secretion.

The fluid entering the collecting tubule is called urine. It flows through the ureters into urinary bladder, where it is stored and discharged from time to time through urethra.

28. (*a*) According to Mendel's law of dominance of traits when two alternative forms of a trait of character are present in an organism, only one factor expresses itself in the F_1 progeny and is called dominant while the other that remains masked is called recessive. For example, Mendel took pea plants with different characteristics – a tall plant and a short plant, produced progeny by crossing them and calculated the percentages of tall and short progeny. In the first generation or F_1 generation he found no medium-height plants and all the plants were tall. He then self-pollinated the F_1 progeny. In the second generation of F_2 generation he got one quarter as short. This indicates that both tallness and shortness traits were inherited in the F_1 plants, but only the tallness trait was expressed.

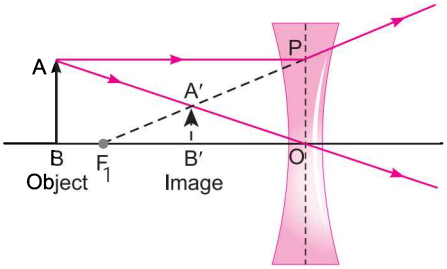
(*b*) The changes in the non-reproductive body cells, *i.e.*, somatic cells of an organism cannot be inherited by its offsprings, because only those traits can be transmitted to future generations in which changes have occurred in the DNA present in the reproductive cells of parent organism.

29. (*a*)



As the image formed is virtual and erect, so sign of magnification will be positive. The value of magnification will be greater than one as the image formed is magnified.

(*b*)



As the image formed is virtual and erect, so sign of magnification will be positive. The value of magnification will be less than one as the image formed is diminished.

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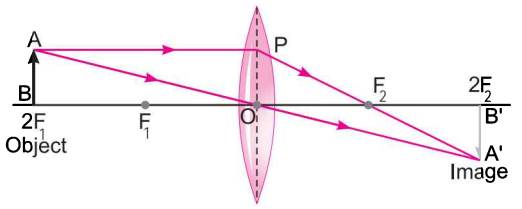
(*c*)



OR

Given, Height of object (h_o) = 4 cm

Object distance (u) = –25 cm

Focal length (f) = –15 cm

Using mirror formula,

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

$$-\frac{1}{15} = -\frac{1}{25} + \frac{1}{v}$$

$$\frac{1}{v} = -\frac{1}{15} + \frac{1}{25}$$

$$\frac{1}{v} = \frac{(-5+3)}{75}$$

$$v = -\frac{75}{2} \quad \Rightarrow \quad v = -37.5 \text{ cm}$$

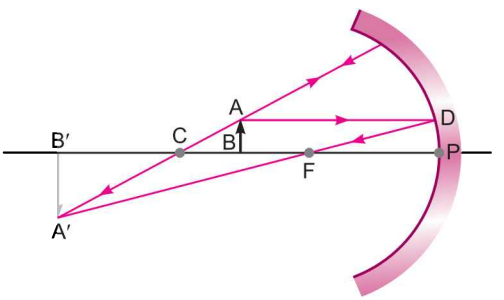
(*a*) As the sign of v is negative, so that means image is in front of the mirror. Thus, screen should be placed in front of the mirror at a distance of 37.5 cm.

(*b*) Magnification, $m = -\frac{v}{u} = \frac{h_i}{h_o}$

$$-\frac{(-37.5)}{-25} = \frac{h_i}{4}$$

$$h_i = \frac{-37.5 \times 4}{25} \quad \Rightarrow \quad h_i = 6 \text{ cm}$$

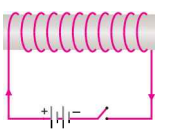
(*c*)



30. (*a*) A temporary magnet of soft iron core with a coil wound around it which retains magnetism only when current passes through the coil.

Used in electric bell, telephone, electric motor, etc.

(*b*) The magnetic field produced due to current flowing in a coil or a solenoid can be used to magnetise a material like soft iron temporarily. The insulated copper wire is wrapped on a soft iron piece. When current is passed through the coil using a battery and a key the iron piece behaves like a bar magnet as long as current is being passed.



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(*c*) Soft iron core is used in making electromagnet because the capacity to retain magnetism of soft iron is very low. Moreover, it loses all its magnetism when the magnetising influence (current) is switched off.

(*d*) Two ways of increasing the strength of an electromagnet if the material of the electromagnet is fixed are:

1. By increasing the amount of current flowing in the solenoid.
2. By increasing the number of turns in the solenoid.

SET–2 (31/1/2) [Uncommon Question of SET–1]

1. Ketonic group (>C=O)

5. (*b*) **OR** (*b*)

11. (*b*)

12. (*d*)

13. Option (*c*) is correct.

15. When an iron object is left in moist air for a considerable time, it gets covered with a red-brown flaky substance called rust. This is called rusting of iron.

Activity:

(*a*) Take three test tubes and place 2-3 clean iron nails in each of them.

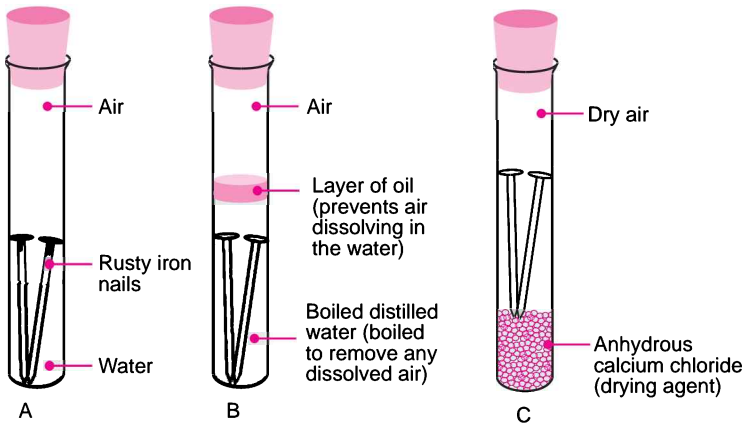
(*b*) Label these test tubes as A, B and C.

(*c*) Pour some water in test tube A and cork it.

(*d*) Pour boiled distilled water in test tube B. Then, pour about 1 ml oil and cork it. The oil will float on water and prevent the air from entering.

(*e*) Put some anhydrous calcium chloride in test tube C and cork it. Anhydrous calcium chloride will absorb the moisture, if any, from the air.

(*f*) Leave these test tubes for some days and then observe.



You will observe that nails rust in test tube A, but they do not rust in test tubes B and C. In test tube A, the nails are exposed to both air and water. In test tube B, the nails are exposed to only water, whereas in test tube C, the nails are exposed to only dry air. This shows that both air and water are necessary for iron to rust.

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19. (*a*)

Binary fission	Multiple fission
1. The parent organism splits into two equal halves during cell division.	1. The parent organism divides into many daughter cells simultaneously.
2. For example, Amoeba.	2. For example, Plasmodium.

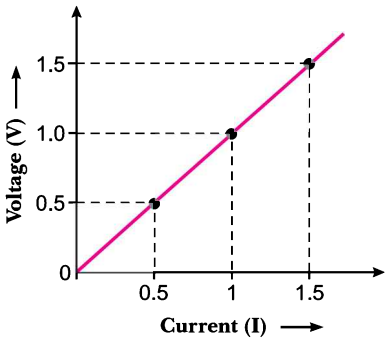
(*b*) When a mature Spirogyra attains considerable length it simply breaks up into smaller pieces.

23. (*a*) If V is the voltage applied and I is the resulting current, then $I \propto V$

$$V \propto I$$

$$V = IR$$

This is called ohm's law.



(*b*) Given, $V = 1.4$ V, $I = 0.35$ A

Using $V = IR$

$$R = \frac{V}{I}$$

$$R = \frac{1.4}{0.35}$$

$$R = 4\ \Omega$$

25. (*a*) The reaction between ferric oxide Fe_2O_3 and aluminium powder is known as thermit reaction. This reaction is highly exothermic and the metal so formed, is obtained in the molten form. Therefore, this process is used to join railway tracks and cracked machine parts.

$$Fe_2O_3(s) + 2Al(s) \longrightarrow Al_2O_3(s) + 2Fe(l)$$

(*b*) Aluminium is present high up in the reactivity series.

(*c*) Ferric oxide is reduced while aluminium is oxidised.

28. (*a*) Genetics is the study of heredity and variation of inherited characteristics.

(*b*) Genes are specific sequence of bases in a DNA molecule which code for a trait or characteristic. Genes are present on chromosomes.

(*c*) Factors responsible for rise of new species are:

1. **Genetic drift:** It is the change in population by elimination or addition of gene for a certain trait.
2. **Geographical isolation:** A physical barrier may divide a population into two or more populations and isolate their gene pool to evolve independently.
3. **Natural selection:** Nature selects only fit and favourable races and eliminate unfavourable or non-adaptive characters, resulting in the formation of a new species.

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SET–3 (31/1/3) [Uncommon Question of SET–1 & SET–2]

2. An important advantage of a.c. over d.c. is that electric power can be transmitted over long distances without much loss of energy.

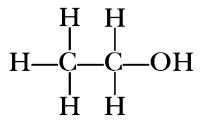
7. (*d*)

8. (*a*)

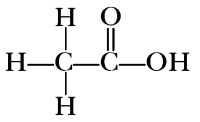
9. (*c*) **OR** (*c*)

14. Option (*c*) is correct.

17. (*a*)



Ethanol



Ethanoic acid

(*b*) The conversion of ethanol into ethanoic acid is called an oxidation reaction because oxygen is added to it during this conversion.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[\text{Or Acidified } K_2Cr_2O_7 + \text{Heat}]{\text{Alk. } KMnO_4 + \text{Heat}} \underset{\text{Ethanoic acid}}{CH_3COOH} + \underset{\text{Water}}{H_2O}$$

Note: A substance which gives oxygen for oxidation is called an oxidising agent. Alkaline potassium permanganate and acidified potassium dichromate oxidise alcohols to acids, that is, adding oxygen to the starting material. Hence, they are known as oxidising agents.

18. (*a*)—receptors, (*b*)—sensory neuron, (*c*)—spinal cord, (*d*)—relay neuron, (*e*)—motor neuron

The sequence of event is termed as reflex arc.

OR

(*a*) The directional movement of a plant part or part in response to external stimulus is called tropism.

(*b*) The movement of tendril around the support is caused by the hormone auxin. Less auxin occurs on the side of contact as compared to the free side. Auxin promotes the growth on the free side. As a result of growth on the free side, the tendril coils around the support.

23. Given, $u = -25$ cm, $v = -50$ cm.

Using lens formula,

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\frac{1}{f} = \frac{1}{-50} - \frac{1}{-25}$$

$$\frac{1}{f} = \frac{1}{50} \qquad f = +50 \text{ cm}$$

As 'f' is positive, so lens is convex lens.

$f = +50$ cm

$f = +0.5$ m

$$P = \frac{1}{f \text{ (in m)}} = \frac{1}{0.5} = 2\text{D}$$

27. (*a*) Oxygen is released during photosynthesis.

Oxygen is evolved when light energy is converted to chemical energy in the chloroplast and this splits the water molecules into hydrogen and oxygen.

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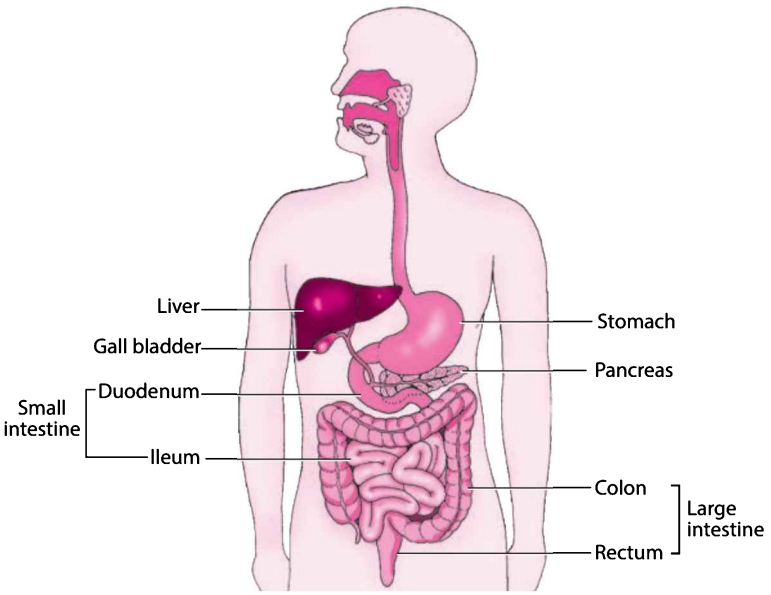
(*b*) Stomata are tiny pores present on the surface of leaves. The opening and closing of the stomatal pore is a function of the guard cells. The guard cells swell when water flows into them, causing the stomatal pore to open. Similarly the pore closes if the guard cells shrink.

OR

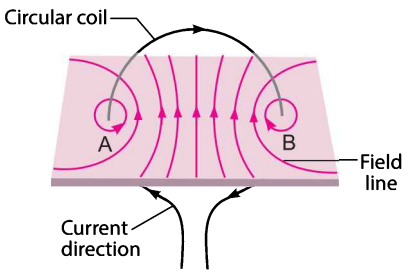
(*a*)



(*b*) Absorption of digested food occurs mainly in small intestine because

1. The inner lining of the small intestine has numerous finger-like projections called villi which increase the surface area for absorption.
2. The villi are richly supplied with blood vessels which take the absorbed food to each and every cell of the body.

30. (*a*) The pattern of the magnetic field lines near the wires of the coil are concentric circles. The curvature of these curves goes on increasing as we move away from the wire. At the centre of the circular loop, the field lines are nearly straight and parallel.



(*b*) The magnetic field produced by a current carrying wire at a given point depends directly on the current passing through it. So, if there is a circular coil having n turns, the field produced is n times as large as that produced by a single turn. This is because the current in each circular turn has the same direction, and the field due to each turn then jus adds up.

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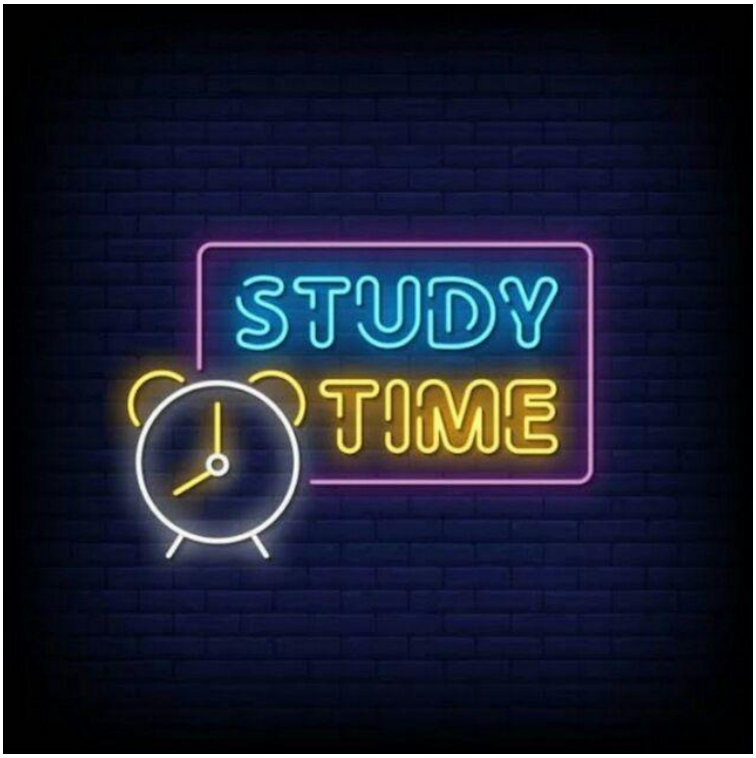

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