Chapter 1: Chemical Reactions and Equations

1. In a combination reaction, two substances combine to form one compound. In a decomposition reaction, a compound breaks down into two or more substances. So, they are opposite to each other.

2. The balanced chemical equation is

$$KClO_{3(s)} \xrightarrow{MnO_2,\ \Delta} KCl_{(s)} + O_{2(g)}$$

3. When a solution of potassium chloride is mixed with silver nitrate solution, an insoluble white silver chloride solution is formed.
   The balanced equation is
   $KCl_{(aq)} + AgNO_{3(aq)} \rightarrow AgCl_{(s)} + KNO_{3(aq)}$
   It is a double displacement and precipitation reaction.

4. Fizzing in the reaction is due to the evolution of hydrogen gas by the action of metal on acid.
   In test tube A:
   $Mg_{(s)} + 2\ HCl_{(aq)} \rightarrow MgCl_{2(aq)} + H_{2(g)}$

   In test tube B:
   $Mg + CH_3COOH_{(aq)} \rightarrow (CH_3COO)_2Mg + H_{2(g)}$
   Since hydrochloric acid is a strong acid and acetic acid is a weak acid, the evolution of H_2 gas occurs more readily in case of HCl.

5.
   i. Take about 2 grams of ferrous sulphate crystals (green coloured) in a dry boiling tube.
   ii. Heat the boiling tube over a burner (by keeping the mouth of the boiling tube away from the face).
   iii. The green colour of ferrous sulphate crystals first changes to white and then a brown solid (ferric oxide) is formed.
   iv. A gas having the smell of burning sulphur comes out of the boiling tube.

$$FeSO_4.7\,H_2O \rightarrow FeSO_4 + 7\,H_2O$$
$$2\,FeSO_4(S) \rightarrow Fe_2O_3(S) + SO_2(g) + SO_3(g)$$

6.

(i) Substance 'X' is calcium oxide. Its chemical formula is CaO.

(ii) Calcium oxide reacts vigorously with water to form calcium hydroxide.

$$\underset{\text{Calcium oxide}}{CaO} + \underset{\text{Water}}{H_2O} \rightarrow \underset{\text{Calcium hydroxide}}{Ca(OH)_2}$$

(iii) $3BaCl_2 + Al_2(SO_4)_3 \rightarrow 3BaSO_4 + 2AlCl_3$

7.

a)

i. $2ZnS_{(s)} + 3O_{2(g)} \xrightarrow{\text{heat}} 2ZnO_{(s)} + 2SO_{2(g)}$

ii. $ZnCO_{3(s)} \xrightarrow{\text{heat}} ZnO_{(s)} + CO_{2(g)}$

iii. $3MnO_{2(s)} + 4Al_{(s)} \xrightarrow{\text{heat}} 3Mn_{(l)} + 2Al_2O_{3(s)}$

b)

i. (a) When a strip of lead metal is placed in a solution of copper chloride, lead chloride solution and copper metal are formed.
The green colour of copper chloride fades and the solution becomes colourless. A red brown coating of copper metal is deposited on the lead strip. Lead is more reactive than copper; hence, it is able to displace it from its solution.

$$Pb_{(s)} + CuCl_{2(aq)} \rightarrow PbCl_{2(aq)} + Cu_{(s)}$$

ii. (b) Any reaction in which an insoluble solid (precipitate) is formed and separates out from the solution is called a precipitation reaction.

$$BaCl_{2(aq)} + Na_2SO_{4(aq)} \rightarrow BaSO_{4(s)} + 2\,NaCl_{(aq)}$$

8. (a)

$$\underset{\text{(water insoluble)}}{CaCO_3} + \text{dil. } H_2SO_4 \rightarrow \underset{(A)}{CaSO_4} + H_2O + \underset{(B)}{CO_2}$$

$$\underset{\text{(Lime water)}}{Ca(OH)_2} + CO_2 \rightarrow \underset{\substack{(A)\\ \text{Milky}}}{CaCO_3} + H_2O$$

A: $CaCO_3$ (limestone)
B: $CO_{2(g)}$

(b)

(i) X: Copper (Cu)
Y: Copper oxide (CuO)

(ii) First: Oxidation of X; Second: Reduction of Y

(iii) $2\ Cu + O_2 \rightarrow 2\ CuO$
$CuO + H_2 \rightarrow Cu + H_2O$

Chapter 2: Acids, Bases and Salts

1. The pH of milk decreases from 6 as it turns into curd. Curd is more acidic than milk.

2. Acidic oxides: SO_2, CO_2
Basic oxides: Na_2O, MgO

3. (a) The chemical name of washing soda is sodium carbonate decahydrate.
The formula is $Na_2CO_3.10\ H_2O$.
It is obtained by heating baking soda, followed by recrystallisation.
$2\ NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$
$Na_2CO_3 + 10\ H_2O \rightarrow Na_2CO_3.10\ H_2O$

(b) Plaster of Paris should be kept in a moisture-proof container because it reacts readily with water (moisture) to give gypsum. This will make the Plaster of Paris useless after sometime.
$2\ CaSO_4{\cdot}(0.5\ H_2O) + 3\ H_2O \rightarrow 2\ CaSO_4{\cdot}2\ H_2O$
(c) Hydrochloric acid will be a stronger acid than acetic acid because it completely ionises in water to produce a large amount of hydrogen ions. On the other hand, acetic acid partially ionises in water to produce only a small amount of hydrogen ions.

4. Water of crystallisation is the number of water molecules which combine chemically in a definite molecular proportion with the concerned salt in the crystalline state.

Two correct examples:

Copper sulphate, chemical formula: $CuSO_4.5\ H_2O$

Washing soda, chemical formula: $Na_2CO_3.10\ H_2O$

5. (i) Sodium carbonate or washing soda is obtained from baking soda which is used for removing the permanent hardness of water.

(ii) Chemical formula: Na_2CO_3

(iii) Anhydrous sodium carbonate becomes hydrated when it is recrystallised from its aqueous solution.

6. (i) It will not undergo any colour change because the solution of Na_2SO_4 (sodium sulphate) in water is almost neutral.

(ii) Concentrated sulphuric acid is highly hygroscopic. It absorbs moisture from the air and gets diluted. Since the volume increases, the acid starts flowing out of the bottle.

7.

a)

i. Dilute sulphuric acid reacts with zinc granules.

$$\underset{\text{Sulphuric acid}}{H_2SO_{4(dil)}} + \underset{\text{zinc}}{Zn_{(s)}} \longrightarrow \underset{\text{zinc sulphate}}{ZnSO_{4(aq)}} + \underset{\text{Hydrogen}}{H_{2(g)}} \uparrow$$

ii. Dilute hydrochloric acid reacts with magnesium ribbon.

$$\underset{\text{Hydrochloric acid}}{HCl_{(dil)}} + \underset{\text{magnesium}}{Mg_{(s)}} \longrightarrow \underset{\text{magnesium chloride}}{MgCl_{2(aq)}} + \underset{\text{Hydrogen}}{H_{2(g)}} \uparrow$$

b) Salts which contain water of crystallisation are called hydrated salts.

Example: Copper sulphate crystals contain 5 molecules of water of crystallisation.

Salts which have lost their water of crystallisation are called anhydrous salts.

Example: On strong heating, copper sulphate crystals lose all the water of crystallisation to form anhydrous copper sulphate.

c) Uses of washing soda:

(i) For removing permanent hardness of water

(ii) In the manufacture of glass, soap and paper

8.

a) Chemical equations for the preparation of

i. Bleaching powder

$$\underset{\text{Calcium Oxide}}{Ca(OH)_2} + \underset{\text{Chlorine}}{Cl_2} \rightarrow \underset{\text{Calcium oxychloride}}{CaOCl_2} + \underset{\text{Water}}{H_2O}$$

ii. Plaster of Paris

$$\underset{\text{Gypsum}}{CaSO_4.2H_2O} \xrightarrow{\text{Heat, 373K}} \underset{\text{Plaster of Paris}}{CaSO_4.1/2H_2O} + \underset{\text{Water}}{1\,1/2H_2O}$$

iii. Caustic soda

$$\underset{\text{Sodium chloride}}{2NaCl} + \underset{\text{Water}}{2H_2O} \xrightarrow{\text{electricity}} \underset{\text{Caustic soda}}{2NaOH} + \underset{\text{Chlorine}}{Cl_2} + \underset{\text{Hydrogen}}{H_2}$$

b) When electricity is passed through an aqueous solution of sodium chloride (brine), it decomposes to form sodium hydroxide. This process is called the chlor-alkali process.

$$\underset{\text{Sodium chloride}}{2NaCl} + \underset{\text{Water}}{2H_2O} \xrightarrow{\text{electricity}} \underset{\text{Caustic soda}}{2NaOH} + \underset{\text{Chlorine}}{Cl_2} + \underset{\text{Hydrogen}}{H_2}$$

Uses of NaOH obtained from the chlor-alkali process:

(i) For de-greasing metals, soaps and detergents

(ii) For making paper and artificial fibres

9.

(a) Distilled water is a pure form of water and it does not contain any ionic species. Therefore, it does not conduct electricity.
Rain water, being an impure form of water, contains many ionic species such as acids, and therefore, it conducts electricity.

(b) Our stomach produces gastric juice which mainly contains hydrochloric acid (pH about 1.4). Overeating or eating spicy foods gives a burning sensation in the stomach because of excess of acid secretion which is called acidity.

(c) Lemon juice contains citric acid and tamarind juice contains tartaric acid. These acids react with the basic layer of copper carbonate on the surface to form soluble salts which are easily removed and the surface shines.

(d) Sodium carbonate is a salt of the weak acid carbonic acid and the strong base sodium hydroxide. The pH of sodium carbonate is 9. So, it is alkaline in nature.

(e) Dry ammonia is neutral in nature, so it has no effect on litmus paper. A solution of ammonia is basic in nature, so it turns red litmus blue.

Chapter 3: Metals and Non-Metals

1. When an iron nail is immersed in an aqueous solution of copper sulphate, a brown coating of copper is developed over the iron nail. The blue copper sulphate solution becomes pale green since iron is more reactive than copper.
   $Fe(s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu(s)$

2. (a) Non-metal which is lustrous: Iodine (I)
   (b) Metal which is non-lustrous: Sodium (Na)

3. (a)Amphoteric oxides are those oxides which show properties of both acids as well as bases to form salts and water.
   (b) Aluminium oxide (Al_2O_3) and ZnO are examples of amphoteric oxides.
   (c) X is a non-metal. Non-metallic oxides are acidic in nature, and hence, they turn blue litmus red.

4. Diamond and graphite are the two allotropes of carbon.
   (a) Diamond:
      (i) hardest substance
      (ii) electrical insulator
   (b) Graphite:
      (i) comparatively soft; it is slippery over layers
      (ii) good electrical conductor

5.
   (a) **Calcination:** It is the process of converting an ore to its oxide by heating strongly below its melting point either in a limited supply or in the absence of air. This method is commonly used for converting carbonates and hydroxides to their respective oxides. During calcination, moisture and volatile impurities are also removed.
   Example: Calcium carbonate is converted to calcium oxide by calcination.
   Roasting: In this process, an ore is converted to its oxide by heating it strongly in excess of air. This method is commonly used for sulphide ores. During roasting, moisture and non-metallic impurities are also removed as volatile gases.
   Example: Zinc sulphide is converted to zinc oxide by roasting.
   (b) The difference between roasting and calcination is that roasting is done in excess of air, while calcination is done in a limited supply or the absence of air.

6.

(i) Zinc reacts with copper sulphate to give zinc sulphate and copper metal.

$CuSO_{4(aq)} + Zn_{(s)} \rightarrow ZnSO_{4(aq)} + Cu_{(s)}$

(ii) Magnesium reacts with HCl to give magnesium chloride and hydrogen gas.

$Mg_{(s)} + 2\ HCl_{(aq)} \rightarrow MgCl_2 + H_{2(g)}$

(iii) Sodium reacts with water to give sodium hydroxide and hydrogen gas.

$2\ Na_{(s)} + 2\ H_2O_{(l)} \rightarrow 2\ NaOH_{(aq)} + H_{2(g)}$

7. Aluminium is used as a reducing agent in the extraction of metals in those cases where the metal oxide is of a comparatively more reactive metal than zinc etc. which cannot be satisfactorily reduced by carbon.

Example: Oxides of manganese and chromium metals are not satisfactorily reduced by carbon. So, these metals are extracted by the reduction of their oxides with aluminium powder. Aluminium powder reduces the metal oxide to metal and itself gets oxidised to aluminium oxide.

Example: When manganese dioxide is heated with aluminium powder, manganese metal is produced.

$3\ MnO_2(s) + 4\ Al(s) \rightarrow 3\ Mn(l) + 2\ Al_2O_3(s) + Heat$

This reduction reaction of manganese dioxide with aluminium is a highly exothermic reaction.

8.

(a) Formation of ionic compounds – Sodium Chloride

i. Sodium has one electron in its outermost shell, and chlorine has seven electrons in its outermost shell.

ii. Sodium donates its one electron to chlorine and develops a net positive charge (Na^+).

iii. Chlorine accepts the electron and develops a net negative charge (Cl^-).

iv. Sodium and chloride ions, being oppositely charged, attract each other and are held by strong electrostatic forces of attraction.

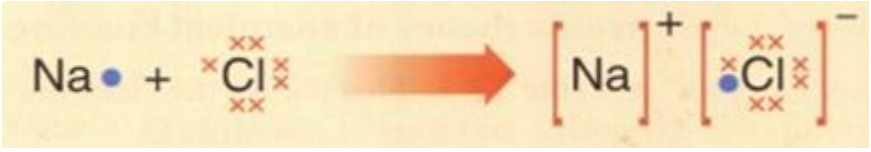
v. This results in the formation of an electrovalent or ionic bond.

$Na \rightarrow Na^+ + e^-$

2, 8, 1 2, 8

$Cl + e^- \rightarrow Cl^-$

2, 8, 7 2, 8,8



(b) This type of bonding is called electrovalent or ionic bonding.

(c) Properties shown by compounds formed by this bonding:

i. Ionic compounds have high melting points and boiling points.

ii. They are strong electrolytes and conduct electricity in the molten state and in aqueous solutions.

9. (a) Iron is extracted from haematite ore.

(b) Bauxite: Aluminium oxide, $Al_2O_3.2\ H_2O$

(c) Aluminium metal is extracted by the electrolytic reduction (electrolysis) of molten aluminium oxide. When electric current is passed through molten aluminium oxide, it decomposes to form aluminium metal and oxygen gas.

$$2Al_2O_{3(l)} \xrightarrow{\text{electrolysis}} 4Al_{(s)} + 3O_{2(g)}$$

(d) Aluminium metal is produced at the cathode (negative electrode). Oxygen gas is produced at the anode (positive electrode).

10.

(a) Alloys are homogeneous mixtures of two or more metals or a metal and a non-metal.

(b) They are prepared in the following ways:

(i) Melting the primary metal

(ii) Dissolving the other elements in a definite proportion and then cooling them to room temperature

(c) Constituents and uses of alloys:

i. Brass: Alloy of copper and zinc

Uses: In making utensils and scientific instruments

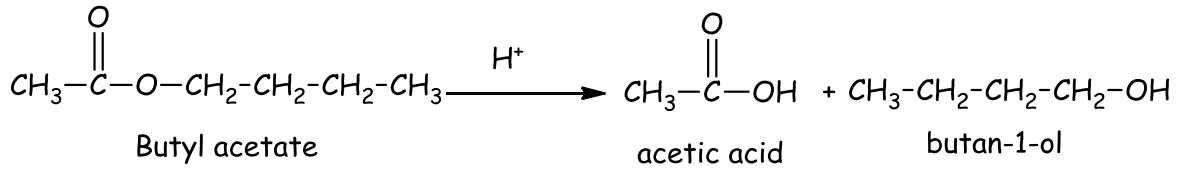
ii. Bronze: Alloy of copper and tin

Uses: In making statues and medals

iii. Solder: Alloy of lead and tin

Uses: In soldering (welding) electrical wires together

1. The name of the given compound is butyl acetate. The name of the acid is acetic acid and the name of the alcohol is butanol.



2. (i) Ketone
   (ii) Carboxylic acid

3. Carboxylic acid can be distinguished from alcohol by performing the following tests:

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.

4. Sodium hydrogen carbonate on reaction with acetic acid releases carbon dioxide gas.

$NaHCO_3 + CH_3COOH \rightarrow CH_3COONa + H_2O + CO_2$

Test for carbon dioxide:

If carbon dioxide is passed through limewater, it turns milky white.

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

Another method of testing CO_2 gas is by bringing a burning splinter near the mouth of the cylinder containing carbon dioxide. The burning splinter gets extinguished.

5. It is a group of organic compounds with a similar structure and similar chemical properties in which the successive compounds differ by a -$\mathbf{CH_2}$ group.

Molecules in a homologous series:

Formula	Name of the molecule
C_3H_6	Propene
C_4H_8	Butene
C_5H_{10}	Pentene

6.

When sodium metal reacts with ethanol, hydrogen gas is liberated.

$$C_2H_5OH + Na \longrightarrow C_2H_5ONa + \frac{1}{2}H_2$$

Ethene can be prepared by treating ethanol with alcoholic KOH and conc. sulphuric acid as a dehydrating agent at about 180°C temperature.

$$C_2H_5OH + H_2SO_4 \longrightarrow C_2H_4 + H_2O$$

Here, conc. sulphuric acid removes the water molecule from ethanol to form ethane.

7. (a) In a saponification reaction, an ester reacts with an alkali to form the salt of an acid and alcohol.

$$CH_3COOC_2H_5 \xrightarrow{NaOH} CH_3COONa + C_2H_5OH$$

(b) Differences between soap and detergent:

(i) Chemical composition:

Soap: Sodium or potassium salts of long-chain carboxylic acids.

Detergent: Ammonium or sulphonate salts of long-chain carboxylic acids.

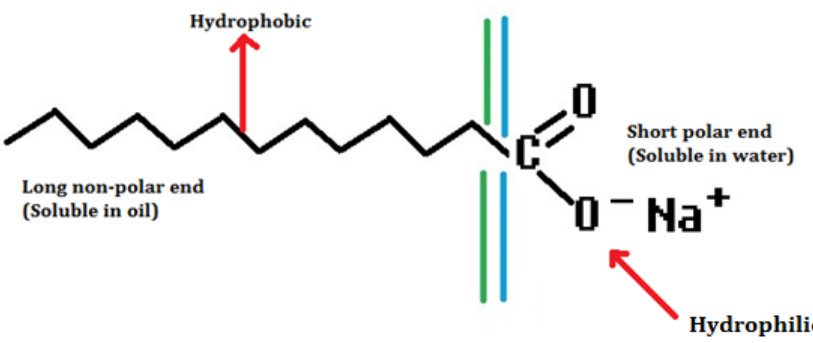
(ii) Action with hard water:

Soap: They form insoluble substances (scum) with hard water.

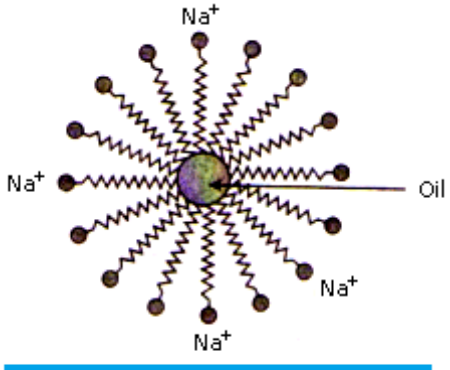
Detergent: They are effective in hard water because they do not form an insoluble precipitate.

Cleansing action of soaps:

- Soaps are cleansing agents capable of reacting with water and dislodging the unwanted particles from clothes or skin.
- At one end (long non-polar end) of the soap molecule is a hydrocarbon chain which is insoluble in water but soluble in oil.
- At the other end (short polar end) of soap molecule, there is a carboxylate ion which is hydrophilic, i.e. soluble in water but insoluble in oil.



- Soap on mixing with water forms a concentrated solution and causes foaming.
- The long non-polar end of soap gravitates towards and surrounds the dirt and absorbs the dust in it.
- The short polar end with the carboxylate ion repels the water away from the dirt.
- A spherical aggregate of soap molecules called a micelle is formed in the soap solution with water.
- Thus, the soap molecule dissolves the dirt and our clothes get clean.



Formation of Micelles

Soaps are not suitable for washing clothes when water is hard:

Soaps when used with hard water do not lather or produce foam easily because of the formation of a curdy precipitate or scum.

This scum is created when soaps react with the calcium and magnesium ions present in hard water.

8. (a)

(i) Catenation: The property of the carbon element due to which its atoms can join to one another to form long carbon chains is called catenation.

(ii) Tetravalency: Carbon has a valency of four. So, it is capable of bonding with four other atoms of carbon or atoms of some other mono-valent element.

Compounds of carbon are formed with oxygen, nitrogen, hydrogen, sulphur, chlorine and many other elements, giving rise to compounds with specific properties which depend on elements other than the carbon present in the molecule.

(b) **Addition reactions** occur only in unsaturated compounds where there are double or triple bonds.

The addition of hydrogen to an unsaturated hydrocarbon to obtain a saturated hydrocarbon is called hydrogenation.

Example: Ethene on heating with hydrogen in the presence of a nickel or palladium catalyst forms ethane.

$$CH_2 = CH_2 + H_2 \xrightarrow{\text{Ni, catalyst Heat}} CH_3 - CH_3$$

Application: The process of hydrogenation is used in industries to prepare vegetable ghee (or vanaspati) from vegetable oils.

In addition reactions, two or more reactants combine to form a single product. In substitution reactions, one atom is replaced by another atom.

$$CH_4 + Cl_2 \xrightarrow{\text{Sunlight}} CH_3Cl + HCl$$

OR

(a) **Isomers:** Organic compounds having the same molecular formula but different structural arrangement of atoms in their molecules are called isomers.

(b) Characteristics of isomers:

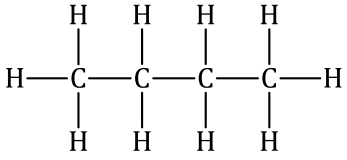
i) They have the same molecular formula but different structural formulae.

ii) They show similar properties only when they contain the same functional group.

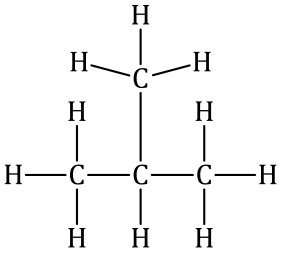
iii) Two isomers can have different boiling points. For example, in isomers of pentane, the branched chain pentane will have lower boiling point than linear pentane because the boiling point depends on the surface area which is more in case of n-pentane (linear).

iv) Isomers can have different functional groups. For example, aldehyde and ketone are two isomers, but they contain different functional groups.

(c) Two isomers of butane:



n-Butane



iso-Butane

(d) Isomers for the first three members of the alkane series are not possible because

i) The parent carbon must contain the most number of carbon atoms.

ii) The branching cannot be done from either the first or the last carbon atom.

9.

'C'- Acetic acid (CH_3COOH)

'R' – Sodium salt of acetate (CH_3COONa)

'A'- Ethanol (C_2H_5OH)

'S'- Methyl acetate (CH_3COOCH_3)

The reactions occur as follows:

$$\underset{C}{2CH_3COOH} + 2Na \longrightarrow \underset{R}{2CH_3COONa} + H_2$$

$$\underset{C}{CH_3COOH} + \underset{A}{CH_3OH} \xrightarrow{conc.H_2SO_4} \underset{S}{2CH_3COOCH_3}$$

$$\underset{C}{CH_3COOH} + NaOH \longrightarrow \underset{R}{2CH_3COONa} + H_2O$$

$$\underset{S}{CH_3COOCH_3} \xrightarrow{NaOH} \underset{R}{CH_3COOH} + \underset{A}{CH_3OH}$$

10.

(i) Combustion: The process of burning a carbon compound in air to give carbon dioxide, water, heat and light is known as combustion. These reactions are exothermic with the evolution of a large amount of heat.

Example: $CH_4(g) + 2\ O_2(g) \rightarrow CO_2(g) + 2\ H_2O(g)$ + Heat and light

(ii) Saponification: Ester on treating with a base such as NaOH is converted back to alcohol and sodium salt of carboxylic acid. This reaction is known as saponification because it is used in the manufacture of soap.

$CH_3COOC_2H_5 + NaOH \rightarrow C_2H_5OH + CH_3COONa$

(iii) **Substitution:** The reaction in which one or more hydrogen atoms of a hydrocarbon are replaced by atoms of other elements is called a substitution reaction.

$CH_4 + Cl_2 \xrightarrow{\text{Sunlight}} CH_3Cl + HCl$

(iv) **Esterification:** Ethanoic acid reacts with alcohols in the presence of a little conc. sulphuric acid to form esters.

$C_2H_5OH + CH_3COOH \xrightarrow{\text{Conc.}H_2SO_4} CH_3COOC_2H_5 + H_2O$

(v) **Oxidation:** Carbon compounds can be oxidised. • Alcohols on oxidation are converted to carboxylic acids. • Alkaline $KMnO_4$ or acidified $K_2Cr_2O_7$ are used as oxidising agents.

$CH_3 - CH_2 - OH \xrightarrow{\text{Alkaline } KMnO_4 + \text{Heat}} CH_3COOH$

Chapter 5: Periodic Classification of Elements

1. The modern periodic table is based on the law that the properties of elements are a periodic function of their atomic numbers. So, the problem was resolved because cobalt has a lower atomic number (27) than nickel (28).

2. The two rows of elements at the bottom of the modern periodic table are called the lanthanides (or lanthanoids) and actinides (or actinoids).
   Lanthanides: Ce (Z = 58) to Lu (Z = 71)
   Actinides: Th (Z = 90) to Lr (Z = 103)

3. Metallic character decreases from left to right along the period of the periodic table, because on moving from left to right, the size of the atoms decreases, and hence, the tendency to release electrons decreases. Thus, the electropositive character decreases.

4. According to the modern periodic law, elements are arranged in the modern periodic table in the increasing order of their atomic numbers. Isotopes have the same atomic number and different atomic mass. So, although they have different atomic masses, they are still given the same position in the modern periodic table.

5.

(a) **Mendeleev's periodic law:** The properties of elements are periodic functions of their atomic masses.

(b) The zero group of noble gas elements was missing from Mendeleev's original periodic table.

(c) Scandium (Sc) and Germanium (Ge) are the other two elements for which gaps were left by Mendeleev in his periodic table.

6. The modern periodic table could remove various anomalies of Mendeleev's periodic table:

In the modern periodic table, the elements are arranged in the increasing order of their atomic number, removing the anomaly regarding certain pairs of elements in Mendeleev's periodic table.

(a) Atomic number of cobalt is 27and nickel is 28. Hence, cobalt will come before nickel even though its atomic mass is greater.

(b) All isotopes of the same elements have different atomic masses but the same atomic number; therefore, they are placed in the same position in the modern periodic table.

7.

i. Third period; Groups 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

8.

i. Larger the atomic size, farther is the valence electron from the nucleus and lesser is the pull exerted on it. As a result, the electron can be easily removed from the valence shell, and hence, more metallic is the element.
ii. When an atom loses or gains an electron to form an ion, the number of electrons present in the outermost shell also changes. Corresponding to that, the effective nuclear charge on the changed number of electrons changes which further changes the size of an atom as there is an inverse relation between the effective nuclear charge and the size of the atom.
iii. K and Li belong to Group 1, i.e. metals. For metals, chemical reactivity of elements increases down the group, because chemical reactivity increases as the electropositive or metallic character increases.

iv. Electronegativity of chlorine is higher than sulphur because both belong to the third group and chlorine follows sulphur. We know that within a period, electronegativity increases as we move from left to right because of a decrease in the atomic size and increase in the nuclear charge.

v. Group 17 elements are non-metals because they have 7 electrons in their valence shell and ionise by accepting 1 electron to form an anion.
For example, the Group 17 elements F, Cl, Br and I all have 7 electrons in their valence shell and ionise by accepting 1 electron to form F^-, Cl^-, Br^- and I^-.
Group 1 elements are metals because they have a tendency to lose the one electron present in their valence shell to form a positive ion.
For example, Group 1 elements Li, Na, K, Rb and Cs have a tendency to lose the one electron present in their valence shell to form the positive ions Li^+, Na^+, K^+, Rb^+ and Cs^+.

9.

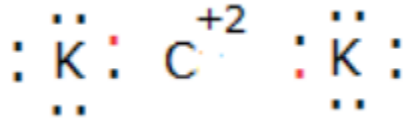
i. The most electronegative is J.

ii. Valence electrons present in G are 5.

iii. B contains 1 valence electron and H contains 6 valence electrons. So, the valency of B is +1 and the valency of H is -2.

iv. In the compound between F and J, the type of bond formed will be covalent.

v. The electron dot structure for the compound formed between C and K is



Chapter 6: Life Processes

1.

- Fish utilise the oxygen dissolved in water for their respiration.
- When fish are taken out of water, the supply of oxygen to the fish is cut as they cannot absorb and breathe using the oxygen present in the atmosphere.
- Hence, the fish die after some time.

2.

- In multicellular organisms such as man, the volume of the human body is large, and hence, oxygen cannot diffuse into all the cells of the human body quickly.
- Diffusion, being a slow process, takes a lot of time to circulate oxygen to all the body cells.
- Hence, diffusion is insufficient to meet the oxygen requirements of multicellular organisms like humans.

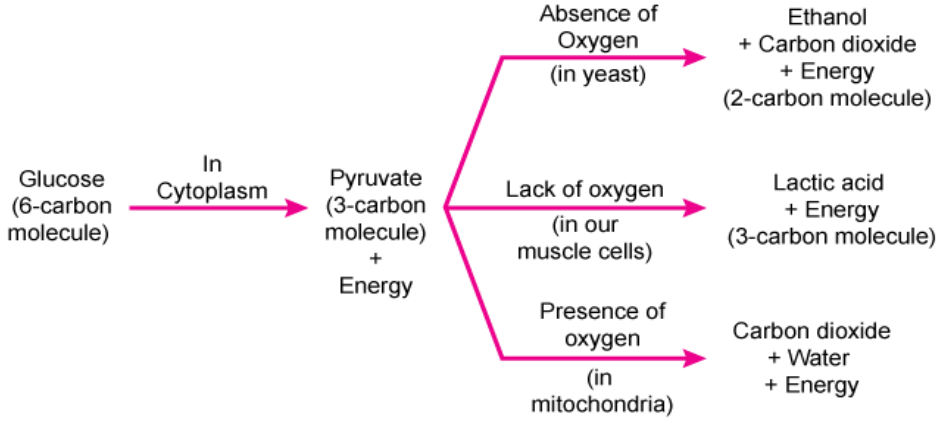
3.

- The opening and closing of stomata is controlled by guard cells.
- When water flows into the guard cells, they swell up and their curved surface causes the stomata to open.
- When the guard cells lose water, they shrink and become flaccid and straight, thus closing the stomata.

4.

- Warm-blooded animals such as birds and mammals maintain a constant body temperature by cooling themselves when they are in a hotter environment and by warming their bodies when they are in a cooler environment.
- Hence, these animals require more oxygen (O_2) for cellular respiration so that they can produce more energy to maintain their body temperature.
- Thus, it is necessary for them to separate oxygenated and deoxygenated blood so that their circulatory system is more efficient and can maintain a constant body temperature.

5. The first step towards obtaining energy is the breakdown of six-carbon glucose into two molecules of three-carbon pyruvate. This process takes place in the cytoplasm.



Respiration in the presence of oxygen in mitochondria:

- Breakdown of glucose in the presence of oxygen is called aerobic respiration. This process takes place in the mitochondria.
- The process of aerobic respiration releases carbon dioxide, water and energy.

Respiration in the absence of oxygen in muscle cells:

- Breakdown of glucose in the absence of oxygen is called anaerobic respiration.
- During heavy physical exercise such as cycling, running or lifting heavy weights, the body is often deprived of oxygen.
- The demand for energy is high, while the supply of oxygen to the body is limited.
- Therefore, muscle cells perform anaerobic respiration to fulfill the increasing energy demands of the body. Here, glucose gets converted to lactic acid.

Respiration in the absence of oxygen in yeast:

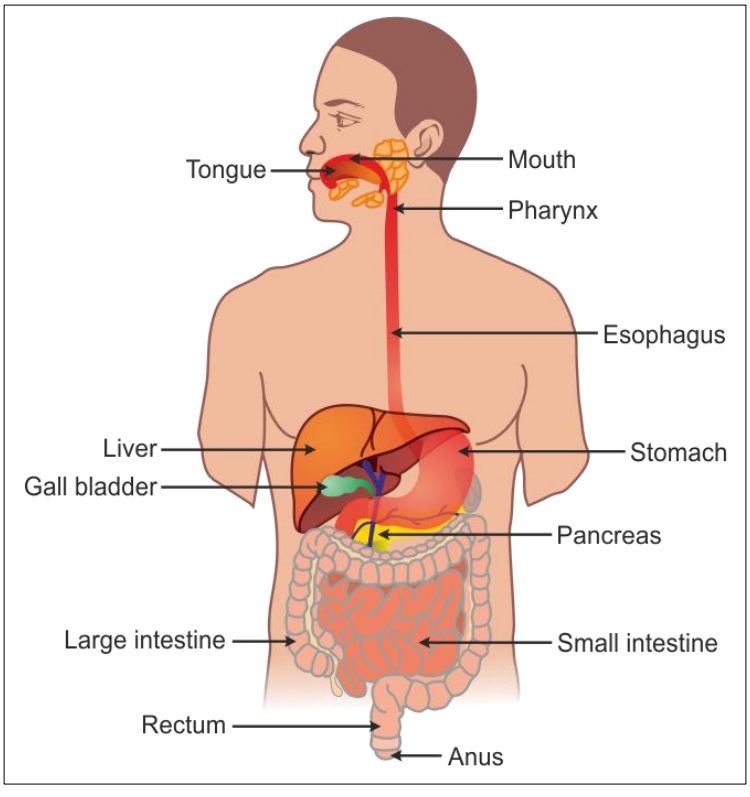
- Organisms which do not require the presence of oxygen for respiration are called anaerobes.
- Unicellular organisms such as yeast and some bacteria are examples of anaerobes.
- The process of anaerobic respiration in yeast results in the formation of ethanol along with the release of carbon dioxide and energy. Water is not released in this process.

6.

- Fats can be digested with the help of bile released from the liver.
- Fats are present in the small intestine in the form of large globules, which makes it difficult for the enzymes to act on them.
- Bile salts break fats into smaller globules to increase the action of enzymes. This process is known as emulsification.
- Later, steapsin, a pancreatic lipase, acts on the emulsified fats and breaks them down into fatty acids and glycerol.
- This aids in the easy digestion of food.
- Fat digestion takes place in the small intestine.
- This digested fat is absorbed into the body through the villi by diffusion.

7.

(a) Human digestive system



(b) Role in digestion:

(i) Bile: Bile helps to emulsify fats and thus aids in their absorption in the small intestine. It also makes the acidic food coming from the stomach alkaline, so as to enable the action of pancreatic enzymes.

(ii) Salivary amylase: The hydrolytic action of salivary amylase hydrolyses starch into maltose.

(iii) HCl: Hydrochloric acid gets mixed with food and kills the bacteria present in food. It also destroys the structure of proteins so that the enzymes can digest them easily. HCl also creates acidic conditions necessary for the action of the enzyme pepsin. It activates pepsin to act on proteins.

8.

(a) Excretion is the process of removal of harmful and unwanted substances, especially nitrogenous wastes, from the body.

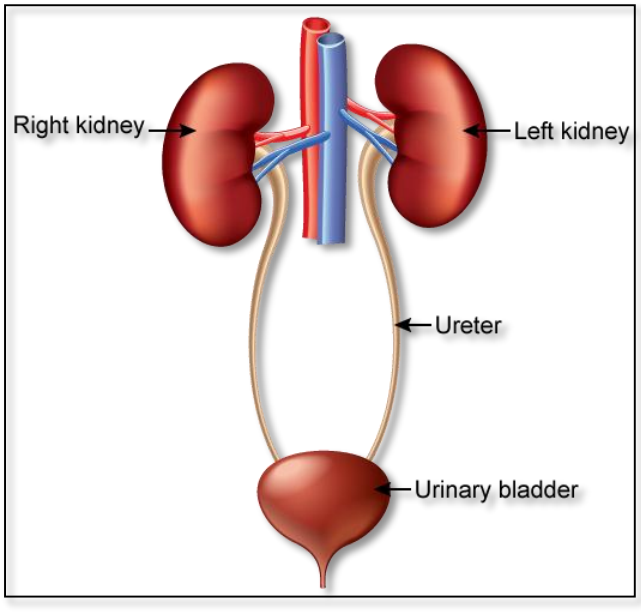
(b) Nephron is the basic filtration unit of the kidneys.

(c)

(i) Kidneys: Form urine

(ii) Ureter: Long tube which collects urine from the kidney

(iii) Urinary bladder: Stores urine until it is passed out



9.

(a) **Components of blood:** Plasma and blood cells (corpuscles)

(b) **Movement of oxygenated blood in the body:**

Pulmonary vein → Left atrium → Left ventricle → Aorta → Rest of the body

(c) Valves present in between atria and ventricles help to restrict the backflow of the blood from the ventricle to the atrium when the ventricle contracts.

(d) **Differences between artery and vein:**

Artery	Vein
1. It has thick elastic muscular walls.	1. It has thin, non-elastic walls.
2. It does not contain valves.	2. It contains valves to prevent the backflow of blood.
3. Blood flows under high pressure.	3. Blood flows under low pressure.

Chapter 7: Control and Coordination

1. Cytokinin is responsible for the promotion of cell division in plants.

2.
   - Iodine is required by the thyroid gland to secrete thyroxine hormone.
   - Thyroxine regulates carbohydrate, protein and fat metabolism in the body to provide the best balance for growth.
   - If the intake of iodine is low in our diet, it might result in the deficiency of thyroxine causing goitre.

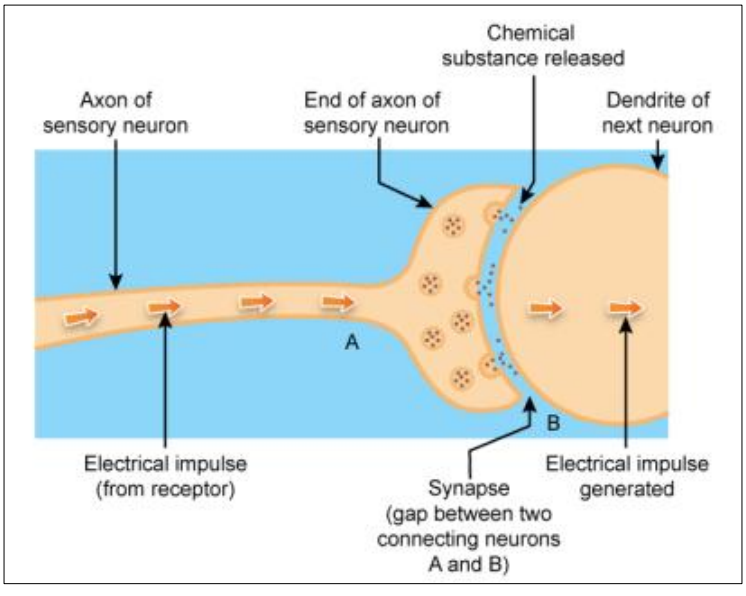
3.
   (a) where information is acquired - dendrites
   (b) through which information travels as an electrical impulse - axon

4. Differences between involuntary actions and reflex actions:

Reflex actions	Involuntary actions
• Rapid automatic responses to a stimulus without the conscious involvement of the brain	• Occurs without the conscious choice of an organism
• Controlled by the spinal cord	• Controlled by the midbrain or medulla oblongata
• Very quick and instantaneous	• Relatively slower
• May involve any muscle or a gland	• Involves only smooth muscles
• Can be conditioned	• Cannot be influenced by external conditioning
• Examples: Blinking of eyes, salivation	• Examples: Beating of heart, blood circulation

5.
   - A microscopic gap between a pair of adjacent neurons over which nerve impulses pass while going from one neuron to another is called a synapse.
   - The synapse between two neurons acts as a one-way valve which allows electrical impulses to pass in one direction only.

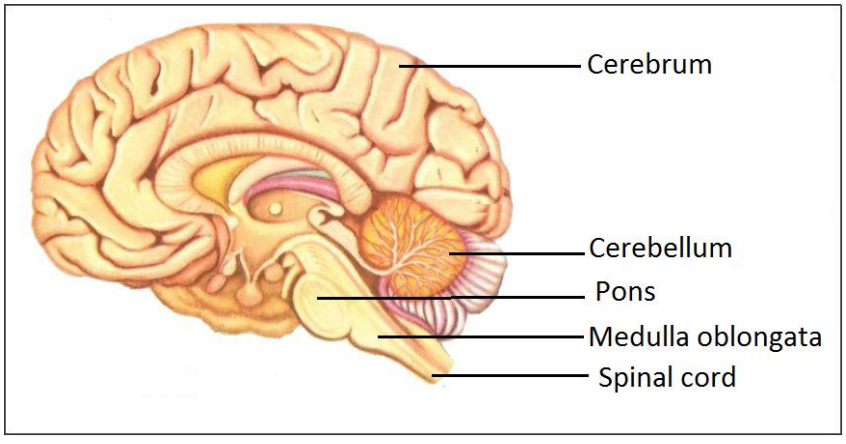
- When an electrical impulse coming from the receptor reaches the end of the axon of a sensory neuron, the electrical impulse releases a small amount of a chemical substance (called neurotransmitter) into the synapse between two adjacent neurons.
- This substance crosses the synapse and starts a similar electrical impulse in the dendrites of the next neuron.
- In this way, the electrical impulses are passed from one neuron to another through the synapse.



6.

Gland	Hormones	Functions
Thyroid	Thyroxine	Regulates the metabolism of carbohydrates, proteins and fats in the body
Pituitary	Growth hormone	Regulates the growth and development of bones and muscles
	Prolactin	Regulates the functioning of mammary glands in females
	Vasopressin	Regulates the balance of water and electrolytes in the body
	Oxytocin	Regulates the ejection of milk during lactation in females
Pancreas	Glucagon	Helps to increase the sugar level in the body
	Insulin	Helps to decrease the sugar level in the body

7. Structure of the human brain



Functions of different parts of the human brain:

The brain consists of three main parts—cerebrum, cerebellum and medulla oblongata.

Cerebrum:

- It controls all voluntary movements.
- It is also associated with concentration, planning, decision-making and intelligence.

Cerebellum:

- It coordinates voluntary movements.
- It maintains body's balance.

Medulla oblongata:

- It conducts impulses from the skin towards the brain.
- It conducts impulses from the brain to the muscles and glands.
- It functions as a centre for coordination of reflex actions.

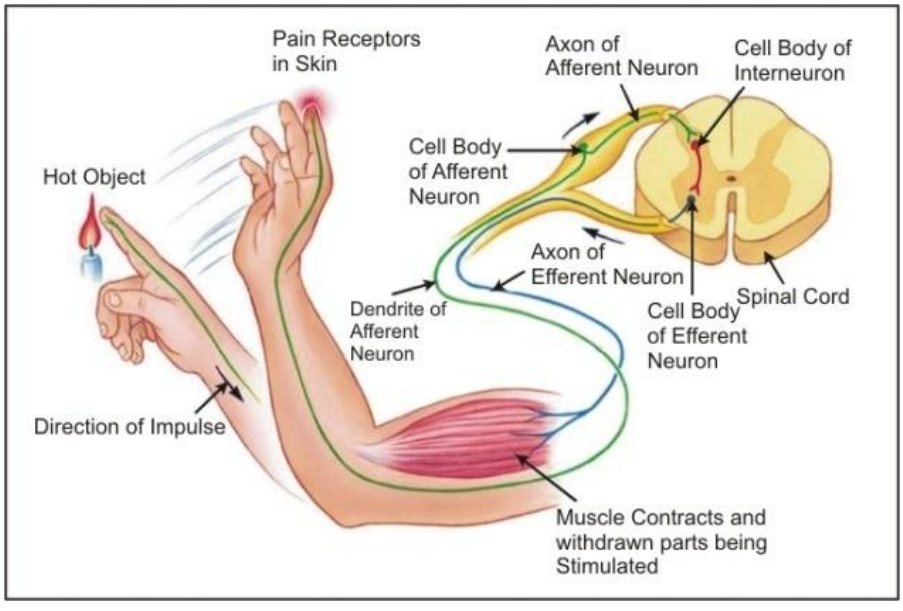
8.

(a) Reflex action is an automatic, quick and involuntary action in the body brought about by a stimulus.

(b) The path travelled by the impulse during a reflex action is called a reflex arc.

A reflex arc can be represented as follows:

Stimulus → receptor in the sense organs → afferent (sensory) nerve fibre → CNS (spinal cord) → efferent (motor) nerve fibre → muscle/gland → Response



(c) Functions:

(i) Insulin: Regulates the blood glucose (sugar) level in the body.

(ii) Adrenaline: Prepares the body for the fight and flight mechanism.

Chapter 8: How do Organisms Reproduce?

1. Cross-pollination is a process which involves the transfer of pollen of one flower to the stigma of another flower on the same plant or different plants of the same species.

2. Diseases caused by bacterial infection: Chlamydia, Gonorrhea, Syphilis
   Diseases caused by viral infection: AIDS, Hepatitis B

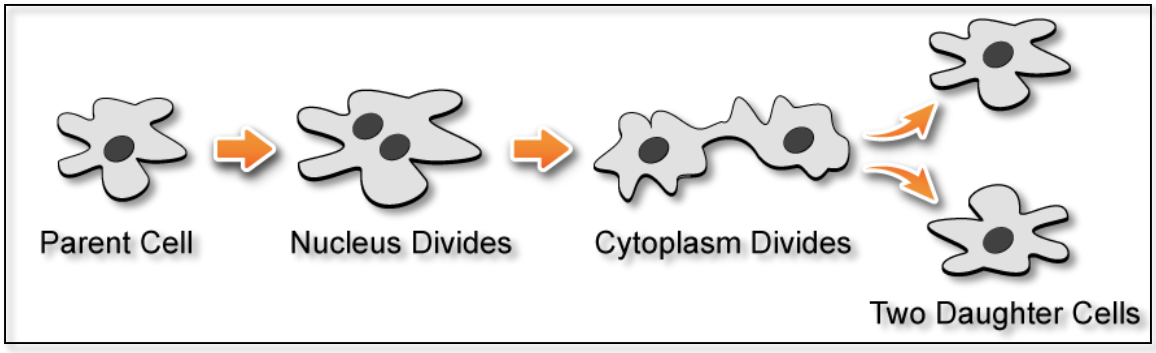
3. Fertilisation in human females takes place in the fallopian tube just outside the ovary.

4. Vegetative propagation is a type of reproduction in which several plants are capable of reproducing naturally through the vegetative parts of plants such as roots, stems and leaves.
   Advantages of vegetative propagation:
   - Plants not capable of reproducing sexually reproduce by this method.
   - It is a fast and certain method to obtain plants with desired features.

Disadvantages of vegetative propagation:

- There is no possibility for variation.
- The new plant grows in the same area as the parent plant which leads to competition for resources.

5. *Amoeba* reproduces by the process of binary fission. In this method, a single parent cell splits and gets divided into two daughter cells.



6. Methods of contraception used by humans:
   - Barrier methods: Use of condoms in males and diaphragms in females
   - Chemical methods: Use of various hormonal pills
   - IUDs: Use of IUDs like copper-T and Lippes loop
     Surgical methods: Tubectomy in females and vasectomy in males

   Impact of these techniques on the health and prosperity of the family:
   - They help to prevent unwanted pregnancies and control population growth.
   - They offer protection from sexually transmitted diseases like AIDS, syphilis etc.
   - They ensure proper health of the mother and child by preventing frequent pregnancies.
   - These techniques offer sufficient gap between the offspring for proper care of children.

7. (a) Differences between sexual and asexual reproduction:

Asexual reproduction	Sexual reproduction
• Involves the participation of a single individual parent.	• Involves the participation of two separate parents.
• Occurs without the formation of gametes.	• Requires the formation of gametes.

• Does not involve meiosis or reduction division.	• Involves meiosis or reduction division.
• Does not involve sexual fusion or fusion of gametes. Zygote is not formed.	• Requires fertilisation to take place between two opposite gametes leading to the production of a zygote.
• Offspring produced are genetically similar to the parents. They do not show variations.	• Offspring produced exhibit genetic variation and are different from either of the two parents.
• Very quick method of multiplication of individuals.	• Very slow method of multiplication of individuals.

(b)

- In sexual reproduction, two parents are involved which are different from one another.
- The male and female gametes are formed by meiosis which allows crossing over and recombination which generates variation in the offspring.
- The fusion of male and female gametes combines two different DNA copies and results in new combinations of genes and increases genetic variation.
- Hence, variations are observed in the offspring of sexually reproducing organisms.

8.

(a) **Functions**:

(i) Ovary:

- Produces ova or female gametes.
- Secretes the female hormones oestrogen and progesterone which are responsible for changes in the female body at the time of puberty.

(ii) Oviduct:

- Acts as the site for the fertilisation of male and female gametes.
- After fertilisation, the ovum travels down to the uterus through the oviduct.

(iii) Uterus:

- Protects and nourishes the developing embryo with the help of placenta.

(b) **Structure and function of the placenta:**

The placenta is embedded in the uterine wall and serves as a connecting link between the mother's body and the baby.

- It is a disc of specialised tissue which provides food and oxygen to the foetus.
- It contains blood spaces on the mother's side and small projections called villi on the foetal side. Here, the mother's blood and foetal blood come in contact with each other.
- It provides a large surface area for the exchange of nutrients and oxygen between the mother and the foetus.
- The foetus gives away waste products and carbon dioxide to the mother's blood for excretion.
- It also functions as an endocrine gland and secretes the hormones necessary to maintain pregnancy.

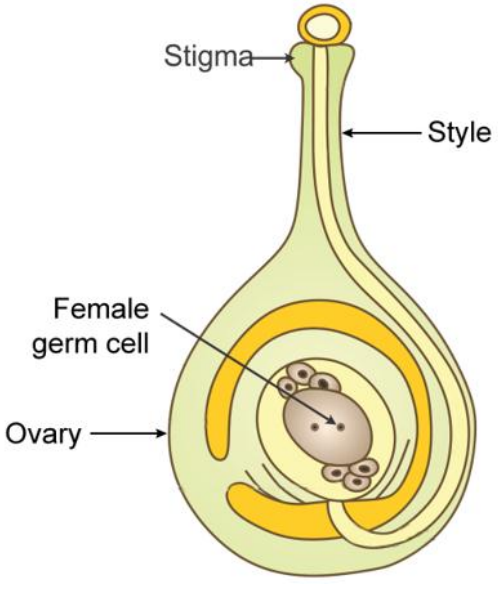
9.

(a) Differences between self-pollination and cross-pollination: (Any four points)

Self-pollination	Cross-pollination
1. It is the transfer of pollen grains from the anther to the stigma of the same flower.	1. It is the transfer of pollen grains from the anther of one flower to the stigma of another flower of a different plant of the same species.
2. It does not require any external agent, such as wind, water and insects, to carry out pollination.	2. It requires an external agent for pollination to occur.
3. It can take place even when the flower is closed.	3. It can occur only when the flower is open.
4. In self-pollinated flowers, the anther and stigma mature at the same time.	4. In cross-pollinated flowers, the anther and stigma mature at different times.
5. It preserves parental characters.	5. It does not preserve parental characters.
6. New varieties are not possible.	6. New varieties can be produced.

The site of fertilisation in flowers is the ovule which is present in the ovary. The product of fertilisation is a zygote which later develops into a fruit.

(b) Diagram of pistil:



Chapter 9: Heredity and Evolution

1. Speciation is a process by which a new species develops from the existing species.

2. The F_1 progeny would bear violet flowers as violet colour is a dominant character over white colour.

3. Inherited character: Eye colour, hair colour of a person
   Acquired character: Body weight

4.
   - Organic evolution can be defined as the slow, progressive, natural and sequential development in primitive organisms to form more complex organisms or a new species.
   - Evolution should not be equated with progress. In fact, there is no real 'progress' in the idea of evolution.

- Evolution is simply the generation of diversity and the shaping of the diversity by environmental factors.
- The only progressive trend in evolution seems to be that more and more complex body designs have emerged over time. However, it is not that older designs are inefficient.
- Example: Bacteria with the simplest body designs are still the most cosmopolitan organisms found on the Earth. They can survive in hot springs, deep seas and even freezing environments.
- Therefore, having complex body designs does make a species superior to another.

5.

(i) Homologous organs:

- Homologous organs are organs which have the same structure and origin but different function.
- Example: Forelimbs of man and bird have the same structure, but they have different functions of handling and flying, respectively.
- The presence of homologous organs provides evidence that they have been derived from the same ancestor and hence have the same structure but different functions.

(ii) Analogous organs:

- Analogous organs are organs which have different structure and origin but the same function.
- Example: Wings of an insect and wings of a bird have different structures but perform the same function of flying.
- Analogous organs prove that organisms belonging to different ancestors perform similar functions and then keep evolving with favourable environmental conditions.

(iii) Fossils:

- Fossils are the dead remains of plants and animals which lived in the remote past.
- The presence of fossils provides evidence for evolution.
- Example: Archaeopteryx is a bird which has many characteristics similar to those of reptiles which implies that birds seem to have evolved from reptiles.

6.

- J.B.S. Haldane suggested that life must have developed from simple inorganic molecules which were present on the Earth soon after it was formed.
- He speculated that the conditions on Earth at that time could have given rise to more complex organic molecules which were necessary for life.
- The first primitive organisms would arise from further chemical synthesis.
- Later on, Stanley Miller and Harold Urey conducted experiments to find out about the origin of organic molecules.
- They assembled an atmosphere similar to that thought to exist on early Earth (this had molecules like ammonia, methane and hydrogen sulphide, but no oxygen) over water.
- This was maintained at a temperature just below 100°C and 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.
- This is how life originated on the Earth from inanimate matter.

7. Formation of fossils:

- Fossils are generally found in the layers of sedimentary rocks.
- They are formed by a continuous process of burying and decomposition over a period of time.
- The hard parts of the body such as the skeleton, shell, teeth, and occasionally, the entire animal are found embedded in the sediments.
- These sediments form rocks.

Methods to determine the age of fossils:

Relative method:

- If we dig into the Earth, we find that the fossils closer to the surface are more recent as compared to the fossils found in deeper layers.

Radiocarbon dating:

- The fossils can also be dated by detecting the ratios of different isotopes of the same element in the fossil material.
- Radiocarbon dating is the most accurate, most studied and most verified of all radiometric dating schemes.
- When living organisms change into fossils, their rate of radioactive ^{14}C decay decreases slowly.

- In this way, the age of fossils can be determined with the help of radioactive ^{14}C.
- As the age of a fossil can be clearly established by radioactive carbon dating technique, the exact period of formation of a species can also be ascertained.

8. **Factors which lead to the rise of a new species:**

- Genetic variation between individuals: There is a large amount of variation in the genes within a population. This genetic variation arises from random mutations in the DNA sequence. Mutations in the DNA of a gene coding for a protein can cause changes in the amino acid sequence of the protein. The resulting protein may function differently.
- Natural selection: All populations respond to changes in their environment. Individuals will respond in different ways depending on their genes. Those individuals whose genes are best suited to the environment are more likely to survive and pass on their genes to the next generation. This is natural selection. Gradually, favourable genes will start to predominate in the population and less favourable genes will decline.
- Genetic drift: It is caused by drastic changes in the frequencies of particular genes by chance alone. Genetic drift with changes in the gene flow imposed by isolation mechanism acts as an agent of speciation which ultimately results in evolution.
- Geographical isolation: It is a major factor in speciation since it interrupts with gene flow. Geographical isolation is caused by various types of barriers such as mountain ranges, rivers, and seas. It leads to reproductive isolation due to which there is no flow of genes between separated groups of population which ultimately results in speciation.

9. Darwin put forth the Theory of Natural Selection involving the struggle for existence and survival of the fittest.

Overproduction of offspring

- All organisms have the capacity to reproduce at a very high rate.
- However, the organisms cannot survive by reproduction alone.
- Due to lack of food and space, the offspring soon begin to die.
- Some are eaten by predators, while some get destroyed due to adverse environmental conditions.

Struggle for existence

- Overproduction of organisms results in a struggle for existence among organisms.
- The struggle is to obtain food, space and a mate.

Natural selection

- Only those organisms who are fit for the changing environment have the right to survive.
- Organisms which are unfit are eliminated and ultimately die.
- The fit species reproduce. The essential variations in the characteristics are passed on from one generation to the next.
- These variations make them fit to survive in the constantly changing environment.

Survival of the fittest

- In the struggle for existence, the organisms which develop new favourable characteristics will survive in the long run. This idea is called 'survival of the fittest'.
- Organisms which survive transmit the favourable characters to their offspring.
- These characters get accumulated and give rise to a new species.

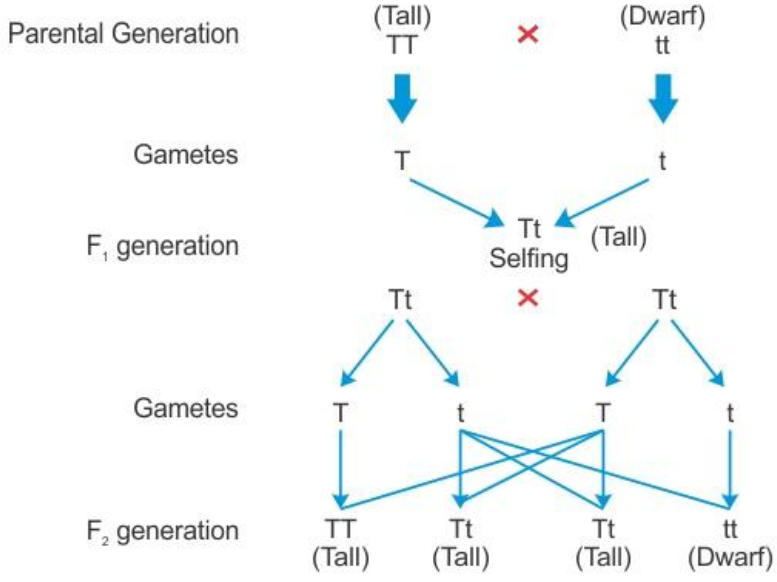
10.

(a)

- A male has one X chromosome and one Y chromosome (XY). Therefore, half of the male gametes or sperms will have X chromosomes and the other half will have Y chromosomes.
- A female has both X chromosomes (XX). Therefore, all the female gametes or ova always have X chromosomes.
- If a sperm carrying the X chromosome fertilises an ovum which always carries the X chromosome, then the combination of sex chromosomes will be XX, and hence, the child born will be a female (girl).
- If a sperm carrying the Y chromosome fertilises an ovum, then the combination of sex chromosomes will be XY, and hence, the child born will be a male (boy).
- Thus, the sex of children is determined by what they inherit from the father and not from the mother.

(b) Monohybrid cross

- Monohybrid cross involves only a single pair of contrasting characters.
- Consider pea plants with a pair of contrasting characters—tallness and dwarfness—with respect to the height of the stem.
- If pure tall pea plants (TT) are crossed with pure dwarf pea plants (tt), then all progeny plants obtained will be tall. This is called the first filial or F_1 generation seeds.
- The F_1 generation has genetic constitution Tt. It is genotypically a hybrid and a heterozygous plant with two different alleles.
- Phenotypically, the plant is tall because the allele or the gene T for tallness masks the effect of its corresponding recessive gene t.



- F_1 plants are self-pollinated to obtain the F_2 generation.
- The second filial generation F_2 has a genotypic ratio 1 TT:2 Tt:1 tt.
- In this case, because the allele T for tallness is dominant, the pea plants with genotype Tt will be tall.
- The phenotypic ratio is 3 tall:1 dwarf.
- Genotypically, it shows 3 types of plants: 1 TT (which is homozygous tall), 2 Tt (which are heterozygous tall) and 1 tt (which is homozygous dwarf). Thus, the genotypic ratio is 1 TT:2 Tt:1 tt.

1. A convex mirror is used as a rear-view mirror in vehicles.

2. R = 60 cm

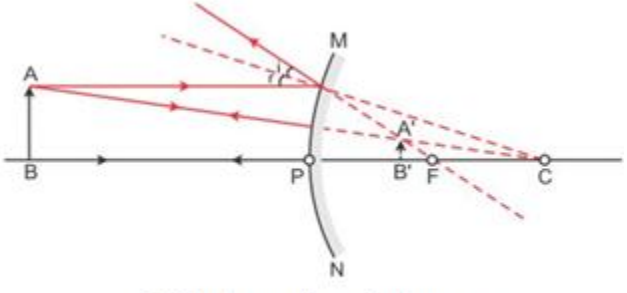
$$f = \frac{R}{2}$$

$$\therefore f = \frac{60}{2} = 30 \text{ cm}$$

Thus, the focal length of this spherical mirror is 30 cm.

3. The nature of image formed when an object is placed at focus F is real, inverted and highly magnified, and the image is formed at infinity.

4.



Object anywhere between infinity and P

When an object is placed between infinity and the pole of a convex mirror, the image formed is virtual, erect and diminished.

5. The refractive index of medium, ${}_an_m = 1.8$

Speed of light in air = 300000 km/s = 3×10^8 m/s

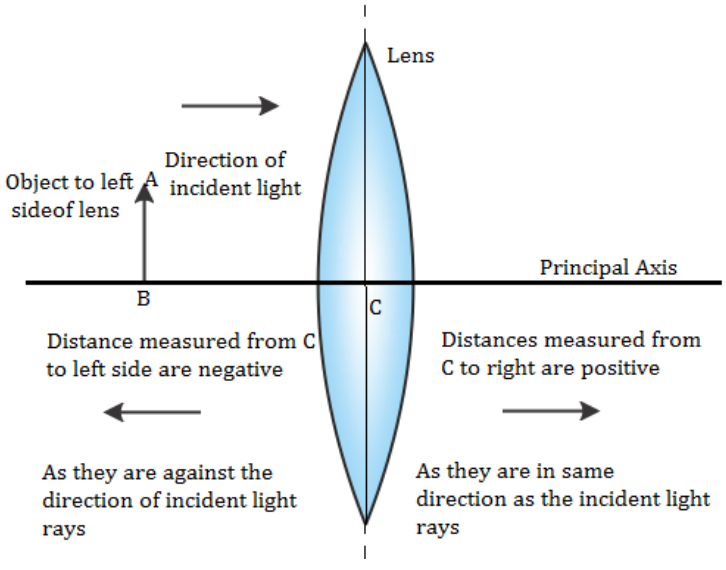
$${}_an_m = \frac{n_m}{n_a} = \frac{v_a}{v_m}$$

$$\Rightarrow v_m = \frac{3 \times 10^8 \times 1}{1.8} \text{ ...(refractive index of air =1)}$$

$$\Rightarrow v_m = 1.66 \times 10^8 \text{ m/s}$$

Thus, the velocity of light in the medium is 1.66×10^8 m/s.

6. Cartesian sign convention used in optics are as follows:



i. All distances are measured from the optical centre of the lens.

ii. All distances measured in the same direction as that of incident light rays are taken as positive.

iii. The distances measured against the direction of the incident ray are taken as negative.

iv. The distances measured above and perpendicular to the principal axis are taken as positive.

v. The distances measured below and perpendicular to the principal axis are taken as negative.

7. f = -15 cm (focal length of the concave mirror)

$m = \frac{-v}{u} = 2$ or -2 (image must be two times the height of an object)

$\therefore v = -2u$

$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

$\frac{1}{-2u} + \frac{1}{u} = \frac{1}{-15}$

Solving this we get,

u = - 7.5 cm

Thus,

v = -2 (-7.5) = 15 cm

Thus, if the object is placed at –7.5 cm, it will form an image of the size twice the size of an object.

For v = 2u

$$\frac{1}{2u}+\frac{1}{u}=\frac{1}{-15}$$

Solving this we get,

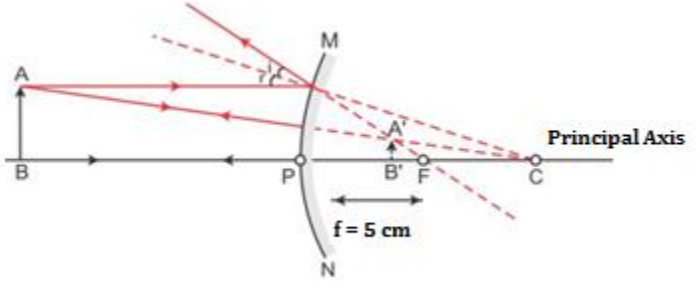
u = -22.5 cm

Thus,

v = 2 (-22.5) = -45 cm

Thus, if the object is placed at –22.5 cm, it will also form an image of size twice the size of an object.

8.



As f = 5 cm

Centre of curvature C will be at a distance of 10 cm.

If an object is placed at a distance of 15 cm from the convex mirror, then the image formed will be behind the mirror and it will be virtual, erect and diminished.

By the mirror formula,

$$\frac{1}{f}=\frac{1}{v}+\frac{1}{u}$$

$$\therefore \frac{1}{5}=\frac{1}{v}+\frac{1}{(-15)}$$

$$v = 3.75 \text{ cm}$$

The image will be formed between the pole and the focus.

9. (a) Power of lens = +3 D

$$P=\frac{1}{f(\text{in metre})}$$

$$f=\frac{1}{+3}=0.33 \text{ m}$$

Focal length = +0.33 m

The positive sign indicates that the lens is a convex lens.

Power of lens = -4 D

$$P = \frac{1}{f(\text{in metre})}$$

$$f = \frac{1}{-4} = -0.25 \text{ m}$$

The negative sign indicates that the lens is a concave lens.

(b) f_1 = +30 cm = +0.3 m

f_2 = +50 cm = +0.5 m

f_3 = -40 cm = -0.4 m

$$P = P_1 + P_2 + P_3$$

$$\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3}$$

$$\frac{1}{f} = \frac{1}{0.3} + \frac{1}{0.5} + \frac{1}{-0.4}$$

$$\frac{1}{f} = +2.8 \text{ D}$$

Thus, the power of the combination of lenses is +2.8 D.

$$f = \frac{1}{P} = \frac{1}{+2.8}$$

And the focal length of the combination of lenses is +0.35 m.

Chapter 11: Human Eye and the Colourful World

1. The far point of the normal human eye is infinity, and the near point of the normal human eye is at a distance of 25 cm from the eye.

2. The ability of the eye to focus on distant objects as well as nearby objects on the retina by changing the focal length of its lens is called the power of accommodation.

3. When a beam of light strikes fine particles of smoke, dust, water droplets etc., the beam of light becomes visible. This phenomenon of the scattering of light by colloidal particles is known as the Tyndall effect.

Example: The sky appearing blue is an example of the Tyndall effect.

The molecules of air and other fine particles in the atmosphere have a size smaller than the wavelength of visible light. Thus, they are more effective in scattering light of shorter wavelengths at the blue end than light of longer wavelengths at the red end.

Red light has a wavelength greater than blue light. Thus, when sunlight passes through the atmosphere, the fine particles in the air scatter blue colour (shorter wavelengths) more strongly than red. The scattered blue light enters our eyes, and hence, the sky appears blue.

4. A)

(i) Red light has a wavelength greater than blue light.

(ii) Thus, when sunlight passes through the atmosphere, the fine particles in air scatter blue colour (shorter wavelengths) more strongly than red.

(iii) The scattered blue light enters our eyes, and hence, the sky appears blue.

B)

(i) At sunrise or sunset, the Sun is at the horizon.

(ii) Light from the Sun near the horizon passes through a thicker layer of air and a larger distance in the Earth's atmosphere before reaching our eyes.

(iii) Near the horizon, most of the blue light and shorter wavelengths are scattered. Thus, the Sun appears reddish in colour.

5.

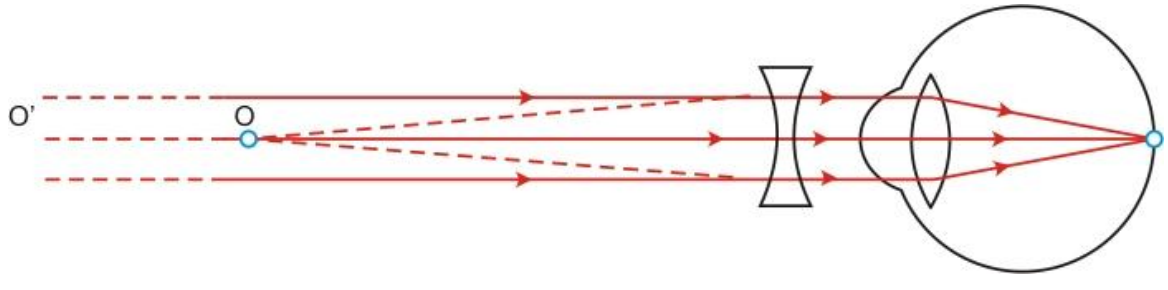
A) Myopia:

(i) A person with myopia can see nearby objects clearly but cannot see distant objects distinctly.

(ii) A person with this defect has the far point nearer than infinity. Such a person may see clearly up to a distance of a few metres.

Correction:

A concave lens of suitable power will bring the image back onto the retina, and thus, the defect is corrected.



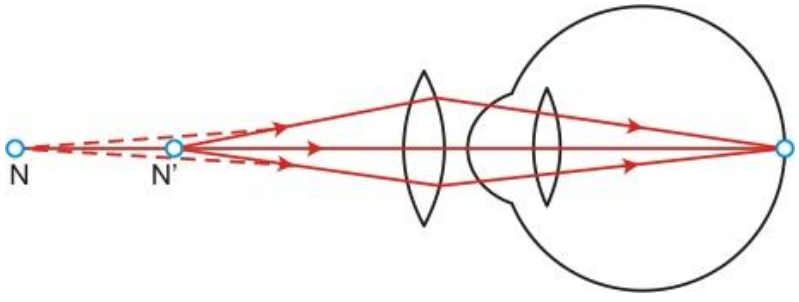
B) Hypermetropia:

(i) A person with hypermetropia can see distant objects clearly but cannot see nearby objects distinctly.

(ii) A person with this defect has the near point farther away from normal near point of 25 cm. Such a person has to keep reading material farther than 25 cm.

Correction:

This defect can be corrected by using a convex lens of suitable power. Eye glasses with converging lenses provide the additional focusing power required for forming the image on the retina.



6. u = ∞

v = -1.5 m

f = ?

By the lens formula,

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\Rightarrow \frac{1}{f} = \frac{1}{-1.5} - \frac{1}{\infty}$$

$$\therefore \frac{1}{f} = \frac{1}{-1.5} - 0$$

$$f = -1.5 \text{ m}$$

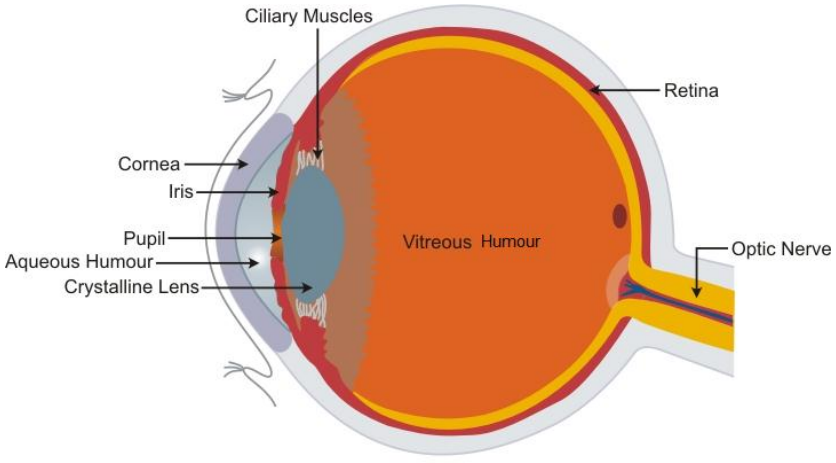
Thus,

Power of lens, $P = \frac{1}{f} = \frac{1}{-1.5} = -0.66$ D

The negative sign indicates that the lens used to correct the vision is a concave lens.

As the far point is -1.5 m, it means that the person cannot see objects which are beyond -1.5 m. Thus, the person is suffering from myopia (short-sightedness).

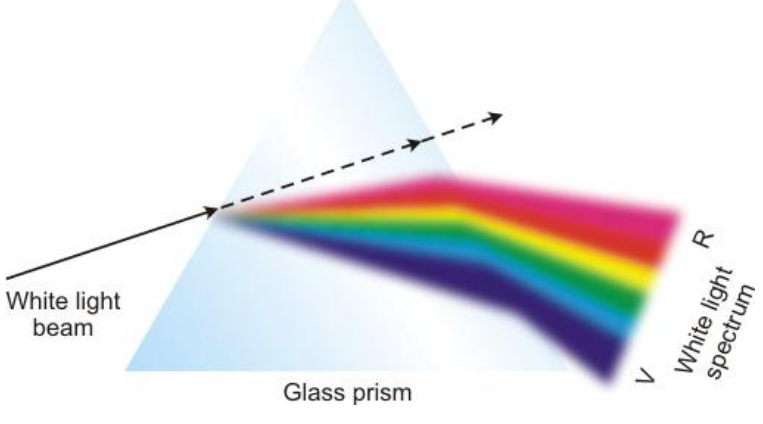
7.



The various parts of the human eye and their respective functions include

Part	Function
Cornea	Protective layer of the eye Refraction of light rays entering the eye
Eye lens	Adjust the focal length and form an inverted image of the object on the retina
Pupil	Regulates the amount of light entering the eye
Iris	Controls the size of the pupil
Retina	Acts as a screen for forming the image
Ciliary muscles	Adjust the thickness of the lens
Optic nerves	Send signals to the brain

8.



i) The band of seven colours formed on the screen when a beam of light passes through a glass prism is called the spectrum of light.

ii) The seven colours are Violet, Indigo, Blue, Green, Yellow, Orange and Red. It is commonly known by the acronym **VIBGYOR.**

iii) The splitting of white light into its seven constituent colours after passing through the transparent medium is called dispersion of light.

iv) The dispersion of white light occurs due to the different speeds of these colours while passing through the prism.

v) Red colour has the maximum speed and deviates the least, while violet colour has the minimum speed and deviates the most.

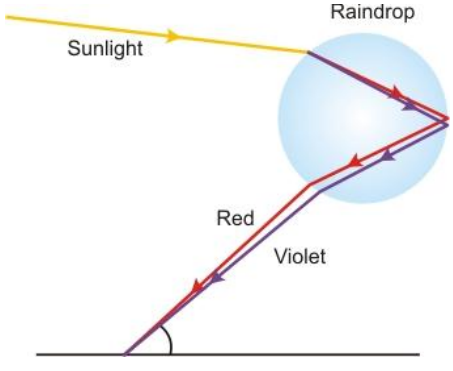
vi) The colours in the order of increasing frequency but decreasing wavelengths are Red, Orange, Yellow, Green, Blue, Indigo and Violet.

9.

(i) A rainbow is a natural spectrum which appears in the sky after rainfall.

(ii) It is caused by the dispersion of sunlight by water droplets in the atmosphere. It always forms in the direction opposite to the Sun.

(iii) The water droplets act like tiny prisms which refract and disperse sunlight. Then, they reflect light internally and refract light again.



Chapter 12: Electricity

1. Electric power is electrical work done per unit time.
The SI unit of power is Watt (W).

2. According to the law, the heat produced in a resistor is

- Directly proportional to the square of the current in the resistor
- Directly proportional to the resistance of the resistor
- Directly proportional to the time for which the current flows through the resistance

The heating effect is used in bulbs. The current passing through the filament of a bulb causes the bulb to heat up and give out light and heat. The filament is made up of an element with a high melting point. The bulb is also filled with chemically inactive nitrogen or argon gas to prolong the life of the filament.

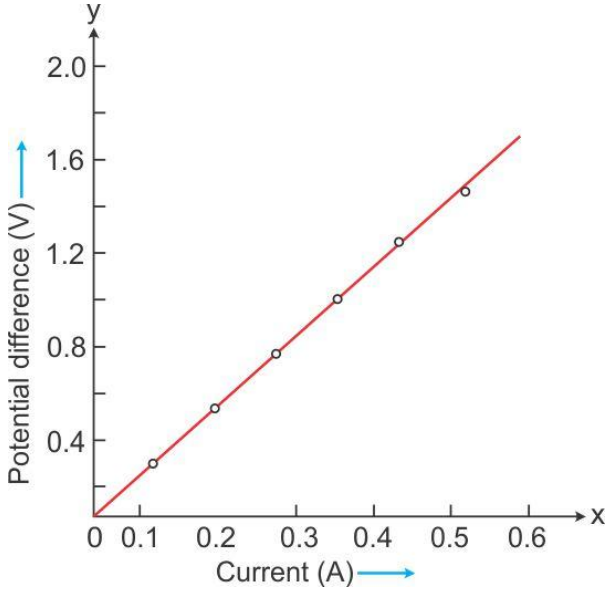
3. Ohm's law states that 'the potential difference V across the ends of a given metallic wire in an electric circuit is directly proportional to the current flowing through it, provided its temperature remains the same'.

$$V \propto I$$

$$\frac{V}{I} = \text{constant} = R$$

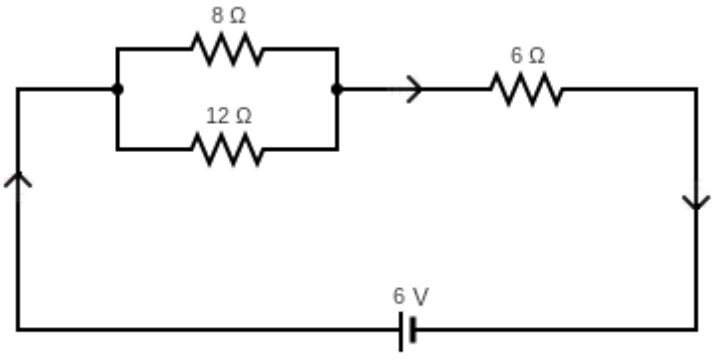
$$V = IR$$

If we plot the V-I graph for a conductor, then it shows a linear nature.



4. Resistivity is defined as the resistance of a material of unit cross-section area and unit length. Resistivity is a characteristic property of a substance.
Resistivity of a material depends on the nature of substance and temperature.
Note: Resistivity does not depend on length and/or thickness of the conductor.

5. $R_1 = 10\ \Omega$, $R_2 = 20\ \Omega$, $R_3 = 30\ \Omega$
$V = 6$ V



Total resistance of the circuit:

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{8} + \frac{1}{12}$$

$R_p = 4.8\ \Omega$

Total effective resistance $R = R_p + R_3 = 4.8 + 6 = 10.8\ \Omega$

Total current in the circuit:

$V = IR$

$$I = \frac{6}{10.8} = 0.55\ A$$

Total potential difference across a 6-Ω resistor:

Current through $R_3 = 0.55\ A$

$R_3 = 6\ \Omega$

Thus,

Potential difference, $V = 0.55 \times 6 = 3.3\ V$

6. $I = 2.4\ A$

$V = 240\ V$

(a) $R = V/I = 240/2.4 = 100\ \Omega$

(b) $P = V \times I = 2.4 \times 240 = 576\ W$

7.

(i)

- Most of the electric power consumed by the filament of the bulb appears as heat due to which the electric bulb becomes hot.
- A small amount of electric power is converted to light.
- Thus, filament-type bulbs are not power efficient.

(ii)

- Resistivity of an alloy is much higher than that of a pure metal like copper.
- An alloy does not undergo oxidation easily even at high temperature, thus avoiding the damage of the electric appliance.

(iii)

- If there is atmospheric air in an electric bulb, the extremely hot tungsten filament will catch fire due to the oxygen.
- Gases like argon and nitrogen are chemically unreactive and do not cause the tungsten filament to catch fire, hence prolonging the life of the electric bulb.

(iv)

- Metals like copper and aluminium have low resistivity. Thus, they are good conductors of electricity.
- They are cheaply available conductors.

(v)

- We can have separate switches for each appliance.
- Each appliance can be operated separately. Thus, the working of one appliance does not affect the working of other appliances.
- The potential difference across each appliance is the same, i.e. 220 V, as the power supply line.
- Thus, each appliance can draw the required amount of current.

8.

i) All materials offer resistance to the flow of current through them. So, some external energy is required to make the current flow. This energy is provided by the battery. Some of this energy gets dissipated as heat energy, so the resistor becomes hot.
Work done in carrying a charge Q through a potential difference V is given as
$Q = It$
Using Ohm's law,
$V = I R$
$W = I^2 Rt$
This work done in carrying the charge through the wire is heat energy produced.
Thus, $H = V I t = I^2 Rt$

(i) This relation is known as Joule's law of heating.
H - Heat energy produced. Its SI unit is Joule (J).
I - Current flowing in the wire. The SI unit is Ampere (A).
R – Resistance. Its SI unit is Ohm (Ω).
t – Time for which the current flows in the wire. Its SI unit is seconds (s).

(ii) How much heat will an instrument of 14 W produce in half an hour if it is connected to a battery of 70 V?

P = 14 W

t = 0.5 h = 30 min × 60 = 1800 s

V = 70 V

We know

$H = I^2 R t = V I t$

We know

P = V × I

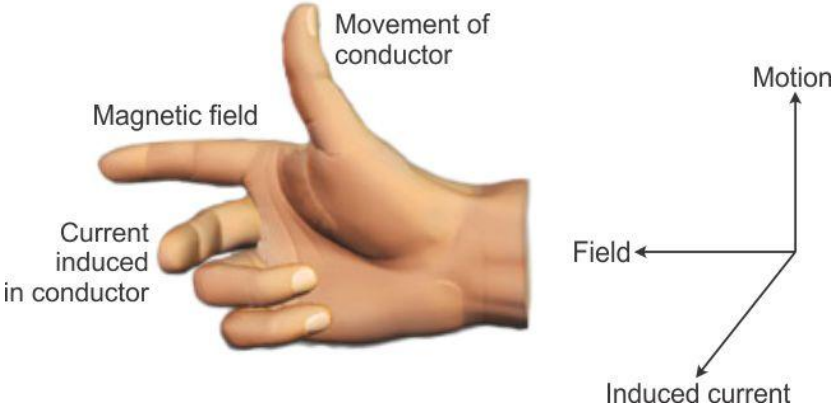
I = 14/70 = 0.2 A

H = 0.2 × 1800 = 360 Joule

Chapter 13: Magnetic Effect of Electric Current

1. If the electric current flowing through a wire is increased, the strength of the magnetic field produced at a point near the straight wire also increases.
2. Oersted's experiment shows that a current-carrying wire produces a magnetic field around it. When the direction of current flowing in the wire is reversed, the direction of the magnetic field is also reversed.
3.
   (i) A current-carrying conductor when placed in a magnetic field experiences a force.
   (ii) When the direction of this current is reversed, the direction of the force also gets reversed.
   (iii) Similarly, when the direction of the magnetic field is reversed, the direction of the force is also reversed.
   (iv) The maximum force on a conductor acts when the current and the field are at right angles to each other.
4. **Fleming's right-hand rule:**

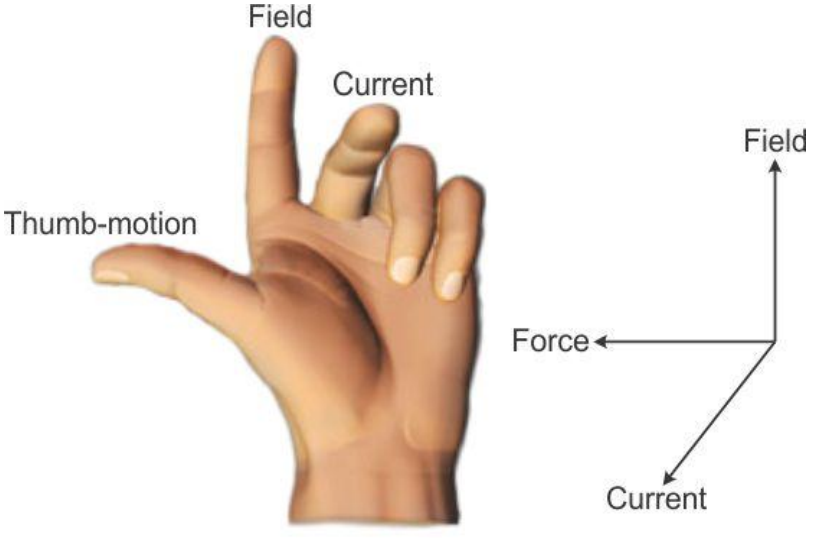
   Fleming's right-hand rule is used to find the direction of induced current.



Stretch the thumb, forefinger and middle finger of the right hand such that they are mutually perpendicular to each other. If the first finger points in the direction of the field and the thumb in the direction of motion of the conductor, then the middle finger gives the direction of induced current in the conductor.

Fleming's left-hand rule:

Fleming's left-hand rule gives the direction of the magnetic force acting on a conductor.



Stretch the thumb, forefinger and middle finger of the left hand such that they are mutually perpendicular to each other. If the first finger points in the direction of the field and the middle finger in the direction of the current, then the thumb gives the direction of the motion or the force on the conductor.

5. The space surrounding a magnet in which a magnetic force is exerted is called a magnetic field.

Characteristics of a magnetic field:

i) Magnetic field lines originate from the North Pole and end at the South Pole of the magnet.

ii) Magnetic field lines come close to one another near the poles of a magnet and are widely separated at other places.

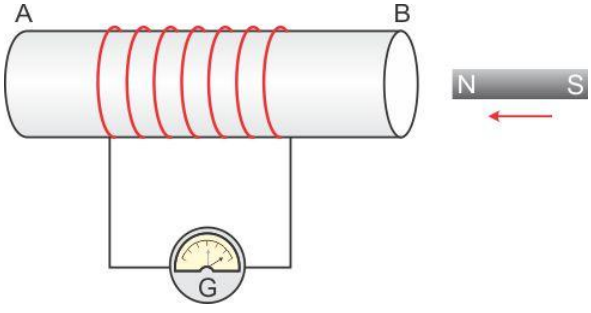
iii) Magnetic field lines do not intersect each other.

Magnetic field lines do not intersect each other at any point because the resultant force on the North Pole at any point can only be in one direction.

But if two magnetic field lines intersect, it will indicate that the resultant force on the North Pole at the point of intersection is in two directions. Such a case is not possible. Thus, two magnetic field lines never appear to intersect each other.

6.

The phenomenon in which an electric current is induced in a conductor because of a changing magnetic field is called electromagnetic induction.
When the North Pole of a bar magnet is brought near a coil, the needle of the galvanometer shows a deflection in one direction. When the magnet is moved away, the deflection is reversed.



When the coil is moved towards the magnet, a similar effect is observed.
Similarly, when the experiment is repeated with the South Pole facing the coil, the galvanometer shows deflection opposite to the case of the North Pole.
The magnetic field may also change due to the relative motion between the coils placed near a current-carrying conductor. In such a case, the magnetic field may change either due to the change in the current through the conductor or due to the relative motion between the coil and the conductor. The change in the magnetic field in the coil results in the current being induced in it.
This phenomenon in which the changing magnetic field in a conductor induces a current in another conductor is known as electromagnetic induction.

7.

i) When a bar magnet is pushed into the coil or withdrawn from the coil, there will be a deflection in the galvanometer.

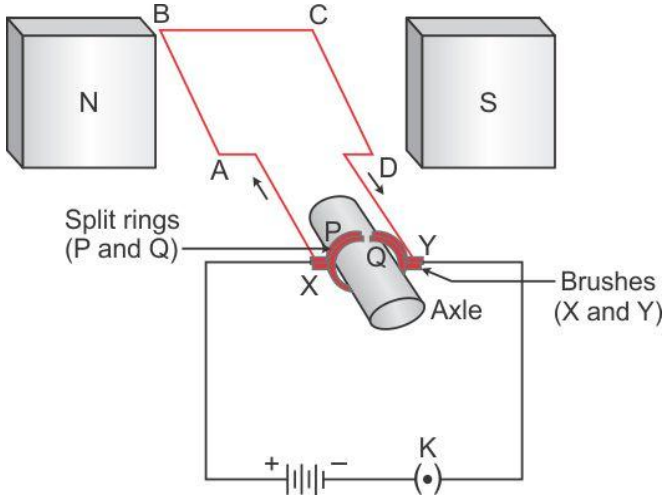
ii) This is because of the induced current in the coil which is generated due to the relative motion between the coil and the magnet.

iii) When held stationary near the coil, there is no relative motion and so no current is induced in the coil.

8.

(i) An electric motor is a device which converts electrical energy to mechanical energy, and it works on the principle of force experienced by a current-carrying conductor in a magnetic field.

(ii) An electric motor consists of a rectangular coil of insulated copper wire. The coil is placed between the two poles of a magnet.



(iii) The current in the coil enters from the source battery through the conducting brush X and flows back to the battery through brush Y. Current in the arms AB and CD is in opposite directions.

(iv) On applying Fleming's left-hand rule, we find that the force acting on the arm AB pushes it downwards, while the force acting on the arm CD pushes it upwards. Thus, the coil and the axle O rotate in the anti-clockwise direction.

(v) After half rotation, the current in the coil gets reversed with the help of a commutator. This reverses the direction of the force acting on the two arms AB and CD. However, these arms have reversed positions after that half rotation.

(vi) Thus, the coil and the axle rotate in the same direction, i.e. anti-clockwise.

9.

i)

Direct Current	Alternating Current
Current flows only in one direction.	Current reverses after equal intervals of time.
Current from a cell or battery is direct current.	Alternating current is produced at power stations.
The positive and negative terminals of direct current are fixed.	The current keeps on alternating; thus, its positive and negative terminals are not fixed.

ii) An advantage of AC over DC is that it can be transmitted over long distances without much loss of electrical energy.

iii) If the split rings of the AC generator are replaced by a commutator, it will work as a DC generator.

iv) Appliances like radio and television require DC supply.

Chapter 14: Sources of Energy

1. A thermal power plant majorly uses coal to produce heat to boil water so that its steam can be used for various purposes. For easy availability of coal, power plants are located near coal fields.
   If a thermal power plant is not near a coal field, then it reserves the coal in advance.

2.
   - Wind energy is an inexhaustible source of energy.
   - It has low cost of production of electricity once set up and is a safe and clean source of energy.

3. **Characteristics of an ideal fuel:**
   An ideal fuel should
   - Have a high calorific value so that a high amount of energy is available by burning a low quantity of fuel
   - Be easy to store and transport
   - Not produce any poisonous and polluting gases while burning
   - Not leave any harmful residue and tar after burning
   - Have low ignition temperature so that it is easy to initiate the burning process

   Characteristics of a good source of energy:
   A good source of energy
   - Does more amount of work per unit mass
   - Is cheap and easily available
   - Is easy to store and transport
   - Is safe to use
   - Does not cause environmental pollution

4.
   Hydroelectric power plant:
   A power plant which produces electricity by using flowing water to rotate a turbine is called a hydroelectric power plant.

Advantages of a hydroelectric power plant:

i) It does not produce any environmental pollution.

ii) Flowing water is a renewable source of energy which will not get exhausted.

iii) Constructing dams on rivers helps in controlling floods and irrigation.

Disadvantages of a hydroelectric power plant:

i) Vegetation which is submerged under water rots due to anaerobic conditions and produces a large amount of methane, a greenhouse gas.

ii) Large ecosystems get destroyed when land is submerged under the water of the reservoir of a dam.

iii) Flora, fauna and human settlements are affected as the land near the dam is submerged under water.

5. Three advantages of solar cells:

(i) The source of energy for solar cells is present in abundance.

(ii) They have no moving parts and hence require little maintenance and work quite satisfactorily without any focusing device.

(iii) They do not cause any environmental pollution like fossil fuels and nuclear power.

(iv) Solar cells last a longer time and have low running costs.

6.

The places where hot rocks occur at some depth below the Earth's surface are called hotspots.

Hotspots are sources of geothermal energy.

Merits:

i) It is economical to use geothermal energy.

ii) The cost of electricity produced using geothermal energy is reduced to half.

iii) Energy production by this method does not cause pollution.

iv) It is a clean and eco-friendly source of energy.

Demerits:

i) It is not available everywhere.

ii) It is available only at those places where hot rocks are present below the Earth's surface.

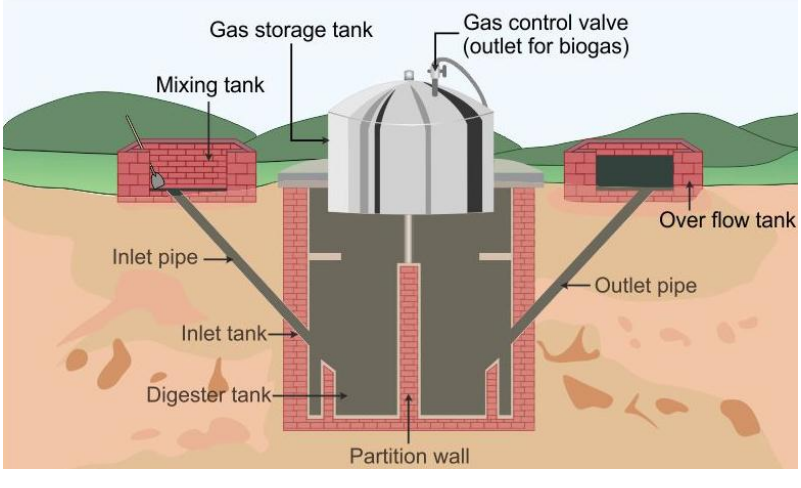
iii) Deep drilling into the Earth to obtain this energy is difficult as well as harmful.

7.

Nuclear fission	Nuclear fusion
In fission reactions, a heavy nucleus is split into two nuclei with smaller mass numbers.	In fusion reactions, two light nuclei are combined to form a heavier, more stable nucleus.
High-speed neutrons are required in nuclear fission reactions.	Very high temperature is required for nuclear fusion reactions.
The amount of energy required to split two atoms in a fission reaction is less as compared to a fusion reaction.	A tremendous amount of energy is required to bring two or more protons close enough to overcome their electrostatic force of repulsion.
Tremendous amount of energy is released by fission reactions, but the energy released is lower than nuclear fusion reactions.	Energy released by fusion reactions is three to four times greater than the energy released by fission reactions.
Energy produced by nuclear fission reactions is used in nuclear power plants for the generation of electricity.	Energy produced by a fusion reaction is not controlled and cannot be used for the generation of electricity. Nuclear fusion occurs in the Sun through which solar energy is created.

8.

Construction a biogas (gobar gas) plant:



The biogas plant is a dome-like structure made of bricks and cement. It consists of the following five compartments:

(i) **Mixing tank:** Present above the ground level.

(ii) **Inlet chamber/tank:** The mixing tank opens underground into a sloping inlet chamber.

(iii) **Digester:** The inlet chamber opens from below into the digester. The digester is a huge tank with a dome-like ceiling. The ceiling of the digester has an outlet with a valve for the supply of biogas.

(iv) **Outlet chamber/tank:** The digester opens from below into an outlet chamber.

(v) **Overflow tank:** The outlet chamber opens from the top into a small overflow tank.

Working:

Cow dung and water are mixed in equal proportions in the mixing tank to prepare the slurry. This slurry is fed into the digester tank through the inlet chamber to fill the tank up to the cylindrical level. Cow dung undergoes anaerobic degradation with the evolution of biogas which collects in the dome. The pressure of biogas on the slurry forces the spent slurry to go into the overflow tank through the outlet chamber from where it is removed.

Chapter 15: Our Environment

1.

- Biodegradable and non-biodegradable wastes should be discarded in two different dustbins so that they can be collected and disposed of separately.
- Biodegradable waste can be decomposed in a natural manner by the process of composting.
- Non-biodegradable wastes can be sent for recycling.
- If the two wastes are collected in a single bin, they would mix and may form toxic compounds which can cause pollution.

2. According to the 10% law of energy transfer,
Energy available from Sun = 20000 J
Energy converted by plants = 1% of 20000
Energy available with plants = 200 J
Energy transferred to deer = 10% of 200
Energy available with deer = 20 J

3. Activities which can be done as an environmentalist to conserve natural resources: (Any two)
   - Use public transport for commuting instead of a personal vehicle to save fuel.
   - Avoid using clothes, accessories or articles made of animal skin to prevent the hunting of animals.
   - Using energy-efficient electrical appliances to save electricity.
   - Ensuring no leakage of water taps and pipes at home to save water resources.

4. Combustion of fossil fuels is responsible for several environmental issues such as accumulation of greenhouse gases, acidification, air pollution, water pollution, damage to land surface and ground-level ozone.

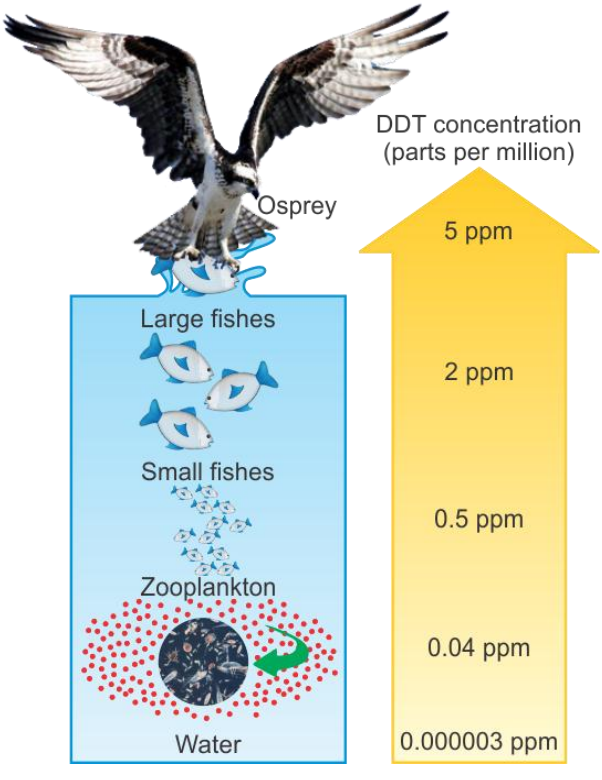
   Steps to minimise environmental pollution caused by burning of fossil fuels:
   - Increase the use of solar, wind and hydro power
   - Use smokeless appliances
   - Promote afforestation

5. Formation of the ozone layer:
   - The ozone layer is naturally found in the upper part of the atmosphere called the stratosphere.
   - It is created when ultraviolet radiation (sunlight) strikes the stratosphere, dissociating or splitting oxygen molecules (O_2) to atomic oxygen (O).
   - Atomic oxygen quickly combines with further oxygen molecules to form ozone.

   Damage to the ozone layer:
   - The ozone layer functions as a shield against strong UV radiations and protects the Earth from these harmful radiations.
   - If the ozone layer is damaged, then the harmful UV rays would penetrate the Earth's surface and can cause skin cancer and damage vegetation, animal life and human beings.

   Causes of ozone layer depletion:
   - Damage to the ozone layer is caused by gases such as methyl bromide, nitrogen oxides released from freezers, air conditioners, aerosol products and industrial solvents.
   - Compounds such as CFCs break down into chlorine atoms in the atmosphere. These chlorine atoms break down O_3 into oxygen (O_2) and nascent oxygen (O) which degrade the ozone layer.

6. The intensity of accumulation of toxic substances such as DDT increases as we move from a lower trophic level to a higher trophic level in a food chain. This phenomenon is called biomagnification.
   - Let's take the example of DDT which has been applied on farm lands to eradicate pests.
   - DDT gets washed off from the farm land and reaches the water body.
   - In water, small phytoplankton (producers) would accumulate certain amounts of DDT which would be passed on to the next trophic level, the zooplankton (primary consumers), and then to fish (secondary consumers) which feed on these zooplankton and finally to tertiary consumers.
   - Concentration of DDT would increase with each trophic level, with producers having the minimum concentration, while the tertiary consumers having the highest concentration of DDT accumulation.
   - This is because tertiary consumers have consumed many secondary consumers which in turn had consumed many primary consumers. In this way, tertiary consumers accumulate the maximum concentration of toxic chemicals.



7. The sequence of living organisms in a community in which one organism consumes another organism to transfer food energy is called a food chain.

- Energy enters plants from the Sun during the process of photosynthesis.
- This energy is then passed on from one organism to another in a food chain.
- Solar energy converted by autotrophs to food energy cannot be reconverted to solar energy, and the energy which passes from the herbivores to the carnivores can never go back to herbivores.
- The energy lost as heat cannot be returned to plants and reused during photosynthesis.
- Therefore, the flow of energy in an ecosystem is said to be unidirectional.

8.

(a) National parks should be allowed to remain in their pristine form so that the natural habitat of wild animals and birds is preserved.

(b) Recycling is the process which involves conversion of used materials to new materials which are ready for use again. It helps in the conservation of raw materials. However, the process involves a lot of expenditure and energy consumption. Recycling units release a lot of toxic chemicals as waste materials and pollute the environment.
Reuse involves using the same materials again and again for different purposes. This does not utilise any money or energy and does not release toxic wastes. Hence, the reuse of materials is better than recycling.

9. Some harmful effects of agricultural practices on the environment:

- Soil degradation: Extensive cropping causes loss of soil fertility. Also, over time, it can lead to soil erosion and finally to desertification.
- Pollution: Use of synthetic fertilisers and pesticides leads to soil, water and air pollution.
- Water shortage: Excess use of groundwater for agriculture lowers the water level. This results in acute water shortage at many places.
- Biomagnification: Chemical pesticides, being non-biodegradable, accumulate in organisms in increasing amounts at each trophic level.
- Deforestation: Indiscriminate cutting down of trees for agriculture has resulted in the loss of habitat for wildlife. Thus, it also causes damage to the natural ecosystem.

Chapter 16: Management of Natural Resources

1. The Chipko Andolan (also called the 'Hug the Trees Movement') was organised to stop the destruction of forests. The movement began in 1970s in the remote village of Reni in Garhwal in the Himalayas.

2. Traditional systems of water harvesting:
   - Khadins
   - Kulhs

3.
   - It takes millions of years for the formation of coal and petroleum.
   - The present rate of consumption of these fossil fuels far exceeds the rate at which they are formed.
   - If exhausted, these resources will not be available for use in the near future, and hence, they should be used judiciously.

4. Need to conserve forests:
   - Forests are renewable natural resources which are essential for the ecological balance of ecosystems.
   - They maintain biological diversity, preserve foods and safeguard the future of tribals.
   - They also provide valuable products for human welfare and raw materials for industries.

   Causes of deforestation:
   - Indiscriminate felling of trees for the purpose of timber and fuel and the industrial demand for wood.
   - Over-grazing by a large livestock population.

5.
   - The exploitation of natural resources with a short-term aim is advantageous for the present generation to meet their daily requirements and growth and development.
   - It will help in the growth of the economy at a faster rate.
   - By this, we may be able to enjoy the comforts of life, but we would damage our

environment gradually.

- Improvement of the lifestyle of people increases the pollution levels, global warming, depletion of resources etc.
- So, it is better to use resources with a long-term perspective. This will prevent the depletion of resources, not harm our environment and ensure the availability of resources for our future generation.

6. Sustainable management of natural resources means to conserve resources, use them efficiently and avoid their misuse for individual purposes.

Advantages of insisting on sustainable resources:

- It protects the existing ecosystem.
- It helps in maintaining biodiversity.
- It helps in the proper utilisation of resources and less generation of wastes.
- It controls depletion and over usage of resources.

7. Dams are man-made structures constructed across rivers to control, collect and regulate the flow of water.

Importance and uses of building dams:

- Regulate the flow of water, which can then be supplied to people in towns and cities for domestic purposes.
- Useful in flood control and collection of water for large irrigation projects.
- Used to harness hydroelectric power.
- Act as reservoirs of water which can be used for supplying water during the lean season.
- Ensure the storage of water for irrigation and for generating electricity.
- Used to carry water over long distances through canal systems.

Main problems to be addressed to maintain peace among local people while building dams:

- Social problems because of displacement of a large number of tribals and peasants who are then rendered homeless.
- No sufficient compensation, rehabilitation or benefits granted from these projects.
- Several environmental problems such as deforestation and loss of biodiversity leading to ecological imbalance.

- Economic problems due to spending of large amounts of public money without generating proportionate funds.
- Submergence of low-lying adjoining areas of ecological, cultural and social importance for the local population.
- Consideration of local interest and welfare of people.

8. Environmental consequences of the increasing demand for energy:

- Fossil fuels are non-renewable sources of energy and can get exhausted faster if increasingly used.
- Burning of fossil fuels produces smoke which causes severe environmental pollution.
- Gases produced on combustion of fossil fuels lead to the greenhouse effect, which is responsible for global warming.

Steps to reduce energy consumption:

- Use of electricity and electrical appliances must be reduced
- Prefer to use public transport or bicycles for commuting
- Prevent unnecessary wastage of water
- Use solar heaters in place of electrical heaters wherever possible

9.

(a) Ways by which awareness on how to save water can be created in the neighbourhood:

- By bringing to notice the current situation of drought in rural areas and its dreadful effects on humans and animals.
- Making people realise the importance of water in life and the shortage of water and its consequences in the near future.

(b) Khadin is one way of recharging groundwater.

- A khadin consists of a 100–300-m long embankment called a bund made of earth. The bund is built across the lower edge of the sloping farmland.
- Rainwater from the catchment area flows down the slope and collects in front of the bund forming a reservoir.
- Pathways through the bund allow excess water to flow through and collect in shallow wells dug behind the bund.
- Water which collects in the reservoir and wells seeps into the land and recharges the groundwater.

10. Biodiversity refers to the number of different life forms found in an area. In a forest, various species exist including bacteria, fungi, plants, birds, reptiles and mammals. As a result, forests are considered biodiversity hotspots.

Steps to contribute to the management of forests and wildlife:

- Avoid cutting down of forests and killing of wildlife
- Educate people about the importance of forests and wildlife