Unit -I : Chemical Substances : Nature and Behaviour

Chapter - 1 : Chemical Reactions

TOPIC-1

Chemical Reactions and Equations

Revision Notes

- A chemical reaction is a process in which the original substance(s) lose their nature and identity and form new substance(s) with different properties.
- Breaking of the chemical bonds and formation of the new chemical bonds is responsible for the occurrence of a chemical reaction.
- The substances which take part in chemical reaction are called **Reactants.**
- The substances which are formed in a chemical reaction are called **Products.**
- **Examples :** Where chemical reactions takes place :
  - **(i)** Digestion of food
  - **(ii)** Respiration
  - **(iii)** Rusting of iron
  - **(iv)** Burning of Magnesium ribbon
  - **(v)** Formation of curd
- A chemical reaction can be identified by either of the following observations :
  - **(i)** Change in state
  - **(ii)** Change in colour
  - **(iii)** Evolution of gas
  - **(iv)** Change in temperature
  - **(v)** Formation of a precipitate
- A chemical equation is written in the following way :
  - **(i)** The symbols of elements and the formulae of reacting substances are written on the left hand side of the equation, with a plus (+) sign between them.
  - **(ii)** The symbols and formulae of the substances formed are written on the right hand side of the equation, with a plus sign (+) between them.
  - **(iii)** An arrow sign (→) is put between the reactants and the products.
  - **(iv)** The physical states of the reactants and products are also mentioned in a chemical equation.
- **Balanced Equation :** The equation in which atoms of various elements on both sides of a chemical equation are equal in accordance with the law of conservation of mass.
- The process of equalizing the atoms of various elements both on either sides of an equation is called the balancing of chemical equation. This is known as hit and trial method. We can balance a chemical equation by following the steps given below :

Step 1. Write the chemical equation and draw boxes around each formula :

$$Fe + H_2O \rightarrow Fe_3O_4 + H_2$$

Step 2. Count the number of atoms of each element on both the sides of the arrow

Element	No. of atoms at reactant side	No. of atoms at product side
1. Fe	1	3
2. H	2	2
3. O	1	4

Step 3. Equalize the number of the atoms of element which has the maximum number of atoms.

$$Fe + 4H_2O \rightarrow Fe_3O_4 + H_2$$

Step 4. Try to equalize all the atoms of elements on reactant and product side by adding coefficient in front of it.

$$3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$$

Now, all the atoms of elements are equal on both sides.

Step 5. Write the physical states of reactants and products.

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

Solid state = (*s*) Liquid state = (*l*) Gaseous state = (*g*) Aqueous state = (*aq*)

Step 6. Write necessary conditions of temperature, pressure or catalyst at above or below the arrow.

E.g.

(i) $CO(g) + 2H_2\,(g) \xrightarrow{340\text{ atm}} CH_3OH(l)$

(ii) $6CO_2(g) + 6H_2O(l) \xrightarrow[\text{chlorophyll}]{\text{sunlight}} C_6H_{12}O_6(aq) + 6O_2\,(g)$

Glucose

TOPIC-2

Types of Chemical Reactions–Corrosion and Rancidity

Revision Notes

➢ **Types of Chemical Reactions**

I. COMBINATION REACTION : The reaction in which two or more reactant combine to form a single product.

e.g., (i) Burning of coal

$C(s) + O_2(g) \rightarrow CO_2(g)$

(ii) Formation of water

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

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

(Quick lime) (Slaked lime)

Exothermic Reactions : Reaction in which heat is released along with formation of products.

e.g., (i) Burning of natural gas.

$CH_4(g) + O_2(g) \rightarrow CO_2(g) + 2H_2O(g) + \text{Heat}$

(ii) Respiration is also an exothermic reaction.

$C_6H_{12}O_6(aq) + 6O_2(g) \rightarrow 6CO_2(aq) + 6H_2O(l) + \text{energy}$

(Glucose)

II. DECOMPOSITION REACTION : The reaction in which a compound splits into two or more simpler substances is called decomposition reaction.

$$A \rightarrow B + C$$

(a) Thermal decomposition : When decomposition is carried out by heating.

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

(Ferrous sulphate) (Ferric oxide)

Green colour Red-brown colour

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

(Lime stone) (Quick lime)

(b) Electrolytic Decomposition : When decomposition is carried out by passing electricity.

e.g., $2H_2O(l) \xrightarrow[\text{current}]{\text{Electric}} 2H_2(g) + O_2(g)$

(c) Photolytic Decomposition : When decomposition is carried out in presence of sunlight.

e.g., (i) $2AgCl(s) \xrightarrow{Sunlight} 2Ag(s) + Cl_2(g)$

(ii) $2AgBr(s) \xrightarrow{Sunlight} 2Ag(s) + Br_2(g)$

This reaction is used in black and white photography.

(d) Endothermic Reaction : The reactions which require energy in the form of heat, light or electricity to break reactants are called endothermic reactions.

III. DISPLACEMENT REACTION : The chemical reactions in which more reactive element displaces less reactive element from its salt solution.

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

(Iron) (Copper Sulphate) (Ferrous sulphate) (Copper)

The iron nail becomes brownish in colour by deposition of Cu and blue colour of $CuSO_4$ changes dirty green colour due to formation of $FeSO_4$.

Zinc displaces copper forming zinc sulphate.

$$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$$

(Zinc Sulphate)

Zn is more reactive than copper.

IV. DOUBLE DISPLACEMENT REACTION : A reaction in which new compounds are formed by mutual exchange of ions between two compounds.

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

(Sodium sulphate) (Barium chloride) (Barium sulphate) (Sodium chloride)

White precipitate of $BaSO_4$ is formed, so it is also called precipitation reaction.

V. OXIDATION AND REDUCTION :

Oxidation : It is a process of gaining oxygen during a reaction.

$$2Cu + O_2 \xrightarrow{Heat} 2CuO$$

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

Reduction : Reduction is just reverse of oxidation. It is a process of losing oxygen during a reaction.

$$CuO + H_2 \longrightarrow Cu + H_2O$$

In this reaction, CuO is reduced to Cu and H_2 is oxidised to H_2O. In other words, one reactant gets oxidised while the other gets reduced. Such reactions are called oxidation-reduction reactions or redox reactions.

- **Corrosion :** The surface of the reactive metals are attacked by air, water and other substances around it, and corrodes. This process is called corrosion. It is a redox reaction where metal gets oxidised to metal oxide and oxygen gets reduced to oxide ion.
- Rust is mainly hydrated iron (III) oxide, $Fe_2O_3.xH_2O$. Rusting weakens the structure of the body of vehicles, bridges, iron railing etc.
- **Prevention of Rusting :**
  - **(i)** The iron articles should be painted.
  - **(ii)** The machine parts should be oiled and greased.
  - **(iii)** Galvanised iron pipes are used for water supply.
  - **(iv)** Iron can be coated with chromium to prevent rusting.
- **Rancidity :** Rancidity is the process of slow oxidation of oil and fat, present in the food materials resulting in the production of foul odour and taste in them.
- When cooked food items are placed for a long time, they become rancid and unsuitable for the consumption.
- **Methods to prevent Rancidity :**
  - **(i)** Packing of food materials in air tight containers.
  - **(ii)** Refrigeration of cooked food at low temperature.

Know the Terms

- **Chemical equation :** It is a complete symbolic representation of a chemical reaction involving reactants and products.
- **Balanced equation :** It is the equation in which atoms of various elements on the reactants and the products side are equal. The number of atoms of elements on both the sides of a chemical equation should be equal in accordance with the law of conservation of mass.
- **Combination reaction :** In a **combination reaction**, two or more reactants combine to give a single product.

- **Decomposition reaction :** In a **decomposition reaction**, a single reactant breaks down into two or more simpler products.
- **Thermal decomposition reaction :** When a decomposition reaction is carried out by heating, it is called as **thermal decomposition reaction**.
- **Photochemical decomposition :** When a decomposition reaction is carried out in the presence of sunlight, the process is called as **photochemical decomposition**.
- **Electrolysis :** When a decomposition reaction is carried out with the help of electric current, the process is called electrolysis.
- **Displacement reaction :** In a **displacement reaction**, a more reactive element displaces a less reactive element from a compound.
- **Double displacement reaction :** The reactions in which the different atoms or group of atoms are displaced by other atoms or group of atoms, *i.e.* the two compounds exchange their ions and one of the products formed is insoluble, such reactions are said to be **double displacement reactions**.
- **Neutralisation reactions :** The reactions in which acid or acidic oxide reacts with base or basic oxide to form salt and water are called as **neutralization reactions.**
- **Oxidation : Oxidation** is a process in which oxygen or an electronegative element is added. It can also be defined as a process in which hydrogen or an electropositive element is removed. In terms of electronic concept, oxidation is a process in which loss of electrons takes place.
- **Reduction :** Reduction is a process in which addition of hydrogen or an electropositive element takes place. It can also be defined as a process in which oxygen or an electronegative element is removed. In electronic concept, reduction process involves the gain of electrons.
- **Redox reaction :** Those reactions in which oxidation and reduction takes place simultaneously are called **redox reactions**.
- **Oxidising agent :** It is a substance which can add oxygen or an electronegative element to other materials. It can also remove hydrogen or an electropositive element from other materials.
- **Reducing agent** : It is a substance which can add hydrogen or an electropositive element to other materials. It can also remove oxygen or an electronegative element from other materials.

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Chapter - 2 : Acids, Bases and Salts

TOPIC-1
Acids and Bases

Revision Notes

- Acids are sour in taste. They turn blue litmus red. Acids are the substances that furnish H^+ ions in aqueous solution.
- If in an aqueous solution, concentration of acid is low, it is called **dilute solution** and if concentration of acid is high, it is called **concentrated solution**.
- Hydrochloric acid is released in stomach to make medium acidic in nature. It leads to coagulation of protein and helps in their digestion. HCl kills bacteria coming in the stomach along with the food.
- When a burning matchstick is brought near the hydrogen gas, it burns with a pop sound.
- When CO_2 gas is passed through lime water, it turns milky. If CO_2 is passed in excess, milkiness disappears.
- There are many natural substances like red onion peels, red cabbage leaves, beetroot extract, coloured petals of some flowers, which are called indicators because they indicate the presence of acid or base by showing the change in colour.
- Acids react with certain metal oxides to form salt and water. Acids react with metal carbonates and hydrogen carbonates to produce carbon dioxide gas.
- Strong bases react with active metals to produce hydrogen gas. Bases react with non-metallic oxides to produce salt and water.
- Both acids and bases conduct free electric current in their aqueous solution due to the presence of free ions.
- Strength of an acid or base depends on the number of H^+ ions or OH^- ions produced by them respectively. More the H^+ ions produced by an acid, stronger is the acid. More the OH^- ions produced by a base, stronger is the base.
- **Indicators :** These are the substances which change their colour / smell in different types of substances.

- **Types of Indicators :**

	S.No.	Indicator	Smell/Colour in acidic solution	Smell/Colour in basic solution
Natural Indicator	1.	Litmus	Red	Blue
	2.	Red cabbage leaf extract	Red	Green
	3.	Flowers of hydrangea plant	Blue	Pink
	4.	Turmeric	No change	Red
Synthetic Indicator	1.	Phenolphthalein	Colourless	Pink
	2.	Methyl orange	Red	Yellow
Olfactory Indicator	1.	Onion	Characteristic smell	No smell
	2.	Vanilla essence	Retains smell	No smell
	3.	Clove oil	Retains smell	Loses smell

- **Chemical Properties of Acids and Bases :**

1. Reaction of Metals with :

Acids	**Bases**
Acid + Metal → Salt + Hydrogen gas	Base + Metal → Salt + Hydrogen gas
e.g., $2HCl + Zn \rightarrow ZnCl_2 + H_2$	*e.g.*, $2NaOH + Zn \rightarrow Na_2ZnO_2 + H_2 \uparrow$ (Sodium zincate)

Hydrogen gas released can be tested by bringing a burning candle near gas bubbles, it burst with pop sound.

2. Reaction of Metal Carbonates / Metal Hydrogen Carbonates with :

Acids	**Bases**
Acid + Metal Carbonate / Metal hydrogen Carbonate	Base + Metal Carbonate / Metal Hydrogen Carbonate
↓	↓
Salt + CO_2 + H_2O	No Reaction

e.g., $2HCl + Na_2CO_3 \rightarrow 2NaCl + CO_2 + H_2O$

$HCl + NaHCO_3 \rightarrow NaCl + CO_2 + H_2O$

CO_2 can be tested by passing it through lime water. Lime water turns milky.

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

When excess CO_2 is passed, milkiness disappears.

$CaCO_3 + CO_2 + H_2O \rightarrow Ca(HCO_3)_2$

3. Reaction of Acids and Bases With Each Other

Neutralization Reaction : Reaction of acid with base is called as neutralization reaction.

e.g., $HCl + NaOH \rightarrow NaCl + H_2O$

- **If :**

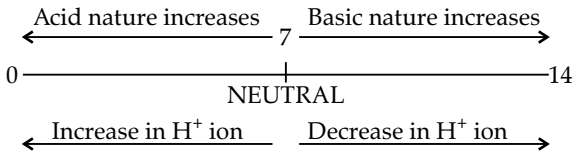
Strong Acid + Weak Base → Acidic salt + H_2O

Weak Acid + Strong Base → Basic salt + H_2O

Strong Acid + Strong Base → Neutral salt + H_2O

Weak Acid + Weak Base → Neutral salt + H_2O

- pH of stomach is 1.5-3.0 due to secretion of HCl. In case of indigestion, acidity increases, which can be neutralised by antacids like milk of magnesia.
- Cold drinks, chocolates and sweets are most harmful for health as well as tooth. They produce acids in mouth which are responsible for tooth decay.
- Salts of a strong acid and a strong base are neutral with pH value of 7.
- Salts have various uses in everyday life and in industries.
- A salt is soluble if it dissolves in water to give a solution with a concentration of at least 0.1 moles per litre at room temperature.
- **pH Scale :** A scale for measuring H^+ ion concentration in a solution. p in pH stands for 'potenz' a German word which means power.
  - pH = 7 → neutral solution
  - pH < 7 → acidic solution
  - pH > 7 → basic solution
  - On diluting an acid : pH increases ↑
  - On diluting a base : pH decreases ↓



➢ **Importance of pH in everyday life :**

1. Plants and animals are pH sensitive.
- Our body works within the pH range of 7 – 7.8.
- When pH of rain water is less than 5.6, it is called acid rain.

2. pH of the soil
- Plants require a specific pH range for their healthy growth.

TOPIC-2

Salts, Their Properties and Uses

Revision Notes

➢ **Salts :** Salts are formed when an acid and base reacts with each other.

➢ **Types of Salts :**

1. Common Salt (NaCl) :

Preparation : $NaOH + HCl \rightarrow NaCl + H_2O$

2. Bleaching Powder ($CaOCl_2$) :

Preparation : It is produced by the action of chlorine on dry slaked lime.

$$Cl_2 + Ca(OH)_2 \rightarrow CaOCl_2 + H_2O$$

Uses :

(a) Bleaching cotton and linen in textile industry.

(b) Bleaching wood pulp in paper factories.

(c) Oxidizing agent in chemical industries.

(d) Disinfecting drinking water.

3. Baking Soda (Sodium Hydrogen Carbonate) ($NaHCO_3$) :

Preparation : $NaCl + H_2O + CO_2 + NH_3 \rightarrow NH_4Cl + \underset{\text{Baking soda}}{NaHCO_3}$

It is mild non-corrosive base.

When it is heated during cooking :

$$2NaHCO_3 \xrightarrow{\Delta} Na_2CO_3 + H_2O + CO_2$$

Uses :

(a) For making baking powder (mixture of baking soda and tartaric acid). When baking powder is heated or mixed with water, CO_2 is produced which causes bread and cake to rise making them soft and spongy.

(b) An ingredient in antacid.

(c) Used in soda acids, fire extinguishers.

4. Washing Soda ($Na_2CO_3.10H_2O$) :

Preparation : Recrystallization of sodium carbonate gives washing soda. It is a basic salt.

$$Na_2CO_3 + 10H_2O \rightarrow Na_2CO_3.10H_2O$$

Uses :

(a) In glass, soap and paper industry.

(b) Manufacture of borax.

5. Plaster of Paris (Calcium sulphate hemihydrates) ($CaSO_4.\frac{1}{2}H_2O$) :

Preparation : On heating gypsum $CaSO_4.2H_2O$ at 373K, it loses water molecules and becomes Plaster of Paris (POP). It is white powder and on mixing with water it changes to gypsum.

$$CaSO_4.\tfrac{1}{2}H_2O + 1\tfrac{1}{2}H_2O \rightarrow CaSO_4.2H_2O$$

Uses :

(a) Doctors use POP for supporting fractured bones.

(b) For making toys and material for decoration.

Know the Terms

- **Acid :** Substances which turn blue litmus solution red are called acidic.
- **Indicators :** Substances which change their colour (or odour) in acidic or basic solutions are called **indicators**.
- **Mineral acids :** The acids which are obtained from minerals are called **mineral acids**.
- **Organic acids :** Acids which are obtained from plants and animals are called organic acids.
- **Concentrated acids :** Acids which contain minimum amount of water are called concentrated acids.
- **Strong acids :** The acids which ionise almost completely are called **strong acids**, *e.g.*, mineral acids.
- **Weak acids :** The acids which ionise only partially or to a lesser extent are called **weak acids**, *e.g.*, organic acids.
- **Bases :** Substances that furnish hydroxide ions (OH^-) in aqueous solution are called **bases**. Bases have bitter taste and produce blue colour in litmus solution.
- **Strong bases :** The substances / bases which ionise completely to furnish OH^- ions are called **strong bases**, *e.g.*, KOH, NaOH etc.
- **Weak bases :** The bases which ionize partially are called **weak bases**, *e.g.*, $Mg(OH)_2$, $Cu(OH)_2$ etc.
- **Alkalies :** Water soluble bases are called **alkalies**, *e.g.*, NaOH, KOH. Thus, all alkalies are bases but all bases are not alkali.
- **Universal indicator :** A universal indicator is a mixture of many different indicators which shows a gradual but well marked series of colour changes over a very wide range of change in concentration of H^+ ions.
- **pH :** pH is the scale for measuring hydrogen ion concentration. The concentrations of H^+ are generally small, therefore concentrations of H^+ are expressed in terms of pH. pH is defined as negative logarithm of H^+ concentration or H_3O^+ concentration.

  $$pH = -\log [H^+] \text{ or } pH = -\log [H_3O^+]$$
- **Neutralisation reaction :** The reaction in which base or basic oxide reacts with acid or acidic oxide is called **neutralization reaction**.

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Chapter - 3 : Metals and Non-Metals

TOPIC-1

Properties of Metals and Non-Metals

Revision Notes

- Metals are mostly solids, possessing high density. They have high melting and boiling points. They have lustre and are sonorous. They are good conductors of heat and electricity.
- Most of the metals are hard. However, some of the metals like sodium, potassium are soft metals and can be easily cut with knife.
- All metals are solids except Mercury, Cesium, Francium, Germanium and Gallium which are solids with low melting point. Gallium becomes liquid if kept on palm but Gallium has very high boiling point which makes it useful for high temperature thermometers.
- **Physical Properties :**

Property	Metals	Non-Metals
1. Lustre	Metals have shining surface.	They do not have shining surface. • Except Iodine.
2. Hardness	They are generally hard. • Except Sodium, Lithium and Potassium which are soft and can be easily cut with knife.	Generally soft. • Except Diamond, a form of carbon which is the hardest natural substance.
3. State	Exist as solids. • Except Mercury.	Exist as solids or gases • Except Bromine.

4. Malleability	Metals can be beaten into thin sheets. ● Gold, Silver and Aluminium are the most malleable metals.	Non-metals are non-malleable.
5. Ductility	Metals can be drawn into thin wires.	They are non-ductile.
6. Conductor of heat & electricity	Metals are good conductor of heat and electricity.	Non-metals are poor conductor of heat and electricity. ● Except Graphite.
7. Density and Melting point	Generally have high density and high melting point. ● Except Sodium and Potassium	Have low density and low melting point.
8. Sonorous	Metals produce a sound on striking a hard surface.	They are not sonorous.
9. Oxides	Metallic oxides are basic in nature.	Non-metallic oxides are acidic in nature.

➢ **Chemical Properties :**

(A) Reaction with Air :

- Metals combine with oxygen to form metal oxide.

  Metals + $O_2 \rightarrow$ Metal oxide

  Examples :

  (i) $2Cu + O_2 \rightarrow 2CuO$

  Copper (II) oxide (black)

  (ii) $4Al + 3O_2 \rightarrow 2Al_2O_3$

  Aluminium oxide

  (iii) $2Mg + O_2 \rightarrow 2MgO$

➢ Different metals show different reactivities towards O_2.

➢ Na and K react so vigorously with water, that they catch fire if kept in open. So they are kept immersed in kerosene.

➢ Surfaces of Mg, Al, Zn and Pb are covered with a thin layer of oxide which prevent them from further oxidation.

➢ Fe does not burn on heating but iron fillings burn vigorously.

➢ Cu does not burn but is coated with black copper (II) oxide.

➢ Au and Ag do not react with oxygen.

➢ **Amphoteric Oxides :** Metal oxides which react with both acids as well as bases to produce salt and water are called amphoteric oxides.

Examples : $Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O$

$Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$

Sodium aluminate

(B) Reaction of Metals with Water :

Metal + Water $\rightarrow$ Metal oxide + Hydrogen

Metal oxide + Water $\rightarrow$ Metal hydroxide

(C) Reaction of Metals with Solutions of other Metal Salts :

Metal A + Salt solution B $\rightarrow$ Salt solution A + Metal B

➢ Reactive metals can displace less reactive metals from their compounds in solution form.

$$Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$$

➢ All the metals do not react with the same rate. Some react very fast, some react moderately whereas others react very slowly. The series of metals in decreasing order of reactivity is called **reactivity** or **activity series of metals.** The metals at the top are most reactive whereas metals at the bottom are least reactive.

K, Na, Ca, Mg, Al, Zn, Fe, Sn, Pb, H, Cu, Hg, Ag, Au, Pt.

➢ Metals react with dilute acids to form salt and hydrogen gas. The metal replaces hydrogen of the acid to form salt.

➢ **Aqua Regia** is a mixture of conc. HCl and conc. HNO_3 in the ratio of 3 : 1. It can dissolve gold and platinum. Aqua Regia is a strong oxidizing agent due to the formation of NOCl (Nitrosyl chloride) and chlorine produced by reaction of two acids.

- **Alloys** are homogeneous mixture of two or more metals. One of them can be non-metal also, *e.g.,* Brass is an alloy of copper and zinc. When a metal is alloyed with mercury, it is called an amalgam.
- Metal, in reactivity series, if placed above hydrogen, can displace hydrogen from dilute acids (HCl and H_2SO_4).

TOPIC-2

Ionic compounds, Metallurgy and Corrosion

Revision Notes

- **Ionic Compounds**

  The compounds formed by the transfer of electrons from a metal to a non-metal are called ionic compounds or electrovalent compounds.
- **Properties of Ionic Compounds**
  - **(i) Physical nature :** They are solid and hard, generally brittle.
  - **(ii) Melting and Boiling Point :** They have high melting and boiling point.
  - **(iii) Solubility :** Generally soluble in water and insoluble in solvents such as kerosene, petrol etc.
  - **(iv) Conduction of electricity :** Ionic compounds conduct electricity in molten and solution form but not in solid state.
- **Occurrence of Metals**
  - **Minerals :** The elements or compounds which occur naturally in the earth's crust are called minerals.
  - **Ores :** Minerals that contain very high percentage of particular metal and the metal can be profitably extracted from it , such minerals are called ores.

Know the Terms

- **Malleability :** The ability of a metal due to which it can be beaten into large thin sheets is called **malleability**.
- **Ductility :** It is the ability of metal due to which it can be drawn into thin and long wires. Copper, aluminium and iron can be drawn into wires. Silver, gold and platinum are highly ductile metals.
- **Electrical conductance :** It is the property due to which electric current can pass through the metal. It is due to presence of free electrons or mobile electrons. Copper, silver, gold and aluminium are good conductors of electricity.
- **Thermal conductivity :** It is the property due to which metals can conduct heat. *e.g.,* Copper, silver, aluminium, gold and iron are good conductors of heat.
- **Anodising :** The process of forming oxide layer on the surface of metal is called **anodising**. *e.g.,* Aluminium forms an oxide layer on its surface when it is exposed to air. It is non-penetrating layer which protects it from corrosion.
- **Metallic lustre :** Metals in their pure state have bright shining surfaces. This property is called **metallic lustre**.
- **Sonorous :** When metals are struck with a hard substance, they produce sound. This property is called **sonority** and the metals are said to be **sonorous**.
- **Amphoteric oxide :** The oxides which are both acidic and basic in nature and react both with acids and bases to form salt and water are called as **Amphoteric oxide**. Example, ZnO, Al_2O_3 etc.
- **Neutral oxides :** The oxides which are neither acidic nor basic in nature, they are also known as **Neutral oxides**. They neither react with acids nor with bases. Some non-metals form neutral oxides. Example, CO, NO, N_2O etc.
- **Ionic compounds :** The compounds in which metal loses electrons and non-metal gains electrons are called **electrovalent compounds or ionic compounds**. Example, NaCl, KCl etc.

  $$2Na + Cl_2 \longrightarrow 2NaCl$$

  Sodium Chlorine Sodium chloride
- **Octet :** A stable group of eight electrons in the outermost orbit of the atom is known as **Octet**.

  The bond which is formed by loss and gain of electrons is called **ionic** or **electrovalent bond**.
- **Corrosion :** It is a process in which metal reacts with substance present in the atmosphere to form surface compounds *e.g.,* silver metal turns black due to formation of Ag_2S, iron forms reddish brown coating of hydrated ferric oxide, $Fe_2O_3.xH_2O$.
- **Galvanisation :** The process of coating iron articles with zinc which is more reactive than iron is called Galvanisation.

- **Metallurgy :** All the processes involved in the extraction of metals from their ores and refining them for use, is called metallurgy.
- **Ore-dressing :** It is a process of removing unwanted substances from the ore. This is also known as concentration of the ore or enrichment of ore. It is usually done by hydraulic washing, magnetic separation or froth floatation process.
- **Froth floatation process :** It process is based on the principle that the mineral particles are more wetted by the oil, whereas the gangue particles are wetted by water. Compressed air is bubbled through the mixture. As a result of agitation, oil froth is formed which contains minerals which float on the top of water and can be separated easily.
- **Gangue :** The unwanted material present in the ores mined from earth is called **Gangue**. It needs to be removed prior to the extraction process.
- **Leaching :** It makes use of difference in the chemical properties of minerals and gangue. The ore is treated with suitable reagent which reacts with the ore, but not with the gangue. The purified ore is regenerated by sequence of reactions. An example of leaching is Bayer's method of obtaining pure aluminium oxide from Bauxite.
- **Roasting :** It is the process in which ore is heated in the presence of air so as to obtain metal oxides, which can be reduced easily to get free metal. Sulphide ores are converted into oxides by roasting.

$$2ZnS(s) + 3O_2(g) \xrightarrow{\text{Heat}} 2ZnO(s) + 2SO_2(g)$$

- **Calcination :** It is the process of heating ore in absence of air so as to remove moisture and volatile impurities and to convert carbonate ores into oxides.

$$ZnCO_3(s) \xrightarrow{\text{Heat}} ZnO(s) + CO_2(g)$$

- **Thermite process :** It is a process in which molten metal oxides are treated with aluminium powder. It is highly exothermic reaction. The molten metal obtained is used for welding of railway tracks or cracked machine parts.

$$\underset{\text{Aluminium}}{2Al} + \underset{\text{Haematite}}{Fe_2O_3} \longrightarrow \underset{\text{Molten iron}}{2Fe} + \underset{\text{Aluminium oxide}}{Al_2O_3} + \text{Heat}$$

- **Refining :** It is a process of converting impure metal into pure metal by different processes depending on the nature of metals. It is a process of purification of metal.
- **Flux :** The substance which reacts with gangue to form a fusible mass which can easily be removed is known as Slag : *e.g.,* CaO (Calcium oxide) is used as flux so as to remove SiO_2 (Silica) as gangue.
- **Slag :** The fusible mass formed by the reaction of flux and gangue is known as **slag**. Slag is lighter than molten metal, hence floats over molten metal and can be easily removed. It prevents metal from oxidation.

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Chapter - 4 : Carbon Compounds

TOPIC-1

Carbon and its Properties, Homologous Series and IUPAC Names

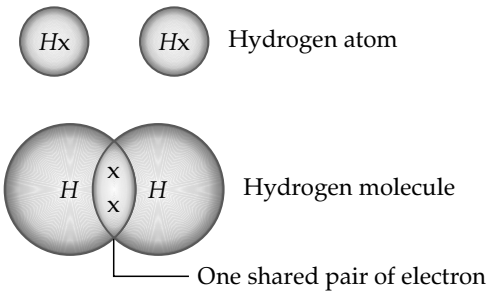
Revision Notes

- The element carbon is non-metal. Its symbol is C.
- Carbon is a versatile element. The percentage of carbon present in earth crust in form of mineral is 0.02% and in atmosphere as CO_2 is 0.03%.
- All the living things, plants and animals are made up of carbon based compounds.
- Carbon always forms covalent bonds :
- The atomic number of carbon is 6.

Electronic configuration :

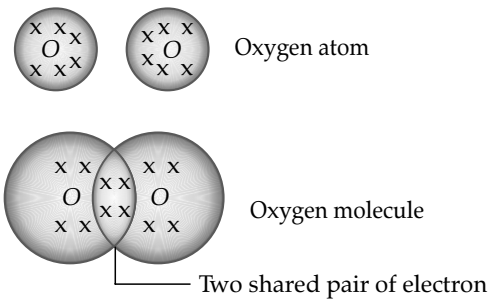
	K	L
C (6)	2	4

- How carbon attain noble gas configuration ?
  - **(i)** Carbon is tetravalent in nature. It does not form ionic bond because it has 4 valence electrons, half of an octet. To form ionic bonds, carbon molecules must either gain or lose 4 electrons. It is because, it is difficult to hold four extra electron and would require large amount of energy to remove four electrons. So, carbon can form bond by sharing of its electron with the electrons of other carbon atom or with other element and attain noble gas configuration.
  - **(ii)** The atoms of other elements like hydrogen, oxygen, nitrogen and chlorine also form bonds by sharing of electrons.
  - **(iii)** The bond formed by sharing of electrons between same or different atoms is covalent bond.
- **Covalent Bond :** A covalent bond is formed by sharing of electrons between atoms. In a covalent bond, the shared pair of electrons belongs to the valence shell of both the atoms.
- Carbon forms covalent bonds.
- **Conditions for formation of a covalent bond :**
  - **(i)** The combining atoms should have 4 to 7 electrons in their valence shell.
  - **(ii)** The combining atoms should not lose electrons easily.
  - **(iii)** The combining atoms should gain electrons readily.
  - **(iv)** The difference in electronegativity of two bonded atoms should be low.
- **Properties of covalent compounds :**
  - **(i) Physical states :** They are generally liquids or gases. Some covalent compounds may exist as solid.
  - **(ii) Solubility :** They are generally insoluble in water and other polar solvents but soluble in organic solvents such as benzene, toluene etc.
  - **(iii) Melting and boiling points :** They generally have low melting and boiling points.
  - **(iv) Electrical conductivity :** They do not conduct electrical current.
- **Steps for writing the Lewis Dot Structures of a covalent compound :**
  - **(i)** Write the electronic configuration of all the atoms present in the molecule.
  - **(ii)** Identify how many electrons are needed by each atom to attain noble gas configuration.
  - **(iii)** Share the electrons between atoms in such a way that all the atoms in a molecule have noble gas configuration.
  - **(iv)** Keep in mind that the shared electrons are counted in the valence shell of both the atoms sharing it.
- **Examples : (i)** H_2



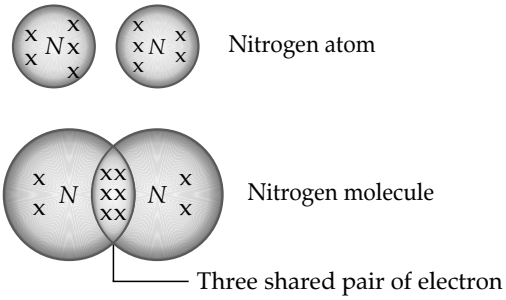
H – H : Single bond between hydrogen atoms

(ii) O_2



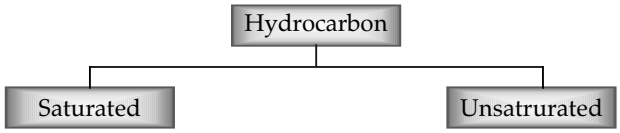
O = O : Double bond between oxygen atoms

(iii) N_2

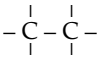


N ≡ N : Triple bond between nitrogen atoms

- Compounds made up of hydrogen and carbon are called hydrocarbon.



Single bond between carbon atoms.



Alkanes : C_nH_{2n+2}

Double or triple bond between carbon atoms.

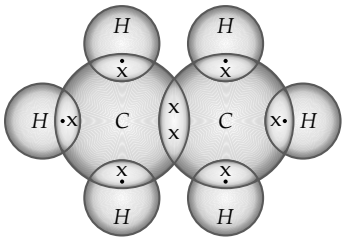
Alkenes : C_nH_{2n}

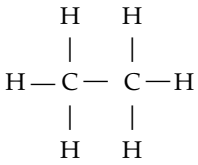
Alkynes : C_nH_{2n-2}

General formulae

- **Electron Dot structure of saturated hydrocarbons :**

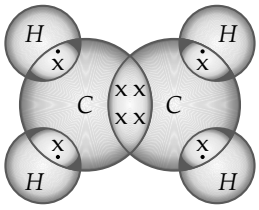
Ethane C_2H_6

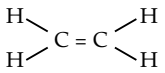




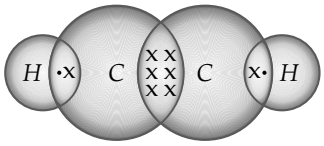
- **Electron Dot Structure of Unsaturated Hydrocarbons :**

Ethene : C_2H_4



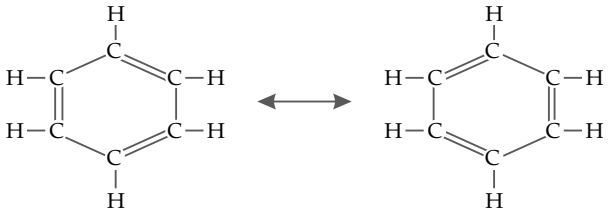


Ethyne : C_2H_2

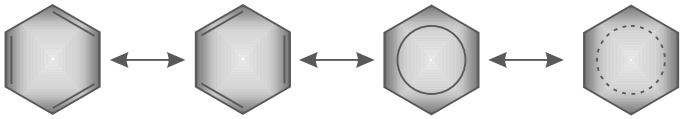


H – C ≡ C – H

- **Cyclic or Closed Chain Hydrocarbons :** These are the hydrocarbons which have carbon carbon closed chain. They are classified as :
  - **(i) Alicyclic hydrocarbons :** These are the hydrocarbons which do not have benzene ring in their structures.
  - **(ii) Aromatic hydrocarbons :** These are the hydrocarbons which have benzene ring in their structures. When hydrogen bonded to carbon of benzene is substituted with halogens, radicals or other functional groups, the derivatives are called aromatic compounds.
- **Benzene :** It is an aromatic hydrocarbon which has the molecular formula C_6H_6. It has alternating carbon- carbon single and double bonds.



- **Benzene can also be represented as :**



- **IUPAC name of hydrocarbon consists of two parts. It involves :**

  (i) Word root : Number of carbons in the longest carbon chain.

Number of carbon atoms	Word root (Greek name)
1	Meth
2	Eth
3	Prop
4	But
5	Pent
6	Hex
7	Hept
8	Oct
9	Non
10	Dec

  (ii) Suffix : It depends on the type of carbon - carbon bond for single bond, suffix is – ane; for double bond, suffix is – *ene*; and for triple bond suffix is – *yne*.

- **Types of Formula for Writing Hydrocarbons :**

  (i) Molecular formula : It involves the actual number of each type of atom present in the compound.

  (ii) Structural formula : The actual arrangement of atoms is written in structural formula.

  (iii) Condensed formula : It is the shortened form of the structural formula.

- In hydrocarbon chain, one or more hydrogen atom is replaced by other atoms in accordance with their valencies. These are heteroatoms.
- These heteroatoms or group of atoms which make carbon compound reactive and decides its properties are called functional groups.

Hetero atom	Functional group	Formula of functional group
Cl/Br	Halo (Chloro/Bromo)	— Cl, — B*r*, — I
Oxygen	1. Alcohol	— OH
	2. Aldehyde	— CHO
	3. Ketone	— C — ‖ O
	4. Carboxylic acid	O ‖ — C — OH
Double bond	1. Alkene group	> C = C <
Triple bond	2. Alkyne group	— C ≡ C —

- **Homologous Series :** A series of organic compounds in which every succeeding member differs from the previous one by – CH_2 or 14 a.m.u. is called homologous series. The molecular formula of all the members of a homologous series can be derived from a general formula.
- **Properties of a homologous series :** As the molecular mass increases in a series, physical properties of the compounds show a variation, but chemical properties which are determined by a functional group remain the same within a series.

- **Homologous series of alkanes :** General formula : C_nH_{2n+2}, where n = number of carbon atoms. CH_4, C_2H_6, C_3H_8.
- **Homologous series of alkenes :** General formula : C_nH_{2n}, where n = number of carbon atoms. C_2H_4, C_3H_6, C_4H_8.
- **Homologous series of alkynes :** General formula : C_nH_{2n-2}, where n = number of carbon atoms. C_2H_2, C_3H_4, C_4H_6.
- **Chemical Properties of carbon compounds**

(a) Combustion

$$CH_4 + 2O_2 \xrightarrow{\text{Combustion}} CO_2 + 2H_2O + \text{Heat} + \text{Light}$$

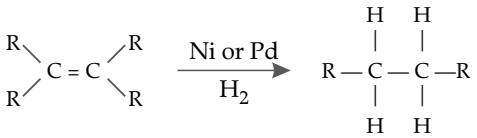
- Carbon and its compounds are used as fuels because they burn in air releasing lot of heat energy.
- Saturated hydrocarbon generally burn in air with blue and non-sooty flame.
- Unsaturated hydrocarbon burns in air with yellow sooty flame because percentage of carbon is higher than saturated hydrocarbon which does not get completely oxidized in air.

(b) Oxidation

Alcohols can be converted to carboxylic acid in presence of oxidizing agent alkaline $KMnO_4$ (potassium permanganate) or acidic potassium dichromate.

$$\underset{\text{Ethanol}}{CH_3CH_2OH} \xrightarrow[\text{Acidic } K_2Cr_2O_7]{\text{Alkaline } KmnO_4 \text{ Or}} \underset{\text{Ethanoic acid}}{CH_3COOH}$$

(c) Addition Reaction :



Unsaturated hydrocarbon add hydrogen in the presence of catalyst palladium or nickel. Vegetable oils are converted into vegetable ghee using this process. It is also called hydrogenation of vegetable oils.

(d) Substitution Reaction :

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

TOPIC-2

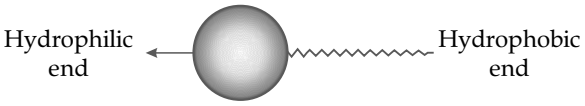
Carbon Compounds, Soap and Detergents

Revision Notes

- Soap is sodium or potassium salt of long chain carboxylic acid. *e.g.*, $C_{17}H_{35}COONa^+$
- Soaps are effective only in soft water.
- Detergents are ammonium or sulphonate salt of long chain of carboxylic acid.
- Detergents are effective in both hard and soft water.
- **Soap molecule has :**

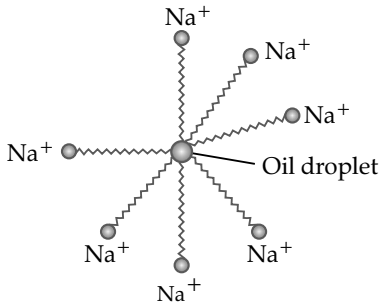
(i) Ionic (hydrophilic) part

(ii) Long hydrocarbon chain (hydrophobic) part



Structure of soap molecule

- **Cleansing Action of Soap :** Most dirt is oily in nature. The hydrophobic end of soap molecule attaches itself with dirt and the ionic end is surrounded with molecule of water. This result in formation of a radial structure called micelles.
- Soap micelles helps to dissolve dirt and grease in water and cloth gets cleaned.



- The magnesium and calcium salt present in hard water reacts with soap molecule to form insoluble product called scum. This scum create difficulty in cleansing action.
- By use of detergent, insoluble scum is not formed with hard water and cloths get cleaned effectively.

Know the Terms

- **Catenation :** The self linking property of carbon atoms through covalent bonds to form long chains and rings is called catenation.
- **Tetravalency :** Tetravalency is the state of an atom in which there are four electrons available with the atom for covalent chemical bonding.
- **Electronegativity :** It is the ability of an atom to attract a shared pairs of electrons towards itself.
- **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.
- **Homologous Series :** It is a family of organic compounds having the same functional group in which the formulae of successive members differ by – CH_2 group. For example, CH_4, C_2H_6, C_3H_8, C_4H_{10} etc. All the members of a homologous series have similar structures and same chemical properties.
- **Oxidation :** Oxidation means controlled combustion. For example, when ethanol is heated with alkaline potassium permanganate solution or acidified potassium dichromate solution, it gets oxidised to ethanoic acid.
- **Esterification Reaction :** When an organic acid reacts with an alcohol in the presence of acid catalyst, it produces a sweet smelling (fruity smell) substance called ester. The reaction is known as esterification reaction.
- **Saponification Reaction :** Esters react in the presence of an acid or a base to give back the alcohol and the carboxylic acid. This reaction is known as saponification because it is used in the preparation of soap.
- **Soaps :** Soaps are sodium and potassium salts of long chain (higher) fatty acids such as stearic acid, palmitic acid etc.
- **Detergents :** Detergents are ammonium or sulphonate salts of long chain hydrocarbons.

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Chapter - 5 : Periodic Classification of Elements

TOPIC-1

Periodic Laws and their Limitations

Revision Notes

- **Need for Periodic Classification :** To make the study of elements easy, elements have been divided into few groups in such a way that elements in the same group have similar properties. Now, study of a large number of elements is reduced to a few groups of elements.
- **Dobereiner's Triads :** When elements are arranged in the order of increasing atomic masses, groups of three elements (known as triads), having similar chemical properties are obtained.

  The atomic mass of the middle element of the triad was roughly the average of the atomic masses of the other two elements.

Elements	Atomic Mass
Ca	40.1
Sr	87.6
Ba	137.3

- Dobereiner could identify only three triads. He was not able to prepare triads of all the known elements.
- **Newland's Law of Octaves :** John Newlands arranged the elements in the order of increasing atomic masses. It states that when the elements are arranged in increasing order of atomic masses, the properties of the eighth element are a kind of repetition of the first, just like notes of music.
- **Table showing Newland's Octaves :**

Sa (do)	re (re)	ga (mi)	ma (fa)	pa (so)	da (la)	ni (ti)
H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe
Co and Ni	Cu	Zn	Y	In	As	Se
Br	Rb	Sr	Ce and La	Zr		

- **Limitations of Newland's law of octaves :**
  - **(i)** The law was applicable to elements up to calcium (Ca) only.
  - **(ii)** It contained only 56 elements. Further, it was assumed by Newlands that only 56 elements existed in nature and no more elements would be discovered in the future.
  - **(iii)** In order to fit elements into the table, Newland adjusted two elements 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 differently away from these elements.
- **Mendeleev's Periodic Table :** Dmitri Ivanovich Mendeleev, a Russian chemist, was the most important contributor to the early development of a periodic table of elements where in the elements were arranged on the basis of their atomic mass and chemical properties.
- **Characteristics of Mendeleev's Periodic Table :**
  - **(i)** Mendeleev arranged all the 63 known elements in increasing order of their atomic masses.
  - **(ii)** The table consists of vertical columns called 'groups' and horizontal rows called 'periods'.
  - **(iii)** The elements with similar physical and chemical properties came under same groups.
- **Mendeleev's Periodic Law :** The properties of elements are the periodic functions of their atomic masses.
- **Merits of Mendeleev's Periodic Table :**
  - **(i)** Mendeleev left some blank spaces for undiscovered elements.
  - **(ii)** Mendeleev predicted the discovery of some elements and named them as eka boron, eka aluminium and eka silicon.
  - **(iii)** Noble gases discovered later could be placed without disturbing the existing order.
- **Limitations of Mendeleev's periodic table :**
  - **(i)** **Position of Hydrogen :** He could not assign a correct position to hydrogen as hydrogen resembles alkali metals as well as halogens.
  - **(ii)** **Position of Isotopes :** Isotopes are placed in same position though they have different atomic masses.
  - **(iii)** Separation of chemically similar elements while dissimilar elements are placed in the same group.
- **Modern Periodic Table :** Henry Moseley gave a new property of elements, 'atomic numbers' and this was adopted as the basis of Modern Periodic Table.
- **Modern Periodic Law :** Properties of elements are the periodic functions of their atomic numbers.

TOPIC-2
Periodic Elements and Periodic Properties

Revision Notes

- **Position of elements in modern periodic table :**
  - **(i)** The Modern Periodic Table consists of 18 groups and 7 periods.
  - **(ii)** Elements present in any one group have the same number of valence electrons. Also, the number of shells increases as we go down the group.
  - **(iii)** Elements present in any one period, contain the same number of shells. Also, with increase in atomic number by one unit on moving from left to right, the valence shell electron increases by one unit.
  - **(iv)** Each period marks a new electronic shell getting filled.
- **Trends in the Modern Periodic Table :**
  - **(i)** **Periodicity in Properties :** The properties of elements depend upon the electronic configuration which changes along a period and down a group in the periodic table. The periodicity properties *i.e.* repetition of properties after a regular interval is due to similarity in electronic configuration.
  - **(ii)** **Tendency to lose or gain electron :** Chemical reactivity of an element depends upon the ability of its atoms to donate or accept electrons.
  - **(iii)** **Variations of tendency to lose electron down the group :** Tendency to lose electron goes on increasing down the group.

    Reason : It is due to the increase in the distance between the valence electrons and the nucleus as the atomic size increases down the group, the force of attraction between the nucleus and the valence electrons decreases, therefore, tendency to lose electron also increases down the group.
  - **(iv)** **Variation of tendency to lose electron along a period :** It goes on decreasing generally along a period from left to right with decrease in atomic size.

    Reason : Due to decrease in the atomic size, the force of attraction between the valence electrons and the nucleus increases and, therefore, electrons cannot be removed easily.
  - **(v)** **Variation of tendency to gain electron down the group :** It goes on decreasing down the group in general.

    Reason : Due to increase in atomic size, the force of attraction between the nucleus and the electron to be added becomes less.
  - **(vi)** **Variation of tendency to gain electron along a period :** It increases left to right in a period.

    Reason : It is due to decrease in the atomic size which leads to an increase in the force of attraction between the nucleus and the electron to be added.
- **Metallic and non-metallic character :** Group 1 to 12 are metals. Group 13 to 18 comprises non-metals, metalloids and metals.
- **Properties of Metals :**
  - **(i)** They are malleable.
  - **(ii)** They are ductile.
  - **(iii)** They are good conductors of heat and electricity.
  - **(iv)** They have generally 1 to 3 valence electrons.
  - **(v)** They have the same or less number of electrons in their outermost shell than the number of shells.
  - **(vi)** They are mostly solids.
- **Properties of Non-metals :**
  - **(i)** They exist in solid, liquid or gaseous state.
  - **(ii)** Non-metals are generally brittle.
  - **(iii)** They are non-conductors.
  - **(iv)** They have 4 to 8 valence electrons.

- **Atomic radii increase down the group.**

Atomic number	Elements	Symbols	Electronic configuration	Valence electrons	Valency
1	Hydrogen	H	(1)	1	1
2	Helium	He	(2)	2	0
3	Lithium	Li	(2, 1)	1	1
4	Beryllium	Be	(2, 2)	2	2
5	Boron	B	(2, 3)	3	3
6	Carbon	C	(2, 4)	4	4
7	Nitrogen	N	(2, 5)	5	3
8	Oxygen	O	(2, 6)	6	2
9	Fluorine	F	(2, 7)	7	1
10	Neon	Ne	(2, 8)	8	0
11	Sodium	Na	(2, 8, 1)	1	1
12	Magnesium	Mg	(2, 8, 2)	2	2
13	Aluminium	Al	(2, 8, 3)	3	3
14	Silicon	Si	(2, 8, 4)	4	4
15	Phosphorus	P	(2, 8, 5)	5	3
16	Sulphur	S	(2, 8, 6)	6	2
17	Chlorine	Cl	(2, 8, 7)	7	1
18	Argon	Ar	(2, 8, 8)	8	0
19	Potassium	K	(2, 8, 8, 1)	1	1
20	Calcium	Ca	(2, 8, 8, 2)	2	2

Know the Terms

- **Mendeleev's Periodic Law :** This law states that the properties of elements are the periodic function of their atomic masses.
- **Modern Periodic Law :** According to this law, the properties of elements are periodic function of their atomic numbers.
- **Groups :** The 18 vertical columns in modern periodic table are known as groups.
- **Periods : 7** horizontal rows in modern periodic table are called periods.
- **Periodicity :** 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.
- **Atomic Radius :** Atomic radius is defined as the distance from the centre of the nucleus of an atom to the outermost shell of electrons.
- **Covalent Radii :** It is defined as half of the distance between the centre of nuclei of two atoms (bond length) bonded by a single covalent bond *e.g.*, bond length in case of H—H is 74 pm.
- **Covalent radius :** It can be measured in case of diatomic molecules of non-metals.
- **Metallic Radii :** It is defined as half of the internuclear distance between the two metal ions in a metallic crystal.
- **Metalloids :** Those elements which resemble both metals and non-metals are called metalloids. They are also called semi-metals. *e.g.*, Boron, Silicon, Germanium, Arsenic, Antimony, Tellurium and Polonium.
- **Isotopes :** Elements which have same atomic number but different mass number are called isotopes.

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Unit -II : World of Living

Chapter - 6 : Life Processes

TOPIC-1
Nutrition

Revision Notes

- All living things perform certain life processes like growth, excretion, respiration, circulation and reproduction etc.
- The basic functions performed by living organisms for their survival and body maintenance are called life processes.
- Basic life processes are :

Life Processes
↓ Growth ↓ Digestion ↓ Respiration ↓ Circulation ↓ Excretion ↓ Reproduction

- Energy required to carry out the different life processes, is obtained from carbon-based food sources through nutrition.
- Depending on the mode of nutrition, organisms are classified as autotrophs and heterotrophs.
  - **(i) Autotrophs** can prepare their own food from simple inorganic sources like carbon dioxide and water. (e.g., green plants, some bacteria).
  - **(ii) Heterotrophs** cannot synthesise their own food and are dependent on the autotrophs for obtaining complex organic substance for nutrition. (*e.g.*, animals)
- Green plants manufacture their food by the process of **photosynthesis**. Here, they utilise CO_2 and H_2O in presence of sunlight, with the help of chlorophyll and giving out O_2 as a by-product.
- In the light reaction of photosynthesis, light energy is absorbed and converted into chemical energy in the form of ATP and NADPH. Also, water molecules split into hydrogen and oxygen.
- Carbon dioxide is reduced to carbohydrates in the dark phase of photosynthesis.
- Plants carry out exchange of gases with surrounding through stomata.
- In humans, digestion of food takes place in the alimentary canal, made up of various organs and glands.
- Liver secretes bile, which emulsifies fat.

Mouth →	Intake of whole food.
↓	
Teeth →	Chewing/grinding of food.
↓	
Tongue →	Rolling of food + Tasting of food + Swallowing/Pushing down of the food.
↓	

Tongue → Secrete saliva + Mucus

↓

Starch —Salivary amylase [Saliva]→ Sugar

Oesophagus → Taking food from mouth to stomach by peristaltic movements. [Contraction and expansion of muscles of the oesophagus]

↓

Stomach → Gastric glands —Secrete→ Gastric juice

↓

Gastric juice
- Pepsin (Enzyme that breaks down proteins)
- HCl (Makes medium acidic)
- Mucus (Protect inner lining of the stomach)

Small Intestine → **(a)** Intestinal enzyme ↓convert
- Carbohydrate ↓ Glucose
- Fats ↓ Fatty acid + Glycerol
- Proteins ↓ Amino acids

Small Intestine → **(b)** Villi (finger like projections) → Helps in absorption of food into the blood

Small Intestine → **(c)** Receives secretion from
- Liver Secretes Bile ↓ Helps in emulsification of fats.
- Pancreas ↓ Pancreatic juice
  - Trypsin: Proteins → Peptones
  - Lipase: Fats → Lipids

Large Intestine → Absorb excess of water

→ The rest of the material is removed from the body via the anus.

TOPIC-2
Respiration

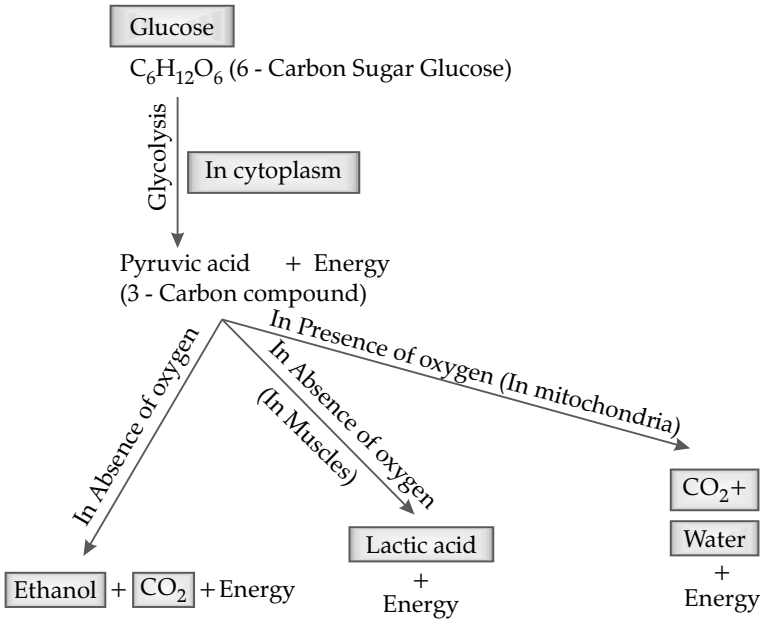
Revision Notes

- **Respiration is the process in living organisms, which involves :**

  (i) Gaseous exchange : Intake of oxygen from the atmosphere and release of CO_2 → Breathing

  (ii) Breakdown of simple food in order to release energy inside the cell → Cellular respiration

- **Breakdown of Glucose by Various Pathways :**



- **Types of Respiration :**

Respiration	
Aerobic	**Anaerobic**
Takes place in the presence of oxygen	Takes place in the absence of oxygen
Occurs in mitochondria	Occurs in cytoplasm
End products are CO_2 and H_2O	End products are alcohol or lactic acid
More amount of energy is released	Less amount of energy is released
Examples : Most plants and animals	Examples : Muscles, bacteria, yeast and parasitic worm etc.

- **In humans, air takes the following path on entering the nostrils :**
  Nostrils → Nasal passage → Pharynx → Larynx → Trachea → Bronchus → Bronchiole → Alveolus.
- The alveoli of lungs are richly supplied with blood and are the sites where exchange of gases (O_2 and CO_2) occurs between blood and atmosphere.
- In humans, the respiratory pigment haemoglobin carries oxygen from lungs to different tissues of the body.
- In plants, gaseous exchange takes place through stomata in leaves, lenticels in stems, general surface of roots and transportation.

TOPIC-3
Circulation and Transportation

Revision Notes

- The circulatory system in human beings consists of : A circulatory medium (blood and lymph), blood vessels (veins, arteries and capillaries) and heart.
- Humans have double circulation system. Blood travels twice through the heart in one complete cycle of the body.
- **Pulmonary Circulation :** Blood moves from the heart to the lungs and back to the heart.
- **Systemic Circulation :** Blood moves from the heart to rest of the body and back to the heart.
- **Differences between arteries and veins :**

Arteries		Veins	
1.	Carry oxygenated blood from heart to different body parts except pulmonary artery.	**1.**	Carry deoxygenated blood from different body parts to the heart except pulmonary vein.

2.	Also called distributing vessel.	**2.**	Also called collecting vessel.
3.	Walls thick and elastic and muscular.	**3.**	Thin, non muscular and less elastic.
4.	Deep seated	**4.**	Superficial as compared to arteries.
5.	Have no valves	**5.**	Have valves, which prevent backward flow of blood.

- There are two main conducting channels in vascular plants. They are Xylem and Phloem.

Xylem		Phloem	
1.	Transports water and minerals from the roots to upper parts of the plant.	**1.**	Transports product of photosynthesis from leaves to the non photosynthesising parts of the plants such as root & stem.
2.	No energy is used for transport.	**2.**	Energy is used from ATP for transport.
3.	On maturity, the xylem is a dead tissue and gives mechanical support to the plant.	**3.**	Phloem exists as living soft tissue.

- **Transpiration :** It is the process of loss of water as vapour from aerial parts of the plant.

TOPIC-4
Excretion

Revision Notes

- During excretion, the harmful metabolic nitrogenous wastes generated are removed from the body.
- Nephrons are the basic filtration units of kidneys. They carry out filtration, selective reabsorption and tubular secretion to form urine in kidney, which is then passed out through the urethra, via the ureters and urinary bladder.
- Each kidney contains many filtration units called as nephrons.
- Nephrons are made up of a cluster of thin walled capillaries called glomerulus which is associated with a cup like structure called as Bowman's capsule and the long tube which terminates through this capsule.
- The renal artery brings oxygenated blood to the kidneys along with the nitrogenous wastes like urea and uric acid and many other substances.
- The blood gets filtered through the glomerulus and this filtrate enters the tubular part of nephron.
- As this filtrate moves down the tubular part, glucose, amino acids, salts and excess of water gets selectively reabsorbed by the blood vessels surrounding tubules.
- **The amount of water reabsorbed depends upon :**
  (a) How much excess of water is there in the body and,
  (b) How much nitrogenous wastes need to be excreted out.
- The fluid now flowing in the tubular part is urine, which gets collected in collecting ducts of nephrons.
- These collecting ducts together leave the kidney at a common point by forming the ureter.
- Each ureter drains the urine in the urinary bladder where it is stored until the pressure of expanded bladder leads to an urge to pass it out through urethra.
- This bladder is a muscular structure which is under nervous control.
- 180 litres of filtrate is formed daily but only 2 litres is excreted out as urine so the rest is reabsorbed in the body.
- In case of kidney failure, haemodialysis is the process of purifying blood by an artificial kidney.

Know the Terms

- **Metabolism :** It is the sum total of all the chemical reactions which occur in a living being due to interaction amongst its molecules. It has two components : Anabolism (build-up reactions) and Catabolism (breakdown reactions).
- **Nutrition :** It is the process by which living beings procure food for obtaining energy and body building materials.
- **Autotrophic Nutrition** : The process in which an organism is able to build up its own organic food from inorganic raw materials with the help of energy.

- **Photosynthesis :** It is the process of synthesis of organic food from inorganic raw materials like $CO_2 + H_2O$ with the help of light energy, inside chlorophyll containing cells.
- **Photolysis :** Photolysis of water is photocatalytic splitting of water into its components, hydrogen and oxygen.

$$2H_2O \longrightarrow 4H^+ + 4e^- + O_2$$

- **Heterotrophic Nutrition :** It is the mode of nutrition in which the organisms obtain food from outside sources.
- **Digestion :** It is the enzyme mediated breakdown of complex insoluble components of food into simple soluble and absorbable forms.
- **Peristalsis :** It is a wave of contraction behind the food and expansion in the region of contained food that occurs in the alimentary canal for pushing the food from anterior to posterior ends.
- **Succus Entericus :** It is the name of digestive juice of small intestine, also known as intestinal juice.
- **Emulsification :** Emulsification of fats is conversion of large fat pieces into very fine fat globules.
- **Phagocytosis :** It is the process of ingestion of solid food particle by a cell or unicellular organism.
- **Circumvallation :** This is the method of intake of food when *Amoeba* comes in contact with a food particle or prey, it throws pseudopodia all around the same. The tips of encircling pseudopodia fuse and the prey comes to lie in a vesicle or phagosome.
- **Respiration :** It is an enzyme controlled biochemical process. It involves stepwise oxidative breakdown of organic compounds releasing energy at various steps.
- **Cutaneous Respiration :** It is the mode of exchange of respiratory gases that occurs through skin.
- **Branchial Respiration :** It is the respiration performed with the help of gills.
- **Breathing :** It is a physical process of alternate inhalation of fresh air (oxygen) and exhalation of foul air (CO_2).
- **Aerobic respiration :** It is the stepwise complete oxidative breakdown of respiratory substrate into carbon dioxide and water with the help of oxygen that act as terminal oxidant.
- **Glycolysis (EMP pathway) :** It is the first step of breakdown of respiratory substrate which occurs in cytoplasm and produces two molecules of pyruvate from a molecule of glucose.
- **Kreb's Cycle :** It is a cyclic series of metabolic reactions of aerobic respiration that occur inside mitochondria.
- **Transportation :** It is the movement of materials from one part to another, usually from the region of their availability to the region of their use, storage or elimination.
- **Circulatory System :** It is a system of organs, tubes and a blood-like fluid that circulates various materials inside the body.
- **Haemolysis :** It is the process of destruction of RBC's.
- **Serum :** It is a whitish water fluid that is squeezed out from contracting blood clot.
- **Diapedesis :** It is the crawling of white blood corpuscles out of blood capillaries into surrounding tissues.
- **Pulse :** It is a repeated throb felt in a superficial artery of the body due to forceful pumping of the blood. It depends on the rate of heart beat.
- **Translocation :** It is the movement of materials in solution form within an organism especially in phloem and / or xylem of plants.
- **Transpiration :** It is the loss of water in vapour form from the aerial and exposed parts of a plant.
- **Ascent of Sap :** It is the upward movement of absorbed water or sap from root to the top of the plant. It occurs through xylem.
- **Excretion :** It is the process of throwing out of waste products and other harmful chemicals from the body.
- **Nephric Filtrate :** It is the fluid passed out of glomerulus due to ultrafiltration in the Malpighian capsule of a nephron.
- **Ultrafiltration :** It is the filtration under pressure of small particles, solutes and solvents, through a finely porous membrane.
- **Glomerulus :** It is a bunch of fine blood vessels or capillaries present in the depression of Bowman's capsule where ultrafiltration occurs.
- **Micturition :** It is the expulsion of urine from the body.
- **Bowman's Capsule :** It is a broad, blind cup-shaped, proximal end of a nephron in which glomerulus is located for ultrafiltration.
- **Osmoregulation :** It is the maintenance of a fixed osmotic concentration of body fluids by controlling the amount of water and salts.

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Chapter - 7 : Control and Co-ordination

TOPIC-1
Control and Co-ordination in Plants

Revision Notes

- All the living organisms respond and react to the changes that happen in the environment around them.
- The changes in the environment to which the organisms respond and react are called stimuli such as light, heat, cold, smell, touch etc.
- Both plants and animals respond to stimuli but in a different manner.
- **Plant Movements :** The movements of the individual plant parts or organs of a plant like shoot, root, etc, are due to some external stimuli like light, force of gravity, chemical substance, water, etc.
- **Tropic Movement :** It is the directional growth movement of a plant organ in response to an external stimulus. Growth towards the stimulus is positive tropism and growth away from the stimulus is negative tropism.
- **Hormones :** They are the chemical substances which co-ordinate and control the activities of living organisms and also their growth. They are functional in small concentration at the site remote from their production.
- **Plant Hormones :** They are the chemical compounds produced naturally in plants which control the growth and other physiological functions at a site, far away from the place of secretion. They are required in very small amount and help to coordinate growth, development and responses to the environment.
- **Main plant hormones are :**

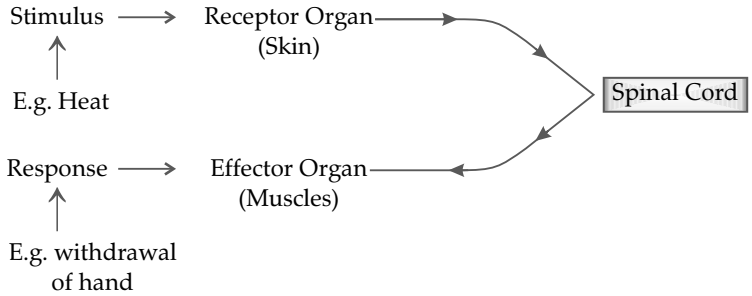
(a)	**Auxins**	Synthesized at shoot tip, Helps the cells to grow longer. Involved in tropic movements of plants.
(b)	**Gibberellin**	Helps in the growth of the stem.
(c)	**Cytokinins**	Promotes cell division, Present in greater concentration in fruits and seeds.
(d)	**Abscisic Acid**	Inhibits growth, Cause wilting of leaves and Also called as Stress hormone.
(e)	**Ethylene ($H_2C=CH_2$)**	A gaseous hormone which helps in artificial ripening of fruits.

TOPIC-2
Control and Co-ordination in Animals

Revision Notes

- Control and coordination is brought about in all animals with the help of two main systems.
- **Nervous system :** It is the system of conducting tissues that receives the stimulus and transmits it to other parts of the body forming a network of nerves. It is involved in receiving information (sensation) and generating responses to that information (motor response).
- The units which make up the nervous system are called **nerve cells or neurons**.
- The **receptors** pass the information to the brain through a type of nerve cells called sensory neurons.
- **Motor neurons :** It transmits the information from the brain to the effector organs, mainly muscles and glands.
- **Nerve Impulse :** It is the information in the form of chemical and electrical signals passing through neurons. These impulses are carried by dendrites towards the cell body.
- **Synapse :** The point of contact between the terminal branches of axon of one neuron with the dendrite of another neuron is called synapse.

- **Voluntary Action :** These are the actions which need thinking and are performed knowingly *i.e.* these are controlled by conscious thought. e.g., : Speaking to a friend, writing a letter etc.
- **Involuntary Action :** These are not under the control of the will of an individual and are automatic response to a stimulus which is not under the voluntary control of the brain. It occurs without the conscious choice of an organism. e.g., **:** Touching a hot plate unknowingly.
- **Reflex action :** It is quick, sudden and immediate response of the body to a stimulus. e.g., Knee jerk, withdrawal of hand on touching hot object.
- **Reflex arc :** The pathway through which nerve impulse passes during reflex action is called reflex arc. *i.e.* it is pathway through which the reflex action occurs.

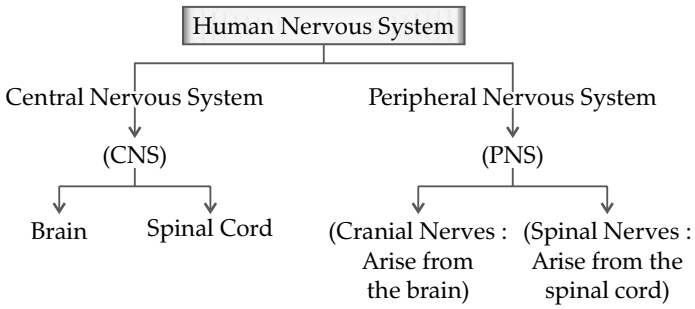


- **Response :** Responses are of three main types :

  (a) Voluntary : Controlled by fore brain. e.g., talking, writing.

  (b) Involuntary : Controlled by mid and hind brain. e.g., heartbeat, vomiting, respiration.

  (c) Reflex action : Controlled by spinal cord. e.g., withdrawal of hand on touching a hot object.
- **Need of Reflex Actions :** In some situations such as touching a hot object, pinching etc. we need to act quickly, otherwise our body would be harmed. Hence, this response is generated from spinal cord instead of brain.
- **Human nervous system :** The nervous system of vertebrates (including humans) is divided into the central nervous system (CNS) and the peripheral nervous system (PNS).



- Human brain is the main coordinating centre of the body. It has three major parts : Forebrain, midbrain and hind brain.

  (a) Fore-brain : It is the most complex or specialized part of the brain. It consists of cerebrum. The main functions of forebrain are as follows :

  (i) Main thinking part of the brain.

  (ii) Control the voluntary actions.

  (iii) Store information (memory).

  (iv) Receives sensory impulses from various parts of the body and integrate it.

  (v) It is the center associated with hunger.

  (b) Mid-brain : Controls involuntary actions.

  (c) Hind-brain : It has three parts :

  (i) Cerebellum : Controls posture and balance, precision of voluntary actions. e.g., picking pen.

  (ii) Medulla : Controls involuntary actions. e.g., blood pressure, salivation, vomiting.

  (iii) Pons : Controls voluntary actions and helps in regulation of respiration.
- Spinal cord is a cylindrical structure and a part of the central nervous system. It is made up of nervous tissue that extends from medulla oblongata in the brain stem to the lumbar region of vertebral column. It functions primarily in the transmission of nerve signals.

- **Glands and hormones secreted by them :**

No.	Gland	Hormones	Functions	Target Site
1.	Hypothalamus	(i) Releasing hormones (RH) (ii) Growth inhibiting hormones	Regulates secretion of pituitary hormones.	Pituitary gland
2.	Pituitary Gland	(i) Growth hormone (GH)	Controls growth-dwarfism and gigantism.	Various body cells which undergo growth
3.	Thyroid Gland	(i) Thyroxin (ii) Triiodothyronine (iii) Thyrocalcitonin (TCT)	Regulate basal metabolic rate, RBC formation. Regulate Ca level.	Body tissues
4.	Adrenal Gland	(i) Adrenaline (ii) Nor adrenaline (iii) Corticoids	Increase alertness, pupillary dilation, piloerection, sweating and heart beat.	Body tissues
5.	Pancreas	(i) Insulin (ii) Glucagon	Regulates glucose homeostasis, stimulates glycogenesis, controls carbohydrate metabolism. Maintains glucose levels, stimulates gluconeogenesis.	Tissues
6.	Testis	(i) Testosterone (ii) Androgens	Plays a role in development of male reproductive tissues and promotes secondary sexual characters in male.	Male body tissues
7.	Ovary	(i) Estrogen (ii) Progesterone	Helps in development of female secondary sexual characters. Support pregnancy.	Female body tissues

Know the Terms

- **Tropic Movement :** Plant growth movements in response to stimuli from a particular direction like light, gravity water or chemicals.
- **Phototropism :** Growth movements of curvature in plants towards light *e.g*, shoots bend towards light (positively phototropic) and roots move away from light (negatively phototropic)
- **Geotropism :** Growth movement of plant towards force of earth gravity.
- **Hydrotropism :** Growth movements of plants in response to external stimulus of water *e.g*, roots bend towards the source of water.
- **Thigmotropism :** Growth movement due to the stimulus of touch with foreign body *e.g*, tendril.
- **Chemotropism :** Growth movements in response to some chemical stimulus *e.g*, growth of pollen tube in style towards ovule.
- **Thermotropism :** Growth movements of plants in response to temperature, *e.g*, seedlings curve toward warm side.
- **Growth :** Permanent or irreversible increase in dry weight, size or volume of living beings.
- **Development :** Series of changes that occur in the structure & functioning of cell, organ or organism during its life history.
- **Meristem :** A tissue the cells of which have the capacity to undergo division.
- **Growth regulators :** The chemical substances which modify growth. They are either **growth promoters** *e.g*, auxins, gibberellins and cytokinins or **growth inhibitors** *e.g*, abscisic acid and ethylene.
- **Phytohormone :** Chemicals that regulate plant growth.
- **Auxins :** Organic substance which promotes shoot elongation when present.
- **Indole 3-Acetic acid (1AA) :** A natural auxin of plants, found in all parts of plants.
- **Synthetic auxins :** Some important synthetic compounds, which show auxin like activity *e.g*, Indole 3 - butyric acid (IBA), 2- 4, dichlorophenoxy acetic acid (2-4-D) *etc.*
- **Neuron :** Structural and functional unit of nervous system.
- **Synapse :** It is a point of contact between the axon of a neuron and the dendrite of another neuron.

- **Nerve impulse :** Information in the form of electrochemical signals passing through neurons.
- **Sensory neurons :** The neurons which transmit impulses towards central nervous system.
- **Motor neurons :** The neurons which transmit impulses from central nervous system to effector organs.
- **Spinal nerves :** Nerves which arise from spinal cord. There 31 pairs of spinal nerves in human beings.
- **Cranial nerves :** Nerves which arise from brain. There are 12 pairs of cranial nerves in humans.
- **Reflex action :** A spontaneous automatic response to a stimulus without the will of an organism.
- **Conditional reflex :** Acquired reflexes during life time of an individual *e.g,* applying brakes of car.
- **Unconditional reflexes :** Unconditional Reflexes are natural and inborn reflexes and are transmitted from generation to generation *e.g,* constriction of pupil in bright light.
- **Brain stem :** Medulla oblongata, pons varolii and mid brain are collectively called the brain stem.
- **Saltatory conduction :** Conduction of impulse along a myelinated nerve fibre.
- **Corpus callosum:** Band of nerve fibres that joins the cerebral hemispheres.
- **Endocrine system :** The endocrine glands and their secretions (hormones) constitute endocrine system.
- **Endocrine glands :** Ductless glands whose secretion are poured directly into the blood stream *e.g,* thyroid glands and adrenal glands etc.
- **Hormones :** Chemical messengers of the body that transfer information from one set of cells to another.
- **Tropic hormone :** A hormone which stimulates another endocrine glands to secrete its hormone. *e.g,* Thyrotropic hormone stimulates the thyroid gland to secrete thyroxine.
- **Pituitary gland :** It is the master gland which controls all other endocrine glands.

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Chapter - 8 : How do Organisms Reproduce?

TOPIC-1

Basics of Reproduction : Asexual Reproduction and Vegetative Propagation

Revision Notes

- Reproduction is the process by which living organisms produce new individuals similar to themselves. It ensures continuity of life on earth.
- Nucleus of the cell contains DNA (Deoxyribose Nucleic Acid) which is the hereditary material.
- DNA replicates and forms new cells causing variation. So, these new cells will be similar but may not be identical to original cell.
- Variations are useful for the survival of the individual and species over time. It is the base of evolution.

Types of Reproduction

(a) Asexual Reproduction

- A single individual give rise to new individual.
- Gametes are not formed.
- New individual is identical to parent.
- Adopted by lower organisms.

(b) Sexual Reproduction

- Two individuals *i.e.*, one male and one female are needed to give rise to new individual.
- Gametes are formed.
- New individual is genetically similar but not identical to parents.
- It is useful to generate more variations in species.
- Adopted by higher organisms.

- **Asexual reproduction** takes place through fission, fragmentation, regeneration, budding, vegetative propagation, spore formation. These modes of reproduction depend on the body design of the organisms.

(a) Fission : It is of two types - binary fission and multiple fission.

(i) Binary fission : It **is** the division of one cell into two similar or identical cells. The nucleus first divides amitotically into two, followed by the division of the cytoplasm. The cell finally splits into two daughter cells. *e.g.*, *Amoeba*

(ii) Multiple fission : In **multiple fission,** many individuals are formed from a single individual. *e.g.*, *Plasmodium.*The nucleus divides repeatedly, producing many nuclei and many daughter cells are formed.

(b) Fragmentation : It takes place in multicellular organisms with simple body organisation such as *Spirogyra*. In this, the body breaks up into two or more small pieces of fragments upon maturation. These fragments grow into new individuals.

(c) Regeneration : It is the ability of a fully differentiated organism to give rise to new individual organisms from its body parts. Small cut or broken parts of the organism's body grow or regenerate into separate individuals. For **example :** *Planaria* and *Hydra*.

(d) Budding : In budding, a small part of the body of the parent grows out as a bud which then detaches and becomes a new organism. *Hydra* reproduces by budding using the regenerative cells.

(e) Vegetative Propagation : In many plants, new plants develops from vegetative parts of plant body such as stem, roots, leaves etc.

Methods of vegetative propagation :

(i) Natural methods are :

(a) By roots : *E.g.*, Dahlias, sweet potato.

(b) By stems : *E.g.*, Potato, ginger.

(c) By leaves : *E.g.*, *Bryophyllum* (leaf margins bear buds which develop into plants).

(ii) Artificial methods :

(a) Grafting : *E.g.*, Mango

(b) Cutting : *E.g.*, Rose

(c) Layering : *E.g.*, Jasmine

(d) Tissue culture : *E.g.*, Ornamental plants, orchid.

(f) Spore Formation : Spores are small bulb like structures which are covered by thick walls. Under favourable conditions, they germinate and produce new organisms.

TOPIC-2

Sexual Reproduction in Plants

Revision Notes

- Flowers are main reproductive part of a plant. The main parts of a flower are : sepals, petals, stamens and carpel.
- Stamens and carpels are the reproductive parts of a flower which contain the germ cells. The male organ of a flower called 'stamen' makes the male gamete which are present in the pollen grain. The female organ of a flower called 'carpel' makes the female gamete, which are present in ovules of the plant.
- Flowers may be unisexual (*e.g.* papaya and watermelon) or bisexual (*e.g.* Hibiscus and mustard).
- **Pollination :** It is the transfer of pollen grain from the anther of a stamen to the stigma of a carpel. Pollination is of two types : self pollination and cross pollination.
- The transfer of pollens takes place by agent like wind, water or animals.
- After pollination, a pollen tube grows out of pollen grains, through which male germ cell reaches the ovary and fuses with the female germ cell.
- Fertilisation is the process of fusion of male and female gamete to produce zygote. It occurs inside the ovary.
- After fertilisation, ovary develops into fruit whereas ovules into the seed.
- **Double fertilisation :** It is a characteristic feature of flowering plants. In this process, out of the two sperm nuclei, one sperm nucleus fuses with the egg nucleus to form an embryo (process is called syngamy) and another fuses with the secondary nucleus to form an endosperm (process is called triple fusion).
- Because two kinds of fusion—syngamy and triple fusion—take place, the process is known as double fertilisation.

TOPIC-3
Reproduction in Human Beings

Revision Notes

- Humans have sexual mode of reproduction.
- It needs sexual maturation, which is the period of life when production of germ cells *i.e.,* ova (female) and sperm (male) start in the body. This period of sexual maturity is called purberty.
- **Changes at Puberty are :**

  (a) Common in male and female
  - Thick hair growth in armpits and genital area.
  - Skin becomes oily, may result in pimples.

  (b) In girls :
  - Breast size begins to increase.
  - Girls begin to menstruate.

  (c) In boys :
  - Thick hair grows on face.
  - Voice begins to crack.
  - These changes signals that sexual maturity is taking place.
- **Male Reproductive System**

  (a) Testes : A pair of testes are located inside scrotum which is present outside the abdominal cavity. Scrotum has a relatively lower temperature needed for the production of sperms.

  Functions of testes :
  - Produce male germ cells *i.e.,* sperms are formed here.
  - Testes release male sex hormone (testosterone). Its function is to :

    (i) Regulate production of sperms.

    (ii) Bring changes at puberty.

  (b) Vas deferens : It passes sperms from testes upto urethra.

  (c) Urethra : It is a common passage for both sperms and urine. Its outer covering is called penis. It is like a fibromuscular long tube which travels through penis. In women it is short of is just above vagina.

  (d) Associated glands : Seminal vesicles and prostate gland add their secretion to the sperms. This fluid provide nourishment to sperms and make their transport easy. Sperm along with secretion of glands form semen.
- **Female Reproductive System**

  (a) Ovary : A pair of ovary is located in both sides of abdomen.
  - Female germ cells *i.e.,* eggs are produced here.
  - At the time of birth of a girl, thousands of immature eggs are present in the ovary.
  - At the onset of puberty, some of these eggs start maturing.

  (b) Oviduct or Fallopian tube
  - Receives the egg produced by the ovary and transfer it to the uterus.
  - Fertilisation *i.e.,* fusion of gametes takes place here.

  (c) Uterus : It is a bag-like structure where development of the foetus takes place.
  - Uterus opens into vagina through cervix.
  - The embryo moves down to reach the uterus. The embedding of the embryo in the thick inner lining of the uterus is called **implantation**.
- The time period from the development of foetus inside the uterus till birth is called **gestation period**. The act of giving birth to the fully developed foetus at the end of gestation period is termed as **parturition**.

- The breakdown and removal of the inner, thick and soft lining of the uterus along with its blood vessels in the form of vaginal bleeding is called **menstrual flow** or **menstruation**.
- Reproductive health is all those aspects of general health which help a person to lead a normal, safe and satisfying reproductive life.
- **Sexually Transmitted Diseases (STDs)** are the diseases which spread by sexual contact from an infected person to a healthy person. Some common STDs are Gonorrhoea, syphilis, trichomoniasis, AIDS.
- There are different methods which are developed to prevent and control pregnancy such as mechanical methods, chemical methods, oral pills and surgical methods.
- **Contraception :** It is the avoidance of pregnancy, which can be achieved by preventing the fertilisation of ova.
- **Methods of contraception**

  (a) Physical barrier
  - To prevent union of egg and sperm.
  - Use of condoms, cervical caps and diaphragm.

  (b) Chemical methods
  - Use of oral pills.
  - These change hormonal balance of body so that eggs are not released.
  - May have side effects.

  (c) Intrauterine contraceptive device (IUCD)
  - Copper-T or loop is placed in uterus to prevent pregnancy.

  (d) Surgical methods
    - In males the vas deferens is blocked to prevent sperm transfer called vasectomy.
    - In females, the fallopian tube is blocked to prevent egg transfer called tubectomy.

Know the Terms

- **Reproduction :** It is the process of producing new individuals of the same species by existing organisms of a species *i.e.* parents.
- **Asexual reproduction :** It is the process of producing new organisms from a single parent without the involvement of sex cells or gametes.
- **Fission :** It is the simplest method of asexual reproduction in unicellular forms of life such as *Amoeba, Paramecium* and other protozoan.
- **Binary fission :** It is the division of one cell into two similar or identical cells.
- **Fragmentation :** It is an asexual reproduction in which a multicellular organisms accidentally breaks up into two or more small pieces of fragment. Upon maturation, each fragment gives rise to a new organism or plant.
- **Regeneration :** It is the ability of a fully differentiated organism to give rise to new individual organism from its body parts.
- **Vegetative method :** It is a method in which new plants are obtained from the vegetative parts of old plants such as stem, roots and leaves, without help of any reproductive organs.
- **Tissue culture :** It is the production or propagation of new plants from isolated plant cells or small pieces of plant tissue in a nutrient medium. This technique is also known as micro propagation, and in vitro culture because it takes place outside the body of the parent plant in a test tube in an artificial environment.
- **Sexual reproduction :** It is the process in which two sexes male and female are involved. The male sexual unit is known as male gamete or sperm while female sexual unit is termed as female gamete or ovum.
- **Pollination :** It is the transfer of pollen grain from the anther of a stamen to the stigma of a carpel.
- **Fertilization :** It is defined as the fusion of a male gamete (sperm) with a female gamete (an ovum) to form a zygote during sexual reproduction.
- **Zygote :** The cell which is formed by the fusion of a male gamete and female gamete is called **zygote**, *i.e.* it is a 'fertilized ovum' or 'fertilized egg.'
- **Embryo :** It is the stage of development between the zygote or fertilized egg and the newly formed offspring.

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Chapter - 9 : Heredity and Evolution

TOPIC-1

Heredity and Mendel's Contribution

Revision Notes

- Variations arise usually during the process of sexual reproduction. They may be few in asexual reproduction, but many in case of sexual reproduction.
- The minor variations arising during sexual reproduction are caused by slight inaccuracies in DNA copying. In sexual reproduction, variations are also caused by crossing over process during meiosis.
- Beneficial variations help the species to survive better in the environment.
- Nature selects the beneficial variations thereby leading to evolution.
- Reproduction produces offspring with similar body design of the parents. However, the offsprings are not identical, but show a great deal of variation from the parents.

Importance of Variation :

(i) Depending upon the nature of variations, different individuals would have different kinds of advantages.
e.g., Bacteria that can withstand heat will survive better in a heat wave.

(ii) Main advantage of variation to species is that it increases the chances of its survival in a changing environment.

Mendel and His Work on Inheritance

- **Gregor Johann Mendel (1833 & 1884) :** Started his experiments on plant breeding and hybridization. He proposed the laws of inheritance in living organisms.
- Mendel was known as the **Father of Genetics.**
- Plant selected by Mendel was *Pisum sativum* (garden pea). Mendel used a number of varieties of garden pea to studied the inheritance of seven pairs of contrast characters.
- **Seven pairs of contrast characters in garden pea, selected by Mendel were :**

Character	Dominant Trait	Recessive Trait
Flower colour	Violet	White
Flower position	Axillary	Terminal
Seed colour	Yellow	Green
Seed shape	Round	Wrinkled
Pod shape	Inflated	Constricted
Pod colour	Green	Yellow
Height of plant	Tall	Dwarf/Short

- Mendel conducted a series of experiments in which he crossed the pollinated plants to study one character (at a time).
- In case of monohybrid cross with pure line breeding varieties of plants, the phenotypic ratio obtained in F_2 generation was 3 : 1.
- In case of dihybrid cross *i.e.*, involving two pairs of contrasting characters, the phenotypic ratio obtained in F_2 generation was 9 : 3 : 3 : 1.
- Mendel concluded that out of any pair of contrasting characters, one is dominant *i.e.*, it makes it appearance in the hybrid while the other is recessive *i.e.*, the manifestation of the other is masked.
- The homozygous dominant trait is denoted by two capital letters whereas the homozygous recessive trait is denoted by two small letters.
- The factors or genes controlling a particular trait separate from each other during gamete formation. Hence, gamete is always pure as far as contrasting characters are considered. Each gamete will possess only one gene set.
- In crossing if two or more traits are involved, their genes assort independently, irrespective of the combinations present in the parents.
- Genes carry information for producing proteins, which in turn control the various body characteristics.

- For a particular trait, the offspring receives one allele from the father and one allele from the mother.
- The combination of the male and female germ cells gives a diploid zygote. Thus, the normal diploid number of chromosomes in the offspring is restored.
- Different mechanisms are used for sex determination in different species.

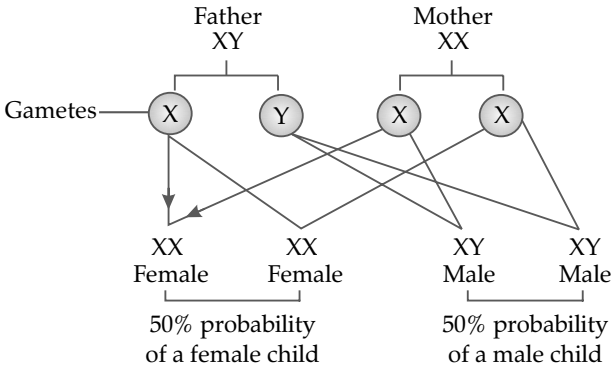
FACTORS

Responsible for sex Determination

Environmental → In some animals, the temperature at which the fertilized eggs are kept, decides the gender E.g., in turtle

Genetic → In some animals like human gender of individual is determined by a pair of chromosomes called sex chromosomes.
XX – Female
XY – Male

- **Sex Chromosomes :** In human beings, there are 23 pairs of chromosomes. Out of these 22 chromosomes pairs are called autosomes and the last pair of chromosome which helps in deciding sex of the individual is called sex chromosome.
- **Sex determination in human beings :**



TOPIC-2

Basic Concepts of Evolution

Revision Notes

Evolution :

- Evolution is the sequence of gradual changes which takes place in the primitive organisms, over millions of years, in which new species are produced.
- Genetic drift can alter gene frequencies in small population and provide diversity without any survival benefits.
- Several factors such as environment, mutations, reproduction, etc., can cause alterations in gene frequencies in a population over generations, leading to evolution.
- Changes occurring in the DNA of germ cells are heritable whereas changes taking place in the non-reproductive tissues are not inherited.
- Charles Darwin proposed that evolution of species occurred by natural selection, but he did not know the underlying mechanism.
- Natural selection, genetic drift, variations and geographical isolation can lead to speciation in sexually reproducing organisms.
- Gene flow between the members of a population prevents speciation.
- **The fundamental characteristics used to classify organisms are :**
  - **(i)** Presence of prokaryotic or eukaryotic cells.
  - **(ii)** Whether the organism is unicellular or multicellular.
  - **(iii)** Ability to perform photosynthesis.
  - **(iv)** Presence of endoskeleton or exoskeleton in heterotrophic organisms.

- Classification of living organisms is closely related to their evolution.
- Both evolution and classification are interlinked.
  1. Classification of species is reflection of their evolutionary relationship.
  2. The more characteristics two species have in common, the more closely they are related.
  3. The more closely they are related, the more recently they have a common ancestor.
  4. Similarities among organisms allow us to group them together and to study their characteristics.
- **Evidences of Evolution :**
  (a) **Homologous Organs :** These are the organs that have same structural plan and origin but different functions.
  (b) **Analogous Organs :** These are the organs that have different origin and structural plan but same function. Analogus organs provide mechanism for evolution. E.g., wings of bird and wings of insects.
  (c) **Fossils :** Fossils help in tracing evolutionary pathways. The age of fossils can be determined by using the relative method or the isotope dating method.
- Evolution is not a one-step process, but a continuous process occurring in several stages.
- Complex organs are formed slowly over many generations, sometimes with intermediate forms playing an important role.
- Sometimes the use of certain features gets modified with time. For example : Feathers may have provided insulation initially, but later became associated with flight.
- Evolutionary studies have shown that birds are closely related to reptiles.
- Humans have carried out artificial selection for various features of cabbage and produced different vegetables. Handogus organs provides evidences for evolution by telling us that they are derived from the same ancestor. *E.g.*, forelimb of frog, lizaard, bird and human being.

Vegetable produced	Selected feature
Broccoli	Arrested flower development
Cauliflower	Sterile flowers
Kohlrabi	Swollen parts
Kale	Larger leaves

- Molecular phylogeny can also be used to trace evolutionary relationships. Here, the DNA of different species is compared. Greater the differences in DNA, more distantly related are the species.
- Disappearance of the existing species is not a requirement for formation of new species.
- The new species formed are better adapted to the environment but they need not be superior to the existing species.
- The common ancestor of humans and chimpanzees evolved in different ways to produce the present forms.
- Evolution produces more diverse and complex body forms over a period of time, but the newly formed species are not more progressive than the already existing ones. So, it is wrong to say that evolution produces progressive higher forms from lower ones.
- All human beings, whether fair skinned or dark skinned, belong to the same species *i.e.*, *Homo sapiens* that originated in Africa.
- The human ancestors gradually migrated from Africa to various parts of the world such as Asia, Europe, Australia and America. Thus they spread to different parts of the earth and adapted as best as they could to their environmental conditions.

Know the Terms

- **F_1 generations :** The generations resulting immediately from a cross of the first set of parents (parental generation).
- **F_2 generations :** Offsprings resulting from a cross of the members of F_1 generation.
- **Dominant :** The gene which expresses itself if F_1 hybrid generation is known as dominant gene.
- **Recessive :** The gene which is unable to express itself in presence of the dominant gene.
- **Genotype :** It is the genetic constitution of an organism which determines the Phenotypic characters.
- **Phenotype :** It is the outward appearance of an individual.
- **Progeny :** The offspring produced as a result of reproduction of the parents.
- **Dominant trait :** A genetic trait is considered dominant if it is expressed in a person who has only one copy of that gene *i.e.* a trait which phenotypically expressed in heterozygote.

- **Recessive trait :** A genetic trait is considered recessive if it is expressed only when two copies of the recessive gene are present.
- **Homozygous :** Having two identical alleles of the same gene.
- **Heterozygous :** Having dissimilar alleles at corresponding chromosomal loci.
- **Monohybrid cross :** A type of cross in which only one pair of contrasting characters are considered.
- **Dihybrid cross :** A type of cross in which the inheritance of two pairs of contrasted characters is considered.
- **Allele :** Either of a pair (or series) of alternative forms of a gene that can occupy the same locus on a particular homologous pair of chromosome and that control the same character.
- **Somatic cells :** All cells forming the body of an organism, except the reproductive cells.
- **Sex chromosomes :** Either of a pair of chromosomes, usually designated X or Y, in the germ cells of most animals, that combine to determine the sex and sex-linked characteristics of an individual.
- **Gene :** A segment of DNA that is involved in producing a polypeptide chain and forms the basic unit of heredity.
- **Trait :** A trait is a distinct variant of a phenotypic character of an organism that may be inherited or environmentally determined.
- **Haploid cell :** Cell that has only one complete set of chromosomes.
- **Diploid cell :** Cell that has two sets of chromosomes, one of paternal origin, the other of maternal origin.
- **Micro-evolution :** Evolution resulting from small specific genetic changes that can lead to a new sub-species.
- **Genetic drift :** It refers to the random change in gene frequencies in a small population, presumably owing to change rather than natural selection, thereby providing diversity without any adaptations.
- **Speciation :** The process of formation of a new species.
- **Homologous organs :** Organs of different organisms which may be dissimilar externally and in function, but are similar in origin and in fundamental structural plan.
- **Analogous organs :** Organs of different organisms which are similar in function and external appearance, but dissimilar in origin and structural plan.
- **Fossils :** Any naturally preserved remains of ancient life or traces of any once living organisms that lived in geological age.
- **Molecular phylogeny :** The use of a gene's molecular characteristics to trace the evolutionary history of organisms.

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Unit -III : Natural Phenomena

Chapter - 10 : Light Reflection and Refraction

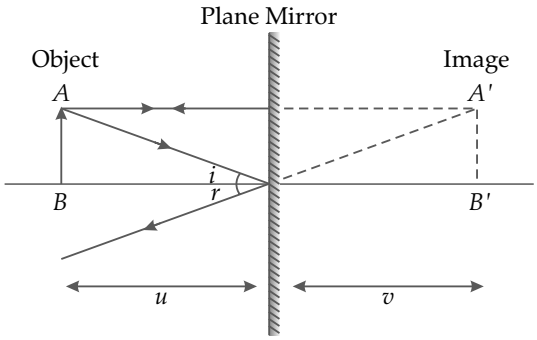
TOPIC-1

Reflection of Light, Image Formed by Spherical Mirrors

Revision Notes

- When light falls on a body, it may be absorbed, may be transmitted or light may get reflected back to the same medium.
- **Reflection of light** is the process of bouncing back the light rays which fall on the surface of an object.
- **Laws of Reflection :**
  - **(i)** The incident ray, the reflected ray, the normal lie in the same plane at the point of incidence.
  - **(ii)** The angle of incidence is equal to the angle of reflection.
- Real image is obtained when the rays of light after reflection or refraction actually meet at some point. It can be obtained on the screen and can be seen with the eye.

- Virtual image forms when rays of light do not actually meet, but appear to meet when produced backwards. It cannot be obtained on the screen.
- **Image Formed by plane Mirror :**



- **Characteristics of Image :**

  (i) Virtual and erect.

  (ii) Size of image is equal to the size of object.

  (iii) Image is formed as far behind the mirror as the object is in front of it.

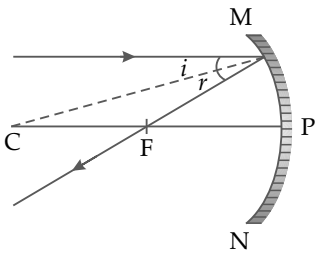
  (iv) Laterally inverted.
- **Lateral Inversion :** The phenomenon due to which the right side of the object appears as left and the left side of the object appears as right. *i.e.,* the image is inverted sideways.
- A spherical mirror whose reflecting surface recessed inward, is concave mirror.
- The spherical mirror, whose reflecting surface bulges towards light source, is a convex mirror.
- Concave mirror mostly forms real images, which can be obtained on the screen. Convex mirror always forms virtual images, which cannot be obtained on the screen.
- **Differentiating between a plane mirror, a concave mirror and a convex mirror, without touching them :**

  (i) If the image formed is erect and is of same size as that of object, then it is a plane mirror.

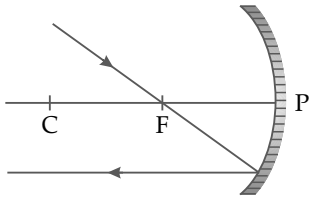
  (ii) If the image formed is erect but smaller in size then it is a convex mirror.

  (iii) If the image formed is erect but magnified when the mirror is close to the object, then it is a concave mirror.
- Solar concentrators use huge concave mirrors to focus large amount of solar energy thereby producing high temperature conditions in a solar power plant.
- The centre of the reflecting surface of a spherical mirror is a point called the pole of the mirror and is usually represented by P.
- The horizontal line passing through the centre of curvature and pole of the spherical mirror is known as principal axis.
- The centre of curvature of a spherical mirror is the centre of the hollow sphere of glass, of which the spherical mirror is a part and is usually represented by C.
- The radius of curvature of a spherical mirror is the radius of the hollow sphere of glass, of which the spherical mirror is a part and is usually represented by R.
- The diameter of the reflecting surface, *i.e.,* twice the radius is called its aperture.
- Radius of curvature (R) = 2 × focal length (f).
- **Rules for making ray diagrams by concave mirror :**

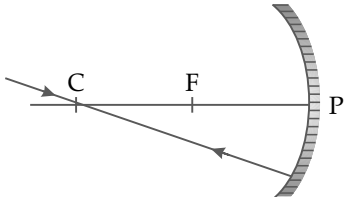
  (i) A ray parallel to the principal axis will pass through the principal focus, after reflection.



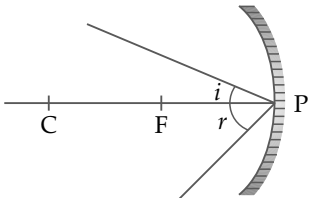
(ii) A ray passing through the principal focus of concave mirror will emerge parallel to principal axis after reflection.



(iii) A ray of light passing through the centre of curvature of a concave mirror is reflected back along the same path as it is a normally incident ray.



(iv) A ray incident obliquely to the principal axis of a concave mirror is reflected obliquely making equal angle.



➢ **Image formation by a concave mirror for different positions of the object :**

Position of Object	Position of Image	Size of Image	Nature of 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

➢ **Image formation by a convex mirror for different positions of the object :**

Position of Object	Position of Image	Size of Image	Nature of 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

➢ **Mirror Formula :**

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

Where, v = Image distance
u = Object distance
f = Focal length

➢ **Magnification of Spherical Mirrors :**

It is the ratio of the height of image to the height of object.

$$m = \frac{\text{Height of image}}{\text{Height of object}}$$

$$m = \frac{h_i}{h_o}$$

Also,

$$m = -\frac{v}{u}$$

If 'm' is negative, image is real.

If 'm' is positive, image is virtual.

If $h_i = h_o$ then $m = 1$, *i.e.*, image is equal to object.

If $h_i > h_o$ then $m > 1$ *i.e.*, image is enlarged.

If $h_i < h_o$ then $m < 1$ *i.e.*, image is diminished.

- Magnification of plane mirror is always + 1.

  '+' sign indicates virtual image.

  '1' indicates that image is equal to object's size.
- If 'm' is '+ve' and less than 1, it is a convex mirror.
- If 'm' is '+ve' and more than 1, it is a concave mirror.
- If 'm' is '–ve', it is a concave mirror.
- The phenomenon of change in the path of light from one medium to another is called refraction of light.
- The angle formed between the incident ray and the normal is called angle of incidence and the angle formed between the refracted ray and the normal is called angle of refraction.
- The cause of refraction is the change in the speed of light as it goes from one medium to another medium.
- Larger the difference in speed of light between the two media across the interface, the greater will be the deviation and vice-versa.
- When a ray of light passes from a rarer medium to a denser medium, it bends towards the normal. Also, the angle of incidence is greater than the angle of refraction.
- When a ray of light passes from a denser medium to a rarer medium, it bends away from the normal. Also, the angle of incidence is less than the angle of refraction.

Know the Terms

- **Ray and beam :** Light travels in a straight line–Rectilinear propagation. The straight line indicating the path of the light (arrow–direction) is called a ray. A bundle of rays originating from the same source of light in a particular direction is called a beam of light.
- **Parallel beam :** When the rays which constitute the beam are parallel to one–another, then it is called a parallel beam of light.
- **Convergent beam :** When the rays actually meet or appear to meet at a point, then the beam containing such rays are called convergent beam and rays are called convergent rays.
- **Divergent beam :** When the rays actually diverge or appear to diverge from a point, then the beam containing such rays are called divergent beam and rays are called divergent rays.
- **Image :** The point of convergence or the point from where the light appears to diverge after reflection or refraction is called image.
- **Aperture :** The width of the reflecting surface from which reflection takes place is called aperture.
- **Pole :** The central point of the reflecting spherical surface is called pole (P). It lies on the surface of the mirror.
- **Centre of curvature :** The centre of the hollow sphere of which the spherical mirror is a part, is called centre of curvature (C).
- **Radius of curvature :** The separation between the pole and the centre of the hollow sphere, of which the mirror is a part, is called radius of curvature (R).
- **Principal axis :** The straight line joining the pole and the centre of curvature is called principal axis.
- **Focus :** The point F on the principal axis, where a beam of light parallel to the principal axis actually meet after reflection or appear to come it from called its principal focus.
- **Focal length :** The distance between the pole and the focus is called focal length.

TOPIC-2
Refraction, Lenses and Power of Lens

Revision Notes

- **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.

- **Refractive index (n) :** The ratio of speed of light in a given pair of media,

$$n = \frac{\text{Velocity of light in medium 1}}{\text{Velocity of light in medium 2}}$$

  n_{21} means refractive index of second medium with respect to first medium and,

$$n_{21} = \frac{v_1}{v_2}$$

  n_{12} means refractive index of first medium with respect to second medium.

$$n_{12} = \frac{v_2}{v_1}$$

- **Absolute Refractive Index :** Refractive index of a medium with respect to vacuum or air.

$$n = \frac{c}{v} \text{ where, } c = 3 \times 10^8 \text{ ms}^{-1}$$

- Refractive index of one medium is reciprocal of other's refractive index in a given pair.

$$n_{12} = \frac{1}{n_{21}}$$

  If refractive index of medium 1 w.r.t. air is given as ${}_1n^{\text{air}}$ and,
  If refractive index of medium 2 w.r.t. air is given as ${}_2n^{\text{air}}$,

  Then, refractive index of medium 1 w.r.t. medium 2 $= \dfrac{{}_1n^{\text{air}}}{{}_2n^{\text{air}}} = {}_1n^2$

- Refractive index of diamond is the highest till date. It is 2.42. It means speed of light is $\dfrac{1}{2.42}$ times less in diamond than in vacuum.

- **Lens Formula :**

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

- **Magnification :**

$$m = \frac{h_i}{h_o}$$

  Also,

$$m = -\frac{v}{u}$$

- **Power of a lens :**

  It is defined as the reciprocal of focal length in meter.
  The degree of convergence or divergence of light rays is expressed in terms of power.

$$\text{Power} = \frac{1}{\text{Focal length (in meter)}} \text{ or P} = \frac{1}{f}$$

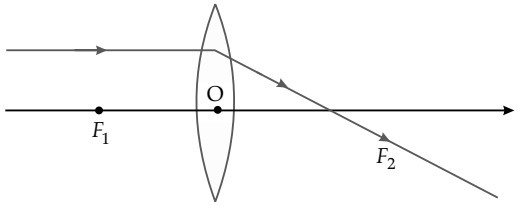
- SI unit of Power = dioptre = D,

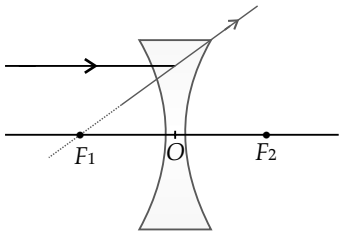
$$1 \text{ D} = 1 \text{ m}^{-1}$$

  1 dioptre is the power of lens whose focal length is one meter.

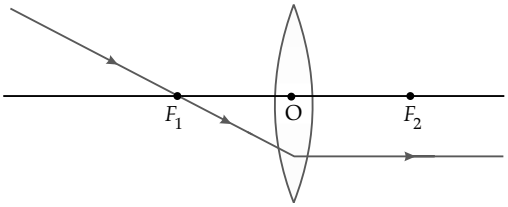
➢ Rules for making ray diagrams by lens :

(i) A ray of light from the object parallel to the principal axis.

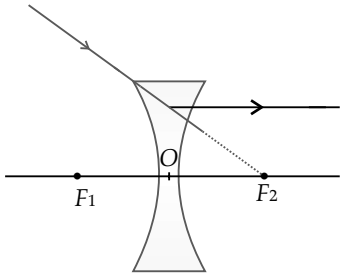




(ii) A ray of light passing through a principal focus.

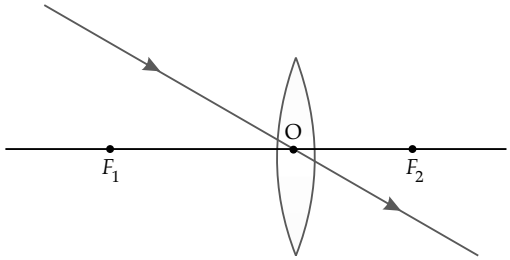


(a)



(b)

(iii) A ray of light passing through the optical centre.



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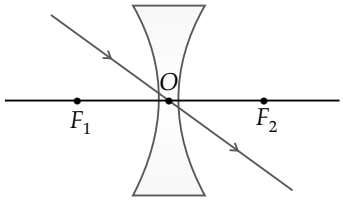

(b)

➢ **Nature, position and relative size of the image formed by a convex lens for various positions of the object :**

Position of the object	Position of the image	Relative size of the image	Nature of the image
At infinity	At 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	Infinitely large or highly enlarged	Real and inverted
Between focus F_1 and optical centre	On the same side of the lens as the object	Enlarged	Virtual and erect

➢ **Nature, position and relative size of the image formed by a concave lens for various positions of the object :**

Position of the object	Position of the image	Relative size of the image	Nature of the image
At infinity	At focus F_1	Highly diminished, point-sized	Virtual and erect
Between infinity and optical centre O of the lens	Between focus F_1 and optical centre O	Diminished	Virtual and erect

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Chapter - 11 : Human Eye and Colourful World

TOPIC-1

Human eye, Defects of vision and corrections

Revision Notes

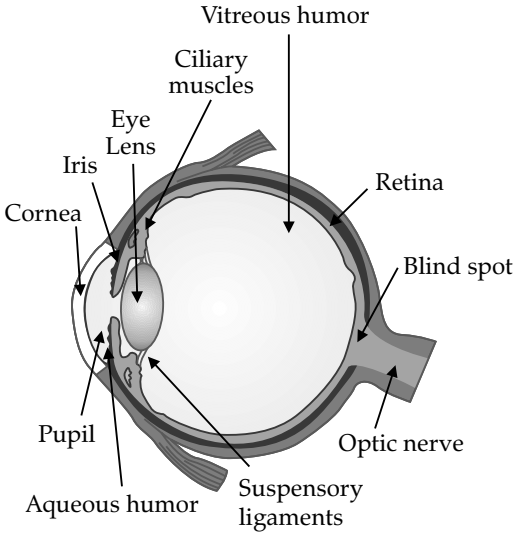
- Eye is a natural optical device using which human could see objects around him. It forms an inverted, real image on a light sensitive surface called retina.
- Rods and cones are the cells in retina, which are light sensitive. Rods respond to the intensity of light. Cones respond to the illumination of colours. There are around 125 million rods and cones. The cells generate signals which are transmitted to the brain through optical nerve.

Parts of Human Eye

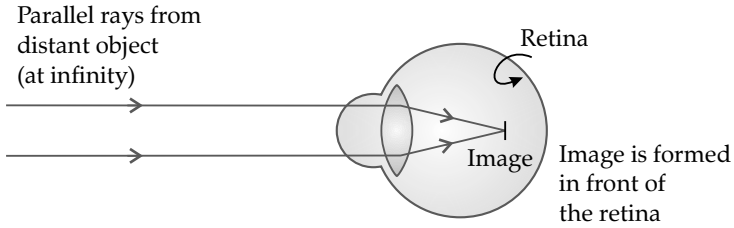
- **Cornea :** It is the outermost, transparent part. It provides most of the refraction of light.
- **Lens :** It is composed of a fibrous, jelly like material. It provides the focused, real and inverted image of the object on the retina. This convex lens converges light at retina.
- **Iris :** It is a dark muscular diaphragm that controls the size of the pupil.
- **Pupil :** It is the window of the eye. It is the central aperture in iris. It regulates and controls the amount of light entering the eye.
- **Retina :** It is a delicate membrane having enormous number of light sensitive cells.
- **Ciliary muscles :** These muscles change the shape and size of the eye lens for focusing.
- **Far point :** The maximum distance at which object can be seen clearly is far point of the eye. For a normal adult eye, its value is infinity.

Near point or Least distance of distinct vision

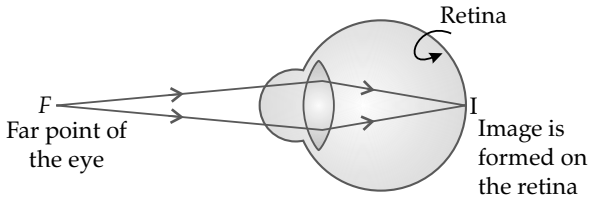
- The minimum distance at which objects can be seen most distinctively without strain.
  - For a normal adult eye, its value is 25 cm.
  - Range of human vision – 25 cm to infinity.
- **Accommodation :** The ability of the eye lens to adjust its focal length is called accommodation. Focal length can be changed with the help of ciliary muscles.



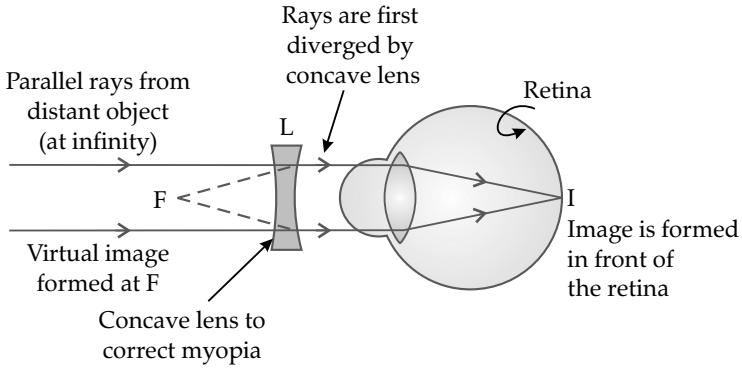
- **Myopia (Near-sightedness) :** Distant objects are not clearly visible. It is corrected by using concave lens.



(a) In a myopic eye, image of distant object is formed in front of the retina (and not on the retina)



(b) The far point (F) of a myopic eye is less than infinity.



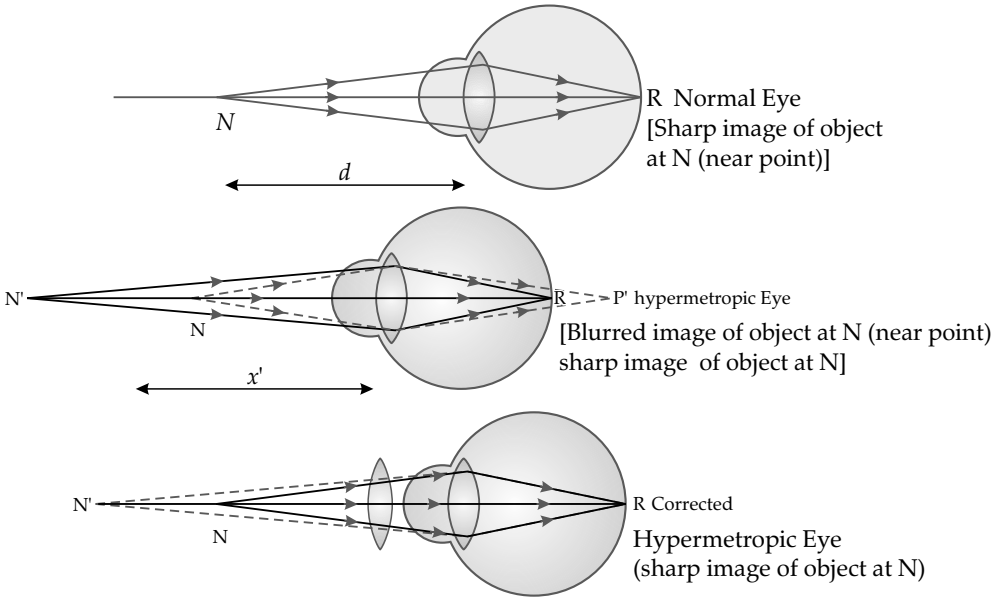
(c) Correction of myopia. The concave lens placed in front of the eye forms a virtual image of distant object at far point (F) of myopic eye.

Hypermetropia (far-sightedness) :

- Affected person can see far objects clearly but cannot see nearby objects clearly.
- The near point of the eye moves away from 25 cm.
- Image is formed behind the retina.

Correction :

- Use of convex lens of suitable power can correct the defect.



Presbyopia (Old age Hypermetropia) :

- It is the defect of vision due to which an old person cannot see the nearby objects clearly due to less power of accommodation of the eye.
  - The near-point of old person having presbyopia gradually recedes and becomes much more than 25 cm.

Know the Terms

- **Range of Vision :** The distance between far point and near point of the eye is called the range of vision.
- **Accommodation :** The ability of an eye lens to adjust its focal length by the action of ciliary muscles to get a clear and sharp image of the distant object as well as nearby object is called accommodation. For a person having normal vision, it is about 4 diopter.
- **Power of Accommodation :** The maximum variation in the converging power (focal length) of eye lens so that the far–off and nearby objects are viewed clearly is called power of accommodation.
- **Persistence of vision :** The time for which the impression or sensation of an object continues in the eye is called the persistence of vision. It is about $1/16^{th}$ of a second.

TOPIC-2

Refraction of Light through prism and Dispersion

Revision Notes

- The phenomenon of splitting of white light into its constituent colours on passing through a glass prism is called **dispersion of light**.
- Different colours undergo different deviations on passing through prism.
- If a second identical prism is placed in an inverted position with respect to the first prism, all the colours recombine to form white light.
- **Atmospheric refraction** is the phenomenon of bending of light on passing through earth's atmosphere.
- As we move above the surface of earth, density of air goes on decreasing.
- Light travelling from rarer to denser layers always bends towards the normal.
- Stars twinkle on account of atmospheric refraction.
- Sun appears to rise 2 minutes earlier and set 2 minutes later due to atmospheric refraction.
- The phenomenon in which a part of the light incident on a particle is redirected in different directions is called **scattering of light.**
- Very small particles scatter light of shorter wavelengths better than longer wavelengths.
- The scattering of longer wavelengths of light increases as the size of the particle increases.
- Larger particles scatter light of all wavelengths equally well.

Know the Terms

- **Prism :** Prism is a homogenous, transparent, refracting material, such as glass, enclosed by two inclined plane refracting surfaces, at some fixed angle, called refracting angle or angle of prism. It has two triangular bases and three rectangular lateral surfaces which are inclined to each other.
- **Angle of Refraction :** The angle between the refracted ray and the normal is called angle of refraction ($\angle r$).
- **Angle of Emergence :** The angle between the emergent ray and normal at the second refracting face of the prism is called angle of emergence ($\angle$e).
- **Angle of Deviation :** The angle formed between the incident ray produced in the forward direction and emergent ray produced in the backward direction in the refraction through the prism is called angle of deviation ($\angle\delta$).
- **Dispersion :** The splitting up of white light into its constituent colours is called dispersion. It occurs because refraction or bending differs with the colour.
- **Atmospheric Refraction :** Change in the direction of propagation of light rays travelling through the atmosphere due to change in density of the different layers of air is called atmospheric refraction.
- **Scattering of Light :** The phenomenon of change in the direction of propagation of light caused by the large number of molecules, such as smoke, tiny water droplets, suspended particles of dust and molecules of air present in the earth's atmosphere is called scattering of light.
- **Tyndall effect :** The phenomenon of scattering of light by the colloidal particles is known as tyndall effect.

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Unit -IV : Effects of Current

Chapter - 12 : Electricity

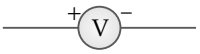
TOPIC-1
Electric Current

Revision Notes

- **Static and Current Electricity :** Static electricity deals with the electric charges at rest while the current electricity deals with the electric charges in motion.
- **Electric Current :** The electric current is defined as the rate of flow of electric charge through any cross section of a conductor.

$$\text{Electric current} = \frac{\text{Charge}}{\text{Time}} \quad \text{or} \quad I = \frac{Q}{t}$$

  Electric current is a scalar quantity.
- **Ampere :** It is the SI unit of current. If one coulomb of charge flows through any cross-section of a conductor in one second, then current through it is said to be one ampere.
- **Electric circuit :** The closed path along which an electric current flows is called an 'electric circuit'.
- **Conventional direction of current :** Conventionally, the direction of motion of positive charges through the conductor is taken as the direction of current. The direction of conventional current is opposite to that of the negatively charged electrons.
- **Electrochemical or voltaic cell :** It is a device which converts chemical energy into electrical energy.
- **Galvanometer :** It is a device to detect current in an electric circuit.
- **Ammeter :** It is a device to measure current in a circuit. It is a low resistance galvanometer and is always connected in series in a circuit.
- **Voltmeter :** It is a device to measure the potential difference. It is a high resistance galvanometer and is always connected in parallel to the component across which the potential difference is to be measured. Symbol is,



- **Ohm's Law :** The current through a conductor between two points is directly proportional to the voltage across the two points provided external conditions remain constant.

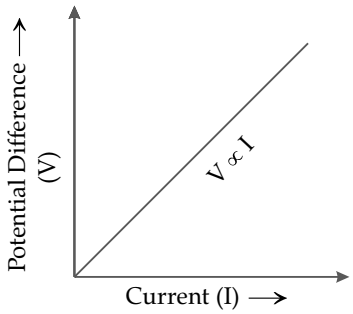
  (i) Mathematical expression for Ohm's law :

  $I \propto V$

  $I = SV \Rightarrow V = IR$ (Where R = Resistance)

  S is a constant called conductance for a given conductor.

  (ii) V-I graph for Ohm's law :



- **Resistance (R) :** It is the property of a conductor to resist the flow of charges through it.

  (i) Ohm (Ω) : S. I. unit of resistance.

  (ii) $1 \text{ ohm} = \dfrac{1 \text{ volt}}{1 \text{ ampere}}$

- When potential difference is 1 V and current through the circuit is 1 A, then resistance is 1 ohm.
- **Rheostat :** Variable resistance is a component used to regulate current without changing the source of voltage.
- **Factors on which the Resistance of a Conductor depends :** Resistance of a uniform metallic conductor is,
  - **(i)** Directly proportional to the length of conductor,
  - **(ii)** Inversely proportional to the area of cross-section,
  - **(iii)** Directly proportional to the temperature and
  - (iv) Depend on nature of the material.
- **Resistivity (ρ) :** It is defined as the resistance offered by a cube of a material of side 1 m when current flows perpendicular to its opposite faces.
  - **(i)** Its S.I. unit is ohm-metre (Ωm).
  - **(ii)** Resistivity does not change with change in length or area of cross-section but it changes with change in temperature.
  - **(iii)** Range of resistivity of metals and alloys is 10^{-8} to 10^{-6} Ωm.
  - **(iv)** Range of resistivity of insulators is 10^{12} to 10^{17} Ωm.
  - **(v)** Resistivity of alloy is generally higher than that of its constituent metals.
  - **(vi)** Alloys do not oxidize (burn) readily at high temperature, so they are commonly used in electrical heating devices.
  - **(vii)** Copper and aluminium are used for electrical transmission lines as they have low resistivity.

Know the Terms

- **Frictional Electricity :** It is the electricity produced by rubbing two suitable bodies and flow of electrons from one body to other.
- **Electricity :** A fundamental form of energy observable in positive and negative forms that occurs naturally (as in lightning) or is produced (as in a generator) and that is expressed in terms of the movement and interaction of electrons.
- **Ohm :** It is the SI unit of resistance. A conductor has a resistance of one ohm if a current of one ampere flows through it on applying a potential difference of 1 volt across its ends.

$$1 \text{ ohm} = \frac{1 \text{volt}}{1 \text{ ampere}} \quad \text{or} \quad 1\,\Omega = \frac{1\text{V}}{1\text{ A}}$$

- **Resistor :** A conductor which has some appreciable resistance is called a 'resistor'.

TOPIC-2

Resistance in Series and Parallel Combination, Electric Power and Heating Effect

Revision Notes

- **Resistances in series :** When two or more resistances are connected end to end so that same current flows through each one of them in turn, they are said to be connected in series. Here, the total resistance is equal to the sum of the individual resistances.

$$R_s = R_1 + R_2 + R_3 + ...$$

- **Resistances in parallel :** When two or more resistances are connected across two points so that each one of them provides a separate path for current, they are said to be connected in parallel. Here, the reciprocal of their combined resistance is equal to the sum of the reciprocals of the individual resistances.

$$\frac{1}{R_P} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ...$$

- **Heating effect of current** : When an electric current is passed through a conductor, heat is produced in it. This is known as heating effect of current.
- **Joule's law of heating :** It states that the heat produced in a conductor is directly proportional to **(i)** the square of the current I through it, **(ii)** its resistance R and **(iii)** the time *t*, for which current is passed. Mathematically, it can be expressed as :

$$H = I^2 Rt \text{ joule} = \frac{I^2Rt}{4.18} \text{cal}$$

or $$H = VIt \text{ joule} = \frac{VIt}{4.18} \text{cal}$$

- **Practical application of the heating effect of electric current :**
  It is utilised in the electrical heating appliances such as electric iron, room heaters, water heaters etc. The electric heating is also used to produce light as in an electric-bulb.
- **Electric energy :** It is the total work done in maintaining an electric current in an electric circuit for a given time.
  Electric energy, $W = VIt = I^2Rt$ joule
- **Electric Fuse :** It is a safety device that protects our electrical appliances in case of short circuit or overloading.
  (i) Fuse is made up of pure tin or alloy of copper and tin.
  (ii) Fuse is always connected in series with live wire.
  (iii) Fuse has low melting point.
  (iv) Current capacity of fuse is slightly higher than that of the appliance.
- **Electric Power :** The rate at which electric energy is consumed or dissipated in an electric circuit :

$$P = VI$$

$$P = I^2R = \frac{V^2}{R}$$

- S.I. unit of power = Watt (W)
  1 Watt = 1 Volt × 1 ampere
- Commercial unit of electric energy = Kilo Watt hour (KWh)
  1 kWh = 3.6×10^6 J
  1 kWh = 1 unit of electric energy
- **Electrical power :** Electrical power is the rate at which electric energy is consumed by an appliance.

$$P = \frac{W}{t} = VI = I^2R = \frac{V^2}{R}$$

- **Watt :** It is the SI unit of power. The power of an appliance is 1 watt if one ampere of current flows through it on applying a potential difference of 1 volt across its ends.

$$1 \text{ watt} = \frac{1 \text{ joule}}{1 \text{ second}} = 1 \text{ volt} \times 1 \text{ ampere}$$

or $$1 \text{ W} = 1 \text{Js}^{-1} = 1 \text{VA}$$

$$1 \text{ kilowatt} = 1000 \text{ W.}$$

- **Kilowatt hour :** It is the commercial unit of electrical energy. One kilowatt hour is the electrical energy consumed by an appliance of 1000 watts when used for one hour.

$$1 \text{ kilowatt hour (kWh)} = 3{\cdot}6 \times 10^6 \text{ J}$$

- **Power rating :** The power rating of an appliance is the electric energy consumed per second by the appliance when connected across the marked voltage of the mains.
- **Efficiency of an electrical device :** It is the ratio of the output power to the input power.

$$\text{Efficiency, } \eta = \frac{\text{Output power}}{\text{Input power}}$$

Know the Terms

- **Semiconductors :** Materials having resistivity between that of an insulator and a conductor are called semiconductors. They are used in making integrated circuits.
- **Superconductors :** These are certain materials that lose their resistivity at low temperature. Such materials are called as superconductors. The phenomenon of complete loss of resistivity by substances below a certain temperature is called superconductivity.
- **Fuse Wire :** The wire which melts, breaks the circuit and prevents the damage of various appliances in the household connections. It is connected in series and its thickness determines the maximum current that can be drawn. It is made of an alloy of aluminium, copper, iron and lead.

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Chapter - 13 : Magnetic Effects of Electric Current

TOPIC-1
Magnetic Effects of Electric Current

Revision Notes

- The black ore of iron (Fe_3O_4) called magnetite, capable of attracting similar pieces of iron is called lodestone. They are naturally existing magnets used by human to find the directions.
- There are two poles of a magnet namely North pole and South pole. Like poles repel each other, while unlike poles attract each other.
- H.C. Oersted, a Danish physicist first noticed the magnetic effect of electric current. According to him, a needle kept near the wire carrying current will deflect due to the magnetic field produced. Any change in the direction of current will show variation in the deflection.
- Magnet is any substance that attracts iron or iron-like substances.

Properties of magnet

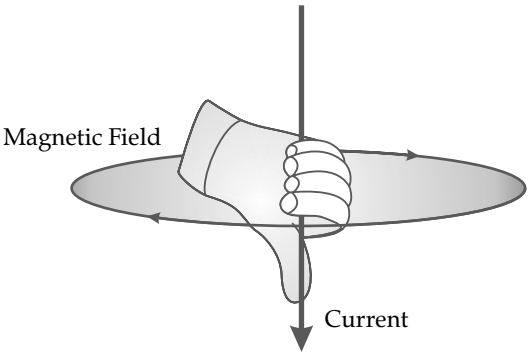
(i) Every magnet has two poles *i.e.*, North and South.
(ii) Like poles repel each other.
(iii) Unlike poles attract each other.
(iv) A freely suspended bar magnet aligns itself in nearly north-south direction, with its north pole towards north direction.

- The substances which are attracted by a magnet are called **magnetic substances**. **Examples :** Iron, nickel, cobalt, steel. The substances which are not attracted by a magnet are called non-magnetic substances. Examples : wood, glass, copper, aluminium, brass, paper etc.
- **Magnetic Field :** The area around a magnet in which its magnetic force can be experienced.
  - Its SI unit is tesla (T).
  - Magnetic field has both magnitude and direction.
  - Magnetic field can be described with help of a magnetic compass.
  - The needle of a magnetic compass is a freely suspended bar magnet.
- **Characteristics of Field Lines**

(i) Field lines arise from North pole and end into South pole of the magnet.
(ii) Field lines are closed curves.
(iii) Field lines are closer in stronger magnetic field.
(iv) Field lines never intersect each other as for two lines to intersect, there must be two north directions at a point, which is not possible.
(v) Direction of field lines inside a magnet is from South to North.
(vi) The relative strength of magnetic field is shown by degree of closeness of field lines.

Right Hand Thumb Rule

- Imagine you are holding a current carrying straight conductor in your right hand such that the thumb is pointing towards the direction of current. Then the fingers wrapped around the conductor give the direction of magnetic field.



Magnetic Field Due to Current through a Straight Conductor

- It can be represented by concentric circles at every point on conductor.
- Direction can be given by right hand thumb rule or compass.
- Circles are closer near the conductor.
- Magnetic field $\propto$ Strength of current
- Magnetic field $\propto \dfrac{1}{\text{Distance from conductor}}$

Magnetic Field Due to Current through a Circular Loop

- It can be represented by concentric circle at every point.
- Circles become larger and larger as we move away.
- Every point on wire carrying current would give rise to magnetic field appearing as straight line at centre of the loop.
- The direction of magnetic field inside the loop is same.

Factors affecting magnetic field of a circular current carrying conductor

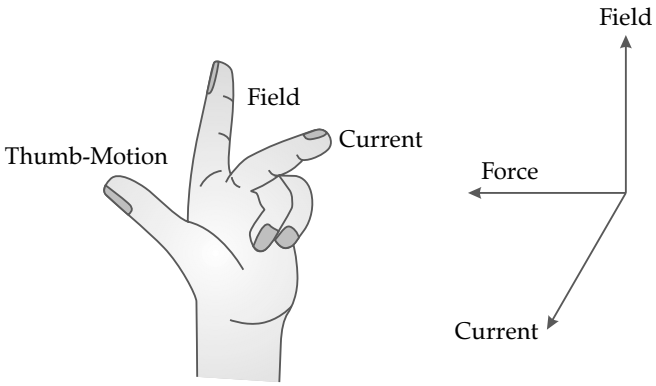
- Magnetic field $\propto$ Current passing through the conductor

  Magnetic field $\propto \dfrac{1}{\text{Distance from conductor}}$

  Magnetic field $\propto$ No. of turns in the coil

  Magnetic field is additive in nature *i.e.*, magnetic field of one loop adds up to magnetic field to another loop. This is because the current in each circular turn has some direction.
- A coil of large number of turns closely wound on a hollow cylinder of insulated material or otherwise is called a **solenoid**. The end of the solenoid having clockwise current will act as south pole-field enters into, while on the other hand having anti-clockwise current will act as north pole-field comes out. Thus, a solenoid acts as a normal magnet.
- **Permanent magnets :** They are made of carbon steel, chromium steel, tungsten steel and some alloys like Alnico and Nipermag. Alnico is an alloy of aluminium, nickel and cobalt.
- When a material is placed inside a coil carrying current, it will get magnetised. A bunch of nails or an iron rod placed along the axis of the coil can be magnetised by the current allowed to pass through the coil. Such magnets are called electromagnets.
- **Ampere** suggested that when a current I passes through a conductor of length l placed in a perpendicular magnetic field B, then the force experienced is given by $F = IBl \sin\theta$, where θ is the angle between the length of the conductor and magnetic field.
- **Fleming's Left Hand Rule**

  Stretch the thumb, fore finger and middle finger of your left hand such that they are mutually perpendicular. If fore finger points in the direction of magnetic field, middle finger in the direction of current then thumb will point in the direction of motion or force.



Know the Terms

- When a bar magnet is placed on a cardboard and iron-filings are sprinkled, they will arrange themselves in a pattern of lines known as **magnetic field lines**.
- The area around a magnet in which its effect can be experienced is called **magnetic field.**
- When electric current flows through a conductor, a magnetic field is produced around it. This is called **magnetic effect of current**.

- An **electromagnet** is a solenoid coil that attains magnetism due to the flow of current. It works on the principle of magnetic effect of current.
- The production of electric current due to relative motion between a conductor and a magnetic field is called **electromagnetic induction.** Electric current produced due to this phenomenon is called **induced current.**
- When the current flowing through a coil changes, then the current is induced in the coil itself. This phenomena is called **self-induction**.

TOPIC-2
Electric Generator and Electric Motor

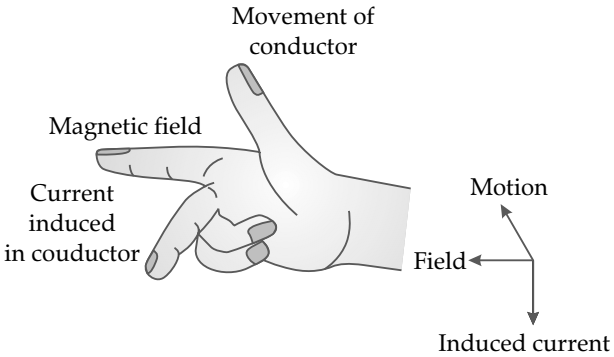
Revision Notes

- **Electric motor :** It is a device used to convert electrical energy to mechanical energy. It works on the principle that force is experienced by a current carrying conductor in a magnetic field.
- **Faraday's Law :** The rate at which the magnetic flux linked with a coil changes, produces the induced emf or current. More the rate, more the current and vice-versa.

$$I = \frac{\Delta\phi}{R \times \Delta t} = \frac{\text{Change in flux}}{\text{Resistance} \times \text{Time}}$$

- **Fleming's Right Hand Rule**

  Hold the thumb, the fore finger and the middle finger of right hand at right angles to each other. If the fore finger is in the direction of magnetic field and the thumb points in the direction of motion of conductor, then the direction of induced current is indicated by middle finger.



- Generator works on the principle of Electromagnetic Induction. It converts the mechanical energy available into electrical energy. A.C. Generator produces potential which reverses after every 180° rotation of the coil. D.C. Generator produces unidirectional current.

Domestic Electric Circuits

- An electric circuit consists of three main wiring components :
  - **(i)** Live wire (positive) with red insulation cover.
  - **(ii)** Neutral wire (negative) with black insulation cover.
  - **(iii)** Earth wire with green insulation cover.
- The potential difference between live and neutral wire in India is 220 V.
- Pole → Main supply → Fuse → Electricity meter → Distribution box → To separate circuits.

Know the Terms

- **Magnetic flux :** It is defined as the product of the magnetic field and the area through which magnetic field passes perpendicularly. $\phi = NBA$, when field passes perpendicular to the plane of the coil. It is measured in weber. If B and A are at angle θ, $\phi = NBA \cos\theta$, where N is the number of turns.
- If the current always flows in the same direction, it is called **direct current**. DC can be obtained from a cell or a battery. The positive and negative polarities of DC are fixed.
- If the current changes direction after equal intervals of time it is called **alternating current**. The positive and negative polarities of AC are not fixed.

- Connecting the outer frame of an appliance to earth to avoid any shock caused by fault or current leakage is called **earthing**.
- The coil having multiple turns used in electric motor or generator is called **armature**.
- **Fuse** is a safety device commonly used in electric circuits. It is connected with the live wire.

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Unit -V : Natural Resources

Chapter - 14 : Sources of Energy

TOPIC-1
Sources of Energy

Revision Notes

- Any system from where energy can be trapped is called a source of energy. A good source of energy is capable of providing adequate amount of energy. It should be convenient to use and easy to store and transport.
- **Law of Conservation of Energy :** Energy can neither be created nor be destroyed, but can be transformed from one form to another.
- **Qualities of a Good Source of Energy :**
  (i) Energy which could do a large amount of work per unit mass or volume.
  (ii) Cheap and easily accessible and provides energy for the maximum period of time.
  (iii) Easy to store and transport.
  (iv) Safe to handle and use.
  (v) Does not cause environmental pollution.
- **Fuel :** The material which is burnt to produce heat energy is known as fuel. *e.g.*, wood, coal, LPG, kerosene.
- **Characteristics of a Good Fuel :**
  (i) High calorific value (give more heat per unit mass).
  (ii) Burn easily in air at a moderate rate without giving out any smoke or harmful gases.
  (iii) Easy to handle, safe to transport.
  (iv) Convenient to store.
  (v) Burn smoothly and does not leave behind any undesirable substances.
  (vi) Less expensive.
- **Conventional Sources of Energy :** Sources of energy which are used since a long time. e.g., fossil fuels, biomass, energy of moving water, wind energy etc.

  I. Fossil Fuels :
  - Fuels developed from the fossils *e.g.*, coal, petroleum.
  - Take million of years to form.
  - Available in very limited amount.
  - Fossil fuels are non-renewable sources of energy.
  - Burning of fossil fuels leads to air pollution and green-house effect.

  II. Thermal power plants
  - In thermal power plants, fossil fuels like coal are burnt to produce heat energy, which is converted into electrical energy. For example, fossil fuels are burnt to heat up water to produce steam which in turn runs turbine to generate electricity. The flow of energy is as listed below :

    Fossil fuels—Heat Energy—Mechanical Energy—Electrical Energy.

  III. Hydro power plants :
  - Hydro power plants, convert the potential energy of falling water into electricity. The energy of water flowing through rivers has been used for rotating the wheels of watermills operating in remote hilly areas.

- **Dams :** High rise dams are constructed on the river to collect water in large reservoirs. This water is then carried through pipes to the turbines, at the bottom of the dam to generate electricity.

IV. Biomass

- The dead part of plants, trees and the waste materials of animals and man are called **Biomass.** Normally, biomass has low calorific value and produce lot of smoke when they are burnt.

(1) Wood : It is a biomass and used as a fuel for a long time.

Disadvantages :

- Produces a lot of smoke on burning.
- Do not produce much heat.

(2) Charcoal : When wood is burnt in limited supply of air, then water and other volatile materials gets removed and charcoal is formed.

$$\text{Wood} \xrightarrow{\text{Limited Supply of } O_2} \text{Charcoal}$$

Charcoal is better fuel than wood because :

(i) It has high heat generation capacity (or higher calorific value) than wood.

(ii) It does not produce smoke while burning.

(iii) Is is a compact fuel, easy to handle than wood and convenient to use.

(3) Cow dung : Cow dung is an efficient and cheap good fuel. However, it is not good to burn cowdung directly as fuel because,

- It produces a lot of smoke.
- It does not burn completely, produces lot of ash as residue.
- It has low calorific value.

(4) Biogas : Biogas is produced by decomposing cow-dung, various plant materials like the residue after harvesting the crops, vegetable waste and sewage in a biogas plant. Bio-gas is used for lighting, cooking in the rural areas while the slurry left behind is used as excellent manure, rich in nitrogen and phosphorus.

(5) Wind Energy : The kinetic energy of the wind can be used to generate dectricity. The rotatory motion of the windmill is used to turn the turbine of the electric generator.

The output of a number of windmills in a farm in coupled together to get electricity on a commercial scale.

TOPIC-2

Alternative or Non-Conventional Sources of Energy

Revision Notes

Alternative or Non-conventional Sources of Energy

- Non-conventional energy sources are energy sources that are infinite, natural and restorable. e.g., tidal energy, solar energy.
- **Reasons for alternate source of energy :**

  (i) To reduce the pressure on fossil fuels making them last for a much longer time.

  (ii) To reduce the pollution level and to save the environment.

I. Solar Energy :

- Sun is the ultimate source of energy.
- Energy obtained from the sun is called solar energy. A large number of devices like solar cooker, solar furnaces, solar cells and solar water heaters utilizes solar energy directly.
- **Solar Cooker :** A black surface absorbs more heat than a white surface. Solar cookers and solar heaters use this property. A solar cooker is covered with a glass plate and have a mirror to focus sun rays.
- **Solar cell :** It is a device which converts solar energy *i.e.*, light energy directly into electricity. They are made up of semi-conductors like–silicon, germanium and selenium. A solar cell can develop a voltage of 0.5–1 V and can produce only about 0.7 W of electricity. However a number of solar cells are combined to form solar panel to produce enough amount of electricity.
- **Solar cell panel :** It absorbs sunlight as a source of energy to generate electricity. It comprises a large number of photo voltaic solar cells and can provide much higher power for many uses.

II. Energy from the Sea :

- **Ocean Thermal Energy (OTE)** : There is always a temperature difference between water at the surface and at deeper level up to 20°C. This form of energy is called ocean thermal energy which can be converted into electricity.
- **Wave Energy :** Energy from oceans is also available in the form of sea-waves. Due to blowing of wind on the surface of ocean, very fast sea-waves move on its surface. It has lot of kinetic energy due to high speed. Energy possessed by huge waves near the seashore can be trapped to generate electricity.
- **Tidal Energy :** The rise of ocean water due to attraction of moon is called '**high tides**' whereas fall of ocean water is called '**low tides**'. The difference in sea-levels gives us tidal energy. A turbine fixed at the opening of the dam constructed across narrow opening of the sea converts tidal energy to electricity.
- **Geothermal Energy :** The heat from inside the earth heats up the water below the surface. This hot water can be used under favourable conditions as a source of energy. This energy with hot water below the earth is called geothermal energy. This energy is used to run a turbine to produce electricity.

III. Nuclear energy :

- **Nuclear Energy :** The nucleus of a heavy atom such as uranium, plutonium or thorium when bombarded with low-energy neutrons, can be split apart into lighter nuclei. This reaction is called nuclear fission. In this reaction, a tremendous amount of energy is released. This energy is called nuclear energy. The released energy can be used to produce steam and further generate electricity. When nuclear fission reaction takes place, neutrons that are released are made to bombard other uranium nuclei to produce more fission. Such self-sustained reactions are called chain reactions.
- Disadvantages of nuclear power generation are complexity in storage and disposable of fuel, environmental contamination and risk of accidental leakage of radiations.

Know the Terms

- **Fossil fuels :** The fuels which are obtained from the remains of plants and animals are called **fossil fuels**, *e.g.*, coal, petroleum and natural gas.
- **Biomass :** The material contained in the bodies of plants and animals is called **biomass**. It acts as a fuel.
- **Conventional or Non-Renewable Sources** : Energy sources which are used traditionally for many years and are to deplete over a period of time are called conventional or non-renewable sources. *e.g.*, coal, petroleum, natural gas etc.
- **Non-Conventional or Renewable Sources :** Energy sources which do not deplete and are scarcely used by the population are called non-conventional or renewable sources *e.g.*, Solar energy, wind energy, tidal energy etc.
- **Solar constant :** The amount of solar energy received per square meter per second on the surface of earth is called **solar constant**. It is approximately 1.4 (kJ/m^2s).
- **Wavelength :** Length of a wave or separation between two points in successive waves which are in same phase is called wavelength. It is expressed in meter.
- **Frequency :** The number of wave motions in one second is called frequency. It is expressed in Hertz (Hz).
- **Nuclear fission reaction :** The action in which a heavy nucleus of an atom splits into two or more smaller nuclei as fission product, with the evolution of large amount of energy when it is bombarded with slow moving neutron is called **nuclear fission**.
- **Chain reaction :** A nuclear reaction in which the bombarding particle is obtained as one of the product, due to which the reaction once initiated proceeds on its own is called a **chain reaction**.
- **Nuclear fusion reaction :** A reaction in which two or more lighter nuclei fuse to form a heavy nucleus and large amount of energy is given out is called nuclear **fusion reaction**.

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Chapter - 15 : Our Environment

TOPIC-1
Ecosystem and Food Chain

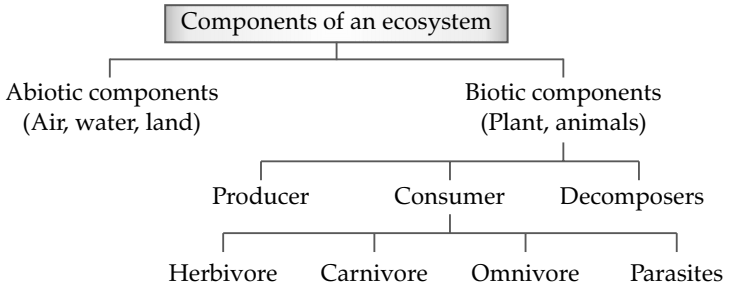
Revision Notes

- Everything that surrounds us is environment. It includes both living (biotic) and non-living (abiotic) components.
- Interaction between these biotic and abiotic components forms an ecosystem.

- In an ecosystem, living components depend on each other for their food which gives rise to food chains and food webs in nature.
- Human activities lead to environmental problems such as depletion of ozone layer and production of huge amount of garbage.
- **Ecosystem :** All the interacting organisms in an area together with the non-living constituents of the environment form an ecosystem. *E.g.*, forest, pond etc.
- **Types of Ecosystem** : It is of two types :

  (a) Natural Ecosystem : The ecosystem which exists in nature on its own. *E.g.*, forest, lake, ocean, etc.

  (b) Artificial Ecosystem : Man-made ecosystem is called artificial ecosystem. *E.g.*, crop field, aquarium, garden, etc.



- Herbivores, carnivores, omnivores and parasites are the various type of consumers.
- **Consumers** are those organisms which depend upon the producers for food, either directly or indirectly by feeding on other consumers for their sustenance. They are also called heterotrophs.
- **Parasites** are those organisms that live outside (ectoparasites) or inside (endoparasites) the body of another organism, *i.e.*, host *e.g.*, parasites of human include fleas and lice.
- **Decomposers** are those micro-organisms that obtain energy from the chemical break down of dead organisms or animals or plant wastes. Decomposers break down the complex organic substances into simple inorganic substances that go into the soil and are used up again by the plants.
- Food chain is the sequence of organisms through which food energy flows in an ecosystem. It is a succession of organisms that eat other organisms and may, in turn, be eaten themselves. **Examples :**

  Grass → Grasshopper → Frog → Snake → Eagle

  (Producer) (Herbivore) (Carnivore) (Carnivore) (Top Carnivore)
- **Trophic Levels** are the various steps or levels in the food chain where transfer of food or energy takes place. Producers are the first trophic level, herbivores are the second trophic level, carnivores or secondary consumers are the third trophic level and large carnivores or tertiary consumers are the fourth trophic level.
- **Food Web** is the network of various food chains which are interconnected at various trophic levels. Since an organism can occupy position in more than one food chain, in a food web it occupies more than one trophic level. It represents the feeding relationship within the community.
- **Energy Flow :** The flow of energy through different steps in the food chain is unidirectional. This means that the energy that is captured by the autotrophs does not revert back to the solar input and the energy which passes to the herbivores does not come back to autotrophs.
- **10 Percent Law** : It states that only 10 per cent of food energy is transferred from one trophic level to the next level. The remaining 90 per cent energy is used in life processes (digestion, growth, reproduction, etc.) by the present trophic level.
- Due to this gradual decrease in energy, food chains contain 3 - 4 trophic levels.
- **Biological Magnification :** The concentration of harmful chemicals goes on increasing with every next trophic level in a food chain. This is called as biological magnification.
- Maximum concentration of such chemicals get accumulated in human bodies as human occupy the top level in any food chain.

TOPIC-2

Biodegradable and Non–Biodegradable Substances and Global Warming

Revision Notes

- Ozone (O_3) is an isotope of oxygen *i.e.*, it is a molecule formed by three atoms of oxygen. Ozone performs an essential function of shielding the surface of the earth from ultraviolet radiation of the sun.

$$O_2 + O \longrightarrow O_3$$

- Ozone layer is a layer of the earth's atmosphere in which most of the atmosphere's ozone is concentrated.
- Ozone layer protects the earth from harmful UV radiations.
- There are several reasons for depletion of the ozone layer.
- The foremost is the use of chlorofluorocarbons (CFCs). The other factor responsible for ozone destruction is the pollutant nitrogen monoxide (NO).
- When the harmful chemicals like chlorofluorocarbons (CFCs) are released into the air, it accumulates in the upper atmosphere and reacts with ozone resulting in reduction in thickness of the ozone layer.
- Thus, the ozone layer in the atmosphere becomes thinner and gets depleted allowing more ultraviolet rays to pass through it. This phenomenon is referred as the Ozone hole.
- The Antarctic hole in ozone layer is caused due to chlorine molecules present in chlorofluorocarbons (CFCs), that are used by human beings.

Garbage disposal

- Improvements in lifestyle have resulted in accumulation of large amounts of waste materials.
- Garbage contains following type of materials :
  - **(a) Biodegradable Wastes :** Substances which can be decomposed by the action of micro-organisms are called as biodegradable wastes. *E.g.*, fruit and vegetable peels, cotton, jute, dung, paper, etc.
  - **(b) Non-biodegradable Wastes :** Substances which cannot be decomposed by the action of micro-organisms are called as non-biodegradable wastes. *E.g.*, plastic, polythene, metals, synthetic fibres, radioactive wastes, pesticides, etc.
- **Methods of Waste Disposal :**
  - **(a) Biogas Plant :** Biodegradable waste can be used in biogas plant to produce biogas and manure.
  - **(b) Sewage Treatment Plant :** The drain water can be cleaned in sewage treatment plant before adding it to rivers.
  - **(c) Land Fillings :** The wastes are buried in low lying areas and are compacted by rolling with bulldozers.
  - **(d) Composting :** Organic wastes are filled in a compost pit and covered with a layer of soil, after about three months garbage changes to manure.
  - **(e) Recycling :** Non-biodegradable waste are recycled to make new items.
  - **(f) Reuse :** It is a conventional technique to use an item again *e.g.*, newspaper for making envelops.

Know the Terms

- **Environment :** It is the sum total of all biotic and abiotic components occurring naturally.
- **Biodegradable substances** : Substances which are broken down into simpler, harmless substances in nature in due course of time by the biological processes such as action of micro-organisms.
- **Non–biodegradable substances :** Substances which cannot be broken down into simpler, harmless substances in nature. These substances may be in solid, liquid or gaseous form and may be inert and accumulate in the environment or may concentrate in the food chain and harm the organisms.
- **Ecosystem :** It is the structural and functional unit of biosphere, comprising of all the interacting organisms in an area together with the non–living constituents of the environment. Thus, an ecosystem is a self sustaining system where energy and matter are exchanged between living and non-living components.
- **Producers :** These organisms produce food by photosynthesis *i.e.* they can make organic compounds like sugar and starch from inorganic substances using the radiant energy of the sun in presence of chlorophyll.
- **Consumers :** Those organisms which depend upon the producers for food, either directly or indirectly by feeding on other consumers for their sustenance. Consumers therefore, feed upon those below it in a food chain and are called as heterotrophs.
- **Decomposers :** They are those micro-organisms that obtain energy from the chemical breakdown of dead organisms or animals or plant wastes. These micro-organisms are decomposers as they breakdown the complex organic substances into simple inorganic substances that go into the soil and are used up again by the plants.
- **Food Chain :** It is the sequence of organisms through which energy is transferred in the form of food by the process of one organism consuming the other. It shows the relationship of producer and consumer *i.e.* 'who eats whom'. Thus, it is a series of organisms taking part at various trophic level from the producer and ends in consumer.
- **Trophic Levels :** A trophic level is the group of organisms within an ecosystem which occupy the same level in food chain. The producers or autotrophs are the first trophic level, the herbivores or primary consumers are the second trophic level, the carnivores or secondary consumers are the third trophic level and the large carnivores or tertiary consumers are the fourth trophic level of the food chain.

- **Food Web :** It is the network of various food chains which are interconnected at various trophic levels. Since, an organism can occupy position in more than one food chain so in a food web it occupies more than one trophic level.
- **Flow of Energy :** The flow of energy through different steps in the food chain is unidirectional. This means that energy captured by autotroph does not revert back to the solar input and it passes to the herbivores. It moves progressively through various trophic levels.

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Chapter - 16 : Management of Natural Resources

TOPIC-1

Natural Resources, Sustainable Development and Biodiversity

Revision Notes

- **Natural Resources :** Anything in the environment which is useful to man or can be transformed into a useful product or can be used to produce a useful thing is called natural resource. *E.g.*, soil, air, water, forests, wildlife, coal and petroleum.

Types of Resources

Exhaustible	Inexhaustible
These are present in limited quantity. *E.g.*, Coal and petroleum of cannot be reproduced	These are present in unlimited quantity. *E.g.*, Air and water can never get exhausted

- Coliform is a group of gram-negative, rod-shaped bacteria that are found in human intestine. Their presence in water is an indicator of contamination by disease-causing micro-organisms indicating fecal pollution. It includes *klebsiella* and *Escherichia coli*.
- Largely untreated sewage such as garbage and excreta are dumped into Ganga. Pollution is also caused by human activities such as bathing, washing and immersion of ashes or unburnt corpses.
- Industries also contribute in Ganga's pollution by discharging chemical effluents which are responsible for making the water toxic and killing aquatic organisms.
- Ganga Action Plan is a massive multi-core project launched in 1985, which has been undertaken to clean the excess pollution from river Ganga.
- **Management of Natural resources :** The principle of reducing waste, reusing and recycling resources is often called the 3R's principle.

3R's

REDUCE Use Less	RECYCLE Segregate waste that can be recycled	REUSE Use again
Switching off unnecessary lights and fans, repairing leaky taps, not wasting food.	Plastic, glass, metal items can be recycled instead of synthesising or extracting new ones.	Instead of throwing things away, they can be used again.

- **Sustainable Management :** Management of resources wisely so they meet current basic human needs while preserving them for the needs of future generations.
- **The management of natural resources requires :**
  (a) Long term perspective so that these will last for generations to come.
  (b) Ensure equitable distribution of resources so that all economic sections benefit from these resources.
  (c) Safe disposal of waste.

- The objective of sustainable development is to provide the economic well being to the present and the future generations and to maintain a healthy environment and life support system.
- Forest is a 'biodiversity hotspot' because it is an area where number of species or range of different life form exists.
- **We need to manage natural resources because :**
  (i) They are limited.
  (ii) Utilisation of natural resources is increasing at an exponential rate due to increase in human population.
- Management of natural resource should ensure equitable distribution to all in order to get benefit from the development of these resources.
- Sustainable natural resource management should ensure the safe disposal of wastes produced while using or extracting the resources.
- Forests are 'biodiversity hot spots' where a number of species are found.
- Conserving forest will preserve the bio-diversity which ensure the ecological stability.
- Management of forest resources has to take into account the interests of various stakeholders.
- **Four stakeholders of forests are :**
  (i) Local people who live in and around the forest and are dependent on the forest produce for their livelihood.
  (ii) The Forest Department of the Government which owns the forest and controls the resources from forests.
  (iii) Industrialists who use various forests produce for their factories.
  (iv) Forest and wildlife activists who want conserve the nature in its original form.
- Industries would consider the forest as merely a source of raw material for its factories.
- Wildlife enthusiasts are in no way dependent on the forests. However they take a great part in conserving the forest and wildlife.
- Amrita Devi Bishnoi, in 1731 sacrificed her life along with 363 others for the protectioi of 'khejri' trees in Khejrali village near Jodhpur in Rajasthan.
- The Government of India has recently instituted an 'Amrita Devi Bishnoi National Award for Wildlife Conservation' in the memory of Amrita Devi Bishnoi.
- The Chipko movement was a forest conservation movement in India where rural people embraced the trees to prevent them from being cut down.
- **Destroying forests affects the**
  (i) Availability of forest products
  (ii) Quality of soil and the sources of water.
- Participation of the local people is important for efficient management of forests.
- Within a period of 10 years the previously worthless forests called sal forest in west bengal became valuable by involving the local people in managing the resources.

TOPIC-2

Water Conservation and Fossil Fuels

Revision Notes

- Necessity of judicious use of coal and petroleum : The fossil fuels, coal and petroleum will get exhausted and their combustion pollutes our environment, so a judicious use of these resources is necessary.
- When combustion takes place, oxides of carbon, hydrogen, nitrogen and sulphur are formed.
- The oxides of sulphur, nitrogen and carbon monoxide are poisonous at high concentrations.
- Carbon dioxide is a greenhouse gas which leads to global warming.
- **Water for all**
  (a) Water is one of the most important and renewable natural resources and is the basic necessity for all forms of life. Therefore, its conservation is very necessary.
  (b) Rain is an important source of water.
  (c) Irrigation methods like dams, tanks and canals have been used in various parts of India.
- **Dams**

  Dams ensure the storage of adequate water for irrigation and are also used for generating electricity. Various dams have been built on rivers to regulate the flow of water.

E.g., (a) Tehri Dam— On river Ganga

(b) Sardar Sarovar Dam — On river Narmada

(c) Bhakra Nangal Dam — On river Satluj

- **Advantages of Dams**
  - **(a)** Ensures adequate water for irrigation.
  - **(b)** To generate electricity.
  - **(c)** Continuous supply of drinking water to cities and towns.
- **Disadvantages of Dams**
  - **(a) Social problems :**
    - **(i)** Many tribals and peasants are displaced and rendered homeless.
    - **(ii)** They do not get adequate compensation or rehabilitation.
  - **(a) Environmental problems :**
    - **(i)** Deforestation
    - **(ii)** Loss of biodiversity
    - **(iii)** Disturbed ecological balance
  - **(c) Economic problems :**
    - **(i)** Huge amount of public money is used.
    - **(ii)** No proportionate benefit to people.
    - **(iii)** No equitable distribution of water.
- **Rain Water Harvesting** : Rain water harvesting is to make rain water percolate under the ground so as to recharge 'groundwater'.

Know the Terms

- **Natural resources :** They are the stock of the nature such as air, water, soil, minerals, coal, petroleum, forest and wildlife that are useful to mankind in many ways.
- **Renewable resources :** They are those resources which can be regenerated *e.g.*, forestry, agriculture, animals, air water.
- **Non-renewable resources :** These are available in limited amounts and can not be reproduced *e.g.*, coal, petroleums, etc.
- **Pollution :** It is defined as the undesirable change in physical, chemical or biological characteristics of our soil, air or water, which harmfully affect human lives or the lives of other species.
- **Biodegradable pollutant :** Pollutants which are degraded by decomposers *e.g.* food, kitchen waste, etc.
- **Non-biodegradable pollutant :** Pollutants which are not degraded or decomposed by decomposers.
- **Sustainable Development :** It is the development which can be maintained for a long time without undue damage to the environment.
- **Biodiversity :** It is the existence of a wide variety of species of plants, animals and micro-organisms in a natural habitat with in a particular environment or of genetic variation with in a species.
- **Wildlife :** It means all those naturally occurring animals, plants and their species that are not cultivated, domesticated and tamed.
- **Conservation :** It is the sensible use of the earth's natural resources in order to avoid excessive degradation and betterment of the environment.
- **Fossil fuels :** Fuels that are formed from organic material over the course of millions of years.

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