UNIT – I: MATTER: NATURE AND BEHAVIOUR

CHAPTER-1

MATTER IN OUR SURROUNDINGS

Revision Notes

Matter

➢ **Physical nature of Matter**

- Matter is made up of particles that vary in size, shape and nature. These small particles are called atoms.
- The particles of matter are too small so they cannot be seen by naked eyes or simple microscope.
- **Characteristics of particles:**

(i) Large number of particles constitute matter.

(ii) Particles of matter are very small in size.

(iii) Particles of matter have spaces between them.

(iv) Particles of matter are continuously in motion.

(v) Particles of matter attract each other.

(vi) The force that exists between the particles is called interparticle force of attraction.

(vii) The force of attraction between particles of solid, liquid and gas can be arranged in decreasing order as: **Solid > Liquid > Gas**.

- Matter around us exists in three states: solid, liquid and gas.

➢ **Solid state:**

(i) All solids have definite shape, distinct boundaries and fixed volumes, that is, they have negligible compressibility.

(ii) Solids have a tendency to maintain their shape when subjected to outside force.

(iii) Solids are rigid.

➢ **Liquid state:**

(i) Liquids have no fixed shape but have a fixed volume. They take up the shape of the container in which they are kept.

(ii) Liquids flow and change shape, so they are not rigid and are called fluid.

(iii) The rate of diffusion of liquid is higher than that of solids. This is due to the fact that in the liquid state, particles move freely and have greater space between each other as compared to particles in the solid state.

➢ **Gaseous state:**

(i) Gases are highly compressible as compared to solids and liquids.

(ii) The liquefied petroleum gas (LPG) cylinder that we get in our home for cooking or the oxygen supplied to hospitals in cylinders is compressed gas.

(iii) In the gaseous state, the particles move around randomly at high speed. Due to this random movement, the particles hit each other and also to the walls of the container. Pressure of gas is applied on the walls of the vessel by the irregular moving gas particles.

➢ **Interconversion of States of Matter**

The phenomenon of change of matter from one state to another and then back to the original state by altering the conditions like temperature and pressure is called the interconversion states of matter. Matter can change its state.

➢ **Water can exist in three states of matter:**

(i) Solid, as ice,

(ii) Liquid, as water, and

(iii) Gas, as water vapour.

- The states of matter are inter-convertible. The state of matter can be changed by changing temperature or pressure.

  S.I. unit of temperature is Kelvin. $T(K) = t(°C) + 273$.
- **Melting Point:** The temperature at which solid melts to form liquid at atmospheric pressure is called melting point. Melting point of ice is 273.16 K (0°C)

  The melting point of a solid is an indication of the strength of the force of attraction between its particles.
- **Boiling Point:** The temperature at which a liquid starts boiling at the atmospheric pressure is known as boiling point. Boiling point of water is 373 K (100° C).
- **Latent heat of vaporization** is the heat energy required to change 1 kg of liquid to gas at atmospheric pressure at its boiling point. Boiling is a bulk phenomenon.
- **Latent heat of fusion** is the amount of heat energy required to change 1 kg of solid into liquid at its melting point.
- **Freezing:** The process in which liquid changes into solid is known as freezing. For example, freezing of water (liquid) into ice (solid).
- **Sublimation:** Sublimation is the change of a solid directly into the gaseous state without passing through the liquid state upon heating and back to the solid state when the temperature is lowered.

Evaporation

- Evaporation takes place only at the surface of the liquid while boiling can take place in all parts of the liquid.
- Evaporation is surface phenomenon. Particles from the surface gain enough energy to overcome the forces of attraction present in the liquid and change into the vapour state.
- Evaporation is a continuous or ongoing process. Evaporation causes cooling.
- The rate of evaporation is affected by the surface area exposed to atmosphere, temperature, humidity and wind speed.
- Since evaporation is a surface phenomenon, therefore, it increases with an increase in surface area.
- Evaporation increases with an increase in temperature.
- Evaporation decreases with an increase in humidity.
- Evaporation increases with the increase in wind speed.

- **Plasma:** The state consists of super energetic and super excited particles. These particles are in the form of ionised gases. The fluorescent tube and neon sign bulb consists of plasma stars. The sun and the stars glow because of the presence of plasma in them.

Key Words

- **Matter:** Anything that has mass and occupies space is called matter.
- **Solid:** Solid is defined as that form of matter which possesses rigidity, is incompressible and hence has a definite shape and a definite volume.
- **Liquid:** Liquid is defined as that form of matter which possesses fluidity but is almost incompressible and hence has a definite volume but no definite shape.
- **Gas:** Gas is defined as that form of matter which possesses fluidity but it is highly compressible and hence has neither definite shape nor definite volume.
- **Humidity:** The amount of water vapour present in the air.
- **Density:** It is the mass occupied by a solid per unit volume and is obtained by dividing the mass of a particular solid by the volume occupied.
- **Fusion:** The process in which a solid changes to liquid state by absorbing heat at constant temperature.
- **Diffusion:** The process in which particles of one substance occupy the vacant spaces present in the particles of the other substance, is called diffusion.
- **Condensation :** The process in which a gas changes into liquid state by giving out heat at constant temperature.
- **Latent heat:** The hidden heat which breaks the force of attraction between the molecules during change of state.
- **Latent heat of fusion:** The amount of heat energy that is needed to convert one kg of a solid into the liquid state at atmospheric pressure at its melting point is termed as latent heat of fusion.
- **Boiling point:** The temperature at which a liquid starts boiling at the atmospheric pressure is known as boiling point.
- **Freezing point:** The temperature at which a liquid changes to solid by giving out heat at the atmospheric pressure.
- **Latent heat of vaporization:** The amount of heat energy that is needed to convert one kg of a liquid at its boiling point temperature into its vapour state without any rise in temperature, is termed as latent heat of vaporization.
- **Melting point:** The melting point of a solid may be defined as the temperature at which a solid melts to become a liquid at the atmospheric pressure.

- **Sublimation:** Sublimation is the change of a solid directly into the gaseous state without passing through the liquid state upon heating and back to the solid state when the temperature is lowered.
- **Evaporation:** The phenomenon of change of liquid to the vapour state at any temperature below the boiling point of the liquid is termed as evaporation.
- **Transpiration:** The process of evaporation of water from the aerial parts of plants especially leaves is called transpiration.
- **Freezing:** The process of conversion of liquid into solid is known as freezing.

Mnemonics

Concept : Matter has three states – Solid, Liquid, Gas
Mnemeonics : **M**a **S**ona **L**e **G**ayi
Interpretation :
M: Matter
S: Solid
L: Liquid
G: Gas

Example 1

Write in brief, an activity to show the particulate nature of matter. List any two characteristics of particles of matter.

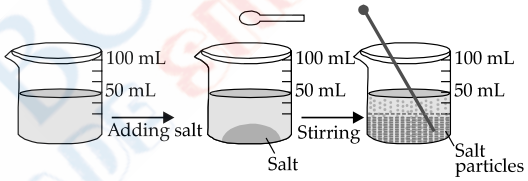
Solution:

Step I: Activity:

(i) Take a 100 mL beaker.
(ii) Fill half the beaker with water and mark the level of water.
(iii) Dissolve some salt / sugar with the help of a glass rod.
(iv) Observe any change in water level.

Step II: Observation: Level of water remains same and salt/sugar, has now spread throughout water.

When we dissolve salt in water, the particles of salt get into the spaces between particles of water. This shows the particulate nature of matter.



Step III: Two characteristics of particles of matter are:

(i) They are continuously moving.
(ii) They attract each other.

CHAPTER-2

NATURE OF MATTER

Revision Notes

- Matter can be classified as pure substances or mixtures.
- A pure substance may either contain constituent particles of only one kind or of different kinds. A pure substance has a fixed composition.

Element

- An element is a basic form of matter which cannot be broken down into simpler substances by any physical or chemical means.
- Elements can be broadly classified as metals, non-metals and metalloids.
- **Metals** are one category of elements that have lustre. They conduct heat and electricity. They are sonorous. They are malleable and ductile.
- **Non-metals** do not have lustre, are not sonorous and are bad conductors of heat and electricity.
- **Metalloids** are elements having properties intermediate between those of metals and non-metals.

Compound

- A compound is a pure substance composed of two or more elements chemically combined in a fixed proportion. It can be broken down into simpler substances by chemical or electrochemical methods.
- Properties of compounds are different from those of its constituent elements, whereas a mixture shows the properties of its constituent elements or compounds.

Mixtures

- A mixture contains two or more elements or compounds which are mixed together in any proportion. From a mixture, no new compound is formed. A mixture shows the properties of the constituent substances.
- Mixtures are classified as homogeneous and heterogeneous mixtures.
- Mixtures whose components mix completely with each other to make a uniform composition are called **homogeneous mixtures**. For example: Alloy.
- A **heterogeneous mixture** has a non-uniform composition.
- Alloys are mixture of two or more metals or a metal and a non-metal and cannot be separated by physical methods.
- The ability of a substance to dissolve in another substance is called **solubility**.

Solution

- Homogeneous mixture of two or more substances is called a **solution**.
- Component of a solution present in small quantity is called a solute. Solute particles cannot be separated from the mixture by filtration.
- Component of a solution present in large quantity is called a **solvent**.
- Particles of a solution are smaller than 1 nm in diameter. They cannot be seen by naked eyes.
- Particles of solution do not scatter beam of light.
- Solution with high solute concentration is called **concentrated solution** and those with low concentration is called **dilute solution**. or
- The **concentration of a solution** is the amount of solute present in a given amount (mass or volume) of solvent solution. Concentration of a solution $= \frac{\text{Amount of solute}}{\text{Amount of solution}}$
- Percentage by mass is one method of expressing concentration of solution.
- There are two kinds of heterogeneous mixtures: colloids and suspensions

Colloids

- Colloids are mixtures with particle sizes from 1 nm to 100 nm.
- The component of colloid present in small amount is called **dispersed phase**.
- The medium in which colloidal particles disperse or suspend themselves is called **dispersion medium**.
- In a colloidal system, particles are always suspended and do not settle down. This constant colliding of the particles in continuous motion is called **Brownian movement**.
- Scattering of a beam of light when light is passed through a colloidal solution is called the **Tyndall effect**.
- Colloids are classified according to the state (solid, liquid or gas) of the dispersed medium or dispersing medium and the dispersed phase.
- Colloid in which dispersed medium is a liquid and dispersed phase is solid is called as **sol**.
- Colloid in which both dispersed phase and dispersed medium are in liquid state is called as an **emulsion**.
- Colloid in which dispersed phase is either liquid or a solid and dispersed medium is a gas is called as **aerosol**.

Suspension

- A suspension is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of medium. Particles of suspension are visible to naked eye. Suspensions are heterogeneous mixtures with particles that have a size greater than 1000 nanometers.
- The change in which the shape, size, appearance or state of a substance may alter but its chemical composition remains the same is called a **physical change**. In a physical change, no new substance is formed.
- Any change that involves the formation of a new substance and leads to a transformation of chemical identity is called **chemical change**.
- Chemical changes are usually accompanied with heat exchange. Chemical changes are permanent changes which are usually irreversible.

Key Words

- **Matter:** Anything that has mass and occupies space is called matter.
- **Pure substances:** It consists of particles of only one kind of matter which are similar to one another and which cannot be separated into other kinds of matter by any physical process.
- **Element:** It is defined as a basic form of matter which cannot be broken down into simpler substances by any chemical method.
- **Metals:** They possess lustre. They are malleable and ductile, good conductors of heat and electricity and are sonorous.
- **Non-metals:** They are neither malleable nor ductile. They are not lustrous and non-conductors of heat and electricity.

- **Metalloids or semi-metals:** They have intermediate properties between those of metals and non-metals.
- **Compound**: It is defined as a pure substance made up of two or more elements chemically combined in a fixed proportion by mass.
- **Mixtures:** A mixture contains two or more substances (elements or compounds) which are physically mixed in any proportion but not chemically combined.
- **Solution:** It is a homogeneous mixture of two or more substances. The major component of the solution is called the solvent and the minor component is called the solute.
- **Alloys:** They are homogeneous mixtures. They may also be regarded as solid in solid solution.
- **Concentration of a solution:** It is the amount of solute present per unit volume or per unit mass of the solution/ solvent.
- **Concentration of Solution:**

  1. Mass by mass percentage $= \frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100$

  2. Mass by volume percentage $= \frac{\text{Mass of solute}}{\text{Volume of solution}} \times 100$

- **Saturated solution:** It is a solution which contains the maximum amount of the solute dissolved in a given quantity of the solvent at the given temperature and which cannot dissolve any more solute at that temperature.
- **Unsaturated solution:** It is a solution which can dissolve more amount of solute in it at the given temperature.
- **Supersaturated solustion:** It is a solution which temporarily contains more solute than the saturation level.
- **Suspension:** It is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of the medium.
- **Colloids:** They are heterogenous mixtures in which the size of the particles lies in between those of true solutions and suspensions.

Example 1

A solution contains 60 g of common salt in 240 g of water. Calculate the concentration in terms of mass by mass percentage of solution.

Solution:

Step I: Concentration of solution

$$= \left(\frac{\text{Mass of solute}}{\text{Mass of solution}}\right) \times 100$$

Mass of common salt is 60 g.

Mass of water is 240 g.

Step II: Mass of solution = (60 + 240)g= 300 g.

Step III: Concentration of solution

$$= \left(\frac{60}{300}\right) \times 100 = 20\% \quad 2$$

CHAPTER-3

PARTICLE NATURE AND THEIR BASIC UNITS

Revision Notes

- **Laws of chemical combination :** There are two laws of chemical combination :
  - **(i) Law of conservation of mass :** Mass can neither be created nor be destroyed in a chemical reaction.
  - **(ii) Law of constant proportions or Law of definite proportions :** In a chemical substance, the elements are always present in a definite proportion by mass.
- **Postulates of Dalton's atomic theory :**
  - **(i)** Every matter is made up of very tiny particles called atoms.
  - **(ii)** Atoms are indivisible particles, which cannot be created or destroyed in a chemical reaction.
  - **(iii)** Atoms of a given element are identical in mass and chemical properties.
  - **(iv)** Atoms of different elements have different masses and chemical properties.
  - **(v)** Atoms combine in the ratio of small whole numbers to form compounds.
  - **(vi)** The relative number and kinds of atoms are constant in a given compound.

Atoms

- Atoms are building blocks of all matters.
- Atomic radius is measured in nanometers (1 m = 10^9 nm).

Elements and their naming

- Each element has a unique name and a unique symbol.
- IUPAC (International Union of Pure and Applied Chemistry) approves names of the elements.
- **Rules for assigning symbols for atoms of various elements are as follows :**

(i) The abbreviation used to represent an element is generally the first letter of the element's name in English.

English name of element	Symbol
Hydrogen	H
Boron	B
Oxygen	O
Nitrogen	N
Fluorine	F

(ii) When the names of two or more elements begins with the same initial letter, the initial letter is followed by the letter appearing later in the name :

Name of element	Symbol
Barium	Ba
Bismuth	Bi
Bromine	Br
Silicon	Si
Cadmium, Calcium	Cd, Ca

(iii) Symbols of some elements are derived from their Latin / German or Greek names :

Name of element	Latin/German/Greek name	Symbol
Sodium	Natrium	Na
Potassium	Kalium	K
Copper	Cuprum	Cu
Iron	Ferrum	Fe
Gold	Aurum	Au
Silver	Argentum	Ag

- **One atomic mass unit** is a mass unit exactly equal to 1/12th the mass of one C-12 atom.
- Atoms of most elements are not able to exist independently. Atoms form molecules and ions.

Molecules

- Molecules of an element are formed by the atoms of the same type.
- Atoms of same or different elements join together in definite proportions to form molecules of compounds.
- The number of atoms constituting a molecule is known as its **atomicity**.

Ions

- An ion is a charged particle and can be negatively or positively charged.
- Ions may consist of a single charged atom or a group of atoms that have a net charge on them.
- Ionic compounds contain charged species called ions as their smallest unit.
- A group of atoms carrying a fixed charge on them are called polyatomic ions or radicals.
- The chemical formula of a compound is a symbolic representation of its composition.

Valency

- Valency is the combining capacity of an element.
- Valency can be used to find out how the atom(s) of an element will combine with the atom(s) of another element to form a chemical compound.
- **Names and symbols of some ions :**

Valency	Name of ion	Symbol	Non-metallic element	Symbol	Polyatomic ions	Symbol
1	Sodium Potassium Silver Copper (I)*	Na^+ K^+ Ag^+ Cu^+	Hydrogen Hydride Chloride Bromide Iodide	H^+ H^- Cl^- Br^- I^-	Ammonium Hydroxide Nitrate Hydrogen Carbonate	NH_4^+ OH^- NO_3^- HCO_3^-
2	Magnesium Calcium Zinc Iron (II)* Copper (II)*	Mg^{2+} Ca^{2+} Zn^{2+} Fe^{2+} Cu^{2+}	Oxide Sulphide	O^{2-} S^{2-}	Carbonate Sulphite Sulphate	CO_3^{2-} SO_3^{2-} SO_4^{2-}
3	Aluminium Iron (III)*	Al^{3+} Fe^{3+}	Nitride	N^{3-}	Phosphate	PO_4^{3-}

*** Some elements show variable valency which is represented by a roman numerical brackets.**

- **Rules for writing the formula of a compound :**
  - **(i)** Formula of compound is given by writing side by side the symbols of constituent elements.
  - **(ii)** Symbol of the more metallic element is written first in the formula.
  - **(iii)** Number of atoms of each of the constituent element present in the molecule is indicated by subscript.
  - **(iv)** When either of the ions or both the ions are polyatomic and their valency is more than one, we enclose the polyatomic ions in brackets. No brackets are necessary if the valency(ies) of polyatomic ion (s) is (are) 1.
  - **(v)** While writing the formula of a compound if the valency numbers have a Highest Common Factor (H.C.F), divide the valency numbers by H.C.F so as to get the simplest ratio between the combining elements.
- The charges or valencies on the ion must be balanced.
- Formula of a binary compound is written by criss-crossing the valencies of elements present in a molecule of the compound.
- A chemical compound is always electrically neutral; hence the positive and negative valencies or charges of the ions in the compound must add upto zero.
- Scientists use the relative mass scale to compare the masses of different atoms of elements.
- Atoms of C-12 isotopes are assigned a relative atomic mass of 12 and the relative masses of all other atoms are obtained in comparison with the mass of a C-12 atom.
- Relative mass of a molecule is expressed in atomic mass unit (u).
- Atoms of different elements are of different sizes and masses.

Key Words

- **Atom :** Smallest particle of an element that shows all the properties of an element.
- **Atomic number :** Number of protons in an atom of an element.
- **Molecule :** Smallest particle of an element/compound that is capable of an independent existence and shows all the properties of that substance.
- **Anion :** Negatively charged ion.
- **Cation :** Positively charged ion.
- **Atomicity :** Number of atoms present in one molecule of an element.
- **Radical :** An atom or a group of atoms carrying positive or negative charge that behaves as a single unit in a chemical reaction.
- **Mole :** Amount of substance that contains the same number of units as there are atoms in exactly 12 g of carbon-12 isotope.
- **Chemical formula :** Expression of the composition of a substance by chemical symbols and numerical subscript.
- **Diatomic :** A molecule which contains two atoms.
- **Triatomic :** A molecule which contains three atoms.
- **Polyatomic :** A molecule which contains more atoms.
- **Valency :** Measure of combining capacity of an element with other atoms when it forms compounds or molecules.
- **Binary compound :** Simplest compounds made up of two different elements. e.g., HCl, H_2O.
- **Gram atomic mass :** Atomic mass of an element expressed in terms of grams.

- **Molecular mass :** Sum of the atomic masses of all the atoms in a molecule of the substance.
- **Formula unit mass :** Sum of the atomic masses of all the atoms in a formula unit of a compound.

Example 1

(a) A sample of vitamin C is known to contain 2.58×10^{24} oxygen atoms. How many moles of oxygen atoms are present in the sample ?

(b) Write one word for the following :

(i) In a balanced chemical equation, the sum of the masses of reactants and products remains unchanged.

(ii) A group of atoms carrying a fixed charge on them.

(c) Write chemical formulae of the following compounds :

(i) Sodium phosphate

(ii) Ammonium carbonate

Solution:

Step I: (a) Number of moles

$$= \frac{\text{Given no. of particles}}{\text{Avogadro number}}$$

$$= \frac{2.58 \times 10^{24}}{6.022 \times 10^{23}}$$

$$= 0.4284 \times 10$$

$$= 4.284 \text{ moles}$$

Step II: (b) (i) Law of conservation of mass.

(ii) Polyatomic Ion

Step III: (c) (i) $Na_3 PO_4$

(ii) $(NH_4)_2 CO_3$

(1 + 2 + 2 = 5)

CHAPTER-4

STRUCTURE OF ATOM

Revision Notes

- An atom is divisible and consists of charged particles.
- Ionization of gases in the discharge tube proved that atoms have sub-atomic particles.
- **Summary of characteristics of electrons, protons and neutrons:**

Characteristics	Electron	Proton	Neutron
Symbol	e	p	n
Relative charge	– 1	+ 1	0
Nature	Negatively charged	Positively charged	Neutral
Discovered by	J. J. Thomson	E. Goldstein	James Chadwick
Mass	1/2000 times mass of hydrogen atom	1 unit	Mass is nearly equal to that of proton

- **Thomson's model of atom:**

(i) An atom is a uniform sphere of positive charges (due to the presence of protons) as well as negative charges (due to the presence of electrons) which are embedded in it. This model is often called the 'Water Melon Model'.

(ii) An atom, as a whole, is electrically neutral because the negative and positive charges are equal in magnitude.

- **Limitations of Thomson's model of atom:** The model failed to explain how protons and electrons could be arranged in an atom so close to each other.
- α-particles are charged particles having two units of positive charge and four units of mass, i.e., they are double-charged helium ions (He^{2+}).
- **Observations predicted from α-particle scattering experiment by Rutherford based on Thomson's model of atom are:**

(i) Rutherford expected that if the model proposed earlier by J. J. Thomson, according to which there is uniform distribution of positive and negative charge, was correct then α-particles striking the gold atoms would be uniformly deflected which was not the case.

(ii) Since the α-particles were much heavier than the protons, he did not expect to see large deflections.

- **Selection of gold metal for Rutherford's α-particle scattering experiment:** Gold is easily malleable and can be beaten into very thin sheets.
- **Observations made by Rutherford from α-particle scattering experiment:**
  - **(i)** Most of the α-particles passed straight through gold foil without suffering any deflection from their original path.
  - **(ii)** Some of the α-particles were deflected by the foil at small angles.
  - **(iii)** One out of every 12000 particles appeared to rebound.
- **Conclusions from Rutherford's α-particle scattering experiment:**
  - **(i)** Most of the space inside the atom is empty. Hence, it allows the α-particles to pass straight through it without any deflection.
  - **(ii)** Very few particles were deflected from their path, which suggests that the positive charge of the atom occupies very little space.
  - **(iii)** The total volume occupied by a nucleus is very small compared to the total volume of the atom, as very few α-particles are reflected by 180^o, and all the positive charge and mass of the gold atom were concentrated in a very small volume within the atom.
- **Rutherford's nuclear model of an atom:**
  - **(i)** There is a positively charged centre in an atom called the nucleus and the entire mass of atom resides in the nucleus.
  - **(ii)** Electrons revolve around the nucleus in well-defined circular orbits.
  - **(iii)** Size of the nucleus is very small as compared to the size of an atom.
- **Defects in Rutherford's model of atom:**
  - **(i)** Rutherford had proposed that electrons move around a positively charged nucleus at a very high speed in circular orbits. Electron would have to be accelerated centripetally (tending to move toward a center) to remain in a circular orbit, but according to electromagnetic theory, if charged body (electron) is accelerated around another charged body (nucleus) then there would be continuous radiation of the moving body (i.e., electron). This loss of energy would slow down the speed of electron and eventually electron would fall into nucleus. But Rutherford's model could not explain such a collapse.
  - **(ii)** Rutherford had proposed that electrons revolve around the nucleus in fixed orbits. He did not specify the number of electrons in each orbit.
- **Postulates put forward by Bohr regarding model of atom:**
  - **(i)** Electrons revolve around the nucleus in a limited number of orbits called discrete orbits of electrons that are also called as permissible orbits.
  - **(ii)** While revolving in discrete orbits, the electrons do not radiate energy i.e., energy of an electron remains constant so long as it stays in a given orbit. Electrons present in different orbits have different energies.
  - **(iii)** When an electron jumps from lower energy level to higher energy level, some energy is absorbed, while energy is released when electron jumps from higher energy level to lower one.
- Orbits or shells are represented by the letters K, L, M, N... or the numbers, $n = 1, 2, 3, 4....$
- **Bohr-Bury scheme for distribution of electrons in different orbits:**
  - **(i)** Maximum number of electrons that can be accommodated in a shell is given by $2n^2$, where n is the shell number i.e., first shell can accommodate two electrons, second shell can accommodate eight electrons, third shell can accommodate 18 electrons and so on.

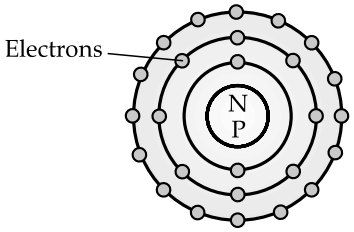


Fig. Distribution of electrons in different orbit.

(ii) Outermost orbit of an atom can accommodate a maximum number of eight electrons.

(iii) Electrons are not accommodated in a given shell, unless the inner shells are filled, i.e., the shells are filled in a step-wise manner.

- Outermost shell of an atom is called **valence shell**.
- Neutrons are situated in the nucleus of all the atoms, except hydrogen.
- If the outermost shell of an atom is completely filled, its valency is 0.
- **Valency of elements having 1 to 4 electrons in the outermost shell are generally determined by the rule :** Valency = Number of electrons in the outermost shell.
- **Valency of elements having number of electrons in outermost shell close to 8 is determined by the formula:** Valency = 8 – Number of electrons in the outermost shell.
- **Significance of valence electrons:**
  - **(i)** Valence electrons are responsible for chemical changes.
  - **(ii)** Elements having same number of valence electrons in their atoms possess similar chemical properties because chemical properties of an element are determined by the number of valence electrons in an atom.
  - **(iii)** Elements having different number of valence electrons in their atoms possess different chemical properties.
- Protons and neutrons together are called **nucleons**.
- All atoms of an element have the same atomic number.
- Atomic number is denoted by 'Z' ($Z = n_p$).
- For a neutral atom, number of protons and electrons are equal.
- Mass number is denoted by 'A' ($A = n_p + n_N$).
  n_p = No. of protons
  n_N = No. of neutrons
- **Isotopes:**
  - **(i)** Isotopes are the atoms of same element having same atomic number but different mass number.
  - **(ii)** Isotopes have similar chemical properties because they have same number of valence electrons.
  - **(iii)** Isotopes have different physical properties such as boiling point and melting point because they have different mass numbers.
  - **(iv)** Atomic masses of elements are fractional, due to the fact that all elements have isotopes.
  - **(v) Applications of isotopes:**
    1. An isotope of uranium is used in nuclear reaction.
    2. An isotope of cobalt is used to remove brain tumours and their treatment.
    3. Isotope of sodium has been used to diagnose restricted circulation of blood.
  - **(vi) Example:** 3 isotopes of hydrogen–protium, deuterium and tritium.
- **Isobars:** Isobars are the atoms of different elements with different atomic numbers, but same mass number. Example: $_{20}Ca^{40}$, $_{18}Ar^{40}$.

Key Words

- **Canal rays:** Positively charged radiations discovered by Goldstein in a gas discharge tube at low pressure and high voltage.
- **Electron:** Negatively charged particle.
- **Proton:** Positively charged particle.
- **Neutron:** Neutral particle.
- **Energy level:** Possible locations around an atom where electrons having specific energy values may be found.
- **Octet:** Shell which has eight electrons in the outermost shell.
- **Valency:** Combining capacity of an atom.
- **Valence shell:** Outermost shell of an atom.
- **Valence electrons:** Electrons present in the valence shell.
- **Atomic number:** Total number of protons present in the nucleus of an atom.
- **Nucleons:** A nucleon is one of the particles that make up the atomic nucleus.
- **Mass number:** Sum of the total number of protons and neutrons present in the nucleus of an atom.

Example 1

Define the terms (a) isotope, (b) isobar giving one example of each.

Name the element whose isotope is used in (i) nuclear reactor, (ii) treatment of cancer.

Solution:

Step I: (a) The atoms of same element having same atomic number, but different mass numbers are called isotopes.

e.g., $_1H^1$, $_1H^2$, $_1H^3$.

(any other example) 1

(b) The atoms of different elements with same mass number and different atomic numbers are called isobars.

e.g., $_{20}Ca^{40}$, $_{18}As^{40}$. **(any other example)**

Step II: Mass number is same (*i.e,* 40) **1**

(i) Uranium

(ii) Cobalt ½ + ½

UNIT – II: ORGANISATION IN THE LIVING WORLD

CHAPTER-5

CELL BASIC UNIT OF LIFE

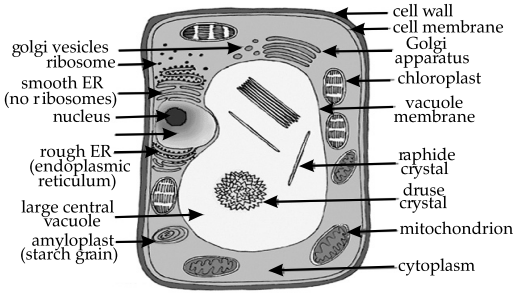
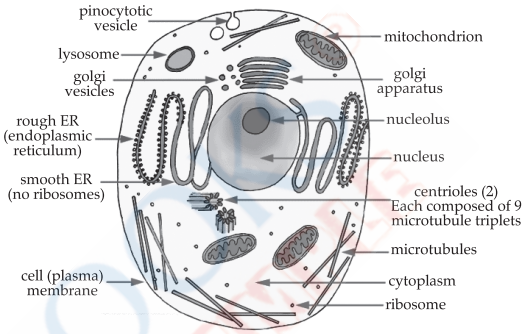
Topic-1 Cell-Prokaryotic, Eukaryotic and Multicellular organisms

Revision Notes

- In 1665, Robert Hooke first discovered and introduced the term 'cell'.
- Cell is the structural and functional unit of all living organisms.
- Organisms may be unicellular or multicellular. A single cell constitutes the unicellular organism whereas many cells coordinately function in case of multicellular organism.
- The size, shape and volume of the cells are related to the specific function that they perform.
- A cell generally shows plasma membrane, nucleus and cytoplasm.
- In 1674, Leeuwenhoek observed the living cells in protists and bacteria.
- In 1831, Robert Brown discovered the nucleus in the cell.
- Purkinje coined the term "Protoplasm" for the fluid substance of the cell in 1839.
- The cell theory that all the plants and animals are composed of cells and the cell is the basic unit of life was proposed by Schleiden and Schwann .
- Virchow (1855) expanded the cell theory by suggesting that all cells arise from pre-existing cells.
- Plasma membrane is the outer covering of the cell which separates the cellular components from the external environment.
- In plants, cell wall is present external to the cell membrane which is rigid and made up of cellulose.
- **Prokaryotic cell:** The primitive cells in which well-defined nuclear membrane is absent and genetic material lies as a single chromosome, i.e., nucleoid is known as a prokaryotic cell. The cell locks membrane - bound cell organelles. Nucleoid as hereditary material lies freely in the cytoplasm. For, e.g., Bacteria, Cyanobacteria.
- **Eukaryotic cell:** The cells that have well-defined nucleus and membrane bound organelles are celled eukaryotic cells. The hereditary material is covered by nuclear envelope. For, e.g., Plants, animals and protozoans.
- **Unicellular and Multicellular organisms:** Single celled organisms are known as unicellular organisms for, e.g., protozoans, *Chlamydomonas*, bacteria etc., and they perform all the life processes like digestion, respiration, excretion and reproduction by a single cell.

  Multicellular organisms are made up of a number of cells specialized for performing different functions. They consists of tissues, organs and organ systems. For, e.g., Plants, Animals, Fungi etc.

Difference between plant cell and Animal Cell:

Plant Cell	Animal Cell
1. Cellulose cell wall present external to cell membrane	**1.** No cell wall. Outermost structure is cell membrane or plasma membrane.
2. Vacuoles are usually large	**2.** Generally vacuoles are absent and if present they are usually small.
3. Plastids present	**3.** Plastids absent
4. Centriole absent	**4.** Centriole present
5. Golgi body present in the form of units known as dictyosomes. 	**5.** Golgi body well developed having 2 cisternae. 

Key Words

- **Cell:** An autonomous self-replicating structure that forms the structural, functional and biological unit of all living organisms.
- **Prokaryotic cell:** A cell characterised by the absence of a distinct, membrane-bound nucleus or membrane-bound organelles, and by DNA that is not organized into chromosomes.
- **Nucleoid:** An undefined nuclear region of the prokaryotic cell, containing the genetic material (nucleic acids).
- **Eukaryotic cell:** A cell containing a membrane-bound nucleus and membrane-bound organelles.
- **Unicellular organism:** Organism having only one cell.
- **Multicellular organism:** Organism consisting of more than one cell, where in the differentiated cells perform specialised functions in the organism.

Mnemonics

Concept : **Cell Organelles present in cell are:**
Mnemeonics : **C**up **M**ein **G**aram **C**offee **P**ina R**oz** **V**erna **E**gg **L**ena
Interpretation :
C: Cytoplasm (Cup)
M: Mitochondria (Mein)
G: Golgi bodies (Garam)
C: Centrosome (Coffee)
P: Plastids (Pina)
R: Ribosomes (Roz)
V: Vacuoles (Varna)
E: Endoplasmic reticulum (Egg)
L: Lysosomes (Lena)

Topic-2 Cellular components

Revision Notes

- **Plasma membrane** is a thin, selectively permeable membrane, covering the cell and is made up of lipids and proteins.

- **Functions of plasma membrane:**
  - **(i)** It separates the contents of a cell from its outside environment.
  - **(ii)** It regulates the flow of substances to and from the cell through diffusion, facilitated diffusion, active transport and endocytosis.
- **Osmosis** is diffusion of water through a selectively permeable membrane.
- **If a cell is placed in different solutions:**
  - **(i) Hypotonic solution:** A cell placed in it will gain water.
  - **(ii) Hypertonic solution:** A cell placed in it will lose water, also known as plasmolysis.
  - **(iii) Isotonic solution:** A cell placed in it will neither gain nor lose water.
- To know about the structure of chromosomes and their significance. in cell division.
  - Chromosomes are rod like or thread like structure which are formed by the condensation of chromatin fiberes during cell division and reproduction.
  - A chromosome consists of two similar threads called chromatids attached to each other at a point called centromere.
  - Chromosomes are made up of DNA molecules and proteins which carry and help to transfer information for inheritance of characters from parents to next generation.
  - Human has 23 pairs of chromosomes.
- **Cells of plants, fungi & bacteria:** Contain both plasma membrane and cell wall. Cell wall is rigid, non-living and outer most covering, composed mainly of cellulose.
- When placed in hypertonic solution, a living plant cell shows plasmolysis.
- **Cell wall** provides mechanical strength to the cell. It permits the cell to withstand huge changes in the surrounding medium. Cell wall of plants, fungi consists of cellulose and chitin respectively.

Bacterial cell is made up of peptidoglycan

- Nucleus is an important, spherical, usually centrally located constituent of the cell and is bounded by double layered nuclear envelope.
- The nucleus of a dividing cell shows rod-shaped chromosomes, made up of DNA and proteins. In a non-dividing cell, the chromosomes elongate and take the form of thread-like chromatin.
- DNA molecules are responsible for transmitting hereditary information from one generation to the next.

- Nucleus controls all metabolic activities of the cell.
- Depending on the presence or absence of nucleus, cells may be prokaryotic or eukaryotic.
  - **(i)** Prokaryotic cells lack a well-defined nucleus and instead show nucleoid, an undefined nuclear region containing the genetic material.
  - **(ii)** Eukaryotic cells possess a proper nucleus with nuclear membrane.
- **Cytoplasm** is the fluid content of the cell, occurring between nucleus and plasma membrane. It stores several vital chemicals and is the site of certain important metabolic pathways.
  - Several specialised cell organelles are present in the cytoplasm. These organelles perform different kinds of metabolic activities and are kept separate from each other.
- The various cell organelles include endoplasmic reticulum, golgi apparatus, lysosomes, mitochondria, plastids, vacuoles and centrosome.
- **Endoplasmic reticulum (ER)** is an extensive, interconnected, membrane bound network of **tubes and sheets.**
- **Ribosomes** are attached to the surface of Rough Endoplasmic Reticulum (RER) and are absent in Smooth Endoplasmic Reticulum (SER).
  - **Functions of Endoplasmic Reticulum (ER):**
    - **(i)** It synthesises important proteins (RER) and lipids (SER).
    - **(ii)** It provides a pathway for intracellular transport of materials.
    - **(iii)** SER of liver cells is important for detoxification.
  - **Ribosomes are the sites of protein synthesis.**

Golgi apparatus

- Golgi apparatus is a network of stacked, flattened, membrane bound sacs and vesicles.
  - Golgi apparatus carries out the storage, modification and packaging of substances manufactured in the cell and is also involved in lysosome formation.
- The spherical, sac-like **lysosomes** contain powerful digestive enzymes and form the waste disposal system of the cell. They are also known as 'suicidal bags'.

Mitochondria

- **Mitochondria and plastids are covered by two membranes and possess their own DNA and ribosomes.**
- **Mitochondria are the 'power house of the cell', providing energy for various metabolic activities.**

Plastids

- **Chromoplasts and leucoplasts are the two types of plastids present in plant cells.**
- **Chloroplasts are chromoplasts containing chlorophyll and carry out photosynthesis in plants.**
- **Leucoplasts store starch, oil and protein granules.**

Vacuole

- The large central vacuole of mature plant cells contains cell sap which provides turgidity to the cell and also stores important substances.
- In unicellular organisms, vacuoles play an important role in nutrition and osmo-regulation.
- **Centrosome** is found only in animal cells and consists of two centrioles. Centrosome helps in cell division.
- The membrane-bound cell organelles are absent in prokaryotic cells.
- The basic structural organisation of the cell helps it to perform important functions like respiration, nutrition, excretion and protein synthesis.

Key Words

- **Diffusion:** The spontaneous movement of a substance from a region of its higher concentration to a region of its lower concentration.
- **Osmosis:** The movement of water through a semi-permeable membrane from a region of high water concentration to a region of low water concentration.
- **Hypertonic solution:** A solution that has a higher solute concentration than the one to which it is compared.
- **Hypotonic solution:** A solution that has a lower solute concentration than the one to which it is compared.
- **Isotonic solution:** A solution that has the same tonicity as another solution with which it is compared.
- **Plasmolysis:** Shrinkage or contraction of the protoplasm away from the wall of a living plant or bacterial cell, caused by loss of water through osmosis.
- **Cell organelle:** A specialised sub-unit within a cell that has a specific function, and is usually enclosed within its own membrane.
- **Genes:** A hereditary unit consisting of a sequence of DNA that occupies a specific location on the chromosomes and determines a particular characteristic in an organism.
- **Membrane biogenesis:** The process of synthesising the biological membranes.
- **Plasma membrane:** The thin, selectively permeable membrane composed of lipids and proteins which surrounds an entire cell and regulates the flow of substances to and from the cell.
- **Cell wall:** The rigid, non-living, outer covering of certain cells (like plant and bacteria), composed mainly of cellulose. It provides the cell with structural support and protection.
- **Cytoplasm:** The jelly like material of a cell that is enclosed within the plasma membrane, except the nucleus and contains the cell organelles.

Example 1

Define osmosis. In what two ways it is different from diffusion ?

Solution:

Osmosis is the movement of solvent (usually water) from a region of high water concentration to a region of low water concentration; it takes place through semi-permeable membrane whereas the diffusion does not require any membrane. In osmosis movement of solvent is involved whereas in diffusion movement of solid, liquid and gases are involved.

Osmosis is the process in which there is a movement of solvent (usually water) from a region of high water concentration to a region of low water concentration.

Differences between osmosis and diffusion:

S.No.	Osmosis	Diffusion
(i)	It takes place through semi-permeable membrane.	The diffusion does not require any membrane.
(ii)	Movement of solvent is involved.	Movement of solid, liquid and gases are involved.

CHAPTER-6

TISSUES

Topic-1 Plant Tissues : Structure and Functions

Revision Notes

Plant Tissues:

- Tissues ensure division of labour in multicellular organisms.
  - The tissues present in plants and animals are different owing to variations in their body organisation and mode of living.
  - Plants have two main types of tissues – meristematic tissues and permanent tissues.
    (a) Meristematic tissues may be apical, lateral or intercalary, depending on their location in the plant.
    (b) Permanent tissues are classified into simple and complex tissues.
  - Simple tissue shows only one type of cells whereas complex tissues consist of more than one type of cells, functioning as a unit.
- Three types of simple permanent tissues are parenchyma, collenchyma and sclerenchyma.
  - Parenchyma is a supporting and storing tissue, composed of unspecialised, thin-walled cells with large intercellular spaces.
  - Collenchyma cells are elongated, with irregularly thickened cell walls. It provides mechanical support and elasticity to the plant.
  - Sclerenchyma is the main supporting tissue, consists of long and narrow cells with thick and lignified cell walls.
  - Parenchyma and collenchyma are living tissues whereas sclerenchyma is a dead tissue.
- **Epidermis** is the outer protective covering of the plant and is usually layered by cuticle.
  - Stomatal pores, present in the epidermis, are essential for transpiration and gaseous exchange.
  - In older plants, many layered cork is seen, made up of dead and compactly arranged cells.
- Xylem and phloem are important types of complex tissues in plants.
  - Xylem is composed of tracheids, vessels, xylem parenchyma and xylem fibres. It conducts water and minerals from roots to aerial parts of the plant.
  - Phloem consists of sieve tubes, companion cells, phloem fibres and phloem parenchyma. It transports food from leaves and storage organs to all other parts of the plant.

Key words

- **Tissues :** A group of specialised cells with similar structure, working together to perform a common function.
- **Meristematic tissue :** Tissue made up of actively dividing cells, present in the growing areas of the plant body.
- **Apical meristem :** Meristem present at the growing tips of stem and root that cause the stem and root to increase in length.
- **Lateral meristem :** Meristem located on the lateral portion of the plant and responsible for increasing the girth of its stem and root.
- **Intercalary meristem :** Meristem found between already differentiated tissues, in locations such as the base of leaves or internode.
- **Permanent tissue :** A well-differentiated plant tissue derived from meristematic tissue, which has lost its ability to divide.
- **Differentiation :** The process by which a cell attains a permanent shape, size and function.
- **Simple permanent tissue :** A permanent tissue composed of only one of cell type.
- **Complex permanent tissue :** A permanent tissue composed of more than one type of cells which coordinate to perform a common function.

- **Chlorenchyma :** Parenchyma whose cells contain chloroplasts and hence performs photosynthesis.
- **Aerenchyma :** Parenchyma containing large air cavities, providing buoyancy to aquatic plants and allowing the circulation of gases.
- **Xylem :** The complex tissue that conducts water and minerals in vascular plants and composed of tracheids, vessels, fibres, and parenchyma.
- **Phloem :** The food-conducting tissue of vascular plants, consisting of sieve tubes, companion cells, fibres and parenchyma.
- **Epidermis :** The outermost, protective layer of cells covering the surface of a plant.

Mnemonics

Concept : **Types of Meristematic tissue:**
Mnemeonics : **A**ccha **I**nnam **L**aga
Interpretation :

A: Apical meristem
I: Intercalary meristem
L: Lateral meristem

Topic-2 Animal Tissues : Structure and Functions

Revision Notes

- Animal tissues are grouped into 4 basic types – epithelial, connective, muscular and nervous tissue.
- **Epithelial tissues** are the covering or protective tissues which act as a barrier between the various systems of the body. It rests on a basement membrane and is composed of tightly packed cells.
- **Connective tissues** is the binding and supporting tissue of the animal body. Matrix forms the main bulk of this tissue, whereas the cells are loosely spaced and less in number.
- **Muscular tissues** have the unique ability to contract and relax for doing mechanical or strenuous work. It help for the movement of organs.
- **Nervous tissues** help to transmits signal to respond for the stimulus received by the sense organs. It is formed by the nerve cell called neurons.
- Blood, bone, ligament, tendon, cartilage, areolar tissue and adipose tissue are important connective tissues present in our body.
  - **Blood** is a fluid connective tissue in which RBCs, WBCs and platelets are suspended and plays a significant role in the process of transportation.
  - **Bone** function is to protect, providing skeletal framework and anchoring are carried out by the strong and hard bone tissue.
  - **Ligaments** connect bones to bones whereas **tendons** connect bones to muscles.
  - **Cartilage** provides support and flexibility to the body parts.
  - **Areolar tissue** repairs the injured tissues and fills spaces within organs. These are found between the skin and muscles, around blood vessels and nerves and in bone marrow.
  - **Adipose tissue** serves as a fat reservoir and also carries out the function of insulator. It is found below the skin and between internal organs.
- **Muscular tissues** is responsible for movements in our body through the contraction and relaxation of their contractile fibres of muscles.
- Striated, unstriated and cardiac are three types of muscle tissues.
- **Nervous tissues** help to transmits signal to respond for the stimulus received by the sense organs. It is formed by the nerve cell called neurons.
  - Nervous tissue is present in the brain, spinal cord and nerves.
  - Neuron is made up of cell body, dendrites and axon.
  - Neurons are specialised to receive and conduct impulses rapidly.

Key words

- **Stratified epithelium :** An epithelium composed of multiple layers of cells, with only the basal layer being in contact with the basement membrane.
- **Ligament :** A fibrous connective tissue that connects (or binds) bones to bones.
- **Tendon :** A fibrous connective tissue that connects bones to muscles.
- **Voluntary muscles :** Muscles which can be controlled according to our will.
- **Involuntary muscles :** Muscles which are not under the control of our will.
- **Multinucleate cell :** Cell containing more than one nucleus.
- **Uninucleate cell :** Cell containing only one nucleus.
- **Neuron :** A cell of the nervous system specialised to conduct nerve impulses and made up of cell body, axon and dendrites.
- **Impulse :** An electrical signal transmitted along a nerve fibre in response to a stimulus.

UNIT – III: MOTION, FORCE AND WORK

CHAPTER-7

MOTION

Topic-1 Distance, displacement, velocity, Uniform and non-uniform motion, acceleration.

Revision Notes

- **State of Motion :**
  - If the position of an object does not change with respect to time, it is said to be at rest.
  - If the position of an object changes as time passes, it is said to be in motion.
  - Reference point is a fixed point with respect to which a body is at rest or in motion.
  - Rest and motion are relative terms.
- **Distance** is the length of the actual path travelled by a body in a given time.
- **Displacement** is the shortest distance between the initial and final positions of the body in a specified direction.
- A physical quantity which has both magnitude and direction is known as **vector quantity**. e.g., velocity, force.
- A physical quantity which has only magnitude is known as **scalar quantity**. e.g., time, speed.
- The S.I. unit of distance and displacement is metre.
- A body is said to be in **uniform motion**, if it travels equal distances in equal intervals of time.
- A body is said to have **non-uniform motion** if it travels unequal distances in equal intervals of time.
- In non-uniform motion, speed of an object is not constant. The S.I. unit of speed is m/s.
- **Speed** is the ratio of distance travelled to the time taken to cover that distance.
- **Average speed** of a body is the total distance travelled divided by the total time taken.
- **Velocity** is displacement per unit time. The S.I. unit of velocity is metre per second.
- **Average velocity** is the total displacement divided by the total time taken.
- Speed is a scalar quantity and velocity is a vector quantity.
- Time is an independent variable, plotted along X-axis. Distance is a dependent variable, plotted along Y-axis in the distance-time graph.
- Graphs are designed to make it easier for the reader to interpret and understand numerical data.
- The distance-time graph is a straight line parallel to time axis when the object is at rest.
- The nature of distance-time graph is a straight line when the object is in the state of uniform motion.
- Slope of the distance-time graph gives the speed of the object.

- A more steeply inclined distance-time graph indicates greater speed. The nature of distance-time graph is a curve having varying slope when the object has non-uniform motion.
- If the velocity of a body remains constant, the velocity-time graph is a horizontal line parallel to the time axis.
- If the velocity of the body changes uniformly at a constant rate, the velocity-time graph is a straight line.
- If the velocity of the object changes non-uniformly, the velocity-time graph is a curve having increasing slope.
- The area enclosed by the velocity-time graph and the time axis represents the displacement.
- The slope of the velocity-time graph gives the acceleration.
- When a body travels along a circular path of constant radius with a constant speed then its motion is **uniform circular motion**.
- In a uniform circular motion, velocity of a particle is not constant but its speed is constant, hence it is an **accelerated motion**.

Keywords

- **Distance :** The distance covered by a moving object is the actual length of the path followed by the object. Distance is a scalar quantity. SI unit of distance is metre .
- **Displacement :** It is the shortest distance covered by a moving object from the point of reference (initial position of the body), in a specified direction. SI unit of displacement is metre.
- **Uniform speed :** An object is said to be moving with uniform speed if it covers equal distances in equal intervals of time.
- **Non-uniform speed :** An object is said to be moving with variable speed or non-uniform speed if it covers equal distances in unequal intervals of time or vice-versa.
- **Average speed :** When we travel in a vehicle the speed of the vehicle changes from time to time depending upon the conditions existing on the road. In such a situation, the speed is calculated by taking the ratio of the total distance travelled by the vehicle to the total time taken for the journey. This is called the average speed.
- **Instantaneous speed :** The speed of a moving body at any particular instance of time, is called instantaneous speed.
- **Velocity :** It is defined as the distance covered by a moving object in a particular direction in unit time or speed in a particular direction.
- **Acceleration :** It is defined as the rate of change of velocity of a moving body with time.
- **Uniform Acceleration :** If the change in velocity in equal intervals of time is always the same, then the object is said to be moving with uniform acceleration.
- **Non-uniform or Variable Acceleration :** If the change in velocity in equal intervals of time is not the same, then the object is said to be moving with variable acceleration.
- **Uniform velocity :** A body is said to be moving with uniform velocity if it covers equal distances in equal intervals of time in a specified direction.
- **Variable velocity :** A body is said to be moving with variable velocity if it covers unequal distances in equal intervals of time and vice-versa in a specified direction or if it changes the direction of motion.
- **Circular motion :** Motion along circular track is called circular motion.

Example 1

The following graph describes the motion of a girl going to meet her friend who stays 50 m from her house.

(i) How much time she takes to reach her friend's house ?

(ii) What is the distance travelled by the girl during the time interval 0 to 12 min ?

(iii) During which time interval she is moving towards her house ?

(iv) For how many minutes she was at rest, during the entire journey ?

(v) Calculate the speed by which she returned home.

Solution:

(i) The friend's house is 50 m away so the time taken to reach that distance from her initial position O to G is 14 min.

(ii) Distance in 12 min = OA + AB+BC + CD+DE
= 20 + 0 + (40 – 20) + 0 + |(20 – 40)|
= 20 + 0 + 20 + 2 + 20
= 60 m

(iii) In the direction DE between 8–10 min.

(iv) Time when she was at rest = AB + CD + EF
= 2 + 2 + 2
= 6 min

(v) Speed with which she reached home = $\frac{50}{2\times 60}$
= 0.417 m/s

1 × 5

Topic-2 Uniformly Accelerated Motion

Revision Notes

➢ **First Equation of Motion :**

Consider a particle moving along a straight line with uniform acceleration 'a'. At $t = 0$, let the particle be at A and u be its initial velocity and when $t = t$, v be its final velocity.

$$\text{Acceleration} = \frac{\text{change in velocity}}{\text{time}} = \frac{v-u}{t}$$

$$\Rightarrow \quad a = \frac{v-u}{t}$$

$$v - u = at$$

$$v = u + at \qquad \text{(I equation of motion)}$$

➢ **Second Equation of Motion :**

$$\text{Average velocity} = \frac{\text{total distance travelled}}{\text{total time taken}}$$

$$\text{Average velocity} = \frac{s}{t} \qquad ...(i)$$

Average velocity can also be written as $\frac{u+v}{2}$ ...(ii)

From equations (i) and (ii) $\frac{s}{t} = \frac{u+v}{2}$ ...(iii)

The first equation of motion is $v = u + at$. Substituting the value of v in equation (iii), we get

$$\frac{s}{t} = \frac{u+u+at}{2}$$

or $$s = \frac{(u+u+at)t}{2}$$

or $$s = ut + \frac{1}{2}at^2 \qquad \text{(II equation of motion)}$$

➢ **Third Equation of Motion :**

The first equation of motion is $v = u + at$

$$v - u = at \qquad ...(i)$$

$$\text{Average velocity} = \frac{s}{t} \qquad ...(ii)$$

$$\text{Average velocity} = \frac{u+v}{2} \quad \text{...(iii)}$$

From equation (ii) and equation (iii) we get,

$$\frac{u+v}{2} = \frac{s}{t} \quad \text{...(iv)}$$

Multiplying equation (i) and equation (iv) we get,

$$(v-u)(v+u) = at \times \frac{2s}{t}$$

$$(v-u)(v+u) = 2as \qquad [a^2 - b^2 = (a+b)(a-b)]$$

$$v^2 - u^2 = 2as \qquad \text{(III equation of motion)}$$

- When a particle is moving upwards or downwards, the above equations of motion can be written as:

(a) For upward motion

(1) $v = u - gt$

(2) $h = ut - \frac{1}{2}gt^2$

(3) $v^2 - u^2 = -2gh$

(a) For downward motion

(1) $v = u + gt$

(2) $h = ut + \frac{1}{2}gt^2$

(3) $v^2 - u^2 = 2gh$

where, h = height covered,
g = acceleration due to gravity,
v = final velocity, and
u = initial velocity

CHAPTER-8

FORCE AND NEWTON'S LAWS

Topic-1 Force, Laws of Motion and Acceleration

Revision Notes

- **Force** is a push or pull acting upon an object.
- **Balanced forces :** The resultant of all the forces acting on a body is zero.
- **Unbalanced forces :** The resultant of all the forces acting on a body is not zero.
- **Newton's first law of motion** states that a body at rest will remain at rest and a body in motion will remain in uniform motion unless acted upon by an unbalanced force.
- The net force acting on the object is zero, whenever balanced forces act on it.
- The **momentum** of an object is the product of its mass and velocity and has the same direction as that of the velocity. Its SI unit is kg-m-s^{-1}.
- **Newton's second law of motion** states that the rate of change of momentum of a body is directly proportional to the force and takes place in the same direction as the force.
- Force is also defined as the product of mass and acceleration.
- The SI unit of force is kg-m-s^{-2}. This is also known as Newton and represented by the symbol N.
- A force of one Newton produces an acceleration of 1 m-s^{-2} on an object of mass 1 kg.
- Force of friction always opposes motion of objects.
- Two forces resulting from the interaction between two objects are called action and reaction forces respectively.
- Action and reaction forces act on two different bodies but they are equal in magnitude.
- **Newton's third law of motion :** For every action there is an equal and opposite reaction; but action and reaction act on different bodies.

Keywords

- **Force :** A force is a physical quantity which, when unopposed, will change the motion, direction and shape of an object.
- **Balanced Force :** When two forces of equal magnitude act in opposite directions on an object simultaneously, then the object continues in its state of rest or a uniform motion in a straight line. Such forces acting on the object are known as balanced force.
- **Unbalanced Force :** When two forces of unequal magnitudes act in opposite directions on an object simultaneously, then the object moves in the direction of the larger force. These forces acting on the object are known as unbalanced force.
- **Momentum :** Momentum of a body is equal to the product of the mass (m) of the body and the velocity $\vec{v}$ of the body. It is denoted by $\vec{p}$.
- **Recoil Velocity :** The velocity with which the gun moves backward after firing a bullet is known as recoil velocity.
- **Friction :** Whenever a body slides or rolls over the surface of another body, a force comes into action which acts in the opposite direction of the motion of a body. This opposing force is called 'friction'.
- **Resultant Forces :** The resultant force or resultant of several forces acting simultaneously on a body is that single force which produces the same effect on a body as all these forces together produce.

Topic-2 Inertia and conservation of momentum

Revision Notes

- **Inertia**
  - The property by the virtue of which an object tends to remain in the state of rest or of uniform motion unless acted upon by some force is called inertia.
  - The mass of a body is a measure of inertia.
  - Inertia is the inability of a body to change its state of rest or of uniform motion in a straight line by itself.
  - The inherent property of a body by virtue of which it cannot change its state of rest is called inertia of rest.
- **Effects of force are :**
  - **(i)** It can produce motion in stationary bodies.
  - **(ii)** It can stop moving bodies.
  - **(iii)** It can change the speed and direction of motion of bodies.
  - **(iv)** It can also bring about change in dimensions of a body.

Key words

- **Inertia :** The tendency of a body to oppose or resist any change in its state of rest or uniform motion is called inertia of the body.
- **Inertia of Motion :** The tendency of a body to oppose any change in its state of uniform motion is known as inertia of motion. e.g., **:** The passengers fall forward when a fast moving bus stops suddenly.
- **Inertia of Direction :** The tendency of a body to oppose any change in its direction of motion is known as inertia of direction. e.g., **:** When a fast moving bus negotiates a curve on the road, passengers fall towards the centre of the curved road.
- **Recoil velocity :** The velocity with which gun moves in the backward when fired.

Example 1

(i) A ball is allowed to roll down from an inclined plane. It reaches the foot of the plane and continues to roll on the ground. It stops after travelling some distance. Is this the violation of law of inertia? Give reasons for your answer.

(ii) A player lowers his hand while catching a ball. Explain reason behind his action.

Solution:

(i) No. It is not the violation of law of inertia. Law of inertia is obeyed only when no external force acts on a body. But in this case the friction due to the ground acts on the ball, so it comes to rest.

(ii) Player lowers his hand because by doing so he increases the time in which velocity of ball comes to zero. This decreases the rate of change of momentum and so the impact of force is reduced. **(1 + 1+ 1)**

CHAPTER-9

GRAVITATION

Revision Notes

- According to the law of gravitation, the force of attraction between any two objects is proportional to the product of their masses and inversely proportional to the square of the distance between them. The law applies to objects anywhere in the universe. Such a law is said to be universal.
- Universal gravitational constant G = 6.67×10^{-11} $Nm^2 kg^{-2}$.
- Gravitation is a weak force unless large masses are involved.
- Acceleration with which a body falls towards the centre of the Earth is called acceleration due to gravity (g).
- The force of gravity decreases with increasing altitude. It also varies on the surface of the Earth, decreasing from poles to the equator.
- Mass is the quantity of matter contained in the body.
- Weight of the body is the force with which the Earth attracts the body.
- The weight is equal to the product of mass and acceleration due to gravity.
- Mass of a body does not change but weight of a body is different at different places.
- Inverse square rule states that F is inversely proportional to the square of d.
- Weight of an object on the Moon is one-sixth time of its weight on the Earth.

Key words

- **Gravitation :** It is the force of attraction between any two bodies in the universe.
- **Gravity :** It is the force of attraction between the Earth and any object lying on or near its surface.
- **Newton's universal law of gravitation :** This law states that everybody in this universe attracts every other body with a force which is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.

  Mathematically,

$$F = G\frac{m_1 m_2}{r^2}.$$

  where, G is Universal gravitational constant.
- **Universal gravitational constant :** It is equal to the force of attraction between two bodies of unit mass each placed at a unit distance apart. It is denoted by G and its value is **6.67×10^{-11} Nm^2/kg^2**.
- **Centripetal acceleration of the Moon :** If the Moon is revolving with speed v in a circular orbit of radius r, then acceleration acting on it along the radius and towards the centre of its orbit is

$$a_c = \frac{v^2}{r}.$$

- **Free fall :** The motion of a body under the influence of force of gravity alone is called a 'free fall'.
- **Acceleration due to gravity :** The acceleration produced in the bodies due to Earth's force of gravity is called acceleration due to gravity. Its value on the Earth's surface is 9.8 m/s^2.
- **Centre of mass :** The centre of mass of a body may be defined as the point at which whole mass of the body may be assumed to be concentrated.
- **Centre of gravity :** The centre of gravity of a body is a point at which the resultant of all the parallel forces experienced by various particles of the body, due to attraction of Earth, passes irrespective of the orientation of the body.
- **Projectile :** Any object thrown into space with some initial velocity and which moves thereafter under the influence of gravity alone is called a 'projectile'. The path of a projectile is a parabola. Its horizontal range is maximum when the angle of projection is 45°.
- **Weightlessness :** The state when an object does not weight anything during free fall.

Example 1

(a) What is the relation between the mass **m** and the weight **w** of a body ?

(b) What are the differences between mass and weight?

Solution:

(a) Weight of a body is the force of attraction of the Earth on that body. This force depends on the mass (m) of the body and the acceleration due to gravity (g).

$F = m \times a$

$F = m \times g$

$W = m \times g$

The weight (W) of the body is directly proportional to the mass of the body.

(b) Difference between mass and weight :

S. No	Mass	Weight
(i)	Its value remains constant at all places.	Its value changes from place to place due to change in the 'g'.
(ii)	It is a scalar quantity.	It is a vector quantity.
(iii)	It is never zero.	It is zero far away from the Earth.
(iv)	Its unit is kg.	Its unit is N or kg- wt.

(1 + 2)

CHAPTER-10
FLOATATION

Revision Notes

- All objects experience a force of buoyancy when they are immersed in a fluid.
- Objects having density less than that of the liquid in which they are immersed, float on the surface of the liquid. If the density of the object is more than the density of the liquid in which it is immersed then it sinks in the liquid.
- **Archimedes' principle :** When a body is immersed partially or completely in a fluid (or liquid), it experiences an upthrust that is equal to the weight of the fluid displaced by the body.
- Lactometers are used to determine the purity of a sample of milk.
- Hydrometers are used for determining the density of liquids.
- Density of different substances are different.

Key words

- **Weight :** Force by which an object is attracted towards the Earth. SI unit is Newton (N).
- **Upthrust / buoyant force :** The upward force exerted by a liquid on the body that is immersed in the liquid.
- **Density :** It is the mass of a unit volume. Its unit is kilogram per metre cube (kgm^{-3}).
- **Pressure :** Force per unit area. SI unit is N/m^2 or Nm^{-2} or Pascal.
- **Gravity :** Force of attraction due to Earth.

Example 1

(i) Radius of an iron sphere is 0.21 cm. If density of iron is 7.8 g/cm^3, calculate its mass.

(ii) A pressure of 1000 Pa, acts on a surface of area 15 cm^2 by a block of mass 'm'. Calculate 'm'. Calculate the new pressure exerted by the same block if the area of contact with the surface becomes 10 cm^2.

Solution:

(i) Density $= \frac{\text{Mass}}{\text{Volume}}$

$M = e \times V$ *(a)*

$e = 7.8$ g/cm^3

Volume of sphere $V = \frac{4}{3}\pi r^3$

$= \frac{4}{3} \times \frac{22}{7} \times \frac{21}{100} \times \frac{21}{100} \times \frac{21}{100}$

$= \frac{4 \times 22 \times 21 \times 21}{100 \times 100 \times 100}$ cm^3 *(b)*

Putting the value of V in eqn *(a)*

$$M = \frac{7.8 \times 4 \times 22 \times 21 \times 21}{100 \times 100 \times 100}$$

$$= \frac{302702.4}{100 \times 100 \times 100}$$

$= 0.3027024$ g

$= 0.30$ g. **3**

(ii) $P = \frac{F}{A} = \frac{mg}{A} \Rightarrow m = \frac{PA}{g}$

$= \frac{1000 \times 15}{10 \times 100 \times 100} = 0.15$ kg

Now, $P' = \frac{mg}{A} = \frac{0.15 \times 10}{10 \times 10^{(-4)}} = 1{,}500$ Pa **2**

CHAPTER-11

WORK, ENERGY AND POWER

Topic-1 Work

Revision Notes

Work

- Work is done when a force acting on a body produces displacement in it.
- Work done = Force × Displacement in the direction of force.
- Work is a scalar quantity.
- Work has only magnitude and no direction.
- The SI unit of work is joule (J).
- Work done is positive if the angle between force and displacement is acute or when the displacement is in the direction of the applied force.
- Work done is negative if the angle between force and displacement is obtuse or when the force acts opposite to the direction of displacement.
- Work done on an object by a force would be zero if the displacement of the object is zero.
- When a body moves along a circular path, the force acts along the radius of the circular path and the motion of the body is along the tangential direction. Therefore, the angle between the direction of motion and the force is 90°. Hence, no work is done on a body when it moves in a circular path.
- An object having a capacity to do work is said to possess energy.

Key Words

- **Joule :** One joule (J) is the amount of work done by an object when a force of one Newton displaces it by one meter along the line of action of force.
- **Motion :** A change in position of an object with respect to time.
- **Force :** Any interaction that tends to change or try to change the motion of an object.
- **Displacement :** The shortest distance from the initial to the final position.

Topic-2 Energy, Types of Energy and Law of Conservation of Energy

Revision Notes

- The change of one form of energy into another is called transformation of energy.
- Law of conservation of energy states that energy can neither be created nor be destroyed, but can be transformed from one form to another.
- Energy exists in nature in several forms such as kinetic energy, potential energy, heat energy and chemical energy. The sum of the kinetic and potential energies of an object is called its total mechanical energy.
- The unit of energy is same as that of work, that is Joule.
- An object of mass 'm' moving with a velocity 'v' has a kinetic energy of $\frac{1}{2}mv^2$.
- The gravitational potential energy of an object of mass 'm' raised through a height 'h' from the Earth's surface is given by mgh.

Key Words

- **Energy :** Capacity of an object / system to perform work.
- **Kinetic energy :** Energy possessed by a body by virtue of its motion.
- **Potential energy :** Energy possessed by a body by virtue of its position or change in configuration.
- **Gravitational potential energy :** Work done in raising an object from the ground to a point against gravity.
- **Mechanical energy :** Energy associated with the motion and position of an object.

Example 1

(i) Name the type of energy possessed by a moving object. Write its SI unit.

(ii) Derive the expression for this energy for an object moving with velocity v and having mass m.

Solution:

(i) Kinetic energy. SI unit is Joule. **(½ +½)**

(ii) $\text{K.E.} = \frac{1}{2}\ mv^2$

$F = ma$

$W = Fs = mas$ (i)

$v^2 - u^2 = 2as$

$v^2 = 2as$, when $u = 0$

$as = \frac{v^2}{2}$ ...(ii)

Substituting (ii) in (i) we have

$W = \frac{1}{2}\ mv^2$,

i.e., Work done is equal to kinetic energy of the body.

$\therefore \text{K.E.} = \frac{1}{2}\ mv^2$ **2**

Topic-3 Power

Revision Notes

- Power is the ratio of work and time.
- It is a scalar quantity.
- In power, time is important but in work, time is not relevant.
- The S.I. unit of power is watt.
- Average power is obtained by dividing the total energy consumed by the total time taken.

Key Words

- **Power :** Rate at which work is done.
- **1 W of power** : When one Joule of work is done in one second.

CHAPTER-12

SOUND

Topic-1 Sound : Its Nature, Production, Propagation, Speed and Reflection

Revision Notes

- **Nature of sound**
  - Sound is a wave motion, produced by a vibrating source.
  - A medium is necessary for the propagation of sound waves.
  - Sound is a longitudinal wave in which the particles of medium move along the direction of motion of wave.
  - Sound travels as successive compression and rarefactions in the medium.
  - Velocity of sound wave depends upon the nature of the medium through which it passes.
  - The speed of sound depends primarily on the nature and the temperature of the transmitting medium.
  - Sound can not travel in vacuum.
- **Propagation of sound**
  - Sound travels faster in solids than in air. The speed of sound in solids is much more than the speed of sound in liquids or gases.
  - Propagation of sound can be visualised as propagation of density variations or pressure variations in the medium.
  - S.I. unit of time period is second (s).
  - S.I. unit of frequency is hertz (Hz).
  - Sound properties such as pitch, loudness and quality are determined by the corresponding wave properties.
- **Production of sound**
  - Objects of different sizes and conditions vibrate at different frequencies to produce sound of different pitch.
  - Sound gets reflected and follows the same law such as reflection of light.
  - Loud sound can travel a larger distance as it is associated with higher energy.
  - **Law of reflection of sound :** The directions in which the sound is incident and is reflected make equal angles with the normal to the reflecting surface at the point of incidence and the three are in the same plane.
  - The speed v, frequency ν, and wavelength λ of sound are related by equation $v = \lambda\nu$.

Key Words

- **Compression :** It is a part of a longitudinal wave in which the particles of the medium are closer to one another.
- **Rarefaction :** It is the part of a longitudinal wave in which the particles of the medium are farther than normal.
- **Crest :** The point of maximum positive displacement on a transverse wave.
- **Trough :** The point of maximum negative displacement on a transverse wave.
- **Pulse :** A wave of short duration, which is confined to small portion of a medium at any given time.
- **Amplitude :** Maximum displacement of particles of the medium from their mean positions during the propagation of a wave.
- **Wave velocity :** Distance travelled by a wave in one second.
- **Wavelength :** Distance between two consecutive compressions or two consecutive rarefactions or between two consecutive crests or troughs.
- **Frequency :** Number of oscillations per second.
- **Time period :** Time taken by the wave to complete one oscillation.
- **Pitch :** The way the brain interprets the frequency of an emitted sound.
- **Loudness :** The degree of sensation of sound produced.
- **Intensity :** Amount of sound energy passing each second through unit area.
- **Transverse wave :** Displacement of the medium is perpendicular to the direction of propagation of the wave, e.g., a ripple on a pond.
- **Longitudinal wave :** Displacement of the medium is parallel to the propagation of the wave, e.g., sound waves in air.
- **Tone :** A sound of single frequency.

Topic-2 Echo, Applications of Sound, Range of Hearing and Structure of Human Ear (Auditory aspect only)

Revision Notes

Introduction

- To hear a distinct echo, the time interval between the original sound and the reflected one must be at least 0.1 sec.
- For hearing distinct echoes, the minimum distance should be 17.2 m.
- Auditorium or halls have roof and walls covered with sound absorbent materials and seats made with the sound absorbent properties.
- **Uses of multiple reflection of sound are :**
  - **(i)** Megaphones, horns, musical instruments,
  - **(ii)** Stethoscope,
  - **(iii)** Curved ceilings of concert halls, conference halls and cinema halls.
- Audible range of frequency for human ear = 20 Hz to 20000 Hz
- **Application of ultrasound :**
  - **(i)** To clean parts located in hard-to-reach places,
  - **(ii)** Detect cracks and flaws in metal blocks
  - **(iii)** Medical devices

Key Words

- **Echo :** Repetition of sound due to the reflection of original sound by a large and hard obstacle.
- **Intensity of sound :** Amount of sound energy passing each second through unit area.
- **Ultrasound :** Sound of frequency greater than 20 kHz.
- **Infrasound :** Sound of frequency less than 20 Hz.
- **Reverberation :** The persistence of sound due to repeated reflection and its gradual fading away.

Example

What is reverberation ? How can it be reduced ? Give two applications of reflection of sound wave.

Solution:

The repeated reflection that results in the persistence of sound is called reverberation.

It can be reduced by covering roof and walls of auditorium with sound absorbent materials and seats are made of material having sound absorbing properties. **2**

Two applications of reflection of sound waves :

(i) Echo. ½

(ii) In megaphones. ½

UNIT – IV: FOOD PRODUCTION

CHAPTER-13

IMPROVEMENT IN FOOD RESOURCES

Topic-1 Breeding, quality improvement and management

Revision Notes

- Agriculture and animal husbandry provide us all our food from plant and animal sources respectively.

➢ **Improvement in food variety**

- Capacity of producing crop plants and managing livestock should be increased through various efforts like green revolution and white revolution. But this should be done by employing sustainable practices without destroying our environment.
- Improving the financial status of people, especially those involved in agricultural practices is essential to provide food security to everyone.
- The optimum requirement of temperature, water, light and other conditions varies for different crops.
- Kharif crops like paddy and cotton are grown in rainy season whereas Rabi crops like wheat and mustard are grown in winter season.
- Crop variety improvement, crop production improvement and crop protection management help to increase the crop yields.
- Hybridisation and genetic modification techniques introduce the useful characters into crop plants.
- It is desirable to develop crops that can survive and give good yields in different climatic conditions and areas.

➢ **Desirable characteristics of crop plants:**

(i) Increased yield

(ii) Improved quality (such as baking quality in wheat, protein quality in pulse) etc.

(iii) Resistance to biotic and abiotic factors, especially those harming the plant.

(iv) Reduction in duration of plant maturity.

(v) Broad range adaptability of the crop plant under various environmental conditions.

(vi) Variety improvement may be done for one or several of these characteristics.

➢ In India, the land holding, financial conditions and use of modern technologies vary among different farmers. Hence the inputs of farmers are also different, leading to different production practices and yields.

➢ The sixteen nutrients required by plants are obtained through air, water and soil.

(i) There are 9 macronutrients. **Examples :** Nitrogen, phosphorus, potassium, calcium, magnesium and sulphur, carbon, oxygen, hydrogen.

(ii) There are 7 micronutrients. **Examples :** Iron, manganese, boron, zinc, copper, molybdenum and chlorine.

(iii) Air supplies carbon and oxygen and hydrogen comes from water.

- **Animal husbandry :** Due to the food needs of the ever increasing human population, animal husbandry, especially of cattle, goat, sheep, poultry and fish, is gaining a lot of importance.
- **Cattle Farming**
  - In India, cows and buffaloes are used for draught labour and producing milk and are called draught animals and milch animals respectively.
  - Long lactation period is a desirable quality in milch animals.
  - Exotic breeds showing long lactation is cross bred with local breeds showing resistance to diseases to obtain high quality breeds.
  - For good health and milk production, proper cattle management is required such as shelter, feeding, breeding and disease control.
  - The cattle shelter should be well-ventilated, hygienic and dry.
  - Cattle food should include roughage and concentrates in balanced amounts and are required for the healthy maintenance as well as milk production of the cattle.
  - Cattle diseases are caused by external and internal parasites as well as by bacteria and viruses. These affect the health as well as milk production of the animals and can be largely controlled through vaccinations.
- **Poultry**
  - Poultry farming targets egg production and broiler production for chicken meat.
  - Cross-breeding is done between the Indian and foreign breeds of poultry to obtain improved varieties containing desirable traits such as tolerance to high temperature, dwarf broiler parent, low maintenance requirements and reduction in size of the layers.
  - The shelter, feeding and other requirements of broilers and layers differ from each other.
  - The diet of broilers is planned with the aim of achieving good growth rate and quality of carcass whereas the diet of layers is aimed to achieve large number and high quality of eggs.
  - Broiler diet is rich in proteins and vitamins, along with the required amount of fat.
  - The poultry shelter should be hygienic, well-lighted and maintained at appropriate temperatures.
  - Poultry need to be protected from various diseases caused by bacteria, fungi, viruses, parasites and nutritional deficiencies, through proper treatment, sanitation and vaccination.
- **Fish Production**
  - In fish production, both the true fish as well as shell fish are obtained from marine or fresh water through capture fishing or culture fishery.
  - India's marine fishery resources are the vast coastlines and extensive seas; the freshwater resources are canals, ponds, reservoirs and rivers whereas the brackish water fishery resources are estuaries and lagoons.
  - In India, marine fishes such as pomfret, tuna, mackerel and sardines can be locating through satellites and echo sounders and captured using fishing nets.
  - Marine fish farming of high economic value fishes like mullets, oysters and prawns are done in sea water.
  - Freshwater fish production is mainly carried out through aquaculture.
  - Composite fish culture system is used commonly for fresh water fish farming. In this system, five or six fish species with different food habits are farmed together in a single pond, so as to increase the yield of fish.
  - Since high quality fish seed is not always available, fish are now-a-days bred using hormonal stimulation, thus ensuring continuous supply of the seed.
- **Bee-keeping**
  - Bee-keeping is a low investment activity carried out by farmers to obtain honey and wax.
  - *Apis cerana indica, Apis dorsata* and *Apis florae* are the Indian bee varieties whereas *Apis mellifera* is an Italian variety used for commercially producing honey.
  - The availability of sufficient amount of pasturage as well as the type of flowers decide the quality of honey.

Key Words

- **Compression :** It is a part of a longitudinal wave in which the particles of the medium are closer to one another.
- **Hybridisation :** Cross between genetically dissimilar plants.
- **Intervarietal hybridisation :** Hybridisation between different varieties of plants.
- **Interspecific hybridisation :** Hybridisation between organisms of the same species but of different population.
- **Intergeneric hybridisation :** Hybridisation between organisms of different genera.
- **Macronutrients :** Nutrients required by plants or animals in large quantities.
- **Micronutrients :** Nutrients required by plants or animals in small quantities.
- **Broiler :** Gallinaceous domesticated fowl, bred and raised specifically for meat production.
- **Composite fish culture :** Polyculture system in which compatible fishes of different species having different feeding habits are selected and grown in the pond to exploit all types of available food.
- **Livestock :** Domesticated animals raised in an agricultural setting to produce commodities such as food, fiber and labour.

Topic-2 Improvement in Crop Yields

Revision Notes

- **Manures**
  - Manures and fertilizers supplement the soil with the required nutrients to increase crop yield.
  - Manures contain decomposed animal and plant wastes and increase soil nutrition and fertility.
- **Composting**
  - The bulk organic matter present in manure improves soil structure.
  - In composting, the biological waste material is decomposed in pits. Composting done using earthworms is called vermi-composting.
- **Fertilizers**
  - In green manuring, green crops are grown, mulched by ploughing and mixed with soil to improve soil structure and fertility.
  - The commercially produced fertilizers provide macronutrients like N, K and P and ensure healthy growth of plants.
  - Excessive use of fertilizers causes water pollution and loss of soil fertility.
  - A best crop yield is obtained by a balance between the use of fertilizers and manures.
  - In organic farming, use of chemicals is discouraged whereas use of organic manures, bio-agents and healthy cropping systems is encouraged.
- **Irrigation**
  - Irrigation is essential to ensure agricultural success in India since our agriculture is mainly rain-fed.
  - Wells, canals, rivers and tanks are some important irrigation systems in our country.
  - The source of wells is underground water whereas canals get water from rivers or reservoirs. River lift systems draw water directly from rivers.
  - Rainwater harvesting and watershed management increase storage of rain water for later use in agriculture.
- **Crop pattern**
  - Risk of crop failure is reduced in mixed cropping wherein two or more crops are grown together on the same field.
  - Two or more crops with different nutritional requirements are grown on the same farm in inter-cropping so as to utilise maximum nutrients and prevent spread of diseases and pests.
  - In crop rotation, different crop combinations are grown on the same field in a pre-planned succession so as to get maximum returns.
- **Nutrient management**
  - Weeds, pests and diseases can destroy large amounts of crop plants.
  - Weed removal from crop fields is essential since they use up the requirements of crop plants like food, space, light etc.
  - Insect pests and plant pathogens attack different parts of the plant and thus reduce crop yields.
  - Pesticides are used to control weeds, insects and diseases, but they should be used only as much as needed to avoid environmental pollution and health hazards.
  - Several preventive methods can be adopted to carry out pest and weed control.
  - Biotic and abiotic factors can cause huge storage losses of food grains that can be taken care of by proper treatment.
  - It is better to use preventive and control methods for protecting crops such as proper cleaning and drying of the crops followed by fumigation, rather than treatment measures.

Key Words

- **Composting :** The process in which farm waste material like livestock excreta, vegetable waste, animal refuse, domestic waste, sewage waste etc is decomposed in pits.
- **Vermicompost :** Compost prepared by using earthworms to hasten the decomposition process of plant and animal refuse.
- **Manure :** Organic substances of animal or plant origin that is added to the soil to increase its fertility and structure.

- **Fertilizer :** Commercially produced plant nutrients that enrich the soil fertility and increase the crop yield.
- **Organic farming :** A farming system with minimal or no use of chemicals as fertilizers, pesticides etc. and with a maximum input of organic manures, recycled farm-wastes, along with use of bio-agents and healthy cropping systems.
- **Mixed cropping :** The practice of growing two or more crops simultaneously on the same field.
- **Inter-cropping :** The practice of growing two or more crops simultaneously on the same field in a definite pattern.
- **Crop rotation :** The growth of different crops on a piece of land in a pre-planned succession.
- **Weeds :** Unwanted plants in the cultivated field.
- **Watershed Management :** Scientific conservation of soil and water.
- **Pest :** Unwanted plants, animals, insects, germs or other organisms that interfere with human activity through bite, destroy food crops, damage property or make our lives more difficult.
- **Biotic factor :** Any living component that affects another organism, including animals, which consume the organism for food. e.g., plants, animals.
- **Abiotic factor :** Non-living components of a habitat which facilitate the thriving of the organisms. e.g., climate, temperature.

Example 1

(A) Briefly describe the formation of vermicompost and green manure.

(B) How can poultry fowl be prevented from various diseases ? State any three methods.

Solution:

(a) Compost and vermicompost: Compost is the process in which farm waste material, vegetable waste, animal refuse, domestic waste, sewage, straw, eradicated weeds etc. are decomposed in pits. It is rich in organic matter and nutrients. Compost is also prepared by using earthworms to hasten the process of decomposition of plant and animal refuse. This is vermicompost.

Green Manure : Manure prepared by the green plants like sunhemp or guar that are grown prior to the sowing of the crop seeds.

(b) Appropriate vaccination.

Spraying of disinfectants at regular intervals.

Proper cleaning, sanitation, hygienic conditions in housing and poultry feed.

❑❑