Some Basic Concepts of Chemistry

- **Change of state**

  - A change of state occurs because heat energy breaks the force of attraction between particles. Kinetic energy of the particle increases.

- **Melting point**

  - The temperature at which a solid melts into a liquid at normal atmospheric pressure.
  - At melting point, the temperature does not change until all solid converts into liquid.

- **Latent heat**

  - The heat required to break the force of attraction between the particles at transition temperature. This heat becomes confined within the material and is called the latent heat.
  - Amount of heat required to change 1 kg of material to change its state at normal atmospheric pressure at transition temperature is called the latent heat for that transition.

- **Sublimation**

  - Solid $\rightleftharpoons$ gas [directly]
  - Example: Ammonium chloride

- **Effect of change of pressure**

  - If pressure is applied,
  - Melting point → decreases
  - Boiling point → increases

- **Dry Ice –** Solid CO_2 [directly converts to gas]

- Everything around us is composed of matter.

- There are five states of matter- solid, liquid, gaseous, plasma and Bose-Einstein condesate
  Solid phase

  - Permanent change in shape is difficult
  - Negligible compressibility

  - Definite shape, size, and boundary

  - No particle motion

- **Liquid phase**

  - No fixed shape and boundary
  - Have a fixed volume
  - Low compressibility
  - Lesser particle motion

- **Gaseous state**

  - No fixed shape, volume, and boundary
  - Highly compressible
  - Gases exert pressure
  - High particle motion

Solid	Liquid	Gas
Definite shape	No definite shape	No definite shape
Occupies space	Occupies space	Occupies space
Definite volume	Definite volume	No definite volume
Cannot be compressed	Slightly compressible	Highly compressible
Rigid	Not rigid	Not rigid
Does not diffuse in other solids	Can diffuse in other liquids	Can diffuse in other gases

- **Plasma State**

  - Super-energetic and super-excited particles
  - No definite shape and volume
  - Most common state of matter in universe
  - Influenced by electric and magnetic field

- **Bose-Einstein Condensate**

  - Super-unenergetic and super-cooled particles
  - Formed on cooling an extremely low density gas to an extremely low pressure
  - Super-fluid and super-conductive

Mass: S.I. Unit is kg.

Volume: S.I. Unit is m^3.

Density: S.I. Unit is kg m^{-3}.

Temperature: Three scales are

- °C (degree Celsius)
- °F (degree Fahrenheit)
- K (kelvin)

S.I. Unit is K

- Relation between °F and °C

$$^{o}F = \frac{9}{5}(^{o}C) + 32$$

- Relation between K and °C

K = °C + 273.15

Laws of chemical combination:

Five laws

- Law of conservation of mass → Matter can neither be created nor destroyed.
- Law of definite proportions → A compound always contains exactly the same proportions of elements by weight.
- Law of multiple proportions → If two elements can combine to form more than one compound, then the masses of one element that combine with a fixed mass of the other element are in small whole number ratios.
- Gay Lussac's law of gaseous volumes → When gases combine or are produced in a chemical reaction, they do so in a simple ratio by volume, provided all gases are at same temperature and pressure.
- Avogadro law → At the same temperature and pressure, equal volumes of all gases contain equal number of molecules.

Dalton's atomic theory:

- Matter consists of indivisible atoms.
- Atoms of a given element have identical properties including identical mass while those of different elements have different masses.
- Atoms of different elements combine in a fixed ratio to form a compound.
- Atoms are neither created nor destroyed in a chemical reaction.

Atomic Mass

One atomic mass unit is defined as a mass exactly equal to one-twelfth the mass of one carbon-12 atom.

Molecular Mass

Molecular mass is the sum of atomic masses of the elements present in a molecule.

Formula Mass

Formula mass is the mass of an ionic compound.

1 mole of any substance can be defined as:

- Amount of a substance that contains as many particles (atoms, molecules or ions) as there are atoms in 12 g of the ^{12}C isotope
- Avogadro number or Avogadro constant (N_A); equal to 6.022×10^{23} particles

Percentage Composition

Mass percent of an element = $\frac{\text{Mass of that element in the compound} \times 100\%}{\text{Molar mass of the compound}}$

Empirical formula and molecular formula:

Empirical formula	Molecular formula
Represents the simplest whole number ratio of various atoms present in a compound	Represents the exact number of different types of atoms present in a molecule of a compound

Limiting reagent (Limiting reactant): Limiting reagent is the reactant present in the lesser amount, which gets consumed after sometime. After that, no reaction takes place further, whatever is the amount of the other reactant present.

Expression for concentration of a solution:

Mass per cent (w/w %) = $\frac{\text{Mass of solute}}{\text{Mass of solution}} \times 100\%$

$$\text{Mole fraction of A} = \frac{\text{No. of moles of A}}{\text{No. of moles of solution}} = \frac{n_A}{n_A + n_B}$$

[Here, A and B are the components of the solution]

Molarity (M) = $\frac{\text{No. of moles of solute}}{\text{Volume of solution in litres}}$

Molality (m) = $\frac{\text{No. of moles of solute}}{\text{Mass of solvent in kg}}$