4. Measurement of Matter

- **Atoms**

- **According to Dalton's atomic theory**
  - Matter is made up of very tiny particles and these particles are called atoms.
  - Atoms cannot be divided further i.e., atoms are indivisible
  - An atom can be defined as the smallest particle of matter that can neither be created nor destroyed by chemical means.

- **Laws of Chemical Combination**
- **Law of conservation of mass**
  - Mass can neither be created nor destroyed in a chemical reaction. It means that the sum of the masses of the reactants and the products remains the same during a reaction.

- **Laws of Chemical Combination**
- **Law of constant proportion**
  - A chemical substance always contains the same elements in a fixed proportion by mass, irrespective of the source of compound.

- The size of an atom is indicated by the radius of the atom called the **atomic radius**. It is often expressed in **nanometers.**
- **Representation of atoms**
  - The symbol of the element is made from one or two letters of the English or the Latin name of the element.
  - Symbols are significant as they represent a particular element and they represent one atom of that element.
- **Atomic Mass**
  - The mass of an atom is known as the atomic mass**.**
  - The atomic mass of an atom of an element is also known as its relative atomic mass, since it is determined relative to the mass of C-12 isotope.

- **Gram molecular mass:** The mass of one mole of atoms is known as the **molar mass of atoms**, **gram atomic mass**, or **gram atoms**. For example, the atomic mass of nitrogen is 14 u and the gram atomic mass of nitrogen is 14 g. The mass of one mole molecules of any substance is equal to the **gram molecular mass** of that substance.
- **Relative atomic mass or atomic weight:** It is the ratio of mass of one atom of an element to the mass of an atom of hydrogen taken as unity.
- **Gram molecular volume:** The volume occupied by 1 gram molecule of a dry gas at S.T.P is called gram molecular volume. The experimental value of 1 gram molecular volume of a gas is 22.4 L at S.T.P.

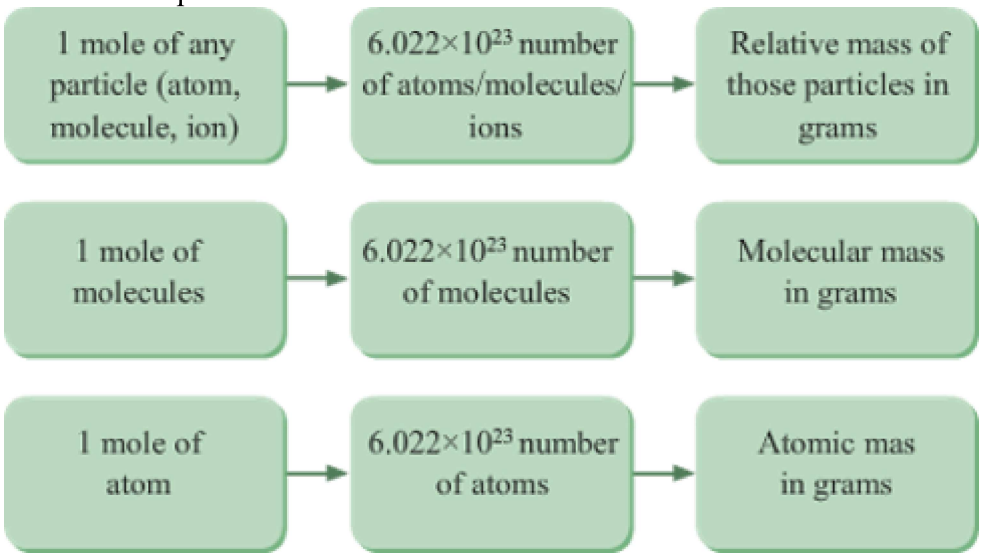
- **Molecule**
  - A molecule is formed when two or more atoms of the same element or different elements get combined chemically.

- The number of atoms that combine to form a molecule is called the atomicity of the molecule.

- **Ion**
  - An ion is a charged species in which an atom or a group of atoms possess a net electric charge (positive or negative).
  - Positively charged ions are called cations (basic radical) and negatively charged ions (acidic radical) are called anions.
  - Compounds in which molecules are formed by the combination of cations (positively charged ions) and anions (negatively charged ions) are known as ionic compounds.

- **Molecular Mass**
  - The molecular mass of a substance is the sum of the atomic masses of all the atoms present in a molecule of that substance.

- **Formula unit mass**
  - The formula unit mass of a substance is the sum of the atomic masses of all the atoms present in a formula unit of that substance.

- **Mole Concept**
  - One mole of a substance is the quantity of the substance containing 6.022×10^{23} numbers of particles (atoms, molecules, or ions). The number i.e., 6.022×10^{23} is known as the Avogadro number. It means that one mole of any substance (element or compound) contains 6.022×10^{23} particles (atoms of molecules).
  - The mass of 1 mole of a substance is known as its molar mass.
- $$\text{Molar mass} = \frac{\text{Mass of substance}}{\text{Number of moles}}$$
- Avogadro's Law: Under the same conditions of temperature and pressure, equal volumes of all gases contain the equal number of moles.
- 

- Gay-Lussac's Law: At constant volume, the pressure of a fixed amount of a gas is directly proportional to the temperature.
- $\frac{p_1}{T_1} = \frac{p_2}{T_2}$

- Valency is defined as the combining capacity of the atom of an element. Valency of an element depends upon the number of electrons present in the outermost shell of its atom.
- The combining capacity of an element is known as its **valency**.
- It has been observed that certain metals exhibit more than one valency. In such a situation, metals are said to exhibit variable valency.

- **Chemical formula**
  - A chemical formula is the representation of the composition of a molecule in terms of the symbols of elements present in that molecule.
- **Molecular formula** is a **chemical formula** that indicates the kinds of atoms and the numbers of each kind of atom in a molecule of a compound.

- To write the chemical formula of a compound, one should have prior knowledge of two things.
  - **The symbols of the constituent elements.**
  - **The combining capacity of the atom of each element constituting the compound.**