Revision Notes

Class 9 Science

Chapter 3 - Atoms and Molecules

Summary of Atoms and Molecules:

Law of conservation of mass:

- In a chemical action, the law of conservation of mass stipulates that **mass can not be created or destroyed**.
- According to this law, the **overall mass of the products** remains **equal to the total mass of the reactants** after any physical or chemical change.

Law of constant proportion:

This law was expressed by another French chemist, **Joseph Proust**, as follows: "A chemical compound always comprises the same elements mixed in the **same** proportion by mass."

Law of multiple proportion:

As established by John Dalton, when two elements combine to form two or more compounds, the mass of the element that combines with the fixed mass of the other bears a simple whole number ratio (1803).

Dalton's atomic theory:

- According to Dalton's atomic theory, all matter, whether an element, a compound, or a mixture, is made up of microscopic particles called **atoms**.
- This theory's **postulates** are as follows::
    1. All matter is made up of **atoms**, which are very small tiny particles that engage in chemical reactions.
    2. In a chemical reaction, atoms are **indivisible** particles that cannot be formed or destroyed.
    3. A given element's atoms have the **same mass and chemical characteristics**.
    4. The masses and chemical characteristics of atoms of various elements differ.
    5. **Compounds** are formed when atoms join in a ratio of tiny whole numbers.

6. In a given compound, the **number and types of atoms** remain **constant**.

Atom:

- An atom is an element's defining structure that can't be broken chemically.
- The **electron, proton**, and **neutron** are the three particles that make up an atom.
- The **nucleus** is the nucleus of the atom.
- An atom's **nucleus** holds the **entire mass** of the atom.
- An atom's **electrons** are grouped in **shells/orbitals**.
- The atomic symbol is made up of three parts:
  The **symbol** X - standard element symbol;
  The **atomic number** A - represents the number of protons;
  The **mass number** Z - represents the total amount of protons and neutrons in an element.
- The **radius of an atom** is measured in **nanometres**.

Atomic Mass:

- The atomic mass was proposed by **Dalton** as an atomic hypothesis.
- The average mass of an atom, or a set of atoms, is the **sum of the masses of the electrons, neutrons, and protons**.
- The atomic mass is the mass of an atomic particle.
- This is often stated in terms of a unified atomic mass unit, as per the international agreement (**AMU**).
- The average mass of one atom of an element, as compared to $\frac{1}{12}$ th the mass of one carbon- 12 atom, is called **atomic mass**.

Valency:

- The electrons in the atom's **outermost orbit** are referred to as **valence electrons**.
- The valency of an atom is determined by its ability to lose, gain, or share valence electrons in order to complete its octet.

Molecule:

- The total of the masses of the elements present in a molecule is the molecule's **molecular mass**.
- The atomic mass of an element is multiplied by the number of atoms in the molecule, and the masses of all the elements in the molecule are added to get the molecule's mass.

- The number of atoms in a single molecule of an element is known as its **atomicity**.
- For example, each of the molecules of hydrogen, nitrogen, oxygen, chlorine, iodine, and bromine has **two atoms**, and hence they all have **two atomicity** each.

Compound:

- When two or more elements join chemically in a defined mass ratio, the result is known as a **compound**.
- Compounds are substances made up of two or more different types of atoms in a specific ratio.

Ions:

- An **ion** is an atom or molecule with a net positive or negative charge due to the gain or loss of one or more of its valence electrons.
- A negatively charged particle is an **anion**, and a positively charged particle is a **cation**.
- **Ionic compounds** are chemical compounds in which ions are held together by **ionic bonds**, which are a type of specialised bond.
- The positive and negative charges in an ionic substance are always in **equal** amounts.

Molecular Mass:

- The total of the masses of the elements present in a molecule is known as the molecule's **molecular mass**.
- The atomic mass of an element is multiplied by the number of atoms in the molecule, and then the masses of all the elements in the molecule are added.

Mole & Avogadro Number:

- A **mole** is the amount of entities existing in a substance, such as atoms, molecules, and ions.
- A mole is 6.022×10^{23} molecules of any substance.
- One of the most practical ways of describing the amount of reactants and products in a reaction is to use the mole idea.
- **Avogadro's number** has a value of about 6.022×10^{23}.
- Avogadro's number is a formula that calculates the number of particles in one mole (or mol) of a substance.
- It's possible that these particles are electrons, molecules, or atoms.
- No. of Moles can be calculated as;

$$1 \text{ Mole} = \frac{\text{Mass of a substance}}{\text{Gram atomic mass}}$$

$$n = \frac{\text{Molecular Weight}}{\text{Empirical Formula Weight}}$$

$$n = \frac{\text{Given No. of particles}}{\text{Avogadro Number}}$$

$$n = \frac{N}{N_A}$$

Some Important formulae:

- $\text{No. of Molecules} = \frac{\text{Given Mass}}{\text{Molar Mass}} \times \text{Avogadro Number}$

  Hence,

  $$N = \frac{m}{M} \times N_A$$

- $1 \text{ Mole} = \frac{\text{Mass of a substance}}{\text{Gram atomic mass}}$

- $\text{Mass of a substance} = \frac{\text{Molar Mass of a substance}}{\text{No. of Moles}}$

- $\text{Percentage composition of an Element} = \frac{\text{Total weight of element in a molecule}}{\text{Gram Molecular Weight}} \times 100$

- $\text{RMM} = \frac{\text{Mass of one molecule of the substance}}{\left(\frac{1}{12}\right) \text{Mass of the atom of Carbon } \left(C^{12}\right)}$

- $\text{Gram Molecular Volume} = \frac{\text{Gram Molecular Weight}}{\text{Weight / Volume of gas at STP}}$