Chemistry Study Materials for Class 9

(Based on Chapter 3: Atoms and Molecules)

Ganesh Kumar Date:- 04/07/2020

Molecular Mass and Mole Concept

Molecular Mass

- The molecular mass of a substance is the sum of all the atoms present in one molecule of the substance. It is expressed in atomic mass unit (u).

How to determine molecular mass?

Example: Let us determine the molecular mass of water.

The molecular mass of water (H_2O) is the sum of the masses of two hydrogen atoms and one oxygen atom.

Therefore, the molecular mass of water (H_2O) = 2 × (Atomic mass of hydrogen) + 1 × (Atomic mass of oxygen).

We know that the atomic mass of hydrogen is 1 unit and that of oxygen is 16 units.

$$= 2\times(1)+1\times(16)$$

$$= 2+16$$

$$= 18 \text{ u}$$

Therefore, the molecular mass of water is **18 u**.

Formula Unit Mass

- The formula unit mass of a substance is the sum of the atomic masses of all the atoms in a formula unit of a compound.
- We do not use term molecular mass for **ionic compounds**. Thus, we use term formula unit for those substances whose constituent particles are **ions**.

How to determine formula unit mass?

The formula unit mass is calculated in the same manner as we calculate the molecular mass. The only difference is that we use the term formula unit for those substances whose constituent particles are **ions**.

Mole Concept

- We know that a dozen is a collection of 12 substances, a century is a collection of 100 substances and a gross is a collection of 144 substances.
- We use the terms dozen, century, gross etc. to express a certain quantity of a substance.
- Similarly, a mole is a word used to describe a collection of particles i.e. atoms, molecules or ions.

Definition of a Mole

1 mole of a substance is equal to its atomic mass or molecular mass expressed in grams.

- The atomic mass expressed in grams is the gram atomic mass.
- The molecular mass expressed in grams is the gram molecular mass.

For example

- The atomic mass of sodium is 23 grams.

  Therefore, 23 grams of sodium is equal to one mole of sodium atoms.

- Similarly, the molecular mass of oxygen (O_2) = 2 × Atomic mass of oxygen

  = 2 × 16 **= 32 g**

Avogadro experimentally found that one mole of any substance always contained 6.022×10^{23} particles. This number is called the Avogadro's number, denoted by N_0.

1 mole (of anything) = 6.022×10^{23} in number

For Example

How many molecules will be present in 2 grams of hydrogen gas (H_2)?

1 mole of hydrogen molecules = molecular mass of hydrogen = 2 grams

We know that 1 mole of hydrogen molecules contains 6.022×10^{23} hydrogen molecules. 2 grams of hydrogen gas will also contain 6.022×10^{23} hydrogen molecules

Important Formulae

Number of moles = n

Given mass = m

Molar mass = M

Given number of particles = N

Avogadro number of particles = N_0

$$\text{The number of moles(n)} = \frac{\text{Given mass}}{\text{Molar mass}} = \frac{m}{M}$$

$$\text{The number of moles(n)} = \frac{\text{Given number of particles}}{\text{Avogadro's number}} = \frac{N}{No}$$

To find mass

Mass (m) = Molar mass (M) × Number of moles (n)

To find the number of atoms when Avogadro number is given in the question

$$\text{The number of atoms(particles)} = \frac{\text{Given mass x Avogadro's number}}{\text{Molar mass}}$$

$$N = \frac{m \times No}{M}$$

$$= n \times No$$

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