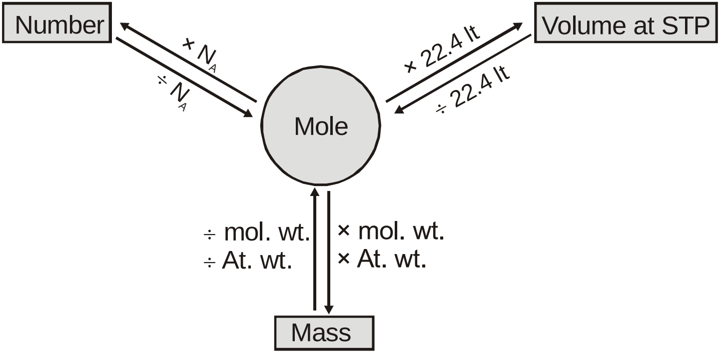
STOICHIOMETRY

☞ Relative atomic mass (R.A.M) = $\dfrac{\text{Mass of one atom of an element}}{\frac{1}{12} \times \text{mass of one carbon atom}}$

= Total Number of nucleons

☞ **Y-map**



Density :

$$\text{Specific gravity} = \frac{\text{density of the substance}}{\text{density of water at } 4^\circ C}$$

For gases :

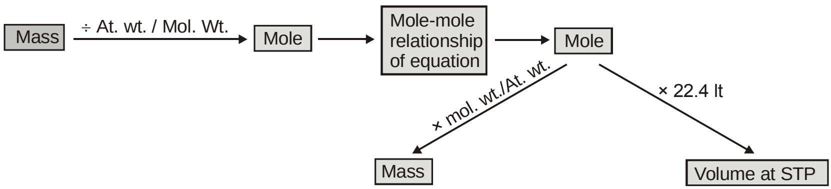
$$\text{Absolute density (mass/volume)} = \frac{\text{Molar mass of the gas}}{\text{Molar volume of the gas}}$$

$$\Rightarrow \quad \rho = \frac{PM}{RT}$$

$$\text{Vapour density} \qquad V.D. = \frac{d_{gas}}{d_{H_2}} = \frac{PM_{gas}/RT}{PM_{H_2}/RT} = \frac{M_{gas}}{M_{H_2}} = \frac{M_{gas}}{2}$$

$$M_{gas} = 2\ V.D.$$

Mole-mole analysis :



Concentration terms :

Molarity (M) :

$$\therefore \quad \text{Molarity (M)} = \frac{w \times 1000}{(\text{Mol. wt of solute}) \times V_{inml}}$$

Molality (m) :

$$\text{Molality} = \frac{\text{number of moles of solute}}{\text{mass of solvent in gram}} \times 1000 \; = 1000\, w_1 / M_1 w_2$$

Mole fraction (x) :

$$\therefore \quad \text{Mole fraction of solution } (x_1) = \frac{n}{n+N}$$

$$\therefore \quad \text{Mole fraction of solvent } (x_2) = \frac{N}{n+N}$$

$$x_1 + x_2 = 1$$

% Calculation :

(i) $\% \text{ w/w} = \dfrac{\text{mass of solute in gm}}{\text{mass of solution in gm}} \times 100$

(ii) $\% \text{ w/v} = \dfrac{\text{mass of solute in gm}}{\text{Volume of solution in ml}} \times 100$

(iii) $\% \text{ v/v} = \dfrac{\text{Volume of solute in ml}}{\text{Volume of solution}} \times 100$

Derive the following conversion :

1. Mole fraction of solute into molarity of solution $M = \dfrac{x_2 \rho \times 1000}{x_1 M_1 + M_2 x_2}$

2. Molarity into mole fraction $x_2 = \dfrac{MM_1 \times 1000}{\rho \times 1000 - MM_2}$

3. Mole fraction into molality $m = \dfrac{x_2 \times 1000}{x_1 M_1}$

4. Molality into mole fraction $x_2 = \dfrac{mM_1}{1000 + mM_1}$

5. Molality into molarity $M = \dfrac{m\rho \times 1000}{1000 + mM_2}$

6. Molarity into Molality $m = \dfrac{M \times 1000}{1000\rho - MM_2}$

M_1 and M_2 are molar masses of solvent and solute. ρ is density of solution (gm/mL)

M = Molarity (mole/lit.), m = Molality (mole/kg), x_1 = Mole fraction of solvent, x_2 = Mole fraction of solute

Average/Mean atomic mass :

$$A_x = \frac{a_1 x_1 + a_2 x_2 + ... + a_n x_n}{100}$$

Mean molar mass or molecular mass :

$$M_{avg.} = \frac{n_1 M_1 + n_2 M_2 + ...n_n M_n}{n_1 + n_2 + ...n_n} \quad \text{or} \quad M_{avg.} = \frac{\sum_{j=1}^{j=n} n_j M_j}{\sum_{j=1}^{j=n} n_j}$$

Calculation of individual oxidation number :

Formula : Oxidation Number = number of electrons in the valence shell – number of electrons left after bonding

Concept of Equivalent weight/Mass :

For elements, equivalent weight (E) = $\dfrac{\text{Atomic weight}}{\text{Valency - factor}}$

For acid/base, $E = \dfrac{M}{\text{Basicity / Acidity}}$

Where M = Molar mass

For O.A/R.A, $E = \dfrac{M}{\text{no. of moles of } e^- \text{ gained / lost}}$

Equivalent weight (E) = $\dfrac{\text{Atomic or moleculear weight}}{\text{v.f.}}$

(v.f. = valency factor)

Concept of number of equivalents :

No. of equivalents of solute = $\dfrac{\text{Wt}}{\text{Eq. wt.}} = \dfrac{W}{E} = \dfrac{W}{M/n}$

No. of equivalents of solute = No. of moles of solute × v.f.

Normality (N) :

Normality (N) = $\dfrac{\text{Number of equivalents of solute}}{\text{Volume of solution (in litres)}}$

Normality = Molarity × v.f.

Calculation of valency Factor :

n-factor of acid = basicity = no. of H^+ ion(s) furnished per molecule of the acid.

n-factor of base = acidity = no. of OH^- ion(s) furnised by the base per molecule.

At equivalence point :

$N_1V_1 = N_2V_2$

$n_1M_1V_1 = n_2M_2V_2$

Volume strength of H_2O_2 :

20V H_2O_2 means **one litre** of this sample of H_2O_2 on decomposition gives **20 lt. of O_2** gas at **S.T.P.**

$$\text{Normality of } H_2O_2 \text{ (N)} = \frac{\text{Volume, strength of } H_2O_2}{5.6}$$

$$\textbf{Molarity of } \mathbf{H_2O_2} \textbf{ (M)} = \frac{\textbf{Volume strength of } \mathbf{H_2O_2}}{\mathbf{11.2}}$$

Measurement of Hardness :

$$\textit{Hardness in ppm} = \frac{\text{mass of } CaCO_3}{\text{Total mass of water}} \times 10^6$$

Calculation of available chlorine from a sample of bleaching powder :

$$\% \text{ of } Cl_2 = \frac{3.55 \times x \times V(\text{mL})}{W(\text{g})}$$ where x = molarity of hypo solution

and v = mL. of hypo solution used in titration.