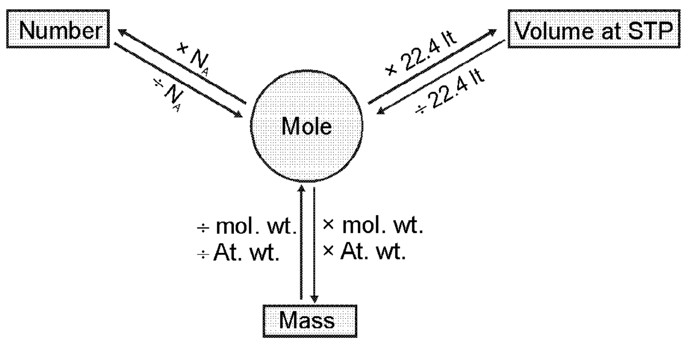
# 2.STOICHIOMETRY

☞ 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 :**

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

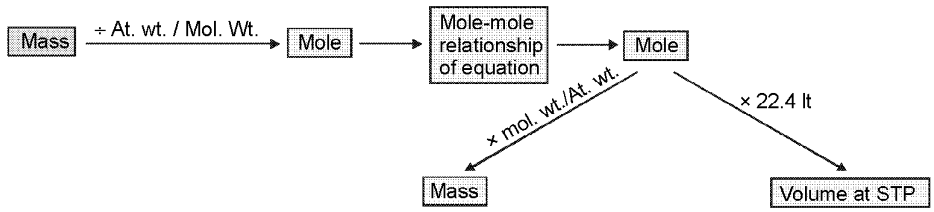
**For gases :**

Absolute density (mass/volume) = $\dfrac{\text{Molar mass of the gas}}{\text{Molar volume of the gas}}$ $\Rightarrow$ $\rho = \dfrac{PM}{RT}$

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

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

**Mole-mole analysis :**




**Concentration terms :**

**Molarity (M) :**

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

**Molality (m) :**

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

**Mole fraction (x) :**

$\therefore$ Mole fraction of solution $(x_1) = \dfrac{n}{n+N}$ $\therefore$ Mole fraction of solvent $(x_2) = \dfrac{N}{n+N}$

$x_1 + x_2 = 1$

**% Calculation :**

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

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

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

**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 :**

$$A_x = \frac{a_1x_1 + a_2x_2 + ..... + a_nx_n}{100}$$

**Mean molar mass or molecular mass :**

$$M_{avg.} = \frac{n_1M_1 + n_2M_2 + ......n_nM_n}{n_1 + n_2 + ....n_n} \quad \text{or} \quad M_{avg.} = \frac{\sum_{j=1}^{j=n} n_jM_j}{\sum_{j=1}^{j=n} n_j}$$

**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 = $\dfrac{Wt}{\text{Eq. wt.}} = \dfrac{W}{E} = \dfrac{W}{M/n}$

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.**

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

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

**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 :**

$\% \text{ of } Cl_2 = \dfrac{3.55 \times x \times V\,(mL)}{W(g)}$ where x = molarity of hypo solution and v = mL. of hypo solution used in titration.