MOLE CONCEPT SHORT NOTES

Mole - Just a number

1 mole = N_A particles → Atoms, Molecules, Ions, Electrons, Protons

N_A → Avagadro's number
= 6.02×10^{23}
= 6×10^{23}

Fundamental particles :

	Mass	Charge
Electron	9.1×10^{-31} kg	-1.6×10^{-19} C
Proton	1.672×10^{-27} kg	$+1.6 \times 10^{-19}$ C
Neutron	1.674×10^{-27} kg	Zero

Mass - $m_e < m_p < m_n$

Charge on e^- = charge on p

Charge is always quantized

$q = \pm ne$ $\quad e = 1.6 \times 10^{-19}$ C

$n = 1, 2, 3, 4, ...$

1 Faraday = 96500 C = $1.6 \times 10^{-19} \times 6.02 \times 10^{23}$ C

Calculation of moles :

Weight ⇄ Mole ⇄ Particles

Mole ⇅ Volume

$n = \dfrac{\text{Given wt}}{\text{Molar mass}}$

wt = moles x molar mass

Always Valid.

$n = \dfrac{\text{Given particles}}{N_A}$

Particles = moles x N_A

Always valid.

$n = \dfrac{\text{Given volume of gas at STP}}{22.4 \text{ L or } 22400 \text{ ml}}$

Valid only - 1) For gases.
2) At STP or NTP

Vapour Density :

→ Relative Density
→ Relative to H_2

$V.D = \dfrac{\text{Molecular mass}}{2}$

Molecular mass [Unit = amu or u]

Mass of 1 molecule of a substance

H_2O = 18 amu $\quad$ Glucose = 180 amu

NH_3 = 17 amu

Atomic mass [Unit - atomic mass unit (amu) or unified mass (u)]

Mass of 1 atom of an element.

H = 1 amu $\quad$ Li = 7 amu
He = 4 amu $\quad$ Be = 9 amu

Gram atomic mass [Unit = grams]

Mass of 1 mole atom of an element

mole atom → N_A atoms

H = 1g $\quad$ Li = 7g
He = 4g $\quad$ Be = 9g

Gram molecular mass [Unit = gram]

Mass of 1 mole molecule

mole molecule → N_A molecule

H_2O = 18g $\quad$ NH_2CONH_2 = 60g.

Molar mass :

Mass of 1 mole of a substance.

H_2O = 18g $\quad$ Na = 23g

NH_3 = 17g $\quad$ Mg = 24g

Average atomic mass : (AAM)

Cl^{35} = 75% $\quad$ Cl^{37} = 25%

$AAM = \dfrac{(35 \times 75) + (37 \times 25)}{75 + 25} = 35.5.$

- Lowest AM < AAM < Highest AM
- AAM is closer to that isotopes where % is more.

Molar Volume

Volume of 1 mole of any gas at STP

22.4 ℓ or 22400 ml

STP - Standard temp and pressure.

T = 0°C or 273 K

P = 1 atm.

Formula mass :

Defined for ionic compounds

NaCl - 58.5 g of amu

1 amu = $\dfrac{1}{12}$ x mass of one C^{12} atom

1 amu = $\dfrac{1}{N_A}$ g = 1.67×10^{-24} g

% Composition

$\%$ of any element = $\dfrac{\text{weight of element}}{\text{Molecular wt}} \times 100$

MOLE CONCEPT SHORT NOTES

Molecular Formula – Represents actual number of atoms in molecule.

(MF) $C_6H_{12}O_6$

Emperical Formula – Represents ratio in which atoms combine.

(EF) CH_2O

$\underbrace{6}_{x} \times CH_2O \rightarrow C_6H_{12}O_6$

$$x = \frac{\text{Molecular Formula mass}}{\text{Emperical Formula mass}}$$

Stoichiometry – Balance the reaction

Case: When information about only one reactant and product is given.

- Moles
- Particles
- Volumes

General equation

Balanced – $aA + bB \rightarrow cC + dD$

Magical equation $\frac{n_A}{a} = \frac{n_B}{b} = \frac{n_C}{c} = \frac{n_D}{d}$

Mass, Volume, Particles $\rightarrow$ Moles

Case-2: When information about 2 or more than 2 reactant is given.

Limiting reagent – that reagent which is consumed first in the reaction.

Q. How to Find Limiting Reagent LR ?

$\rightarrow$ That reagent is LR whose $\frac{\text{Moles}}{\text{SC}}$ is minimum.

$\hookrightarrow$ Per stoichiometric.

[If value is same then there is no LR]

Element	%	% / AM	Relative Ratio	Simplest Ratio
C	80	$80/12 = 20/3$	$\frac{20/3}{20/3} = 1$	1
H	20	$20/1 = 20$	$\frac{20}{20/3} = 3$	3

CH_3

% V/V

Volume of solute in ml present in 100 ml of solution.

$$\% V/V = \frac{\text{Volume of Solute in ml} \times 100}{\text{Volume of Solution in ml}}$$

$\hookrightarrow$ 30% V/V

30 ml of solute in 100 ml of solution

$\therefore$ $V_{solvent}$ = 70 ml

% W/V

Weight of solute in gm present in 100 ml of solution.

$$\% W/V = \frac{\text{Weight of Solute in gm} \times 100}{\text{Volume of solution in ml}}$$

$\hookrightarrow$ 30% W/V

30 gm solute in 100 ml of solution

Solution

Solute (B) n_B — Solvent (A) n_A

$$x_B = \frac{n_B}{n_A + n_B} \qquad x_A = \frac{n_A}{n_A + n_B}$$

$x_A + x_B = 1$

Molarity:

$$M = \frac{n_{\text{solute}}}{\text{Vol. of solution in L}}$$

$$M = \frac{n_{\text{solute}} \times 1000}{\text{Vol. of solution in ml}}$$

Molar – 1M

Semi-molar – $\frac{1}{2}$ M

Deci molar – $\frac{1}{10}$ M

Molality

$$m = \frac{n_{\text{solute}}}{\text{weight of solvent in kg.}}$$

$$m = \frac{n_{\text{solute}} \times 1000}{\text{weight of solvent in g}}$$

Molal – 1m

Semi-molal – $\frac{1}{2}$ m

Deci-molal – $\frac{1}{10}$ m

Parts per million (PPM)

$$PPM = \frac{\text{Weight of solute} \times 10^6}{\text{Weight of Solution}}$$

Mole Fraction (x)

$$x_{\text{substance}} = \frac{n_{\text{substance}}}{n_{\text{Total}}}$$

MOLE CONCEPT SHORT NOTES

% w/w

Weight of solute in gm present in 100 gm of solution.

$$\% \, w/w = \frac{\text{Weight of solute in gm} \times 100}{\text{Weight of solution in gm}}$$

↳ 30% w/w

30 gm of solute present in 100 gm of solution

W solvent = 70 gm.

Solute + Solvent = Solution

W solute + W solvent = W solution

V solute + V solvent = V solution

Homogenous solution

↑

Concenteration terms

Temperature dependent	Temperature independent
→ % v/v	→ % w/w
→ % w/v	→ Mole Fraction
→ Molarity	→ Molality
→ Normality	→ PPM

Mixing of Solutions

Case I: When two non-reacting substances are mixed.

→ Acid + Acid

→ Base + Base

Case II. When reacting species are mixed.

→ Acid + Base

Some important terms:

a) $\% \, W/V = \% \, W/W \times d$

b) $M = \dfrac{10 \times \% \, W/W \times d}{\text{MM solute}}$

c) $m = \dfrac{1000 \, M}{1000 \, d - M \times \text{MM solute}}$

d) $m = \dfrac{x_{solute} \times 1000}{x_{solvent} \times \text{MM solvent}}$

d = density

M = Molarity

MM solute = Molar mass solute

m = molality.

Dilution:

On Dilution — a) Moles solute remains same.

b) Concenteration decreases.

c) Volume increases.

$(M_1V_1 = M_2V_2)$

% Yeild

Q. 5 moles of N_2 reacts with H_2 to form 8 moles of NH_3.

$$N_2 + 3H_2 \longrightarrow 2NH_3$$

5 moles 10 moles

$$\% \text{ yeild} = \frac{8}{10} \times 100 = 80\%$$