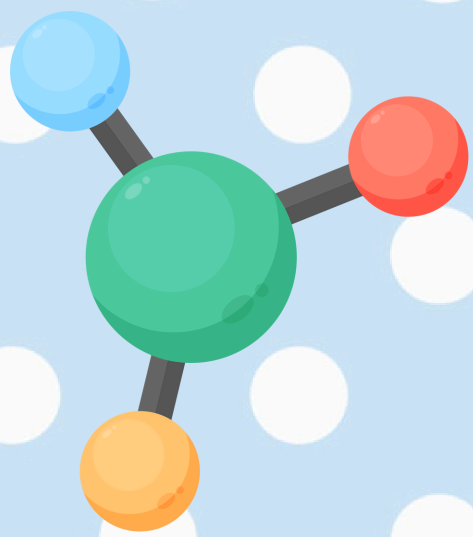
MIRACLE ACADEMY

MOLE CONCEPT

FOR

NEET 2025



Mole – Just a number

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

N_A → Avagadro's number
$= 6.02 \times 10^{23}$
$= 6 \times 10^{23}$

Calculation of moles :

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

wt = moles x molar mass

Always Valid.

Weight ⇄ Mole ⇄ Particles
Mole ⇅ Volume

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

Particles = moles x N_A

Always valid.

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

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

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

Vapour Density :

→ Relative Density
→ Relative to H_2

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

Molecular mass [Unit = amu or u]

Mass of 1 molecule of a substanc[e]

H_2O = 18 amu   Glucose = 180 am[u]

NH_3 = 17 amu

Charge is always quantized

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

$n = 1, 2, 3, 4, \ldots$

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

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

Mass of 1 atom of an element.

H = 1 amu   Li = 7 amu
He = 4 amu   Be = 9 amu

Gram atomic mass [Unit ≡ grams]

Mass of 1 mole atom of an element
→ N_A atoms

H = 1g   Li = 7g
He = 4g   Be = 9g

Gram molecular mass [Unit = gram]

Mass of 1 mole molecule
→ N_A molecule

H_2O = 18g NH_2CONH_2 = 60g.

Molar mass :

Mass of 1 mole of a subst[ance]

H_2O = 18g   Na = 23g
NH_3 = 17g   Mg = 24g

Average atomic mass : (AAM)

Cl^{35} = 75%
Cl^{37} = 25%

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

- 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 compoun[ds]

NaCl - 58.5 g[m]
of amu.

$1 \text{ amu} = \frac{1}{12} \times$ mass of one C^{12} atom

$1 \text{ amu} = \frac{1}{N_A} g = 1.67 \times 10^{-24} g$

% Composition

% of any element = $\frac{\text{weight of element}}{\ldots} \times 100$

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 → 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 ?

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

SC → 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.

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

→ 30% V/V

30 ml of solute in 100 ml of solution

∴ $V_{solvent}$ = 70 ml

% W/V

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

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

→ 30% W/V

30 gm solute in 100 ml of solution

Solution

→ Solute (B): n_B, $x_B = \frac{n_B}{n_A + n_B}$

→ Solvent (A): n_A, $x_A = \frac{n_A}{n_A + n_B}$

$x_A + x_B = 1$

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)

$$x\ \text{substance} = \frac{n\ \text{substance}}{n\ \text{Total}}$$

% 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

- → % v/v
- → % w/v
- → Molarity
- → Normality

Temperature independent

- → % w/w
- → Mole Fraction
- → Molality
- → 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) $M = \frac{10 \times \% w/w \times d}{MM_{solute}}$

c) $m = \frac{1000 M}{1000 d - M \times MM_{solute}}$

d) $m = \frac{x_{solute} \times 1000}{x_{solvent} \times MM_{solvent}}$

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

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