# MOLE CONCEPT SHORT NOTES

**Mole - Just a number**

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

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.

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

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

**Fundamental particles :**

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

$H_2O$ = 18 amu  Glucose = 180 amu

$NH_3$ = 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 substance.

$H_2O$ = 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 compounds

NaCl - 58.5 g of amu

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

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

**% Composition**

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

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# 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) $CH_2O$

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

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

**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

**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

**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

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 $\frac{\text{Moles}}{SC}$ is minimum.

SC → Per stoichiometric.

[If value is same then there is no LR]

**Parts per million ( PPM )**

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

**Mole Fraction ( x )**

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

| 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

∴ Vsolvent = 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

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# MOLE CONCEPT SHORT NOTES

**% w/w**

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

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

↳ 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:**

d = density

M = Molarity

MM solute = Molar mass solute

m = molality.

a) $\% \text{ w/V} = \% \text{ w/w} \times d$

b) $M = \frac{10 \times \% \text{ w/w} \times d}{\text{MM solute}}$

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

d) $m = \frac{x \text{ solute} \times 1000}{x \text{ solvent} \times \text{MM solvent}}$

**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

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

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