

# Some Basic Concepts of chemistry

Mole Concept

Concentration

Stoichiometry

Miscellaneous

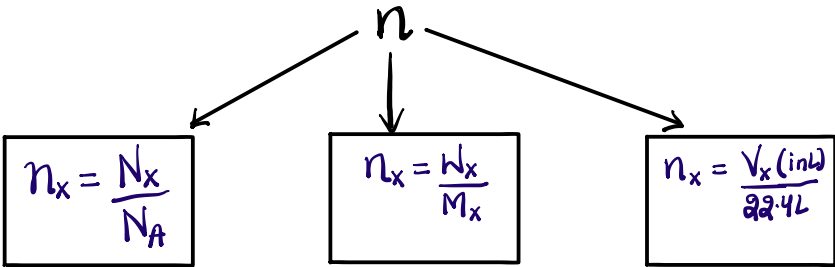
Equivalent Concept

## Mole Concept

$N_A$  ← Avogadro's Number

1 mole =  $6.023 \times 10^{23}$  things = Number of atoms present in 12g C-12 sample.

1g-atoms → 1 mole atoms  
 1g-molecules → 1 mole molecule  
 1g-ions → 1 mole ions



only for gas & only at S.T.P. (Oct 1st)

$N_{\text{atoms}} = \text{Atomicity} \times n_{\text{molecule}}$

### Mass / weight

$1 \text{amu} = 1.66 \times 10^{-24} \text{g}$  or  $\frac{1}{N_A} \text{g}$   
 $1 \text{amu} = 9\text{t}$  is  $\frac{1}{12}$ th of mass of 1 carbon atom.

Atomic mass / Molecular mass  
 (Relative mass)

Actual mass  
 (in g)

Molar mass  
 (mass of 1 mole things)

He	4
CO <sub>2</sub>	44

$4 \times 1.66 \times 10^{-24} \text{g}$
$44 \times 1.66 \times 10^{-24} \text{g}$

4g
44g

g-atomic mass → Molar mass of atom  
 g-molecular mass → Molar mass of molecule

Atomic number →  $Z$   $A$  ← mass number

Number of protons =  $Z$

Number of electrons =  $Z$   
 (if neutral atom)

Number of neutrons =  $A - Z$

# Concentration

%	ppm	Molarity (M)	Molality (m)	Mole fraction (X)
$W/W = \frac{W_{\text{solute}} \times 100}{W_{\text{solution}}}$	$W/W = \frac{W_{\text{solute}} \times 10^6}{W_{\text{solution}}}$	$M = \frac{n_{\text{solute}}}{V_{\text{solution}}(\text{in L})}$	$m = \frac{n_{\text{solute}}}{W_{\text{solvent}}(\text{in kg})}$	$X_B = \frac{n_B}{n_A + n_B}$
$V/V = \frac{V_{\text{solute}} \times 100}{V_{\text{solution}}}$	$V/V = \frac{V_{\text{solute}} \times 10^6}{V_{\text{solution}}}$			$X_A = \frac{n_A}{n_A + n_B}$
$W/V = \frac{W_{\text{solute}} \times 100}{V_{\text{solution}}}$	$W/V = \frac{W_{\text{solute}} \times 10^6}{V_{\text{solution}}}$			$X_A + X_B = 1$

## Cross-Concentration

$$m = \frac{M \times 1000}{1000d - MM_B}$$

$d \rightarrow$  density of solution (in g/ml)  
 $M_B \rightarrow$  Molar mass of Solute  
 $M \rightarrow$  Molarity of Solution  
 $m \rightarrow$  molality of Solution

$$m = \frac{X_B \times 1000}{X_A \cdot M_A}$$

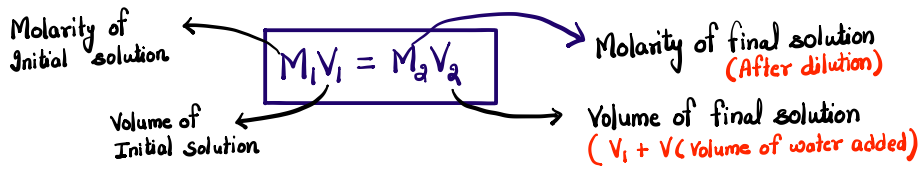
$X_B \rightarrow$  Mole fraction of solute  
 $X_A \rightarrow$  Mole fraction of solvent  
 $M_A \rightarrow$  Molar mass of solvent  
 $m \rightarrow$  molality of solution

अगर किसी भी Conc. को दूसरी Conc. में Convert करना है तो जो conc. दी है उसको खोल कर लिख लो (मतलब उसकी definition) + जो Conc. चुनी है उसका formula लिख कर जो चाहिए वो put कर दो!

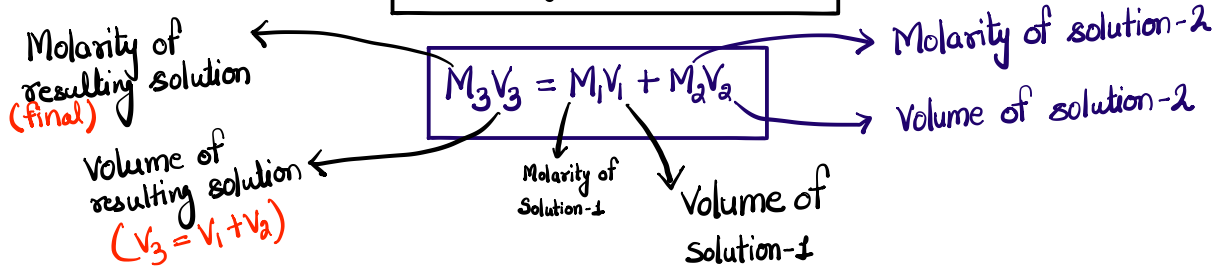
- $\rightarrow 10\% (W/W) \rightarrow 10g \text{ solute in } 100g \text{ of solution.}$
- $\rightarrow 10ppm (W/W) \rightarrow 10g \text{ of solute in } 10^6g \text{ of solution.}$
- $\rightarrow 10M \rightarrow 10 \text{ moles of solute in } 1L \text{ of solution.}$
- $\rightarrow 10m \rightarrow 10 \text{ moles of solute in } 1kg \text{ of solvent.}$

## Dilution

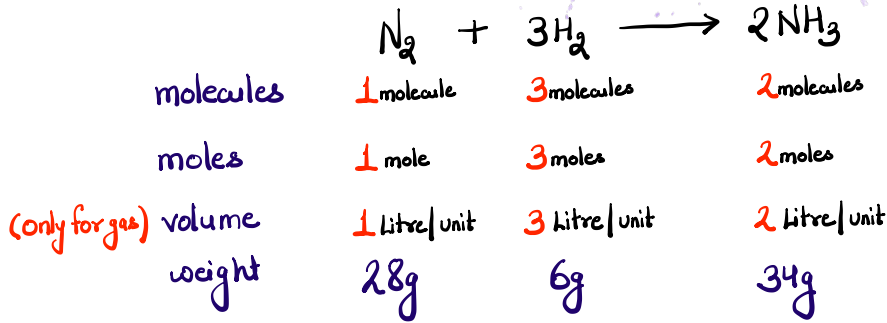
Addition of solvent in a solution  
 (Dilution  $\downarrow$  the Concentration)



## Mixing (Same Solution)



# Stoichiometry



## Limiting Reagent

$$\text{L.R. ratio} = \frac{\text{Given moles}}{\text{Stoichiometric Coefficient}}$$

Reactant having lower L.R. ratio is Limiting Reagent.

$$\% \text{ yield} = \frac{\text{Actual Yield} \times 100}{\text{Theoretical yield}}$$

$$\% \text{ purity} = \frac{\text{Weight of pure Compound} \times 100}{\text{Weight of Impure Compound}}$$

# Empirical Formula

	Element-1 (C)	Element-2 (H)
% (mass)	75	25
Moles	$\frac{75}{12} = 6.2$	$\frac{25}{1} = 25$
Mole ratio	$\frac{6.2}{6.2} = 1$	$\frac{25}{6.2} = 4.03$
Simple Mole ratio	1	4

E.F = CH<sub>4</sub>

$$V \cdot D = \frac{M_{\text{gas}}}{2}$$

Vapour Density

Average atomic mass

$$\text{Average atomic mass} = \frac{A_1 x_1 + A_2 x_2 \dots}{100}$$

$x_1$  = % Composition of isotope-1  
 $A_1$  = Atomic mass of isotope-1

Laws

Law of Conservation of mass  
 Lavoisier  
 Matter [ Neither created  
 Nor destroyed ]

Law of Definite proportion  
 Proust  
 Compound  
 Always same element  
 same proportion

Law of Multiple proportion  
 Dalton  
 2 elements  
 More than 1 compound  
 fixed Mass of 1 element  
 Masses of other elements  
 in simple whole number

Law of Gaseous volume  
 Gay Lussac's  
 Gases  
 Combine or produced  
 Simple ratio  
 of volume.

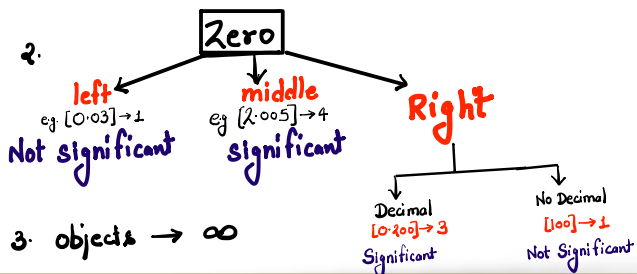
Avogadro's law  
 Avogadro  
 Equal volumes of gas  
 Equal no. of molecules  
 (At same T & P)

## Significant figures

→ Meaningful digits which are known with certainty plus one which is uncertain.

Rule

1. Non-zero → Significant (All)



3. objects → ∞

⊙ Addition & subtraction: Result cannot have more digits to the right of the decimal point than either of numbers.  
 $12.11 + 18.0 + 1.012 = 31.122 \rightarrow$  Answer: 31.1

⊙ Multiplication & Division: Result must be reported with no more significant figures as in the measurement with the few significant figures.  
 $2.5 \times 1.25 = 3.125 \rightarrow$  Answer: 3.1

- $10^{-15}$  → femto f
- $10^{-12}$  → pico p
- $10^{-9}$  → Nano n
- $10^{-6}$  → Micro μ
- $10^{-3}$  → Milli m
- $10^{-2}$  → Centi c
- $10^{-1}$  → Deci d
- $10^3$  → Kilo k
- $10^6$  → Mega M
- $10^9$  → Giga G

$1 \text{ m}^3 = 1000 \text{ L}$   
 $1 \text{ dm}^3 = 1 \text{ L}$   
 $1 \text{ cm}^3 = 1 \text{ mL}$

$1 \text{ atm} = 760 \text{ mm Hg}$   
 $1 \text{ atm} = 760 \text{ torr}$   
 $1 \text{ atm} = 1.01325 \times 10^5 \text{ Pa}$   
 $\approx 10^5 \text{ Pa}$   
 $1 \text{ atm} = 1.01325 \text{ bar}$   
 $\approx 1 \text{ bar}$

$$F = \frac{9}{5}(C) + 32$$

$$K = C + 273$$

# Equivalent Concept

$$n_{eq} = \frac{W}{E.W.}$$

E.W. that Combines  
or  
Displace

1g Hydrogen  
8g Oxygen  
35.5g chlorine  
108g Silver

$$E.W. = \frac{M}{n_f}$$

Ion  
 $n_f = \text{charge}$

Ionic  
Compound  
 $n_f = \text{Total +ve charge}$

Acid  
 $n_f = \text{Basicity}$

Base  
 $n_f = \text{Acidity}$

$$n_{eq} = n \times n_f$$

$$N = \frac{n_{eq}}{V_{\text{solution (ml)}}$$

$$N = M \times n_f$$

## Law of Equivalence



$$n_{eq}(A) = n_{eq}(B) = n_{eq}(C) = n_{eq}(D)$$