Some Basic Concepts of chemistry

Mole concept | Concentration | Stoichiometery | Miscellaneous | Equivalent Concept

Mole Concept

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

N_A ← Avogadro's Number

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

n →

$$n_x = \frac{N_x}{N_A}$$

$$n_x = \frac{W_x}{M_x}$$

$$n_x = \frac{V_x (\text{in L})}{22.4L}$$

(only for gas & only at S.T.P (0°C, 1 atm))

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

$1 amu = 1.66 \times 10^{-24} g$ or $\frac{1}{N_A} g$

1amu = It is $\frac{1}{12}$th of mass of 1 carbon atom.

Mass / weight

	Atomic mass / Molecular mass (Relative mass)	Actual mass (in g)	Molar mass (mass of 1 mole things)
He	4	$4 \times 1.66 \times 10^{-24} g$	4g
CO_2	44	$44 \times 1.66 \times 10^{-24} g$	44g.

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

$^{A}_{Z}X$ — A ← mass number; Atomic number → Z

Number of protons = Z

Number of electrons = Z (If neutral atom)

Number of neutrons = A-Z

Concentration

%

$$W/W = \frac{W_{solute}}{W_{solution}} \times 100$$

$$V/V = \frac{V_{solute}}{V_{solution}} \times 100$$

$$W/V = \frac{W_{solute}}{V_{solution}} \times 100$$

ppm

$$W/W = \frac{W_{solute}}{W_{solution}} \times 10^6$$

$$V/V = \frac{V_{solute}}{V_{solution}} \times 10^6$$

$$W/V = \frac{W_{solute}}{V_{solution}} \times 10^6$$

Molarity (M)

$$M = \frac{n_{solute}}{V_{solution}(\text{in L})}$$

Molality (m)

$$m = \frac{n_{solute}}{W_{solvent}(\text{in kg})}$$

Mole fraction (χ)

$$\chi_B = \frac{n_B}{n_A + n_B}$$

$$\chi_A = \frac{n_A}{n_A + n_B}$$

$$\chi_A + \chi_B = 1$$

Cross-Concentration

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

- d → density of solution (in g/mL)
- M_B → Molar mass of Solute
- M → Molarity of Solution
- m → molality of Solution

$$m = \frac{\chi_B \times 1000}{\chi_A \cdot M_A}$$

- χ_B → Mole fraction of solute
- χ_A → Mole fraction of solvent
- M_A → Molar mass of solvent
- m → molality of solution

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

→ 10% (w/w) → 10g solute in 100g of solution.

→ 10ppm (w/w) → 10g of solute in 10^6g of solution.

→ 10 M → 10 moles of solute in 1L of solution.

→ 10 m → 10 moles of solute in 1kg of solvent.

Dilution

Addition of solvent in a solution (Dilution ↓ the Concentration)

$$M_1V_1 = M_2V_2$$

- M_1 → Molarity of Initial solution
- V_1 → Volume of Initial Solution
- M_2 → Molarity of final solution (After dilution)
- V_2 → Volume of final solution ($V_1 + V$ (Volume of water added))

Mixing (Same Solution)

$$M_3V_3 = M_1V_1 + M_2V_2$$

- M_3 → Molarity of resulting (final) solution
- V_3 → Volume of resulting solution ($V_3 = V_1 + V_2$)
- M_1 → Molarity of Solution-1
- V_1 → Volume of Solution-1
- M_2 → Molarity of solution-2
- V_2 → Volume of solution-2

Stoichiometery

	N_2	+ $3H_2$	$\longrightarrow$ $2NH_3$
molecules	1 molecule	3 molecules	2 molecules
moles	1 mole	3 moles	2 moles
(only for gas) volume	1 Litre/unit	3 Litre/unit	2 Litre/unit
weight	28g	6g	34g

Limiting Reagent

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

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

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

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

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_4

Vapour Density

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

Average atomic mass

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

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 ga... → Equal no. of molecule... (At same T & P)

Significant figures

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

Rule

1. Non-zero → Significant (All)

2. Zero
   - left, eg. [0.03] → 1 — Not significant
   - middle, eg. [2.005] → 4 — significant
   - Right
     - Decimal: [0.200] → 3 — Significant
     - No Decimal: [100] → 1 — Not Significant

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 → 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 × 1.25 = 3.125 → 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

- $1\,m^3 = 1000\,L$
- $1\,dm^3 = 1\,L$
- $1\,cm^3 = 1\,mL$

1 atm = 760 mm Hg
1 atm = 760 torr
1 atm = 1.01325×10^5 Pa ≈ 10^5 Pa
1 atm = 1.01325 bar ≈ 1 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 = charge
- Ionic Compound: n_f = Total +ve charge
- Acid: n_f = Basicity
- Base: n_f = Acidity

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

$$N = \frac{n_{eq}}{V_{solution\,(in\,L)}}$$

$$N = M \times n_f$$

Law of Equivalence

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

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