HOW TO SOLVE ? STOICHIOMETRY PROBLEM

$$3A + 4B \rightarrow A_3B_4$$

1 Converting reactants into moles

- Grams(w) → $n = \frac{w}{m}$
- Liters(V) → $n = \frac{PV}{RT}$
- No. of Particles → $n = \frac{\text{No. of Particles}}{6.022 \times 10^{23}}$

→ Moles(n) → We Get

(A)	(B)
x moles	y moles

2 Finding Limiting Reagent (L.R)

Divide by Coefficient of any Reactant, in above reaction its 'A' i.e. 3

$$A + \frac{4}{3}B \rightarrow \frac{1}{3}A_3B_4$$

1 mole A reacts with $\frac{4}{3}$ moles B

x mole A reacts with $\frac{4}{3}x$ moles B

Is $\frac{4}{3}x > y$?

- Yes → B is LR
- No → A is LR

3 Find Moles of Product using L.R (assume L.R = B)

$$4B \rightarrow A_3B_4$$

$$n = \frac{1}{4}y$$

4 moles of 'B' gives 1 mole A_3B_4 → so y moles of 'B' gives $\frac{1}{4}$ (y) moles A_3B_4

4 Converting Product Moles into required quantity

Product A_3B_4 (n)

- $w = n \times m$ → Grams(w) → w / A.M.U → A.M.U 1.66×10^{-24} gm
- $V = \frac{nRT}{P}$ → Liters(V)
- No. of particle = $n \times 6.022 \times 10^{23}$ → Particles → Total no. of Particles → Gram Atom

Concentration Terms

Part-I

Molarity (M)

Molarity is no. of moles of a solute per liter of solution

$$M = \frac{\text{moles of solute}}{\text{volume of solution(in liter)}}$$

Molality (m)

Molality is the no. of moles of solute per kilogram of solvent.

$$m = \frac{\text{moles of solute}}{\text{weight of solvent (in kg.)}}$$

Normality (N)

Normality is the gram equivalent weight per liter of solution.

$$N = \frac{\text{gram equivalents of solute}}{\text{volume of solution(in liter)}}$$

Formality (f)

Formality is the no. of gram formula masses of the ionic solute dissolved per liter of solution.

$$f = \frac{\text{weight in gram}}{\text{formula weight} \times \text{volume of solution(liter)}}$$

Mole Fraction

Mole Fraction is equal to the moles of one component divided by total moles in the solution or mixture.

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

Parts per million (ppm)

Parts per million is value that represent the part of whole no. in units of 1/1000000

$$ppm = \frac{\text{mass of solute}}{\text{mass of solvent}} \times 10^6$$

CONCENTRATION OF SOLUTION

Part-II

(1) % by weight

(4.9% H_2SO_4 by weight) : ⇒

100gm of solution contains **4.9gm** of H_2SO_4

(2) % by volume

(4% H_2SO_4 by Volume) : ⇒

100ml of solution contains **4ml** of H_2SO_4

(3) % weight by volume

(4% H_2SO_4 w/v) : ⇒

4ml H_2SO_4 present in **100ml** of solution.

(4) % volume by weight

(4% H_2SO_4 v/w) : ⇒

4ml H_2SO_4 present in**100gm** solution.

EQUIVALENT MASS

Definition

The mass of a substance especially in grams that combines with or is chemically equivalent to eight grams of oxygen or one gram of hydrogen

$$\text{Equivalent Mass} = \frac{\text{Molar Mass}}{\text{n- Factor}}$$

EQUIVALENT MASS

- **Element**: $E = \frac{\text{Atomic mass of element}}{\text{Valence of element}}$
- **Ion**: $E = \frac{\text{Formula mass of ion}}{\text{Charge on ion}}$
- **Salt**: $E = \frac{\text{Formula mass of salt}}{\text{Total positive or negative charge on cationic or anionic part}}$
- **Acid**: $E = \frac{M_{acid}}{\text{Basicity}}$
- **Base**: $E = \frac{M_{Base}}{\text{Acidity}}$
- **Acid Salt**: $E = \frac{M}{\text{Replaceable 'H' left in the salt}}$
- **Redox Change**: $E = \frac{M_{\text{oxident or reductant}}}{\text{Number of electrons lost or gained by one molecule of oxidant of reductant}}$

CHEMICAL REACTIONS

Part-I

COMBUSTION

COMBUSTION or burning is a high temperature exothermic redox chemical reaction between a fuel and an oxidant usually atmospheric oxygen.

$$CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$$

ADDITION

ADDITION reaction is a reaction in which one molecule combines which another to form a large molecule with no other product.

$$C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$$

DECOMPOSITION

DECOMPOSITION reaction involves the breakdown of chemical compound into its elements or simpler compounds. These reactions often involve an energy source such as heat, light, or electricity that breaks apart the bonds of compounds.

$$2H_2O_2 \xrightarrow{\text{Heat}} 2H_2O + O_2$$

PRECIPITATION

PRECIPITATION reaction is the one in which aqueous compounds react to form an insoluble solid, called a precipitate. Whether or not a reaction will form a precipitate is dictated by solubility rules for ionic compounds.

$$2NaOH(aq) + MgCl_2(aq) \rightarrow 2NaCl(aq) + Mg(OH)_2(s)$$

NEUTRALISATION

NEUTRALISATION reaction is the one in which an acid and a base react to form a salt and water. Neutralisation reactions do not necessarily result in a pH of 7, resultant pH is dependent on the strengths of the acid and base.

$$NaOH + HCl \rightarrow NaCl + H_2O$$

CHEMICAL REACTIONS

Part-II

CONDENSATION

CONDENSATION reaction is the one in which two molecules combine to form a larger molecule with a small molecule. The small molecule lost is usually water, but not always. It can be considered to be the opposite of hydrolysis.

$$CH_3NH_2 + CH_3COOH \rightarrow CH_3NHCOCH_3 + H_2O$$

HYDROLYSIS

HYDROLYSIS reaction involves the breaking of chemical bonds by the addition of water to a substance. In some cases, this addition can cause both the substance and the water molecule to split into two parts.

$$H_2SO_4 + H_2O \rightarrow H_3O^+ + HSO_4^-$$

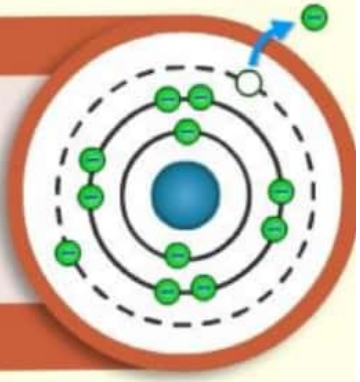
DISPLACEMENT

DISPLACEMENT reaction is chemical reaction in which a more reactive element displaces a less reactive element from its compound. Both metals and non-metals take part and more reactive displaces the less reactive.

$$Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$$

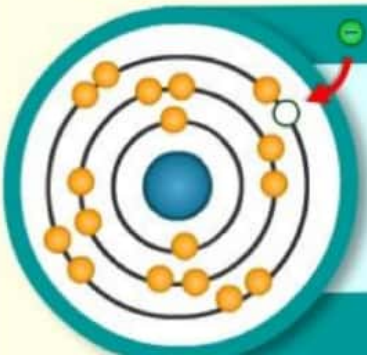
OXIDATION

OXIDATION reactions are sometimes defined as the reactions in which an element forms bonds with oxygen atoms. Generally, oxidation can be defined as a reaction in which atoms of an element lose electrons.



$$4Fe + 3O_2 + 2H_2O \rightarrow 2Fe_2O_3.H_2O$$

REDUCTION



REDUCTION reactions are sometimes defined as reactions in which other molecules lose oxygen atoms. Generally, reduction can be defined as a reaction in which atoms of an element gain electrons.

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$