Stoichiometry of formulas And Equations

The mole : Amount of substance That Contains the same number of atoms, ions or molecules of a 12g of Carbon

1 Mole = 6.022×10^{23} entities (atoms, ions and molecules)

Molar Mass :-
- from the Periodic Table (Monatomic elements)
- Multiply Number of atoms with the Mass of one Molecule (Polyatomic Mass)

* **To find the Number of Moles (N) :-**

$$N = \frac{\text{Mass (g)}}{\text{Molecular Mass (g/mol)}}$$

* **To find the number of entities** :-
find N and multiply with 6.022×10^{23}

* **To find Mass**
Multiply N with Molecular Mass

- If You are asked to find Number of atoms of an elements in a Compound Then :-

1- find The formula of the Compound Ex:- H_3PO_4

2- " number of atoms of the Whole Compound = T

3- Multiply The number of the atoms of the element With T

- let's say you Wanna Calculate number of Hydrogen atoms in a 42.62g of H_3PO_4

[1] $T = \frac{6.022 \times 10^{23} \times 42.62}{(3\times1)+(1\times31)+(4\times16)}$

$T = 2.62 \times 10^{23}$

[2] Number of Hydrogen atoms $= 3 \times 2.62 \times 10^{23}$
$= 7.86 \times 10^{23}$ atom

Mass percent of element

$\frac{\text{Mass of element (g)}}{\text{Mass of Compound (g)}} \times 100$

or $\frac{\text{Molecular Mass of element}}{\text{Molecular Mass of Compound}} \times 100$ ← Multiplied by atoms Number in the formula

↳ Ex:- C_2H_4

Mass% of C:- $\frac{2\times12}{4+2\times12} \times 100 = 86\%$

If the Question Gives You The Mass of Compound ⊙
You Can find Mass of element by multiplying
It's mass% with the Mass of the Compound

- Mass of element = % of element in the Compound × Mass of the Compound

• Empirical And Molecular formulas

Empirical formula

Steps :-

1- Divide number of moles of each element by The smallest number of moles

2- Multiply the results with the SMALLEST integer that gives a Whole number

Molecular formula

(*) Steps 1- find empirical formula

2- find Molecular Mass of empirical formula (E)

3- Divide Molecular Mass of The Compound by E

4- Round to an integer (i)

5- Multiply empirical formula with i.

• To find Molecular formula in Combustion Analysis

1- find percentage (Mass %) of oxidized element

2- find mass of Compound in each absorber
(Mass before − Mass after)

3- Multiply % with mass of Compound

4- find mass of O

5- find moles of each element

6- Do the same steps of Molecular formula (*)

Writing and Balancing Chemical Equations

- Chemical Equations:-

Reactants ⟶ Products

→ To Balance an equation :-

1- Put states of Matter
2- Balance the atoms using Coefficients

Reactions in Sequence :-

→ Reactants ⟶ Products (Reactants again) ⟶ Products

$A \longrightarrow C$
$C \longrightarrow B$
$A \longrightarrow B$

- C can Be eliminated

Limiting Reactants :-

* A limiting reactant : • used up in the reaction
• limit the amount of product

How to find limiting Reactant ?:-

1- Convert all mass masses to moles
2- Compare actual mole ration to mole ratio of the balanced Equation

or Calculate the ~~number~~ mass of Product That each reactant gives
The one That gives the smaller Quantity is limiting

Percent Yield

The experimental amount of Product

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

↳ The (maximum) Theoretical amount of Product

Actual yield < Theoretical

why:- 1- side reactions
2- incompleted reactions
3- Some Product is lost during product isolation.

fundamentals of Solution Stoichiometry

Molarity:-

$$M = \frac{\text{number of mols}}{\text{Volume of Solution}}$$

moles → m/L (L: liter)

Solve Sample Problem 3.26

- $Hg(NO_3)_2 + Na_2S \longrightarrow HgS + 2NaNO_3$

→ find mols of $Hg(NO_3)_2$ and Na_2S using molarity and volume

$$M_{Hg(NO_3)_2} = \frac{\#\text{ of mols}}{\text{Volume}}$$

# of moles of $Hg(NO_3)_2$ = 0.05×0.01 = 5×10^{-1} mols

# of mols of Na_2S = 0.02×01 = 20×10^{-4}

Dilution of Solutions

- Moles should be Constant
- $M_1V_1 = M_2V_2$