

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 element 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

$$[1] T = \frac{6.022 \times 10^{23} \times 42.62}{(3 \times 1) + (1 \times 31) + (4 \times 16)}$$

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

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

Mass Percent of element

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

or

$$\frac{\text{Molecular Mass of element}}{\text{Molecular Mass of Compound}} \times 100$$

Ex:- C_2H_4

$$\text{Mass\% of C} = \frac{2 \times 12}{4 + 2 \times 12} \times 100 = 86\%$$

← Multiplied by atoms Number in the formula

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 = $\frac{\% \text{ of element in the Compound}}{100} \times \text{Mass of the Compound}$

• Empirical And Molecular formulas

Empirical formulae

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 formulae

(*) Steps 1- find empirical formula

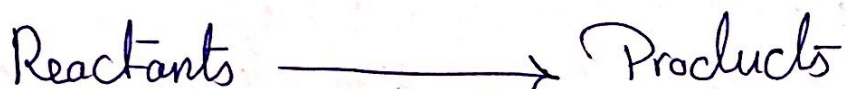
- 2- find Molecular Mass of empirical formula (E)
- 3- Divide Molecular Mass of the Compound by E
- 4- Round to an integer (i)
- 5- Multiply empirical formula with i.

• 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

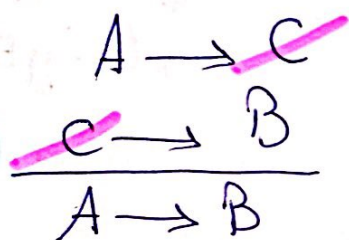
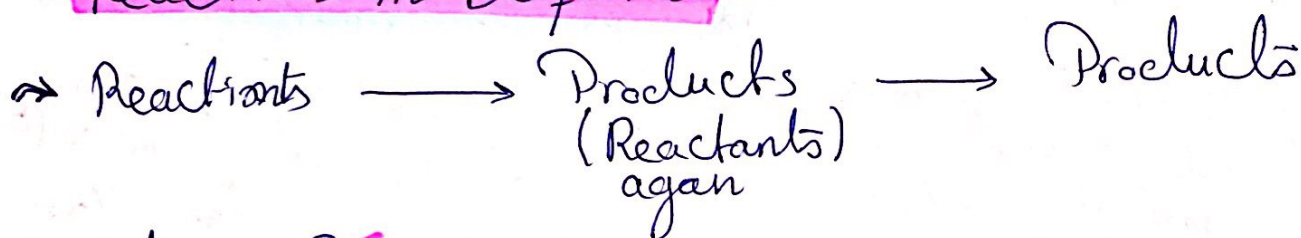
Chemical Equations:-



→ To Balance an equation :-

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

Reactions in Sequence:-



• 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 ratio 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 ⁽³⁾

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

The (maximum) Theoretical amount of Product

$$\text{Actual yield} < \text{Theoretical}$$

why:- 1- side reactions

2- incomplete reactions

3- Some Product is lost during product isolation.

• fundamentals of Solution Stoichiometry

Molarity:-

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

moles

m/L
↑
liter

Solve Sample Problem 3.26



→ find moles of $\text{Hg}(\text{NO}_3)_2$ and Na_2S using molarity and volume

$$M_{\text{Hg}(\text{NO}_3)_2} = \frac{\text{\# of moles}}{\text{Volume}}$$

$$\begin{aligned} \text{\# of moles of } \text{Hg}(\text{NO}_3)_2 &= 0.05 \times 0.01 \\ &= 5 \times 10^{-4} \text{ moles} \end{aligned}$$

$$\begin{aligned} \text{\# of moles of } \text{Na}_2\text{S} &= 0.02 \times 0.01 \\ &= 2 \times 10^{-4} \end{aligned}$$

Dilution of Solutions

- Moles should be Constant
- $M_1V_1 = M_2V_2$