

# Stoichiometry of formulas<sup>①</sup> And Equations

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

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

Molar Mass :-  
• from the Periodic Table (Monatomic element)  
• 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  $6.022 \times 10^{23}$

\* 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  $H_3PO_4$

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

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

$$\begin{aligned} \text{Number of Hydrogen atoms} &= 3 \times 2.62 \times 10^{23} \\ &= 7.86 \times 10^{23} \text{ atom} \end{aligned}$$

### 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



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



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  $\times$  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.

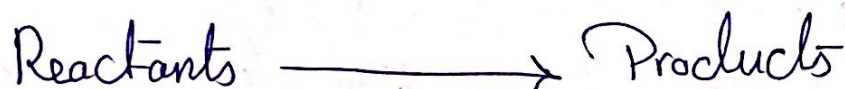
• To find Molecular formula in Combustion Analysis

- 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

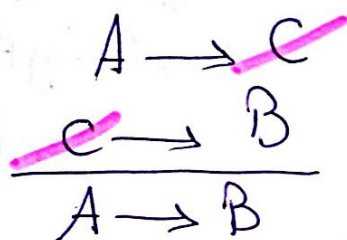
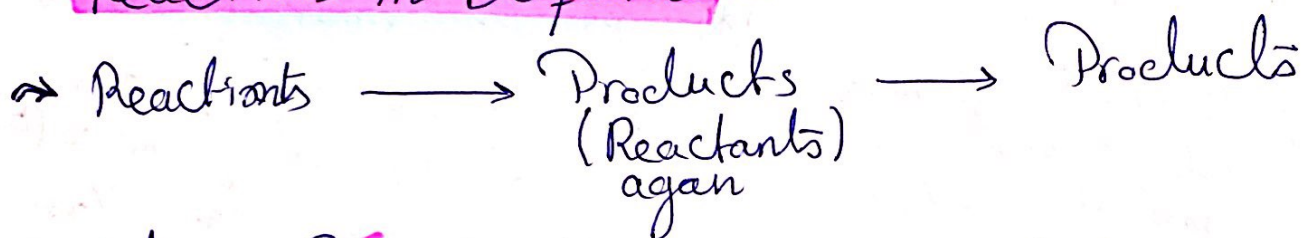
Chemical Equations:-



→ 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 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 <sup>③</sup>

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

↳ The (maximum) Theoretical amount of Product

Actual yield < Theoretical

why:- 1- side reactions

2- 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  $\text{Na}_2\text{S}$  using molarity and volume

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

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

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



## Dilution of Solutions

- Moles should be Constant
- $M_1V_1 = M_2V_2$