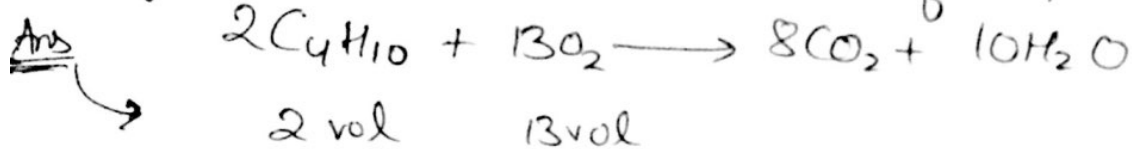


# MOLE CONCEPT

① State Gay-Lussac's Law of Combining Volumes.

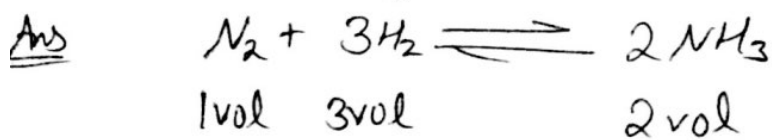
Ans: When Gases react, they do so in volumes which bears a simple whole no. ratio to one another and to the volumes of products formed if gaseous

② What volume of oxygen is required to burn completely 90dm<sup>3</sup> of butane under similar conditions of temperature and pressure



2 vol of butane requires 13 vol of O<sub>2</sub>  
 so 90dm<sup>3</sup> " " "  $\frac{13}{2} \times 90$  dm<sup>3</sup> of O<sub>2</sub>

③ In a container, 20ml of N<sub>2</sub> and 30ml of H<sub>2</sub> are mixed. Find the volume of resultant mixture.

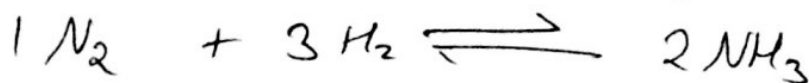


Watch  
Mole Concept  
Video for Numericals

1 vol N<sub>2</sub> Combines with 3 vol H<sub>2</sub>  
 so 20ml N<sub>2</sub> " " " 60ml H<sub>2</sub> → But we don't have this much H<sub>2</sub>

## Charge Approach

3 vol of H<sub>2</sub> Combines with 1 vol of N<sub>2</sub>  
 so 30ml of H<sub>2</sub> " " " 10ml of N<sub>2</sub> → we have this much N<sub>2</sub>



~~30ml~~            ~~10ml~~  
 10ml            30ml                    20ml

resulting mixture → 20ml of NH<sub>3</sub> is formed  
 10ml of unreacted N<sub>2</sub>

State Avagadro's Law.

Ans: Under similar conditions of temperature and pressure, equal volume of all gases contains equal no. of molecules.

⑤ A vessel contains 'X' number of molecules of  $H_2$  gas. How many molecules of  $N_2$  gas will be present under similar conditions.

Ans 'X', Avagadro's Law Equal volume of all gas  $\rightarrow$  Equal molecule

⑥ The volumes of gases A, B, C, D are in ratio 1:2:2:4. Under similar conditions, which sample contains maximum no. of molecules.

Ans D more volume  $\Rightarrow$  more molecules, Avagadro's Law

⑦ Complete the table (under similar conditions)

Gas	Volume	Molecules
$Cl_2$	10	_____
$N_2$	20	X
$NH_3$	20	_____
$SO_2$	5	_____

Ans  $Cl_2 \rightarrow X/2$

$NH_3 \rightarrow X$

$SO_2 \rightarrow X/4$

⑧ Define the term vapour density.

Ans: It is defined as the ratio of mass of a certain volume of a gas to the mass of an equal volume of  $H_2$  under same conditions.

⑨ How to solve Mass/Volume/Molecules/Atom Numericals

[WATCH VIDEO] (Highly Recommended for Mole Concept)

How is vapour Density related to Molecular Mass?

Ans:  $V.D. = \frac{\text{Molar Mass}}{2}$

⑪ How to solve Mole Concept Numericals :-

See Notes Attached: Solved Numericals of Mole Concept OR VIDEO.

## Types of Numerical Based on Mole Concept

The vapour density of  $\text{CO}_2$  [C=12, O=16] is -

Ans 
$$\text{V.D.} = \frac{\text{Molar Mass}}{2} = \frac{12 + 16 \times 2}{2} = 22 \text{ (no units)}$$

② How to find no. of mole?

Ans 
$$\text{no. of mole} = \frac{\text{mass given}}{\text{Molar Mass}} \quad \text{no of mole} = \frac{\text{Volume given (At STP)}}{22.4 \text{ L}}$$

$$\text{no. of mole} = \frac{\text{molecules given}}{6.022 \times 10^{23}}$$

③ Calculate the volume of 320g of  $\text{SO}_2$  at STP [S=32, O=16]

Ans : 
$$\text{no of moles} = \frac{\text{Mass given}}{\text{Molar Mass}} = \frac{320}{32 + 16 \times 2} = 5$$

$$\text{no of moles} = \frac{\text{volume (At STP)}}{22.4 \text{ L}}$$

$$5 = \frac{\text{volume}}{22.4 \text{ L}} \Rightarrow \boxed{\text{volume} = 5 \times 22.4 \text{ L}} \text{ Ans}$$

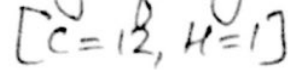
④ The mass of 5.6 dm<sup>3</sup> of a certain gas at STP is 12g. Calculate the Molecular Mass of gas.

Ans 
$$\text{no of moles} = \frac{\text{volume given}}{22.4 \text{ L (or dm}^3\text{)}} = \frac{5.6}{22.4} = \frac{1}{4}$$

$$\text{no of moles} = \frac{\text{mass given}}{\text{Molecular Mass}}$$

$$\frac{1}{4} = \frac{12}{M} \quad \boxed{M = 48 \text{ g}}$$

Calculate the no. of moles and the no. of molecules present in 1.4g ethylene gas. What is the volume occupied by the same amount of ethylene? What is vapour density of ethylene?



Ans: ethylene  $C_2H_4$

$$\text{no of moles} = \frac{\text{mass given}}{\text{Molecular Mass}} = \frac{1.4}{12 \times 2 + 1 \times 4} = \frac{1.4}{28} = \frac{1.4}{20} = \frac{0.1}{20}$$

$$\text{no of moles} = \frac{\text{molecules}}{6.022 \times 10^{23}} \Rightarrow \frac{1}{20} = \frac{\text{molecules}}{6.022 \times 10^{23}}$$

$$\Rightarrow \text{molecules} = \frac{6.022 \times 10^{23}}{20}$$

$$\text{no of moles} = \frac{\text{volume given}}{22.4L} \Rightarrow \frac{1}{20} = \frac{\text{Volume}}{22.4L}$$

$$\Rightarrow \text{volume} = \frac{22.4L}{20}$$

$$\text{V.D.} = \frac{\text{Molar Mass}}{2} = \frac{12 \times 2 + 1 \times 4}{2} = 14$$

⑥ Calculate the mass of i)  $10^{22}$  atoms of S ii) 0.1 mole of  $CO_2$

Ans: i) no of moles =  $\frac{\text{Atoms}}{6.022 \times 10^{23}} = \frac{10^{22}}{6.022 \times 10^{23}}$  [S=32, C=12, H=1, O=16]

$$\text{no of moles} = \frac{\text{mass}}{\text{Molar Mass}} = \frac{\text{mass}}{32}$$

$$\frac{10^{22}}{6.022 \times 10^{23}} = \frac{\text{mass}}{32} \quad \text{Calculate mass}$$

$$\text{ii) no of moles} = \frac{\text{mass}}{\text{Molar Mass}}$$

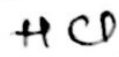
$$0.1 = \frac{\text{mass}}{12 + 16 \times 2} \Rightarrow \text{mass} = 0.1 \times 44 = 4.4g$$

## Percentage Composition:



$$\text{H} = 1$$

$$\text{Cl} = 35.5$$



$$\text{H} = 1, \text{Cl} = 35.5$$

$$\begin{aligned} \% \text{ of H} &= \frac{\text{mass of H}}{\text{molecular mass}} \times 100 \\ &= \frac{1}{36.5} \times 100 \end{aligned}$$

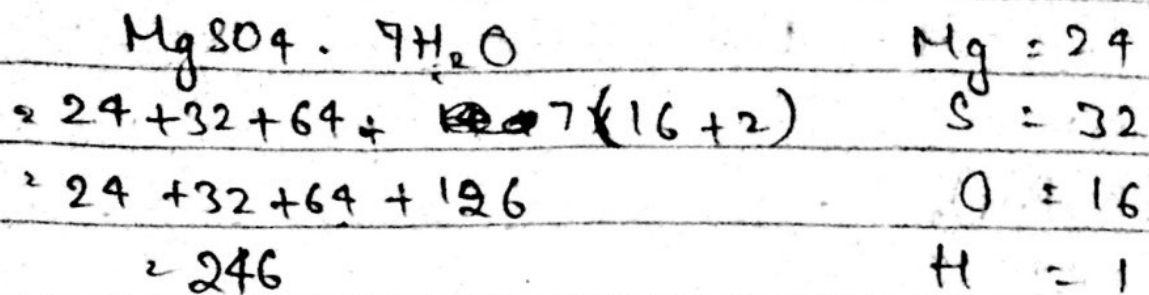
$\text{H}\% = \frac{\text{mass of H}}{\text{total mass}} \times 100$   
 $= \frac{1}{36.5} \times 100$

$$\begin{aligned} \% \text{ of Cl} &= \frac{\text{mass of Cl}}{\text{molecular mass}} \times 100 \\ &= \frac{35.5}{36.5} \times 100 \end{aligned}$$

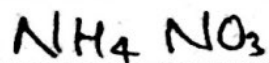
% of N in ammonia  $\text{NH}_3$

$$\text{N} = 14 \quad \text{H} = 1$$

$$\% \text{ of N} = \frac{14}{17} \times 100$$

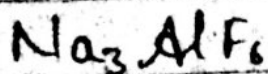


Find percentage of Oxygen and Nitrogen in Ammonium Nitrate



$$\% \text{ of N} = \frac{2 \times 14}{14 + 4 + 14 + 48} \times 100 = \frac{28}{80} \times 100$$

Calc. the percentage of sodium in sodium aluminium fluoride.



$$\text{Na} = 23, \text{Al} = 27, \text{F} = 19$$

$$\% \text{ of Na} = \frac{3 \times 23}{3 \times 23 + 27 + 6 \times 19} \times 100$$

## Determining empirical formula

Elements	% Comp	At. Wt.	At. Ratio = %/At. wt.	Sim. rat of atom
N	42%	14	$\frac{42}{14} = 3$	$\frac{3}{3} = 1$
O	48%	16	$\frac{48}{16} = 3$	$\frac{3}{3} = 1$
H	9%	1	$\frac{9}{1} = 9$	$\frac{9}{3} = 3$

Empirical Formula =  $\text{NOH}_3$



9CSE - 2011

E	% Comp	At. wt	A.R. %/wt	S.R.
C	12.67	12	$\frac{12.67}{12} = 1.05$	1
H	2.13	1	$\frac{2.13}{1} = 2.13$	2
Br	85.11	80	$\frac{85.11}{80} = 1.06$	1

~~CH<sub>2</sub>Br~~ Molecule

Emp. form = CH<sub>2</sub>Br

$$\eta = \frac{\text{Mol. mass}}{\text{emp. mass}}$$

$$V.D. = 94$$

$$V.D. = \frac{\text{Molecular Mass}}{2}$$

$$\eta = \frac{188}{94}$$

$$188 = \text{Mol. Mass}$$

$$= 2$$

$$\begin{aligned} \text{Mol. for} &= \eta \times \text{Emp. form} \\ &= 2 \times \text{CH}_2\text{Br} \\ &= \text{C}_2\text{H}_4\text{Br}_2 \end{aligned}$$

9CSE - 2009

E	% Comp	At. Wt.	A.R.	S.R.
N	87.5	14	$\frac{62.5}{14}$	$\frac{6.25}{6.25} = 1$
H	12.5%	1	12.5	$\frac{12.5}{6.25} = 2$

M.M. 37

$\text{NH}_2 = 2$  Emp. form

$$\text{Emp. mass} = 14 + 2 = 16$$

~~Mol. mass = n x Emp. mass~~

~~37 =~~

$$n = \frac{\text{molecular mass}}{\text{emp. form mass}}$$

$$= \frac{37}{16} = 2.3$$
$$\frac{37}{16} \approx 2$$

$$\text{Mol. form} = 2 \times \text{NH}_2$$

