



Handwritten Notes  
On  
Mole Concept

3rd Jan.

## Mole Concept

$$\rightarrow 1 \text{ amu} = 1.67 \times 10^{-24} \text{ g} \quad [\text{mass of } 1 \text{ P}^+] = \frac{1}{12} \times 12 \text{ (m)}$$

$$\rightarrow 1 \text{ amu} = \frac{1}{N_A} \quad \left[ \begin{array}{l} 24 \text{ amu} \rightarrow \text{Mass of 1 Mg atom.} \\ 24 \text{ gm} \rightarrow \text{Mass of } N_A \text{ Mg atom} \end{array} \right]$$

$\rightarrow$  Molecular / atomic mass expressed in amu.

$\rightarrow$  Molar mass expressed in gram.

$\rightarrow$  Q - 180 amu of  $\text{H}_2\text{O}$  (a) How many no. of molecules

Ans: no. of molecules =  $\frac{180}{18} = 10$  molecules.

$$\text{no. of H atom} = 2 \times 10 = 20$$

$$\text{no. of } e^- = 10 \times 8 = 80$$

$$\rightarrow 88 \text{ amu of } \text{CO}_2 \qquad 88 \text{ gm of } \text{CO}_2$$

$$\textcircled{1} \text{ no. of moles} = \frac{88}{44} = 2 \qquad \rightarrow \frac{88}{44} = 2$$

$$\textcircled{2} \text{ No. of molecules} = 2 \rightarrow 2 \times N_A$$

$$\textcircled{3} \text{ Total atoms} = 2 \times 3 \rightarrow 3 \times N_A$$

$$\textcircled{4} \text{ No. of } e^- \text{ total} = 22 \times 2 \rightarrow 22 \times 2 \times N_A$$

$$\# \text{ No. of molecules} = \frac{\text{mass (amu)}}{M.M.} = \frac{M(g) \times N_A}{M.M.}$$

$$\rightarrow \text{moles} = \frac{\text{Mass (g)}}{M.M.} = \frac{\text{Particles}}{6.022 \times 10^{23}} = \frac{\text{Volume given}}{22.4}$$

$$\rightarrow \text{No. of atoms} = \text{moles} \times N_A \times \text{atoms}$$

Q-  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$  of  $12.044 \times 10^{24}$   $\text{H}_2\text{O}$  molecules + then mass of  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ ?

Ans.  $\text{mols of H}_2\text{O} = \frac{12.044 \times 10^{24}}{N_A} = 20 \text{ mols}$

So mols of washing soda = 2

Mass = 2 x mol mass

molar mass washing soda = 286

$\Rightarrow 2 \times 286 = 572 \text{ gm.}$

$\rightarrow$  In case of ionic compounds no. of molecules = no. of formula unit.

$\rightarrow \text{charge} = \text{mols} \times n \times F$   $n = \text{no. of } e^- \text{ change}$

$\uparrow$   
Electricity.

Q- How much amt. of  $\text{Ca}^{+2}$  deposition on electrolysis of  $\text{CaCl}_2$ ?  
20 gm

Ans  $\rightarrow \text{mols of } \text{Ca}^{+2} = \frac{20}{40} = 1/2$

Electricity = charge =  $1/2 \times 2 \times F = 1F \Rightarrow 96500 \text{ C.}$

$\rightarrow \text{Amount of deposited} = \frac{\text{molar mass} \times i \times t}{n \times F}$  Electrochemistry

$\rightarrow \text{Average atomic mass} = \frac{\text{Mass} \times \% + \text{Mass} \times \%}{\text{Total } \%}$

Q- 80%  $\text{B}^{10}$  20%  $\text{B}^{11}$  AMM?

Ans AMM =  $\frac{10 \times 80 + 11 \times 20}{100} = 10.3 \text{ gm.}$



→ Average molecular mass =  $\frac{M_1 \times n_1 + M_2 \times n_2}{n_1 + n_2}$

$M_1, M_2$  = Molecular Mass  $n_1, n_2$  = no. of moles

Q - 88 gm of  $\text{CO}_2$ , 44.8 L of  $\text{N}_2\text{O}$  + 10 g molecule of  $\text{SO}_2$  AMM?

Ans: AMM =  $\frac{2 \times 44 + 2 \times 44 + 10 \times 64}{2+2+10} = \frac{816}{14} = 58$

→ Mole fraction (X) → unitless

① Mixture of A + B + C

$X_A = \frac{n_A}{n_{\text{Total}}} = \frac{n_A}{n_A + n_B + n_C}$

$n$  = moles

$X_B = \frac{n_B}{n_A + n_B + n_C}$

$X_C = \frac{n_C}{n_A + n_B + n_C}$

②  $X_A + X_B + X_C = 1$

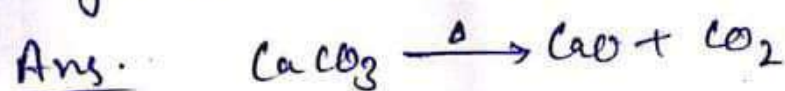
$\frac{P}{M} = \frac{D}{RT}$   
M.m. → density

→ Vapour density =  $\frac{\text{Molecular mass}}{2} = \frac{\text{Avg MM}}{2} = \frac{\rho_{\text{gas}}}{\rho_{\text{H}_2}}$   
Vap. den. of Mixture

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→ Mass % =  $\frac{\text{Mass of element}}{\text{Mass of comp.}} \times 100$

Ques Impure sample of 400g  $\text{CaCO}_3$  on heating gives 4 gm of  $\text{CO}_2$  Calculate % purity of  $\text{CaCO}_3$ ?

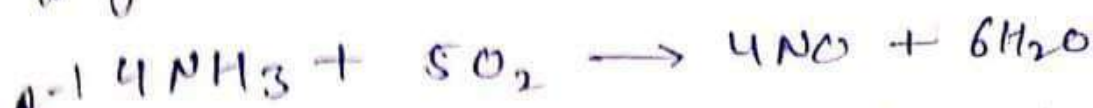


400g  $\text{CaCO}_3$  → 100g m  
11 →  $\frac{100}{44} \times 11$   
25  $\frac{100}{4} = 25$

Purity =  $\frac{25}{400} \times 100 = 6.25\%$

## Limiting Reagent :-

Simply divide given moles of Reactant by their stoichiometric coefficient and which is not give least value is L.R.



10 moles of  $\text{NH}_3$  react with 40 moles of  $\text{O}_2$  Calculate

(i) moles of  $\text{NO}$

Ans: L.R =  $\left(\frac{4}{10}\right) \cdot \frac{40}{5}$  NO formed =  $\begin{matrix} 4 \rightarrow 4 \\ 10 \rightarrow 10 \text{ moles} \end{matrix}$

(ii) Molecules of  $\text{NO} = 10 \text{ NA}$

Q-2  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$   
50 moles of  $\text{H}_2$  react with 200 moles of  $\text{O}_2$  then

(i) L.R = ?

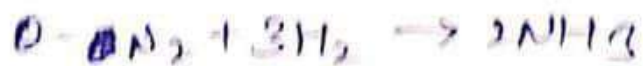
Ans (i)  $\frac{2}{50} = \frac{200}{1} \Rightarrow \underline{\text{H}_2 \text{ L.R.}}$

(ii)  $50\text{H}_2 \rightarrow 50\text{H}_2\text{O} \Rightarrow 50 \times 22.4 \text{ L.}$

(iii)  $2 \rightarrow 1\text{O}_2 \Rightarrow \begin{matrix} 1 \rightarrow \frac{1}{2}\text{O}_2 \\ \text{H}_2 \end{matrix} \quad \begin{matrix} 50 \rightarrow 25\text{O}_2 \\ \text{H}_2 \end{matrix}$

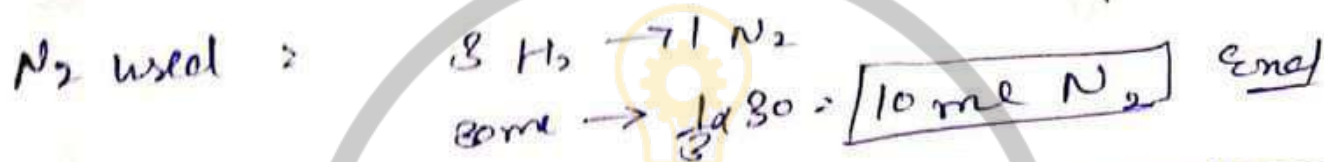
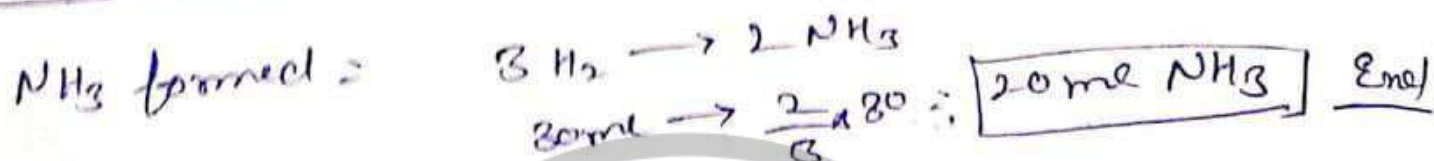
Left  $\text{O}_2 = 100 - 25 = 75 \text{ moles}$





30 ml of  $N_2$  react with 30 ml of  $H_2$ . Calculate volume of  $N_2, H_2, NH_3$  after reaction of 50% of expected product formed.

Ans. L.R =  $H_2$   $\left[ \frac{\text{moles}}{1} \right] \left[ \frac{\text{moles}}{3} \right] \rightarrow \text{moles} = 30/22.4$



Q- Calculate no. of molecules in 1 mole gas at STP

Ans. 1 mole =  $N_A$  atoms =  $22.4 \text{ L} = 22400 \text{ ml}$ .

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\* Molecular formula =  $n \times$  Empirical formula

\* Molar mass =  $n \times$  E.F. mass

Q- C = 60% H = 8% O = 32% E.F.?

Ans.  $\frac{60}{12} : \frac{8}{1} : \frac{32}{16} \rightarrow 5 : 8 : 2$   
 $E.F. = C_5 H_8 O_2$

Q- C = 93.71% O = 6.29% molecular mass = 128  
vapour density = 64

[E.F. & M.P. = ?]

Ans: C:H  $\Rightarrow \frac{93.71}{12} : \frac{6.29}{1} \Rightarrow 5 : 4$   
E.F. =  $C_5H_4$

$$n = \frac{\text{mol. mass}}{\text{E.F. mass}} = \frac{128}{64} = 2$$

$$\text{M.P.} = 2 \times C_5H_4 = C_{10}H_8$$

→ Normality :-  $\frac{\text{No. of gm equivalents}}{\text{Liter of soln.}} = \text{Molarity} \times n\text{-factor}$

\* Moles =  $\frac{\text{mass giv}}{\text{mol. mass}}$ ; Eq. mass =  $\frac{\text{Molarmass}}{n\text{-factor}}$ ; Equivalents =  $\frac{\text{mass g.}}{\text{eq. mass.}}$

Equivalents = moles  $\times$  n-factor

$$\begin{aligned} \rightarrow N_1 V_1 &= N_2 V_2 & \rightarrow N_R &= \frac{N_1 V_1 + N_2 V_2}{V_1 + V_2} \\ \rightarrow \frac{W_1}{E_1} &= \frac{W_2}{E_2} & \rightarrow M_R &= \frac{M_1 V_1 + M_2 V_2}{V_1 + V_2} \end{aligned} \quad \left. \begin{array}{l} \text{Acid/} \\ \text{Base} \\ \text{only.} \end{array} \right\}$$

$$\rightarrow \text{Conc. of ion} = \frac{\text{no. of ions} \times \text{conc.} \times \text{vol.}}{\text{Total vol.}}$$

$$\rightarrow m = \frac{1000M}{1000d - M M_b}$$

$M_b \rightarrow$  molar mass of solute  
 $d \rightarrow$  density of solution  
 $M \rightarrow$  Molarity  
 $m \rightarrow$  molality

$$\rightarrow X_B = \frac{m M_A}{1000 + M_A}, \quad X_B = \frac{M M_b}{1000d + (M_A - M_b) M}$$