EXAMS ROAD
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Handwritten Notes
On
Mole Concept

3rd Jan. | Mole Concept |

→ 1 amu = 1.67×10^{-24} g [mass of 1 p^+] = $\frac{1}{12} \times$ C-12 (m)

→ 1 amu = $\frac{1}{N_A}$ [24 amu → Mass of 1 Mg atom. 24 gm → Mass of N_A Mg atom]

→ Molecular | atomic mass expressed in amu.

→ Molar mass expressed in gram.

→ Q - 180 amu of H_2O (a) How many no. of molecules

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

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

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

→ 88 amu of CO_2 | 88 gm of CO_2

① no. of moles = $\frac{88}{44} = 2$ → $\frac{88}{44} = 2$

② No. of molecules = 2 → $2 \times N_A$

③ Total atoms = 2×3 → $3 \times N_A$

④ No. of e^- total = 22×2 → $22 \times 2 \times N_A$

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

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

→ No. of atoms = moles $\times N_A \times$ atoms

Q- $Na_2CO_3 \cdot 10H_2O$ if 12.044×10^{24} H_2O molecule rnt then ~~mass of~~ mass of $Na_2CO_3 \cdot 10H_2O$?

Ans. moles of $H_2O = \frac{12.044 \times 10^{24}}{N_A} = 20$ moles

So moles of washing soda = 2

Mass = 2 × mol. mass molarmass washing soda = 286

⇒ $2 \times 286 = 572$ gm.

→ In case of ionic compounds no. of molecules = no. of formula unit.

→ charge = moles × n × f. n = no. of e^- change
↕
Electricity.

Q- How much amt. of ecity in Faraday req. for 20 gm Ca^{+2} deposition on electrolysis of $CaCl_2$?

Ans → moles of $Ca^{+2} = \frac{20}{40} = 1/2$

ecity = charge = $1/2 \times 2 \times F = 1F$ ⇒ 96500 C.

→ Amount of deposited = $\frac{\text{molar mass} \times i \times t}{n \times F}$. [Electrochemistry]

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

Q- 80% $_5B^{10}$ 20% $_5B^{11}$ AMM?

Ans AMM = $\frac{10 \times 80 + 11 \times 20}{100} = 10.2$ gm.

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

M_1 / M_2 = Molecular Mass n_1 / n_2 = no. of moles

Q- 88 gm of CO_2, 44.8 L of N_2O (STP) + 10g molecule of SO_2 AMM?

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

→ Mole fraction (X) → unitless

(1) Mixture of $A + B + C$

$X_A = \frac{n_A}{n_{Total}} = \frac{n_A}{n_A + n_B + n_C}$ [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) $X_A + X_B + X_C = 1$

[$PM = DRT$ — M.m. (molar mass); D → density]

→ Vapour density = $\frac{\text{Molecular mass}}{2} = \frac{\text{Avg MM}}{2} = \frac{\rho_{gas}}{\rho_{H_2}}$

($\frac{\text{Avg MM}}{2}$ → Vap. den. of Mixture)

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

Que- Impure sample of 400g $CaCO_3$ on heating gives 4 gm of CO_2. Calculate % purity of $CaCO_3$?

Ans. $CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

44 gm CO_2 → 100 gm

4 → $\frac{100}{44} \times 11$

⇒ $\frac{100}{4} = 25$

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

Limiting Reagent :-

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

Q.1 $4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$

10 moles of NH_3 react with 40 moles of O_2 Calculate

(i) moles of NO

Ans: L.R = $\frac{4}{10}$, $\frac{40}{5}$ — LR ✓

NO formed = $4 \longrightarrow 4$
$10 \longrightarrow 10$ moles.

(ii) Molecules of NO = 10 N_A

Q.2 $2H_2 + O_2 \longrightarrow 2H_2O$

50 moles of H_2 react with 200 moles of O_2 then

(i) LR = ? (ii) Vol. H_2O (iii) which is not in excess & how much?

Ans (i) $\frac{2}{50}$, $\frac{200}{1}$ ⇒ H_2 L.R.

(ii) $50 H_2 \longrightarrow 50 H_2O$ ⇒ 50×22.4 L.

(iii) $\underset{H_2}{2} \longrightarrow 1 O_2$ ⇒ $\underset{H_2}{1} \longrightarrow \frac{1}{2} O_2$ ⇒ $\underset{H_2}{50} \longrightarrow 25\ O_2$

Left O_2 = 200 − 25 = 175 moles.

Q- $N_2 + 3H_2 \rightarrow 2NH_3$

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 $\left[\frac{moles}{1} \quad \frac{moles}{3}\right]$, moles = 30/22.4

50% Rxn → 50% $2NH_3$

NH_3 formed = $3H_2 \rightarrow 2NH_3$
30 ml → $\frac{2}{3} \times 30$ = **20 ml NH_3** End

N_2 used : $3H_2 \rightarrow 1N_2$
30 ml → $\frac{1}{3} \times 30$ = **10 ml N_2** End

So after 50% ⇒ **NH_3 = 10 ml** **N_2 = 5 ml** **H_2 = 15 ml**

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

Ans. 1 mole = N_A atoms = 22.4 L = 22400 ml.

* Molecular formula = n × Empirical formula
* Molar mass = n × E.F. mass.

Q- C = 60% H = 8% O = 32% EF ?

Ans. $\frac{60}{12} : \frac{8}{1} : \frac{32}{16}$ ⇒ 5 : 8 : 2

EF = $C_5H_8O_2$

Q. C = 93.71%   O = 6.29%   molecular mass = 128

Vapour density = 64

| E.F. & M.F. = ? |

Ans. C : H ⇒ $\frac{93.71}{12} : \frac{6.29}{1}$ ⇒ 5 : 4

E.F. = C_5H_4

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

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

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

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

Equivalents = moles × n-factor.

→ $N_1V_1 = N_2V_2$

→ $N_R = \frac{N_1V_1 + N_2V_2}{V_1 + V_2}$

→ $M_R = \frac{M_1V_1 + M_2V_2}{V_1 + V_2}$

] Acid / Base only.

→ $\frac{w_1}{E_1} = \frac{w_2}{E_2}$

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

→ $m = \frac{1000M}{1000d - MM_b}$

M_b → molar mass of solute
d → density of solution
M → Molarity   m → molality

→ $x_B = \frac{mM_A}{1000 + M_A}$, $x_B = \frac{MM_b}{1000d + (M_A - M_B)M}$.