

## Chapter 2: Stoichiometry

Q1.

Sol: (i)  $\text{Ca} \longrightarrow \text{CaCO}_3(\text{s})$

Since 1 mole of  $\text{CaCO}_3(\text{s})$  contains 1 moles of Ca, So

1 mole of Ca will produce 1 mole of  $\text{CaCO}_3(\text{s})$ .

$\therefore$  5 mole of Ca  $\longrightarrow$  5 mole of  $\text{CaCO}_3$

(ii)  $\text{BaCl}_2 \longrightarrow \text{BaSO}_4$

(moles)

5 moles of  $\text{BaCl}_2$  contains 5 moles of Ba & 5 moles of Ba & can form 5 moles of  $\text{BaSO}_4$ ; since 1 mole of  $\text{BaSO}_4$  contain 1 mole of Ba.

(iii)  $2 \text{Na} \longrightarrow \text{Na}_2\text{O}$

5 moles (given)

$\therefore$  2 moles produces 1 mole of  $\text{Na}_2\text{O}$ .

$\therefore$  1  $\longrightarrow \frac{1}{2}$

$\therefore$  5  $\longrightarrow 5 \times \frac{1}{2} = 2.5$  moles of  $\text{Na}_2\text{O}$ .

Q2.

Ans:  $\text{Ca} + \frac{1}{2} \text{O}_2 \longrightarrow \text{CaO}$  (Balanced chemical reaction)

Wt. of Ca = 40 g (Given)

So, moles of Ca =  $\frac{40}{40} = 1$  moles

Now from balanced chemical reaction: 1 moles of Ca reacts with  $\frac{1}{2}$  moles of  $\text{O}_2$ .

Wt of  $\text{O}_2$  with which 40 g to Ca react =  $\frac{1}{2} \times 32 = 16$  g

Ans

Q3.

Sol:  $\text{NaCl} \longrightarrow \text{Cl}_2$

50 gm

If we have not to balance the chemical equation, then we have to apply POAC rule or g-equivalence rule.

By POAC (on Cl atom)

(no. of Cl atom) before reaction = (no. of Cl atom) after reaction.

no. of moles of  $\text{NaCl} \times N_A = 2 \times \text{no. of moles of } \text{Cl}_2 \times N_A$

$\frac{50}{58.5} = 2 \times \text{moles of } \text{Cl}_2$

moles of  $\text{Cl}_2 = \frac{50}{117}$



$$\text{Volume of Cl}_2 \text{ at NTP} = \frac{50}{117} \times 22.4 \text{ lit} = 9.57 \text{ lit} \quad \text{Ans}$$

**Q4.**

$$\text{Sol: Weight of Fe}_2\text{O}_3 \text{ in iron ore} = \frac{94}{100} \times 2 \text{ tons} = \frac{94}{100} \times 2000 \text{ Kg} = 1880 \text{ kg.}$$

$$\therefore \text{Mol. wt of Fe}_2\text{O}_3 = 56 \times 2 + 16 \times 3 = 160 \text{ g}$$

$$\therefore 160 \text{ g of Fe}_2\text{O}_3 \text{ contains } 112 \text{ g of Fe}$$

$$\therefore 1 \text{ ————— } \frac{112}{160}$$

$$\therefore 1880 \text{ ————— } \frac{112}{160} \times 1880 = 1316 \text{ kg} \quad \text{Ans}$$

**Q5.**



100 gm

By POAC on C-atom

(moles of C atom) before reaction = (moles of C-atom) after reaction.

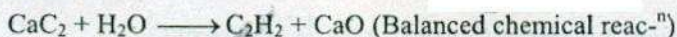
$$2 \times \text{moles of CaC}_2 = 2 \times \text{mole of C}_2\text{H}_2(\text{g})$$

$$\frac{100}{(40 + 2 \times 12)} = \text{moles of C}_2\text{H}_2(\text{g}),$$

$$1.5625 = \text{moles of C}_2\text{H}_2(\text{g}).$$

$$\text{Volume of acetylene at NTP} = 1.5625 \times 22.4 \text{ lit} = 35 \text{ lit}$$

**2<sup>nd</sup> method**



$$\text{moles of CaC}_2 = \frac{100}{64} = 1.5625$$

$$\therefore 1 \text{ moles of CaC}_2 \text{ gives } 1 \text{ mole of C}_2\text{H}_2$$

$$\therefore 1.5625 \text{ ————— } 1.5625 \text{ —}$$

$$\therefore \text{Volume of C}_2\text{H}_2 \text{ at NTP} = 1.5625 \times 22.4 \text{ lit} = 35 \text{ lit}$$

**Q6.**

**Sol:** Detonating gas is (2 mole H<sub>2</sub> + 1 mole O<sub>2</sub>)



(Detonating gas)

$$0.1 \text{ mole} \longrightarrow 0.1 \text{ mole} + \frac{1}{2} \times 0.1 \text{ mole}$$

From reaction stoichiometry.

$$0.1 \text{ mole of H}_2\text{O produces } 0.1 \text{ mole of H}_2 + \frac{0.1}{2} \text{ mole of O}_2 = \frac{0.3}{2} \text{ mole of donating gas.}$$

$$\therefore \text{Volume of denoting gas produced} = \frac{0.3}{2} \times 22.4 \text{ lit} = 3.36 \text{ lit} \quad \text{Ans}$$

Q7.



By POAC (I don't like to balance equation). If you like you can have another method by balancing this equation and applying mole stoichiometric relationship)

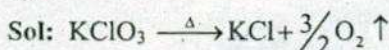
(mole of Cu) before reaction = (mole of Cu) after reaction

$$\frac{10}{63.5} = \text{mole of } \text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O}.$$

$$\therefore \text{Wt of } \text{Cu}(\text{NO}_3)_2 \cdot 3\text{H}_2\text{O} = \frac{10}{63.5} (63.5 + 2 \times 62 + 3 \times 18) = \frac{10}{63.5} \times 241.5 = 38 \text{ g}$$

Ans

Q8.



Weight loss will be due to evolution of oxygen gas on heating.

$\therefore \frac{3}{2}$  mole of  $\text{O}_2$  is produced from 1 mole of  $\text{KClO}_3$

$\therefore \frac{3}{2} \times 32 \text{ g of } \text{O}_2$  produced from 122.5 g of  $\text{KCl}$ .

$$\therefore 1 \text{ ————— } \frac{122.5}{48}$$

$$\therefore 0.384 \text{ ————— } \frac{122.5 \times 0.384}{48} = 0.98 \text{ g}$$

$$\therefore \% \text{ purity} = \frac{0.98}{4.9} \times 100 = 20\%$$

Q9.

Sol:  $\text{MgCO}_3 + \text{CaCO}_3$ . (Considered 100 g of mixture) You can actually consider any weight, but taking 100 g is easiest to solve the problems.

X g (say)

(100-x)g

Let wt of  $\text{MgCO}_3 = x \text{ g}$

$\therefore$  wt of  $\text{CaCO}_3 = (100-x) \text{ g}$



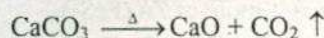
X gm

$$\frac{x}{84} \text{ mole} \longrightarrow \frac{x}{84} \text{ mole}$$

$$\text{Wt. of } \text{CO}_2 \text{ evolved} = \frac{x}{84} \times 44 \text{ g}$$

A/q.

Wt loss = 50% (which will be due to evolution of  $\text{CO}_2$ )



(100-x) g

$$\left( \frac{100-x}{100} \right) \text{ mole} \longrightarrow \left( \frac{100-x}{100} \right) \text{ mole}$$

$$\text{Wt. of } \text{CO}_2 \text{ evolved} = \frac{100-x}{100} \times 44 \text{ g}$$



$$\frac{x}{84} \times 44 + \frac{100-x}{100} \times 44 = 50 \quad (50\% \text{ of } 100 \text{ g} = 50)$$

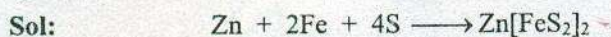
$$\frac{x}{84} + \frac{100-x}{100} = \frac{50}{44}$$

Solving for x, we have

$$X = 71.59\%$$

$$\left. \begin{aligned} \% \text{ of } \text{MgCO}_3 &= \frac{x}{100} \times 100 = 71.59\% \\ \% \text{ of } \text{CaCO}_3 &= (100 - x) = 28.41\% \end{aligned} \right\} \text{Ans}$$

**Q10.**



Given amount:  $\begin{array}{ccc} 2\text{g} & 3\text{g} & 4\text{g} \\ & & 0 \end{array}$

Given moles:  $\begin{array}{ccc} \frac{2}{65.4} & \frac{3}{56} & \frac{4}{32} \end{array}$

From the balanced chemical equation.

1 mole of Zn  $\equiv$  2 mole of Fe

$\therefore$  2 mole of Zn = 1 mole of Fe

$$2 \times \frac{2}{65.4} = \text{mole of Fe} \Rightarrow \text{Mole of Fe (required)} = \frac{4}{65.4} > \frac{3}{56} \text{ (given amount)}$$

$\therefore$  Fe will be the limiting agent between Zn & Fe ----- (1)

Further, we have to decide the limiting reagent between Fe and Sulphur

2 mole of Fe  $\equiv$  4 mole of S

$\therefore$  4 mole of S = 2 mole of Fe

$$2.4 \times \frac{4}{32} = 2 \times \text{mole of Fe} \Rightarrow \therefore \text{Moles of Fe (required)} = \frac{1}{4} > \frac{3}{56}$$

$\therefore$  Between Fe & sulphur, Fe is the limiting reagent. ----- (2)

(1) & (2)  $\Rightarrow$  Overall, Fe will be the limiting reagent

So, moles of Fe will determine the moles of  $\text{Zn}(\text{FeS}_2)_2$  produced.

2 mole of Fe  $\equiv$  1 mole of  $\text{Zn}(\text{FeS}_2)_2$

$\therefore$  1 mole of Fe = 2  $\times$  mole of  $\text{Zn}(\text{FeS}_2)_2$

$$\therefore \text{Mole of } \text{Zn}(\text{FeS}_2)_2 = \frac{\text{mole of Fe}}{2} = \frac{3}{56 \times 2} \text{ moles}$$

$$\therefore \text{Wt of } \text{Zn}(\text{FeS}_2)_2 = \left[ \frac{3}{112} \times 65.4 + 2 \times (56 + 2 \times 32) \right]$$



**Q11.**

**Sol:**

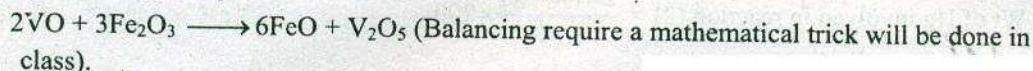


Given amount: 2 g      5.78 g

Moles:  $\frac{2}{67}$        $\frac{5.78}{160}$

Before we can know the limiting reagent, either we have to balance it or we have to apply the law of equivalence in above reaction by calculating valances factor for each species.

By balancing of equation



$\therefore 2 \text{ mole of VO} \equiv 3 \text{ moles of Fe}_2\text{O}_3$

$\therefore 2 \text{ moles of Fe}_2\text{O}_3 = 3 \text{ moles of CO.}$

$$2 \times \frac{5.75}{160} = 3 \times \text{moles of VO}$$

$$\text{Moles of VO} = \frac{12.50}{480} \times \frac{2}{67} \text{ (given amount)}$$

(required)

Since given amount of VO is larger than the required amount of VO. So  $\text{Fe}_2\text{O}_3$  will be limiting reagent.

Now from balanced chemical equation

3 moles of  $\text{Fe}_2\text{O}_3 \equiv 1 \text{ mole of V}_2\text{O}_5$

$\therefore 1 \text{ mole of Fe}_2\text{O}_3 = 3 \times \text{mole of V}_2\text{O}_5$

$$\therefore \text{mole of V}_2\text{O}_5 = \frac{1}{3} \times \text{mole of Fe}_2\text{O}_3 = \frac{1}{3} \times \frac{5.75}{160} = \frac{5.75}{480}$$

$$\therefore \text{Wt of V}_2\text{O}_5 \text{ produced} = \frac{5.75}{480} \times (182) = 2.18 \text{ gm}$$

**Ans**

**Q12.**

**Sol:** Let W g is the weight of mercury & iodine taken, from which x g is the weight of iodine involved in  $\text{HgI}_2$  formation, then (w-x)g will be involved in  $\text{Hg}_2\text{I}_2$  formation.



x gm

$\frac{x}{254}$  moles

$$\therefore \text{mole of Hg involved in this reac}^n = \frac{x}{254}$$

$$\therefore \text{wt of } \text{Hg}_2\text{I}_2 = \frac{x}{254} \times 200$$





(w-x) g

$\frac{w-x}{254}$  moles

2 mole of Hg  $\equiv$  1 mole of  $\text{I}_2$

$$\therefore 1 \text{ mole of Hg} = 2 \times \text{mole of } \text{I}_2 = 2 \times \left( \frac{w-x}{254} \right)$$

$$\therefore \text{Wt of Hg involved in reaction (2)} = \frac{2 \times (w-x)}{254} \times 200$$

$$\text{A/q, } \frac{200}{254}x + \frac{2(w-x)}{254} \times 200 = w.$$

$$x + 2(w-x) = \frac{254w}{200}$$

$$2w-x = 1.27w$$

$$x = 0.73w$$

$$\text{Wt of HgI}_2 \text{ produced} = \text{mole of HgI}_2 \times (454) = \frac{x}{254} \times 454$$

$$\text{Wt of Hg}_2\text{I}_2 \text{ produced} = \text{mole of Hg}_2\text{I}_2 \times (654) = \frac{w-x}{254} \times 654.$$

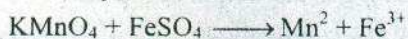
Ratio of the weight of  $\text{Hg}_2\text{I}_2$  &  $\text{HgI}_2$

$$= \frac{\frac{(w-x)}{254} \times 654}{\frac{x}{254} \times 454} = \frac{w-0.73w}{0.73w} \times \frac{654}{454} = \frac{0.27}{0.73} \times \frac{654}{454} = 0.532:1. \quad \text{Ans}$$

**Q13.**

**Sol:**  $\text{W}(\text{FeSO}_4 \cdot 7\text{H}_2\text{O} + \text{Fe}_2(\text{SO}_4)_3 \cdot 9\text{H}_2\text{O}) = 5.5 \text{ g (given)}$

With  $\text{KMnO}_4$  (a strong O.A.) only  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  react because Fe is in lower oxidation state here only



From law of chemical-equivalence

gm equivalence of  $\text{KMnO}_4$  = gm equivalence of  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$

$$\frac{5.4}{1000} \times 0.1 = \frac{\text{wt}}{\text{Mol.wt} / v.f} = \frac{\text{wt}}{278}$$

$$\text{Wt} = \frac{5.4 \times 278}{10^4} = 0.1501 \text{ g}$$

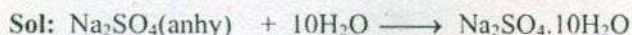
$$\therefore \text{Wt of } \text{Fe}_2(\text{SO}_4)_3 \cdot 7\text{H}_2\text{O} = 5.5 - 0.15 = 5.35 \text{ g}$$

$$\therefore \text{Moles of Ferric sulphate (hydrated)} = \frac{5.35}{562}$$

$$= 0.0095 \text{ moles; Ans}$$



Q14.



$$1 \text{ g} = \frac{1}{142} \text{ moles}$$

$$\text{moles of water with which 1 gm of } \text{Na}_2\text{SO}_4 \text{ react} = \frac{10 \times 1}{142}$$

$$\therefore \text{Wt of } \text{H}_2\text{O} = \frac{10 \times 1}{142} \times 18$$

$\therefore$  Wt of 1 gm of  $\text{Na}_2\text{SO}_4$  will increase by 1.27 g. Ans

Q15.

Sol: In drying only water's amount will change.

Clay	Silica	Water	Others
Original	X(say)%	12%	$100 - (12 + x)\% = 88 - x\%$
Partially dried	50%	7%	43%

Since amount of silica & other won't change

$\therefore$  Ratio of silica to other will remain same.

$$\frac{x}{88 - x} = \frac{50}{43}$$

$$43x = 50 \times 88 - 50x$$

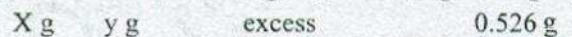
$$x = \frac{50 \times 88}{93} = 47.3\% \text{ Ans}$$

Q16.

Sol:  $\text{W}(\text{NaCl} + \text{NaBr} + \text{inert substance}) = 1 \text{ g}$

Let wt of NaCl is x g

& wt of NaBr is Y g.



$$\frac{x}{58.5} \quad \frac{y}{103}$$

$$\frac{x}{58.5} \text{ moles of NaCl will produce } \frac{x}{58.5} \text{ moles of AgCl}$$

$$\therefore \frac{x}{58.5} \times 143.5 \text{ g}$$

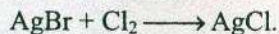
$$\frac{y}{103} \text{ moles of NaBr will produce } \frac{y}{103} \text{ mole of AgBr}$$

$$\therefore \frac{y}{103} \times 183 \text{ g}$$

A/q,

$$\frac{x}{58.5} \times 143.5 + \frac{y}{103} \times 183 = 0.526 \text{ g} \quad \text{--- (1)}$$

Now when  $\text{Cl}_2$  gas is passed over ( $\text{AgCl} + \text{AgBr}$ ) mixture then  $\text{AgBr}$  will convert into  $\text{AgCl}$ .



$$\frac{y}{103} \text{ moles} \longrightarrow \frac{y}{103} \text{ moles}$$

$$\therefore \text{Wt of AgCl produce from AgBr} = \frac{y}{103} \times 143.5 \text{ g}$$

$$\therefore \text{A/q, Total wt. of AgCl} = 0.426 \text{ g}$$

$$\therefore \frac{x}{58.5} \times 143.5 + \frac{y}{103} \times 143.5 = 0.426 \text{ g} \quad \text{--- (2)}$$

Solving (1) & (2), we have

$$X = 0.0425 \text{ g}$$

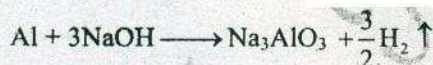
$$Y = 0.232 \text{ g}$$

$$\therefore \% \text{ of NaCl} = \frac{x}{1} \times 100 = 4.25\%$$

$$\% \text{ of NaBr} = \frac{y}{1} \times 100 = 23.2\% ; \quad \text{Ans}$$

**Q17.**

$$\text{Sol: } W(\text{Al} + \text{Al}_2\text{O}_3) = 3.9 \text{ g}$$



Volume of  $\text{H}_2$  produced = 840 ml (at NTP)

$$\text{moles of H}_2 = \frac{840}{22400} = 0.0375$$

$$\therefore \frac{3}{2} \text{ moles of H}_2 \text{ is produced by 1 mole of Al}$$

$$\therefore 1 \times \frac{1}{\frac{3}{2}} = \frac{2}{3} \text{ moles of Al}$$

$$\therefore 0.0375 \times \frac{2}{3} \times 0.0375 = 0.025$$

$$\therefore \text{Wt of Al} = 0.025 \times 27 = 0.675 \text{ g}$$

$$\therefore \% \text{ of Al} = \frac{0.675}{3.9} \times 100 = 17.3\% \quad \text{Ans}$$

**Q18.**

$$\text{Ans: } W(\text{NaCl} + \text{NaOH}) \rightarrow 2 \text{ g}$$

Let x g of NaCl is present in 2 g of commercial NaOH





$$\text{X g} \qquad \qquad \qquad 0.287 \text{ g}$$

$$\frac{x}{58.5} \text{ moles} \longrightarrow \frac{x}{58.5} \text{ moles}$$

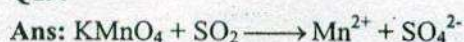
$$\therefore \text{Wt of AgCl produced} = \text{mole of AgCl} \times \text{Mol. wt}$$

$$= \frac{x}{58.5} \times 143.5$$

$$\text{A/q, } \frac{x}{58.5} \times 143.5 = 0.287 \text{ g}$$

$$x = 0.117 \text{ g; Ans}$$

**Q19.**



$$15.8 \text{ g} \quad \text{v.f.}=2$$

$$\text{v.f.}=5$$

$$\text{gm eq. of KMnO}_4 = \text{gm eq. of SO}_2$$

$$\frac{15.8}{158/5} = \frac{\text{wt}}{64/2}$$

$$\text{Wt of SO}_2 = \frac{1}{2} \times 32 = 16 \text{ g}$$



$$\text{By POAC; mole of S in FeS}_2 = \text{mole of S in SO}_2$$

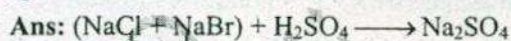
$$2 \times \text{mole of FeS}_2 = \text{mole of SO}_2$$

$$= \frac{16}{64}$$

$$\text{Mole of FeS}_2 = \frac{1}{8} \therefore \text{wt} = \frac{1}{8} \times 120 = 15 \text{ g}$$

**Ans**

**Q20.**



$$\text{Let } (x + y) \text{ g} = 1 \text{ gm is taken}$$

$$\text{Then according to question, Wt of Na}_2\text{SO}_4 \text{ produced} = 1 \text{ g}$$



$$\text{X g} = \frac{x}{58.5} \text{ moles}$$

$$\therefore \text{Mole of Na}_2\text{SO}_4 \text{ (produced)} = \frac{1}{2} \times \left( \frac{x}{58.5} \right)$$

$$\therefore \text{Wt of Na}_2\text{SO}_4 \text{ produced from NaCl} = \frac{x}{117} \times 142 \text{ g}$$





$$y \text{ g} = \frac{y}{103} \text{ moles}$$

$$\text{Moles of Na}_2\text{SO}_4 \text{ (Produced)} = \frac{1}{2} \times \frac{y}{103} = \frac{y}{206}$$

$$\therefore \text{Wt of Na}_2\text{SO}_4 \text{ Produced from NaBr} = \frac{y}{206} \times 142 \text{ g}$$

$$\text{A/q, } \frac{x \times 142}{117} + \frac{y}{206} \times 142 = 1 \text{ g}$$

$$\therefore \frac{x}{117} + \frac{1-x}{206} = \frac{1}{142} \quad (x+y=1)$$

$$\frac{206x + 117 - 117x}{206 \times 117} = \frac{1}{142}$$

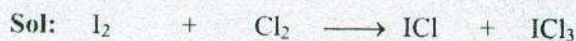
$$89x = 169.732 - 117 \Rightarrow x = \frac{52.732}{89} = 0.59 \text{ g}$$

$$\therefore \text{Wt of NaBr} = 1 - x = 0.41 \text{ g}$$

$$\therefore \text{Ratio of the wt.} = \frac{0.59}{0.41} = 1.45:1$$

**Ans**

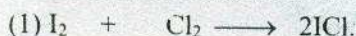
**Q21.**



$$\begin{array}{l} 25.4 \text{ g} \quad 14.2 \text{ g} \\ \frac{254}{254} = 0.1 \quad \frac{142}{710} = 0.2 \end{array}$$

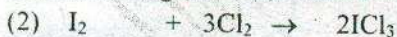
Let x moles of  $\text{I}_2$  involved in  $\text{ICl}$  formation

$\therefore$  moles of  $\text{Cl}_2$  involved in  $\text{ICl}$  formation = x



x mole  $\rightarrow$  x moles  $\rightarrow$  2x moles

The remaining  $(0.1 - x)$  moles of  $\text{I}_2$  will be involved in  $\text{ICl}_3$  formation.



$(0.1 - x) \rightarrow 3(0.1 - x)$

$\therefore$  Moles of  $\text{Cl}_2$  involved =  $3(0.1 - x)$

Now  $x + 3(0.1 - x) = 0.2$  (moles of  $\text{Cl}_2$  given)

$\Rightarrow$

$$x + 0.3 - 3x = 0.2$$

$$2x = 0.1 \Rightarrow x = \frac{0.1}{2}$$

(1)  $\Rightarrow$  moles of  $\text{ICl}$  formed =  $2x = 0.1$  moles

(2)  $\Rightarrow$  moles of  $\text{ICl}_3$  formed =  $(0.1 - x) \times 2 = 0.1$  moles. **Ans**



**Q22.**



Nobel metals (Ag, Au, Pt, Hg Cu) doesn't react with acid/ $\text{H}_2\text{O}$  to produce  $\text{H}_2$ .

Volume of  $\text{H}_2$  produced =  $415 \text{ cm}^3$   $\therefore$  moles of  $\text{H}_2$  produced =  $\frac{415}{22400}$

From balanced chemical reac<sup>n</sup>

$\therefore \frac{3}{2}$  mole of  $\text{H}_2$  produced by 1 mole of Al

$\therefore 1 \text{ mole of } \text{H}_2 \text{ produced by } \frac{2}{3} \text{ mole of Al}$

$\therefore \frac{415}{22400} \text{ mole of } \text{H}_2 \text{ produced by } \frac{2}{3} \times \frac{415}{22400} \text{ mole of Al} = 0.01235$

$\therefore \text{Wt. of Al} = 0.01235 \times 27 \text{ g} = 0.3335 \text{ g}$

$\therefore \% \text{ of Al} = \frac{0.3335}{0.35} \times 100 = 95.3\% \text{ Ans}$

**Q23.**

**Ans:** Absorption rate of  $\text{CO}_2 = 4.7 \times 10^{-3}$  moles of  $\text{CO}_2$  / hr by 1 gm green algae

Starch -  $(\text{C}_6\text{H}_{10}\text{O}_5)_n$

$\therefore$  For doubling the mass of green algae (1 g), it must form 1 gm of starch.

$\therefore \text{Wt of } (\text{C}_6\text{H}_{10}\text{O}_5)_n = 1 \text{ g}$



moles of in  $\text{CO}_2 = \text{moles of C in } (\text{C}_6\text{H}_{10}\text{O}_5)_n$

moles of  $\text{CO}_2 = 6n \times \text{mole of } (\text{C}_6\text{H}_{10}\text{O}_5)_n = 6n \times \frac{1}{n(162)}$

$\therefore \text{Mole of } \text{CO}_2 \text{ required} = \frac{6}{162}$

Rate of absorption =  $4.7 \times 10^{-3}$  moles/hr

Time(hr) =  $\frac{6/162}{4.7 \times 10^{-3}} = 7.88 \text{ hrs} \text{ Ans}$

**Q24.**



Let x g is the weight of CaO taken, from which Y g of CaO reacts with carbon to produce  $\text{CaC}_2$ ,

$\therefore$  So, Wt. of CaO remained =  $(x-y)$  g

Wt of  $\text{CaC}_2$  produced = mole of  $\text{CaC}_2 \times \text{Mol. wt } \text{CaC}_2$

= mole of CaO reacted  $\times$  M.w.  $\text{CaC}_2 = \frac{y}{56} \times 64 = \frac{8y}{7}$

$\therefore$  Total weight now,  $(x-y) + \frac{8y}{7} = \left(x + \frac{y}{7}\right) \text{ g}$

(Wt of  $\text{CaC}_2$  produced remained + Wt of CaO produced)



A/q, Wt of  $\text{CaC}_2 = 85\%$

$$\Rightarrow \frac{\frac{8y}{7}}{x + \frac{y}{7}} \times 100 = 85 \Rightarrow \frac{8y}{7x + y} = \frac{85}{100} = \frac{17}{20}$$

$$\Rightarrow 160y = 119x + 17y \Rightarrow 143y = 119x$$

$$\Rightarrow y = \frac{119}{143}x = 0.832x$$

(a) Pure wt of  $\text{CaC}_2$ ,  $\frac{8y}{7} = 1000 \text{ kg (given)} \Rightarrow y = \frac{7000}{8} \text{ Kg}$

$$\therefore x \text{ (wt of CaO have to take)} = \frac{y}{0.832} = \frac{7000}{8 \times 0.832} \text{ Kg} = \frac{7000}{6.657} = 1051.5 \text{ Kg}$$

(b)- Crude product =  $(x - y) + \frac{8y}{7} = x + \frac{y}{7} = 1000 \text{ Kg}$

$$x + \frac{0.832x}{7} = 1000 \Rightarrow \frac{7.832x}{7} = 1000 \text{ Kg}$$

$$\Rightarrow x = \frac{7000}{7.832} = 893.7 \text{ Kg} \quad \text{Ans}$$

**Q25.**

**Sol:**  $W(\text{BaO} + \text{CaO}) = 2.5 \text{ g}$

Let  $x \text{ g}$  of  $\text{BaO}$  is present

Then wt of  $\text{CaO} = (2.5 - x) \text{ g}$



$x \text{ g}$

$$\frac{x}{153} \text{ moles} \longrightarrow \frac{x}{153} \text{ moles} = \frac{x}{153} \times 233 = 1.523x$$



$(2.5 - x) \text{ g}$

$$\frac{(2.5 - x)}{56} \text{ moles} \longrightarrow \left( \frac{2.5 - x}{56} \right) \text{ moles} = \frac{(2.5 - x)}{56} \times 136 = (2.5 - x) 2.43 \text{ g}$$

A/q, wt of  $\text{CaSO}_4$  + wt of  $\text{BaSO}_4 = 4.713 \text{ g}$

$$(2.5 - x) 2.43 + 1.523x = 4.713$$

$$6.07 - 2.43x + 1.523x = 4.713$$

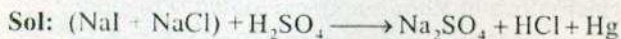
$$1.358 = 0.907x$$

$$x = \frac{1.358}{0.907} = 1.497 \text{ g} = 1.5 \text{ g}$$

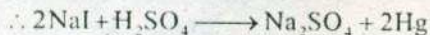
$$\therefore \% \text{ of BaO} = \frac{x}{2.5} \times 100 = \frac{1.5}{2.5} \times 100 = 60\% \quad \text{Ans}$$



Q26.



Let 1 g of  $(\text{NaCl} + \text{NaI})$  is taken, in which  $x$  g of NaI is present &  $(1-x)$  g of NaCl is Present



$$\begin{aligned} \frac{x}{150} \text{ moles} &\longrightarrow \frac{1}{2} \times \frac{x}{150} \text{ moles} \\ &= \frac{1}{2} \times \frac{x}{150} \times 142 = \frac{71x}{150} \text{ g} \end{aligned}$$



$$\begin{aligned} \frac{(1-x)}{58.5} \text{ moles} &\longrightarrow \frac{1}{2} \times \frac{(1-x)}{58.5} \\ &= \frac{1}{2} \times \frac{1-x}{58.5} \times 142 \quad 71 = \frac{71}{58.5} (1-x) \text{ g} \end{aligned}$$

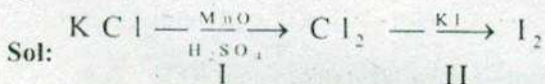
A/q, Wt of  $\text{Na}_2\text{SO}_4$  produced = 1 g

$$\begin{aligned} \frac{71x}{150} + \frac{71(1-x)}{58.5} &= 1 \Rightarrow \frac{58.5x + 150 - 150x}{150 \times 58.5} = \frac{1}{71} \\ 150 - 91.5x &= 123.6 \end{aligned}$$

$$91.5x = 26.4 \Rightarrow x = \frac{26.4}{91.5} = 0.2885$$

$$\therefore \% \text{ of NaI} = \frac{x}{1} \times 100 = \frac{0.2885}{1} \times 100 = 28.85\% \quad \text{Ans}$$

Q27.



7.46 g

By POAC (in reaction I)

mole of Cl in KCl = moles of Cl atom in  $\text{Cl}_2$

mole of KCl =  $2 \times$  moles of  $\text{Cl}_2$

$$\frac{7.46}{74.6} = 2 \times \text{moles of } \text{Cl}_2$$

$$\frac{1}{10} = 2 \times \text{mole of } \text{I}_2 \quad (\text{mole of } \text{Cl}_2 = \text{mole of } \text{I}_2 \text{ from II nd reac}^{\text{on}})$$

$$\text{mole of } \text{I}_2 = \frac{1}{20} \Rightarrow \text{Wt of } \text{I}_2 = \frac{1}{20} \times 258 = 12.7 \text{ g}$$

Ans

Q28.

Sol: Let is consider 100 g of Carnalite

Wt of water = 38.86 g

$$\therefore \text{Wt of } \text{KCl} + \text{MgCl}_2 = (100 - 38.86) \text{ g} = 61.14 \text{ g}$$



Let wt of KCl = x gm

∴ Wt of MgCl<sub>2</sub> = (61.14 - x) g



By POAC

mole of Cl atom before reaction = mole of Cl atom reaction

mole of Cl in KCl + mole of Cl in MgCl<sub>2</sub> = mole of Cl in AgCl

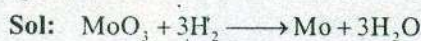
mole of KCl + 2 × mole of MgCl<sub>2</sub> = mole of AgCl

$$\frac{0.458 \times x}{100 \times 74.5} + 2 \times \frac{(61.14 - x)}{100 \times 95} \times 0.458 = \frac{0.71}{143.5}$$

$$\Rightarrow \frac{x}{74.5} + \frac{(61.14 - x)2}{95} = \frac{700}{143.5 \times 0.458} = \frac{700}{65.72}$$

Calculating x = 26.46%      **Ans**

**Q29.**



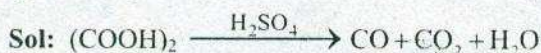
125 g

$\frac{125}{144}$  moles

Moles of H<sub>2</sub> reacts with  $\frac{125}{144}$  moles of MoO<sub>3</sub> =  $3 \times \frac{125}{144}$

∴ Volume of H<sub>2</sub> required =  $\frac{375}{144} \times 22.4 \text{ lit} = 58.33 \text{ lit}$       **Ans**

**Q30.**



10 g =  $\frac{10}{90}$  moles

moles of CO produced =  $\frac{10}{90} = \frac{1}{9} \Rightarrow$  mole CO<sub>2</sub> produced =  $\frac{10}{90} = \frac{1}{9}$

∴ Volume of gases produced at 0°C & 760 mm of Hg (at NTP)

$$\left( \frac{1}{9} + \frac{1}{9} \right) = \frac{2}{9} \times 22.4 \text{ lit} = 4.96 \text{ lit} \quad \text{Ans}$$

**Q31.**

**Sol:**  $\text{W}(\text{CH}_4 + \text{C}_2\text{H}_6 + \text{C}_3\text{H}_8 + \text{N}_2) 100\text{g}$

$\downarrow \qquad \qquad \downarrow \qquad \qquad \downarrow \qquad \qquad \downarrow$   
 % by volume    84%    10%    3%    3%

We know, volume % = mole % (at constant temp. and pressure)

mole % of CH<sub>4</sub> = 84%    &    mole % of C<sub>2</sub>H<sub>6</sub> = 10%

mole % of C<sub>3</sub>H<sub>8</sub> = 3%    &    mole % of N<sub>2</sub> = 3%



By POAC

mole of C before reaction = mole of c after reaction

mole of C ( in  $\text{CH}_4$  + in  $\text{C}_2\text{H}_6$  + in  $\text{C}_3\text{H}_8$  ) = mole of C in  $\text{C}_4\text{H}_6$

mole of  $\text{CH}_4$  + 2 mole of  $\text{C}_2\text{H}_6$  + 3 × mole of  $\text{C}_3\text{H}_8$  = 4 × mole of  $\text{C}_4\text{H}_6$

$$84 + 2 \times 10 + 3 \times 3 = 4 \times \text{mole of } \text{C}_4\text{H}_6$$

$$84 + 20 + 9 = 4 \times \text{mole of } \text{C}_4\text{H}_6$$

$$\text{mole of } \text{C}_4\text{H}_6 = \frac{213}{4} = 28.25 \text{ moles}$$

mole of ( $\text{CH}_4 + \text{C}_2\text{H}_6 + \text{C}_3\text{H}_8 + \text{N}_2$ ) taken (in 100 g of mixture)

$$= \frac{\text{wt}}{\text{Mol.wt}} = \frac{100}{\frac{84 \times 16 + 10 \times 30 + 3 \times 44 + 3 \times 28}{100}} = \frac{10000}{1860} = 5.367$$

∴ 100 moles of mixture produces 28.25 moles

$$\therefore 1 \text{ ————— } \frac{28.25}{100}$$

$$\therefore 5.376 \text{ ————— } \frac{5.376 \times 28.25}{100}$$

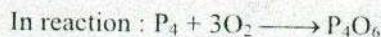
∴ Wt of  $\text{C}_4\text{H}_6$  produced = mole × Mol. Wt =  $1.518 \times 54 = 82 \text{ g}$ . **Ans**

**Q32.**



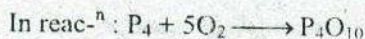
2 g                  2 gm

$$\frac{2}{124} \text{ moles} \quad \frac{2}{32} \text{ moles}$$



moles of  $\text{O}_2$  required to react with  $\frac{1}{62}$  moles of  $\text{P}_4$  Completely

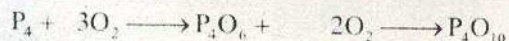
$$= \frac{1}{62} \times 3 = \frac{3}{62} < \frac{1}{16}$$



mole of  $\text{O}_2$  required to react completely with

$$\frac{1}{62} \text{ moles of } \text{P}_4 = \frac{1}{62} \times 5 = \frac{5}{62} > \frac{1}{16}$$

SO,  $\text{P}_4$  will first react with  $\text{O}_2$  to produce  $\text{P}_4\text{O}_6$  & then the remaining  $\text{O}_2$  will react with  $\text{P}_4\text{O}_6$  to produce  $\text{P}_4\text{O}_{10}$

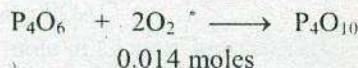


$$\frac{1}{62} \longrightarrow \frac{3}{62} \text{ moles} \quad \frac{1}{62} \text{ mole} \quad \left( \frac{1}{16} - \frac{3}{62} \right)$$



$$\text{Wt of P}_4\text{O}_6 \text{ produced} = \frac{1}{62} \times 220 \text{ g} = 3.55 \text{ g}$$

$$\text{moles of O}_2 \text{ (remaining)} = \frac{1}{16} - \frac{3}{62} = \frac{62-48}{62 \times 16} = 0.014133$$



$$\therefore \text{moles of P}_4\text{O}_6 \text{ (reacted)} = \frac{0.014}{2} = 0.00706$$

$$\therefore \text{moles of P}_4\text{O}_6 \text{ (remained)} = \frac{1}{62} - 0.00706 = 0.00907$$

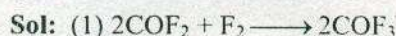
$$\text{moles of P}_4\text{O}_{10} \text{ (produced)} = \frac{0.014113}{2} = 0.00706$$

$$\text{Wt of P}_4\text{O}_{10} \text{ (produced)} = 0.00706 \times 284 = 2.004 \text{ g} \quad \text{Ans}$$

$$\text{Wt of P}_4\text{O}_6 \text{ (Produced)} = 0.00906 \times 220 = 1.996 \text{ g} \quad \text{Ans}$$

[Note → Please don't approximate the calculation]

**Q33.**



(1)  $\Rightarrow \{1 \text{ mole of F}_2 \equiv 2 \text{ mole of COF}_3\} \times 2n$

(2)  $\Rightarrow 4n \text{ mole of COF}_3 \equiv 1 \text{ mole of } (\text{CF}_2)_n$

$\therefore 2n \text{ mole of F}_2 \equiv 1 \text{ mole of } (\text{CF}_2)_n$

$1 \times \text{mole of F}_2 = 2n \times \text{mole of } (\text{CF}_2)_n$

$$= 2n \times \frac{1000 \text{ g}}{50n} = 40 \text{ mole}$$

$\therefore \text{Wt of F}_2 \text{ required} = 40 \times 38 \text{ g} = 1529 \text{ g} = 1.52 \text{ Kg} \quad \text{Ans}$

**Q34.**



$$\text{Wt of H}_2\text{O} \text{ (produced)} = \frac{1.8}{18} = 0.1 \text{ moles}$$

(2) Moles of  $\text{KHCO}_3 = 0.1 \times 2 = 0.2$

Wt of  $\text{KHCO}_3 = 0.2 \times 100 = 20 \text{ g} \quad \text{Ans}$

$$\text{Also mole O}_2 \text{ produced} = \frac{4}{32} = \frac{1}{8}$$

(1) 2 moles of  $\text{KClO}_3 \equiv 3 \text{ moles of O}_2$

$3 \times \text{moles of KClO}_3 = 2 \times \text{moles of O}_2$

$$\text{Moles of KClO}_3 = \frac{2}{3} \times \frac{1}{8} = \frac{1}{12} \text{ mole}$$



$$\therefore \text{Wt of KClO}_3 = \frac{1}{12} \times (39 + 35.5 + 3 \times 16) = \frac{1}{12} \times 122.5 = 10.2 \text{ g}$$

Ans

$$\text{Also moles of CO}_2 \text{ produced} = \frac{13.2}{44}$$

(2) & (3)

$$\text{Moles of CO}_2 \text{ produced} = \text{Mole of KHCO}_3 + \text{Mole of K}_2\text{CO}_3$$

$$\frac{13.2}{44} = 0.2 + \text{mole of K}_2\text{CO}_3$$

$$\text{Mole of K}_2\text{CO}_3 = \frac{13.2}{44} - 0.2 = 0.3 - 0.2 = 0.1 \text{ moles}$$

$$\therefore \text{Wt of K}_2\text{CO}_3 = 0.1 \times 138 = 13.8 \text{ g.} \quad \text{Ans}$$

### Objection Problems

Q1. Ans:(c) Stoichiometry tells about moles or volume for gases not directly about mass.

Q2. Ans:(d)

$$\text{Q3. Ans:(b) Volume of O}_2 \text{ produced per volume of H}_2\text{O}_2 = \frac{50}{5} = 10$$

$$\text{Q4. Ans:(c) mole of Ag}_2\text{CO}_3 = \frac{2.76}{276} = 0.01$$



$$\text{CO}_2 (0.01 \text{ moles} \rightarrow 0.01 \times 44 = 0.44 \text{ g})$$

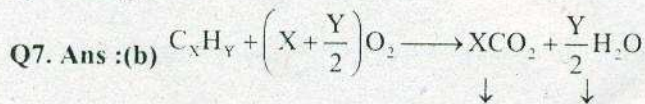
$$\text{Q5. Ans:(c) Wt of C}_8\text{H}_{18} = 800/\text{g} \times 1.425/\text{g} = 1140 \text{ g}$$

$$\text{mole of C}_8\text{H}_{18} = \frac{1140}{114} = 10$$



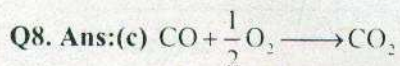
$$\therefore \text{Moles of O}_2 \text{ (required)} 10 \times 12.5 = 125 \text{ mole}$$

Q6. Ans:(b)



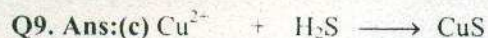
$$10 \text{ ml} \longrightarrow 40 \text{ ml} \quad 50 \text{ ml}$$

$$x = 4, \frac{y}{2} = 5, y = 10 \quad \therefore \text{C}_4\text{H}_{10}$$



$$4 \text{ lit} \rightarrow 2 \text{ lit (required)}$$



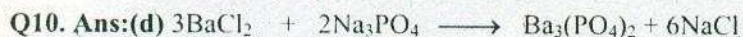


$$63.5 \text{ g}$$

$$\frac{63.5}{63.5} = 1 \text{ mole}$$

mole of  $\text{H}_2\text{S}$  required = 1 moles

$$\therefore \text{Wt} = 1 \times 34 \text{ g} = 34 \text{ g}$$



$$0.5 \text{ moles} \quad 0.2 \text{ moles}$$

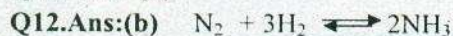
3 mole of  $\text{BaCl}_2 \equiv 2 \text{ moles of } \text{Na}_3\text{PO}_4 \Rightarrow 2 \times \text{mole of } \text{BaCl}_2 = 3 \times \text{moles of } \text{Na}_3\text{PO}_4$

$$\text{mole of } \text{Na}_3\text{PO}_4 = \frac{2}{3} \times 0.5 = \frac{1}{3} > 0.2$$

$\therefore \text{Na}_3\text{PO}_4$  is the limiting reagent

$$\therefore \text{moles of } \text{Ba}_3(\text{PO}_4)_2 = \frac{0.2}{2} = 0.1 \text{ moles}$$

**Q11. Ans: (b)**



Initially moles    A        B                    0

At eq-<sup>b</sup>    A-x        B-x                    2x

$$2x=2 \Rightarrow x=1$$

$$A-x=2 \Rightarrow A-1=2 \Rightarrow A=3$$

$$B-3x=2, \Rightarrow B-3=2, \Rightarrow B=5$$

$$C_v = \frac{R \left( \frac{8}{2} + 3 \right)}{3} = \frac{7}{3} R$$

$$\frac{R}{Y-1} = \frac{7}{3} R \Rightarrow Y-1 = \frac{3}{7} \Rightarrow Y = \frac{3}{7} + 1 = \frac{10}{7} = 1.428$$