

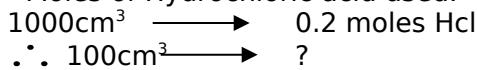
MOLE CONCEPT

MARKING SCHEME

1. a) Moles of Zinc used

$$\text{Moles} = \frac{\text{Mass given}}{\text{Molar mass}} = \frac{1.96\text{g}}{65.4} = 0.0299 \text{ moles of Zn used } \checkmark_{1/2}$$

- Moles of Hydrochloric acid used.



$$\frac{100 \times 0.2}{1000\text{cm}^3} = 0.02 \text{ moles of HCl acid used.}$$

- Thus Zinc metal was in excess $\checkmark 1$

- b) If 65.4g of Zinc metal $\checkmark_{1/2} \longrightarrow 22.4 \text{ litres at S.T.P}$

$$\therefore 1.96\text{g of Zinc metal} \longrightarrow ?$$

$$= \frac{1.96\text{g} \times 22.4 \text{ litres}}{65.4\text{g}}$$

$$0.6713 \text{ litres of H}_2 \text{ gas } \checkmark_{1/2}$$

or

$$671.3\text{cm}^3 \text{ of H}_2 \text{ gas}$$

2. For Hydrogen, H₂, molar mass = 2g

$$2\text{g} \longrightarrow 1\text{mole}$$

$$\therefore 10\text{g} \longrightarrow ?$$

$$\frac{10\text{g} \times 1\text{mole}}{2\text{g}} = 5 \text{ moles of H}_2 \text{ gas}$$

For Nitrogen (IV) oxide gas, NO₂

$$\text{Molar mass} = 14 + 32 = 46\text{g}$$

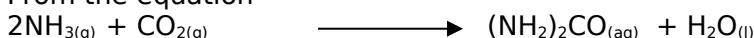
$$1 \text{ mole of NO}_2 \longrightarrow 46\text{g } \checkmark_{1/2}$$

$$\therefore 5 \text{ moles of NO}_2 \longrightarrow ? \quad \checkmark_{1/2}$$

$$= \frac{5 \text{ moles} \times 46\text{g}}{1\text{mole}}$$

= 230g of NO₂ gas will occupy the same volume of 10g of H₂ gas

3. From the equation

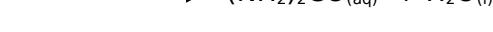


Where;

$$2 \text{ moles of NH}_3$$

$$2(14 + 3)$$

$$2(17)$$



$$(2 \times 14) + (4 \times 1) + (1 \times 12) + (1 \times 16)$$

$$28 + 4 + 12 + 16$$

$$\begin{array}{l} 34g \checkmark^{1/2} \\ \text{Hence; } 34g \text{ of } \text{NH}_3 \longrightarrow 60g \\ \therefore 340000g \text{ of } \text{NH}_3 \longrightarrow 1 \text{ mole of urea} \\ \quad \quad \quad \quad \quad \quad \quad \quad ? \\ \quad \quad \quad \quad \quad \quad \quad \quad 10000 \\ \underline{\frac{340000g \times 1 \text{ mole}}{34g}} \checkmark^{1/2} \\ = 10,000 \text{ moles of urea} \checkmark^{1/2} \end{array}$$

4. RFM of NaOH = 40
Moles of NaOH = $\frac{8}{40} = 0.2\text{m} \checkmark^{1/2}\text{mk}$
Moles of NaOH in 25cm³
$$\frac{25 \times 0.2}{1000} = 0.005 \checkmark^{1/2}$$

Mole ratio 1: 2

$$\text{Moles of acid} = \frac{0.005}{2} \checkmark^{1/2}$$

$$\begin{array}{rcl} 1m & \frac{1 \times 0.245}{0.0025} & \checkmark 1 \\ & = 98 & \checkmark^{1/2} \end{array}$$

5. $\text{CH}_{4(g)} : \text{O}_{2(g)} : \text{CO}_{2(g)}$
12.0 cm³ : 24cm³ : 36cm³ (1mk)
1cm³ : 2cm³ : 3cm³
1vol : 2vol : 3vol which is a small (simple) whole number ratio according to Gay Lussac's law of combining volumes. (1mk)

6. $500\text{cm}^3 \geq 4.9 \text{ g}$

$$1000\text{cm}^3 \geq \frac{1000}{500} \times 4.9\text{g} = 9.8\text{g} \quad (1\text{mk})$$

if 0.3 molar w.r.t $\text{H}_{(aq)}^+$ then $\frac{0.3}{3}$ molar w.r.t acid since it is a tribasic acid

$$0.1\text{mols} = 9.8g$$

$$1\text{mol} \equiv \frac{1}{0.1} \times 9.8 = 98g \quad (1\text{mk})$$

$$\text{RMM of acid} = 98 \quad (\frac{1}{2}\text{mk})$$

7.

$$24\text{dm}^3 = \frac{24}{1} \times 2.667g = 64.008g$$

(1mark)

$$\text{Rmm of gas} x = 64.008 \text{ (no unuts)} \quad (1\text{mark})$$

8. Mass per litre of NaOH = $7.5 \text{ g} \times 1000 = 30\text{gdm}^{-3}$

Molarity of NaOH = $30/40 = 0.75 \text{ M} (\frac{1}{2})$

Moles of NaOH reacted = $0.02 \times 0.75 = 0.015 \text{ moles}$

Moles of HCl used = $0.013 \times 1 = 0.013 \text{ moles } \frac{1}{2}$

Moles of NaOH that should have been used = 0.013 moles

Mass of NaOH reacted = $0.015 \times 40 = 0.06g (\frac{1}{2})$

Mass of NaOH required = $0.013 \times 40 = 0.52g (\frac{1}{2})$

% purity of NaOH = $\frac{0.56}{0.52} \times 100 = 11.54\%$

9. a)

	N	O
Mass %	30.4	69.6
No of moles	$\frac{3.04}{14} = 2.17$	$\frac{69.6}{16} = 4.35$
Mole ration	$\frac{2.17}{2.17} = 1$	$\frac{4.35}{2.17} = 2$

$\frac{1}{2}$

E.F of compound is NO_2 $\frac{1}{2}$

If 22.4 dm^3 of gas = 1 mole

Then 1 dm^3 of gas = $1/22.4 = 0.044$ moles

If 0.044 moles of the gas = 4.11g

Then 1 mol of the gas = $1/0.044 \times 4.11\text{g} = \underline{\underline{92.064\text{g}}}$

OR

If 1 dm^3 of gas = 4.11g

Then 22.4 dm^3 of gas = $22.4 \times 4.11\text{g}$
 $= 92.064\text{g} (\frac{1}{2})$

E.F.M of $\text{NO}_2 = 14 + 32 = 46$

$$N = M.F. M = \frac{\underline{\underline{92}}}{46} = 2$$



$$\text{Moles of Na}_2\text{CO}_3 \text{ reacting} = \frac{1}{2} \times \frac{20 \times 0.5}{1000} = 0.005 \text{ moles } \frac{1}{2}$$

$$\text{Moles of Na}_2\text{CO}_3 \text{ in } 100\text{cm}^3 = \frac{0.005 \times 100}{25} = 0.02 \text{ moles } \frac{1}{2}$$

$$\text{Mass of Na}_2\text{CO}_3 \text{ in the mixture} = 0.02 \times 10.6 \\ = 2.12\text{g. } \frac{1}{2}$$

11. RFM of Na_2SO_3 is 126 ✓ $\frac{1}{2}$

$$\text{Number of moles of Na}_2\text{SO}_3 = \frac{\underline{\underline{25.2}}}{126} = 0.2 \checkmark \frac{1}{2}$$

$$\text{Number of moles of HCl} = \frac{700 \times 0.5}{1000} = 0.35 \checkmark \frac{1}{2}$$

Reacting ratio is 1:2 ∴ 0.2 moles of Na_2SO_3 require 0.4 mole of HCl
∴ Reagent in excess is Na_2SO_3

12. i) Concentration

$$\text{g/l} = \frac{9.42}{600} \times 1000 \\ = 15.7 \text{ g/l} \checkmark 1$$

Molarity

$$\frac{21.5 \times 0.207}{25} \\ = 0.17802 \text{ M} \checkmark 1$$

RFM

$$\frac{15.7}{0.17802} \\ = 88.192 \approx 88 \checkmark 1$$

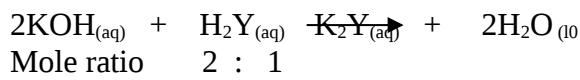
ii) RCOOH = 88

$$R + 12 + 32 + 1 = 88$$

$$R = 88 - 45$$

$$R = 43 \checkmark 1$$

13. a) Equation for the reaction



$$\text{Moles of KOH} = \frac{25}{1000} \times 0.12 \checkmark \frac{1}{2}$$
$$= 0.003 \text{ moles}$$

$$\therefore \text{Moles of acid (H}_2\text{Y}) = \frac{1}{2} \times 0.003$$
$$= 0.0015 \text{ moles} \checkmark \frac{1}{2}$$

If 30cm³ contains 0.0015 moles

$$100\text{cm}^3 \text{ contains} = \frac{1000}{30} \times 0.0015 \checkmark \frac{1}{2}$$
$$= 0.05 \text{ moles/l (0.05M)}$$

b) Molarity = $\frac{\text{mass / l}}{\text{R.F.M}}$

If 500cm³ contains 3.15g

$$1000\text{cm}^3 \text{ contains} = \frac{1000}{500} \times 3.15 \checkmark \frac{1}{2}$$
$$= 6.30 \text{ g/l}$$

$$0.05 = \frac{6.30}{\text{R.F.M}}$$

$$\therefore \text{R.F.M} = \frac{6.30}{0.05} \checkmark \frac{1}{2}$$

$$\text{R.F.M} = 126 \checkmark \frac{1}{2}$$

14.(a) (i) RMM ZnSO₄ = 65+32+64 = 161 $\checkmark 1$

$$\text{moles of Zn} = \frac{65}{165} = 0.4037 \text{ moles} \checkmark 1$$

(ii) Mass of water = 3.715 - 2.08

$$= 1.635 \text{ g} \checkmark 1$$

$$\text{RMM H}_2\text{O} = 2 + 16 = 18$$

$$\text{Moles of water} = \frac{1.635}{18} = 0.09083 \text{ moles.}$$

(iii)	ZnSO ₄	H ₂ O
	mass: <u>2.08</u>	0.09083 $\text{g}^{-\frac{1}{2}}$
	161	
	0.01291	
	mole ratio : $\frac{0.01291}{0.1291}$	$\frac{0.09083}{0.01291} \text{ g}^{-\frac{1}{2}}$
	1	7.035 $\text{g}^{-\frac{1}{2}}$
	1	7
		R = 7 $\text{g}^{-\frac{1}{2}}$

$$(b) (i) \text{RMM ZnSO}_4 \cdot 7\text{H}_2\text{O} = 161 + 7 \times 18 = 287 \text{ g}^{-\frac{1}{2}}$$

$$\begin{aligned} 287 \text{ g ZnSO}_4 \cdot 7\text{H}_2\text{O} &= 65 \text{ g} \\ &= 0.015 \text{ g} \\ \frac{287 \times 0.015}{65} &= 0.06623 \text{ g} \end{aligned}$$

$$(ii) \text{Moles of ZnSO}_4 \cdot 7\text{H}_2\text{O} = \frac{0.06623}{287}$$

$$= 0.0002308 \text{ moles}$$

$$5\text{cm}^3 = 0.0002308 \text{ moles}$$

$$1000\text{cm}^3 = ?$$

$$\begin{aligned} \frac{1000\text{cm}^3 \times 0.0002308 \text{ moles}}{5\text{cm}^3} &= 0.04616 \text{ M} \end{aligned}$$

