MOLE CONCEPT

MARKING SCHEME

1. a) Moles of Zinc used

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

- Moles of Hydrochloric acid used.

$1000cm^3 \longrightarrow$ 0.2 moles Hcl

$\therefore$ $100cm^3 \longrightarrow$?

$$\frac{100\ x\ 0.2}{1000cm^3} \sqrt{½} = 0.02\ moles\ of\ Hcl\ acid\ used. \sqrt{½}$$

- Thus Zinc metal was in excess ✓ 1

b) If 65.4g of Zinc metal ✓ ½ $\longrightarrow$ 22.4 litres at S.T.P

$\therefore$ 1.96g of Zinc metal $\longrightarrow$?

$$= \frac{1.96g\ x\ 22.4litres}{65.4g} \sqrt{½}$$

$$0.6713\ litres\ of\ H_2\ gas\ \checkmark {}^{1}/_{2}$$

$$or$$

$$671.3cm^3\ of\ H_2\ gas$$

2. For Hydrogen, H_2, molar mass= 2g

2g $\longrightarrow$ 1mole ½

$\therefore$ 10g $\longrightarrow$?

$$\frac{10g\ x\ 1mole}{2g} = 5\ moles\ of\ H_2\ gas\ ½$$

For Nitrogen (IV) oxide gas, NO_2

Molar mass = 14 + 32 = 46g

1 mole of NO_2 $\longrightarrow$ 46g ✓ ½

$\therefore$ 5 moles of NO_2 $\longrightarrow$? √ ½

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

= 230g of NO_2 gas will occupy the same volume of 10g of H_2 gas

3. From the equation

$2NH_{3(g)} + CO_{2(g)} \longrightarrow (NH_2)_2CO_{(aq)} + H_2O_{(l)}$

Where;

2 moles of NH_3 $\longrightarrow$ 1mole of urea

2(14 + 3) (2 x 14) + (4 x 1) + (1 x 12) + (1 x 16)

2(17) 28 + 4 + 12 + 16

34g ✓ ½ $\longrightarrow$ 60g

Hence; 34g of NH_3 $\longrightarrow$ 1 mole of urea

∴ 340000g of NH_3 $\longrightarrow$?

$$\frac{\overset{10000}{\cancel{340000}}g\ x\ 1mole}{\cancel{34g}}$$ ✓ 1

= 10,000 moles of urea ✓½

4. RFM of NaOH = 40

Moles of NaOH = $^8/_{40}$ = 0.2m ✓ ½mk

Moles of NaoH in 25cm^3

$$\frac{25x0.2}{1000} = 0.005$$ ✓ ½

Mole ratio 1: 2

Moles of acid = $\frac{0.005}{2}$ ✓ ½

0.0025

$1m = \frac{1x0.245}{0.0025}$ ✓ 1

$= 98$ ✓ ½

5.

$CH_{4(g)}$	:	$O_{2(g)}$	:	$CO_{2(g)}$	
12.0 cm^3	:	24cm^3	:	36cm^3	(1mk)
1cm^3	:	2cm^3	:	3cm^3	
1vol	:	2vol	:	3vol	which is a small (simple) whole number

ratio according to Gay Lussac's law of combining volumes. (1mk)

6. 500cm^3 ≥ 4.9 g

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

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

$0.1 mols = 9.8g$

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

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

7.

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

(1mark)

$Rmm\ of\ gas\ x = 64.008\ (no\ unuts)$ (1mark)

8. Mass per litre of NaOH = 7.5 g x 1000 = 30gdm^3

Molarity of NaOH = 30/40 = 0.75 m (½)

Moles of NaOH reacted = 0.02 x 0.75 = 0.0015 moles
Moles of HCl used = 0.013 x 1 = 0.013 moles ½
Moles of NaOH that should have been used = 0.013 moles
Mass of NaOH reacted = 0.0015 x 40 = 0.06g (½)
Mass of NaOH required = 0.013 x 40 % = 0.52g (½)
% purity of NaOH = 0.56/0.52 x 100 % = 11.54 %

9. a)

	N	**O**
Mass %	**30.4**	**69.6**
No of moles	**3.04/14 = 2.17**	**69.6/16 = 4.35**
Mole ration	**2.17/2.17 = 1**	**4.35/2.17 = 2**

½

E.F of compound is NO_2 **½**

If $22.4dm^3$ 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 x 4.11g = **92.064g**

OR

If 1 dm^3 of gas = 4.11g

Then $22.4dm^3$ of gas = 22.4 x 4.11g
= 92.064g (½)

E.F.M of No_2 = 14 + 32 = 46

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

10. $2HCl_{(aq)} + Na_2CO_{3(aq)} \rightarrow 2NaCl_{(aq)} + H_2O_{(l)} + CO_{2(g)}$ 1

Moles of $Na_2\ CO_3$ reacting = $\frac{1}{2} \times \frac{20 \times 0.5}{1000} = 0.005\ moles$ ½

Moles of $Na_2\ CO_3$ in $100cm^3$ = $\frac{0.005 \times 100}{25}$ ½ = 0.02 moles ½

Mass of Na_2CO_3 in the mixture = 0.02x 10.6
= 2.12g. ½

11. RFM of Na_2SO_3 is 126 ✓ ½

Number of moles of Na_2SO_3 = $\frac{25.2}{126}$ = 0.2✓ ½

Number of moles of HCl = $\frac{700 \times 0.5}{1000}$ = 0.35✓ ½

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	Molarity	RFM
g/l = $\frac{9.42}{600} \times 1000$	$\frac{21.5 \times 0.207}{25}$	$\frac{15.7}{0.17802}$
= 15.7 g/l✓1	= 0.17802M✓1	= 88.192 ≈88✓1

ii) RCOOH = 88
R + 12 + 32 + 1 = 88
R = 88 – 45
R = 43✓1

13. a) Equation for the reaction

$2KOH_{(aq)} + H_2Y_{(aq)} \rightarrow K_2Y_{(aq)} + 2H_2O_{(l0}$

Mole ratio 2 : 1

Moles of KOH = $\frac{25}{1000} \times 0.12$ ✓½

= 0.003 moles

∴ Moles of acid (H_2Y) = ½ x 0.003

= 0.0015 moles✓½

If 30cm^3 contains 0.0015 moles

100cm^3 contains = $\frac{1000}{30} \times 0.0015$ ✓½

= 0.05 moles/l (0.05M)

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

If 500cm^3 contains 3.15g

1000cm^3 contains $\frac{1000}{500} \times 3.15$ ✓½

= 6.30g/l

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

∴ R.F.M = $\frac{6.30}{0.05}$ ✓½

R.F.M = 126✓½

14.(a) (i) RMM ZnSO4 = 65+32+64 = 161✓1

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

(ii) Mass of water = 3.715 -2.08

= 1.635g✓1

RMM H_2O = 2 + 16 = 18

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

(iii) $ZnSO_4$ H_2O

mass: $\frac{2.08}{161}$ 0.09083 ½

0.01291

mole ratio : $\frac{0.01291}{0.1291}$ $\frac{0.09083}{0.01291}$ ½

1 7.035 ½

1 7

R = 7 ½

(b) (i) RMM $ZnSO_4.7H_2O$ = 161 + 7 x 18 = 287g ½

287g ZnSO4.7H2O = 65g

= 0.015g

$$\frac{287\ x\ 0.015}{65} = 0.06623g$$

(ii) $Moles\ of\ ZnSO_4.7H_2O = \frac{0.06623}{287}$

= 0.0002308 moles

5cm3 = 0.0002308moles

1000cm3 =?

$$\frac{1000cm^3 \times 0.0002308\ moles}{5cm^3}$$

$$= 0.04616\ M$$