**032/2A CHEMISTRY**

**MARKING SCHEME**

1. Pipette used 25.00 $cm^3$ ***(01mark)***

**Table of results (04 marks)**

| **Experiment** | **Pilot** | **1** | **2** | **3** |
|---|---|---|---|---|
| **Final readings ($cm^3$)** | 20.10 | 40.00 | 20.00 | 40.00 |
| **Initial reading ($cm^3$)** | 0.00 | 20.00 | 0.00 | 20.00 |
| **Volume used ($cm^3$)** | 22.10 | 20.00 | 20.00 | 20.00 |

**a).** Average volume (volume of acid) = $\frac{v1+v2+v3}{3}$ ***(1/2 mark )***

Average volume = $\frac{20.10+20.00+20.00}{3}$ ***(1/2 mark)***

$= \frac{60.00}{3}$ ***(1/2 mark )***

**Average volume (volume of acid) = 20.00 $cm^3$** ***(1/2 mark)***

**b). 20.00 $cm^3$ of** T required **25.00 $cm^3$** B for complete reaction ***(01mark@1/2 mark)***

**c).** $2HCl\,(aq) + Na_2CO_3\,(aq) \rightarrow 2\,NaCl\,(aq) + H_2O(l) + CO_2\,(g)$ ***(01mark)***

**d).** Ionic equation:

$2HCl\,(aq) + Na_2CO_3\,(aq) \rightarrow 2NaCl\,(aq) + H_2O(l) + CO_2\,(g)$

$2H^+(aq) + 2Cl^-(aq) + 2Na+(aq) + CO_3^{2-}\,(aq) \rightarrow 2Na^+(aq) + 2Cl^-(aq) + H_2O(l) + CO_2(g)$

$2H^+(aq) + \cancel{2Cl\,(aq)} + \cancel{2Na+(aq)} + CO_3^{2-}\,(aq) \rightarrow \cancel{2Na^+(aq)} + 2Cl^-(aq) + H_2O(l) + CO_2(g)$

**$2H^+(aq) + CO_3^{2-}\,(aq) \rightarrow H_2O(l) + CO_2(g)$** ***(02marks@1/2 mark )***

**e).** Concentration of T in mole per litre.

Mr of HCl = (1x1) + ( 1x 35.5)

**= <u>36.5g/mol</u>** ***(01marks)***

Molarity = $\frac{\text{concentration}}{\text{molar mass}}$ ***(1/2mark)***

Concentration of T = 3.65g/$dm^3$

Molarity = $\frac{3.65\ g/dm3}{36.5g/mol}$

= 0.1M

**<u>Concentration of T in mol/$dm^3$ is 0.1M</u>** ***(02marks)***

**f). (i).** Concentration of B in mol/$dm^3$

**Data:**

Volume of acid (Va) = 20.00 $cm^3$

Volume of base (Vb) = 25.00 $cm^3$

Molarity of T acid (Ma) = 0.1M ***(1/2 mark)***

Number of moles of acid ($n_a$) = 1mol

Number of moles of base ($n_b$) = 2mol

**Formula:**

$\frac{MaVa}{MbVb} = \frac{Na}{Nb}$ ***(1/2 mark)***

**Calculations:**

$\frac{0.1M \times 20.00cm3}{Mb \times 25.00\ cm3} = \frac{2}{1}$

Mb = 0.04M

**<u>Concentration of B in mol/litre= 0.04M</u>** ***(02marks)***

ii. Concentration of B in g/$dm^3$

Formula:

Molarity = $\frac{\text{concentration}}{\text{molar mass}}$ ***(1/2mark)***

Molar mass of $Na_2CO_3$= (2x23) + (1x12) + (3x16)

**=<u>106g/mol</u>**

Concentration of pure (g/$dm^3$)= Molarity (M) x Molar mass (g/mol)

= 0.04mol/$dm^3$ x 106g/mol **(001/2 mark)**

**Concentration of pure $Na_2CO_3$ (g/dm$^3$ ) = 4.24g/dm$^3$** ***(01 1/2mark)***

**g).** The percentage purity of $Na_2CO_3$

Concentration of pure $Na_2CO_3$ $\frac{\text{mass(g)}}{volume\ (dm3)}$

**250cm$^3$= 250/1000=0.25dm$^3$**

Concentration of impure $Na_2CO_3$ $\frac{1.2\text{g}}{0.25(dm3)}$

**= 4.8g/dm$^3$** ***(02marks)***

Percentage purity= $\frac{\text{concentration of pure}(\frac{\text{g}}{\text{dm3}})}{Concentration\ of\ impure\ (\frac{g}{dm3})}$ $x$ 100% **(*1/2 mark)***

Percentage purity = $\frac{4.24\text{g/dm3}}{4.80g/dm3}$ $X$ 100%

**The percentage purity = 88.33%** **(*02mark)***

2. SOLUTION

(a) Table of results **(*05mark)***

| Number of experiment | Volume of D (cm$^3$) | Volume of distilled $H_2O$ (cm$^3$) | Concentration of $Na_2S_2O_3$ (mol/dm$^3$) | Time (t) in second | Rate of reaction($S^{-1}$) |
|---|---|---|---|---|---|
| 1 | 50 | 50 | 0.13 | 10.22 | 0.10 |
| 2 | 40 | 50 | 0.10 | 13.63 | 0.07 |
| 3 | 30 | 50 | 0.08 | 17.22 | 0.06 |
| 4 | 20 | 50 | 0.05 | 25.34 | 0.04 |
| 5 | 10 | 50 | 0.03 | 55.50 | 0.02 |

Molarity = $\frac{\text{Concentration g/dm}^3}{\text{Molar mass}}$

Molarity = $\frac{20.54\text{g/dm}^3}{158.11\text{g/mol}}$

Molarity = 0.13mol/$dm^3$ ***(1/2 mark)***

Experiment 1

0.13 x 50 = 6.5

6.5 ÷ 50 = 0.13M ***(1/2 mark)***

Experiment 2

0.13 x 40 = 5.2

5.2 ÷ 50 = 0.10M ***(1/2 mark)***

Experiment 3

0.13 x 30 = 3.9

3.9 ÷ 50 = 0.08M ***(1/2 mark)***

Experiment 4

0.13 x 20 = 2.6

2.6 ÷ 50 = 0.05M ***(1/2 mark)***

Experiment 5

0.13 x 10 = 1.3

1.3 ÷ 50 = 0.03M ***(1/2 mark)***

(b) $Na_2S_2O_{3(aq} + 2HCl_{(aq)} \rightarrow 2NaCl_{(aq)} + H_2O_{(L)} + SO_{2(g)} + S_{(s)}$ ***(02mark)***

(c) Substance that was produced during the reaction which obscured the mark X was Sulphur (S) ( sulphur precipitates) ***(01mark)***

(d) Conclusion: As concentration of sodium thiosulphate decreases the time taken for disappearance of letter X increases. ***(02mark)***

(e) The smell is irritating chocking smell produced due to production of Sulphur dioxide ($SO_2$) ***(02mark)***

(f) Increase in concentration of sodium thiosulphate increases the rate of chemical reaction so concentration is directly proportional to the rate of chemical reaction.(Decrease in concentration of sodium thiosulpate decrease the rate of chemical reaction) ***(04mark)***

(g) The graph of time (y-axis) against Concentration of $Na_2S_2O_3$ (x- axis) (06 mark)

- Heading= 01 mark
- Scale= 01 mark
- Labelling=01mark

  (horizontal vertical axis)
- Graph= 03 mark

# THE GRAPH OF TIME AGAINST CONCENTRATION OF SODIUM THIOSULPHATE.

SCALE

Hs 1cm ≡ 0.02 Mol/dm³

Vs 1cm ≡ 5 seconds