**CHRISTIAN SOCIAL SERVICES COMMISSION**
An Ecumenical Body of Tanzania Episcopal Conference and Christian Council of Tanzania
**P.O. Box 9433, Dar es Salaam, Tanzania**
CSSC-SOUTHERN ZONE FORM FOUR JOINT EXAMINATION

**032/2B CHEMISTRY 2B (MARKING GUIDE)**
**Time 2:30 hours** **AUGUST 2024.**

**1.** If **25cm$^3$** pipette used, the table of results is:

| **Burette reading** | **Pilot** | **1** | **2** | **3** |
|---|---|---|---|---|
| Final reading (cm$^3$) | 25.40 | 25.20 | 24.90 | 24.90 |
| Initial reading (cm$^3$) | 0.00 | 0.00 | 0.00 | 0.00 |
| Titre volume used (cm$^3$) | 25.40 | 25.20 | 24.90 | 24.90 |

**FT = 01 Mark, DP = 01 Mark and Ac = 02 Marks**

(a) (i) The mean titre volume $= \frac{T1+T2+T3}{3}$ **(0.5mark)**

$= \frac{25.20+24.90+24.90}{3}$ **(0.5mark)**

$=25cm^3$

The average volume of acid used is **25cm$^3$**. **(01mark)**

(ii) **25cm$^3$** of solution **BB** required **25cm$^3$** of solution **CC** for complete neutralization. **(01mark)**

(iii) The colour change at the end point was from **Orange/ Yellow** to **Pink**. **(01 mark)**

(b) (i) It can be used because the reaction involves strong acid and strong base in which any of the two indicators (POP or MO) can be suitable. **(01 mark)**

(ii) It might lead to errors in the volume of acid used because the air space will be filled with acid first before dropping on the metal carbonate solution which in turn reduces a few volume of acid from the reading in the burette. **(01 mark)**

(c) $H_2SO_4$ (aq) + 2NaOH (aq) $\longrightarrow$ $Na_2SO_4$ (aq) + $2H_2O$ (l). **(01 mark)**

Data given

Mass of impure $H_2SO_4$ solution = 3.5g

Volume of $H_2SO_4$ solution = $500cm^3$ ($0.5dm^3$)

Mass of NaOH solution = 4g

Volume of NaOH solution = $1000cm^3$ ($1dm^3$)

Volume of acid, Va = $25cm^3$

Volume of base, Vb = $25cm^3$ **(01mark)**

Number of moles of acid, na = 1mol

Number of moles of base, nb = 2mol

Required to find the percentage purity of $H_2SO_4$ =?

From,

Concentration = $\frac{\text{mass}}{\text{volume}}$ **(0.5 mark)**

$= \frac{4g}{1dm3}$ **(0.5 mark)**

$= 4\ g/dm^3$

The concentration of base (NaOH) is **$4g/dm^3$** **(01 mark)**

Again from,

Molarity = $\frac{\text{concentration}}{\text{molar mass}}$ **(0.5 mark)**

$= \frac{4g/dm3}{40g/mol}$ **(0.5 mark)**

$= 0.1mol/dm^3$

The molarity of base (NaOH) is **$0.1mol/dm^3$**. **(01 mark)**

Then from,

$\frac{MaVa}{MbVb} = \frac{na}{nb}$ **(0.5 mark)**

$Ma = \frac{MbVbna}{Vanb}$ **(0.5 mark)**

$= \frac{0.1M \times 25cm3 \times 1mol}{25cm3 \times 2mol}$ **(0.5 mark)**

= 0.05M

The molarity of pure acid ($H_2SO_4$) is **0.05mol/dm$^3$**. **(01 mark)**

Again from,

Molarity = $\frac{\text{concentration}}{\text{molar mass}}$ **(0.5 mark)**

Concentration = Molarity x Molar mass **(0.5 mark)**

= 0.05mol/dm$^3$ x 98g/mol **(0.5 marks)**

= 4.9g/dm$^3$

The concentration of pure acid ($H_2SO_4$) is **4.9g/dm$^3$**. **(01 mark)**

Again from,

Concentration = $\frac{\text{mass}}{\text{volume}}$ **(0.5 mark)**

= $\frac{3.5g}{0.5dm3}$ **(0.5 mark)**

= 7g/dm$^3$

The concentration of impure acid ($H_2SO_4$) is **7g/dm$^3$** **(01 mark)**

Then from,

Percentage purity = $\frac{\text{concentration of pure sample}}{\text{concentration of impure sample}}$ x 100% **(0.5 mark)**

= $\frac{4.9g/dm3}{7g/dm3}$ x 100% **(0.5 mark)**

= 70%

The percentage purity of sulphuric acid ($H_2SO_4$) is **70%**. **(01 mark)**

**2.**

**SOLUTION**

a) The aim of the whole experiment is to show the effect of concentration on the rate of chemical reaction.
02 marks

b) Table of results

Table 1

| Number of experiment | Volume of U($cm^3$) | Volume of V($cm^3$) | Volume of T($cm^3$) | **Time (t) in second** | **1/t($sec^{-1}$)** |
|---|---|---|---|---|---|
| 1 | 8 | 10 | 2 | **21.12** | **0.047** |
| 2 | 6 | 10 | 4 | **28.62** | **0.035** |
| 3 | 4 | 10 | 6 | **44.78** | **0.022** |
| 4 | 2 | 10 | 8 | **102.31** | **0.010** |
| 5 | 1 | 10 | 9 | **295.65** | **0.003** |

10 marks@ each row 2 mark

c)

i. The experiment in which the reaction was fast was experiment number 1 because it has higher concentration and the time taken for disappearance of letter X was the shortest compared to others. 02 marks

ii. The experiment in which the reaction was slow was experiment number 5 because it has lower concentration and the time taken for disappearance of letter X was the longest compared to others. 02 marks

d)

$$2HCl_{(aq)} + Na_2S_2O_{3(aq)} \longrightarrow 2NaCl_{(aq)} + H_2O_{(L)} + SO_{2(g)} + S_{(s)}$$ 03 marks

e)

i. Concentration
ii. Temperature
iii. Pressure
iv. Catalyst 02 marks

f) The electronic configuration of the product which cause the solution to cloud letter X , the product was Sulphur (S) and its electronic configuration = 2:8:6 02 marks

g) Conclusion

As concentration decreases, the times taken for the disappearance of letter X increases. Or concentration is inversely proportional to the time but the concentration is directly proportional to the rate of reaction. 02 marks