PRESIDENT'S OFFICE
REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT
FORM SIX NJOMBE REGION AND MBARALI DISTRICT

132/3A CHEMISTRY 3A (ACTUAL PRACTICAL)

MARKING GUIDE

1. Volumetric Analysis:

RESULTS

Volume of pipette used = 25 cm^3 (01 Mark)

Burette readings:

Titration number	Pilot	1	2	3
Final reading (cm^3)	25.20	25.10	24.90	25.00
Initial reading (cm^3)	0.00	0.00	0.00	0.00
Tthe value (cm^3)	25.20	25.10	24.90	25.00

(04 Marks)

$$\text{Average value} = \frac{25.10 + 24.90 + 25.00}{3}$$

$$= 25.00\ cm^3$$

(02 Marks)

Summary,

25.00 cm^3 of solution N_1 required 25.00 cm^3 of N_2 in the presence of N_3, N_4 and N_5 for complete reaction.

(a) (i) $2MnO_4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2+} + 5I_2 + 8H_2O$

(ii) $I_2 + 2S_2O_3^{2-} \rightarrow 2I^- + S_4O_6^{2-}$ (01@ = 03 Marks)

(iii) $2MnO_4^- + 10S_2O_3^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 5S_4O_6^{2-} + 8H_2O$

(b) Molarity of $Na_2S_2O_3 \cdot xH_2O$

From $\frac{n_a}{n_b} = \frac{M_a V_a}{M_b V_b}$

$n_{N_1} = 2$ $\quad M_{N_2} = ?$

$n_{N_2} = 10$ $\quad V_{N_1} = 25cm^3$

$M_{N_1} = 0.02M$ $\quad V_{N_2} = 25cm^3$

From the data above,

$$M_{N_2} = \frac{10 \times 0.02 \times 25}{2 \times 25}$$

$$M_{N_2} = 0.1 \text{ mol/dm}^3$$

∴ The molarity of $Na_2S_2O_3 \cdot XH_2O$ is **0.1** mol/dm³ (03 Marks)

(c) Molar mass of $Na_2S_2O_3 \cdot XH_2O$

From, $\text{Molarity} = \frac{\text{concentration}}{\text{Molar mass}}$

whereby,

Molarity = 0.1M

Concentration = $12.4g / 0.5dm^3 = 24.8 g/dm^3$

$$\text{Molar mass} = \frac{\text{concentration}}{\text{Molarity}}$$

$$= \frac{24.8 g/dm^3}{0.1 \text{ mol/dm}^3}$$ (03 Marks)

$$= 248 g/mol$$

∴ The Molar Mass of $Na_2S_2O_3 \cdot XH_2O = 248 g/mol$

(d) The value of X from the formula $Na_2S_2O_3 \cdot XH_2O$

$Na_2S_2O_3 \cdot XH_2O = 248 g/mol$

$(23 \times 2) + (32 \times 2) + (16 \times 3) + 18x = 248$

$158 + 18x = 248$

$$18x = 248 - 158$$

$$\frac{18x}{18} = \frac{90}{18}$$

$$x = 5$$

(03 Marks)

The value of x in the formula is 5.

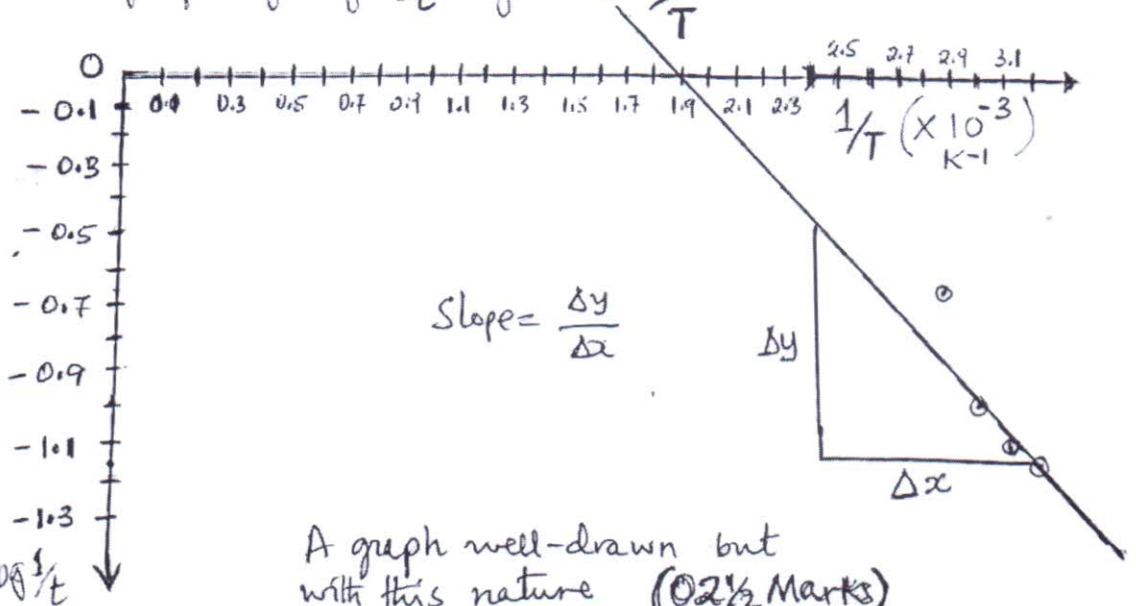
(e) It was necessary to add N_4 (starch solution) near the end point of the reaction in order to prevent the formation of starch–iodine complex which may interfere the formation of the end product. (01 Mark)

2. Table of results:

Temperature		Time (t) (sec)	log t (s)	$\frac{1}{t}$ (s^{-1})	log $\frac{1}{t}$ (s^{-1})	$\frac{1}{T}$ (K^{-1})
°C	K					
40	313	14.10	1.1492	0.0709	-1.1492	0.0032
50	323	11.60	1.0645	0.0862	-1.0645	0.0031
60	333	9.70	0.9868	0.1031	-0.9868	0.0030
70	343	4.60	0.6628	0.2174	-0.6628	0.0029

(02 Marks)

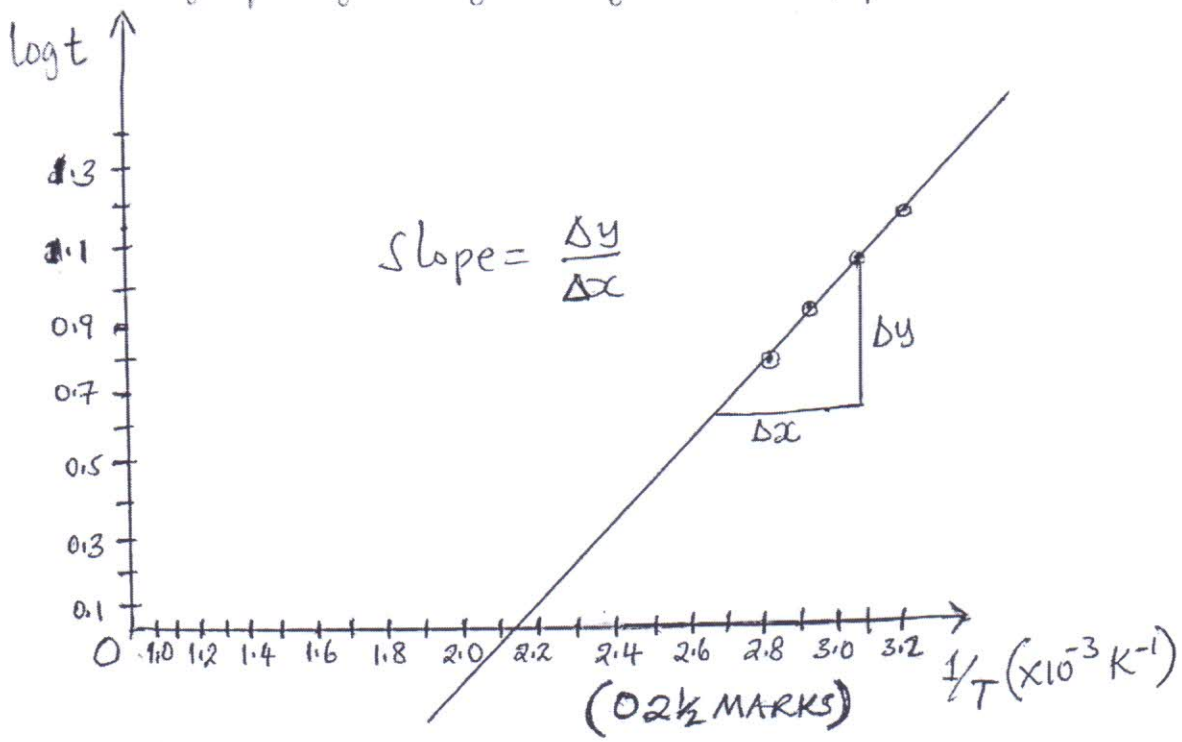
a) The graph of log $\frac{1}{t}$ against $\frac{1}{T}$



A graph well-drawn but with this nature extending to obtain y-intercept. (02½ Marks)

(3)

(b) The graph of log t against $1/T$



(02½ MARKS)

c) slope of the graph in (a) above:

$$\text{Slope} = \frac{\Delta y}{\Delta x}$$
$$= (-1.0645 - (-1.1492)) / (0.0031 - 0.0032)$$
$$= -847$$

$\therefore$ slope, $m = -847$ (01 Mark)

Slope of the graph in (b) above

$$\text{slope} = \frac{\Delta y}{\Delta x}$$
$$= (1.0645 - 1.1492) / (0.0031 - 0.0032)$$
$$= 847$$ (01 Mark)

$\therefore$ slope, $m = 847$

NB: It can be seen that slopes in (a) and (b) above are the same in magnitude but opposite in sign. (01 Mark)

d) The ionic equation for this experiment is

$$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 8H_2O + 10CO_2$$

(e)(i) From, $\log t = -\log A + \frac{Ea}{2.303R}\frac{1}{T}$ (01 Mark)

$\text{Slope} = \frac{Ea}{2.303R}$, hence $Ea = 2.303R \times \text{slope}$

$Ea = 2.303 \times 8.314 \times 847$

$= 16,217.63$ J/mol

$Ea \simeq \underline{16.218 \text{ kJ/mol}}$.

∴ The activation energy, Ea for this reaction is 16.218 kJ mol^{-1} (01 Mark)

From, $\log \frac{1}{t} = \log A - \frac{Ea}{2.303R}\frac{1}{T}$

$\text{Slope} = \frac{-Ea}{2.303R}$; $Ea = -2.303R \times \text{slope}$

$Ea = -2.303 \times 8.314 \times -847$

$= 16,217.63$ J/mol

$Ea \simeq \underline{16.218 \text{ kJ mol}^{-1}}$ (01 Mark)

NB: It is noted that the values of Ea are the same.

(ii) From $\log \frac{1}{t} = \log A - \frac{Ea}{2.303R} \times \frac{1}{T}$; using any of the values obtained at any temperature, and interpolating through the y-intercept of the graph, then;

$\text{Log } A = 1.5612$ and the value of A is $\log^{-1}(1.5612)$ which equals to $\underline{36.408}$ (02 Marks)

(Total = 15 Marks)

3.

S/N	EXPERIMENT	OBSERVATION	INFERENCE
1.	Appearance of sample R	Blue & Green Crystalline	- Cu^{2+} may be present - HCO_3^- or CO_3^{2-} probably absent.
2.	A little of sample R was heated in a dry test tube	- Colourless gas evolved which turned wet blue litmus paper red and formed dense white fumes with Ammonia - Black residue	Cl^- may be present Cu^{2+} may be present.
3.	Flame test for sample R.	- Blue-green flame	Cu^{2+} may be present.
4.	Action of Conc. H_2SO_4 to little of solid sample R.	- colourless gas with irritating smell evolved turning wet blue litmus paper red and formed dense white fumes with Ammonia	Cl^- may be present.
5.	A sample solution was prepared	Soluble salt	- Absence of insoluble salts. - Cl^- of Cu^{2+} NO_3^- or SO_4^{2-} of Cu^{2+} may be present.
	(i) To a sample solution, ethanoic acid was added followed by lead ethanoate	white ppt insoluble in dil. HCl but soluble in Ammonium ethanoate soln was formed	SO_4^{2-} confirmed

S/N	EXPERIMENT	OBSERVATION	INFERENCE
	(ii) To the second portion, $AgNO_3$ was added	White precipitate was formed	Cl^- confirmed
	(iii) To the third portion NaOH was added dropwise until present in excess	Blue precipitate insoluble in excess NaOH was formed	Cu^{2+} may be present
6.	To the sample solution portion, potassium hexacyano-ferrate (II) was added.	Reddish-brown precipitate was formed.	Cu^{2+} confirmed

(06½@ = 09 Marks)

CONCLUSION

(i) The cation in sample R is Cu^{2+}. (01 Mark)

(ii) The Anions in sample R are Cl^- and SO_4^{2-} (01 Mark)

(iii) The chemical formulae of salts in sample R are $CuCl_2$ and $CuSO_4$. (02 Marks)

(iv) The equation for the reaction in step 5(ii) is

$$CuCl_{2(aq)} + 2AgNO_{3(aq)} \rightarrow Cu(NO_3)_{2(aq)} + 2AgCl_{(s)}$$

(02 Marks)

(Total = 15 Marks)

— X — X — X —