

**THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
ADVANCED CERTIFICATE OF SECONDARY EDUCATION
EXAMINATION**

132/3C

CHEMISTRY 3C

(ACTUAL PRACTICAL C)

(For Both School and Private Candidates)

Time : 3:30 Hours

ANSWERS

Year : 2023

Instructions

1. This paper consists of three questions, answer all questions
2. All writing should be in **blue** or **black** ink.
3. Communication devices and any unauthorised materials are **not** allowed in the examination room.
4. Write your **Examination Number** on every page of your answer booklet(s).

maktaba.tetea.org



1. You are provided with the following:

B1: A solution of H_2O_2 prepared by diluting 1.00 cm^3 with distilled water to form 250 cm^3 of an aqueous solution;

B2: A solution of KMnO_4 made by dissolving 0.79 g in 250 cm^3 of distilled water;

B3: A dilute H_2SO_4 .

Procedure summary:

B1 (H_2O_2) is titrated against B2 (KMnO_4) in acidic medium.

Questions

(a) Write the two half reaction equations for the experiment.

Oxidation: $\text{H}_2\text{O}_2 \rightarrow \text{O}_2 + 2\text{H}^+ + 2\text{e}^-$

Reduction: $\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$

(b) Write a balanced ionic equation for the whole process.

$2\text{MnO}_4^- + 5\text{H}_2\text{O}_2 + 6\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 5\text{O}_2 + 8\text{H}_2\text{O}$

(c) Calculate the concentration of the original solution of hydrogen peroxide in g dm^{-3} .

Moles of KMnO_4 in $250 \text{ cm}^3 = 0.79 \div 158 = 0.005 \text{ mol}$.

Concentration = $0.005 \div 0.25 = 0.02 \text{ M}$.

From the equation: 2MnO_4^- react with $5\text{H}_2\text{O}_2$.

So 1 mole of KMnO_4 reacts with 2.5 moles of H_2O_2 .

If mean titre of B2 = 25 cm^3 (0.025 dm^3), then moles $\text{KMnO}_4 = 0.02 \times 0.025 = 5.0 \times 10^{-4} \text{ mol}$.

Moles $\text{H}_2\text{O}_2 = 2.5 \times 5.0 \times 10^{-4} = 1.25 \times 10^{-3} \text{ mol}$.

If B1 pipetted was 25 cm^3 (0.025 dm^3), concentration = $1.25 \times 10^{-3} \div 0.025 = 0.05 \text{ M}$.

Mass concentration = $0.05 \times 34 = 1.7 \text{ g dm}^{-3}$.

(d) Calculate the volume of oxygen gas produced at s.t.p when B1 reacted with an acidified B2.

From equation: $5\text{H}_2\text{O}_2 \rightarrow 5\text{O}_2$.

Thus 1 mol H_2O_2 produces 1 mol O_2 .

Moles of H_2O_2 in $25 \text{ cm}^3 = 1.25 \times 10^{-3} \text{ mol}$.

Moles $\text{O}_2 = 1.25 \times 10^{-3} \text{ mol}$.

Volume of O_2 at s.t.p = $1.25 \times 10^{-3} \times 22.4 \text{ dm}^3 = 0.028 \text{ dm}^3 = 28 \text{ cm}^3$.

2. You are provided with the following:

S: 0.5 M sodium thiosulphate solution.

T: 0.1 M nitric acid.

Theory: $\text{S}_2\text{O}_3^{2-} + 2\text{H}^+ \rightarrow \text{SO}_2 + \text{S}\downarrow + \text{H}_2\text{O}$

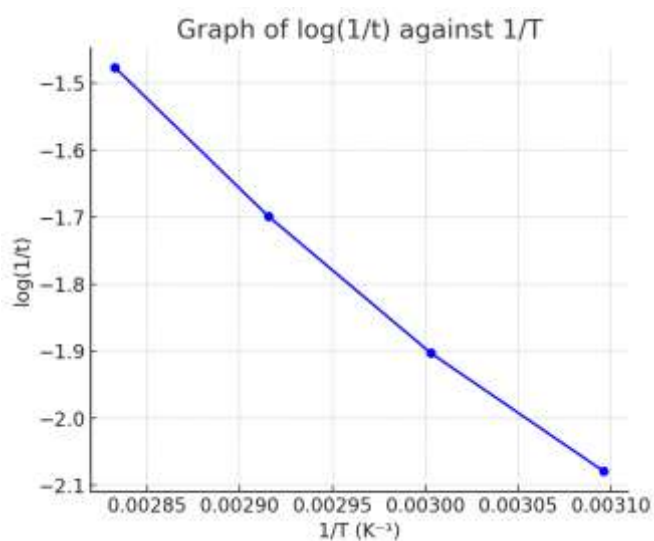
The reaction time is measured until the cross mark disappears.

Table 1 calculations (example with times in seconds):

T (°C)	T (K)	Time t (sec)	1/t (s ⁻¹)	log(1/t)
50	323	120	0.0083	-2.08
60	333	80	0.0125	-1.90
70	343	50	0.0200	-1.70
80	353	30	0.0333	-1.48

(a) Plot graph of log(1/t) vs 1/T.

This graph will be a straight line with negative slope.



(b) Determine the slope of the graph.

$$\text{Slope} = \Delta \log(1/t) \div \Delta(1/T).$$

$$\text{From data: } (-1.48 - -2.08) \div (1/353 - 1/323).$$

$$= 0.60 \div (0.00283 - 0.00310).$$

$$= 0.60 \div -0.00027 = -2222.$$

(c) Using Arrhenius equation, determine activation energy.

$$\text{Arrhenius: slope} = -E_a / (2.303R).$$

$$E_a = -\text{slope} \times 2.303R.$$

$$R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}.$$

$$E_a = 2222 \times 2.303 \times 8.314 \approx 42.5 \text{ kJ mol}^{-1}.$$

Table 2: Experimental Table

S/n	Experiment	Observations	Inferences
(a)	Observe sample Z	White crystalline solid	Inorganic metallic salt
(b)	Heat small portion of the sample in a dry test tube	Colourless gas turns lime water milky	Presence of carbonate (CO_3^{2-}) anion
(c)	Perform a flame test	Yellow flame observed	Presence of sodium ion (Na^+)

(d)	Add concentrated sulphuric acid to the dry sample	Effervescence with colourless gas that turns lime water milky	Confirms carbonate (CO_3^{2-}) anion
(e)	To the small portion of the prepared solution, add HCl followed by barium chloride solution	White precipitate insoluble in dilute HCl	Presence of sulphate (SO_4^{2-}) anion
(f)	To the small portion of the prepared solution, add excess ammonia solution and then pass hydrogen sulphide gas slowly for one minute	Black precipitate observed	Presence of Cu^{2+} ion
(g)	Perform confirmatory tests for cations present in the sample	Blue solution with aqueous ammonia confirms Cu^{2+} , yellow flame confirms Na^+	Cations are Na^+ and Cu^{2+}

Questions

(i) Write the molecular formula for the sample.

Since the anion is SO_4^{2-} and cations are Na^+ and Cu^{2+} , the molecular formula is **$\text{Na}_2\text{Cu}(\text{SO}_4)_2$** .

(ii) What are the cations and anion in the sample?

Cations: Sodium ion (Na^+) and Copper(II) ion (Cu^{2+}).

Anion: Sulphate ion (SO_4^{2-}).