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

132/3B

CHEMISTRY 3B
ACTUAL PRACTICAL B
(For Both School and Private Candidates)

Time: 3:20 Hours **Year: 2023**

Instructions

1. This paper consists of **three (3)** questions. Answer **all** the questions.
2. Question number **one (1)** carries **20** marks and the other **two (2)** carry **15** marks each.
3. Qualitative Analysis Guide (QAG) sheet authorised by NECTA may be used.
4. Mathematical tables and non programmable calculators may be used.
5. All writing must be in **blue** or **black** ink **except** drawing which must be in pencil.
6. Cellular phones and any unauthorised materials are **not** allowed in the examination room.
7. Write your **Examination Number** on every page of your answer booklet(s).
8. You may use the following constants:
   - Atomic masses: H = 1, C = 12, O = 16, S = 32, Na = 23, K = 39, Mn = 55.
   - Molar gas constant = 8.314 J K^{-1} mol^{-1}.

1. You are provided with the following:

J: A solution made by dissolving 1.58 g of $KMnO_4$ in a distilled water to form a 0.5 dm^3 of an aqueous solution;

K: A solution made by dissolving 7.91 g of $Na_2S_2O_3.XH_2O$ in a distilled water to form 0.25 dm^3 of an aqueous solution;

L: A solution of 10% KI;

M: A starch solution;

N: A dilute H_2SO_4 solution.

Theory

A quantitative reaction between potassium permanganate, $KMnO_4$ and potassium iodide, KI can be represented by the reaction: $MnO_4^-(aq) + I^-(aq) \longrightarrow Mn^{2+}(aq) + I_2(aq)$.....(i)

The liberated iodine, I_2 is titrated against sodium thiosulphate, $Na_2S_2O_3$. The reaction taking place during this titration can be represented as follows:

$I_2(aq) + 2S_2O_3^{2-} \longrightarrow S_4O_6^{2-} + 2I^-$ .....(ii)

Procedure

(i) Pipette 20 or 25 cm^3 of **J** into a conical flask. Add an equal volume (20 cm^3 or 25 cm^3) of **L**, followed by another equal volume (20 cm^3 or 25 cm^3) of **N** in the same flask.

(ii) Titrate the mixture in (i) with **K**, until the colour change is observed. Add 2 cm^3 of **M** and continue titrating until a permanent colour change is observed.

(iii) Repeat the procedures (i) and (ii) three more times and record your results in a tabular form.

Summary

(i) The volume of the pipette used was _____.

(ii) _____ cm^3 of **J** liberated iodine that required _____ cm^3 of **K** for complete reaction.

Questions

(a) State the function of **M** in this experiment.

(b) State the main purpose of adding **L** into the conical flask containing an acidified **J**.

(c) Why is it advisable to add **M** just close to the end point in this experiment?

(d) Write an overall balanced reaction equation for the whole experiment.

(e) Calculate the;

(i) concentration of $KMnO_4$ in g/dm^3.

(ii) molarity of $KMnO_4$.

(iii) concentration of $Na_2S_2O_3.XH_2O$ in g/dm^3.

(iv) molarity of $Na_2S_2O_3$.
(v) concentration of $Na_2S_2O_3$ in g/dm^3.

(f) Find the value of X in $Na_2S_2O_3.XH_2O$.

2. You are provided with the following:

A: A solution of 0.02 M potassium permanganate;

C: A solution of 0.05 M oxalic acid in 0.5 M of sulphuric acid;

A thermometer (0°–100°C);

Stop watch/clock.

Theory

In an acidic medium, oxalic acid is oxidized by potassium permanganate. Completion of the reaction is indicated by the disappearance of the purple colour of the permanganate ions as shown by the following chemical equation:

$2MnO_4^-(aq) + 5C_2O_4^{2-}(aq) + 6H^+(aq) \rightarrow 2Mn^{2+}(aq) + 10CO_2(g) + 8H_2O(l)$.

Procedure

(i) Put about 200 cm^3 of water into a 250 or 300 cm^3 beaker. Heat the beaker containing water. Use it as your water bath.

(ii) Measure 10 cm^3 of solution **A** and 10 cm^3 of **C**; put them into two separate boiling test tubes.

(iii) Take the test tubes containing **A** and **C** and put them into the water bath; allow the contents to warm to 50°C.

(iv) Pour both solutions **A** and **C** into a 50 cm^3 beaker. Immediately, start a stop watch/clock and record the time taken for the purple colour to disappear.

(v) Repeat the procedures (ii) to (iv) using temperatures 60°C, 70°C, 80°C and 90°C. Record your results as indicated in Table 1:

Table 1: Experimental Table

Temperature, T (^{0}C)	Temperature, T (K)	Time for Reaction, t (Sec)	$\frac{1}{T}$ (K^{-1})	Log t (sec)
50				
60				
70				
80				
90				

Questions

(a) Write ionic redox half equations for this experiment.

(b) Plot a graph of log t (s) against $\frac{1}{T}(K^{-1})$.

(c) Calculate the activation energy (Ea) of the reaction for the experiment.

3. Sample **B** contains **two cations** and **one anion**. Perform the experiments given in Table 2 and record the observations and make appropriate inferences. Hence, identify the two cations and an anion.

Table 2: Experimental Table

S/n	Experiment	Observations	Inferences
(a)	Observe sample **B**.		
(b)	Heat a small portion of the sample in a dry test tube.		
(c)	Add concentrated sulphuric acid to a small portion of the sample.		
(d)	Perform a flame test.		
(e)	To a small portion of the sample solution, add NaOH solution.		
(f)	To a small portion of the sample solution, add dilute nitric acid followed by silver nitrate solution, then ammonia solution.		
(g)	To the small portion of the sample solution, pass hydrogen sulphide gas or ammonium sulphide solution in the presence of hydrochloric acid. Filter the precipitates to obtain filtrate and residue.		
	(i) To the filtrate add dilute acetic acid followed by a few drops of lead acetate.		
	(ii) Dissolve the residue, add aqua regia and then excess ammonia solution.		

Questions

(i) Write the molecular formula for the sample.

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