

**THE UNITED REPUBLIC OF TANZANIA
PRESIDENT'S OFFICE,
REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT
NJOMBE REGION**



FORM SIX PRE – NATIONAL EXAMINATION

CODE: 132/3A

CHEMISTRY 3A

(For Both School and Private Candidates)

TIME: 03: 20 HOURS

TUESDAY, 19TH March 2024 A.M

INSTRUCTIONS

1. This paper consists of three (3) questions.
2. Answer all questions
3. Question number one carries twenty marks while the other two carries 15 marks each
4. Mathematical table and non-programmable calculators may be used
5. Cellular phone are not allowed in the examination room
6. Write your examination number on every page of your answer sheets
7. You may use the following constants

Atomic masses H=1, C=12, O=16, S=32, K=39, Cr=52, Mn=55, Fe=56, I=127,
Na=23

1. You are provided with the following solutions;

N1: A solution containing **1.58g of KMnO_4** in **500 cm^3** of distilled water

N2: A solution containing **12.4g of $\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{XH}_2\text{O}$** in **$500 \text{ cm}^3$** of distilled water

N3: **0.1M** of Potassium iodide (**KI**)

N4: Starch solution

N5: **2M** H_2SO_4 solution

Theory:

Potassium permanganate reacts quantitatively with Potassium iodide in acidic medium to liberate iodine, which is then used up during titration with sodium thiosulphate solution. The overall quantitative redox reaction can be deduced by adding the two redox reactions above.

Procedure:

- i Pipette 25 cm^3 of **N1** into a conical flask, then add to it 20 cm^3 of **N5** and 20 cm^3 of **N3**.
- ii Shake (or swirl) the conical flask for 5 seconds.
- iii Titrate the resulting solution against solution **N2** (present in the burette) until a **pale yellow colour** is obtained (It is very close to the end point). Add to it about 2 cm^3 of **N4** and continue titrating carefully with only few drops until a **colourless solution** is obtained.
- iv Record the titre volume.
- v Repeat the procedure above three more times and tabulate your results as shown below;

Results:

Volume of pipette used was _____ cm^3

Burette readings

Titration number	Pilot	1	2	3
Final volume (cm^3)				
Initial volume (cm^3)				
Titre Volume (cm^3)				

Summary:

_____ cm^3 of solution **N1** required _____ cm^3 of solution **N2** in the presence of **N3**, **N4** and **N5** for complete reaction.

Questions:

- (a) Write a balanced chemical equation for a reaction which took place when;
 - (i) MnO_4^- reacts with I^-
 - (ii) I_2 reacts with $\text{S}_2\text{O}_3^{2-}$
 - (iii) MnO_4^- reacts with $\text{S}_2\text{O}_3^{2-}$ (**Overall equation**)
- (b) Calculate the **Molarity** of $\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{XH}_2\text{O}$

- (c) Calculate the **Molar mass** of $\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{XH}_2\text{O}$
- (d) Determine the **value of X** in the formula $\text{Na}_2\text{S}_2\text{O}_3 \cdot \text{XH}_2\text{O}$.
- (e) Why was it necessary to add **N4** near the end point of the chemical reaction?

2. You are provided with the following:

AA: A solution of 0.02M potassium permanganate (KMnO_4) solution

BB: A solution of 0.1M oxalic acid ($\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$) in 0.5M Sulphuric acid solution.

Procedures

- (i) Measure 10cm^3 of solution **AA** and 10cm^3 of solution **BB** put them into separate boiling test tubes.
- (ii) Place the two boiling test tubes containing **AA** and **BB** in the water bath and dip a thermometer into one of them without touching the bottom of the tube. Allow the contents to warm up to 40°C .
- (iii) Pour the solutions **AA** and **BB** into a small beaker (100cm^3). Immediately start a stop watch and record the time taken for the purple colour to disappear.
- (iv) Repeat the experiment using the temperatures 50°C , 60°C and 70°C respectively and record your results in a tabular form as follows:

Table of results

Temperature		Time (sec)	$\log t$	$\frac{1}{\text{Time}(t)}$	$\log \frac{1}{t}$	$\frac{1}{T}$ (K^{-1})
$^\circ\text{C}$	K					
40						
50						
60						
70						

Questions

- (a) Plot a graph of $\log \frac{1}{t}$ against $\frac{1}{T}$
- (b) Plot the graph of $\log t$ against $\frac{1}{T}$
- (c) Find the slope of the graph in (a) and (b) above and comment on their similarity.
- (d) Write the ionic equation of this experiment
- (e) If $\log t = -\log A + \frac{Ea}{2.303RT}$ (i)
- $\log \frac{1}{t} = \log A - \frac{Ea}{2.303RT}$ (ii)

Calculate the:

- Activation energy of the reaction in this experiment using both of the above formulae and comment if the values are similar not under experimental error.
- Value of A.

3. You are provided with sample **R** containing ONE CATION and TWO ANIONS. Carry out the guided qualitative analysis procedures in the table below and identify the cation and anions present in the sample **R**.

S/N	Experiments	Observation	Inference
1.	Observe the appearance of sample R		
2.	Heat a small portion of sample R in a dry test tube		
3.	Perform flame test for sample R		
4.	Place a portion of sample R in a test tube and add concentrated Sulphuric acid		
5.	Prepare a solution of sample R . Divide the resulting solution into three portions.		
	(i) In the first portion add ethanoic acid followed by lead ethanoate solution		
	(ii) In the second portion add Silver nitrate (AgNO_3) solution		
	(iii) Add Sodium hydroxide to the third portion, dropwise till excess		
6.	Perform confirmatory test for the cation		

Conclusion:

(i) The cation in sample **R** is _____

(ii) The anions in sample **R** are _____ and _____

(iii) The chemical formulae of salts in sample **R** are _____ and _____

(iv) Write the equation for the reaction which took place in experiment 5(ii)