

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)

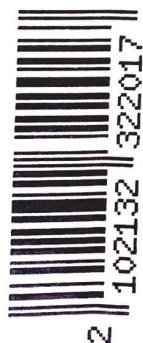
Time: 3:20 Hours

Year : 2021

Instructions

1. This paper consists of **three (3)** questions. Answer **all** questions.
2. Question number **one (1)** carries **twenty (20)** marks and the other **two (2)** carry **fifteen (15)** marks each.
3. Qualitative Analysis Guide (QAG) sheet authorized by NECTA may be used.
4. Mathematical tables and non-programmable calculators may be used.
5. Cellular phones and any unauthorised materials are **not** allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklet(s).
7. You may use the following atomic masses:

H = 1, C = 12, O = 16, S = 32, Na = 23, Cu = 64, I = 127.



1. You are provided with the following:
- M1:** A solution made by dissolving 6.25 g of $\text{CuSO}_4 \cdot \text{XH}_2\text{O}$ in distilled water to make a 250 cm^3 of a solution;
 - M2:** A solution made by dissolving 12.40 g of $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ in distilled water to make a 500 cm^3 of a solution;
 - M3:** A solution of 10% KI;
 - M4:** A starch solution.

Theory

A quantitative reaction between copper sulphate and potassium iodide can be represented by the following equation: $2\text{Cu}^{2+} + 4\text{I}^- \rightarrow \text{Cu}_2\text{I}_2 + \text{I}_2$ (i)

The liberated iodine can be titrated against sodium thiosulphate whose reaction can be represented as follows: $2\text{S}_2\text{O}_3^{2-} + \text{I}_2 \rightarrow \text{S}_4\text{O}_6^{2-} + 2\text{I}^-$ (ii)

Procedure

- (i) Pipette 20 cm^3 or 25 cm^3 of **M1** into a conical flask. Add 10 cm^3 of solution **M3** and shake well the mixture.
- (ii) Titrate the mixture at step (i) with solution **M2** from the burette until a pale yellow colour appears. Then, add about 2 cm^3 of solution **M4**. Continue titrating until the pale yellow colour just disappears and a pale yellow green colour appears.
- (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 **M1** liberated iodine that required _____ cm^3 of **M2** for complete reaction.

Questions

- (a) Calculate the concentration of **M2** in mol/dm^3 .
- (b) Write the half-reaction equations to show the oxidation and reduction processes taking place in procedure (ii) indicating in each case the oxidants and reductants.
- (c) Calculate the;
 - (i) molarity of **M1**.
 - (ii) concentration of **M1** in g/dm^3 .
 - (iii) value of X in the formula $\text{CuSO}_4 \cdot \text{XH}_2\text{O}$.

You are provided with the following:

C1: 0.2 M sodium thiosulphate solution;

C2: 0.1 M hydrochloric acid solution;

C3: Distilled water;

Stop watch/clock;

A white plain sheet of paper marked **X**.

Theory

The rate of reaction between thiosulphate ion and an acid is given by,

Reaction rate = $\frac{\delta[S_2O_3^{2-}]}{\delta t} = K[S_2O_3^{2-}]^m[H^+]^n$. Where m is the order of the reaction with respect to $S_2O_3^{2-}$ and n is the order of reaction with respect to H^+ .

Procedure

- Place a 50 cm³ beaker on top of a white plain paper marked **X** in such a way that, the mark is clearly seen through the bottom of the beaker.
- Measure 2 cm³ of **C1** and 8 cm³ of **C3** and put them in a 50 cm³ beaker in procedure (i) above.
- Measure 10 cm³ of **C2** and pour the content into a beaker in procedure (ii) and immediately start the stop watch.
- Record the time taken for the mark **X** to disappear.
- Discard the contents and clean the conical flask, then, repeat the procedures (i) to (iv) using the specifications as indicated in Table 1.

Table 1: Experimental Table

Experiment	Volume of C1 (cm ³)	Volume of C3 (cm ³)	Volume of C2 (cm ³)	Time, t (sec.)	$\frac{1}{\text{time}} (\text{sec}^{-1})$
A	2	8	10		
B	4	6	10		
C	6	4	10		
D	8	2	10		
E	10	0	10		

Questions

- Write the ionic equation for the experiment.
- Plot the graph of $\frac{1}{t}$ (vertical axis) against the volume of sodium thiosulphate (horizontal axis).

- (c) Determine the order of the reaction with respect to sodium thiosulphate from the graph.
- (d) Given that, the value of n is 2, determine the order of reaction with respect to sodium thiosulphate using rate law equation.
- (e) Comment on the order of reaction obtained in (c) and (d).
- (f) Find the value of K .
- (g) What causes the precipitate to occur in the reaction?

3. You are provided with sample **Z** containing **two** cations and **two** anions. Carry out the experiments described in Table 2. Record carefully your observations, make appropriate inferences and finally identify the cations and anion present in sample **Z**.

Table 2: Experimental Results

S/n	Experiment	Observations	Inference
(a)	Take a spatulaful of sample Z into a boiling test tube then add about 3 cm ³ of distilled water. Heat gently the mixture for about one minute while swirling the test tube. Filter to obtain a clear solution and divide the resulting solution into three portions.		
	(i) To the first portion add NaOH solution.		
	(ii) To the second portion add dilute HNO ₃ followed by AgNO ₃ and then NH ₃ solution.		
	(iii) To the third portion, add ammonia solution.		
(b)	(i) Dissolve the residue in a little quantity of HCl as possible and identify any resulting gas.		
	(ii) Dilute the resulting solution in (a) (i) with distilled water and divide the solution into three portions.		
		• To the first portion, add few drops of CaCl ₂ solution.	
		• To the second portion, add dilute NH ₄ OH till no further change.	
		• To the third portion add excess ammonia solution followed by ammonium oxalate solution.	

Questions

- (i) Write the molecular formulas for the samples.
- (ii) What are the cations and anions in the sample?