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 $CuSO_4.XH_2O$ in distilled water to make a 250 cm^3 of a solution;

M2: A solution made by dissolving 12.40 g of $Na_2S_2O_3.5H_2O$ 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: $2Cu^{2+} + 4I^- \rightarrow Cu_2I_2 + I_2$ .....(i)

The liberated iodine can be titrated against sodium thiosulphate whose reaction can be represented as follows: $2S_2O_3^{2-} + I_2 \rightarrow S_4O_6^{2-} + 2I^-$ .....(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 $CuSO_4.XH_2O$.

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

(i) Place a 50 cm^3 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.

(ii) Measure 2 cm^3 of **C1** and 8 cm^3 of **C3** and put them in a 50 cm^3 beaker in procedure (i) above.

(iii) Measure 10 cm^3 of **C2** and pour the content into a beaker in procedure (ii) and immediately start the stop watch.

(iv) Record the time taken for the mark **X** to disappear.

(v) 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.)	$\frac{1}{time}$ (sec^{-1})
A	2	8	10		
B	4	6	10		
C	6	4	10		
D	8	2	10		
E	10	0	10		

Questions

(a) Write the ionic equation for the experiment.

(b) 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_4OH 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?