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: 2022**

Instructions

1. This paper consists of **three (3)** questions**,** Answer **all** questions.
2. Question **one (1)** carries **20** marks, and the other **two(2),** carry **15** marks each.
3. Qualitative Analysis Guide (QAG) authorized 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 unauthorized materials are **not** allowed in the examination room.
7. Write your **Examination Number** on every page of your answer booklet (s).

   The folowing information may be useful:

   H=1, C=12, 0=16, S=32, Na=23, K=39, Mn=55

1. You are provided with the following:

   AA: A solution of sodium oxalate, $Na_2C_2O_4$ made by dissolving 3.35 g of the salt in a 0.5 dm^3 solution;

   BB: A solution of potassium permanganate, KMnO4;

   CC: A solution of hydrated iron(II) ammonium sulphate, $FeSO_4(NH_4)_2$ $SO.XH_2O_4$. made by dissolving 33.3 g of the salt in distilled water to form 1 dm^3 of an aqueous solution;

   DD: Dilute sulphuric acid; Thermometer.

   Theory

   Standardization of **BB** solution is done by titrating it against the standard solution of **AA** in an acidic medium. The resulting reaction equation is as follows:

   $$2MnO_2 + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 8H_2O + 10CO_2 .$$

   The standardized is then titrated against **CC** whose number of molecules of water of crystallization can then be calculated. The resulting equation is as follows:

   $$MnO_4^- + 5Fe^{2+} + 8H^+ \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O .$$

   Procedure:

   Part I

   (i) Measure 10 cm^3 of solution **AA** into a titration flask and then add 10 cm^3 of solution **DD**.

   (ii) Heat the contents near boiling (about 80 °C)

   (iii) (Titrate this hot mixture against solution **BB** from the burette until there is a colour change.

   (iv) Repeat the steps (i) to (iii) to obtain three more readings and record the results in a tabular form.

Summary

_____ cm^3 of solution AA required _____ cm^3 of solution **BB** for a complete reaction.

Part II

(i) Measure 10 cm3 of solution CC into a titration flask and then add 10 cm^3 of solution **DD**.

(ii) Titrate the reaction mixture against solution **BB** from the burette until there is a colour change.

(iii) Repeat the steps (i) and (ii) to obtain three more readings and record the titration results in a tabular form.

Questions

(a) Calculate the;

(i) molarity of potassium permanganate.

(ii) concentration of potassium permanganate in gdm^{-3} .

(iii) molarity of iron(II) salt.

(iv) concentration of anhydrous iron(II) salt in gdm^{-3} .

(b) Find the value of **X** in the formula $FeSO_4(NH_4)_2$ SO. XH_2O_4.

2. You are provided with the following:

JJ: 0.05 M sulphuric acid;

MM: 0.035 M potassium iodide;

KK: 0.035 M sodium thiosulphate;

LL: 0.9 M hydrogen peroxide;

HH: Starch solution; Stop watch.

Theory

Hydrogen peroxide reacts with iodide ions in the presence of hydrogen ions in an aqueous solution as follows: $H_2O_2 + 2I^- + 2H^+ \rightarrow 2H_2O + I_2$**.** The iodine produced immediately reacts with thiosulphate ions as follows:

$I_2 + 2S_2O_3^{2-} + 2I^- + S_4O_6^{2-}$**.** When all the thiosulphate ions have reacted, iodine begins to accumulate in the solution and its presence can be detected by starch.

Procedure

(i) Using a measuring cylinder, put 100 cm^3 of solution JJ into a conical flask and then 10 cm^3 of solution **MM** into the same flask, followed by 10 cm^3 of solution **HH**.

(ii) Swirl the contents of the flask to ensure proper mixing.

(iii) Fill the burette with the solution **KK** and adjust the level to zero mark. Run 2.0 cm^3 of the solution **KK** into the mixture and again swirl the contents.

(iv) Using a measuring cylinder, add 10 cm^3 of solution **LL** into the mixture and immediately start the stop watch. Shake well the flask when the solution **LL** is running into it.

(v) Note the time when suddenly the mixture turns blue. Without stopping the stop watch, add further 2.0 cm^3 of solution **KK** and shake well the flask. Again note the time when the blue colour reappear.

(vi) Continue this way until you have added 12 cm^3 of the solution KK.

(vii) Record all your readings as indicated in Table **1**.

(viii) Repeat procedure (i) to (vii) using fresh portions of the solutions, but this time use 10 cm^3 of diluted solution **LL**. Dilute solution LL as follows; measure 10 cm^3 of solution LL into a beaker and then add 10 cm^3 of distilled water. Swirl the contents

Results

Table 1: Undiluted LL

Volume of **KK** added (cm^3)	2	4	6	8	10	12
Time in seconds						

Table 2: Diluted LL

Volume of **KK** added (cm^3)	2	4	6	8	10	12
Time in seconds						

Questions

(a) On the same axes, plot a graph showing the volume of sodium thiosulphate solution, **KK** against time for each experiment.

(b) Comment on the shapes of your graphs and explain what is expected to the graph if you continue adding **KK** for a longer period of time.

(c) Calculate the slope of each curve and deduce the order of the reaction with respect to hydrogen peroxide.

(d) How is the amount of iodine liberated related to the amount of hydrogen peroxide consumed?

3. Substance **T** contains two cations and one anion. Use the information given in the experiments column of the Table **3** to complete the observations and inferences columns. Hence, identify the two cations and an anion.

Table 3

S/N	Experiments	Observations	Inferences
(a)	Appearance of the sample.		
(b)	Heat a small portion of the sample in a dry test tube.		
(c)	Add concentrated sulphuric acid to the small portion of the sample.		
(d)	Perform a flame test.		
(e)	To a small portion of a sample solution, add sodium hydroxide solution.		
(f)	To a small portion of a sample solution add nitric acid followed by silver nitrate solution, then aqueous ammonia.		
(g)	To the small portion of the solution, pass hydrogen sulphide gas or ammonium sulphide solution in presence of hydrochloric acid. Filter the precipitates to obtain filtrate and residue.		
	(i) To the filtrate, add bariumchloride solution.		
	(ii) Dissolve the residue, add aquea regia and then excess 50% ammonia solution.		

Questions

(i) Write the molecular formulas for the sample.

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