THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

132/3C **CHEMISTRY 3C**

ACTUAL PRACTICAL C

(For Both School and Private Candidates)

Duration: 3:20 Hours **Year: 2025**

Instructions

1. This paper consists of **three (3)** questions.
2. Answer **all** questions.
3. Question **one (1)** carries 20 marks and the other **two (2)**, carry 15 marks each.
4. Qualitative Analysis Guide (QAG) sheet authorised by NECTA may be used
5. Mathematical tables and non programmable calculators may be used.
6. Communication devices 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, Cl = 35.5, K = 39, Mn = 55
   - Density of water = 1 g/cm^3
   - Specific heat capacity of water = 4.18 $Jg^{-1}K^{-1}$

1. Use the reagents and apparatus given to demonstrate how you would analyse hydrated $Na_2S_2O_3$ to determine the number of molecules of water of crystallisation.

   W1: A solution of 0.08 mole of $KMnO_4$ in 2000 cm^3;

   W2: A solution of $Na_2S_2O_3.XH_2O$ made by dissolving 14.88 g in 600 cm^3 of distilled water;

   W3: A solution of 10% KI;

   W4: A starch solution;

   W5: A solution of 1 M sulphuric acid.

   Theory

   A quantitative reaction between potassium permanganate and potassium iodide in acidic medium leads to the production of iodine. During titration, iodine reacts with sodium thiosulphate in presence of starch which acts as an indicator.

   Procedure

   (i) Fill a burette with **W2**.

   (ii) Measure 10 cm3 of **W1** into a conical flask. Add 10 cm3 of distilled water. Swirl the mixture gently and add 10 cm3 of **W3**. Add 10 cm3 of **W5** into the mixture.

   (iii) Titrate **W2** against the mixture until a pale yellow colour is observed. Add 2 cm^3 of **W4** and continue to titrate until the colour of the solution changes from dark blue to colourless.

   (iv) Record the first titre value.

   (v) Repeat steps (i) to (iv) three times and record the titre values.

Questions

(a) Tabulate the results.

(b) Write balanced redox chemical equations to represent the following:

(i) Reaction between potassium permanganate and potassium iodide in the presence of sulphuric acid.

(ii) Reaction between iodine and sodium thiosulphate.

(c) Calculate the concentration of potassium permanganate that reacted with potassium iodide.

(d) Determine the percentage composition of water in $Na_2S_2O_3.XH_2O$.

(e) Suggest another suitable substitute for potassium permanganate in this experiment.

2. Use the following reagents and the given apparatuses to determine the rate constant of the reaction:

   R1: Hydrogen peroxide solution;

   R2: A solution made by dissolving 7.9 g of sodium thiosulphate in 1 dm3 of distilled water;

   R3: A solution made by dissolving 8.3 g of KI per litre in 0.5 M $H_2 SO_4$;

   Starch solution;

   Distilled water;

   100 cm^3 beakers labelled **I** and **II**;

   Stopwatch.

   Theory

   Hydrogen peroxide reacts with iodide ions in acidic medium to form iodine. The iodine produced reacts with thiosulphate ions as indicated in the following reaction equations:

   $H_2 O_2 (aq) + 2H^+(aq) + 2I^-(aq) \rightarrow I_2 (aq) + 2H_2 O(aq)$

   $2S_2 O_3^{2-}(aq) + I_2 (aq) \rightarrow S_4 O_6^{2-}(aq) + 2I^-(aq)$

   The initial rate of oxidation of iodide ions by hydrogen peroxide in acidic solution is found by measuring the time taken to liberate sufficient iodine to react with thiosulphate ions.

   Procedure

   (i) Measure 15 cm3 of **R3**, add few drops of starch followed by 5 cm3 of distilled water and put in beaker **I**.

   (ii) Using another measuring cylinder, measure 5 cm3 of **R2** solution and 30 cm3 of **R1** then put in beaker **II**.

   (iii) Add mixture of beaker **II** into beaker **I** and start stopwatch.

   (iv) Swirl the mixture thoroughly.

   (v) Record the time taken for the blue colour to appear and tabulate the results.

(vi) Repeat the steps (i) to (v) but this time change the volume of **R1** and distilled water as indicated in the Table 1. Each time keep the volume of **R2**, **R3** and starch solution as in the first experiment.

Volume of R1(cm^3)	30	25	20	15	10	5
Volume of distilled water (cm^3)	5	10	15	20	25	30
Time for blue colour to appear (sec)						
Rate (1/time) (sec^{-1})						

Questions

(a) Plot a graph of (1/t) against (volume) of **R1**.

(b) What is the order of reaction with respect to **R1**?

(c) Calculate the rate constant for the reaction.

3. Sample **RV** contains one cation and one anion. Using systematic qualitative analysis procedures analyse the sample. Carefully, record your experiments, observations and inferences as shown in Table 2. Finally, identify the anion and cation present in sample **RV**.

Table 2: Experimental Table.

S/N	Experiments	Observations	Inferences

Questions

(a) What are the cation and anion in the sample?

(b) Write the molecular formula for the sample.