THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

132/3A

CHEMISTRY 3A
ACTUAL PRACTICAL A
(For Both School and Private Candidates)

Time: 3:20 Hours **Year: 2024**

Instructions

1. This paper consists of **three** (3) questions. Answer **all** the 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. Communication devices 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, Cl = 35.5, K = 39, Mn = 55.

1. A chemist in a certain bakery industry has brought to you the product labelled **M1** containing 1 dm^3 of an aqueous solution of a mixture of sodium carbonate and sodium hydrogen carbonate. Use the following reagents to determine the percentage composition of sodium carbonate and sodium hydrogen carbonate in the product.

M2: 0.2 M hydrochloric acid solution;
MO: methyl orange indicator;
POP: phenolphthalein indicator.

Procedure

(i) Measure 75 cm^3 of **M2** and put into a 250 cm^3 beaker. Add 75 cm^3 of distilled water into the beaker containing **M2** and stir the mixture using a glass rod. Label the resulting solution as **M5**.
(ii) Put solution **M5** into the burette.
(iii) Pipette 20 or 25 cm^3 of **M1** into a conical flask and add two or three drops of **POP**.
(iv) Titrate **M5** against **M1** until the first colour change is observed. Record the first titre value.
(v) Add two or three drops of **MO** to the same solution in the conical flask.
(vi) Titrate until the second colour change is observed and record the second titre value.
(vii) Repeat steps (i) to (vi) three times and record the titre values.

Questions

(a) Record your results in a tabular form.

(b) (i) What was the volume of the pipette used?
(ii) Calculate the average titre values (cm^3) of **M5** when **MO** and **POP** were used.

(c) What is the colour change when:
(i) **POP** was used?
(ii) **MO** was used?

(d) Write the balanced chemical equation for the reaction under **POP**.

(e) Write the balanced chemical equation for the reaction under **MO**.

(f) Why **POP** was used first instead of **MO** in this experiment?

(g) Calculate the percentage composition of sodium carbonate and sodium hydrogen carbonate in the product.

2. Karibu plastic manufacturing industry aim at achieving optimum production. The production manager has been advised to operate at optimum activation energy by using the following reagents:

TZ: a solution made by dissolving 0.79 g of $KMnO_4$ in 0.25 dm^3 of distilled water.
TY: a solution made by dissolving 1.575 g of hydrated oxalic acid in 0.25 dm^3 of 0.5 M H_2SO_4.

Use the proposed reagents, **TZ** and **TY** to determine the required activation energy.

Theory

In acidic medium, oxalic acid is oxidized by potassium permanganate and the completion of the reaction is indicated by the disappearance of the purple colour of potassium permanganate.

Procedure

(i) Prepare a water bath using a 250 cm^3 or 300 cm^3 beaker. Heat the water to about 100 °C.

(ii) Measure 10 cm^3 of solution **TZ** and 10 cm^3 of solution **TY** and put into separate boiling test tubes.

(iii) Put a thermometer into the boiling tube containing **TZ** solution.

(iv) Warm both the boiling tubes to a temperature of 50 °C.

(v) Pour **TY** into **TZ** and immediately start the stop watch and record the time taken for the purple colour to disappear.

(vi) Repeat the steps (ii) to (v) at 60 °C, 70 °C and 80 °C temperatures.

(vii) Record your results in tabular form.

Questions

(a) Write the half ionic equations and overall reaction equation for the reaction in this experiment.

(b) Plot the graph of $\log(\frac{1}{\text{time}})$ against $\frac{1}{T}(K^{-1})$.

(c) Determine the slope of the graph.

(d) Determine the activation energy.

3. Sample **X** contains two cations and anion. Using systematic qualitative analysis procedures, analyse the sample to identify the cations and anion present in sample **X**. Carefully, record your experiments, observations and inferences as shown in the experimental table.

Experimental Table

S/N	Experiments	Observations	Inferences

Questions

(i) Write the molecular formula for the sample.

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