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: 2022**

Instructions

1. This paper consists of **three (3)** questions. Answer **all** questions.
2. Question number **one (1)** carries 20 marks and the other **two (2)** carry 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, Cl = 35.5, Na = 23.

1. You are provided with the following solutions:
   A: 2.96 g of a mixture of sodium carbonate and sodium bicarbonate in a 500 cm^3 of an aqueous solution;
   B: 1.46 g of a pure hydrochloric acid in a 0.4 dm^3 of an aqueous solution;
   MO: Methyl orange indicator;
   POP: Phenolphthalein indicator.

   Procedure
   (i) Pipette 20 or 25 cm^3 of **A** into a 250 cm^3 titration flask.
   (ii) Add two drops of **POP**.
   (iii) Titrate this solution against **B** until a colour change is observed.
   (iv) Record the first titre value.
   (v) Add **MO** to the same solution.
   (vi) Continue titrating until a second colour change is observed.
   (vii) Record the second titre value.
   (viii) Repeat the titration procedures (i) to (vii) three times and record your results in a tabular form.

   Summary
   _____ cm^3 of solution **A** required _____ cm^3 of solution **B** when **POP** was used and _____ cm^3 of solution **B** when **MO** was used.

   Questions
   (a) Based on the indicators used, state the colour changes during the titrations.

   (b) Calculate the concentration of solution **A** in moles per litre when;
   (i) **POP** was used.
   (ii) **MO** was used.

   (c) Calculate the percentage of sodium carbonate in solution **A**.

2. You are provided with the following:
   K1: 0.1 M sodium hydroxide;
   K2: Butanedioic acid of unknown concentration;
   K3: Isobutyl alcohol;
   POP: Phenolphthalein indicator;
   Distilled water.

   Theory
   Butanedioic acid $(CH_2COOH)_2$ dissolves in both water and isobutyl alcohol at a constant ratio of concentration and temperature.

   Procedure 1
   (i) Pipette 20 or 25 cm^3 of **K2** into a conical flask. Add 2 or 3 drops of **POP**.
   (ii) Put **K1** in a burette.
   (iii) Titrate **K2** against **K1** in the presence of **POP** until a colour change is observed.
   (iv) Record the volume of the pipette and the volume of **K1** used as well as the room temperature.

Procedure 2

(i) Put 50 cm^3 of **K3** into a separating funnel. Add to it 50 cm^3 of distilled water.

(ii) Measure 50 cm^3 of **K2** and put it into a separating funnel in (i). Shake the mixture well.

(iii) Run off the lower aqueous layer into a clean beaker.

(iv) Using a measuring cylinder, measure 25 cm^3 of the aqueous layer into a clean conical flask.

(v) Titrate this aliquot against **K1** using **POP** (only one titration is enough).

Summary 2

Volume of **K1** used was _____.

Questions

(a) Write a balanced chemical equation representing the reaction taking place in the titration.

(b) Calculate the;

(i) initial concentration of **K2** in water.

(ii) final concentration of **K2** in the aqueous layer.

(iii) acid concentration in the organic layer.

(iv) partition coefficient of **K2** between water and isobutyl alcohol.

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

Experimental Table

S/n	Experiments	Observations	Inferences
(a)	Appearance of the sample **H**.		
(b)	Heat a small portion of the sample in a dry test tube.		
(c)	Perform a flame test.		
(d)	Add concentrated sulphuric acid to the small portion of the sample.		
(e)	To the small portion of the prepared solution, add dilute sodium hydroxide.		
(f)	To the small portion of the solution, add dilute HCl followed by hydrogen sulphide. Filter the precipitates to obtain filtrate and residue then proceed as follows:		

	(i) To the filtrate, add potassium ferrocyanide (III).		
	(ii) Dissolve the residue in aqua regia and then add excess 50% ammonia solution.		
(g)	To the small portion of the solution, add dilute nitric acid followed by silver nitrate.		

Questions

(i) Write the molecular formula for the sample.
(ii) What are the cations and anion in the sample?