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)

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

Instructions

1. This paper consists of **three (3)** questions.
2. Answer **all** the questions.
3. Question number **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. You are required to demonstrate your analytical skills by doing iodometric titration aiming at determining the number of molecules of water of crystallization. Use the following reagents to accomplish the analysis.

U1: solution of 0.04 M $KMnO_4$;
U2: solution of $Na_2S_2O_3.XH_2O$ made by dissolving 12.4 g in 0.5 dm^3 of distilled water;
U3: solution of 10% KI;
U4: starch solution;
U5: solution of 1 M sulphuric acid.

Theory

A quantitative reaction between potassium permanganate and potassium iodide in acidic medium involves production of iodine. During the titration process, molecules of iodine produced react with sodium thiosulphate.

Procedure

(i) Fill the burette with **U2**.
(ii) Pipette 20 cm^3 of **U1** into a conical flask. Add 20 cm^3 of distilled water. Swirl the mixture gently and then add 20 cm^3 of **U3** into the flask followed by 20 cm^3 of **U5** into the same flask.
(iii) Titrate **U2** with the solution mixture in the conical flask until a pale yellow colour is observed. Add 2 cm^3 of **U4** and continue to titrate until the dark blue colour is discharged to colourless.
(iv) Record the first titre value.
(v) Repeat steps (i) to (iv) three times to obtain three titre values.

Questions

(a) Tabulate the results.

(b) Write the balanced chemical equation for the experiment which involved:
  (i) production of iodine.
  (ii) consumption of iodine.
  (iii) the whole experiment.

(c) Calculate the actual molarity of solution **U1** after dilution.

(d) Compute the value of X in the formula $Na_2S_2O_3.XH_2O$.

(e) Explain what will happen when potassium permanganate is missing in this experiment.

2. Identification of the type of chemical reaction is an experimental parameter that requires chemical analysis skills. Using the reagents and apparatuses provided, determine whether the process of dissolving sample **PR** and **PK** is endothermic or exothermic:

PR: 2 g ammonium chloride;
PK: 2 g sodium hydroxide pellets;
Themometer.

Theory

When a solid chemical substance is dissolved in water, heat is either given out or absorbed. When heat is evolved to the surrounding, the reaction is exothermic and when heat is absorbed the reaction is endothermic.

Procedure

(i) Measure 50 cm^3 of distilled water in 100 cm^3 plastic beaker and record the initial temperature.

(ii) Add **PR** in a beaker containing distilled water. Stir the mixture using thermometer and record the final temperature.

(iii) Repeat steps (i) – (ii) using **PK** and hence record the results as indicated in Table 1.

Table 1: Experimental Results

Compound	Final temperature °C	Initial temperature °C	Temperature change °C	Total volume (cm^3)	Mass of solution g
PR					
PK					

Questions

(a) Find the heat change for dissolution of:
   (i) PR
   (ii) PK

(b) Calculate the molar enthalpy change for dissolution of:
   (i) PR
   (ii) PK

(c) Giving a reason in each case, state the type of reaction (in relation to heat changes) for the dissolution of:
   (i) PR
   (ii) PK

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

Table 2: Experimental Data

S/N	Experiments	Observations	Inferences

Questions

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

(b) Write the molecular formula for the sample.