

**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: 2023

Instructions

1. This paper consists of **three (3)** questions. Answer **all** the questions.
2. Question number **one (1)** carries **20** marks and the other **two (2)** carry **15** marks each.
3. Qualitative Analysis Guide (QAG) sheet authorised 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 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 atomic masses:

H = 1, C = 12, O = 16, S = 32, Na = 23.



1. You are provided with the following solutions:

T1: A solution containing a mixture of NaOH and Na₂CO₃;

T2: 0.2 M hydrochloric acid;

POP: Phenolphthalein indicator;

MO: Methyl orange indicator.

Procedure

- (i) Pipette 20 or 25 cm³ of **T1** into a clean conical flask.
- (ii) Add 3 drops of **POP** into **T1** in (i) and titrate the mixture against **T2** until a colour change is observed.
- (iii) Record the first titre value.
- (iv) After the first end point in step (ii), add 3 drops of **MO** in the solution mixture and continue titrating until the second colour change is observed.
- (v) Record the second titre value.
- (vi) Repeat the procedures (i) to (v) three times. Record your results as shown in Table 1.

Table 1: Table of Results

Burette Readings (cm ³)	Pilot	1	2	3
Second end point				
First end point				
Initial reading				
First titre volume				
Second titre volume				

Summary

_____ cm³ of **T1** required _____ cm³ of **T2** in presence of **POP** and
_____ cm³ of **T2** in presence of **MO** for complete reaction.

Questions

- (a) Explain the colour change observed for the reaction taking place between:
 - (i) **T1** and **T2** in the presence of **POP**.
 - (ii) **T1** and **T2** in the presence of **MO**.
- (b) Write a balanced chemical equation for the reaction taking place in:
 - (i) procedure (ii).
 - (ii) procedure (iv).
- (c) Calculate;
 - (i) the concentration of sodium carbonate in g/dm³.
 - (ii) the concentration of sodium hydroxide in g/dm³.
 - (iii) the percentage composition of each component in **T1**.

2. You are provided with the following:

P1: A solution containing 49.6 g/dm^3 of $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$;

P2: Dilute HCl;

Distilled water;

A white plain paper marked **X**;

Stop watch/clock.

Procedure

You are required to investigate the effect of concentration of sodium thiosulphate on the rate of reaction between sodium thiosulphate and hydrochloric acid using the following steps:

- (i) Place a 50 cm^3 beaker on top of the mark **X** in such a way that, the mark is clearly seen through the bottom of the beaker.
- (ii) Measure 10 cm^3 of solution **P1** and pour it into a beaker in (i). Then, add 5 cm^3 of **P2** and immediately start the stop watch. Stir the mixture gently and record the time taken for the disappearance of the mark **X**.
- (iii) Repeat the procedure (ii) using:
 - 8 cm^3 of **P1**, 2 cm^3 of water and 5 cm^3 of **P2**.
 - 6 cm^3 of **P1**, 4 cm^3 of water and 5 cm^3 of **P2**.
 - 4 cm^3 of **P1**, 6 cm^3 of water and 5 cm^3 of **P2**.
- (iv) Record your results in a tabular form as follows:

Volume of P1 (cm^3)	Volume of Distilled Water (cm^3)	Volume of P2 (cm^3)	[P1] (mol/dm^3)	t (Sec)	1/t (Sec^{-1})	[P1] \times t ($\text{mol/dm}^3\text{Sec}$)

Questions

- (a) Plot a graph of [P1] (mol/dm^3) against time, t (sec).
- (b) Plot a graph of $1/t$ (sec^{-1}) against [P1] (mol/dm^3).
- (c) Study the results and the graphs then answer the following questions:

- (i) What is the effect of concentration of $\text{Na}_2\text{S}_2\text{O}_3$ on the rate of reaction?
- (ii) What is the order of reaction with respect to $\text{Na}_2\text{S}_2\text{O}_3$?
- (iii) How did you reach your conclusion in (c) (ii)?

(d) Comment on the value of the product of concentration and time; that is $[\text{P1}] \times t$.

3. You are provided with sample **U** containing **two cations** and **one anion**. Perform the experiments given in Table 2 and record the observations. Make appropriate inferences and hence identify the two cations and anion.

Table 2: Experimental Table

S/n	Experiments	Observations	Inferences
(a)	Observe sample U.		
(b)	Heat a small portion of the sample in a dry test tube.		
(c)	Perform a flame test.		
(d)	Add concentrated sulphuric acid to a small portion of the sample.		
(e)	To the small portion of solution of the sample, add dilute sodium hydroxide.		
(f)	To the small portion of the solution of the sample 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 hexacyanoferrate(II).		
	(ii) Dissolve the residue in aqua regia and then add excess ammonia solution.		
(g)	To the small portion of the solution of the sample, 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?