THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
DIPLOMA IN SECONDARY EDUCATION EXAMINATION

732/2A **CHEMISTRY 2A**

(ACTUAL PRACTICAL A)

Time: 3 Hours **ANSWERS** **Year: 2016**

Instructions.

1. This paper consists of **three (3)** questions.
2. Answer **all** questions
3. Question number 1 carries 20 marks and the rest carry 30 marks.
4. Cellular phones are **note** allowed in the examination room.
5. Write your **examination Number** on every page of your answer booklet(s).

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1. You are provided with the following:

Solution A: 0.1 M hydrochloric acid

Solution B: A solution prepared by dissolving 0.720 g of an unknown metallic hydroxide MOH in 250 cm^3 of solution

Indicator: Methyl orange

(a) Pipette 25.0 cm^3 of solution B into a conical flask and add 3 drops of methyl orange indicator. Titrate it against solution A until a permanent colour change is observed. Repeat the titration three times.

The titration was performed as described. The methyl orange changed from yellow to orange-red at the end point, showing neutralization.

(i) Tabulate your titration results clearly and determine the average volume of hydrochloric acid used.

Titration Number	**Final Burette Reading (cm^3)**	**Initial Burette Reading (cm^3)**	**Volume Used (cm^3)**
1	24.6	0.0	24.6
2	24.8	0.0	24.8
3	24.7	0.0	24.7

Average volume = (24.6 + 24.8 + 24.7) ÷ 3 = 74.1 ÷ 3 = **24.7 cm^3**

(ii) Write the balanced chemical equation for the neutralization reaction between MOH and HCl.

$MOH + HCl \rightarrow MCl + H_2O$

(iii) Calculate the number of moles of HCl used in the average titration.

Moles = molarity × volume in dm^3

= 0.1 × (24.7 ÷ 1000)

= 0.1 × 0.0247 = **0.00247 mol**

(iv) Using your result, calculate the number of moles of MOH present in the pipetted volume.

From the equation, 1 mol of MOH reacts with 1 mol of HCl

So moles of MOH = moles of HCl = **0.00247 mol**

(v) Determine the concentration of solution B in mol/dm^3.

Concentration = moles ÷ volume

= 0.00247 ÷ 0.025 = **0.0988 mol/dm^3**

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(vi) From the mass of MOH used to prepare the 250 cm^3 solution, calculate the molar mass of MOH.

Mass in 1 dm^3 = 0.720 × (1000 ÷ 250) = 2.88 g

Molar mass = mass ÷ moles = 2.88 ÷ 0.0988 = **29.15 g/mol**

(vii) Deduce the identity of element M, given that it is a common reactive metal.

MOH has a molar mass of approximately 29.15 g/mol. Subtracting 17 (OH),

M = 29.15 − 17 = 12.15 g/mol ≈ **12**, which is **magnesium**.

So, element M is **magnesium**.

2. You are provided with:

T1: 40 g/dm^3 sodium thiosulphate solution

T2: 0.5 M sulphuric acid

T3: Distilled water

A white paper marked "X", a beaker, and stopwatch

(a) Place the white paper marked "X" on the bench and a clean 50 cm^3 beaker over it. Mix the given volumes of T1 and T3 (distilled water) in the beaker. Then add 10 cm^3 of T2 quickly and start the stopwatch. Record the time taken for the "X" to disappear from view. Use the volumes below:

(b)

Experiment	Volume of T1 (cm^3)	Volume of T3 (cm^3)	Volume of T2 (cm^3)
1	2	8	10
2	4	6	10
3	6	4	10
4	8	2	10

(b) Record your results in the table provided and calculate the rate of reaction for each.

Experiment	t (s)	1/t (s^{-1})
1	420	0.00238
2	180	0.00556
3	90	0.01111
4	44	0.02273

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(c) Plot a graph of rate (1/t) against volume of T1.

(d) What is the shape of the graph and what does it indicate about the reaction?
The graph is a straight line passing through the origin. This indicates that the rate is directly proportional to the concentration of sodium thiosulphate.

(e) Determine the order of reaction with respect to sodium thiosulphate.
Since the rate is directly proportional to the volume (concentration), the reaction is **first-order** with respect to sodium thiosulphate.

(f) Write the balanced ionic equation for the reaction that occurred.
$S_2O_3^{2-}(aq) + 2H^+(aq) \rightarrow SO_2(g) + S(s) + H_2O(l)$

(g) State one observable change that confirms the reaction has taken place.
The solution turns cloudy due to the formation of a **sulphur precipitate**, which causes the "X" to disappear.

(h) Suggest one experimental factor that must be kept constant to ensure fair comparison.
The **volume and concentration of T2 (acid)** must be kept constant in each trial.

3. You are provided with a white crystalline solid labeled Sample N. Carry out the following tests and record both observations and inferences.

Test	Observation	Inference
(a) Appearance of the sample	White crystalline solid	Likely ionic salt
(b) Solubility of the sample in cold water	Dissolves completely	Soluble salt
(c) Flame test	Yellow flame	Sodium ion present (Na^+)
(d) Add dilute HCl to a portion of the solid	Effervescence; gas turns limewater milky	Carbonate ion present (CO_3^{2-})
(e) Add barium chloride to the solution of N	White precipitate forms	Sulphate or carbonate suspected
(f) Add sodium hydroxide dropwise, then in excess	No precipitate	Group I metal ion likely
(g) Add ammonia solution dropwise, then in excess	No precipitate	Confirms Na^+ ion

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(b) Identify the anion and the cation present in Sample N.

Cation: Sodium ion (Na^+)

Anion: Carbonate ion (CO_3^{2-})

(c) Write two balanced chemical equations to confirm the presence of the ions.

$Na_2CO_3(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + CO_2(g) + H_2O(l)$

$CO_3^{2-}(aq) + 2H^+(aq) \rightarrow CO_2(g) + H_2O(l)$

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