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: 2015**

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).

1. You are provided with the following:

Solution P: A 0.1 M solution of sodium hydroxide

Solution Q: A solution prepared by dissolving 0.950 g of a metallic nitrate (MNO_3) in 250 cm^3 of distilled water

Indicator: Methyl orange

(a) Using a pipette, measure 25.0 cm^3 of solution Q into a conical flask and add 3 drops of methyl orange. Titrate with solution P from a burette until the solution turns from orange to yellow. Repeat the titration to get three consistent readings.

The titration was performed as instructed. Methyl orange changed from orange to yellow, indicating the end point. Three titrations were performed to ensure accuracy.

(b) Record the titration results clearly in a table and calculate the average volume of sodium hydroxide used.

Titration Number	**Final Burette Reading (cm^3)**	**Initial Burette Reading (cm^3)**	**Volume Used (cm^3)**
1	19.8	0.0	19.8
2	20.0	0.0	20.0
3	20.0	0.0	20.0

Average volume used = (19.8 + 20.0 + 20.0) ÷ 3 = **19.93 cm^3**

(c) Write a balanced chemical equation for the reaction between sodium hydroxide and MNO_3.

$MNO_3 + NaOH \rightarrow M(OH) + NaNO_3$

(d) Calculate the number of moles of NaOH used during titration.

Moles = molarity × volume in dm^3

= 0.1 × (19.93 ÷ 1000)

= 0.1 × 0.01993 = **0.001993 mol**

(e) Determine the number of moles and concentration of MNO_3 in solution Q.

From the balanced equation: 1 mol of MNO_3 reacts with 1 mol of NaOH

Moles of MNO_3 = 0.001993 mol

Concentration = moles ÷ volume = 0.001993 ÷ 0.025 = **0.07972 mol/dm^3**

(f) Using the total mass of MNO_3 used to prepare the solution, calculate its molar mass.

Mass in 1 dm^3 = 0.950 × (1000 ÷ 250) = 3.8 g

Molar mass = mass ÷ moles = 3.8 ÷ 0.07972 = **47.65 g/mol**

(g) Deduce the likely identity of metal M if it is a reactive alkali earth metal.

Molar mass of MNO_3 = 47.65 g/mol.

Given molar mass of 47.65 g/mol ≈ metal hydroxide, then

Subtract OH = 47.65 − 17 = 30.65 g/mol, closest to **magnesium (Mg = 24.3)**

Hence, the likely identity of M is **magnesium**.

2. You are provided with:

Hydrogen peroxide solution (H_2O_2), freshly prepared manganese(IV) oxide powder (MnO_2), and distilled water.

You are to study how the amount of MnO_2 affects the rate of oxygen gas evolution during the decomposition of hydrogen peroxide.

Experiment	Mass of MnO_2 (g)	Volume of H_2O_2 (cm^3)	Time for bubbling to stop (s)
1	0.1	10	180
2	0.2	10	100
3	0.4	10	48
4	0.6	10	30

(b) For each trial, calculate the rate of reaction as 1/t and complete the table.

Experiment	Mass of MnO_2 (g)	Time (s)	1/t (s^{-1})
1	0.1	180	0.00556
2	0.2	100	0.01000
3	0.4	48	0.02083
4	0.6	30	0.03333

(c) Plot a graph of rate (1/t) against mass of MnO_2.

[A straight line graph is expected, indicating direct proportionality.]

(d) What is the relationship between the rate of reaction and the amount of catalyst?

The rate increases proportionally as the mass of MnO_2 increases. This shows that the amount of catalyst positively affects the speed of reaction, although the catalyst itself is not consumed.

(e) Write the balanced chemical equation for the decomposition of hydrogen peroxide.

$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$

(f) What is the role of MnO_2 in this experiment?

MnO_2 acts as a **catalyst**. It increases the rate of decomposition of H_2O_2 without being consumed in the reaction.

(g) State two safety precautions to observe when handling hydrogen peroxide.

1. Wear safety goggles and gloves to avoid contact with skin and eyes, as hydrogen peroxide is corrosive.
2. Handle with care in a well-ventilated area, as it releases oxygen which may intensify fire.

3. A white powder labelled Substance Y is suspected to be an ionic compound. Carry out the following tests to identify the ions present.

Test	Observation	Inference
(a) Appearance of substance Y	White powder	Likely ionic salt
(b) Solubility in cold water	Dissolves completely	Soluble ionic salt
(c) Perform a flame test using a platinum wire	Bright yellow flame	Sodium ion (Na^+) present
(d) Add dilute nitric acid to a small amount of Y	Effervescence observed	Carbonate ion (CO_3^{2-}) present
(e) Add barium nitrate solution to the above solution	White precipitate forms	Confirms CO_3^{2-} (not SO_4^{2-} as no acid present)
(f) Add sodium hydroxide to a fresh portion of Y	No precipitate	Confirms Group I metal ion
(g) Add excess sodium hydroxide to the above solution	Still no precipitate	Confirms Na^+

(a) Complete the table above by recording your observations and inferences.

Done above.

(b) Identify the cation and anion present in substance Y.

Cation: **Sodium ion (Na^+)**

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

(c) Write two ionic equations for confirmatory tests of these ions.

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

$Na^+(aq) + OH^-(aq) \rightarrow$ no visible reaction (remains in solution)