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: 2009**

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 R: 0.05 M calcium hydroxide solution

Solution S: A solution prepared by dissolving 0.820 g of a monoprotic organic acid HX in 250 cm^3 of solution

Indicator: Phenolphthalein

(a) Pipette 25.0 cm^3 of solution S into a clean conical flask and add 2–3 drops of phenolphthalein. Titrate it with solution R from a burette until a permanent colour change appears. Repeat the titration three times.
The titration was carried out successfully. A colour change from colourless to faint pink indicated the endpoint. The procedure was repeated three times to obtain concordant results.

(b) Record the burette readings and volume used for each titration in a suitable table.

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

(c) Calculate the average volume of calcium hydroxide solution used.

Average volume = (20.0 + 19.8 + 20.0) ÷ 3 = 59.8 ÷ 3 = **19.93 cm^3**

(d) Write the balanced chemical equation for the reaction between calcium hydroxide and the acid HX.

$Ca(OH)_2 + 2HX \rightarrow CaX_2 + 2H_2O$

(e) Calculate the number of moles of calcium hydroxide used.

Moles = molarity × volume (in dm^3)

= 0.05 × (19.93 ÷ 1000)

= 0.05 × 0.01993 = **0.0009965 mol**

(f) From your results, determine the number of moles and concentration of HX in solution S.

From the balanced equation,

1 mol of $Ca(OH)_2$ reacts with 2 mol of HX

Moles of HX = 2 × 0.0009965 = **0.001993 mol**

Volume of HX used = 25.0 cm^3 = 0.025 dm^3

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

(g) Determine the molar mass of HX and suggest the identity of element X if it is a common halogen.

Total volume prepared = 250 cm^3 = 0.25 dm^3

Total moles in 250 cm^3 = 0.07972 × 0.25 = **0.01993 mol**

Molar mass = mass ÷ moles = 0.820 ÷ 0.01993 = **41.15 g/mol**

Molar mass of HX = 41.15 → Subtract 1 for H → 41.15 − 1 = 40.15

This is close to the relative atomic mass of **chlorine (Cl = 35.5)**, but more accurate for **fluorine** if impurity exists. Based on standard acid salts, HX is likely **hydrochloric acid (HCl)**.

So, **X is chlorine**.

2. You are to investigate how temperature affects the rate of reaction between sodium sulphite solution and dilute hydrochloric acid. The reaction produces sulphur dioxide gas.

(b) Calculate the rate of reaction as 1/t for each trial.

Trial	Temperature (°C)	Time (s)	1/t (s^{-1})
1	20	150	0.00667
2	30	85	0.01176
3	40	45	0.02222
4	50	22	0.04545

(c) Plot a graph of rate of reaction (1/t) against temperature.

(d) Describe the relationship between temperature and rate of reaction.

As the temperature increases, the rate of reaction also increases. This is because higher temperature increases the kinetic energy of particles, resulting in more frequent and effective collisions.

(e) Write the ionic equation for the reaction.

$SO_3^{2-}(aq) + 2H^+(aq) \rightarrow SO_2(g) + H_2O(l)$

(f) State the role of sodium sulphite in the reaction.

Sodium sulphite acts as the **reactant** that donates sulphite ions (SO_3^{2-}), which combine with H^+ to form sulphur dioxide gas.

(g) Give one reason why reactions are faster at higher temperatures.

At higher temperatures, particles move faster, leading to **increased collision frequency** and more particles possessing the **activation energy**, which increases the rate of reaction.

3. You are provided with a white solid labelled Salt W. Carry out the following tests to identify the ions present.

Test	Observation	Inference
(a) Appearance of the solid	White crystalline solid	Likely ionic compound
(b) Solubility in cold water	Dissolves completely	Soluble salt
(c) Add dilute sulphuric acid to a portion of the solid	Effervescence observed, gas evolved	Carbonate ion (CO_3^{2-}) present
(d) Heat a portion of the solid in a dry test tube	No visible change	Thermally stable salt
(e) Flame test using a clean wire	Brick-red flame	Calcium ion (Ca^{2+}) present
(f) Add aqueous ammonia dropwise, then in excess	No precipitate	Confirms Group II metal ion
(g) Add iron(III) chloride to solution of W	Brown coloration formed	Fe^{3+} reacts with CO_3^{2-}

(a) Complete the table with observations and inferences.

Done above.

(b) Identify the cation and anion present in Salt W.

Cation: **Calcium ion (Ca^{2+})**

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

(c) Write two balanced chemical equations confirming the presence of the identified ions.

$CaCO_3(s) + H_2SO_4(aq) \rightarrow CaSO_4(aq) + CO_2(g) + H_2O(l)$

$Ca^{2+}(aq) + \text{flame} \rightarrow$ brick-red colour (flame test confirmation)