THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

032/2A **CHEMISTRY 2A**

(ACTUAL PRACTICAL A)

(For Both School and Private Candidates)

Time: 2:30 Hours **ANSWERS** **Year: 2001**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. You are provided with the following:
(a) Solution A which contains 4.39 g of sulphuric acid per dm^3
(b) Solution B of monovalent metal X hydroxide. Solution B is made by dissolving 2.00 g of X hydroxide in distilled water and making up to 1000 cm^3
(c) Methyl orange indicator

Procedure:
Put the acid solution in the burette. Pipette 25 cm^3 of solution B into the titration flask. Add a few drops of methyl orange indicator. Titrate this base against solution A until the end point is reached. Record your titration results.

(a) Volume of pipette used was 25.00 cm^3

(b) Table of results

Titration	Final reading (cm^3)	Initial reading (cm^3)	Volume used (cm^3)
Pilot	24.90	0.00	24.90
1	25.00	0.00	25.00
2	24.80	0.00	24.80
3	25.00	0.00	25.00

(c) The colour change at the end point was from yellow to pink-orange

(d) The volume of acid solution A needed for complete neutralisation was 24.93 cm^3

(e) Write a balanced equation for the reaction
$H_2SO_4 + 2XOH \text{ ----> } X_2SO_4 + 2H_2O$

(f) Calculate:
(i) The molarity of acid solution
Mass = 4.39 g
Molar mass of H_2SO_4 = 98
Moles = 4.39 ÷ 98 = 0.0448 mol
Molarity = 0.0448 mol/dm^3

(ii) The molarity of the base solution
Moles of H_2SO_4 used = 0.0448 × (24.93 ÷ 1000) = 0.001117 mol
From equation, 1 mol H_2SO_4 reacts with 2 mol XOH
Moles of XOH = 0.001117 × 2 = 0.002234 mol
Volume = 25.00 cm^3 = 0.025 dm^3
Molarity = 0.002234 ÷ 0.025 = 0.08936 mol/dm^3

(iii) The molar mass of monovalent metal X hydroxide

Concentration = 2.00 g in 1 dm^3
Molar mass = 2.00 ÷ 0.08936 = 22.38 g/mol

(iv) The atomic mass of metal X
XOH = X + 16 + 1 = X + 17
X + 17 = 22.38
X = 5.38
X ≈ 6
Atomic mass of X = 6

(v) Metal X is most likely lithium (Li)

2. Sample X is a simple salt containing ONE cation and ONE anion. Carry out the experiments described and identify the cation and anion in sample X.

Test	Experiment	Observation	Inference
(i)	Appearance	White crystalline solid	Colourless ionic salt
(ii)	Heat a spatula of sample X in a test tube	White fumes observed	Presence of ammonium salt
(iii)	Add NaOH solution and warm. Test gas with moist red litmus	Gas turns red litmus blue	Ammonia evolved confirms NH_4^+
(iv)	Add dilute HCl to X, warm, pass gas into limewater	Effervescence, gas turns limewater milky	CO_3^{2-} present
(v)	Add $FeSO_4$, then conc. H_2SO_4 down the test tube side	Brown ring observed at interface	Confirms NO_3^-
(vi)	Dissolve sample in water	Clear solution formed	Salt is soluble
(vii)	Add $MgCl_2$ then NH_4OH	White precipitate	Confirms PO_4^{3-} or carbonate

Conclusion
The cation is NH_4^+ and the anion is CO_3^{2-}
(a) Balanced chemical equations:
(ii) $NH_4Cl + NaOH \longrightarrow NaCl + NH_3 + H_2O$
(iv) $(NH_4)_2CO_3 + 2HCl \longrightarrow 2NH_4Cl + H_2O + CO_2$

(b) Confirmatory test for CO_3^{2-}: Add HCl and pass evolved gas through limewater; turns milky

3. Sample Z contains ONE cation and ONE anion. Using systematic qualitative analysis procedures, identify the ions in sample Z.

Test	Experiment	Observation	Inference
(a)	Observe physical appearance of Z	White crystalline solid	Colourless ionic salt
(b)	Heat solid Z in a dry test tube	No water or gas evolved	No water of crystallization
(c)	Dissolve in water and add NaOH dropwise and in excess	White precipitate, soluble in excess	Zn^{2+} confirmed
(d)	Add NH_4OH dropwise and then in excess	White precipitate, dissolves in excess	Confirms Zn^{2+}
(e)	Add $BaCl_2$ then HCl to solution of Z	White precipitate persists	Confirms SO_4^{2-}
(f)	Add $AgNO_3$ to solution of Z followed by HNO_3	No precipitate	Confirms absence of Cl^-, Br^-
(g)	Perform flame test	No colour	Non-alkali metal

Conclusion
The cation present in Z is Zn^{2+} and the anion is SO_4^{2-}