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: 2003**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. You are provided with:
1.1 Solution K containing 8.94 g/dm³ of HQ acid solution
1.2 Solution M containing 2.0 g of sodium hydroxide in 0.5 dm³ of the solution
1.3 Methyl orange indicator

Procedure
Put solution K into the burette. Pipette 25 cm³ of solution M in a titration flask. Add two drops of methyl orange indicator. Titrate solution M against solution K until a colour change is observed. Repeat the procedure to obtain three more readings and record your results.

(a) Table of results

Titration	Final reading (cm³)	Initial reading (cm³)	Titre volume (cm³)
Pilot	25.00	0.00	25.00
1	24.90	0.00	24.90
2	25.00	0.00	25.00
3	24.80	0.00	24.80

(i) The colour change at the end point was from yellow to orange-pink
(ii) Summary: 25.00 cm³ of solution M required 24.90 cm³ of K for complete reaction

(b) Write a balanced chemical equation for the reaction between solution M and K
$NaOH + HQ \text{ ----> } NaQ + H_2O$

(c) Calculate the:
(i) Molarity of solution M
Mass of NaOH = 2.0 g in 0.5 dm³
Molar mass = 40 g/mol
Moles = 2.0 ÷ 40 = 0.05 mol
Molarity = 0.05 ÷ 0.5 = 0.10 mol/dm³

(ii) Molarity of solution K
Moles of NaOH in 25 cm³ = 0.10 × 0.025 = 0.0025 mol
From balanced equation, mole ratio = 1:1
Moles of HQ = 0.0025 mol
Volume = 24.90 cm³ = 0.02490 dm³
Molarity = 0.0025 ÷ 0.02490 = 0.1004 mol/dm³

(iii) Molar mass of HQ
Concentration = 8.94 g/dm³
Moles = 0.1004 mol/dm³
Molar mass = 8.94 ÷ 0.1004 = 89.01 g/mol

(iv) Atomic mass of Q
HQ = H + Q = 1 + Q = 89.01
Q = 89.01 − 1 = 88.01
Q = 88
Element Q is likely strontium (Sr = 88)

(v) What is element Q in the acid HQ?
Element Q is strontium (Sr)
2. Sample S is a simple salt containing ONE cation and ONE anion. Carry out the experiments described below carefully and record ALL observations and appropriate inferences. Identify the CATION and ANION present in the salt sample S.

(a) Appearance
Observation: White crystalline solid
Inference: Colourless ionic compound

(b) Heat a spatula of sample S in a test tube while rotating. Test for gas
Observation: No gas observed
Inference: No water of crystallization or thermally unstable anion

(c)(i) Add dilute HCl to sample S
Observation: Effervescence observed
Inference: CO_3^{2-} present

(ii) Heat contents and allow to cool
Observation: No further reaction
Inference: Confirms no ammonium ion

(iii) Add concentrated HCl to sample
Observation: More effervescence
Inference: Confirms carbonate

(d) Add dilute nitric acid
Observation: Effervescence
Inference: CO_3^{2-} confirmed

(e) Divide solution into two portions:
(i) Add potassium dichromate
Observation: Yellow solution remains
Inference: No Cr^{3+}

(ii) Add potassium iodide
Observation: Yellow precipitate

Inference: Pb^{2+} likely

(f) Warm the contents
Observation: Precipitate darkens
Inference: Confirms Pb^{2+}

Conclusion
The cation in sample S is Pb^{2+} and the anion is CO_3^{2-}

3. Substance P is a simple salt containing ONE cation and ONE anion. Using systematic qualitative analysis procedures, carry out tests on P and make appropriate observations and inferences to identify the CATION and ANION in the sample P.

Test	Experiment	Observation	Inference
(a)	Observe the physical appearance of solid P	Blue crystalline solid	Likely presence of Cu^{2+}
(b)	Heat a little of solid P in a dry test tube	No water droplets or gas evolved	No water of crystallization
(c)	Dissolve a spatula of P in distilled water and shake	Blue solution formed	Salt is soluble, confirms Cu^{2+}
(d)	Add dilute HCl to a portion of solid P	Blue solution formed, no effervescence	Absence of carbonate
(e)	Perform a flame test	Bluish-green flame observed	Presence of copper
(f)	Add NaOH dropwise to solution of P, then in excess	Blue precipitate formed, insoluble in excess	Cu^{2+} confirmed ($Cu(OH)_2$ formed)
(g)	Add aqueous NH_3 dropwise to solution of P, then in exces	Deep blue solution formed	Confirms Cu^{2+} ($[Cu(NH_3)_4]^{2+}$)
(h)	Add $AgNO_3$ to solution of P followed by dilute HNO_3	White precipitate formed, soluble in NH_3	Cl^- confirmed (AgCl)
(i)	Add $BaCl_2$ to solution of P followed by dilute HCl	No precipitate formed	Absence of SO_4^{2-}
(j)	Add $Pb(NO_3)_2$ to solution of P	No precipitate formed	Absence of CO_3^{2-}

Conclusion
The cation present in P is Cu^{2+} and the anion is Cl^-