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: 2006**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. You are provided with the following:
Solution AA containing 3.65 g of HCl per dm³ of the solution
Solution BB containing 7.15 g of hydrated sodium carbonate ($Na_2CO_3 \cdot xH_2O$) in 0.5 dm³ of the solution
Methyl orange indicator
Determine the value of x in $Na_2CO_3 \cdot xH_2O$

Procedure
Put the acid solution AA in the burette. Pipette 25 cm³ of solution BB into the titration flask. Add two drops of methyl orange indicator. Titrate solution BB against solution AA from the burette until a colour change is observed. Note the reading of the burette. Repeat the procedure to obtain three more readings.

(a)(i) Burette readings

Titration	Final reading (cm³)	Initial reading (cm³)	Volume used (cm³)
Pilot	25.00	0.00	25.00
1	24.90	0.00	24.90
2	25.00	0.00	25.00
3	24.90	0.00	24.90

(ii) The volume of pipette used was 25.00 cm³
(iii) Summary: 25.00 cm³ of solution BB required 24.93 cm³ of solution AA for complete reaction
(iv) The colour change at the end point was from yellow to orange-pink

(v) Write the balanced chemical equation for the reaction between solution AA and BB
$Na_2CO_3 + 2HCl \longrightarrow 2NaCl + H_2O + CO_2$
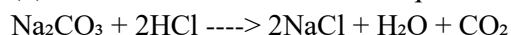
(c)(a) Concentration of solution AA in moles/dm³
Mass = 3.65 g
Molar mass of HCl = 36.5 g/mol
Moles = 3.65 ÷ 36.5 = 0.10 mol
Volume = 1 dm³
Molarity = 0.10 mol/dm³

(b) Molarity of solution BB
Volume of AA used = 24.93 cm³ = 0.02493 dm³
Moles of HCl = 0.10 × 0.02493 = 0.002493 mol
From equation: 2 mol HCl react with 1 mol Na_2CO_3
Moles of Na_2CO_3 = 0.002493 ÷ 2 = 0.001247 mol
Volume of BB = 25.00 cm³ = 0.02500 dm³
Molarity of BB = 0.001247 ÷ 0.02500 = 0.04988 mol/dm³

(c) Determine the value of x in $Na_2CO_3 \cdot xH_2O$
Mass = 7.15 g in 0.5 dm³ = 14.30 g/dm³

Moles = 0.04988 mol
Molar mass = 14.30 ÷ 0.04988 = 286.7 g/mol
Molar mass of Na_2CO_3 = 106
Water = 286.7 − 106 = 180.7
x = 180.7 ÷ 18 = 10.04 ≈ 10
Value of x = 10

2. Sample Q is a pure salt containing one cation and one anion. Carry out carefully the experiments described below. Record all your observations and appropriate inferences. Identify the cation and anion present in sample Q.

(a) Appearance of sample Q
Observation: White crystalline solid
Inference: Colourless ionic salt

(b) To half a spatula of sample Q in a test tube add concentrated H_2SO_4 and warm
Observation: Pungent gas evolved
Inference: Likely HCl; Cl^- present

(c) To half a spatula of sample Q in a test tube add distilled water and stir then boil
Observation: Clear solution formed
Inference: Salt is soluble

(d) Dissolve a spatula full of sample Q in dilute nitric acid. Divide the solution into three portions.

(i) Add sodium hydroxide solution till excess
Observation: White precipitate, insoluble in excess
Inference: Pb^{2+} present

(ii) Add $NH_3(aq)$ till excess
Observation: White precipitate, slightly soluble
Inference: Pb^{2+} confirmed

(iii) Add $AgNO_3$ solution followed by dil. HNO_3, then $NH_3(aq)$
Observation: White precipitate that dissolves in NH_3
Inference: Cl^- confirmed

Conclusion
The cation in sample Q is Pb^{2+} and the anion is Cl^-
The molecular formula of salt Q is $PbCl_2$

3. Sample M is a simple salt containing one cation and one anion. Using systematic qualitative analysis procedures carry out tests on sample M and make appropriate observations and inferences to identify the cation and anion in sample M.

Experiment: Add NaOH solution
Observation: Blue precipitate
Inference: Cu^{2+} present

Experiment: Add $AgNO_3$
Observation: White precipitate
Inference: Cl^- present

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