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: 2009**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. You are provided with the following solutions:
Solution WW containing 4.38 g of pure hydrochloric acid per dm^3 of solution
Solution ZZ containing 14.30 g of hydrated sodium carbonate ($Na_2CO_3 \cdot xH_2O$) per dm^3
Methyl orange indicator

Procedure
Put solution WW in the burette. Pipette 25 cm^3 of solution ZZ into a titration flask. Add about three to four drops of methyl orange indicator into the titration flask. Titrate solution WW against solution ZZ until the end point is reached. Note the burette reading. Repeat the procedure to obtain three more readings. Record your results as shown in the following table:

(a)(i) Burette readings

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

(ii) The volume of pipette used was 25.00 cm^3
(iii) The volume solution WW needed for complete neutralization was 25.00 cm^3
(iv) The colour change at the end point was from yellow to orange-red

(b) Write down a balanced chemical equation for the reaction between solution ZZ and WW
$Na_2CO_3 + 2HCl$ ----> $2NaCl + H_2O + CO_2$

(c) Calculate the molarity of
(i) Solution WW
Mass = 4.38 g
Molar mass of HCl = 36.5 g/mol
Moles = 4.38 ÷ 36.5 = 0.12 mol
Molarity = 0.12 mol/dm^3

(ii) Solution ZZ
Volume of WW used = 25.00 cm^3 = 0.025 dm^3
Moles of HCl = 0.12 × 0.025 = 0.003 mol
From equation: 2 mol HCl reacts with 1 mol Na_2CO_3
Moles of Na_2CO_3 = 0.003 ÷ 2 = 0.0015 mol
Volume of ZZ = 25.00 cm^3 = 0.025 dm^3
Molarity of ZZ = 0.0015 ÷ 0.025 = 0.06 mol/dm^3

(d) Calculate the value of x in the formula $Na_2CO_3 \cdot xH_2O$
Mass of hydrated salt = 14.30 g in 1 dm^3

Moles = 0.06 mol
Molar mass = 14.30 ÷ 0.06 = 238.33 g/mol
Molar mass of Na_2CO_3 = 106
xH_2O = 238.33 − 106 = 132.33
x = 132.33 ÷ 18 = 7.35 ≈ 7
Value of x = 7

2. Sample M is a simple salt containing one cation and one anion. Carry out carefully the experiments described in the following table. Record all your observations and appropriate inferences to identify the ions present in M.

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

(b) Place a spatulaful of sample M in a test-tube and heat while rotating the tube. Test for any gas(es) evolved.
Observation: No gas evolved
Inference: No water of crystallization or decomposable anion present

(c) Place a spatulaful of sample M in a test tube and add dilute hydrochloric acid. Test for any gas(es) evolved. Add more of the acid until the test tube is half full. Divide the solution into three portions and then do the following:

(i) Add sodium hydroxide solution dropwise and then in excess to the first portion
Observation: White precipitate, soluble in excess
Inference: Zn^{2+} present

(ii) Add a few drops of potassium iodide solution to the second portion
Observation: No visible reaction
Inference: Pb^{2+} not present

(iii) Add ammonium hydroxide solution dropwise till excess to the third portion
Observation: White precipitate forms, dissolves in excess
Inference: Confirms Zn^{2+}

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

3. Substance V is a simple salt containing one cation and one anion. Using systematic qualitative analysis procedures carry out tests on V and make appropriate systematic observations and inferences to identify the cation and anion in V. Record your experiments, observations and inferences as shown in the following table:

Experiment: Add NaOH solution
Observation: Reddish-brown precipitate
Inference: Fe^{3+} present

Experiment: Add $BaCl_2$ followed by dilute HNO_3
Observation: White precipitate persists
Inference: SO_4^{2-} present

Conclusion
The cation in sample V is Fe^{3+} and the anion is SO_4^{2-}