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: 2005**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. You are provided with the following:
Solution Q containing 2.0 g of sodium hydroxide in 0.5 dm^3 of the solution
Solution R containing 3.15 g of hydrated oxalic acid, $(COOH)_2 \cdot xH_2O$ in 0.25 dm^3 of the solution
Phenolphthalein indicator

You are required to determine the value of x in $(COOH)_2 \cdot xH_2O$.

Procedure
Pipette 25 cm^3 of solution Q into the conical flask. Add two or three drops of phenolphthalein indicator and titrate it against solution R from the burette to the end point. Note the burette reading. Repeat the procedure to obtain three more readings and record your results in a table as shown below.

(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	24.90	0.00	24.90
3	25.00	0.00	25.00

(ii) The volume of the pipette used was 25.00 cm^3
(iii) The colour change at the end point was from pink to colourless
(iv) The volume of solution R needed for complete neutralization of 25.00 cm^3 of solution Q was 24.97 cm^3

(b) Given the equation for the reaction
$(COOH)_2 + 2NaOH \text{ ----> } (COONa)_2 + 2H_2O$

(c)
(i) Calculate the concentration of the base, in grams per dm^3
Mass = 2.0 g
Volume = 0.5 dm^3
Concentration = $2.0 \div 0.5 = 4.0$ g/dm^3

(ii) Calculate the concentration of the acid solution R in moles per dm^3 and in grams per dm^3
Molar mass of NaOH = 40 g/mol
Moles of NaOH = $2.0 \div 40 = 0.05$ mol
Volume = 0.5 dm^3
Molarity of NaOH = $0.05 \div 0.5 = 0.10$ mol/dm^3

Volume of NaOH used = 25.00 cm^3 = 0.02500 dm^3
Moles = $0.10 \times 0.025 = 0.0025$ mol
From equation: 2 mol NaOH reacts with 1 mol oxalic acid

Moles of oxalic acid = 0.0025 ÷ 2 = 0.00125 mol
Volume = 24.97 cm^3 = 0.02497 dm^3
Molarity of R = 0.00125 ÷ 0.02497 = 0.05004 mol/dm^3

Concentration in g/dm^3 = 3.15 ÷ 0.25 = 12.6 g/dm^3

(iii) Find the value of x, the number of molecules of water of crystallization of oxalic acid in the formula $(COOH)_2 \cdot xH_2O$
Molar mass = 12.6 ÷ 0.05004 = 251.85 g/mol
Molar mass of $(COOH)_2$ = 90 g/mol
xH_2O = 251.85 − 90 = 161.85
x = 161.85 ÷ 18 = 8.99 ≈ 9
x = 9

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

(a) Observe the solid for its appearance
Observation: White crystalline solid
Inference: Colourless ionic compound

(b) Dissolve half a spatula of sample B in distilled water. Shake well
Observation: Clear solution formed
Inference: Salt is soluble in water

(c) Put a spatula of sample B in a test tube and heat gently, then very strongly
Observation: No gas evolved
Inference: No carbonate or water of crystallization

(d) Add dilute hydrochloric acid to a half spatula of sample B in a test tube
Observation: No effervescence
Inference: No carbonate ion

(e) Add concentrated sulphuric acid to a half spatula of sample B in a test tube
Observation: No visible reaction
Inference: No halide ions released

(f) Dissolve a spatula of sample B in dilute nitric acid. Shake until no solid remains. Divide the solution into three portions.

(i) Add sodium hydroxide dropwise till excess
Observation: White precipitate, soluble in excess
Inference: Zn^{2+} present

(ii) Add dilute ammonia dropwise till excess
Observation: White precipitate, soluble in excess
Inference: Zn^{2+} confirmed

(iii) Add potassium ferrocyanide solution
Observation: No visible precipitate
Inference: No heavy metal cation like Pb^{2+}

Conclusion
The cation in B is Zn^{2+} and the anion is likely Cl^{-}
The salt B is zinc chloride, $ZnCl_2$

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

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

Experiment: Add $BaCl_2$ solution
Observation: White precipitate persists in acid
Inference: SO_4^{2-} confirmed

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