

**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.

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1. You are provided with the following:

Solution Q containing 2.0 g of sodium hydroxide in 0.5 dm<sup>3</sup> of the solution

Solution R containing 3.15 g of hydrated oxalic acid, (COOH)<sub>2</sub>·xH<sub>2</sub>O in 0.25 dm<sup>3</sup> of the solution

Phenolphthalein indicator

You are required to determine the value of x in (COOH)<sub>2</sub>·xH<sub>2</sub>O.

#### Procedure

Pipette 25 cm<sup>3</sup> 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

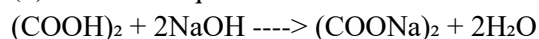
Titration	Final reading (cm <sup>3</sup> )	Initial reading (cm <sup>3</sup> )	Volume used (cm <sup>3</sup> )
Pilot	25.00	0.00	25.00
1	25.00	0.00	25.00
2	24.90	0.00	24.90
3	25.00	0.00	25.00

(ii) The volume of the pipette used was 25.00 cm<sup>3</sup>

(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<sup>3</sup> of solution Q was 24.97 cm<sup>3</sup>

(b) Given the equation for the reaction



(c)

(i) Calculate the concentration of the base, in grams per dm<sup>3</sup>

Mass = 2.0 g

Volume = 0.5 dm<sup>3</sup>

Concentration =  $2.0 \div 0.5 = 4.0 \text{ g/dm}^3$

(ii) Calculate the concentration of the acid solution R in moles per dm<sup>3</sup> and in grams per dm<sup>3</sup>

Molar mass of NaOH = 40 g/mol

Moles of NaOH =  $2.0 \div 40 = 0.05 \text{ mol}$

Volume = 0.5 dm<sup>3</sup>

Molarity of NaOH =  $0.05 \div 0.5 = 0.10 \text{ mol/dm}^3$

Volume of NaOH used = 25.00 cm<sup>3</sup> = 0.02500 dm<sup>3</sup>

Moles =  $0.10 \times 0.025 = 0.0025 \text{ mol}$

From equation: 2 mol NaOH reacts with 1 mol oxalic acid

Moles of oxalic acid =  $0.0025 \div 2 = 0.00125$  mol

Volume =  $24.97 \text{ cm}^3 = 0.02497 \text{ dm}^3$

Molarity of R =  $0.00125 \div 0.02497 = 0.05004 \text{ mol/dm}^3$

Concentration in  $\text{g/dm}^3 = 3.15 \div 0.25 = 12.6 \text{ g/dm}^3$

(iii) Find the value of x, the number of molecules of water of crystallization of oxalic acid in the formula  $(\text{COOH})_2 \cdot x\text{H}_2\text{O}$

Molar mass =  $12.6 \div 0.05004 = 251.85 \text{ g/mol}$

Molar mass of  $(\text{COOH})_2 = 90 \text{ g/mol}$

$x\text{H}_2\text{O} = 251.85 - 90 = 161.85$

$x = 161.85 \div 18 = 8.99 \approx 9$

$x = 9$

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:  $\text{Zn}^{2+}$  present

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

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

#### Conclusion

The cation in B is  $\text{Zn}^{2+}$  and the anion is likely  $\text{Cl}^-$   
The salt B is zinc chloride,  $\text{ZnCl}_2$

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:  $\text{Fe}^{3+}$  present

Experiment: Add  $\text{BaCl}_2$  solution  
Observation: White precipitate persists in acid  
Inference:  $\text{SO}_4^{2-}$  confirmed

#### Conclusion

The cation in sample TR is  $\text{Fe}^{3+}$  and the anion is  $\text{SO}_4^{2-}$