

**THE UNITED REPUBLIC OF TANZANIA  
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA  
DIPLOMA IN SECONDARY EDUCATION  
EXAMINATION**

732/2C

**CHEMISTRY 2C**

**Time: 3 Hours**

**ANSWERS**

**Year: 2021**

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**Instructions.**

1. This paper consists of sections three questions.
2. Answer **all** questions
3. Cellular phones are **not** allowed in the examination room.
4. Write your **examination Number** on every page of your answer booklet(s).

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1. You are given:

- **Solution A:** 43.99 g of impure anhydrous sodium carbonate in 1 dm<sup>3</sup>
- **Solution B:** 7.30 g of HCl in 1 dm<sup>3</sup>
- **Indicator:** Methyl orange

**Instructions:**

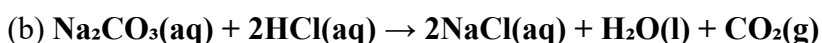
- (i) Measure 20 cm<sup>3</sup> of A and dilute it to 100 cm<sup>3</sup>. Name the resulting solution as L.
- (ii) Titrate B against 25.0 cm<sup>3</sup> of L. Record three accurate titre values.

**Questions:**

- (a)
  - (i) What was the colour change observed during this titration experiment?
  - (ii) What was the volume of the pipette used?
  - (iii) Calculate the average volume of solution B used to neutralize solution L.
- (b) Write a balanced chemical equation between L and B.
- (c) Calculate the **percentage purity** of A.

**Answer 1:**

- (a)
  - (i) **Colour change:** Yellow to orange/red (methyl orange in acid-base titration)
  - (ii) **Volume of pipette:** 25.00 cm<sup>3</sup>
  - (iii) Assume titres: 17.40 cm<sup>3</sup>, 17.60 cm<sup>3</sup>, 17.50 cm<sup>3</sup>  
→ Average volume = (17.40 + 17.60 + 17.50) / 3 = **17.50 cm<sup>3</sup>**



Calculate molarity of B:

Molar mass of HCl = 36.5 g/mol

Moles = 7.30 / 36.5 = **0.2 mol** → [B] = 0.2 mol/dm<sup>3</sup>

Use formula:

$$M_a V_a / n_a = M_b V_b / n_b$$

Let  $M_a$  = concentration of L

$$\rightarrow M_a = (0.2 \times 17.5 \times 1) / (25 \times 2) = 3.5 / 50 = \mathbf{0.07 \text{ mol/dm}^3}$$

Use dilution:

$$M_d V_d = M_c V_c$$

$$\rightarrow M_c = (0.07 \times 100) / 20 = \mathbf{0.35 \text{ mol/dm}^3}$$

Convert to g/dm<sup>3</sup>:

Molar mass of Na<sub>2</sub>CO<sub>3</sub> = 106 g/mol

→ 0.35 mol/dm<sup>3</sup> × 106 g/mol = **37.1 g/dm<sup>3</sup>**

Purity = (mass of pure / mass of impure) × 100

→ Purity = (37.1 / 43.99) × 100 ≈ **84.4%**

### Instructions:

Use sodium thiosulphate solution (AA) and nitric acid (BB). Add water to vary concentration of AA and record time for mark “X” to disappear.

### Questions:

- (a) Complete the table (done above).
- (b) Why did mark X disappear?
- (c)
  - (i) Write a balanced chemical equation (with states).
  - (ii) Write the ionic equation.
- (d) Plot graph of AA volume vs 1/time.
- (e) How does rate change if BB concentration increases but AA is constant?
- (f) What does 1/time mean?

### Answer 2:

- (b) The mark X disappeared due to formation of **solid sulfur precipitate**, which made the solution opaque.
- (c)
  - (i)  $\text{Na}_2\text{S}_2\text{O}_3(\text{aq}) + 2\text{HNO}_3(\text{aq}) \rightarrow 2\text{NaNO}_3(\text{aq}) + \text{S}(\text{s}) + \text{SO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$
  - (ii)  $\text{S}_2\text{O}_3^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) \rightarrow \text{S}(\text{s}) + \text{SO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$
- (d) The graph of AA volume vs 1/time is a **straight line sloping downward**, showing that as the volume of AA decreases, rate of reaction also decreases.
- (e) Increasing BB concentration **increases rate** of reaction because more H<sup>+</sup> ions are available to react with thiosulphate, increasing collision frequency.
- (f) 1/time represents the **rate of reaction** — the faster the reaction, the smaller the time, and thus higher the value of 1/time.

**2. Sample Z** is a simple salt. Perform the following tests:

- (a) Appearance
- (b) Action of heat
- (c) Action of conc.  $\text{H}_2\text{SO}_4$
- (d) Solubility
- (e) NaOH solution
- (f) Flame test
- (g) Action of  $\text{HNO}_3 + \text{AgNO}_3$

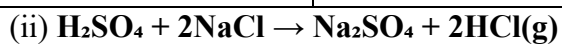
**Questions:**

- (i) Prepare a Table showing results and inferences.
- (ii) Write the reaction for test (c).
- (iii) Write electronic configuration of Z cation.
- (iv) How is Z prepared in the lab? Include equation.
- (v) State two uses of sample Z and explain briefly.

**(i) Table of Results**

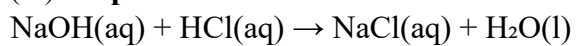
Test	Observation	Inference
(a)	White crystalline solid	Salt, likely NaCl
(b)	No visible change	Stable to heat
(c)	Colourless gas, choking smell	HCl gas formed $\rightarrow$ $\text{Cl}^-$ present
(d)	Soluble in water	Soluble salt
(e)	No precipitate	$\text{Na}^+$ ion does not form ppt with NaOH
(f)	Yellow flame	Sodium ion present

(g)	White precipitate	Cl <sup>-</sup> confirmed with AgNO <sub>3</sub>
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(iii) **Electronic configuration of Na<sup>+</sup> = 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup> → 2:8**

(iv) **Preparation in lab:**



Evaporate to crystallize NaCl

(v) **Uses of NaCl:**

- *Preserving food:* It inhibits microbial growth.
- *Manufacture of chlorine:* Used in electrolysis of brine to produce Cl<sub>2</sub>.