

THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION
132/3B **CHEMISTRY 3B**

(For Both School and Private Candidates)

Time: 3 Hours

ANSWERS

Year: 2017

Instructions

1. This paper consists of THREE questions.
2. Answer all questions.

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1. You are provided with the following:

A: A mixture solution containing NaOH and Na₂CO₃

B: 0.2 M hydrochloric acid solution

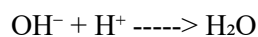
C: Methyl orange indicator

D: Phenolphthalein indicator

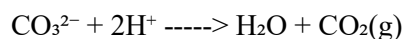
Questions:

(i) Write the ionic equations for the reactions taking place in:

(ii) Procedure (ii):



(iii) Procedure (iv):



(b) Calculate the:

(i) Molarities of NaOH and Na₂CO₃ in solution A

Suppose 25 cm³ of A required 20.00 cm³ of B in the presence of D (for NaOH) and an additional 15.00 cm³ of B in the presence of C (for Na₂CO₃)

NaOH reacts 1:1 with HCl

Na₂CO₃ reacts 1:2 with HCl

Moles of HCl used for NaOH = $(0.2 \times 20) / 1000 = 0.004 \text{ mol}$

Moles of NaOH = 0.004 mol

Molarity of NaOH = $0.004 / 0.025 = 0.16 \text{ mol/dm}^3$

Moles of HCl used for Na₂CO₃ = $(0.2 \times 15) / 1000 = 0.003 \text{ mol}$

Moles of Na₂CO₃ = $0.003 / 2 = 0.0015 \text{ mol}$

Molarity of Na₂CO₃ = $0.0015 / 0.025 = 0.06 \text{ mol/dm}^3$

(ii) Concentration of NaOH and Na₂CO₃ in g/dm³

$$\text{NaOH: } 0.16 \times 40 = 6.4 \text{ g/dm}^3$$

$$\text{Na}_2\text{CO}_3: 0.06 \times 106 = 6.36 \text{ g/dm}^3$$

(iii) Percentage composition by mass of NaOH in A

$$\text{Total mass} = 6.4 + 6.36 = 12.76 \text{ g}$$

$$\% \text{ NaOH} = (6.4 / 12.76) \times 100 = 50.16\%$$

2. You are provided with:

J₁: 49.6 g/dm³ Na₂S₂O₃ · 5H₂O

J₂: Dilute HNO₃

J₃: Distilled water

Table 1: Volume of the mixture

| S/n | J₁ (cm³) | H₂O (cm³) | J₂ (cm³) | Time t (sec) | 1/t (s⁻¹) |

|-----|-----|-----|-----|-----|-----|

| 1 | 5 | 0 | 5 | 24 | 0.0417 |

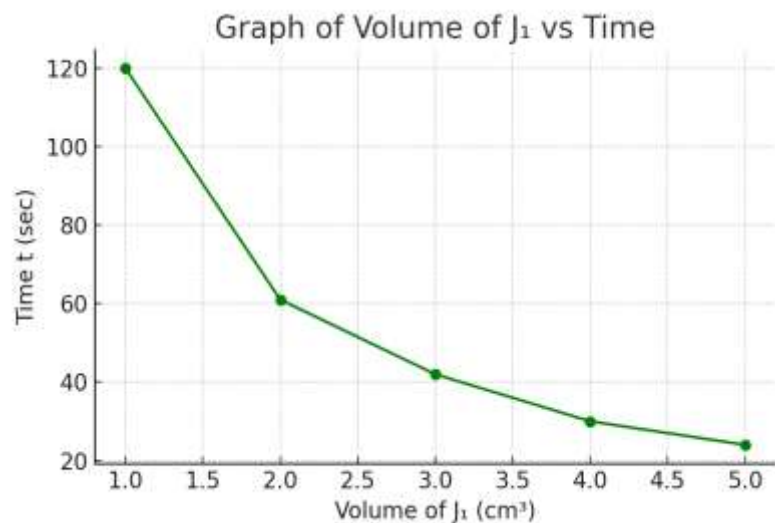
| 2 | 4 | 1 | 5 | 30 | 0.0333 |

| 3 | 3 | 2 | 5 | 42 | 0.0238 |

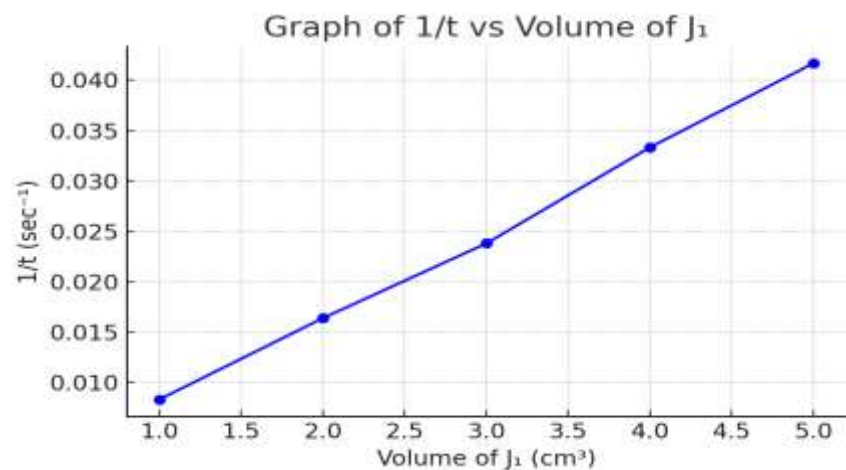
| 4 | 2 | 3 | 5 | 61 | 0.0164 |

| 5 | 1 | 4 | 5 | 120 | 0.0083 |

(a) Plot a graph of [S₂O₃²⁻] against t



(b) Plot a graph of $1/t$ against $[\text{S}_2\text{O}_3^{2-}]$



(c) From the graphs, deduce order of reaction: The graph of $1/t$ vs $[\text{S}_2\text{O}_3^{2-}]$ is linear, so first-order

(d) $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$ is first-order with respect to its concentration

3. Sample B contains two cations and a common anion

S/n	Experiment	Observations	Inferences
(a)	Observe appearance of B	White crystalline solid	Inorganic salt

(b) Add 1 ml conc. H_2SO_4 to solid B	Effervescence, colorless gas	Presence of carbonate	
(c) Add MnO_2 then H_2SO_4	Brown fumes observed	Presence of nitrate	
(d) Make solution of B, divide into 4 parts	-	-	
(e) Add CuSO_4 then NaOH to 1st portion	Blue ppt formed	Presence of carbonate (CO_3^{2-})	
(f) Add NaOH and warm 2nd portion	Ammonia gas evolved	Presence of ammonium ion	
(g) $\text{NaOH} + \text{NH}_4\text{OH}$ to 3rd portion	White ppt, soluble in excess	Presence of Zn^{2+}	

Conclusion:

(i) The cations in B were Zn^{2+} and NH_4^+

(ii) The anion in B was CO_3^{2-}

(iii) Sample B contained zinc carbonate and ammonium carbonate

(iv) Ionic equations:

