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.

1. You are provided with the following:

A: A mixture solution containing NaOH and Na_2CO_3

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):

$OH^- + H^+ \text{-----> } H_2O$

(iii) Procedure (iv):

$CO_3^{2-} + 2H^+ \text{-----> } H_2O + CO_2(g)$

(b) Calculate the:

(i) Molarities of NaOH and Na_2CO_3 in solution A

Suppose 25 cm^3 of A required 20.00 cm^3 of B in the presence of D (for NaOH) and an additional 15.00 cm^3 of B in the presence of C (for Na_2CO_3)

NaOH reacts 1:1 with HCl

Na_2CO_3 reacts 1:2 with HCl

Moles of HCl used for NaOH = (0.2 × 20) / 1000 = 0.004 mol

Moles of NaOH = 0.004 mol

Molarity of NaOH = 0.004 / 0.025 = 0.16 mol/dm^3

Moles of HCl used for Na_2CO_3 = (0.2 × 15) / 1000 = 0.003 mol

Moles of Na_2CO_3 = 0.003 / 2 = 0.0015 mol

Molarity of Na_2CO_3 = 0.0015 / 0.025 = 0.06 mol/dm^3

(ii) Concentration of NaOH and Na_2CO_3 in g/dm³

NaOH: 0.16 × 40 = 6.4 g/dm³

Na_2CO_3: 0.06 × 106 = 6.36 g/dm³

(iii) Percentage composition by mass of NaOH in A

Total mass = 6.4 + 6.36 = 12.76 g

% NaOH = (6.4 / 12.76) × 100 = 50.16%

2. You are provided with:

J_1: 49.6 g/dm³ $Na_2S_2O_3 \cdot 5H_2O$

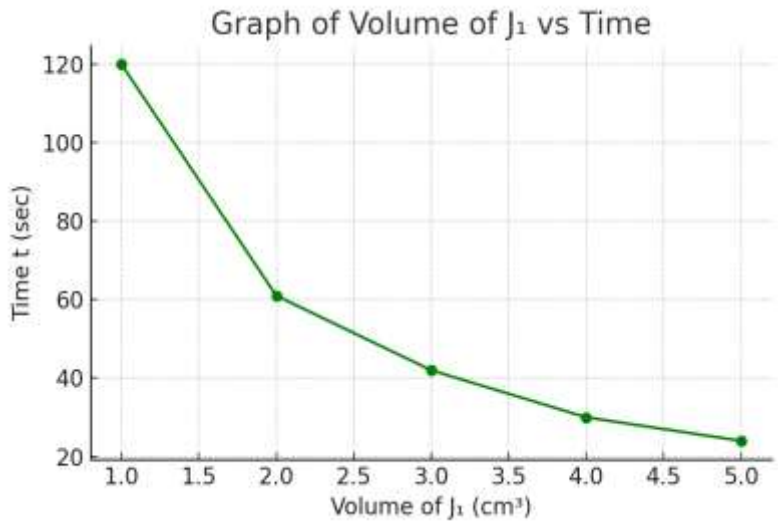
J_2: Dilute HNO_3

J_3: Distilled water

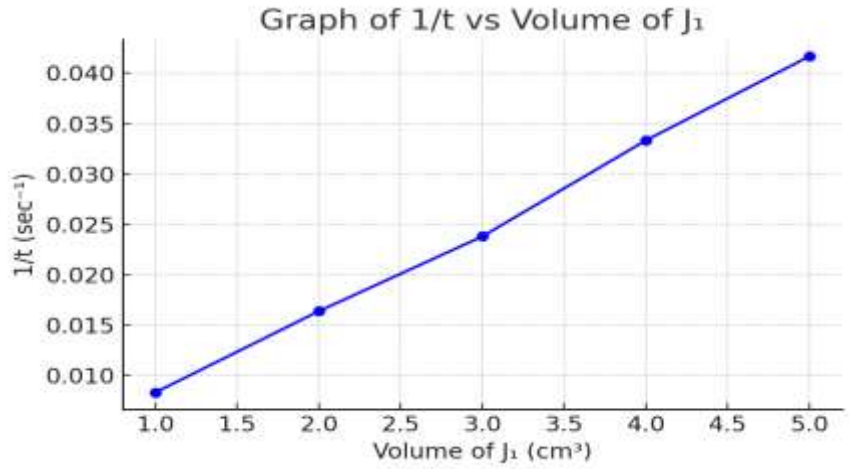
Table 1: Volume of the mixture

S/n	J_1 (cm³)	H_2O (cm³)	J_2 (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 [$S_2O_3^{2-}$] against t



(b) Plot a graph of 1/t against $[S_2O_3^{2-}]$



(c) From the graphs, deduce order of reaction: The graph of 1/t vs $[S_2O_3^{2-}]$ is linear, so first-order

(d) $Na_2S_2O_3 \cdot 5H_2O$ 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) | NaOH + NH_4OH 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:

(b) $CO_3^{2-} + 2H^+ \text{-----> } H_2O + CO_2$

(f) $NH_4^+ + OH^- \text{-----> } NH_3 + H_2O$