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

732/2B **CHEMISTRY 2B**

Time: 3 Hours **ANSWERS** **Year: 2021**

Instructions.

1. This paper consists of sections three questions.
2. Answer **all** questions
3. Cellular phones are **note** allowed in the examination room.
4. Write your **examination Number** on every page of your answer booklet(s).

1. Titrate **E2 (hydrochloric acid, 2.92 g/dm³)** from the burette against **E1 (sodium carbonate)** in the conical flask using **methyl orange (MO)** indicator. Then answer:

(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 E2 used to neutralize E1.

(b) Write a balanced chemical equation (include state symbols) between E1 and E2, and the corresponding ionic equation.

(c) Calculate the concentration in moles/dm³ of solution E1.

Answer 1:

(a) (i) Colour change: **Yellow to orange/red**, indicating a complete neutralization.
(ii) Volume of pipette used: **25.00 cm³** (standard pipette size).
(iii) Let's assume three titres: 24.80 cm³, 25.00 cm³, and 25.20 cm³
Average volume of E2 = (24.80 + 25.00 + 25.20) / 3 = **25.00 cm³**

(b) **Molecular equation:**
$Na_2CO_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$

Ionic equation:
$CO_3^{2-}(aq) + 2H^+(aq) \rightarrow H_2O(l) + CO_2(g)$

(c) Given:

- Mass conc. of HCl (E2) = 2.92 g/dm³
- Molar mass of HCl = 36.5 g/mol
  → Moles/L = 2.92 / 36.5 = **0.08 mol/dm³**

Use formula:
Ma × Va / na = Mb × Vb / nb
HCl = Ma = 0.08 mol/dm³
Va = 25.00 cm³ = 0.025 dm³
na = 2
Vb = 25.00 cm³ = 0.025 dm³
nb = 1
Solve for Mb:

Mb = (0.08 × 0.025 × 1) / (0.025 × 2) = 0.002 / 0.05 = **0.04 mol/dm³**

2. Instructions:
Study the effect of **temperature** on rate of reaction between **EE (sodium thiosulphate)** and **FF (hydrochloric acid)** using a stopwatch and a marked paper "M".

Experimental Setup:

- Measure 10 cm^3 of EE and FF in separate test tubes.
- Warm both to specified temperatures (e.g. 40°C, 50°C, ...).
- Mix them in a beaker over "M", record time until mark disappears.

Questions:

(a) Record the room temperature in Kelvin (K).
(b) Why did the mark "M" disappear?
(c) Complete the table by filling blank columns (Time and 1/time).
(d)
(i) Write a balanced chemical equation for EE + FF (include state symbols).
(ii) Write the ionic equation.
(e) Plot graph of time(s) vs. temperature(K).
(f) What conclusion can you draw from the graph?

Answer 2:

(a) Room temperature ≈ 25°C = **298 K**

(b) The mark "M" disappeared because **sulfur (S)** was formed as a **precipitate**, which made the solution opaque.

(c) Let's assume the following times for illustration:

Temp (°C)	Temp (K)	Time (s)	1/Time (s^{-1})
40	313	60	0.0167

50	323	45	0.0222
60	333	30	0.0333
70	343	20	0.0500
80	353	15	0.0667

(d) (i) **Balanced equation:**
$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + SO_2(g) + S(s) + H_2O(l)$

(ii) **Ionic equation:**
$S_2O_3^{2-}(aq) + 2H^+(aq) \rightarrow SO_2(g) + S(s) + H_2O(l)$

(e) The graph of **time vs. temperature** shows a **decreasing curve**, meaning time taken decreases as temperature increases.

(f) Conclusion: **The rate of reaction increases with temperature**, showing that temperature is directly proportional to reaction rate.

3. Sample O is a salt with one cation and one anion. Perform:

(a) Appearance
(b) Action of heat
(c) Action of concentrated H_2SO_4, then warm
(d) Solubility
(e) Action of aqueous NaOH
(f) Action of $K_4[Fe(CN)_6]$ then dilute HCl
(g) Action of $FeSO_4$ then conc. H_2SO_4

Questions:

(i) Prepare a table of observations and inferences
(ii) Write a balanced chemical equation for test (b)
(iii) Write a balanced equation between sample and sodium carbonate

(i) **Table of Results**

Test	Observation	Inference
(a)	White crystalline solid	Likely a salt
(b)	Yellow residue, brown gas	NO_3^- present (nitrate)
(c)	Brown fumes evolve	Confirms NO_3^-
(d)	Soluble in water	Soluble salt
(e)	White ppt soluble in excess	Zn^{2+} ion
(f)	Blue ppt	Presence of Zn^{2+}
(g)	No brown ring	Nitrate confirmed but not nitrite

(ii) **Equation for test (b):**
$2Zn(NO_3)_2(s) \rightarrow 2ZnO(s) + 4NO_2(g) + O_2(g)$

(iii) **Equation with sodium carbonate:**
$Zn(NO_3)_2(aq) + Na_2CO_3(aq) \rightarrow ZnCO_3(s) + 2NaNO_3(aq)$