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

732/2B **CHEMISTRY 2B**

(ACTUAL PRACTICAL B)

Time: 3 Hours **ANSWERS** **Year: 2009**

Instructions.

1. This paper consists of **three (3)** questions.
2. Answer **all** questions
3. Question number 1 carries 20 marks and the rest carry 30 marks.
4. Cellular phones are **note** allowed in the examination room.
5. Write your **examination Number** on every page of your answer booklet(s).

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1. You are provided with the following:

Solution coded **G1** (a solution of hydrochloric acid with unknown concentration)

Solution **G2**, a standard sodium carbonate solution containing 2.65 g of Na_2CO_3 per dm^3

Methyl orange indicator

Instruction: Titrate **G2** (from the burette) against **G1** (in the titration flask) using methyl orange as the indicator. Record your results including one rough and three accurate titrations in a tabular form.

Questions

(i) The colour change observed during the titration is from yellow to orange-pink at the endpoint. This is due to the pH change near 4 when all carbonate is neutralized by the acid.

(ii) The volume of the pipette used is 25.0 cm^3. This is a standard volume used in titrations to transfer a known amount of analyte.

(iii) If the average titre volume recorded is around 25.0 cm^3, then the average volume of solution G2 used to neutralize G1 is **25.0 cm^3**.

(iv) The balanced chemical equation between HCl and Na_2CO_3 is:

Na_2CO_3 (aq) + 2HCl (aq) → 2NaCl (aq) + H_2O (l) + CO_2 (g)

(v) The ionic equation is:

CO_3^{2-} (aq) + $2H^+$ (aq) → H_2O (l) + CO_2 (g)

(vi) Molar mass of Na_2CO_3 = 23×2 + 12 + 16×3 = 106 g/mol

Concentration of G2 = 2.65 g/dm^3 ÷ 106 g/mol = 0.025 mol/dm^3

From the equation:

1 mol Na_2CO_3 reacts with 2 mol HCl

Moles of Na_2CO_3 in 25.0 cm^3 = 0.025 mol/dm^3 × 25.0 cm^3 ÷ 1000 = 0.000625 mol

Then moles of HCl = 0.000625 mol × 2 = 0.00125 mol

So concentration of G1 (HCl) = 0.00125 mol ÷ 25.0 cm^3 × 1000 = **0.05 mol/dm^3**

2. You are provided with:

0.1 M sodium thiosulphate labeled **TQ**

0.1 M hydrochloric acid labeled **TR**

Distilled water

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A stopwatch, beaker, test tubes, thermometer, and a sheet of paper with a black letter "Z"

(i) Room temperature is approximately 25°C, which is **298 K**.

(ii) The mark "Z" disappeared because the reaction between thiosulphate and hydrochloric acid produces sulfur, which forms a cloudy precipitate that obscures the black letter on the paper.

(iii) Sample data (you can adjust):

Experiment	Temperature (°C)	Temperature (K)	Time (s)
1	30	303	60
2	40	313	42
3	50	323	28
4	60	333	20
5	70	343	14

(iv) The balanced chemical equation is:

$Na_2S_2O_3$ (aq) + 2HCl (aq) → 2NaCl (aq) + H_2O (l) + SO_2 (g) + S (s)

(v) The net ionic equation is:

$S_2O_3^{2-}$ (aq) + $2H^+$ (aq) → H_2O (l) + SO_2 (g) + S (s)

(vi) The graph of temperature (K) vs time (s) would show a **negative correlation**. As temperature increases, time decreases, indicating that the reaction proceeds faster at higher temperatures.

(vii) Conclusion: Increasing the temperature increases the rate of reaction. This is due to higher kinetic energy of particles, leading to more frequent and energetic collisions.

3. You are given a salt coded **Q**. It contains one cation and one anion.

(i) Sample table of observations and inferences:

Test	Observation	Inference
Appearance	White crystalline solid	Could be a metal salt
Heating	No water or colour change	No water of crystallization
Solubility in water	Soluble	Ionic compound
NaOH (few drops)	White precipitate forms	Possible Zn^{2+}, Al^{3+} or Pb^{2+}
NaOH (excess)	Precipitate dissolves	Zn^{2+} likely
Aqueous ammonia (few drops)	White precipitate	Zn^{2+} or Al^{3+}
Aqueous ammonia (excess)	Precipitate dissolves	Confirms Zn^{2+}
$BaCl_2$ + dilute HCl	White precipitate forms	Presence of SO_4^{2-}

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$AgNO_3$ + dilute HNO_3	No precipitate	No Cl^- or Br^- present

(ii) Balanced chemical equation for test with NaOH:

Zn^{2+} (aq) + 2NaOH (aq) → $Zn(OH)_2$ (s) + $2Na^+$ (aq)

(iii) The cation is **Zn^{2+}**, and the anion is **SO_4^{2-}**, so salt **Q** is **zinc sulfate ($ZnSO_4$)**.

(iv) Reaction between zinc sulfate and sodium carbonate:

$ZnSO_4$ (aq) + Na_2CO_3 (aq) → $ZnCO_3$ (s) + Na_2SO_4 (aq)

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