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: 2013**

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).

1. A student was given a solution labeled **L1**, which is a solution of nitric acid of unknown concentration. She was also given a solution labeled **L2**, which contains 5.3 g of sodium carbonate (Na_2CO_3) dissolved in 1 dm^3 of solution. Using methyl orange as the indicator, she was instructed to determine the concentration of **L1** through titration.

(a) The colour change observed at the end point is from **yellow to orange-pink**. Methyl orange turns yellow in alkaline solution and orange-pink in acidic solution after complete neutralization.

(b) The average volume of nitric acid delivered from the burette is **25.0 cm^3**, which is common and acceptable as a standard titre volume.

(c)

Balanced chemical equation:

$Na_2CO_3\ (aq) + 2HNO_3\ (aq) \rightarrow 2NaNO_3\ (aq) + H_2O\ (l) + CO_2\ (g)$

Ionic equation:

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

(d)

Molar mass of $Na_2CO_3 = 23\times2 + 12 + 16\times3 = 106$ g/mol

Moles of $Na_2CO_3 = 5.3\ g \div 106\ g/mol = 0.05\ mol/dm^3$

In 25.0 cm^3 of L2:

$0.05 \times 25 \div 1000 = 0.00125$ mol of Na_2CO_3 used

(e)

From the equation, 1 mol of Na_2CO_3 reacts with 2 mol of HNO_3

Moles of $HNO_3 = 0.00125 \times 2 = 0.0025$ mol

Volume of L1 used = 25.0 cm^3 = 0.025 dm^3

Concentration of L1 = 0.0025 mol ÷ 0.025 dm^3 = **0.1 mol/dm^3**

2. In a study of the effect of temperature on reaction rate:

(a) Temperatures in Kelvin:

30°C = 303 K

40°C = 313 K

50°C = 323 K

60°C = 333 K

70°C = 343 K

(b) The cross disappears because the reaction produces **sulfur precipitate**, which turns the solution cloudy and blocks the view of the cross.

(c) Example of completed table:

Temperature (°C)	Temperature (K)	Time (s)
30	303	58
40	313	42
50	323	30
60	333	20
70	343	12

(d)

Balanced chemical equation:

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

Net ionic equation:

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

(e) The graph of temperature (K) against time (s) would show a **downward slope**, indicating that as temperature increases, the reaction time decreases.

(f) The reaction becomes **faster at higher temperatures** due to increased kinetic energy of particles, leading to more frequent and energetic collisions.

3. A white salt labeled **M** was given for qualitative analysis.

(i) Table of observations and inferences:

Test	Observation	Inference
Heating dry salt	Brown fumes evolved	Presence of nitrate (NO_3^-)
Solubility in water	Soluble	Soluble ionic salt
NaOH (few drops)	White gelatinous precipitate	Possible Al^{3+}
NaOH (excess)	Precipitate dissolves	Confirms Al^{3+}
Ammonia (few drops)	White precipitate	Could be Al^{3+} or Zn^{2+}
Ammonia (excess)	Precipitate remains	Confirms Al^{3+}
HCl + $BaCl_2$	No precipitate	No SO_4^{2-} or CO_3^{2-}
$AgNO_3$ + HNO_3	No precipitate	No halide ions present

(ii) The cation is **Al^{3+}**, and the anion is **NO_3^-**. Therefore, salt **M** is **aluminium nitrate ($Al(NO_3)_3$)**.

(iii)

Reaction with sodium hydroxide:

Al^{3+} (aq) + 3NaOH (aq) → $Al(OH)_3$ (s) + $3Na^+$ (aq)

(iv)

Reaction with sodium carbonate:

$2Al(NO_3)_3\ (aq) + 3Na_2CO_3\ (aq) \rightarrow 2Al(OH)_3\ (s) + 3CO_2\ (g) + 6NaNO_3\ (aq)$