THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

032/2A **CHEMISTRY 2A**

(ACTUAL PRACTICAL A)

(For Both School and Private Candidates)

Time: 2:30 Hours **ANSWERS** **Year: 2017**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. You are provided with the following:
PP: A solution of 0.1 M hydrochloric acid
RR: A solution of 1.39 g of impure sodium carbonate anhydrous in 250 cm^3 of solution
Indicator: Methyl orange

(a)(i) Titrate solution PP against 25 cm^3 of RR until the colour changed. Assume average titre volume was 24.50 cm^3
(ii) The colour changed because methyl orange turned from yellow to orange-red, indicating neutralization.
(iii) The average titre volume was 24.50 cm^3
(iv) 24.50 cm^3 of PP was required to neutralize 25.00 cm^3 of RR
(v) If sulphuric acid was used instead, the volume required would be half because H_2SO_4 is diprotic (releases two H^+ ions per molecule), while HCl is monoprotic.

(b) (i) Apparatus used to measure PP: 25 cm^3 pipette
(ii) It is best because it gives accurate, fixed volumes suitable for titration.

(c) Balanced chemical equation:

$Na_2CO_3(aq) + 2HCl(aq) \longrightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$

(d)(i) Molarity of RR:
Moles of HCl = $0.1 \times 0.0245 = 0.00245$ mol
Mole ratio Na_2CO_3 : HCl = 1:2
Moles of $Na_2CO_3 = 0.00245 \div 2 = 0.001225$ mol
Volume of RR = 25 cm^3 = 0.025 dm^3
Molarity of RR = $0.001225 \div 0.025 = 0.049$ mol/dm^3
(ii) Percentage purity of RR:
Moles in 250 $cm^3 = 0.049 \times 0.25 = 0.01225$ mol
Mass = $0.01225 \times 106 = 1.2985$ g
Actual mass = 1.39 g
Percentage purity = $(1.2985 \div 1.39) \times 100 = 93.38$ percent

(e) Two applications of volumetric analysis:

- Used to determine concentration of unknown solutions
- Used in quality control for titrations in industries

2. (a) Completed Table 1:

Volume of E (cm^3)	Volume of G (cm^3)	Time taken (s)
25	0	20
20	5	24

15	10	30
10	15	38
5	20	50

(b)
(i) Plot of volume – time graph is shared below.
(ii) The graph shows that time increases as volume of E decreases, indicating slower reaction at lower concentrations.

(c) Ionic equation:

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

(d) The letter X disappeared because sulphur formed in the reaction turned the solution cloudy, blocking the visibility of the cross.

(e) Two uses of sulphur:

- Used in vulcanization of rubber
- Used in the manufacture of sulphuric acid

3. (a) Table 2

Experiment	Observation	Inference
Observe Q	Green crystalline solid	Transition metal salt
Add water	Dissolved, green solution	Soluble ionic compound
Add dilute HCl	Effervescence	CO_3^{2-} present
Add conc H_2SO_4	Effervescence	CO_3^{2-} confirmed
Add NaOH	Green precipitate, insoluble	Fe^{2+} present
Add NH_3	Green precipitate	Confirms Fe^{2+}
Add $K_3Fe(CN)_6$	Deep blue precipitate	Fe^{2+} confirmed
Add Pb^{2+} + CH_3COOH	White precipitate	CO_3^{2-} confirmed

(b) Conclusion:
(i) The cation in sample Q is Fe^{2+}
(ii) The anion in sample Q is CO_3^{2-}
(iii) The compound Q is $FeCO_3$

(c) Reaction with HCl:
$FeCO_3(s) + 2HCl(aq) \longrightarrow FeCl_2(aq) + CO_2(g) + H_2O(l)$

(d) Three chemical properties of Fe^{2+}:

- Forms green precipitate with NaOH
- Reacts with potassium hexacyanoferrate(III) to give a blue complex
- Oxidizes slowly to Fe^{3+} in air

(e) Two uses of Q:
- Used in pigments and ceramics
- Used in synthesis of iron-based compounds