THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATIONS COUNCIL

CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

032/2B **CHEMISTRY 2B**

(ACTUAL PRACTICAL B)

(For Both School and Private Candidates)

Time: 2:30 Hours **ANSWERS** **Year: 2010**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. You are provided with the following solutions:
Solution W – containing 3.0 g of acetic acid (CH_3COOH) per 0.5 dm^3 of solution
Solution Q – containing 2.2 g of impure sodium bicarbonate per 0.25 dm^3 of solution
Methyl orange indicator solution

Procedure
Put solution W in the burette. Pipette 25 cm^3 of solution Q into a titration flask. Add a few drops of methyl orange indicator in the titration flask. Titrate solution Q against W until an end-point is reached. Note the burette reading. Repeat the titration to obtain three more titre values. Record your titre results as shown in the following table:

(a)
(i) Burette readings

Titration	Final reading (cm^3)	Initial reading (cm^3)	Volume used (cm^3)
Pilot	24.90	0.00	24.90
1	25.00	0.00	25.00
2	24.80	0.00	24.80
3	24.80	0.00	24.80

(ii) Volume of pipette used was 25.00 cm^3
(iii) The colour change at the end-point was from yellow to pink
(iv) The volume of solution W needed for complete neutralization reaction was 24.87 cm^3

(b) If the balanced equation for the above neutralization reaction is
$NaHCO_3 + CH_3COOH$ ----> $CH_3COONa + H_2O + CO_2$
Calculate the

(i) Molarity of the acid solution W
Mass of CH_3COOH = 3.0 g in 0.5 dm^3
Molar mass of CH_3COOH = 12 + 3 + 12 + 16 + 16 + 1 = 60 g/mol
Moles = 3.0 ÷ 60 = 0.050 mol
Molarity = 0.050 ÷ 0.5 = 0.10 mol/dm^3

(ii) Molarity of the base solution Q
Volume of W used = 24.87 cm^3 = 0.02487 dm^3
Moles of CH_3COOH = 0.10 × 0.02487 = 0.002487 mol
From the equation, 1 mol of acid reacts with 1 mol of base
Moles of $NaHCO_3$ = 0.002487 mol
Volume of Q used = 25 cm^3 = 0.025 dm^3
Molarity of Q = 0.002487 ÷ 0.025 = 0.09948 mol/dm^3

(iii) Concentration of $NaHCO_3$ in solution Q in g/dm^3

Molar mass of $NaHCO_3$ = 23 + 1 + 12 + 48 = 84 g/mol
Concentration = 0.09948 × 84 = 8.36 g/dm³

(c) The impurity in the sodium hydrogen carbonate does not react with the acid. Calculate the percentage by weight of the unreactive material (impurity in the sodium bicarbonate solution)

Mass of impure sample = 2.2 g in 0.25 dm³
Pure $NaHCO_3$ = 8.36 g/dm³
Pure mass in 0.25 dm³ = 8.36 × 0.25 = 2.09 g
Impurity = 2.2 − 2.09 = 0.11 g
Percentage impurity = (0.11 ÷ 2.2) × 100 = 5%
Percentage of unreactive material = 5%

2. Sample A is a simple salt containing one cation and one anion. Carry out the experiments described in the following table carefully and record all your observations. Make appropriate inferences and identify the cation and anion present in the salt.

(a) Appearance of sample A
Observation: White crystalline solid
Inference: Likely a colorless ionic salt

(b) Put a spatulaful of the sample in a test-tube. Add water until the test-tube is three quarters full. Shake to dissolve the salt. Divide the solution into six portions and then do the following to the portions of the solution of sample:

(i) Add potassium iodide solution to the first portion
Observation: Yellow precipitate
Inference: Presence of Pb^{2+}

(ii) Add sodium hydroxide solution till excess to the second portion
Observation: White precipitate, insoluble in excess
Inference: Confirms Pb^{2+}

(iii) Add ammonia solution till the ammonia is in excess to the third portion
Observation: White precipitate, slightly soluble
Inference: Confirms Pb^{2+}

(iv) Add potassium ferrocyanide solution to the fourth portion
Observation: White/cream precipitate
Inference: Confirms Pb^{2+}

(v) Add dilute hydrochloric acid followed by barium chloride solution to the fifth portion
Observation: White precipitate

Inference: Presence of SO_4^{2-}

(vi) Add lead acetate solution to the sixth portion
Observation: White precipitate
Inference: Presence of SO_4^{2-}

(vii) Into the resulting reaction mixture in (vi) add ammonium acetate solution till excess
Observation: Precipitate remains
Inference: Confirms SO_4^{2-}

Conclusion
The cation in sample A is Pb^{2+} and the anion is SO_4^{2-}

3. Sample L is a salt containing one cation and one anion. Using systematic qualitative analysis procedures carry out tests on L and make appropriate observations and inferences to identify the cation and anion respectively.

Experiment: Add NaOH
Observation: Reddish-brown precipitate
Inference: Fe^{3+} present

Experiment: Add $BaCl_2$ then HNO_3
Observation: White precipitate remains
Inference: SO_4^{2-} present

Conclusion
The cation present in L is Fe^{3+} and the anion is SO_4^{2-}