

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: 2003

Instructions

1. This paper consists of two questions.
2. Answer all questions.

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1. You are provided with the following solutions:
 - 1.1 Solution P containing 28.60 g per litre of impure sodium carbonate
 - 1.2 Solution Q containing 0.20 mole of hydrochloric acid in a litre of solution
 - 1.3 Methyl orange as an indicator

PROCEDURE

Put the acid solution in a burette. Pipette 25 cm³ of solution P into a titrating flask. Add a few drops of methyl orange indicator. Titrate solution P against the acid solution until the end point is reached. Repeat this procedure until three titre values are obtained and record your titration results in a tabular form as shown below:

(a)(i) Table of results:

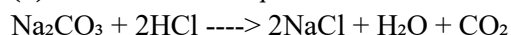
Titration	Final reading (cm ³)	Initial reading (cm ³)	Volume used (cm ³)
Pilot	25.00	0.00	25.00
1	24.90	0.00	24.90
2	25.00	0.00	25.00
3	25.00	0.00	25.00

(ii) Volume of pipette used = 25.00 cm³

(iii) The mean titre is = $(24.90 + 25.00 + 25.00) \div 3 = 24.97 \text{ cm}^3$

(iii) Summary: 25.00 cm³ of solution P required 24.97 cm³ of solution Q for complete reaction

(b) Write balanced equation for the above neutralization reaction



(c) Calculate the molarity of P:

(i) in moles per litre

Molarity of Q = 0.20 mol/dm³

Volume of Q used = 24.97 cm³ = 0.02497 dm³

Moles of HCl = $0.20 \times 0.02497 = 0.004994 \text{ mol}$

From the balanced equation: 2 mol HCl react with 1 mol Na₂CO₃

Moles of Na₂CO₃ = $0.004994 \div 2 = 0.002497 \text{ mol}$

Volume of P used = 25.00 cm³ = 0.02500 dm³

Molarity of P = $0.002497 \div 0.025 = 0.09988 \text{ mol/dm}^3$

(ii) in grams per litre

Molar mass of Na₂CO₃ = 106 g/mol

Concentration in g/dm³ = $0.09988 \times 106 = 10.59 \text{ g/dm}^3$

(d)(i) Calculate the amount of impurity in g per litre

Mass of impure sodium carbonate = 28.60 g

Mass of pure sodium carbonate = 10.59 g

$$\text{Impurity} = 28.60 - 10.59 = 18.01 \text{ g}$$

(ii) If this impurity was due to water of crystallization in the salt, calculate the number of moles of water in one mole of sodium carbonate crystals

$$\text{Molar mass of impure salt} = 28.60 \div 0.09988 = 286.37 \text{ g/mol}$$

$$\text{Water of crystallization} = 286.37 - 106 = 180.37 \text{ g}$$

$$\text{Number of moles of water} = 180.37 \div 18 = 10.02 \approx 10$$

So, number of water molecules = 10

$$\text{Formula} = \text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$$

2. Sample R is a simple salt containing ONE cation and ONE anion. Carry out carefully the experiments described below and record all your observations and inferences in the table. Identify the cation and anion present in the sample.

Test	Experiment	Observation	Inference
2.1	Appearance of R ionic salt	White crystalline solid	Colourless
2.2	Heat some of sample R in a hard glass test tube gently then strongly No water of crystallization		No gas evolved
2.3	Add concentrated sulphuric acid on sample R limewater milky CO_3^{2-} present (CO_2 gas evolved)		Effervescence, colourless gas turns
2.4	Dissolve some of R in water soluble	Clear solution	Salt is
2.5	Add NaOH dropwise and then in excess excess Ca^{2+} likely	White precipitate formed, insoluble in	
2.6	Add ammonium hydroxide dropwise and then in excess insoluble in excess Confirms Ca^{2+}		White precipitate formed,
2.7	Add potassium ferrocyanide to solution of R absence of Fe^{3+} , Pb^{2+}	No visible reaction	Confirms
2.8	Add freshly prepared FeSO_4 and conc. H_2SO_4 carefully Confirms absence of NO_3^-		No brown ring seen

Conclusion

Cation in R is Ca^{2+}

Anion in R is CO_3^{2-}

R is CaCO_3

3. Sample X contains ONE anion and ONE cation. Using systematic qualitative analysis procedures, carry out tests on X and make observations and inferences, hence identify the anion and cation present in sample X.

Test	Experiment	Observation	Inference
(a)	Observe the physical appearance of solid X	White crystalline solid	Colourless ionic compound
(b)	Heat a little of solid X in a dry test tube	Colourless gas evolved turns limewater milky	Presence of CO_3^{2-} (CO_2 gas)
(c)	Dissolve solid X in distilled water and shake	Colourless solution formed	Salt is soluble
(d)	Add dilute HCl to the solution of X	Effervescence observed	Confirms CO_3^{2-}
(e)	Add NaOH solution dropwise and then in excess to the solution of X	White precipitate, soluble in excess	Zn^{2+} present
(f)	Add aqueous NH_3 dropwise and then in excess to the solution of X	White precipitate, soluble in excess	Confirms Zn^{2+}
(g)	Add BaCl_2 to solution of X followed by dilute HCl	Absence of SO_4^{2-}	No precipitate
(h)	Add AgNO_3 to solution of X followed by HNO_3	Absence of Cl^- , Br^- , I^-	No precipitate
(i)	Add $\text{Pb}(\text{NO}_3)_2$ to solution of X	Confirms presence of CO_3^{2-}	White precipitate formed
(j)	Flame test on solid X	No alkali metal cation present	No characteristic flame colour

Conclusion

The cation present in X is Zn^{2+} and the anion present in X is CO_3^{2-}