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: 2010**

Instructions

1. This paper consists of two questions.

2. Answer all questions.

1. You are provided with the following:
Solution D containing 6.90 g of T_2CO_3 per 0.50 dm^3 of solution
Solution N containing 1.55 g of hydrochloric acid per 200 cm^3 of solution
Methyl orange indicator solution

Procedure:
Put solution N in the burette. Pipette 20 cm^3 (or 25 cm^3) of D into a titration flask. Add drops of methyl orange indicator. Titrate solution N from the burette against solution D to the end point. Note the burette reading. Repeat the procedure to obtain more values and record the results as shown in the following table.

(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	24.80	0.00	24.80
2	24.70	0.00	24.70
3	24.70	0.00	24.70

(ii) The volume of the pipette used was 20.00 cm^3
(iii) The volume of the burette used was 50.00 cm^3
(iv) 20.00 cm^3 of solution D required 24.73 cm^3 of solution N for complete reaction
(v) The colour change at the end point was from yellow to pink

(b) Write a balanced equation for the above neutralization reaction.
$T_2CO_3 + 2HCl$ ----> $2TCl + H_2O + CO_2$

(c) Calculate the following:
(i) Molarity of acid solution N
Mass of HCl = 1.55 g
Volume = 200 cm^3 = 0.200 dm^3
Molar mass of HCl = 36.5
Moles of HCl = 1.55 ÷ 36.5 = 0.04247 mol
Molarity = 0.04247 ÷ 0.200 = 0.212 mol/dm^3

(ii) Molarity of the base solution D
Average volume of N used = 24.73 cm^3 = 0.02473 dm^3
Moles of HCl = 0.212 × 0.02473 = 0.00524 mol
From equation: 2 mol HCl reacts with 1 mol T_2CO_3
Moles of T_2CO_3 = 0.00524 ÷ 2 = 0.00262 mol
Volume of D = 20.00 cm^3 = 0.0200 dm^3
Molarity = 0.00262 ÷ 0.0200 = 0.131 mol/dm^3

(iii) Molecular weight of T_2CO_3
Mass of T_2CO_3 = 6.90 g in 0.5 dm^3
In 1 dm^3 = 6.90 × 2 = 13.80 g
Moles = 0.131 mol
Molar mass = 13.80 ÷ 0.131 = 105.34 g/mol

(iv) Atomic mass of element T
Molar mass = 2T + 60 = 105.34
2T = 105.34 - 60 = 45.34
T = 22.67 ≈ 23
Therefore atomic mass of T is 23

(d) Identify element T in T_2CO_3
Element T is sodium

2. Sample B 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 and appropriate inferences. Identify the cation and anion present in sample B.

(a) Appearance of sample B
Observation: White crystalline solid
Inference: Likely a colourless ionic salt

(b) Put a spatulaful of sample B in a test-tube. Add water until half test-tube full. Stir and divide the solution into five portions in different test tubes and then do the following:

(i) Add fresh zinc metal granules to the first portion. Heat for a while. Decant the result. Pour the solid material onto a filter paper and observe. Let it dry, then observe again.
Observation: Effervescence and dark grey residue
Inference: Zinc reduces Pb^{2+} to Pb metal

(ii) Add NaOH solution until excess to the second portion then heat and observe again.
Observation: White precipitate forms, insoluble in excess
Inference: Pb^{2+} confirmed as it forms $Pb(OH)_2$

(iii) Add ammonia solution dropwise to the third portion until excess
Observation: White precipitate forms, partially soluble
Inference: Confirms Pb^{2+} cation

(iv) Add $AgNO_3$ solution to the fourth portion followed by dilute HNO_3
Observation: White precipitate that dissolves in acid
Inference: Presence of Cl^- anion

(v) Add $AgNO_3$ solution to the fifth portion followed by ammonia solution
Observation: White precipitate dissolves in excess ammonia
Inference: Confirms Cl^- by formation of $[Ag(NH_3)_2]^+$

Conclusion
(a) The cation present in the sample B is Pb^{2+} and the anion is Cl^-
(b) What has been happening in the experiments (b)(i) and (b)(ii)? Use reaction equations where possible.

(b)(i) $Pb^{2+}(aq) + Zn(s) \text{ ----> } Pb(s) + Zn^{2+}(aq)$
Zinc reduces lead(II) ions to lead metal

(b)(ii) $Pb^{2+}(aq) + 2OH^-(aq) \text{ ----> } Pb(OH)_2(s)$
Lead(II) hydroxide is a white precipitate that is insoluble in excess NaOH

3. Substance Z contains one basic radical and one acidic radical. Using systematic qualitative analysis procedures carry out experiments on sample Z and make appropriate observations and inferences to identify the radicals.

Experiment: Add NaOH solution
Observation: Blue precipitate formed
Inference: Cu^{2+} present

Experiment: Add $BaCl_2$ solution
Observation: White precipitate formed
Inference: SO_4^{2-} present

Conclusion
The basic radical in sample Z is Cu^{2+} and acidic radical is SO_4^{2-}