

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: 2003

Instructions

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

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1. You are provided with:

1.1 Solution K containing 8.94 g/dm³ of HQ acid solution

1.2 Solution M containing 2.0 g of sodium hydroxide in 0.5 dm³ of the solution

1.3 Methyl orange indicator

Procedure

Put solution K into the burette. Pipette 25 cm³ of solution M in a titration flask. Add two drops of methyl orange indicator. Titrate solution M against solution K until a colour change is observed. Repeat the procedure to obtain three more readings and record your results.

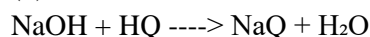
(a) Table of results

| Titration | Final reading (cm ³) | Initial reading (cm ³) | Titre volume (cm ³) |
|-----------|----------------------------------|------------------------------------|---------------------------------|
| Pilot | 25.00 | 0.00 | 25.00 |
| 1 | 24.90 | 0.00 | 24.90 |
| 2 | 25.00 | 0.00 | 25.00 |
| 3 | 24.80 | 0.00 | 24.80 |

(i) The colour change at the end point was from yellow to orange-pink

(ii) Summary: 25.00 cm³ of solution M required 24.90 cm³ of K for complete reaction

(b) Write a balanced chemical equation for the reaction between solution M and K



(c) Calculate the:

(i) Molarity of solution M

Mass of NaOH = 2.0 g in 0.5 dm³

Molar mass = 40 g/mol

Moles = $2.0 \div 40 = 0.05$ mol

Molarity = $0.05 \div 0.5 = 0.10$ mol/dm³

(ii) Molarity of solution K

Moles of NaOH in 25 cm³ = $0.10 \times 0.025 = 0.0025$ mol

From balanced equation, mole ratio = 1:1

Moles of HQ = 0.0025 mol

Volume = 24.90 cm³ = 0.02490 dm³

Molarity = $0.0025 \div 0.02490 = 0.1004$ mol/dm³

(iii) Molar mass of HQ

Concentration = 8.94 g/dm³

Moles = 0.1004 mol/dm³

Molar mass = $8.94 \div 0.1004 = 89.01$ g/mol

(iv) Atomic mass of Q

$$H_Q = H + Q = 1 + Q = 89.01$$

$$Q = 89.01 - 1 = 88.01$$

$$Q = 88$$

Element Q is likely strontium ($Sr = 88$)

(v) What is element Q in the acid HQ ?

Element Q is strontium (Sr)

2. Sample S is a simple salt containing ONE cation and ONE anion. Carry out the experiments described below carefully and record ALL observations and appropriate inferences. Identify the CATION and ANION present in the salt sample S.

(a) Appearance

Observation: White crystalline solid

Inference: Colourless ionic compound

(b) Heat a spatula of sample S in a test tube while rotating. Test for gas

Observation: No gas observed

Inference: No water of crystallization or thermally unstable anion

(c)(i) Add dilute HCl to sample S

Observation: Effervescence observed

Inference: CO_3^{2-} present

(ii) Heat contents and allow to cool

Observation: No further reaction

Inference: Confirms no ammonium ion

(iii) Add concentrated HCl to sample

Observation: More effervescence

Inference: Confirms carbonate

(d) Add dilute nitric acid

Observation: Effervescence

Inference: CO_3^{2-} confirmed

(e) Divide solution into two portions:

(i) Add potassium dichromate

Observation: Yellow solution remains

Inference: No Cr^{3+}

(ii) Add potassium iodide

Observation: Yellow precipitate

Inference: Pb^{2+} likely

(f) Warm the contents

Observation: Precipitate darkens

Inference: Confirms Pb^{2+}

Conclusion

The cation in sample S is Pb^{2+} and the anion is CO_3^{2-}

3. Substance P is a simple salt containing ONE cation and ONE anion. Using systematic qualitative analysis procedures, carry out tests on P and make appropriate observations and inferences to identify the CATION and ANION in the sample P.

| Test Experiment | Observation | Inference |
|--|--|--|
| ----- ----- ----- | | |
| (a) Observe the physical appearance of solid P | Blue crystalline solid | Likely presence of Cu^{2+} |
| (b) Heat a little of solid P in a dry test tube | No water droplets or gas evolved | No water of crystallization |
| (c) Dissolve a spatula of P in distilled water and shake | Blue solution formed | Salt is soluble, confirms Cu^{2+} |
| (d) Add dilute HCl to a portion of solid P | Blue solution formed, no effervescence | Absence of carbonate |
| (e) Perform a flame test | Bluish-green flame observed | Presence of copper |
| (f) Add NaOH dropwise to solution of P, then in excess | | Blue precipitate formed, insoluble in excess Cu^{2+} confirmed ($\text{Cu}(\text{OH})_2$ formed) |
| (g) Add aqueous NH_3 dropwise to solution of P, then in excess | Deep blue solution formed | Confirms Cu^{2+} ($[\text{Cu}(\text{NH}_3)_4]^{2+}$) |
| (h) Add AgNO_3 to solution of P followed by dilute HNO_3 | White precipitate formed, soluble in NH_3 | Cl^- confirmed (AgCl) |
| (i) Add BaCl_2 to solution of P followed by dilute HCl | No precipitate formed | Absence of SO_4^{2-} |
| (j) Add $\text{Pb}(\text{NO}_3)_2$ to solution of P | No precipitate formed | Absence of CO_3^{2-} |

Conclusion

The cation present in P is Cu^{2+} and the anion is Cl^-