

THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL
CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

032/2C

CHEMISTRY 2C

(ACTUAL PRACTICAL C)

(For Both School and Private Candidates)

Time: 2:30 Hours

ANSWERS

Year: 2011

Instructions

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

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1. You are provided with the following:

C: Solution of 2.0 g sodium hydroxide in 0.5 dm³ of the solution

F: Solution of 3.15 g of hydrated oxalic acid, (COOH)₂·xH₂O in 0.25 dm³ of the solution

POP: Phenolphthalein indicator

Procedure:

Put solution F into the burette. Pipette 20 cm³ or 25 cm³ of solution C in a titration flask. Add two drops of phenolphthalein indicator. Titrate solution C against F from the burette until a colour change is observed. Note the reading of the burette. Repeat the procedure to obtain three more readings and record your results in a tabular form.

(a) (i) Determine the titre volume.

Assume concordant values were 24.60 cm³, 24.70 cm³, and 24.70 cm³

Average titre = $(24.60 + 24.70 + 24.70) \div 3 = 24.67 \text{ cm}^3$

(ii) 24.67 cm³ of solution F required 25.00 cm³ of solution C for complete reaction

(b) Given the equation for the reaction:



(i) Concentration of C in grams per dm³

Mass = 2.0 g

Volume = 0.5 dm³

Concentration = $2.0 \div 0.5 = 4.0 \text{ g/dm}^3$

(ii) Molarity of C

Molar mass of NaOH = $23 + 16 + 1 = 40 \text{ g/mol}$

Moles = $2.0 \div 40 = 0.05 \text{ mol}$

Volume = 0.5 dm³

Molarity = $0.05 \div 0.5 = 0.10 \text{ mol/dm}^3$

(iii) Concentration of F in grams per dm³

Mass = 3.15 g

Volume = 0.25 dm³

Concentration = $3.15 \div 0.25 = 12.6 \text{ g/dm}^3$

(c) Find the value of x in the formula (COOH)₂·xH₂O

Average volume of F = $24.67 \text{ cm}^3 = 0.02467 \text{ dm}^3$

Moles of NaOH = $0.10 \times 0.025 = 0.0025 \text{ mol}$

From equation, 1 mol of oxalic acid reacts with 2 mol of NaOH

So moles of oxalic acid = $0.0025 \div 2 = 0.00125 \text{ mol}$

Mass of oxalic acid = 3.15 g

Molar mass = $3.15 \div 0.00125 = 252 \text{ g/mol}$

$$(\text{COOH})_2 = 90 \text{ g/mol}$$

$$x\text{H}_2\text{O} = 252 - 90 = 162$$

$$x = 162 \div 18 = 9$$

$$x = 9$$

(d) What colour change is observed when phenolphthalein is added to solution C (NaOH)?

Pink colour appears

(e) What is the colour change of the mixture at the end of each titration?

Pink to colourless

(f) What is the significance of the colour change when enough acid has been added to the base?

It shows the end point where all the NaOH has reacted and the solution is now neutral; the phenolphthalein becomes colourless in acidic or neutral medium.

2. You are provided with the following materials:

JJ: A solution of 0.13 M $\text{Na}_2\text{S}_2\text{O}_3$ (sodium thiosulphate)

KK: A solution of 2 M HCl

Stopwatch

Thermometer

Heat source/burner

Distilled water

Procedure:

Conduct a reaction between sodium thiosulphate and hydrochloric acid at different temperatures and record the time taken for a cross marked on a paper under the beaker to disappear.

Table 1: Table of results

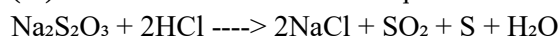
Exp. No.	Temperature (°C)	Time (sec)
1	40	90
2	50	70
3	60	50
4	70	30

(i) Table completed above.

(ii) What substance was produced during the reaction which obscured the letter X?

Sulfur (S), which forms as a fine yellow precipitate

(iii) Write a balanced chemical equation for this reaction:



(iv) Plot a graph of time against temperature:

(Already plotted earlier. The graph shows time decreases with increasing temperature)

(v) Give a brief comment on how the time changes with temperature:

As the temperature increases, the time taken for the reaction to complete decreases. This indicates that the reaction rate increases with temperature due to increased kinetic energy and more effective collisions between reacting particles.

3. Sample Y

(a) Observe the appearance of sample Y

Observation: White crystalline solid

Inference: Likely a colorless ionic salt such as PbSO_4 , ZnCl_2 , etc.

(b) Put a little sample in a test tube and heat

Observation: No water droplets formed

Inference: No water of crystallization

(c) Add dilute hydrochloric acid

Observation: No effervescence

Inference: No carbonate present

(d) Dissolve and divide into three portions:

(i) Add NaOH in small quantities till in excess

Observation: White precipitate forms, insoluble in excess

Inference: Pb^{2+} present

(ii) Add KI solution

Observation: Bright yellow precipitate forms

Inference: Confirms Pb^{2+} (forms PbI_2)

(iii) Add MgSO_4 and boil

Observation: White precipitate forms

Inference: SO_4^{2-} anion present

Conclusion:

(a) Cation in sample Y is Pb^{2+} , anion is SO_4^{2-}

(b) Chemical formula of sample Y: PbSO_4

(c) Balanced chemical equations:

(b) Heating: No reaction observed

(d)(iii) $\text{Pb}^{2+}(\text{aq}) + \text{SO}_4^{2-}(\text{aq}) \rightarrow \text{PbSO}_4(\text{s})$