THE KENYA NATIONAL EXAMINATIONS COUNCIL

Kenya Certificate of Secondary Education

233/3

CHEMISTRY — (Practical)

Mar. 2022 – 2¼ hours

Paper 3

Name .... Index Number ....

Candidate's Signature .... Date ....

Instructions to candidates

(a) Write your name and index number in the spaces provided above.

(b) Sign and write the date of examination in the spaces provided above.

(c) Answer all the questions in the spaces provided above.

(d) You are **not** allowed to start working with the apparatus for the first 15 minutes of the 2¼ hours allowed for this paper. This time is to enable you to read the question paper and make sure you have all the chemicals and apparatus that you may need.

(e) All working **must** be clearly shown where necessary.

(f) **Non-programmable** silent electronic calculators and KNEC mathematical tables may be used.

(g) **This paper consists of 8 printed pages.**

(h) Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

(i) Candidates should answer the questions in English.

For Examiner's Use Only

Question	Maximum Score	Candidate's Score
1	15	
2	8	
3	17	
Total Score	40	

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233/3

Turn over

1. You are provided with:

- **Solution A:** 0.10M solution of a monobasic acid A;
- **Solution B:** Sodium hydroxide solution;
- **Solution C:** containing 10.0g of acid C per litre of solution.

You are required to:

- Standardise solution B using solution A;
- Determine the number of moles of sodium hydroxide that react with one mole of acid C.

PROCEDURE I

Fill the burette with solution A. Using a pipette and pipette filler, place 25.0cm³ of solution B into 250ml conical flask. Titrate solution B with solution A using phenolphthalein indicator and record your results in **Table 1**. Repeat the titration and complete **Table 1**.

(a) **Table 1**

	I	II	III
Final burette reading			
Initial burette reading			
Volume of solution A used, cm³	24.0		

(4 marks)

(b) Calculate the:

(i) average volume of solution A used.

(1 mark)

Corect Working $\frac{1}{2}$ Corect a-s (b)(i) $\frac{1}{2}$

(ii) number of moles of solution A in the average volume used.

(1 mark)

$$= \frac{\text{correct ans(b)(i)} \times 0.1}{1000} \frac{1}{2} = \text{Cor nect a-s (b)(ii)} \frac{1}{2}$$

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(iii) number of moles of sodium hydroxide (N) in 25.0cm³ of solution B. (1 mark)

Ratio A : N is 1:1 ✓

∴ ans(b)(ii) ≡ ans(b)(iii) ✓ T

(iv) concentration of sodium hydroxide in moles per litre. (1 mark)

....

....

= 1000 × ans (b)(iii) / 25 ✓ = ans(b)(iv) ✓ T

PROCEDURE II

Clean the burette and fill it with solution C. Using a pipette and pipette filler, place 25.0cm³ of solution B into a 250ml conical flask.

Titrate solution B with solution C using phenolphthalein indicator and record your results in Table 2. Repeat the titration and complete Table 2.

(c) Table 2

	I	II	III	
Final burette reading				CT1
Initial burette reading	16·5			D1
				A1
Volume of solution C used, cm³				PA1
				FA1

(4 marks) 05

(d) Calculate the:

(i) average volume of solution C used. (1 mark)

....

Correct working ✓½   Correct ans (d) (i) ✓½   T

(ii) concentration in moles per litre, of solution C, given that the relative formula mass of acid C is 210.0. (1 mark)

$$= \frac{10}{210} \sqrt{\frac{1}{2}} = 0.0476 \sqrt{2} \quad \mathbf{1}$$

....

(iii) number of moles of acid C in the average volume used. (1 mark)

$$= \frac{\text{correct ans (d) (i)} \times 0.0476}{1000} \sqrt{\frac{1}{2}} = \text{correct ans (d)(ii)} \sqrt{\frac{1}{2}} \quad \mathbf{1}$$

....

(e) (i) Write the ratio of moles of acid C to moles of sodium hydroxide (N) in the 25.0 cm³ of solution B. (1 mark)

$$= \text{ans (d)(iii)} : \text{ans (b)(ii)} \sqrt{\quad \mathbf{1}}$$

....

(ii) Determine the number of moles of sodium hydroxide that react with one mole of acid C. (1 mark)

$$= \frac{\text{ans (b)(ii)}}{\text{ans (d)(iii)}} \sqrt{\frac{1}{2}} = \frac{\text{ans (e)(ii)}}{2} \sqrt{\frac{1}{2}} \quad \mathbf{1}$$

* MUST BE A WHOLE NUMBER

2. You are provided with solid D.

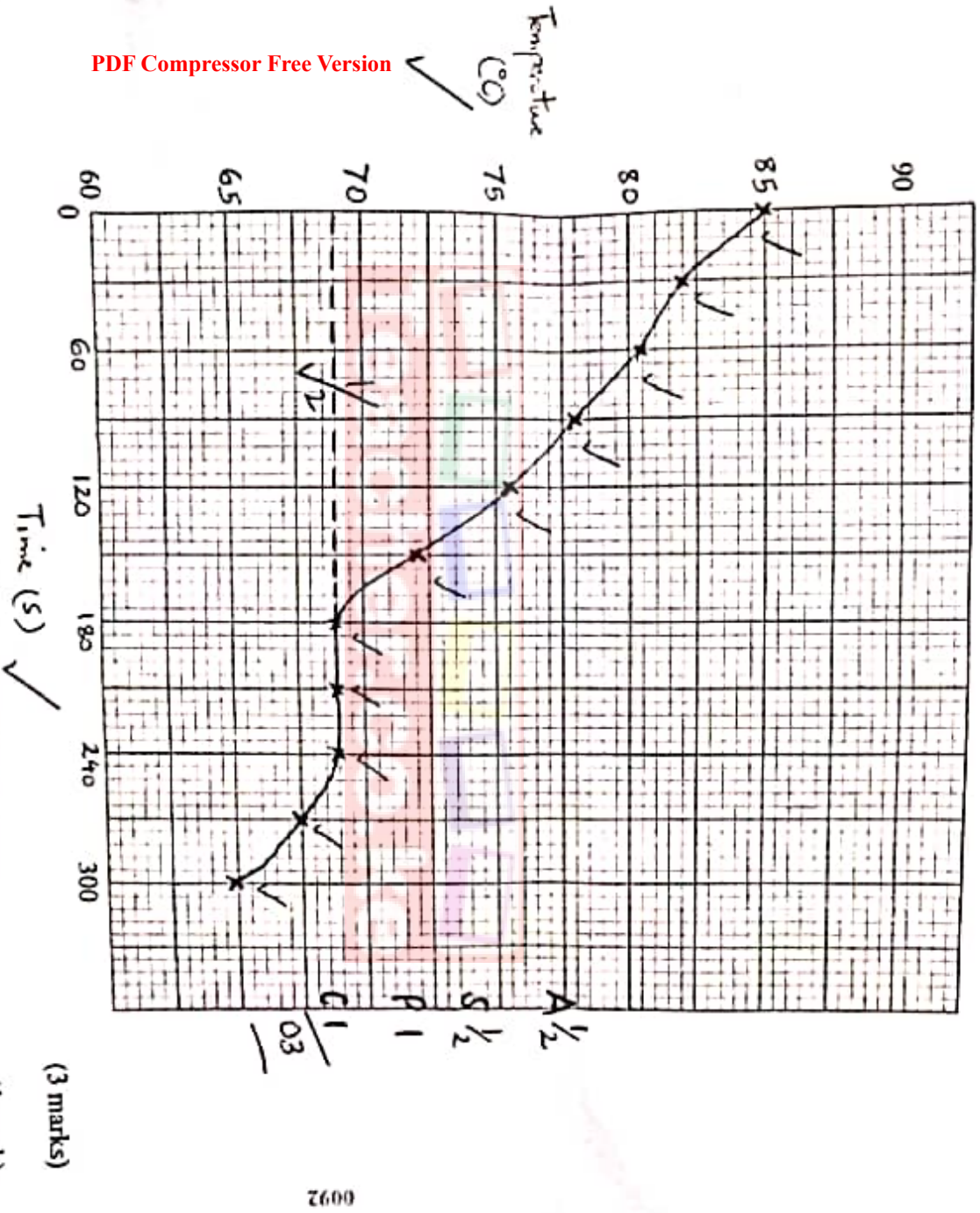You are required to determine the freezing point of solid D.

PROCEDURE

(i) Fill a 250 ml beaker with about 200 cm³ of tap water and heat the water until it boils.

(ii) Place all **solid D** provided in a **dry test tube** and insert a thermometer into the solid.

(iii) Place the test tube in the boiling water and allow the solid to heat until it all melts.

(iv) When the temperature of the melted solid is approximately 90 °C, remove the test tube, wipe the sides with tissue paper and then place the test tube into an empty 250 ml beaker

(v) Start the stop watch or clock when the temperature of the melted solid is 85.0 °C.

(vi) As the solid cools, measure and record its temperature every 30 seconds and complete **Table 3**.

5

(a) Table 3

69.0

Time, s	0	30	60	90	120	150	180	210	240	270	300	CT1
Temperature, °C	85.0	82.0	80.5	78.0	75.5	72.0	69.0	69.0	69.0	67.5	65.0	D½, A½

(b) On the grid provided, plot a graph of temperature (vertical axis) against time.

(3 marks)

T½, Q3

(c) Using the graph in (b), determine the freezing point of solid D.

(1 mark)

(3 marks)

Sharing ½   Correct reading ½   I

3. You are provided with solid E. Carry out the following tests and record your observations and inferences in the spaces provided.

(a) Place all the solid E in a boiling tube. Add about 10 cm³ of dilute nitric(V) acid, warm the mixture and then allow to stand until all the solid dissolves. Add about 10 cm³ of distilled water to the solution and shake. Retain the solution for tests (b) and (c).

Observations	Inferences
No effervescence ✓ 2	CO_3^{2-} / SO_3^{2-} absent ✓ 2
E dissolves to form a blue solution	Cu^{2+} present ✓ 2

(1 marks)   (1 mark)

(b) Use about 2 cm³ portions of the solution obtained in 3(a) for each of the following tests.

(i) To the first portion add 2 or 3 drops of aqueous barium nitrate.

Observations	Inferences
No white ppt formed ✓ 1	SO_4^{2-} absent ✓ 1

(1 mark)   (1 mark)

(ii) To the second portion add 2 or 3 drops of aqueous lead(II) nitrate.

Observations	Inferences
No yellow ppt formed ✓ 2	I^- absent ✓ 2
No white ppt formed ✓ 2	Cl^- / Br^- absent ✓ 2

(1 mark)   (1 mark)

(iii)   To the **third portion** add aqueous sodium hydroxide dropwise until in excess

Observations	Inferences
Blue ppt formed insoluble ✓ in excess	Cu^{2+} present ✓

(1 mark)

(iv)   Place about 3 cm³ of aqueous ammonia in a test tube. To the **fourth portion**, add all the aqueous ammonia from the test tube dropwise.

Observations	Inferences
Blue ppt formed that dissolves in excess to form a deep blue solution ✓	Cu^{2+} present ✓

(1 mark)

(c)   To the remaining solution of **solid E** in the boiling tube, add all the **solid G** provided. Shake the mixture for about 2 minutes. Filter the mixture into a boiling tube. Retain the filtrate for tests (i) and (ii) below.

Observations	Inferences
Blue solution changes to green ✓ Brown residue ✓ Green filtrate ✓	Cu^{2+} displaced by G/G is more reactive than Cu/G is oxidized by Cu^{2+}/Cu^{2+} are reduced by G ✓ Boiling tube (insoluble residue) Cu^{2+} are displaced by Fe

Boiling tube (insoluble residue ✓
½ mk @ to a max. of 1mk

(i) To about 2 cm³ portion of the filtrate, add aqueous ammonia dropwise until in excess.

Observations	Inferences
Green ppt formed insoluble in excess	Fe^{2+}

(1 mark)

(ii) To about 2 cm³ portion of the filtrate add 2 or 3 drops of dilute hydrogen peroxide solution.

Observations	Inferences
Green solution changes to brown/yellow	Fe^{2+} oxidized to Fe^{3+}. Fe^{3+} formed
Effervescence	Rej. turn

(1 mark)