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Paper 3

CHEMISTRY – (Practical)

Mar. 2022 – 2¼ hours



Name Index Number

Candidate's Signature Date

Instructions to candidates

- Write your name and index number in the spaces provided above.
- Sign and write the date of examination in the spaces provided above.
- Answer **all** the questions in the spaces provided in the question paper.
- 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.
- All working **must** be clearly shown where necessary.
- Non-programmable** silent electronic calculators and KNEC mathematical tables may be used.
- This paper consists of 8 printed pages.
- Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.
- 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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1. You are provided with:

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- **Solution A:** 0.10M solution of a monobasic acid A;
- **Solution B:** Sodium hydroxide solution;
- **Solution C:** containing 10.0 g 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 25.0 cm³ of **solution B** into 250 ml 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, cm ³			

(3 marks)

(b) Calculate the:

- (i) average volume of **solution A** used. (1 mark)

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- (ii) number of moles of **solution A** in the average volume used. (1 mark)

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

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

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PROCEDURE II

Clean the burette and fill it with **solution C**. Using a pipette and pipette filler, place 25.0 cm³ of **solution B** into a 250 ml 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			
Initial burette reading			
Volume of solution C used, cm ³			

(3 marks)

- (d) Calculate the:

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

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

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

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- (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)

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

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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**.



(a) **Table 3**

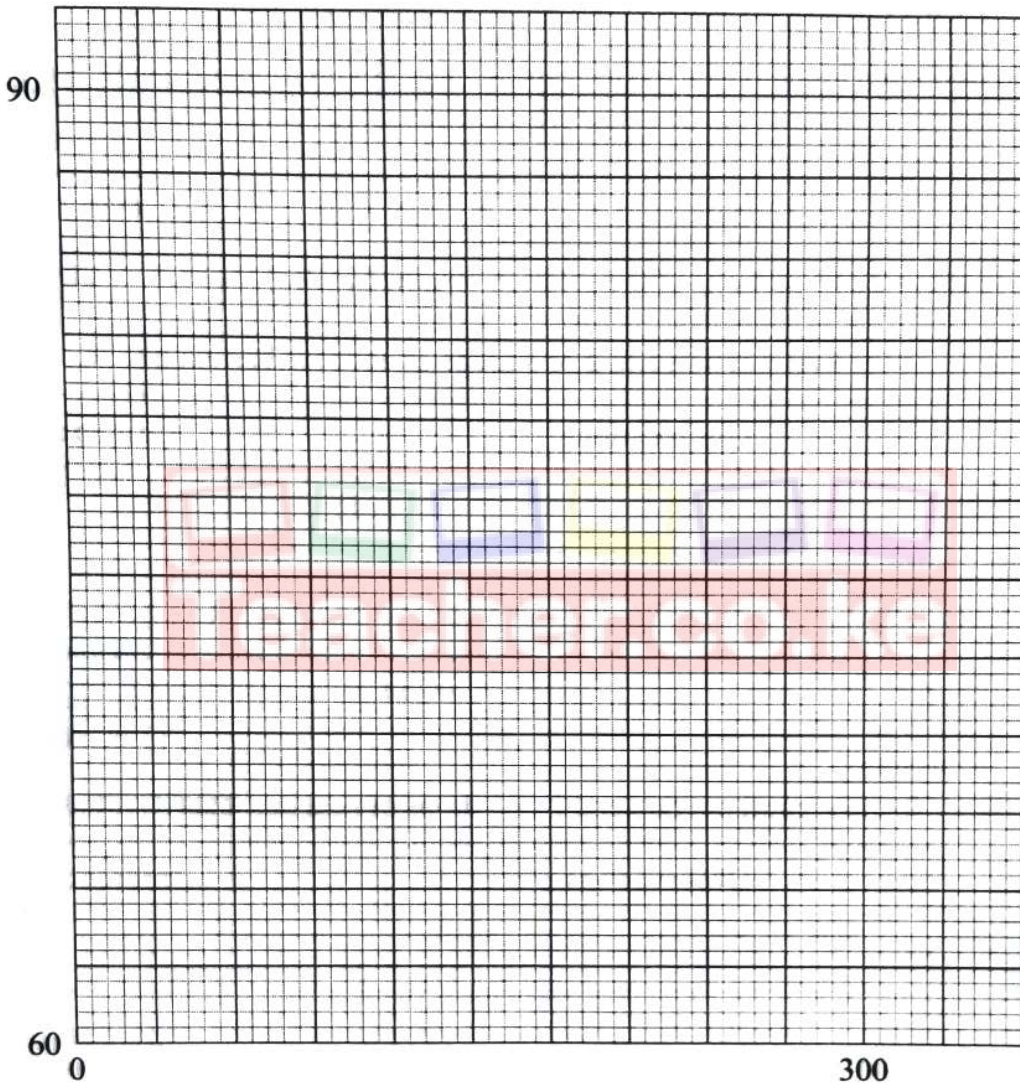
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Time, s	0	30	60	90	120	150	180	210	240	270	300
Temperature, °C											

(4 marks)

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

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(3 marks)

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

(1 mark)

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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

(2 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

(1 mark)

(1 mark)

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

Observations	Inferences

(1 mark)

(1 mark)

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

Observations	Inferences

(1 mark)

(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

(1 mark)

(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

(1 mark)

(1 mark)

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

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Observations	Inferences

(1 mark)

(1 mark)

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

Observations	Inferences

(1 mark)

(1 mark)

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