

CHEMISTRY – (Practical)

Mar. 2022 – 2¼ hours



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 in the question paper.
- (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	



1. You are provided with:

- **Solution A:** 0.10 M 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 1

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**

	24.0			
	I	II	III	
Final burette reading				CT I
Initial burette reading				DI
Volume of solution A used, cm ³				AI
				PAI
				FAI

(4 marks) 05

(b) Calculate the:

(i) average volume of **solution A** used.

(1 mark)

Correct Working $\sqrt{2}$ Correct ans (b)(i) $\sqrt{2}$

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

(1 mark)

= $\frac{\text{correct ans (b)(i)} \times 0.1}{1000} \sqrt{2} = \text{correct ans (b)(ii)} \sqrt{2}$ I

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

Ratio A : N is 1 : 1 $\checkmark/2$
 $\therefore \text{ans(b)(ii)} \equiv \text{ans(b)(iii)} \checkmark/2$ I

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

$$= \frac{1000 \times \text{ans(b)(iii)}}{25} \checkmark/2 = \text{ans(b)(iv)} \checkmark/2$$
 I

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

	16.5			
	I	II	III	CTI
Final burette reading				DI
Initial burette reading				AI
Volume of solution C used, cm ³				PAI FAI

(4 marks) 05

- (d) Calculate the:

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

Correct working $\checkmark/2$ Correct ans (d)(i) $\checkmark/2$ I

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

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

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

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

- (c) (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)

$$= \text{ans (d) (ii)} : \text{ans (b) (ii)} \quad \sqrt{\frac{1}{2}} \quad \text{I}$$

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

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

* 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.

(a) Table 3

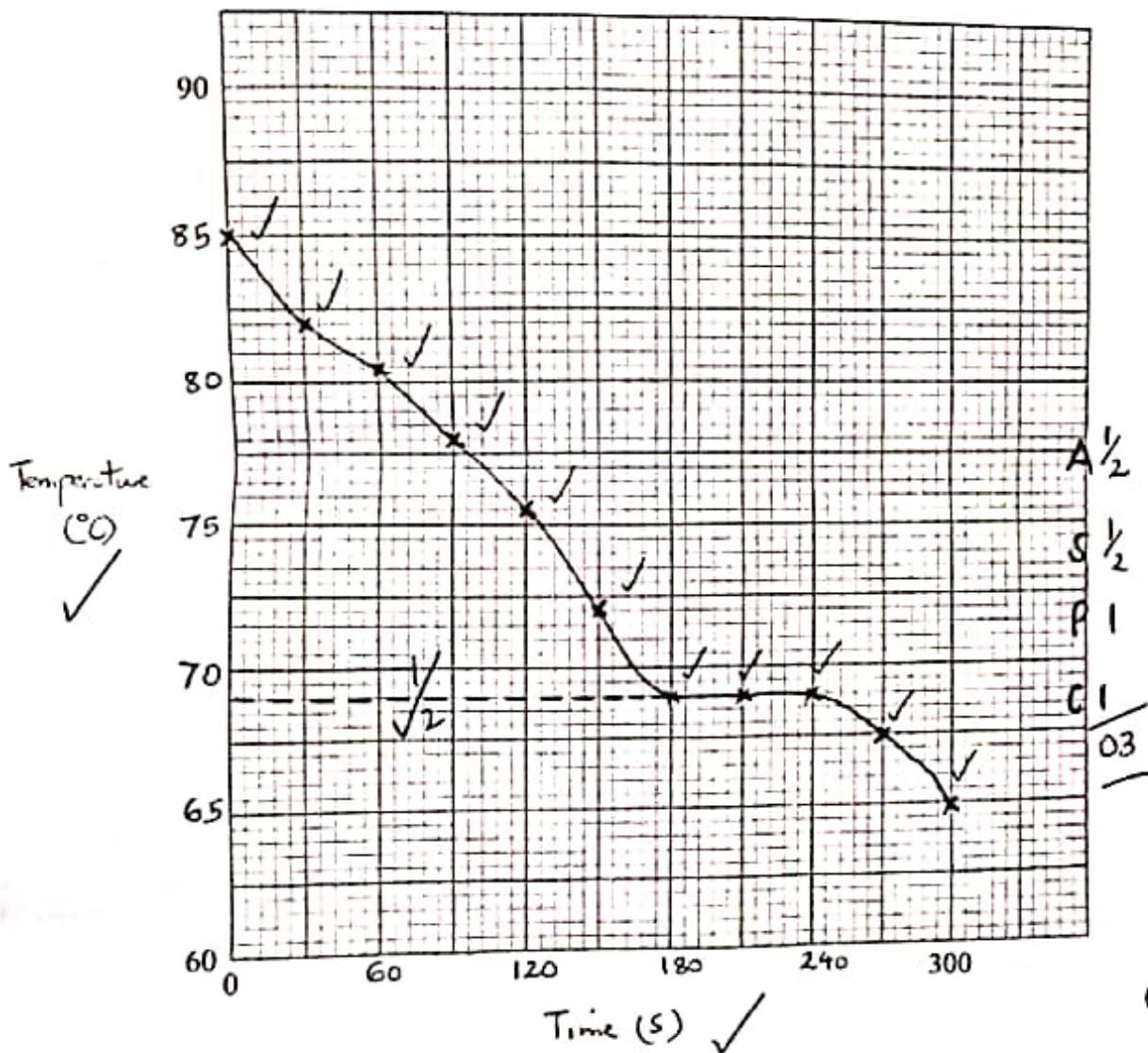
Time, s	0	30	60	90	120	150	180	210	240	270	300
Temperature, °C	85.0	82.0	80.5	78.0	75.5	72.0	69.0	69.0	69.0	67.5	65.0

69.0

CT1

(3 marks) $\frac{11}{03}$

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



(3 marks)

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

(1 mark)

Showing $\frac{1}{2}$ correct reading $\frac{1}{2}$ 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 cm^3 of dilute nitric(V) acid, warm the mixture and then allow to stand until all the solid dissolves. Add about 10 cm^3 of distilled water to the solution and shake. Retain the solution for tests (b) and (c).

Observations	Inferences
No effervescence $\checkmark/2$	$\text{CO}_3^{2-}/\text{SO}_3^{2-}$ $\checkmark/2$ absent
E dissolves to form $\checkmark/2$ a blue solution	Cu^{2+} present $\checkmark/2$

(1 marks)

(1 mark)

- (b) Use about 2 cm^3 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 $\checkmark/1$	SO_4^{2-} absent $\checkmark/1$

(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 $\checkmark/2$	I^- absent $\checkmark/2$
No white ppt formed $\checkmark/2$	Cl^-/Br^- absent $\checkmark/2$

(1 mark)

(1 mark)

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

Observations	Inferences
Blue ppt $\frac{1}{2}$ formed insoluble \checkmark in excess \checkmark	Cu^{2+} present \checkmark
(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
Blue ppt $\frac{1}{2}$ formed that dissolves \checkmark in excess to form a deep blue solution \checkmark	Cu^{2+} present \checkmark
(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
Blue solution changes to green \checkmark	Cu^{2+} displaced by G / G is more reactive than Cu / G is oxidized \checkmark
Brown residue \checkmark	
Green filtrate \checkmark	by Cu^{2+} / Cu^{2+} are reduced by G / Cu^{2+} are displaced by Fe
Boiling tube becomes warm \checkmark $\frac{1}{2}$ mark @ to a max. of 1 mark	

- (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)

(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)

(1 mark)