THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education

233/3 — CHEMISTRY — Paper 3

(PRACTICAL)

Apr. 2021 – 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	21	
2	10	
3	09	
Total Score	40	

1. You are provided with:

- 5.3 g **solid A**, sodium carbonate;
- **Solution B**, hydrochloric acid.

You are required to determine the:

- Molar heat of the solution of **solid A**;
- Concentration of the hydrochloric acid, **solution B**.

PROCEDURE I

Using a burette, place 30.0 cm^3 of distilled water in a 100 ml plastic beaker. Stir the water with a thermometer and measure its temperature after every half-minute interval. Record the readings in **Table 1**.

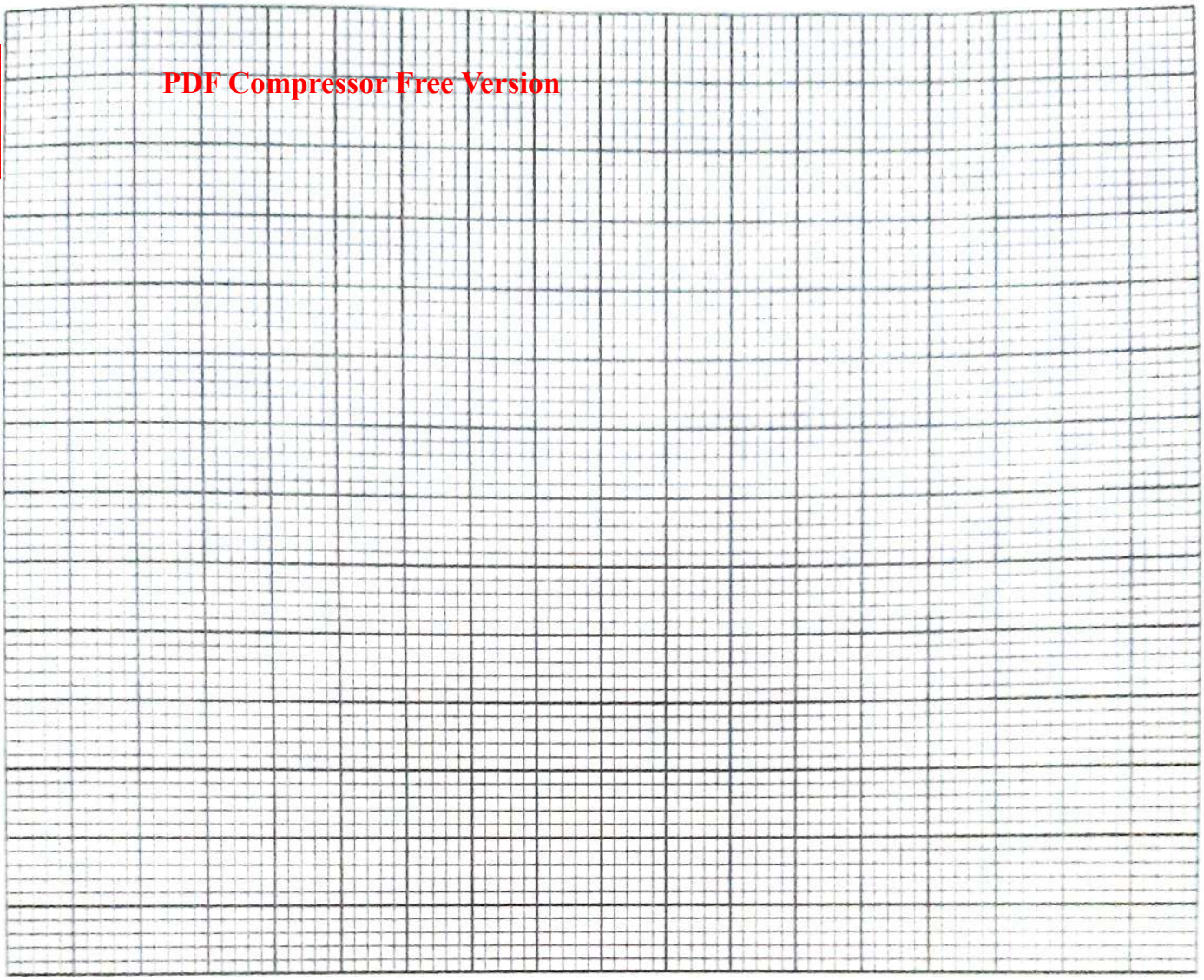
At exactly 2 minutes, add **all** of solid **A** to the water at once. Stir well and continue measuring the temperature of the mixture after every half-minute interval. Record the readings in **Table 1**. **Retain the mixture in the beaker for use in Procedure II.**

(a) **Table 1**

Time (minutes)	0	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$	5
Temperature (°C)					**X**						

(3 marks)

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



(3 marks)

(c) Determine from the graph, the temperature change, ΔT. (1 mark)

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(d) Calculate the:

(i) number of moles of **solid A** used. (RFM = 106) (1 mark)

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(ii) molar enthalpy of solution, ΔH_{soln} and show the sign of ΔH_{soln}.
(Assume that for the solution, density = 1.0 gcm^{-3} and specific heat capacity = 4.2 Jg^{-1}K^{-1}) (2 marks)

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PROCEDURE II

(i) Fill a burette with **solution B**.

(ii) Transfer all of the mixture in the 100 ml plastic beaker from **procedure I** into a 250 ml volumetric flask. Add distilled water to make up to the mark and shake. Label the mixture as **solution A**.

(iii) Using a pipette and pipette filler, place 25.0 cm^3 of **solution A** into a 250 ml conical flask. Add two or three drops of phenolphthalein indicator and titrate with **solution B**. **Do not pour out the contents of the conical flask.**
Record the readings in **Table 2**
Add two or three drops of methyl orange indicator to the contents of the conical flask. Titrate the mixture with **solution B** and record the readings of this second titration in **Table 3**.
Repeat **Procedure II**, step **(iii)** and complete **Tables 2** and **3**.

(e) (i) **Table 2**, using phenolphthalein indicator.

	I	II
Final burette reading		
Initial burette reading		
Volume of **solution B** used, cm^3		

(3 marks)

Average volume, V_1, of **solution B** used = ... ($\frac{1}{2}$ mark)

(ii) **Table 3**, using methyl orange indicator.

	I	II
Final burette reading		
Initial burette reading		
Volume of **solution B** used, cm^3		

(3 marks)

Average volume, V_2, of **solution B** used = ($\frac{1}{2}$ mark)

(f) Calculate the:

(i) concentration, in moles per litre, of sodium carbonate in **solution A**. (1 mark)
RFM = 106

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(ii) number of moles of sodium carbonate in 25.0 cm^3 of **solution A**. (1 mark)

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(iii) number of moles of hydrochloric acid in the total volume, $V_1 + V_2$, of **solution B**. (1 mark)

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(iv) concentration, in moles per litre, of hydrochloric acid in **solution B**. (1 mark)

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2. You are provided with **solid C**. Carry out the following tests. Write the observations and inferences in the spaces provided.

Place **all** of **solid C** in a boiling tube. Add about 20 cm^3 of distilled water and shake until all of the solid dissolves. Label the solution as **solution C**. Use about 2 cm^3 of **solution C** in a test tube for each of the following tests.

(a) Add aqueous sodium hydroxide dropwise until in excess.

Observations	Inferences

(1 mark) (2 marks)

(b) Add **three** drops of aqueous sodium sulphate.

Observations	Inferences

(1 mark) (1 mark)

(c) Add **three** drops of aqueous barium nitrate.

Observations	Inferences

(1 mark) (2 marks)

(d) Add **three** drops of aqueous lead(II) nitrate. Heat the mixture

Observations	Inferences

(1 mark) (1 mark)

3. You are provided with an organic compound, **solid D**. Carry out the following tests. Record the observations and inferences in the spaces provided.

(a) Describe the appearance of **solid D**. (1 mark)

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(b) Divide **solid D** into **four** portions.

(i) Place the first portion of **solid D** on a watch glass and burn it with a Bunsen burner flame.

Observations	Inferences

(1 mark) (1 mark)

(ii) Place the second portion of **solid D** in a test tube. Add about 3 cm^3 of aqueous sodium hydroxide and shake.

Observations	Inferences

(1 mark) (1 mark)

(iii) Place the third portion of **solid D** in a test tube. Add about 3 cm^3 of distilled water. Heat the mixture and add **three** drops of acidified potassium manganate(VII).

Observations	Inferences

(1 mark) (1 mark)

(iv) Place the fourth portion of **solid D** in a test tube. Add about 3 cm^3 of distilled water. Heat the mixture and add **all** the solid sodium hydrogen carbonate provided.

Observations	Inferences

(1 mark) (1 mark)

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