

233/3

— CHEMISTRY —
(PRACTICAL)

Paper 3

Apr. 2021 – 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	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**.

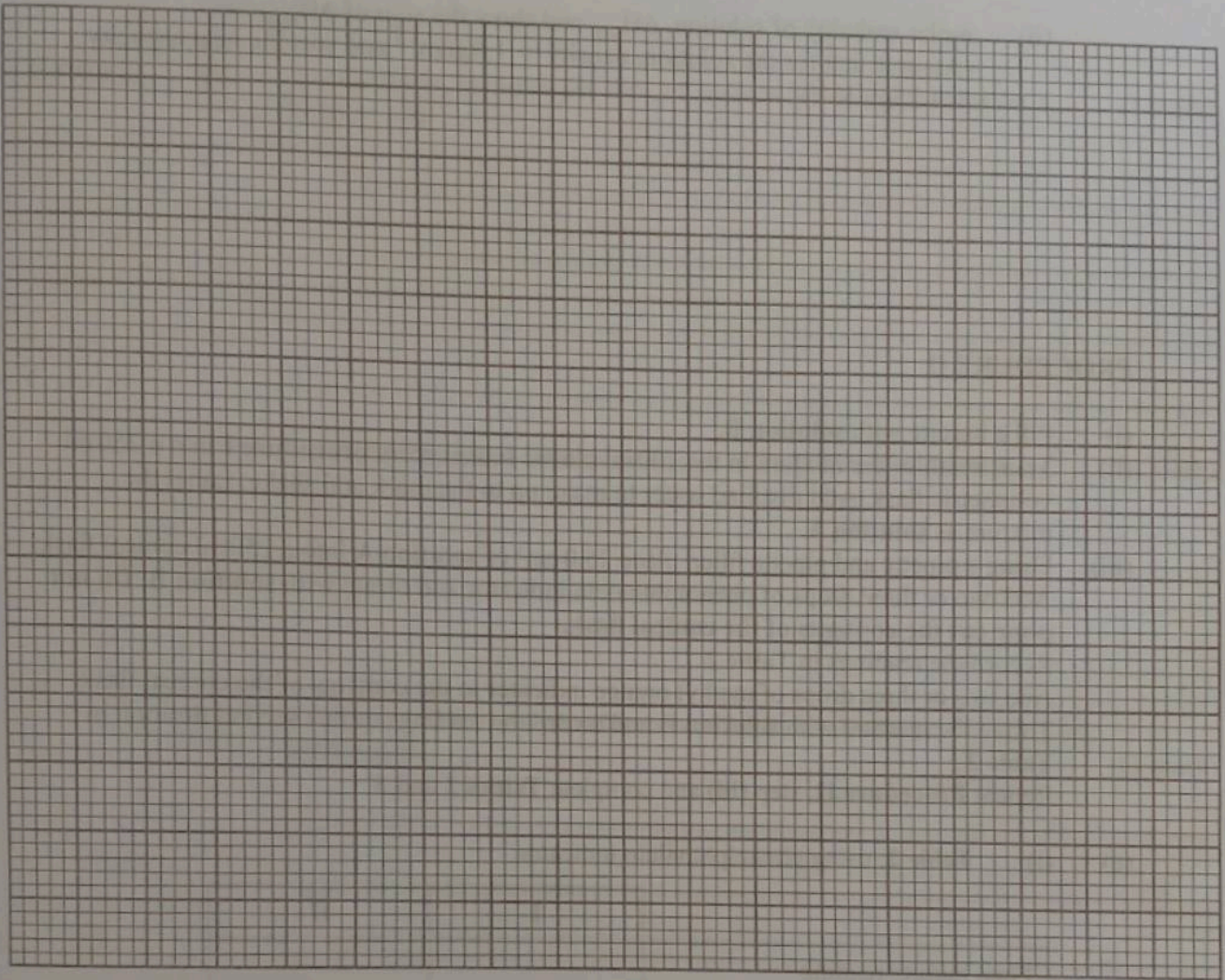
At exactly 2 minutes, add **all** of **solid A** to the water at once. Stir well and continue measuring the temperature of the mixture after every half-minute interval. Record the readings in **Table 1**. **Retain the mixture in the beaker for use in Procedure II.**

(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 ($^{\circ}\text{C}$)					X						

(3 marks)

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



- (c) Determine from the graph, the temperature change, ΔT . (3 marks)
(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 g cm^{-3} and specific heat capacity = $4.2 \text{ J g}^{-1} \text{ K}^{-1}$) (2 marks)
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PROCEDURE II

- (i) Fill a burette with **solution B**.
- (ii) Transfer all of the mixture in the 100ml 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 cm³ 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 cm³ 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 cm³ 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 cm³ 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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**233/3
Inst. Sch.**

**— CHEMISTRY —
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INSTRUCTIONS TO SCHOOLS

The information contained in this paper is to enable the head of the school and the teacher in charge of Chemistry to make adequate preparations for this year's Chemistry practical examination.

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No one else should have access to this paper or acquire knowledge of its contents. Great care **must** be taken to ensure that the information herein does not reach the candidates either directly or indirectly. The teacher in charge of Chemistry should **not** perform any of the experiments in the same room as the candidates nor make the results of the experiments available to the candidates or give any other information related to the experiments to the candidates. Doing so will constitute an examination irregularity which is punishable.

A003

These instructions consist of 8 printed pages.



In addition to the fittings and chemicals found in a chemistry laboratory, each candidate will require the following:

1. 5.3 g of **solid A** weighed **accurately** and supplied in a stoppered container
2. 0.5 g of **solid C** supplied in a stoppered container
3. 0.3 g of **solid D** supplied in a stoppered container
4. 0.2 g of solid sodium hydrogen carbonate
5. 100 cm³ of **solution B**
6. One burette, 0 – 50 ml
7. One 25.0 ml pipette
8. One pipette filler
9. One 100 ml plastic beaker
10. One thermometer, (– 10 °C to 110 °C)
11. One stopwatch or clock.
12. One 250 ml volumetric flask
13. One filter funnel
14. Three labels
15. Two 250 ml conical flasks
16. One boiling tube
17. Six dry test-tubes.
18. Test tube rack
19. One watch glass
20. About 500 cm³ of distilled water supplied in a wash bottle

Access to:

1. Methyl orange indicator supplied with a dropper
2. Phenolphthalein indicator supplied with a dropper
3. 2M aqueous sodium hydroxide supplied with a dropper
4. Bunsen burner
5. Acidified potassium manganate(VII) supplied with a dropper
6. Aqueous lead(II) nitrate supplied with a dropper
7. Aqueous sodium sulphate supplied with a dropper
8. Aqueous barium nitrate supplied with a dropper



PREPARATIONS

1. **Solution B** is prepared by measuring exactly 26.0 cm^3 of concentrated hydrochloric acid of specific gravity 1.18 g cm^{-3} , and placing it in a one litre volumetric flask, then adding distilled water to the mark. Label this as **solution B**.
2. Aqueous lead(II) nitrate is prepared by dissolving 33.0 g of solid lead(II) nitrate in about 750 cm^3 of distilled water and diluting to one litre solution. Label this as aqueous lead(II) nitrate.
3. Sodium sulphate solution is prepared by dissolving 14.2 g of solid sodium sulphate in about 750 cm^3 of distilled water and diluting to one litre of solution. Label this as aqueous sodium sulphate.
4. Barium nitrate solution is prepared by dissolving 26.0 g of solid barium nitrate in about 750 cm^3 of distilled water and diluting to one litre of solution. Label this as aqueous barium nitrate.
5. Acidified potassium manganate(VII) is prepared by dissolving 3.2 g of solid potassium manganate(VII) in about 200 cm^3 of 2M sulphuric(VI) acid, adding about 600 cm^3 of distilled water and diluting to one litre of solution. Label this as acidified potassium manganate(VII). (Each candidate will require about 1 cm^3)

Note:

Solids **A**, **C** and **D** will be supplied by the Kenya National Examinations Council.

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