

THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education

233/3

CHEMISTRY (Practical)

Paper 3

Nov. 2024 – 2¼ hours

Candidate's signature: Date:

Instructions to Candidates

- (a) Confirm that this question paper has your name and the correct index number.
- (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) KNEC mathematical tables and non-programmable silent electronic calculators 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	24	
2	10	
3	06	
Total Score	40	



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1 You are provided with the following:

Solution A - aqueous sodium hydroxide

Solution B - 0.10 M of a monobasic acid B

Solid C - metal C

Solution D - 2.0 M hydrochloric acid

You are required to determine the:

- concentration of aqueous sodium hydroxide, solution A.
- molar heat of reaction between metal C and hydrochloric acid.

PROCEDURE I

- Using a pipette and pipette filler, place 25.0 cm³ of solution B in a 250 ml conical flask.
- Fill the burette with aqueous sodium hydroxide, solution A and use it to titrate solution B using 2 drops of phenolphthalein indicator. Record the results in Table 1.
- Repeat the titration and complete Table 1.

Retain the remaining amount of solution A for use in procedure III.

(a) Table 1

	I	II	III
Final burette reading			
Initial burette reading			
Volume of solution A used, cm ³			

(3 marks)

(b) Calculate the:

- average volume of solution A used;

(1 mark)

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- number of moles of the monobasic acid, solution B used;

(1 mark)

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- (iii) concentration in moles per litre, of aqueous sodium hydroxide, solution A. (1 mark)
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PROCEDURE II

- (i) Using a 100 ml measuring cylinder, place 50 cm³ of the hydrochloric acid, **solution D** in a 100 ml plastic beaker.
- (ii) Measure the temperature of the solution at $\frac{1}{2}$ - minute intervals and record in **Table 2**.
- (iii) At the exactly 1 $\frac{1}{2}$ - minute interval, add **all** of **solid C** and stir with the thermometer.
- (iv) Continue measuring and recording the temperature of the mixture and complete **Table 2**.

Retain the mixture for use in procedure III.

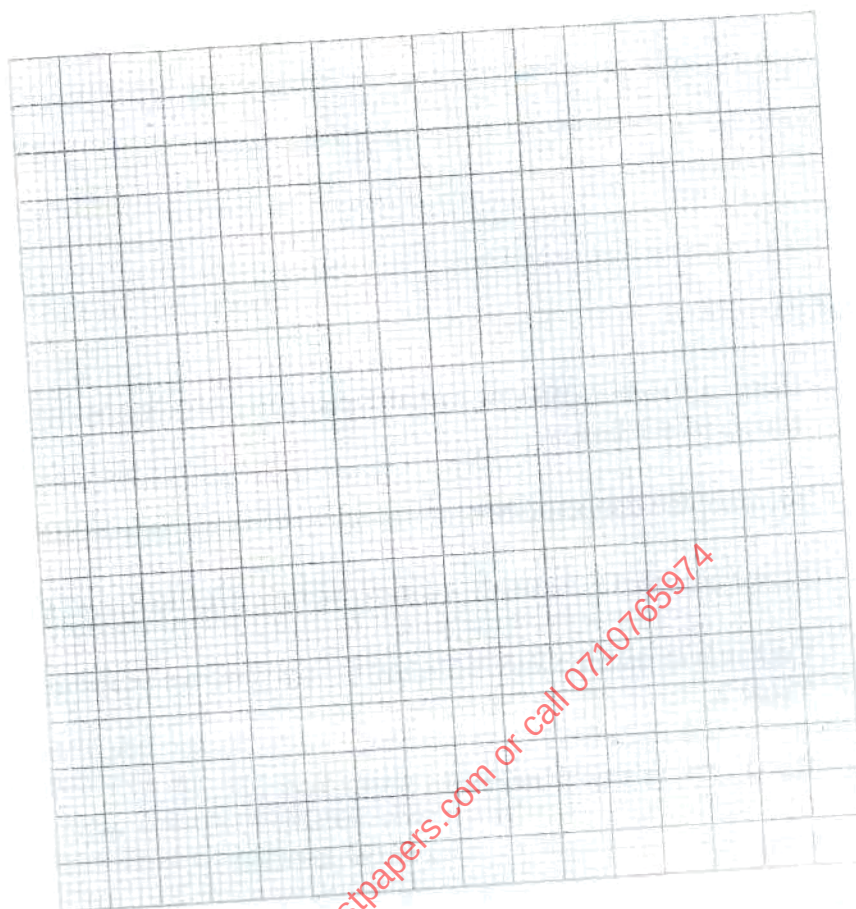
- (c) **Table 2**

Time, minutes	0	$\frac{1}{2}$	1	1 $\frac{1}{2}$	2	2 $\frac{1}{2}$	3	3 $\frac{1}{2}$	4
Temperature, °C				-					

(3 marks)

- (d) On the grid provided, plot a graph of temperature (vertical axis) against time. (3 marks)

1



- (e) (i) Using the graph, determine the temperature change, ΔT ; (1 mark)

- (ii) Calculate the heat change for the reaction (Assume that for the solution, specific heat capacity = $4.2 \text{ Jg}^{-1} \text{ degree}^{-1}$ and density = 1.00 gcm^{-3}). (1 mark)

PROCEDURE III

- (i) Transfer **all** of the solution obtained in procedure II into a 250 ml volumetric flask. Add distilled water to the mark and label this as **solution E**.
- (ii) Fill a clean burette with solution E.
- (iii) Using a pipette and pipette filler, place 25.0 cm^3 of sodium hydroxide, solution A into a 250 ml conical flask.
- (iv) Titrate the sodium hydroxide with solution E using 2 drops of phenolphthalein indicator. Record the results in **Table 3**.
- (v) Repeat the titration and complete **Table 3**.

Table 3

	I	II	III
Final burette reading			
Initial burette reading			
Volume of solution E used, cm^3			

(3 marks)

- (g) Calculate the:

- (i) average volume of solution E used;

(1 mark)

- (ii) number of moles of sodium hydroxide in
- 25.0 cm^3
- used;

(1 mark)

- (iii) number of moles of hydrochloric acid in the
- 250 cm^3
- solution E;

(1 mark)



- (iv) initial number of moles of hydrochloric acid in the 50 cm³ of solution D used; (1 mark)

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- (v) number of moles of hydrochloric acid that reacted with metal C. (1 mark)

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- (h) Given that the reaction ratio of hydrochloric acid with metal C is:
HCl : metal C = 2 : 1,

Calculate the:

- (i) number of moles of metal C that reacted; (1 mark)

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- (ii) heat of reaction between hydrochloric acid and one mole of metal C. (1 mark)

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2

You are provided with **solid F**. Carry out the following tests and record the observations and inferences in the spaces provided.

- (a) Place about one-quarter of solid F in a **dry** test tube. Heat the solid strongly and test any gases produced with blue litmus paper.

Observations	Inferences
(1 mark)	(1 mark)

3

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

Place the remaining amount of solid F in a boiling tube. Add about 15 cm³ of distilled water and shake to dissolve the solid. Place **all** of solid G in a boiling tube. Add about 10 cm³ of distilled water and shake to dissolve. Use about 2 cm³ portions in a test tube, for each of the following tests.

- (i) To the first portion, add aqueous sodium hydrogen carbonate provided.
(a) To the first portion, add **all** of the solid sodium hydrogen carbonate until in excess.

Observations	Inferences
(1 mark)	(1 mark)
(1 mark)	(1 mark)

- (b) To the second portion, add aqueous ammonia dropwise until in excess. Then add 1 cm³ of aqueous potassium dichromate(VI), shake well and then add 2 cm³ of dilute sulphuric(VI) acid. Heat the mixture strongly and then allow it to stand for about 2 minutes.

Observations	Inferences
(1 mark)	(1 mark)

- (iii) To the third portion, add about 1 cm³ of aqueous sodium chloride.

Observations	Inferences
(1 mark)	(1 mark)

- (c) To the third portion add, 2 or 3 drops of bromine water.

Observations	Inferences
(1 mark)	(1 mark)

- (iv) To the fourth portion, add 2 drops of aqueous barium nitrate. Shake the mixture and then add 5 drops of dilute nitric(V) acid.

Observations	Inferences
(1 mark)	(1 mark)

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