THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education

233/3 –

CHEMISTRY – Paper 3
(PRACTICAL)
Nov. 2018 – 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) *KNEC mathematical tables and 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	20	
2	11	
3	09	
Total Score	40	

1. You are provided with:

- 0.30 g **solid A**, magnesium metal
- Hydrochloric acid, **solution B**
- 0.15 sodium carbonate, **solution C**
- Methyl orange indicator

You are required to determine the:

- Enthalpy change, ΔH per mole, of the reaction between magnesium metal and excess hydrocholoric acid.
- Concentration in moles per litre of hydrochloric acid, **solution B**.

PROCEDURE I

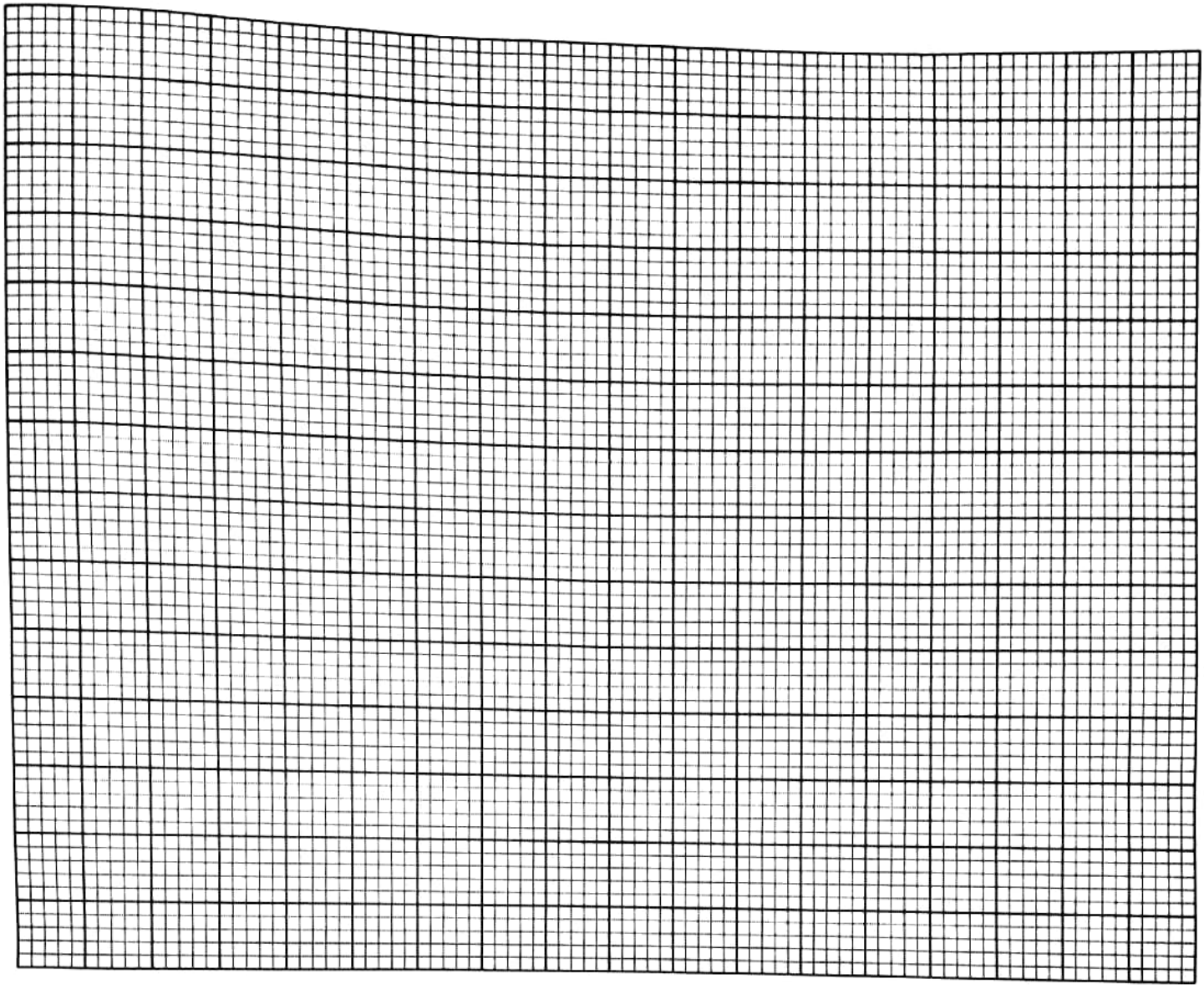
(i) Using a burette, measure 50.0 cm^3 of **solution B** and place it in a 100 ml plastic beaker.
(ii) Measure the temperature of **solution B** in the beaker after every 30 seconds and record it in **Table 1**.
(iii) At the 90th second, add **all** of the **solid A** provided into the beaker, stir with the thermometer and continue measuring and recording the temperature after every 30 seconds. Complete **Table 1**. **Retain the mixture in the beaker for use in procedure II.**

Table 1

Time (seconds)	0	30	60	90	120	150	180	210	240	270
Temperature (°C)	30			X	32.0	36.0	39.0	41.0	39.0	38.0

(3 marks)

(a) Plot a graph of temperature (vertical axis) against time on the grid provided.
(3 marks)



(b) Determine the change in temperature, ΔT, for the reaction. Show the working on the graph.

ΔT = ... (1 mark)

(c) Calculate the heat change, in joules, for the reaction. Assume that for the solution, specific heat capacity is $4.2\,J\,g^{-1}K^{-1}$ and density is $1.0\,g\,cm^{-3}$. (2 marks)

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(d) The relative atomic mass of magnesium is 24.0. Calculate the enthalpy change, ΔH, of the reaction per mole of magnesium. Indicate the sign of ΔH. (1 mark)

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PROCEDURE II

(i) Fill a **clean** burette with the 0.15M sodium carbonate, **solution C**.
(ii) Place **all** of the mixture in the beaker from **procedure I** into a 250 ml volumetric flask. Add distilled water to the mark and shake thoroughly. Label the mixture as **solution D**.
(iii) Using a pipette filler, pipette 25.0 cm^3 of **solution D** into a 250 ml conical flask and add 2 drops of methyl orange indicator.
(iv) Titrate **solution D** in the conical flask with the sodium carbonate, **solution C** and record the readings in **Table 2**.
(v) Repeat steps **(iii)** and **(iv)** and complete **Table 2**.

Table 2

	I	II	III
Final burette reading			
Initial burette reading			
Volume of **solution D** used (cm^3)			

22.8 22.8

(3 marks)

(a) Determine the average volume of the 0.15M sodium carbonate, **solution C**, used. (1 mark)

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(b) Calculate the number of moles of:

(i) sodium carbonate used. (1 mark)

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(ii) hydrochloric acid in the 25.0 cm^3 of **solution D**. (1 mark)

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(iii) hydrochloric acid in the 250 cm^3 of **solution D**. (1 mark)

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(iv) hydrochloric acid that reacted with magnesium metal. (1 mark)

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(v) total number of moles of hydrochloric acid in the 50.0 cm^3, **solution B**. (1 mark)

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

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

(a) Place about one-third of **solid E** in a **dry** test-tube. Heat the solid strongly and test any gas with both blue and red litmus papers.

Observations	Inferences

(2 marks) (1 mark)

(b) Place the remaining amount of **solid E** in a boiling tube. Add about 15 cm^3 of distilled water and shake. Divide the mixture into **four** test tubes each containing about 2 cm^3.

(i) To the first portion, add three or four drops of dilute hydrochloric acid.

Observations	Inferences

(1 mark) (2 marks)

(ii) To the second portion, add two or three drops of aqueous barium nitrate.

Observations	Inferences

(½ mark) (½ mark)

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

Observations	Inferences

(1 mark) (1 mark)

(iv) To the fourth portion, add aqueous ammonia dropwise until in excess.

Observations	Inferences

(1 mark) (1 mark)

3. 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-third of **solid F** on a **clean** metallic spatula and burn it in a Bunsen burner flame.

Observations	Inferences

(1 mark) (1 mark)

(b) **Place the remaining amount of solid F in a boiling tube. Add about 10 cm³ of distilled water and shake. Use the mixture for tests (i) to (iii) below.**

Observations	Inferences

(½ mark) (½ mark)

(i) Using about 2 cm³ of the mixture in a test-tube, determine the pH using universal indicator paper and chart.

pH	Inferences

(1 mark) (1 mark)

(ii) To about 2 cm³ of the mixture in a test tube, add two or three drops of acidified potassium manganate(VII).

Observations	Inferences

(1 mark) (1 mark)

(iii) To about 2 cm³ of the mixture in a test-tube add two or three drops of bromine water.

Observations	Inferences

(1 mark) (1 mark)

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