THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education

233/3 – CHEMISTRY – Paper 3
(PRACTICAL)
Nov. 2017 – 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	19	
2	12	
3	9	
Total Score	40	

1. You are provided with:

- **Solution A**, 0.5 M copper(II) sulphate
- **Solid B_1**, metal B_1 powder
- **Solid B_2**, Iron powder
- **Solution C**, 0.02 M acidified potassium manganate(VII)

You are required to determine the:

- Enthalpy change for the displacement reaction between metal B_1 and copper(II) sulphate.
- Mass of iron that reacts with copper(II) sulphate in the displacement reaction.

PROCEDURE I

(a) (i) Using a pipette and a pipette filler, place 25.0 cm^3 of **solution A** into a 100 ml plastic beaker. Allow to stand for about 1 minute and then measure the temperature of the solution. Record the reading in **Table 1** as the initial temperature. Add all of **solid B_1** to the solution. Stir the mixture carefully with the thermometer and measure the highest temperature reached. This will take about **5 minutes**. Record the reading in **Table 1** as maximum temperature reached.

Table 1

Maximum temperature reached (°C)	
Initial temperature (°C)	
Change in temperature, ΔT_1 (°C)	

(3 marks)

(ii) Calculate the:

I number of moles of copper(II) sulphate used. (1 mark)

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II enthalpy change for the reaction of metal B_1 with one mole of copper(II) sulphate.
(Assume that for the mixture, specific heat capacity = 4.2 $Jg^{-1}K^{-1}$ and density = 1.0 g cm^{-3}) (1 mark)

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(b) Repeat **procedure I, (a) (i)** with all of **metal B_2** (iron powder) in place of **metal B_1**. The maximum temperature is reached after about 8 minutes. Record the temperature readings in **Table 2**. **Retain the mixture for use in PROCEDURE II.**

Table 2

Maximum temperature reached (°C)	
Initial temperature (°C)	
Change in temperature, ΔT_2 (°C)	

(3 marks)

(c) Compare the changes in temperature ΔT_1 and ΔT_2 and comment on the differences. (2 marks)

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PROCEDURE II

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

(ii) Filter the mixture obtained in **procedure I (b)** into a 250 ml volumetric flask. Wash the residue with distilled water and add into the flask. Add more distilled water to make up to the mark. Label this as **solution B_2**.

(iii) Using a pipette and a pipette filler, place 25.0 cm^3 of **solution B_2** into a 250 ml conical flask. Titrate **solution B_2** with **solution C** until a permanent pink colour just appears. Record the readings in **Table 3**.

Repeat step **(iii)** and complete **Table 3**.

(d) **Table 3**

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

(4 marks)

(e) Calculate the average volume of **solution C** used. (1 mark)

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(f) The equation for the reaction between manganate(VII) and iron(II) ions is:

$$MnO_4^-(aq) + 5Fe^{2+}(aq) + 8H^+(aq) \longrightarrow Mn^{2+}(aq) + 5Fe^{3+}(aq) + 4H_2O(aq)$$

Calculate the number of moles of:

(i) potassium manganate(VII) used. (1 mark)

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(ii) iron (II) ions in 25.0 cm^3 **solution B** (1 mark)

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(iii) iron that reacted with copper(II) sulphate. (1 mark)

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(g) Determine the mass of iron that reacted. (RAM of Fe = 55.8) (1 mark)

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2. You are provided with:

- **Solid K**
- Aqueous ammonia
- Aqueous sodium sulphate
- Dilute nitric(V) acid
- Wooden splint

Solid K is suspected to be **lead(II) carbonate**.

(a) From the reagents provided, select and describe **three** tests that could be carried out **consecutively** to confirm if **solid K** is lead(II) carbonate. Write the tests and expected observations in the places provided.

(i)

Test 1	Expected Observations

(1 mark) (1 mark)

(ii)

Test 2	Expected Observations

(1 mark) (1 mark)

(iii)

Test 3	Expected Observations

(1 mark) (1 mark)

(b) Carry out the tests described in (a) using **solid K** and record the observations and inferences in the spaces provided.

(i) Test 1

Observations	Inferences
(½ mark)	(½ mark)

(ii) Test 2

Observations	Inferences
(1 mark)	(2 marks)

(iii) Test 3

Observations	Inferences
(1 mark)	(1 mark)

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

(a) Place **all** of **solid M** in a boiling tube. Add about 10 cm^3 of distilled water and shake. Retain the solution for use in procedure (b) (i), (ii) and (iii).

Observations	Inferences

(1 mark) (1 mark)

(b) Use about 2 cm^3 portions of the mixture in a test tube for tests **(i)**, **(ii)** and **(iii)**.

(i) To the first portion, add all the solid sodium carbonate provided.

Observations	Inferences

(1 mark) (1 mark)

(ii) To the second portion, add two drops of acidified potassium manganate(VII) and warm the mixture.

Observations	Inferences

(1 mark) (2 marks)

(iii) To the third portion, add about 2 cm^3 of acidified potassium dichromate(VI). Heat the mixture to boiling and allow to stand for about 2 minutes.

Observations	Inferences

(1 mark) (1 mark)

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