Name..... Marking scheme. ..... Index No.....

Class: ..... Adm no:.....

Date..... venue:.....

233/3
CHEMISTRY PRACTICAL

PAPER 3

November, 2020

TIME: 2 ¼ HOURS

MOKASA I JOINT EXAMINATIONS 2020

Kenya Certificate of Secondary Education (K.C.S.E.)

Chemistry 233/3

2 ¼ Hours

INSTRUCTIONS TO CANDIDATES

- Write your **name** and **index number** in the spaces provided.
- **Sign** and write the **date** of examination in the spaces provided.
- Answer ***all*** the questions in the spaces provided in the question paper in **English**.
- You are not allowed to start working with the apparatus for the first 15 minutes of the 2 ¼ 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 you need.
- All working **must** be clearly shown where necessary.
- Mathematical tables and silent electronic calculators may be used
-

For examiners use only

Question	Maximum Score	Candidate's Score
1	22	22
2	10	10
3	08	08
TOTAL	40	40 .

Question 1 (22)

You are provided with the following reagents:

- **Solution K**- Copper (II) sulphate solution
- **Solid L**- Iron powder
- **Solution M**- Acidified Potassium manganate (VII) solution, containing **0.8g** of Potassium Manganate (VII) in $250cm^3$ of the solution.

You are required to determine the ***molar heat of displacement*** of copper in a solution of its ions by iron metal.

Procedure I

- Place $50cm^3$ of **Solution K** in a $100cm^3$ plastic beaker using a burette.
- Measure the constant temperature of the solution and record it in the **Table 1** below.
- Add all of the **Solid L** provided at once and start a stop watch immediately.
- Using a thermometer, Stir the mixture **thoroughly and continuously** and record the temperature of the mixture after every **one minute** in the table 1.
- **Retain** the resultant mixture for use in the next **Procedure II.**

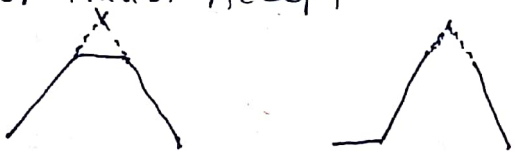
Table 1

Time (Min)	0	1	2	3	4	5	6	7	8	9	10
Temperature(^{0}C)	21.0	22.5	24.0	25.0	27.0	28.0	29.5	31.0	31.0	31.0	29.5

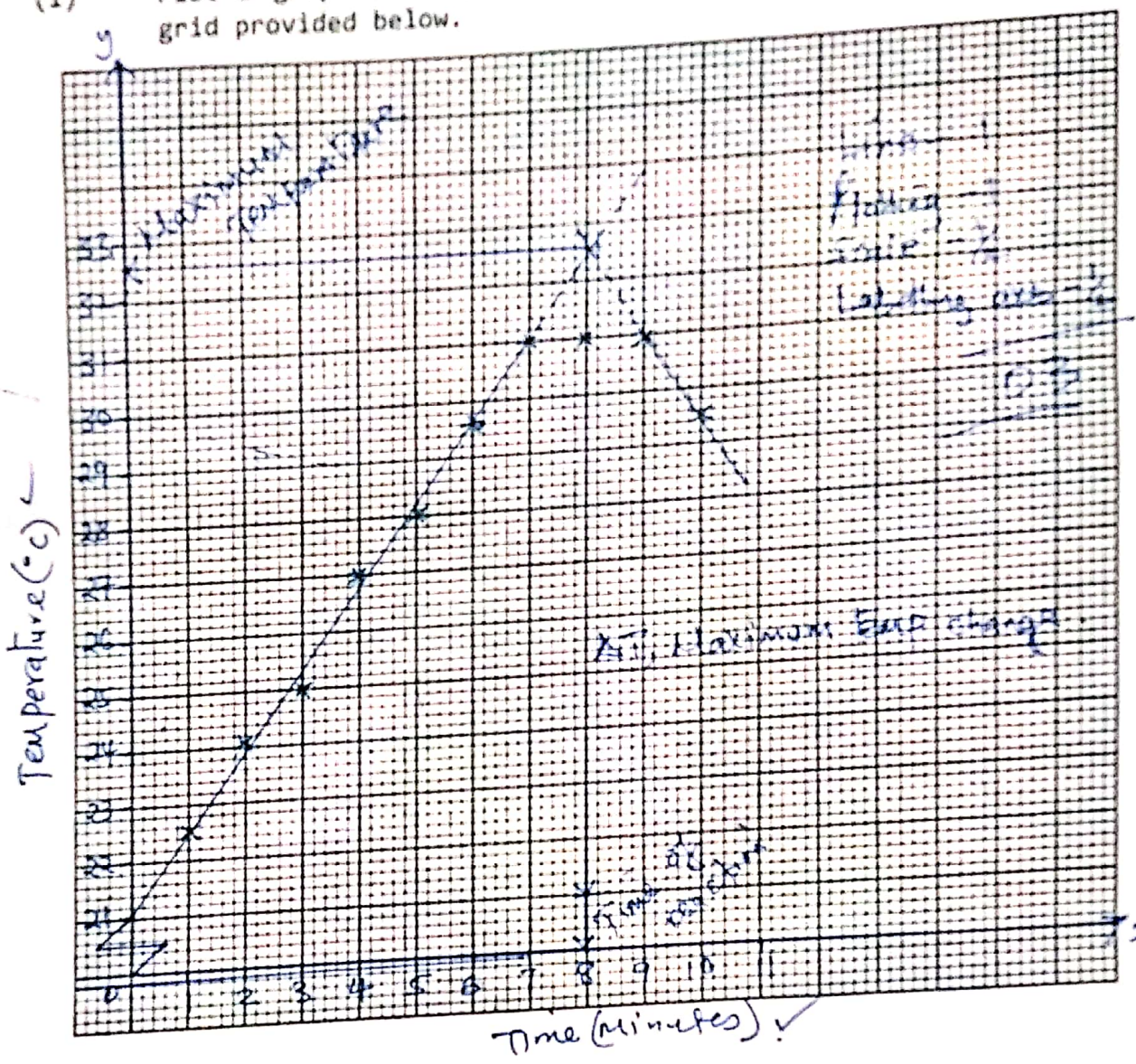
(3 marks)

Ct-1
D-½
Ac-1
Trend-½
03.

For trend Accept.



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



03

(ii) From the graph you have drawn, determine the;

a) highest change in temperature, ΔT (1 mark)

$32.6 - 21.0 = 11.6°C$ or $11.6K$. ✓1

Must be shown on graph.

01

b) time taken for the reaction to completely occur (1 mark)

8 minutes ✓1

Must be shown on graph.

01

(iii) Calculate the heat change for the reaction. (Take density of the solution to be 1g/cm³ and specific heat capacity of the solution to be 4200kJ/Kg/K) **(2 marks)**

$\Delta H = mC\Delta T$.

$= \frac{50}{1000}$ Kg x 4.2KJ Kg^{-1}K^{-1} x Ans. (ii) (a) ✓1 = Ans. (iii) ✓1 02

eg. $= \frac{50}{1000}$ kg x 4.2KJ Kg^{-1}K^{-1} x 11.6K ✓1

$= 2436$KJ. ✓1

Procedure II

- Swirl the mixture obtained in procedure I above and filter into a 250mL volumetric flask.
- Thoroughly rinse the beaker with 20cm³ of distilled water and ensure all the mixture has been transferred onto the filter paper.
- Add 50cm³ of 2M Sulphuric (VI) acid to the filtrate mixture in the volumetric flask.
- Add more distilled water to the solution in the volumetric flask to the mark. Mix the contents thoroughly and label this solution as **Solution N.**
- Fill the burette with **Solution M.**
- Place 25 cm³ of **Solution N** into a 250 cm³ conical flask using a pipette and a pipette filler.
- Titrate **Solution N** against **Solution M** until the **first permanent pink** colour is seen.
- Record your results in **Table 2** below.
- Repeat the titration **twice** and complete **Table 2.**

Table 2

Titre	I	II	III
Final burette reading(cm³)	20.5	20.2	40.3
Initial burette reading(cm³)	0.0	0.0	20.2
Volume of solution M used(cm³)	20.5	20.2 ✓	20.1

CT=1 Ac=1 D=½ PA=½ FA=1 04

(3 marks)

(i) What is the average volume of **Solution M** used? **(1 mark)**

$\frac{20.2 + 20.1}{2} = 20.15$ ✓

(ii) Calculate the molarity of Solution M, $KMnO_4$ (1 mark)

$KMnO_4 = 39+55+(16\times4)$ (K=39, Mn=55, O=16)

$= 158$

$= \frac{0.8\times4}{158}$ ½

Molarity $= \frac{\text{Mass/L}}{\text{RFM.}}$

$= \frac{3.2}{158}$ ½ $= 0.2023\ M.$ ½ 01

(iii) Calculate the number of moles of:

a) Potassium manganate (VII) used, solution M (1 mark)

Moles = Vol. in L × Molarity

$= \frac{\text{Ans (i)}}{1000} \times \text{Ans (ii)}$ ½

= Ans (iii) ½

eg. $\frac{20.15}{1000} \times 0.2023$ ½

$= 0.0004081$ moles. ½ 01

b) Iron (II) ions in 25cm³ of solution N (1 mark)

The equation for the reaction is:

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

$MnO_4^- : Fe^{2+} = 1:5$ ½

Moles of $Fe^{2+} = 5 \times$ Ans. (iii) (a) = Ans. (iii) (b) ½ 01

eg. $= 5 \times 0.0004081$ ½

$= 0.002041$ Moles ½

c) Iron (II) ions in the 250cm³ of solution N (1 mark)

$= \frac{250}{25} \times$ Ans. (iii) (b) ½ = Ans. (iii) (c) ½ 01

eg. $\frac{250}{25} \times 0.002041$ ½ ½

$= 0.02041$ Moles.

(iv) Determine the molar heat of displacement of copper from a solution of its ions by iron metal (2 marks)

$Cu^{2+}(aq) + Fe(aq) \rightarrow Cu(s) + Fe^{2+}(aq)$.

$Cu^{2+} : Fe^{2+} = 1:1$

Moles of Cu^{2+} displaced = Ans. (iii) (c) ½

Ans (iii) (c) ⟶ Ans. Procedure I (iii)

1 mole → ?

Molar enthalpy change = $\frac{\text{Ans. Proc. I (iii)}}{\text{Ans. Proc. II (iii) (c)}}$ ½

= Ans. (iv) ½

eg. $\frac{2.436\ kJ}{0.02041\ mol}$ ½ ✓1

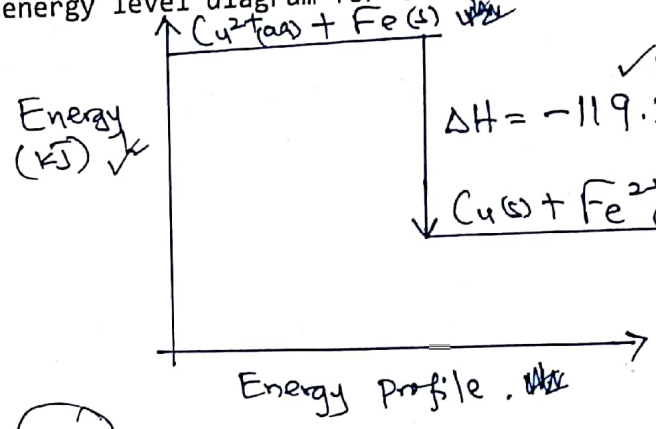
$= -119.3533\ kJ/mol.$ 02

Wrong or No sign – penalize ½

Wrong units – Penalize ½

Award fully if no units

(v) Draw an energy level diagram for the reaction (2 marks)



Labelling axes = ½
Equation = 1
ΔH = ½

02

Question 2 10

(a) You have been provided with solutions X, Y and Z. Carry out the flame tests for each and indicate the colour of the flames and inferences below.

Ions	Flame colour	Inference
X	Purple flame ½	K^+ present ½
Y	Yellow flame ½	Na^+ present ½
Z	Green flame ½	Cu^{2+} present ½

03

(3 marks)

(b) You are provided with **Solid Q**. Carry out the tests below and Write your observations and inferences in the spaces provided.

Na_2SO_3

i) Place all **Solid Q** in a clean test tube. Add about 8cm³ of distilled water and shake. Divide the solution into 3 portions

Observation	Inference
Dissolves to form a colourless solution ½	- Polar Substance ‖ Soluble ½ Substance - Absence of Cu^{2+}, Fe^{2+}, Fe^{3+}
(1/2 mark)	**(1/2 mark)**

01

ii) To the first portion add a few drops of Lead (II) nitrate solution and warm

Observation	Inference
White precipitate Insoluble on warming ✓1 (1 mark)	CO_3^{2-}, SO_4^{2-}, SO_3^{2-} present ✓1 3 ions – 1 mark 2 ions – ½ 0 or 1 ion – 0 (1 mark) Penalize ½ for each contradictory ion

02

(iii) To the first portion add a few drops of Barium nitrate solution followed by few drops of dilute ~~hydrochloric acid~~ HNO_3

Observation	Inference
-White Precipitate ½ Soluble ½ in the acid to form a colourless solution - Effervescence of a colourless gas (1 mark)	CO_3^{2-}, SO_3^{2-} ½ ½ present Ignore SO_4^{2-} absent 2 ions – 1 1 ion – ½ (1 mark) Penalize ½ for each contradiction

01

iv) To the third portion add a few drops of acidified potassium dichromate (VI) then warm gently

Observation	Inference
Orange ½ $H^+/K_2Cr_2O_7$ Turns green ½ (1 mark)	SO_3^{2-} present. ✓1 (1 mark) Penalize fully for any contradiction ⊠.

02

3. You have been provided with **Liquid E.** (08)

i) Place about $2cm^3$ of the **Liquid E** in a clean test tube. Add an equal amount of distilled water and shake the mixture. Allow to settle.

Observation	Inference
Miscible with water // forms uniform mixture ✓1	Liquid E is polar ✓1
(1 mark)	**(1 mark)**

02

ii) Place about $2cm^3$ of the **Liquid E** in a clean test tube. Add a half spatulaful of sodium hydrogen carbonate.

Observation	Inference
No fizzing // no bubbles or No effervescence of a colourless gas ✓1	$RCOOH, H^+, H_3O^+ - COOH$ absent ✓1
(1 mark)	**(1 mark)**

02

iii) To about $2cm^3$ the **Liquid E** add 3 drops of acidified potassium dichromate (VI) solution and warm gently

Observation	Inference
Colour of $H^+ / K_2Cr_2O_7$ changes from orange to green ✓1	ROH present ✓1
(1 mark)	**(1 mark)**

02

iv)Take a few drops of **Liquid E** on a **clean and dry** metallic spatula and ignite over a non-luminous Bunsen flame

Observation	Inference
Burns with a blue non-Sooty/non-Smoky flame ✓1	ROH Confirmed ✓1
(1 mark)	**(1 mark)**

02

(08)