MARANDA HIGH SCHOOL

Kenya Certificate Of Secondary Education

THE 2025 MOCK EXAMINATION

233/2 **CHEMISTRY** **PAPER 2**

June, 2025 **TIME: 2 Hrs**

Name: ..... Marking Guide ..... Admission No: .....

Stream: ..... Signature: .....

233/2 - CHEMISTRY

Date.....

Instructions

(a) Write your **name, admission number, date, stream and signature** in the spaces provided above.

(b) All answers must be written in the spaces provided in the booklet.

(c) ***This paper consists of 13 printed pages with 7 questions. Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing***

(d) Candidate should answer the questions in **English**

FOR EXAMINERS USE ONLY

Questions	Maximum Score	Candidate's Score
1	12	
2	10	
3	11	
4	12	
5	13	
6	10	
7	12	
TOTAL	80	

1. Use standard potential for elements G, M, N, P and Q given below to answer the questions that follow.

			E^{θ} volts
$G^{+}_{[aq]} + e^{-}$	⇌	$G_{[s]}$	-2.71
$M^{2+}_{[aq]} + 2e^{-}$	⇌	$M_{[s]}$	-2.37
$2N^{+}_{[aq]} + 2e^{-}$	⇌	$N_{2[g]}$	0.00
$P^{2+}_{[aq]} + 2e^{-}$	⇌	$P_{[s]}$	+0.34
$\frac{1}{2} O_{2[g]} + e^{-}$	⇌	$Q_{[g]}$	+2.87

(a) (i)Which element is likely to be hydrogen? Give a reason to your answer. (2marks)

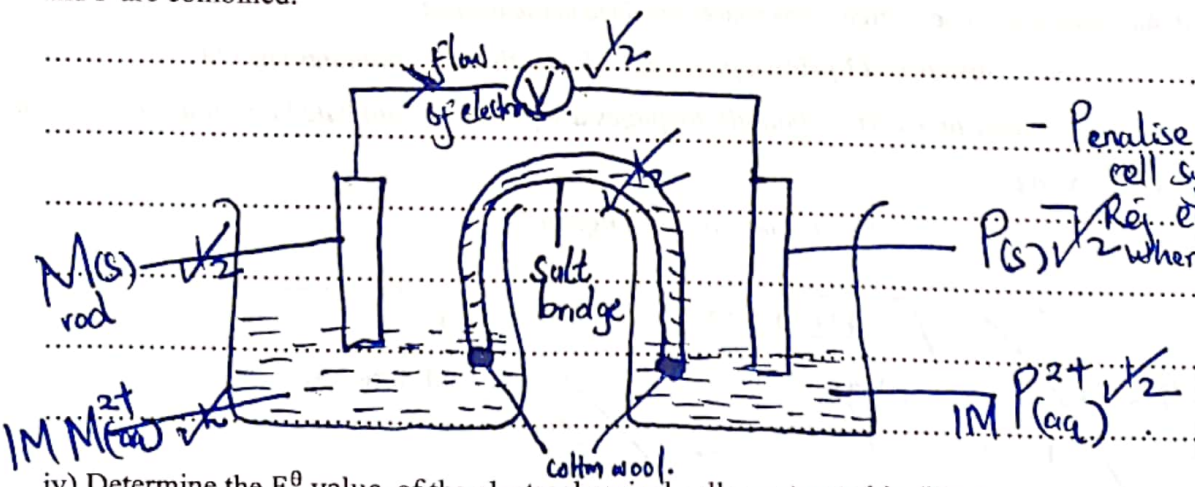
Element N. Its E^{θ} value is 0.00V. ✓1

rej N_2 / N^+ 2

ii) What is the E^{θ} value of the strongest oxidizing agent? (1mark)

+2.87V ✓1 1

iii) Draw a well labelled diagram of the electrochemical cell that would be obtained when half cells of M and P are combined. (3marks)



- Penalise fully when cell symbol is used.
Rej. electrolyte & electrod when interchanged.

3

iv) Determine the E^{θ} value of the electrochemical cell constructed in (iii) above. (2marks)

$E^{\ominus} = +0.34 - -2.37 = +2.71V$ ✓1 ✓1 2

(b) During the electrolysis of aqueous copper (II) sulphate using copper electrodes a current of 0.8 amperes was passed through the cell for 10hours.

(i) Write ionic equation for the reactions that took place at the cathode. (1mark)

$Cu^{2+}_{(aq)} + 2e^{-} \longrightarrow Cu_{(s)}$ ✓1 1

09

(ii) Determine the change in mass of the anode which occurred as a result of the electrolysis process.

(Cu = 63.5, 1 Faraday = 96500 Coulombs) (3marks)

Change in Mass = $\frac{63.5 \times (0.8 \times 10 \times 60 \times 60)}{2 \times 96,500}$

$= \frac{63.5 \times 28,800}{2 \times 96,500}$

$= 9.476\text{g}$ 3

— Accept alternatives.

2. a) Give a reason why the following combination of reagents should not be used to prepare hydrogen gas in the laboratory.

i) Copper and dilute hydrochloric acid. (½ mark)

Copper is less reactive; cannot displace Hydrogen from HCl

ii) Calcium and dilute sulphuric (VI) acid. (½ mark)

Formation of insoluble $CaSO_4$; coat the metal preventing reaction.

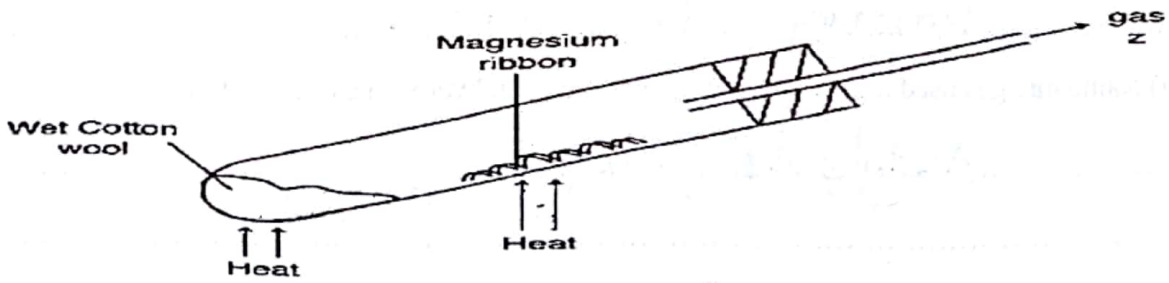
iii) Sodium and dilute hydrochloric acid. (½ mark)

Reacts explosively 2

iv) Zinc and dilute nitric (V) acid. (½ mark)

HNO_3 is a strong oxidizing agent/oxidizes H_2 to H_2O

b) A student reacted magnesium with steam as shown below.



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i) Explain why the wet cotton wool should be heated first before heating magnesium. (1 mark)

To generate steam ✓1 that expells air initially present in the combustion tube

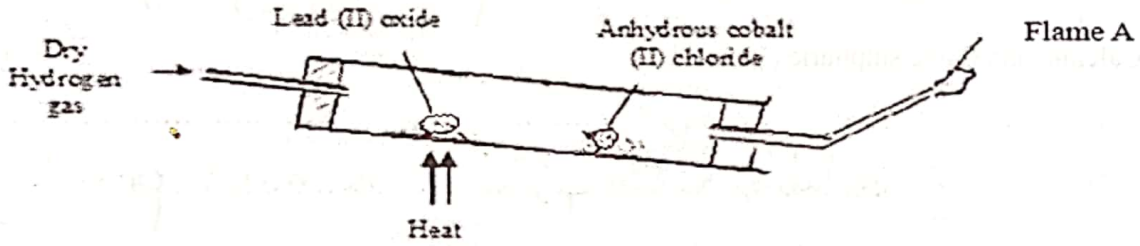
ii) Name gas Z. (1 mark)

Hydrogen ✓1 1

iii) Write the equation taking place in the boiling tube. (1 mark)

$Mg(s) + H_2O(g) \longrightarrow MgO(s) + H_2(g)$ ✓1 1

c) Dry hydrogen gas was passed over heated lead (II) oxide in a combustion tube as shown below.



i) State two observations made in the combustion tube. (2 marks)

- (Hot) orange lead(II) oxide ✓1 changes to grey lead metal
- Blue anhydrous cobalt(II) chloride ✓1 changes to pink hydrated cobalt (II) chloride. 2

ii) Give the colour of flame A. (1 mark)

Blue ✓1 Accept:- Pale blue. 1

iii) State the type of change undergone by anhydrous cobalt (II) chloride at the end of the reaction. (1 mark)

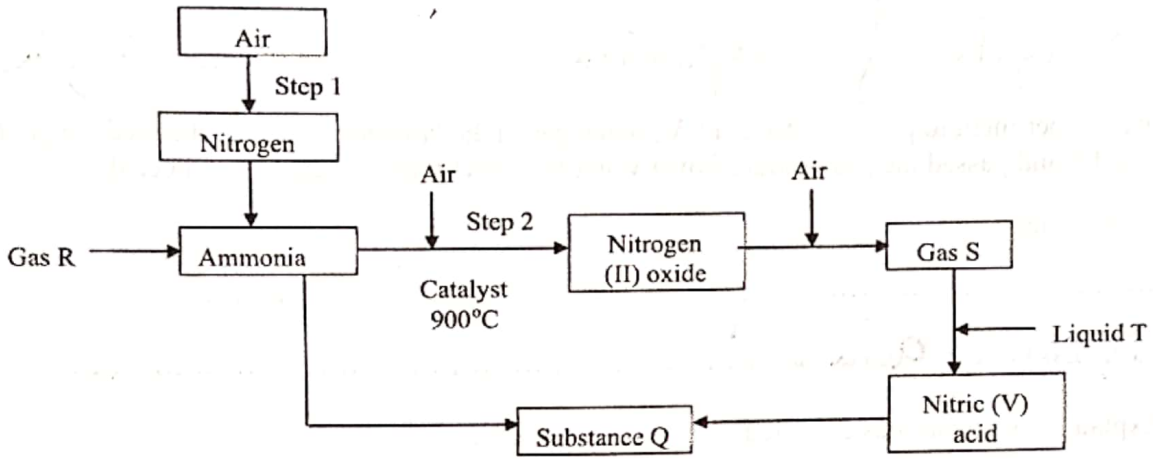
Temporary Chemical ✓1 1

iii) Name **one** gas used together with Oxygen other than hydrogen gas in welding. (1mark)

Acetylene / Ethyne ✓1 1

08

3.a) The chart below shows the stages involved in the manufacture of fertilizer Q in a factory. Study it and answer the questions that follow.



i) State one source of gas R. (1 mark)

- Cracking of long chain alkanes ... Accept Cracking of alkanes - 1
- Electrolysis of brine. ... Any @ 1mk

ii) Identify:

I: Liquid **T** (1 mark)

Water / H_2O ✓1 ... 1

II: Gas **S** (1 mark)

Nitrogen (iv) oxide / NO_2 ✓1 ... 1

iii) Write an equation for the reaction in **step 2**. (1 mark)

$4NH_3(g) + 5O_2(g) \longrightarrow 4NO(g) + 6H_2O(g)$ ✓ ... 1

iv) Name the process in **step 1**. (1 mark)

Fractional distillation of liquid air

v) Substance Q involves direct reaction between ammonia and nitric (V) acid. If 6.4×10^3 kg of substance Q is made per day, calculate the mass of ammonia used daily. (N = 14.0, O = 16.0, H = 1.0)

(3 marks)

$NH_3(g) + HNO_3(aq) \longrightarrow NH_4NO_3(aq)$ ✓1

Moles of $NH_4NO_3 = \frac{6.4 \times 10^3 \times 1000}{80}$ ✓1

$= 80,000$ moles

Moles of $NH_3 = 80,000$ ✓½

Mass of $NH_3 = 80,000 \times 17$ ✓½

$= 1,360,000$ g ✓½

OR 1360 kg // 3

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vi) Other than use as a fertilizer, state one other use of substance Q. (1 mark)

- Laboratory preparation of ~~Ammonia~~ Nitrogen (I) oxide
- Manufacture of explosives. Any 1 @ 1mk 1

b) In an experiment to prepare nitrogen (IV) oxide gas in the laboratory, a student added copper turnings to liquid P and passed the gas produced over water to collect it and no gas was collected.

i) Name liquid P. (1 mark)

Nitric(V) acid ✓1

ii) Explain why no gas was collected. (1 mark)

NO_2 is soluble in water ✓1

4.The table below shows the elements in period 3 of the periodic table. Use it to answer the questions that follow

Element	Na	Mg	Al	Si	P	S	Cl	Ar

I. a) Write the formulae of two oxides for each of the following :-

i) Sodium: Oxide (I) Na_2O ✓½ Oxide (II) Na_2O_2 ✓½ (1 mark) 1

ii) Sulphur: Oxide (I) SO_2 ✓½ Oxide (II) SO_3 ✓½ (1 mark) 1

oxides can be interchanged

b) The products of the reaction between phosphorus and chlorine depend on the conditions used. Write the equation for the reaction when phosphorus reacts with limited chlorine gas (1mark)

$P_4(s) + 6Cl_2(g) \rightarrow 4PCl_3(l/g)$ / $4P(s) + 6Cl_2(g) \rightarrow 4PCl_3(l/g)$ 1

c) Identify the most electronegative element. Give a reason (1mark)

Cl ✓½ Has the smallest atomic radius; most readily/easily gains electron. 1

07

d) State and explain the difference in the boiling point of Sulphur and phosphorus (2marks)

Sulphur has a higher boiling point than Phosphorus since S is octa-atomic while Phosphorus is tetra-atomic making S to have stronger Van der Waals forces. 2

II. Study the information below and answer the questions that follow. The letters do not represent the actual symbols of elements

element	Atomic number	M.P of element	M.P of chloride
G	11	98	801
H	12	650	715
J	14	1410	-70
K	16	113	-80
L	20	851	780

i) Write the formula of the compound formed when element **H** reacts with element K (1mark)

HK | MgS ✓1 1

ii) Use dot (.) and cross (x) to show bonding between **G** and **K** (2marks)

distribution – 1
Charge – 1 2

iii) Determine the oxidation number of **J** in its chloride (1mark)

JCl_4

$J + (-1 \times 4) = 0 \Rightarrow J = +4$ 1

iv) How does the melting point of fluoride of G compare with that of its chloride (2marks)

G flounde has a higher melting point than G chloride. F/F⁻ flounde ion has a smaller radius than Cl/Cl⁻ hence stronger ionic bond. 2

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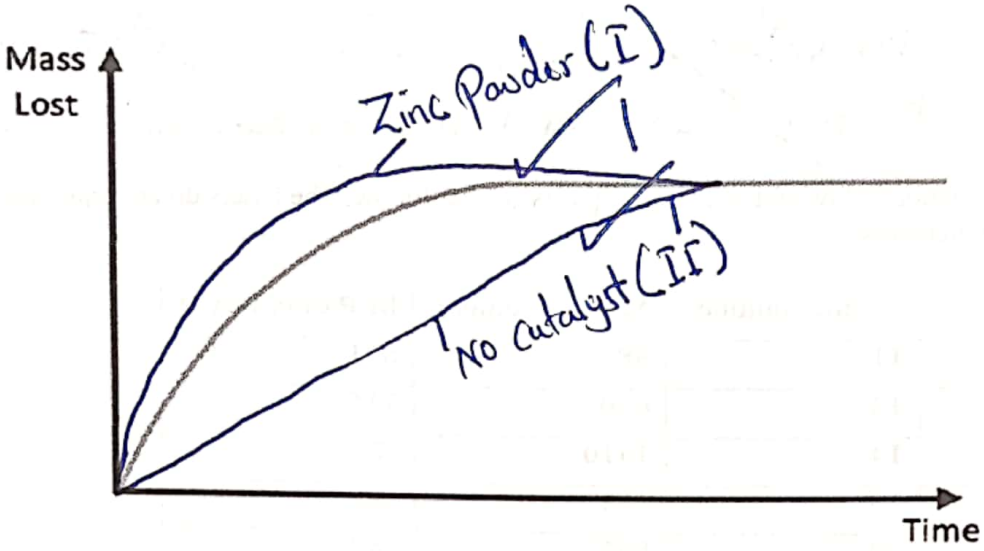
5. a) The sketch below represents a graph obtained when zinc granules were reacted with excess 0.2M sulphuric (VI) acid in the presence of a catalyst in a conical flask placed on an electric balance.



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i) Write an equation for the reaction that took place. (1 mark)

$Zn(s) + H_2SO_4(aq) \longrightarrow ZnSO_4(aq) + H_2(g)$ 1

ii) Explain why there is loss in mass. (1 mark)

H_2 formed escape. 1

iii) Name the catalyst used. (1 mark)

Copper (II) sulphate crystals 1

iv) Sketch, on the same axes, the curves obtained when;

I) The same mass of zinc powder was used under same conditions. (1 mark)

II) No catalyst was used. (1 mark)

b) In the contact process sulphur (IV) oxide is converted to sulphur (VI) oxide in catalytic chamber in which a dynamic chemical equilibrium is reached.

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)} \quad \Delta H = -97 \text{ kJ mol}^{-1}$$

i) What is meant by dynamic equilibrium? (1 mark)

state of balance where the rate of forward reaction equals the rate of backward reaction. 1

T

06

ii) State and explain how each of the following would affect the position of equilibrium.

iii) Decrease in temperature. (2 marks)

Equilibrium shifts to the right. The reaction is exothermic meaning decrease in temperature favours forward reaction. 2

iv) Decrease in pressure. (2 marks)

Equilibrium shifts to the left. Pressure decrease shifts equilibrium towards the side with more gaseous molecules. 2

v) Catalyst.

– No effect. Catalyst only makes equilibrium to be attained faster by increasing reaction rate. 1

c) In a closed system, iron (III) chloride reacts with hydrogen sulphide gas as shown in the equation below.

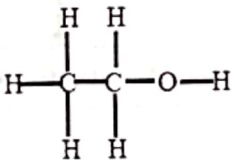
$$FeCl_{3(aq)} + H_2S_{(aq)} \rightleftharpoons 2FeCl_{2(aq)} + 2HCl_{(aq)} + S_{(s)}$$

State and explain the observation that would be made if dilute hydrochloric acid is added to the system at equilibrium. (2 marks)

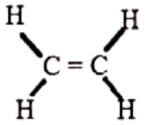
Intensity of yellow/brown colour increases. Increase in concentration of $H^+_{(aq)}$ favours backward reaction. 2

Reagent green colour fades. Pale green solution changes to yellow/brown.

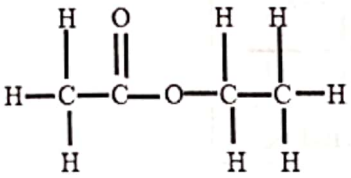
6. a) The figures below shows some organic compounds labelled as A, B, C, D and E.



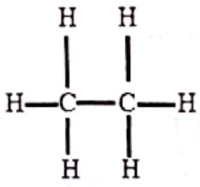
A



B

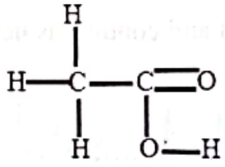


C



D

E



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Select the compounds that matches the following descriptions

i) Is a saturated hydrocarbon (½ mark)

D H-C(H)(H)-C(H)(H)-H ✓½ Accept Correct name.

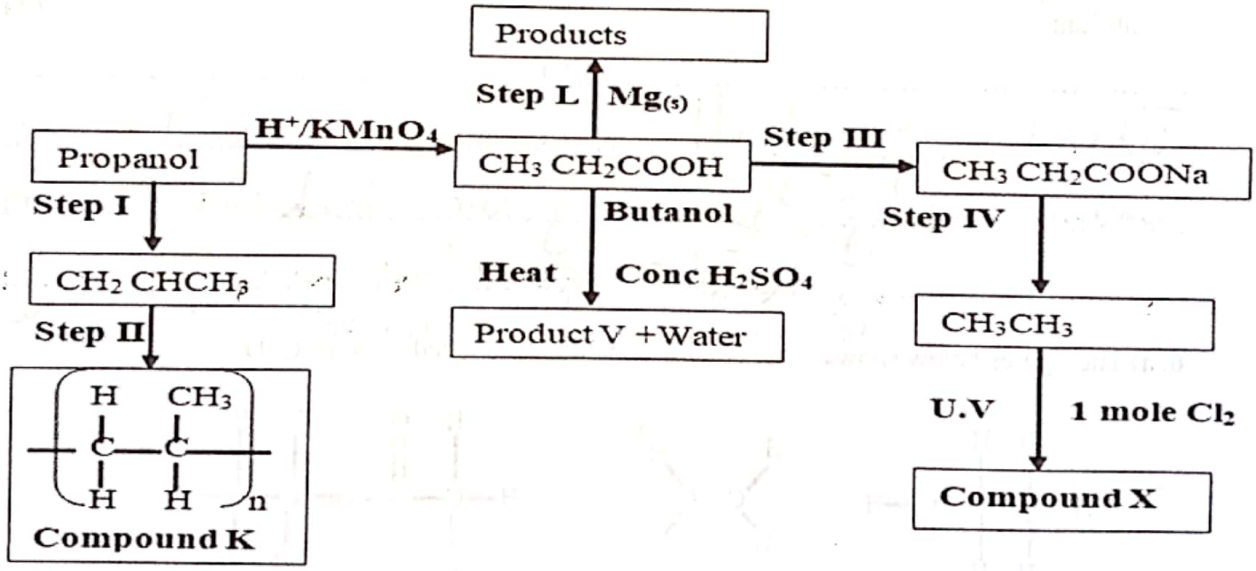
ii) Has a molecular formula C_2H_6O (½ mark)

A H-C(H)(H)-C(H)(H)-O-H Accept Correct name. 1½

iii) Reacts with sodium carbonate (½ mark)

E H-C(H)(H)-C(=O)-O-H ✓½ Accept correct name.

b) The scheme below shows a series of reactions starting with propanol. Study it and answer questions that follow.



i) Name the type of reaction in step 1 (1 mark)

Dehydration ✓1

ii) Give the reagent and conditions necessary for step 1 to take place 1½

Reagent (½ mark)

Concentrated Sulphuric (VI) acid ✓½ Aluminium oxide

03

Condition (½ mark)

Temperature of 160°–180°C ½ / Temperature of 300°C or Heat

(Accept specific temp with in range)

iii) Write the equation for the reaction that takes place in step L. (1 mark)

$2CH_3CH_2COOH + Mg \rightarrow (CH_3CH_2COO)_2Mg + H_2$ OR 1 I

$2C_3H_6O_2 + Mg \rightarrow (C_3H_5O_2)_2Mg + H_2$

iv) Name the product V and give the equation responsible for its formation. (2 marks)

Butylpropanoate ✓1 2

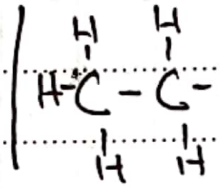
$CH_3CH_2COOH + CH_3CH_2CH_2CH_2OH \rightarrow CH_3CH_2COOCH_2CH_2CH_2CH_3 + H_2O$

(Accept condensed structure)

v) Give the IUPAC name and structural formula of compound X. (1½ mark)

1-Chloroethane ✓½ Chloroethane

CH_3CH_2Cl

 1½

vi) Name the compound K and state the type of reaction involved in its formation. (2 marks)

Polyprop-1-ene ✓1 / Polypropene

Addition polymerization ref addition / Polymerization 2

7. In an experiment, 20cm^3 of 2.0M sodium hydroxide solution was placed in a suitable apparatus and portions of 4.0M hydrobromic acid were added. The resulting mixture was stirred with a thermometer and the temperature recorded after each addition. The following results were obtained.

Volume of HBr (cm^3)	4.0	6.0	8.0	10.0	12.0	16.0	20.0
Temperature (°C)	27.0	30.0	33.0	36.0	35.0	34.0	32.0

a). Draw a graph of temperature against the volume of acid added. (3 marks)

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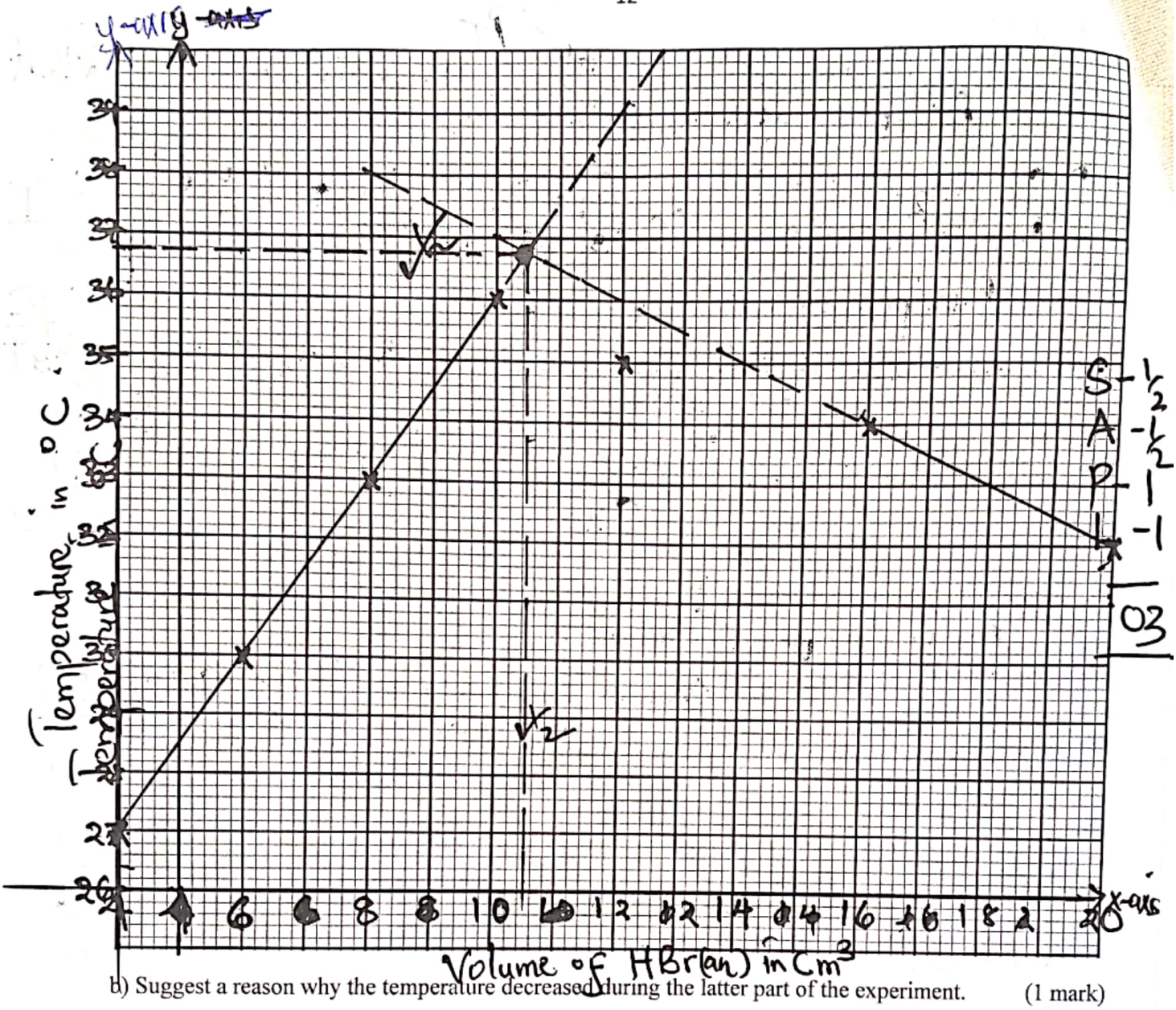


b) Suggest a reason why the temperature decreased during the latter part of the experiment. (1 mark)

Reactim is completer // The mixture loses heat I

c) From your graph:

(i) Determine the temperature change (1mark)

36.8 − 27.0 = 9.8°C ± 0.2 I

05

(ii) Find the volume of hyrobromic acid which completely neutralized 20cm^3 of 2.0M NaOH. (1mark)

10.5 cm^3 ± 0.2. 1

(iii) Calculate the molar heat of neutralization of hydrobromic acid with sodium hydroxide.
(C = 4.2kJKg-1K-1 density of solution = 1g/cm3). (3marks)

$\Delta H = \frac{30.5 \times 4.2 \times 9.8}{1000}$ (20 + Ans(ii), Ans(i))

$= 1.2554$kJ ✓½

Moles of NaOH $= \frac{2 \times 20}{1000} = 0.04$ ✓½

$\Delta H = \frac{1.2554}{0.04}$ ✓½

$= -31.39$kJ/mol ✓½

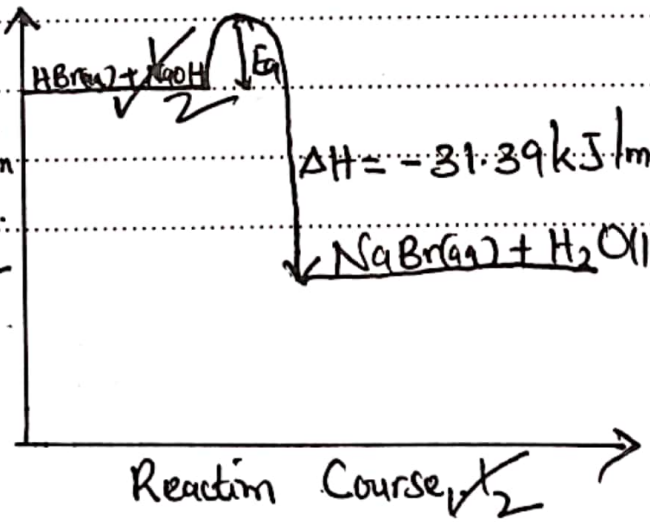
(Consequential marking applies). 3

d) Write a thermochemical equation for the reaction between hydrobromic acid and sodium hydroxide.
(1 mark)

$HBr(aq) + NaOH(aq) \longrightarrow NaBr(aq) + H_2O$ ✓½ $\Delta H = -31.39$ kJ/mol

Accept $H^+(aq) + OH^-(aq) \longrightarrow H_2O(l)$ $\Delta H = -31.39$kJ/mol

e) Draw the energy level diagram for the reaction above. (2 marks)



(Accept when activation energy is missing.)

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