MARANDA HIGH SCHOOL

Kenya Certificate Of Secondary Education

THE 2024 MOCK EXAMINATION

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

June, 2024 **TIME: 2 Hrs**

Name: ...M I G..... Admission No: .....

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

233/2 - CHEMISTRY
Friday, 7th June, 2024

8.00-10.00 Am

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 9 printed pages with 25 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	10	
2	14	
3	12	
4	08	
5	13	
6	14	
7	09	
TOTAL	80	

1.The table below shows elements with their atomic numbers, mass numbers and their melting points. Study it and answer the questions that follow. Letters do not represent actual symbols of the elements

Element	B	C	D	E	F	G	H	I	J	K
Atomic number	7	8	19	15	2	9	6	16	12	11
Atomic mass	14	16	39	31	4	19	12	32	24	23
Melting point	-	-	637	44	-272	-223	vary	113	669	980

(a) Select two elements with oxidation state -2 (1mark)

C and I ✓1 tried 1

(b) Which element represents

(i) The most powerful oxidizing agent? (1mark)

G. ✓1 1

(ii) The most powerful reducing agent? (1mark)

D ✓1 1

(c) Which element has the highest ionization energy? Explain (1mark)

F ✓1 Has the smallest atomic ½ radius and stable 1

(d) Select two elements, when reacted form a compound that conducts electricity in molten and aqueous state (1mark)

D and G | K and G | D and C | K and C | J and G ✓1 1

J and B.

(e) Select two elements when reacted form a compound that dissolves in water to form acidic solution (1mark)

E and C / I and C / H and C ✓1 1

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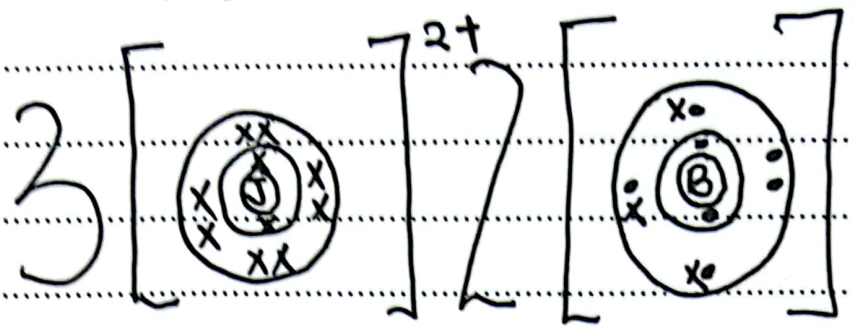
(f) Using dot (•) and cross (x) diagram, show the bond between B and J (2marks)



(g) Explain why the melting point of K is higher than that of D (2marks)

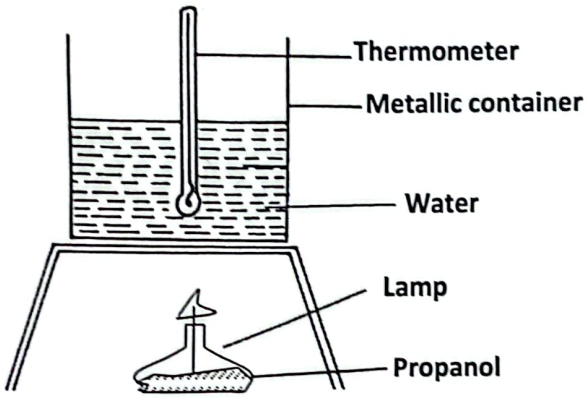
K has a smaller atomic radius hence stronger metallic bond 2

2.(a) State **one** factor that should be considered when choosing a fuel for cooking (1mark)

- Heating value
- Ease of transportation
- Ease of storage
- Environmental effect
- Ease of combustion
- Availability
- cost

Any First @ 1mk

(b) The diagram below represents a set-up that was used to determine the molar heat of combustion of propanol.



During the experiment, the data given below were recorded;

Volume of water = $460cm^3$

Initial temperature of water = 25°C

Final temperature of water = 47.5°C

Mass of propanol + lamp before burning = 127.5g

Mass of propanol + lamp after burning =123.0g

05

Calculate the;

(i) Heat evolved during the experiment

(*Density of water = 1g/cm³*) specific heat capacity of water =4.2KJ/Kg/K) (2marks)

$\Delta H = \frac{460}{1000} \times 4.2 \times 22.5$ ✓T

$= 43.47 kJ$ ✓1 2

sign not a must but acc -ve sign.

(ii) Molar heat of combustion of propanol (2marks)

Moles of $C_3H_7OH = \frac{4.5}{60} = 0.075$ ✓✓

$\Delta H = \frac{43.47}{0.075}$ ✓✓

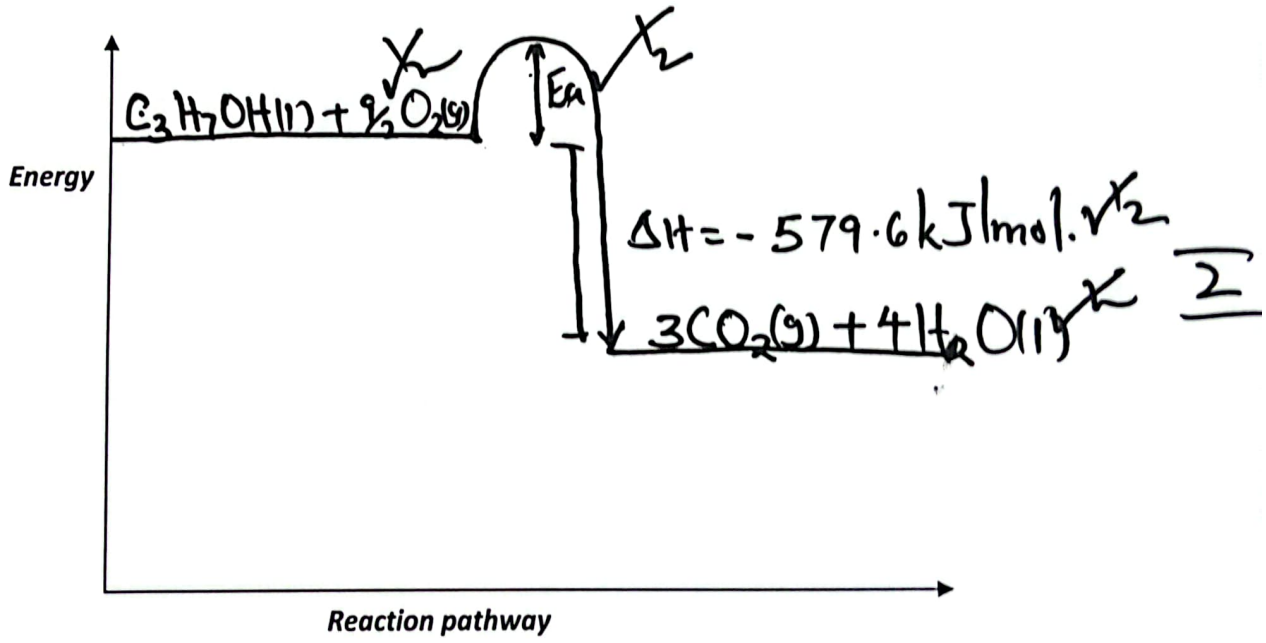
$= -579.6 kJ/mol$ ✓✓ 2

-ve sign awarded must

(iii) Write the thermo-chemical equation for the combustion of propanol (1mark)

$C_3H_7OH(l) + \frac{9}{2}O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l) \quad \Delta H = -579.6 kJ/mol$

(c) On the axis, draw an energy level diagram for the combustion of propanol (2marks)



(d) Name the heat change represented by ΔH in the process represented below.

$Na_{(s)} \longrightarrow Na_{(g)}$ $\Delta H = +ve$ (1mark)

Lattice enthalpy ✓1

(e) (i) Define enthalpy of formation of a substance. (1mark)

Enthalpy change that occurs when (one mole) of a substance is formed from it constituent elements. (ignore standard conditions)

(ii) Given that

$\Delta H_f^{\theta}(C_4H_{10(g)}) = -125 KJmol^{-1}$

$\Delta H_f^{\theta}(CO_{2(g)}) = -395 KJmol^{-1}$

$\Delta H_f^{\theta}(H_2O_{(l)}) = -289 KJmol^{-1}$

Calculate the molar heat of combustion of butane (C_4H_{10}) (3marks)

$4C(s) + 5H_2(g) \xrightarrow{\Delta H_1} C_4H_{10}(g)$

$4C(s) + 4O_2 \xrightarrow{\Delta H_2} 4CO_2(g)$

$5H_2(g) + \frac{5}{2}O_2(g) \rightarrow 5H_2O$

$C_4H_{10}(g) + \frac{13}{2}O_2(g) \rightarrow 4CO_2(g) + 5H_2O$

$\Delta H_1 = \Delta H_2 - \Delta H_3$

but $\Delta H_2 = (4 \times -395) + (5 \times -289)$

$= -3025$

$\Rightarrow -125 = -3025 - \Delta H_3$

$\Delta H_3 = -3025 + 125$

$= -2900 KJ/mol$ 3

(f) The atomic numbers of Li and K are 3 and 19 respectively.

$Li^+_{(g)} + (aq) \longrightarrow Li^+_{(aq)} \quad \Delta H_3 = -519$

$K^+_{(g)} + (aq) \longrightarrow K^+_{(aq)} \quad \Delta H_4 = -322$

Study the equations above and state why ΔH_3 is larger than ΔH_4. (1mark)

Li has a smaller atomic radius than K. 1

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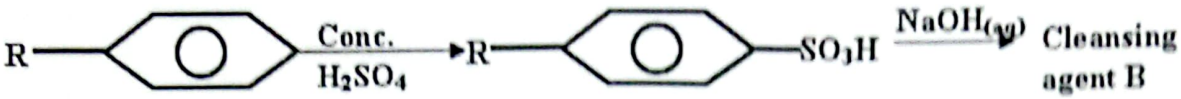
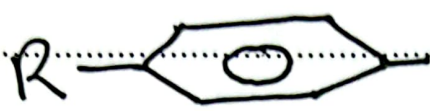
3) The scheme below represents the manufacture of a cleansing agent.



i) Draw the structure of **B** and state the type of cleansing agent for which it belongs.

Structure (1mark)



ignore charges. ✓1

rej ~~R—OS~~ $R-SO_3^-Na^+$ I

Type (1mark)

Soapless detergent ✓1 I

ii) State one disadvantage of using **B** as a cleansing agent. (1mark)

Expensive / Non-biodegradable (hence pollute environment) Any @ 1mk

b). The list below shows the formulae of some organic compounds. Use letters T_1 to T_6 to answer the questions that follow.

T_1 – $CH_3CH_2CH_2CH_2CH_3$

T_2 – $CH_3CH_2CH_2COOC_2H_5$

T_3 – $CH_3CH_2CH_2CH_2CH_2OH$

T_4 – $CH_3CH_2CH_2COOH$

T_5 – $CH_3CH_2CHCH_2$

T_6 – CH_3CCCH_3

I Select two compounds which:

(i) Are not hydrocarbons (1mark)

T_2, T_3, T_4 any 2@ 1mk (tried) I

(ii) Would decolourise both bromine water and acidified potassium manganate (VII). (1mark)

T_5 and T_6 ✓1 (tried) without contradiction.

(iii) Would produce hydrogen gas when reacted with potassium metal. (1mark)

T_3 and T_4 (tried) I

06

II.Select a compound which would produce bubbles of a gas when reacted with sodium carbonate.

(1mark)

I4 ✓1 I

(c) (i) Identify the compound that is likely to undergo polymerization. Give a reason for answer. Using two molecules show how polymerization occurs.

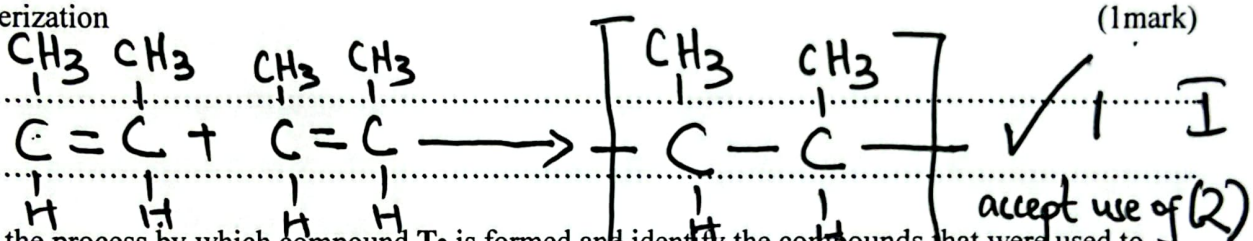
I. Compound (1mark)

I5 ✓1 I

II. Reasons (1mark)

Has double bond ✓1 I

III.Polymerization (1mark)



✓1 I

accept use of (2)

(ii) Name the process by which compound T_2 is formed and identify the compounds that were used to form it.

I. Process (1mark)

Esterification ✓1

II.Compounds (1mark)

Butanoic acid and Ethanol ✓1 (tied) 2

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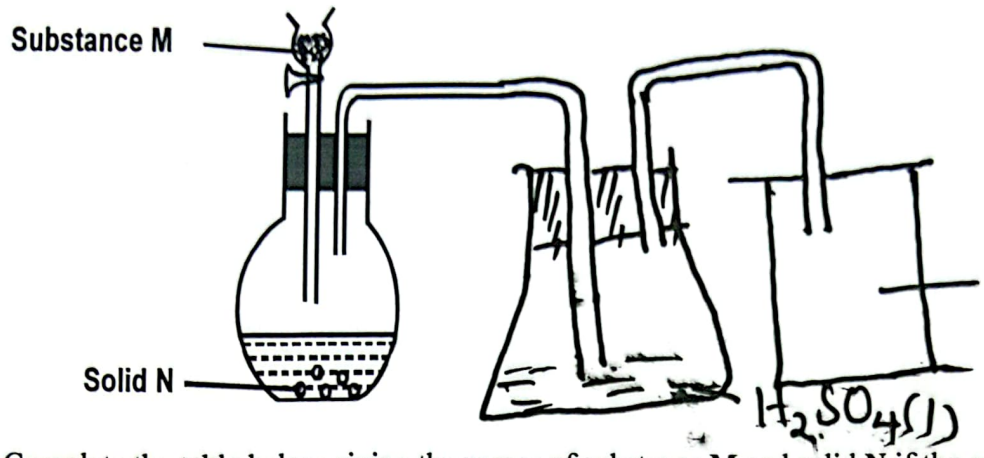
4.The set up below can be used to prepare a gas without heating. This occurs when substance M reacts with solid N.



Drying - 1
Collection - 1
Solubility - 1
HCl(g)
Accept syringe,
Aq. $CaCl_2$ in a tube
rej CaO.

a) i) Complete the table below giving the names of substance M and solid N if the gases generated are hydrogen chloride and Sulphur (IV) oxide. (2 marks)

	Hydrogen chloride	Sulphur (IV) oxide
Substance M	Concentrated sulphuric (VI) acid ✓½	Dilute Hydrochloric acid / concentrated H_2SO_4 ✓½
Solid N	Sodium Chloride / Rock salt ✓½	Sodium sulphite ✓½ / Copper turnings / Zn(s)

2

ii) Complete the diagram above to show how a dry sample of hydrogen chloride can be collected.

(3marks)

iii) State and explain the observation that would be made when hydrogen chloride gas is bubbled through a solution of lead (II) nitrate. (2marks)

White precipitate ✓1 of lead (II) chloride ✓1 formed.

2

iv) Concentrated hydrochloric acid is used for removing oxides from metal surfaces (pickling). Explain why concentrated nitric acid cannot be used for the same Purpose (1mark)

Strong oxidizing agent ✓1

1

5. I) Use standard electrode potentials for elements A, B, C, D and F given below to answer the questions that follow.

	E^{θ}(Volts)
$A^{2+}_{(aq)} + 2e^- \rightarrow A_{(s)}$	−2.90
$B^{2+}_{(aq)} + 2e^- \rightarrow B_{(s)}$	−2.38
$C^{+}_{(aq)} + e^- \rightarrow \frac{1}{2}C_{2(g)}$	0.0
$D^{2+}_{(aq)} + 2e^- \rightarrow D_{(s)}$	+0.34
$\frac{1}{2}F_{2(g)} + e^- \rightarrow F^-_{(aq)}$	+2.87

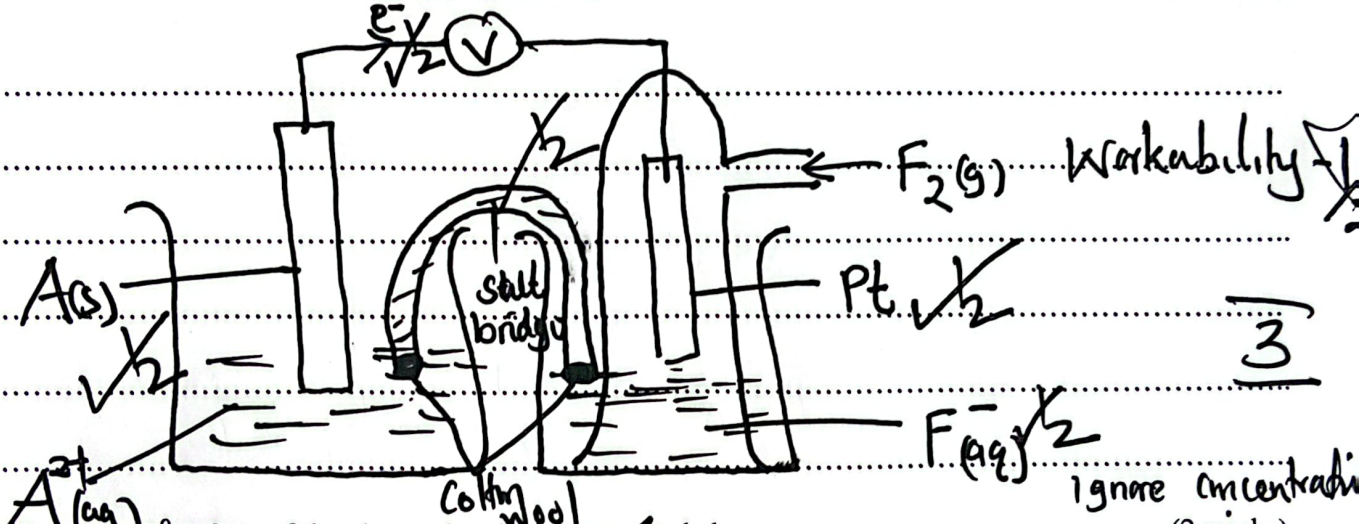
a) Identify the strongest oxidizing agent. (1 mark)

$F_{2(g)}$ ✓1 rej F^- 1

b) Which **two** half-cells would produce the highest potential difference when combined? (1mark)

Half cell of A and F ✓1 $A_{(s)}|A^{2+}//\frac{1}{2}F_{2(g)}|F^-$ 1

c) Draw a labelled diagram of the electrochemical cell that would be obtained when half-cells above (b) is formed. Show the direction of the flow of electrons. (3 marks)



d) Calculate E^{θ} value of the electrochemical constructed above. (2 marks)

$E^{\theta} = +2.87 - -2.90$ ✓1

$+2.87 + 2.90 = +5.77\,V$ ✓1 2

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e) Is it advisable to store a solution of a nitrate of D in a container of metal B? Explain. (2marks)

$D^{2+}(aq) + B(s) \longrightarrow D(s) + B^{2+}$

$E^{\ominus} = +0.34 + 2.38 = +2.72V$ No. Reaction will occur 2

II) During the electrolysis of aqueous copper (II) sulphate using copper electrodes, a current of 0.2 amperes was passed through the cell for 5 hours.

i)Write the ionic equation for the reaction that took place at the anode. (1 mark)

$Cu(s) \longrightarrow Cu^{2+}(aq) + 2e^-$

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) (3 marks)

$$\text{Change in Mass} = \frac{Q \times R.A.M}{F \times \text{charge}}$$

$$= \frac{(0.2 \times 5 \times 60 \times 60) \times 63.5}{2 \times 96,500}$$

$$= \frac{3600 \times 63.5}{2 \times 96,500}$$

$= 1.184g$ 3

6.(a) Define the term solubility (1mark)

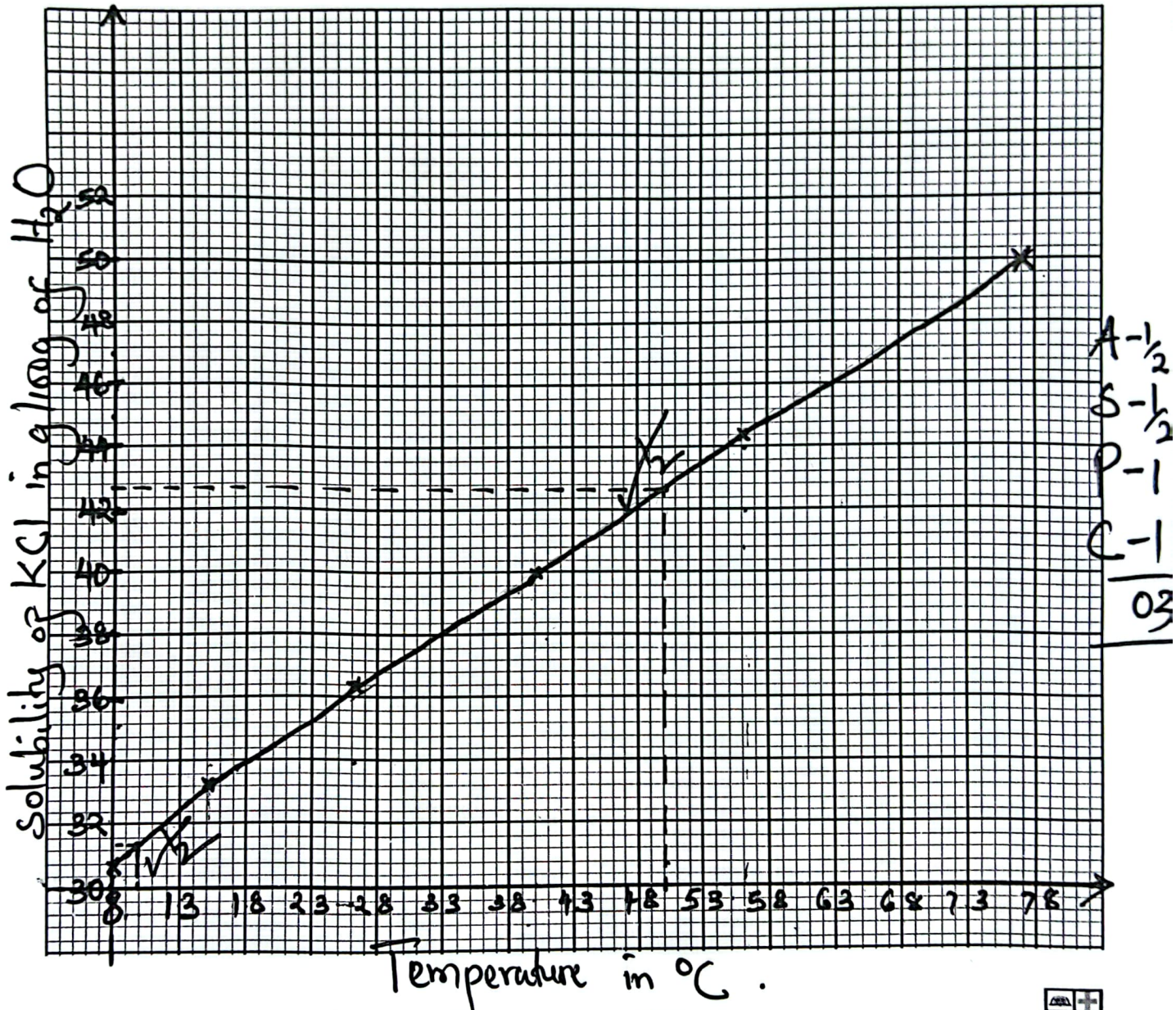
Maximum mass of solute in grams that can saturate 100g of water at a given temperature. 1

07

(b) (i) Complete the table below by calculating the solubility of KCl in grams per 100g of water (3marks)

Mass of $KCl_{(g)}$	20	20	20	20	20	20
Volume of water (cm^3)	40.0	45.0	50.0	55.0	60.0	65.0
Temperature at which crystals first appear (°C)	77.0	56.0	40.0	26.0	15.0	8.0
Solubility in g per 100g of water	50.00	44.44	40.00	36.36	33.33	30.77

(ii) On the grid provided, Plot the graph of solubility in g/100g of water (y-axis) against temperature (x-axis) (3marks)



A-½
S-½
P-1
C-1
03

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(iii) From your graph determine solubility at 50°C (1mark)

42.6 ± 1g/100g of H_2O ✓½

(iv) If a saturated solution of potassium chloride is cooled from 50°C to 10°C. What mass of the crystals would be obtained? (1mark)

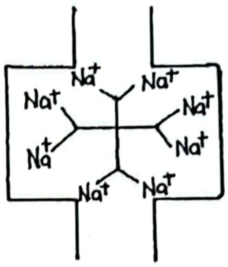
42.6 − 31.4 = 11.2g ✓½ ± 2

(v) Calculate the concentration of the saturated solution at 50°C. (K=39.0, Cl = 35.5) (2marks)

Concentration in g/l = 1000 × Ans (iii) / 100 ✓½ ⟹ I above ✓½ / 74.5

= Correct Ans ✓½ = Correct Ans ✓½

(c) The set-up below was used to remove hardness in water.



(i) Identify the above method of removing water hardness (1mark)

Ion Exchange ✓ / Permutit method

(ii) The above system eventually lack the ability to soften hard water. Explain how it can be reactivated. (1mark)

Passing brine ✓½ through the system which exchanges ✓½ Na^+ for Mg^{2+}/Ca^{2+}

OR. Passing a solution of Conc. HCl followed by NaOH to exchange ✓½ Na^+ for Mg^{2+}/Ca^{2+}

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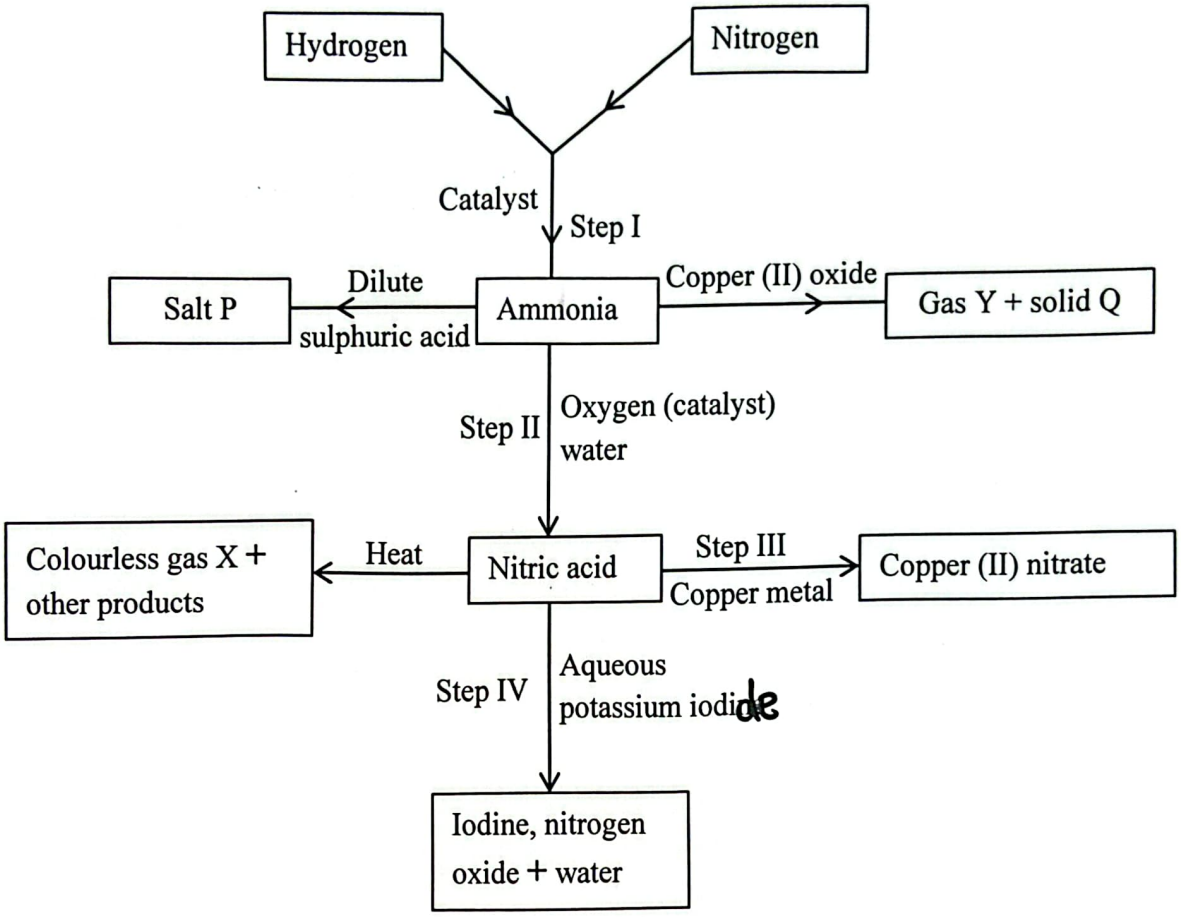
(iii) State ~~any~~ one advantage of hard water (1mark)

- Provides Ca^{2+} for growth of bones and teeth ✓1
- Does not dissolve lead from lead pipes (Any for 1mk)
- Beer brewing.

7. The scheme below shows various reactions starting with hydrogen and nitrogen. Study it carefully and answer the questions that follow.



i) Give **one** condition other than the use of a catalyst that would favour reaction in step I. (1 mark)

Temperature of 450°C (400°C - 500°C) ref range
Pressure of 200atm (200 - 500atm) Any @ 1mk ✓1

ii) Name the catalyst used in step I and II. (2 marks)

Step I - Finely divided iron / Iron ✓1
Step II - Platinum - Rhodium / Platinum / Nichrome wire ✓2

04

(g) Name substances P, Q, X and Y (2 marks)

P – Ammonium Sulphate ½ Q – Copper ½
X – Oxygen gas ½ Y – Nitrogen gas ½ 2

(h) Write equations for the reactions that take place in step II (3 marks)

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

(ii) $2NO(g) + O_2(g) \longrightarrow 2NO_2(g)$ ✓1 $4NO_2(g) + 2H_2O(l) + O_2(g) \longrightarrow 4HNO_3(aq)$ ✓1 3
(must be in the right order)

(i) Name the oxidizing agent for the reaction that takes place in step IV (1 mark)

Concentrated nitric(V) acid / Nitric(V) acid ✓1 1

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