NAME: ..Marking Scheme..... ADM: .....STREAM: .....

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233/2
CHEMISTRY
Time: 2 Hours

MOKASA II EXAMINATIONS 2025

CHEMISTRY PAPER TWO

Instructions to students:

- *Write your name, admission number and class in the spaces provided.*
- *Answer all questions in the spaces provided*
- *This paper consists of 12 printed pages.*
- *Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.*
- *Candidates must answer all questions in **English***

Question	Maximum Score	Student's Score
1	11	
2	13	
3	10	
4	13	
5	11	
6	09	
7	13	
TOTALS	80	

1. The table below shows part of the Periodic Table. The letters used are not the actual symbols of elements. Study and use it to answer the questions that follow.

Please correct this.

X	R						
U	T			Y		Q	W	S	Z
							P

i. Name the family in which elements **R** and **T** belong. (1 mark)

Alkaline Earth Metals ✓

ii. Write down the formula of the compound formed when **S** and **T** react. **(1 mark)**

TS_2 ✓

iii. Compare the atomic radii of **U** and **Y**. **(2 marks)**

T has a smaller atomic radius than U. ✓

T has more protons hence stronger nuclear attraction than U. ✓

iv. What name is given to the elements found in the shaded region? **(1 mark)**

Transition Metals ✓

v. State one use of element **Z**. **(1 mark)**

- in arch-welding / in light bulbs ✓

vi. Identify the strongest reducing agent U ✓ **(1 mark)**

vii. Compare the boiling points of **S** and **P**. **(2 marks)**

P has higher boiling point than S ✓

P has larger molecules hence more Van der Waals forces. ✓

viii. Write an equation showing how an atom of **T** forms a stable ion. **(1 mark)**

$T_{(s)} \longrightarrow T^{2+}_{(aq)} + 2e^-$ ✓

ix. Element **Q** has atomic number 15. Indicate its position on the grid. **(1 mark)**

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2. (a) Use the standard reduction potentials given below to answer the questions that follow.

Half –cell reactions			E^0(V)
$B^{2+}_{(aq)} + 2e^- \rightleftharpoons B_{(S)}$			- 0.44
$A^{2+}_{(aq)} + 2e^- \rightleftharpoons A_{(S)}$			- 0.76
$C_{2\,(aq)} + 2e^- \rightleftharpoons 2C^-_{(aq)}$			+0.54
$2E^+_{(aq)} + 2e^- \rightleftharpoons E_{2\,(g)}$			0.00
$D^{3+}_{(aq)} + 3e^- \rightleftharpoons D_{(S)}$			-1.66

(i) Identify the strongest oxidizing agent. Give a reason. (1mark)

C_2. Has the most positive E° value.

(ii) Arrange the elements having the negative standard reduction potentials in order of increasing reactivity. (2 marks)

D, A, B

(iii) Calculate the **e.m.f** of a cell formed by combing the half-cells of **B** and **D.** (2 marks)

$E_{cell} = E_{most\ +ve} - E_{most\ -ve}$.

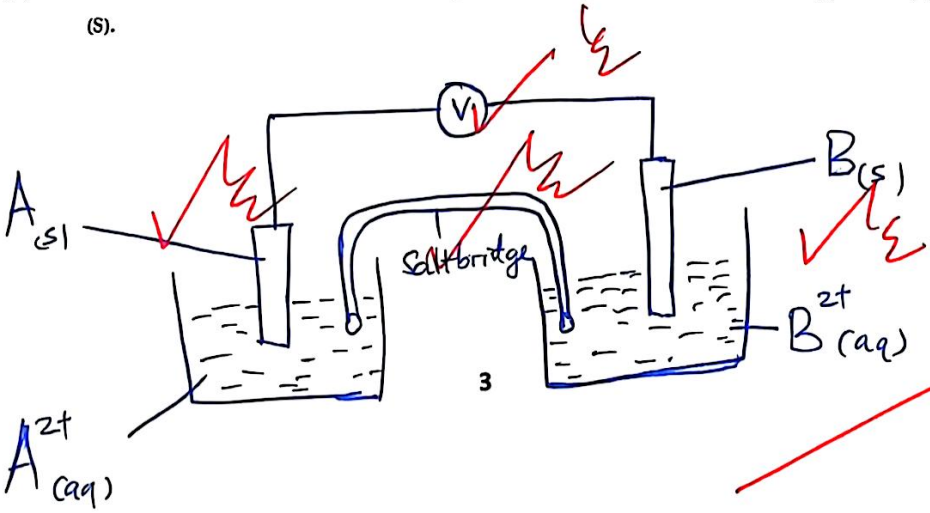
$= -44 - (-1.66) = +1.22V$.

(iv) Write down the overall equation for the reaction taking place in (iii) above. (1mark)

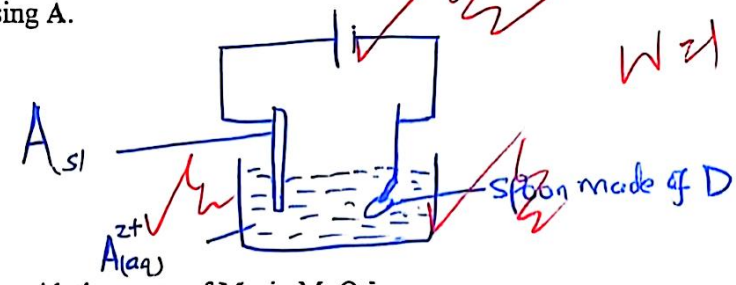
$2D_{(s)} + 3B^{2+}_{(aq)} \longrightarrow 2D^{3+}_{(aq)} + 3B_{(s)}$

(v) Draw an electrochemical cell represented by the cell notation $A_{(s)} / A^{2+}_{(aq)} // B^{2+}_{(aq)} / B_{(S)}$.

(3marks)



(vi) Draw a well – labeled diagram to showing how a spoon made of **D** is electroplated using **A**. **(3marks)**



(b) Determine the oxidation state of **Mn** in MnO_4^- **(1mark)**

$Mn + 4(-2) = -1$; $Mn = +7$

$Mn - 8 = -1$

3. (a) Consider the reaction below at equilibrium .

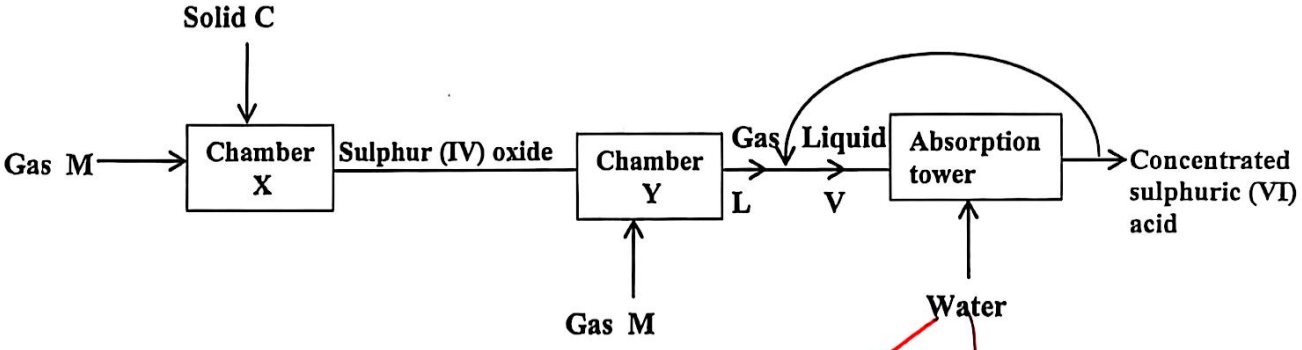
$$Br_{2(g)} + H_2O_{(l)} \rightleftharpoons 2H^+_{(aq)} + OBr^-_{(aq)} + Br^-_{(aq)}$$

(Orange) **(Colourless)**

State and explain the observation made when sodium hydroxide solution is added to the equilibrium mixture. **(2marks)**

The Orange colour fades / solution becomes colourless.
- Addition of Sodium hydroxide solution neutralizes H^+ hence the equilibrium shifts to the right.

(II) The flow chart below shows some of the processes involved in the large-scale manufacture of sulphuric (VI) acid. Study and use if to answer the questions that follow.



(i) Why is the process referred to as ***Contact Process***? (1 mark)

the conversion of SO_2 to SO_3 is done in contact with the catalyst.

(ii) Identify (2 marks)

Solid **C** Sulphur / Zinc Sulphide / Copper I sulphide

Gas **M** Air

Gas **L** Sulphur (VI) oxide

Liquid V ..... Oleum ..... (1)

(iii) Write down the equation for the reaction taking place in the absorption tower. (1mark)

$H_2S_2O_{7(l)} + H_2O_{(l)} \longrightarrow 2H_2SO_{4(aq)}$

(iv) Other than recycling, describe how pollution can be minimized in the process. (1mark)

By scrubbing / fitting exhaust chimneys with alkalis.

(v) 15,000 litres of suphuric (IV) oxide is reacted in chamber Y. With an efficiency of 80% determine the final mass of sulphuric (VI) acid produced in Kg. (3 marks)

(MGV= 24 L, H=1, S=32, O=16)

Moles of $SO_2 = \frac{15000}{24000} = 625$

actual $= \frac{80}{100} \times 625 = 500$ moles

$SO_3 : H_2S_2O_7 : 2H_2SO_4$

1 : 1 : 2

500 : 500 : 1000

Moles of H_2SO_4 produced = 1000

Mass of $H_2SO_4 = 1000 \times 98 = 98000$

$= 98$ kg

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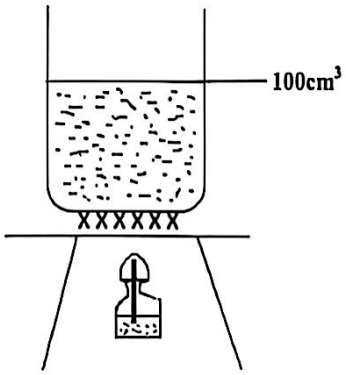
4. (a) In an experiment to determine the heat of methanol, a student set-up the apparatus as shown below. Study the set-up and use the data obtained to answer the questions that follow.



Initial temperature of water = 22 ^{0}C
Finial temperature of water = 36 ^{0}C
Initial mass of lamp + methanol = 85.10 g
Final mass of lamp + methanol = 84.75 g
Density of water = 1g/cm^3 C = 4.2 Jg^{-1}k^{-1}

(i) Determine the heat change for this experiment. (1mark)

$\Delta H = MC\Delta T$

$= 100g \times 4.2 J/g/K \times 14K = 5880 J = 5.88 kJ$

CH_3OH

(ii) Determine the molar enthalpy of combustion of methanol. (2marks)

(C=12, H=1, O=16)

Moles of methanol burnt $= \frac{0.35}{32} = 0.00984$ moles

0.0076 → 5.88 kJ

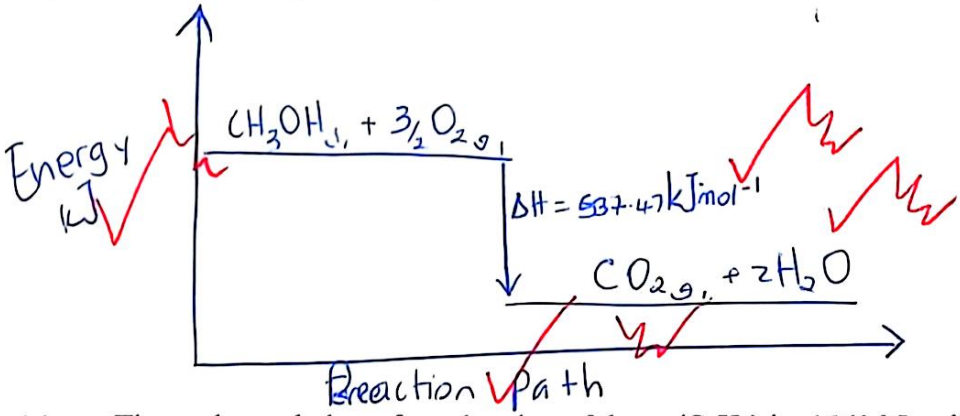
∴ 1 × 5.88 kJ

$\frac{1 \times 5.88}{0.00984} = 537.47$ kJ mol^{-1} (5)

(iii) Write down a thermochemical equation for the reaction. **(1mark)**

$CH_3OH_{(l)} + \frac{3}{2}O_{2(g)} \longrightarrow CO_{2(g)} + 2H_2O_{(l)}$ $\Delta H = -537.47\ kJmol^{-1}$

(iv) Draw an energy level diagram for the reaction. **(2 marks)**



(v) The molar enthalpy of combustion of ethane (C_2H_6) is -1560 kJmol^{-1}. Explain which one is a better fuel between methanol and ethane.
(C= 12, O = 16, H = 1). **(2 marks)**

Heating value of ethane $= \frac{1560}{30} = 52\ kJg^{-1}$ Heating value of Methanol $= \frac{537.47}{32} = 16.8\ kJg^{-1}$

∴ Ethane is a better fuel

(b) Use the information below to answer the question that follow

$Ca_{(s)} + \frac{1}{2}O_{2(g)} \longrightarrow CaO_{(s)}$ $\Delta H_1 = -635 kJmol^{-1}$

$C_{(s)} + O_{2(g)} \longrightarrow CO_2(g)$ $\Delta H_2 = -394 kJmol^{-1}$

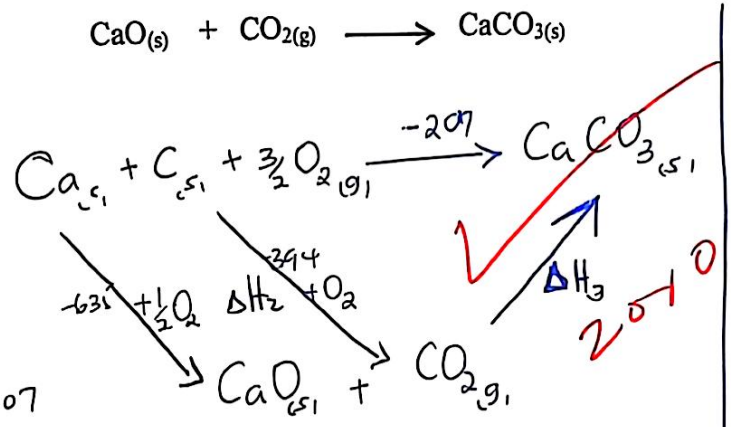
$Ca(s) + C(s) + \frac{3}{2}O_{2(g)} \longrightarrow CaCO_{3(s)}$ $\Delta H_3 = -207 kJmol^{-1}$

(i) Name two enthalpy changes represented by ΔH_2. **(2 marks)**

Enthalpy of combustion of carbon.
Enthalpy of formation of Carbon (IV) oxide.

(ii) Use the information above to calculate the enthalpy change for the reaction. **(3 marks)**

$CaO_{(s)} + CO_{2(g)} \longrightarrow CaCO_{3(s)}$



$\Delta H_1 = -207$

$\Delta H_2 = -635 + -394$

$= -1029$

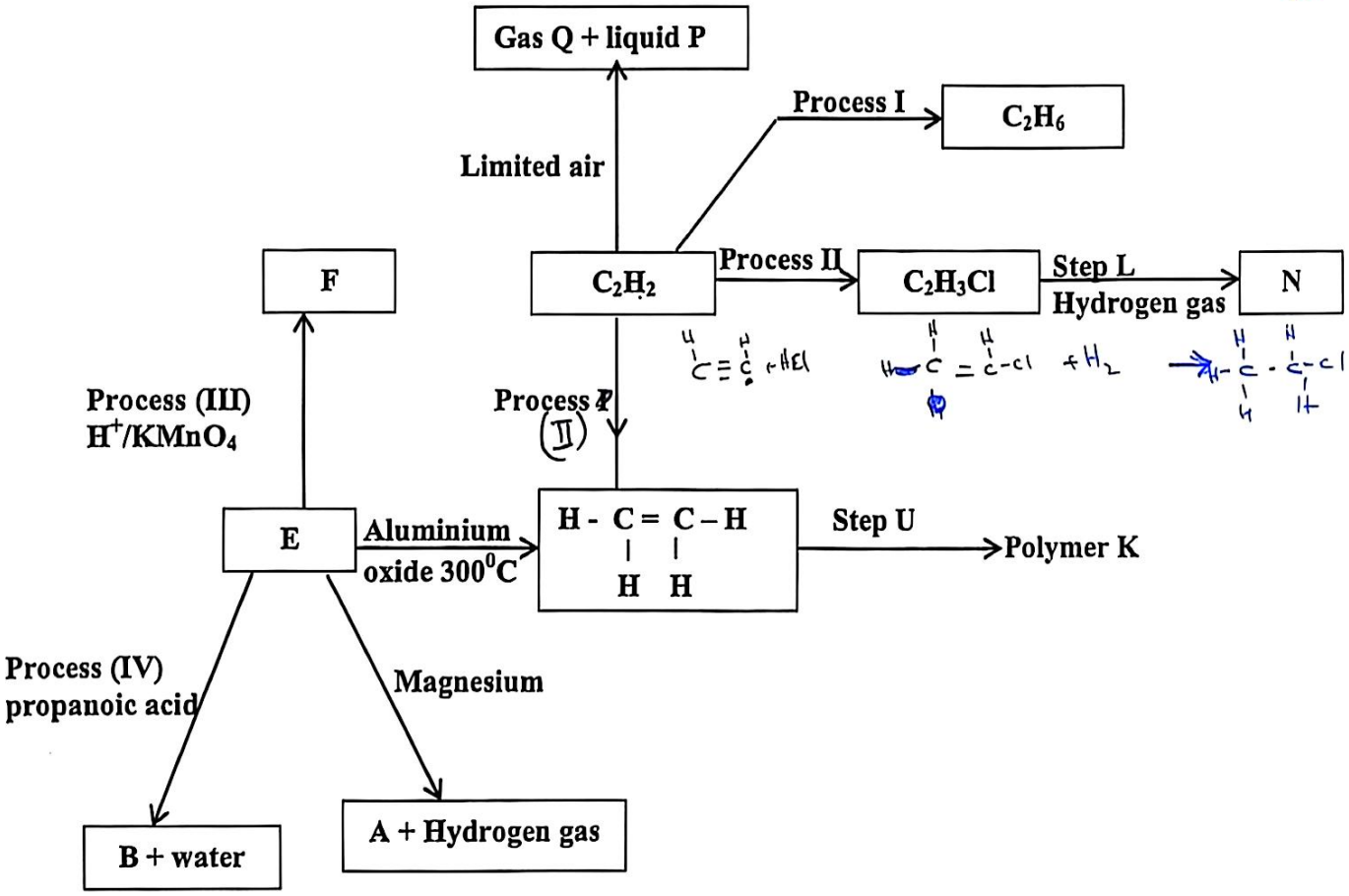
$\Delta H_1 = \Delta H_2 + \Delta H_3$

$-207 = -1029 + \Delta H_3$

$\Delta H_3 = -207 + 1029$

$= +822 \text{ kJmol}^{-1}$

5. Study the flow chart below and use it to answer the questions that follow.



a) Give the names of substances. (2 marks)

N.....Chloroethane.....

F.....Ethanoic acid.....

A.....Magnesium Ethoxide.....

E. Ethanol ✓

b) Give the conditions necessary for: (1 ½marks)

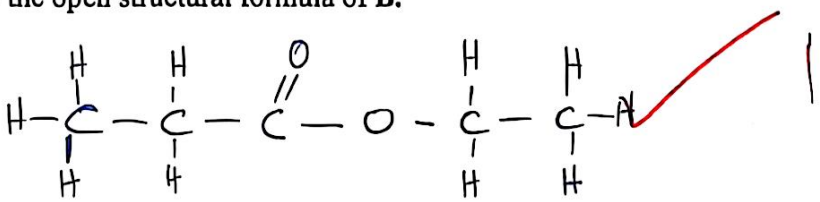
Process I

Nickel / Palladium Catalyst
200°C
Hydrogen gas as reagent

Process IV. (½ mark)

Warm Concentrated Sulphuric(VI) acid.

c) Draw the open structural formula of **B.** (1mark)



d) Write balanced chemical equations for the reaction in

i) Process II. (1mark)

$C_2H_{2(g)} + H_{2(g)} \longrightarrow C_2H_{4(g)}$

ii) Between E and magnesium. (1mark)

$2CH_3CH_2OH_{(l)} + Mg_{(s)} \longrightarrow (CH_3CH_2O)_2Mg + H_{2(g)}$

e) Name: (1 ½ marks)

Process (I) Hydrogenation ✓

Process (III) Oxidation ✓

Process (IV) Esterification ✓

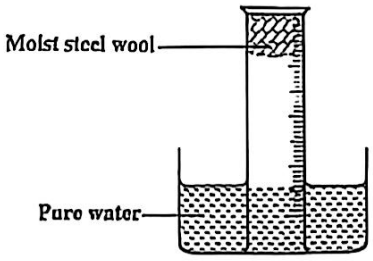
f) Give one distinguishing property of substance **B.** (½mk)

Pleasant Smell ✓

g) State two ways in which polymers **K** has improved human life. (2mks)

✓ Any 2 Correct uses of Polythene eg Packing Materials

6. (I) A measuring cylinder fitted with moist steel wool was inverted in a trough of water as shown in the diagram below.



(a) State and explain the observations made on the:

(i) Moist steel wool after four days; **(1 mark)**

Grey ✓Steel wool turns brown

(ii) Water level in the measuring cylinder after four days. **(1 mark)**

✓the water level in the Measuring cylinder rises.

(b) What would be the effect of using steel wool moistened with salty water? **(1 mark)**

✓ the steel wool turns brown faster

(II) Element V conducts electricity and melts at 933 K. When chlorine gas is passed over heated V, it forms a vapour that solidifies on cooling. The solid chloride dissolves in water to form an acidic solution. The chloride vapour has a relative molecular mass of 267 and contains 19.75% of V. At a higher temperature, it dissociates to a compound of relative molecular mass 133.5. When aqueous sodium hydroxide is added to the aqueous solution of the chloride, a white precipitate is formed which dissolves in excess alkali. (V = 27.0; Cl = 35.5)

(i) Determine the:

I. empirical formula; **(2 marks)**

	V	Cl
%	19.75	80.25
M.M	27	35.5
mole	0.7315	2.26
M.R	1 :	3

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E.F = VCl_3

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II. molecular formula. **(2 marks)**

$(VCl_3)_n = 267$

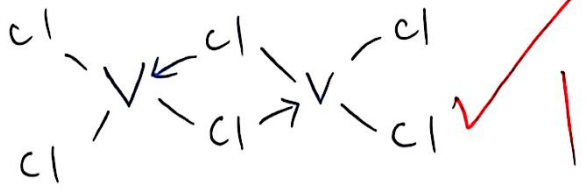
$(27 + 106.5)n = 267$

$133.5n = 267$

$n = 2$

M.F = V_2Cl_6

(ii) Draw the structure of the chloride vapour and label the bonds. **(1 mark)**



Accept use of Al

(iii) Write an equation for the reaction that form a white precipitate with sodium hydroxide. **(1 mark)**

$V^{3+}_{(aq)} + 3OH^-_{(aq)} \longrightarrow V(OH)_{3(s)}$

or $Al^{3+}_{(aq)} + 3OH^-_{(aq)} \longrightarrow Al(OH)_{3(s)}$ 09

7. (i) Name the raw material from which sodium is extracted. **(1 mark)**

Rock Salt

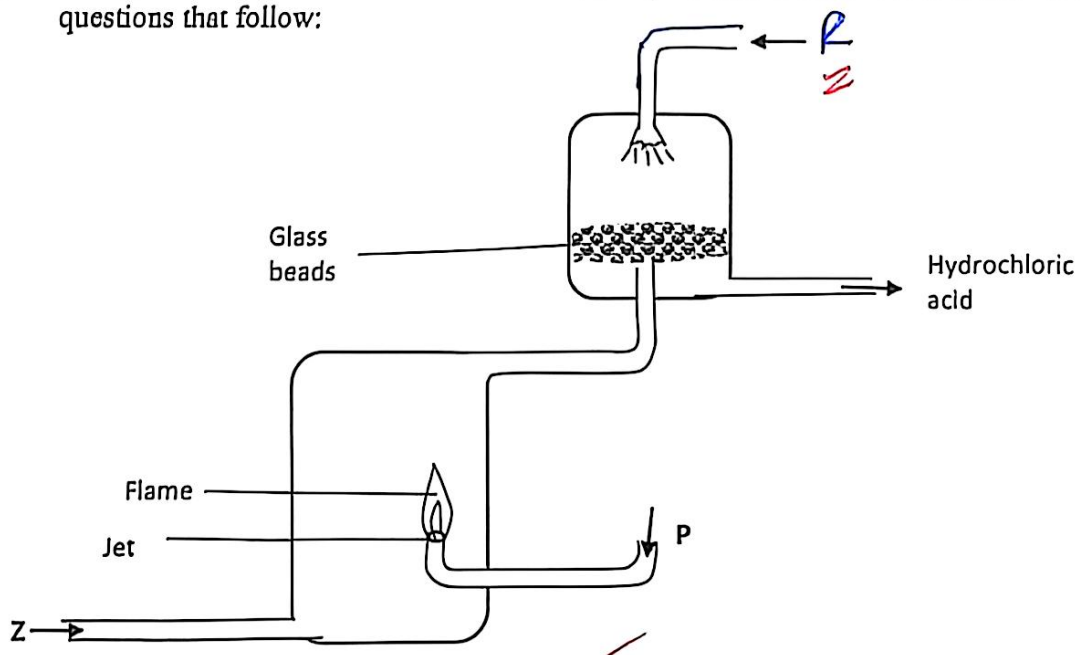
(ii) Give a reason why sodium is extracted using electrolysis. **(1 mark)**

It is more reactive

(iii) Give two uses of sodium metal. **(1 mark)**

Any two correct uses of sodium @ ½ mk

(iv) The diagram below is used in the manufacture of Hydrochloric acid. Use it to answer the questions that follow:



(a) Identify substances; (3 marks)

(i) R Water ✓1

(ii) P Hydrogen gas. ✓1

(iii) Z Chlorine gas. ✓1

(b) Why is the jet used in the set up above? (1 mark)

✓ to prevent explosion / control the amount of hydrogen used.

(c) Write a chemical equation to show how substance Z can be prepared in laboratory. (1 mark)

$MnO_{2(s)} + 4HCl_{(aq)} \longrightarrow MnCl_{2(aq)} + Cl_{2(g)} + 2H_2O_{(l)}$ ✓1 balanced, correct

Accept - PbO_2 - $KMnO_4$

(d) State one source of gas P. (1 mark)

Electrolysis of acidified water / Brine ✓1

(e) Write an ionic equation for the reaction that will occur if hydrochloric acid is reacted with silver nitrate solution. (1 mark)

$Ag^+_{(aq)} + Cl^-_{(aq)} \rightarrow AgCl_{(s)}$

(f) State the following in full. (2 marks)

(i) DDT

Dichlorodiphenyltrichloroethane ✓ 1

(ii) CFC's

Chlorofluorocarbons. ✓ 1

(g) Describe a test that can be carried out to identify hydrogen chloride gas. (2 marks)

Dip a glass rod into Ammonia solution. Place the glass rod on the mouth of a jar containing hydrogen chloride gas. White dense fumes will form. ✓ ✓ 1

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Ends