

1. The grid below represents part of the periodic table. Study it and answer the questions that follow. The letters do not represent the actual symbols of the elements.

							L
C							K
D	E						
						J	

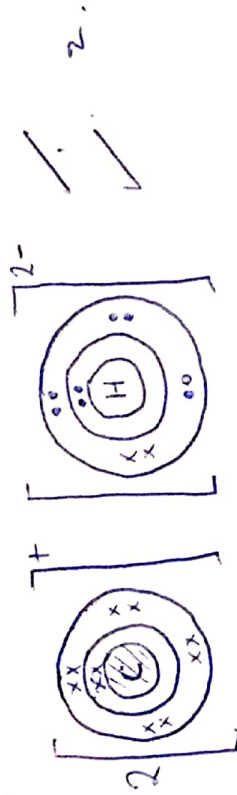
i) Identify the most reactive non-metal. Explain. (2 marks)

I. It has the smallest atomic size hence has the most electronegative property. hence has the most electronegative.

ii) What is the name given to the family of elements of which I and J belong? (1/2 mark)

Halogens

iii) Using dots (•) and crosses (x) to represent electrons, show bonding in the compound formed between C and H. (2 marks)



iv) How does the atomic radius of F compare with that of I. Explain. (2 marks)

I has a smaller atomic radius than F. I has more protons than F, hence its outermost electrons experience a greater nuclear attraction.

v) Identify the least reactive element. (1 mark)

K

b) Study the table below and answer the questions that follow.

Substance	M	N	O	P	Q	R
M.Pt. °C	801	1356	-101	26	-39	113
B.Pt. °C	1410	2850	-36	154	457	445
Electrical conductivity in solid state	Poor	Poor	Poor	Poor	Good	Poor
Electrical conductivity in molten state	Good	Poor	Poor	Poor	Good	Poor

i) Explain why substance M is a good conductor in molten state and not in solid state. (2 marks)

M is an ionic substance hence its ions are mobile in molten state and immobile in solid state.

ii) What is the most likely structure of substance N. Explain.

(1 ½ marks)

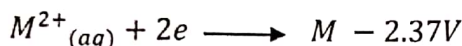
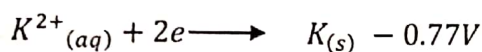
Giant atomic structure / giant covalent structure.
It has the highest m.p. & b.p. and has poor electrical conductivity.
It is both solid and molten state.

iii) Identify, with reasons, a substance that exists as a liquid at room temperature.

(2 marks)

Q. 1
Its m.p. is below R.T.

2. The standard electrode potentials of metals J, K, L and M are as shown below. Use it to answer the questions. (The letters are not the actual chemical symbols).

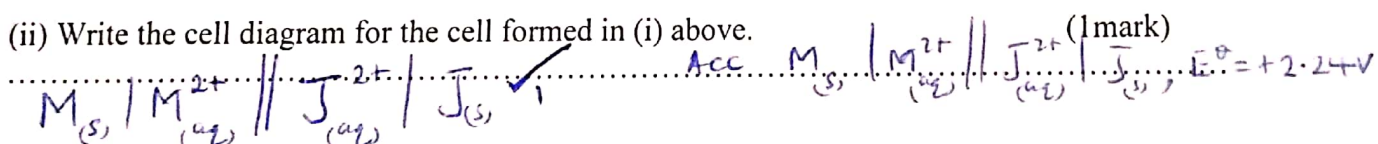


(i) Select two metals whose half cells will yield the highest e.m.f. when connected. Give a reason for your answer. (2marks)

M and J. They have the most negative and most positive $E^\ominus$ values.

(ii) Write the cell diagram for the cell formed in (i) above.

(1 mark)



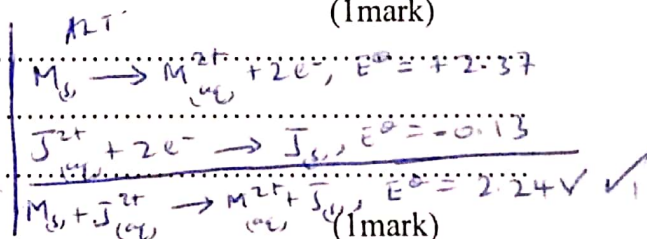
(iii) Calculate the initial e.m.f of the cell formed.

(1 mark)

$$E_{\text{mf}} = E_{\text{red}} - E_{\text{oxid}}$$

$$= -0.13 - (-2.37)$$

$$= +2.24V$$

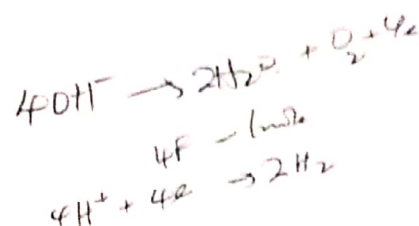
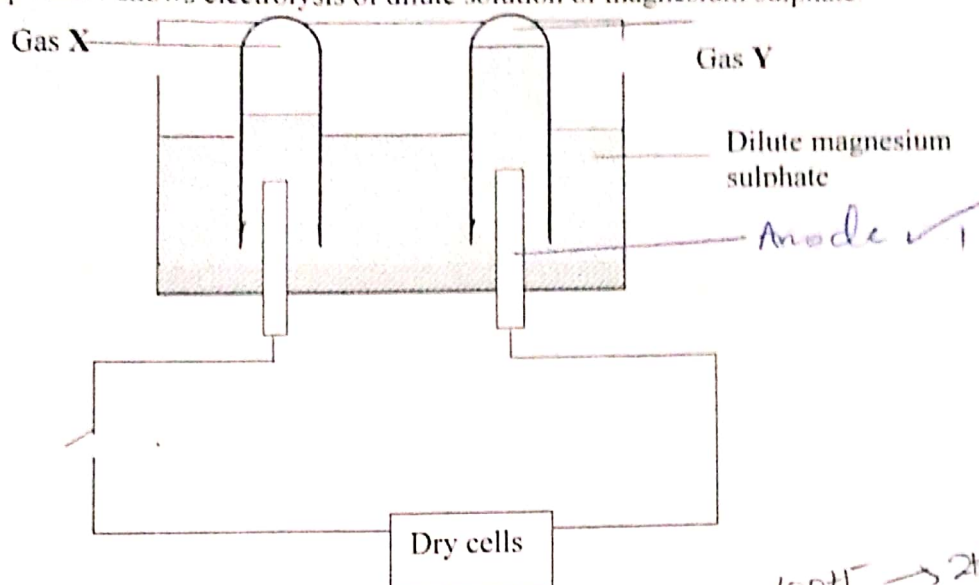


(iv) State one use of salt bridge in electrochemical cells.

(1 mark)

Complete the circuit by making contact between the two slides or electrolytes. // maintain charge balance.

- (v) The set-up below shows electrolysis of dilute solution of magnesium sulphate



- a) Identify the gases X and Y.

X.....Hydrogen ✓
Y.....Oxygen ✓

(1 mark)

- b) On the diagram, label the electrode that is the anode.

(1 mark)

- c) A current of 1.5A was passed through the solution for 50 minutes. Calculate the volume of the gas produced at the cathode. (M.G.V. r.t.p. = 24000cm³, IF = 96500C). (3marks)

$$Q = It$$

$$= 1.5 \times 50 \times 60 \checkmark$$

$$= 4500 C \checkmark$$

$$2H^+ + 2e^- \rightarrow H_2 \checkmark$$

$$\text{Volume of gas} = \frac{Q \times M.G.V.}{nF}$$

$$= \frac{4500 \times 24000}{2 \times 96500} \checkmark$$

$$= 559.5855 \text{ cm}^3 \checkmark$$

$$V = \frac{2 \times M.G.V. \times Q}{nF}$$

$$= \frac{2 \times 24000 \times 4500}{4 \times 96500}$$

$$= 559.5855 \text{ cm}^3$$

- d) State the effect of electrolysis of magnesium sulphate on the concentration of the electrolyte.

(1 mark)

The concentration increases after electrolysis.

- e) Give any one application of electrolysis.

(1 mark)

Extraction of reactive metals // Electroplating // Purification of metals.
Acc any other application.

3. (a) Name the following organic compounds.



(1 mark)

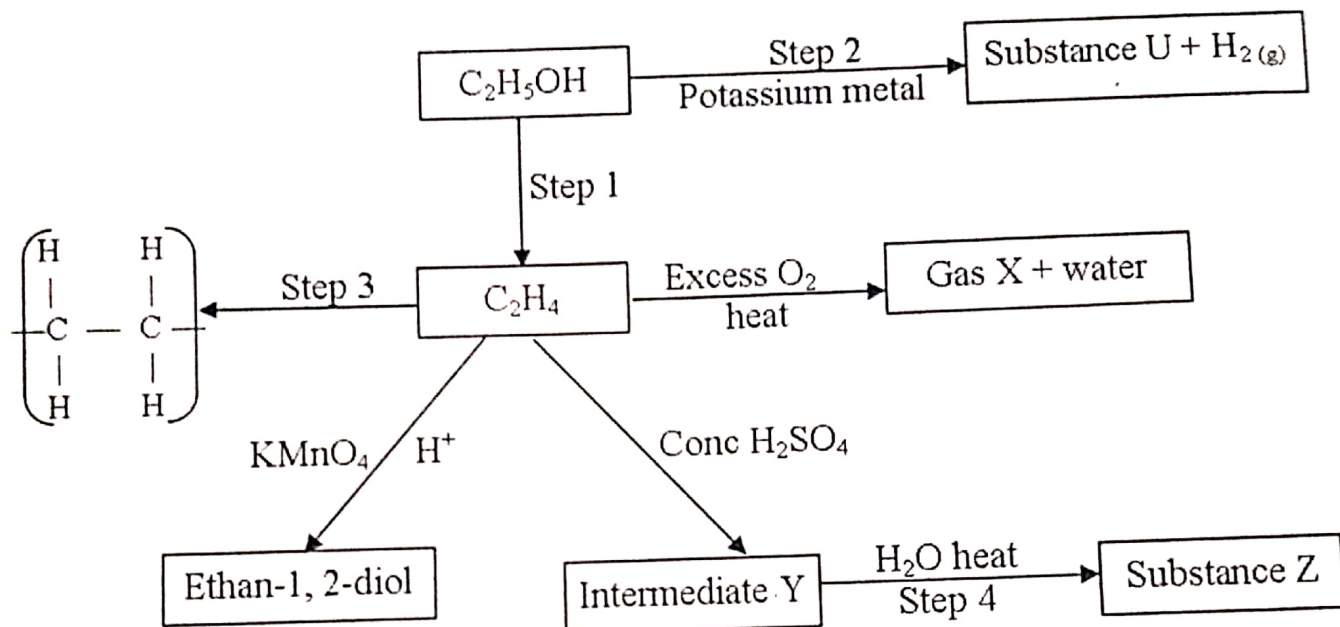
Ethylethanoate ✓



(1 mark)

Hept-3,4-diene ✓

(b) Study the flow diagram below and use it to answer the questions that follow.



(i) Name the compounds:

U... Potassium ethoxide ✓

(½ mark)

Gas X... Carbon (iv) oxide ✓

(½ mark)

Intermediate Y... Ethylhydrogen sulphate ✓

(1 mark)

(ii) Name the process which leads to the formation of substance Z from the intermediate Y.

(1 mark)

Hydrolysis ✓

(iii) Identify the reagent and the condition for step 1 ✓

Reagent: H_2SO_4

Reagent... Conc. Sulphuric (vi) acid // conc. H_2SO_4

(1 mark)

Condition... Temperature of 180°C ✓

(1 mark)

iv) State one disadvantage for the continued use of items made from compound formed in step 3.

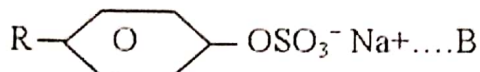
They cause environmental pollution since they are non biodegradable. (1mark)

v) Write a balanced equation for the reaction taking place in step 2.

$2C_2H_5OH + 2K_2 \rightarrow 2C_2H_5OK + H_2$ (1mark)

c) Below are structures of two cleaning agents

$R - COO^-Na^+ \dots\dots\dots A$



i) Identify the cleaning agent suitable to be used in water containing calcium chloride. (1mark)

B ✓

ii) State one advantage of using cleaning agent A.

(1mark)

Do not cause pollution since they are biodegradable // cheap

iii) Name the cleaning agent A.

(1mark)

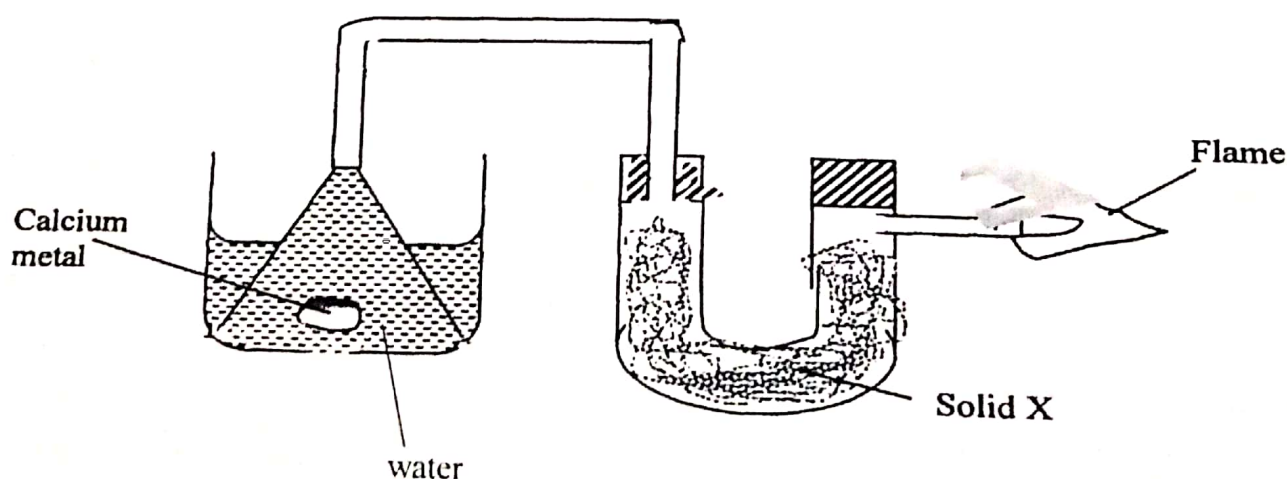
Soapy detergent ✓

d) Ethanol is an important organic solvent. It can be prepared by the fermentation of glucose, $C_6H_{12}O_6$. Give two conditions necessary for the reaction to take place. (1mark)

Yeast ✓

Temperature of $25 - 35^\circ C$ // warmth ✓

4. i) The setup below was used to investigate the reaction between metals and water.

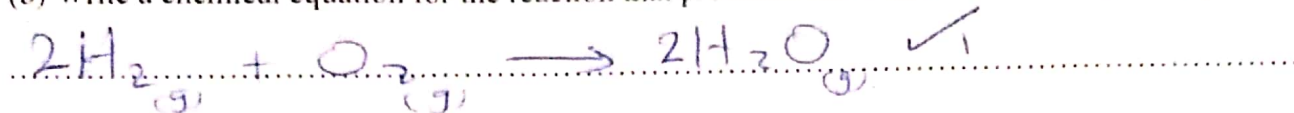


a) Identify solid X and state its purpose.

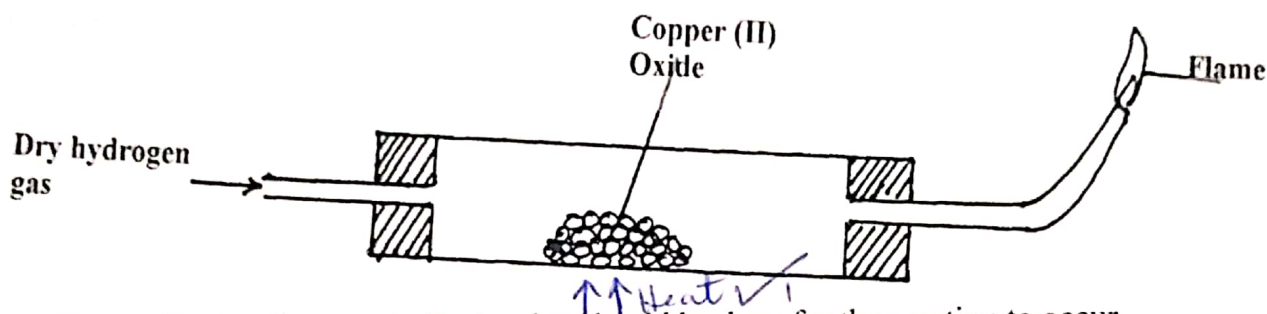
Solid X Anhydrous calcium chloride / Quicklime (½ mark)

Purpose To dry H₂ gas (½ mark)

(b) Write a chemical equation for the reaction that produces the flame. (1 mark)



ii) The set-up below was used to investigate the properties of hydrogen.

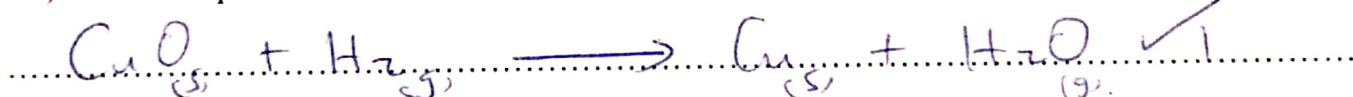


I. On the diagram, indicate what should be done for the reaction to occur. (1 mark)

II. Hydrogen gas is allowed to pass through the tube for some time before it is lit. Explain. (1 mark)

To drive out air present in the combustion tube.

iii) Write an equation for the reaction that occurs in the combustion tube. (1 mark)



iv) When the reaction is complete, hydrogen gas is passed through the apparatus until it cools down. Explain. (2 marks)

To prevent reoxidation of copper metal. ✓

v) What property of hydrogen is being investigated? (1 mark)

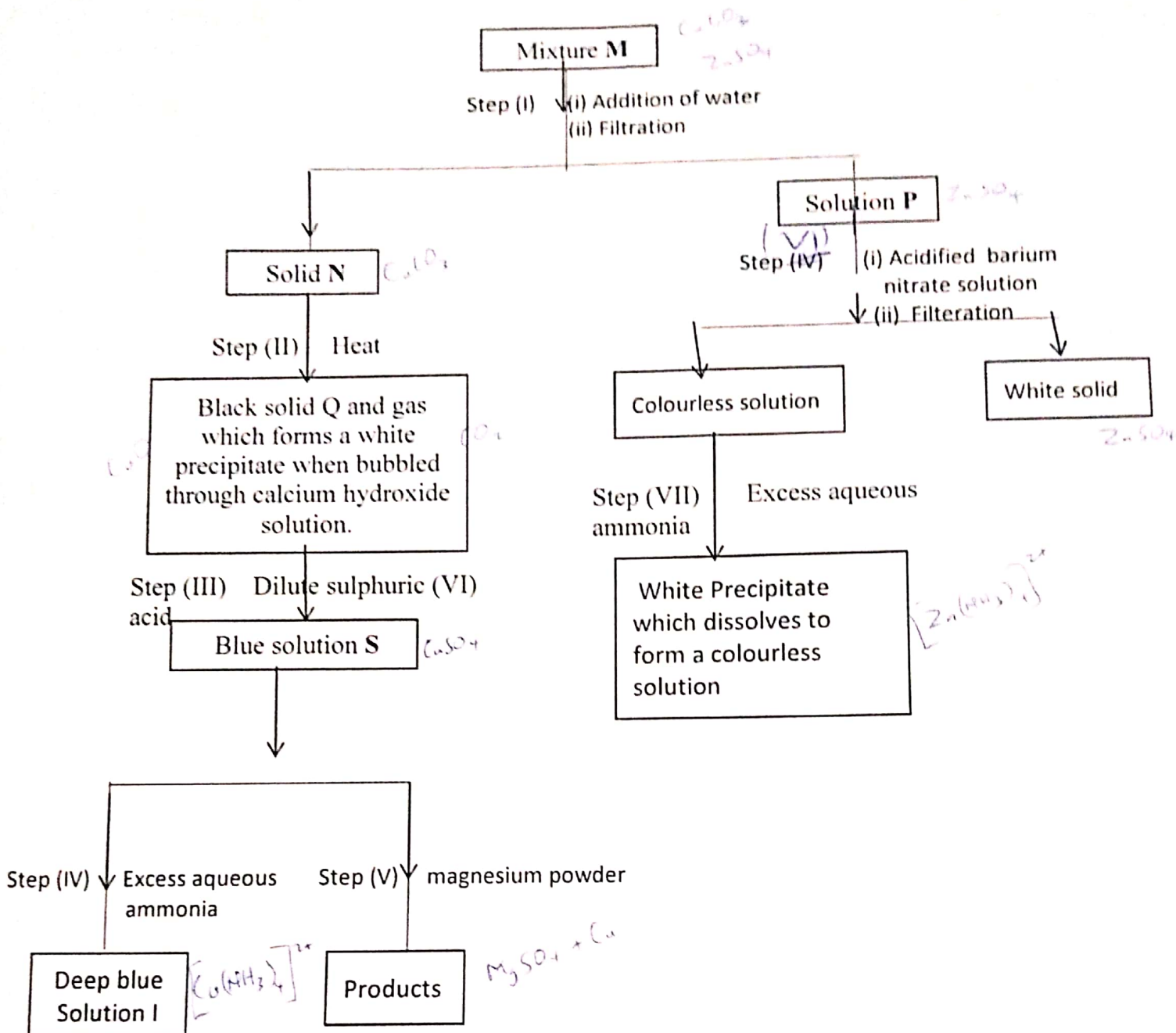
Reducing property. ✓

vi) What observation confirms the property stated in (v) above? (1 mark)

Black CuO turns to brown Cu. ✓

vii) Why is zinc oxide not used to investigate this property of hydrogen gas? (1 mark)

Zinc is above H₂ in the reactivity series hence H₂ cannot displace it from its oxide. ✓



I. a) write the formula of the following:

(i) Anion in solid Q

O^{2-} ✓

(1 mark)

(ii) The two salts present in mixture M.

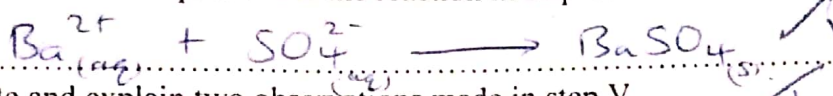
(2 marks)

CuCO_3 ✓

ZnSO_4 ✓

a) Write an ionic equation for the reaction in step VI.

(1 mark)



b) State and explain two observations made in step V.

(3 marks)

Blue solution turns to colourless and brown solid is formed. Mg displaces Cu from its solution to form MgSO_4 which is colourless and Cu which is brown.

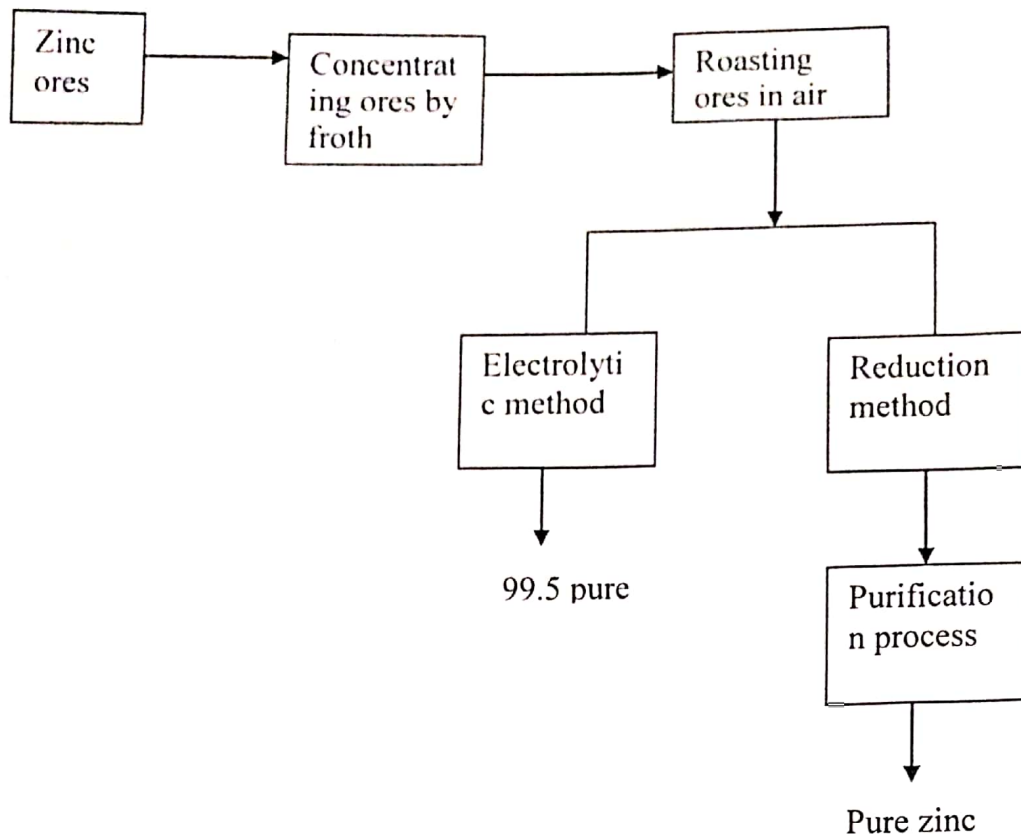
II. a) You are provided with copper solid, sodium carbonate solid, dilute hydrochloric acid, distilled water and dilute nitric (v) acid. Describe how you can prepare crystals of copper (II) carbonate. (3 marks)

React copper solid with dil. nitric acid. Heat Cu solid strongly in air (oxygen) to form CuO. Add Na_2CO_3 solution to $\text{Cu(NO}_3)_2$ solution. Stir to obtain CuCO_3 . Decant and wash with distilled water. Dry CuCO_3 between filter papers.

React CuO with dil. HCl to form CuCl_2 . Add Na_2CO_3 soln to CuCl_2 to form CuCO_3 and decant. Wash with distilled water and dry between filter papers.

(b) Name the industrial process by which the sodium carbonate used in II (a) above can be obtained. (1 mark)

The Solvay Process ✓

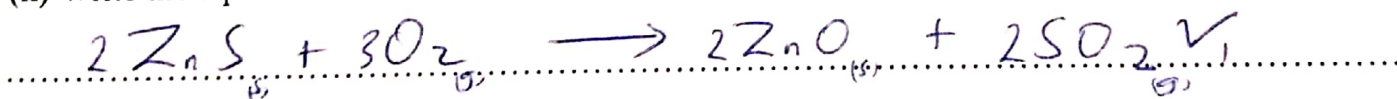


(i) Name the two ore from which zinc can be extracted.

(2marks)

Zinc carbonate ✓
Zinc blende ✓

(ii) Write the equation for the reaction that takes place when zinc ores are roasted in air. (1mark)



(b) Explain the effects of the by-products of the roasting process of zinc ores on the environment.

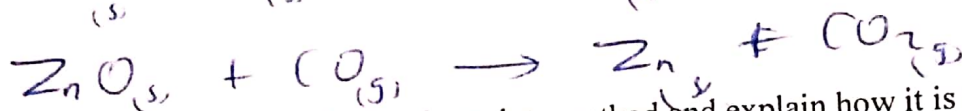
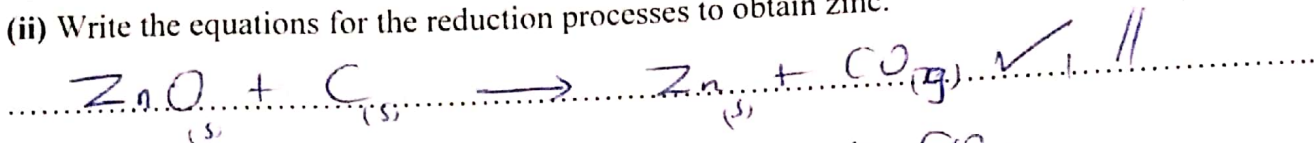
(2marks)

The SO_2 gas produced readily combines with oxygen in air to form SO_3 . The SO_3 is very soluble in water hence dissolves in rain water and falls as acid rain which destroys aquatic life, iron sheets. The gases are also poisonous when inhaled causing respiratory problems.

(c) (i) Name the reducing agents used in the furnace during extraction process of zinc by reduction method. (1 mark)

Carbon (solid) ✓
Carbon (II) oxide ✓

(ii) Write the equations for the reduction processes to obtain zinc. (1 mark)



(d) Name the electrolyte used in the electrolyte method and explain how it is acquired. (2 marks)

Zinc sulphate // ZnSO_4 ✓
Obtained from the reaction between zinc oxide and sulphuric (VI) acid // $\text{ZnO}_{(s)} + \text{H}_2\text{SO}_{4(l)} \rightarrow \text{ZnSO}_{4(l)} + \text{H}_2\text{O}_{(l)}$ ✓
(1 mark)

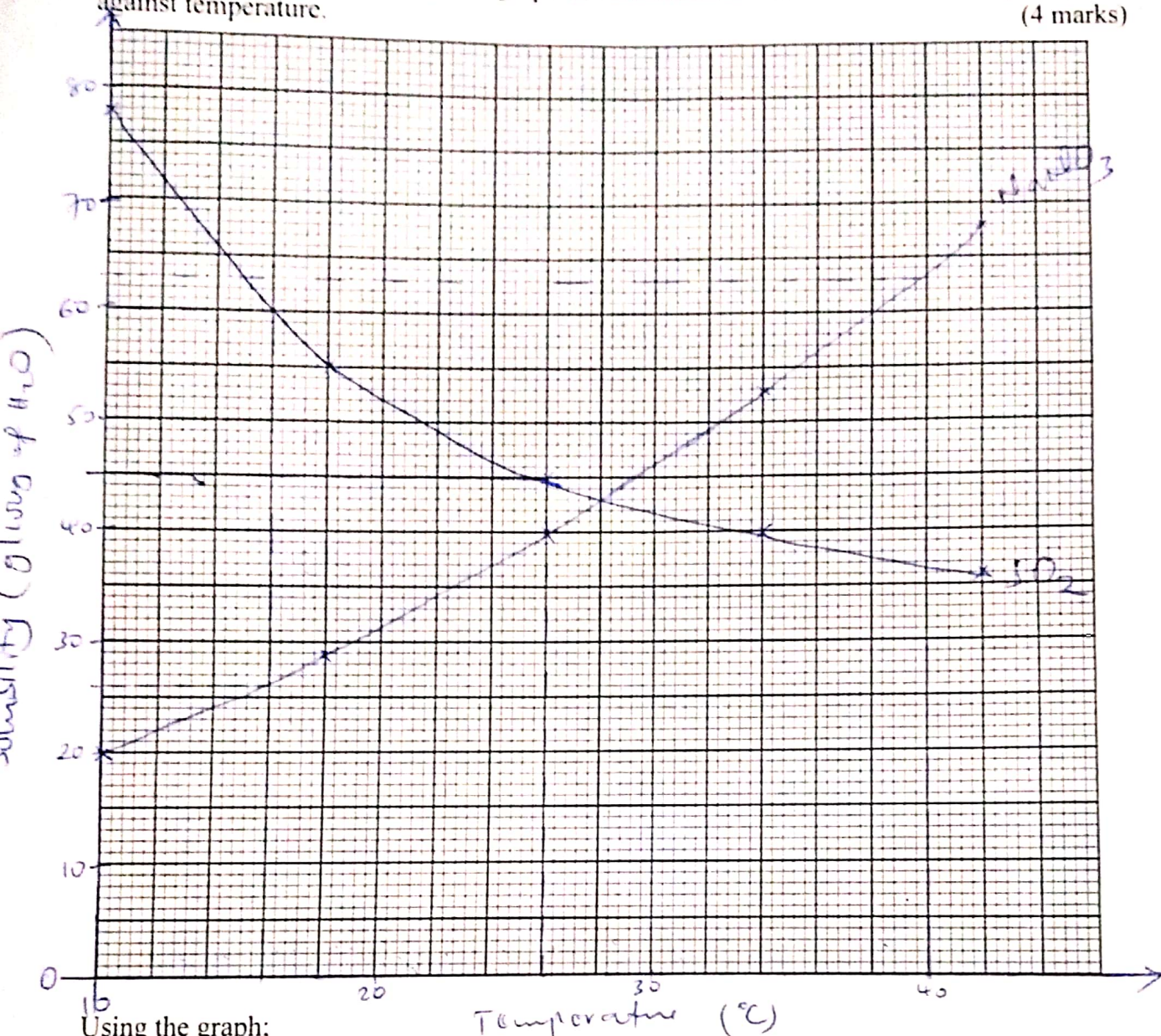
7. (a) Define the term solubility.

The maximum mass of solute that can saturate 100g of water at a particular temperature ✓

(b) The table below represent the solubilities of sodium nitrate and Sulphur (IV) oxide at different temperatures.

Temperature (°C)	10	18	26	34	42
Solubility of sodium nitrate (g/ 100g of water)	20	29	40	53	68
Solubility of sulphur (IV) oxide (g/ 100g of water)	78	55	45	40	36

On the grid provided below, plot a graph of solubilities of sodium nitrate and Sulphur (IV) oxide against temperature. (4 marks)



Using the graph;

- i. Determine the solubility of Sulphur (IV) oxide at 16°C.

(½ mark)

60g/100g of water ✓ ±1

- ii. The concentration, in moles per litre, of sodium nitrate at 16 °C. (assume density of solution is 1 g/cm³) (Na=23, O=16, N=14).

(3 marks)

Solubility = 26g/100g of H₂O ✓ ±1

Rfm of NaNO₃ = 23 + 14 + 48 = 85 ✓

Conc = 260g/L ✓

conc = $\frac{260}{85} \approx 3.0588$ mol per litre ✓

- iii. Mass of crystals formed when a solution of sodium hydroxide is cooled from 40°C to 26°C.

(2 marks)

63g - 40g ✓ = 23g ✓ ±1

Follow through marks

iv. What is the relationship between solubility of sodium nitrate and temperature? (1 mark)

The solubility of NaNO_3 increases with increase in temperature ✓

(c) Give one advantage of hard water. (½ mark)

Beer brewing // Strengthening bones // Prevents lead poisoning ✓

(d) Explain why the reaction between 1g of sodium carbonate with 2M hydrochloric acid is faster than between 1g of sodium carbonate with 2M ethanoic acid. (1 mark)

~~2M~~ Hydrochloric acid is a strong acid which dissociates fully in solution while ethanoic acid is a weak acid which dissociates partially in solution ✓