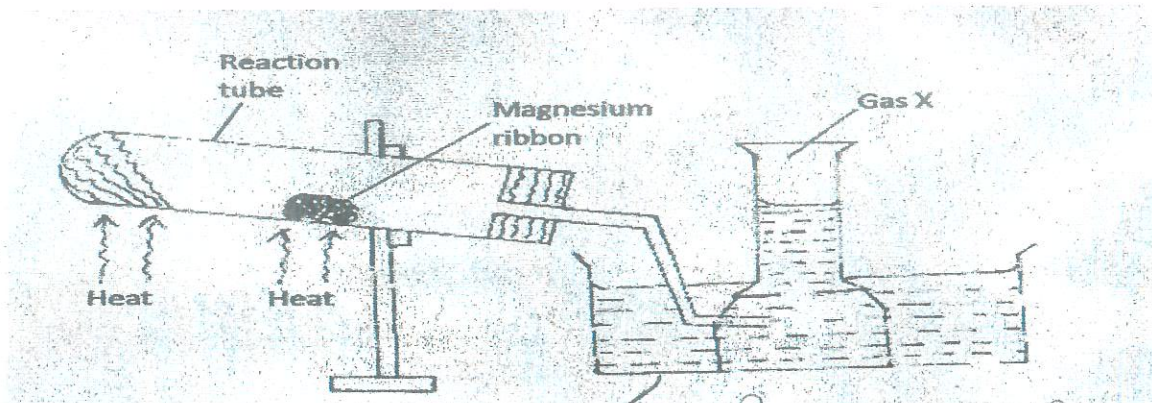


1. The set-up below was used to prepare and collect gas X. During the experiment cleaned magnesium ribbon was strongly heated before heating the wet glass wool.



a) Name gas X. Hydrogen gas ✓ 1. Reject symbol. (1 mark)

b) Why is magnesium ribbon cleaned before it is used? (1 mark)
- To remove the oxide layer ✓ 1

c) State **one** observation that would be made in the reaction tube. (1 mark)
- Bright white flame of burning Magnesium ✓ 1
- white solid residue of magnesium oxide ✓ 1
 Any 1x1 =

d) Write the equation for the reaction in the reaction tube. (1 mark)

$$\text{Mg} + \text{H}_2\text{O} \longrightarrow \text{MgO} + \text{H}_2$$
 (s) (g) (s) (g)
 - Missing symbols
 - Not balanced
 Penalize fully.

e) State **one** industrial use of the solid product formed in the reaction tube. (1 mark)
- Manufacture of cements ✓
- Antacid ✓
- Linings of furnaces ✓
 Any 1x1 = 1mk

f) What precaution should be taken at the end of experiment? Explain. (2 marks) 2mk
- Heating should be continued ✓
from sucking back ✓
- To prevent water

g) At the end of the experiment 96.0cm³ of gas X were collected at 10°C and 1 atmosphere pressure. (molar gas volume = 22.4liters at s.t.p, T =273K at s.t.p, P = 1 atmosphere at s.t.p).

(i) Determine the volume gas X would occupy at s.t.p. (2 marks)

$$\begin{array}{l}
 T_1 = 283 \quad T_2 = 273 \\
 P_1 = 1 \quad P_2 = 1 \\
 V_1 = 96 \quad V_2 = ? \\
 \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \\
 \frac{1 \times 96}{283} = \frac{1 \times x}{273} \\
 x = \frac{96 \times 273}{283} \\
 = 92.60 \text{ cm}^3
 \end{array}$$

(ii) Calculate the mass of magnesium ribbon used (Mg = 24)

Mole ratio: 1:1 (1 mark) ✓

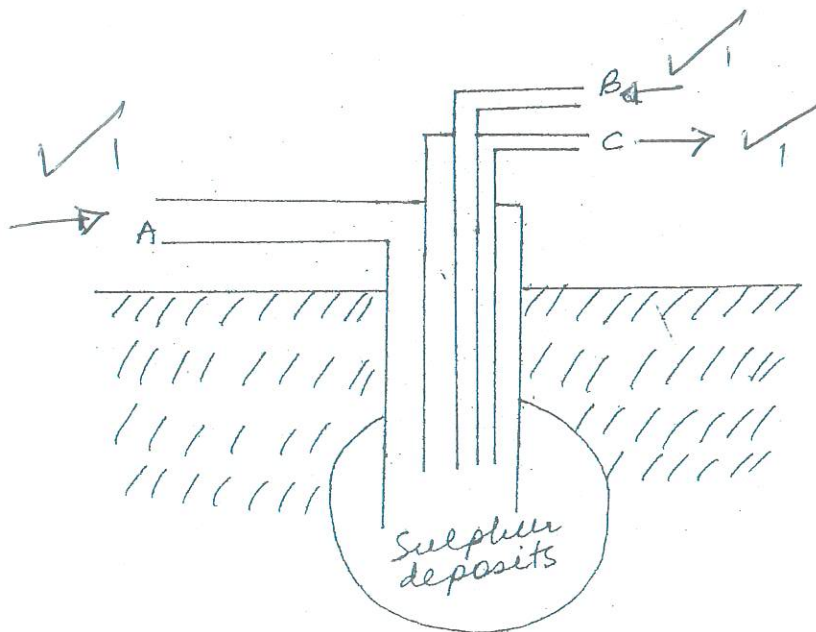
Molec of H₂ ✓

22.4 litres = 1 mole ✓

0.096 = $\frac{0.096 \times 1}{22.4}$ = 0.00429 mole ✓

Mass = 0.00429 × 24 = 0.10296 g ✓

2. a) The diagram below shows how sulphur is extracted by the Frasch process.



Indicate with arrows (→ or ←) what enters or leaves the tube A, B and C in the diagram above.

(3 marks)

b) State **two** properties of sulphur that enable it to be extracted using the Frasch Process. (1 mark)

- Insoluble in water ✓
- Low BP ✓

c) i) Hydrogen sulphide is prepared by the action of dilute acids on metal sulphides. Explain why the combination of dilute hydrochloric acid and lead sulphide cannot be used to prepare the gas.

Formation of insoluble lead chloride which forms a coating on the acid thus prevents further reaction. (2 marks) (1 mark)

ii) Hydrogen sulphide is normally collected over warm water but not over cold water. Explain.

- Soluble in warm water (1 mark)
- Insoluble in cold water

iii) State **one** chemical test for hydrogen sulphide.

- Bubble the gas in lead nitrate as it reacts with lead acetate & black precipitate is formed. (1 mark)

3. Study the standard electrode potential for the half cells given below and answer the questions that follow. The letters do not represent the actual symbols of the elements.

				E° volts	
$N^{+}_{(aq)}$	+	e^{-}	\longrightarrow	$N_{(g)}$	-2.92
$J^{+}_{(aq)}$	+	e^{-}	\longrightarrow	$J_{(g)}$	+0.52
$K^{+}_{(aq)}$	+	e^{-}	\longrightarrow	$\frac{1}{2}K_{(g)}$	0.00
$\frac{1}{2}G_{(g)}$	+	e^{-}	\longrightarrow	$G_{(aq)}$	+1.36
$M^{2+}_{(g)}$	+	$2e^{-}$	\longrightarrow	$M_{(g)}$	-0.44

a)(i) Identify the strongest oxidizing agent. Give reason for your answer. (2marks)

- G - Most positive electrode potential ✓

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

G and N half cell ✓

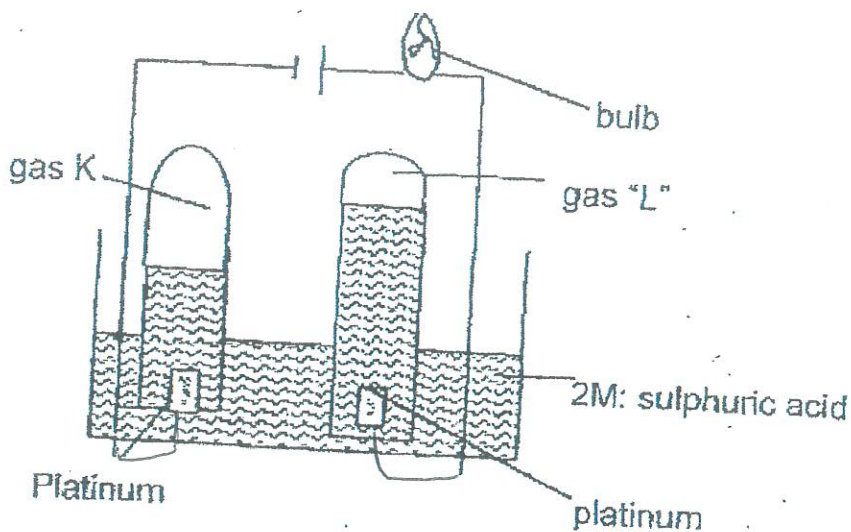
(iii) Explain whether the reaction represented below can take place.

(2marks)



- No / N is more reactive and can't displace

b) 100cm³ of 2M sulphuric acid was electrolyzed using the set up represented by the diagram below.



i) Write the equation for the reaction that produces gas "L".

(1mark)



ii) Describe how gas "K" can be identified.

(2marks) (1mark)

- Produces a "pop" sound when a burning splint is inserted inside

iii) Explain the differences in:

a) The volume of gases produced at the electrodes.

(1mk)
(2 marks)

- The ratio of electrons required to produce the gas is $2:1$ for H_2 and $1:1$ for O_2 .

b) Brightness of the bulb if 100cm^3 of 2M ethanoic acid is used in place of sulphuric acid. (1 mark)

(2 marks)

- In 2M ethanoic the bulb would be less bright. Ethanoic acid is weaker acid and dissociates partially to produce less ions H^+ .

c) A solution of 1.0 M copper II sulphate was electrolyzed using carbon electrodes. A steady current of 2.5 A was passed through the solution for 15 minutes and the mass of copper deposited was determined. Given that 1 mole of copper requires 2 Faradays to be deposited. Calculate the mass of copper deposited after 15 minutes. (3 marks)

(Cu = 63.5, IF = 96,500C)

$$\text{Mass} = \frac{2.5 \times 15 \times 60 \times 63.5}{2 \times 96500}$$

$$= 0.7402\text{g}$$

4. (a) At 30°C , 54g of potassium nitrate were added to 100g of water to make a saturated solution.

Define a saturated solution.

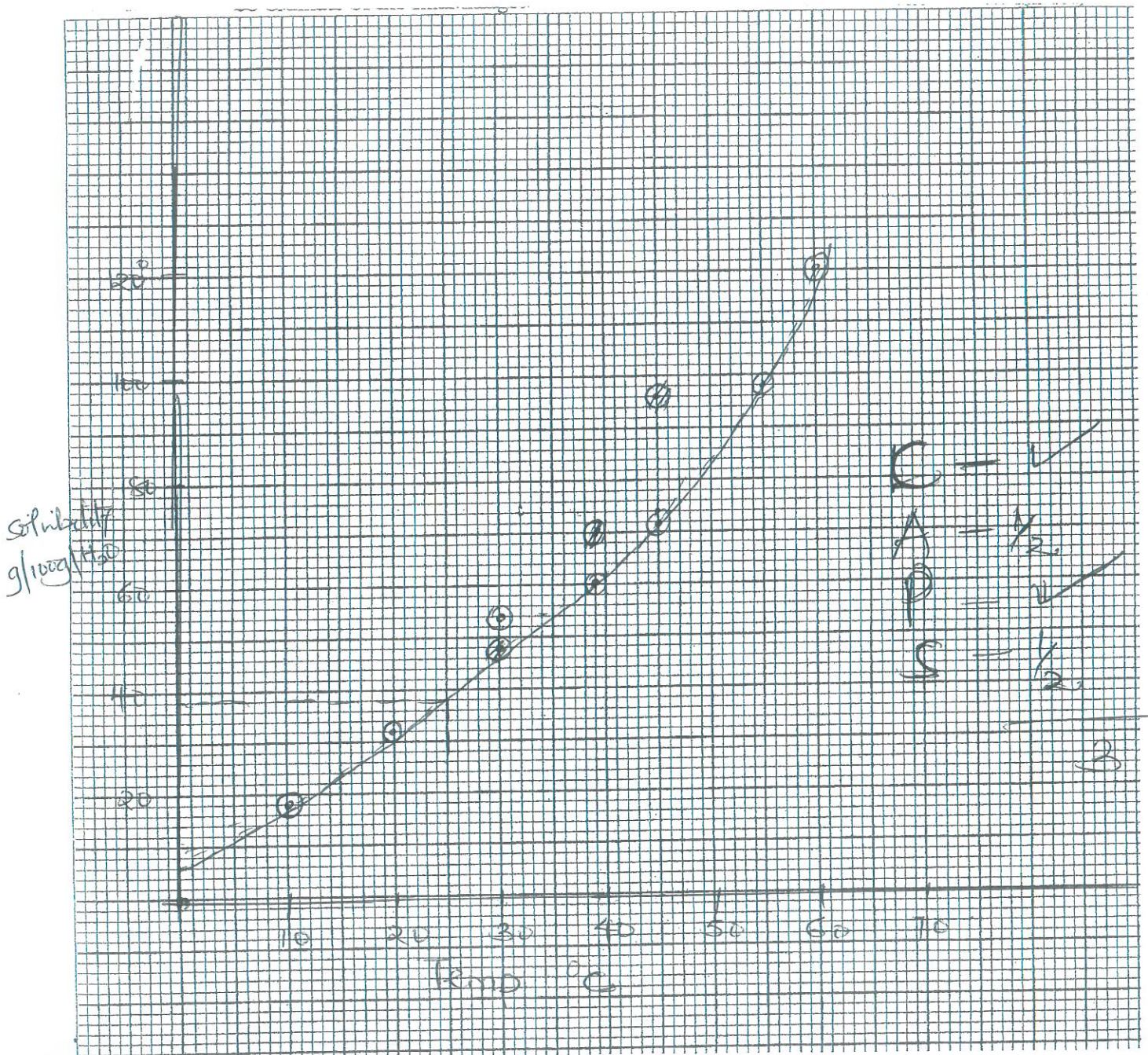
(1 mark)

- A solution that can't dissolve any more solute at a given temperature.

b) The table below gives the solubilities of potassium nitrate salt at different temperatures.

Temperature (°C)	10	20	30	39	45	55	60
Solubility(g/100g of H ₂ O)	19	31	44	60	72	98	120

i) Plot the graph of the solubility of potassium nitrate (y-axis) against temperature. (3marks)



(ii) Use your graph to

I. Determine the solubility of potassium nitrate at 25°C

(1 mark)

38g/100g of water ± 2

II. Determine the mass of potassium nitrate that remained undissolved when 80g of potassium nitrate were added to 100cm³ of water and heated to 40°C.

(2 marks)

At 40°C - 62g/100g of water ✓

- 80 - 62 ✓

- Mass undissolved = 18g ✓

3

(c) Determine the molar concentration of potassium nitrate at 25°C (K = 39, N = 14, O = 16, density of water = 1.0g/cm³)

(3 marks)

38g in 100cm³ of water

$KNO_3 = 39 + 14 + 48$

0.3762 moles ✓ = 100cm³

moles = $\frac{38}{101}$ ✓

$\frac{1000 \times 0.3762}{100} = 3.762$ ✓

= 0.3762 moles

= 3.762M ✓

c) The table below gives the solubilities of potassium bromide and potassium sulphate at 0°C and 40°C.

Substance	Solubility g/100g water at	
	0°C	40°C
Potassium bromide	55	75
Potassium sulphate	10	12

When an aqueous mixture containing 60g of potassium bromide and 7g of potassium sulphate in 100g of water at 40°C was cooled to 0°C some crystals were formed.

i) Identify the crystals formed.

(1 mark)

- Potassium Bromide ✓

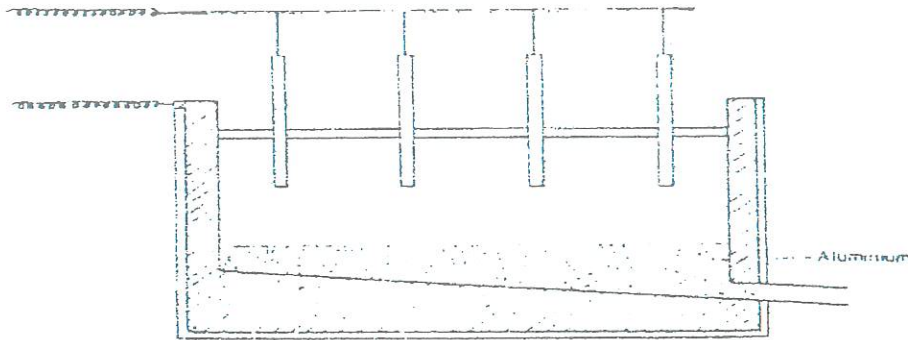
ii) Determine the mass of the crystals formed.

(1 mark)

$$60 - 55$$

$$= 5g$$

5. The extraction of aluminum from its ore takes place in two stages, purification stage and Electrolysis stage. The diagram below shows the set – up for the electrolysis stage.



a) i) Write the formulae of the ore from which aluminum extracted.

(1 mark)



ii) Name one impurity, which is removed at the purification stage.

(1 mark)

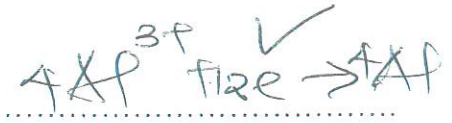
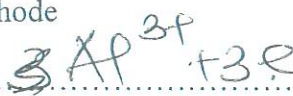
Iron III oxide, silica

b) i) Write ionic equation at each of the following

i) Anode



ii) Cathode



ii) The melting point aluminum oxide is 2015°C, but electrolysis is carried out between 800 °C.

i) Why is the electrolysis not carried out at 2015°C

(1 mark)

To save on cost of production by saving electricity

ii) What is done to lower the temperatures? (1 mark)
 - Cryolite is added as an impurity to lower MP.

iii) The aluminium which is produced is tapped off as a liquid. What does this suggest about its melting point? (1 mark)
 - MP of Al is higher than BP of Al.

6. Study the table below and answer the questions that follow. The letters do not represent the actual symbols of the element.

Formula of ion	Electronic configuration
E ²⁺	2
D ⁻	2.8
Cl ⁻	2.8.8
B ³⁺	2.8
A ²⁺	2.8.2

a) With a reason, select the elements found in:

i) The same group (1 1/2 marks) 1mk
 E, A. each ✓ vs D and Cl.

ii) Period three (1 1/2 marks) 3mk
 Cl, B, A. each ✓

iii) What is the name given to the group to which element E belongs? (1 mark) 1/2mk
 Alkaline Earth metal

5mk
 7mks

b) With a reason compare the atomic radius of elements B and A. (2 marks)
 A has a larger radius ✓ | A has more protons hence stronger nuclear charge ✓

c) State two industrial uses of element B. (2 marks)
 - Aeroplane bodies ✓
 - Electrical cables ✓

d) How does the reactivity of E and A compare? Explain your answer. (2 marks)
 A is more reactive - A is more electropositive due to larger radius ✓

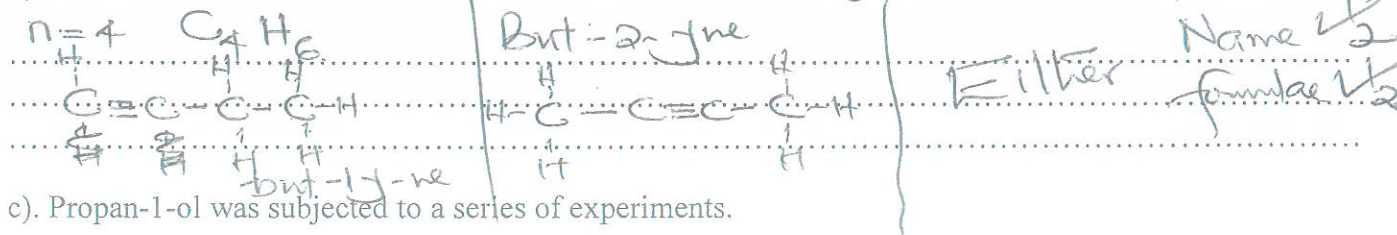
e) Write the formula of the compound formed when D and A react together. (1 mark)
 AD_2 ✓

f) What type of bond is formed when element E reacts with oxygen? Give a reason for your answer. (2 marks)
 - Ionic ✓ - Involves transfer of electrons from E to Oxygen (Accept metal and non-metal)

7. a) Describe a chemical test that can be used to distinguish CH_3COOH from CH_3CH_2OH (3 marks)
 - Add Na_2CO_3 or $NaHCO_3$ - In CH_3COOH effervescence while in CH_3CH_2OH no effervescence ✓
 OR
 Accept any reaction with oxidising agent ✓

20
12

b) Draw and name **one** isomer of the third member of the homologous series C_nH_{2n-2} . (1 mark)



c). Propan-1-ol was subjected to a series of experiments.

I. It was heated with concentrated sulphuric (VI) acid at temperature of 160-180°C to form **gas R** in the process called **W**. Gas R was then subjected to high pressure to form a **polymer X**.

i) Name gas R. steam / water (1 mark)

ii) What is the name given to process W? Dehydration (1 mark)

iii) State **one** disadvantage of continued use of polymer X. - Pollutes the environment ✓ (1 mark)

II. Propan-1-ol was converted to propanoic acid in the process Y. The propanoic acid was then reacted with dilute sodium hydroxide solution to form solution C which was heated to saturation and cooled. Crystals of C were obtained. Solid C was added to soda lime and the mixture heated. Ethane gas was collected.

i) Name the process Y. - Oxidation (1 mark)

ii) Write the equation for the reaction that occurs when solid C is heated with sodalime. $CH_3CH_2COONa + NaOH \rightarrow Na_2CO_3 + C_2H_6$ ✓ (1 mark)
ignore symbols

d) In the presence of U.V light, ethane gas undergoes substitution reaction with chlorine.

i) What is meant by the term substitution reaction? (1 mark)
- Reaction where one or more atoms of an alkane is replaced by halogen ✓

ii) Give the structural formula and the name of the organic compound formed when equal volumes of ethane and chlorine react together. (1 mark)

