Marking Scheme

233/2
Chemistry paper 2
Time:2 hours

**INSTRUCTIONS TO CANDIDATES:**

- *Answer **all** the questions in the spaces provided.*
- *Write **your Name** and **Index Number** in the spaces provided above.*
- *Mathematical tables and electronic calculators may be used for calculations.*
- *All working **must** be clearly shown where necessary*

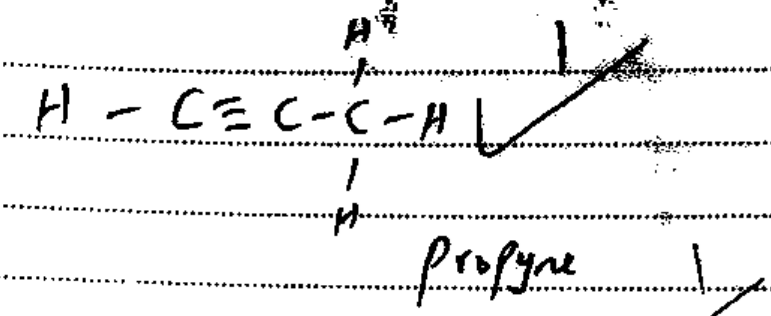
**For Examiner's Use only.**

| QUESTION | MAXIMUM SCORE | CANDIDATE'S SCORE |
|---|---|---|
| 1 | 12 | |
| 2 | 13 | |
| 3 | 13 | |
| 4 | 12 | |
| 5 | 11 | |
| 6 | 11 | |
| 7 | 08 | |
| Total score | 80 | |

*This paper consists of **14** printed pages. Candidates should check the questions to **ascertain** that all the pages are printed as indicated and no questions are missing.*

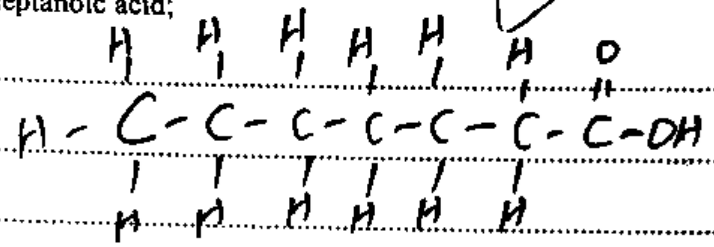
1. (a) Draw the structures of;

(i) the second member of the alkyne homologous series; (1 mark)

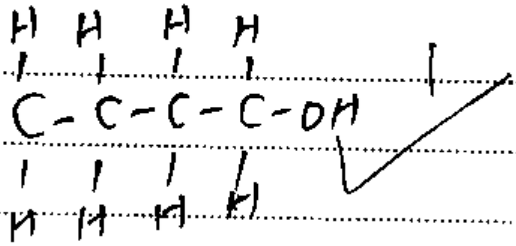


Propyne

(ii) heptanoic acid; (1 mark)



(iii) 1-butanol. (1 mark)



(b) State and explain how ethanol could be distinguished from ethanoic acid (2 marks)

Add a few drops of acidified potassium dichromate (VI) to each in separate test-tubes. In ethanol the orange colour of $K_2Cr_2O_7/H^+$ changes to green while in ethanoic acid $K_2Cr_2O_7/H^+$ remains orange.

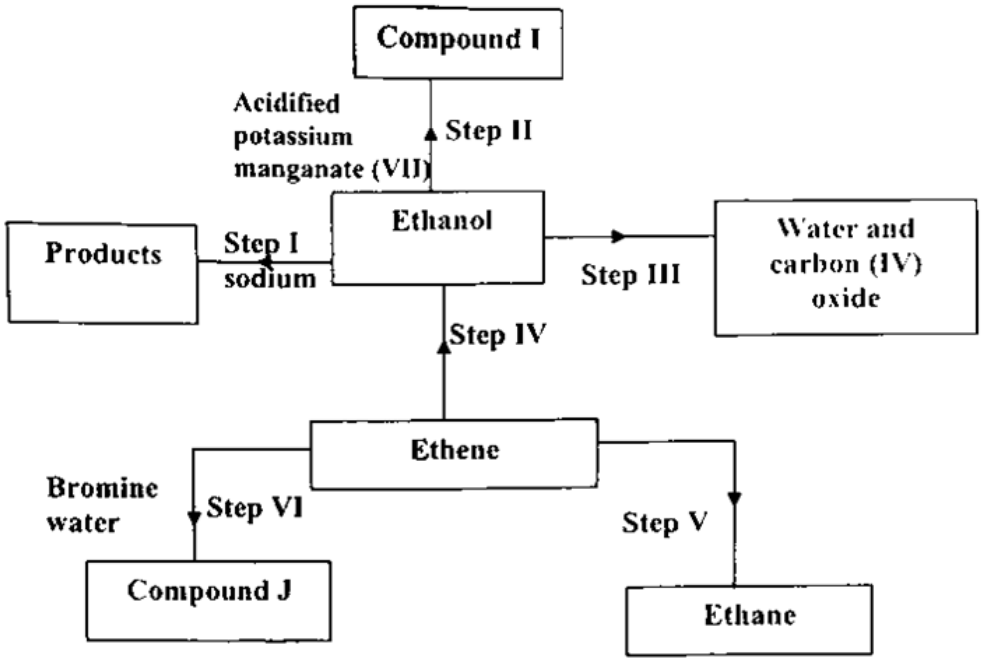
OR

Add a few drops of $KMnO_4/H^+$ to each in separate test tubes. Ethanol will decolourise $KMnO_4/H^+$ while ethanoic acid will not decolourise it.

OR

Use sodium carbonate. Ethanoic acid gives effervescence while ethanol does not

(c) Use the information in the scheme below to answer the questions that follow.




(i) give the name of ;

(I) compound **I** (1 mark)

Ethanoic acid ✓1

(II) compound **J** (1 mark)

1,2-dibromoethane ✓1

(ii) Give the name of the reaction which occurs in step **III** (1 mark)

Combustion ✓1

(iii) Write the equation for the chemical reaction in step **I** (1 mark)

$2C_2H_5OH + 2Na \longrightarrow 2C_2H_5ONa + H_{2(g)}$ ✓1

(iv) Name the reagent and conditions necessary for the reaction **step V**

Reagent (1 mark)

Hydrogen ✓1

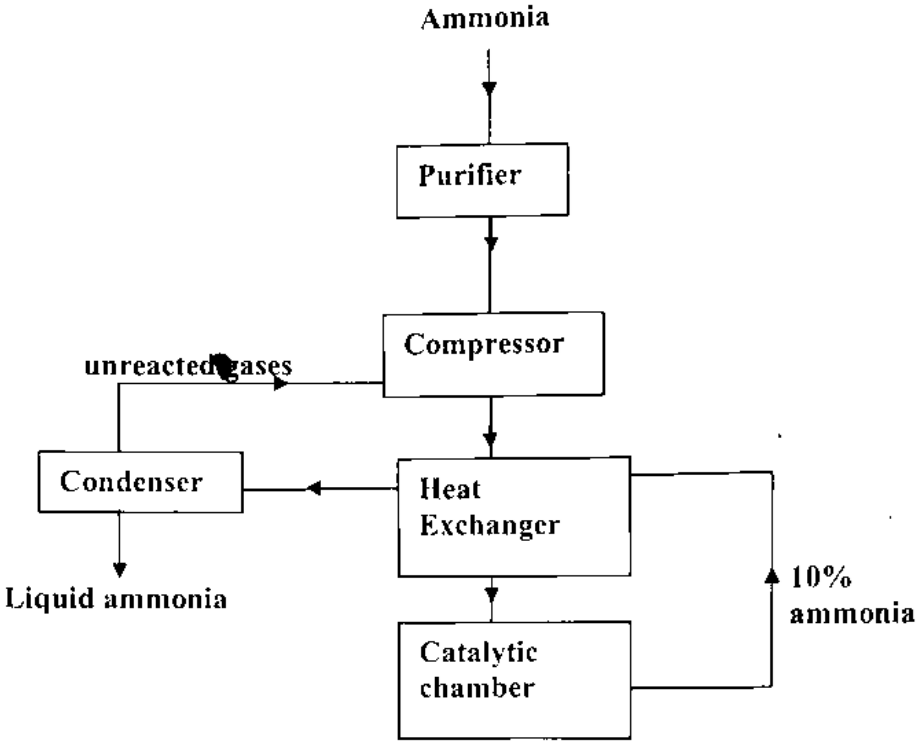
Condition (s) (1 mark)

Nickel catalyst ✓1, temp of 150-250°C ✓1

(v) State the observations made in step **II** (1 mark)

Purple acidified potassium manganate (VII) ✓1 changes to colourless

2. (a) The diagram below represents the industrial process for the manufacture of ammonia. Study it and answer the questions that follow.




(i) Give the name of the catalyst used in the above process (1 mark)

Iron ✓

(ii) State two impurities removed in the purifier. (1 mark)

Dust particles ✓

Carbon(IV) oxide ✓

(iii) state the other optimum temperature and pressure for this process . (2 marks)

Optimum temperature 450°C ✓

Optimum pressure 200 atm ✓

(iv) Proper ventilation is important when using cleaning products that contain ammonia. Explain why this is important. (2 marks) ✓

High concentration of ammonia causes irritation of skin, eyes and lungs.

(b) **Ammonium nitrate can be** prepared by reacting ammonia and dilute nitric (V) **acid.**

(i) **Write an equation** for the reaction which occurs. (1 mark)

$NH_{3(g)} + HNO_{3(aq)} \longrightarrow NH_4NO_{3(aq)}$

(ii) Determine the mass of ammonium nitrate formed in b (i) above given that 720 liters of ammonia was used.( N=14, O=16, Molar gas volume = 24 000 cm (4 marks)

Molar mass of $NH_4NO_3$ = 80

$24000\ cm^3 \rightarrow 80$

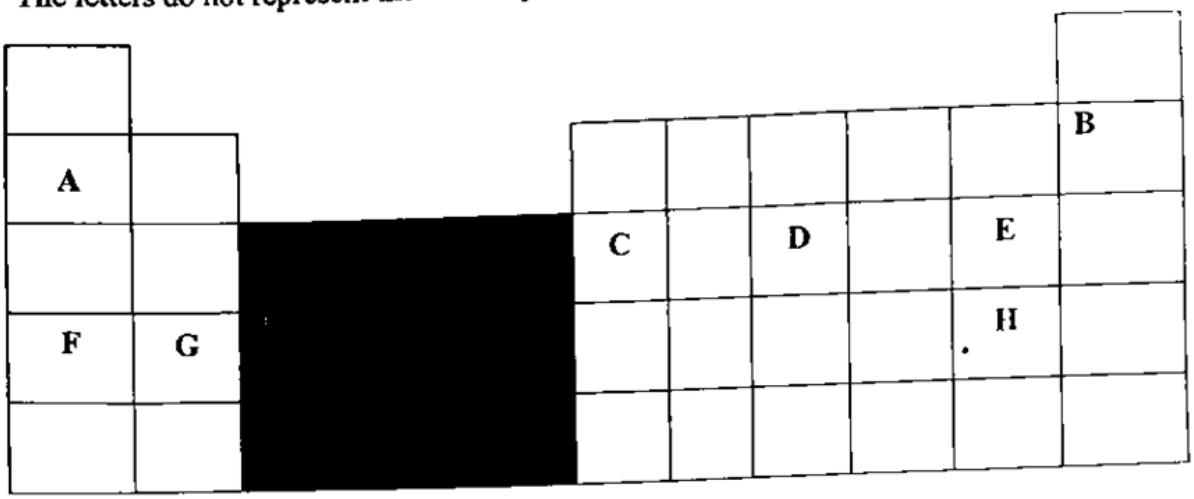
$720000\ cm^3 \rightarrow ?$

$\frac{720000 \times 80}{24000} = 240g$

(c) State and explain what would be observed when aqueous ammonia is added dropwise until in excess to a solution of zinc nitrate. (2 marks)

White precipitate which dissolves in excess forming a colourless solution.

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




(a) Which element forms an ion of charge - 3? Explain your answer (2 marks)

D. ✓ Ionizes by gaining 3 electrons ✓

(b) What is the nature of the oxide formed by element C? (1 mark)

Amphoteric ✓

(c) Which is the least reactive element? Explain. (2 marks)

B ✓ Has octet ten electron ✓ configuration. / Is Stable. Neither loses nor gains electrons.

(d) Write the chemical equation for the reaction between F and water? (1 mark)

$2F_{(s)} + 2H_2O_{(l)} \longrightarrow 2FOH_{(aq)} + H_{2(g)}$ ✓

(e) How the atomic radii C and E compare? (1 mark)

E has a smaller atomic radius than C. E has higher/greater nuclear charge than E. E experiences stronger nuclear force of attraction than C.

(f) The oxide of A is dissolved in water. State, with a reason the most likely pH of the resulting solution. (2 marks)

pH 12.0 Molten formed is strongly alkaline

or

pH 13.0

or pH 14.0

(g) 22.5 $cm^3$ of a solution of a hydroxide of F completely neutralizes 20.0 $cm^3$ of a dibasic acid whose concentration is 0.2 moles per litre. Calculate the concentration of hydroxide of F in moles per litre. (3 marks)

Mles of acid = $\frac{0.2 \times 22.5}{1000}$

= 0.0045

Mles of hydroxide = 0.0045 x 2

= 0.009

Molarity = $\frac{0.009 \times 1000}{22.5}$

= 0.4 M

(h) What name is given to the family of G? (1 mark)

Alkaline earth metals

4. (a) The table below shows the standard reduction potentials for four half cells. Study it and answer the questions that follow.

| Number | Half -reaction | $E^0$volts |
|---|---|---|
| I | $Ag^{+}_{(aq)} + 2\bar{e} \rightleftharpoons Ag_{(s)}$ | + 0.80 |
| II | $Cu^{2+}_{(aq)} + 2\bar{e} \rightleftharpoons Cu_{(s)}$ | + 0.34 |
| III | $Pb^{2+}_{(aq)} + 2\bar{e} \rightleftharpoons Pb_{(s)}$ | - 0.13 |
| IV | $Zn^{2+}_{(aq)} + 2\bar{e} \rightleftharpoons Zn_{(s)}$ | - 0.76 |

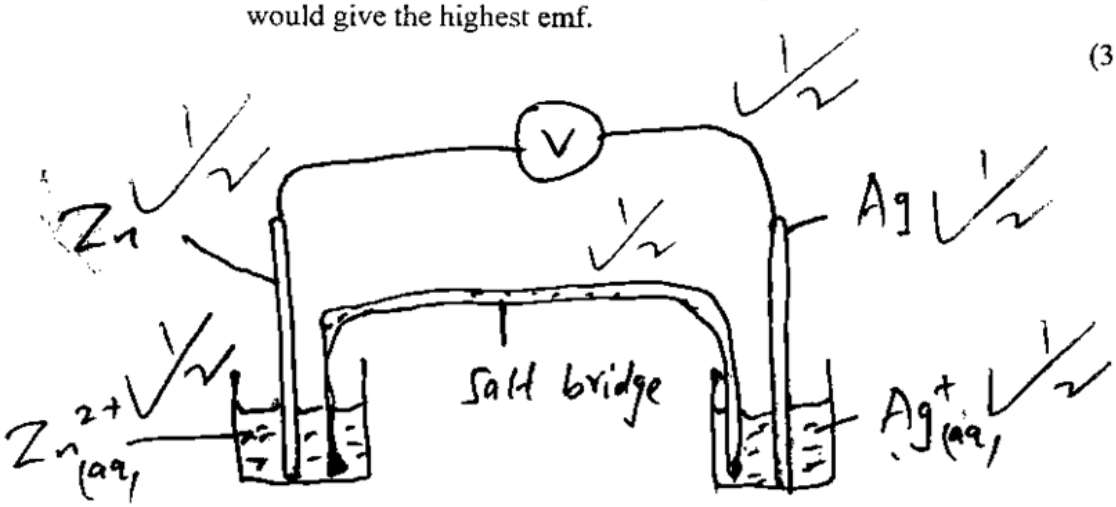
(i) Identify the strongest reducing agent (1 mark)

Zn ✓

(ii) Predict whether or not a solution of copper (II) nitrate can be stored in a container made of lead (2 marks)

lead container will lose electrons to ions of copper hence dissolve. Thus it not a possible. ✓ ✓

(iii) In the space provided, draw a labeled diagram of the electrochemical cell that would give the highest emf. (3 marks)




(iv) Calculate the $E^{\ominus}$ of the electrochemical cell constructed in (iii) above.(1 mark)

$0.80 - (-0.76) = +1.56\,V$ ✓ ✓

During the electrolysis of aqueous silver nitrate using silver electrodes, a current of 1.2 amperes was passed through the electrolytic cell for 6 hours and 50 minutes.

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

$Ag_{(s)} \longrightarrow Ag^{+}_{(aq)} + e$ ✓1

ii) Determine the change in mass at the anode which occurred as a result of the electrolysis process. (Ag=108 1 F = 96,500C) (3 marks)

$Q = 1.2 \times (6 \times 60 + 50) \times 60$ ✓✓

$= 29520$ ✓1

96,500C ⟶ 108

29520 ⟶ ?

$\frac{29520 \times 108}{96500}$ 1✓✓

$= 33.04$ ✓✓

(c) State **one** application of electrolysis other than extraction of metals (1 mark)

- Purification of metals ✓1
- Electroplating ✓1

5 (a) What is activation energy? (1 mark)

Minimum amount of energy that must be available to reactants for a chemical reaction to occur.

(b) Oxygen may be prepared in the laboratory by decomposition of hydrogen peroxide using a certain catalyst.

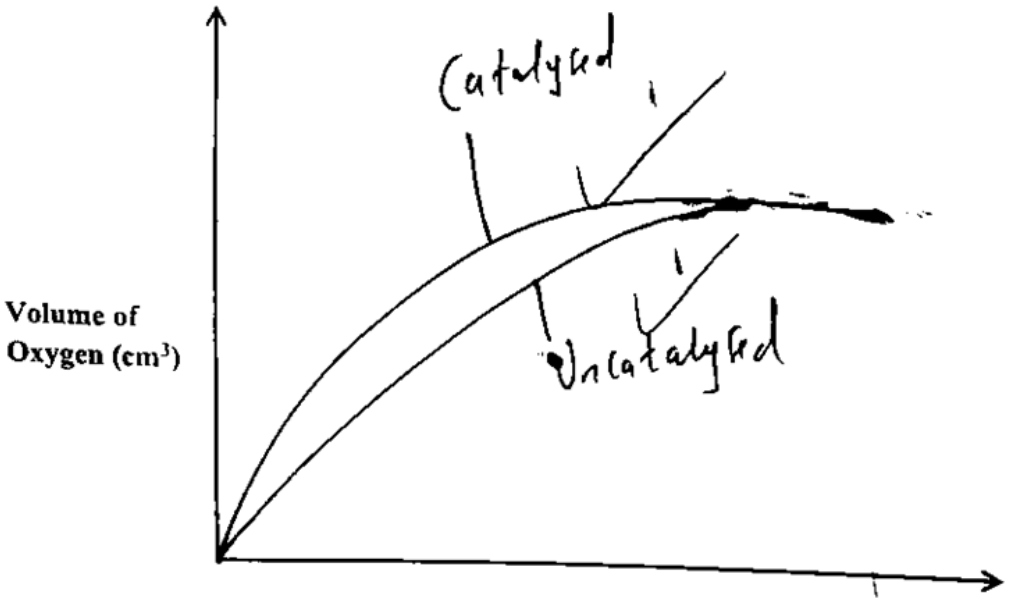
(i) Name the catalyst used; (1 mark)

Manganese (IV) oxide

(ii) State and explain the effect of the catalyst named in b (i) on the rate of production of oxygen. (1 mark)

increases rate of production of oxygen.

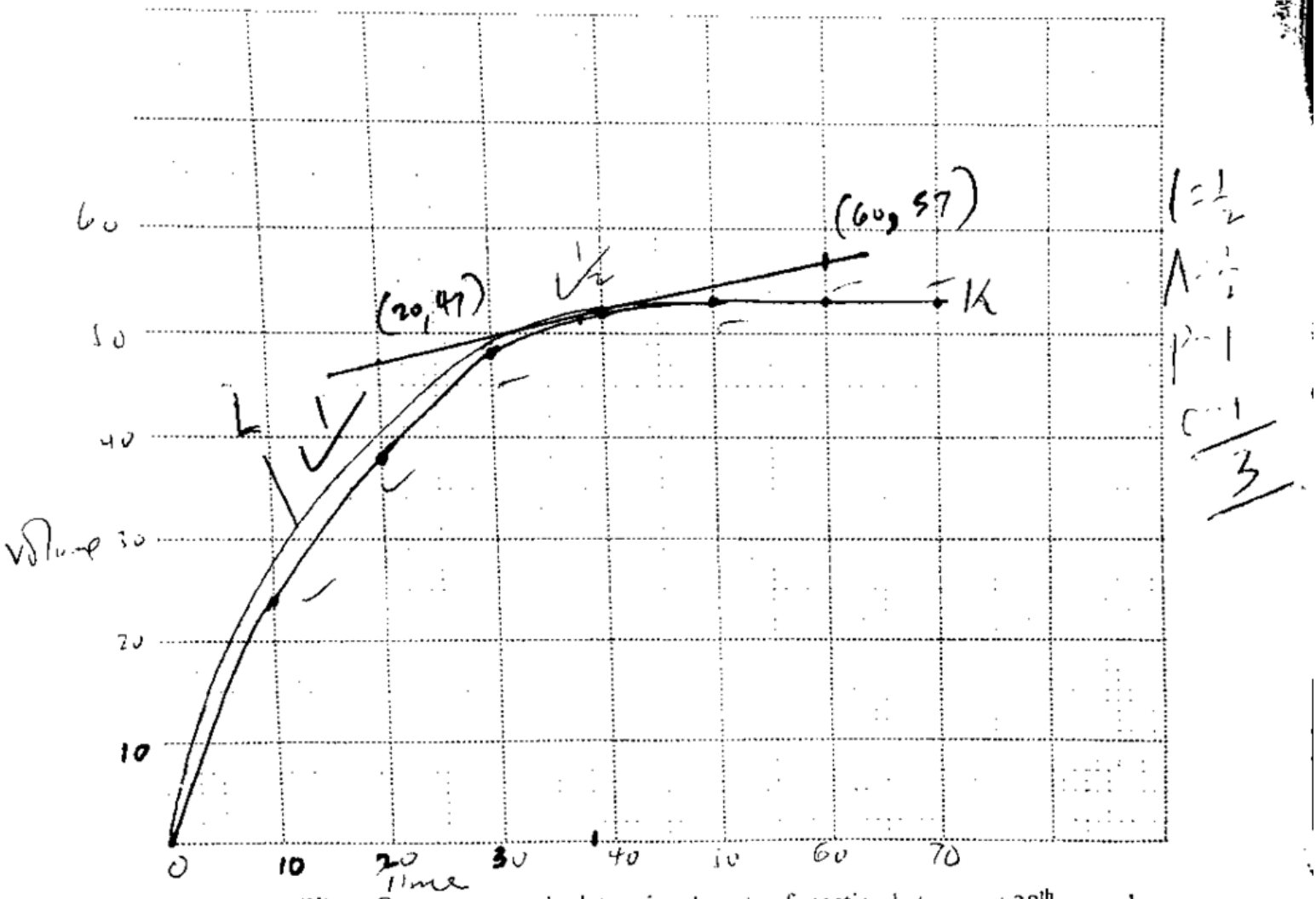
(iii) On the axes below sketch a graph of catalyzed and uncatalysed decomposition of hydrogen peroxide. Label the curves. (2 marks)



(c) 100 $cm^3$ of 0.5 M hydrochloric acid was reacted with a clean 20 millim[illegible] ribbon. The volume of hydrogen evolved was measured and recorded at 10 interval. The results were recorded as shown in the table below.

| volume of gas ( $cm^3$) | 0 | 24 | 38 | 48 | 52 | 53 | 53 | 53 |
|---|---|---|---|---|---|---|---|---|
| Time in seconds | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 |

(i) (I) On the grid provided, plot a graph of volume (vertical axis) against time. ←Label it as **K** (3 marks)




(II) From your graph, determine the rate of reaction between at 38th second. (2 marks)

$\frac{57-47}{60-20} = \frac{10}{40} = 0.25 cm^3 s^{-1}$ Showing 1 mark

(iii) On the same grid, sketch a curve that would be obtained if the same experiment was repeated using excess 0.8 M hydrochloric acid. Label it as **L**. (1 mark)

6. (a) (i) Name and give the formula of **two** ores from which copper is extracted.(2 mar

| | Ore | Formula |
|---|---|---|
| I. | Copper pyrites | $CuFeS_2$ |
| | Malachite | $CuCO_3 \cdot Cu(OH)_2$ |
| II. | Cuprite | $Cu_2O$ |
| | Chalcocite | $Cu_2S$ |

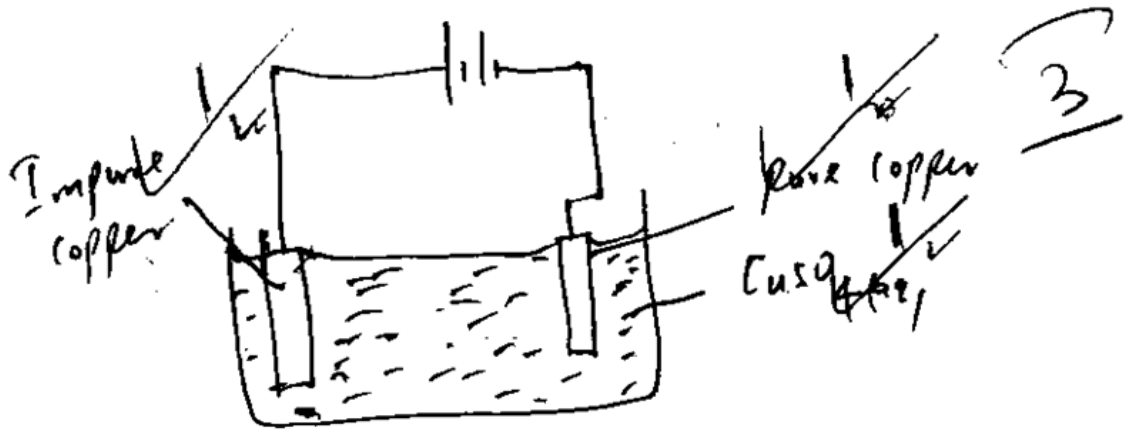
(ii) During extraction of copper, the ore is first crushed into fine powder and then concentrated by froth flotation. Why this is important? (1 mark)

Raises low copper concentrations which makes it economically viable to extract it.

(ii) One of the gases evolved during copper extraction is sulphur (IV) oxide. Give **two** ways of preventing the gas from escaping to the atmosphere. (2 marks)

- Scrubbing
- Fed in sulphuric(VI) acid plant / used in contact process.

(iii) Blister copper is impure copper which is about 97.5 % pure. To obtain pure copper from blister copper electrolysis is done. Draw a set up that can be used to purify copper. (3 marks)




3

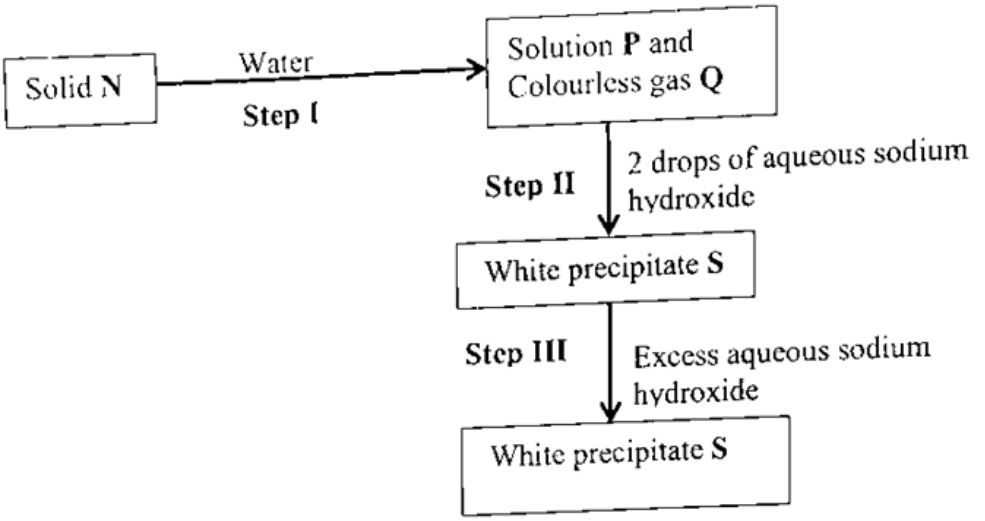
(iv) Give **two** uses of copper (2 marks)

- Heat exchangers
- making electrical wires
- In construction

(v) State **one** way in which the extraction of copper causes environmental pollution. (1 mark)

- land degradation
- Water pollution
- Human health risk

7 (a) Study the flow chart below and answer the questions that follow.




(i) Identify:

I solid N (1 mark)

Calcium, Ca

II Colourless gas Q (1 mark)

Hydrogen

(ii) Give the formula of white precipitate S (1 mark)

$Ca(OH)_2$

(iii) Write the ionic equation for the reaction in step II (1 mark)

$Ca^{2+}_{(aq)} + 2OH^- \longrightarrow Ca(OH)_{2(s)}$

(iv) Give **one** use of solution **P** (2 marks)

- Sewage treatment
- Paper production
- Food processing

(b) Calculate the number of nitrate ions present in 25.0 cm$^3$ of 0,80 M aluminium nitrate solution. ($L = 6.0 \times 10^{23}$) (3 marks)

$\frac{25.0 \times 0.8}{1000} = 0.02$

$0.02 \times 6.0 \times 10^{23} \times 3 = 2.6 \times 10^{22}$ $NO_3^-$

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