CHEMISTRY

CHEMISTRY | F4 P2 MKS

1. a) What is radioactivity? (1 mk)

Spotaneous distentigration of an unstable nuclide to form a stable nuclide.

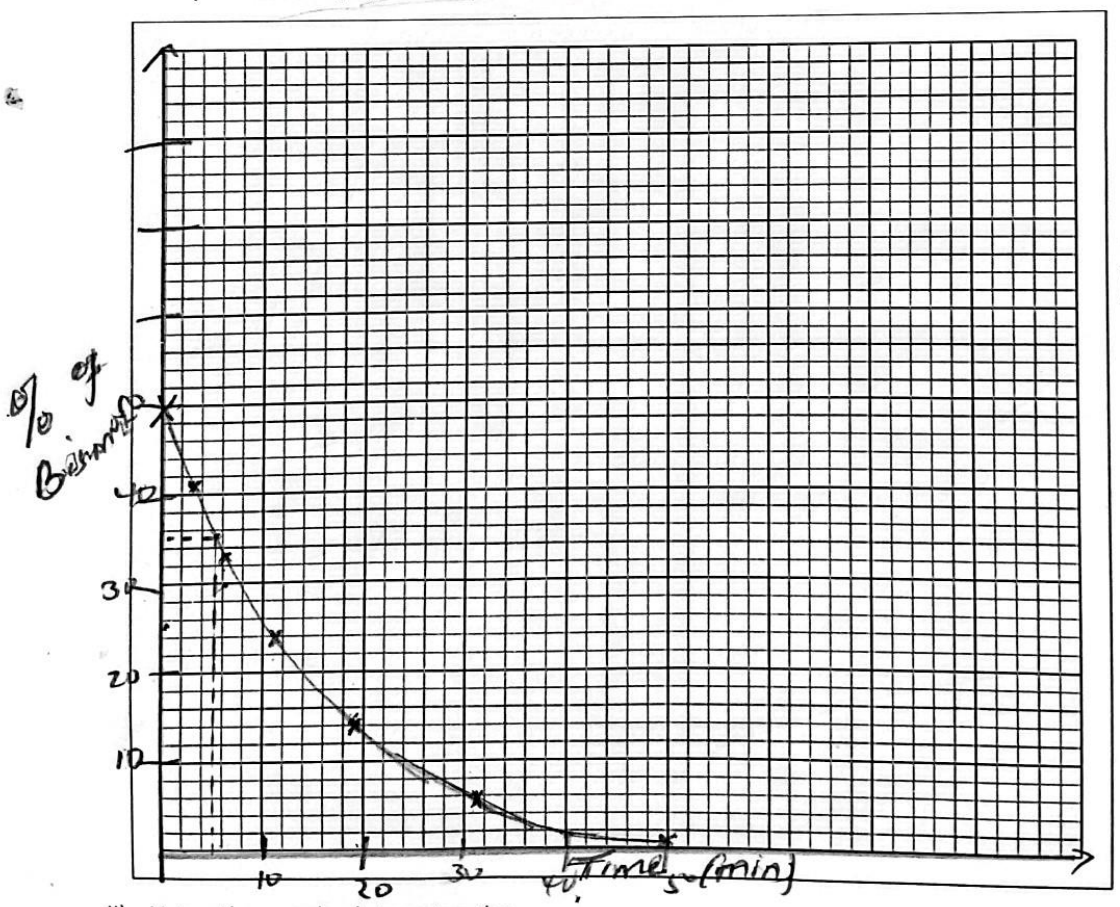
b) State two differences between chemical and nuclear reactions (2 mk)

Nuclear	Chemical
- Involves protons & electrons	Involves valence electron only
- Not affected by extena factors	- Affected by external factors

c) The table below give the percentages of a radioactive isotope of Bismuth that remains after decaying at different times.

Time (min)	0	3	6	11	19	31	50
Percentage of Bismuth	50	40.5	32.5	24	14.5	6	1.5

i) On the grid provided, plot a graph of the percentage of Bismuth remaining (Vertical axis) against time. (3 mk)



Scale = 1
Plotting 1
Curve 1

ii) Using the graph, determine the:

I. Half – life of the Bismuth isotope (1 mk)

Time when percentage is 50 = 0 1
Time when % is 25 = 10
10 - 0 = 10 mins
10 mins
1

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II. Original mass of the Bismuth isotope given that the mass that remained after 35 minutes was 0.08 g (2 mk)

At 35min ⇒ % = 5%
If 5% → 0.08g ½
100% → ?

100 x 0.08 / 5 = 1.6g ½ 1

d) Give one use of radioactive isotopes in the following fields:

i) Medicine – to destroy cancerous cells – Sterilization of surgical blades ✓1 (1 mk)
- Powering heart pace setter
- Monitor growth in bones and healing of fractures
- I_2 in goitre detection

ii) Agriculture (1 mk)
- Absorption of phosphate fertilizers ✓1
- Following the path of photosynthesis

iii) Food industry (1 mk)
- Preservation of food by exposing micro-organisms to gamma radiation ✓1
- Measuring the level of food in canned and packed food

2..a) The reduction potentials of Mg(s) | Mg2+(aq) and Zn(s) | Zn2+(aq) half-cells are:

$Mg^{2+}(aq) + 2e^- \rightleftharpoons Mg(s)$ $E\theta = -2.37V$

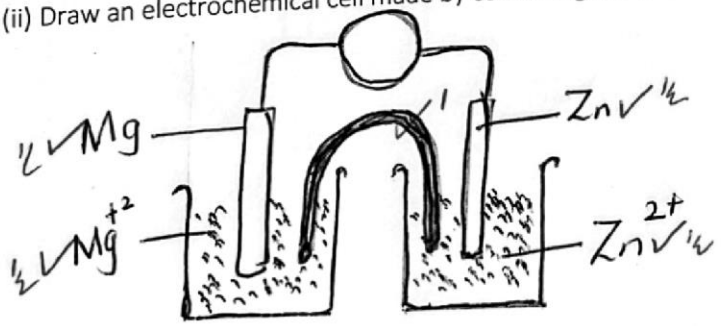
$Zn^{2+}(aq) + 2e^- \rightleftharpoons Zn(s)$ $E\theta = -0.76\ V$

Using the electrode potentials, answer the following questions.

(i) Write an ionic equation for a cell made by combining the two half cells. (1mk)

−0.76 − −2.37 = 1.61 V

(ii) Draw an electrochemical cell made by combining the two half cells above . (3mk)



Deny 1mk for workability.

b) Use the cell representation below to answer the question that follows

Cu(s) | Cu2+(aq) | | Ag+(aq) | | Ag(s) $E\theta cell = +0.46\ V$

Given that the E value for Ag+(aq) | Ag(s) is + 0.80 V, calculate the Eθ value for Cu(s) | Cu2+(aq).. (2mk)

$E_{reduced} - E_{oxidized} = E.M.F$

Ag − Cu = E.M.F

+0.80 − x = +0.46 ✓1

+0.80 − 0.46 = x

x = +0.34V ✓1

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c) In an experiment to electrolyse copper (II) sulphate solution using copper electrodes, 0.2 amperes were passed through the solution for 23 hours. Calculate the mass of copper deposited at cathode. (1 Faraday = 96,500 coulombs, Cu = 64). (3mk)

Mass deposited = $\frac{QRAM}{Fc}$

$\frac{0.2 \times 23 \times 60 \times 60 \times 64}{96500 \times 2}$

$= 5.49g$

$Q = IT$

$0.2 \times 23 \times 60 \times 60$

OR $16560C$

$Cu^{+2} + 2e \rightarrow Cu$

2 moles $\rightarrow$ 64g

2 moles $- 2F \rightarrow 64g$

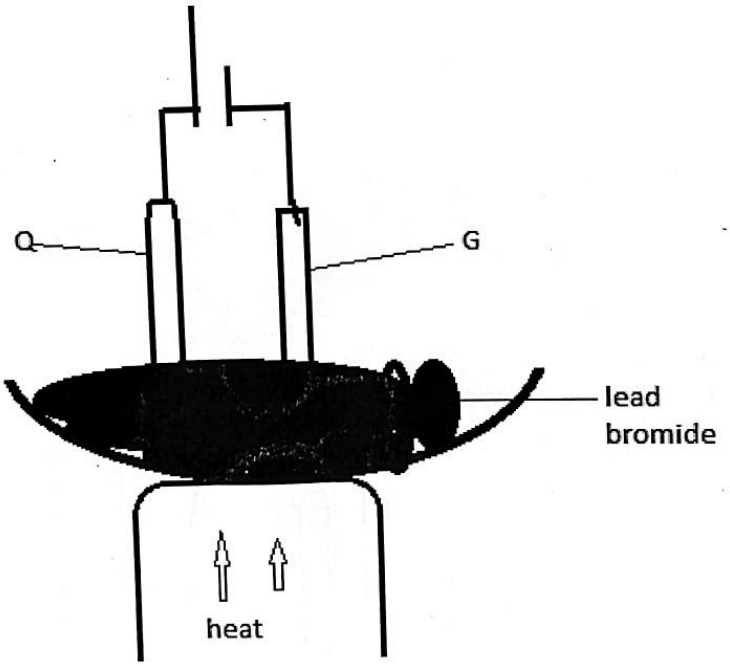
$\therefore 96500 \times 2 \rightarrow 64$

$16560 \rightarrow ?$

$\frac{16560 \times 64}{193000}$

$= 5.49g$

d)The set-up below was used to electrolyse a bromide of lead. Study it and answer the questions that follow.



(i) Write the equation for the reaction at electrode G (1 mk)

$Pb^{+2}_{(l)} + 2e \rightarrow Pb_{(s)}$

(ii)State the observation made at electrode Q (1 mk)

Brown fumes

3

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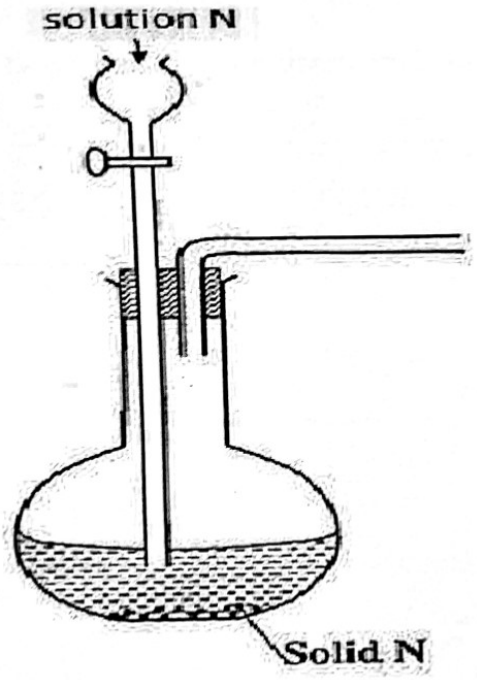
- Sacrificial / Cathodic protection

e) List any two applications of electrolysis. - Electroplating ✓1 (1mk)
- Purification of metals
- Extraction of reactive metals

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



a i) Complete the table below giving the names of ~~substance~~ Solution M and solid N if the gasses generated are chlorine and sulphur (IV) oxide. (2 marks)

~~Substance~~ Solution	Chlorine	Sulphur (IV) Oxide
~~Substance~~ M	Conc. HCl ✓	dil HCl / H_2SO_4 ✓1
Solid N	MnO_2, PbO_2 ✓1	Na_2SO_3 ✓1

(ii) Complete the diagram above to show how a dry sample of chlorine gas can be collected (3mk)

Downward delivery ✓B1
Drying agent - Conc. H_2SO_4 / An. $CaCl_2$ ✓1
Workability - 1

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(b) Write balanced chemical equation to show how chlorine with cold and dilute sodium hydroxide. (1mk)

$NaOH_{(aq)} + Cl_{2(g)} \rightarrow NaCl_{(aq)} + NaOCl_{(aq)} + H_2O_{(l)}$

(c) $600cm^3$ of dry chlorine gas were passed over excess heated iron powder in a combustion tube until no further change.

i) State the observations made in the combustion tube. (1mk)

Grey Iron turned brown/yellow.

ii) Calculate the mass of the product formed. ($MGV = 24dm^3$, Cl=35.5, Fe= 56) (3mk)

$2Fe + 3Cl_2 \rightarrow 2FeCl_3$

(s) (g) (s)

Moles of Cl_2

$\frac{600}{24000} = 0.025$ moles

Moles of $FeCl_3$

3 : 2

0.025 : ?

$\frac{0.025 \times 2}{3} = 0.01667$

Mass of $FeCl_3$

$= 0.01667 \times 162.5$

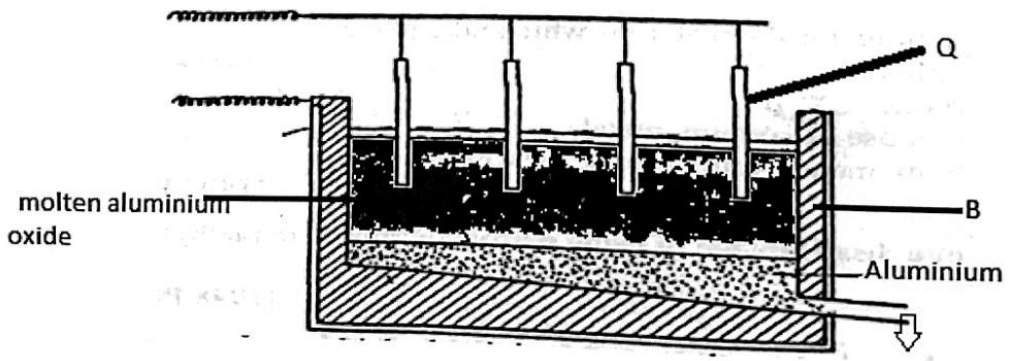
$= 2.70879g$

d) A soil sample was suspected to contain chloride ions. Describe a simple experiment that can used to confirm the presence of the chloride ions. (3mk)

- Add water to the sample
- Add dilute silver nitrate soln followed by dilute HNO_3
- A white ppt insoluble in acid is formed

Or Add water
Add acidified $Pb(NO_3)_2$ and warm. A white ppt that dissolves on warming.

4. The extraction of aluminium from it s ore takes place in two stages, purification stage and electrolysis stage. The diagram below shows the set – up for the electrolysis stage.



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a)i)Name the ore from which aluminium extracted. (1mk)

Bauxite.

ii) Outline the stages involved in the purification stage, which is removed at the purification stage.(2mk)

- Crush, heat to remove water of crystallization and $Al(OH)_3$ 3
- Add hot conc. NaOH to dissolve SiO_2
- Filter to remove Fe_2O_3
- Bubble CO_2 to ppt $Al(OH)_3$ - Heat $Al(OH)_3$)

(1mk)

b)i)Identify the electrode labelled B

Cathode ✓1

ii)The melting point of aluminium oxide is 2054°C, but electrolysis is carried out between 800 – 900°C.What is done to lower the temperatures? (1mk)

Cryolite ✓1

iii) The aluminium which is produced is tapped off as liquid. what does this suggest about its melting point? (1mk)

It's lower than the temp. in the cell ✓1

iv) What makes it possible to tap aluminium from the lower side (1mk)

It has a lower density than Al_2O_3 ✓1

v) Write the half-cell equation for the reaction taking place at electrode Q (1mk)

$2O^{-2}_{(l)} \longrightarrow O_{2(g)} + 2e$ ✓1

vi) State two reasons that makes aluminium to be used to make cooking utensils. (1mk)

- good conductor of heat. ✓1
- Not easily corroded by cooking liquids CO_3 of Al_2O_3 layer. ✓1

vii) Why cant aluminium be extracted through reduction method. (1mk)

It's more reactive than C ✓1

5. a) Explain why a solution of hydrogen chloride gas in methylbenzene was do not change a blue litmus (1 mk)

It remains in molecular state in methylbenzene hence no ions. ✓1

b) Compare the electrical conductivity of solution J with pH 6 and L pH 2. (2 mk)

L is a better conductor because being a strong acid fully ionizes producing Many H^+ ions.

c)Name the process that takes place when:

i) Sulphur is heated with natural rubber. ..... Vulcanization ✓1 (1 mk)

ii) Fats or oils are hydrolyzed using an alkali. ..... Saponification ✓1 (1 mk)

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d) i)Oxygen is obtained by fractional distillation of liquid air. Name two other gases which are obtained from this process during distillation.(1 mk).

- Nitrogen, Argon 1

ii) Give two industrial uses of oxygen gas. (1mk) 1 - As a reactant in fuel cells

- Steel making
- Welding & cutting of metals

e) Describe the procedure used to obtain oil from groundnuts. (3mk)

- Crush using a pestle and a mortar.
- Add propanone/ethanol
- Decant/filter
- Decant

- place in the 3 tin for propanone to evaporate

6. The following is an extract of the periodic table. Study it and answer the questions that follow. (the letters do not represent the actual symbols of the elements.)

N								
						R	X	
	G			T				F
	W						V	
L								

a) In which other group can N be placed and why ? (1mk)

VIIA Can gain 1e to become stable.

b)i) Write the formulae of the compound formed when elements X and W reacts. (1mk)

W X
2 X 1

WX_2 | CaF_2 1

ii) Comment on the electrical conductivity of the compound formed above. (2mk)

Conducts only in molten or aqueous state but not in solid state 1

c) Choose;

i) The most unreactive element (1mk)

F 1

ii) The strongest reducing agent. (1mk)

- L 1

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d) State the nature of each of the following;

i) The chloride of W (1mk)

- Neutral ✓1

ii) The oxide of T (1mk)

Acidic ✓1

e) What name is given to the group of elements where G and W belongs? (1mk)

Alkaline earth metals ✓1 3

f) Use letter B to show the ~~presence~~ position of an element that ~~an~~ forms a divalent anion with ~~two~~ energy levels. (1mk)

divalent = 2
Anion -
Therefore 2, 8, 6 ✓1
G ✓1
Period 3 ✓1

g) Describe how a pure and solid sample of lead ii chloride can be separated from its solid mixture with the chloride of G. (3mk) 2

($MgCl_2$ and $PbCl_2$) Add cold water ✓1
$MgCl_2$ dissolves while $PbCl_2$ will not.
Filter ✓1
Rinse & dry ✓1 btn filter papers.

7. a) List any two physical tests for water. (1mk)

- Freezes at 0°C at sea level ✓1
- B.P 100°C at sea level. Any one
- Density of 1g/cm³

b) A student wanted to prepare hydrogen gas in the lab. He reacted dilute hydrochloric acid with copper metal but no gas was collected.

i) Explain this observation. (1mk) 1

- Copper is less reactive than H/is below H in the reactivity series ✓1 and therefore can not displace H from an acid ✓1

ii) What adjustments would have been made in order to collect the gas. (1mk)

- Use Mg or Zn metal. ✓1

c) Metal E reacts with steam but not with cold water, metal M do not react with dilute acids, metal D reacts with cold water vigorously while metal S reduces the oxide of D. arrange the metals starting with the most reactive. (2mk)

SDEM ✓2

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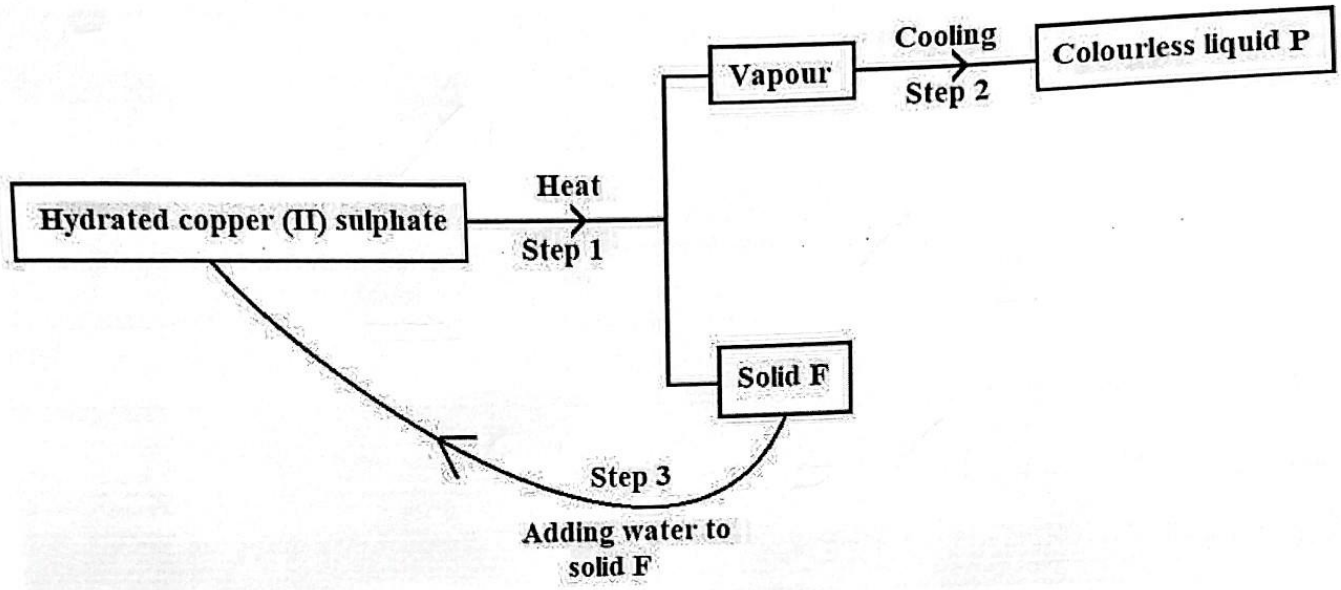
d) 10. Study the flow chart below and answer the questions that follow



i)Classify the change in step 1 (1 mk)

Temporary Chemical Change ✓1

ii)Name another substance that undergoes a similar change as hydrated copper (II) sulphate when heated. (1 mark)

Hydrated Cobalt (II) Chloride ✓1

e)i) Explain why hydrogen is not commonly used as a fuel (1mk)

- It's very expensive, Any 1
- It explodes upon ignition

ii) Apart from rocket fuel, list any other two uses of hydrogen gas (1mk)

- Manufacture of HCl
- " " NH_3 ✓Any 1
- Hydrogenation of oils to fats

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