NAME: Marking guide ..... CLASS: ..... ADM: .....

SIGNATURE: ..... INDEX NO: ..... DATE: .....

233/2
CHEMISTRY
Time: 2 Hours

MOKASA II EXAMINATIONS JULY 2024

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 **11 printed** pages containing 7 questions.*
- *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	11	
3	14	
4	11	
5	13	
6	11	
7	9	
TOTALS	80	

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

K									W
				E			Q		
H	P		S	T	G	Y	Z	J	
	B						V		
A									

i. Select an element with the highest ionization energy. Explain (1mark)

W. Smallest atomic radius thus stronger nuclear force of attraction.

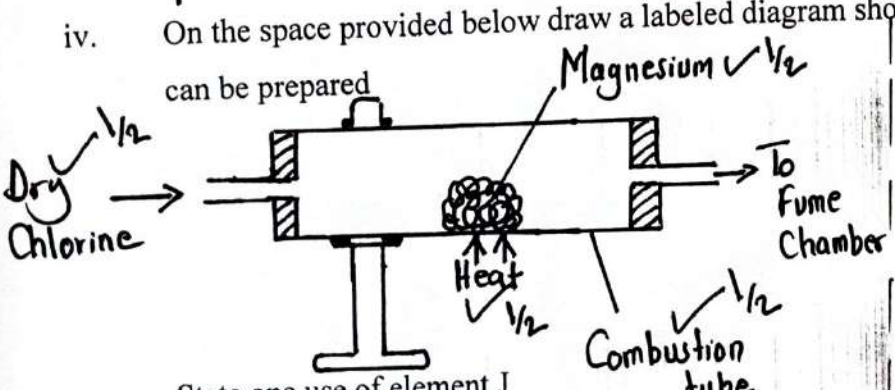
ii. Compare the ionic radius of G and Y. Explain (2marks)

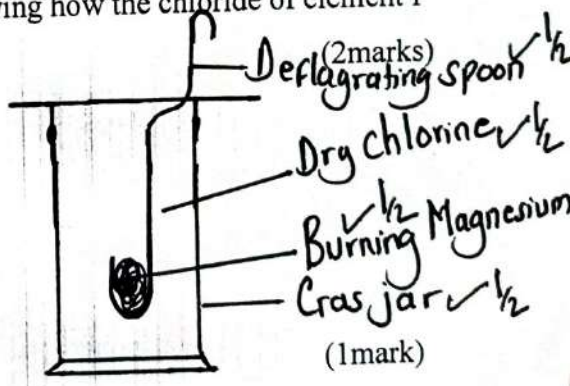
Ionic radius of G is larger than the ionic radius of Y. G gains more electrons than Y thus higher electron electron repulsive forces.

iii. In terms of structure and bonding compare the melting point of the oxides of E and T (3marks)

Oxide of T has higher M.P than the oxide of E. Oxide of T has giant atomic structure with strong covalent bonds, oxide of E has simple molecular structure with weak vandelwaal forces.

iv. On the space provided below draw a labeled diagram showing how the chloride of element P can be prepared (2marks)





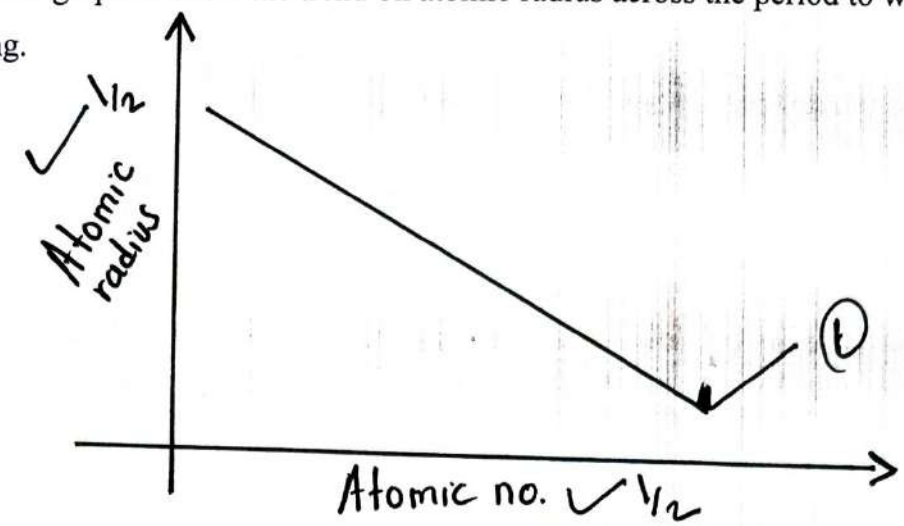
v. State one use of element J (1mark)

Accept one correct

vi. From the grid above select the most electropositive element (½mark)

A

vii. Sketch a graph to show the trend on atomic radius across the period to which element H and P belong. (2marks)



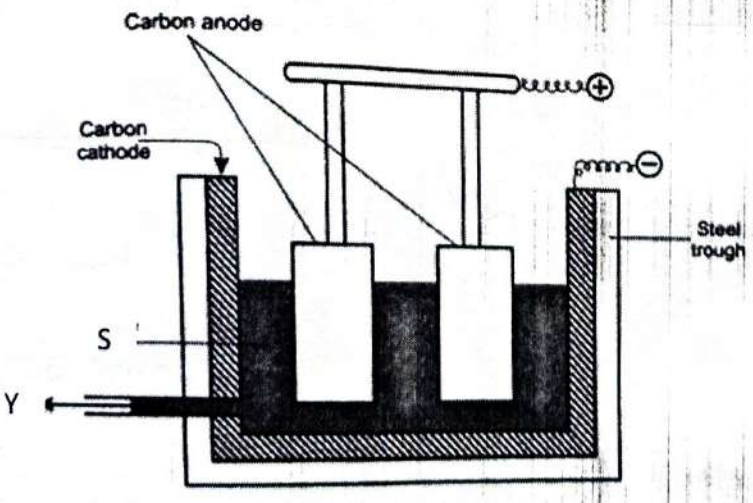
2. a) A piece of unpolished aluminium foil is not attacked by water or steam. Explain why this is so.(1mark)

Due to unreactive oxide layer

b) Zubeida a form four student at Joburg high school collected a piece of rock in the school compound .The rock was suspected to contain aluminium. Explain how Zubeida can confirm the presence of aluminium in the ore. (3marks)

Crush the rock and add dilute nitric(v) acid. filter to remove the unreacted substances. Divide the resulting solution into three equal portions. To the first portion add few drops of NH_3(aq) excess white ppt insoluble indicates Al^{3+}, Pb^{2+}, Mg^{2+}. To the 2nd portion add few drops of NaOH untill excess, white ppt soluble indicates, Al^{3+} and Pb^{2+}. To the 3rd portion add Na_2SO_4, HCl, NaCl, No white ppt indicates Al^{3+} present

c) The diagram below illustrates the hall's cell for extraction of aluminium .Study it and answer the questions that follow.



i. Name the ore from which aluminium is extracted (½mark)

Bauxite

ii. Name substances S and Y (1mark)

S Molten aluminium oxide (Molten alumina) ✓½

Y Molten aluminium ✓½

iii. The melting point of alumina is 2015°c yet the electrolysis process is carried out at 800°c.

Explain how this is achieved. (1mark)

Cryolite ✓½ is added ✓½ which lowers the m.p.

iv. Write the overall equation that takes place in the hall's cell during electrolysis. (1mark)

$4Al^{3+}_{(l)} + 6O^{2-}_{(l)} \rightarrow 4Al_{(l)} + 3O_{2(g)}$ ✓1

v. Duralumin is an alloy of aluminium and magnesium. State two reasons why it is mostly preferred in construction of aeroplane body parts. (2marks)

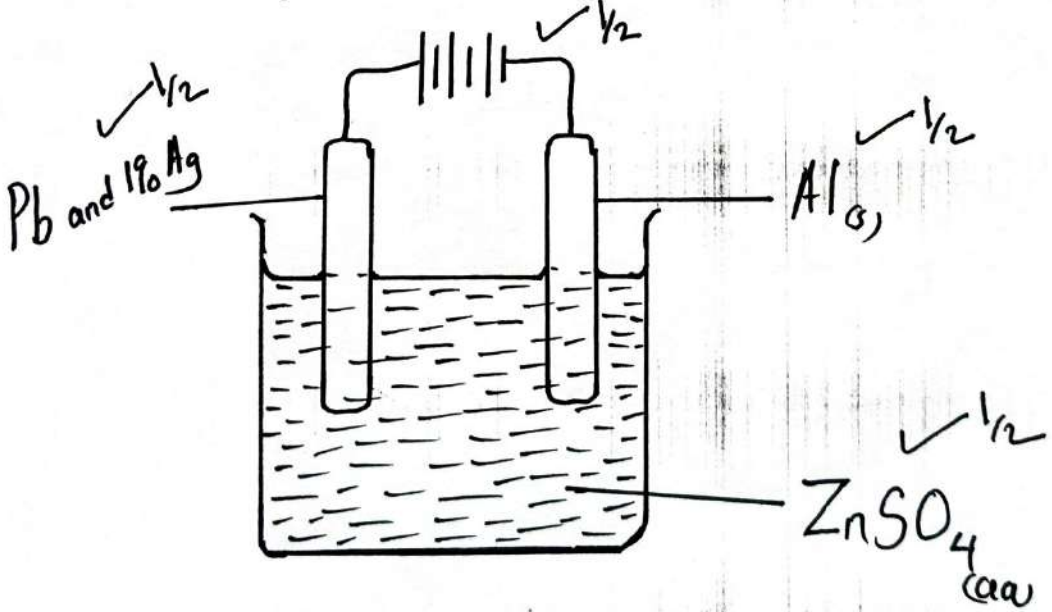
It is unreactive ✓½

It is lighter // low density ✓½

vi. State two uses of aluminium. (1mark)

Accept any correct ½ for one correct.

3. a) Draw a well labelled diagram to show how zinc metal is extracted by electrolysis. (2marks)



b) Use the standard electrode potentials given below to answer the questions that follows

Reaction	$E^{o}(V)$
$MnO^{-}_{4\,(aq)} + 8H^{+}_{(aq)} + 5e^{-} \longrightarrow Mn^{2+}_{(aq)} + 4H_2O_{(l)}$	+1.44
$M^{3+}_{(aq)} + e^{-} \longrightarrow M^{2+}_{(aq)}$	+077
$A^{2+}_{(aq)} + 2e^{-} \longrightarrow A_{(s)}$	+0.34
$P^{2+}_{(aq)} + 2e^{-} \longrightarrow P_{(s)}$	-0.23
$T_{2(g)} + 2e^{-} \longrightarrow 2T^{-}_{(aq)}$	+2.86

i. State whether acidified $MnO^{-}_{4\,(aq)}$ can oxidise M^{2+}. Give a reason for your answer. (2marks)

It can oxidise. The emf for the overall cell is positive.

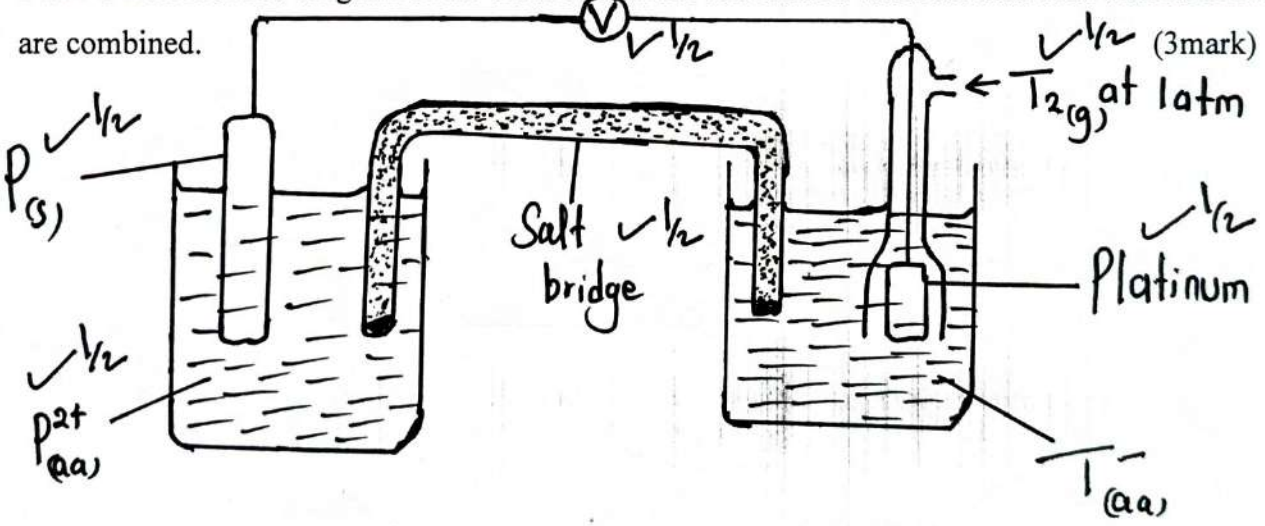
ii. Write the e.m.f of the half-cell of A if P was used as a reference electrode. Show working. (1mark)

+0.34 + 0.23 = +0.57V

iii. Select two half cells which would produce the highest e.m.f when combined (1mark)

Half cell of P and T_2 // $P^{2+}_{(aq)} + 2e^{-} \rightarrow P_{(s)}$ and $T_{2(g)} + 2e^{-} \rightarrow 2T^{-}_{(aq)}$

iv. Draw a well labelled diagram of the electrochemical cell formed when the half cells named above are combined. (3mark)



v. Calculate the e.m.f of the electrochemical cell above. (2marks)

+2.86 + 0.23 = +3.09V

vi. An alloy containing iron was dissolved in an acid and the total volume made up to $250cm^3$. $25cm^3$ of tis solution required $18.0cm^3$ of 0.15M acidified potassium dichromate VI to react with completely as shown $Cr_2O^{2-}_{7\,(aq)} + 14H^+_{(aq)} + 6Fe^{2+} \longrightarrow 2Cr^{3+}_{(aq)} + 6Fe^{3+} + 7H_2O_{(l)}$

Calculate the mass of iron in the alloy. (Fe=56) (3marks)

0.15moles → 1000cm³
? → 18cm³

$\frac{18 \times 0.15}{1000} = 0.0027$moles ✓½ ✓½

Ratio 1:6

$6 \times 0.0027 = 0.0162$moles ✓½

0.0162mole → 25cm³
? → 250cm³

$\frac{250 \times 0.016}{25} = 0.162$moles ✓½ ✓½

$0.162 \times 56 = 9.072g$ ✓½

4. a). When a mixture of concentrated sulphuric (VI) acid and copper turnings is strongly heated, a colourless gas and a solid mixture of white and black solids are formed. When the solid mixture is treated with distilled water and filtered a blue filtrate and a black residue are obtained. Explain the observation on the solid mixture formed in the above experiment. (3marks)

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Conc H_2SO_4 oxidises Cu metal to black CuO solid, $SO_{2(g)}$ and water. The CuO reacts with excess conc H_2SO_4 to form $CuSO_4$ which is dehydrated by conc H_2SO_4 to white unhydrous $CuSO_4$ solid. $CuSO_4$ dissolves in the distilled water to form blue solution of Copper(II) sulphate.

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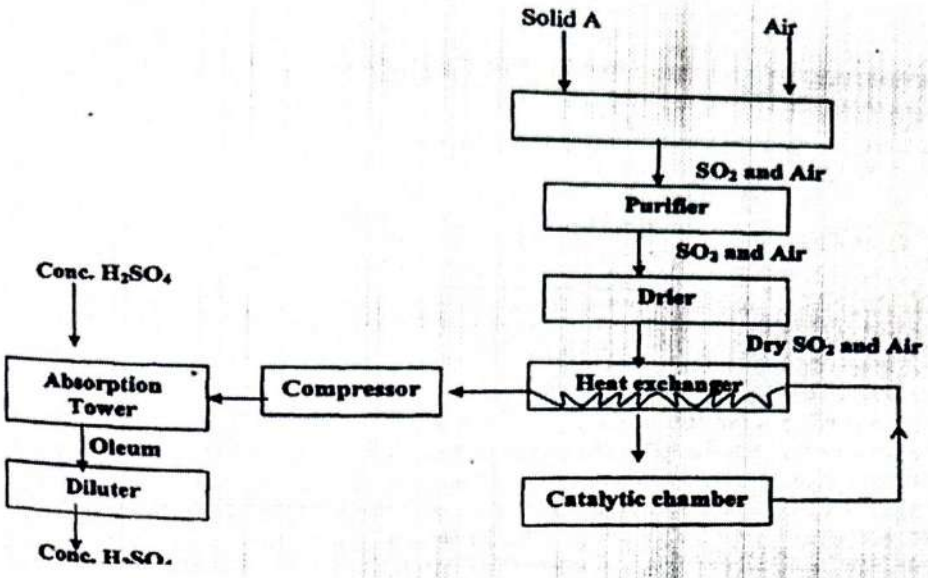
b). Study the flow chart below and answer the questions that follows.



i. Besides sulphur name two possible identities of solid A (1mark)

- Lead (II) Sulphide (Galena) - Iron (II) Sulphide 2 x ½
- Zinc Sulphide (Zinc blende) - Copper pyrite

ii. Explain why it is important to remove the impurities in the above process (1mark)

To prevent poisoning of the catalyst.

iii. Explain why in the above process sulphur (VI) oxide gas is not directly dissolved in water to form sulphuric (VI) acid but instead dissolved in concentrated sulphuric (VI) acid (2marks)

Dissolving SO_3 in water produces a lot of heat which boils the acid to form mist droplets of the acid making the reaction dangerous.

iv. Write the chemical equation that takes place in the catalytic chamber. (1mark)

$2SO_{2(g)} + O_{2(g)} \longrightarrow 2SO_{3(g)}$

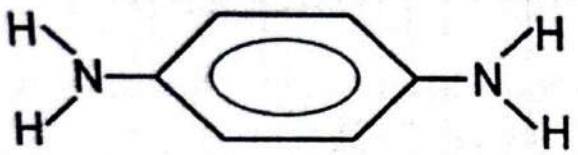
v. State two conditions for the reaction in iv above to take place (2marks)

Pressure of 2-3 atm Vanadium (V) oxide / Platinum catalyst.
Temperature 450 - 500°C

vi. Give a reason why the above process is called the contact process (1mark)

Reaction in catalytic chamber involves reactants reacting on the surface of the catalyst.

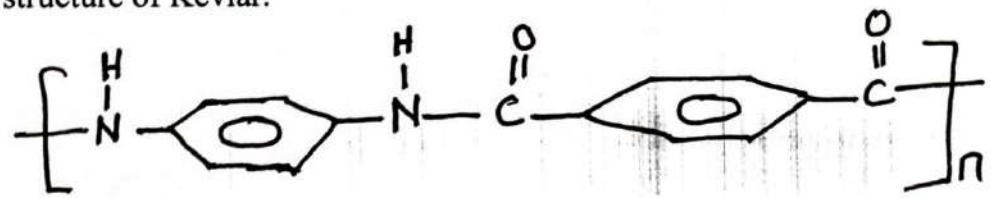
5. Kevlar is a polyamide which is made from two different monomers whose structures are shown below



Benzene-1,4-diamine

Benzene-1,4-dicarboxylic acid

a. Draw the structure of Kevlar. (1mark)



b. State one disadvantages of continued use of Kevlar (1mark)

Non-biodegradable thus pollute the environment.

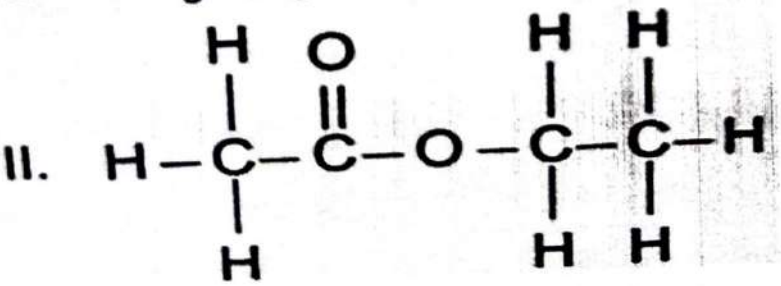
c. Kevlar is used to make body suits for superbike riders due to being tough and friction less. Name one other application it is popular for. (1mark)

Manufacture of gloves, Manufacture of bulletproof jackets (1x1) Accept one correct.

d. Give the names of the molecules shown below (2marks)

I. CH_3CH_2COOH

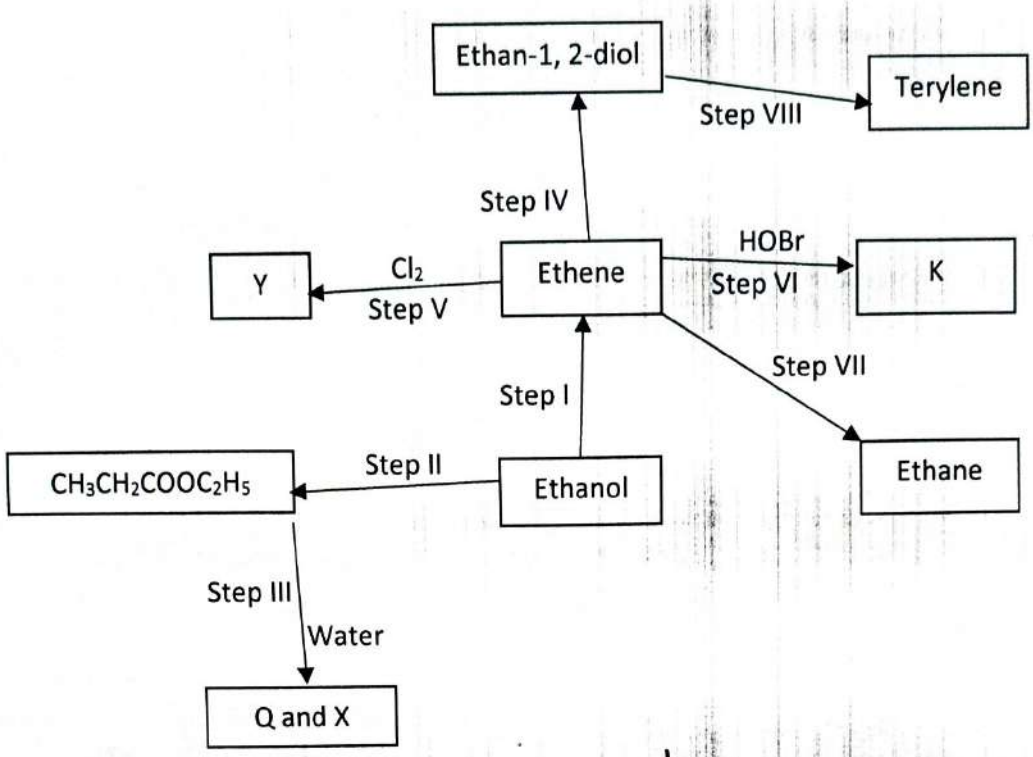
II.



I. Propanoic acid

II. Ethylethanoate

e. Study the reaction scheme below and answer the questions that follows.



i. Name substances K and Y (2marks)

K.. 2-bromoethanol // bromoethan-2-ol // 1-bromoethan-2-ol ✓1

Y... 1,2-dichloroethane ✓1

ii. Write the chemical equation for the reaction in step VI (1mark)

$CH_2CH_2 + HOBr \longrightarrow CH_2BrCH_2OH$ ✓1 Accept structural

iii. Name the reagent and two conditions for step VII (3marks)

Reagent.... Hydrogen gas ✓1

Conditions..... Temp 150 - 250°C ✓1

Nickel catalyst ✓1

iv. Name the process that takes place in: (2marks)

a. Step III..... Acidic hydrolysis ✓1

b. Step VIII.... Condensation polymerization ✓1

6. a. After 112 days 1/16 of the mass of R remained, Determine the half-life of R (3marks)

$1 \xrightarrow{1^{st}} 1/2 \xrightarrow{2^{nd}} 1/4 \xrightarrow{3^{rd}} 1/8 \xrightarrow{4^{th}} 1/16$

$\frac{112}{4} = 28 \text{ days}$

$1/16 = 1(1/2)^{\frac{112}{t}}$

$\log 1/16 = \frac{112}{t} \log 1/2$

$\frac{112}{t} = \frac{\log 1/16}{\log 1/2}$

$\frac{112}{t} = 4$

$t = 28 \text{ days}$

b. (i) State **two** ways in which nuclear reactions differ from ordinary chemical reactions (2marks)

Nuclear reaction produce large amount of energy while chemical reaction produce less energy. ✓0

Nuclear reaction involves Protons and neutron while chemical reaction involve electrons ✓1

(1X2)

(ii) The following is a part of Uranium decay series

$$^{238}_{92}U \xrightarrow{\text{Step I}} {}^{234}_{90}Th \xrightarrow{\text{Step II}} {}^{234}_{91}Pa \xrightarrow{\text{Step III}} {}^{Z}_{A}X$$

(iii) Which particles are emitted in **step I** and **II** (1mark)

Step I alpha, α step II beta (β)

(iv) If a beta particle is emitted in **step III,** find the values of **Z** and **A** (2marks)

$234 = Z + 0$

$Z = 234$

$91 = A + -1$

$91 + 1 = A$

$A = 92$

(v) State two factors that determine the stability of an isotope (1mark)

Proton to neutron ratio

Total number of protons and neutrons

(vi) State one application of radioactivity in each following fields: (2marks)

a. Tracers ....To detect leaks in underground water, oils and gas pipes

b. Paper industries. Monitor and control thickness of a paper.....

7. A) Chemical reaction occur as a result of collision of particles. Give a reason why not all collisions are effective (1mark)

Lack of minimum activation energy ✓½

Lack of proper orientation ✓½

B) State and explain how the following factors affect the rate of a chemical reaction (4marks)

Pressure. Increase in pressure reduces ✓½ the distance between the reacting particles thus leading to fruitful ✓ collision thus increase ✓½ in rate of reaction

Temperature. Increase in temperature increase ✓ the kinetic energy ✓½ of the reacting particles thus leading to fruitful ✓ collision hence increase in the rate of reaction. ✓½

C) Bismuth chloride reacts with water according to the equation below.

$$BiCl_{3\,(aq)} + H_2O_{(l)} \rightleftharpoons BiOCl_{(s)} + 2HCl_{(aq)}$$

(Colourless) (White)

i. State and explain the observation made when a few drops potassium hydroxide are added to the system at equilibrium. (2marks)

Amount of the white ppt increases. KOH reacts with HCl hence favouring forward reaction

D) Define the Lechatelier's principle (1mark)

When a change in condition is applied to a system at equilibrium, the system shifts to oppose the change

E) State one industrial application of dynamic equilibrium (1mark)

Applied in Haber process to form ammonia

" " Contact to form Sulphur(VI) oxide