KCSE CHEMISTRY REPLICA SERIES 2022

SEPTEMBER-DECEMBER 2022.

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KCSE REPLICA TRIAL

EXAMS 1-10

PAPER 1 AND 2

FOR MS

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KCSE REPLICA 1
PAPER 1

1. State two laboratory rules that should be followed to avoid contamination and wastage of chemicals. (2 marks)

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2. Describe one method used to distinguish between sodium sulphate and sodium sulphite. (2 marks)

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3. A gaseous compound consists of 86% carbon and 14% hydrogen by mass. At s.t.p 3.2 dm^3 of the compound has a mass of 6 grams. Calculate:

   a) its empirical formulae (C=12,H=1, MGV=at stp 22.4dm^3 (2 marks)

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   b) its molecular formulae (2 marks)

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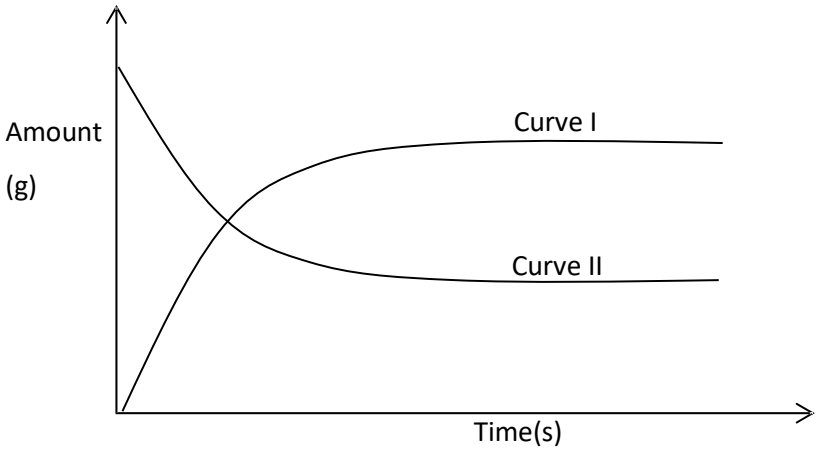
4. The graph below shows amount of calcium carbonate and calcium chloride varying with time in the reaction.

   $CaCO_3 + 2\ HCl \longrightarrow CaCl_2 + H_20 + CO_2$



   a) Which curve shows amount of calcium chloride varying with time (1 mark)

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   b) Explain why the two curves become horizontal after given period of time (1 mark)

   ……
   ……

c) Sketch on graph curve II would appear if the experiment was repeated using more dilute hydrochloric acid solution (1 mark)

5. The thermal chemical equation for the reaction between X and Y are shown below.

$2X_{2\,(g)} + Y_{2(g)} \longrightarrow 2X_2Y_{(g)} \quad \Delta H = -197KJ/mol$

a) Other than change in temperature, suggest two ways in which yield of X_2Y can be increased (1 mark)

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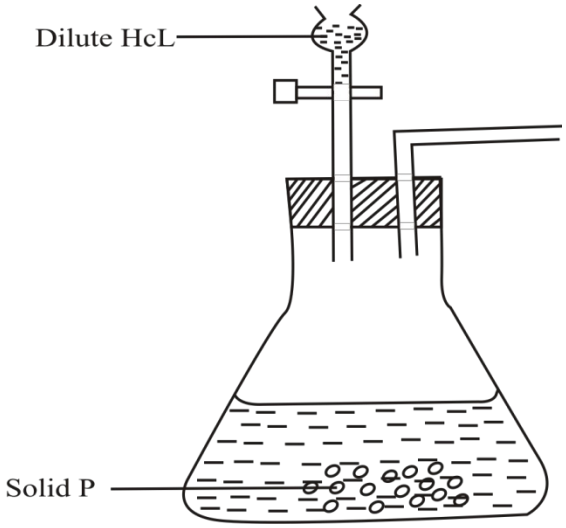
b) draw a well labeled energy level diagram for the forward reaction (2 marks)

6. The diagram below was used by a form two student at Kimuchul secondary school to prepare and collect dry carbon IV oxide.



a) Name suitable solid p (1 mark)

……

b) Complete the diagram above (3 marks)

7. The melting point of Nitrogen is -196^0c while that of sodium is 98^0 c. In terms of structure and bonding explain the difference in the melting point of Nitrogen and sodium (2 marks)

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8. The following tests were carried out on three separate portion of colourless solution P.

TEST	OBSERVATION

i)Addition of dilute hydrochloric acid to the first portion of solution P	Formation of effervescence
ii)Addition of aqueous potassium sulphate solution to the second portion of solution P	No white precipitate
iii)Addition of acqueous sodium hydroxide to the third portion to portion of solution P till in excess	White precipitate formed which dissolved in excess to form colorless solution

a) From information in test(i),name two anions that are likely to be present in solution P (1 mark)

……

b) Identify cations that are likely to be present in solution P (1 mark)

……

……

c) Write an ionic equation for the reaction which takes place in test (i) (1 mark)

……

9. Describe how you would prepare crystals of potassium sulphate starting with $100cm^3$ of 0.5M Potassium hydroxide (3 marks)

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10. use dot(.) and cross(x) diagram to show bonding in magnesium fluoride (Mg=12 , F=9) (1 mark)

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11. An element R has a relative atomic mass 88. When a current of 0.5A were passed through fused chloride of R for 32 minutes and 10 seconds, 0.44g of R were deposited at cathode. Determine charge of ion Q (I F– 96500C) (3 marks)

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12. a) Define the term isomerism (1 mark)

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b. Draw and name two positional isomers of butanol (2 marks)

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13. During the extraction copper and zinc from their ores, some processes include:
    a) Crushing (1 mark)
    ……
    ……
    b) Mixing of the crushed one with oil and water and bubbling air through it.
        i) Name the process (b) above (1 mark)
        ……
        ii) What is the purpose of(b) above (1 mark)
        ……

14. Write an equation when the following compounds are heated
    a) zinc nitrate (1 mark)

    ……
    b) silver nitrate (1 mark)

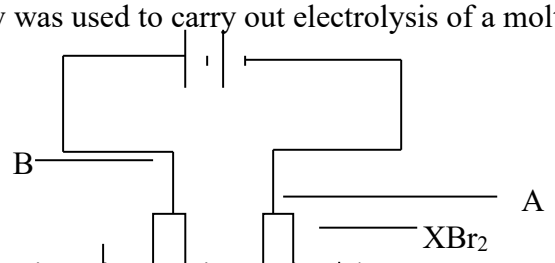
    ……

15. The table below gives solubilities of potassium bromide and potassium sulphate at 0^0c and 40^0c.

	Solubility g/100g H_2O at	
	0^0c	40^0c
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 40^0c was cooled to 0^0c some crystals were formed.
    a) identify the crystal (1 mark)
    ……
    b) Determine the mass of the crystal (1 mark)
    ……

16. The set up below was used to carry out electrolysis of a molten bromide of metal X,XBr_2.



    a) write equations for reaction taking place at:
        i) Anode : …… (1 mark)
        ii) Cathode …… (1 mark)
    b) Give reason why experiment should be carried out in fume chamber (1 mark)
    ……
    ……

17. below are the standard electrode for electrodes X and Y

$X^{2+}_{(aq)} + 2e$ _____ $X(s)$ -2.92 V

$Y^{2+}_{(aq)} + 2e$ _____ $Y(s)$ + 0.34 V

a) identify the electrode which is the least reducing agent (1 mark)

……

b) calculate the e.m.f of the cell formed when the two electrodes are connected (2 marks)

……

……

……

c) write cell representation for the cell above (1 mark)

……

18. a) Give two differences between a nuclear reaction and a chemical reaction (2 marks)

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b. complete the nuclear equation below (1 mark)

$^{230}_{90}Th \longrightarrow {}^{230}_{92}Pa + \ldots\ldots\ldots\ldots\ldots\ldots$

19. Explain why the boiling point of ethanol is higher than that of hexane (R.m.m of ethanol 46 while that of hexane is 86. (2 marks)

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20. The atomic number of element Q is 8 and that of P is 11.

a) Write down the formulae of compound formed between Q and P (1 mark)

……

b) Name the type of bond formed by compound given in (a) above .Explain. (2 marks)

……

……

21. a) State charles' law (1 mark)

……

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b. sketch a graph to represent Charles law (1 mark)

c. A gas occupied a volume of $250cm^3$ at -23^0c and atmosphere. Determine volume at $107\ ^0c$ when pressure kept constant. (2 marks)

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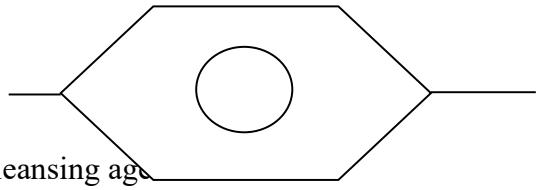
22. The structures shown below represent two cleansing agent A and B.

A **B**

R-COO^-Na^+



(a) Name the type of cleansing ag… (1 mark)

……

(b) Which of the **two** cleansing agents is more suitable for washing in water containing calcium chloride? Give a reason. (2 marks)

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……

23. a) Define the term enthalpy of formation of a compound. (1 mark)

……
……

b)Use the information below to answer the questions that follow:

	Equation	Enthalpy of formation
(i)	$H_{2(g)} + ½\ O_{2(g)} \longrightarrow H_2O_{(l)}$	$\Delta H_1 = -286 kJmol^{-1}$
(ii)	$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$	$\Delta H_2 = -394 kJmol^{-1}$
(iii)	$2C_{(s)} + 3H_{2(g)} + ½\ O_{2(g)} \longrightarrow C_2H_5OH_{(l)}$	$\Delta H_3 = -277 kJmol^-$

Calculate the molar enthalpy of combustion of ethanol. Given that:

$C_2H_5OH_{(l)} + 3O_{2(g)} \longrightarrow 2CO_{2(g)} + 3H_2O_{(l)}$ (3mks)

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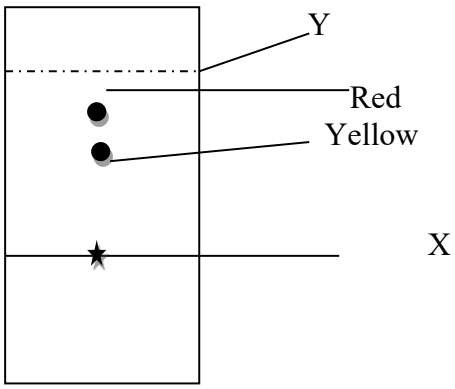
24. The chromatogram below shows the constituents of a flower extract. Study it and answer the questions that follow



a) Explain the different positions of red and yellow pigments. (2 marks)

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b) Describe how the solid yellow pigment can be obtained in the chromatogram (2 marks)

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25. When excess chlorine gas is bubbled through cold dilute sodium hydroxide solution, the resulting solution acts as a bleaching agent.

(a)Write an equation for the reaction between chlorine gas and sodium hydroxide solution. (1 mark)

……

(b)Explain how the resulting solution acts as a bleaching agent. (2 marks)

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26. The table below gives some properties of four substances. Study it and answer the questions that follow:

Substance	**M.P ^{0}C**	**B.P ^{0} C**	**Electrical Conductivity**	
			Solid	**Liquid**
W	1723	2230	Poor	Good
X	993	1695	Poor	Poor
Y	- 183	- 164	Poor	Poor
Z	1083	2567	Good	Good

(a) Which substance is suitable for making cooking pans? Explain. ($1\frac{1}{2}$ marks)

……

……

(b) Which substance is likely to have a giant atomic structure? Explain. ($1\frac{1}{2}$ marks)

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27. 17g of Zinc carbonate was reacted with 50 cm^3 of 4M nitric acid .Calculate the mass of Zinc Carbonate that remained unreacted. (Zn = 65, C = 12, O = 16) (3 marks)

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28. A certain element Z forms an ion of type Z^{3-}. If the element is in period 3.

(a) Write the electronic configuration of Z^{3-}. (1 mark)

……

(b) How do the sizes of Z and Z^{3-} compare. Explain your answer. (2 marks)

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……
……

29. A sample of copper turnings was found to have contaminated with copper II oxide .Describe how a sample of copper metal can be separated from the mixture. (2 marks)

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PAPER 2

1. Use the table below to answer the questions that follow.
(The letters are not the actual symbols of the elements)

Element	Atomic number	Melting point (^0C)
A	11	97.8

B	13	660
C	14	1410
D	17	-101
E	19	63.7

(a) Write the electronic arrangement for the ions formed by the elements B and D

B …… (½ mark)

D…….. (½ mark)

(b) Select an element which is

(i) a poor conductor of electricity …… (½ mark)

(ii) most reactive metal …… (½ mark)

(c) Explain briefly how the atomic radii of element B and C compare. (2 marks)

……

(d) Use dots (•) and crosses (x) to represent outermost electrons and show the bonding in the compound formed between C and D. (2 marks)

(e) Explain why the melting point of element B is higher than that of element A. (2 marks)

……

(f) Write an equation for the reaction that takes place between element A and water. (1 mark)

(g) Describe how a solid mixture of the sulphate of element E and lead (II) sulphate can be separated into solid samples. (3 marks)

2. (a) (i) State Hess's law. (1 mark)

(ii) Use the thermochemical equations given below to calculate the enthalpy of formation of ethane. (3 marks)

$C_2H_{6\,(g)} + 7/2\ O_{2\,(g)} \longrightarrow 2CO_{2\,(g)} + 3H_2O_{\,(g)}$ $\Delta H = -1560\ kJmol^{-1}$

$C_{\,(graphite)} + O_{2\,(g)} \longrightarrow CO_{2\,(g)}$ $\Delta H = -394\ kJmol^{-1}$

$H_{2(g)} + ½\ O_{2\,(g)} \longrightarrow H_2O_{\,(g)}$ $\Delta H = -286\ kJmol^{-1}$

(b) The table below gives the volumes of oxygen gas produced at different times when hydrogen peroxide solution decomposed in the presence of a catalyst.

Time in seconds	0	10	20	30	40	50	60
Volume of oxygen (cm^3)	0	66	98	110	119	120	120

(i) Name the catalyst used for this reaction. (1 mark)

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(ii) Write the chemical equation for the decomposition of hydrogen peroxide. (1 mark)

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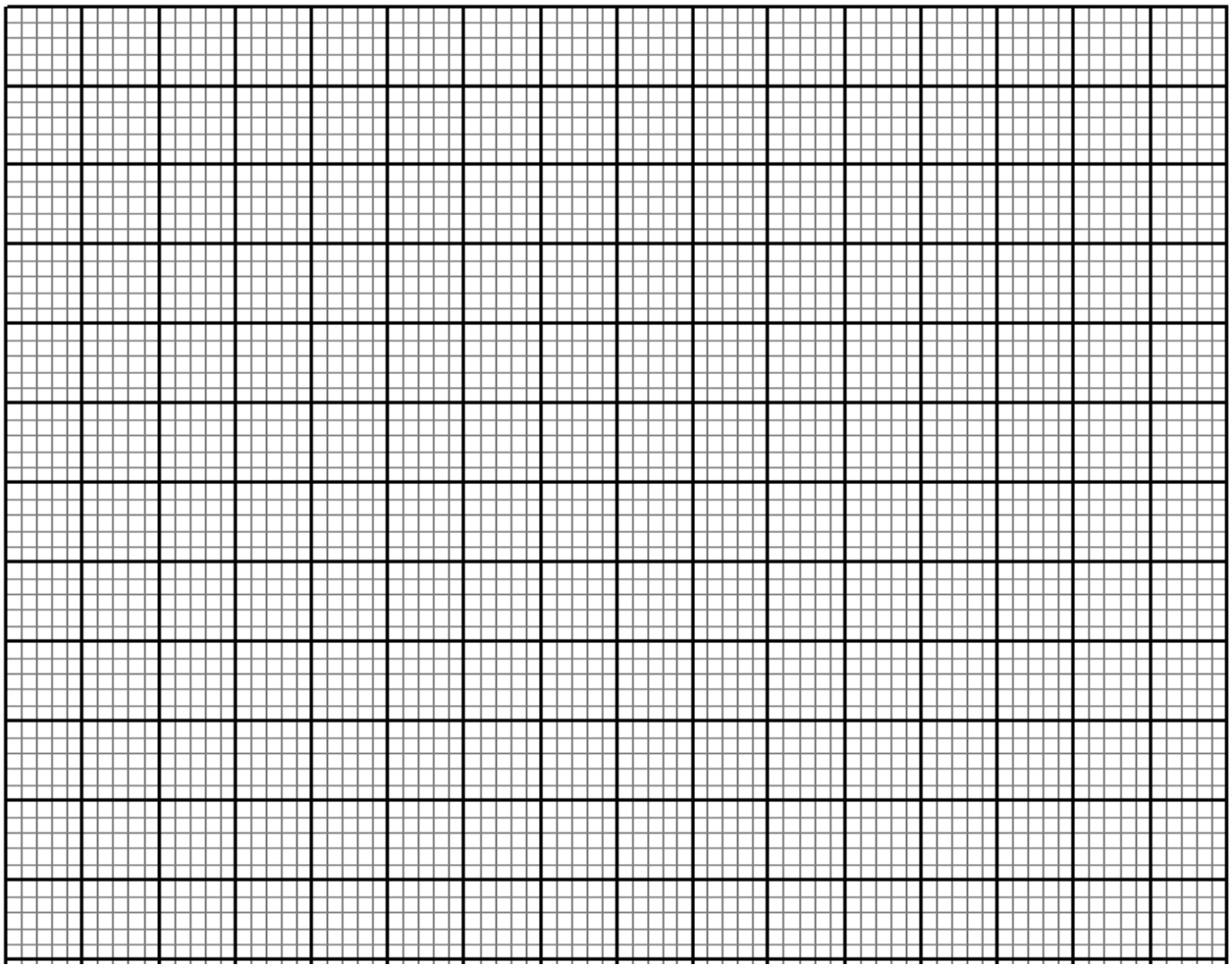
(iii) On the grid provided, draw the graph of the volume of oxygen gas (vertical axis) against time (horizontal axis). (3 marks)



(iv) Using the graph, determine the rate of decomposition of hydrogen peroxide 24th second and 34th second. (2 marks)

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(v) Give a reason why the total volume of oxygen gas produced after 50 seconds remain constant. (1 mark)

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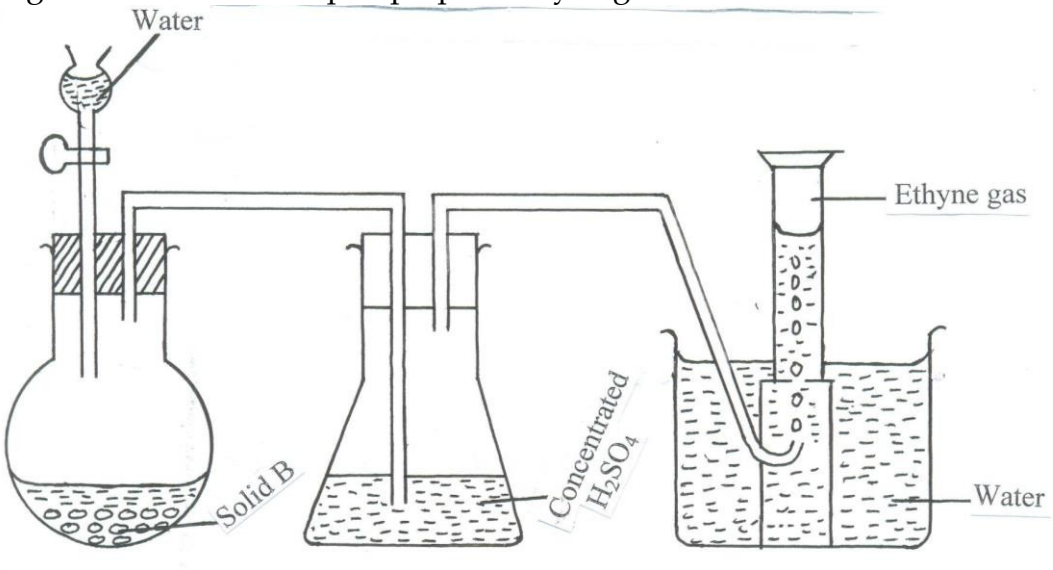
3. (a) The diagram below is a set-up to prepare ethyne gas.



(i) Name solid B …… (1 mark)

(ii) Write an equation for the reaction taking place between solid B and water (1 mark)

(iii) State the property that makes the gas to be collected by the method shown in the diagram. (1 mark

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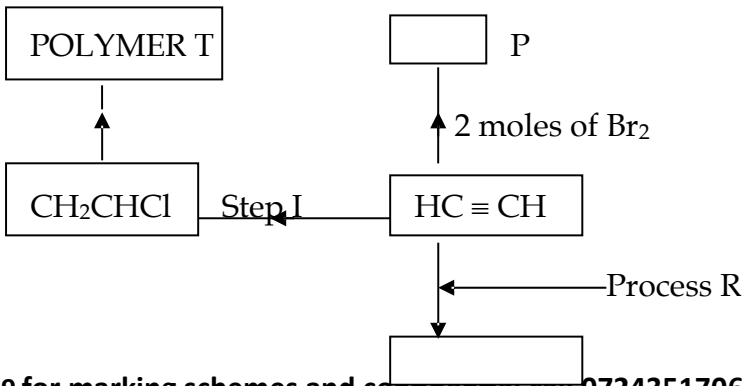
……

(iv) State the main commercial use of ethyne. (1 mark)

……

(b) The scheme below represents some reactions of ethyne. Study it and answer the questions that follow.



CH_3CH_3

(i) Name compound P and draw it's structural formula. (1 mark)
(ii) Name the reagents used in:

I) Process R …….. ……. (½ mark)

II) Step I ……. (½ mark)

(iii) Draw the repeating unit in polymer T. (1 mark)

(iv) Name polymer T …… (1 mark)

(v) Give one use of T (1 mark)

(c) Ethanol and ethanoic acid react according to the following equation under condition M and process N to form product Z.

$CH_3CH_2OH_{(l)} + CH_3COOH_{(aq)} \longrightarrow Z_{(l)} + H_2O_{(l)}$

Name:
(i) Condition M ……. (½ mark)

(ii) Product Z ……. (½ mark)

(iii) Draw the structural formula of product Z. (1 mark)

(iv) State any 1 difference between the above reaction and that of an hydroxide and an acid. (1 mark)

……

(v) Butane is often used as the main component in domestic gas fuels. Calculate it's heating value (H = 1, C = 12, ΔH^0C (C_4H_{10}) = 2877.0 k $Jmol^{-1}$) (1 mark)

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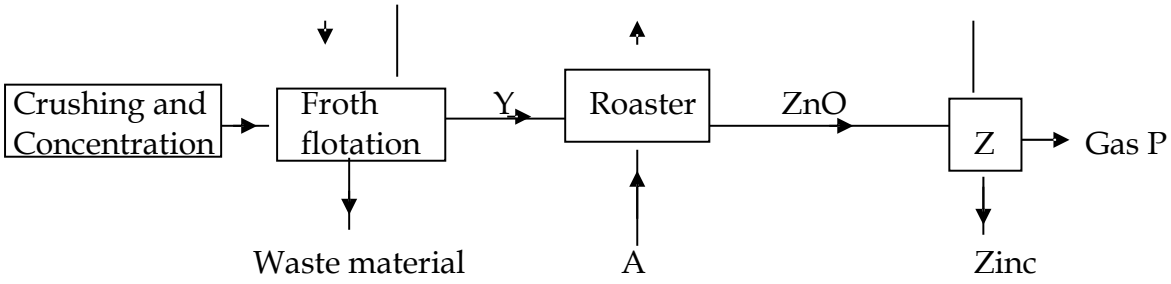
4. The flow chart below shows the extraction of zinc. Study it and answer the questions that follow.

Water → X → B → Coke



(a) (i) Identify substance X (1 mark)

(ii) Give one waste material of the froth flotation process. (1 mark)

(iii) Identify substances A and B.

A …… (½ mark)

B …… (½ mark)

(iv) Write equation for the reaction taking place in the roaster. (1 mark)

……

(v) Identify gas P and write an equation for it's formation. (1 ½ marks)

……

……

(b) Use the standard electrode potentials given below to answer the questions that follow.

Half reactions	Electrode potential, E^{θ} (V)
$D^{+}_{(aq)} + e^{-} \longrightarrow D_{(s)}$	+ 0.80
$E^{2+}_{(aq)} + 2e^{-} \longrightarrow E_{(s)}$	+ 0.34
$F^{2+}_{(aq)} + 2e^{-} \longrightarrow F_{(s)}$	-0.13
$G^{2+}_{(aq)} + 2e^{-} \longrightarrow G_{(s)}$	-0.76

(i) Construct an electrochemical cell that will produce the lowest emf. (3 marks)

(ii) Calculate the emf of the cell constructed in (i) above. (1 mark)

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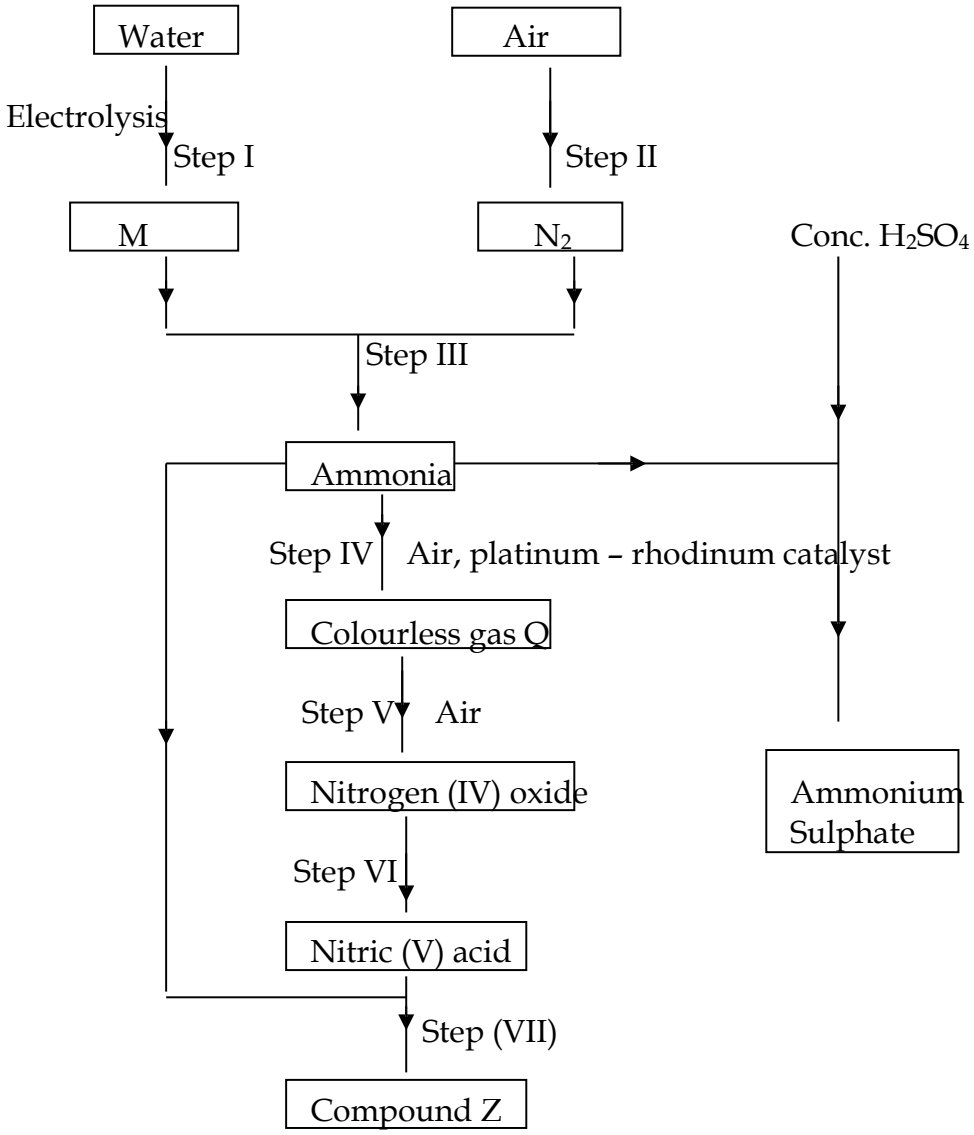
……

(iii) From the half reactions listed in the table in (b) above select strongest oxidizing agent.
(½ mark)

5. (a) Fractional distillation of liquid air is mainly used to obtain nitrogen and oxygen.
(i) Name one substance that is used to remove carbon (IV) oxide from the air before it is changed into liquid. (1 mark)

(ii) Describe how nitrogen gas is obtained from the liquid air.
(Boiling points nitrogen = -196^{0}C, Oxygen = -183^{0}C) (3 marks)

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



(i) Name substance M ……. (1 mark)

(ii) Identify gas Q …… (1 mark)

(iii) State one use of compound Z (1 mark)

(iv) A fertilizer manufacturing industry uses 1400dm^3 of ammonia gas per hour to produce ammonium sulphate. Calculate the amount of ammonium sulphate produced in kg for one day if the factory operates for 18 hours.
(N = 14, H = 1, S = 32, O = 16, 1 mole of gas = 24dm^3) (3 marks)

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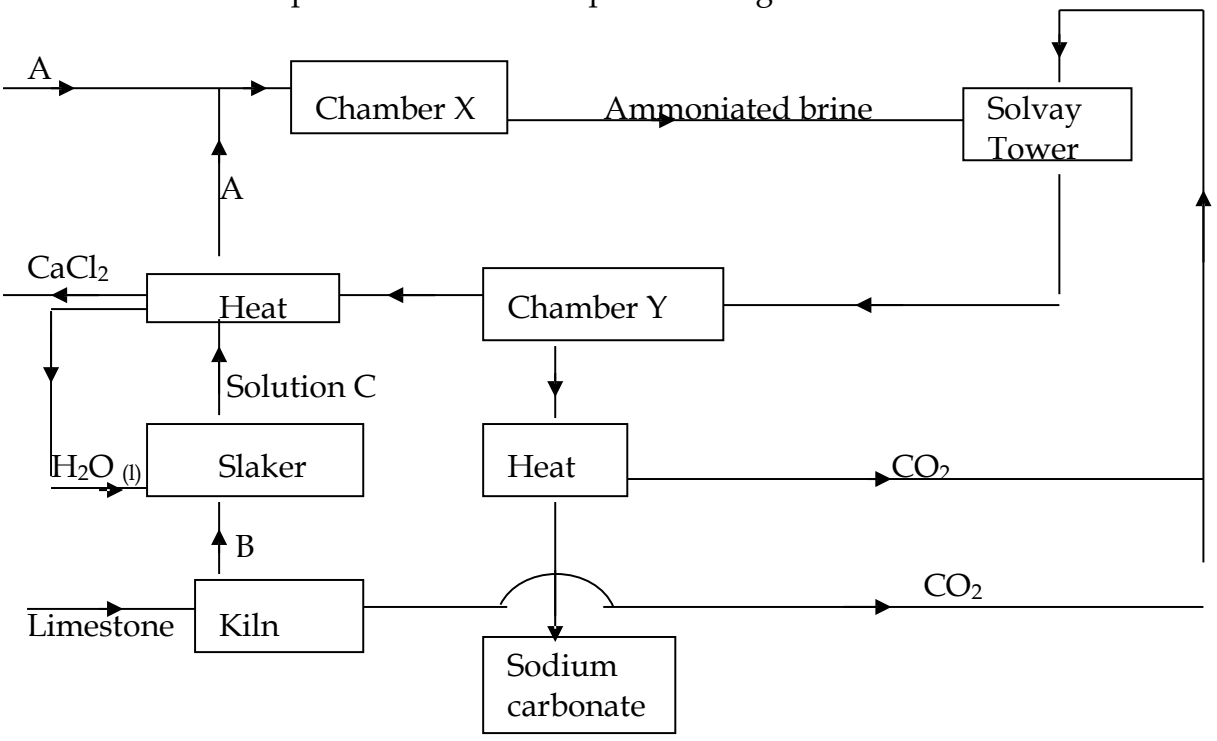
6. The chart below represents the main steps in the large-scale manufacture of sodium carbonate.



(a) Name substances A and B.
A ……. (1 mark)

B ……. (1 mark)

(b) Write down the chemical equation leading to formation of C. (1 mark)

……

(c) A stream of cold water is made to circulate around chamber X. What does this suggest about the reaction taking place. (1 mark)

……

(d) Name the process that takes place in chamber Y. (1 mark)

……

(e) State any 2 by-products recycled in the process. (2 marks)

……

(f) In an experiment, wood charcoal was mixed with concentrated sulphuric (VI) acid in a test-tube. The mixture was then placed over a Bunsen-burner flame for some time.

(i) Write down the chemical equation of the reaction that takes place. (1 mark)

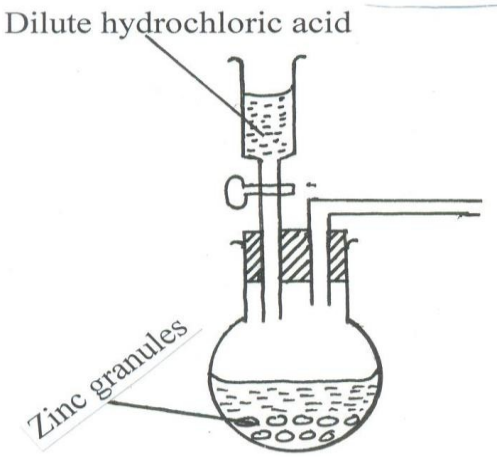
……

(ii) State the property of concentrated sulphuric (VI) acid investigated in (i) above. (1 mark)

(g) Mention any 2 uses of sodium carbonate. (1 mark)

7. The set up below shows the reagents that can form hydrogen gas in a laboratory.

(a) Complete the diagram to show how a dry sample of hydrogen gas can be collected. (3 marks)

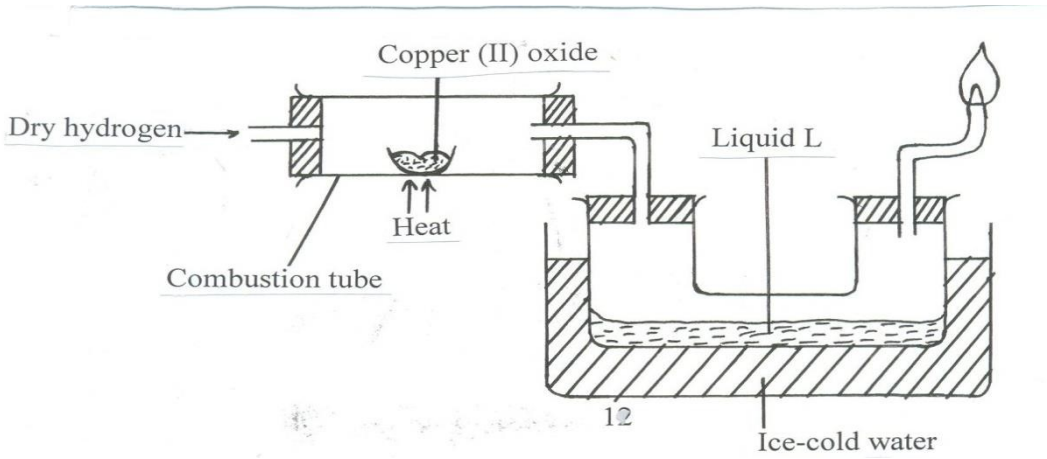


(b) Write the chemical equation for above reaction. (1 mark)

(c) Why is it not advisable to use calcium in this method to prepare hydrogen? (1 mark)

(d) Why is it advisable to discard the first jar of the gas collected? (1 mark)

(e) The set-up below was used to investigate the properties of hydrogen gas.



(i) State the observation made in the combustion tube. (1 mark)

……

……

(ii) Write down the equation leading to formation of liquid L. (1 mark)

……

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

……

(iv) Why is potassium oxide not used to investigate this property of hydrogen gas. (1 mark)

……

……

(v) Hydrogen gas is used in hydrogenation of oils. What do you understand by the term hydrogenation? (1 mark)

(vi) Give any 2 other industrial uses of hydrogen gas. (2 marks)

PAPER 3

1. You are provided with;

- **4.0g** of solid **P.** Hydrated dibasic acid **$H_2C_2O_4.nH_2O$**
- **0.2M** sodium hydroxide Solution **X**

You are required to determine the;

(i) Solubility of solid **P**

(ii) Value of n in the formula **$H_2C_2O_4.nH_2O$**

Procedure

(i) Fill the burette with distilled water

(ii) Place all solid **P** in a boiling tube

(iii) Transfer **$4cm^3$** of distilled water from the burette into the boiling tube containing solid **P**

(iv) Heat the mixture while stirring with the thermometer to a temperature of about 80^0C.

(v) Allow the mixture to cool while stirring with a thermometer. You may use cold water in a beaker to enhance cooling.

(vi) Record the temperature at which the crystals start to form in table **1** below.

(vii) Add a further **2cm³** of distilled water from the burette to the mixture in the boiling tube. Repeat procedure (iv) and (v) above and record the crystallization temperature. Complete the table below by adding the volumes of distilled water as indicated. (***Preserve the contents of the boiling tube to be used in procedure II)***

(viii) Calculate the solubility of solid P in g/100g of water and complete **table 1.**

Table 1

Volume of distilled water	*Crystallization temperature*	*Solubility of solid P in g/100g of water*
4		
6		
8		
10		
12		

(7 marks)

(a) On the grid provided, plot a graph of solubility of solid $\boldsymbol{P}(\boldsymbol{y-axis})$ against crystallization temperature. **(3 marks)**

(b) From the graph determine;

(i) The solubility of solid **P** at **60⁰C.** (1 mark)

……

……

(ii) The temperature at which **40g** of **P** dissolves in **50g** of water. (1 mark)

……

……

(iii) The mass of **P** that crystallizes out when the mixture is cooled from **55⁰C** to **45⁰C**. (1 mark)

……

Procedure II

(i) Transfer all the contents of the boiling tube in procedure 1 to a clean 250ml volumetric flask.
(ii) Add distilled water to the mark, shake thoroughly.
(iii) Label the resulting solution as **Q**.
(iv) Fill the burette with solution **Q.**
(v) Pipette **25cm³** of solution **X** into a clean conical flask. Add three drops of phenolphthalein indicator.
(vi) Titrate **Q** against **X** to an accurate end point.

Record your results in table II below.

Table II

	I	**II**	**III**
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution Q used in (cm^3)			

(4 marks)

Calculate;

(a) Average volume of Q used. (1 mark)

……

……

(b) i) Moles of solution **X** used. (1 mark)

……

……

ii) Moles of solution **Q** used. (1 mark)

……

……

iii) Concentration of solution **Q** in moles per litre. (1 mark)

……

……

(c) Determine the value of **n** in the formula $H_2C_2O_4.nH_2O$ (2 marks)

(H=1.0, C=12.0, O=16.0)

……

2. You are provided with solid **R**. Carry out the following tests and record the observations and inferences in the spaces provided.

(a) Place about one-third of solid **R** in dry test-tube. Heat the solid strongly and test any gas with both blue and red litmus papers.

Observations	*Inferences*

(1½ marks) (1 mark)

(b) Place the remaining amount of solid **R** in a boiling tube. Add about **15cm³** of distilled water and shake. Divide the mixture into four test tubes each containing about **2cm³.**

(i) To the first portion, add four drops of dilute hydrochloric acid.

Observations	*Inferences*

(1 mark) (2 marks)

(ii) To the second portion, add two or three drops of aqueous barium nitrate.

Observations	*Inferences*

(½ mark) (½ mark)

(iii) To the third portion, add aqueous sodium hydroxide dropwise until in excess.

Observations	*Inferences*

(1 mark) (1 mark)

(iv) To the fourth portion, add aqueous ammonia dropwise until in excess.

Observations	*Inferences*

(1 mark) (½ mark)

3. You are provided with **solid S**. carry out the following tests and record the observations and inferences in the spaces provided.

(a) Place about one-third of solid **S** on a clean metallic spatula and burn it in a Bunsen burner flame.

Observations	*Inferences*

(1 mark) (1 mark)

(b) Place the remaining amount of solid **S** in a boiling tube. Add about **10cm³** of distilled water and shake. Use the mixture for tests (i) and (iii) below.

Observations	*Inferences*

(½ mark) (½ mark)

(i) Using about **2cm³** of the mixture in a test-tube, determine the PH using universal indicator paper and chart.

Observations	*Inferences*

(½ mark) (½ mark)

(ii) To about **2cm³** of the mixture in a test-tube, add two or three drops of acidified potassium manganate (VII).

Observations	*Inferences*

(1 mark) (1 mark)

(iii) To about **2cm³** of the mixture in a test-tube add **two** drops of acidified potassium dichromate (VI).

Observations	*Inferences*

(1 mark) (1 mark)

KCSE REPLICA 2
PAPER 1

1. (a) Draw a labeled diagram showing the structure of $^{27}_{13}A1^{3+}$ ion (2 marks)

(b) Explain why the atom is said to be electricity neutral. (1 mark)

_____

_____

2. Explain why luminous flame is yellow and sooty. (2 marks)

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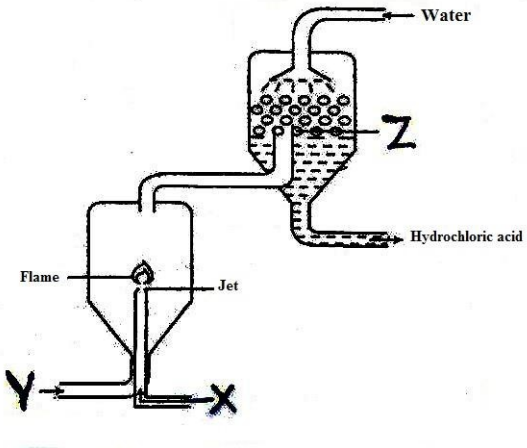
3. The diagrams below represent a simplified industrial process for manufacturing hydrochloric acid. Study it and answer the question that follows.



a) Give two sources of substance X (1 mark)

_____

_____

b) State the role of the substance labeled Z. (1 mark)

_____

_____

c) State two uses of dilute hydrochloric acid. (1 mark)

_____

_____

4. During laboratory preparation of oxygen reagent H is added to Sodium Peroxide.

a) Name the equation for the reaction that takes place. (1 mark)

_____

b) Write the equation for the reaction that takes place. (1 mark)

_____

_____

c) Name a gas that is mixed with oxygen to be used in welding. (1 mark)

_____

5. The elements fluorine, Chlorine, Bromine and Iodine belong to group (VII). Select the element with lowest melting point, Give a reason. (2 marks)

6. Starting with magnesium granules, describe how you can suitably obtain magnesium hydroxide solid. (3 marks)

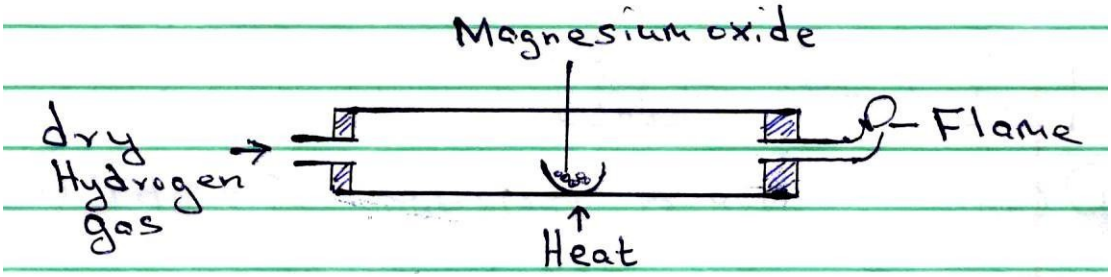
7. Aqueous Copper (II) Sulphate was electrolyzed using graphite electrodes.

a) How does PH of the electrolyte change during electrolysis? (1 mark)

b) Write the cathode equation. (1 mark)

c) The experiment was repeated using copper electrodes. Write the anode equation. (1 mark)

8. In an experiment, dry hydrogen gas was passed Overheated magnesium oxide as shown in the diagram below.



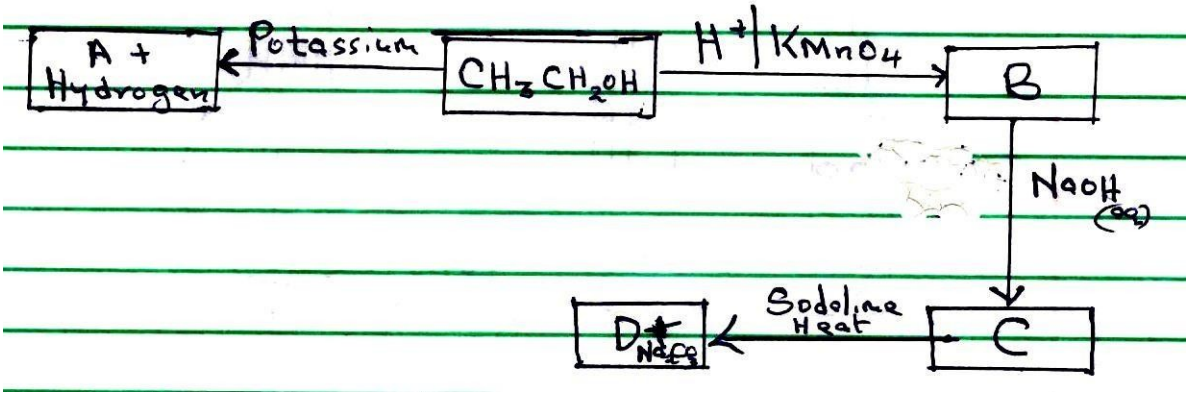
a) State and explain the observations made in the combustion tube. (1 mark)

b) The experiment was repeated using Lead (II) oxide. State the observations made in the combustion tube. (1 mark)

9. Explain why an increase in temperature increases the rate of a reaction. (2 marks)

10. 10g of an oxide of Sodium contains 5.9g of sodium. Its molar mass is 78. Determine its molecular formula. (Na = 23, O = 16) (3 marks)

11. Study the flow chart below and answer the questions that follow:



a) Identify substance B and C (1 mark)

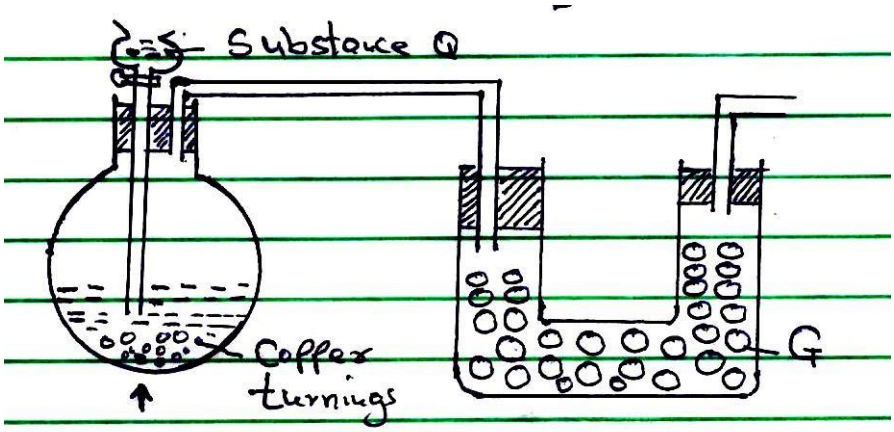
b) Name and draw the structure of substance A (1 mark)

c) Write the equation for the reaction that occur when D react with excess Bromine gas in presence of sunlight. (1 mark)

12. A piece of sodium metal was placed in a beaker containing pure water.
a) Write the equation for the reaction that occurs. (1 mark)

b) Using oxidation numbers show that the reaction in (a) above is redox. (2 marks)

13. (a) The set up in the figure below can be used to prepare dry nitrogen (iv) oxide. Use it to answer the questions that follow.



(i) Name the substance G and Q (1 mark)

_____

_____

(ii) Complete the set up to show how nitrogen (iv) oxide is exposed to air. (1 mark)

(b) State the observation made when a gas jar containing nitrogen (II) oxide is exposed to air. (1 mark)

_____

_____

14. The table below shows ammeter readings recorded when 2M potassium hydroxide and 2M aqueous ammonia were tested separately.

Electrolyte	Current (A)
2M Potassium Hydroxide	8.1
2M Ammonia	2.5

Explain the difference in the ammeter readings. (2 marks)

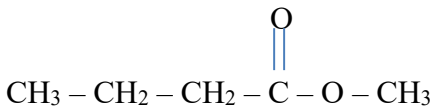
_____

_____

_____

_____

15. Compound H has the following structure



$CH_3 - CH_2 - CH_2 - \overset{\overset{O}{\|}}{C} - O - CH_3$

a) Give the name of the compound H. (1 mark)

_____

b) In which group of compounds does H belong? (1 mark)

_____

c) Name the reagents that were used to prepare compound H. (1 mark)

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16. (a) State Boyle's law. (1 mark)

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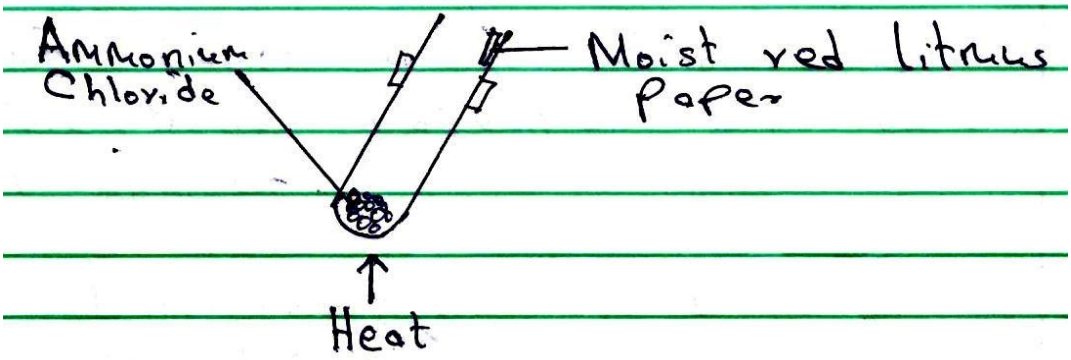
(b) Study the set up below and answer the questions that follow.



State and explain the observations made. (2 marks)

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17. Draw a well labeled diagram that can be used to electroplate iron spoon with silver.
(3 marks)

18. 2g of sodium hydroxide is added to $40cm^3$ of 1M sulphuric (vi) acid. What volume of 0.1M potassium hydroxide solution will be needed to neutralize the excess acid?
(Na = 23.0 O = 16.0 H = 1.0) (3 marks)

19. (a) Explain why it is not advisable to prepare a sample of carbon (iv) oxide using calcium carbonate and dilute sulphuric (vi) acid. (2 marks)

_____

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(b) Give one use of coke. (1 mark)

_____

20. The table below shows the standard electrode potentials of the elements P and Q.

Half reactions	$E^{\ominus}V$
$P^{2+}_{(aq)} + 2e \longrightarrow P_{(s)}$	-0.44
$Q^{2+}_{(aq)} + 2e \longrightarrow Q_{(s)}$	-2.37

Use the information to predict whether the reaction represented below can take place.
(2 marks)

$$P_{(s)} + Q^{2+}_{(aq)} \longrightarrow P^{2+}_{(aq)} + Q_{(s)}$$

21. The table below shows the atomic numbers and electron affinities of three elements. The letters are not actual chemical symbols. Use it to answer the questions that follow.

Element	Atomic number	Electron Affinity kJ/mol
A	17	-349 kJ/mol
B	35	-325 kJ/mol
C	53	-295kJ?mol

a) What is electron affinity? (1 mark)

b) Explain the trend in electron affinity from A to C. (2 marks)

_____

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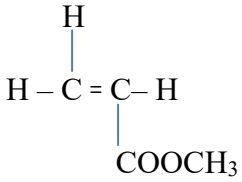
22. A sample of herbicide in solution form is suspected to contain Lead (II) ions. Describe how the presence of Lead (II) ions can be established. (2 marks)

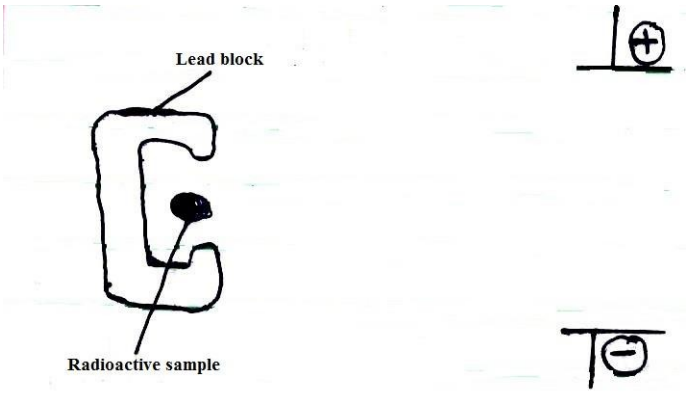
23. A monomer has the following structure.



a) Draw the structure of the polymer that contain three monomers. (1 mark)

b) A sample of the polymer formed from the monomer has a molecular mass of 7740. Determine the number of monomers that formed the polymer.
(C = 12.0 H = 1.0 O = 16.0) 2 marks)

24. (a) The figure below is an incomplete diagram that can be used to illustrate how alpha, beta and gamma radiations can be distinguished from each other



Complete the diagram above (1½ marks)

(b) Radioactive decay of $^{212}_{82}Pb$ gives $^{212}_{83}Bi$, gamma radiations and X.

(i) Identify X. (½ mark)

_____

_____

(ii) Write a nuclear equation for the decay. (1 mark)

25. A small amount of sulphur was burnt in a deflagrating spoon. The burning sulphur was then lowered into a gas jar full of oxygen.

a) The product formed is dissolved in water. Suggest the PH of the resulting solution. Give a reason. (1 mark)

_____

_____

b) Explain the observation made when pink flower is immediately dropped in the solution obtained in (a) above. (2 marks)

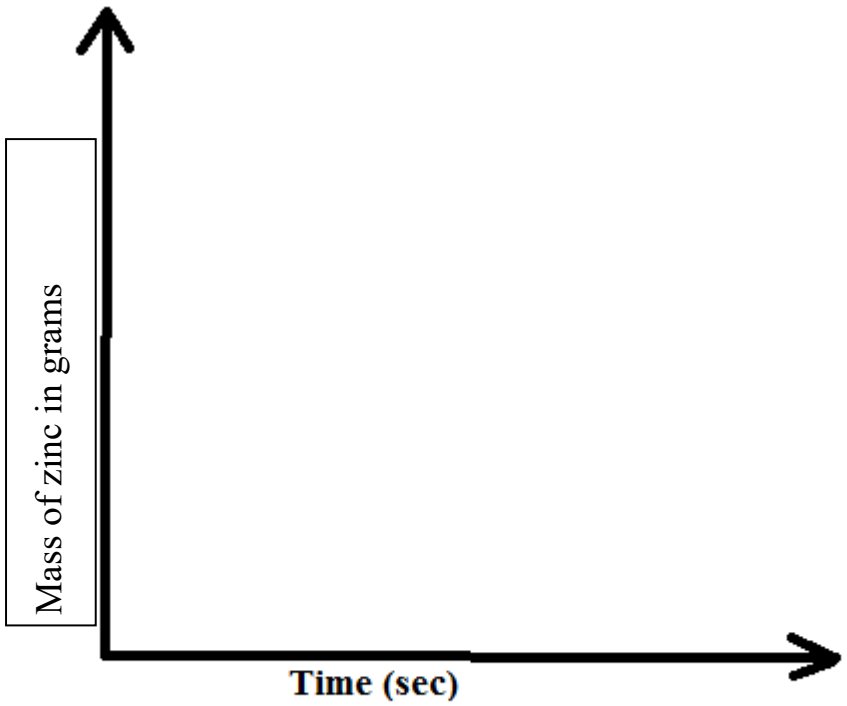
_____

_____

26. The table below gives three experiment on the reaction of excess dilute hydrochloric acid and 0.5g of zinc done under different conditions. In each the change in mass of the reactant was recorded at different time intervals.

Experiment	Forms od Zinc	Hydrochloric acid
I	Powder	0.6M
II	Granules	0.6M
III	Powder	1M

On the axis below, draw and label the three curves that could be obtained from such results. (3 marks)



27. The relative atomic mass of an element is 10.28, it has two isotopes ^{10}R and ^{11}R. Calculate the relative abundance of each isotope. (2 marks)

28. (a) Define the standard enthalpy of formation of a substance. (1 mark)

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_____

(b) Use the thermochemical equations below to answer the questions that follow.

$H_{2(g)} + ½\ O_{2(g)} \longrightarrow H_2O_{(1)}$ $\Delta H = -286kJ/mol$

$C_{s)} + ½\ O_{2(g)} \longrightarrow C\ O_{2(g)}$ $\Delta H = -393kJ/mol$

$C_4\ H_{10(g)} + 9/2\ O_{2(g)} \longrightarrow 4CO_2 + 5H_2O_{(1)}$ $\Delta H = -2877kJ/mol$

(i) Draw an energy cycle diagram linking the heat of formation of butane with its heat of combustion of its constituent elements. (2 marks)

(ii) Calculate the heat of formation of butane. (1 mark)

29. Name an appropriate apparatus that can be used to measure $29.3cm^3$ of 0.1M sodium hydroxide solution in the laboratory. (1 mark)

_____

30. Copper is mostly extracted from copper pyrite.

a) Give the chemical formula of copper pyrite. (1 mark)

_____

b) State the role of silica that is added during extraction of copper from copper pyrite. (1 mark)

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PAPER 2

1. The grid below shows part of the periodic table. Use it to answer question the follow. The letters do not represent actual symbols.

						S	U	V
P	R					T		W
Q								

(a). Which of the elements has the highest atomic radius? Explain. (2 marks)

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

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(c). Give the electron configuration of:

(i). Element S. ($^1/_2$ mark)

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(ii). Element Q. ($^1/_2$ mark)

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(d). Compare the atomic radius of P and R. Explain. (2 marks)

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(e). Given that the atomic mass of W is 40. Write down the composition of its nucleus. (1 mark)

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(f). Write the formula of compounds formed between

(i). Element P and S. (1 mark)

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(ii). Element R and T. (1 mark)

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(g). Give the formula of one stable Ion with an electron arrangement of 2.8 which is
(i). Negatively charged. (1 mark)
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……
(ii). Positively charged. (1 mark)
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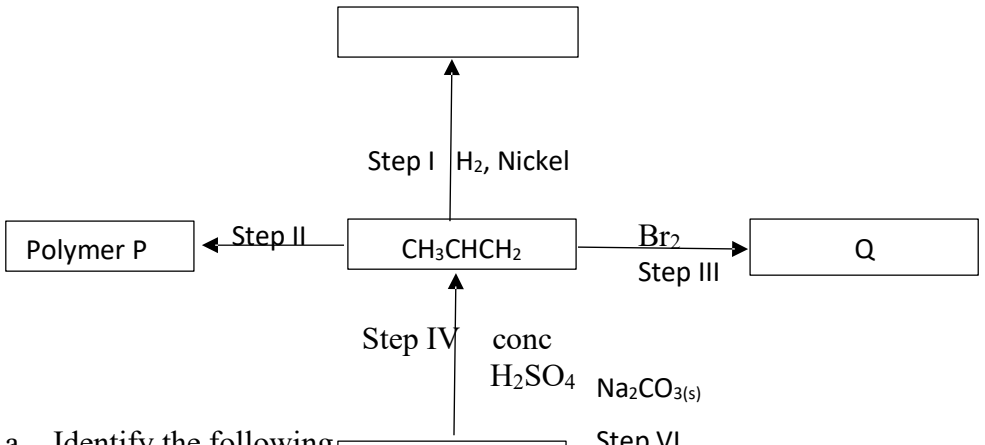
2. Study the flow chart below and answer the question that follows.



a. Identify the following
i. Substance W ……. (1mark)

ii. Gas V …… ……..... (1 mark)

b. Name the processes i
i. Step I …… …… (1 mark)

ii. Step II …… …….. (1 mark)

c. i. What type of reaction is taking place in step V. (1mark)
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(iii). Draw the structure and give their IUPAC name for the following compounds. (4 marks)

Compound	Structure	Name
Q	(1 mark)	(1mark)

P	(1 mark)	(1 mark)

d. Write the equation that took place in step III. (1 mark)

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3. Study the standard electrode potentials for the half cells given below and answer the questions that follow.

	E^o (volts)
$A^+_{(aq)} + e^- \longrightarrow A_{(s)}$	-2.92
$B^+_{(aq)} + e^- \longrightarrow B_{(s)}$	+ 0.52
$C^+_{(aq)} + e^- \longrightarrow {}^1/_2C_{2(g)}$	0.00
$D^{2+} + 2e^- \longrightarrow D_{(s)}$	-0.44
${}^1/_2E_{2(aq)} + e^- \longrightarrow E_{(aq)}$	+1.36

a. Identify the strongest oxidising agent. Explain. (2 marks)

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b. (i). Which two half cells would produce the highest potential difference combined. (1 mark)

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(ii). Give the cell diagram for b (i) above (1mark)

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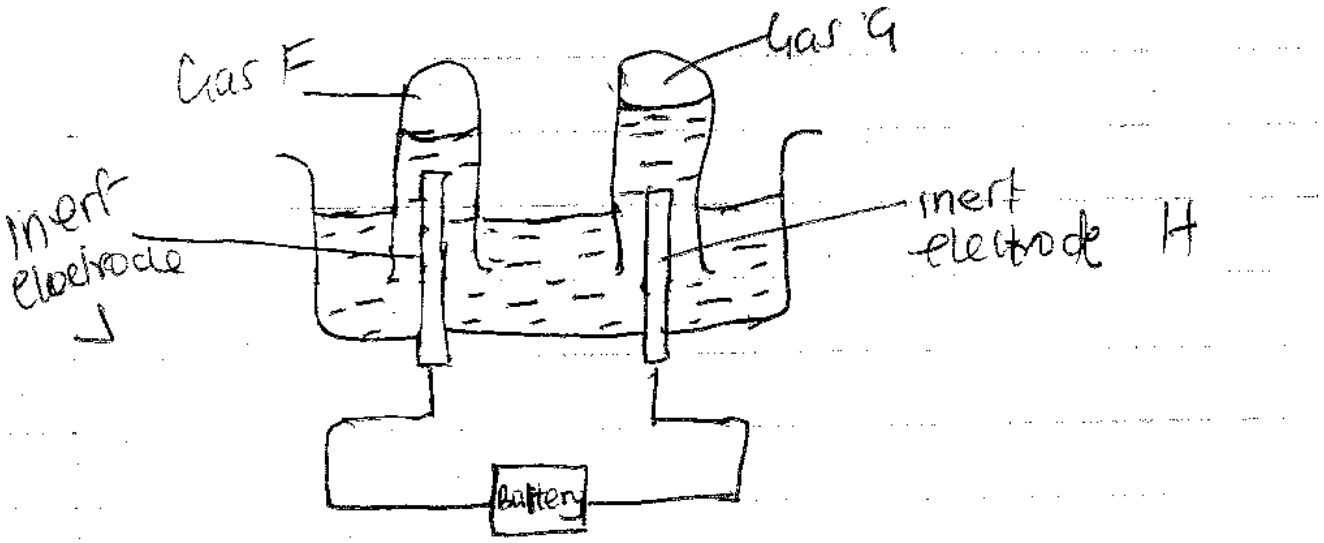
c. (I). Explain whether the reaction represented by the equation below can take place. (2 marks)

$2A^+_{(aq)} + D_{(s)} \longrightarrow A_{(s)} + D^{2+}_{(aq)}$

(II). 90cm^3 of acidified water was electrolysed using the set up below.



a. Identify electrodes H and J

H - …… .(1/2 mark)

J - …… (1/2 mark)

b. Describe how gas F can be identified. (2marks)

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c. In the above experiment 5A of electricity was passed through the acidified water for 3 minutes and 21 seconds. Calculate the volume of gas G produced at room temperature and pressure molar gas volume at r.t.p= 24000cm^3/ F=96 500c. (3 marks)

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4.(a). The following results were obtained in an experiment
Mass of crucible + Lid = 19.52g
Mass of crucible + Lid + Magnesium ribbon = 20.36g
Mass of crucible + Lid + Magnesium oxide = 20.92g

(i). Use the results to determine the percentage mass of magnesium and oxygen in magnesium oxide. (2 marks)

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(ii). Determine the empirical formula of magnesium oxide.
(Mg = 24, O = 16)

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(b). Sodium hydroxide pellets were accidentally mixed with sodium chloride. 8.8g of the mixture were dissolved in water to make one litre of solution. $50cm^3$ of the solution was neutralised by $20cm^3$ of 0.25M Sulphuric acid.

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

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(ii). Calculate the:

(I). number of moles of the substance that reacted with sulphuric acid. (2 marks)

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(II).number of moles of the substances that would react with sulphuric acid in the one litre solution. (2 marks)

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(iii). The percentage of sodium chloride in the mixture. (2 marks)

(H = 1.0, Na = 23.0, Cl = 35.5, O = 16.0)

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5. (a). In an experiment to determine the heat of combustion of ethanol the following data was collected.

Volume of water = $450cm^3$

Initial temperatures of water = 25°c

Final temperature of water = 46.5°c

Mass of ethanol + lamp before heating = 125.5g

Mass of ethanol + lamp after heating = 124.0g

Calculate:

(i). Heat evolved during the experiment (Density of water = $1g/cm^3$, specific heat capacity of water = $4.2k/kg^{-1}k^{-1}$. (2 marks)

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(ii). Molar heat of combustion of ethanol. (2 marks)

(C = 12, O = 16, H = 1).

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(b). Write the equation for the complete combustion of ethanol. (1 mark)

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(c) The molar heat of combustion obtained from an experiment like the one above is usually lower than the theoretical value.
Explain. (2 marks)

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(d). The molar heat of combustion of hydrogen is given as -286K/mol^{-2}
(i). Write the thermochemical equation for the reaction. (1 mark)

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(ii). Draw an energy level diagram for the reaction in b (i) above. (2 marks)

e(i). What is a fuel? (1 mark)

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.....

(ii). State two factors considered when choosing fuel. (1 mark)

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6. The factors which affects the rate of reaction between lead (II) carbonate and dilute nitric (V) acid were investigated by carrying out three experiments.

Experiment number	Lead (II) carbonate	Concentration of nitric (V) acid
1	Lumps	4M
2	Powdered	4M
3	Lumps	2M

(a). Other than concentration, name another factor that was investigated in the experiment.
(1mark)

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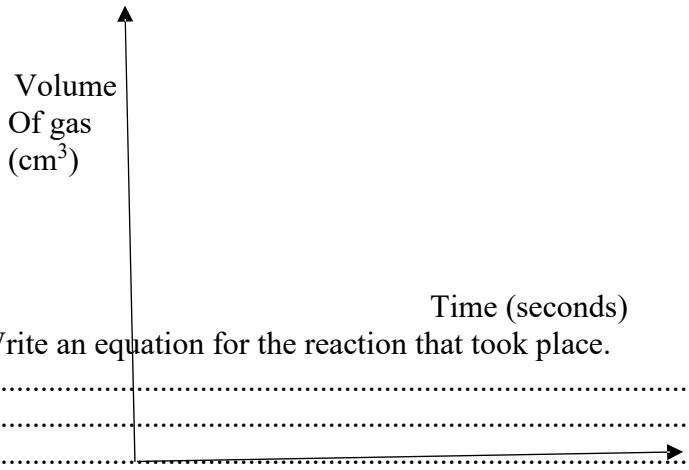
.....

(b). For each experiment the same volume of acid (excess) and mass of lead (II) carbonate were used and the volume of gas liberated measured with time.
(i). Draw set up that can be used to investigate the rate of reaction for one of the experiments. (3 marks)

(ii). On the grid provided, sketch the curves obtained when the volume of gas produced was plotted against time for each of the experiments and label each as 1,2 or 3. (3 marks)



(iii). Write an equation for the reaction that took place. (1mark).

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(c). If the experiments were carried out using dilute hydrochloric acid instead of dilute nitric (V) acid, the reaction would start, slow down and eventually stop. Explain. (2 marks)

(d). Bromine gas dissolves in water according to the following equation.

$Br^{2}_{(g)} + H_2O_{(l)} \rightleftharpoons 2H^+_{(aq)} + Br^-_{(aq)} + OBR^-_{(aq)}$

Colourless.

Yellow/orange

State and explain the observation made when hydrochloric acid is added to the mixture at equilibrium.
(2 marks)

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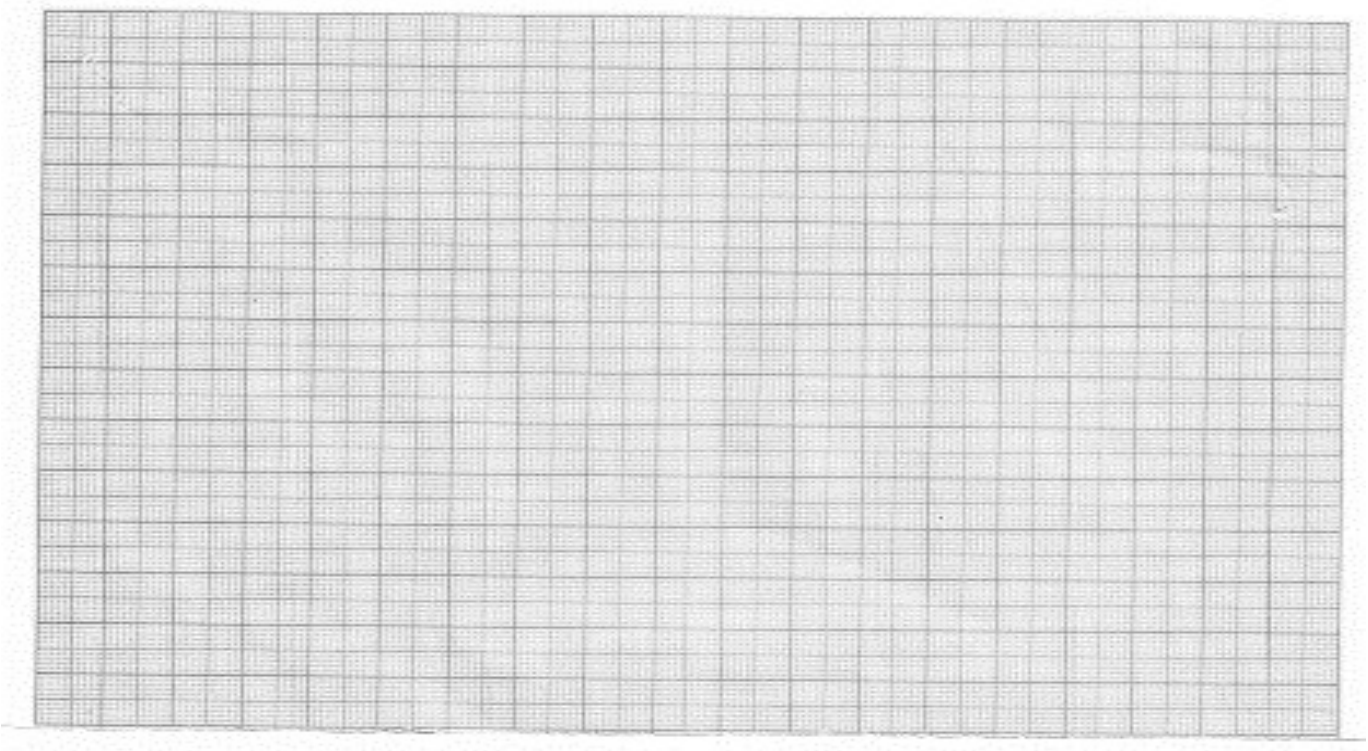
7. In an experiment to determine the solubility of potassium chlorate, the following results were obtained.

Total volume of water added (cm^3)	10.0	20.0	30.0	40.0	50.0
Mass of potassium chlorate	5.0	5.0	5.0	5.0	5.0
Temperature at which crystals appear (°c)	80.0	65.0	55.0	45.0	30.0
Solubility of potassium chlorate (g/long H_2O)					

(a).Complete the table to show the solubility of potassium chlorate at different temperatures. (3 marks)

(b). Plot a graph of mass of potassium chlorate per 100g water against temperature at which crystals from. (3 marks)



(c). From the graph, determine:

(i). the solubility of potassium chlorate at 40°C. (1 mark)

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(ii). The temperature at which the solubility of potassium chlorate is 35g/100g water. (1 mark)

(d). Explain the shape of the graph. (1 mark)

(c). State one application of solubility and solubility curves. (1 mark)

PAPER 3

1. (a). You are provided with

(i). 0.3g of metal F.

(ii). 100cm^3 of 1.0M hydrochloric acid solution labelled as solution G.
(iii). 120cm^3 of 0.1M sodium hydroxide solution, labelled as solution H.
(iv). Screened methyl orange indicators solution.

You are required to determine the Relative Atomic Mass of metal F.

Procedure

(a). Using a burette, measure 50.0cm^3 of solution G into a clean 250ml beaker.
(b). Add the WHOLE AMOUNT of F provided into the beaker containing 50.0cm^3 of solution G and stir well with a glass rod until ALL the solid metal reacts completely.
(c). Transfer the mixture left in the beaker after the reaction into a 250ml Volumetric flask. Rinse the beaker as well as the glass rod with distilled water and transfer ALL the rinsings into the volumetric flask. Make up the volume of the solution in the volumetric flask up to the calibration mark with distilled water, cover the flask with a stopper, shake well and label as solution Q.
(d). Fill a clean burette with solution Q.
(e). Pipette 25.0cm^3 of solution H into a 250ml conical flask, add 3 drops of screened methyl orange indicator solution and titrate against solution Q from the burette.
A change in colour of the mixture from green to pink marks the end point of titration.
Record your results in table 1.
(f). Repeat the titration TWO more times to complete table I.

Table I

Titration	1	2	3
Final burette reading, cm^3			
Initial burette reading,cm^3			
Volume of solution Q used,cm^3			

(4 marks)

Average volume of Q used, cm^3 …….. (1 mark)

(g). Calculate:

(i). Calculate the number of moles of HCl in 50.0cm^{3}of solution G. (1 mark)

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(ii). Determine the number of moles of NaOH in 25.0cm^3 of solution H. (1 mark)

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(iii). Determine the number of moles of HCl in the average volume of solution Q useD in the titration. (1 mark)

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(iv). Calculate the moles of HCl left unreacted after the reaction between F and solution G. (1 mark)

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(vi). Determine the moles of HCl that reacted with metal F. (1 mark)

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(vi). Given that metal F forms a divalent cation, determine the moles of metal F that reacted with hydrochloric acid. (1 mark)

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(vii). Determine the Relative Atomic mass of metal F. (1 mark)

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……

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1(b). You are provided with
(i). 2.00g of solid K.
(ii). A thermometer
(iii). Distilled water
(iv). Boiling tube
(v). Hot water bath.

You are required to determine the temperatures at which solutions of known concentrations of compound K becomes saturated and plot solubility curve.

Procedure.

(a). Transfer the whole amount of solid K supplied to you into clean dry boiling tube.

(b). Using a burette, add 5.0cm^3 of distilled water into the boiling tube with solid K
(c) Put the boiling tubeinto a beaker of hot water bath and warm the boiling tube, while continuously stirring the content with thermometer, until the crystals of K dissolve/disappear
(DO NOT BREAK THE THERMOMETER)

(d). Remove the boiling tube from the hot water bath and allow the content to cool slowly while stirring with the thermometer. Not the temperature at which crystals
FIRST form/reappear and record this temperature in Table 2.

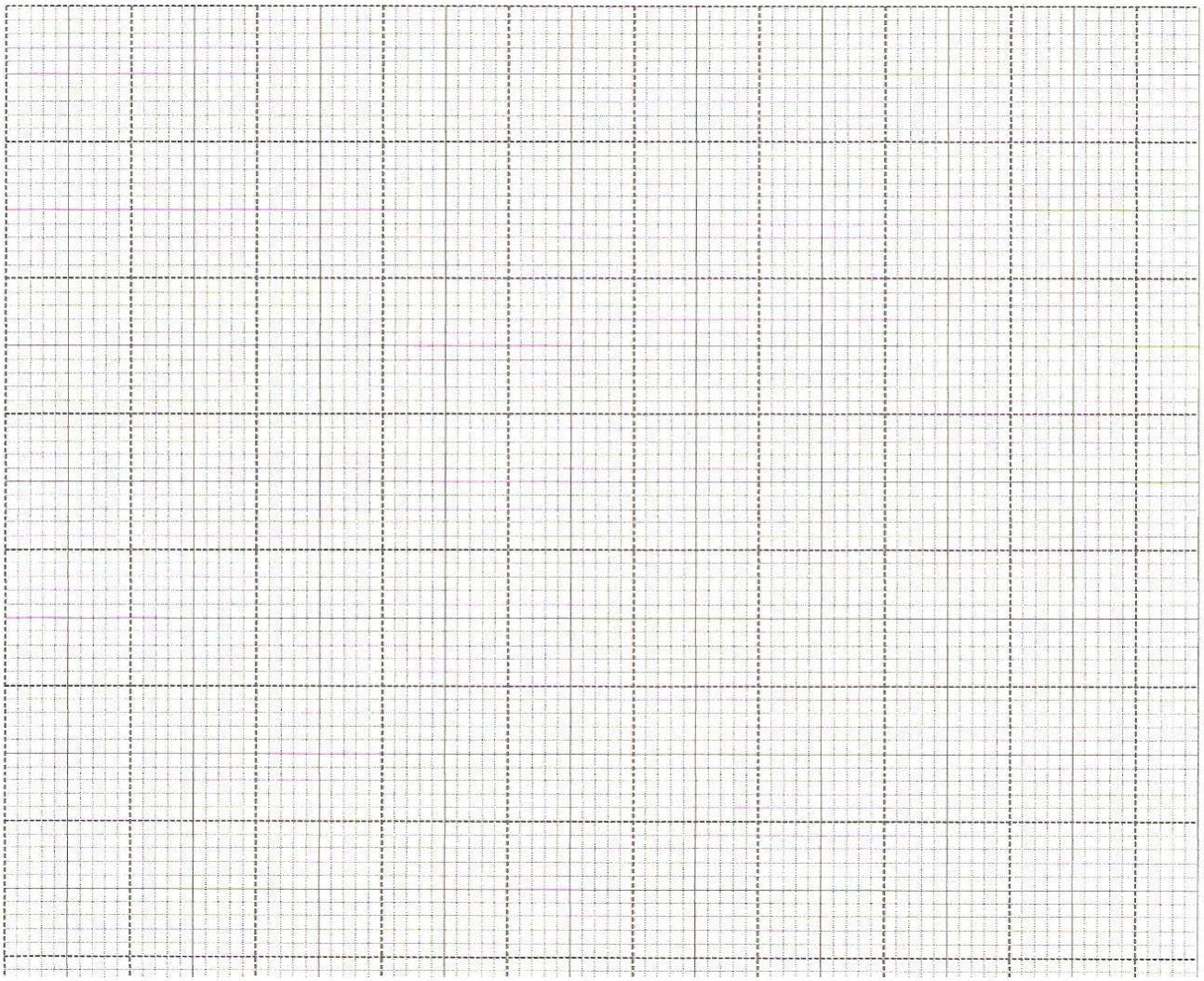
(e). Add a further 2.00cm^3 of distilled water from the burette into the boiling tube containing the mixture and repeat steps (c) and (d) above. Continue this way until the volume of water added to boiling tube is 5.00cm^3.

(f). Complete Table 2 by calculating the solubility of compound K in water at different temperatures.

Total volume of water added (cm^3)	Temperature at which crystals first appear (^{o}c)	Solubility of compound K in water (g/100g water)
5.00		
7.00		
9.00		
11.00		
13.00		
15.00		

(6 marks)

(g). On the grid provided plot a graph of solubility of compound K (vertical axis) against temperature.
(3 marks)



(h). From your graph determines the solubility of K in water at 25.0°c. (1 mark)

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2. You are provided with 10cm^3 of solution R containing TWO cations and ONE anions carry out the tests below and record your observations and inferences in the spaces provided.

(a). Add 20cm^3 of 2M sodium hydroxide to all of solution R provided. Shake well. Filter the mixture into a conical flask. Retain both the filtrate and residue.

Observation	Inference

(½ mark)	(½ mark)

(b). To about $2cm^3$ of the filtrate, add $1cm^3$ of $2cm^3$ of 2M nitric acid. Retain the mixture.

Observation (1/2)

Divide the mixture in (b) above into TWO portions

(i). To the FIRST portion, add aqueous sodium hydroxide solution drop wise until in excess.

Observation	Inference
(1 mark)	(1 mark)

(ii). To the SECOND portion, add 2M aqueous ammonia solution DROPWISE until in excess.

Observation	Inference
(1 mark)	(1 mark)

(c). To about $2cm^3$ of the filtrate, add 3 drops of 2M hydrochloric acid

Observation	Inference

(1/2 mark)	(1/2 mark)

(d). To about $2cm^3$ of the filtrate, add about $1cm^3$ of acidified Barium chloride solution

Observation	Inference
(1/2 mark)	(1 mark)

(e). To the RESIDUE add about $5cm^3$ of dilute nitric acid and filter into a clean test tube. To about $2cm^3$ of this filtrate add 2M aqueous. Ammonia solution dropwise until in excess and filter into clean test tube.

Observation	Inference
(1 mark)	(1 mark)

3. You are provided with solid Z.

Carry out tests below. Write your observations and inferences in the spaces provided.

(a). Scoop a little of solid Z (using a clean spatula and burn it in a |Bunsen burner flame.

Observation	Inference
(1 mark)	(1 mark)

(b). To the remaining portion, add about $6m^3$ of distilled water and shake. Divide the mixture into two portions

Observation	Inference
(1 mark)	(1 mark)

(c). To the second portion, add the whole of sodium carbonate provided.

Observation	Inference
(1 mark)	(1 mark)

(d). To a little amount of Z, add sodium carbonate.

Observation	Inference
(1 mark)	(1 mark)

KCSE REPLICA 3
PAPER 1

1. Ammonia burns in air in the presence of a catalyst according to the equation below :

$4NH_3(g)+5O_2(g) \rightleftharpoons 4NO(g)+6H_2O(g)$

a) Given that increase in temperature raises the amount of ammonia .State whether the left-right reaction is exothermic or endothermic .Give a reason. (2mks)

b) How will increase in pressure affect the yield of nitrogen (II) oxide? (1mk)

2. 0.98g of zinc and $100cm^3$ of 0.2M hydrochloric acid were reacted .

a) Show that zinc metal was in excess. (2mks)

b) Calculate the volume of hydrogen that was liberated at s.t.p (Zn =65.4,MGV=$22400cm^3$) (1mk)

3. The general formula for a homologous series of organic compound is $C_nH_{2n+1}OH$,name and draw the structural formula of the third member of this series

i. Name (1mk)

ii. Structural formula (1mk)

iii. Write an equation for the complete combustion of third member of the series (1mk)

4. The following are electrode potential of two half cells.(the letters do not represent actual symbols of the elements)

Half cell	**E^{θ}(V)**
$M^{2+}/M(s)$	-0.76
C^{2+}/C (s)	+0.34

a) Calculate the potential difference of the following cell:

$M(s)/M^{2+}(aq)//C^{2+}(aq)/C(s)$ (1mk)

b) Draw a cell diagram for the cell in (a) above (3mks)

5. 50g of crystals of salt W were added to $80cm^3$ of water at 25°C. after stirring 10g of the crystals of salt W were filtered out. Determine the solubility of salt W at 25°C (density of water $=1g/cm^3$) (3mks)

6. Elements F and G react forming a compound H. The compound has the following properties :
   I. It does not conduct electricity in solid state.
   II. It has low melting and boiling points.

a) State weather the elements are metals or non-metals (1mk)

b) What type of structure does compound H have ? (1mk)

c) Name the bond formed between F and G. (1mk)

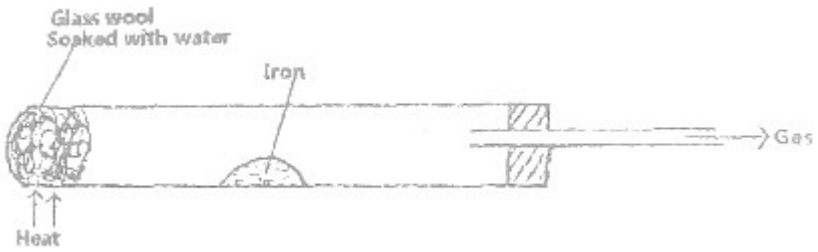
7. a) Distinguish between nuclear fission and nuclear fusion (1mk)

b) The half life of $^{235}_{92}U$ is 4500 years.

i. The isotope decays by alpha emissions, Write a nuclear equation for its decay for thorium (Th). (1mk)

ii. Work out the fraction of radioactive material that would be remaining after 18000 years (3mks)

8. The diagram below represents a set-up that was used to react iron with steam. Study it and answer the equations that follow.



a) Write an equation for the reaction that takes place. (1mk)

b) Why would it not be advisable to use potassium in place of iron in the above set –up? (1mk)

c) The glass wool is heated prior to heating of iron. Explain. (1mk)

9. In an experiment , sulphur (IV) oxide was bubbled into water followed by chlorine gas. The resulting solution gave a white precipitate when mixed with acidified barium chloride solution .

a) Explain this observation . (2mks)

b) Write an ionic equation for the formation of the white precipitate . (1mk)

10. Elements X^{3+} and Y^{-} have atomic numbers 13 and 8 respectively :

i. Write down the electron arrangement of elements X and Y. (1mks)

ii. Write the formula of the compound formed between element X and Y (1mk)

11. Corn oil can be converted into solid fat as shown by the equation below.

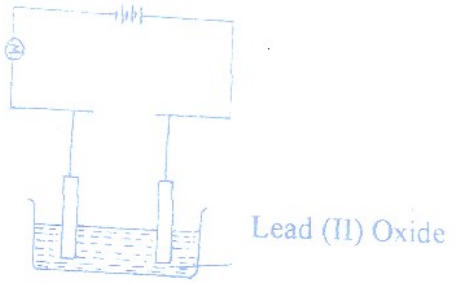
Corn oil $\xrightarrow{\text{reagent Y}}$ solid fat

a) Name the process shown above by the equation. (1mk)

b) What is the importance of this process (1mk)

c) Name reagent Y (1mk)

12. The set up below was used to investigate electrical conductivity of lead (II) iodide .study it and answer the questions that follow.



i. Label the anode (1mk)
ii. State one omission on the set up above (1mk)

iii. If the omission is corrected, Write an equation at the cathode. (1mk)

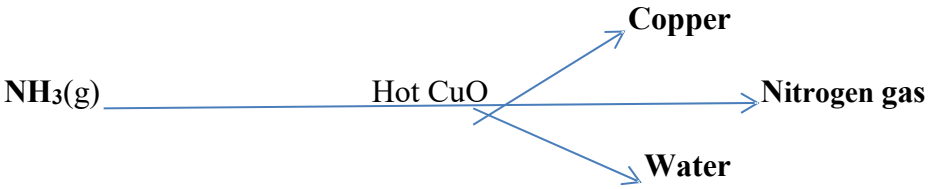
13. A student was provided with copper turnings and concentrated sulphuric (VI) acid. Draw a set- up that the student would use to prepare and collect a dry sample of sulphur (IV) oxide gas. (3mks)

14. Copper is extracted from its ores by a process of froth floatation and then roasted in air to produce copper (I) oxide.
    a) What is froth floatation (1mk)

    b) Write an equation for roasting of the ore in air (1mk)

c) Name one impurity in the ore and how it is removed. (1mk)

15. Dry ammonia gas was passed over hot copper (II) oxide as shown below.



a) State the property of ammonia being investigated above . (½ mk)

b) Write an equation for the reaction that took place (1mk)

c)Name one other gas that would be used in place of ammonia gas. (1mk)

16. Hydrogen peroxide decomposes according to the equation given below.

$$H_2O_{2(l)} \longrightarrow H_2O_{(l)} + \frac{1}{2}O_{2(g)};\ \Delta H = -98KJ/mol$$

If 6.8 g of hydrogen peroxide contained in 75cm^3 of solution with water were completely decomposed, determine the rise in temperature due to the reaction. (3mks)
(specific heat capacity of water =4.2Jg^{-1}K^{-1},density =1g/cm^3,O=16.0, H=1.0)

17. The figure below shows a Bunsen burner flame.

a) Describe how this type of flame is produced. (1mk)

b) Which part on the diagram is the hottest part of the flame. (½ mk)

c) Name the gas produced by a burning candle that is non-pollutant. (1mk)

18. A mixture of 5.0 g of sodium carbonate and sodium hydrogen carbonate was heated until there was no further change in mass .the loss in mass was 0.31 g. calculate the percentage by mass of sodium hydrogen carbonate in the mixture. (3mks)
(Na=23.0, H=1.0, C=12.0, O=16.0). (Assume loss in mass is due to loss of carbon (IV) oxide)

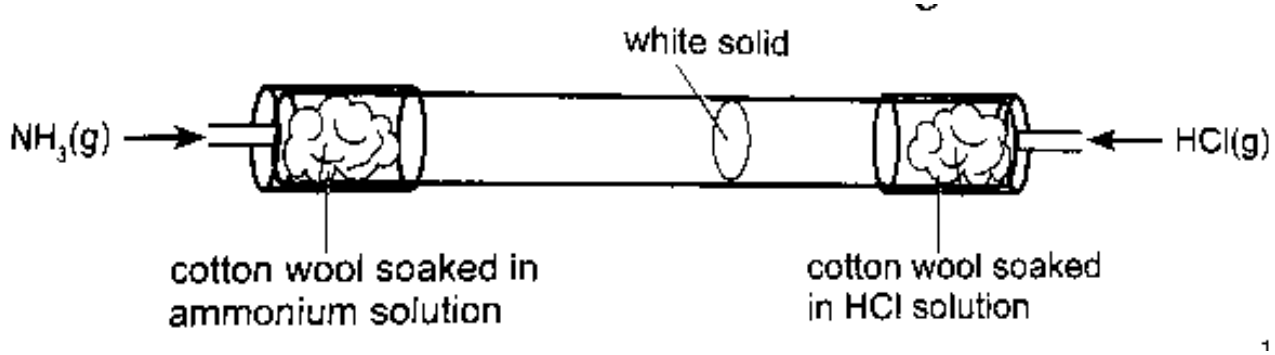
19. In the manufacture of sodium carbonate by Solvay process, ammonical brine trickles down the carbonator while carbon (IV) oxide rises up the same tower.
    a. What is ammonical brine. (1mk)

    b. Write two equations taking place in the carbonator. (2mks)

20. An atom of an element W has atomic radius of 0.099 nm and ionic radius of 0.181 nm.
    a. State whether W is a metal or a non- metal. (1mk)

    b. Explain the difference in atomic and ionic radius. (2mks)

21. The figure below shows a set up used by form 3 students to compare the rates of diffusion of ammonia and hydrogen chloride gas.



Given that ammonia travels through a distance of 30cm in 1 ½minutes.

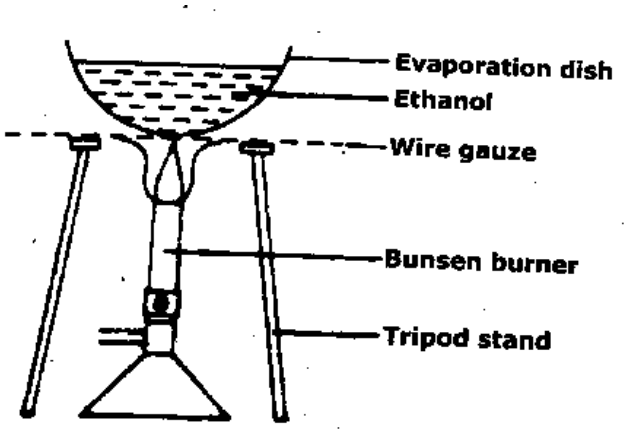
I. Calculate the distance through which hydrogen chloride travels within same time.(3mks)

II. Write an equation to show how the white solid is formed. (1mk)

22. Given that 3.52 g of carbon (IV) oxide and 1.40 g of water are produced when a mass of a hydrocarbon is completely burnt in oxygen , determine the formula of the hydrocarbon.
(H=1, C=12, O=16) (3mks)

23. $10cm^3$ of a gaseous hydrocarbon were mixed with $30cm^3$ of oxygen gas and the mixture exploded . After the mixture had cooled to room temperature, $20cm^3$ of gas remained. After shaking this gas with sodium hydroxide solution its volume was reduced to $10cm^3$.The remaining gas rekindled a glowing splint. Determine the formula of the hydrocarbon. (3mks)

24. The diagram below shows a method used by a student to determine the boiling point of ethanol. After setting the apparatus as shown below he inserted a thermometer into the ethanol.

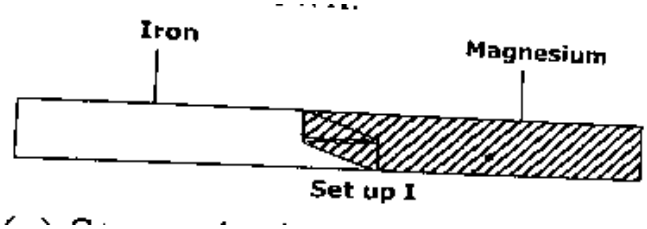


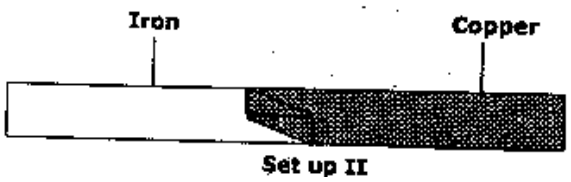
i. Give a reason why it is not a safe method. (1mk)

ii. Suggest a better method. (1mk)

iii. What will happen to the boiling point of ethanol if crystals of benzoic acid were first dissolved in it? (1mk)

25. A form two student in an attempt to stop rusting she put copper and magnesium in contact as shown.





I. State whether rusting occurred in each set-up after one week if the set-ups were left outside. (1mk)

II. Explain your answer in (a) above. (2mks)

26. The table below describes the properties of an acid,alkali and a salt solution.

a) Complete the table. (2 ½ mk)

solution	Colour with universal indicator solution	Approximate pH	Ions present
Sodium hydroxide	blue		Na^+ , OH^-
Hydrochloric acid	red		
Sodium sulphate		7	

b) Name two solutions which when mixed together form a solution of sodium sulphate. (1mk)

27. Complete the following equation.

Name the reaction above. (½ mk)

PAPER 2

1. The grid below shows a section of the periodic table. The letters do not represent the actual symbols of the elements.

K	L				M		N	P
	Q		R	S		T	V	
W								

a) Name the family to which element P belongs. **(1mk)**

b) Which two elements will form carbonates that do not decompose on heating **(2mks)**

c) With a reason, identify an element in period 3 with the largest atomic radius **(2mks)**

d) Write the formula of the compound formed between L and M **(1mk)**

e) State two uses of element **R** and for each use , state property of element **R** that makes it possible for the use

(i) Use **(1mk)**

Property **(1 mk)**

(ii) Use **(1mk)**

Property **(1mk)**

f) Using dots **(.)** and cross **(x),** show bonding in the compound formed between **R** and oxygen **(2 mks)**

g) In terms of structure and bonding explain why the oxide of element V has relatively low boiling points **(2mks)**

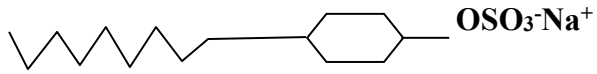
2. a. Name the following compounds **(3mks)**

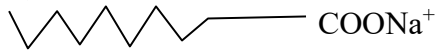
(i) $CH_3CH_2CH_2COOH$

(ii) $H_2C\ Br– CH(CH_3) – CH_2 – CBr = CH – CH_3$

(iii) $CH_3CH_2COOCH_2CH_3$

b. Two types of detergents P and Q can be represented as

P;  **$OSO_3^-Na^+$**

Q;  $COONa^+$

i. Identify each type of the detergent **(2mks)**

P

Q

ii) Which of the two detergents is the best to use with hard water? Give reason. **(2mks)**

iii). State one disadvantage of detergent **P** **(1mk)**

iv). State advantage of detergent **Q** **(1mk)**

c. A compound is represented as shown below

$CH_3CH_2CH_2COOC_2H_5$

i. Name the compound. **(1mk)**

ii. Name two reagents that can be used to generate the compound **(2mks)**

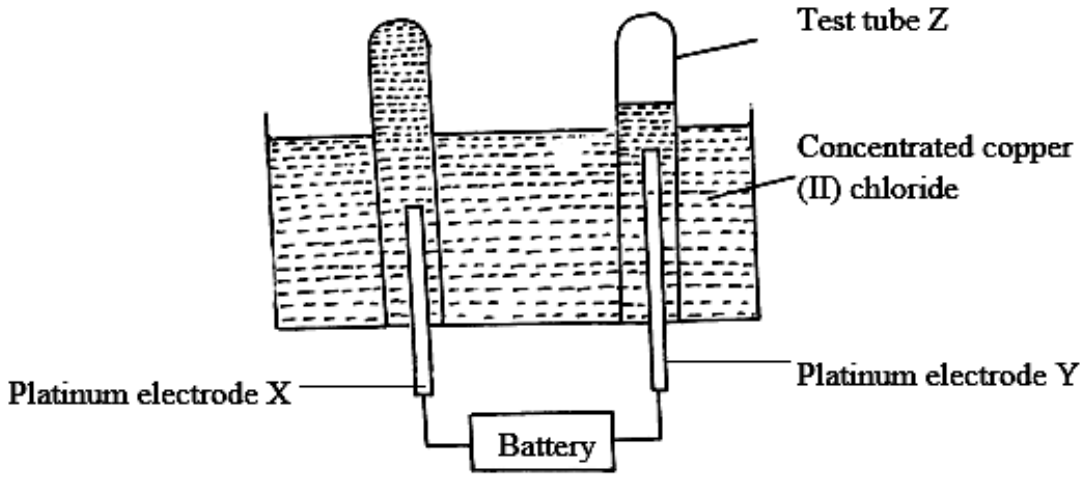
3. (a) Define the term electrolysis **(1mk)**

(b) State two function of the salt bridge during electrolysis (**2mks**)

(c) During the electrolysis of a molten chloride of metal Q, a current of 0.25A was passed through the molten chloride for 2 hours and 10 minutes .Given that 0.9 g of metal Q were deposited at the cathode.
(i) Calculate the quantity of electricity passed **(1mk)**

(ii) Charge carried by the ions of metal Q given that R.A.M of metal Q is 84 (**3 mks)**

(d)Electric current was passed through a concentrated solution of copper (II) chloride as shown in the diagram below.



(i) Write the chemical equation for the reaction at the cathode? (1 mark)

(ii) After sometime test-tube Z was found to contain a mixture of two gases. Explain this observation. (2 marks)

(iii) State the observations that would be made at the anode if the platinum electrodes are replaced with copper electrodes. (2 marks)

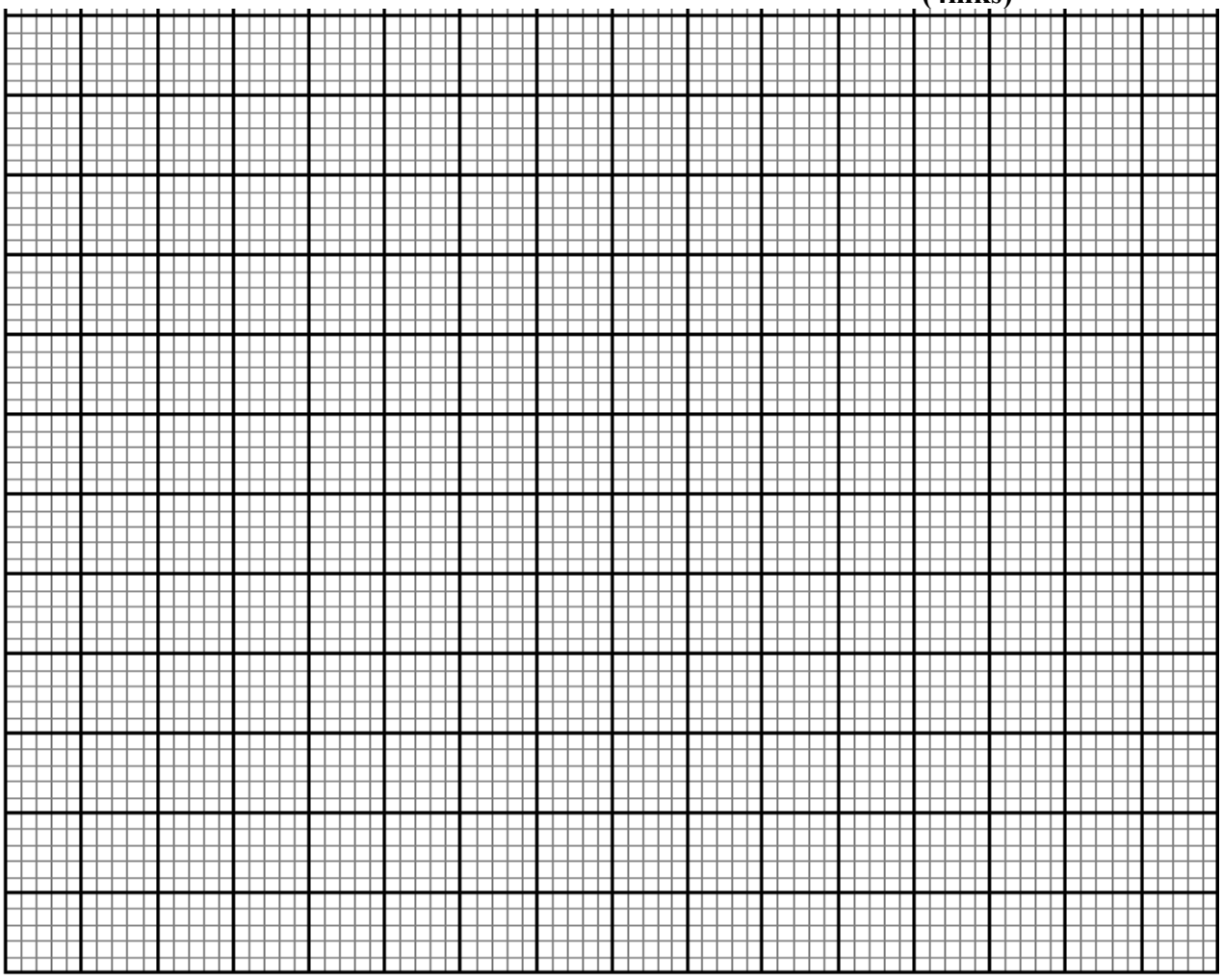
(iv) State one application of electrolysis in iron industry (1mk)

4. a) Define the term saturated solution. (1mk)

b) Solubility of salt X and Y were determined at different temperatures as shown in the following data.

Temperature (ºC)		0	20	40	60	80	100
Solubility of 100g of water	X	12	30	75	125	185	250
	Y	15	20	35	45	65	80

i. On the grid provided, plot a graph of solubility (vertical axis) against temperature.
(4mks)



ii. From the graph determine the solubility of each at 50ºC.

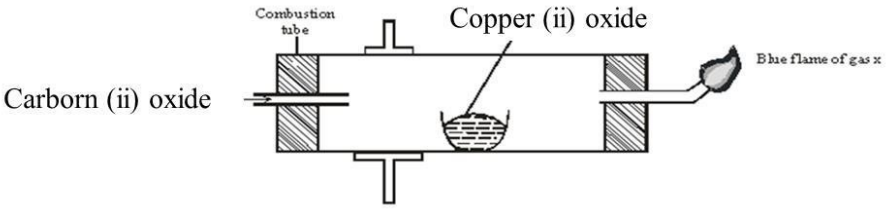
X **(1mk)**

Y **(1mk)**

iii. At what temperature was the solubility of both salts equal? **(1mk)**

c) What is permanent hardness of water? **(1mk)**

5. The diagram below shows an experiment incorrectly set-up to investigate a property of carbon (ii) oxide. Study it and answer the questions that follow.



a) Name one c : to proceed.

b) If the experiment was carried out properly, what observation would be made in the combustion tube? **(1mk)**

c) Give a name for the type of reaction that occurs in the combustion tube. **(1 mk)**

d) Write an equation for the reaction that takes place as gas x burns. **(1 mk)**

d) Why is it necessary to burn gas x? **(1mk)**

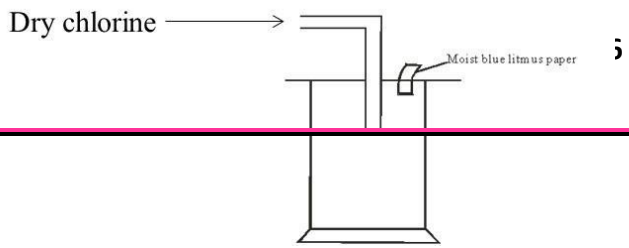
e) Name the reducing and oxidizing agent. **(2mks)**
(i) Reducing agent

(ii) Oxidising agent

f) Identify any other substance that would have the same effect on copper (II) oxide as carbon (II) oxide. **(1mk)**

g) What would happen if copper (II) oxide was replaced with sodium oxide? Explain. **(2mks)**

6. Dry chlorine was collected using the set up below.



a) Name a suitable drying agent for chlorine gas? **(1mk)**

b) State one property of chlorine gas which facilitates this method of collection. **(1mk)**

c) State the observations made on the moist blue litmus paper. Explain. **(2mks)**

d) Chlorine gas was bubbled through distilled water. With aid of an equation show the formation of chlorine water. **(1mk)**

e) Write the formula of the compounds formed when chlorine gas reacts with warm dry phosphorous. **(2mks)**

f) Chlorine gas is mixed with moist hydrogen sulphide gas. State and explain the observations. **(2mks)**

g) Give one use of chlorine gas. **(1mrk)**

7. A metal F is very reactive and therefore it is extracted by electrolysis of its fused chloride. The electrolytic cell used in its extraction is made of anode surrounded by a ring shaped iron cathode enclosed in a wire gauze shell that acts as a partition separating the two electrodes.When exposed to air it loses its lustre.At 620°C, it reacts with liquid ammonia liberating hydrogen gas.It is used as a deoxidizing agent in the preparation of light alloys and some rare earth metals from their oxides.

i) Name the process by which metal F is extracted. **(1mk)**

ii) What is the identity of metal F. **(1mk)**

iii) State the name of the ore from which metal F is extracted. **(1mk)**

iv) Explain why the metal loses its lustre when exposed to air. **(1mk)**

v) What is the function of wire gauze shell that separates the anode from the cathode?

(1mk)

vi) Write a chemical equation for the reaction between metal F and ammonia**(1mk)**

vii) Apart from being a deoxidizing agent, state two other uses of metal F. **(2mks)**

b) During extraction of aluminium by electrolysis, molten cryolite is used instead of water and the anode must be replaced from time to time.

i. State the main ore from which aluminium is extracted **(1mk)**

ii. Explain why cryolite is preferred over water **(1mk)**

iii. Give a reason why the anode is replaced from time to time. **(1mk)**

iv. Extraction of aluminium is very expensive compared to other metals like Iron, explain **(1mk)**

PAPER 3

1. You are provided with :-
   - Sulphuric (VI) acid, solution P
   - 0.25M sodium hydroxide, solution S
   - Solid R

   You are required to determine the concentration of sulphuric (VI) acid in moles per litre

PROCEDURE I

Using a burette, place 50.0cm^3 of sulphuric (VI) acid, solution P in a 100ml beaker. Measure the temperature of the solution after every half – minute and record the values in table 1 .At exactly 1 ½ minute, add solid R to the acid. Stir the mixture gently with the thermometer ensuring the solid is intact in the solution and note the temperature of the mixture after every half – minute and record the values in table 1.

a) ***Table 1***

Time (minute)	0	½	1	1 ½	2	2 ½	3	3 ½	4	4 ½	5	5 ½	6
Temperature (°C)													

(3mks)

b) Plot a graph of temperature (y – axis) against time. (3mks)

ii) Using the graph, determine the highest change in temperature. (1mk)

iii) Calculate the heat change for the reaction (Assume that the specific heat capacity of the mixture is $4.2Jg^{-1}\ k^{-1}$ and density of the mixture is $1g/\ cm)^3$. (2mks)

iv) Given that the molar heat of reaction of sulphuric (VI) acid with solid R is 320 kJ mol^{-1}, calculate the number of moles of sulphuric acid that were used during the reaction. (2mks)

PROCEDURE II

Transfer ALL the contents of the 100 ml beaker used in procedure I into a 250ml volumetric flask. Add distilled water to make up to the mark. Label this solution Q.
Rinse the burette and fill it with sodium hydroxide, solution S
Using a pipette and a pipette filler, place 25.0 cm^3 of solution Q into a 250ml conical flask. Add two or three drops of phenolphthalein indicator and titrate against sodium hydroxide. Record your results in table 2. Repeat the titration two more times and complete table 2.

Table 2

Experiment		I	II	III
Final burette reading	(cm^3)			
Initial burette reading	(cm^3)			
Volume of solution S used	(cm^3)			

(4mks)

a) Calculate the :-

i) Average volume of solution S used. (1mk)

ii) the number of moles of sodium hydroxide used. (1mk)

iii) Sulphuric (VI) acid in 25cm^3 of solution Q (1mk)

iv) Sulphuric (VI) acid in $250cm^3$ of solution Q. (1mk)

d) Calculate the number of moles of sulphuric (VI) in $50cm^3$ of solution P. (1mk)

e) Calculate the concentration of the original sulphuric (VI) acid solution P in moles per litre (2mks)

2. You are provided with solution **Q**. Carry out the tests shown below and answer the questions that follow.

(a) Dip a clean glass rod in solution **Q** provided and heat it using a non-luminous flame.

Observations	**Inferences**
(1 mark)	(1mark)

Divide the above solution Q into four portions

(b) To about $1cm^3$ of the solution add 2M sodium hydroxide dropwise until excess.

Observations	**Inferences**
(1 mark)	(1 mark)

(c) To the second portion add 2M ammonia solution dropwise until excess.

Observations	Inferences
(1 mark)	(1mark)

(d) To 1cm^3 of solution **Q** add a few drops of Lead (II) nitrate solution.

Observations	Inferences
(1 mark)	(1 mark)

(e) To 1cm^3 of solution **Q** add four drops of barium nitrate solution followed by a few drops of 2M nitric (V) acid.

Observations	Inferences
(1 mark)	(1 mark)

3. You are provided with substance E. Carry out tests on it.

a) (i) Place about one third of solid E on a metallic spatula and ignite it in a flame.

Observations	Inferences
(1mk)	(1mk)

Place the remaining solid E boiling tube and add about 5cm^3 of distilled water. Shake the contents and divide into 3 portions.

ii) To portion one add 3 drops of Universal indicator

Observations	Inferences
(1 mk)	(1 mk)

(b) To the second portion add all the sodium carbonate provided

Observations	Inferences
(1mk)	(1 mk)

(c) To third portion add 2 drops of acidified potassium manganate (VII) solution. Warm the mixture

Observations	Inferences
(1mk)	(1 mk)

KCSE REPLICA 4
PAPER 1

1.a) Define the term fuels (1mk)

……
……
……

b) State two reasons why hydrazine is used as rocket propellant (2mks)

……
……
……

2. Hydrogen can be placed in group VII and group I of the periodic table respectively. Use equations to explain (3mks)

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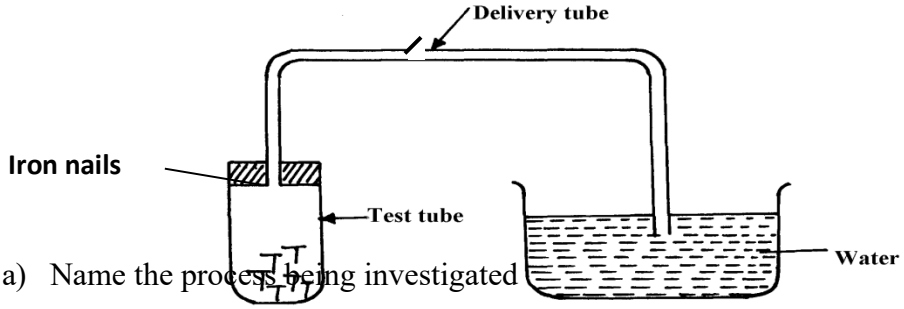
……
……
……
……
……

3. Study the set-up below and answer the questions that follow:-



a) Name the process being investigated (1mk)

……
……

b) State **two** observations that would be made after one week. Explain (2mks)

……
……
……

4.i) Apart from water softening list two other uses of sodium carbonate (2mks)

……
……

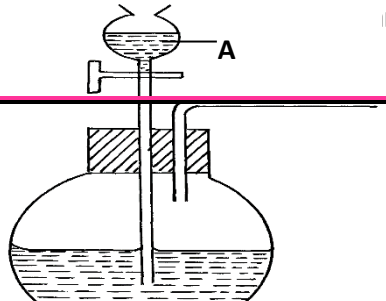
ii) Using an ionic equation show how sodium carbonate is used to soften hard water (1mks)

……
……

5. A form four student from Orawa secondary school found a white solid in a beaker that had two labels of zinc sulphate and aluminium sulphate respectively. Briefly explain how the student would test whether it was a compound of zinc or aluminium (3mks)

……
……
……
……

6. The set-up below was used to prepare a carbon (II) oxide gas.



(a) Give the name of substance **A** ……..($\frac{1}{2}$mk)

(b) Complete the diagram to show how the gas can be collected ($1\frac{1}{2}$mks)

……

……

(c)Write the equation for the reaction (1mk)

……

……

7. A certain gas A was passed over a hot black metal oxide B, a brown solid was formed and a colorless liquid C that boiled at 105 ºC, the liquid also changed a blue anhydrous cobalt (II) chloride paper to pink.

i. Name

a) Gas A……..($\frac{1}{2}$mk)

b)Metal oxide B……..($\frac{1}{2}$mk)

c)Colourless liquid C……($\frac{1}{2}$mk)

ii. State and explain a reason why the colourless liquid C boiled at 105ºC (1mk)

……

……

……

8. The following elements belong to the same group of the periodic table. (Letters do not represent the actual symbols)

Element	Atomic radius (nm)	Ionic radius (nm)	First ionization Energy (KJ mol^{-1})
A	0.136	0.065	736
B	0.089	0.031	900
C	0.174	0.099	590

(i) Are the elements metals or non-metals? Explain (2mks)

……

……

……

(ii) Which of the elements is the most reactive? (1mk)

……

……

……9. Zinc reacts with HCl according to the equation below.

$Zn(s) + 2\ HCl(aq) \rightarrow ZnCl_2(aq) + H_2\ (g)$

Complete the table to show how the factors given affect the rate of reaction above and give explanation (2 mks)

Factors	**Effect on rate**	**Explanation**

Using Zinc powder instead of granules		
Heat the reactants		

10. Which allotrope of sulphur:
    a. Is stable at room temperature ……..(1mk)

    b. Has prismatic crystals …….(1mk)

    c. Has higher density ……..…(1mk)

11. A certain flower was suspected to contain red and yellow pigments. Describe how the pigments could be separated (3mks)

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12. A certain element has two isotopes with atomic mass 6 and 7 respectively. Given that the relative atomic mass is 6.94. Calculate the relative abundance of each isotope (2mks)

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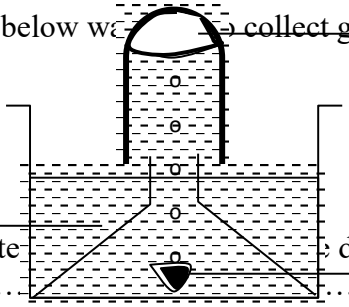
13. The set up below was used to collect gas **K**, produced by the reaction between water and calcium metal.



    i. State ; during the experiment (2mks)

……
……
……
……

    ii. Write an equation for the reaction taking place. (1mk)

……
……

14. State the properties of concentrated sulphuric (vi) acid demonstrated in the following reactions

i. Reacts with sodium chloride to form hydrogen chloride gas (1mk)

……

ii. Reacts with copper metal to form sulphur (iv) oxide (1mk)

……

15. 1.0g sample of limestone was allowed to react with 100cm^3 of 0.2M hydrochloric acid. The excess acid required 24.8cm^3 of 0.1M sodium hydroxide solution for complete neutralisation. Calculate the percentage of calcium carbonate in the limestone (3mks)

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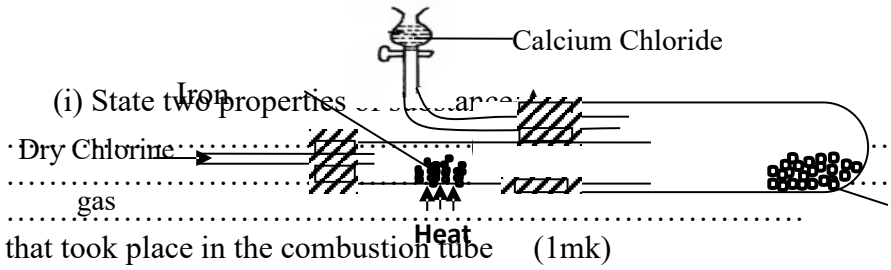
16. In an experiment, dry chlorine gas was reacted with aluminium as shown in the diagram below



(i) State two properties of substance A (2mk)

……

……

(ii) Write an equation for the reaction that took place in the combustion tube (1mk)

……

17. State one use each of the following apparatus in the laboratory (3mks)

i. Desiccator

……

……

ii. Crucible

……

……

iii. Deflagrating spoon

……

……

18. Using dots and crosses to represent electrons draw diagrams to represent bonding in (2mks)

i. H_3O^+(H=1,O=8)

……

……

……

……

……

……

19. Carbon powder and copper (ii) oxide are both black in colour. Suggest two reactions that can be used to differentiate them and state the observation in each case. (3mks)

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20. Starting with sodium metal explain how sodium hydrogen carbonate crystals can be prepared (3mks)

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……

21. i) Define the term simple acid base-indicator (1mk)

……
……
……

ii. State two disadvantages of using simple acid-base indicators (2mks)

……
……
……
……

22. i State two applications of complex ions in industries (2mks)

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……

23. What do the following abbreviations stand for? (2mks)

IUPAC……

DDT……

24.i. Differentiate between nuclear fission from nuclear fusion (2mks)

……
……
……
……

ii. A radioactive cobalt ($^{61}_{28}Co$) undergoes decay by emitting a beta particle and forming Nickel atom. Write a balanced decay equation for the above change (1mk)

……
……
……
……

25. The following are heats of combustion of carbon, hydrogen and ethanol the following substances calculate the heat of formation of ethanol

$C_{(s)} + O_{2\,(g)} \longrightarrow CO_{2\,(g)}$; $\Delta H = -393 KJmol^{-1}$

$H_{2\,(g)} + \frac{1}{2} O_{2\,(g)} \longrightarrow H_2O_{(l)}; \Delta H = -286 KJmol^{-1}$

$CH_3CH_2OH_{(l)} + O_{2\,(g)} \longrightarrow 2CO_{2\,(g)} + 3H_2O_{\,(l)}; \Delta H = 1386 KJmol^{-1}$

a) Draw an energy cycle diagram to represent the heat of formation of ethanol (1mk)

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b) Calculate the heat of formation of ethanol (2mks)

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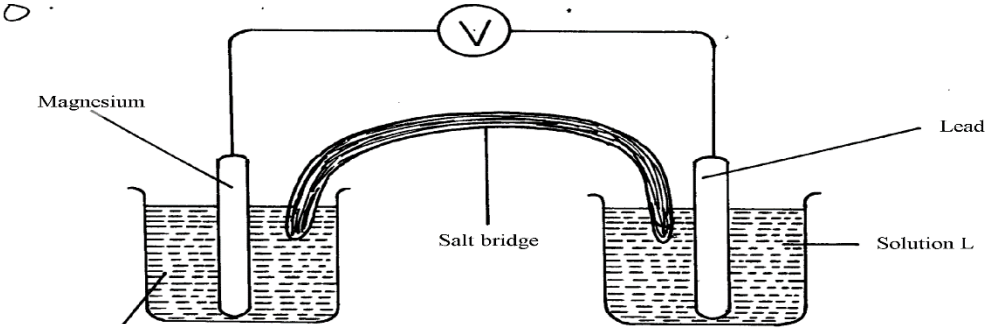
……

26. The diagram below shows an electrochemical cell:



a) (1mk)

……. ……

……. $MgSO_{4(aq)}$

(b) On the diagram show the direction of movement of electrons (1mk)

……(c)

Write the cell representation (1mk)

……

……

27. a) State the Graham's law (1mk)

……

……

……

……

b). $100cm^3$ of Carbon (IV) oxide gas diffused through a porous partition in 30seconds. How long would it take $150cm^3$ of Nitrogen (IV) oxide to diffuse through the same partition under the same conditions? (C = 12.0, N = 14.0, O = 16.0) (2mks)

……

……

……

……

28. A compound Q was oxidised by acidified potassium dichromate (vi) to form substance Z. Substance Z reacts with Q to form a pleasantly smelling compound ethylethanoate.

i. Name substance Q and Z (1mk)

……

……

……ii. Write an equation for the reaction between

a. Substance Q and potassium metal (1mk)

……

……b. Substance Z and sodium carbonate (1mk)

……

……

29. i. State two distinctive features of a dynamic equilibrium. (2mks)

……

……

……

……

ii. Explain the effect of increase in pressure on the following equilibrium (1mk)

$N_2(g) + O_2(g) \equiv\equiv\equiv 2NO(g)$

……

……

……

……

PAPER 2

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

M								
							B	
G	T		H			J	L	R
							V	
S								

a. An element X forms a divalent cation with the electron configuration 2.8.8. Place element X in its position on the grid (1 mark)

b. Element G was put in a trough with cold water containing phenolphthalein indicator
   i. State two observations made during the reaction (2 marks)
   ……
   ……
   ……
   ……
   ii. Write a chemical equation for the reaction (1 mark)
   ……
   ……
   iii. Compare the reactivity of G and S with cold water. Explain (2 marks)
   ……
   ……
   ……
   ……

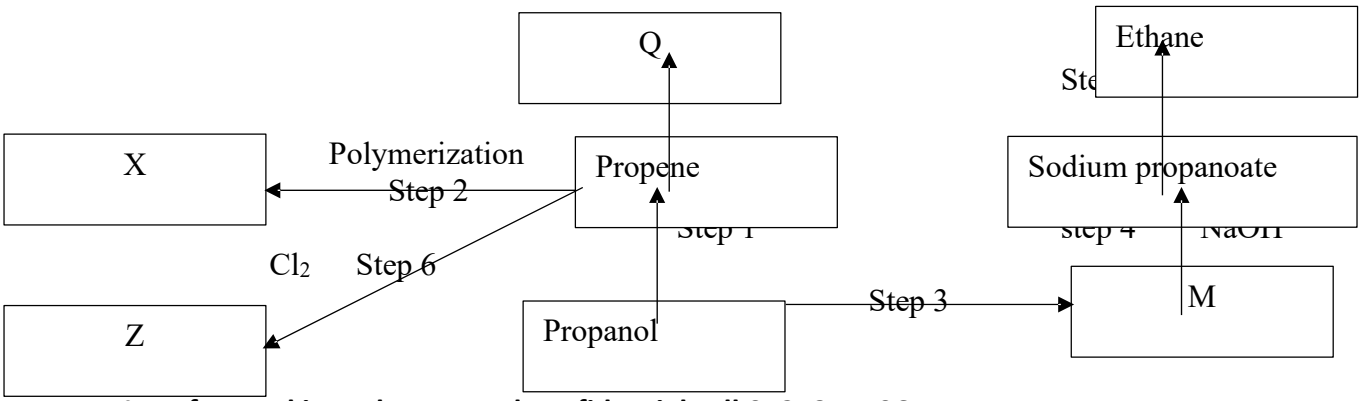
c. Draw dot(o) and cross (x) diagram showing bonding when element T and element L combine to form a compound. (1 mark)
   ……
   ……

d. Kamau accidentally mixed a chloride of S, iron (III) chloride and an oxide of H. Describe how he obtained a solid sample of each. (3 marks)
   ……
   ……
   ……
   ……
   ……
   ……

e. Explain why at room temperature, an oxide of G is a solid while an oxide of J is gaseous. (1 mark)
   ……
   ……
   ……
   ……

f. State one use of element R (1 mark)
   ……
   ……

2. The flow diagram below shows reactions starting with propanol. Study it and use it to answer the questions that follow.



a. Name the process in (1 mark)
   i. Step 1 ……
   ii. Step 3 ……

b. State the condition in (2 marks)
   i. Step 1 ……
   ii. Step 5 ……

c. Draw the structure of substance (2 marks)
   i. X

   ii. Z

d. Name the reagent used in (2 marks)
   i. Step 7 ……
   ii. Step 3 ……

e. Identify substance (1 mark)
   i. M ……
   ii. Q ……

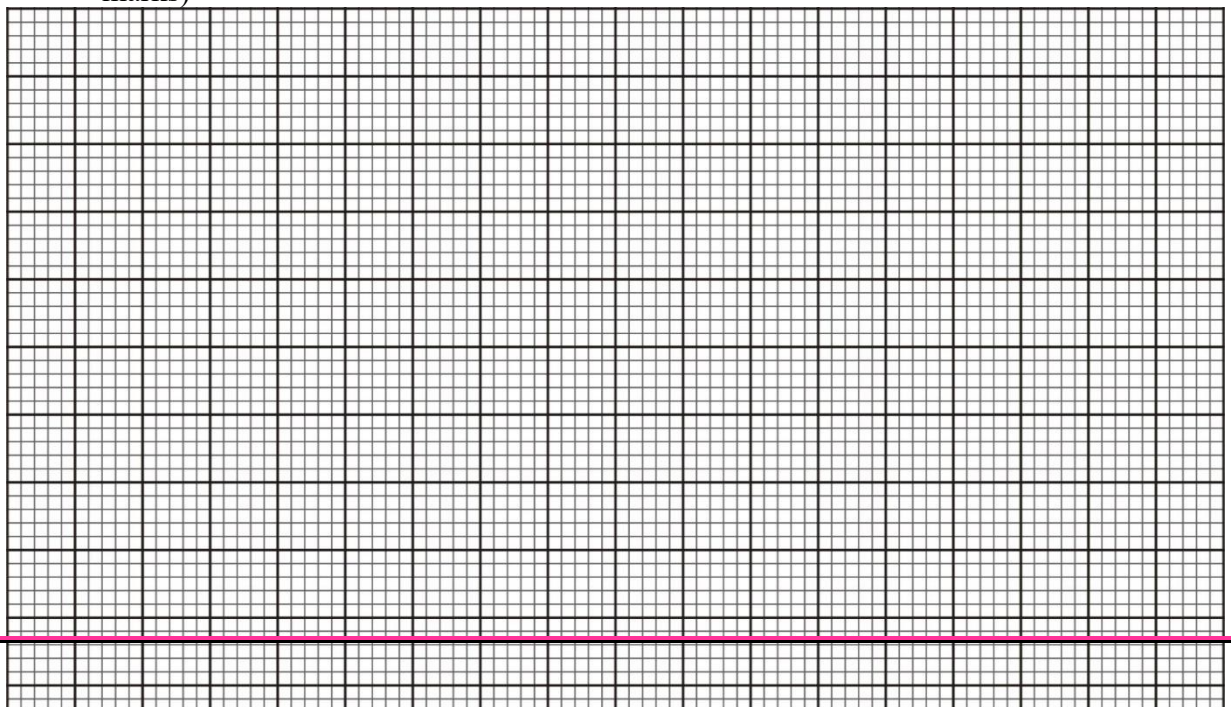
f. Describe an experiment used to distinguish between the product in step 1 and step 7 (2 marks)
……
……
……
……
……

g. Write an equation for the reaction of
   i) Propanol with potassium (1 mark)
……
……
……
   ii) Propene with oxygen (1 mark)
……
……
……

3. A student reacted 6g of magnesium ribbon with 50 cm^3 of 0.1M Hydrochloric acid and measured volume of hydrogen gas given off every 10 seconds for 60 seconds. The table below gives the results obtained.

Volume of hydrogen gas (cm^3)	0	9	15	19	20	20	20
Time taken (seconds)	0	10	20	30	40	50	60

a. On the grid below, plot a graph of Volume of hydrogen gas (y – axis) against time (x – axis) (3 marks)



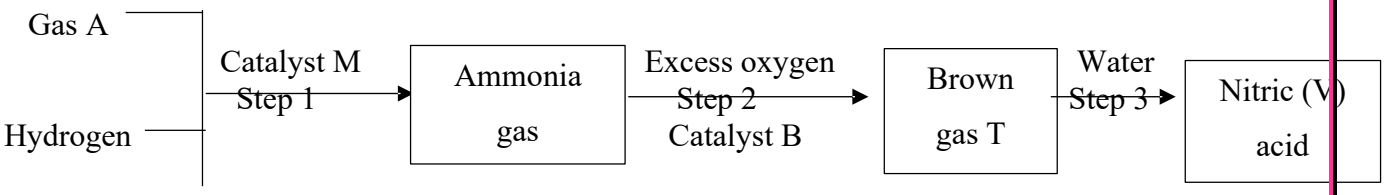
b. From the graph determine:
   i) Volume of gas produced at time 25 seconds ……. (1 mark)
   ii) Time taken for 12 cm^3 of hydrogen gas produced …… (1 mark)

c. Explain the shape of the curve between 40 – 60 seconds (1 mark)
……
……
……
……

d. The experiment was repeated using 1M Hydrochloric acid.
   i) On the same axes sketch the curve that would be obtained (1 mark)

   ii) Explain your answer in d(i) above (1 mark)
……
……
……
……

4. Study the flow diagram below and use it to answer the questions that follow

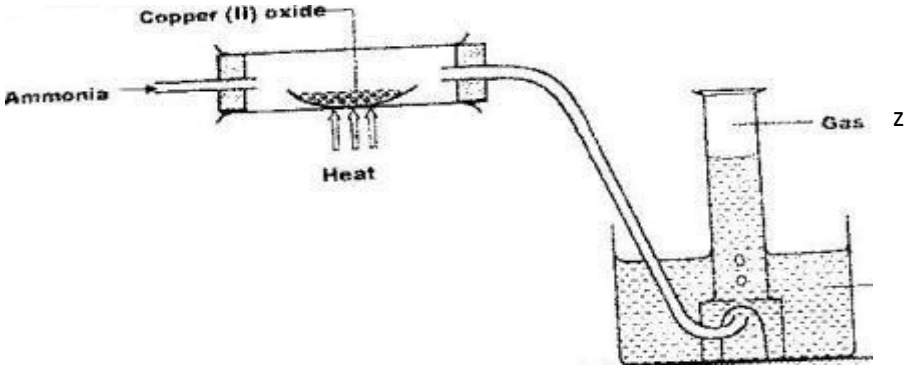


a. Name; (2 marks)
   iii. Gas A ……
   iv. Catalyst M ……
   v. Catalyst B ……
   vi. Gas T ……

b. Write an equation for: (2 marks)
   i) Step 1
……
……
……
   ii) Step 3
……
……
……

c. Name the main source of gas A (1 mark)
……
……

d. Ammonia gas was passed through a combustion tube containing heated copper (II) oxide as shown in the diagram below.



i) State and explain one observation made in the combustion tube (2 marks)

……

……

……

……

……Identify gas Z (1 mark)

……

……

ii) What property of ammonia is being investigated? (1 mark)

……

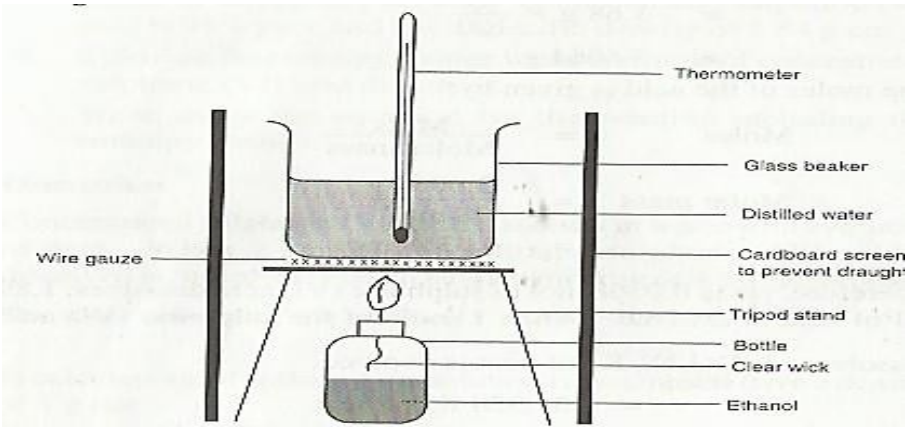
……

iii) Name a suitable drying agent for ammonia gas (1 mark)

……

……

5. The diagram below shows the set – up used to investigate enthalpy of combustion of ethanol when 450cm^3 of water was heated



The data below was obtained during the experiment

Volume of water = 450 cm^3

Initial temperature of water = 23.0 ^{0}C

Final temperature of water = 41.0 ^{0}C

Mass of the lamp + ethanol before heating = 141.7g

Mass of the lamp + ethanol after heating =140.2 g

Density of water = 1g/cm^3

Specific heat capacity = 4.2 Kj Kg^{-1} K^{-1}

a. Calculate;

i) Heat evolved during the experiment (2 marks)

……
……
……

ii) Moles of ethanol that reacted (C=12.0, H= 1.0, O=16.0) (1 mark)

……
……
……

iii) Molar heat of combustion of ethanol (2 marks)

……
……
……

b. Write a thermochemical equation for the reaction (1 mark)

……
……
……

c. The theoretical molar enthalpy of combustion of ethanol is – 1260 kJ/Mol. Give two reasons why the experimental value is less (2 marks)

……
……
……
……
……

d. Name two factors to consider before choosing a fuel (2 marks)

……
……
……

e. Study the information below and use it to answer the questions that follow

ΔH^{θ} lattice $= MgCl_2$ $-2477 kjmol^{-1}$

ΔH^{θ} hydration Cl^{-1} (aq) $-363 kjmol^{-1}$

ΔH^{θ} hydration Mg^{+2} (aq) $-1891 jmol^{-1}$

i) Define the molar enthalpy of solution combustion of a substance? (1 mark)

……
……
……

ii) Using the above information Draw an energy level diagram to represent the heat of solution of Magnesium Chloride (1 mark)

……
……
……
……

iii) Calculate the heat of solution of Magnesium Chloride (2 marks)

……
……
……

6. Use the reduction potentials below for P, Q, R, S and T to answer the questions that follow.

Reaction	E ° value (V)
$P^{2+}(aq) + 2e^- \rightarrow P(s)$	– 0.79
$2Q^{+}(aq) + 2e^- \rightarrow Q_2(s)$	0.00
$R^{2+}(aq) + 2e^- \rightarrow R(s)$	+ 0.45
$S^{2+}(aq) + 2e^- \rightarrow S(s)$	– 0.21
$\frac{1}{2} T_2(g) + 2e^- \rightarrow T^-(aq)$	+ 2.91

a. Identify;

i) The element that is likely to be hydrogen (1 mark)

……
…

ii) The strongest reducing agent (1 mark)

……
…

b. The half cells of P and R were combined

i) Draw the electrochemical cell formed (3 marks)

ii) Calculate the e.m.f. of the cell formed (1 mark)

……
……

c. During the extraction of sodium using the Down's cell, molten sodium chloride is electrolyzed.

i) State the role of the following in the cell (2 marks)

Calcium chloride

……
……

Steel diaphragm

……
……

ii) State the observation made at the anode (1 mark)

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……
……

iii) Write an equation for the reaction at the cathode (1 mark)

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……
……

iv) 2A was passed through molten sodium chloride for 2 hours and 35 minutes. Calculate the mass of sodium metal formed (1F= 96,500C, Na=23, Cl=35.5) (2 marks)

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……

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d. State two applications of electrolysis (2 marks)
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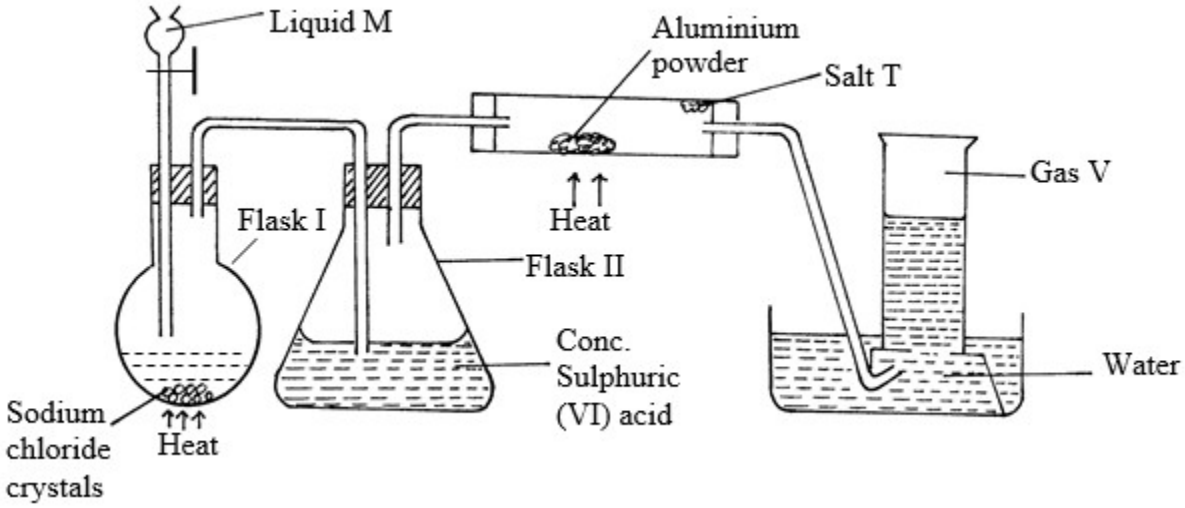
7. The set up below was used to prepare hydrogen chloride gas and salt T.



a. Identify the following
i) Liquid M…… (1 mark)
ii) Gas V…… (1 mark)
iii) Salt T…… (1 mark)

b. Write balanced chemical equations for reactions that occur at:
i. Flask I (1 mark)
……
ii. Combustion tube. (1 mark)
……

c. Name the process that formed salt T as shown in the diagram. (1 mark)
……

d. Sulphuric (VI) acid is used as a drying agent in this experiment. Explain why calcium oxide is unsuitable for the same purpose in this reaction. (1 mark)
……
……

e. The water in the trough was found to have a pH of 2.0 at the end of the experiment. Explain. (1 mark)
……
……

f. In the space provided below, draw a well labelled diagram showing how you would dissolve hydrogen chloride gas in water.
(1 mark)

……
……

g. Explain why hydrogen chloride gas dissolved in methylbenzene does not react with calcium carbonate.
(1 mark)

……
……

PAPER 3

1. You are provided with:
- Solid F
- 2.0 M hydrochloric acid solution G
- 0.1 M sodium hydroxide

You are required to determine the;

i) Enthalpy change ΔH, for the reaction between solid F and one mole of hydrochloric acid

Procedure:

I. Using a burette place 20.0cm^3 of 2.0M hydrochloric acid, solution G in a 100ml beaker. Measure the initial temperature of the solution after every ½ minute and record the values in table 1 below. At exactly 2 minutes, add all of solid F to the acid. Stir the mixture gently with the thermometer. Measure the temperature of the mixture after every half-minute and complete the table. **(Retain the mixture for use in procedure II)**

Table 1 (5 marks)

Time (min)	0	½	1	1½	2	2½	3	3½	4	4½	5
Temperature (°C)											

a) Plot a graph of temperature (y-axis) against time. (3 marks)

b) From the graph determine the change in temperature ΔT (1mark)

c) Calculate the heat change for the reaction (Assume the specific heat capacity of the mixture is 4.2 J g^{-1} K^{-1} and the density of the mixture is 1g/cm^3) (1mark)

Procedure II

Rinse the burette thoroughly and fill it with sodium hydroxide. Transfer all the contents of the 100ml beaker from procedure I above into a 250ml volumetric flask, add distilled water to make up to the mark. Label this solution H. using a pipette and a pipette filler, place 25cm3 of solution H into a 250ml conical flask. Add two to three drops of phenolphthalein indicator and titrate against sodium hydroxide. Record your results in table 2. Repeat the titration two more times and complete the table.

Table 2 (4 marks)

	I	II	III
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution solution D used (cm^3)			

Calculate the;

I. Average volume of sodium hydroxide used (1mark)

II. Number of moles of:

i) Sodium hydroxide used (1 mark)

ii) Hydrochloric acid in 25cm^3 of solution H (1 mark)

iii) Hydrochloric acid in $250cm^3$ of solution H (1 mark)

iv) Hydrochloric acid in $20cm^3$ of solution G (1 mark)

v) Hydrochloric acid reacted with solid F (1 mark)

c. Calculate the enthalpy of reaction between solid F and one mole of hydrochloric acid.

(Show the sign of ΔH) (1 mark)

2. You are provided with solid A. Carry out the tests described below and write your observations and inferences accordingly.

i. Dissolve solid A in about $10cm^3$ of distilled water in a boiling tube divide the resulting solution into five portions.

Observations	Inferences
(1 mark)	(1 mark)

ii. To the first portion and 5 drops of 2M sodium hydroxide solution

Observations	Inferences
(1 mark)	(1 mark)

iii. To the second portion dip a glass rod to one of the remaining portions and heat it in a non-luminous flame.

Observations	Inferences
(½ mark)	(½ mark)

iv. To the third portion add 2 or 3 drops of lead (II) nitrate solution

Observations	Inferences

(1 mark)	(1 mark)

v. To the forth portion add 2 or 3 drops of barium (II) chloride followed by $2cm^3$ of 2M hydrochloric acid. Shake the mixture well.

Observations	Inferences
(1 mark)	(1 mark)

vi. To the fifth portion add 3 drops of acidified potassium manganate (VII) solution

Observations	Inferences
(1 mark)	(1 mark)

3. You are provided with substance B.
Carry out the tests described below and record your observations and inferences accordingly.

Procedure

(i) Place a little amount of substance B in a metallic spatula and ignite it in a blue bunsen burner flame.

Observations	Inferences
(1 mark)	(1 mark)

(ii) Place a spatulaful of substance B in a boiling tube. Add about $20cm^3$ of distilled water and shake well. Divide the solution into three portions. Test the pH of one portion of the solution above using a full range pH chart.

Observations	Inferences
(1 mark)	(1 mark)

(iii) Add the sodium carbonate provided to the second portion.

Observations	Inferences
(1 mark)	(1 mark)

Add a few drops of potassium manganate (VII) solution to the third portion and warm mixture.

Observations	Inferences
(1 mark)	(1 mark)

KCSE REPLICA 5

PAPER 1

1. Study the information given below and use it to answer the questions that follow;
Red dye is more soluble than green dye, green is more soluble than yellow whereas blue dye is the least soluble.
   i) Represent the three dyes on a round paper chromatography. **(2marks)**

   ii) Name one industrial application of chromatography. **(1mark)**

……
…

2. a) What is a fuel? **(1mark)**

……
……
……
……

   b) Calculate the heat value of ethanol if its molar enthalpy of combustion is-1360kjmol^{-1}
   (C=12.0, O=16.0, H=1.0) **(2marks)**

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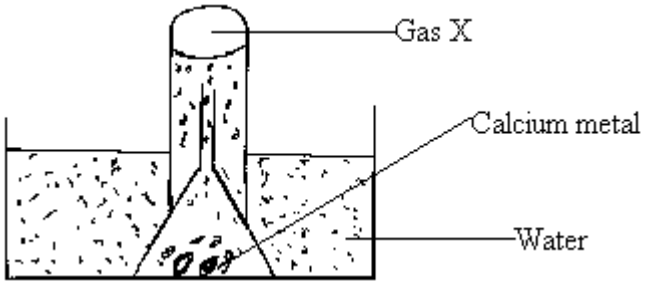
……

3. Study the set up below and use it to answer the questions that follow.



   a) What physical property of calcium metal is demonstrated in the diagram above? **(1mark)**

……
……

   b) What would be observed if water was replaced with dilute Sulphuric (VI) acid?
   (2marks)

……
……
……
……

4. A hydrocarbon decolorizes chlorine gas in presence of ultra violet light but does not decolorize acidified potassium manganate (VII) solution.
   i) Name the homologous series to which the hydrocarbon belongs. **(1mark)**

……
……

ii) Draw the structural formula and name the fourth member of the homologous series to which the hydrocarbon belongs? **(2marks)**

……
……
……
……
……
……
……
…

5. Explain why a solution of hydrogen chloride in water turns blue litmus paper red but a solution of hydrogen chloride in methylbenzene has no effect on litmus papers. **(2marks)**

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……
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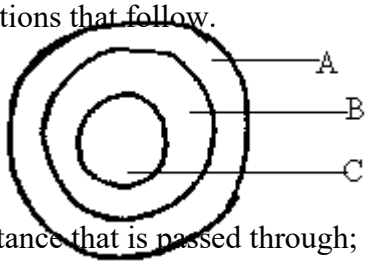
…

6. The diagram below represents a cross section of the apparatus used to extract sulphur from its deposits. Study it and answer the questions that follow.



a) State the role of the substance that is passed through;

i) A ……..

(1mark)

ii) C……

(1mark)

b)Give one reason why the method shown in the diagram is suitable for extraction of sulphur.
(1mark)

……
……..
.....

7. Explain how you would obtain magnesium carbonate from a mixture of magnesium carbonate and sodium carbonate.

(2mark

……
……
……
……
…

8. 20g of potassium carbonate were dissolved in $50cm^3$ of water in a conical flask. Lemon juice was then added drop wise while shaking until there was no further observable change.
   a) Explain the observation that was made in the conical flask when the reaction was in progress. **(1mark)**

……
……

   b) What observation would be made if lemon juice had been added to copper turnings in a conical flask?
   Give a reason. **(2marks)**

……
……
……
……

9. Explain why a burning magnesium continues to burn in a gas jar full of carbon (IV) oxide while a burning candle would be extinguished. **(2marks)**

……
……
……
……
…

10. 8.4g of carbon (IV) oxide and 3.42g of water are formed when a hydrocarbon is burnt completely in oxygen. Determine the empirical formula of the hydrocarbon.
    (H=1.0; C=12.0; O=16.0) **(3marks)**

……
……
……
……
…
……..

11. The melting point of nitrogen is -196^0C while that of sodium is 98^0C, in terms of structure and bonding explain the differences in the melting points of nitrogen and sodium. **(2marks)**

……
……
……
……
…
……

12. a) What is an amphoteric substance? **(1mark)**

……
……
……
……

   b) Identify the reagent that acts as a base in the equation below. Give a reason for your answer.

$$H_2O_{2(aq)} + H_2O_{(I)} \longrightarrow H_3^+O_{(aq)} + HO_{2(aq)}$$ **(2marks)**

……
……
……
…

13. In the industrial manufacture of ammonia gas by Harber process, Nitrogen and hydrogen gases are reacted together.

a) State any two conditions necessary for ammonia to be formed in the Harber process. **(1mark)**

……
……
……

b) Nitrogen and hydrogen must be purified before they are reacted. Give a reason. **(1mark)**

……
……
……

c) Other than manufacture of fertilizers state one use of ammonia. **(1mark)**

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14. Describe how you would prepare crystals of potassium sulphate starting with $100cm^3$ of 0.5M potassium hydroxide. **(3marks)**

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……15. Distinguish between atomic mass and relative atomic mass.
(2marks)

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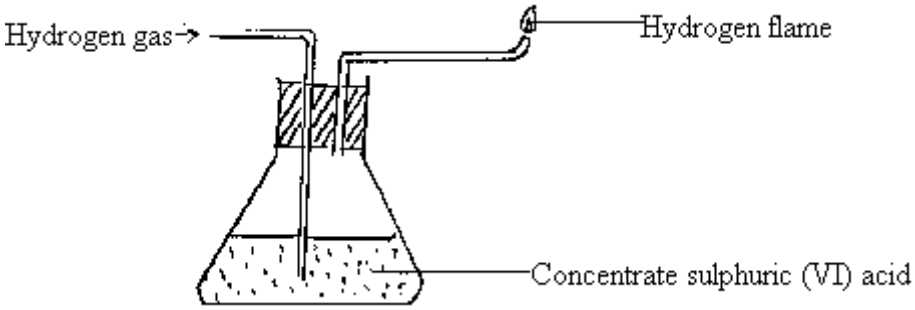
……

16. Study the diagram below and answer the questions that follow:



a) Name one chemical and one physical property of hydrogen being demonstrated in the set-up above.

i) Chemical property. **(1mark)**

……
....

ii) Write a chemical equation for the reaction taking place. **(1mark)**

b) Name any other substance that can be used in place of concentrated sulphuric (VI) acid. **(1mark)**

……
……
……

c) Give a reason why it is necessary to burn the hydrogen gas as shown in the set-up. **(1mark)**

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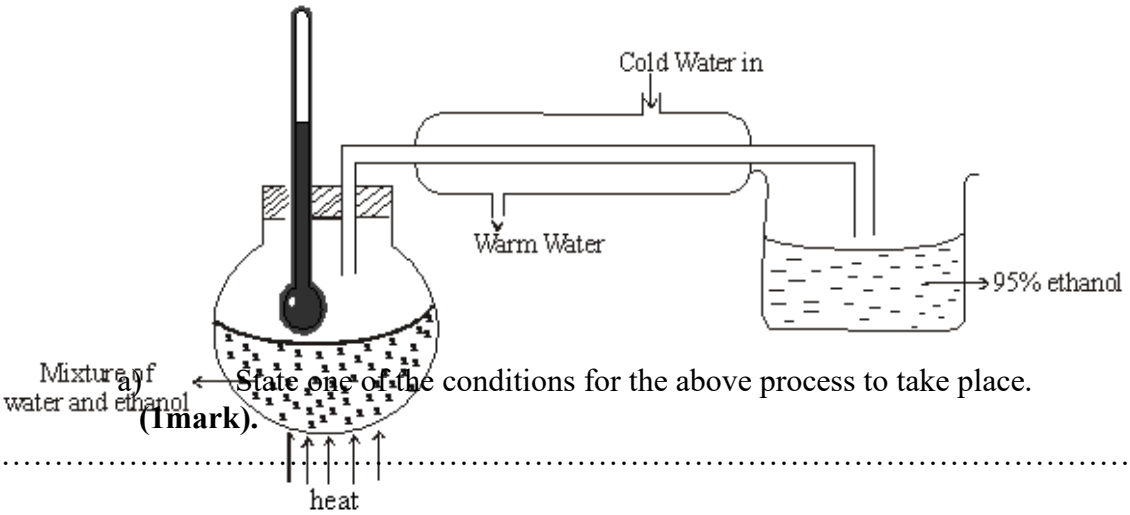
17. The diagram below shows a simple distillation to separate water and ethanol.



a) State one of the conditions for the above process to take place. **(1mark).**

……

…

b) Ethanol collected is 95% pure. Secondary distillation is carried out in which calcium metal is placed in ethanol to react with water. Give a reason why the following cannot be used. **(2marks)**

i. Sodium

……

……

…….

ii. Copper……

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…..

18. A solution of potassium chloride was added to a solution containing a lot of lead (II) nitrate. A precipitate that weighed 5.56g was formed. Find the amount of potassium chloride in the solution **(3marks)**

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19. 1.9g of Magnesium chloride was dissolved in water. Silver nitrate solution was added till excess. Calculate the mass of silver nitrate that was added for complete reaction. **(3marks)**
(MgCl$_2$= 95, N=14, O=16, Ag = 108)

……

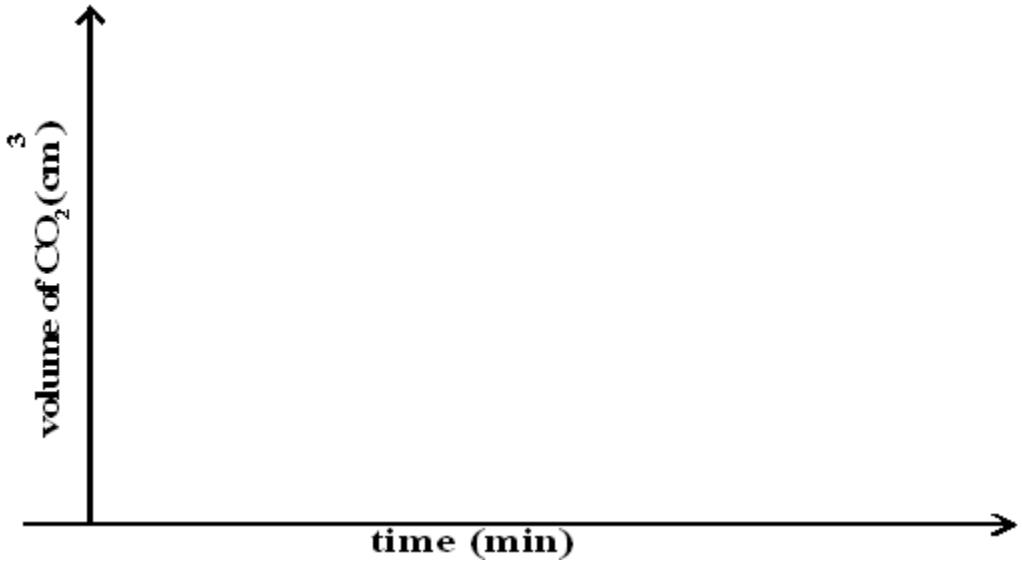
……

20. In an experiment 40cm^3 of 0.5M nitric acid was reacted with excess Sodium Carbonate and the volume of Carbon (IV) Oxide produced recorded with time. In another experiment, the same volume and concentration of ethanoic acid was reacted with excess Sodium Carbonate and the volume of Carbon (IV) Oxide produced recorded with time.

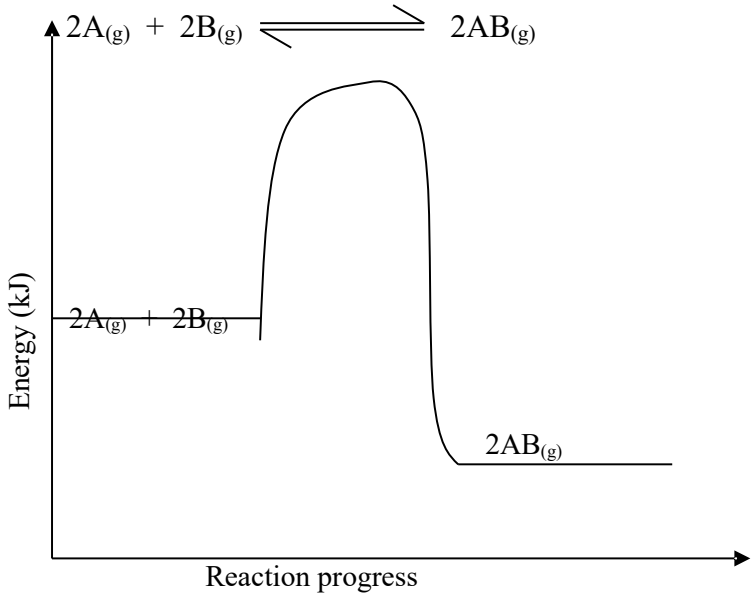
a) Why was Sodium Carbonate used in excess? **(1marks)**

b) On the graph below sketch and label the curves of the volumes of Carbon (IV) Oxide produced against time.

(2marks)



21. The figure below is an energy level diagram for the reaction.



Explain how the following conditions would affect the yield of AB.

(i) Increase in pressure. **(2marks)**

……

(ii) Decrease in temperature. **(2marks)**

22. A white solid K was heated. It produced a brown gas **A** and another gas **B** which relights a glowing splint. The residue left was yellow even after cooling.

a) Identify gases **A** and **B**. **(2marks)**

……

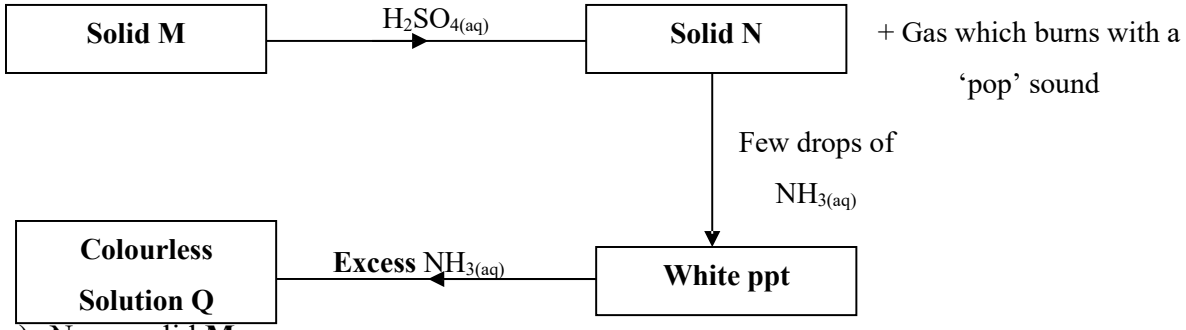
……

b) Write a balanced chemical equation for the decomposition of solid K. **(1mark)**

……

……

…… 23. The scheme below shows some reaction sequence starting with solid M.



a) Name solid **M**. **(1mark)**

……

b) Write the formula of a complex ion present in solution **Q**. **(1mark)**

……

Write an ionic equation of the reaction between barium nitrate and solution **N**. **(1mark)**

……

24. (a) What is meant by a saturated solution? **(1mark)**

……

……..

(b) In an experiment to determine the solubility of solid Y in water at 30^0C the following results were obtained.

Mass of evaporating dish	=	26.2g
Mass of evaporating + saturated solution	=	42.4g
Mass of evaporating dish + dry solid Y	=	30.4g

Using the information, determine the solubility of solid Y at 30^0C. **(2marks)**

……

25. Compare the electrical conductivity of dilute Sulphuric (VI) acid and concentrated Sulphuric (VI) acid. Explain your answer. **(2marks)**

26. Draw a well labelled diagram of a setup used to prepare and collect dry Sulphur IV oxide. **(3marks)**

27. The molar heat of formation of carbon (II) oxide is -105kJmol^{-1}, molar heat of combustion of carbon is -393kJmol^{-1}.
By using an energy cycle diagram, determine the molar heat of combustion of carbon (II) oxide.

(3marks)

28. In an experiment, a small amount of charcoal was added into a test tube and 5cm^3 of concentrated nitric (V) acid added, then warmed.

(i) State the observation that was made. **(1mark)**

……
……

(ii) Explain the observation made in (i) above. **(1mark)**

……
……

(iii) Write an equation for the reaction that took place. **(1mark)**

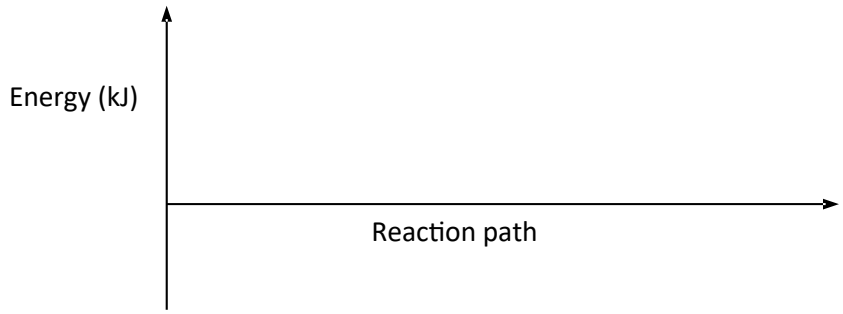
……
……
……

PAPER 2

1. a) Consider the following reaction:

$A_{2(g)} + B_{2(g)} \rightleftharpoons 2AB_{(g)}, \quad \Delta H = +75$ kJ

Sketch an energy level diagram showing the relative activation energies for the catalysed and uncatalysed reactions using the axes below. (2mks)



b) Given that; $\Delta H_f (Al_2O_3) = -1590$ kJmol^{-1}
$\Delta H_f (Cr_2O_3) = -1134$kJmol^{-1}

Calculate the heat of reaction for; $2Al_{(s)} + Cr_2O_{3(s)} \rightarrow Al_2O_3 + 2Cr_{(s)}$ **(2mks)**

c) The following data was obtained during an experiment

Mass of ethanol burnt	=	0.2g
Mass of water in the calorimeter	=	200g
Specific heat capacity of water	=	4.2 jg^{-1}k^{-1}
Initial temperature of water	=	23.5 ^{0}C
Final temperature of water	=	28.0 ^{0}C

i) **How** was the mass of ethanol that burnt determined? (1mk)

……
……

ii) **How** much heat was required to raise the temperature of water from 23.5 ^{0}C to 28.0^{0}C? (2mks)

……
……

iii) Two assumptions were made in calculating the enthalpy of combustion for ethanol. **State them.** (1mk)

……

……

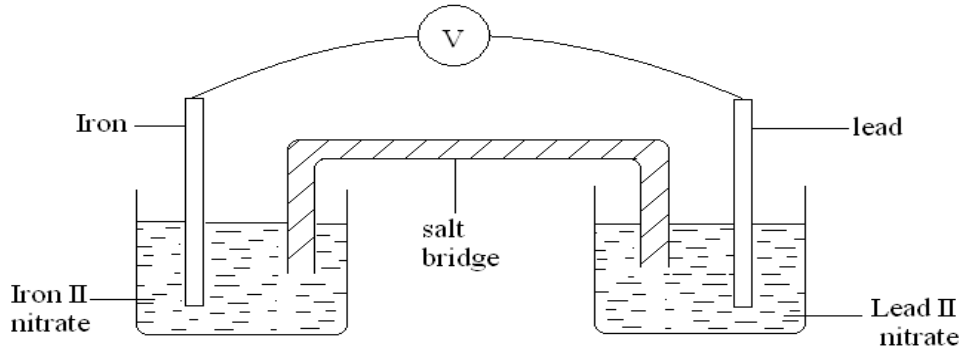
iv) **Determine** the molar enthalpy of combustion of ethanol.(C= 12,H=1, O=16)

(2mks)

v) **Write** a thermochemical equation for the combustion of ethanol given the accurate value for enthalpy of combustion is – 1368 $kJmol^{-1}$. (1mk)

……

2. Two half cells were connected as shown to form a voltaic cell. The reduction potentials are given.



$Pb^{2+}_{(aq)} + 2e \longrightarrow Pb_{(s)}$ $\quad E^{\Theta} = -0.13V$

$Fe^{2+}_{(aq)} + 2e \longrightarrow Fe_{(s)}$ $\quad E^{\Theta} = -0.44V$

a) **Calculate** the e.m.f of the cell. (1mk)

b) **Sodium chloride is used as the salt bridge. State the** two functions of the salt bridge. (2mks)

……

……

c) **Show** the direction of the electron flow in the external circuit. (1mk)

d) The e.m.f of the cell will reduce with time. Give a reason for this. (1mk)

……

……

e) During electrolysis of water acidified with Sulphuric acid, two gases were produced at the electrodes:

i) **State** which ions are preferentially discharged at the electrodes. **Explain** with aid of half ionic equations.

Anode.

(2mks)

……

……

Cathode.

(2mks)

……

……

ii) **Calculate** the volume of the gases at s.t.p produced when a current of 0.025A is passed for 4 hours. (1 Faraday=96500C) (3mks)

3. a) The fermentation of glucose is catalysed by enzymes from yeast. Yeast is added to aqueous glucose, the solution starts to bubble and becomes cloudy as more yeast cells are formed.

$C_6H_{12}O_{6(aq)} \xrightarrow{} 2C_2H_5OH_{(aq)} + 2CO_{2(g)}$

The reaction is exothermic. Eventually the fermentation stops when the concentration of ethanol is about 12%.

(i) On a large scale, the reaction mixture is cooled. Suggest a reason why this is necessary. (1mk)

……

……..

(ii) Why does the fermentation stop? Suggest one reasons. (1mk)

……

……

(iii) What technique is used to concentrate the aqueous ethanol? (1mk)

……

……

b) A compound X contains carbon, hydrogen and oxygen only. X contains **54.54**% of carbon by mass, **9.09**% of hydrogen by mass and **36.37**% of oxygen by mass. (C=12, O=16, H=1)

(i) Determine the empirical formula of compound X. (2mks)

(ii) Compound X has a relative molecular mass of 88. Draw the structural formula of compound X. (2mks)

c) The table below gives formulae of three organic compounds A, B and C

Compound	Formulae
A	$C_2H_4O_2$
B	C_2H_6O
C	C_2H_6

Giving a reason in each case, select the letter(s) which represent a compound that

i) Decolourises acidified potassium manganate (VII). (1mk)

……

……

ii) .Gives effervescence with sodium hydrogen carbonate. (1mk)

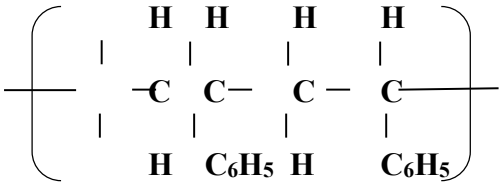
……

……

iii) Undergoes substitution reaction with chlorine gas. (1mk)

……
……

d) The following is a small reaction of polystyrene polymer. Study it and answer the questions that follow.



(i) Draw the structure of the monomer unit of polystyrene. (1mk)

(ii) Calculate the number of monomers used to form the polystyrene of relative molecular mass of 18096.
(H = 1, C = 12) (1mk)

4. An experiment was carried out using magnesium ribbon and dilute hydrochloric acid of different concentrations. The time needed to produce $50cm^3$ of the gas for every experiment was recorded in a table.

Concentration of HCl (moles per litre)	2.0	1.75	1.50	1.25	1.00	0.75	0.50	0.25
Time (seconds)	8.8	10.0	11.7	14.0	17.5	18.7	35.0	70.0
$\frac{1}{time}$ (Sec^{-1})								

a) Complete the table above for $^1/_{time}$. (4mks)

b) Plot a graph of rate i.e $^1/_{time}$ against concentration. (3mks)

c) From your graph determine the concentration needed to produce $50cm^3$ of hydrogen gas when time is 15.0 seconds (1mks)

……
……

d) From your graph state the relationship between the rate of reaction and concentration. Give a reason. (1mk)

……
……

e) A state of equilibrium between dichromate (vi) and chromate ions is established as shown below

$Cr_2O_7^{2-}{}_{(aq)} + 2OH^-{}_{(aq)} \rightleftharpoons 2CrO_4^{2-}{}_{(aq)} + H_2O_{(l)}$

Orange **(Yellow)**

i) What is meant by dynamic equilibrium?
(1mk)

……
……
……

ii) State and explain observation made, when a few pellets of Hydrochloric acid are added to equilibrium mixture (2mks)

……
……
……
……

5. I) The table below shows properties of some elements represented by symbols W,X,Y and Z. Study the information in the table and answer the questions that follows

Element	No. Of protons	Atomic radius(nm)	Boiling point ^{0}C
W	2	0.93	-269
X	10	1.31	-246
Y	18	1.54	-186
Z	36	1.89	-152

a) Write down the electron arrangement for elements W and X (1mk)

……
……

b) In which group of the periodic table are the elements in the table above? Give the name of the group (2mks)

……
……..

c) Explain why the atomic radius of W is smaller than that of X (1mk)

……
……

d) state one use of element X (1mk)

……
……

II. The section below represents part of the periodic table. Study it and answer the questions that follow. The letters are not the actual symbol of the elements.

				Q				
X			B	H		M	T	
Y		A					V	
Z							S	

a) **Select** the least reactive non-metal. (1mk)

……

b) **Which** of the elements has the greatest tendency of forming covalent compounds in nature? **Explain** your choice. (1mk)

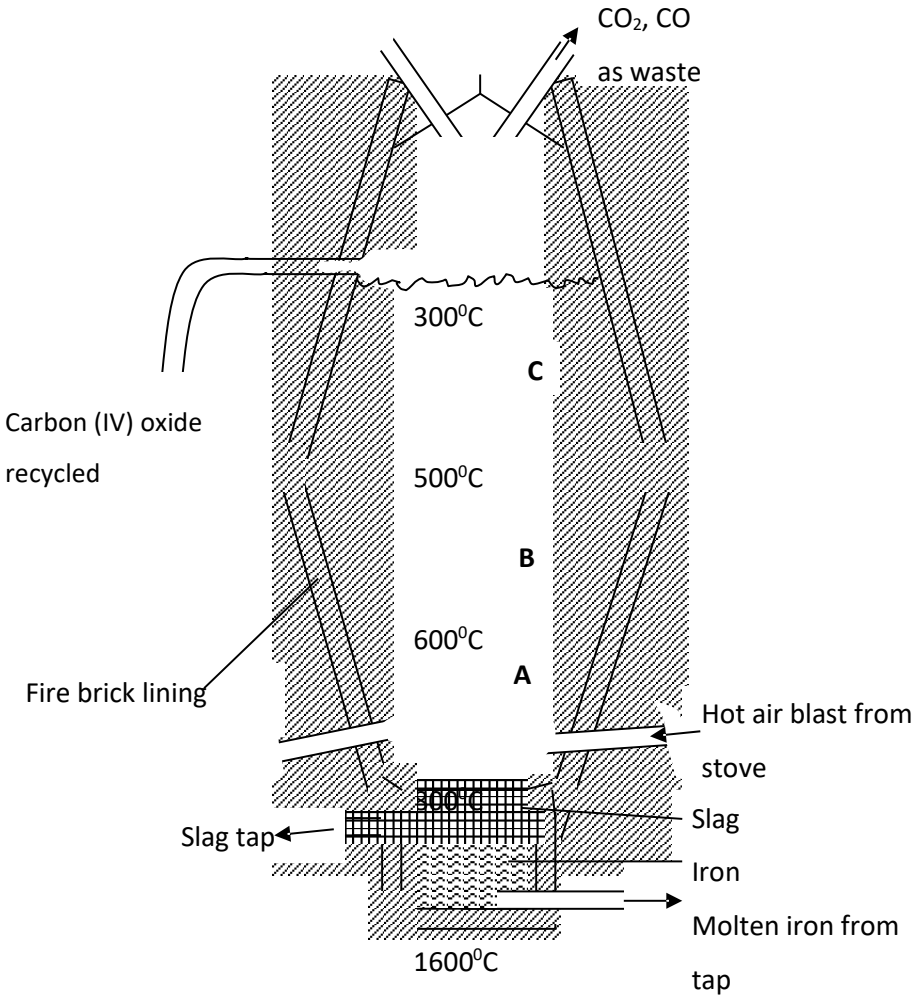
……
……

c) **Explain** why the atomic radius of **T** is smaller than that of **M**. (2mks)

……
……

d) Compare the electrical conductivity of element X and B. (2mks)

6. Extraction of iron involves two main processes, smelting and refining. Below is the blast furnace which is used to smelt iron from its ore.



a) (a) (i) The chief ore is Haematite. Name one other ore used in extraction of iron (1 mark)

……

…… (ii) Name the reducing agent in the process. **(1mk)**

……

……

(i) What is the role of the hot air blast in the process? **(2mks)**

……

……

(b) Write equations for the reactions that take place at the region marked A, B and C. **(3mks)**

A……

B……

C ……

(c) What is the purpose of limestone in the extraction process? **(1mk)**

……

(d) Write equations to show how impurities are removed from the ore. **(2mks)**

……

……

……

(e) State one environmental effect of the process. (1mk)

……

……

7. a) Read the following passage and answer the questions.

A salt K was heated with slaked lime (calcium hydroxide). A colourless gas L with a characteristic smell and turns red litmus paper blue was evolved. A large quantity of this gas was passed through an inverted filter funnel into Copper(II)sulphate solution, and a deep blue solution M was obtained.

a) Identify gas L
(1mk)

……

……

b) What is K most likely to be?
(1mk)

……

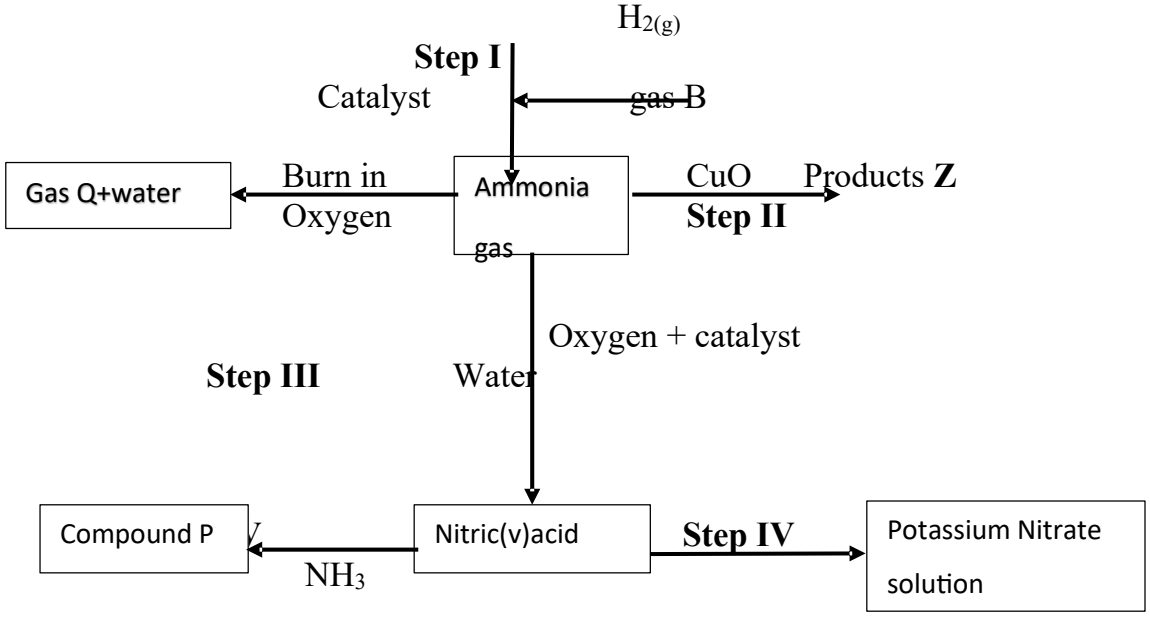
……

c) Write an equation for the reaction between K and slaked lime (1mk)

……

d) Write an ionic equation for the reaction with copper(II) sulphate forming the deep blue solution
(1mk)

b) Study the flow chart below and answer questions that follow:



(i) State **one** source of gas B (1mk)

……

……

(ii) Name the catalysts used in; (1mk)

a) Step I

……

b) Step III

……

(iii) Write chemical equations for reactions in; (3mks)

a) Step I

……

b) Step II

……

c) Step V

……

(iv) Identify any other gas that can be used instead of Ammonia in step II (1mk)

……

(v) State one use of gas Q (1mk)

……

……

PAPER 3

1. You are provided with:

- 6.2 g of an alkanoic acid labelled **solid A** in a boiling tube.
- 2 M sodium hydroxide solution labelled **solution B.**

You are required to:

i) Determine the solubility of solid A at different temperatures.

ii) Find the molar mass of the alkanoic acid.

Procedure 1

i) Using a burette, add 10cm^3 of distilled water to **solid A** in the boiling tube. Heat the mixture while stirring with the thermometer to about 75^{0}C. When the entire solid had dissolved, allow the solution to cool while stirring with the thermometer. Note the temperature at which crystals of solid M appear. Record this temperature in table I.

ii) Using the burette, add 2cm^3 of distilled water to the contents of the boiling tube. Warm the mixture while stirring with the thermometer until all the solid dissolves. Allow the mixture to cool while stirring. Note the temperature at which crystals of **solid A** appear.

iii) Repeat procedure (ii) two more times and record the temperatures in table I.
Retain the contents of the boiling tube for use in procedure II.

a) i) Complete table I by calculating the solubility of solid A at different temperatures. (6 marks)

Table I

Volume of water in the boiling tube (cm^3)	**Temperature at which crystals of solid A appear (^0C)**	**Solubility of A (g/100g water)**
10		
12		
14		
16		

ii) On the grid provided, plot a graph of the solubility of solid A against temperature. (3 marks)

iii) Using the graph determine the temperature at which 52 g of solid A would dissolve in 100cm^3 of water. (1 mark)

Procedure II

i) Transfer the contents of the boiling tube in procedure I into a 250ml volumetric flask. Rinse both the boiling tube and the thermometer with distilled water and add it to the volumetric flask. Add more distilled water to make up to the mark. Transfer the solution into a 250ml beaker. Label this **solution E**. Rinse the volumetric flask with distilled water ready for use in step (ii).

ii) Using a measuring cylinder, place 25cm^3 of solution B into a 250ml volumetric flask. Add about 200cm^3 of distilled water and shake well. Add more distilled water to make up to the mark. Label this **solution F**.

iii) Fill the burette with **solution E**. Using a pipette and a pipette filter, place 25cm^3 of **solution F** into a conical flask. Add 2 – 3 drops of **phenolphthalein indicator** and titrate with **solution E**. Record your results in table II. **Repeat** the procedure (iii) two more times to complete the table.

Table 2

Titration	1	2	3
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution E used (cm^3)			

(4 marks)

Determine:

i) Average volume of solution E used. (1 mark)

ii) Concentration of solution F in moles per litre (1 mark)

iii) Number of moles in $25cm^3$ of solution B (1 mark)

iv) Moles of alkanoic acid, solution E used (1 mark)
(1 mole of acid reacts with 2 moles of base)

v) Concentration of solution E in moles per litre (1 mark)

vi Relative formula mass of the alkanoic acid, solid B. (1 mark)

2. You are provided with solid **E**, carry out the tests below and record your observations and inferences in the spaces provided

a) Place all the solid **E** provided into a test tube. Add about $6cm^3$ of distilled water and shake thoroughly. Filter and rinse the residue thoroughly with distilled water. Keep the Residue for use in procedure (c). Divide the filtrate into four portions.

i. To the first portion add sodium hydroxide solution dropwise until in excess

Observations	**Inferences**
(½ mark)	(1 mark)

ii. To the second position dip a clean glass rod and hold its tip in the non-luminous Bunsen burner flame.

Observations	**Inferences**
(1 mark)	(1 mark)

iii. To the third portion add two drops of barium nitrate solution

Observations	**Inferences**
(1 mark)	(1 mark)

iv. To the fourth portion add two drops of acidified potassium manganite (VII)

Observations	**Inferences**
(1 mark)	(1 mark)

b. Put the residue in a boiling tube and add about 5 cm3 of dilute nitric (V) acid provided and shake thoroughly.

Observations	Inferences
(½ mark)	(½ mark)

Divide the solution into two equal portions.

i. To the first portion add sodium hydroxide solution dropwise until in excess

Observations	Inferences
(1 mark)	(1 mark)

ii. To the second portion add two drops of sodium iodide solution.

Observations	Inferences
(½ mark)	(1 mark)

3. You are provided with liquid L in stoppered container. Carry out the tests and record your observations and inferences.

a) Place about 3 drops of liquid L on a watch glass and ignite using a Bunsen burner flame.

Observations	Inferences
(1 mark)	(1 mark)

b) Divide the remaining liquid L into four portions in test tubes.

(i) To the first portion, add about $6cm^3$ of distilled water and shake well.

Observations	Inferences
(½ mark)	(½ mark)

(ii) To the second portion, add the sodium hydrogen carbonate solid provided.

Observations	Inferences

(½ mark)	(1 mark)

(iii) To the third portion, add two drops acidified potassium manganite (VII) solution.

Observations	Inferences
(½ mark)	(1 mark)

(iv) To the last portion, add two drops acidified potassium dichromate (VI) solution.

Observations	Inferences
(1 mark)	(1 mark)

KCSE REPLICA 6
PAPER 1

1. a) Distinguish between ionization energy and electron affinity. (2 marks)

……

……

(b) The atomic number of Q and R are 9 and 17 respectively. Compare the electron affinity of Q and . Explain. (1 mark)

……

2. The relative atomic mass of an element is 10.28, it has two isotopes $^{10}_{5}R$ and $^{11}_{5}R$.

Calculate the relative percentage abundance of each isotope. (3 marks)

……

……

Describe how solid Aluminum chloride can be separated from a solid mixture of sodium chloride and ammonium chloride.

(3 marks)

……

……

3. The number of protons and neutrons of atoms W, X, Y and Z are shown in the table below.

Atom	No. of protons	No. of neutrons
W	6	6
X	12	12
Y	6	8
Z	17	20

(a) Write down the electronic configuration of X. (1 marks)

……

……

……

(b) (i) Which one of the atoms is of an element in group (VII) of the periodic table .(1mk)

……

…

(ii) Name the type of bond which is formed when X and Z reacts. (1 mark)

……

4. Sulphur exists in two crystalline forms

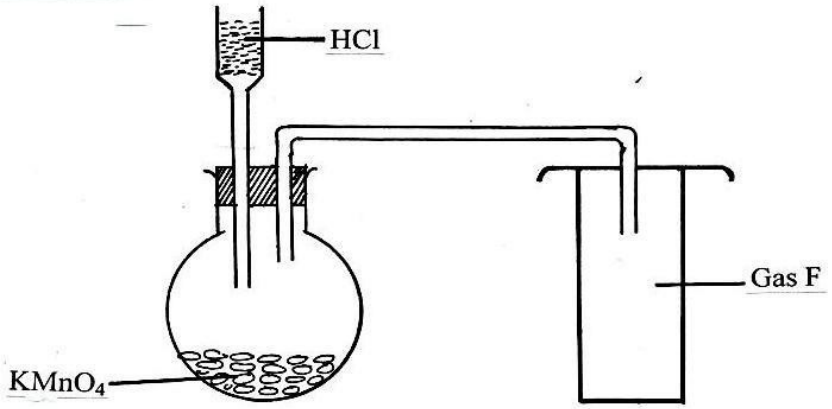
(a)Name one crystalline form of sulphur. (1 mark)

……

(b) Give any two uses of sulphur. (2 marks)

……

5. An experiment was set as shown below



(a)Name the gas F (1 mark)

……

(b)State one physical characteristic of gas F. (1 mark)

……

(c) What would be observed if a litmus paper was put in a solution of gas F. (1 mark)

……

6. Below is a list of oxides.

MgO, N_2O, K_2O, CaO and Al_2O_3

From the above list select

(a)A neutral oxide. (1 mark)

……

…

(b) An oxide that can react with both potassium hydroxide and dilute hydrochloric acid.(1 mark)

……

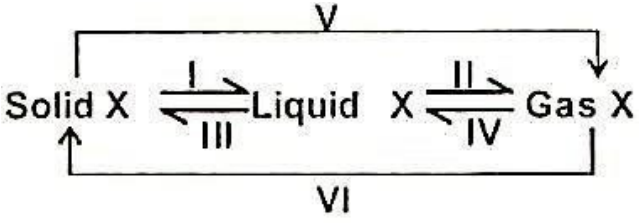
…

(c) What property is exhibited by the reaction in b above. (1 mark)

……

…

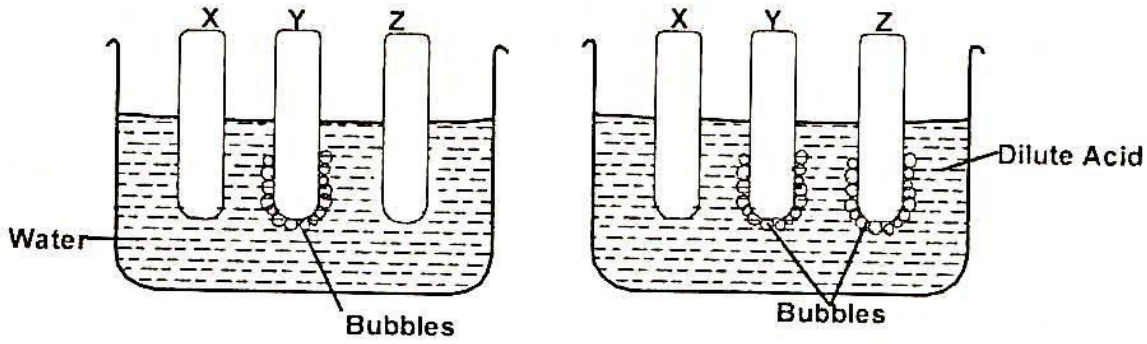
7. a) The figure below shows some changes in state for a substance X. Study the diagram and answer the questions.



Each of the changes can be speeded up by heating or by cooling. Which changes are speeded up by cooling and which ones by heating.
(2marks)

……
……
……

8. In an experiment, rods of metal X, Y, Z were cleaned with sand paper and placed in a beaker containing water. Another set of rods was also placed in a beaker containing dilute acid. After placing the rods in the two liquids, bubbles of gas were seen around some of the rods as shown in the diagram below.



(a) Why is it necessary to clean the rods with sand paper before dipping them into the liquid. (1 mark)

……

(b) Arrange the three metals in order of their reactivity starting with the most reactive. (2 marks)

……
……
……

9. Study the table below and use it to answer the question that follow

Solution	PH
A	3.5
B	14
C	8.5

i) In which of the solution will phenolphthalein indicator be colourless. (1mark)

……

ii) Which of the solutions could be used to relieve heartburn ? Explain. (2marks)

……
……

……

10. a) Why is air considered as a mixture rather than a compound ? (1mark)

……

……

……

b) State one similarity between rusting and combustion of iron. (1mark)

……

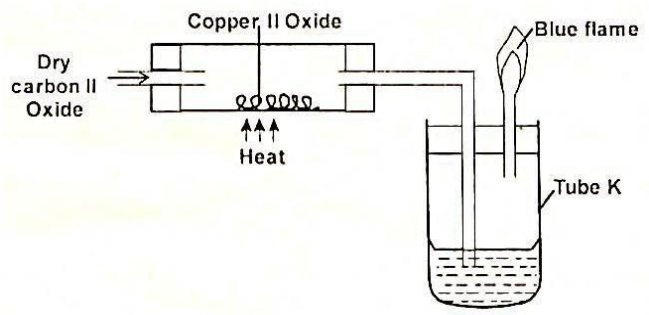
…

c) Explain why iron nails rust faster in sodium chloride solution than in tap water. (1mark)

……

……

11. The apparatus shown below was used to investigate the effect of carbon II oxide on copper II oxide.



a) State the observation that was made in the combustion tube by the end of the experiment. (1 mark)

……..

b) Write an equation for the reaction that took place in the combustion tube. (1mark)

……..

c) Why is it necessary to burn gas coming out of tube K ? (1mark)

……..

12. a) What is air pollution ? (1 mark)

……..

b) State four gaseous substances present in unpolluted air. (2marks)

……..

……..

13. The table below shows properties of some chlorides. Study it and answer the questions that follow.

Chloride	Mp(°C)	BP (°C)	Electrical conductivity in aqueous solution	PH of solution
Al	-	183	Good	3
Na	860	1420	Good	7

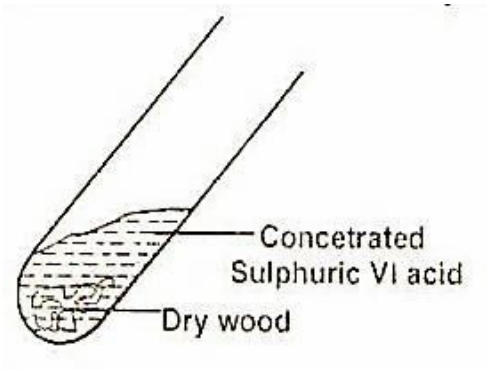
P	32	75	Good	3
H	-146	-29	Good	1

a) Explain the high melting and boiling points of sodium chloride. (1mark)
……..

b) Write an equation for the reaction between PC15 and water. (1mark)
……..

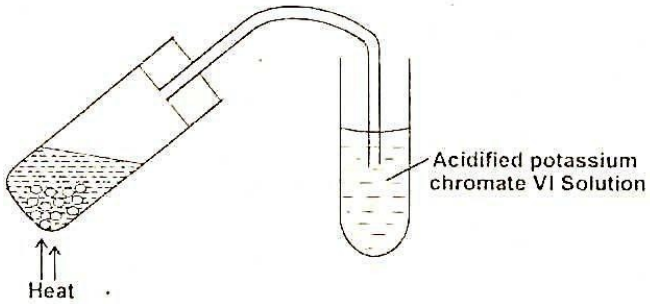
c) Draw the dot (•) and cross (x) diagram to show bonding in NaCl. (1 mark)
……..

14. Excess Concetrated Sulphuric Vi acid with pieces of dry wood as shown



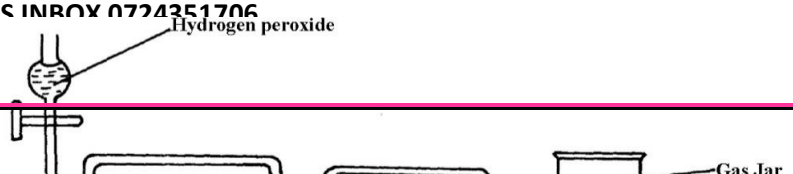
a) State the observation made in the tube. (1 mark)
……..
……..

b) When the reaction was complete, the mixture was heated gently, then strongly and set up adjusted as



shown below.
State and explain the observation made on acidified potassium chromate VI solution. (2 marks)
……..
……..

15. The diagram below shows the set-up that can be used to prepare and collect oxygen gas. Study



it and answer the questions that follow.

a) Identify two mistakes from the diagram which must be corrected for one to collect dry oxygen gas.

(2marks)

……..

……..

b) What property of oxygen gas makes it possible to be collected over water. (1mark)

……..

……..

16. When a grey powder P, which has no action on cold water, is placed into a salt solution of Q, a brown solid R is deposited. The blue solution of Q, fades giving way to a green solution.

a) Name the type of reaction that takes place. (1 mark)

……..

……..

b) Identify solids P and R (1 marks)

……..

……..

c) Write an equation for the reaction leading to formation of the brown solid. (1mark)

……..

……..

17. Calculate the number of molecules of water of crystallization in oxalic acid crystals, $H_2C_2O_4.xH_2O$, from the following data:5g of the crystals were made up to 250cm^3 of this solution required 15.9cm^3 of 0.5M sodium hydroxide to neutralize it. (H=1, C=12, 0 16, H_20= 18) (3marks)

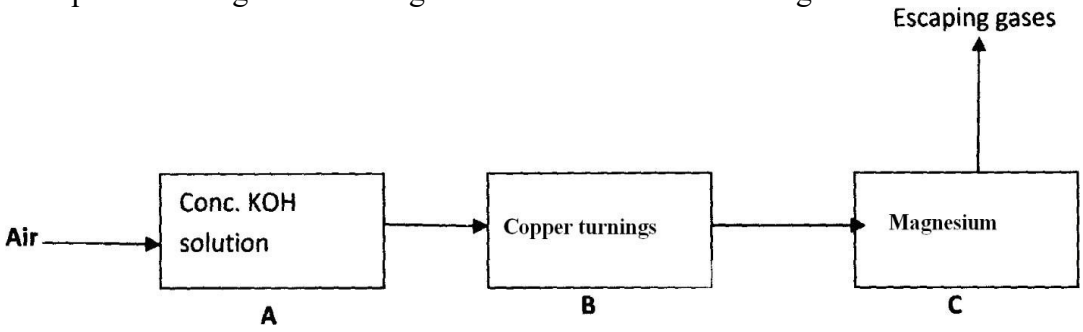
……..

……..

……..

……..

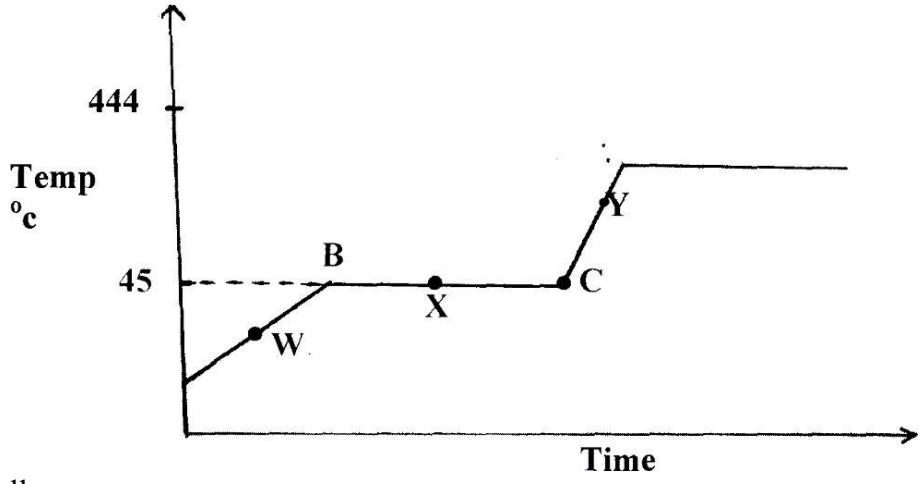
18. Air is passed through several reagents as shown in the flow diagram below



Name one gas which escapes from chamber C. Give a reason for your answer (3marks)

……..
……..
……..
……..

19. The diagram below shows the heating curve of a pure substance. Study it and answer the questions



that follow.

(a) What are the physical states of the substances at points W and Y. (2marks)

W……..

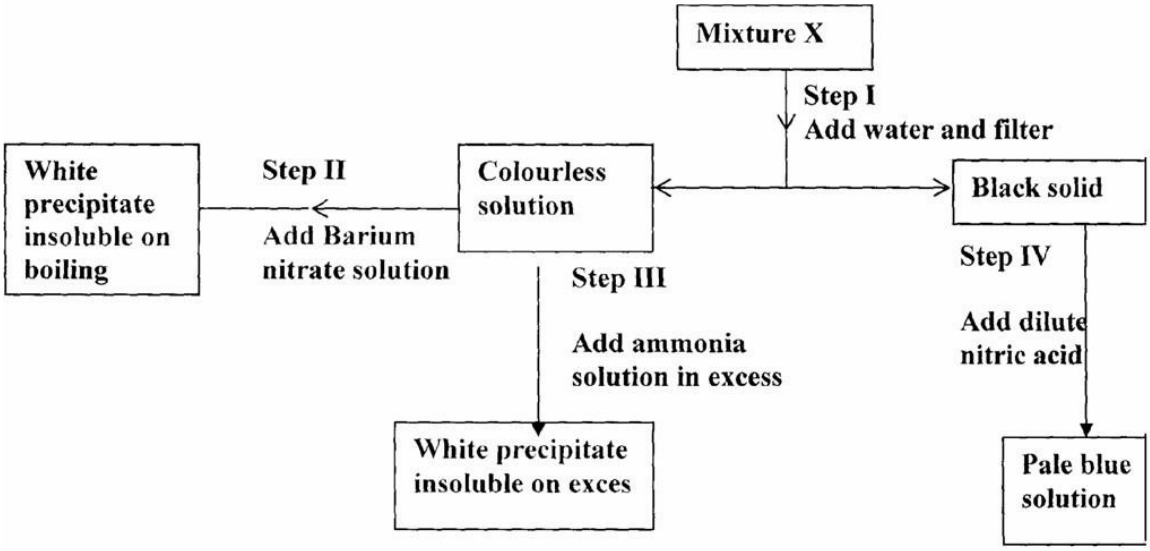
Y……..

(b) Explain why the temperature remains constant between points B and C. (2marks)

……..

……..

20. Study the chart below and answer the questions that follow.



(a) Name:

(i) Cations present in mixture X. (1mark)

……..

(ii) Anions present in the solution. (1mark)

……..

(b) Write an equation to show how the white precipitate in step III is formed. (1mark)

……..

21. When solid Zinc carbonate was added to a solution of hydrogen chloride in methylbenzene, there was no observable change. On addition of some water to the mixture there was effervescence. Explain these observations. (2mark

……..

22. (a) State the law of combining volumes of gases. (1 mark)

……..

……..

(b) What volume of methane would remain if a burner containing 40cm³ of methane burns in 40cm³ of enclosed air (assuming that oxygen is 20% of air)? (2 marks)

……..

……..

23. The molecular formula of compound T is C_3H_8O. T reacts with acidified potassium manganate (VII) to form another compound U whose formula $C_3H_6O_2$. T also reacts with sodium metal to produce hydrogen gas and T is neutral to litmus.

(a) Suggest the homologous series to which T belongs. (1 mark)

……..

……..

(b) Name the type of reaction leading to the formation of U in the reaction described above. (1 mark)

……..

……..

(c) Write the structural formula of U. (1 mark)

……..

……..

24. (a) State Boyle's law .(1 mark)

……..

(b) 60cm³ of oxygen gas diffused through a porous hole in 50 seconds. How long will it take 80cm³ of sulphur (IV) oxide to diffuse through the same hole under the same conditions

(S = 32, O = 16). (2 marks)

……..

25. When sulphur is heated in a boiling tube in the absence of air, the yellow crystals melt into a golden yellow mobile liquid at 113 °C. The liquid turns into a dark brown viscous mass at 180°C. At 400°C the brown liquid becomes less viscous and flows easily. Explain these observations. (3 marks)

……..

26. In an experiment soap solution was used against 3 separate samples of water. Each sample was later boiled and soap added. Each water sample was 1000cm³. The results are tabulated below.

Volume of soap used to form lather	**Sample**		
	I	II	III
Before boiling (cm³)	27	3	10.6
After boiling (cm³)	27	3	3

(a) Which sample was likely to be soft water? Explain. (2 marks)

……..

……..

(b) State the cause of change in volume of soap used to form lather in sample **III**. (1 mark)

……..

……..

PAPER 2

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

A								B
C		Transition		D		X	E	F
G	H	Elements	I	J	K	L	M	N
O	P			Q			R	S

a) Name the chemical family to which the following elements belong

i C, G, O (½ mk)

……

ii B, F, N, S (½ mk)

……

b) Classify elements H and M as either metals or non-metals.

i H (½ mk)
……
ii M
…….. (½ mk)

i c) State one use of element.

i A (1mk)
……
……

(ii) N (1mk)
……
……

d) Compare the atomic radius of G and H. (2mks)
……
……

e) Ionic radius of R is larger than its atomic radius. Explain. (2mks)
……
……

f) Write down the formula of the compound formed when element I reacts with element X. (1mk)
……
……

g) Identify the strongest oxidising agent. Explain. (2mks)
……
……

h) Write down the electron arrangement of:-
i) Element P (½ mk)
……

ii) Ion of E (½ mk)

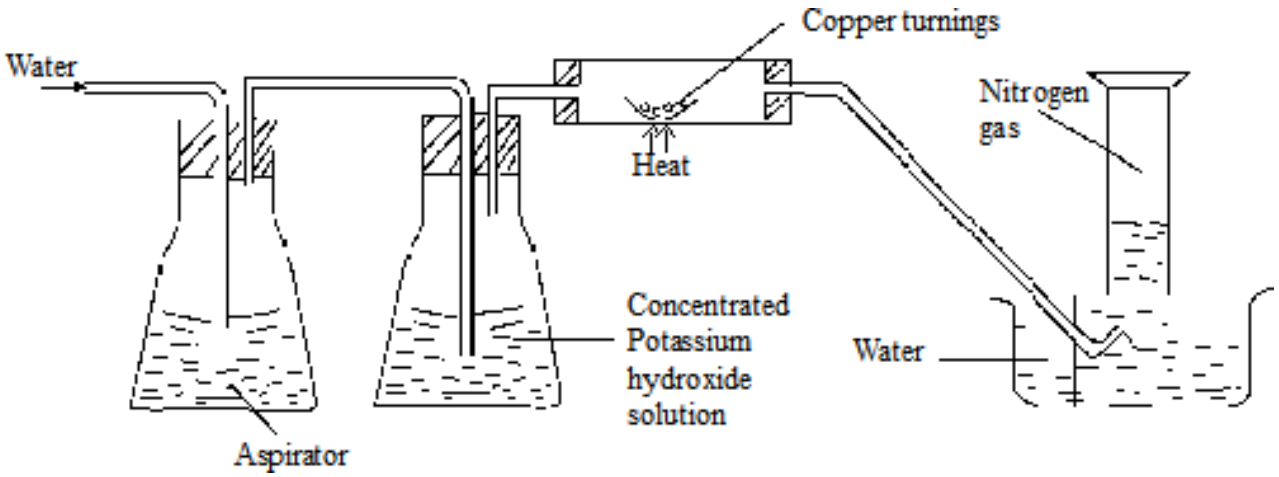
……

i) Identify an element with a charge of +2. (½ mk)

……

j) Compare the first and second ionisation energies of element H. (2mks)
……
……

2. Nitrogen gas can be obtained from air as shown below.



a) What is the purpose of the following

i) Potassium hydroxide solution? (1mk)

……

……

(ii)Copper turnings (1 mk)

……

……

B) Why should water be pumped into the aspirator? (1mk)

……

C) Name another substance that can be used in place of potassium hydroxide. (1mk)

……

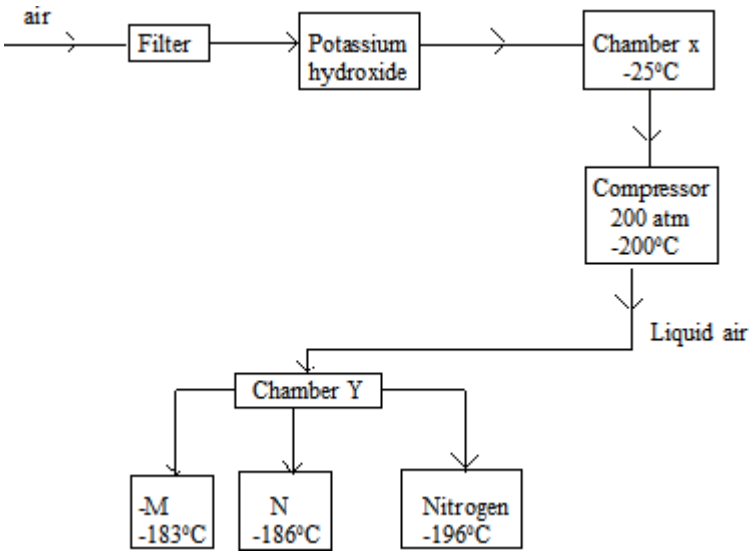
……

D) The nitrogen gas obtained above is not pure. Identify one gaseous impurity in the gas. (1mk)

……

……

e) The flow chart below shows how pure nitrogen gas is obtained.



i) What is the functions of the following chambers?

Filter (1mk)

……

……

Chamber X (1mk)

……

……

ii) Name the process that takes place in chamber Y. (1mk)

……

……

iii) Identify

M - (½ mk))

……

N (½ mk)

……

g) State two uses of nitrogen gas. (2mks)

……

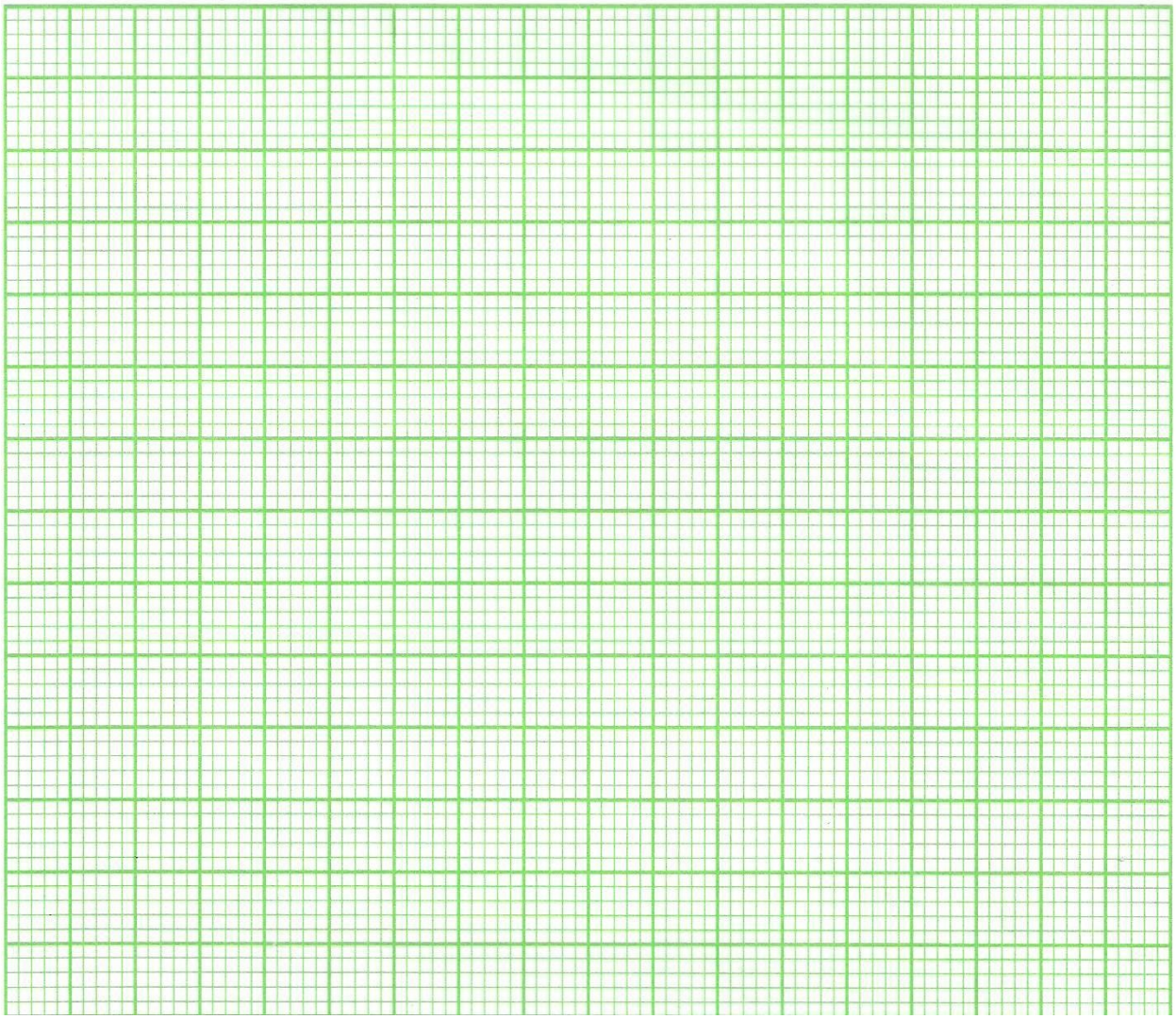
……

3. 3. 0.6g of Manganese (IV) oxide was placed in a flask and 25cm^3 of hydrogen peroxide added. The volume of oxygen gas produced was recorded after every 10 seconds. The results obtained were

Time (s)	0	10	20	30	40	50	60	70	80
Volume (cm^3)	0	13.5	25	34.5	42.5	49	53	55	55

recorded in the table below.

a. Plot a graph of volume (cm^3) against time (sec). (3mks)



b. From the graph, determine the volume of oxygen gas produced. (1mk)

……

……

c. The experiment was repeated using more concentrated hydrogen peroxide.
On the same axis; sketch the curve that was obtained. (2mks)

d. Write an equation for catalytic decomposition of hydrogen peroxide. (1mk)

……

……

e. Give the test for oxygen gas. (1 mk)

……

f. State two uses of oxygen gas. (2 mk)

……

…

4. a) Other than neutralisation state any other method used to prepare salts. (1mk)

……

……

……

b) Describe how to prepare sodium chloride starting with 1M sodium hydroxide. (3mks)

……

……

c) Write a balanced chemical equation to show effect of heat on calcium carbonate. (1mk)

……

……

d) Distinguish between a strong base and a weak base. (2mks)

……

e) i) Explain why permanent hardness cannot be removed by boiling. (2mks)

……

……

ii) State one disadvantage of hard water. (1mk)

……

……

f) Aluminium oxide reacts with both acids and alkalis. Name any other oxide that behaves like aluminium. (1mk)

……

5. a) A student wrongly categorised air as a compound and not as a mixture. Give two reasons as to why the student was wrong.(2mks)

……

……

(b) The table below shows the results obtained when four solvents were used to separate a dye. Study the results and use them to answer the questions that follow.

Solvent	Number of Solute components
A	5
B	1
C	0
D	2

i) i) i) Identify the most suitable solvent for this separation. Give a reason for your answer. (2mks)

……

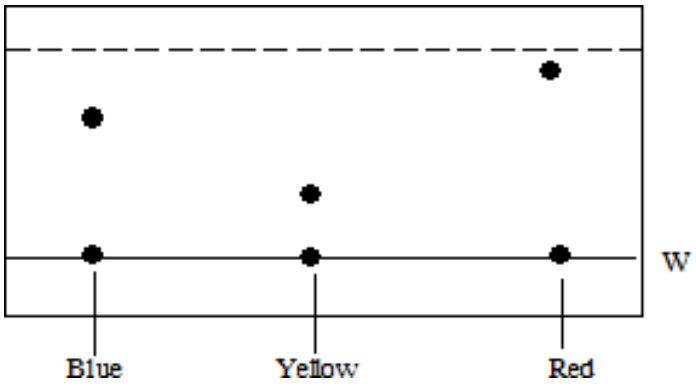
……

ii) What does the result of the solvent C tell us about the dye? (1mk)

……

……

iii The chromatogram below was obtained from a plant extract. Use it to answer the questions that follow.



i) Name line W
ii) What does the dotted line represent?
iii) State with a reason the least soluble dye in the moving solvent

d) Below is a list of major component of crude oil and their boiling points.

Component	**Boiling point (^{0}C)**
Bitumen	Above 400
Lubricating oil	350 - 400
Petrol	40 - 175
Gases	Below 40

(I)What is the name of the process by which the constituents of crude oil can be separated?

(1mk)

……

(II)Give one use of the gases component.(1mk)

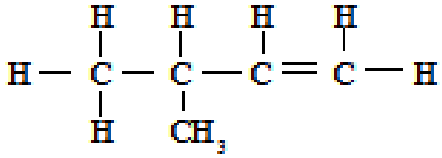
(III)Give the order by which the components are obtained from the mixture, starting with the first.

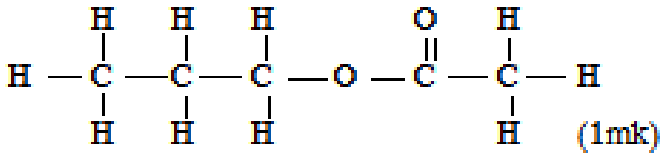
(1mk)

……

6. a) Candle wax is mainly a hydrocarbon. What is a hydrocarbon? 1mk)

b) Name the following

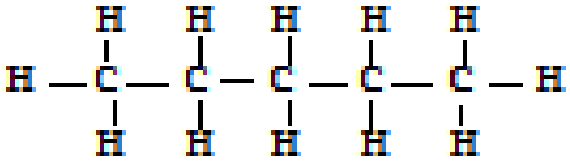




(1mk)

compounds. i)

ii)



c) Castor oil extracted from castor seeds is found to change the colour of acidified potassium managanate (VII) .

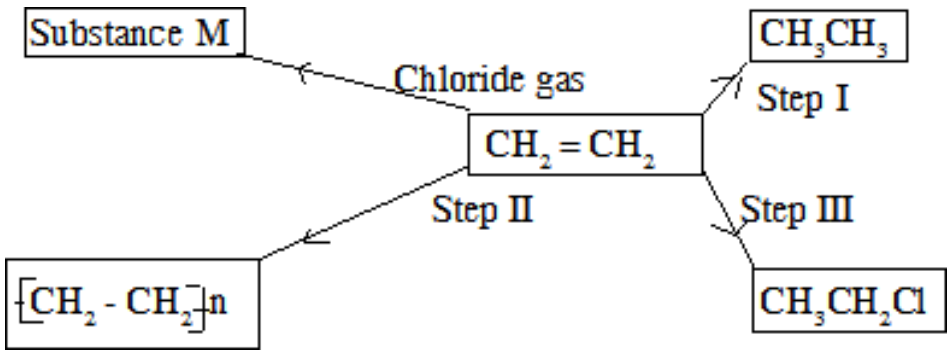
i) State the colour change.

……

ii) Explain why castor oil reacts with acidified Potassium mangate (VII) to cause the colour change.

(1mk

d) Study the reaction scheme below and use it to answer the questions that follow.



ii) Name the process in;

Step I(1mk)

……

……
……

Step II(1mk)
……
……
……

ii) State the reagent necessary for the process in Step II(1mk)
……
……
……

Step III(1mk)
……
……

iii) Name the type of reaction taking place in step III (1mk)
……
……

7. a)Define the following terms :
a. Atomicity(1 mark)
……

b. Molar gas volume(1 mark)
……
……

b) i) State Gay-Lussac's law. (1 mark)
……
……

ii) A sample of $10cm^3$ of hydrogen sulphide was burned in $40cm^3$ of oxygen. Calculate the volume and composition of residual gas (assume all volumes are measured at s.t.p)(2 marks)

c) i) Calculate the mass of sodium carbonate contained in $200cm^3$ of 0.02M sodium carbonate solution.

(2 marks)

ii) 0.239g of copper (II) oxide was placed in a conical flask. Calculate the volume of 0.1M solution of hydrochloric acid that would completely react with copper (II) oxide in the conical flask. (O = 16.0, Cu = 63.5, H = 1.0, Cl = 35.5)(2 marks)

(II)Find the mass of 5.2×10^{23} atoms of sodium. (Na = 23.0, L = 6.023×10^{23})(2 marks

PAPER 3

1.

You are provided with:

- **Solution A, containing 4.0gdm^{-3} of sodium hydroxide**
- **solution B, hydrochloric acid**
- **2.5 g of a mixture of two salts, xcl (RFM 58.5) and CO_3 (RFM 106)**

You are required to:

i) Standardize solution B, hydrochloric acid.

ii) Determine the mass composition of the salt mixture

PROCEDURE 1

1. Fill the burette with solution B
2. Pipette solution A into a clean dry conical flask. Then add 2 -3 drops of phenolphthalein indicator.
3. Titrate solution A solution with solution B. Record your results in the table below.
4. Repeat the procedure two more times to retain concord and values.

TABLE 1

Titration number	1	2	3
Final burette reading (cm^3)			
Initial burette reading(cm^3)			
Volume of acid used (cm^3)			

a. Calculate the average volume of solution B used. (1mk)

b. Find;

i Moles of sodium hydroxide that reacted with the acid (2mks)

ii Moles of hydrochloric acid present in the average volume (1mk)

iii Molarity of the acid (1mk)

PROCEDURE II

1. Put about 100cm^3 of water in a 250ml volumetric flask add all the 2.5g of salt mixture. Shake the mixture to dissolve and the solid. Top up the solution to the mark with distilled water Label this solution C
2. Fill this burette with solution B.
3. Pipette 25c m^3 of solution C and put it into a clean conical flask. Add 3 drops of methyl orange indicator.
4. Titrate solution C with solution B. Record your results in the table below.
5. Repeat the titration two more times

TABLE II

TITRATION	1	2	3
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution B used (cm^3)			

c. Calculate the average volume of solution B
(1mk)

d. Calculate the number of moles in the hydrochloric acid used (1mk)

e. The equation for the reaction of the acid with one of the salts in the mixture is;

$$\mathbf{2}\,HCL_{(aq)} + X_2CO_{3(s)} \rightarrow 2XCL_{(aq)} + CO_2(g) + H_2O_{(l)}$$

Calculate;

i Moles of X_2CO_3 that reacted with the acid in the experiment
(1mk)

ii Molarity of X_2CO_3 (2mks)

f. Calculate the mass of the salt mixture in grammes dm^{-3} (1mk)

g. Calculate the percentage of xcl in this mixture (2mks)

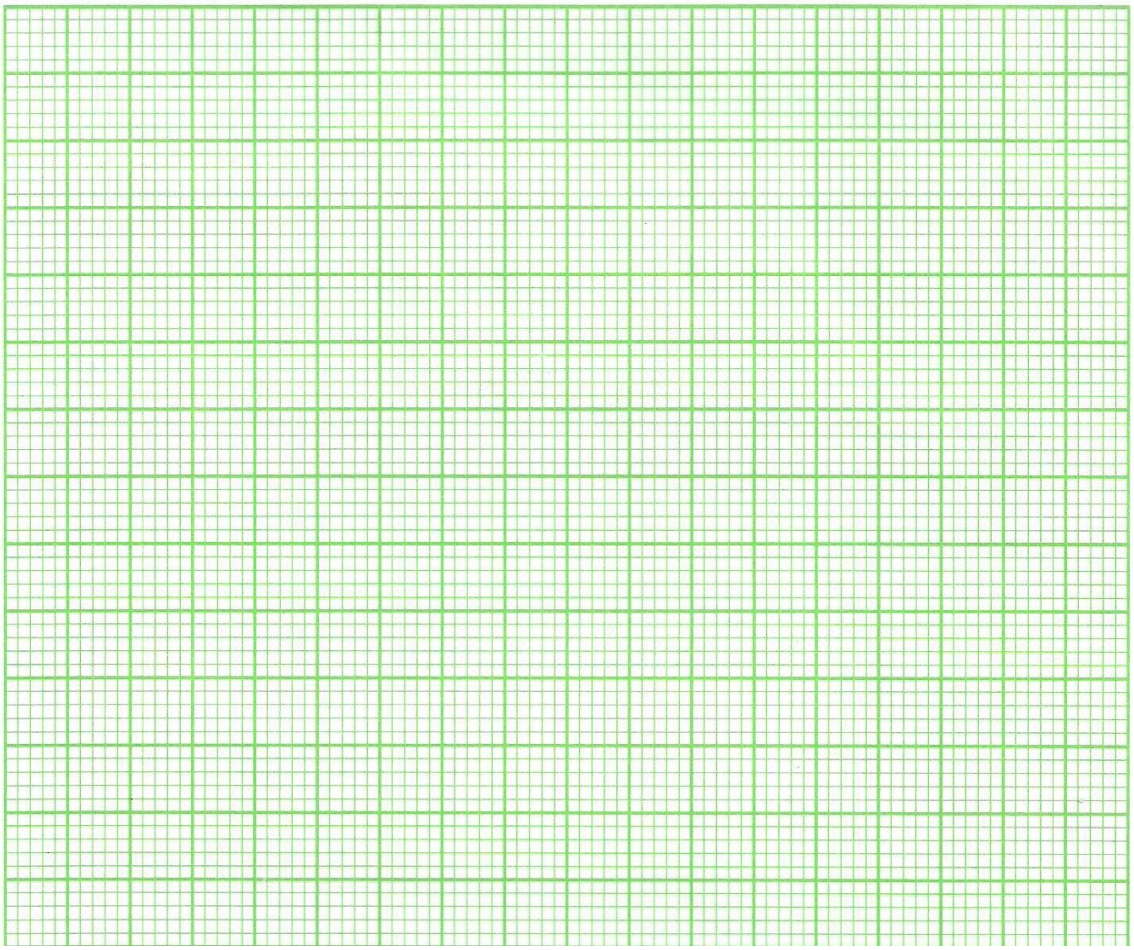
2. In this experiment, you're required to determine the time takes for a precipitate to be formed when S_3 which is sodium thiosulphate solution , reacts with dilute hydrochloric acid.

PROCEDURE

1. Using a measuring cylinder measure 50cm^3 of S^3 into a 100ml beaker.
2. Make a pencil cross on a white piece of paper so that when a beaker is placed top of the paper , the cross can be seen through the bottom of the beaker.
3. To solution A add 10 cm^3 of 2M hydrochloric acid and at the same time start a stop watch / stop clock. Swirl the contents of the beaker twice and then place it over the cross on the paper . Look at the cross from above the beaker through the mixture. Stop the stop watch immediately the precipitate makes the cross invisible . Record time taken for the cross to become invisible in the table below, rinse beaker .
4. Repeat the procedure with solutions B,C,D and E.as per the table.

SOLUTION	Volume of solution S_3 in the beaker (cm^3)	Volume of water added (cm^3)	Volume of 2M HCL	Time taken in seconds
A	50	0	10	
B	40	10	10	
C	30	20	10	
D	20	30	10	
E	10	40	10	

a. Plot the graph of volume of solution S_3 (Y – axis)against time (4mks)



5. a) From the graph state the relationship between concentration of solution S_3 and time. (1mk)

……

b) Why is water added to the S_3 (1mk)

3. You're provided with solid D. Carry out the tests shown below on the solid.

a. Heat a spatula full of D in A clean dry test – tube.

Observation	Inference

(1 mk) (½ mks)

b. Put a spatula end- full of D in a boiling tube. Half fill it with water. shake this mixture.

Observation	Inference

(½ mks) (½ mks)

c Divide the resultant mixture in (b)above into 5 portions

i. To the first portion add dilute nitric acid followed by a few drops of Barium nitrate

Observation	Inference

(1mk) (1mk)

ii. To the second portion, add nitric acid a few drops followed by lead (ii) nitrate and then warm the mixture.

Observation	Inference
(1mk)	(½ mk)

iii To the third portion, add sodium hydroxide solution drop wise until in excess. Warm this mixture. Test any gas produced withy Litmus paper

Observation	Inference
(½ mk)	(½ mk)

d. You are provided with liquid B . Carry out the tests shown below and write your observations and inferences in the spaces provided:

i. To about $1cm^3$ of liquid B in a test – tube , add about $1cm^3$ of distilled water and shake the mixture.

Observation	Inference
(½ mk)	(½ mk)

To about $1cm^3$ of liquid B in a test tube add a small amount of solid sodium hydrogen carbonate

Observation	Inference
(½ mk)	(½ mk)

iii. To about $2cm^3$ of liquid B in A test – tube, add about $1cm^3$ of acidified potassium dichromate (vi) . Warm the mixture gently and allow it to stand for about one minute.

Observation	Inference
(1mk)	(1mk)

KCSE REPLICA 7
PAPER 1

1 (a) Give the name of the first member of the alkyne homologous series (1 mark)

(b) Describe a chemical test that can be used to distinguish ethanol from ethanoic acid. (2 marks)

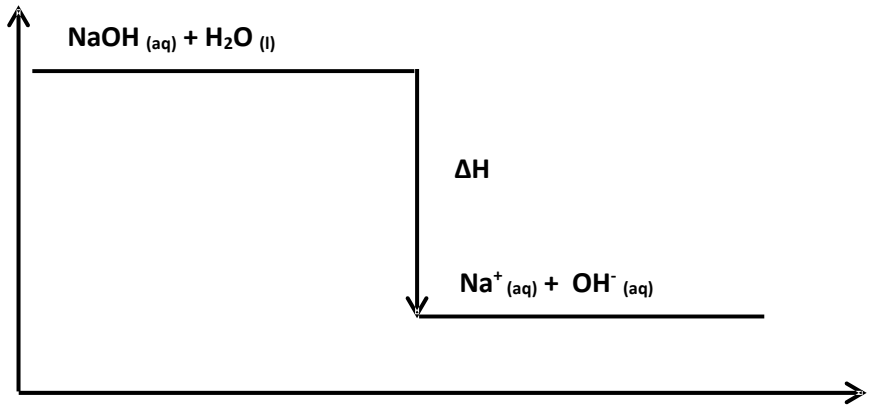
2 (a) Name the raw material from which aluminium is extracted (l mark)

(b) Give a reason why aluminium is extracted using electrolysis. (1 mark)

(c) Give **one** use of aluminium metal. (l mark)

3 (a) What is meant by lattice energy? (1 mark)

(b) Study the energy level diagram below and answer the question that follows:



What type of reaction is represented by the diagram? (1 mark)

……

4 (a) Sketch a graphical representation of Boyles law on the axes below. (1 mark)

(b) A gas occupies 400 cm^3 at 25°C and 100,000 Pa. What will be its volume at 27°C and 101325 Pa? (2 marks)

5 (a) What is half- life? (1 mark)

……

……

(b) The half-life of protactinium - 234 is 1.17 minutes. Determine the mass that decays in 5.85 minutes starting with 100 g of the sample. (2 marks)

……

6 State **two** disadvantages of hard water. (2 marks)

……

……..

7 Hydrogen chloride gas can be prepared by reacting sodium chloride with an acid.

(a) Name the acid. (1 mark)

……..

(a) Write an equation for the reaction between sodium chloride and the acid. (1 mark)

……

(c) State **two** uses of hydrogen chloride. (1 mark)

……..

……..

8 When solid **B** was heated strongly, it gave off water and a solid residue. When water was added to the solid residue, the original solid **B**, was formed.

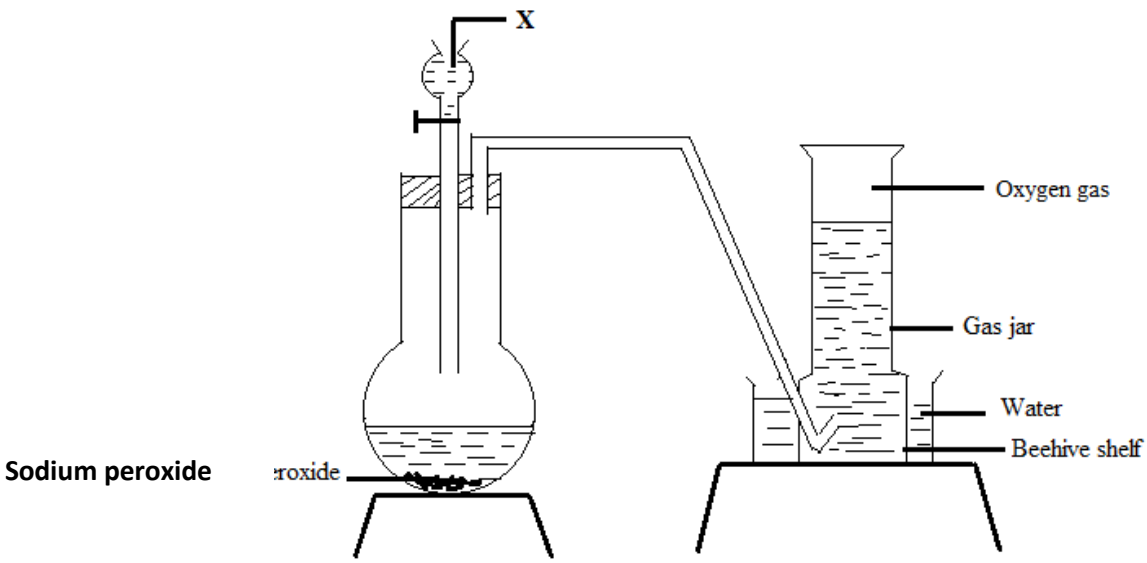
(a) What name is given to the process described? (1 mark)

……

……

(b) Give **one** example of solid **A**. (1 mark)

9 The set up below can be used to prepare oxygen gas. Study it and answer the questions that follow.



(a) Identify **X**. (1 mark)

……

(c) Write the equation for the reaction which occurs in the flask. (1 mark)

……

(d) State **one** use of oxygen other than in welding (1 mark)

……

10 The atomic number of an element, **M** is 13.

(a) Write the electronic configuration of the ion $\mathbf{M^{3+}}$. (1 mark)

……

(b) Write the formula of the chloride of **M**. (1 mark)

……

……

(c) State the structure of the compound formed in (b) above (1 mark)

……..

11 Concentrated sodium chloride was electrolysed using graphite electrodes. Name the product formed at the anode and give a reason for your answer. (2 marks)

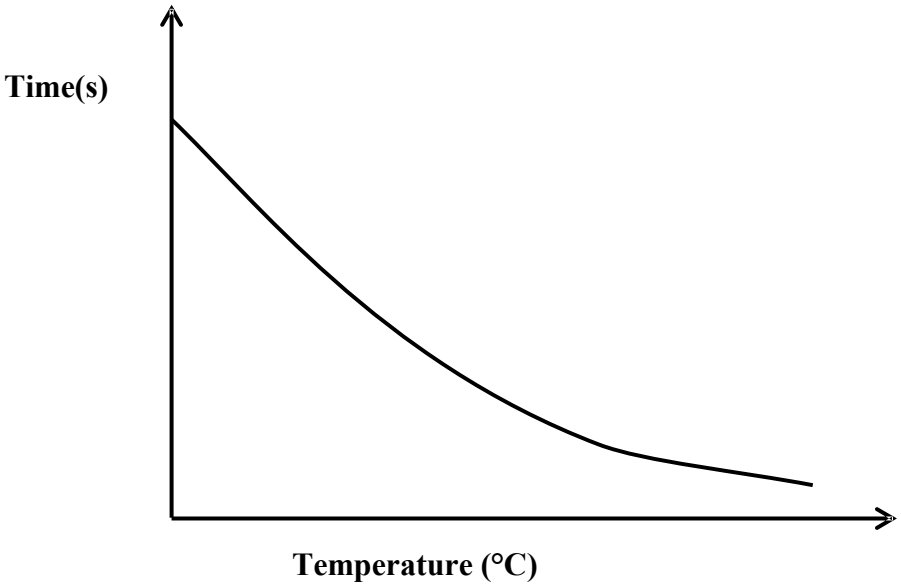
……

……

……

……

12 The curve shown below shows the variation of time against temperature for the reaction between sodium thiosulphate and hydrochloric acid.



(a) Explain the shape of the curve. (2 marks)

(b) Other than temperature name **one** factor that affects the rate of reaction. (1 mark)

13 (a) Dry ammonia was passed over heated copper (II) oxide in a combustion tube.

(i) State the observations made in the tube (1 mark)

……

(ii) Write an equation for the reaction that occurs. (1 mark)

……

(b) What products would be formed if red hot platinum is introduced into a mixture of ammonia and oxygen? (1 mark)

……

14 The table below shows behaviour of metals P, Q, R and S. Study it and answer the questions that follow:

Metal	Appearance on exposure to air	Reaction with water	Reaction with dilute sulphuric (VI) acid
P	Remains the same	Doesn't react	Reacts moderately
Q	Remains the same	No reaction	Doesn't react
R	Slowly tarnishes	Slow	Vigorous
S	Slowly turns white	Vigorous	Violent

(a) Arrange the metals in the order of reactivity starting with the most reactive. (2 marks)

(b) Name a metal which is likely to be **R** (1 mark)

……..

15 Given the following substances: sodium carbonate, orange juice and sodium bromide.

(a) Name **one** commercial indicator that can be used to show whether sodium carbonate, orange juice and sodium bromide are acidic, basic or neutral. (1 mark)

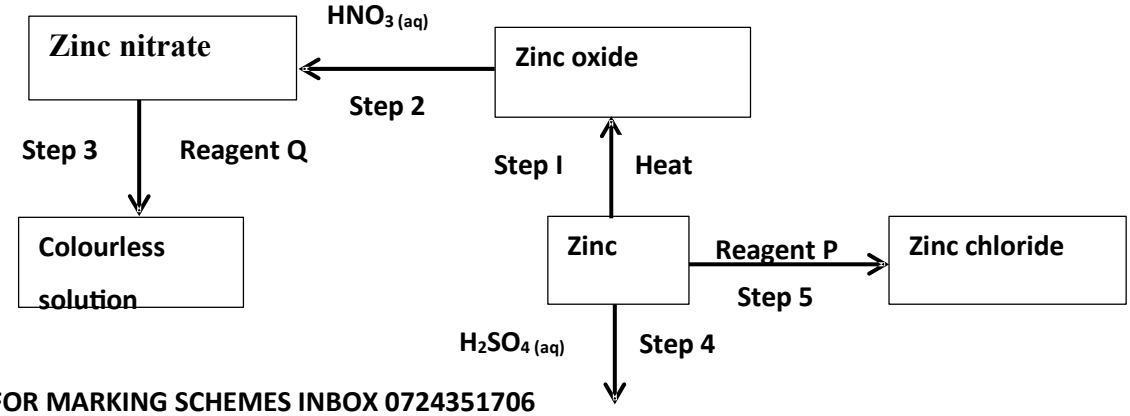
……

……

(b) Classify the substances in 15 (a) above as acids, bases or neutral. (2 marks)

Acid	
Base	
Neutral	

16 The flow chart below shows various reactions of zinc metal. Study it and answer the questions that follow:



Products

(a) (i) Other than water, name another reagent that could be **Q**. (1 mark)

……..

(ii) Write the formula of reagent **P**. (1 mark)

……

(b) Write an equation for the reaction in **step 4**. (1 mark)

……..

17 (a) One of the allotropes of sulphur is monoclinic sulphur, name the other allotrope (1 mark)

……..……..

(b) Concentrated sulphuric (VI) acid reacts with copper and prapanol. State the property of the acid shown in each case. (2 marks)

Copper ……..……..….

Propanol ……

18 Study the standard electrode potentials in the table below and answer the questions that follow.

Half -reaction	E^{θ}(V)
$Ag^{+}(aq) + e \longrightarrow Ag(s)$	+ 0.80
$Cu^{2+}(aq) + 2e \longrightarrow Cu(s)$	+ 0.34
$Mg^{2+}(aq) + 2e \longrightarrow Mg(s)$	- 2.38
$Ca^{2+}(aq) + 2e \longrightarrow Ca(s)$	- 2.87

(a) Which of the metals is the strongest oxidising agent? (1 mark)

……

(b) What observations will be made if a copper coin was dropped into an aqueous solution of calcium nitrate? Explain. (2 marks)

19 Calculate the number of sulphate ions present in 22.5 cm^3 of 2 M aluminium sulphate solution. ($L=6.0 \times 10^{23}$) (3 marks)

……
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……
……
……

20 (a) A crystal of iodine, heated gently in a test tube gave off a purple vapour.
(i) Write the formula of the substance responsible for the purple vapour.
(1 mark)

……..

(b) What type of bond is broken when the iodine crystal is heated gently?
(1 mark)

……

(b) State **one** use of chlorine. (1 mark)

……

21 Describe how samples of barium (II) sulphate, ammonium chloride and common salt can be obtained from a mixture of the three. (3 marks)

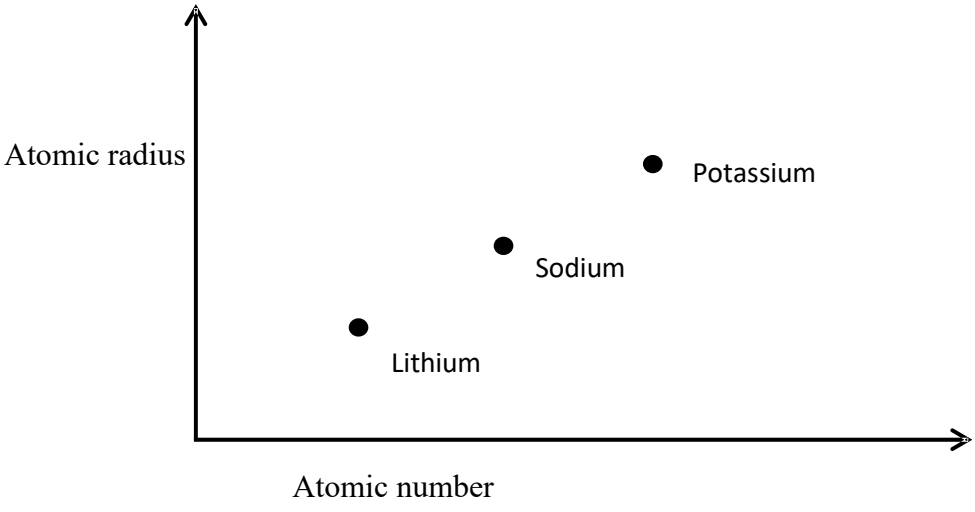
22 (a) Give the name of the process which takes places place when maize flour is converted to ethanol (1 mark)

……

(b) Write the formula of the compound formed when ethanol reacts with sodium metal.
(1 mark)

……..

23 (a) Study the graph below which shows variation of atomic radius with atomic number



State and explain the trend shown in the graph above. (2 marks)

(b) State **one** use of sodium. (1 mark)

24 A farmer intended to plant blueberries in her farm. She first tested the pH of the soil and found it to be 10.0. In order to obtain high yield, what advice would be given to the farmer if blueberries do well in acidic solution? (2 marks)

25 Starting with calcium nitrate solution, describe how a pure dry sample of calcium carbonate can be prepared in the laboratory. (3 marks)

26 A hydrocarbon contains 81.82% of carbon. If the molar mass of the hydrocarbon is 44, determine the molecular formula of the hydrocarbon. (C = 12.0; H = 1.0) (3 marks)

27 (a) Describe how Carbon (II) Oxide can be distinguished from Carbon (IV) Oxide using calcium hydroxide solution. (2 marks)

(b) What is the role of carbon (IV) oxide in fire extinguishing? (1 mark)

28 (a) Name **one** source of alkanes. (1 mark)

……

(b) Methane gas was reacted with one mole of chlorine gas. State the condition necessary for this reaction. (1 mark)

……

……...

29 (a) What is meant by heating value of a fuel? (1 mark)

……..

(b) Other than heating value, name **one** factor to be considered when choosing a fuel. (1 mark)

……..

PAPER 2

1. (a) Define nuclear fission. (1 mark)

……
……

(b) State two similarities between nuclear fission and nuclear fusion? (2 marks)

……
……
……
……

(c) The following table shows the activity of a sample of protactinium ($^{234}_{91}Pa$), a radioactive element, measured at regular intervals.

Time (sec)	10	30	50	70	90	110	130	150	170	190
Activity(c/s)	33	29	23	17	14	12	10	9	8	6

(i) Plot a graph of activity against time. (3 marks)

(ii) From the graph:

(I) The initial activity of the element. (1 mark)

……

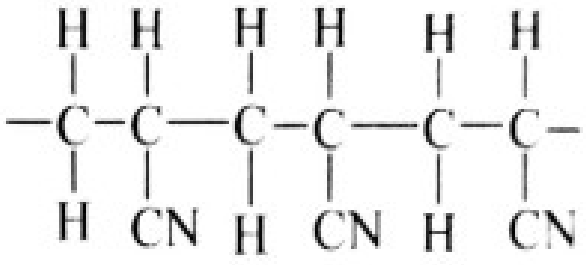
(II) Determine the half-life of the nuclide. (1 mark)

……

(d) State two dangers associated with radioactivity. (2 marks)

……
……

2. (a)Acrylan and orlon are names of fibers which are made of the polymer.



(i) How many repeat units are shown in this structure? (1 mark)

……

(ii) Draw a structural formula of the monomer unit from which the polymer is made. (1 mark)

……
……
……

(iii) State two disadvantages of using the above synthetic fiber. (2 marks)

……
……

(b) Detergents contain additives that enhance their cleaning performance. Name two such additives. (2 marks)

……
……

(c) Calculate the mass of ethanol that can be made from 56g of ethene.
(2 marks)

……
……
……

(d) An organic **compound P** is found on analysis to have the empirical formula $\mathbf{C_6H_{14}O}$. Compound P is slightly soluble in water. On oxidation compound P is converted into a **compound Q** of empirical formula $\mathbf{C_3H_6O}$ and relative molecular mass 116. Both compound P and Q react with sodium metal liberating hydrogen gas.

(i) To what class of compounds does compound P belong? (1 mark)

……

(ii) Draw the displayed structural formula of P. (1 mark)

……
……
……

(iii) Deduce the molecular formula of Q and draw its displayed structural formula. (2 marks)

……
……
……
……

(iv) What other test would you carry out on Q to confirm the presence of the functional group you have indicated? (2 marks)

……
……

3. (a) During the electrolysis magnesium sulphate a current of 2 amperes was passed through the solution for 4 hours. Calculate the volume of the gas produced at the anode. (1 faraday 96,500 coulombs and volume of a gas at room temperature is 24,000cm^3). (2 marks)

……
……
……

(b) Table gives standard reduction potentials for some half cells.

Half-cell	Half-cell equation	E^θ /V
I	$Cr^{3+}(aq) + e^- \rightarrow Cr^{2+}(aq)$	-0.41
II	$Cd^{2+}(aq) + 2e^- \rightarrow Cd(s)$	-0.40
III	$Na^+(aq) + e^- \rightarrow Na(s)$	-2.71
IV	$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$	+0.34
V	$Pb^{2+}(aq) + 2e^- \rightarrow Pb(s)$	-0.13
VI	$Br_2(aq) + 2e^- \rightarrow 2Br^-(aq)$	+1.07
VII	$2H^+(aq) + 2e^- \rightarrow H_2(g)$	0.00
VIII	$Fe^{2+}(aq) + 2e^- \rightarrow Fe(s)$	-0.44V
IX	$O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$	+0.40V
X	$H_2O_2(aq) + 2H^+(aq) + 2e^- \rightarrow 2H_2O(l)$	+1.23V

(i) Identify: (1 mark)

I. The strongest oxidizing agent.

……

II. The strongest reducing agent.

……

(ii) Construct an electrochemical cell from half-cells **V** and **VI**. (3 marks)

(iii) Write the equation and calculate the electrode potential for the electrochemical cell constructed from half-cells **V** and **VI**. (2 marks)

……

……

……

(iv) Explain why it is not advisable to use aqueous sodium sulphate as the salt bridge in the electrochemical cell formed between half-cells **V** and **VI.**
(1 mark)

……

……

(v) Write the cell diagram for an electrochemical cell made using half-cells **V** and **VI**.
(1 mark)

……

(vi) Write an equation to show how rusting occurs.(2 marks)

……

……

……

(vii) Give two reasons why electroplating is necessary. (2 marks)

……

……

4. Below is a periodic table grid study it and answer the questions. (*The letters does not represent the actual symbols of the elements*)

								B
C	**D**		**E**				**F**	
	G						**H**	
I								

(a) Which element will require the least amount of energy to remove one of the outermost electrons.
(1 mark)

……

(b) Select the most reactive metal. (1 mark)

……

(c) What name is given to the family of elements to which **elements D** and **G** belong?
(1 mark)

……

(d) An **element A** has atomic number 9. Indicate the position of **A** on the grid.

(1 mark)

(e) Explain why the atomic radius of **D** is smaller than that of **C**. (1 mark)

……
……
……

(f) Explain why the atomic radius of **A** is smaller than its ionic radius.

(2 marks)

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……
……

(g) Element **C** combines with oxygen to from an oxide. Using dots (•) and crosses(**x**) to represent the outermost electrons, show how the two elements combine.
(1 mark)

……
……
……
……

(h) Explain why **chloride of E** has higher melting point than **chloride of D**.
(2 marks)

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……
……

5. (a) Describe how you can determine change in mass when magnesium is heated. (3 marks)

……
……
……
……
……

(b) The table below shows the tests that were carried out on five portions of a compound and the results obtained. Study it and answer the questions that follow.

	Test	**Observation**
1	Addition of few drops of sodium hydroxide to the first portion until in excess.	White precipitate soluble in excess.
2	Addition of few drops of aqueous potassium iodide to the second portion	No yellow precipitate is formed.
3	Addition of few drops of acidified barium nitrate to the third portion.	White precipitate formed.
4	Addition of few drops of Lead (II) nitrate to the fourth portion.	White precipitate formed.
5	Addition of few drops of dilute nitric (V) acid to the fifth portion.	Effervescence of a colorless gas.

(i) Identify the ions likely present in; (2 marks)

I. **Step 2**

……

II. **Step 5**

……

(ii) Write an ionic equation for the reaction in the fifth portion. (1 mark)

……

(iii) Dilute nitric (V) acid was added to a solid which is an alloy of copper. The resultant mixture was then filtered. To the filtrate, few drops of sodium hydroxide solution was added till in excess.

I. Sate any two observations made when dilute nitric (V) acid is added to the alloy. (2 marks)

……
……
……

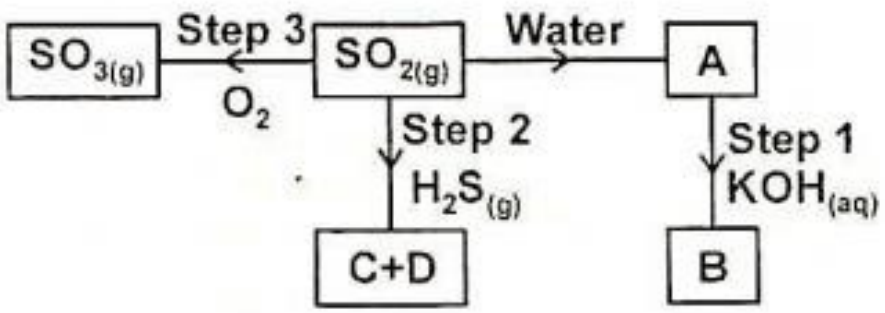
II. Name the other metal present in the alloy. (1 mark)

……

III. Write an ion equation for the reaction that took place when few and excess sodium hydroxide solution is added. (2 marks)

……
……

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



(i) Name a suitable method of gas collection that can used to collect Sulphur (VI) oxide gas in the laboratory. (1mark)

……

(ii) Name substances A, B, C and D. (2 marks)

……
……
……

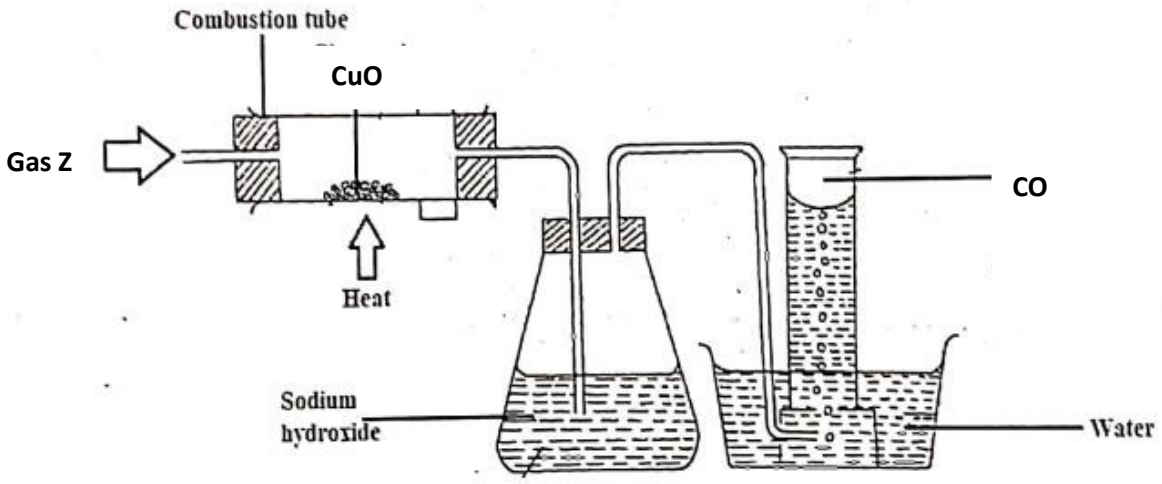
(iii) State the property of Sulphur (IV) oxide exhibited in step 2. (1mark)

……

(b) (i) Explain the observations made when burning magnesium is lowered into a gas jar containing carbon (IV) oxide. (3 marks)

……
……
……

(ii) Study the diagram below and answer the questions that follows.



I. Name gas Z. (1 mark)

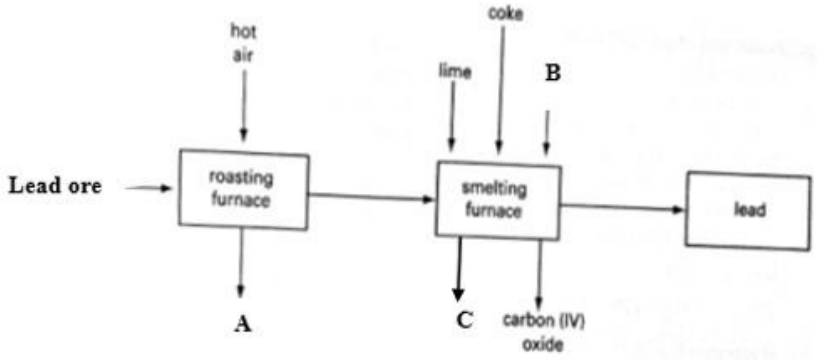
……

II. Write an equation for the reaction taking place in the combustion tube. (1mark)

……

III. State and explain the observations made in the combustion tube.(1 mark)

7. The flow chart in the figure below represents some stages in the extraction of lead metal. Study it and answer the questions that follow.



(a) Identify:

(i)The lead ore. (1 mark)

……

(ii)Substance A, B and C. (3 marks)

……

……

……

(b) Write an equation for the reaction that forms **substance C**. (1 mark)

……

(c) Name an impurity resent in the ore. (1 mark)

……

(d) State the process by which the ore is concentrated. (1 mark)

……

(e) Write an equation for the reaction which occurs in the roasting chamber. (1 mark)

……

(f) State any one use of lead.(1 mark)

……

(g) Give one reason why the extraction of lead causes pollution to the environment. (1 mark)

……

PAPER 3

1. You are provided with:

- **Solution A,** potassium iodate solution.
- **Solution B**, acidified sodium hydrogen sulphite solution.
- **Solution C,** starch indicator.
- Stop watch.
- Distilled water.

You are required to find out the **effect** of **concentration of potassium iodate**, **A** on the **rate of reaction** with acidified sodium hydrogen sulphite, **B**.

NB: *The end point of reaction of potassium iodate with acidified sodium hydrogen sulphite is indicated by the formation of a blue colored complex using starch indicator.*

Procedure 1:

Step 1

- **Label** 5 test tubes as 1, 2, 3, 4 and 5 and place them in a test tube rack.

Step 2

- Using a 10 cm^3 measuring cylinder add **5 cm^3** of acidified sodium hydrogen sulphite, **solution B** to **each** of the test tube in the rack.

Step 3

- Using a burette pour **10 cm^3** of potassium iodate solution to the **first** test tube.

Step 4

- Add **8 cm^3** of potassium iodate solution to the **second** test tube, **6 cm^3** to the **third** test tube, **4 cm^3** to the **fourth** test tube and **2 cm^3** to the **fifth** test tube.

Step 5

- Using a 10 cm^3 measuring cylinder add **2 cm^3** of distilled water into the **second** test tube, **4 cm^3** to the **third** test tube, **6 cm^3** to the **fourth** test tube and **8 cm^3** to the **fifth** test tube.

Step 6

- Using a 10 cm^3 measuring cylinder add 10 **cm^3** of **solution B** into a 100 cm^3 beaker, add 3 drops of

solution C and shake well. To this mixture add quickly contents in the first test tube and start a stopwatch immediately. Shake the mixture and note the time taken for the blue color to appear. Record the time taken in **table I.**

Step 7

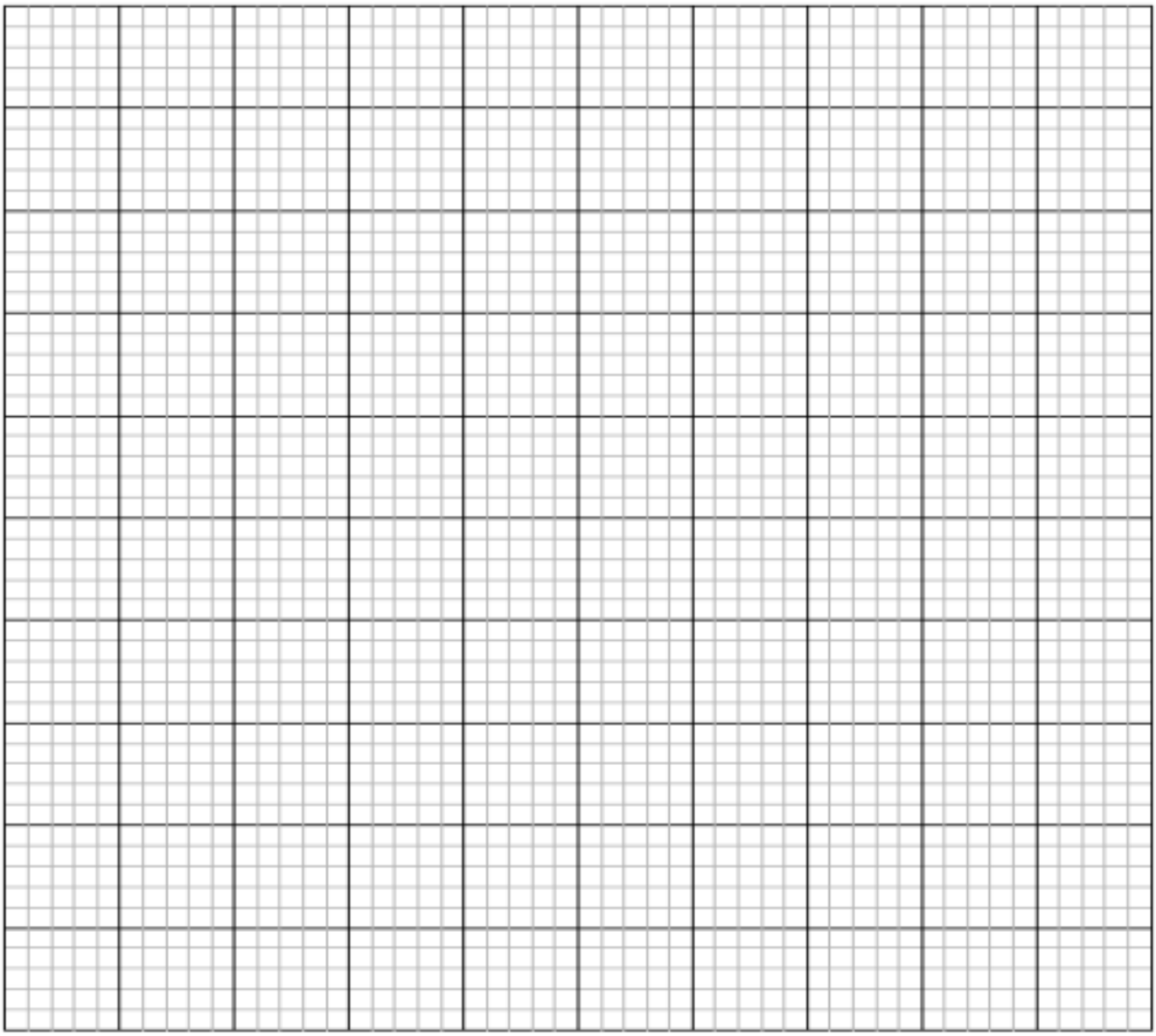
- **Rinse** the beaker and **repeat** procedure in **step 6** using the other solutions prepared in **step 4** above and complete the **table I**.

Table I

Experiment	Volume of Sodium hydrogen sulphite ($NaHSO_3$) used (cm^3)	Volume of distilled water used (cm^3)	Volume of potassium iodate (KIO_3) used in (cm^3)	Time taken to change color (secs)
1	5	0	10	
2	5	2	8	
3	5	4	6	
4	5	6	4	
5	5	8	2	

(3 marks)

(a) On the grid below plot a graph of time taken for the color change against volume of aqueous potassium iodate used. (3 marks)



(b) (i) From your graph determine the time taken for the blue colour to appear if 7cm^3 of aqueous potassium iodate was used. (1 mark)

……

……

(ii) Calculate the volume of distilled water required if 7 cm^3 of aqueous potassium iodate was used. (1 mark)

……

(c) On the graph sketch the graph that could be expected if the above experiments were done at a higher temperature. Explain. (1 mark)

(d) How does the volume of potassium iodate **solution A**, affect its rate of reaction with acidified sodium hydrogen sulphite **B**? Explain your answer.

(2 marks)

……

2. You are provided with:

- **Solution D**, which is 0.05M acidified potassium manganate (VII) solution ($KMnO_4$).
- **Solution E**, containing 5.0g/l of a dibasic acid, $H_2M.2H_2O$

You are required to determine the **concentration** of dibasic acid $H_2M.2H_2O$, **solution E** and then the **formula mass** of **M**.

Procedure II

1. Fill the burette with **solution D**.
2. Using a clean pipette, place 25 cm^3 of **solution E** into a clean conical flask. Heat this solution to about 70^0C.
3. Titrate using **solution D** until a permanent pink colour just appears. *Shake* thoroughly during titration.
4. Record the reading in **table II** below.
5. Repeat the titration one more time to complete the table below.

(a) Complete the **table II** below.

Table II

Titration	**I**	**II**	**III**
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution D used (cm^3)			

(3 marks)

(b) **Determine** the average volume of **solution D** used. (1 mark)

……

……

(c) **Calculate**:

(i) The number of **moles** of manganate (VII) ions in the average volume of solution B used above.
(1 mark)

……

(ii) Given that 2 moles of manganate (VII) ions react with 5 moles of dibasic acid $H_2M.2H_2O$. Calculate the number of moles of the dibasic acid $H_2M.2H_2O$ in the 25 cm^3 of **solution E**.
(1 mark)

……

(iii) The **concentration** of **solution E** in moles per litre. (1 mark)

……

……

(iv) Calculate the formula mass of **M** in the dibasic acid $H_2M.2H_2O$. (H = 1, O=16).
(2 marks)

3. (a) You **are provided** with **solid F**. **Carry out** the tests below. Write **your observations** and **inferences in the spaces** provided.

(i) Place about one third of **solid F** in a clean dry test-tube and heat it strongly.

Observations	**Inference**

(1 mark) (1 mark)

(ii) Place the remaining **solid F** in a boiling tube. Add about 10 cm^3 of distilled water. Shake the mixture thoroughly for about one minute. Filter and divide the filtrate into four portions.

Observations	**Inference**

(1 mark) (1 mark)

I. To the first portion, add 2 drops of **phenolphthalein indicator**.

Observations	**Inference**

(1 mark) (1 mark)

II. To the second portion, add 2 cm^3 of **dilute sulphuric (VI) acid.**

Observations	**Inference**

(1 mark) (1 mark)

III. To the third portion, add 3 cm^3 of **aqueous potassium iodide**.

Observations	**Inference**

(1 mark) (1 mark)

IV. To the fourth portion, add **dilute ammonia solution** drop wise until excess

Observations	**Inference**

(1 mark) (1 mark)

b) You are provided with **solid G**. Carry out the following tests and record your observations and inferences in the spaces provided.

i) Using a metallic spatula, take one third of **solid G** and **ignite** it using a Bunsen burner flame.

Observations	**Inference**

(1 mark) (1 mark)

ii) Place the remaining **solid G** in a boiling tube. Add about $10cm^3$ **distilled water**. Shake the mixture well. Divide the mixture into two portions.

Observations	**Inference**

(1 mark) (1 mark)

I. To about $4cm^3$ of the solution, add **solid sodium carbonate** and shake well.

Observations	**Inference**

(1 mark) (1 mark)

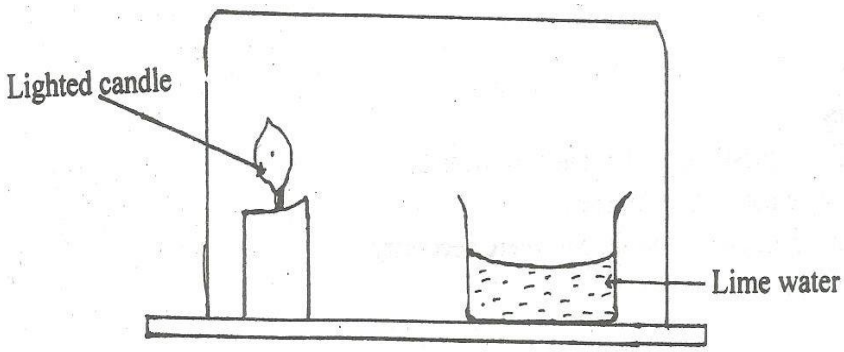
II. To about 4 cm^3 of the solution, add 3 drops of **acidified potassium dichromate (VI)**. **Warm** the mixture.

Observations	**Inference**

(1 mark) (1 mark)

KCSE REPLICA 8
PAPER 1

1. Study the arrangement below and answer the question that follows.



Explain what will be observed after some time. (3 marks)

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……

2. Briefly explain industrial application of the following processes.

a. Crystallization. (1½ marks)

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……
……
……

b. Fractional distillation. (1½ marks)

……
……
……
……

3. Four solutions of pH = **7**, **2**, **8.5** and **13** respectively were each reacted with calcium turnings. In which of the solutions would <u>hydrogen</u> gas be produced. Explain each case. (3 marks)

(a) ……
……
……

(b) ……
……
……

4. Describe how you would prepare a dry sample of zinc carbonate in the laboratory starting with zinc chloride solid. (3 marks)

……
……
……
……

……
……
……
……

5. The solubility of salt Y at 60^0C is 40g/100g of water and at 100^0C the solubility is 48g/100g of water.

i. How much salt of Y would saturate 190g of water at 100^0C? (2 marks)

……
……
……
……

ii. 50g of saturated solution of Y at 100^0C is cooled to 60^0C. Calculate the mass of Y that crystallizes out. (1 mark)

……
……

6. An oxide of carbon contains 42.8g by mass of carbon and has a relative molecular mass of 28. What is its molecular formula? (C = 12; O = 16) (2 marks)

……
……
……
……
……

7. Sulphur (iv) oxide gas was bubbled into acidified potassium dichromate (vi) and iron (iii) sulphate solutions respectively. Explain the observations made in each case.

(a) With potassium dichromate (vi). (1½ marks)

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……
……
……

(b) With iron (iii) sulphate. (1½ marks)

……
……
……
……

8. A known volume of ozone gas (O_3) diffuses through a small hole in 55 seconds; whereas the same amount of chlorine takes 67 seconds under the same conditions. Determine the molecular mass of ozone. (Cl = 35.5; O = 16) (3 marks)

……
……
……
……
……
……

9. a) Give the name of the following compound $CH_3CHCHCH_2CH_3$. (1 mark)

……
……

b) Ethane and ethene react with chlorine according to the equations given below.

I. $C_2H_{6(g)} + Cl_{2(g)} \xrightarrow{\text{U.V light}} C_2H_5Cl_{(l)} + HCl_{(g)}$

II. $C_2H_{4(g)} + Cl_{2(g)} \longrightarrow C_2H_4Cl_{2(l)}$

Name the type of chlorination reaction that takes place in: - (1 mark)

I……

……

II……

……

10. In the Haber process, the optimum yield of ammonia is obtained when a temperature of 450 ^{0}C, a pressure of 200 atmospheres and an iron catalyst are used.

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ **ΔH = -92kJ.**

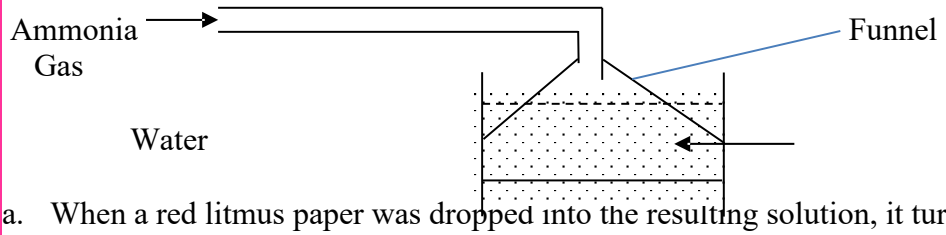
How would the yield of ammonia be affected if the temperature was raised to 600 ^{0}C? Explain. (2 marks)

……

……

……

11. Ammonia gas was passed into water as shown below.



a. When a red litmus paper was dropped into the resulting solution, it turned blue. Give a reason to this observation. (1 mark)

……

……

……

b. Explain the function of the funnel? (2 marks)

……

……

……

12. Draw a dot (•) and cross (**x**) diagram to show bonding in hydroxonium ion, H_3O^+. (H = 1; O = 8) (2 marks)

……

……

……

……

13. a) Draw a labelled diagram showing the structure of the most stable ion of $^{39}_{19}K$ (1 mark)

……

……

……

……

b) The atomic structure of element M is 11. Write the formula of the compound formed when element M reacts with sulphuric (vi) acid (1 mark)

……

14. The molar enthalpy of solution of sodium hydroxide is – 42kJmol^{-1}

a) On the space provided, draw a labelled energy level diagram for the dissolution of sodium hydroxide in water (2 marks)

b) Calculate the enthalpy change when 2g of sodium hydroxide is completely dissolved in water (Na = 23, H = 1, O = 16) (2 marks)

……
……
……
……

15. Write the discharge equations (half equations) for the electrode reactions when molten sodium chloride is electrolyzed using graphite electrodes.

Anode (1 mark)

……
……

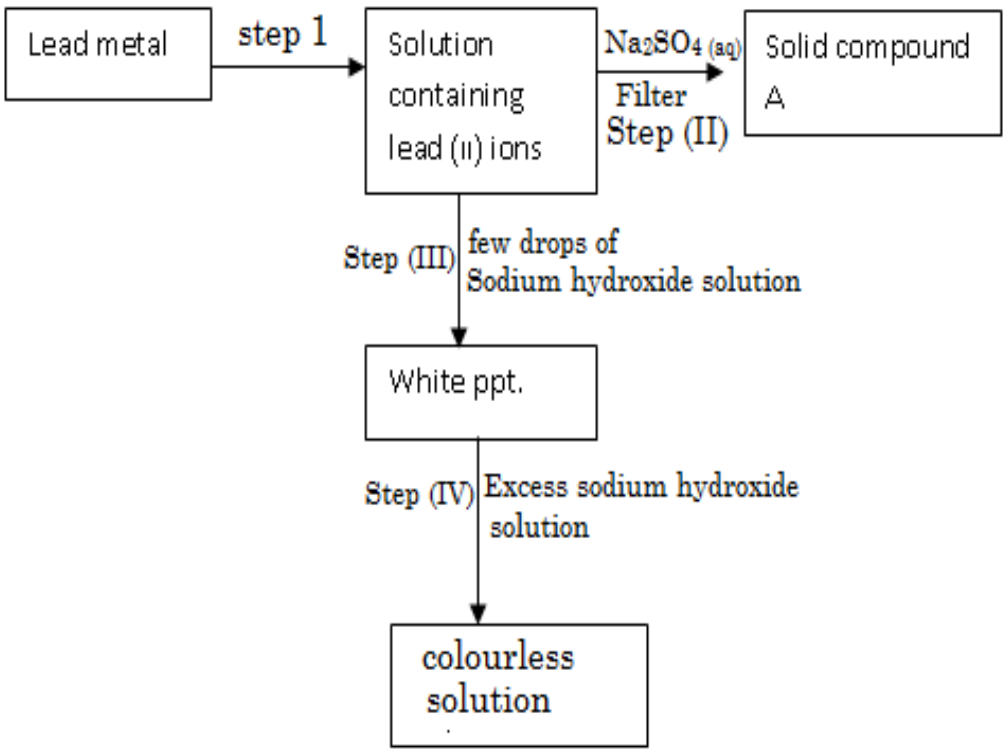
Cathode (1 mark)

……
……

16. An aluminum metal is a good conductor of heat and electricity and is used for overhead electric cables. State any two properties that makes aluminum suitable for this use. (2 marks)

……
……
……
……

17. Study the flow chart below and answer the questions that follow.



a) Name

I. The reagent used in step (I) (1 mark)

……..……

……..

II. Compound A. (1 mark)

……..……

……

b) Write an ionic equation for the reaction in step (IV). (1 mark)

……...……..

……

18. Study the information below and answer the questions that follow.

Ions	Electronic arrangement	Ionic radius
Na^+	2.8	0.095
K^+	2.8.8	0.133
Mg^{2+}	2.8	0.065

a. Explain why the ionic radius of K^+ is greater than that of Na^+. (1 mark)

..……

……

……

b. Compare the ionic radii of Mg^{2+} and Na^+. Explain. (2 marks)

…..……..…

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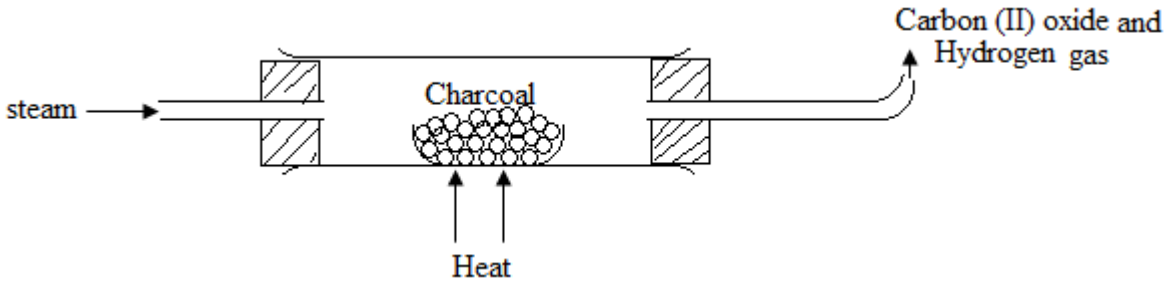
……..……

……..

19. When steam was passed over heated charcoal as shown in the diagram below, Hydrogen and Carbon (II) oxide gases were formed.



a) Write the equation for the reaction that takes place. (1 mark)

……..……

……

b) State **two** uses of Carbon (II) oxide gas which are also uses of Hydrogen gas. (2 marks)

……..……

……..

……

……

20. A radioactive isotope P decays by emitting two alpha particles and one Beta particle to form $^{214}_{83}Bi$

a) What is the atomic number of P (1 mark)

……

……

b) After 112 days, only 6.25% of the original mass of P remained, determine the half-life of P. (2 marks)

……

……

……

……

21. a) Write the electronic configuration of sodium and lithium *(sodium atomic number 11 and lithium atomic number 3)*

Sodium (1 mark)

……

……

Lithium (1 mark)

……

……

b. Why does sodium have a lower melting point than lithium? (2 marks)

……

……

……

……

22. Oxygen and Sulphur belong to group (VI) of the periodic table. Explain why there is a big difference in their melting points (*melting point of Oxygen is -216^{o}C while that of Sulphur is 444^{o}C)* (2 marks)

……

……

……

……

……

23. Painting, Oiling, galvanizing and tin plating are methods of rust prevention.

a. Explain the similarity of these methods in the ways they prevent rusting. (1 mark)

……

……

……

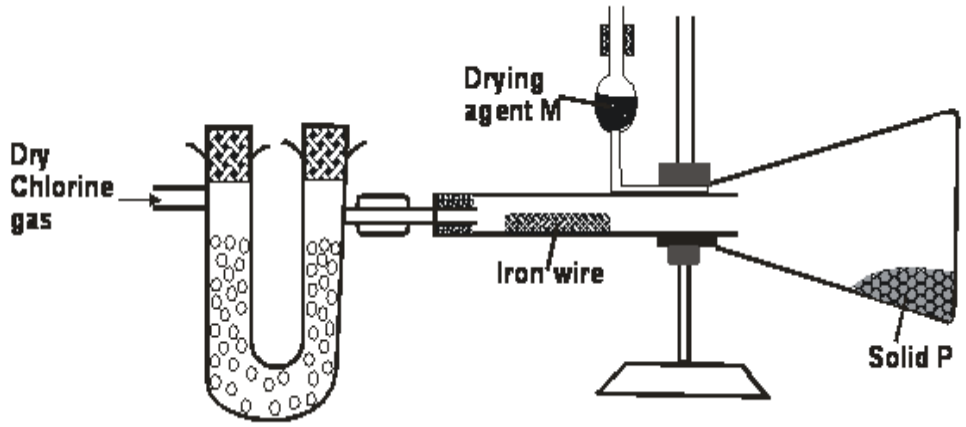
b. Explain why galvanized iron objects are better protected even when scratched. (1 mark)

……

……

……

24. The apparatus set up below was used to prepare an anhydrous solid P



a. Write an equation for formation of solid P (1 mark)

……

……

b. Suppose the gas used in the set up was dry hydrogen chloride gas; what would be the product obtained after the reaction? Give a reason for your answer. (1 mark)

……

……

……

25. When Sulphur is heated in a boiling tube in absence of air, the yellow crystals melt into golden yellow mobile liquid at 113°C. The liquid changes at 180°C into a dark brown very viscous liquid. More heating to about 400°C, produces a brown less viscous liquid.

a. Explain why the molten liquid becomes viscous. (1 mark)

……

……

b. If the brown liquid at 400°C is cooled rapidly by pouring it into cold water, which form of Sulphur is produced? (1 mark)

……

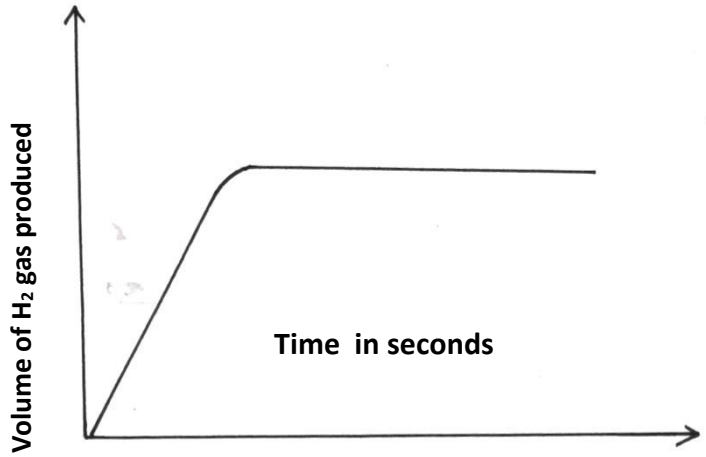
……

c. State the observation made when Sulphur is heated in a deflagrating spoon. (1 mark)

……

……

26. The reaction between a piece of magnesium ribbon with excess 2M hydrochloric acid was investigated at 25°C by measuring the volume of hydrogen gas produced as the reaction progressed. The sketch below represents the graph that was obtained.



a. Name one piece of apparatus that may be used to measure the volume of

hydrogen gas produced in this experiment. (1 mark)

……

……

b. On the same diagram, sketch the curve that would be obtained if the experiment was repeated at 35°C. (1 mark)

27. A steady current of 0.2 Amperes was passed through molten silver bromide for 80 minutes.

a. Calculate the quantity of electricity that passed through the set up. (1 mark)

……

……

……

b. Calculate the mass of product deposited at the cathode. (1F = 96500C; Ag = 108, Br = 80) (2 marks)

……

……

28. A group of compounds called chlorofluorocarbons have a wide range of uses but they have harmful effects on the environment. State and explain one harmful effect of chlorofluorocarbons on the environment. (2 marks)

……

29. Alkanols is one of the homologous series of organic compounds

(a) Give the name and structural formula of the fourth member of this series

(i) name; (1mark)

……

……

(ii) structural formula (1mark)

……

……

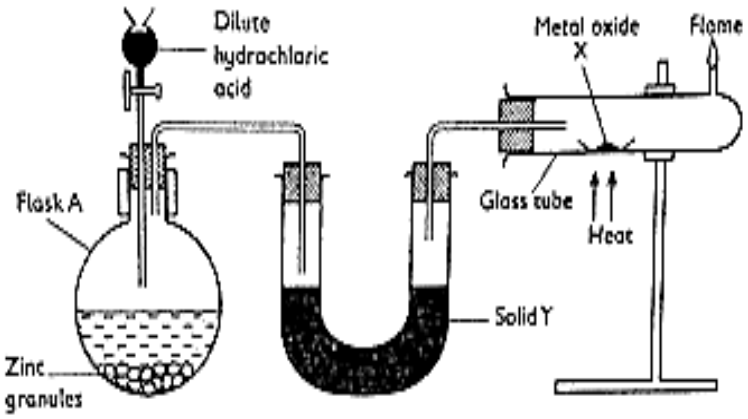
……

(b) Write an equation for the complete combustion of the fourth member of this series (1mark)

……

……

30. The apparatus is used to prepare hydrogen gas and then compare the affinity of hydrogen and metals towards oxygen gas. X is an oxide of a metal.

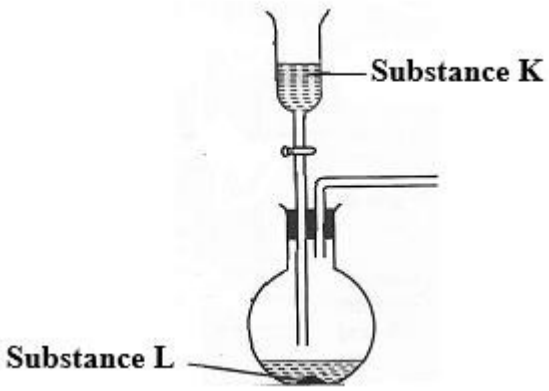


a) Name solid Y (1 mark)

b) If metal X was copper, state the observations made in the glass tube. Explain. (2 marks)

PAPER 2

1. The set-up below can be used to generate a gas.



(a) (i) Complete the table below giving the names of substance **K** and **L** if the gases generated are carbon (IV) oxide and carbon (II) oxide. **(2marks)**

Substance	Carbon (IV) oxide	Carbon (II) oxide
K		
L		

(ii) Complete the diagram to show how a sample of carbon (II) oxide can be collected. (2mks)

(iii) State two ways that can be used to distinguish carbon (IV) oxide from carbon (II) oxide? (2mks)

……
……
……

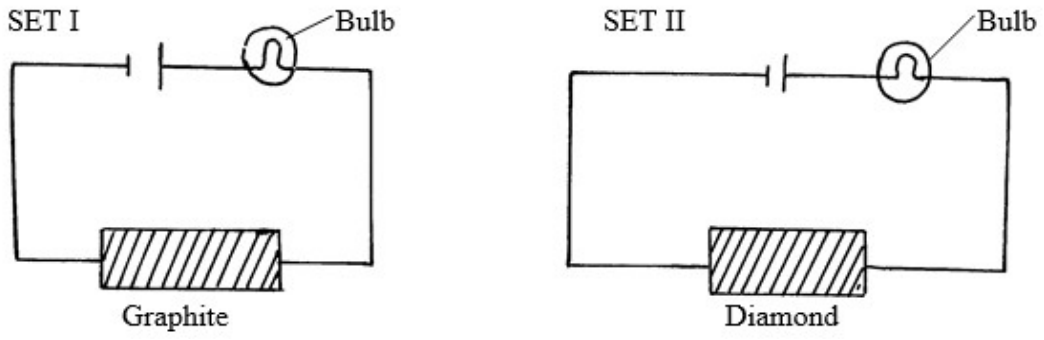
(b) (i) In an experiment, carbon (IV) oxide gas was passed over heated charcoal held in a combustion tube. Write a chemical equation for the reaction that took place in the combustion tube. **(1mk)**

……

(ii) State **one** use of carbon (II) oxide. **(1mk)**

……
……

(c) The following set ups were used by Form Two students of Kekalet Secondary School. Study and use them to answer the questions that follow.



State and explain the difference in observation made in set up I and II above. **(3 mks)**

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……
……
……
……

2. a) What is the molar enthalpy of neutralization? (1mk)

……
……

b) In order to determine the molar heat of neutralization of sodium hydroxide, 100cm^3 of 1M sodium hydroxide and 1M of hydrochloric acid both at the initial temperature were mixed and stirred continuously using a thermometer. The temperature of the resulting solution was recorded after every 30seconds until the highest temperature was attained. Thereafter the temperature of the solution was recorded for a further two minutes.

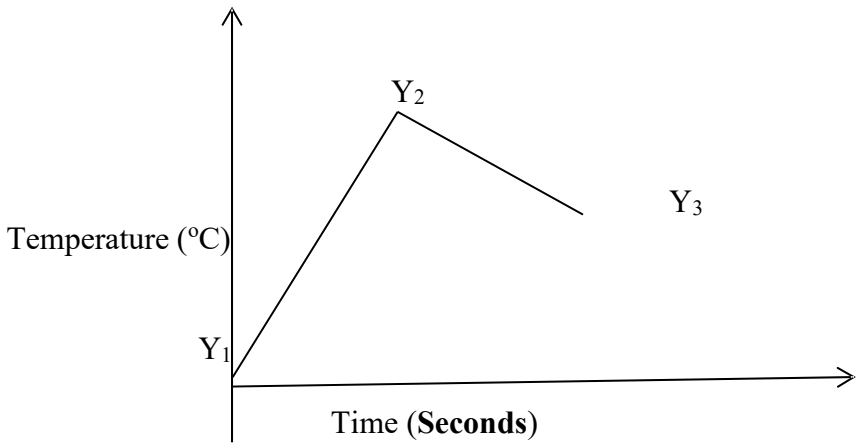
i. Why was it necessary to stir the mixture of the two solutions? (1mk)

……
……

ii. Write an ionic equation for the reaction that took place. (1mk)

……

iii. The sketch below was obtained when temperature of the mixture was plotted against time. Study it and answer the questions that follow.



Explain the temperature changes between points

Y_1 and Y_2 (1mk)

……
……

Y_2 and Y_3 (1mk)

……
……

iv. If the initial temperature for both solution was 25°C and the highest temperature was 31.4°C for the mixture. **Calculate;**

Heat change for the reaction (Specific heat capacity of solution=4.2Kjg^{-1}K^{-1}, Density of the solution =1gcm^{-3}) (2mks)

……
……
……

v) Molar heat of neutralization of sodium hydroxide. (2mks)

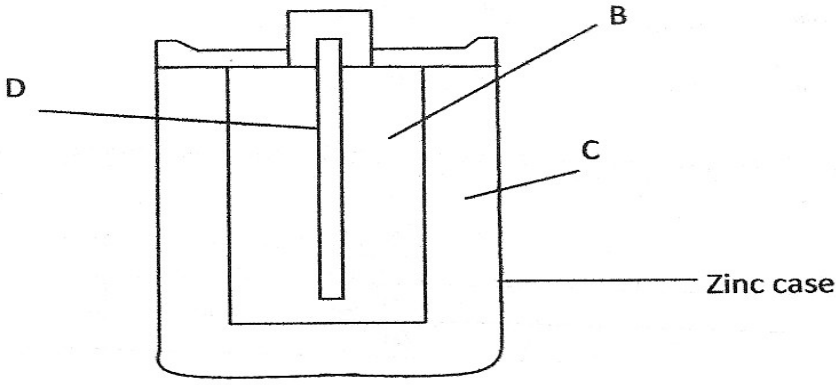
……
……
……

v. **Explain** how the molar heat of neutralization obtained in this experiment would compare with one that would be obtained using 1.0M ethanoic acid and $100cm^3$ of 1M sodium hydroxide solution. (2mks)

……
……
……

v) Draw an Energy level diagram for the reaction represented by reaction between hydrochloric acid and sodium hydroxide solution. (3mks)

3. The figure below shows parts of Le'Clanche cell (dry cell).



(a) Name:

(i) Substance D (1mark)

……

(ii) Mixture B (1mark)

……

(iii) Electrolyte C (1mark)

……

(b) In the cell, the electrolyte is a paste. Explain. (1mark)

……

(c) The following reaction occurs when the cell is in use.

$$Zn_{(s)} + 2NH_4^+{}_{(aq)} \xrightarrow{MnO_2} Zn^{2+}{}_{(aq)} + 2NH_{3(aq)} + H_2O_{(l)}$$

Given that:

$Zn^{2+}{}_{(aq)} + 2e^- \longrightarrow Zn(s)$ $\quad$ **$E^{\Phi} = -0.76V$**

$2NH_4^+{}_{(aq)} + 2e^- \xrightarrow{MnO_2} 2NH_{3(g)} + H_2O_{(l)}$ $\quad$ **$E^{\Phi} = +0.74V$**

Calculate the e.m.f. of the cell. (2mark)

……
……
……
……
……

(d) Use the standard electrode potentials given below to answer the questions that follow.

Half reactions	Electrode potential, E^{θ} (V)
$D^+{}_{(aq)} + e^- \longrightarrow D_{(s)}$	+ 0.80
$E^{2+}{}_{(aq)} + 2e^- \longrightarrow E_{(s)}$	+ 0.34
$F^{2+}{}_{(aq)} + 2e^- \longrightarrow F_{(s)}$	-0.13
$G^{2+}{}_{(aq)} + 2e^- \longrightarrow G_{(s)}$	-0.76

(i) Construct an electrochemical cell that will produce the lowest e.m.f. (2 marks)

……
……
……

(ii) Draw a labeled diagram of the electrochemical cell in d(i) above. (3 mark)

4. a) Name the method that can be used to obtain pure ammonium chloride from a mixture of ammonium chloride and sodium chloride. (1mk)

……
……

b) A student was provided with a mixture of sunflower flour, common salt and a red dye. The characteristics of the three substances in the mixture are given in the table below.

Substance	Solubility in water	Solubility in ethanol
Sunflower flour	Insoluble	Insoluble
Common salt	Soluble	Soluble
Solid red dye	Soluble	Soluble

A student was provided with ethanol and any other materials needed. Describe how the student can separate the mixture into its three components (3mks)

……
……
……
……

c) The diagram below shows part of the periodic table. The letters do not represent the actual symbols of the elements. Use the diagram to answer the questions that follow.

								Q
R				**T**				
			N		**V**		**W**	
Y							**X**	

i) Explain why the oxidizing power of W is more that of X. (2mks)

……
……
……

ii) How do the melting points of R and T compare? Explain (2mks)

……
……

iii) Select an element that could be used :

I. In weather balloons (1mk)

……

II. For making cooking pot. (1mk)

……

5. The following is a procedure that was used to obtain the solubility of a salt **Q** in water at 25 ^{0}C. Study it and answer the questions that follow. Salt **Q** was dissolved in warm distilled water until no more could dissolve. The mixture was then cooled to 25^{0}C and allowed to settle. A dry evaporating dish and dry watch glass were weighed. Some of the solution was decanted into the dish, covered with the watch glass, and then weighed. The solution was evaporated to dryness over a small flame. This residue, the dish and the watch glass were weighed. The residue was then heated repeatedly until a constant mass was obtained. The results below were obtained.

- Mass of dish + Watch glass = 50.60g
- Mass of solution + dish + watch glass = 80.6g
- Mass of residue + dish + watch glass = 62.60g

a) Use the data to answer the questions that follow.

(i) What is the purpose of the watch glass in such an experiment? (1mk)

……

.....

(ii) Why should the heating be continued until a constant mass is obtained? (1mk)

.....

.....

(iii) Calculate the mass of the solution. (1mk)

.....

.....

(iv) Calculate the mass of the residue. (1mk)

.....

.....

(v) Calculate the mass of the water. (1mk)

.....

.....

(vi) Calculate the solubility of salt **Q** in g per 100g of water at 25^0C. (2mks)

.....

.....

.....

(b) Hard water has both advantages and disadvantages. Give one advantage and one disadvantage of using hard water. (2mks)

.....

.....

(c) Using an equation, explain how addition of sodium carbonate is used to remove water hardness. (2mks)

.....

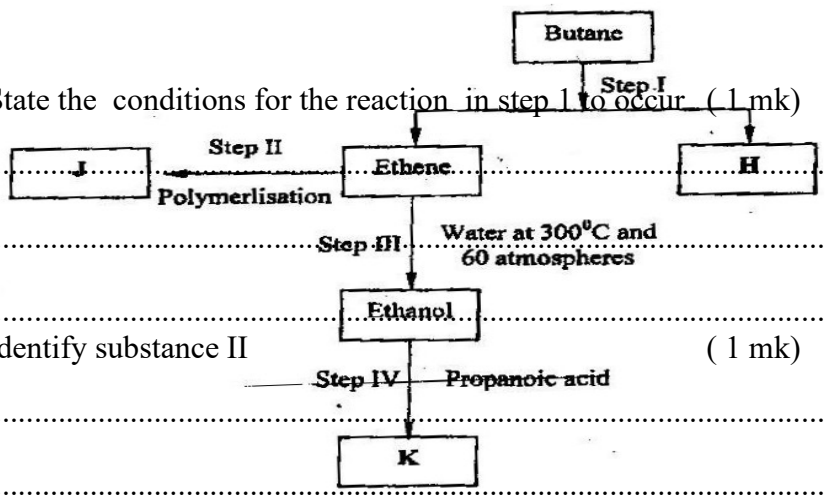
.....

6. (a) Alkanes, alkenes and alkynes can be obtained from crude oil. Draw the structure of the second member of the alkyne homologous series. (1mks)

.....

.....

b) Study the flow chart below and answer the questions that follow



i) State the conditions for the reaction in step I to occur (1 mk)

.....

.....

ii) Identify substance II (1 mk)

.....

.....

.....

iii) Give:

I. One advantage of the continued use of substance such as J (1 mk)

.....

.....

II The name of the process that takes place in step III (1 mk)

.....

III The name and the formula of substance K (2mks)

Name:……

Formula:……

iv) The relative molecular mass of J is 16,800. Calculate the number of monomers that make up J. (2mks)

.....

.....

.....

(b) The table below give the formula of four compounds L,M,N and P

Compound	Formula
L	C_2H_6O
M	C_3H_6
N	$C_3H_6O_2$
P	C_3H_8

Giving a reason in each case, select the letter which represents a compound that:

(i) Decolorizes bromine in the absence of UV light (2mks)

.....

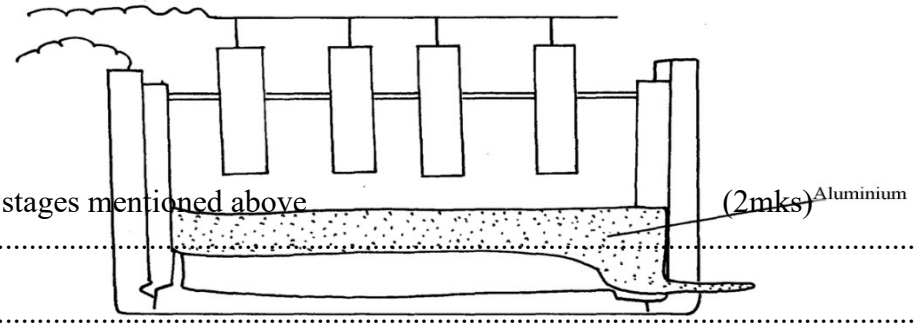
.....

.....

(iii) Gives effervescence when reacted with aqueous sodium carbonate (2mks)

.....

7. The diagram below is for extraction of Aluminium from its ore. It takes place in two stages. Use it to answer the questions that follow:-



(a) Name the **two** stages mentioned above (2mks)

.....

.....

(b) Name:-

(i) The ore from which Aluminium is extracted (1mk)

.....

(iv) The impurities removed during the extraction of Aluminium (1 mk)

.....

c) On the diagram label:- (3 mks)

(i) The anode and cathode

(ii) The region containing the electrolyte

d) Molten cryolite is added to Aluminium Oxide during extraction. Explain (1 mk)

.....

.....

e) Identify the electrode that should be replaced after some time. Give reasons (2 mks)

.....

PAPER 3

1. You are provided with the following solutions:
   - M_1 containing 95g of a mixture of sodium carbonate and sodium chloride per litre of solution.
   - M_2 which is 1MHCl.

You are required to determine the percentage of sodium chloride in the mixture.

Procedure

- Fill the burette with solution M2.
-using a clean pipette and Pipette filler, place 25.0cm^3 of solution M_1 into 250cm^3 conical flask
-add 3 drops of methyl orange indicator and titrate with solution M2
-Stop titrating when a permanent pink colour appears. Repeat experiment and complete the table below.

(a) Table 1

	I	II	III
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of M_2 used (cm^3)			

(4 marks)

(b) Determine the average volume of M_2 used. Show your workings. (1 mark)

(c) Determine the number of moles of M_2 used. (1 mark)

(d) Write down an ionic equation for the substances that react. (1 mark)

(e) Determine the number of moles of the carbonate used. (1 mark)

(f) Calculate the concentration of sodium carbonate in mole per liter (1 mark)

(g) Determine the mass of sodium carbonate in 1 litre of the solution (Na = 23, C = 12,O = 16)
(1 mark)

(h) Determine the percentage of sodium chloride in the mixture. (2 marks)

2. You are provided with:
   i). 2.20g of solid **BA11**,
   ii). Thermometer.
   iii). Distilled water.
   v). Boiling tube.

You are required to determine the solubility of compound **BA11** at various temperatures.

Procedure I:

a) Place the whole amount of solid **BA11** supplied to you into a clean, dry boiling tube.
b) Using a burette, add 2.00cm^3 of distilled water into the boiling tube with solid **BA11**.
c) Insert a thermometer into the boiling tube and heat the mixture in the hot water-bath, while stirring continuously with the thermometer, until the temperature of the mixture is about 80^0C when **ALL** the crystals **JUST** dissolve
d) Remove the boiling tube from the hot water bath and allow the contents to cool slowly while stirring with the thermometer. Note the temperature at which the crystals FIRST form/reappear and record this crystallization temperature, T_c in Table 2
e) Using the same mixture from (d) above, add 1.00cm^3 of distilled water from the burette into the boiling tube containing the mixture and repeat steps (c) and (d) above. Continue in this way until a total volume of water added to the boiling tube is 7.00cm^3. Complete Table 2 by calculating the solubility of compound **BA11** in water at the different temperatures.

Table 2: (6mks)

Total volume of water added (cm^3)	Crystallization Temperature ,T_C(^oC)	Solubility of compound **BA11** in water (g/100g of water)
2.00		
3.00		
4.00		
5.00		
6.00		
7.00		

f) On the grid provided plot a graph of solubility of compound BA11 (vertical axis) against temperature. (3mks)

g) Using the graph determine:

I. The temperature at which 100.0g compound **BA11** would dissolve in 100g of water. (1mk)

II. Solubility of compound **BA11** at 30.0^0C. (1mk)

h) A solution containing 100g of **BA11** per 100g of water was cooled to 30.0 ^{0}C. Determine the mass of crystals formed. (2mks)

3A). You are provided with solid P. Carry out the tests below. Write your observations and inferences in the spaces provided.

(a) Transfer a half spatula end full of solid P into a clean dry boiling tube
Heat the solid strongly and test any gas produced using litmus papers.

Observations	**Inferences**

(1 mark) (1 mark)

(b) Place the remaining solid P into a boiling tube .Add 8cm^3 of distilled water and shake thouroughly.Filter the mixture into another boiling tube .Retain the filtrate for use in c below
Place the entire residue into a boiling tube .add all the nitric (V) acid provided in atest tube labeled Z .divide the resulting mixture into two portions

.

1) To the firs portion in atest tube add ammonia solution dropwise till in excess

Observations	**Inferences**
(1 mark)	(1 mark)

11) To the second portion in atest tube add two drops of potassium iodide

Observations	**Inferences**
(1 mark)	(1 mark)

(c) To 2 cm^{3}of the filtrate in a test tube, add three drops of dilute nitric (v) acid

Observations	**Inferences**
(1 mark)	(1 mark)

(d) To 2 cm^{3}of the filtrate in a test tube, add three drops of lead (II) nitrate solution.

Observations	**Inferences**
(1 mark)	(1 mark)

3B) You are provided with solid X. Carry out the tests and record your observations in the spaces below.

(i) Put the solid X in a boiling tube. Add about $10cm^3$ of distilled water and shake. Divide the resulting solution into three portions

Observations	Inferences
(1/2 mark)	(1/2mark)

(ii) To the first portion add three drops of acidified potassium manganate (VII) and shake

Observations	Inferences
(1/2mark)	(1mark)

(iii) To the second portion add sodium hydrogen carbonate provided

Observations	Inferences
(1/2mark)	(1mark)

(vi) To the fourth portion add three drops of universal indicator. Compare the colour of the solution using pH colour chart

Observations	Inferences
(1/2mark)	(1mark)

KCSE REPLICA 9
PAPER 1

1. A magnesium ribbon sample was heated in separate volumes of pure oxygen and air.

a) In which sample was the mass of the product higher? Explain. (2 Marks)

_____

_____

b) Write the equations for the reactions in the sample with air. (2 Marks)

_____

2. Give the systematic name of the following compound and draw the structure of the polymer it forms:

CH_2CHCl

Name _____ (1 Mark)

Structure (1 Mark)

_____

_____

_____

3. When aqueous sodium hydroxide solution was added to freshly prepared acidified iron (II) sulphate solution, a green precipitate was formed. When hydrogen peroxide was first added to iron (II) sulphate solution followed by sodium hydroxide solution, a brown precipitate was formed. Explain these observations. (3 Marks)

_____

_____

_____

_____

4. Study the following nuclear reaction and complete it by giving the values of **m** and **n**

$$^{232}_{92}X \rightarrow ^{m}_{n}Y + 2\,^{0}_{-1}e^{-} + ^{4}_{2}He$$

m _____ (1 Mark) **n** _____ (1 Mark)

5.

a) State Charles' Law (1 Mark)

_____

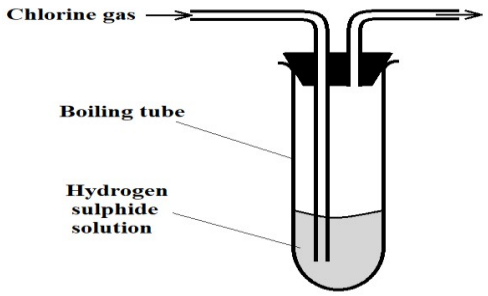
_____

b) A certain mass of carbon (IV) oxide gas occupied 200cm^3 as 25°C and 750mmHg pressure. Calculate the volume occupied by the same mass of gas if pressure is lowered to 300mmHg and the temperature raised to 30°C. (2 Marks)

_____

_____

6. Chlorine gas was bubbled into as solution of hydrogen sulphide as shown in the diagram below.



a) Explain the observation made in the boiling tube (2 Marks)

_____

_____

b) What precaution should be taken in this experiment? (1 Mark)

_____

c) Distinguish between the bleaching action of chlorine and that of sulphur (IV) oxide. (1 Mark)

_____

_____

7. Concentrated sulphuric (VI) acid was left exposed in air for a few days. It was found that the level of the acid had risen.

a) Why did the level of the acid in the container rise? (1 Mark)

_____

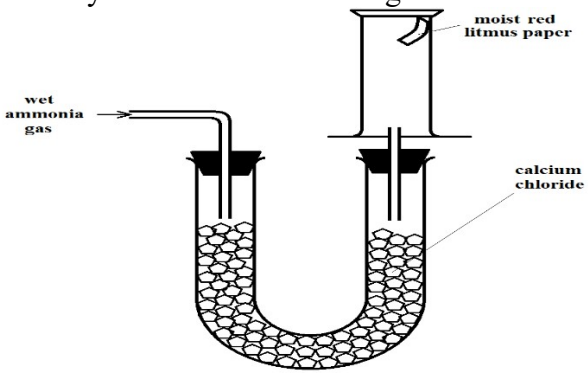
_____

b) How is this property useful in the laboratory? (1 Mark)

_____

_____

8. The setup below can be used to dry and collect ammonia gas. Use it to answer the questions that follow.



a) The wet red litmus paper remained red. Explain. (1 Mark)

_____

_____

b) Name the method used when collecting ammonia gas. (1 Mark)

_____

9. $400cm^3$ of **gas D** diffuses from a porous plug in 50 seconds while $600cm^3$ of oxygen gas diffuses from the same apparatus in 30 seconds. Calculate the relative molecular mass of **gas D**. (3 Marks)

_____

_____

_____

10. Use the information in the table below on solubility to answer the questions that follow.

Salt	Solubility at	
	70°C	35°C
$CuSO_4$	38	28
$Pb(NO_3)_2$	78	79

A mixture containing 38g copper (II) sulphate and 78g of lead (II) nitrate in 100g of water at 70 °C is cooled to 35°C.

a) Which of the two salts will crystallize? (1 Mark)

_____

b) Calculate the mass of crystals formed. (1 Mark)

_____

_____

c) State the salt that will be unsaturated at 35°C (1 Mark)

_____

d) How much of the salt in **c)** above would be required to make a saturated solution at 35°C? (1 Mark)

_____

_____

11. Methane burns in oxygen as shown by the equation below.

$$CH_4\ (g) + 2O_2\ (g) \rightarrow CO_2\ (g) + 2H_2O\ (g)$$

Given the following bond energies:

Bond	Bond Energy (kJ/mole)
C – H	413
O = O	497
C = O	740
O – H	463

a) Calculate the heat change for the reaction. (2 Marks)

_____

_____

_____

b) Define molar heat of combustion. (1 Mark)

_____

_____

_____

12. Given solid sodium carbonate, lead (II) nitrate crystals and water, explain how you can obtain a solid sample of lead (II) carbonate. (3 Marks)

_____

_____

_____

_____

_____

13. Calculate the volume of oxygen produced when 10g of silver nitrate was completely decomposed by heating at s.t.p. (Ag = 108, N = 14, O = 16, MGV at s.t.p. = 22.4dm^3) (3 Marks)

_____

_____

_____

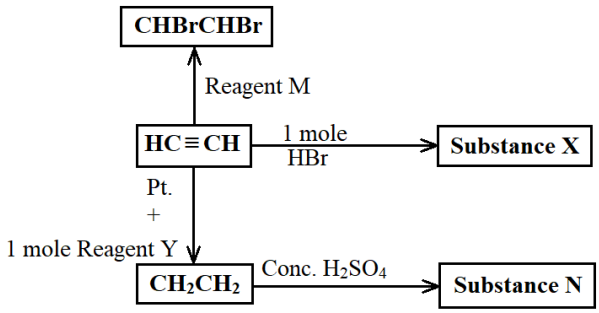
_____

14. A solution of hydrogen chloride gas in water conducts an electrical current, while that of hydrogen chloride in methylbenzene does not conduct. Explain. (2 Marks)

_____

_____

15. The scheme below shows some reactions, starting with ethyne. Study it and answer the questions that follow.



a) Name substance

i) **X** _____ (½ Mark)

ii) **N** _____ (½ Mark)

iii) **M** _____ (½ Mark)

b) Ethene undergoes polymerization to form a polymer. Give an equation for the reaction and name the product. (1½ Marks)

_____

_____

16. When 16g of ammonium nitrate was dissolved in 100cm^3 of water at 25°C, the temperature of the solution drops to 19°C.

a) Calculate the molar enthalpy of solution of ammonium nitrate (3 Marks)
(N = 14, O = 16, H = 1, Specific Heat Capacity for Water = 4.2kJ/kg/k)

_____

_____

_____

_____

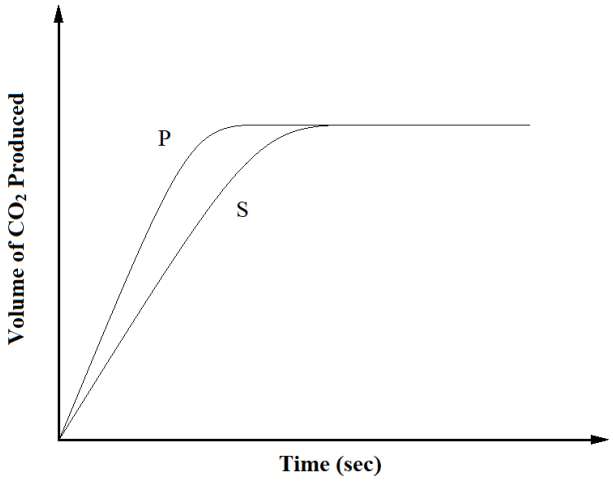
b) Is the enthalpy change endothermic or exothermic? Give a reason (1 Mark)

_____

_____

_____

17. The curves below represent the volume of carbon (IV) oxide gas evolved when 2M hydrochloric acid was reacted with 100g of powdered calcium carbonate and when 1M hydrochloric acid was reacted with the same quantity of calcium carbonate.



a) Which of the two curves represents the reaction of 2M concentrated hydrochloric acid? Explain. (2 Marks)

_____

_____

_____

b) Why do the two curves flatten at the same level of production of CO_2? (1 Mark)

_____

_____

18. The electron arrangement of ions X^{3+} and Y^{2-} are **2.8**, and **2.8.8** respectively.

a) In which groups do **X** and **Y** belong? (1 Mark)

X_____ **Y**_____

b) State the formula of the compound that would be formed between **X** and **Y** (1 Mark)

_____

19.

a) State **two** ores from which sodium metal can be extracted. (1 Mark)

_____

_____

b) During the extraction, calcium chloride solid is added into the sodium chloride solid. Why is calcium chloride added to the sodium chloride? (1 Mark)

_____

_____

c) State **two** uses of sodium metal. (2 Marks)

_____

_____

20. Using and energy cycle diagram, calculate the enthalpy change of formation of carbon disulphide, given: (3 Marks)

$S(s) + O_2(g) \rightarrow SO_2(g)$ $\Delta H = -294kJ/mole$

$CS_2(g) + 3O_2(g) \rightarrow CO_2(g) + 2SO_2(g)$ $\Delta H = -1072kj/mole$

$C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = -393kJ/mole$

_____

_____

_____

21. The table below shows tests carried out in a sample of water and the results obtained.

Sample	Results	observations
A	Addition of sodium hydroxide dropwise until excess	Whit precipitate which dissolves in excess
B	Addition of excess ammonia solution	White precipitate
C	Addition of dilute nitric (V) acid followed by barium chloride	White precipitate

a) Identify the **anion** present in the water sample (1 Mark)

b) Write an ionic equation for the reaction in **C** (1 Mark)

22. Use the following information to answer the questions that follow:

$Sn^{2+}(aq) + 2e^- \rightarrow Sn(s)$ $E^\theta = -0.14V$

$Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$ $E^\theta = +0.34V$

a) Write the cell representation for the cell made up of the two half cells (1 Mark)

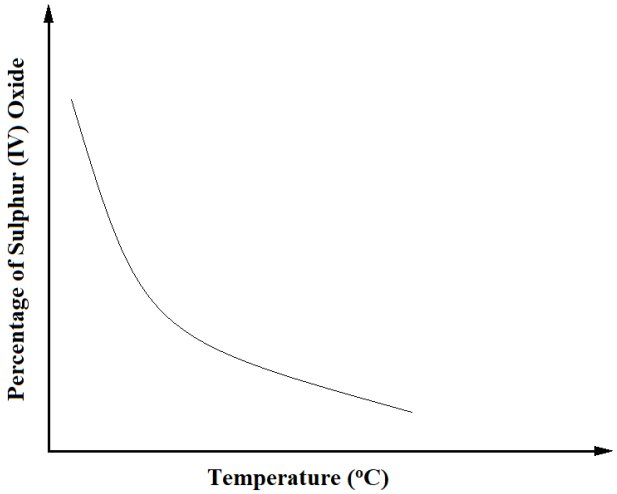
b) Identify the reducing species (1 Mark)

c) Calculate the E^θ value for the cell (1 Mark)

23. The following is a reaction of an equilibrium mixture:

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

The percentage of sulphur (VI) oxide in the equilibrium mixture varies with temperature as illustrated in the sketch graph below



a) How does the percentage of sulphur (VI) oxide in the equilibrium mixture vary as the temperature increases? Explain. (1½ Mark)

b) Is the forward reaction in the equilibrium exothermic or endothermic? Give a reason for your answer. (1½ Mark)

24. Radioactive polonium (Po) with a mass number of 212 and atomic number of 84 was detected in a sample of water. The water had an activity of 1000 counts per second.

a) If the water is boiled, explain whether the activity would be affected or not. (1 Mark)

b) Given that polonium resulted from bitumen (B) following emission of a beta (β) particle, write a nuclear equation for the decay. (1 Mark)

c) State **one** medical application of radioactivity. (1 Mark)

_____

25. Name and give the formula of:

a) The **chief ore** from which zinc is extracted (1 Mark)

_____

b) The **main impurity** in the ore. (1 Mark)

_____

c) The ore is concentrated by froth floatation. What is froth floatation? (1 Mark)

_____

_____

26. The atomic number of sulphur is 16. Write the electron arrangement of sulphur in the following compounds

a) H_2S _____ (1 Mark)

b) SO_3^{2-} _____ (1 Mark)

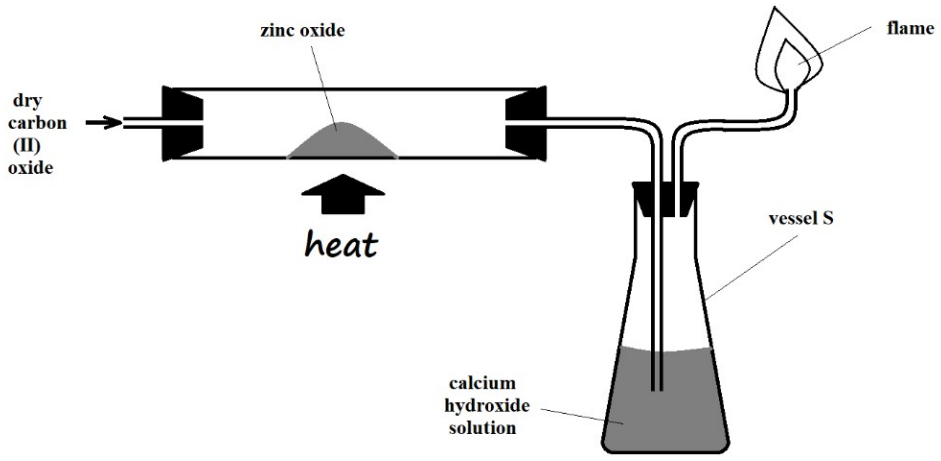
27. For the reaction: $\mathbf{Cl_2\ (g) + 2I^-\ (aq) \rightarrow 2Cl^-\ (aq) + I_2\ (s)}$

Using oxidation numbers, state and explain the reducing species. (2 Marks)

_____

_____

28. The setup below was used to investigate the effect of carbon (II) oxide on zinc oxide.



a) State the observations made on the setup. (2 Marks)

_____

_____

b) Write equations for the reactions that took place. (2 Marks)

_____

_____

PAPER 2

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

C				**F**	**G**		**I**		
						H		**K**	
D	**E**								
							J		

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

_____

_____

_____

ii) What is the name given to the family of elements to which **I** and **J** belong? (1 Mark)

_____

iii) Using dots (•) and crosses (×) 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)

_____

_____

_____

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

Substance	**M**	**N**	**O**	**P**	**Q**	**R**
Melting Point (°C)	801	1356	-101	26	-39	113
Boiling Point (°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 of electricity in the molten state but not in the solid state. (2 Marks)

_____

_____

_____

ii) What is the most likely structure and bond in **substance N**? Explain. (2 Marks)

Structure _____ Bond _____

_____

_____

iii) Identify, with a reason, a substance that exists as a liquid at room temperature. (2 Marks)

_____

_____

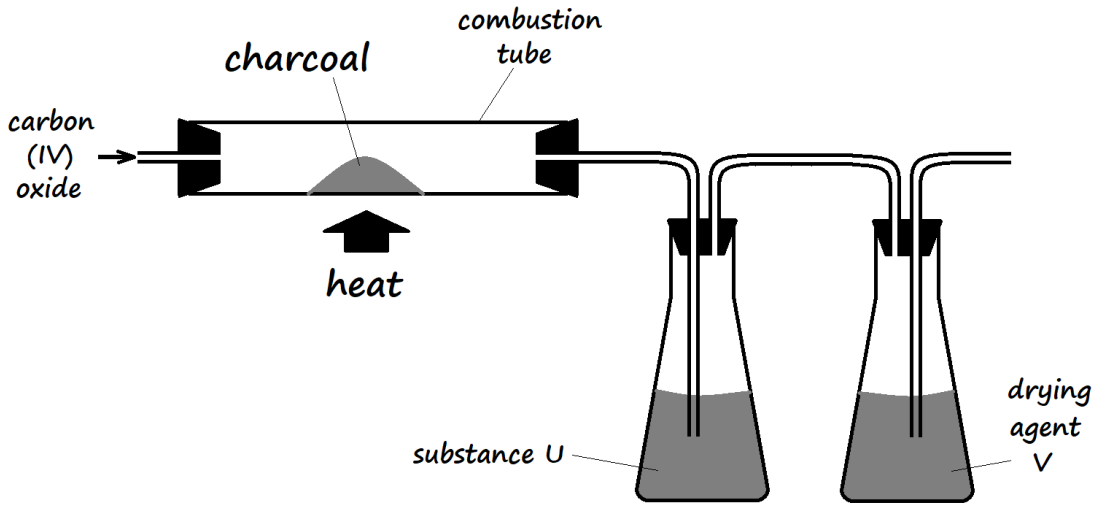
2.

a)

i) What name is given to different forms of an element which exist in the same physical state? (1 Mark)

ii) Name **two** crystalline forms of carbon (1 Mark)

b) The figure below is part of a setup used to prepare and collect dry carbon (II) oxide from carbon (IV) oxide.



i) Complete the diagram to show how dry carbon (II) oxide gas is collected. (1 Mark)

ii) Identify:

- Substance **U** and state its use

- Drying agent **Y**

iii) Write a chemical equation for the reaction which takes place in the combustion tube (1 Mark)

iv) Carbon (II) oxide is a major environmental pollutant.

- Give **one** major source of carbon (II) oxide in the atmosphere (1 Mark)

- Explain how carbon (II) oxide causes poisoning (1 Mark)

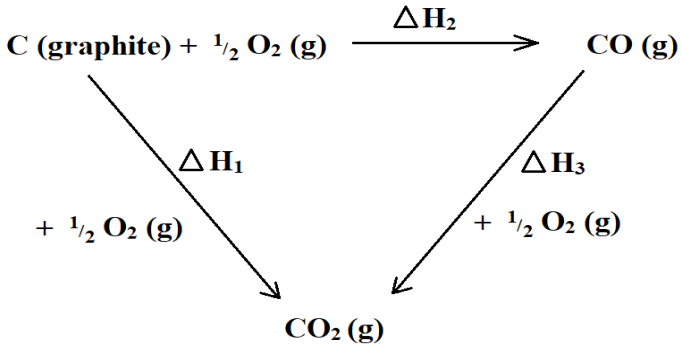
c) State **one** use of carbon (II) oxide (1 Mark)

d) Write an equation for the formation of water gas. (1 Mark)

e) Explain why sodium hydroxide solution is not used in testing for carbon (IV) oxide gas, while calcium hydroxide is preferably used. (2 Marks)

3.

a) Study the following energy cycle diagram and then answer the questions that follow.



i) Name the enthalpy change represented by ΔH_2. (1 Mark)

_____

ii) Use the following information to calculate the value of ΔH_1 for 144g of graphite. (2 Marks)

ΔH_2 = -110 kJ/mole ΔH_3 = -283kJ/mole

_____

_____

_____

_____

b) The following are thermochemical equations for molar enthalpies of combustion for some substances. Study them and answer the questions that follow.

$C_4H_{10}(g) + \frac{13}{2}O_2(g) \rightarrow 4CO_2(g) + 5H_2O$ $\quad \Delta H^{\theta}_c = -2877kJ/mole$

$C(s) + O_2(g) \rightarrow CO_2(g)$ $\quad \Delta H^{\theta}_c = -399kJ/mole$

$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$ $\quad \Delta H^{\theta}_c = -286kJ/mole$

i) What is molar enthalpy of combustion of a substance? (1 Mark)

_____

_____

ii) Calculate the molar enthalpy of formation of butane (C_4H_{10}) using the information given above. (3 Marks)

_____

_____

_____

c) The following results were obtained in an experiment, to determine the heat of neutralization of 25cm^3 of 2M sodium hydroxide solution, using 25cm^3 of hydrochloric acid:

Initial temperature of acid	= 25.0°C
Initial temperature of alkali	= 26.0°C
Final temperature of mixture of acid + alkali	= 38.5°C
Density of solution	=1g/cm^3
Specific heat capacity of solution	=4.2 J/g/K

i) Define molar heat of neutralization (1 Mark)

_____

_____

ii) Write an **ionic equation** for the neutralization reaction involving hydrochloric acid and sodium hydroxide solution. (1 Mark)

_____

iii) Calculate:

- The enthalpy change during this experiment. (2 Marks)

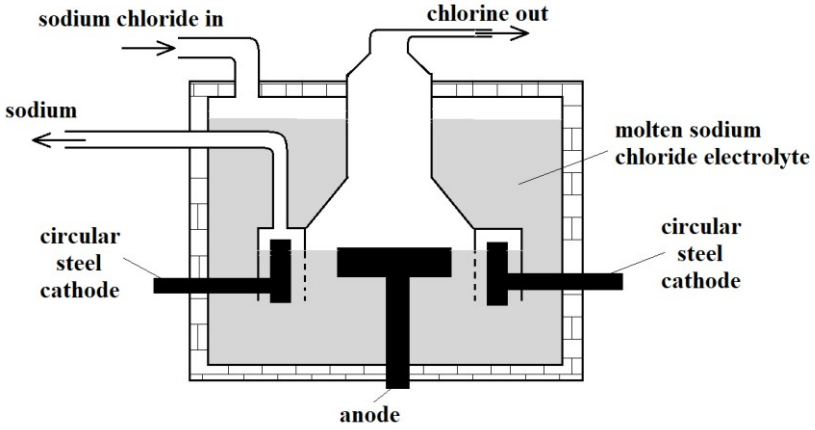
_____
_____
_____
_____

- The molar enthalpy of neutralization for this reaction (2 Marks)

_____
_____
_____
_____

4.

a) Below is a simplified diagram of the Down's Cell, used for the manufacture of sodium. Study it and answer the questions that follow.



i) What material is the anode made of? Give the reason why that material is used. (2 Marks)

_____
_____

ii) What precaution is taken to prevent chlorine and sodium from re-combining? (1 Mark)

_____
_____

iii) Write an ionic equation for the reaction in which chlorine gas is formed (1 Mark)

_____

b) In the Downs process, (used for manufacture of sodium), a certain salt is added to lower the melting point of sodium chloride from about 800°C to about 600°C.

i) Name the salt that is added. (1 Mark)

_____

ii) State why it is necessary to lower the temperature in **b)** above (1 Mark)

_____
_____

c) Explain why aqueous sodium chloride is not suitable as an electrolyte for the manufacture of sodium in the Down's Process. (2 Marks)

_____
_____

d) Sodium metal reacts with air to form two oxides. Give the formulae of the two oxides (1 Mark)

_____ _____

e) State **two** uses of sodium (2 Marks)

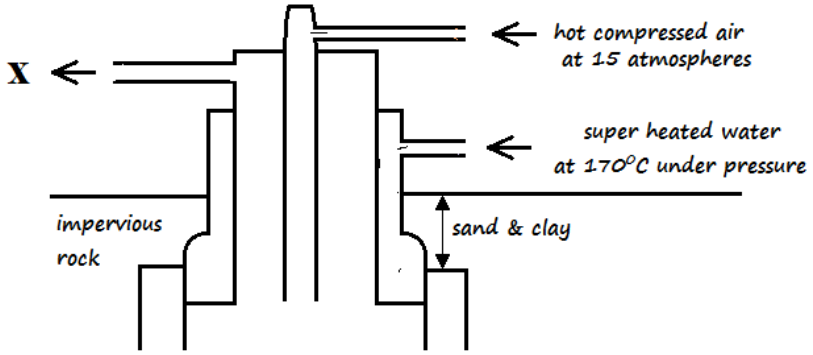
_____

_____

_____

5.

a) The diagram below shows part of the Frasch process, used for the extraction of sulphur. Use it to answer the questions that follow.



i) Identify **X** _____(1 Mark)

ii) Why is it necessary to use superheated water and hot compressed air in this process?
(2 Marks)

_____

_____

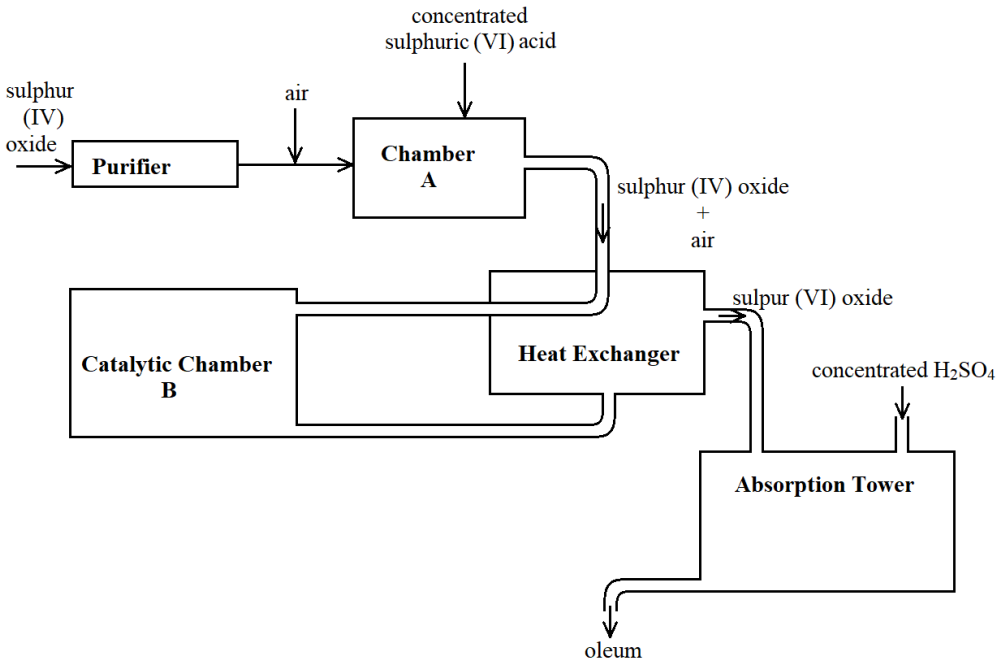
_____

iii) State **two** physical properties of sulphur that makes it possible for it to be extracted by this method.
(2 Marks)

_____

_____

b) The diagram below shows part of the process in the manufacture of sulphuric (VI) acid. Study it and use it to answer the questions that follow.



i) Give **two** reasons why air is referred to as a mixture (2 Marks)

_____

_____

ii) What is the role of concentrated sulphuric (VI) acid in **Chamber A**? (1 Mark)

_____

_____

iii) Name **two** catalysts that can be used in the Catalytic **Chamber B**. (2 Marks)

_____

_____

iv) State **two** roles of the heat exchanger (2 Marks)

_____

_____

v) Describe the test for sulphite anion, $\mathbf{SO_3^{2-}}$ (2 Marks)

_____

_____

_____

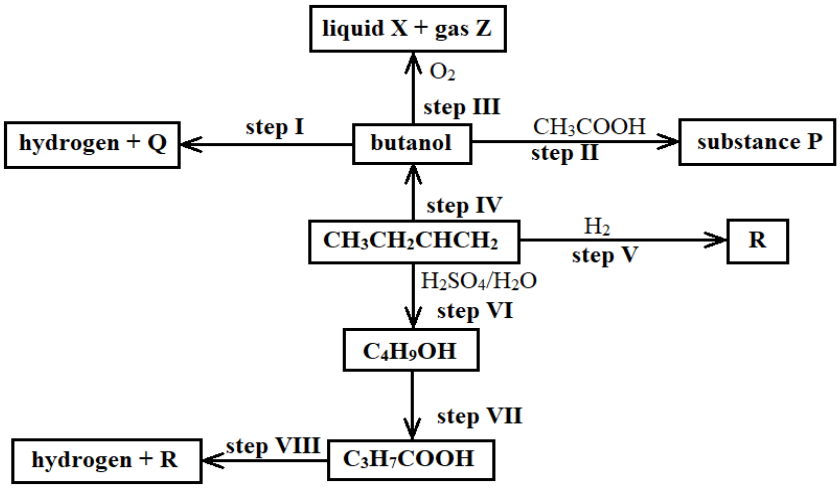
vi) Explain the observation made when a few drops of concentrated sulphuric (VI) acid are added to crystals of hydrated copper (II) sulphate. Explain your answer. (2 Marks)

_____

_____

_____

6. Study the reaction scheme below and answer the questions the follow:



i) What is the distinguishing physical property of **Substance P**? (1 Mark)

_____

_____

ii) Identify a suitable reagent that can be used in **Step I**. (1 Mark)

_____

iii) Describe a chemical test on how **C_3H_7COOH** can be distinguished from **C_4H_9OH**. (2 Marks)

_____

_____

_____

iv) Write an equation for the reaction that takes place in **Step III** (1 Mark)

_____

v) Name the types of reaction that occur in steps **II**, **III**, **V**, and **VII** (2 Marks)

II _____ **III** _____

V _____ **VII** _____

vi) If 7.4g of butanol completely underwent Step III, determine the volume of gas Z produced at s.t.p. (MGV = 22.4 litres, C = 12, H = 1, O = 16) (3 Marks)

_____

_____

_____

_____

vii) Write an equation for the reaction between **R** and one mole of fluorine gas (1 Mark)

_____

viii) Describe a chemical test for **liquid X** (2 Marks)

_____

_____

_____

PAPER 3

QUESTION 1.

You are provided with:

- Sulphuric acid solution A
- 0.5M sodium hydroxide solution B
- Magnessium ribbon labelled C

You are required to:-

- Investigate the rate of reaction between solution A and metal C
- Determine the concentration of sulphuric acid in moles per litre

Procedure I

(i) Using a ruler, make 6 marks at 2cm length interval on the Magnesium ribbon provided. Cut the magnesium ribbon into 2 cm long pieces.

(ii) Transfer 50cm^3 of acid solution using a measuring cylinder into a clean dry 100ml beaker. Place 2cm length piece of magnesium ribbon into the beaker with the acid and immediately start the stop watch/clock. Shake gently and note the time taken for the piece of magnesium ribbon to react completely.

(iii) Record in table I below. Place another piece of magnesium ribbon (2cm) to the same solution and again note the time taken.

(iv) Repeat the procedure until all six pieces of magnesium ribbon have reacted with the same solution initially placed in the beaker

(v) Complete the table I below:

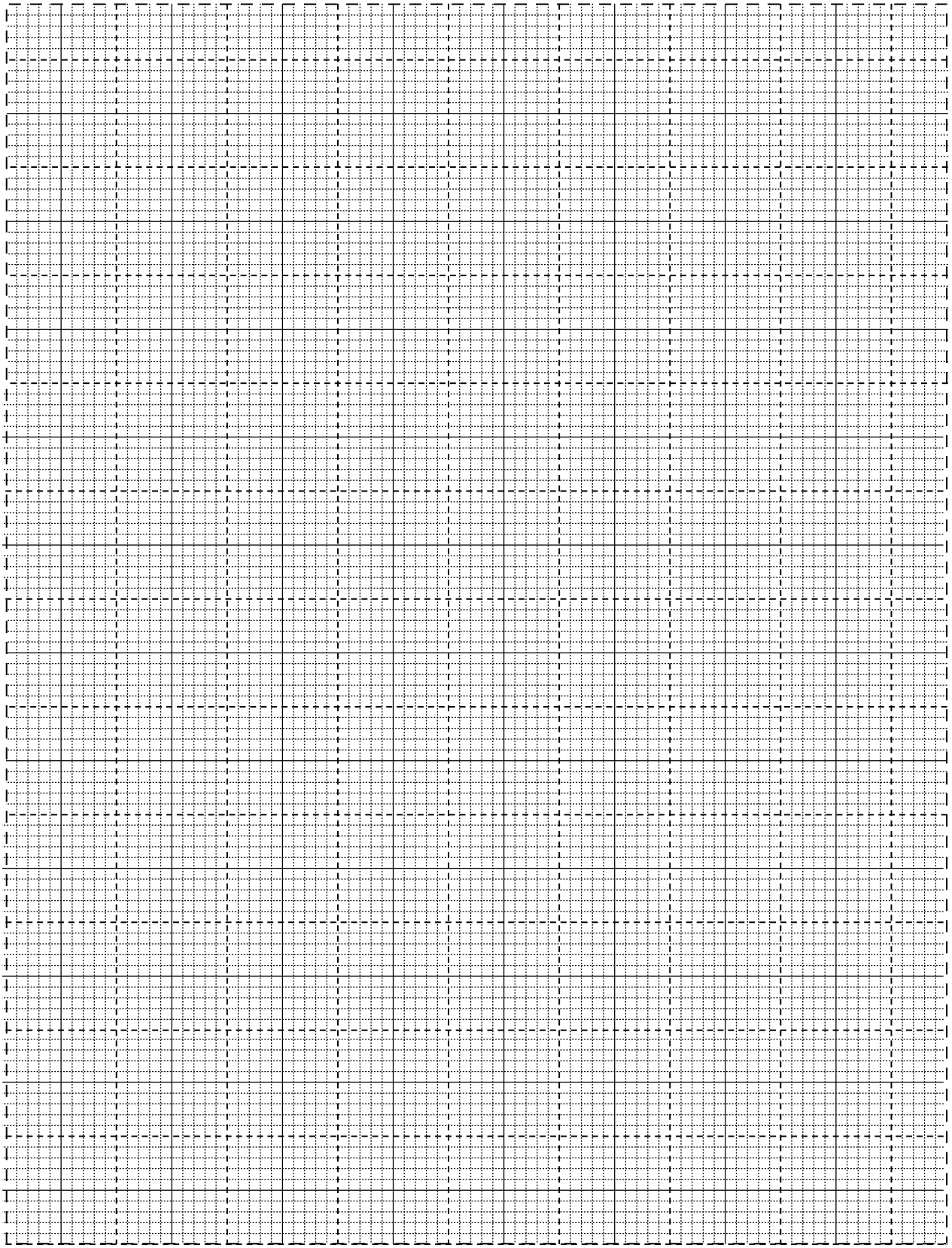
Note: Keep the solution obtained in this experiment for use in procedure II

(a) Table I

Piece of magnesium added	1	2	3	4	5	6
Length of magnesium added (cm)	2	4	6	8	10	12
Time taken t(second)						
Reciprocal of time $^1/_{t^{(s-1)}}$						

(4 marks)

(b) (i) On the grid provided, plot a graph of total length of magnesium ribbon added against reciprocal of time ($^1/_t$) for the reaction to go to completion. (3 marks)



(ii) From your graph, determine the time taken when 4.5cm length of magnesium ribbon to react completely. (1 mark)

(iii) Write a chemical equation for the reaction between magnesium and sulphuric acid. (1 mark)

(iv) Given that the mass of solid V, which reacted was 0.12g and that atomic mass of

magnesium is 24.0g, determine the number of moles of sulphuric (VI) acid that were used up during the reaction. (1 mark)

(v) From your graph, state and explain the relationship between the length of magnesium ribbon and the reciprocal of time ($^1/_t$) (1 mark)

Procedure II

Place all the solution obtained in procedure I in a clean 100ml measuring cylinder. Add distilled water to make 100cm^3 of solution. Transfer all the solution into a beaker and shake well. Label it solution D. Fill the burette with solution B. Pipette 25.0cm^3 of solution D into a conical flask. Add 2-3drops of phenolphthalein indicator and titrate with solution. Record your results in the table II below. Repeat the titration two more times

Table II

Titration	I	II	III
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution B (cm^3) used			

(4 marks)

(c) (i) Determine the average volume of solution B used . (1 mark)

(ii) Calculate the number of moles of sodium hydroxide solution B used. (1 mark)

(d) Calculate:

(i) The number of moles of sulphuric acid in 25.0cm^3 of solution D. (1 mark)

(ii) The number of moles of sulphuric acid in 100cm^3 of solution D. (1 mark)

(e) Determine the total number of moles of sulphuric acid in 50cm^3 of solution A. (1 mark).

(f) Calculate the concentration of the original sulphuric acid solution A in moles per litre. (1 mark

QUESTION 2.

You are provided with solid E. Carry out the following tests and write your observations and inferences in the table below:

(a) Place all the solid E in a boiling tube. Add about 15cm^3 of distilled water and shake vigorously for about 2 minutes.

Observations	Inferences

½ mark	1 mark

b) Divide the solution into five equal portions in five different clean test tubes.

(i) To the first portion, add 2M ammonia solution drop wise until in excess.

Observations	Inferences
1 mark	½ mark

ii) To the second portion add 2M Sodium hydroxide solution drop wise until in excess.

Observations	Inferences
1 mark	1 mark

iii) To the third portion add 4 drops of 2M Lead (II) nitrate solution.

Observations	Inferences
1 mark	1 mark

iv) To the fourth portion, add 4 drops of 0.2M silver nitrate solution.

Observations	Inferences
1 mark	1 mark

(v) Clean one end of the glass rod provided. Dip the clean end of the glass rod in the fifth portion. Remove the end and heat it in the non-luminous part of a Bunsen burner flame. Note the colour of the flame and record below.

Observations	Inferences
1 mark	1 mark

QUESTION 3.

You are provided with solid F. Carry out the tests below. Write your observations and inferences in the spaces provided

(a) Place about a half of solid F on a metallic spatula and burn it using a Bunsen burner flame.

Observations	Inferences
½ mark	½ mark

(b) Place the remaining of solid F in a boiling tube. Add about 10cm3of distilled water and shake the mixture well.

Observations	Inferences
1 mark	1 mark

(c) Divide the mixture obtained into three portions.

(i) To the first portion, add a small amount of solid sodium hydrogen carbonate.

Observations	Inferences
1 mark	1 mark

(ii) To the second portion, add about $1cm^3$ of acidified potassium dichromate (VI) and warm.

Observations	Inferences
1 mark	1 mark

(iii) To the third portion, add two drops of acidified potassium magnate (VII)

Observations	Inferences
1 mark	1 mark

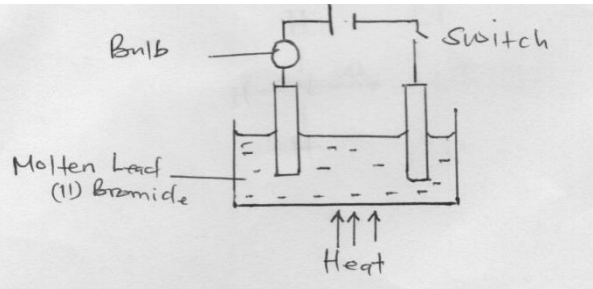
KCSE REPLICA 10
PAPER 1

1. a) When the air hole is fully opened, the Bunsen burner produces a non-luminous flame. Explain (1mks)

   b) Draw a labeled diagram of a non-luminous flame (2mks)

2. Describe an experimental procedure that can be used to extract oil from nuts seeds (2mks)

3. Study the diagram below and use it to answer the questions that follow



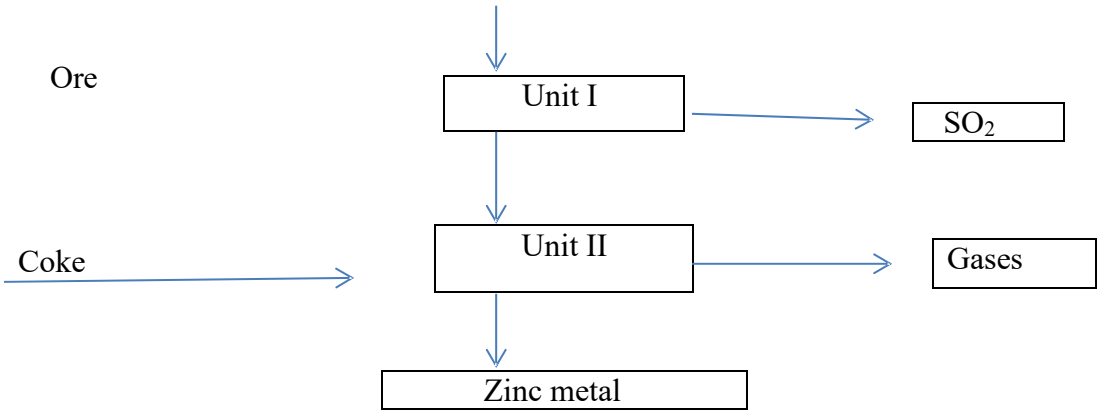
   a) Write the equations for the reactions taking place at the;
      I. Anode (1mks)

      II. Cathode (1mks)

   b) Name one application of electrolysis (1mks)

4. In a titration experiment, 25cm^3 of a solution of sodium hydroxide containing 8 g per litre was required for complete neutralization of 0.245 g of a dibasic acid. Calculate the relative molecular mass of the acid (Na = 23.0, O = 16.0, H = 1) (3mks)

5. The flow chart below shows processes involved in the industrial extraction of Zinc metal



a) Name **one** ore from which zinc is extracted (1mks)

b) Write the equation of the reaction taking place in unit II (1mks)

c) Name **two** uses of zinc metal (1mks)

6. The table below shows the pH values of solutions P, R, Q and S

Solution	P	R	Q	S
pH	2	7	6.5	13.5

a) Which solution represents:
   i) Strong base (1mks)

   ii) Weak acid (1mks)

b) Give an example of solution S (1mks)

7. The electron arrangement of ions of a certain elements represented by letters P, Q, R and S are:
   P^{2-} -2.8.8
   Q^{2+} -2.8

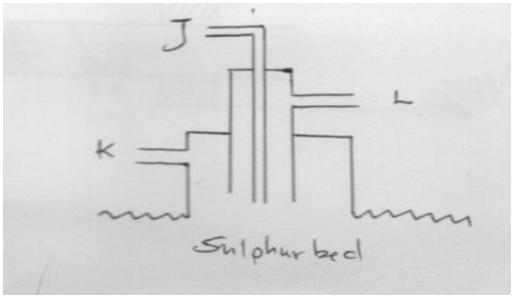
   R^{+} - 2.8

   S -2.8.8

   a) Explain why S is not represented as an ion (1mks)

   b) Which element has the largest atomic radius? Explain. (2mks)

8. Sulphur is extracted from underground deposits by a process in which three concentric pipes are sunk down to the deposits as shown



   a) Name the process represented above (1mks)

   b) What is passed down through pipe J? (1mk)

   c) Name the **two** allotropes of sulphur (1mk)

9. Element **A** has atomic mass 23 and element **B** has atomic mass 7 and also have 12 neutrons and 4 neutrons respectively.

   a) Write the electronic arrangement of **A** and **B**. (1mk)

   b) Which element has higher ionization energy? Explain (2mks)

10. W grammes of a radioactive isotope decayed to 5 grammes in 100 days. The half life of the isotope is 25 days.

a) What is meant by half life? (1mk)

b) Calculate the initial mass W of the radioactive isotope (3mks)

11. Haber process (the manufacture of ammonia gas) is given by the following equation

$N_{2\,(g)} + 3H_{2\,(g)} \rightleftharpoons 2NH_{3\,(g)}$ $\Delta H = -92kJ/mole$

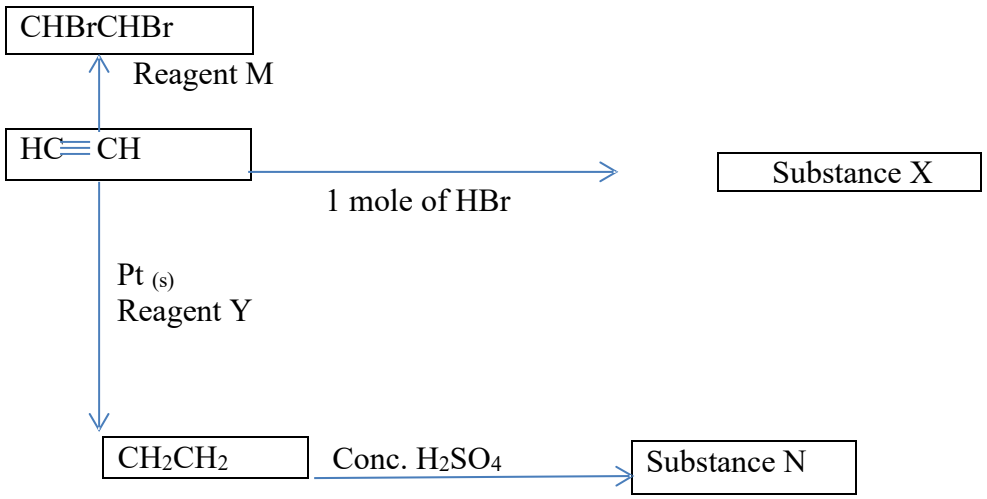
State and explain the effect of

a) Introducing some drops of water to the equilibrium (1mk)

b) Pumping nitrogen gas to the equilibrium mixture (1mk)

c) Lowering the temperature of the reaction (1mk)

12. The scheme below shows some reactions starting with ethyne. Study it and answer the questions that follow.



a) Name substance

i) X (½mk)

ii) N (½mk)

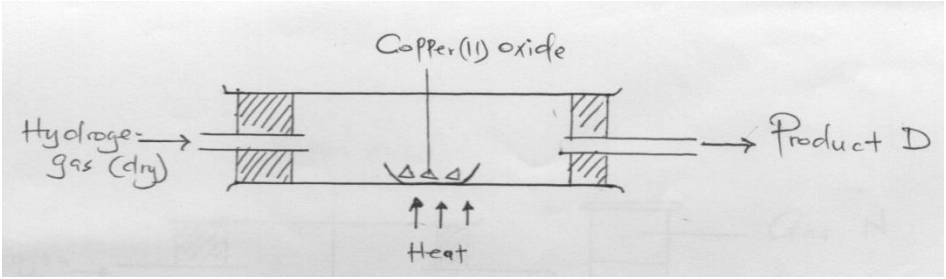
b) Name the reagent M (½mk)

c) Ethene undergoes polymerization to form a polymer. Write an equation for the reaction and name the product (1½mks)

13. a) State Graham's law of diffusion (1mk)

c) 30cm^{3}of hydrogen chloride gas diffuses through a porous in 20 seconds. How long would it take 42cm^3 of sulphur (IV) gas to diffuse through the same pot under the same conditions? (H = 1, Cl = 35.5, S = 32, O = 16) (2mks)

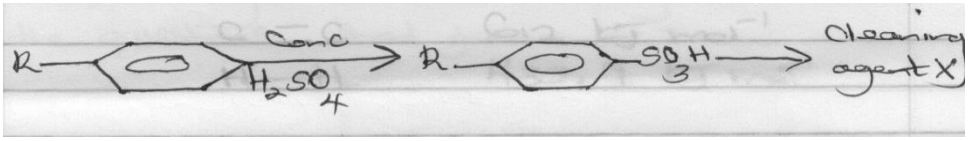
14. In the laboratory experiment, hydrogen gas was passed over heated copper (II) oxide as shown in the diagram below



a) Write equation for the reaction taking place in the combustion tube (1mk)

b) Describe a chemical test that can be used to identify the product D (2mks)

15. The scheme below represents the manufacture of a cleaning agent X



a) Draw the structure of X and state the type of clearing agent to which X belong (1mk)

b) State **one** disadvantage of using X as a cleaning agent (1mk)

16. Diamond and graphite are allotrope of carbon.

a) What are **allotropes**? (1mk)

b) Explain why graphite can be used as a lubricant while diamond cannot? (1mk)

c) Give another element which exhibit allotropy (1mk)

17. Given sodium carbonate solid, lead II nitrate solid and water, Explain how you can obtain a solid sample of lead II carbonate (3mks)

18. Given the following bond energies:

C - C	347kJ/mol
C - H	413kJ/mol
C = C	612 kJ/mol
H - H	435.9kJ/mol

Calculate the enthalpy change of hydrogenation of ethane (3mks)

19. Excess magnesium ribbon sample was heated in equal volumes of:

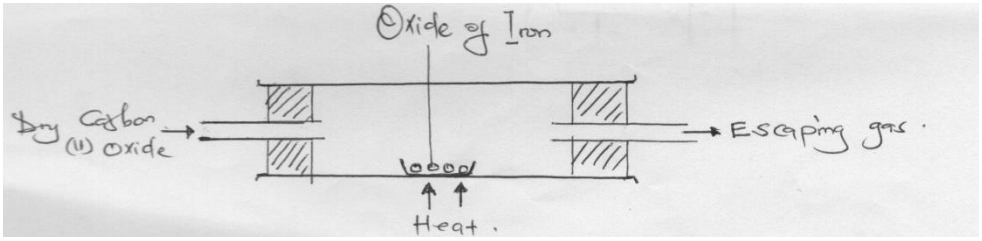
    i) Pure oxygen gas

    ii) Air

    a) Why was the mass of the resulting product in (ii) more than in (i)? (1mk)

    b) Write the equations for the reactions in part (ii) (2mks)

20. Excess carbon (II) oxude was passed over heated sample of an oxide of ironas shown in the diagram below. Study it and answer the questions that follow.



Data collected as follows:

Mass of empty crucible	10.98 g
Mass of empty crucible + oxide of iron	13.30 g
Mass of crucible + residue	12.66 g

Determine;

i) The mass of the iron (½mk)

ii) The mass of oxygen (½mk)

iii) The empirical formula of the oxide of iron (2mks)

21. The table below gives some properties of three elements in groups (VII) of the periodic table. Study it and answer the questions that follow

Element	Atomic No.	Melting point (^{0}C)	Boiling point(^{0}C)
Chlorine	17	-101	-34.7
Bromine	35	-7	58.8
iodine	53	114	185

a) Which element is a gas at room temperature (25^{0}C)? Explain. (1mk)

b) Explain why the boiling point of bromine is higher than that of chlorine (1mk)

c) Identify the element which has the highest electron affinity. Give a reason (imk)

22. An element X has relative atomic mass of 88. When a current of 0.5 Ampheres was passed through the fused chloride of X for 32 minutes 10 seconds, 0.44 g of X was deposited at the cathode. (IF = 96500C)

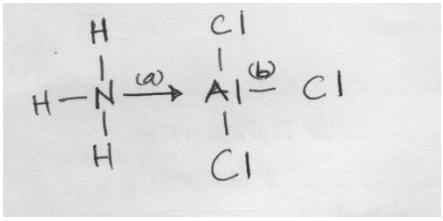
a) Calculate the number of Faradays needed to liberate 1 mole of X (2mks)

b) Write the formula of the chloride of X (1mk)

23. Aqueous ammonia was added to copper (II) sulphate solution dropwise until in excess.
a) What observations were made? (1½ mks)

b) Write down the ionic equations representing the observations mentioned in (a) above. (1½mks)

24. The diagram below shows the bonding between aluminium chloride and ammonia

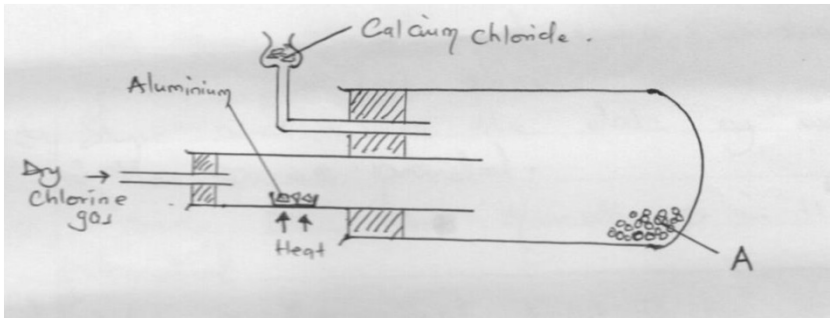


i) Name the type of bond labeled
a) (1mk)

b) (1mk)

ii) How many electrons are used for bonding in the molecule? (1mk)

25. In an experiment, dry chlorine gas reacted with aluminium as shown in the diagram below.



i) Name substance A (1mk)

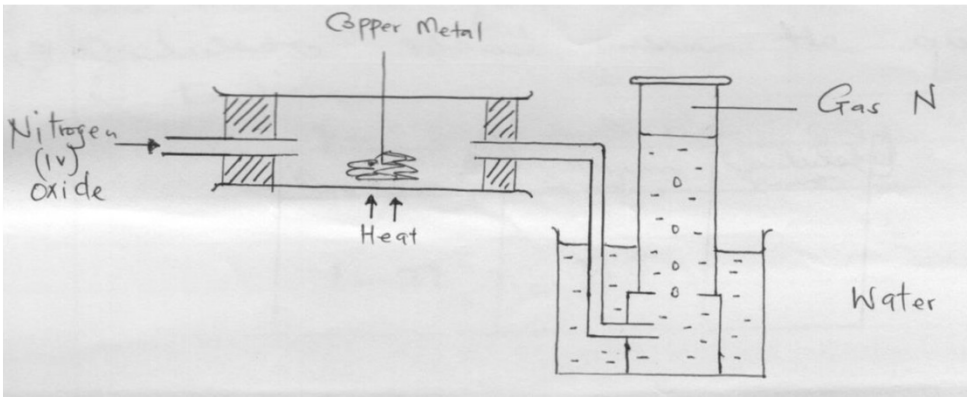
ii) Write an equation for the reaction that took place in the combustion tube (1mk)

iii) State the function of the calcium chloride in the set up above (1mk)

26. a) State the **Gay Lussaic's** law (1mk)

c) $10cm^3$ of gaseous hydrocarbon C_2H_X required $30cm^3$ of oxygen for combustion. If 1 mole of steam and $20cm^3$ of carbon (IV) oxide were produced, what is the value of X? (2mks)

27. The set up below is an arrangement showing how metals react with nitrogen (IV) oxide. Study it and answer the questions that follow.



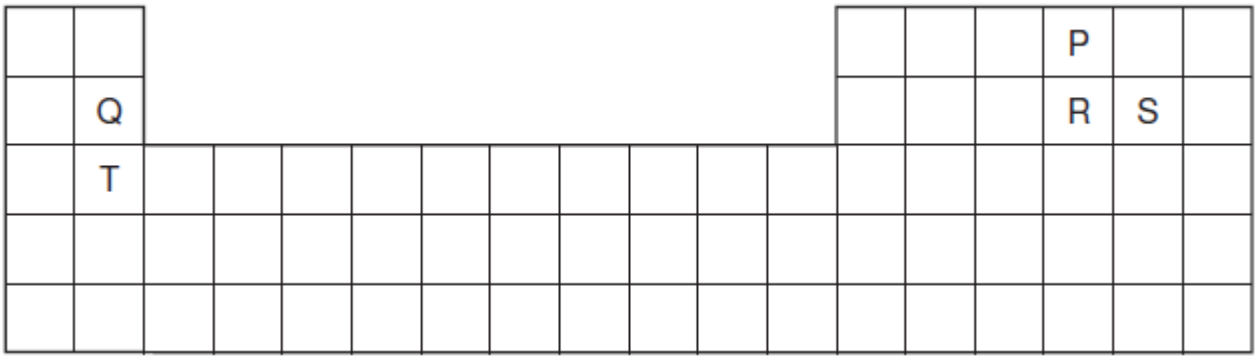
a) Nitrogen (IV) oxide is passed through the combustion tube before copper is heated. Give a reason. (1mk)

b) State the observations that would be made at the end of the experiment in the combustion tube (1mk)

c) Name gas N (1mk)

PAPER 2

1. The diagram shows part of the Periodic Table. The letters are not the actual symbols of the elements.



(a) Compare the reactivity between elements Q and T. (2 marks)

(b) Explain the electrical conductivity of the chloride of element T. (2 marks)

(c) Compare the melting and boiling points of elements R and S. (2 marks)

(d) Write an equation for the second ionization energy of element Q. (1mark)

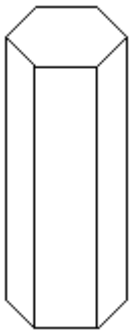
(e) How does the atomic and ionic radius of each of the following elements compare?
(i) Element T. (1½ marks)

(ii)Element P (1½ marks)

(f) Compare atomic radius of elements R and Q. (1½ marks)

(g) Explain the difference in the melting points of the oxides of element Q and the oxide of element R.
(1½ marks)

2 (a) The diagram below shows the structure of an allotrope of sulphur

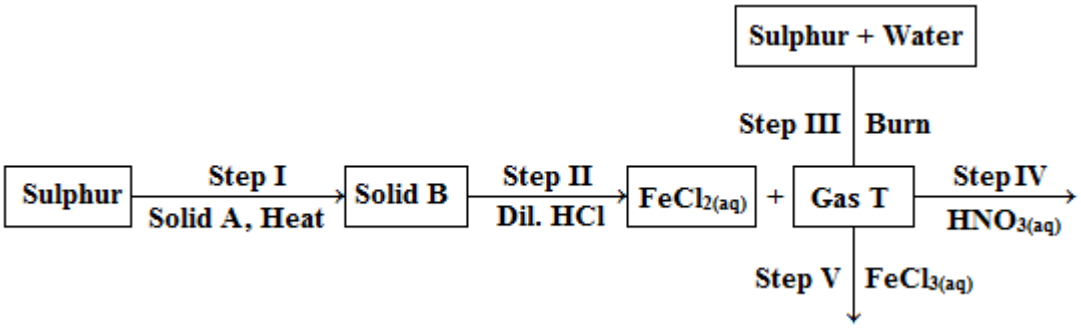


(i) What are allotropes? (1mark)

(ii) Identify the allotrope shown in the diagram above. (1mark)

(iii) State **two** properties of the allotrope above. (2 marks)

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



(i) Write the equation for the reactions in:
I. step I. (1mark)

II. Step II. (1mark)

(ii) State **two** observations made in step II. (2 marks)

(iii) Explain the observations made in:
I. Step IV. (1½ marks)

II. Step V. (1½ marks)

(iv) State **one** use of gas T. (1mark)

3. Next to each letter, **A** to **F**, in the table below is the molecular formula of an organic compound.

A	C_2H_5Br	**B**	C_2H_4
C	C_4H_{10}	**D**	C_2H_6O
E	C_3H_6O	**F**	$C_3H_6O_2$

(a) Choose a molecular formula above that represents an organic compound below. Write down only the letter (A to F) next to the question numbers
(i) A haloalkane (½ mark)

(ii) An alcohol (½ mark)

(iii) An unsaturated hydrocarbon (½ mark)

(iv) A product of thermal cracking of compound C. (½ mark)

(b) If compound F is a carboxylic acid, write down the following:
(i) The structural formula of a functional isomer (an isomer with a different functional group) of F. (1mark)

(ii) The IUPAC name of a functional isomer of F. (1mark)

(c) Compound B is a monomer used to make a polymer. Write down the:
(i) Definition of a polymer. (1mark)

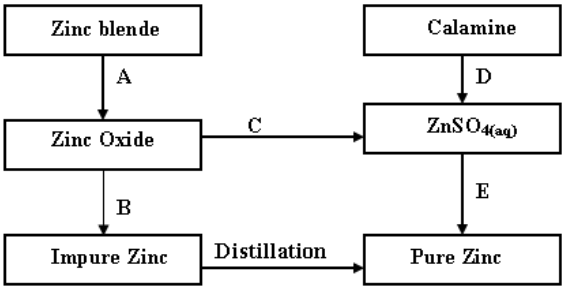
(ii) IUPAC name of the polymer. (1mark)

(iii) Balanced equation for the polymerisation reaction (1mark)

(d) Compound A is used as a reactant in the production of compound D.
(i) Name the type of reaction that takes place. (1mark)

(ii) State two changes that can be made to the reaction conditions in (d) (i) to obtain compound B, instead of D, as product. (2 marks)

4. The flow chart below summarizes the extraction of Zinc, study it and answer the questions that follow.



(a) Name the process represented by A and B
A……. (2 marks)

B …….

(b) Identify the reagents required for process B, C and D (3 marks)

B …….
C …….
D …….

(c) Write a chemical equation of the reaction that occurs in process B (1mark)

(d) With an aid of a diagram, explain how you would obtain a pure sample of Zinc by process E. (2 marks)

(e) State two uses of Zinc metal (2 marks)

5 (a) The table below gives some values of standard enthalpies of formation ($\Delta H_f^{\ominus}$).

Substance	$F_{2(g)}$	$CF_{4(g)}$	$HF_{(g)}$
$\Delta H_f^{\ominus}$ (kJmole^{-1})	0	– 680	– 269

The enthalpy change for the reaction $\mathbf{C_2H_{6(g)} + 7F_{2(g)} \rightarrow 2CF_{4(g)} + 6HF_{(g)}}$ is –2889 kJ mol^{-1}.
Use this value and the standard enthalpies of formation in **Table 2** to calculate the standard enthalpy of formation of $C_2H_{6(g)}$. (3 marks)

(b) In an experiment to determine the enthalpy of solution of concentrated sulphuric (VI) acid (specific gravity = $1.84gcm^{-3}$) the following procedure was used:
- A clean 250.0 cm^3 glass or plastic beaker is wrapped with a newspaper leaf.
- About 50.0 cm^3 of tap water is measured into the beaker and the steady temperature noted.

- The beaker is held in a tilted position and 2.0 cm^3 of and sulphuric acid added into the water

(i) Why was the beaker wrapped with newspaper leaf? (1mark)

(ii) Why was the acid added into water and not vice versa? (1mark)

(iii) Explain the reason for tilting the beaker during addition of the acid into water. (2 marks)

(iv) Calculate the molar enthalpy of solution of concentrated sulphuric (VI) acid given that ΔT for the reaction = ⁰C.
(Density of water = $1gcm^{-3}$; specific heat capacity of water = $4.2kJkg^{-1}K^{-1}$). (4 marks)

6 (a) Consider the electrochemical cell represented by the cell notation below, where X is an unknown metal:
$\mathbf{Pt_{(s)} \mid Fe^{2+}_{(aq)}, Fe^{3+}_{(aq)} \parallel X^{+}_{(aq)} \mid X_{(s)}}$
(The cell potential of this cell was found to be 0.03 V.

(i) Write down the type of electrochemical cell illustrated above. (1mark)

(ii) What does the single line (|) in the above cell notation represent? (1mark)

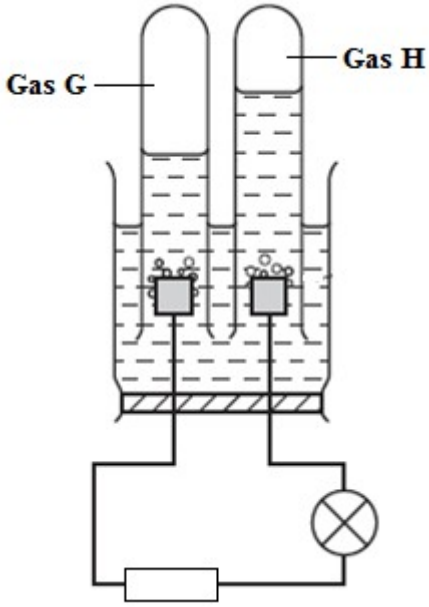
(iii) Write down the half-reaction that takes place at the anode in the above cell. (1mark)

(iv) Given that:

Half reaction	E^{O} (volts)
$Fe^{3+}_{(aq)} + e \rightarrow Fe^{2+}_{(aq)}$	+ 0.77
$Ag^{+}_{(aq)} + e \rightarrow Ag_{(s)}$	+ 0.80
$Na^{+}_{(aq)} + e \rightarrow Na_{(s)}$	– 2.87
$K^{+}_{(aq)} + e \rightarrow K_{(s)}$	– 2.92

Identify X with the aid of a calculation. (2 marks)

(b) The diagram below shows the apparatus that can be used to electrolyse dilute Sulphuric acid. Study it to answer the questions that follow.



(i) Identify the gases H and G

I. H (1mark)

II. G (1mark)

(ii) What happens to the concentration of the Sulphuric acid during the process with time? Explain (2 marks)

(iii) During the electrolysis a current of 0.72A was passed through the electrolyte for 15 minutes. Calculate the volume of gas H produced. (1 Faraday = 96,500C, molar gas volume = 24 dm^3 at r.t.p). (3 marks)

7 (a) (i) What is a salt? (1mark)

(ii) Write the formula of any **two** double salts. (1mark)

(b) A student has found that her sample of potassium nitrate is contaminated with small amounts of a green solid. She picks out a small piece of the green solid and finds that it is insoluble in water.
(i) Describe how you would make a pure sample of potassium nitrate from the impure mixture. (3 marks)

(ii) The student believes that the green solid is copper (II) carbonate. Describe a series of 3 tests that the student could use to confirm this. (6 marks)

Test	Procedure	Observations	Conclusion
1			
2			
3			

(c) In an experiment 50g of a saturated solution of a salt X was heated to dryness in an evaporating dish. The mass of crystals when weighed gave a reading of 2.7g. Determine the solubility of the salt. (2 marks)

PAPER 3

1. You are provided with:
   - Solution A, containing 4.0gdm^{-3} of sodium hydroxide
   - Solution B, hydrochloric acid
   - 2.5 g of a mixture of two salts, XCl (RFM 58.5) and X_2CO_3 (RFM 106)

You are required to:
(i) Standardize solution B, hydrochloric acid.
(ii) Determine the mass composition of the salt mixture

PROCEDURE 1
1. Fill the burette with solution B
2. Pipette 25 cm^3 of solution A into a clean dry conical flask. Then add 2 -3 drops of phenolphthalein indicator.
3. Titrate solution A solution with solution B. Record your results in the table below.
4. Repeat the procedure two more times to retain concord and values.

TABLE 1 (3 marks)

Titration number	1	2	3
Final burette reading (cm^3)			
Initial burette reading(cm^3)			
Volume of acid used (cm^3)			

(a) Calculate the average volume of solution B used. (1mark)

(b) Find;
(i) Moles of sodium hydroxide that reacted with the acid. (2 marks)

(ii) Moles of hydrochloric acid present in the average volume. (1mark)

(iii) Molarity of the acid (1mark)

PROCEDURE II
1. Put about 100cm^3 of water in a 250ml volumetric flask add all the 2.5g of salt mixture. Shake the mixture to dissolve and the solid. Top up the solution to the mark with distilled water Label this solution C
2. Fill this burette with solution B.

3. Pipette 25c m^3 of solution C and put it into a clean conical flask. Add 3 drops of methyl orange indicator.
4. Titrate solution C with solution B. Record your results in the table below.
5. Repeat the titration two more times

TABLE II (3 marks)

TITRATION	1	2	3
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution B used (cm^3)			

(c) Calculate the average volume of solution B (1mark)

(d) Calculate the number of moles in the hydrochloric acid used (1mark)

(e) The equation for the reaction of the acid with one of the salts in the mixture is:

$$2HCl_{(aq)} + X_2CO_{3(s)} \rightarrow 2XCl_{(aq)} + CO_{2(g)} + H_2O_{(l)}$$

Calculate;

(i) Moles of X_2CO_3 that reacted with the acid in the experiment (1mark)

(ii) Molarity of X_2CO_3 (2 marks)

(f) Calculate the mass of the salt mixture in gdm^{-3}. (1mark)

(g) Calculate the percentage of XCl in this mixture (2 marks)

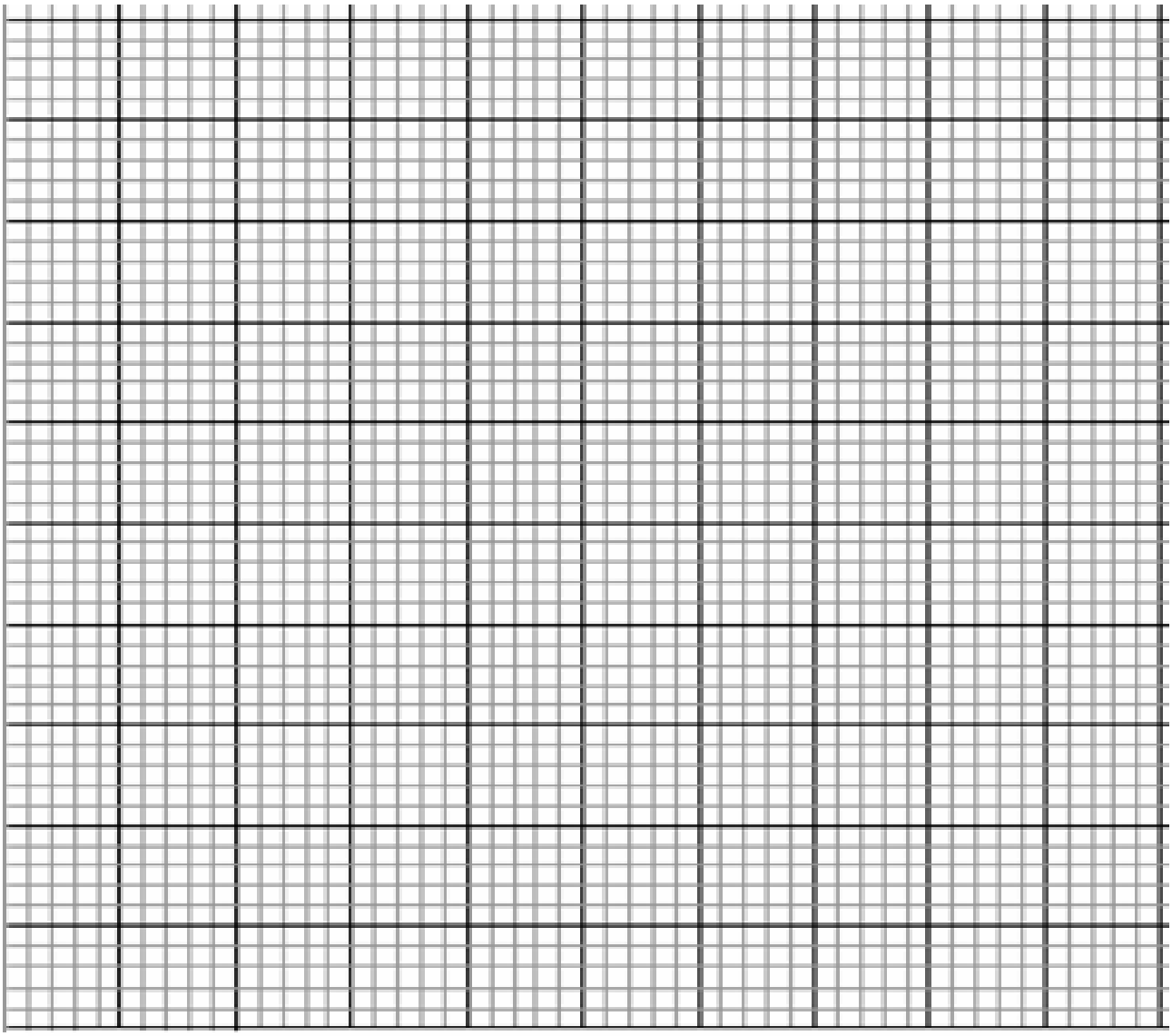
2. In this experiment, you're required to determine the time takes for a precipitate to be formed when S, which is sodium thiosulphate solution, reacts with dilute hydrochloric acid.

PROCEDURE

1. Using a measuring cylinder measure 50cm^3 of **S3** into a 100ml beaker.
2. Make a pencil cross on a white piece of paper so that when a beaker is placed top of the paper , the cross can be seen through the bottom of the beaker.
3. To solution A add 10 cm^3 of 2M hydrochloric acid and at the same time start a stop watch / stop clock. Swirl the contents of the beaker twice and then place it over the cross on the paper. Look at the cross from above the beaker through the mixture. Stop the stop watch immediately the precipitate makes the cross invisible. Record time taken for the cross to become invisible in the table below, rinse beaker.
4. Repeat the procedure with solutions B, C, D and E as per the table.

SOLUTION	**Volume of solution S3 in the beaker (cm^3)**	**Volume of water added (cm^3)**	**Volume of 2M HCl**	**Time taken in seconds**
A	50	0	10	
B	40	10	10	
C	30	20	10	
D	20	30	10	
E	10	40	10	

(a) Plot the graph of volume of solution S3 (y – axis) against time (4 marks)



(b) From the graph state the relationship between concentration of solution S_3 and time. (1mark)

(c) Why is water added to the solution S3? (1mark)

3. You're provided with solid D. Carry out the tests shown below on the solid.

(a) Heat a spatula full of D in A clean dry test – tube.	
OBSERVATIONS	**INFERENCES**

(1mark)	(1 mark)
(b) Put a spatula end- full of D in a boiling tube. Half fill it with water. shake this mixture	
OBSERVATIONS (1mark)	**INFERENCES** (1 mark)
(c) Divide the resultant mixture in (b) above into 5 portions (i) To the first portion add dilute nitric acid followed by a few drops of Barium nitrate	
OBSERVATIONS (1mark)	**INFERENCES** (1mark)
(ii) To the second portion, add nitric acid a few drops followed by lead (II) nitrate and then warm the mixture.	
OBSERVATIONS (1mark)	**INFERENCES** (1 mark)
(iii) To the third portion, add sodium hydroxide solution drop wise until in excess. Warm this mixture. Test any gas produced withy Litmus paper	
OBSERVATIONS (1 mark)	**INFERENCES** (1mark)

(d) You are provided with liquid B. Carry out the tests shown below and write your observations and inferences in the spaces provided.

(i) To about $1cm^3$ of liquid B in a test – tube, add about $1cm^3$ of distilled water and shake the mixture.	
OBSERVATIONS	**INFERENCES**

(1mark)	(1 mark)
(ii) To about $1cm^3$ of liquid B in a test tube add a small amount of solid sodium hydrogen carbonate	
OBSERVATIONS (1mark)	**INFERENCES** (1 mark)
(iii) To about $2cm^3$ of liquid B in A test – tube, add about $1cm^3$ of acidified potassium dichromate (VI). Warm the mixture gently and allow it to stand for about one minute.	
OBSERVATIONS (1mark)	**INFERENCES** (1mark)