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SMARTFOCUS QUICK REVISION SERIES 2025



CHEMISTRY PAPER 2

24 SERIES EXAMS

KNEC COMPLIANT

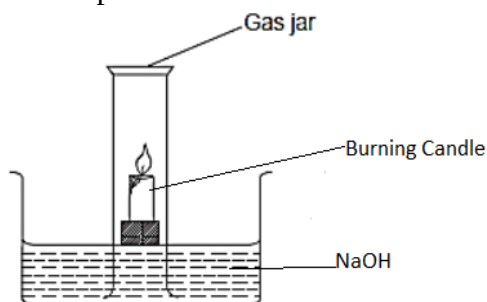
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SERIES 1

This question paper has 12 printed pages. Confirm that all the pages are printed as indicated

1. (a) Study the set up below and use it to answer the questions that follow.



(i) What is the aim of the experiment? (1 mk)

.....

(ii) Identify one mistake in the set up above. (1 mk)

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(iii) After the experiment, the student calculated the volume of air used and found to be 19.2%. Comment on the results. (2 mks)

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(b) Another student carried out the same experiment using phosphorous. Instead of burning candle:

(i) State one modification the student should carry out on the above set up to suit the experiment. (1 mk)

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(ii) Describe the above experiment to show how results were obtained. (3 mks)

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(iii) After the experiment the student added three drops of methyl orange indicator in the trough. State and explain the observation made. (2 mks)

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2. (a) The grid below represents part of the periodic table. Study it and answer the questions that follow. The letters do not represent the actual symbols of elements.

A				B		C	
	D		E		F	G	J
H							

- (i) Using an ionic equation explain the observation made when a solution of potassium bromide is reacted with G. (2 mks)

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- (ii) Both F and G are period 3 elements. Compare with a reason, their electronegativities. (2 mks)

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- (iii) Element A combines with chlorine to form a chloride of A. State the most likely pH value of a solution of a chloride of A. Explain. (2 mks)

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- (i) Write a chemical equation for the reaction between an oxide of E and sodium hydroxide. (1 mk)

- (b) (i) Explain why molten calcium chloride and magnesium chloride conducts electricity while carbon tetrachloride and silicon tetrachloride do not. (2 mks)

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- (ii) Under the same conditions gaseous neon was found to diffuse faster than gaseous fluorine. Explain the observation. (F = 19.0, Ne = 20.0) (2 mks)

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 (iii) Give one use of element J (1mk)

.....

 3. I. Study Table below and answer the questions that follow

		$E^0(V)$
$Ag^+_{(aq)} + e^-$	$\longrightarrow$	$Ag_{(s)} + 0.80$
$Cu^{2+}_{(aq)} + 2e^-$	$\longrightarrow$	$Cu_{(s)} + 0.34$
$2H^+_{(aq)} + 2e^-$	$\longrightarrow$	$H_{2(g)} 0.00$
$Cr^{3+}_{(aq)} + 3e^-$	$\longrightarrow$	$Cr_{(s)} -0.74$
$Na^+_{(aq)} + e^-$	$\longrightarrow$	$Na_{(s)} -2.17$

a) Identify the strongest reducing agent. Explain. (2mks)

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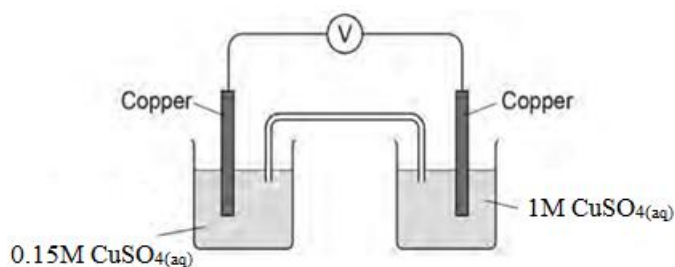
 b) Give two half cells which will produce the highest E^0 value when connected. (1mk)

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 c) Why is it not practical to make the cell you have given in (b) above. (1mk)

.....
 II. A certain celebrity wanted to electroplate a certain ornament with Copper to a surface of 0.25 cm^2 . How long will it take to pass a current of $0.5A$ through a solution of copper (II) Sulphate in order to electroplate 2 cm of the ornament. (Density of copper = 8.92 g/cm^3 , $IF = 96500$, $Cu = 63.5$) (3mks)

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III. A student set up the cell shown in the figure below

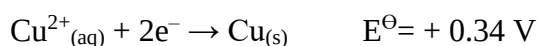


The student recorded an initial voltage of +0.16 V at 25⁰C

(a) Explain how the salt bridge provides an electrical connection between the two solutions. (1 mark)

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(b) The standard electrode potential for the Cu²⁺_(aq)/Cu_(s) electrode is



(c) Calculate the electrode potential of the left-hand electrode in the Figure [1mark]

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(d) Both electrodes contain a strip of copper metal in a solution of aqueous Cu²⁺ ions. State why the left-hand electrode does not have an electrode potential of +0.34 V [1mk]

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(e) Give the conventional representation for the cell in the figure above. [1mk]

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(f) When the voltmeter is replaced by a bulb, the emf of the cell in the Figure decreases over time to 0V, Suggest how the concentration of copper (II) ions in the left-hand electrode changes when the bulb is alight. Give one reason why the emf of the cell decreases to 0V [1mk]

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4. I. One of the factors which determine the reaction rate of solids is particle size.

(a) A mixture of finely powdered aluminium and air may explode when ignited. This causes a large and sudden increase in temperature. Explain each of the following in terms of collisions between reacting particles.

(i) Why is the reaction between finely powdered aluminium and air very fast? (1mk)

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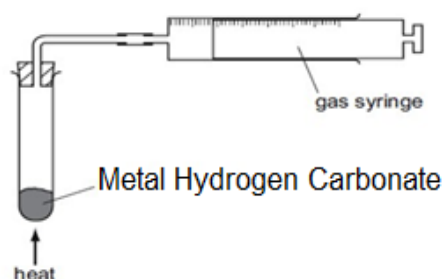
(ii) Explain why for most reactions the rate of reaction decreases with time. (1mk)

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(iii) Suggest an explanation why the rate of reaction in an explosion could increase rather than decrease with time. (1mk)

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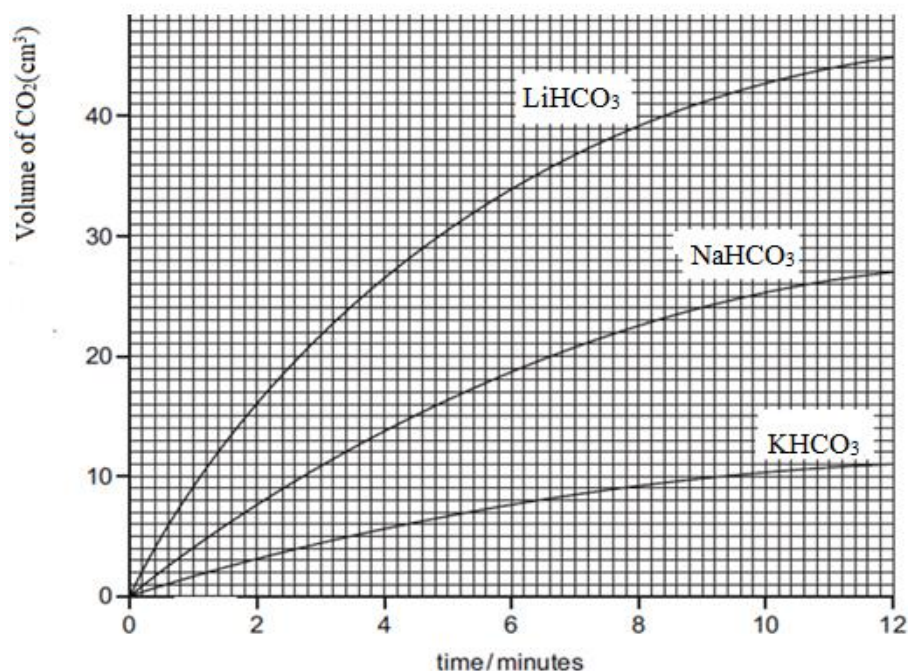
(b) A student compared the rates of reaction of three metal Hydrogen carbonates. She measured the volume of gas released using the apparatus shown.



State one thing that must be kept constant if the rates of the three reactions are to be compared in a fair way. (1 mk)

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- (c) The graph shows the volume of carbon (IV) oxide released when the three metal Hydrogen carbonates were heated.



- (ii) Which carbonate produced carbon (IV) oxide at the highest rate? (1mk)

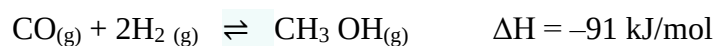
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- (iii) What volume of carbon (IV) oxide was produced by Sodium Hydrogen Carbonate in twelve minutes? (1 mk)

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II. Carbon (II) oxide and hydrogen are used in the manufacture of methanol (CH₃OH). The reaction is reversible and can reach a position of dynamic equilibrium.



The reaction is carried out at a pressure of about 100 atmospheres and a temperature of 250°C.

- (a) State one feature of a reaction that is in dynamic equilibrium. (1mks)

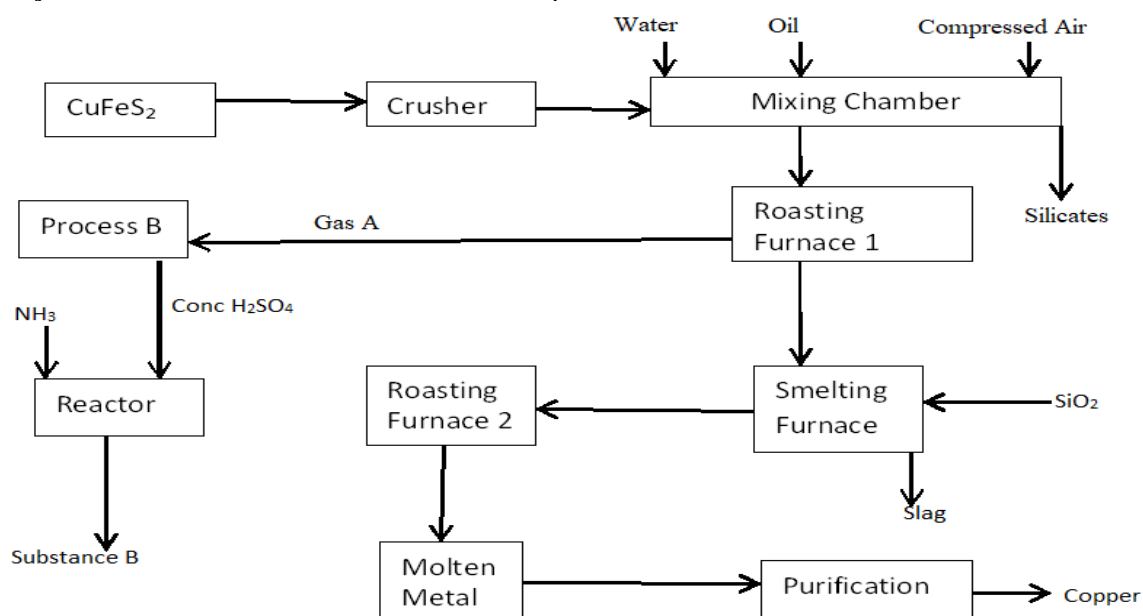
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- (b) (i) How would a decrease in temperature at constant pressure affect the amount of methanol in the equilibrium mixture? Explain your answer (2mks)

- (ii) How would an increase in pressure at constant temperature affect the amount of methanol in the equilibrium mixture? (1mk)

5. Study the flow charts below and answer the questions that follow.



- (a) Identify process B. (1 mk)
- (b) Give two optimum conditions required in the process named above. (2 mks)
- (c) Explain why the ore is crushed. (1 mk)
- (d) Which process occurs in the mixing chamber?
- (e) Explain use of the following: (2 mks)
- (i) Water

(ii) oil

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(f) Write the equation for the formation of slag (1 mk)

.....

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(g) Identify the cations present where the metal is being purified (1 mk)

.....

(h) Give a reason for the following use of the above metal.

I. Making electrical wires (1 mk)

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II. Making soldering wires (1 mk)

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(i) Give two environment effects of the above process. (2 mks)

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6. a) Phosphorus trichloride reacts with water to form two acids.

(i) One of the acid is H_3PO_3 , Calculate the oxidation state of Phosphorus in the acid and hence give the IUPAC name for the acid [2marks]

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(ii) Describe how you could show that the other acid is a weaker acid than hydrochloric acid. (2mks)

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- (iii) Two salts of phosphoric acid are its sodium salt, which is soluble in water, and its calcium salt which is insoluble in water. Suggest a method of preparation for each of these salts from aqueous phosphoric acid. (2mks)

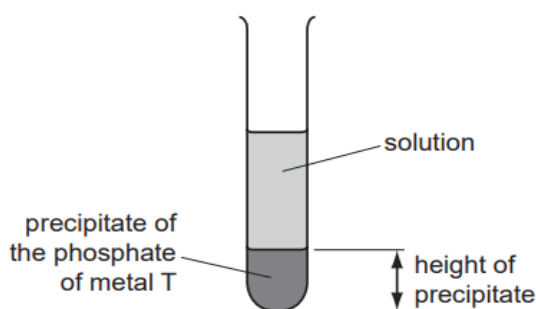
sodium salt

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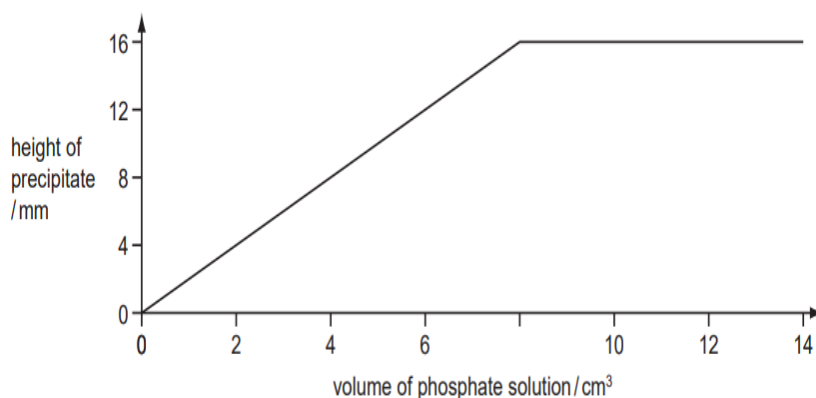
Calcium salt.....

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- b) The formulae of insoluble compounds can be found by precipitation reactions. To 12.0 cm^3 of an aqueous solution of the nitrate of metal T was added 2.0 cm^3 of aqueous sodium phosphate, Na_3PO_4 . The concentration of both solutions was 1M. When the precipitate had settled, its height was measured.



The experiment was repeated using different volumes of the phosphate solution. The results are shown on the following graph.



- (i) What is the formula of the phosphate of metal T? Give your reasoning. (2mks)

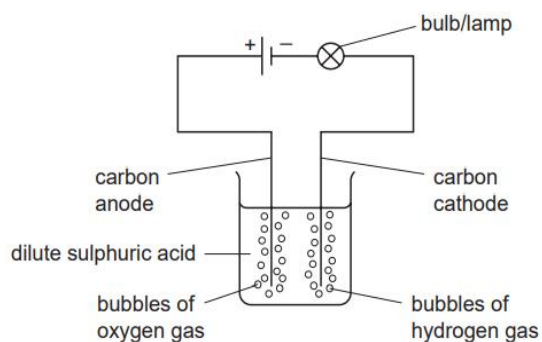
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- c) The following apparatus was set up to investigate the electrical conductivity of dilute acids



If it was replaced by a weak acid, what two differences in the observations would you expect to make (2mks)

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d) Explain the following observation. A certain Chloride dissolves in water to form an electrolyte while the same chloride dissolves in methylbenzene to form a non-electrolyte. (2mks)

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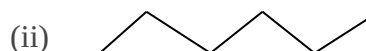
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7. (a) Name the following compounds (2mks)

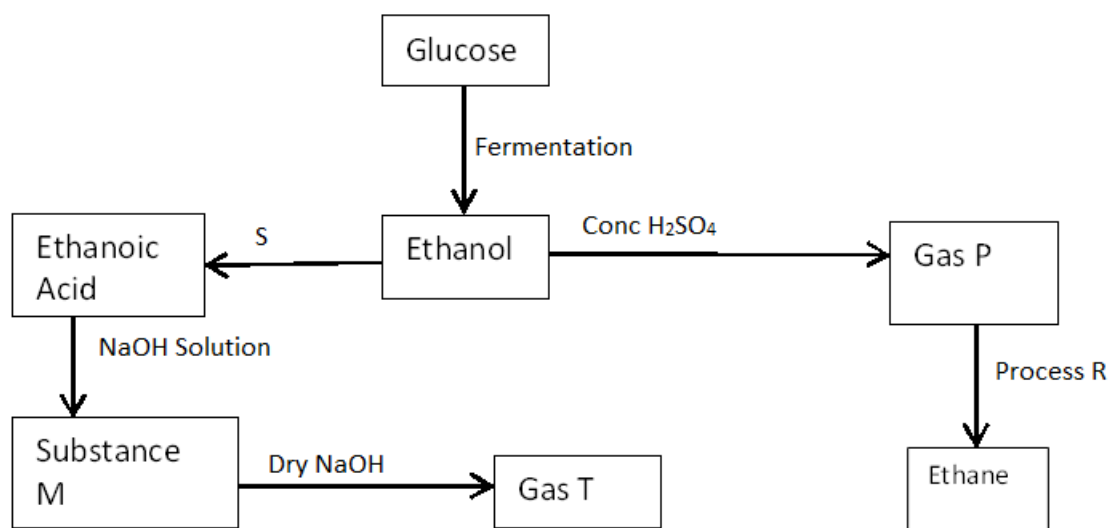


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(b) Study the flow chart below and answer the questions that follow.



(i) State the conditions necessary for fermentation of glucose to take place. (1mk)

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.....

(ii) State one reagent that can be used to carry out process S. (1 mk)

.....

(iii) Identify the substances (2 mks)

P.....

T.....

(iv) Write an equation for the reaction resulting to formation of substance M. (1 mk)

.....

(v) How sodium hydroxide is kept dry during the reaction. (1 mk)

.....

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(vi) Give one commercial use of process R. (1 mk)

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(c) Describe a chemical test to distinguish between the compounds represented by formula C_nH_{2n+2} and C_nH_{2n} (2mks)

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(d) State one use of ethanol other than as an alcoholic drink. (1 mk)

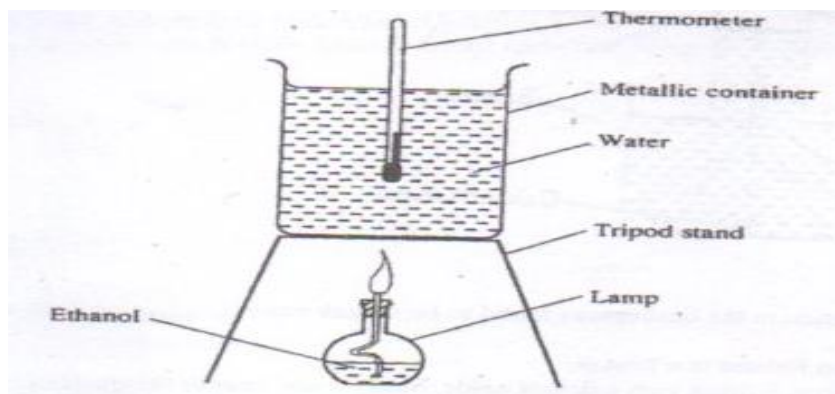
SERIES 2

1. State two factors that should be considered when choosing fuel for cooking. (2 marks)

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(b) The diagram below represents a set –up that was used to determine the molar heat of combustion of ethanol



During the experiment, the data given below was recorded

Volume of water	450cm ³
Initial temperature of water	25 ⁰ C
Final temperature of water	46.5 ⁰ C
Mass of ethanol + Lamp before burning	125.5g
Mass of ethanol + Lamp after burning	124.0g

Calculate the:

i. Heat evolved during the experiment (density of water=1g/cm³, Specific heat capacity of water =4.2Jg⁻¹K⁻¹) (2marks)

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ii. Molar heat of combustion of ethanol (C=12.0, O=16.0, H=1.0) (3 marks)

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(c) Write the thermal chemical equation for the complete combustion of ethanol. (1mark)

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(d) The value of the molar heat of combustion of ethanol obtained (b) (ii) above is lower than the theoretical value. State two sources of error in the experiment. (2 marks)

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e) Define the term molar heat of combustion (1 mark)

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2. 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. (1mark)

.....

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

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c) With a reason, identify an element in period three with the largest atomic radius.(2marks)

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.....

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

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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 (1/2mark)

.....

Property (1/2 mark)

.....

(ii) Use (1/2 mark)

.....

Property (1/2 mark)

.....

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

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g) In terms of structure and bonding, explain why the boiling point of the oxide of L is higher than that of N. (1 marks)

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h) Calculate the volume of the gas produced when 1.95g of element W reacts with water (W= 39, Molar gas volume at S.T.P= 24,000cm³) (2 marks)

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3. Use the information below on standard electrode potentials to answer the questions that follow

Electronic reaction	E ^Θ volts
$C^{2+}_{(aq)} + 2e^{-} \rightarrow C_{(s)}$	+0.34
$D^{2+}_{(aq)} + 2e^{-} \rightarrow D_{(s)}$	+0.44
$E^{+}_{(aq)} + e^{-} \rightarrow E_{(s)}$	-2.92
$F^{2+}_{(aq)} + 2e^{-} \rightarrow F_{(s)}$	-2.71
$G^{2+}_{(aq)} + 2e^{-} \rightarrow G_{(s)}$	-0.14
$\frac{1}{2}H_2(g) + e^{-} \rightarrow H^{-}_{(aq)}$	+2.87
$\frac{1}{2}K_2(g) + e^{-} \rightarrow K^{-}_{(aq)}$	+1.09
$L^{+}_{(aq)} + e^{-} \rightarrow \frac{1}{2}L_2(aq)$	0.00

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

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ii) Calculate the e.m.f of the cell obtained by connecting half cells **C** and **D** (1 mark)

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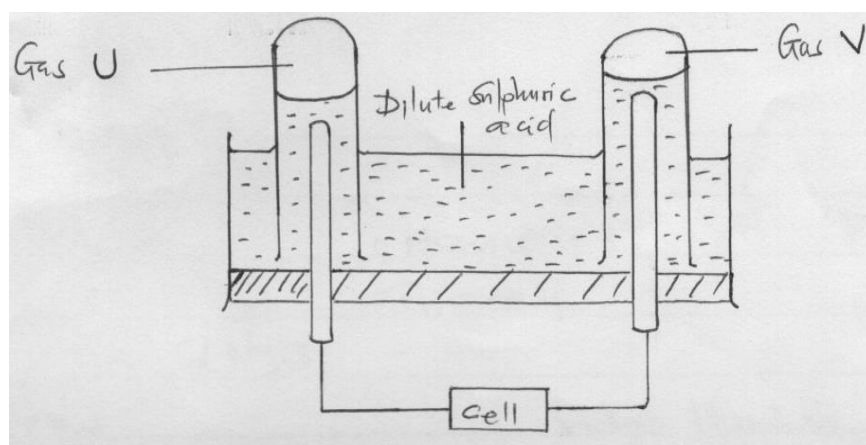
b) Draw a well labeled diagram of a cell formed by connecting half cells **C** and **D**. (3 marks)

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c) The figure below shows the electrolysis of dilute sulphuric (VI) acid



i) On the diagram label the cathode and anode (2 mark)

ii) Name the gases **U** and **V** (2 mark)

Gas **U**

.....

Gas **V**

iii) Write the equation taking place at the anode (1 mark)

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d) Define the term electrolysis (1 marks)

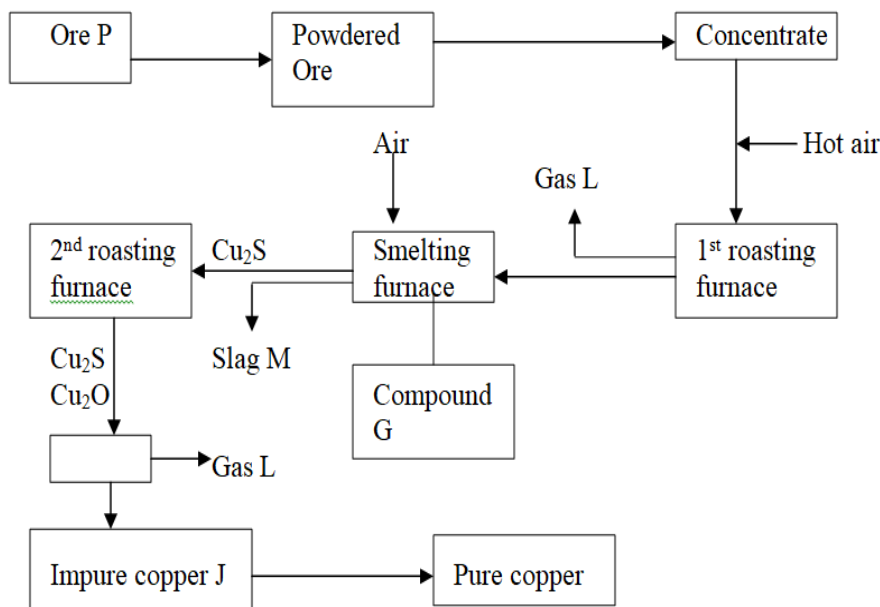
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e) State **two** applications of electrolysis

(2 marks)

4. The flow chart below outlines some processes involved in the extraction of copper from copper pyrites. Study it and answer the questions that follow.



(a) Name the following:

(3 marks)

(i) Ore P

(ii) Gas L.....

(iii) Slag M

(b) (i) Explain how the ore is concentrated.

(1 mark)

(ii) Why is it necessary to grind the ore into powder?

(1 mark)

(c) Give the purpose of adding silicon (IV) oxide compound G into the smelting furnace.

(1 mark)

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.....
(d) Pure copper is obtained from impure copper by electrolysis. Name the material used as anode and cathode. (1 mark)

Anode

Cathode

(e) What effects does this process of copper extraction have to the environment? (1 mark)

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(f) State two uses of copper metal. (2 marks)

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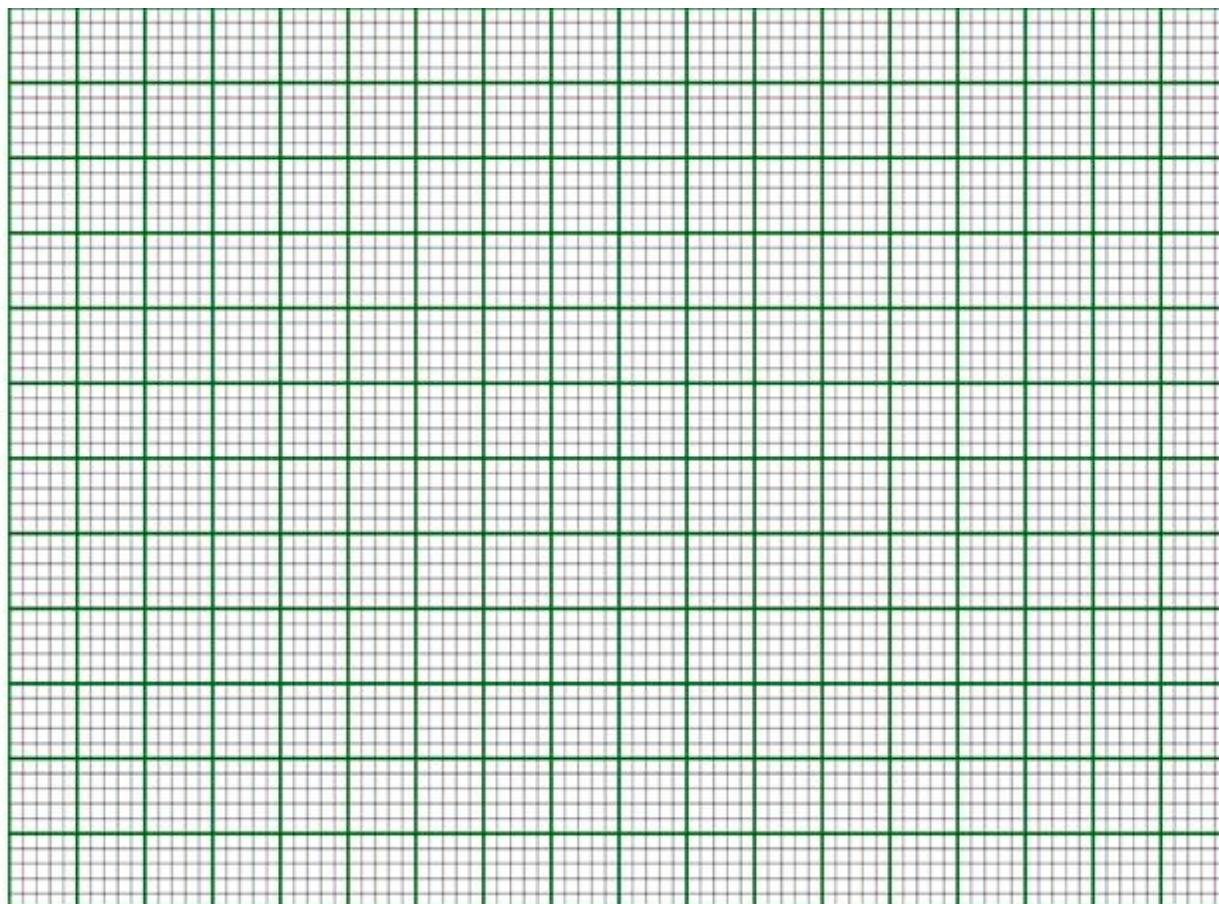
(g) A current of 100 Amperes was passed for 20 days. What mass of copper in kg was deposited at the cathode? (Cu = 64, If = 96500 C) (2 marks)

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5. The table below shows the solubility of potassium nitrate at different temperatures.

Temperature ⁰ c	10	20	30	40	50	60	70	80	90	100
Solubility g/100g of water	80	88	96	104	114	124	136	148	162	180

a) Plot a graph of solubilities of potassium nitrate against temperature. (3mk)



b) From your graph determine;

i) the solubility of the potassium nitrate at 65°C .

(1mk)

.....

ii) the mass of potassium nitrate that would **dissolve in 50g of water at 82°C** . (2mk)

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c) Determine the molar concentration of potassium nitrate at 37°C . (N=14, O= 16, K= 39.
Assume the density of solution to be $1\text{g}/\text{cm}^3$) (3mk)

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d) 130g of potassium nitrate salt was added to 100g of water and heated to 90⁰c. It was then cooled to 15⁰ c.

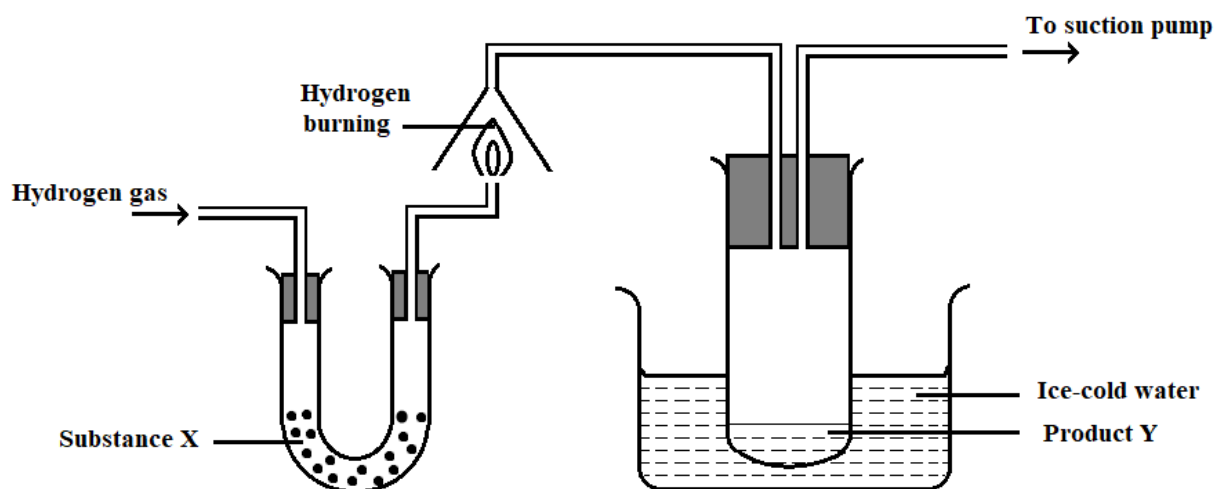
i) At what temperature were the crystals first formed? (1mk)

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ii) Calculate the mass of crystals formed. (1mk)

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6. The figure below shows the apparatus used to burn hydrogen in air. Use it to answer the questions that follow.



i) State the role of substance X (1 mark)

.....

ii) Give the name of the substance that could be used as X (1 mark)

.....

iii) State the role of the suction pump (1 mark)

.....

iv) Name the product Y formed (1 mark)

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v) Give a simple physical test to prove the identity of **Y** (2 mark)

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vi) State the difference between “**dry**” and “**anhydrous**”. (2 marks)

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7 a) Name the following compounds (3 marks)

i) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$

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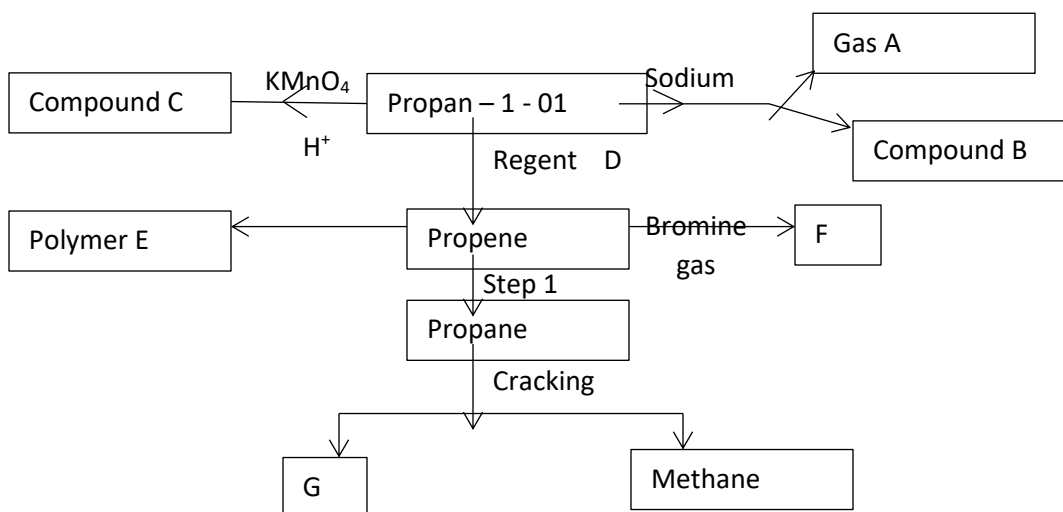
ii). $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$

.....

iii). $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOCH}_2\text{CH}_3$

.....

b). Study the scheme below and answer the questions that follow



i. Identify product

A. (1 mark)

F. (1 mark)

ii. Name the compound C (1 mark)

.....

iii. State the conditions for step 1 (2 mark)

iv. Name the process leading to formation of compound C (1 mark)

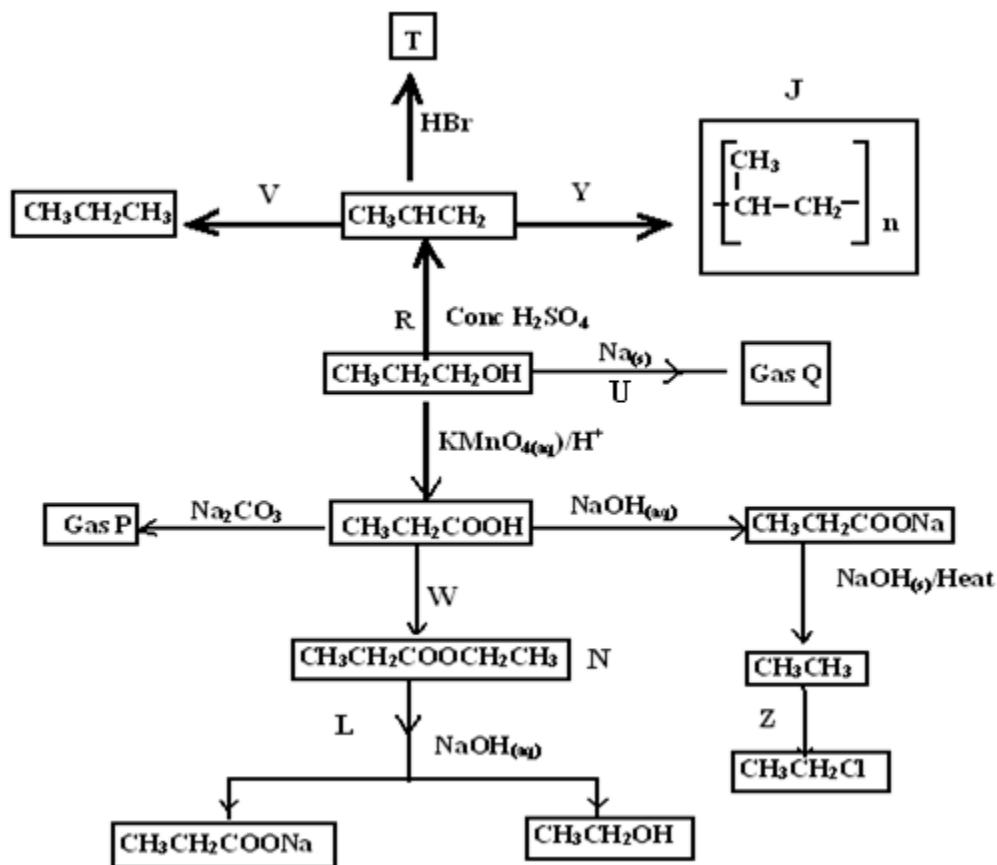
v. Write an equation for the reaction leading to the formation of methane.(1 mark)

vi. Identify reagent D. (1 mark)

vii. Draw the structure of F. (1 mark)

SERIES 3

1. Study the reaction scheme below and answer the questions that follow.



a. Name I gas P

II gas Q

III Substance J

(1½ mks)

b. Give the most probable structural formula of product T

(1 mk)

c.

I. Name reaction producing substance labeled N

(1mk)

II. State the characteristic property of N

(1mk)

d. Complete the table below.

Reaction	Reagents	Condition
W		
Z		
V		

(3mks)

e. I. Name the organic product of reaction U

(½mk)

II Write the equation for the reaction represented by U

(1mk)

f. What is the specific name of process Y?

(½mk)

g. What is the type of reaction represented by Z?

(½mk)

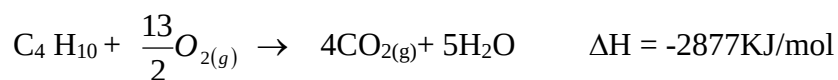
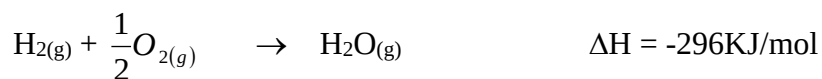
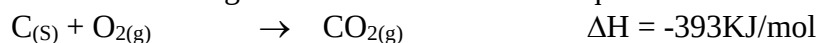
h. Give two reasons why ethanoic acid has a higher melting point than ethanol when both of them have two carbon atoms.

(2 mks)

2. (a) State Hess's law.

(1 mark)

(b) Use the following information to answer the questions that follow:



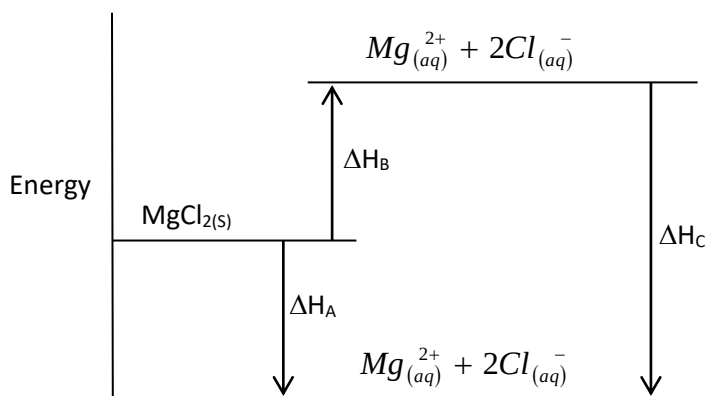
(i) Draw an energy cycle diagram relating heat of formation and combustion of butane.

(2 marks)

(ii) Calculate the heat of formation of butane. (3 marks)

(c) Distinguish between hydration energy and lattice energy. (2 marks)

(d) The diagram below shows an energy level diagram for the formation of magnesium chloride. Study it and answer the questions that follow.



(i) State the enthalpy changes represented by

A (½ mark)

B (½ mark)

C (½ mark)

(ii) What is the relationship between ΔH_A , ΔH_B and ΔH_C . (½ mark)

(e) (i) Define heat value of a fuel. (1 mark)

(ii) Give **two** reasons why wood and charcoal are chosen for domestic heating. (2marks)

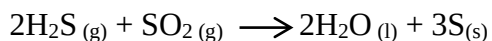
3. a) Sulphur is mined using the frasc process which uses superheated water at 170°C and hot compressed air.

i) Explain how water at 170°C is obtained. (1 mark)

ii) What is the role of superheated water? (1 mark)

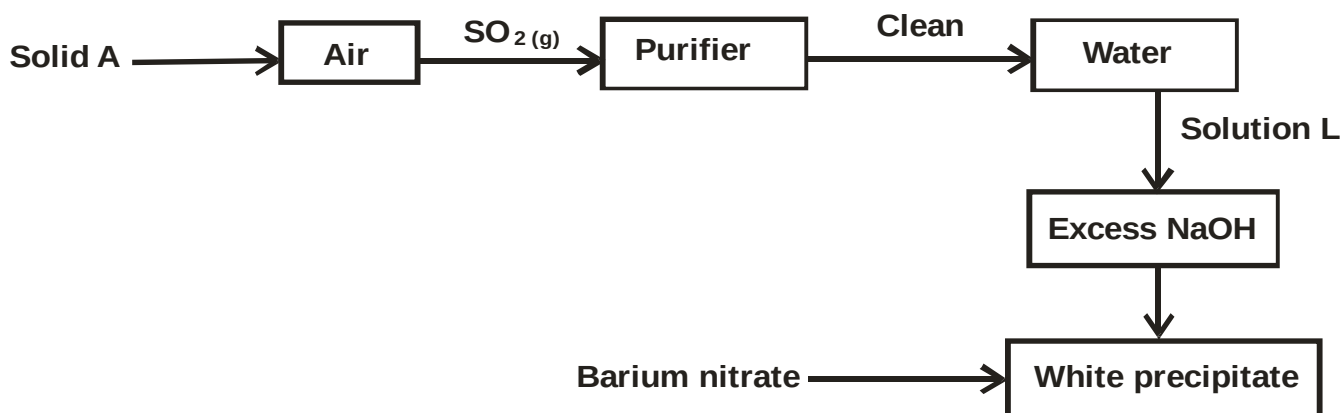
iii) State the role of compressed air. (1 mark)

b) In an experiment, 3.6g of sulphur were obtained by reacting sulphide with sulphur (IV) oxide as shown in the equation below.



Given that the yield of sulphur is 75%. Calculate the volume of SO₂ Used at room temperature and pressure. (H = 1, S = 32, O = 16, Molar gas volume at r.t.p is 24dm³) (3 marks)

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



i) Other than sulphur, name **two** other possible identities of solid A. (1 mark)

ii) Write an ionic equation for the formation of the white precipitate. (1 mark)

iii) State and explain the observation made when dilute hydrochloric acid is mixed with the white precipitate. (1 mark)

iv) State and explain the observation made when blue litmus papers were dipped into solution L. (1 mark)

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

Element	Atomic number	M.P ($^{\circ}\text{C}$)
A	11	97.8
B	13	660
C	14	1410
D	17	-101
E	19	63.7

a) Select an element which is

i) A poor conductor of electricity. (1 mk)

ii) The most reactive non-metal. (1 mk)

b) To which period of the periodic table does element E belong? (1 mk)

c) Element E loses its outermost electron more readily than A. Explain. (2mks)

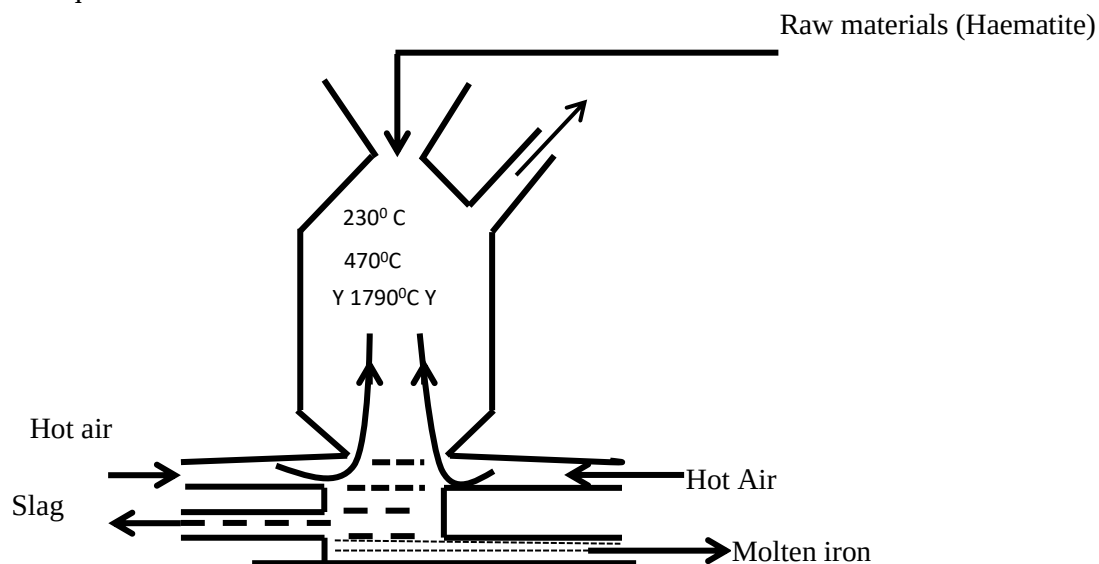
e) Use dots ($\bullet$) and crosses ($\times$) to represent the valence electrons and show the bonding in the compound formed between element **C** and **D**. (2mks)

(f) Explain why the melting point of element **B** is higher than that of element **A** (2mks)

(g) Write an equation for the reaction that takes place between element **A** and **water**. (1 mk)

h) Describe how a solid mixture of the sulphate of element **E** and **Lead (II) sulphate** can be separated into solid samples. (3mks)

5. a) Iron is obtained from haematite using a blast furnace shown below. Study it and answer the questions that follow.



i) Four raw materials are required for the production of iron. Three of these are haematite, hot air and coke. Give the name of the fourth raw material and its use. (1 mark)

I Name

II Use

ii) Name another Iron ore other than the one shown in the blast furnace. (1 mark)

iii) State one physical property of slag other than density that allows it to be separated from molten Iron as shown in the figure. (1 mark)

iv) Iron from the blast furnace contains about 5% carbon.

I. Describe how the carbon content is reduced.

(1 mark)

II. Why is it necessary to reduce the carbon content?

(1 mark)

v) Explain why temperature in the region marked Y is higher than that of the incoming hot air (1 mark)

vi) Describe the process which led to the formation of iron in the blast furnace

(3 mark)

vii) Give a reason why the melting point of the Iron obtained from the blast furnace is 1200°C while that of pure iron is 1535°C

(1 mark)

viii) One of the components of the waste gases is Nitrogen (IV) oxide. Describe the adverse effects it has on the environment.

(2 marks)

6. The equation below is for the manufacture of ethanol by direct hydration of ethane.



a) State the effect an increased in pressure will have on the equilibrium yield of ethanol and give a reason for your answer.

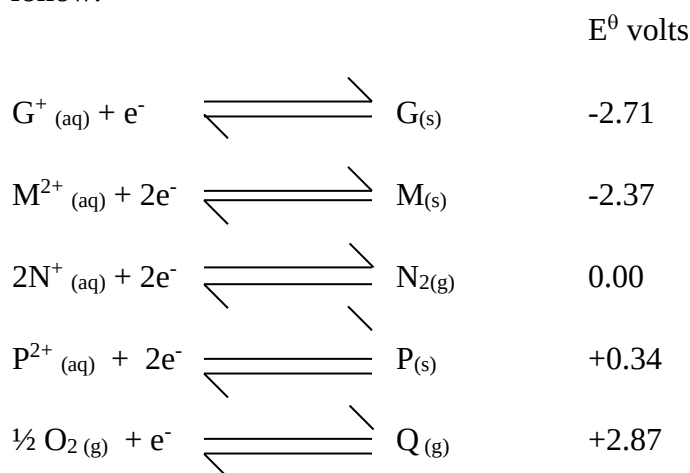
(2mks)

(b) In an experiment, excess solid calcium carbonate was added to 100cm^3 of 0.2M hydrochloric acid at 20°C . The volume of carbon (IV) oxide produced was measured at regular time interval. The results of the experiment are as shown in the table below.

Time (seconds)	0	10	20	30	40	50	60	70	80	90	100
Volume of carbon(IV)oxide(cm ³)	0	18	30	40	48	53	57	58	58	58	58

- a) Draw a diagram of suitable apparatus for the experiment. (2mks)
- b) On the grid provided plot of volume of CO₂ produced against time. (3mks)
- c) On the grid plot a graph you would expect if the acid was kept at 30°C. (1mk)
- d) What is the rate of reaction if the volume of hydrogen per minute between 4th and 5thsecond(1mk)
- e) Other than raising the temperature state two ways by which the rate of reaction would be increased. (2mks)

7. Use standard potential for elements G, M, N,P and Q given below to answer the questions that follow.



- (a) (i) Which element is likely to be hydrogen? Give a reason to your answer. (2mks)
- (ii) What is the E^{θ} of the strongest oxidizing agent? (1mk)
- (iii) Calculate the E^{θ} value of the electric chemical cell constructed using M and P. (2mks)
- (b) During the electrolysis of aqueous copper (II) sulphate using copper electrodes a current of 0.8 amperes was passed through the cell for 10hours.
- (i) Write ionic equation for the reactions that took place at the cathode. (1mk)
- (ii) Determine the change in mass of the anode which occurred as a result of the electrolysis process. (Cu = 63.5, 1 Faraday = 96500 Coulombs) (3mks)

SERIES 4

1. The grid below represents a section of the periodic table. Study it and answer the questions that follow

								Q
A				C	N	H	J	
B	X		R		E	P	D	
M							F	

- (a) Give the formula of the compound formed between X and N (1 mark)

.....

- (b) Which element forms a stable trivalent cation? (1 mark)

.....

- (c) Identify the least reactive element (1 mark)

.....

- (d) Explain how the melting point of D and F compare (2 marks)

.....

.....

.....

- (e) Explain the difference in atomic and ionic radius of F (2 marks)

.....

.....

.....

- (f) How do atomic radii of X and D compare? Explain (2 marks)

.....

.....

.....

(g) Write the electron arrangement of X^{2+} (1 mark)

.....

(h) What would be the pH of aqueous solution of chloride of M? (1 mark)

.....

(i) Identify an element which;

(I) is the strongest reducing (½ mark)

.....

(II) is the most electronegative (½ mark)

.....

2. (a). What is meant by rate of reaction? (1 mark)

.....

.....

.....

(b) Define activation energy (E_A) (1 mark)

.....

.....

.....

(c) An experiment was carried out to measure the volume of hydrogen gas produced when 1.0 g of Zinc chippings (excess) is reacted with 25cm³ of dilute sulphuric (VI) acid. Give two other ways of speeding up the reaction apart from addition of catalyst. (2 marks)

.....

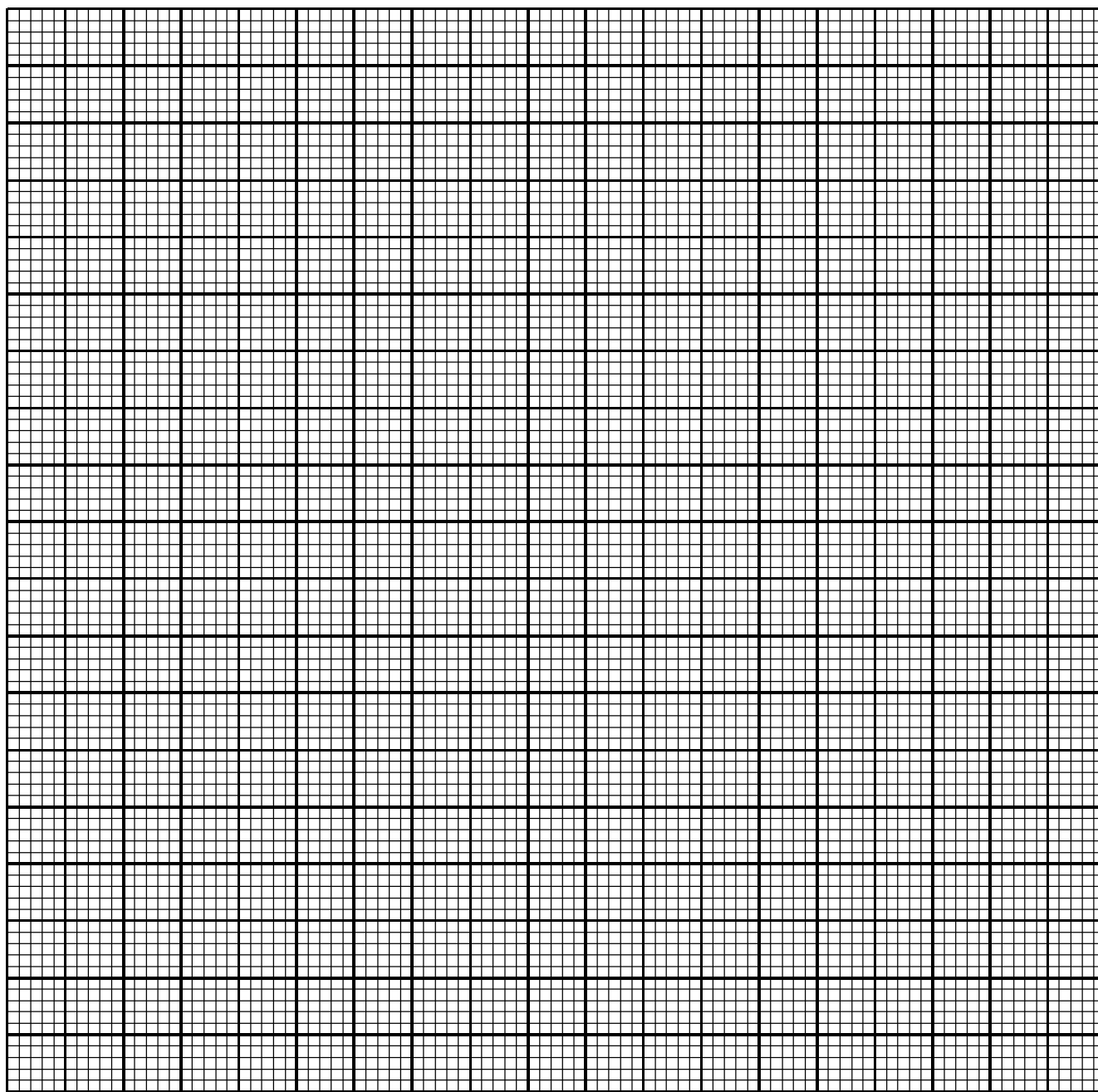
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(d) The decomposition of a compound M carried out at 30°C was monitored by measuring the concentration of the compound remaining at different time intervals and recorded as shown below.

Time (min)	0	1.0	2.0	3.0	4.0	5.0
Concentration (mol/litre)	1.20	0.54	0.36	0.26	0.17	0.10

(i) Plot a graph of the concentration of compound M (vertical axis) against time (3 marks)



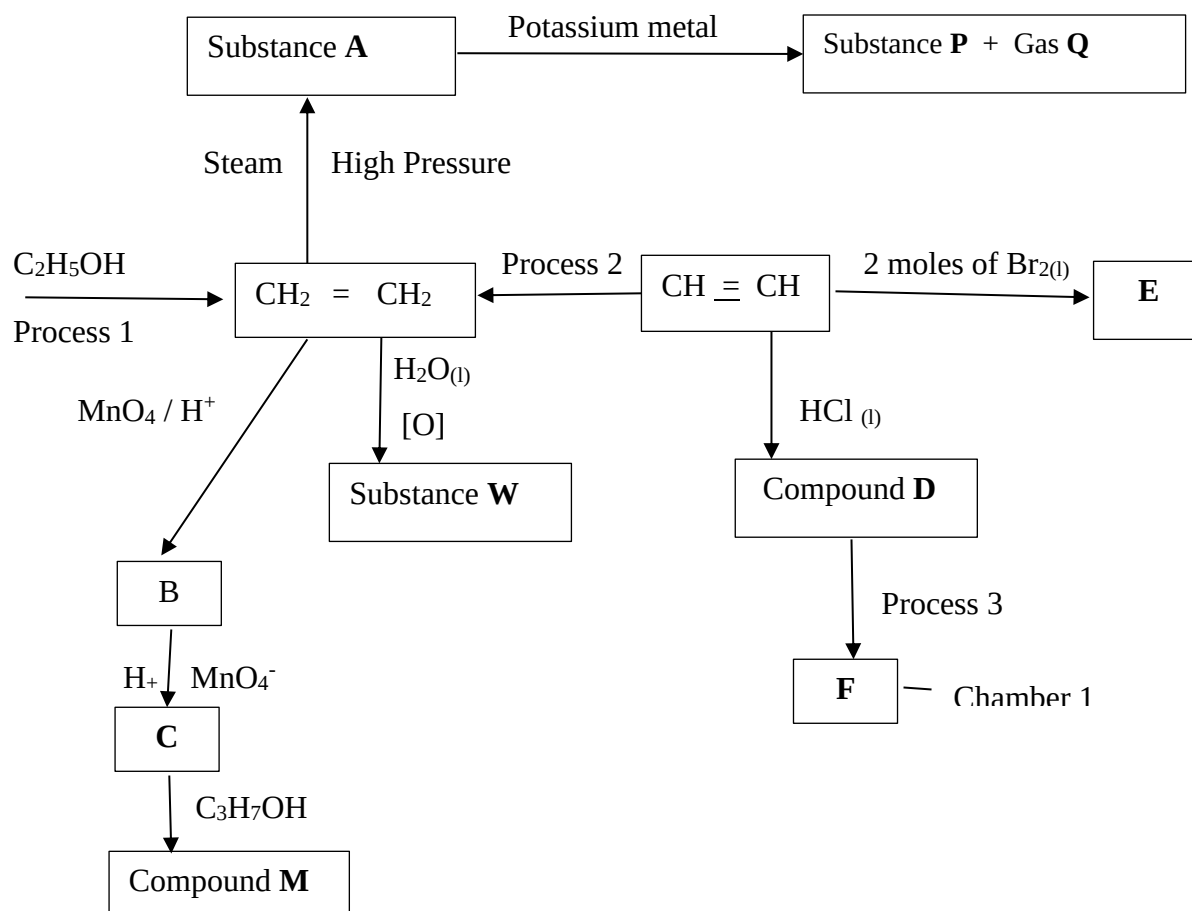
(ii) From the graph, determine the rate of decomposition of M at 2.5 minutes (2 marks)

.....

(iii) On the same axis, sketch the curve that would be obtained if the decomposition was carried out at 15°C, label the curve A and give a reason for your answer. (3 marks)

.....

3. Study the flow chart and use it to answer the questions that follow



(a) Identify substances:

(3 marks)

A.....

W.....

P.....

E.....

D.....

Gas Q.....

(b) State the conditions and reagents that are required for processes:

1: Reagent.....

(½ mark)

Condition.....

(½ mark)

2: Reagent.....

(½ mark)

Condition.....

(½ mark)

3: Reagent.....

(½ mark)

Condition.....

(½ mark)

(c) (i) Write the formula and the name of the compound formed in chamber 1.

(2marks)

.....
.....

(ii) Give the uses of the compound in c (i) above

(2 marks)

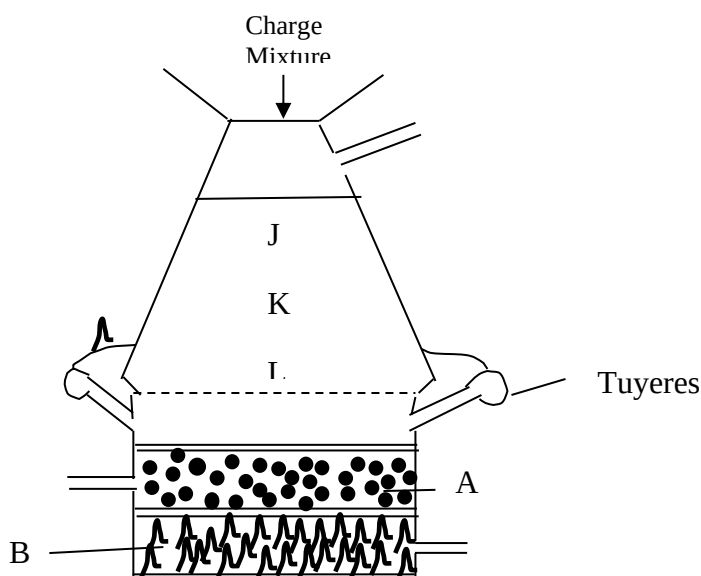
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(d) State the physical property of compound M and write its structural formula

(2 marks)

.....
.....

4. The diagram below represents a blast furnace used for extraction of iron.



(a) Name three substance contained in the charge mixture

(3 marks)

.....
.....
.....

(b) Name substances labelled A and B

(2 marks)

.....

.....

(c) Arrange regions J, K and L in order of decreasing temperature (1 mark)

.....

.....

(d) Write an equation for the reaction that occurs in region L (1 mark)

.....

.....

(e) What is the function of the tuyeres? (1 mark)

.....

.....

(f) Distinguish between cast iron and wrought iron (1 mark)

.....

.....

(g) Write an equation for the reaction between heated iron and chlorine (1 mark)

.....

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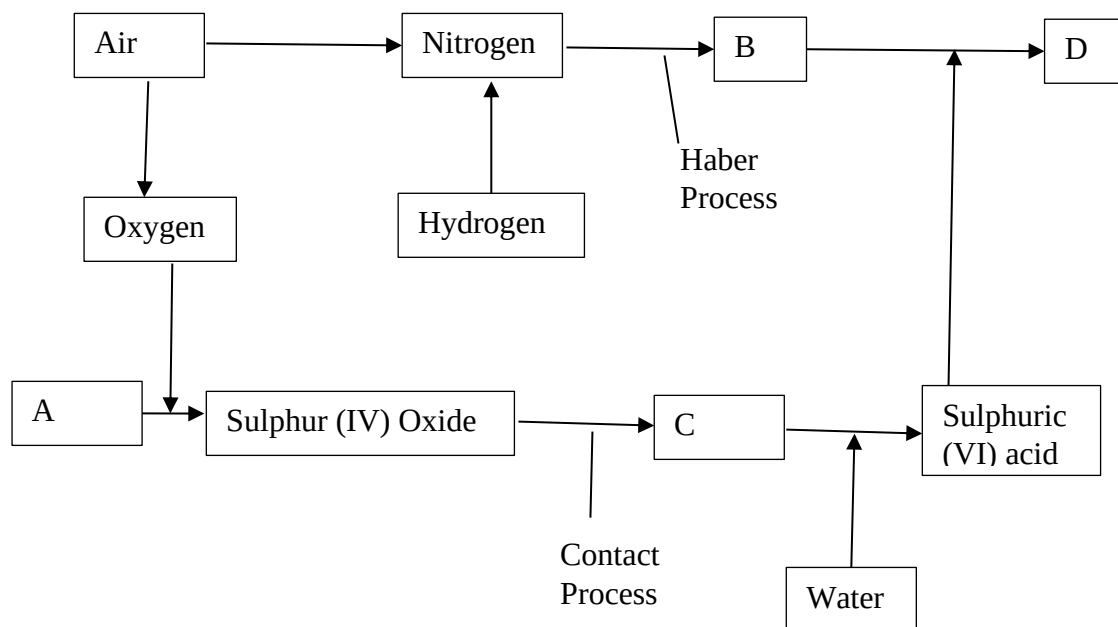
(h) Iron -60 is a radio isotope of iron (half - life 2.6×10^6 years). Its ultimate decay product is nickel -60. Write a nuclear equation for this process. (Atomic numbers Fe=26, Ni=28) (1 mark)

.....

.....

(i) State one use of stainless steel (1 mark)

5. The flow chart below illustrates two industrial processes, Haber and Contact processes, each with air as one of the starting materials and other chemical reactions



(a) (i) Give the name of the process by which air is separated into oxygen and nitrogen (1 mark)

.....

(ii) Apart from oxygen and nitrogen gases produced in **a(i)** above , name any other gas produced in the process above. (1 mark)

.....

(b) Name the substances which are represented by the letter (2 marks)

A.....

B.....

C.....

D.....

(c) Name the catalyst used in

(i) Haber process (1 mark)

.....

(ii) Contact process (1 mark)

.....

(iii) Explain the role of the catalyst in both the Haber and Contact processes. (2 marks)

.....

(d) (i) Write a balanced equation for the formation of compound D (1 mark)

.....

(ii) Calculate the percentage by mass of nitrogen present in compound D

(N=14, H=1, S=32, O=16) (2marks)

.....

(iii) .Give one use of compound D (1 mark)

.....

6. The following are reduction potential of some element , study them and answer the questions that follow.

Half Reaction	Electrode Potential (Volts)
$R^{2+}_{(aq)} + 2e \longrightarrow R_{(s)}$	-0.34
$G^{2+}_{(aq)} + 2e \longrightarrow R_{(s)}$	+1.32
$\frac{1}{2}L_{2(aq)} + e \longrightarrow L_{(aq)}$	+2.07
$J^{+}_{(aq)} + e \longrightarrow \frac{1}{2}J_{2(g)}$	0.00
$Q^{2+}_{(aq)} + 2e \longrightarrow Q_{(s)}$	-2.70
$S^{2+}_{(aq)} + 2e \longrightarrow S_{(s)}$	-1.20

(a) What is the reduction potential of the strongest reducing agent? (1 mark)

.....

(b) Which element is most likely to be substance J? Explain your answer (1 mark)

.....

.....

.....

(c) (i) Draw a well labeled diagram for the electrochemical cell that would be formed when elements G and S are combined (3marks)

(c) Calculate the electromotive force of cell formed above (1 mark)

.....

.....

.....

(d) During electrolysis of dilute sodium chloride solution using graphite electrodes, a current of 0.8 amperes was passed through the cell for two and a half hours.

(i) Write an ionic equation for the reaction that occurred at the cathode (1 mark)

.....

(ii) Calculate the volume of the gas produced at the anode in cm^3 . (Faraday=96500C, 1 mole of gas at r.t.p = 24dm^3) (3 marks)

.....

.....

.....

7. The following results were obtained when the molar heat of neutralization between hydrochloric acid and sodium hydroxide was determined. 100cm^3 of 1.0M hydrochloric acid was reacted with 50cm^3 of 2M sodium hydroxide solution.

Initial temperature of the base was 25°C

Initial temperature of the acid was 27°C

The final stable temperature when the acid and base were mixed was 34°C

(a) Write an ionic equation for the reaction (1 mark)

.....

(b) Calculate the,

(i) Change in temperature (1 mark)

.....

.....

(ii) Heat change for the reaction (specific heat capacity = 4.2 kJ/gK and density of solution = 1.0 g/cm³). (1 mark)

.....

.....

.....

(iii) Molar heat of neutralization of hydrochloric acid (2 marks)

.....

.....

.....

(c) Draw an energy level diagram for the reaction (2 marks)

(d) Account for the heat loss (1 mark)

.....

.....

(e) How can the heat loss be minimized? (1 mark)

.....

.....

(f) Write the thermochemical equation for the reaction (1 mark)

.....

SERIES 5

1. The table below shows elements with their atomic numbers, mass numbers and their melting points. Study it and answer the questions that follow. Letters do not represent actual symbols of the elements

Element	B	C	D	E	F	G	H	I	J	K
Atomic number	7	8	19	15	2	9	6	16	12	11
Atomic mass	14	16	39	31	4	19	12	32	24	23
Melting point	-	-	637	44	-272	-223	vary	113	669	980

(a) Select two elements with oxidation state -2 (1mark)

(b) Which element represents

(i) The most powerful oxidizing agent? (1mark)

(ii) The most powerful reducing agent? (1mark)

(c) Which element has the highest ionization energy? Explain (1mark)

(d) Select two elements, when reacted form a compound that conducts electricity in molten and aqueous state (1mark)

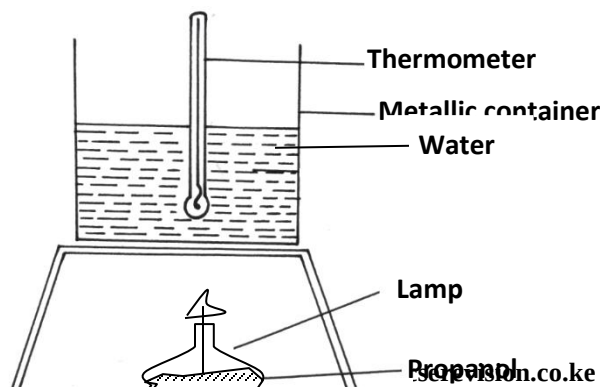
(e) Select two elements when reacted form a compound that dissolves in water to form acidic solution (1mark)

(f) Using dot (•) and cross (x) diagram, show the bond between **B** and **J** (2marks)

(g) Explain why the melting point of **K** is higher than that of **D** (2marks)

2.(a) State **one** factor that should be considered when choosing a fuel for cooking (1mark)

(b) The diagram below represents a set-up that was used to determine the molar heat of combustion of propanol.



During the experiment, the data given below were recorded;

Volume of water = 460cm³

Initial temperature of water = 25°C

Final temperature of water = 47.5°C

Mass of propanol + lamp before burning = 127.5g

Mass of propanol + lamp after burning = 123.0g

Calculate the;

(i) Heat evolved during the experiment

(Density of water = 1g/cm³) specific heat capacity of water = 4.2KJ/Kg/K) (2marks)

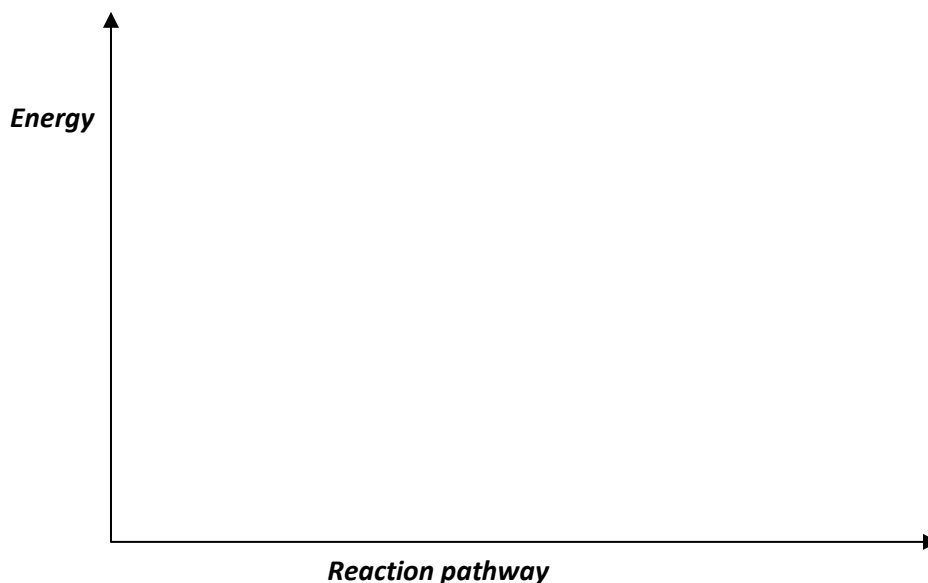
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(ii) Molar heat of combustion of propanol (2marks)

.....
.....

(iii) Write the thermo-chemical equation for the combustion of propanol (1mark)

.....
(c) On the axis, draw an energy level diagram for the combustion of propanol (2marks)



(d) Name the heat change represented by ΔH in the process represented below.



.....

(e) (i) Define enthalpy of formation of a substance. (1mark)

.....
.....

(ii) Given that

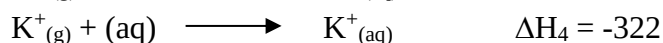
$$\Delta H_f^\theta (\text{C}_4 \text{H}_{10(g)}) = -125 \text{KJmol}^{-1}$$

$$\Delta H_f^\theta (\text{CO}_{2(g)}) = -395 \text{KJmol}^{-1}$$

$$\Delta H_f^\theta (\text{H}_2\text{O}_{(l)}) = -289 \text{ KJmol}^{-1}$$

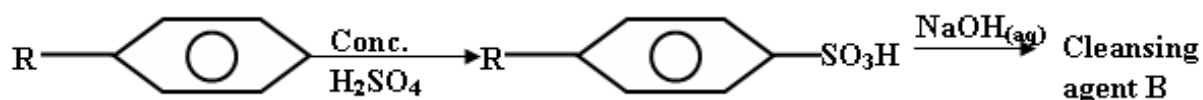
Calculate the molar heat of combustion of butane (C_4H_{10}) (3marks)

(f) The atomic numbers of Li and K are 3 and 19 respectively.



Study the equations above and state why ΔH_3 is larger than ΔH_4 . (1mark)

3.a) The scheme below represents the manufacture of a cleansing agent.



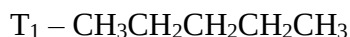
i) Draw the structure of **B** and state the type of cleansing agent for which it belongs. (1mark)

Structure

Type

ii) State one disadvantage of using **B** as a cleansing agent. (1mark)

b). The list below shows the formulae of some organic compounds. Use letters T₁ to T₆ to answer the questions that follow.



I Select two compounds which:

(i) Are not hydrocarbons (1mark)

(ii) Would decolourise both bromine water and acidified potassium manganate (VII). (1mark)

(iii) Would produce hydrogen gas when reacted with potassium metal. (1mark)

II. Select a compound which would produce bubbles of a gas when reacted with sodium carbonate. (1mark)

(c) (i) Identify the compound that is likely to undergo polymerization. Give a reason for answer. Using two molecules show how polymerization occurs.

I. Compound (1mark)

II. Reasons (1mark)

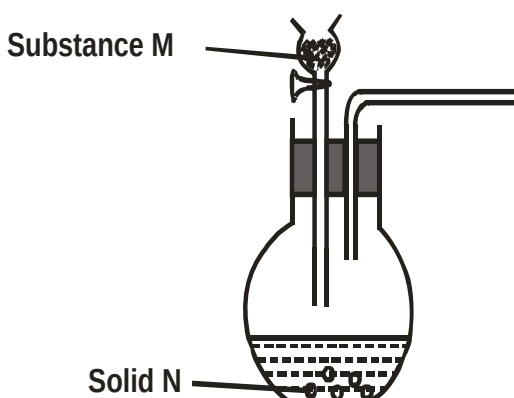
III. Polymerization (1mark)

(ii) Name the process by which compound **T₂** is formed and identify the compounds that were used to form it.

I. Process (1mark)

II. Compounds (1mark)

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



a) i) Complete the table below giving the names of substance **M** and solid **N** if the gases generated are hydrogen chloride and Sulphur (IV) oxide. (2 marks)

	Hydrogen chloride	Sulphur (IV) oxide
Substance M		
Solid N		

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

iii) State and explain the observation that would be made when hydrogen chloride gas is bubbled through a solution of lead (II) nitrate. (2marks)

iv) Concentrated hydrochloric acid is used for removing oxides from metal surfaces (pickling). Explain why concentrated nitric acid cannot be used for the same Purpose (1mark)

5. **I**) Use standard electrode potentials for elements A, B, C, D and F given below to answer the questions that follow.

	E^θ (Volts)
$A^{2+}_{(aq)} + 2e^- \rightarrow A_{(s)}$	-2.90
$B^{2+}_{(aq)} + 2e^- \rightarrow B_{(s)}$	-2.38
$C^+_{(aq)} + e^- \rightarrow \frac{1}{2}C_{2(g)}$	0.0
$D^{2+}_{(aq)} + 2e^- \rightarrow D_{(s)}$	+0.34
$\frac{1}{2}F_{2(g)} + e^- \rightarrow F_{(aq)}$	+2.87

a) Identify the strongest oxidizing agent. (1 mark)

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

c) Draw a labelled diagram of the electrochemical cell that would be obtained when half-cells above (b) is formed. Show the direction of the flow of electrons. (3 marks)

d) Calculate E^θ value of the electrochemical constructed above. (2 marks)

e) Is it advisable to store a solution of a nitrate of D in a container of metal B? Explain. (2marks)

II) During the electrolysis of aqueous copper (II) sulphate using copper electrodes, a current of 0.2 amperes was passed through the cell for 5 hours.

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

ii) Determine the change in mass of the anode which occurred as a result of the electrolysis process. (Cu = 63.5, 1 Faraday = 96500 Coulombs) (3 marks)

6.(a) Define the term solubility (1mark)

(b) (i) Complete the table below by calculating the solubility of KCl in grams per 100g of water (3marks)

Mass of $KCl_{(g)}$	20	20	20	20	20	20
Volume of water (cm^3)	40.0	45.0	50.0	55.0	60.0	65.0
Temperature at which crystals first appear ($^\circ C$)	77.0	56.0	40.0	26.0	15.0	8.0
Solubility in g per 100g of water						

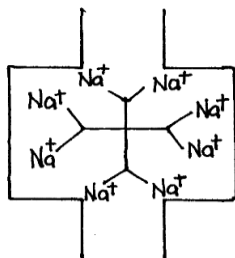
(ii) On the grid provided, Plot the graph of solubility in g/100g of water (y-axis) against temperature (x-axis) (3marks)

(iii) From your graph determine solubility at $50^\circ C$ (1mark)

(iv) If a saturated solution of potassium chloride is cooled from $50^\circ C$ to $10^\circ C$. What mass of the crystals would be obtained? (2marks)

.....
.....
.....
(v) Calculate the concentration of the saturated solution at 50°C. ($K=39.0$, $Cl = 35.5$) (1mark)

.....
.....
(c) The set-up below was used to remove hardness in water.

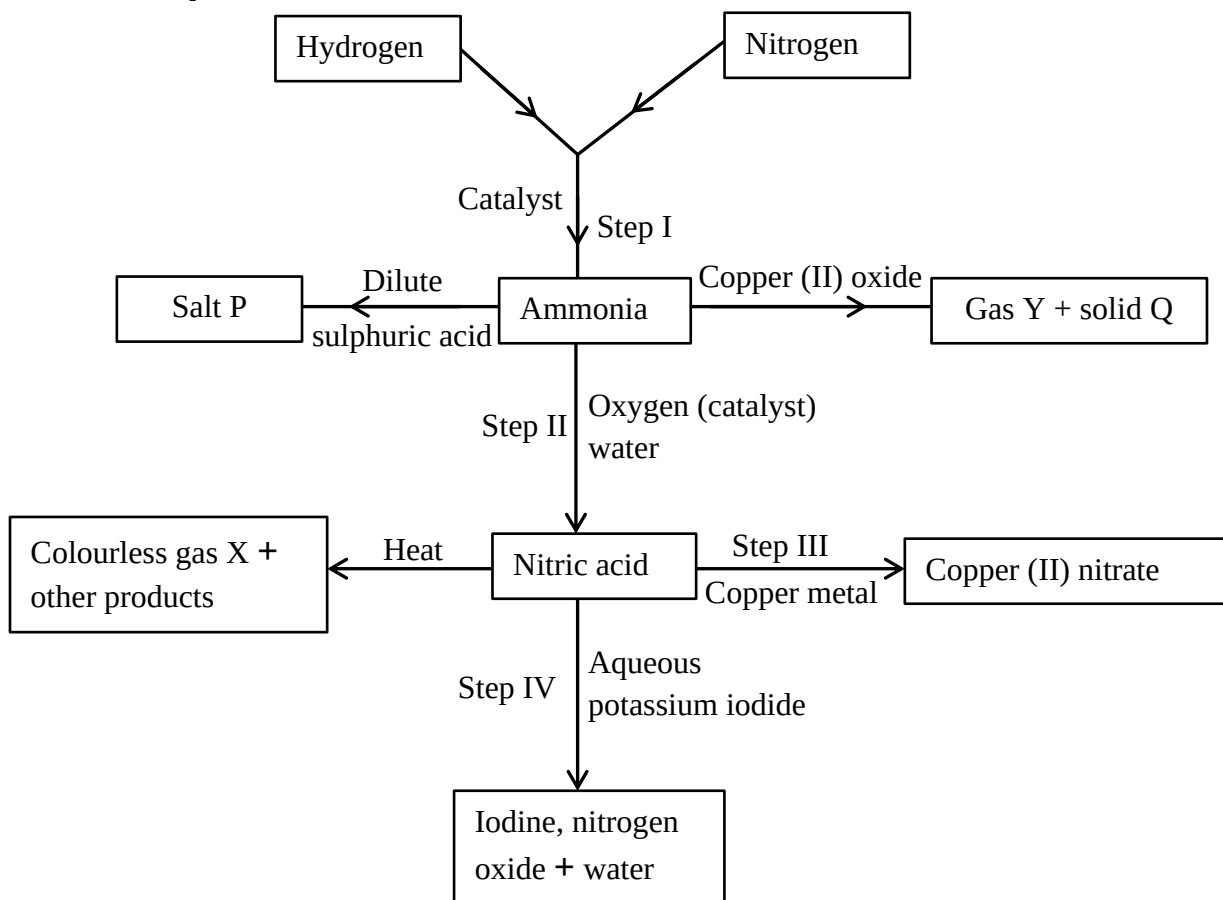


(i) Identify the above method of removing water hardness (1mark)

.....
(ii) The above system eventually lack the ability to soften hard water. Explain how it can be reactivated. (1mark)

.....
(iii) State **one** advantage of hard water (1mark)

.....
7. The scheme below shows various reactions starting with hydrogen and nitrogen. Study it carefully and answer the questions that follow.



- i) Give **one** condition other than the use of a catalyst that would favour reaction in step I. (1 mark)
.....
.....
- ii) Name the catalyst used in step I and II. (2 marks)
.....
.....
- iii) Name substances P, Q, X and Y. (2 marks)
.....
.....
- iv) Write equations for the reactions that take place in step II. (3 marks)
.....
.....
- v) Name the oxidizing agent for the reaction that takes place in step IV. (1 mark)
.....

SERIES 6

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

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

- Select an element with the highest ionization energy. Explain (1mark)
.....
.....
- Compare the ionic radius of G and Y. Explain (2marks)
.....
.....
.....
- In terms of structure and bonding compare the melting point of the oxides of E and T (3marks)
.....
.....
.....
.....
- On the space provided below draw a labeled diagram showing how the chloride of element P can be prepared (2marks)
- State one use of element J (1mark)
.....
- From the grid above select the most electropositive element ($\frac{1}{2}$ mark)
.....
- Sketch a graph to show the trend on atomic radius across the period to which element H and P belong. (2marks)

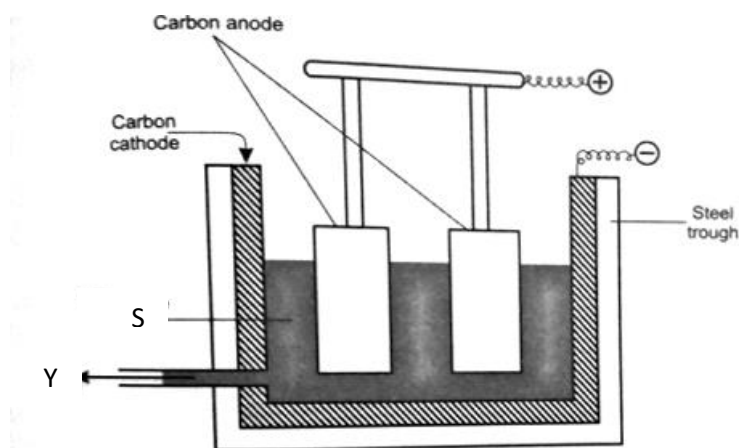
2. a) A piece of unpolished aluminium foil is not attacked by water or steam. Explain why this is so.(1mark)

.....

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

.....

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



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

.....

ii. Name substances S and Y (1mark)

S.....

Y.....

iii. The melting point of alumina is 2015°C yet the electrolysis process is carried out at 800°C. Explain how this is achieved. (1mark)

.....

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

.....

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

.....

.....

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

.....

.....

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

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

Reaction	$E^{\circ}(\text{V})$
$\text{MnO}_4^{-}(\text{aq}) + 8\text{H}^{+}(\text{aq}) + 5\text{e}^{-} \longrightarrow \text{Mn}^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})$	+1.44
$\text{M}^{3+}(\text{aq}) + \text{e}^{-} \longrightarrow \text{M}^{2+}(\text{aq})$	+0.77
$\text{A}^{2+}(\text{aq}) + 2\text{e}^{-} \longrightarrow \text{A}(\text{s})$	+0.34
$\text{P}^{2+}(\text{aq}) + 2\text{e}^{-} \longrightarrow \text{P}(\text{s})$	-0.23
$\text{T}_{2(\text{g})} + 2\text{e}^{-} \longrightarrow 2\text{T}^{-}(\text{aq})$	+2.86

i. State whether acidified $\text{MnO}_4^{-}(\text{aq})$ can oxidise M^{2+} . Give a reason for your answer. (2marks)

.....

.....

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

.....

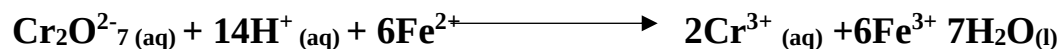
iii. Select two half cells which would produce the highest e.m.f when combined (1mark)

.....

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

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

vi. An alloy containing iron was dissolved in an acid and the total volume made up to 250cm³. 25cm³ of this solution required 18.0cm³ of 0.15M acidified potassium dichromate VI to react with completely as shown



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

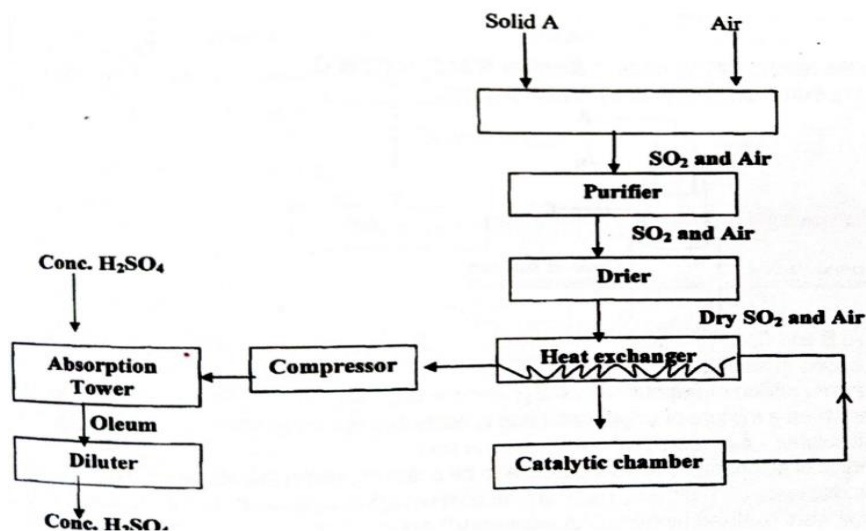
4. a). When a mixture of concentrated sulphuric (VI) acid and copper turnings is strongly heated, a colourless gas and a solid mixture of white and black solids are formed. When the solid mixture is treated with distilled water and filtered a blue filtrate and a black residue are obtained. Explain the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

.....

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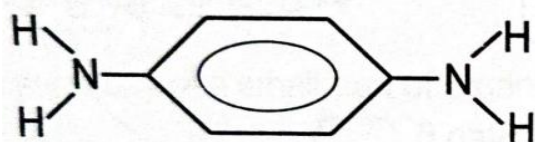
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b). Study the flow chart below and answer the questions that follows.

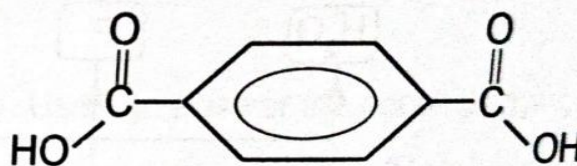


i. Besides sulphur name two possible identities of solid A (1mark)

-
-
- ii. Explain why it is important to remove the impurities in the above process (1mark)
-
- iii. Explain why in the above process sulphur (VI) oxide gas is not directly dissolved in water to form sulphuric (VI) acid but instead dissolved in concentrated sulphuric (VI) acid (2marks)
-
-
-
- iv. Write the chemical equation that takes place in the catalytic chamber. (1mark)
-
- v. State two conditions for the reaction in iv above to take place (2marks)
-
- vi. Give a reason why the above process is called the contact process (1mark)
-
5. Kevlar is a polyamide which is made from two different monomers whose structures are shown below



Benzene-1,4-diamine

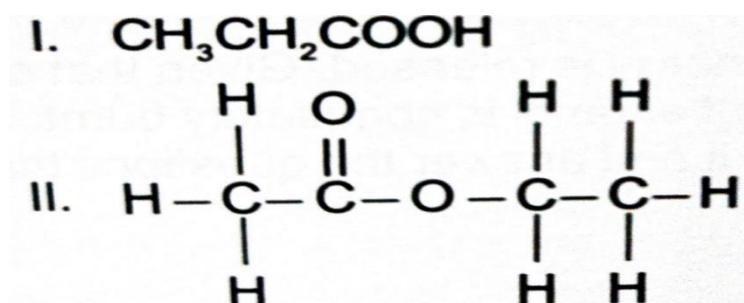


Benzene-1,4-dicarboxylic acid

- a. Draw the structure of Kevlar. (1mark)
-
- b. State one disadvantages of continued use of Kevlar (1mark)
-
- c. Kevlar is used to make body suits for superbike riders due to being tough and friction less. Name one other application it is popular for. (1mark)

d. Give the names of the molecules shown below

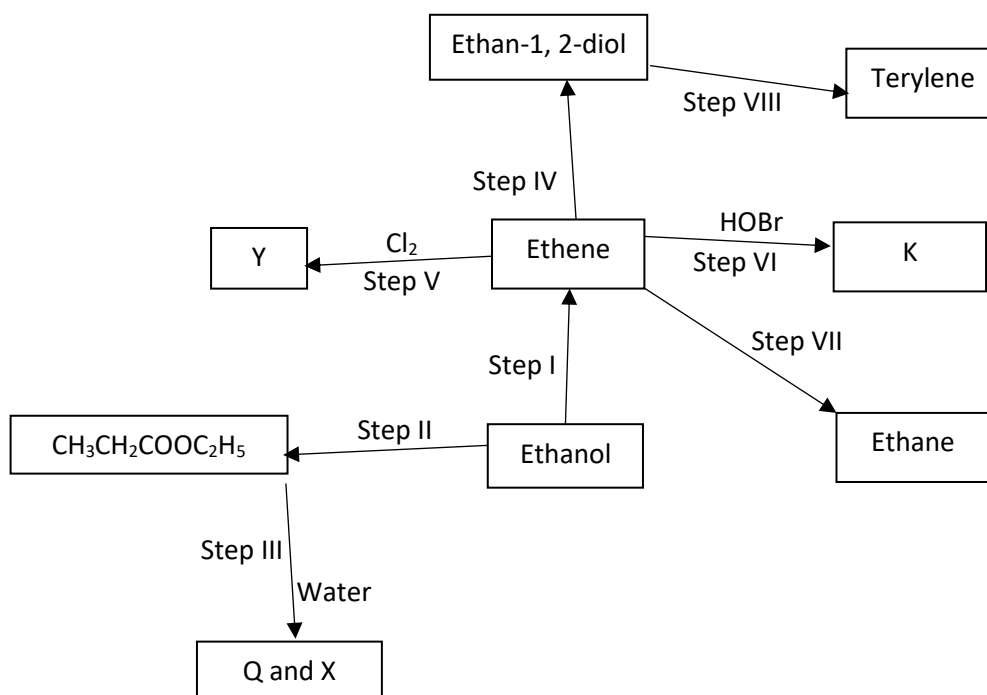
(2marks)



I.....

II.....

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



i. Name substances K and Y

(2marks)

K.....

Y.....

ii. Write the chemical equation for the reaction in step VI

(1mark)

.....

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

Reagent.....

Conditions.....

.....

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

a. Step III.....

b. Step VIII.....

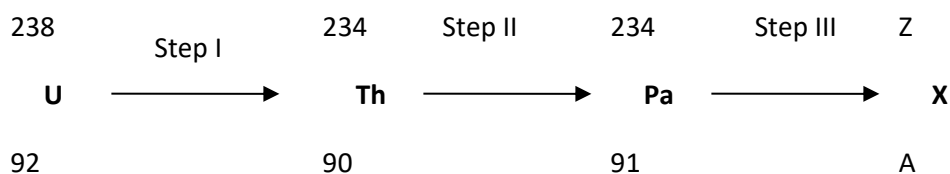
6. a. After 112 days $\frac{1}{16}$ of the mass of R remained, Determine the half-life of R (3marks)

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

.....

.....

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



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

.....

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

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

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

a. Tracers

b. Paper industries.....

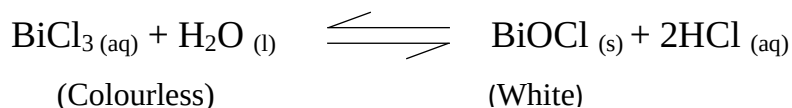
7. A) Chemical reaction occur as a result of collision of particles. Give a reason why not all collisions are effective (1mark)

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

Pressure.....

Temperature.....

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



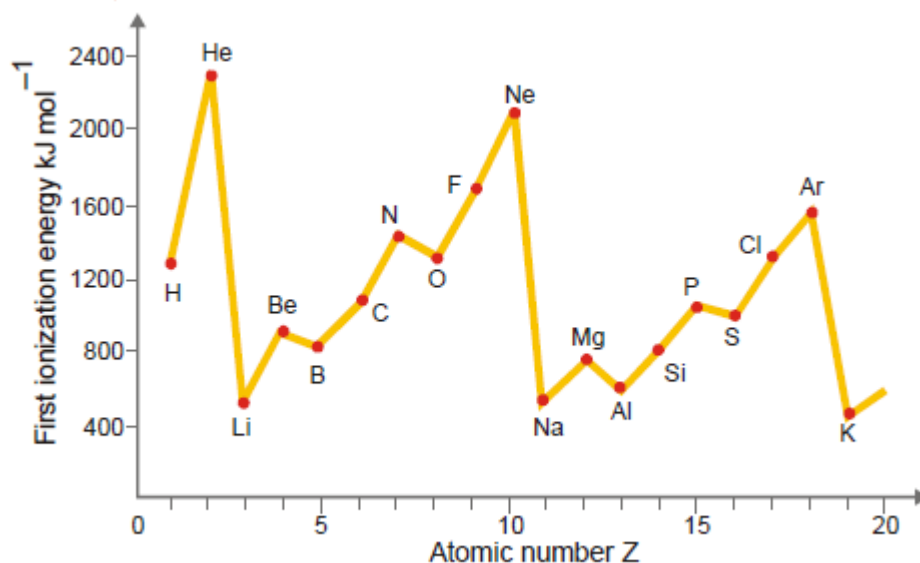
i. State and explain the observation made when a few drops potassium hydroxide are added to the system at equilibrium. (2marks)

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

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

SERIES 7

1. **Figure 1** below is a graph showing the variation of first ionization energies with increase of atomic number.



- (i) Define the ionization energy. (1 mark)
-
-
-
- (ii) Explain why the 1st ionization energy of **Al** is higher than that of **Na**. (1 mark)
-
-
-
- (iii) Write the equation for the 2nd ionization energy of **Mg**. (1 mark)
-
-
-
- (iv) From the graph identify an element
- I. which is the most electronegative. (½ mark)
-
-
- II. That has the largest atomic radius. (½ mark)
-
-
- (v) Explain why the 2nd ionization energy is higher than the 1st ionization energy. (2 marks)
-
-
-
- (vi) Give the chemical family to which the element **Be** and **Mg** belong to. (1 mark)
-
-

- (vii) Give the reason why magnesium hydroxide which is used as anti-acid medicine and not sodium hydroxide (1 mark)
-
-

- (viii) Why is the atomic radius of **Mg** larger than that of **Al**? (1 mark)
-
-

(b) **Table 1** gives the boiling points ($^{\circ}\text{C}$) of some compounds.

Compound	Na₂O	MgO	SiO₂	Cl₂O
Boiling point ($^{\circ}\text{C}$)	1278	3601	2231	-9

- (i) Write another formula for the oxide of chlorine. (1 mark)
-
-

- (ii) Explain, in terms of structure and bonding, the difference in the boiling point of Na_2O and MgO . (2 marks)
-
-
-

2. (a) Define dynamic equilibrium (1 mark)
-
-

- (b) What is an effective collision? (1 mark)
-
-
-

- (c) State and explain how the following factors affect the rate of reaction.

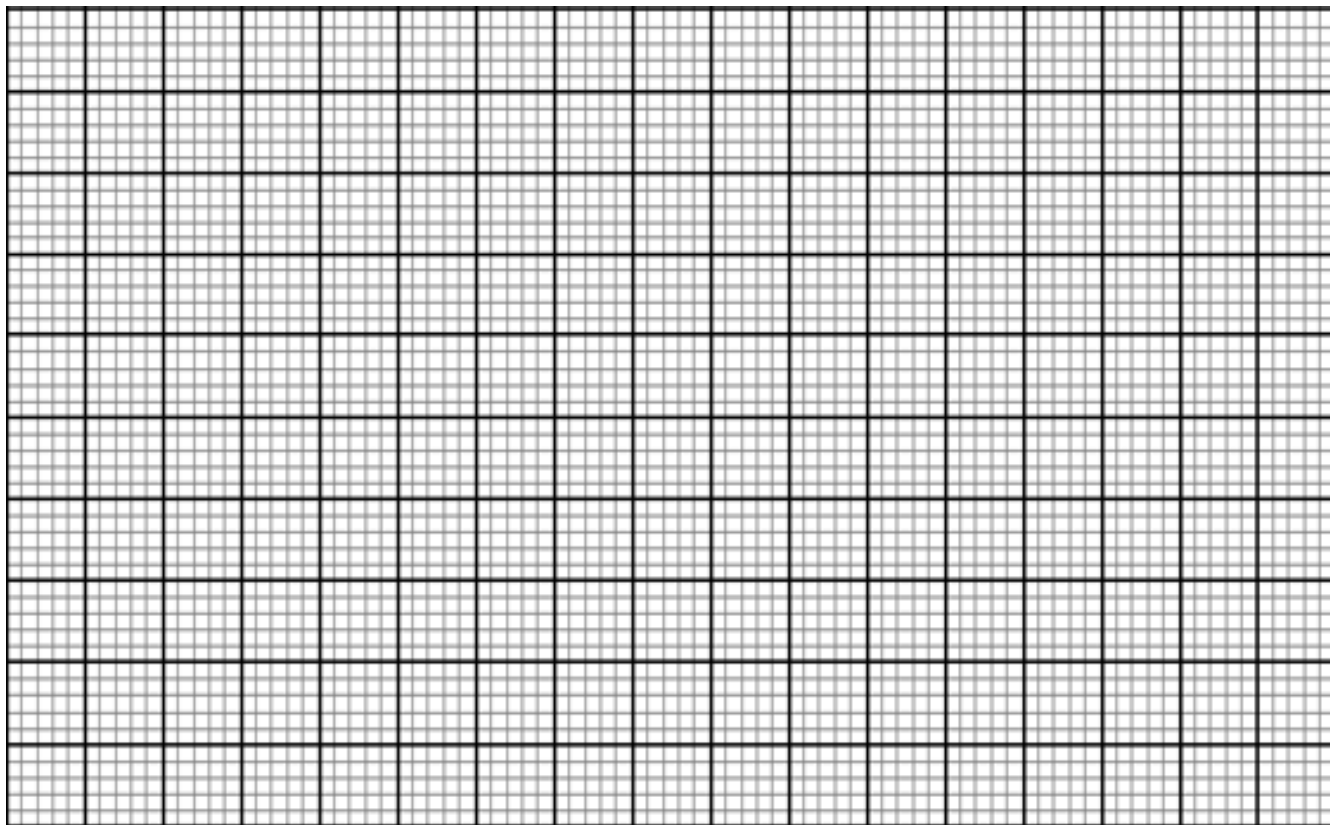
- (i) Catalyst. (1 mark)
-
-
-

- (ii) Concentration of the reactants. (1 mark)
-
-
-

- (d) Compound **Q** decomposes at 25°C . The decomposition of compound **Q** was monitored at 25°C by measuring the concentration of the compound remaining at different time intervals. The following data was obtained as shown in **table 2**.

Time (min)	0	1.0	2.0	3.0	4.0	5.0
Concentration(Mol/litre)	1.20	0.54	0.36	0.26	0.17	0.10

- (i) Plot a graph of the concentration of compound **Q** (vertical axis) against time. (3 marks)



- (ii) From the graph, determine the rate of decomposition of **Q** at 2.5 minutes. (2 marks)

.....
.....

- (iii) On the same axis, sketch the curve that would be obtained if the decomposition was carried out at 10°C. label this curve A. give a reason for your answer. (3 marks)

.....
.....
.....

3. (a) One mole of octane was cracked, two hydrocarbons Q and P were formed. Q was an alkene molecule with three carbon atoms.

(i) Give the molecular formula of:

I. Q. (½ mark)

.....

II. P. (½ mark)

.....

(ii) Draw the structural formula of Q. (1 mark)

.....

.....

.....

(iii) Name the compound formed when Q undergoes polymerization reaction.

(1 mark)

.....

(iv) State **one** disadvantage of using the product named in a (iii) above. (1 mark)

.....

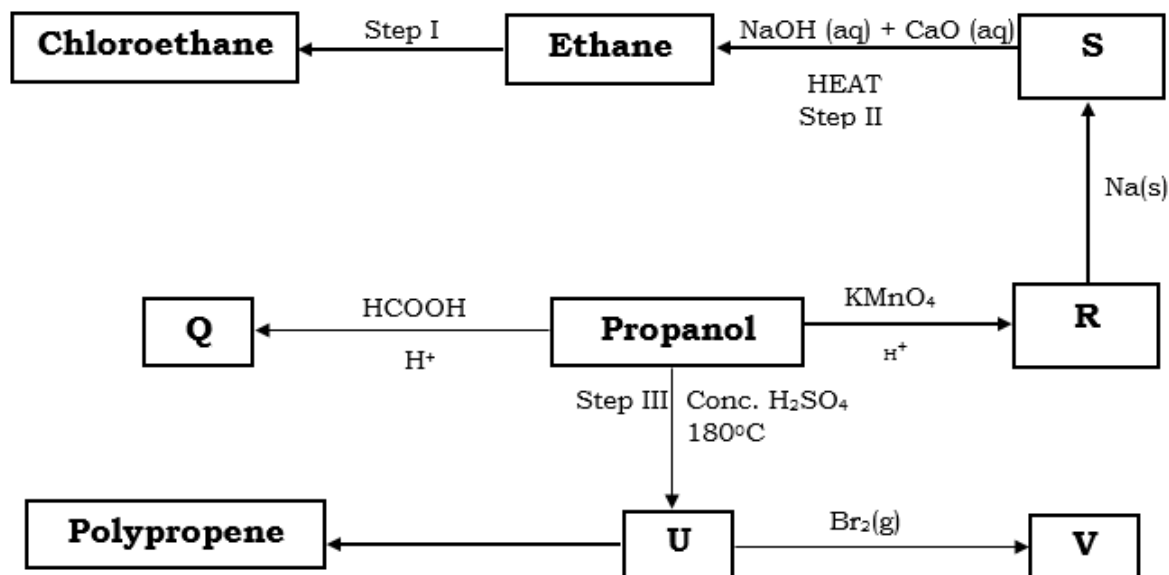
.....

(v) Cracking can also be achieved using less amount of heat in the presence of a catalyst. Name **one** catalyst that is often used. (1 mark)

.....

.....

(b) The **Scheme 1** below shows some reactions starting with propanol. Study it and use it to answer the questions that follow.



(i) Name substance Q, R, S, and V. (2 marks)

.....

(ii) Name the reagent and condition required for the reaction in step I. (1 mark)

.....

(iii) Write the equation for the reaction between:

I. Sodium metal and **R**. (1 mark)

.....

II. Bromine gas and compound **U**. (1 mark)

.....

(iv) State the role of Calcium oxide in step II. (1 mark)

.....

(c) The structures below represent two cleansing agents.



In the **Table 3** below, give **one** advantage and **one** disadvantage of using each one of them. (2 marks)

	Advantage	Disadvantage
R-COONa		
R-OSO ₃ Na		

4. (i) State Hess's law. (1 mark)

.....

ii) The equations below represent changes in physical state of iron metal



Calculate the amount of heat required to convert 32g solid iron to gaseous iron (Fe=56) (3 marks)

iii) 50 cm³ of 2 M HCl and 50 cm³ of 2M NaOH both at 22°C were mixed in a plastic beaker. The mixture was stirred and its maximum temperature was recorded as 35°C. Calculate the molar heat of neutralization of the acid. (specific heat capacity = 4.2 kJ/K/g and density of resultant solution = 1g/cm³). (3 marks)

iv) How would you expect the molar enthalpy of neutralization of ethanoic acid and aqueous ammonia solution compare with the one obtained in (iii) above? Explain. (2 marks)

-

 5. (a) State the Faraday's law of electrolysis. (1 mark)

-

 (b) Calculate how long it would take an aqueous gold (III) chloride cell to coat 2.5 g of gold on a bracelet using a current of 2.5 A. The half reaction has been provided for you. (Au = 197, 1F=96,500C). (3 marks)



-

 (c) Two half-cells are connected under standard conditions to make an electrochemical cell. The two half-cells are a copper-copper (I) ion (**Cu/Cu⁺**) and an aluminum-aluminum ion (**Al/Al³⁺**). Using the Standard Reduction Potentials in **Table 5** below answer the questions that follow.

No	Half cell	Volt (V)
I	$\text{Al}^{3+} (\text{aq}) + 3\text{e}^{-} \rightarrow \text{Al} (\text{s})$	-1.66
II	$\text{Cu}^{+} (\text{aq}) + \text{e}^{-} \rightarrow \text{Cu} (\text{s})$	+0.52

- (i) Calculate the E.M.F of the cell. (1 mark)

-

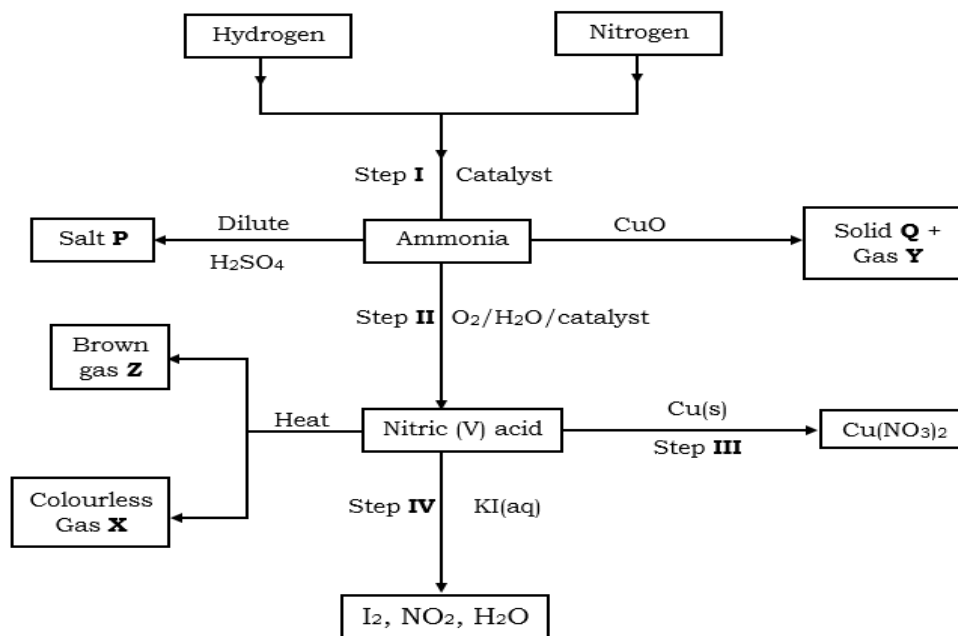
 (ii) Write an overall equation for the electrochemical cell. (1 mark)

-

 (iii) Draw a labelled diagram of an electrochemical cell that is used to measure the standard electrode potential for the equation in **(ii)** above. (3 marks)

- (iv) State one use of electrochemical cells. (1 mark)

6. Study **Scheme 2** below and answer the questions that follow.



(a) Name the processes taking place in step I and II.

(2marks)

Step	Process
I	
II	

(b) Give the name of substances P, Q, X, and Z.

(2marks)

Substance	Name
P	
Q	
X	
Z	

(c) Write the equations for the reactions taking place in step I, II and III

(3marks)

Step	Equation
I	

II	
III	

(d) Identify the oxidizing agent in step IV. Explain. (2marks)

.....

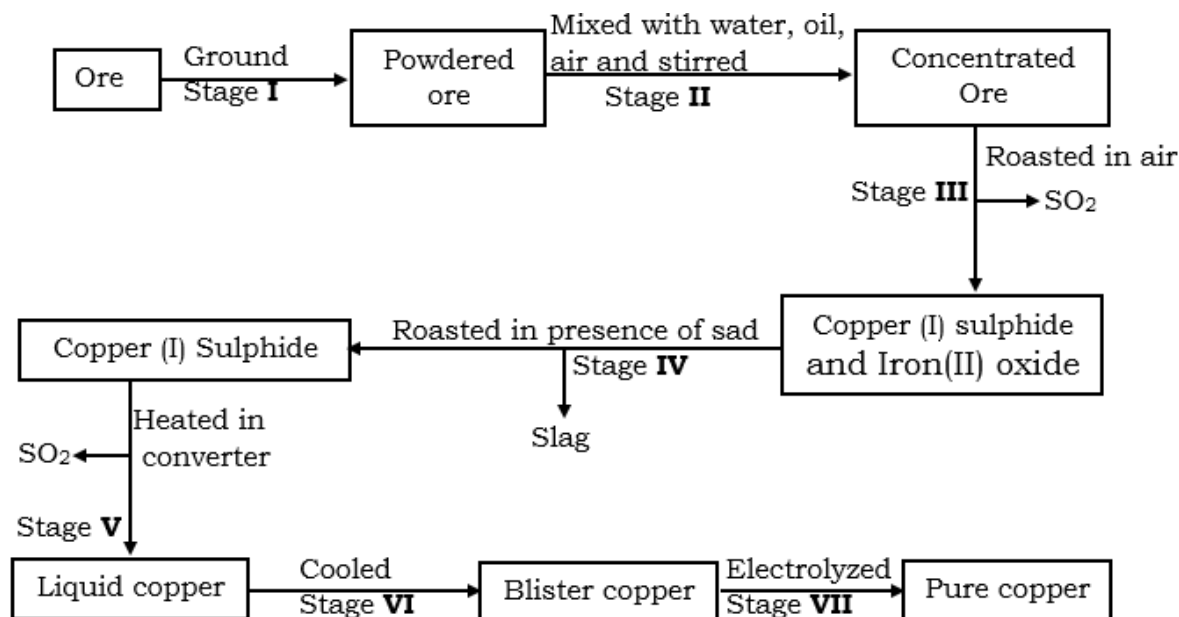
(e) Why is concentrated nitric (v) acid stored in dark bottles in cool places? (1mark)

.....

(f) State **two** uses of nitric (V) acid. (1mark)

.....

7. **Figure 3** below is a flow chart of extraction of copper. Study it and answer the questions that follow.



(a) Give the name and the formula of the major ore from which copper is extracted. (1mark)

Name	Formula

(b) Explain what happens in step IV. (2marks)

.....

- (c) Give the equations for the reactions taking place in step II and V. (3mrks)

Step	Equation
III	
V	

- (d) Draw a simple diagram showing a set up that is used in electrolytic purification of copper. (3marks)

- (e) A green rocky material is suspected to be the ore malachite $[\text{CuCO}_3 \cdot \text{Cu}(\text{OH})_2]$. Describe the process to confirm the presence of copper in the ore. (2marks)

.....

- (f) Give **two** uses of copper. (2marks)

.....

SERIES 8

1. The table below shows the elements in period 3 of the periodic table. Study it and answer the questions that follow

Element	Na	Mg	Al	Si	P	S	Cl	Ar
---------	----	----	----	----	---	---	----	----

- I. a) Write the formulae of two oxides for each of the following [2 marks]

i. Sodium: Oxide I Oxide II

Oxide II

ii. Sulphur: Oxide I Oxide II

Oxide II

- b) The products of the reaction between phosphorus and chlorine depend on the conditions used. Write the equation for the reaction when phosphorus reacts with limited chlorine gas [1 marks]

- c) Identify the most electronegative element. Give a reason [1 marks]

- d) State and explain the difference in the boiling point of sulphur and phosphorus [2 marks]

II. Study the information below and answer the questions that follow. The letters do not represent the actual symbols of elements

element	Atomic number	M.P of element	M.P of chloride
G	11	98	801
H	12	650	715
J	14	1410	-70
K	16	113	-80
L	20	851	780

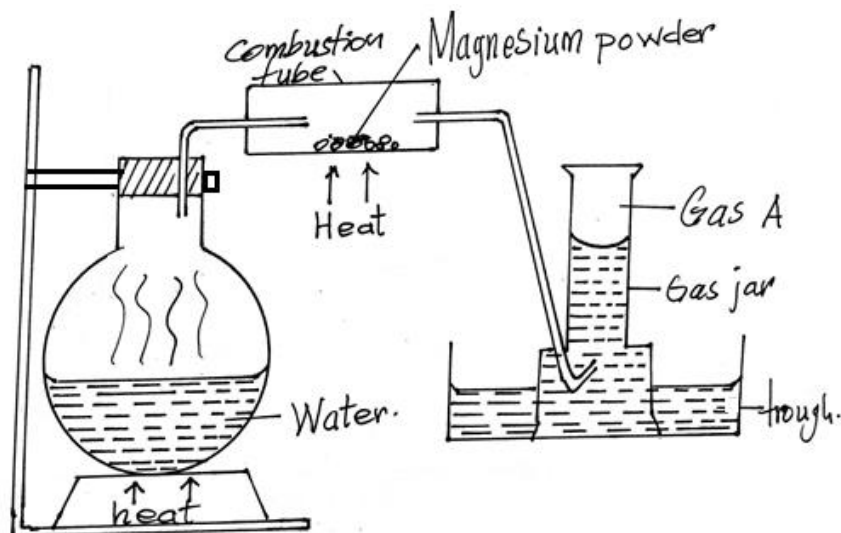
- i) Write the formula of the compound formed when element H reacts with element K [1 mark]

- ii) Use dot (.) and cross (x) to show bonding between G and K [2 marks]

iii) What is the oxidation state of J in its chloride [1 marks]

iv) How does the melting point of fluoride of G compare with that of its chloride [2 marks]

2. Study the setup below and answer the questions that follow



a) Give two reasons why it is necessary to heat the water in the flask just before heating the magnesium powder [2 marks]

b) Write a chemical equation for the reaction taking place in the combustion tube [1 mark]

c) Give the test for gas A [1 mark]

d) Give two uses of gas A [2marks]

e) Given that 240cm³ of gas A was produced in the experiment, determine the mass of magnesium powder used.(molar gas volume = 24000cm³ at R.T.P, Mg = 24) [2 marks]

f) What would be observed if magnesium powder was replaced with;

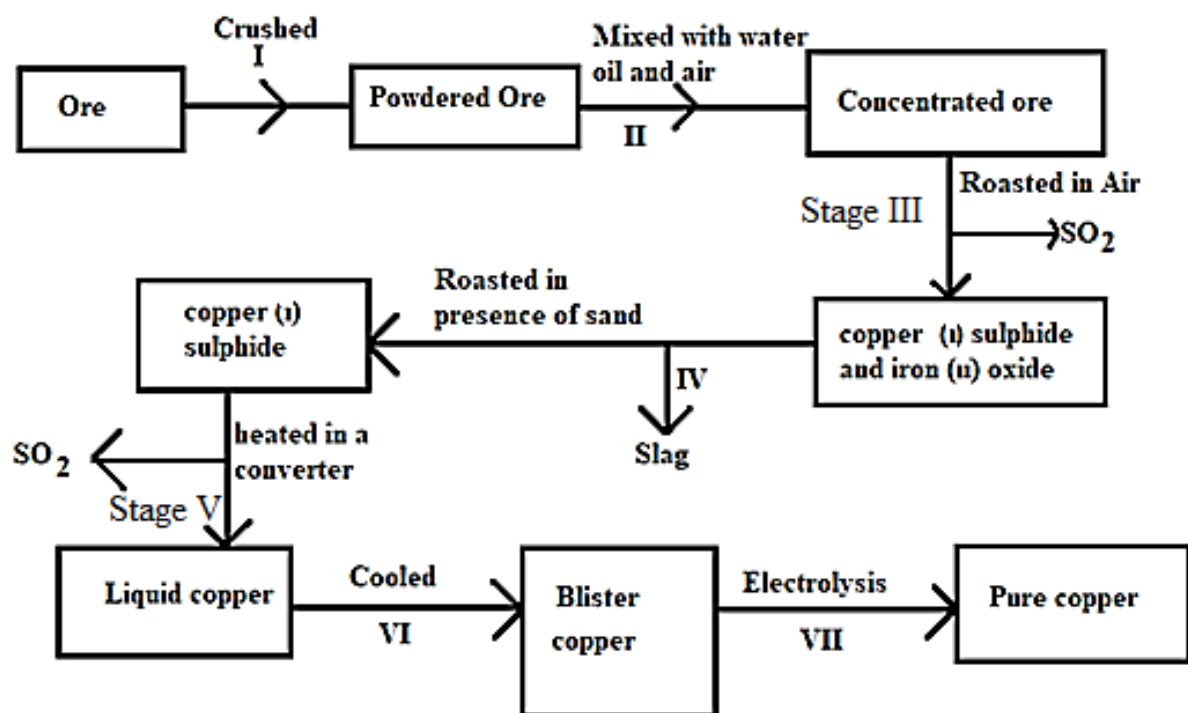
i) Copper metal?

[1 marks]

ii) Potassium metal?

[1 marks]

3. The diagram below is a flow chart for the extraction of copper from the chief ore. Study it and answer the questions that follow.



a) Name two ores of copper metal

[2 marks]

b) Name process II [1 mark]

c) Give an equation for the reaction that occurs in stage III [1 mark]

d) Explain what happens in stage IV [1 mark]

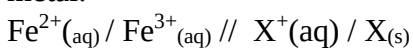
e) Write half-cell equations occurring at the anode and cathode in stage VII
Anode [1 marks]

Cathode [1 marks]

f) State one impurity in blister copper [1 mark]

g) Draw a simple diagram showing the setup that is used in electrolytic purification of copper
[2 marks]

4. Consider the electrochemical cell represented by the cell notation below, when X is an unknown metal:



a) The cell potential of the cell was found to be 0.03V

i) What does the single line (|) in the above cell notation represent? [1 mark]

ii) Write down the half reaction that takes place at the anode in the above cell [1 marks]

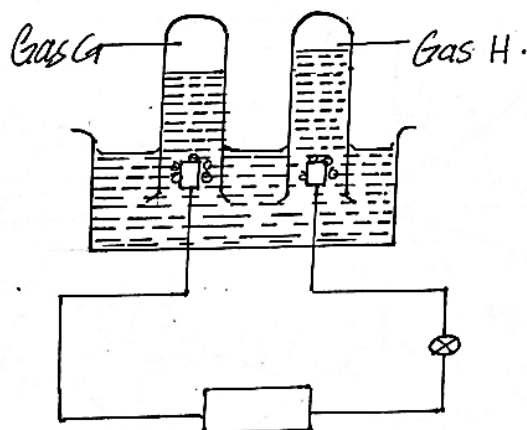
iii) Given that:

<u>Half reaction</u>	<u>E^θ(volts)</u>
$\text{Fe}^{3+}(\text{aq}) + \text{e}^- \longrightarrow \text{Fe}^{2+}(\text{aq}),$	+0.77
$\text{Ag}^+(\text{aq}) + \text{e}^- \longrightarrow \text{Ag}(\text{s})$	+0.80
$\text{Na}^+(\text{aq}) + \text{e}^- \longrightarrow \text{Na}(\text{s})$	-2.87
$\text{K}^+(\text{aq}) + \text{e}^- \longrightarrow \text{K}(\text{s})$	-2.92

Identify X with the aid of calculation

[2 marks]

b) The diagram below shows the apparatus that can be used to electrolyze dilute sulphuric acid. Study it and answer the questions that follow.



i) Identify the gases H and G

I. H

[1 mark]

II. G

[1 mark]

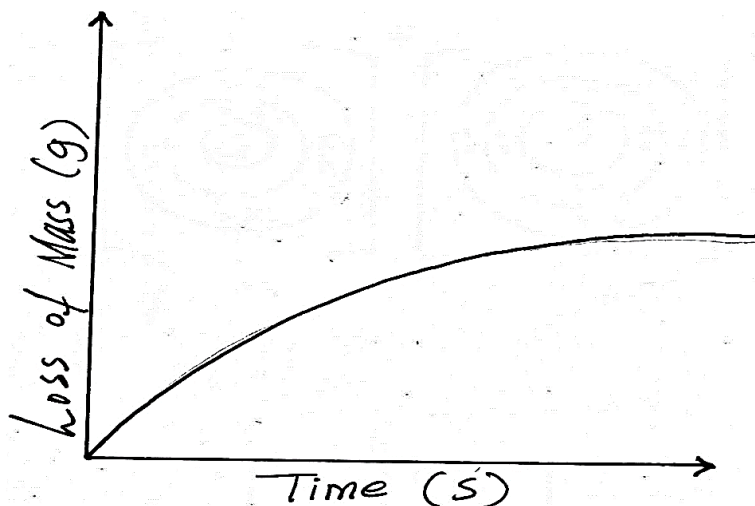
ii) What happens to the concentration of the sulphuric acid during the process with time? Explain

[2marks]

iii) During electrolysis a current of 0.72A was passed through the electrolyte for 15 minutes.

Calculate the volume of gas G produced. (1 Faraday = 96500C, molar gas volume = 24dm³ at r.t.p) [3 marks]

5. a) The sketch below represents a graph obtained when zinc granules were reacted with excess 0.2M sulphuric (VI) acid in the presence of a catalyst in a conical flask placed on an electronic balance.



i) Write an equation for the reaction that took place [1 mark]

ii) Explain why there is loss in mass [1 mark]

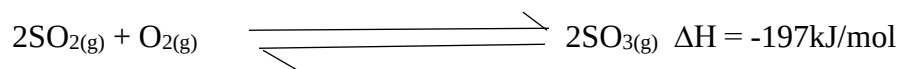
iii) Name the catalyst used [1 mark]

iv) Sketch on the same axes, the curves obtained when

I. Zinc powder was used under the same conditions [1 mark]

II. No catalyst was used [1 mark]

b) In the contact process, sulphur(iv)oxide is converted to sulphuric(vi)oxide in the catalytic chamber which a dynamic chemical equilibrium is reached.



i) What is meant by dynamic equilibrium [1 mark]

ii) State and explain how each of the following would affect the position of equilibrium

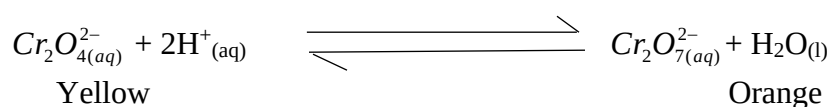
a) Decrease in temperature

[2 marks]

b) Decrease in pressure

[2marks]

iii) Equilibrium exists between chromate and dichromate ions as shown below.



State and explain the observation made when aqueous sodium hydroxide is added to the above mixture. [2 marks]

6. Study the formulae below and answer the questions that follow

I. $\text{CH}_3\text{CH}_2\text{COOH}$

II. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$

a) i) Give the systematic name of each compound

[2 marks]

I.

II.

ii) Write the molecular formula of the compounds

[1 mark]

I.

II.

iii) How does the boiling point of I compare to that of II. Explain

[2 marks]

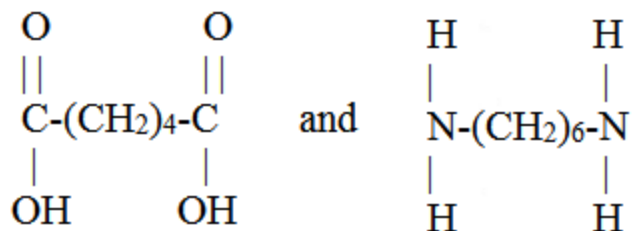
iv) A gas J is bubbled into concentrated sulphuric(vi)acid. Water is added to the mixture then boiled to yield compound II. Name gas J.

[1 mark]

v) Draw the structural formula of the compound immediately after compound I in the homologous series

[1 mark]

b) Study the structural formula of the two monomers below and answer the questions that follow.



i) Name the type of polymerization these monomers would undergo to form a polymer

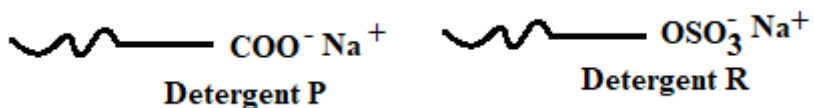
[1 mark]

ii) Draw the structural formula to represent the polymer formed. [1 mark]

iii) What is the name of the polymer [1 mark]

iv) State the use of this polymer [1 mark]

c) Two cleaning agents are represented below



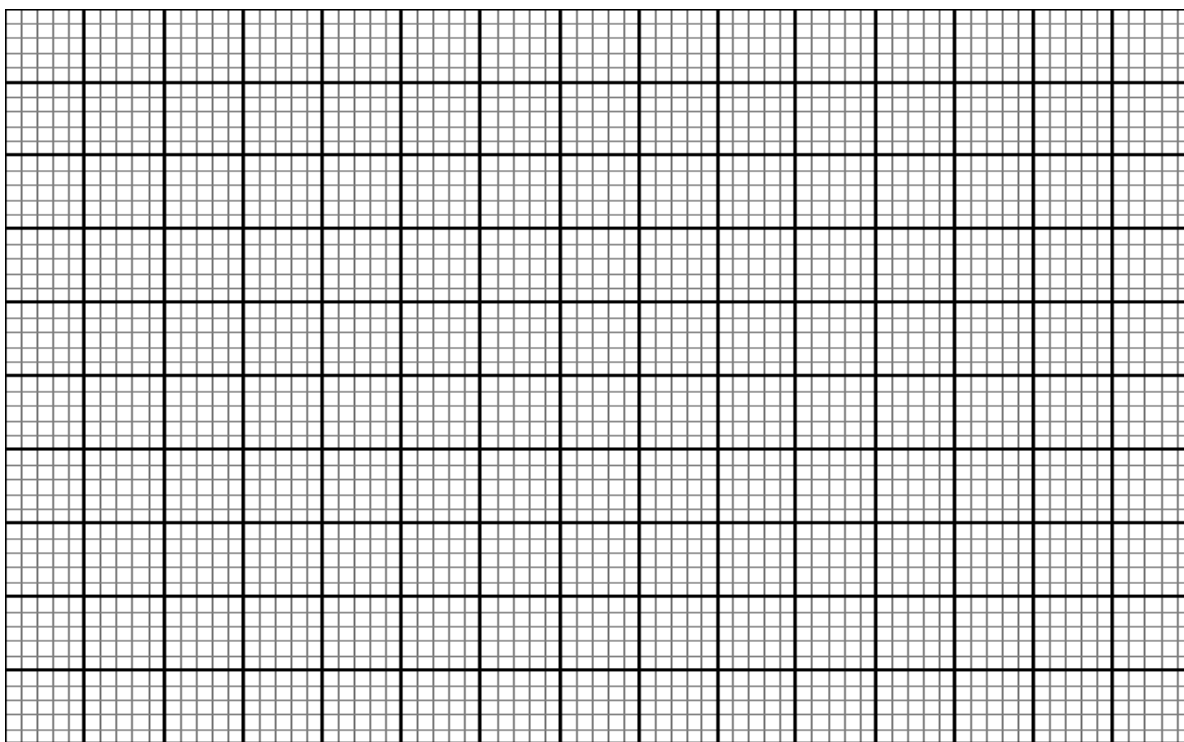
Select one of the detergent which would be suitable for washing in water containing magnesium chloride.
Explain [2marks]

7. a) Define the term half-life [1 mark]

b) The table below contains information from the measurements made of the radioactivity in counts per minute from a radioactive iodine – 128

Counts per minute	240	204	180	156	138	122	108
Time (min)	0	5	10	15	20	25	30

i) Plot a graph of counts per minute against time [3 marks]



ii) Use the graph to determine the half-life of iodine – 128 [1 mark]

iii) What is the count rate after 22 minutes [1 mark]

iv) After how many minutes were the counts rate 160 counts per minute [1 mark]

c) Potassium has two isotopes ${}_{19}^{39}\text{K}$ and radio active ${}_{19}^{40}\text{K}$

i) State how the two isotopes differ

[1 mark]

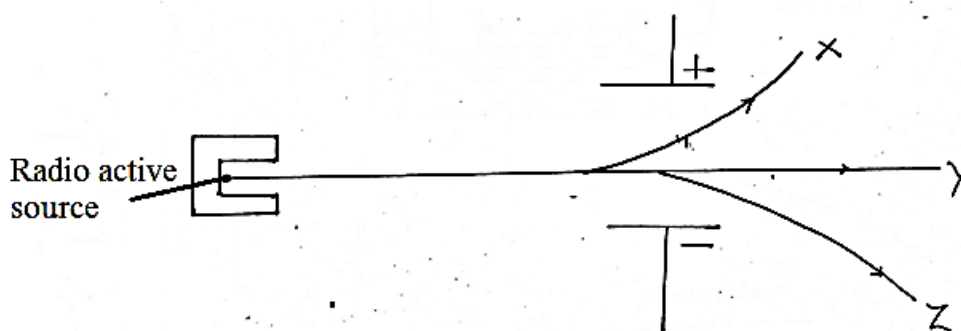
ii) The half life of ${}^{40}_{19}\text{K}$ is 1.3×10^9 years. Determine how long it would take for 4g of the isotope to decay to 1g

[1 mark]

iii) ${}^{39}_{19}\text{K}$ undergoes beta decay to form an isotope of calcium. Write the nuclear equation for this decay

[1 mark]

d) The figure below shows how a radioactive material emitted radiations from its source. Study it and answer the questions that follows as shown.



Identify the radiation that:

i) Has no mass

[1 mark]

ii) Contains helium particles

[1 mark]

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SERIES 9

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

P				T	V	W	Y	M
	Q		S	U		X		
	R						Z	

- a) Write the general name given to the elements to which Y and Z belong. (1mk)

- b) An element N has an atomic number of 15. Write down its electronic arrangement and hence fix it in its right position on the grid above. (2mks)
 Electronic arrangement _____
- c) Compare the size of the atom of R and that of its ion. Explain your answer. (2mks)

- d) Give the formula of the compound formed between
 i. P and W _____ ½ mk
 ii. T and Y _____ ½ mk
- e) Compare the melting points of element Q and S. Explain (2mks)

- f) State the least reactive element in the grid. Give a reason for your answer (2mks)
 Element _____
 Reason _____
- g) Give two advantages that element S has over element Q in making electric cables (2mks)

- h) Draw (a) dot (.) and cross (x) diagram to represent the bonding in compound formed between T and Y (2mks)

2. Study the condensed formulae below and answer the questions that follow

(a) I $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CHCH}_2$

II $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{OH}$

- i. Draw the structural formula of each of the compounds I and II (2mks)

I. .

II.

- ii. Give the systematic name of each of the compounds represented by the formulae above (2mks)

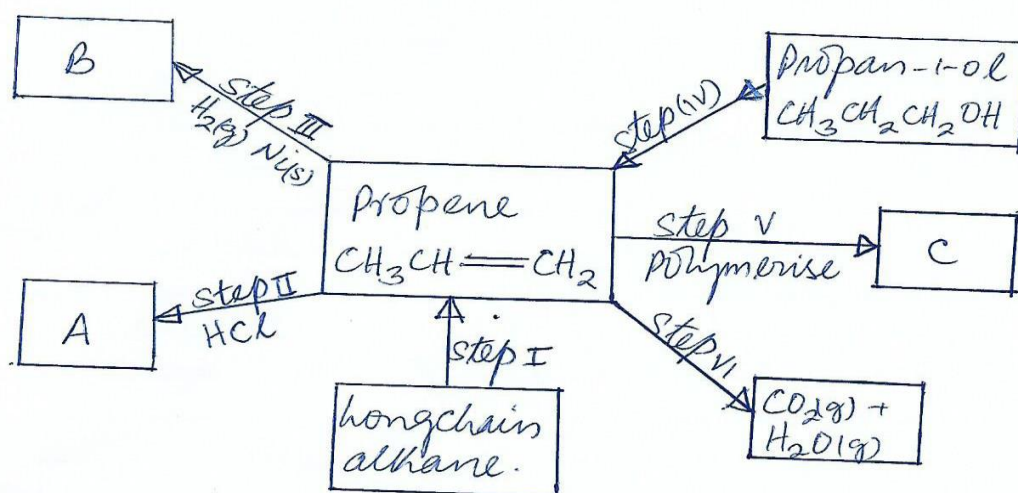
I _____

II _____

- iii. To which homologous series does the compound represented by I belong (1mk)

.....

(b) The flow chart below shows some reactions starting with a long chain alkane. Study it and answer the questions that follows.



- i. Name substance (3mks)

A _____

B _____

C _____

- ii. What is the name given to the process represented by

Step I _____ ½ mk

Step III _____ ½ mk

Step IV _____ ½ mk

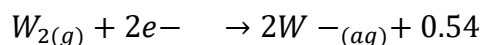
Step VI _____ ½ mk

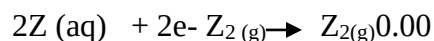
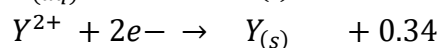
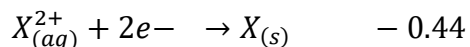
- iii. Write down the chemical equation represented by the reaction in step VI (1mk)

.....
.....

3. (a) The following table shows the standard reduction potentials for four half cells. Study it and answer the questions that follow. The letters do not represent the actual symbols of the elements

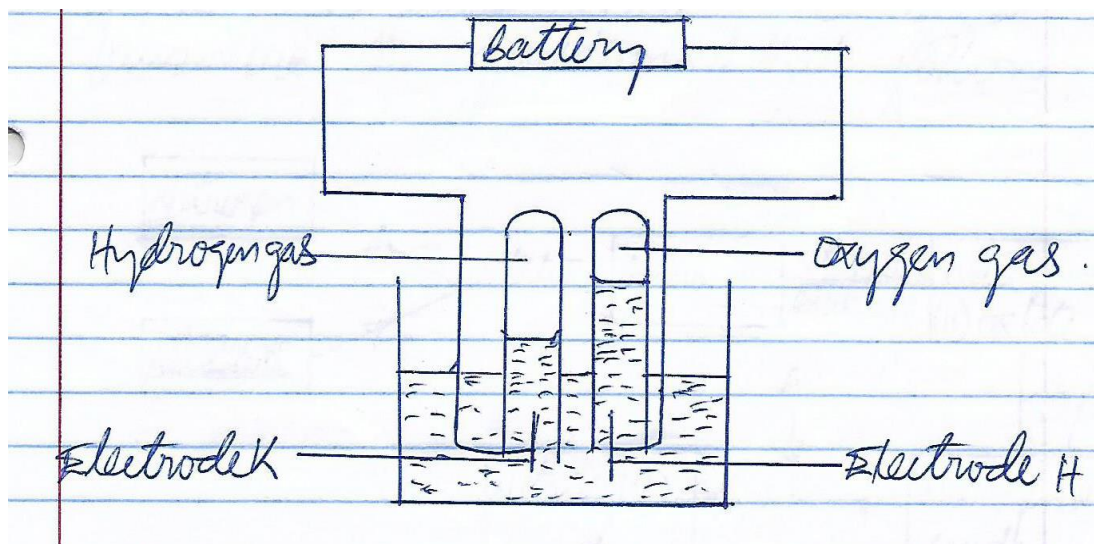
E θ volts





- Explain why the Z half- cell has 0.00 voltage (1mk)
.....
- Identify the strongest reducing agent (1mk)
.....
- Write the equation for the reaction which takes place when solid X is added to the solution containing Y^{2+} ions (1mk)
.....
- Which two half-cells above would provide the highest voltage if connected? (1mk)
.....
- Calculate the voltage generated by the half-cell you have mentioned in (IV) above (2mks)

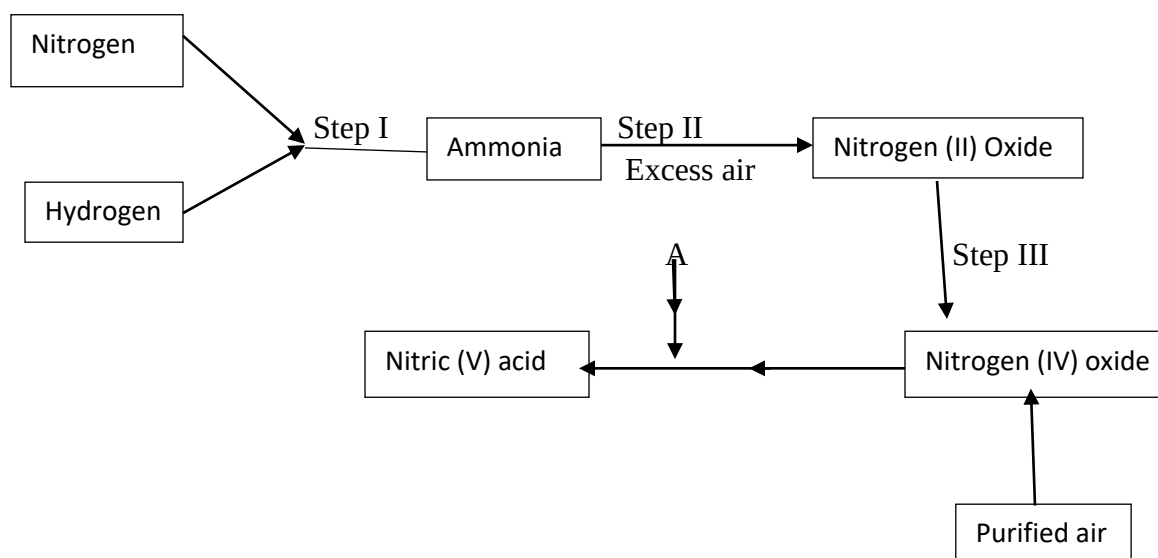
(b) The following diagram shows the electrolysis of water that is slightly acidic study it and answer the questions that follows.



- Identify Electrode K (1mk)
.....
- Why was it necessary to acidify the water? (1mk)
.....

- iii. Explain why the water could not be acidified using hydrochloric acid if the desired products were oxygen and hydrogen (1mk)
-
-
- iv. During the electrolysis of aqueous copper (II) sulphate 48,250 coulombs of electricity were used. Calculate the mass of copper that was deposited at the cathode (2mks)
- (IF=96500columbs Cu=63.5)

4. The diagram below represent two industrial processes; one leading to the manufacture of ammonia and the second leading to the manufacture of Nitric acid. Study it and answer the questions that follow.



- a) Describe one large scale source of

i. Nitrogen (1mk)

.....

.....

ii. Hydrogen (1mk)

.....

.....

- b) Name the catalyst required in

i. Step II _____

ii. Write the chemical equation for the reaction that takes place between ammonia and oxygen in the presence of the catalyst you have named in b (i) above (1mk)

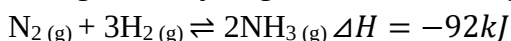
.....
.....
c) Ammonia reacts with nitric acid to form substance P.

i. write the chemical equation for the formation of substance P (1mk)
.....
.....

ii. Give one possible use of substance P (1mk)
.....

d) Give the general name given to the process represented by Step I (1mk)
.....

e) Nitrogen and hydrogen reacts according to the following equation at 450°C and 200 atmospheres



i. State and explain how the yield of ammonia would be affected if the pressure is reduced (2mks)
.....
.....

ii. Name one use of nitric acid apart from making substance P named in (c) above (1mk)
.....

f) Name substance A and write an equation to show how it reacts with nitrogen (IV) oxide to form nitric (V) acid

Substance A _____

Equation
.....
.....

5. (a) Draw a diagram in the space provided below to show how the heat of combustion of ethanol can be measured experimentally (3mks)

(b) In an experiment to measure the heat of combustion of ethanol the following data was collected.

Volume of water	450cm ³
Initial temperature 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

i. calculate:

I. Heat evolved during the experiment (Density of water = 1g/cm^3 . Specific heat capacity of water = $4.2\text{KJ Kg}^{-1}\text{K}^{-1}$) (2mks)

II. Molar heat of combustion of ethanol ($\text{C}=12, \text{O}=16, \text{H}=1$) (2mks)

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

(c) The molar heat of combustion of hydrogen is given as -286KJmol^{-1}

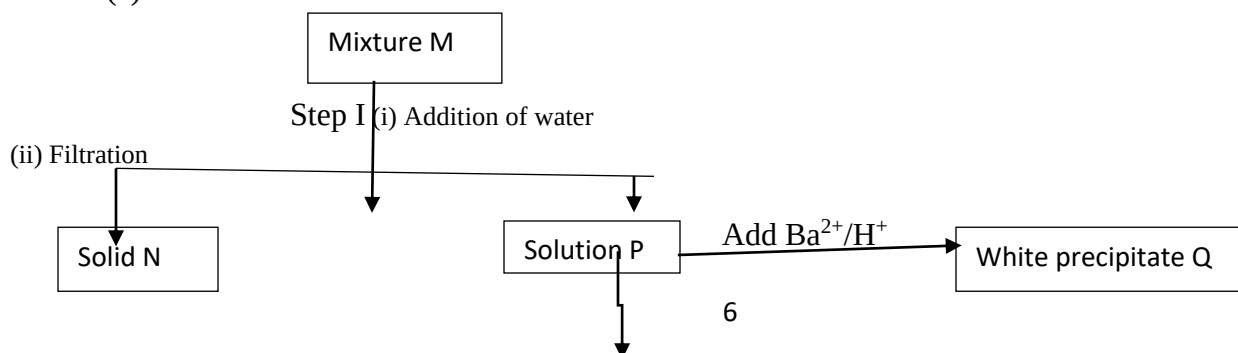
i. Write the thermochemical equation for the reaction above (1 ½ mk)

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

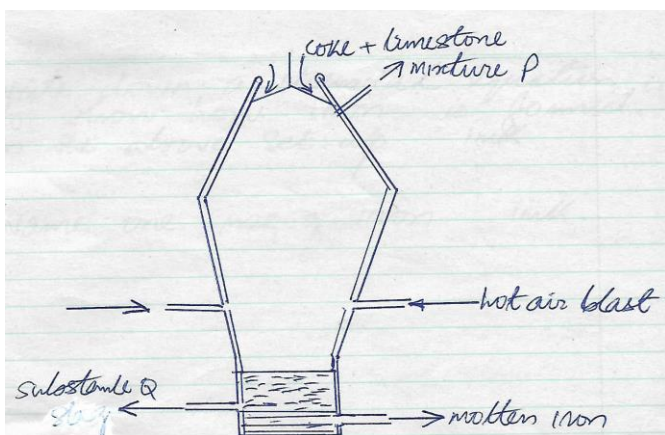
d) (i) What is a fuel? (1mk)

(ii) Name one environmental effect of using carbon and some of its compounds as fuels (½mk)

6. (a)



7. The diagram below shows a blast furnace that is used in the extraction of iron



a) State the composition of mixture P (2mk)

.....

b) Write down the use of the following in the process above.

i. Limestone.....(1mk)

ii. Coke.....(1mk)

c) Name substance Q and write chemical equations to show how it is formed

Name(1mk)

Chemical equations (2mks)

.....

d) Write down a chemical equation to show how iron is formed in the above set-up. (1mk)

.....

e) Name one use of iron (1mk)

.....

SERIES 10

1. Study the information in the table below and answer the questions that follows. The letters do not represent the symbol of the elements.

Element	Atomic number	Melting point (°C)
A	8	-2188
B	9	-219.6
C	12	650
D	13	660
E	14	1410
F	17	-101
G	20	842

- a) Write the electron arrangement for the

i) Atom of D.

(1mark)

ii) Ion of F

(1mark)

- b) Select an element which is

i) The most reactive non-metal.

(1mark)

ii) Best conductor of electricity.

(1mark)

- c) To which group of the periodic table does element G belong.

(1 mark)

- d) How do the reactivity of element C and G compare? Explain

(2 marks)

- e) Using dots [•] and crosses [×] to represent outermost electrons, show the bonding in the compound formed between elements B and D.

(1 mark)

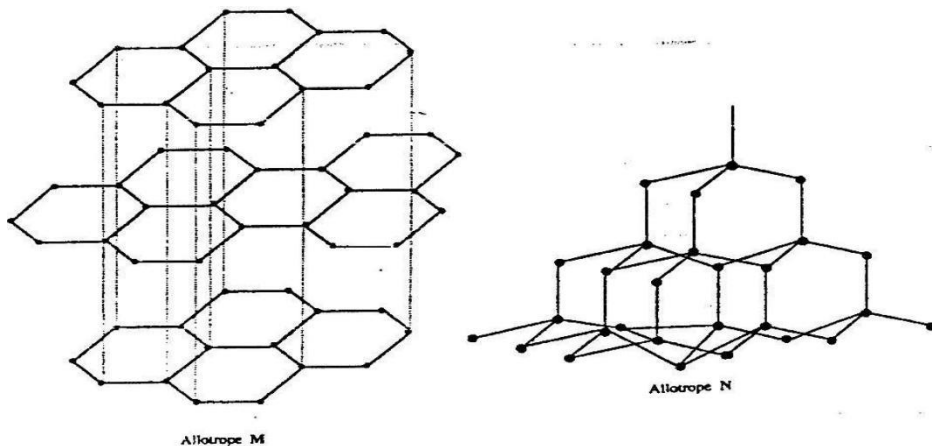
- f) Explain why the melting point of element D is higher than that of element C.(2 marks)

- g) Write a chemical equation for the reaction that will occur between C and A. (1 mark)

- h) Compare the atomic and ionic radius of element F.

(2 marks)

2. (a) The following diagrams show the structures of two allotropes of carbon. Study them and answer the questions that follow.



(i) What is meant by the term allotropy?

(1mark)

ii) Name allotrope M and N

(2mark)

M.....

N.....

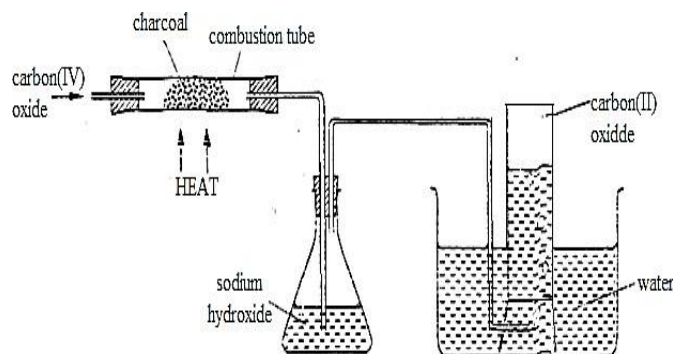
iii) Give one use of N

(1mark)

iv) Which allotrope conducts electricity? Explain

(2mark)

b) In an experiment, carbon (IV) oxide gas was passed over heated charcoal and the gas produced collected as shown in the diagram below



i) Write an equation for the reaction that took place in the combustion tube (1mark)

ii) Name another substance that can be used instead of sodium hydroxide (1mark)

.....

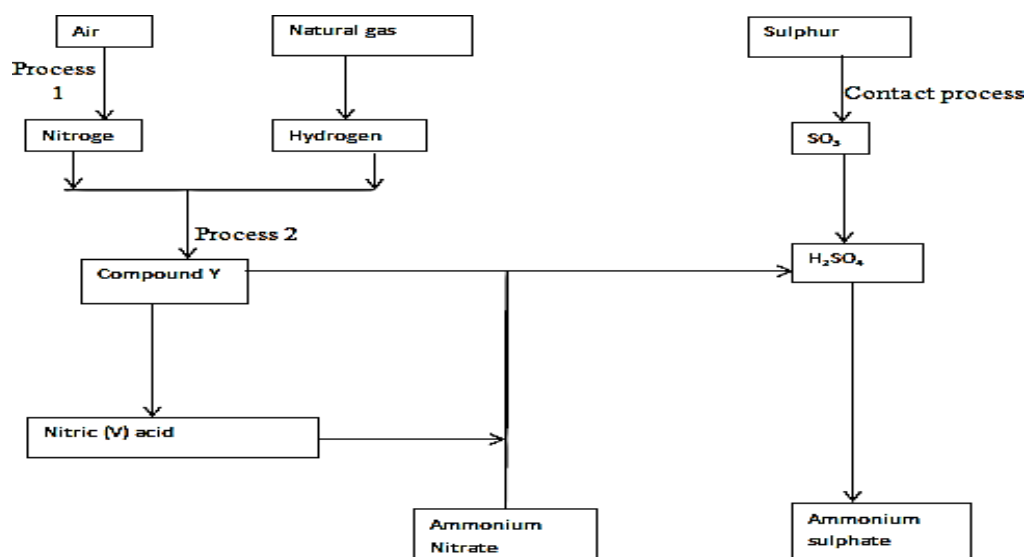
i) Describe a simple chemical test that can be used to distinguish between carbon(IV)oxide and carbon(II) oxide (3marks)

.....

ii) Give one use of carbon (II) oxide (1mark)

.....

3. The flow chart below represents some industrial processes leading to the formation of two nitrogenous fertilizers.



a) Name each of the process above

i) Process 1 (1mark)

.....

ii) Process 2 (1mark)

.....

b) Name the catalyst used in

i) Process 2 (1mark)

.....

ii) Ostwald process (1mark)

.....

iii) Contact process

(1mark)

c) Name compound Y

(1mark)

d) Write the equation for the reaction that leads to formation of ammonium sulphate (1mark)

e) Ammonium nitrate is a better fertilizer than ammonium sulphate. Explain and show your working. (N = 14, H = 1, O = 16, S = 32). (2 marks)

4. a) Study the table below and answer the questions that follows

Formula of hydrocarbon	Boiling points (K)
C ₂ H ₄	-104
C ₃ H ₆	-47.7
C ₄ H ₈	-62
C ₅ H ₁₀	30
C ₆ H ₁₂	63.9

i) What name is given to a series of organic compounds like the ones in the table? (1 mark)

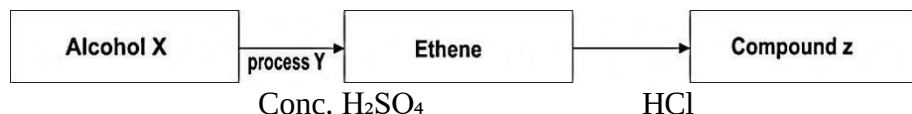
ii) To what class of organic compounds does the above hydrocarbon belong? (1 mark)

iii) Select one hydrocarbon that would be a gas at room temperature (298K); give a reason for your answer. (2 marks)

iv) Give the formula of the seventh member of the above series. (1 mark)

v) What is the relationship between the boiling point and the relative molecular masses of the hydrocarbons in the table above? Explain your answer. (2marks)

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



a. Write the formula of

i) Alcohol X

..... (1mark)

ii) Compound Z

..... (1mark)

iii) Name process Y.

..... (1mark)

b) Propane and chlorine react as shown below;



iv) Name the type of reaction that takes place.

(1mark)

.....

v) State the condition under which this reaction takes place.

(1 mark)

.....

c) The table below gives the volume of the gas produced when different volumes of 2M sulphuric (VI) acid were reacted with 0.6g of magnesium powder at room temperature.

Volume of sulphuric acid(cm^3)	Volume of gas (cm^3)
0	0
10	240
20	480
30	600
40	600
50	600

a) On the grid provided plot a graph of the volume of gas produced against volume of the acid used. (3marks)

b) Write an equation for the reaction between sulphuric (VI) acid and magnesium (1mark)

.....

c) From the graph determine

(i) The volume of the gas produced if 12.5cm^3 of 2M sulphuric (VI) acid has been used. (1mark)

.....

(ii) The volume of 2M sulphuric (VI) acid which reacted completely with 0.6g of magnesium powder. (1mark)

d) Explain the effect on rate of production of the gas if;

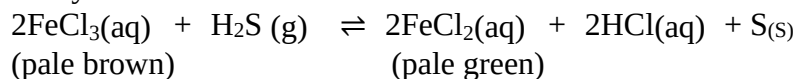
i) 0.6g of magnesium ribbon was used instead of magnesium powder

(1mark)

.....
ii) 3M sulphuric (VI) acid was used instead of 2M sulphuric (VI) acid (1mark)

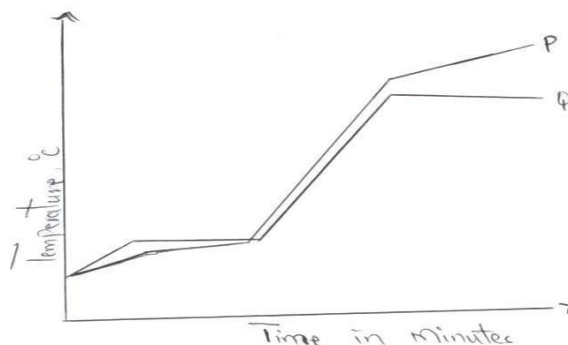
.....
e) Given that one mole of a gas occupied 24000cm^3 at room temperature, calculate the relative atomic mass of magnesium. (3marks)

.....
f) In another experiment, aqueous iron (III) chloride reacts with hydrogen sulphide gas in a closed system as shown below.



State and explain the observation that would be made if dilute hydrochloric acid is added to the system at equilibrium. (2marks)

.....
5. The curves below represent the variation of temperature with time when pure and impure samples of a solid were heated separately.



a) Which curve shows the variation in temperature for the pure solid? Explain. (2marks)

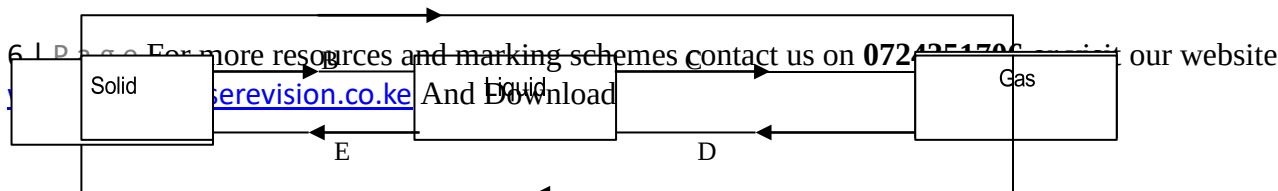
.....
b) State the effect of impurities on the melting and boiling points of a pure substance. (1/2mark)

i. Melting points

.....
ii. Boiling points (1/2mark)

.....
c) The diagram below shows the relationship between the physical states of matter.

A



F

- i) Identify the processes B and D.

B.....(1/2 mark)

D.....(1/2 mark)

- ii) Name process A (1mark)

.....

- iii) State two substances in chemistry that undergo the process A (2marks)

.....

- iv) Is the process E exothermic or endothermic? Explain (2marks)

.....
.....

- 7 a) What method can be used to separate a mixture of ethanol and propanol. (1mark)

.....

- b) Explain how a solid mixture of Sulphur and sodium chloride can be separated into solid Sulphur and sodium chloride crystals. (3marks)

.....

- c) The table below gives the solubility's of potassium bromide and potassium sulphate at 0°C and 40°C

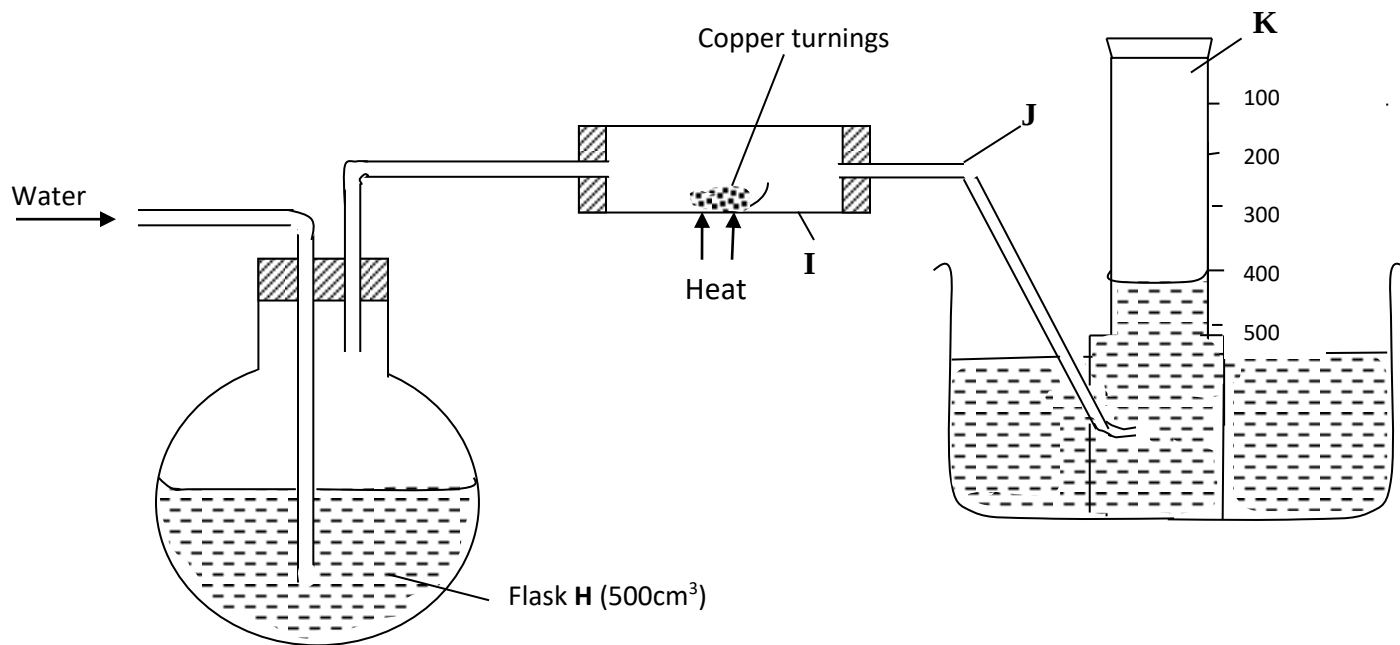
Substance	Solubility g/100g water at	
	40°C	80°C
Potassium bromide	55	75
Potassium sulphate	85	95

When an aqueous mixture containing 60g of potassium bromide and 70 g of potassium sulphate in 100g of water at 80°C was cooled to 40°C some crystals were formed

- a) Identify the crystals. (1mark)
 b) Determine the mass of the crystals formed. (1mark)
 c) Name the method used to obtain the crystals. (1mark)
 d) Suggest one industrial application of the method named in (iii) above. (1mark)

SERIES 11

1. A. In an experiment to determine the percentage of oxygen in air, the apparatus below were set up. Study the set up and the information provided to answer the questions that follow.



A 500cm³ measuring cylinder **K** was filled with water and assembled for gas collection. Copper turnings were heated red hot and water was slowly passed into 500cm³ flask **H** until it reached the 500cm³ mark. A colourless gas was collected in **K**.

- (i) What was the purpose of passing water into flask **H**? (1 mark)

.....

- (ii) What observations were made in the tube **I**? (1 mark)

.....

- (iii) Name one of the gases that is likely to be found in **J**. (1 mark)

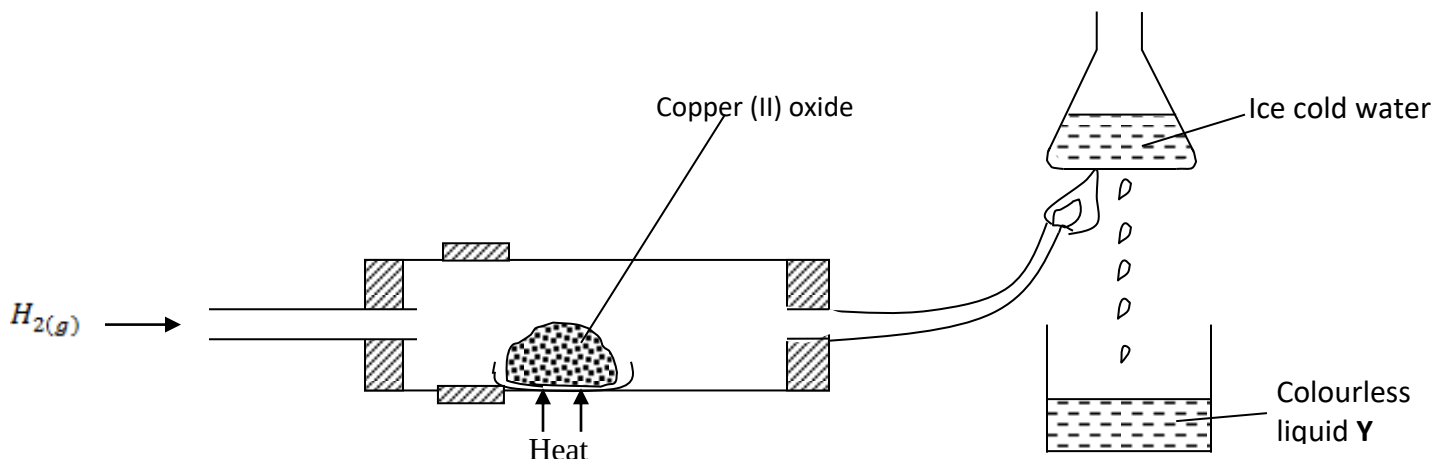
.....

- (iv) What was the volume of the gas collected in the measuring cylinder at the end of the experiment? (1 mark)

.....

- (v) Calculate the percentage of oxygen in air using the above results. (2 marks)

B. Study the diagram below and answer the questions that follow.



- (a) Give **one** observation made in the combustion tube after some time. (1 mark)
- (b) Write an equation for the formation of the colourless liquid **Y**. (1 mark)
- (c) What was the aim of the above experiment as demonstrated in the combustion tube? Explain. (2 marks)

2. Use the information below to answer the questions that follow. The letters are not the actual symbols of the elements.

Element	Atomic No.	M.P ⁰ C	B.P ⁰ C	Ionic radius (nm)
P	11	98	890	0.095
Q	12	650	1110	0.065
R	13	660	2470	0.050
S	14	1410	2360	0.041
T	15	44.2 & 590	280	0.034
U	16	113 & 119	445	0.184
V	17	-101	-35	0.181
W	18	-189	-186	-

- (a) (i) Write the electronic configuration of the atoms represented by letters **T** and **W**. (1 mark)

- (ii) State the nature of the oxides of the elements represented by **Q** and **U**. (2 marks)

.....

(b) Why does the elements represented by the letters **T** and **U** have two values of melting points? **(1 mark)**

.....

(c) Explain the following observations in terms of structure and bonding.

(i) There is an increase in boiling point from **P** to **R**. **(2 marks)**

.....

(ii) Element **S** has a high boiling point. **(2 marks)**

.....

(iii) There is a decrease in boiling points from **U** to **W**. **(2 marks)**

.....

(d) (i) Compare the atomic radius of **U** and **V**. **(1 mark)**

.....

(ii) Why is there no ionic radius for **W** reported in the table? **(1 mark)**

.....

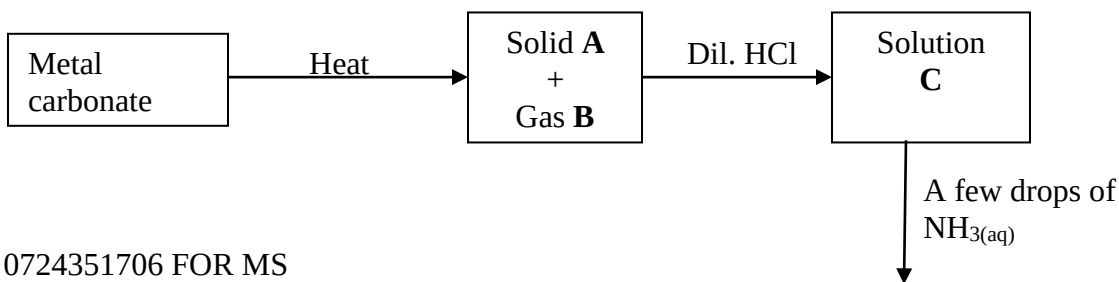
3. (a) The solubilities of potassium nitrate and potassium bromide at different temperatures was determined. The following data was obtained.

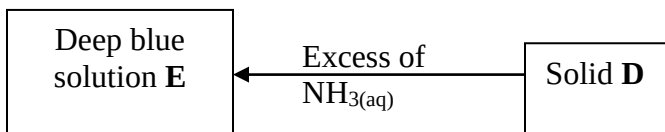
Temperature $^{\circ}\text{C}$		0	10	20	30	40	50	60	70	80
Solubility g/100g H_2O	KNO_3	5	15	26	43	61	83	105	135	165
	KBr	50	55	60	65	70	77	85	90	95

(i) Draw solubility curves for both salts on the same axis. **(3 marks)**

(iii) 100g of a saturated solution of potassium nitrate at 70°C was cooled to 20°C . What mass of the crystals will be crystallized? **(2 marks)**

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





(i) Write an equation for the formation of solid **A** and gas **B**. (1 mark)

(ii) Name;

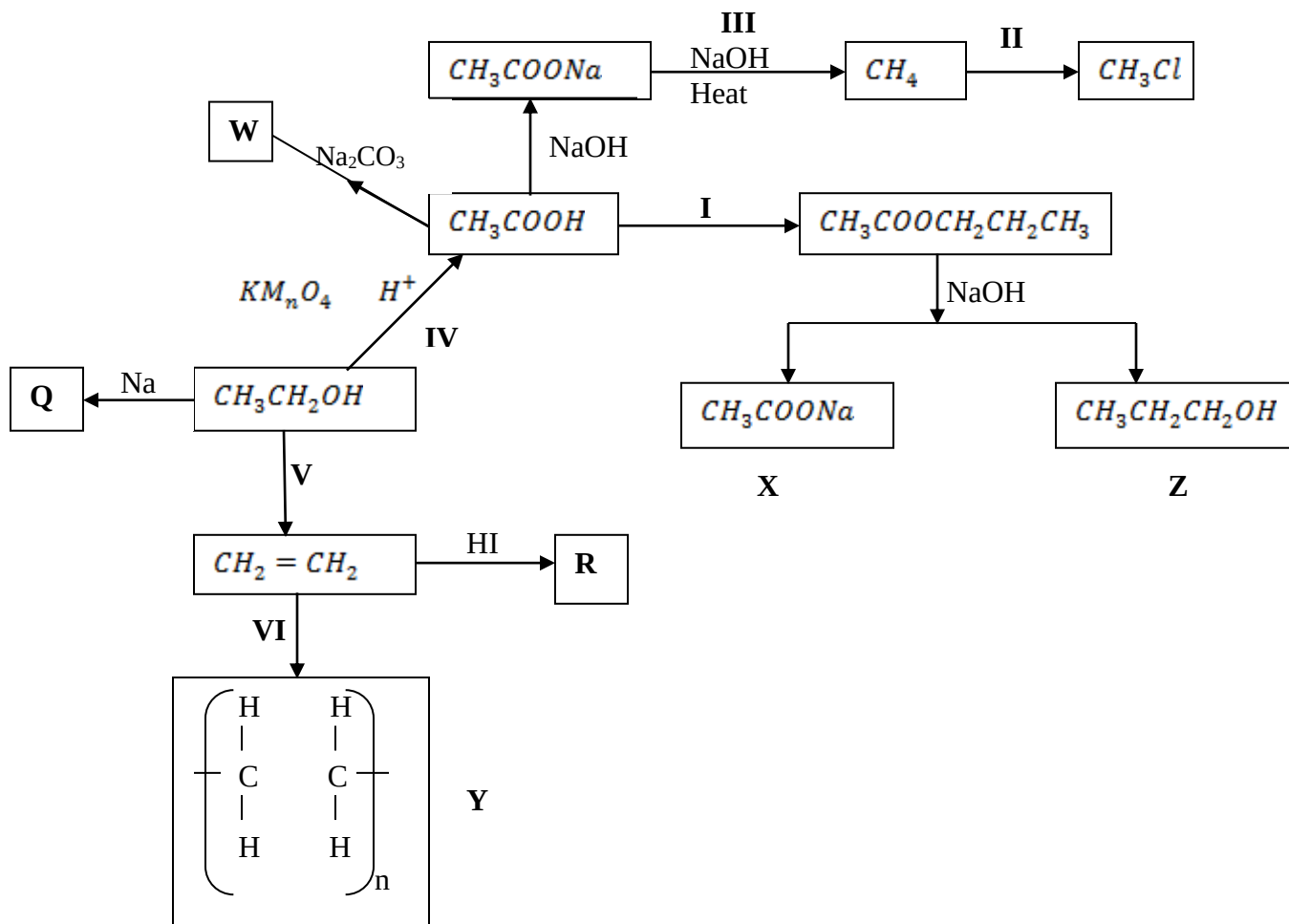
Solution **C** - (1 mark)

Solid **D** - (1 mark)

(c) Write the formula of the complex ion in solution **E**. (1 mark)

.....

4. Study the flow chart below and answer the questions that follow.



(a) Name substance. (3 marks)

X -

Q -

R -

(b) Write down an equation for the reaction represented by step III. (1 mark)

.....
(c) What are the conditions and reagent required for steps?

(i) I (2 marks)

Reagent -

.....
Condition -

(ii) IV (2 marks)

Reagent -

.....
Condition -

(b) Name the process represented by: (4 marks)

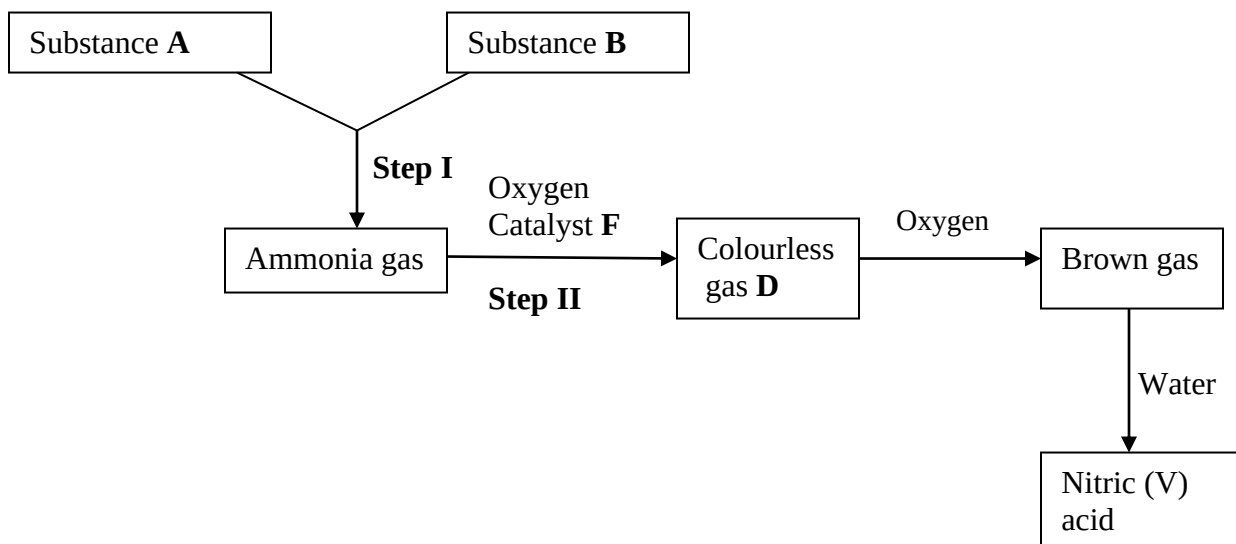
I -

II -

IV -

V -

5. I. Study the scheme below and answer the questions that follow.



(a) Identify substances.

A -

B -

D -

(b) State the catalyst necessary for; (2 marks)

Step I -

.....

Step II -

.....

(c) Write an equation for the reaction taking place in step II. (1 mark)

.....

(d) Write two balanced chemical equations for the reaction between chlorine gas and;

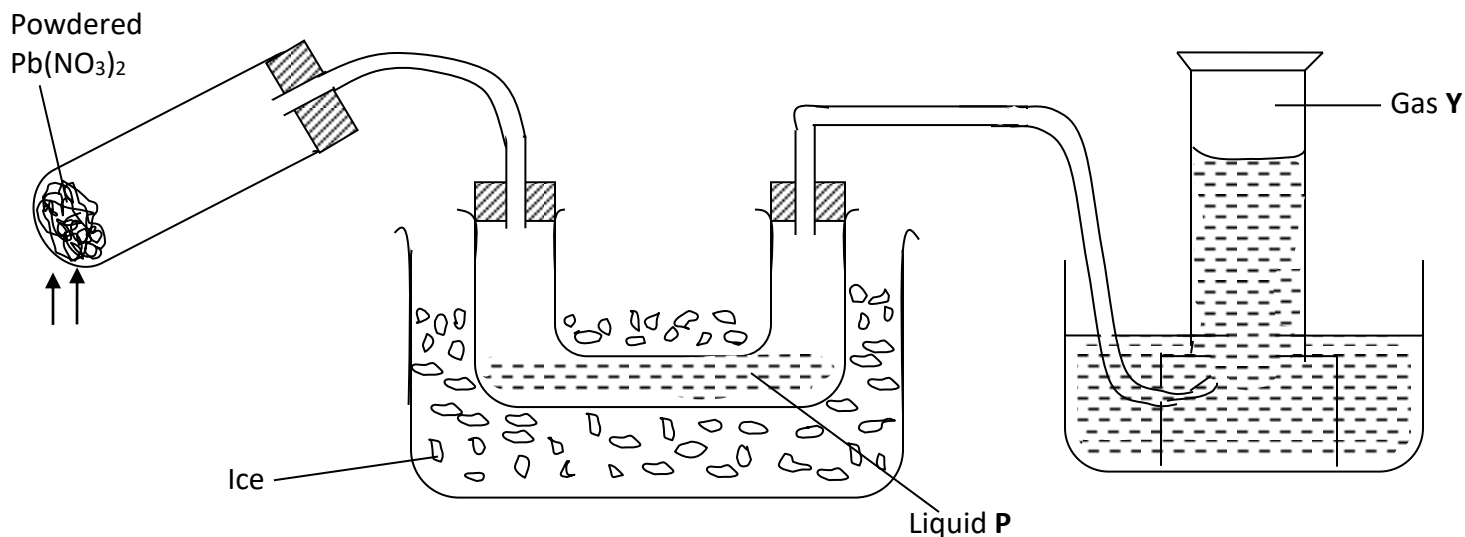
(i) Hot and concentrated sodium hydroxide. (1 mark)

.....

(ii) Dilute and cold sodium hydroxide. (1 mark)

.....

II. The diagram below shows an experiment in which the Lead (II) nitrate crystals are heated.



(a) Name; (2 marks)

(i) Liquid **P** -

.....

(ii) Gas Y -

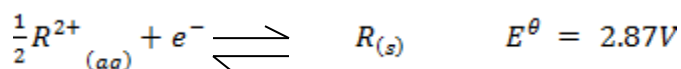
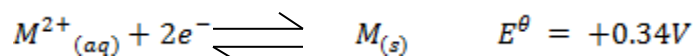
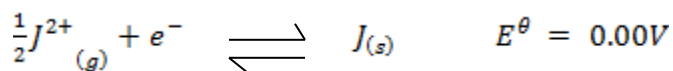
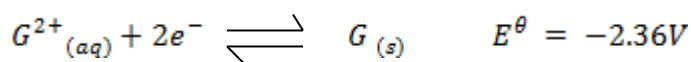
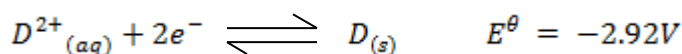
(b) Write a balanced chemical equation for the decomposition of Lead (II) nitrate.
(1 mark)

.....

(c) Explain how you can distinguish between nitrogen (II) oxide and nitrogen (I) oxide.
(2 marks)

.....
.....
.....
.....
.....

6. I. Study the standard electrode potentials given below and answer the questions that follow.



(a) Identify the strongest:

(i) Reducing agent (1 mark)

(ii) Oxidizing agent (1 mark)

(b) Calculate the e.m.f of a cell made of G and M. (2 marks)

(c) Write the cell representation for the above cell in (b). (1 mark)

(d) Draw a cell diagram for the cell in (b) above. (2 marks)

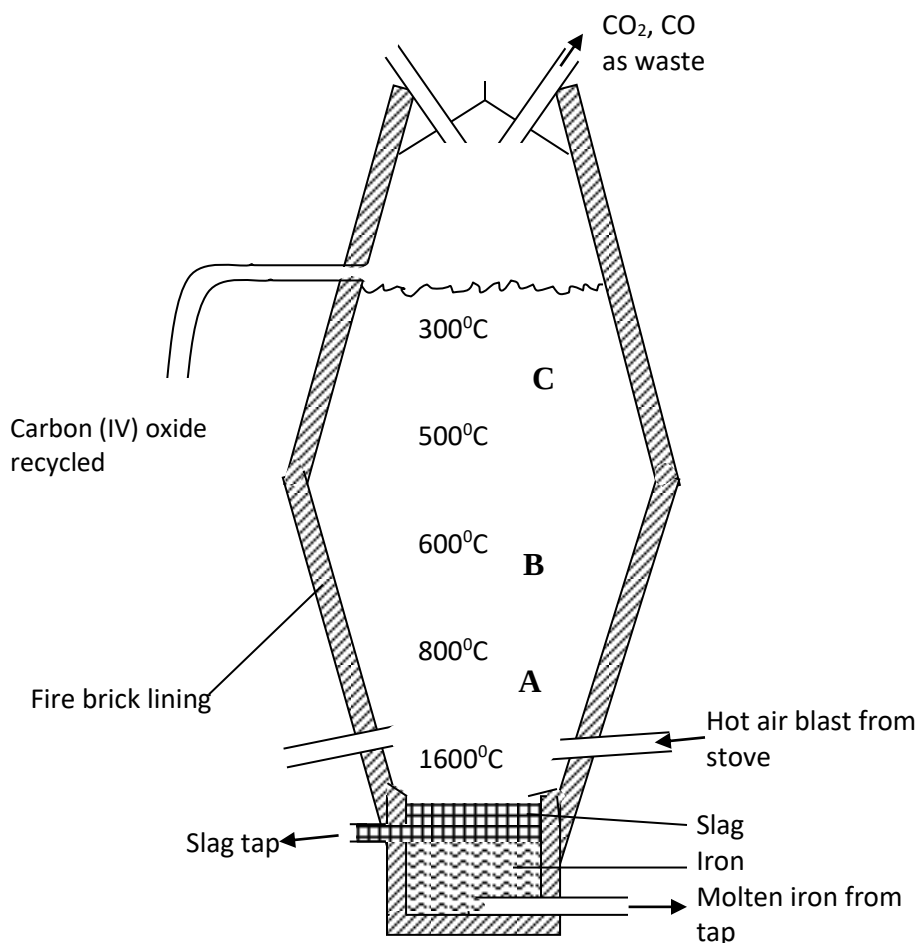
(e) Write the cell reaction for the drawn cell diagram in (d) above. (1 mark)

II. Electrolysis of aqueous solution of metal M resulted in the deposition of 1.07g of metal upon passage of a current of 1.32 amperes for 75 minutes.
($M = 52$, $1F = 96500C$)

(i) Calculate the quantity of electricity passed through the cell. **(1 mark)**

(ii) Calculate the charge on the metal ion. **(3 marks)**

7. 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) (i) What does the word smelt mean? **(1 mark)**

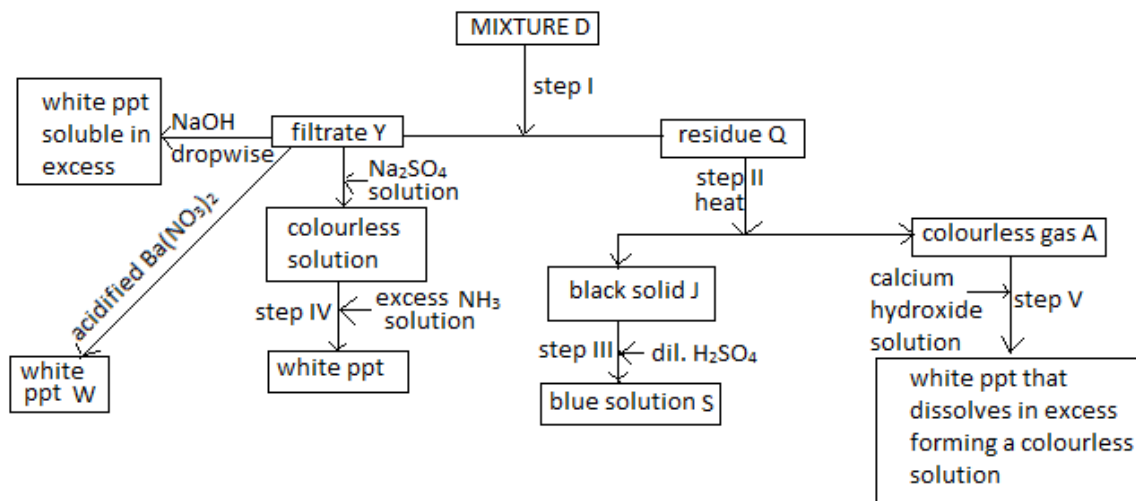
.....

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

-
- (iii) What is the role of the hot air blast in the process? **(2 marks)**
-
- (b) Write equations for the reactions that take place at the region marked A, B and C. **(3 marks)**
- (c) What is the purpose of limestone in the extraction process? **(1 mark)**
-
- (f) Write equations to show how impurities are removed from the ore. **(3 marks)**

SERIES 12

1. Study the flow chart below and answer the questions that follow.



a) Identify the following;

(2mk)

i) Residue Q-

ii) gas A-

iii) Filtrate Y-

iv) solid J-

b) Name the process taking place in step 1

(1mk)

c) Write balanced chemical equations for the following;

i) an ionic equation that led to the formation of the white precipitate formed in step IV.

(1mk)

ii) an equation of the reaction that led to the formation of white precipitate W

(1mk)

d) **Explain** the observations that were made in step V

(2mk)

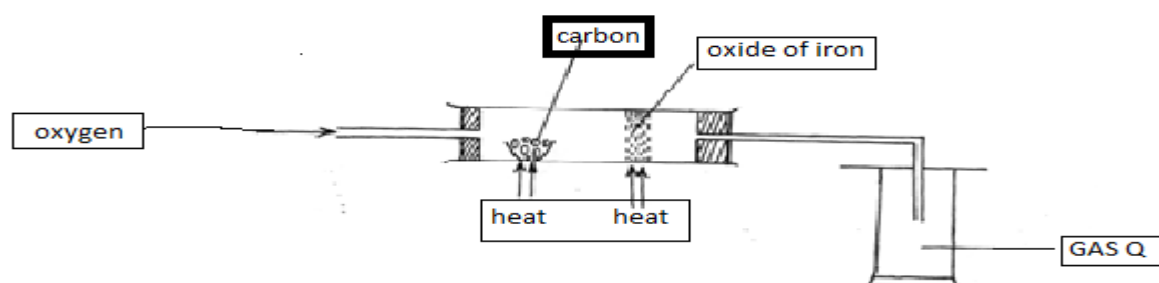
e) State the observations that would be made if the product of step III is added ammonia solution drop wise till in excess.

(1mk)

f) 100cm³ of the blue solution formed in step III was placed in a plastic beaker, its initial temperature was recorded. Excess magnesium powder was then added and the mixture stirred and the highest temperature attained recorded. **State** and **explain** the observation made in the above reaction apart from the change in temperature.

(2mk)

2. a) The set up below was used on a sample of an iron iii oxide. Study it and answer the questions that follow.



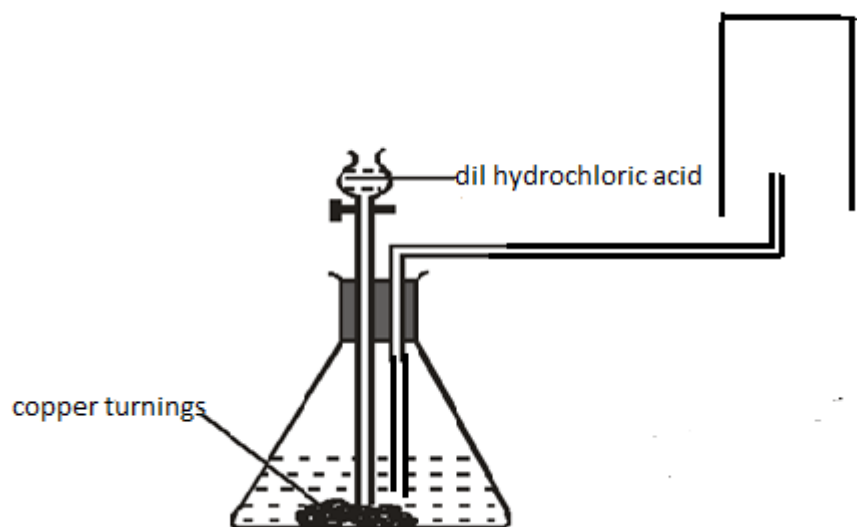
i) Identify the gas Q collected (½ mk)

ii) What observation is made on the excess iron (III) oxide? (1 mk)

iii) Write equations for the two reactions that take place in the combustion tube (2mk)

b) Diamond and graphite are both allotropes of carbon explain using structure and bonding why diamond is hard while graphite is soft. (2mk)

c) The diagram below was used by a form I student from Rami secondary school to prepare a certain gas. Study it and answer the questions that follow.



i) Identify two mistakes in the set up above. (2mk)

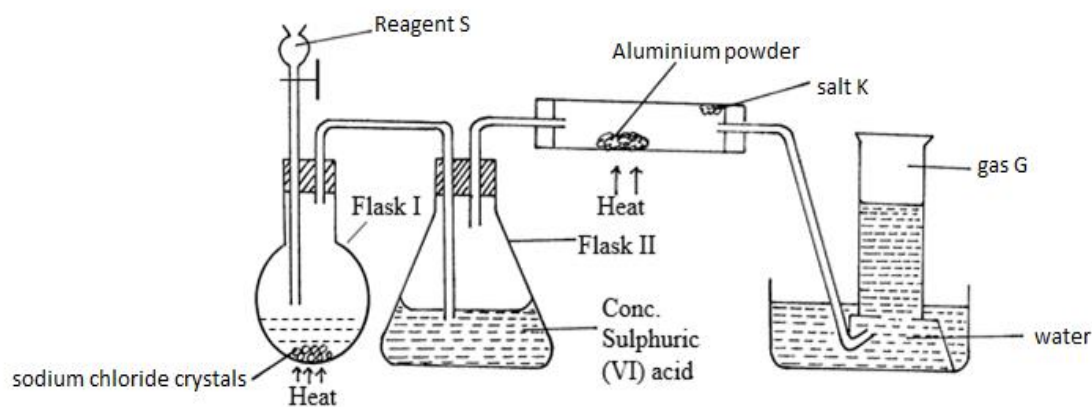
ii) Identify one of its physical properties apart from its solubility in water and one of its uses (1mk)

Property-

Use –

d) A student was supplied with a colourless liquid suspected to be water describe one chemical test that could have been used to show that the liquid was water (1½ mk)

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



i) Identify the following

ii) Reagent S (½ mk)

iii) Gas G (½ mk)

iv) Salt K (½ mk)

v) Write balanced chemical equations for reactions that occur at:

Flask I (1mk)

Combustion tube. (1mk)

vi) Name the process that formed salt K as shown in the diagram. (1mk)

vii) Both blue and red litmus papers had been placed in the water in the trough, state and explain the observations made at the end of the experiment. (1 ½ mk)

b)i) State Graham's Law of diffusion of gases

(1mk)

ii) 100cm^3 of carbon (IV) oxide gas takes 75 seconds to diffuse through a porous plate. How long would it take 120cm^3 of nitrogen gas to diffuse through the same plate under the same conditions. (N=14, O=16, C=12) (2mk)

c) A mixture of 70cm^3 of chlorine gas and 110cm^3 of hydrogen gas were exploded. Calculate the total volume of the resulting gaseous mixture. (2mk)

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

								L
R							J	
	G			D				
	Y						V	
Z					E			

a) What name is given to the group of elements where G and Y belongs?

($\frac{1}{2}$ mk)

b) i) Write the formulae of the compound formed when elements Y and J reacts.

($\frac{1}{2}$ mk)

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

(1mk)

c) Compare

i) The atomic radius of elements Z and E

(1 $\frac{1}{2}$ mk)

ii) The reactivity of element J with magnesium metal and that of V with magnesium

(1 $\frac{1}{2}$ mk)

d) The melting point the chloride of G is much higher than that of the chloride of D. Explain this observation

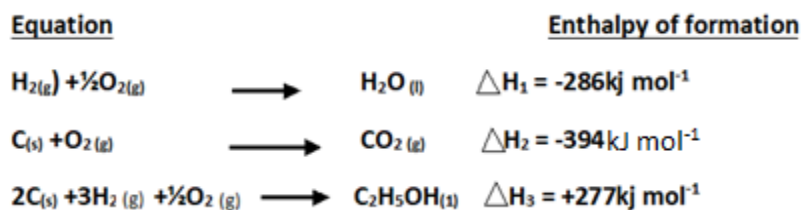
(2mk)

e) Use letter T to show the position of an element that forms a trivalent anion that with three occupied energies levels. (1mk)

f) An element M with a relative atomic mass of 15.2 was found to have 2 isotopes, M- 16 and M-12. Calculate the percentage abundance of each isotope. (2mk)

5. a) Define the term enthalpy of formation (1mk)

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



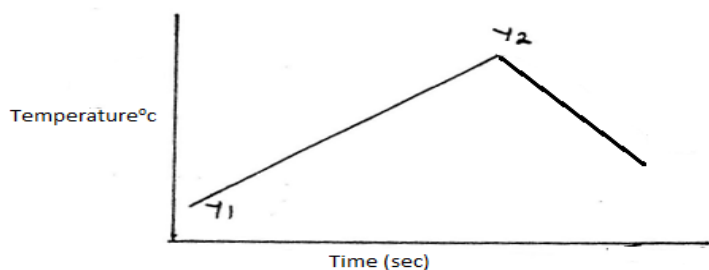
i) Draw an energy cycle diagram linking the above enthalpy changes and the **enthalpy of combustion** of ethanol (2mk)

ii) Use the energy cycled diagram to calculate the enthalpy of formation of ethanol. (1mk)

c) In order to determine the molar of neutralization of sodium hydroxide, 100cm³ of 2M sodium hydroxide and 100cm³ of 2M hydrochloric acid both at the same initial temperature were mixed and stirred continuously with a thermometer. The thermometer of the resulting solution was recorded after every 30 seconds until the highest temperature of the solution was attained. Thereafter the temperature of the solution was recorded for a further two minutes.

(i) Write an ionic equation for the reaction which took place (1mk)

(ii) The sketch below was obtained when the temperature of the mixture were plotted against time. Study and answer the questions that follow.



What is the significance of point Y₂? (1mk)

iii). If the heat change in the above reaction was 10,500Joules, and the initial temperature for both solutions was 22.5⁰C calculate;

I) The highest temperature attained by the mixture.(specific heat capacity of the solution = 4.2Jg⁻¹K⁻¹ and the density of the solution = 1.0g/cm³) (2mk)

II) The molar heat of neutralization of sodium hydroxide. (1½ mk)

III) Explain how the value of the molar heat of neutralization obtained in this experiment would compare with the one that would be obtained if the experiment was repeated using 100cm³ of 2M ethanoic acid instead of hydrochloric acid. (2mk)

6. The following are reduction potentials of some elements, study them and answer the questions that follow.

Half reaction	electrode potential ((volts)
$R^{+2}_{(aq)} + 2e^{-} \longrightarrow R_{(s)}$	-0.34
$G^{+2}_{(aq)} + 2e^{-} \longrightarrow G_{(s)}$	+1.32
$\frac{1}{2} L_{2(g)} + e^{-} \longrightarrow L^{+}_{(aq)}$	+2.07
$J^{+}_{(aq)} + e^{-} \longrightarrow \frac{1}{2} J_{2(g)}$	0.00
$Q^{+2}_{(aq)} + 2e^{-} \longrightarrow Q_{(s)}$	-2.7
$S^{+2}_{(aq)} + 2e^{-} \longrightarrow S_{(s)}$	-1.2

a) What is the reduction potential of the strongest reducing agent (½ mk)

b) Which element is most likely to be substance J.Explain your answer (1 mk)

c) i)Draw a well labelled diagram for the electrochemical cell that would be formed when elements G and S are combined . (3mk)

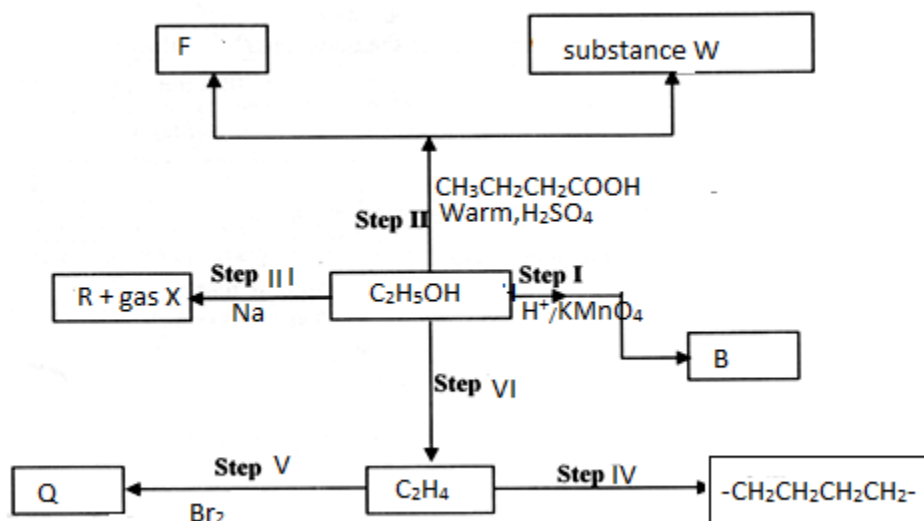
ii)Calculate the electromotive force of the cell formed above. (1mk)

d)During the electrolysis of dilute sodium chloride solution using graphite electrodes, a current of 0.8 amperes was passed through the cell for two and a half hours.

i)Write an ionic equation for the reaction that occurred at cathode (1mk)

ii) Calculate the volume of the gas produced at anode in cm^3 . ($1\text{F} = 96500\text{coulombs}$, 1 mole of gas at RTP = 24dm^3) (3mk)

7. Study the scheme and answer the questions that follow.



a) Name the following substances (1mk)

i) F -

ii) R -

b) Give the names of the processes taking place in the following steps (2mk)

i) Step IV-

ii) Step I-

c) Draw the structural formulae of compound W and give its name (2mk)

d) State the conditions necessary for step VI to take place. (1mk)

e) Draw any two possible isomers of substance Q (2mk)

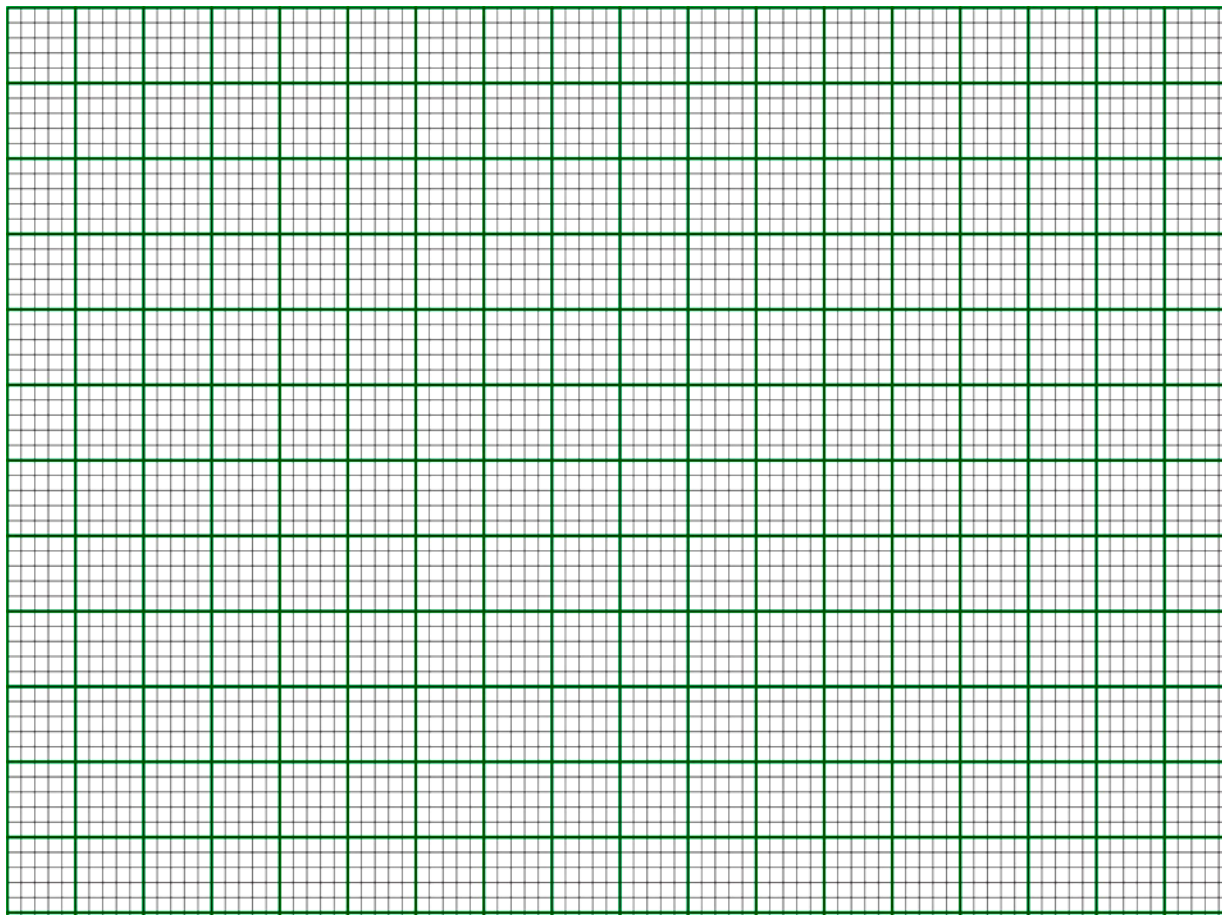
f) State any two uses of the product of step IV. (1mk)

8. A student reacted excess dilute hydrochloric acid with 12.5grams of an impure calcium carbonate. The volume of carbon (iv) oxide produced was recorded after every thirty seconds. The data obtained was recorded in the table below. Study it and answer the questions that follow.

Time in seconds	0	30	60	90	120	150	180	210	240	270
Volume of carbon oxide in cm^3	0	440	840	1230	1530	1720	1840	1860	1860	1860

a) Draw a graph of the volume of carbon (iv) oxide produced against time.

(3mk)



b) Use the graph to determine;

i) The time at which the volume of the gas is 1640cm^3

($\frac{1}{2}$ mk)

ii) The volume of the gas at the 48th second

($\frac{1}{2}$ mk)

c) Calculate the rate of the reaction at the 165th second

(2mk)

d) Calculate percentage purity of the calcium carbonate used (C=12, O=16, Ca=40, 1 mole of gas at RTP= 24dm^3)

(3mk)

SERIES 13

1. (a) Draw the structures of;
 (i) the second member of the alkyne homologous series; (1 mark)

.....

- (ii) heptanoic acid; (1 mark)

.....

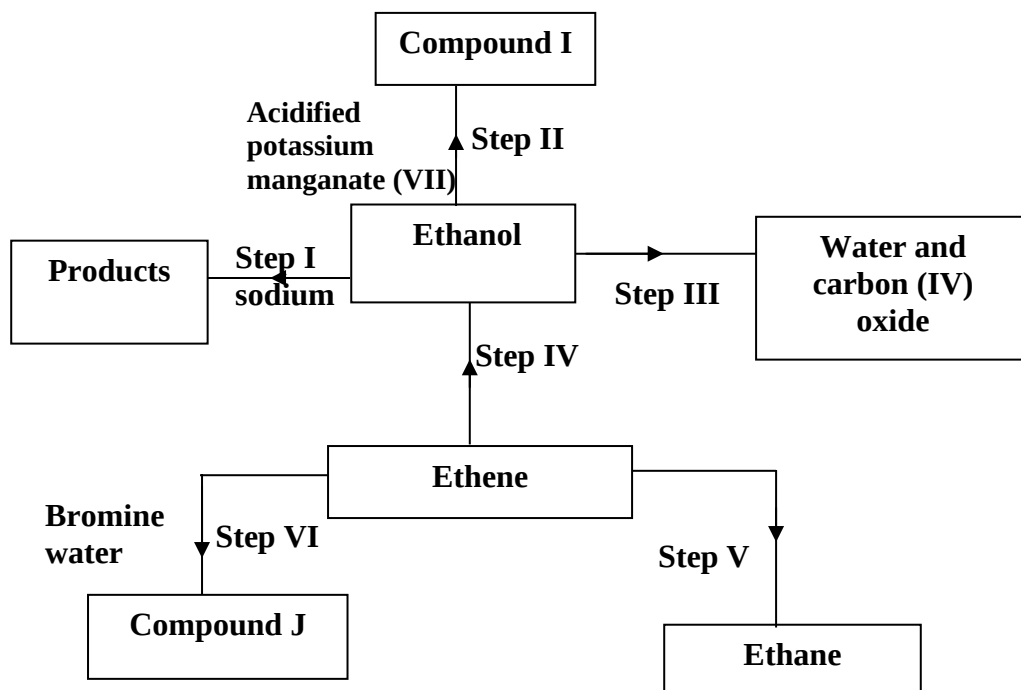
- (iii) 1-butanol. (1 mark)

.....

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

.....

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



- (i) give the name of ;
 (I) compound I (1 mark)

- (II) compound J (1 mark)

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

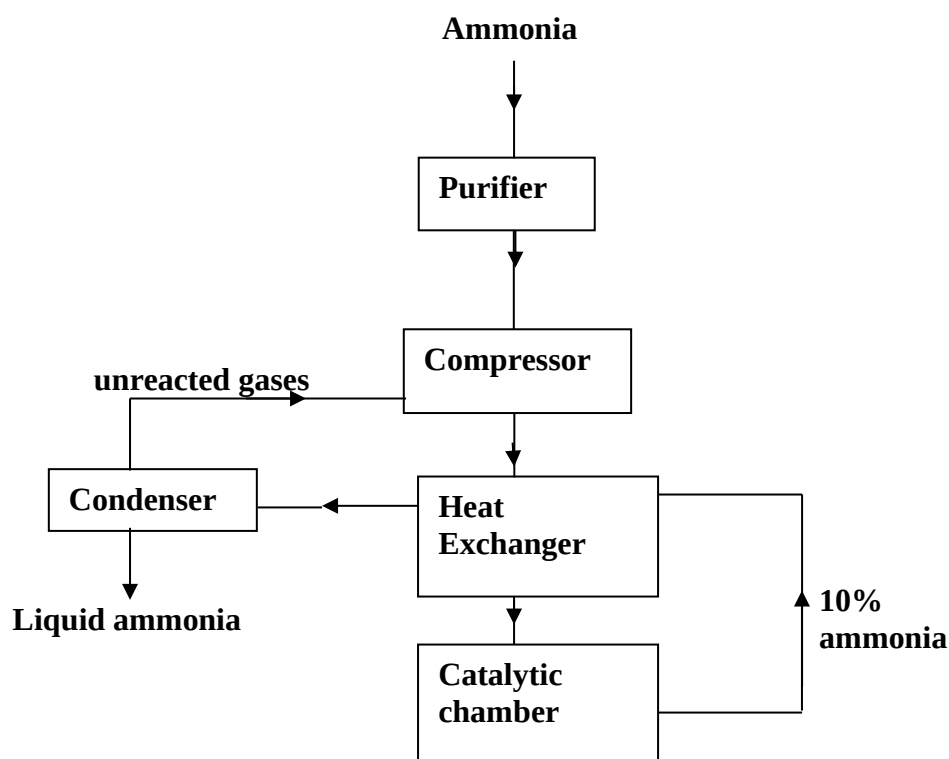
- (iii) Write the equation for the chemical reaction in step I (1 mark)

- (iv) Name the reagent and conditions necessary for the reaction step **V**
 Reagent (1 mark)

 Condition (s) (1 mark)

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

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



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

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

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

Optimum temperature.....
 Optimum pressure.....

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

.....

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

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

.....

(ii) Determine the mass of ammonium nitrate formed in b (i) above given that 720 liters of ammonia was used. (N=14, O=16, Molar gas volume = 24 000 cm³) (4 marks)

.....

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

.....

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

A								B	
				C		D		E	
F	G							H	

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

.....

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

.....

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

.....

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

.....

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

.....

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

.....

(g) 22.5 cm³ of a solution of a hydroxide of **F** completely neutralizes 20.0 cm³ of a dibasic acid whose concentration is 0.2 moles per litre. Calculate the concentration of hydroxide of **F** in moles per litre. (3 marks)

.....

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

.....

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

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

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

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

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

(iv) Calculate the E^o of the electrochemical cell constructed in (iii) above. (1 mark)

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

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

.....

.....

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

.....

.....

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

.....

.....

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

.....

.....

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

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

.....

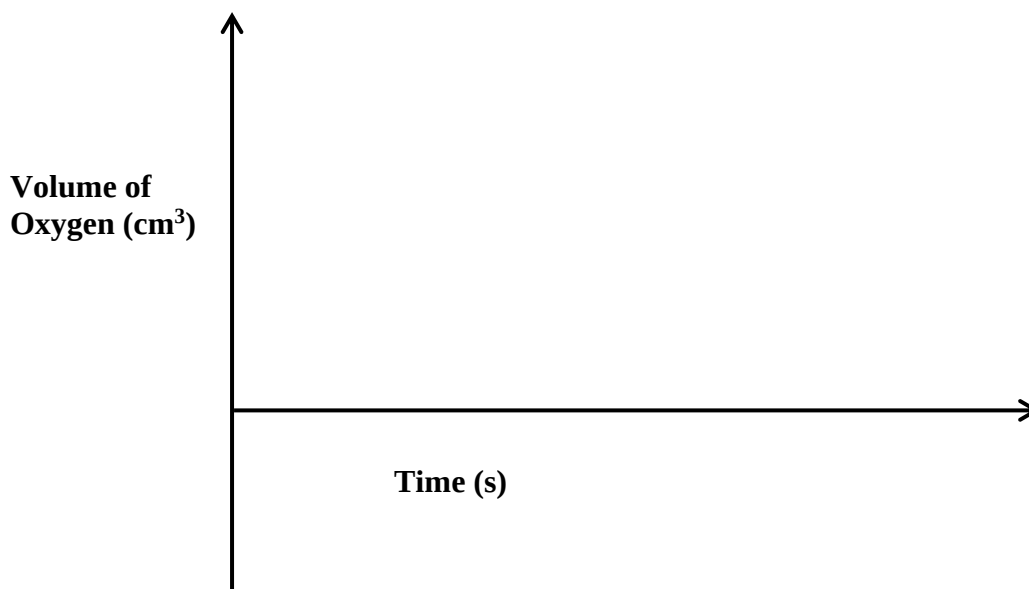
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(ii) State and explain the effect of the catalyst named in b (i) on the rate of production of oxygen. (1 mark)

.....

.....

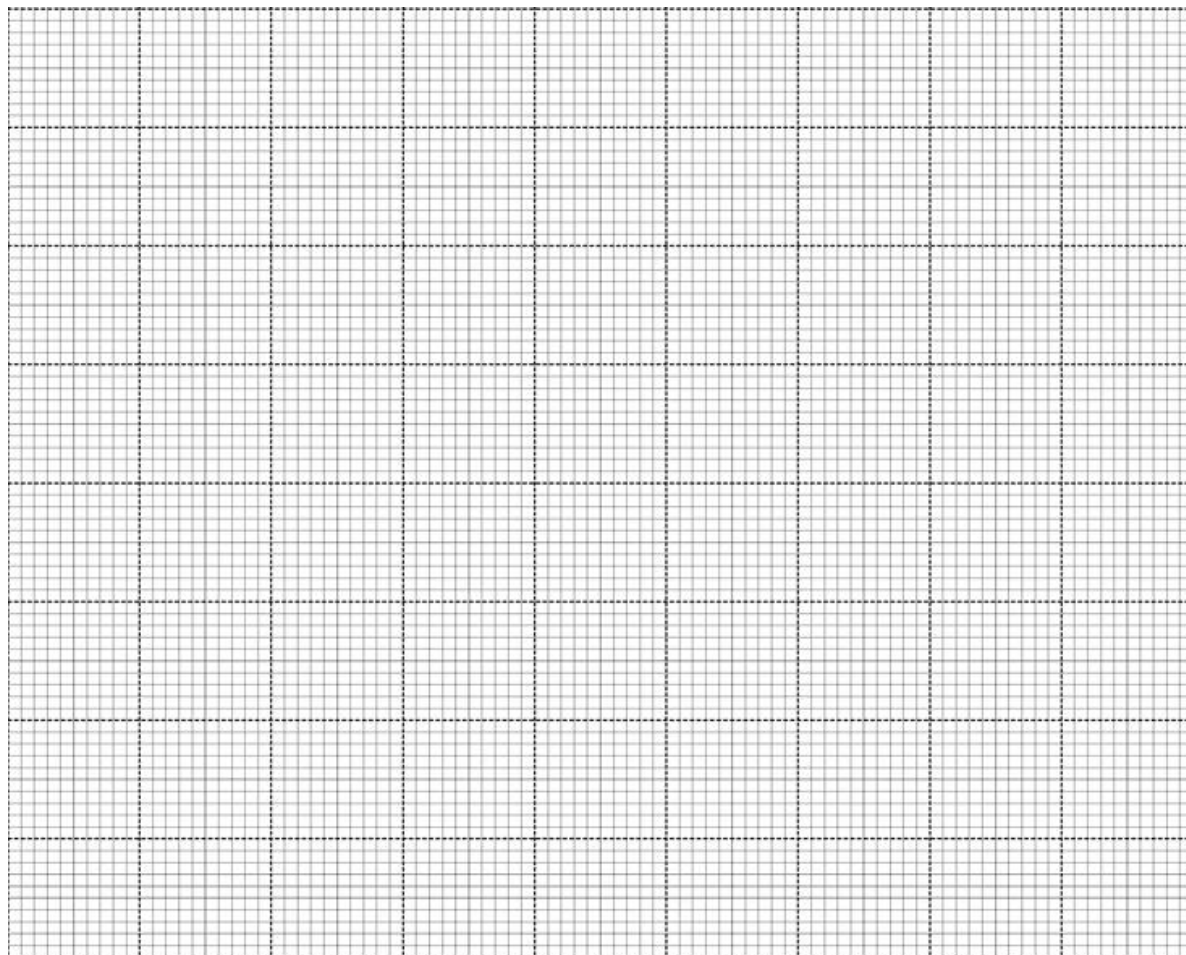
(iii) On the axes below sketch a graph of catalyzed and uncatalysed decomposition of hydrogen peroxide. Label the curves. (2 marks)



- (c) 100 cm³ of 0.5 M hydrochloric acid was reacted with a clean 20 millimeters magnesium ribbon. The volume of hydrogen evolved was measured and recorded at 10 seconds interval. The results were recorded as shown in the table below.

volume of gas (cm³)	0	24	38	48	52	53	53	53
Time in seconds	0	10	20	30	40	50	60	70

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



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

.....

.....

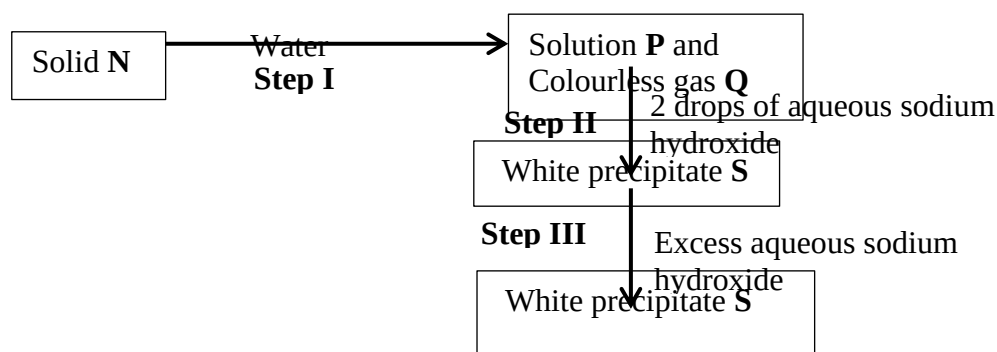
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- (iii) On the same grid, sketch a curve that would be obtained if the same experiment was repeated using excess 0.8 M hydrochloric acid. Label it as **L**. (1 mark)

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

- | Ore | Formula |
|---------|---------|
| I..... | |
| II..... | |
- (ii) During extraction of copper, the ore is first crushed into fine powder and then concentrated by froth flotation. Why this is important? (1 mark)
-
-
- (ii) One of the gases evolved during copper extraction is sulphur (IV) oxide. Give **two** ways of preventing the gas from escaping to the atmosphere. (2 marks)
-
-
-
- (iii) Blister copper is impure copper which is about 97.5 % pure. To obtain pure copper from blister copper electrolysis is done. Draw a set up that can be used to purify copper. (3 marks)
-
- (iv) Give **two** uses of copper (2 marks)
-
-
- (v) State **one** way in which the extraction of copper causes environmental pollution. (1 mark)
-
-

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



- (i) Identify;
- I solid N (1 mark)
-
- II Colourless gas Q (1 mark)
-
- (ii) Give the formula of white precipitate S (1 mark)

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

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

(b) Calculate the number of nitrate ions present in 25.0 cm³ of 0.80 M aluminium nitrate solution. (L = 6.0×10²³) (3 marks)
.....
.....
.....

SERIES 14

1. The table below represents elements across period three of the periodic table. Study it and answer the questions that follow.

Element	Na	Mg	Al	Si	P	S	Cl
Atomic numbers	11	12	13	14	15	16	17
Atomic Radius(nm)	0.156	0.136	0.125	0.118	0.110	0.104	0.099
Ionic Radius (nm)	0.095	0.065	0.050	-	-	0.184	0.181
Melting Point(0°C)	97.8	650	660	1410	44.2	11.9	-101

- (a) (i) Explain why the atomic radius of Na is bigger than its ionic radius (2mks)

.....

.....

.....

- (ii) Compare the atomic radius of Mg with that of Al (2mks)

.....

.....

.....

- (iii) Explain the trend in the melting points from Na to Al (2mks)

.....

.....

.....

- (iv) Write the formula of the compound formed when Mg combines with Si. (1mk)

.....

.....

- (v) Name the type of bond formed in (iv) above. (1mk)

.....

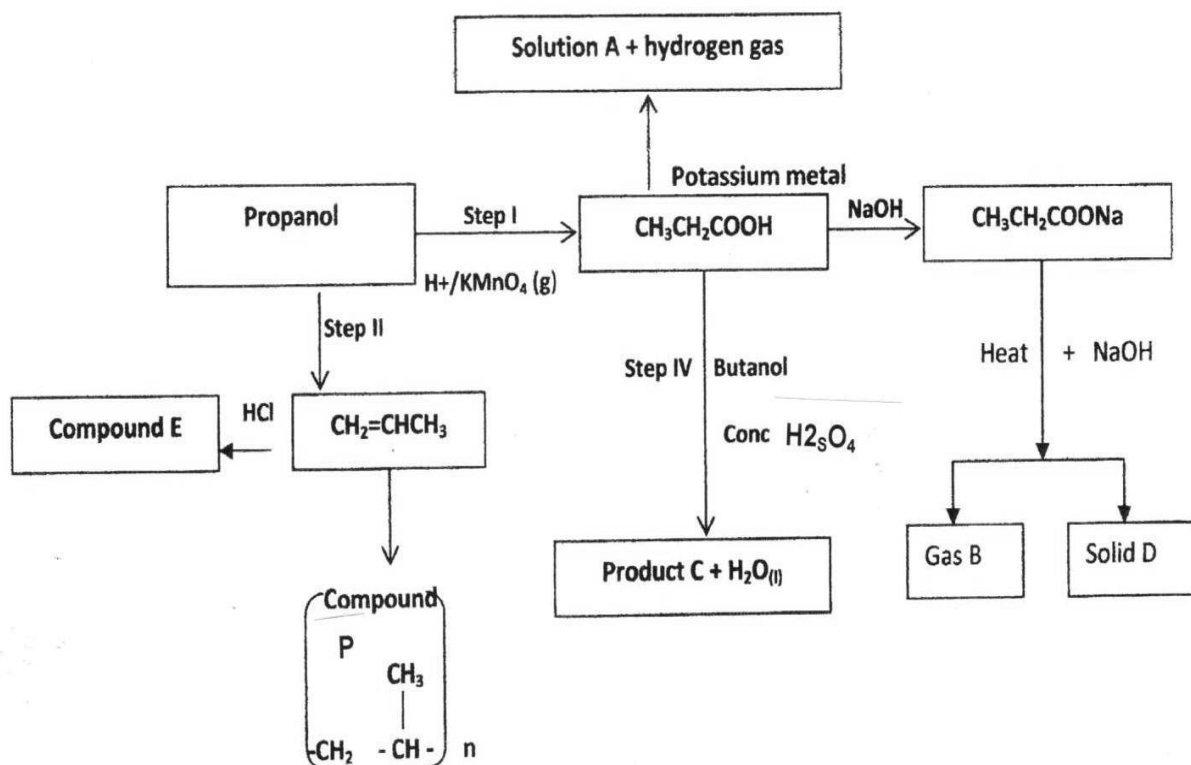
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- (b) The melting and boiling points of sodium chloride are 801°C and 1430°C respectively. Explain why sodium chloride does not conduct electricity at 25°C, but does so at temperature 801°C and 1430°C. (2mks)

.....

.....

2. The scheme below shows a series of reactions starting with Propanol. Study it and answer the questions that follow:-



a. Name the type of reaction in steps I and II.

Step I (1mk)

Step II (1mk)

b. Write a balanced chemical equation for the reaction that produces:

(i) Gas B (1mk)

.....

(ii) Solution A. (1mk)

.....

c. Name the substances labelled A, D and E. (3 mks)

A

D

E

d. Draw the structural formula of product C. (1mk)

e. Name the process in Step (IV) (1mk)

.....

f. If the relative molecular mass of P is 35,700, determine the value of n.

(C = 12, H = 1) (2mks)

3. (a) State the Hess' law. (1 mark)

.....
.....
.....
(b). Use the standard enthalpies of combustion of graphite, hydrogen and enthalpy of formation of propane to answer the questions that follow.

$\Delta H^\circ_{\text{combustion}} (\text{Graphite}) = -393 \text{ kJ mol}^{-1}$

$\Delta H^\circ_{\text{combustion}} (\text{H}_2 (\text{g})) = -286 \text{ kJ mol}^{-1}$

$\Delta H^\circ_{\text{formation}} (\text{C}_3\text{H}_8 (\text{g})) = -104 \text{ kJ mol}^{-1}$

(i). Write the equation for the formation of propane. (1 mark)

.....
.....
(ii). Draw an energy cycle diagram that links the heat of formation of propane with its heat of Combustion of graphite and hydrogen. (3 marks)

(iii). Calculate the standard enthalpy of combustion of propane. (2 marks)

(c). Other than the enthalpy of combustion, state one other factor which should be considered when choosing a fuel. (1 mark)

.....
.....
(e). The following data was obtained during an experiment to determine the molar heat of combustion of ethanol.

Volume of water used = 500 cm^3

Initial temperature of water = 25°C

Final temperature of water = 44.5°C

Mass of ethanol + lamp before burning = 121.5 g

Mass of ethanol + lamp after burning = 120.0 g

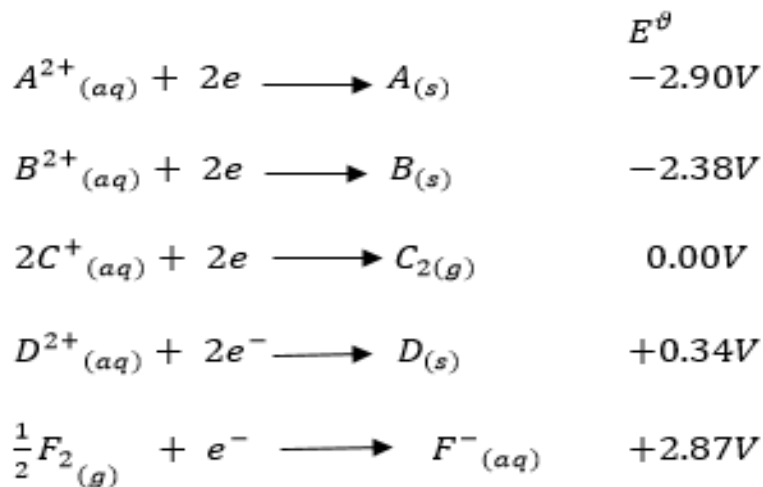
Calculate the

(i) Heat evolved during the experiment (density of water = 1 g/cm^3 , specific heat capacity of water = $4.2 \text{ J g}^{-1} \text{ K}^{-1}$). (1 mark)

(ii) Molar heat of combustion of ethanol (C = 12, O = 16, H = 1). (2 marks)

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

4. (a) Use the standard electrode potentials for elements **A**, **B**, **C**, **D** and **F** given below to answer the questions that follow. The letters do not represent the actual symbols of the elements.



- (i) Identify the strongest oxidizing agent. Give a reason. (2 marks)

.....

- (ii) Which element is likely to be hydrogen? Give a reason for your answer. (2 marks)

.....

- (iii) Identify two half-cells which when connected will produce the highest E^θ value. (1 mark)

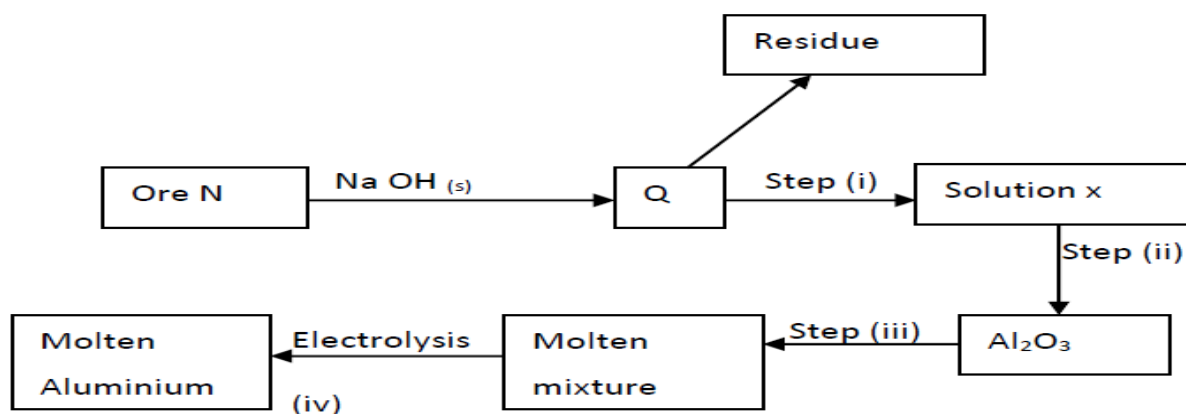
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- (iv) Calculate the E^θ value of the electrochemical cell obtained when the half-cells of elements C and D are combined. (1 mark)

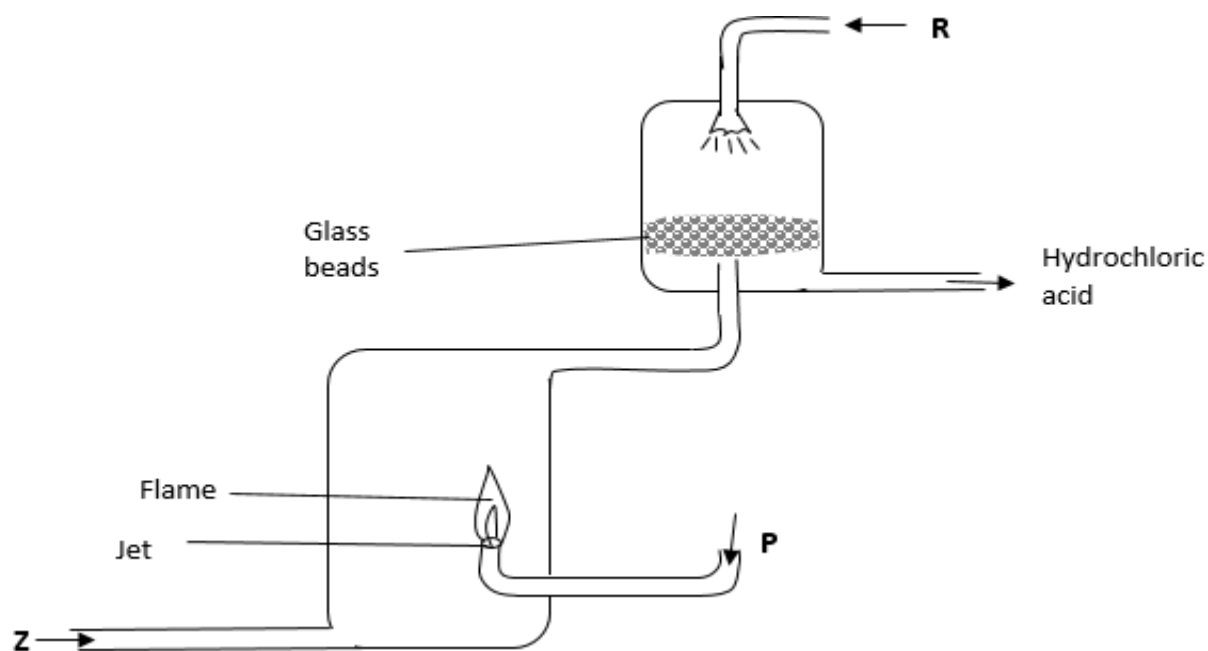
- (b) Draw a fully labelled diagram to show how you can purify **LEAD ROD** through electrolysis. (3 marks)

- (c) During electrolysis of aqueous copper (II) sulphate 144750 coulomb of electricity were used. Calculate the mass of copper metal that was obtained. (Cu= 64, 1 Faraday = 96500 C) (2mks)

5. Study the flow chart below and answer the questions that follow.



- a) Name ore N (1mark)
-
- b) Explain why the ore is first dissolved in excess sodium hydroxide solution. (2 marks)
-
- c) Name the major compound present in the residue. (1mark)
-
- d) Give the formula of the aluminium compound present in solution. (1mrk)
-
- i) Explain how to obtain aluminium hydroxide from solution X. (1mark)
-
-
- ii) Write equation for reaction that takes place in (e) above. (1mark)
-
- iii) What is the role of cryolite in the extraction of alluminium. (1mark)
-
- e) Aluminium is a good conductor of heat and electricity. State two uses of aluminium based on this property. (2marks)
-
-
-
- g) The melting point of alluminium oxide is 2054⁰C, but electrolysis is not carried out between 800 – 900⁰C.
- (i) Why is the electrolysis not carried out at 2054⁰C? (1mk)
6. The diagram below is used in the manufacture of Hydrochloric acid. Use it to answer the questions that follow:



- a) Identify substances; (2 marks)

R

P

- b) Why is the jet used in the set up above? (1 mark)

.....

- c) Write a chemical equation to show how substance **Z** can be prepared in laboratory. (1 mark)

.....

- d) State **one** large scale source of gas **P**. (1 mark)

.....

- e) Nitrogen and hydrogen reacts according to the following equation at 450°C and 200 atmospheres



State and explain how the yield of ammonia would be affected if the pressure is increased (2 marks)

.....

- f) The half-life of sodium-20 is 8 seconds. P grams of sodium-20 decays to 3 grams in 32 seconds.

i Calculate the initial mass P, of the isotope. (2mks)

i State one application of radioactivity in medicine. (1mk)

g) Study the information in the table below and answer the question that follows.

SALT	SOLUBILITY (g/100g of H ₂ O) at	
	45 °C	60 °C
Sodium carbonate	35	80
Lead (II) Nitrate	77	101

A mixture containing 70g of sodium carbonate and 72g of lead II nitrate in 100g of water at 60 °C was cooled to 45 °C.

i Identify the salt that crystallized out. (1mk)

i Calculate the mass of the salt that crystallized out. (2 mks)

7. An impure solid copper (II) carbonate weighing 10.8g was placed in a beaker containing 50 cm³ of dilute nitric (V) acid. The volume of carbon (IV) oxide produced was recorded after every 20 seconds and tabulated as follows.

Time (s)	0	20	40	60	80	100	120
Volume of CO ₂ at S.T.P (cm ³)	0.0	650	900	1070	1100	1120	1120

On the grid provided, plot a graph of volume of carbon (IV) oxide produced against time (3 marks)

a) Using the graph, calculate:

i) The rate of reaction between 20 and 40 seconds (2 marks)

ii) The rate of reaction at the 70th second (2 marks)

b) Explain the trend in the rate of reaction as the reaction progresses. (1 marks)

c) Why was there no increase in volume of the gas produced after 100 seconds? (1 marks)

d) How many moles of carbon (IV) oxide were in the maximum volume produced from this reaction? (M.G.V at s.t.p = 22400 cm³) (1 mark)

e) What mass of copper (II) carbonate will have reacted with the acid after 100 seconds? (Cu=64 C=12 O=16) (2 marks)

SERIES 15

1. a) What is radioactivity?

(1 mk)

b) State two differences between chemical and nuclear reactions

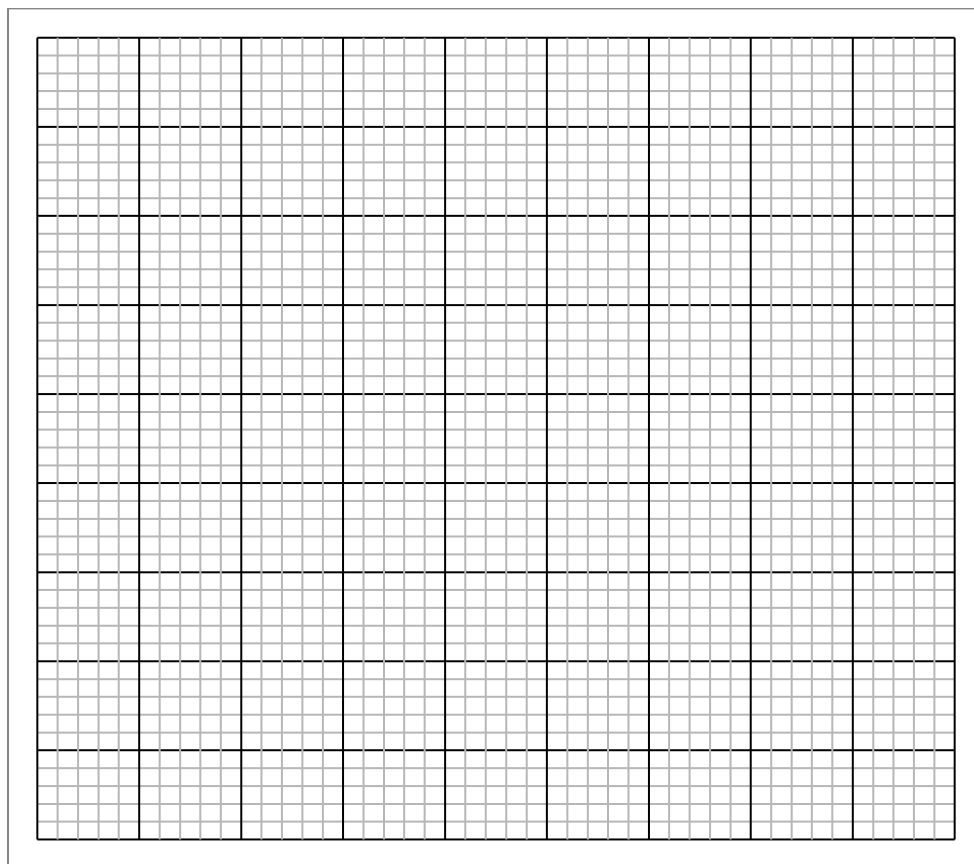
(2 mk)

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

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

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

(3 mk)



ii) Using the graph, determine the:

I. Half – life of the Bismuth isotope

(1 mk)

II. Original mass of the Bismuth isotope given that the mass that remained

after 35 minutes was 0.08 g (2 mk)

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

i) Medicine (1 mk)

ii) Agriculture (1 mk)

iii) Food industry (1 mk)

2..a) The reduction potentials of $\text{Mg(s)} | \text{Mg}^{2+}(\text{aq})$ and $\text{Zn(s)} | \text{Zn}^{2+}(\text{aq})$ half-cells are:



Using the electrode potentials, answer the following questions.

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

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

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



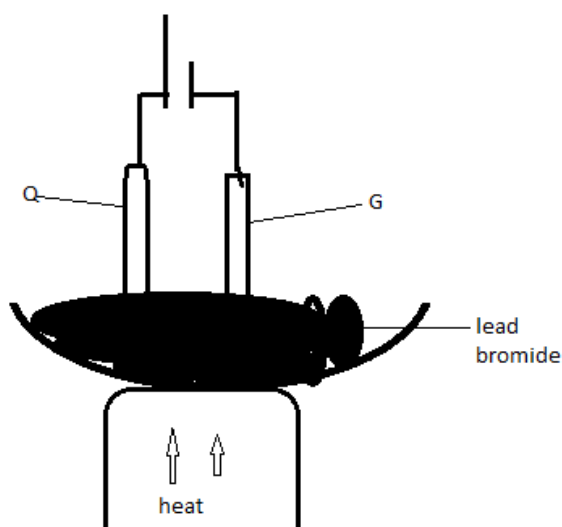
Given that the E value for $\text{Ag}^{+}(\text{aq}) | \text{Ag(s)}$ is +0.80 V, calculate the E^{θ} value for $\text{Cu(s)} | \text{Cu}^{2+}(\text{aq})$.

(2mk)

c) In an experiment to electrolyse copper (II) sulphate solution using copper electrodes, 0.2 amperes were passed through the solution for 23 hours. Calculate the mass of copper deposited at cathode. (1

Faraday = 96,500 coulombs, Cu = 64). (3mk)

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

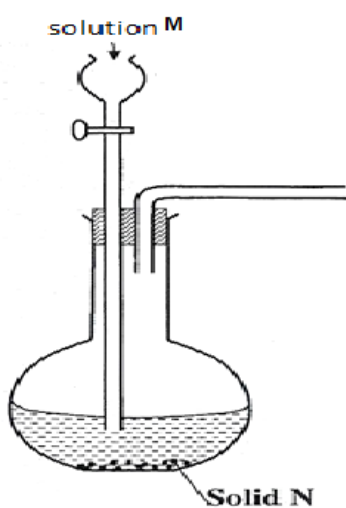


(i) Write the equation for the reaction at electrode G (1 mk)

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

e) List any two applications of electrolysis. (1mk)

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

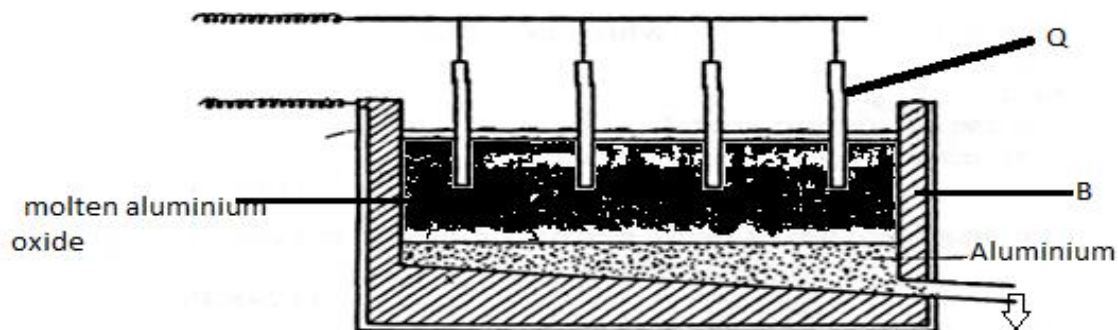


a i) Complete the table below giving the names of Solution M and solid N if the gases generated are chlorine and sulphur (IV) oxide. (2 marks)

	Chlorine	Sulphur (IV) Oxide
Substance M		
Solid N		

- (ii) Complete the diagram above to show how a dry sample of chlorine gas can be collected (3mk)
- (b) Write balanced chemical equation to show how chlorine with cold and dilute sodium hydroxide.
(1mk)
- (c) 600cm³ of dry chlorine gas were passed over excess heated iron powder in a combustion tube until no further change.
i) State the observations made in the combustion tube. (1mk)
- ii) Calculate the mass of the product formed. (MGV= 24dm³, Cl=35.5, Fe= 56) (3mk)
- d) A soil sample was suspected to contain chloride ions. Describe a simple experiment that can used to confirm the presence of the chloride ions. (3mk)

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



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

ii) Outline the stages involved in the purification stage. (2mk)

b)i) Identify the electrode labelled B (1mk)

ii) The melting point of aluminium oxide is 2054°C , but electrolysis is carried out between $800 - 900^{\circ}\text{C}$. What is done to lower the temperatures? (1mk)

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

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

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

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

vii) Why can't aluminium be extracted through reduction method. (1mk)

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

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

c) Name the process that takes place when:

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

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

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

ii) Give two industrial uses of oxygen gas. (1mk)

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

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

N								
						R	X	
	G			T				F
	W						V	
L								

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

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

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

c) Choose;

i) The most unreactive element (1mk)

ii) The strongest reducing agent. (1mk)

d) State the nature of each of the following;

i) The chloride of W (1mk)

ii) The oxide of T (1mk)

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

f) Use the letter B to show the position of an element that forms a divalent anion with three energy levels in the periodic table (1mk)

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

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

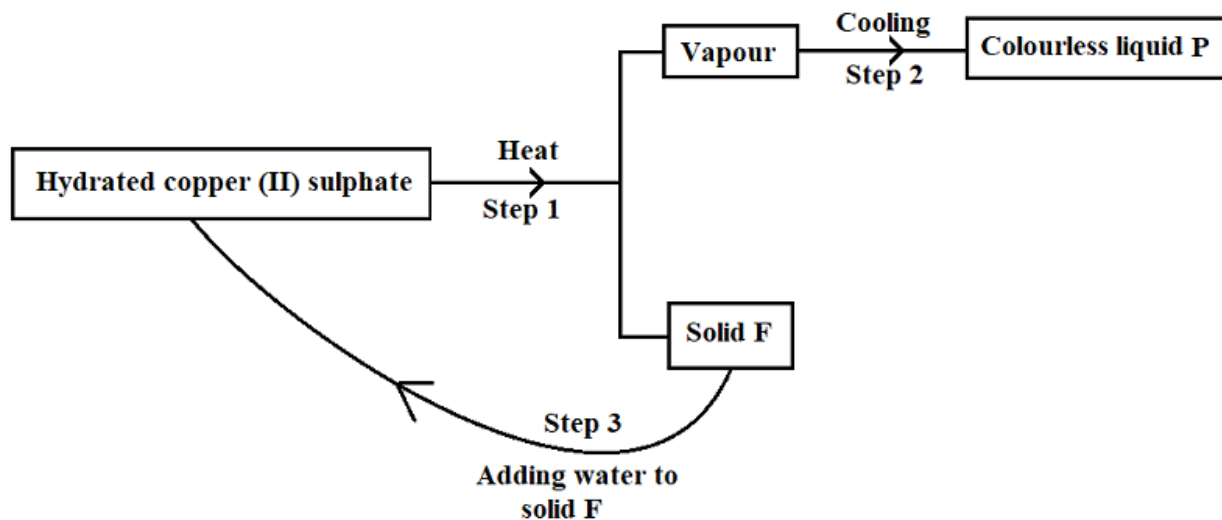
b) A student wanted to prepare hydrogen gas in the lab. He reacted dilute hydrochloric acid with copper metal but no gas was collected.

i) Explain this observation. (1mk)

ii) What adjustments would have been made in order to collect the gas. (2mks)

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

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



i) Classify the change in step 1

(1 mk)

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

(1 mk)

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

(1mk)

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

(1mk)

THE END

SERIES 16

1. (a) The following table gives the standard electrode potential for a number of half-reactions.

Half-reaction		E° (V)
$\text{Zn}^{2+}_{(\text{aq})} + 2\text{e}^- \longrightarrow$	$\text{Zn}_{(\text{s})}$	-0.76
$\text{Fe}^{2+}_{(\text{aq})} + 2\text{e}^- \longrightarrow$	$\text{Fe}_{(\text{s})}$	-0.44
$\text{Ag}^+_{(\text{aq})} + \text{e}^- \longrightarrow$	$\text{Ag}_{(\text{s})}$	+ 0.80
$\text{Cu}^{2+}_{(\text{aq})} + 2\text{e}^- \longrightarrow$	$\text{Cu}_{(\text{s})}$	+0.34

i) Draw an electrochemical cell for the reaction that would give the least e.m.f. (3 marks)

ii) Determine the e.m.f of the cell in (i) above (2 marks)

.....

iii) Select the strongest oxidizing agent. Give reason. (2 marks)

.....

(b) In the production of aluminum from aluminum oxide, 100 A was passed for 6 hours and 40 minutes. Determine the mass of aluminum obtained. ($1F = 96500C$, $Al = 27$) (3 marks)

.....

(c) Define;

(i) Primary cell; (1 mark)

.....

(ii) fuel cell. (1 mark)

.....

.....

(d) Give **one** reason for electroplating (1 mark)

.....

.....

2. (a) (i) What is fractional crystallization (1 mark)

.....

.....

(ii) The table below shows the solubility of two salts **A** and **B** at various Temperatures

Salt	Solubility at various temperatures(°C)	
	50	20
A	86 g	31 g
B	18 g	8 g

A mixture of the salts contains 29.5 g of salt **A** and 16.25 g of salt **B** at 50 °C. The mixture is cooled to 20 °C. Determine the mass of the salt that crystallizes(3 marks)

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(b) Explain how the use of ion exchange resin removes water hardness (2 marks)

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(c) Name **two** disadvantages of hard water (2 marks)

.....

(d) State and explain the observations made when aqueous ammonia is added dropwise until in excess to a solution of copper (II) nitrate. (3 marks)

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3. (a) (i) State Gay Lussac's law of combining gas volumes. (1 mark)

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(ii) 100 cm³ of propane was ignited in 180 cm³ of oxygen and the gaseous product allowed to cool. Determine the volume of the residual gas. (3 marks)

.....

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(b) (i) What's is empirical formula? (1 mark)

.....
.....

(ii) Vitamin C (ascorbic acid) contains 40.92 % C, 4.58 % H, and 54.50 % O, by mass.

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

(i) Determine it's empirical formula. (2 marks)

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(ii) Given that the experimentally determined molecular mass of ascorbic acid is 176 amu, determine its molecular formula. (2 marks)

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(c) A solution of calcium nitrate is made by dissolving 16.4 g in 2 litres of solution. Calculate the concentration of nitrate ions in moles per liter. (Ca = 40, N = 14, O = 16) (3 marks)

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4 (a) Give the IUPAC name of the following organic compounds

(i) $\text{C}(\text{CH}_3)_4$ (1 mark)

.....

.....

(ii) $\text{C}(\text{CH}_3)_3\text{Br}$ (1 mark)

.....

.....

(iii) $\text{HCCCH}_2\text{CH}_3$ (1

mark)

.....

.....

(b) Describe how $\text{C}(\text{CH}_3)_3\text{Br}$ would be distinguished from $\text{HCCCH}_2\text{CH}_3$.

(2 marks)

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.....

(c) Ethyne can be prepared by adding water to calcium carbide.

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

mark)

.....

.....

(ii) Explain why ethyne may be collected over water

(1 mark)

.....

.....

(iii). Give **two** uses of ethyne.

(2 marks)

.....

.....

(d) Draw the structure of all organic compounds with the molecular formula C_5H_{12}

(3 marks)

5. (a) The diagram below shows part of the periodic table. The letters used in it do not represent the actual symbols of the elements. Study it and answer the questions that follow.

	A							G
	B			C		D		E
H								

- (i) Compare the trend in atomic radius between element **D** and **E** . (2 marks)

.....

- (ii) What name is given to the elements in the same group as element H? (1 mark)

.....

- (iii) Write down the formula of the oxide of **E** (1 mark)

.....

- (iv) An element **F** is found just above element **D** in the periodic table. Write down the electronic configuration of element **F**. (1

mark)

.....

.....

(v) Select the most reactive non-metal (1 mark)

.....

(vi) Give **two** uses of element **G** (1 mark)

.....

.....

(vii) A sample of the chloride of **C** was dissolved in distilled water. Both red and blue litmus papers were dipped into this solution. State and explain what was observed. (2 marks)

.....

.....

(b). The table below gives information on four elements by letters **E**, **F**, **G**, and **H**. study it answer the questions that follow. The letters do not represent the actual symbols of the elements.

Element	Electron arrangement	Atomic radius(nm)	Ionic radius(nm)
E	2.8.2	0.136	0.065
F	2.8.7	0.099	0.181
G	2.8.8.1	0.203	0.133
H	2.8.8.2	0.174	0.099

(i) The ionic radius of H is smaller than its atomic radius. Explain. (2 marks)

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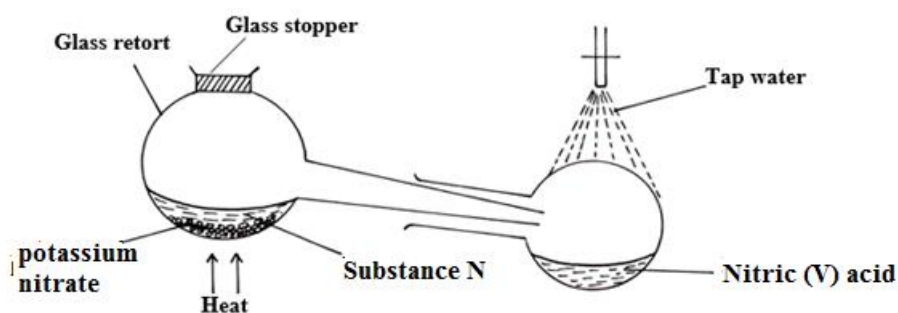
(ii) Write the equation for the reaction between **E** and chlorine

(1 mark)

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6 The set-up below was used to prepare Nitric (V) acid.



(i) Give the name of substance **N**.

(1

mark)

.....

(ii) Write an equation for the reaction which takes place in the retort flask.

(1 mark)

.....

(iii) Explain the following;

(I) nitric (V) acid is stored in dark bottles.

(1 mark)

.....

.....

(II) No gas is evolved when 0.5 M nitric (V) acid is reacted with copper turnings

(2 marks)

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- (iv) A factory uses nitric (V) acid and ammonia gas as the only reactants for the preparation of fertilizer. If the daily production of the fertilizer is 4,800kg, Determine the volume of ammonia used daily. (N=14.0, O=16.0, H=1.0, Molar gas volume =24 000cm³) (3 marks)

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- (v) Give **two** uses of nitric (V) acid (2 marks)

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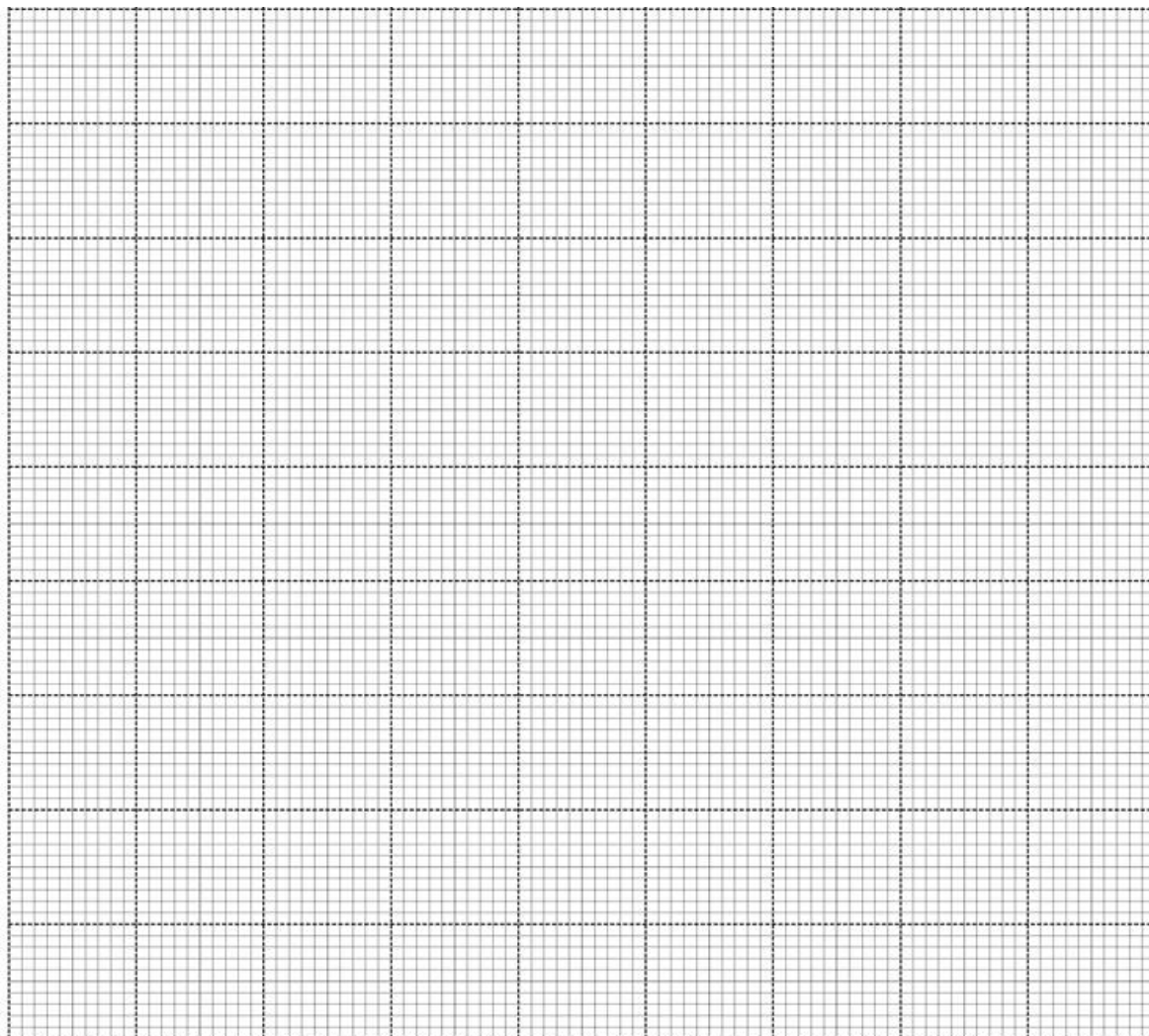
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- 7 (a) In an experiment to study the rate of reaction excess calcium was reacted with 50cm³ of 1M hydrochloric acid. The volume of hydrogen liberated was collected in a syringe and recorded in the table below.

Time(sec)	0	10	20	30	40	50	60	70	80
Volume of hydrogen (cm ³)	0	60	90	105	112	116	118	120	120

- (i) Plot a graph of volume of hydrogen against time. (3 marks)



(ii) From the graph determine;

(I) Volume of hydrogen when $t = 36$ seconds (1 mark)

.....

(II) The time when volume is 100 cm^3 . (1 mark)

.....

.....

(b). State **two** factors affecting reaction rate (2 marks)

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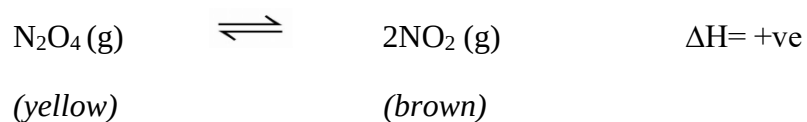
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c) What is dynamic equilibrium? (1 mark)

.....

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- (d) Dinitrogen tetraoxide and nitrogen (IV) oxide exists in a dynamic equilibrium as shown below.



State and explain effect of heating the above mixture on the equilibrium (2 marks)

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SERIES 17

1. Study the information in the table below and answer the questions that follows. The letters do not represent the symbol of the elements.

Element	Atomic number	Melting point (°C)
A	8	-2188
B	9	-219.6
C	12	650
D	13	660
E	14	1410
F	17	-101
G	20	842

- a) Write the electron arrangement for the

i) Atom of D.

(1mark)

.....

ii) Ion of F

(1mark)

.....

- b) Select an element which is

i) The most reactive non-metal.

(1mark)

.....

ii) Best conductor of electricity.

(1mark)

.....

- c) To which group of the periodic table does element G belong.

(1 mark)

.....

- d) How do the reactivity of element C and G compare? Explain

(2 marks)

.....

.....

.....

- e) Using dots [•] and crosses [×] to represent outermost electrons, show the bonding in the compound formed between elements B and D.

(1 mark)

f) Explain why the melting point of element D is higher than that of element C. (2 marks)

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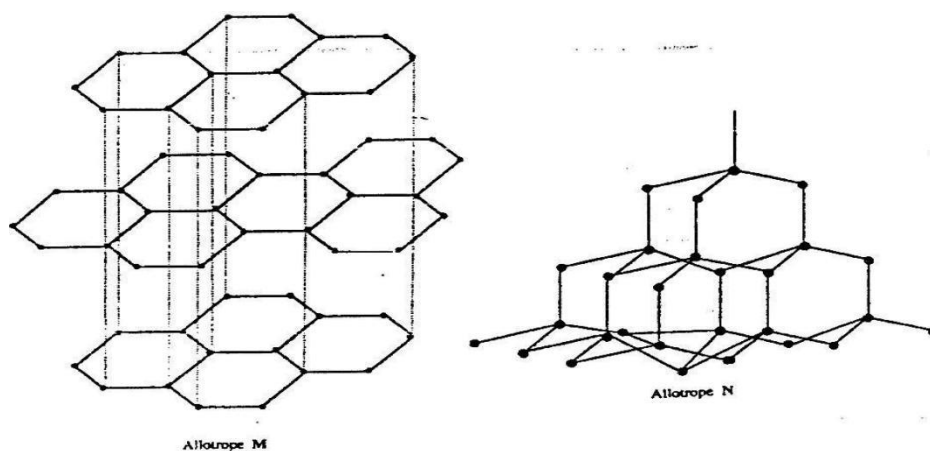
g) Write a chemical equation for the reaction that will occur between C and A. (1 mark)

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.....

h) Compare the atomic and ionic radius of element F. (2 marks)

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.....

2. (a) The following diagrams show the structures of two allotropes of carbon. Study them and answer the questions that follow.



(i) What is meant by the term allotropy? (1mark)

.....
.....

ii) Name allotrope
M and N

(2mark)

M.....

N.....

iii) Give one use of N

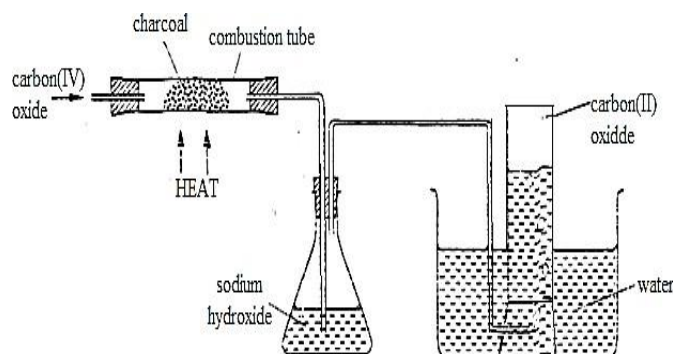
(1mark)

.....
.....

iv) Which allotrope conducts electricity? Explain

(2mark)

b) In an experiment, carbon (IV) oxide gas was passed over heated charcoal and the gas produced collected as shown in the diagram below



i) Write an equation for the reaction that took place in the combustion tube (1mark)

.....

ii) Name another substance that can be used instead of sodium hydroxide (1mark)

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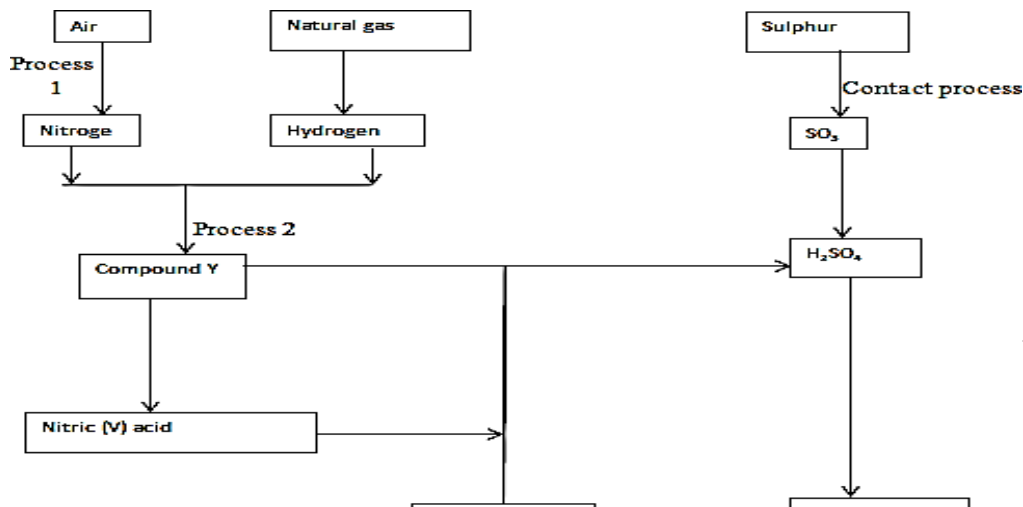
i) Describe a simple chemical test that can be used to distinguish between carbon(IV)oxide and carbon(II) oxide (3marks)

.....

ii) Give one use of carbon (II) oxide (1mark)

.....

3. The flow chart below represents some industrial processes leading to the formation of two nitrogenous fertilizers.



a) Name each of the process above

j) Process 1 (1mark)

.....

ii) Process 2 (1mark)

.....

b) Name the catalyst used in

i) Process 2 (1mark)

.....

ii) Ostwald process (1mark)

.....

iii) Contact process (1mark)

.....

c) Name compound Y (1mark)

.....

d) Write the equation for the reaction that leads to formation of ammonium sulphate
(1mark)

.....

.....

e) Ammonium nitrate is a better fertilizer than ammonium sulphate. Explain and show your working. (N = 14, H = 1, O = 16, S = 32). (2 marks)

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4. a) Study the table below and answer the questions that follows

Formula of hydrocarbon	Boiling points (K)
C_2H_4	-104
C_3H_6	-47.7
C_4H_8	-62
C_5H_{10}	30
C_6H_{12}	63.9

i) What name is given to a series of organic compounds like the ones in the table? (1 mark)

.....

ii) To what class of organic compounds does the above hydrocarbon belong? (1 mark)

.....

iii) Select one hydrocarbon that would be a gas at room temperature (298K); give a reason for your answer. (2 marks)

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iv) Give the formula of the seventh member of the above series. (1 mark)

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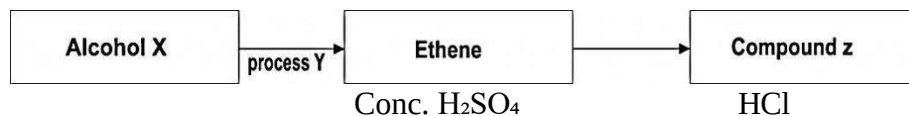
v) What is the relationship between the boiling point and the relative molecular masses of the hydrocarbons in the table above? Explain your answer. (2marks)

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



a. Write the formula of

i) Alcohol X

..... (1mark)

ii) Compound Z

..... (1mark)

iii) Name process Y.

..... (1mark)

b) Propane and chlorine react as shown below;



iv) Name the type of reaction that takes place.

(1mark)

.....

v) State the condition under which this reaction takes place.

(1 mark)

.....

c) The table below gives the volume of the gas produced when different volumes of 2M sulphuric (VI) acid were reacted with 0.6g of magnesium powder at room temperature.

Volume of sulphuric acid(cm^3)	Volume of gas (cm^3)
0	0
10	240
20	480
30	600
40	600
50	600

a) On the grid provided plot a graph of the volume of gas produced against volume of the acid used. (3marks)

b) Write an equation for the reaction between sulphuric (VI) acid and magnesium (1mark)

.....

c) From the graph determine

(i) The volume of the gas produced if 12.5cm^3 of 2M sulphuric (VI) acid has been used. (1mark)

.....

(ii) The volume of 2M sulphuric (VI) acid which reacted completely with 0.6g of magnesium powder. (1mark)

.....

.....

d) Explain the effect on rate of production of the gas if;
i) 0.6g of magnesium ribbon was used instead of magnesium powder (1mark)

.....

.....

ii) 3M sulphuric (VI) acid was used instead of 2M sulphuric (VI) acid (1mark)

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e) Given that one mole of a gas occupied 24000cm^3 at room temperature, calculate the relative atomic mass of magnesium. (3marks)

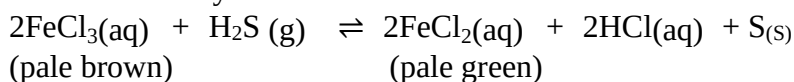
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f) In another experiment, aqueous iron (III) chloride reacts with hydrogen sulphide gas in a closed system as shown below.



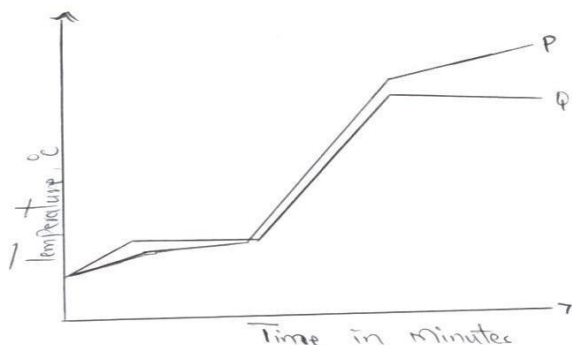
State and explain the observation that would be made if dilute hydrochloric acid is added to the system at equilibrium. (2marks)

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5. The curves below represent the variation of temperature with time when pure and impure samples of a solid were heated separately.



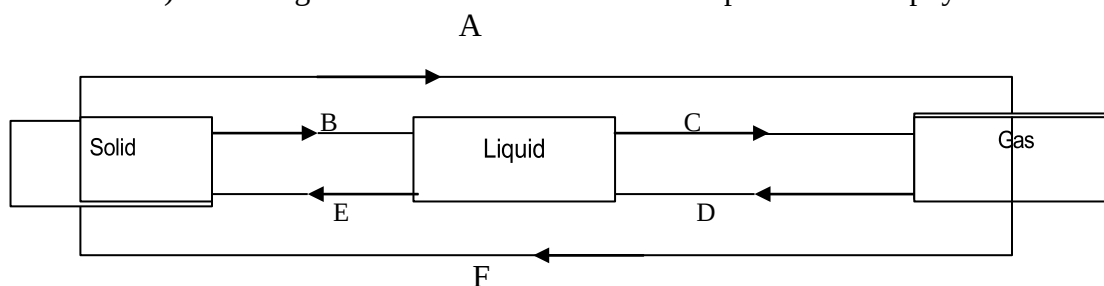
a) Which curve shows the variation in temperature for the pure solid? Explain. (2marks)

.....

- b) State the effect of impurities on the melting and boiling points of a pure substance.
i. Melting points (1/2mark)

- ii. Boiling points (1/2mark)

- c) The diagram below shows the relationship between the physical states of matter.



- i) Identify the processes B and D.

B.....(1/2 mark)

D.....(1/2 mark)

- ii) Name process A (1mark)

- iii) State two substances in chemistry that undergo the process A (2marks)

- iv) Is the process E exothermic or endothermic? Explain (2marks)

- 7 a) What method can be used to separate a mixture of ethanol and propanol. (1mark)

- b) Explain how a solid mixture of Sulphur and sodium chloride can be separated into solid Sulphur and sodium chloride crystals. (3marks)

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- c) The table below gives the solubility's of potassium bromide and potassium sulphate at 0°C and 40°C

Substance	Solubility g/100g water at	
	40°C	80°C
Potassium bromide	55	75
Potassium sulphate	85	95

When an aqueous mixture containing 60g of potassium bromide and 70 g of potassium sulphate in 100g of water at 80°C was cooled to 40°C some crystals were formed

- i) Identify the crystals. (1mark)

.....

- ii) Determine the mass of the crystals formed. (1mark)

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- iii) Name the method used to obtain the crystals. (1mark)

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- iv) Suggest one industrial application of the method named in (iii) above. (1mark)

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SERIES 18

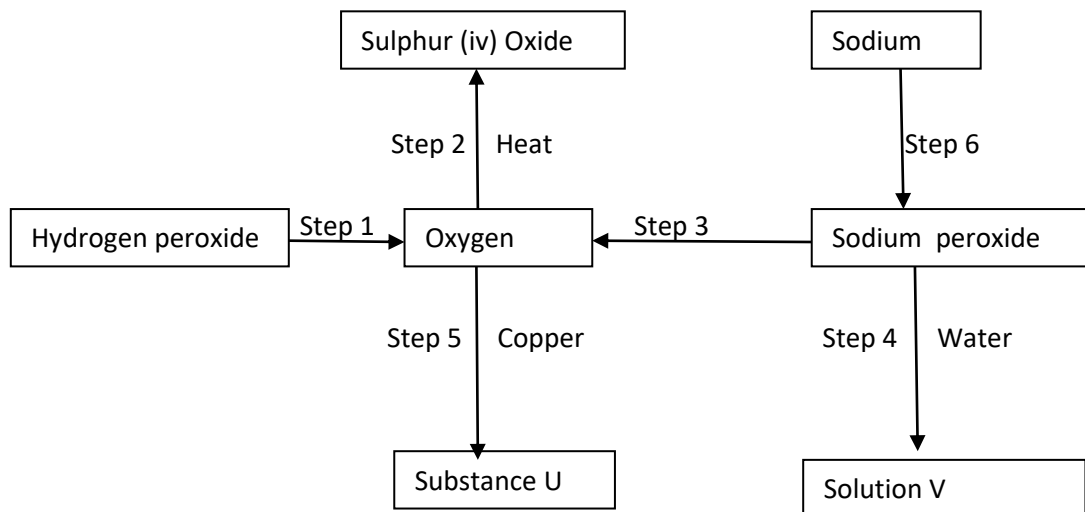
1. The grid shown below represents the periodic table. Study it and answer the questions that follow (the letters do not represent actual symbols of the element)

	K							S
G							T	
	H							
L								

- a) Which element exists naturally as a; (2mks)
- Diatomic gas
 - Monoatomic gas
- b) Write down the formula for the most stable ion of K and its electronic arrangement. (1mk)
- c) How do the atomic radii of G and L compare? Explain. (2mks)
- d) How do the first ionization energies of G and L compare? Explain. (2mks)
- e) Which two elements would react most vigorously with each other? (1mk)
- f) Give an equation for the reaction between the elements you have given in (e) above. (2mks)
- g) Which element has the smallest atomic radius? Explain. (2mks)
- h) Give the number of valence electrons in; (2mks)
- K

ii. T

2. Study the reaction scheme below and answer the questions that follow.



a) Identify substance U and solution V. (2mks)

b) Name the reagents necessary for the reactions in the following steps. (2mks)

i. Step 1

ii. Step 2

iii. Step 3

iv. Step 6

c) Give the condition necessary for the reaction in step 5 to take place. (1mk)

d) Write equations for the reactions in the following steps. (3mks)

i. Step 1

ii. Step 2

iii. Step 5

e) State and explain the observation made in step 5. (2mks)

3. The table shows the variation of volumes at different amounts of pressure.

Pressure in atmosphere	10	8	5	2	1
Volume (cm ³)	160	200	320	800	1600
Reciprocal of pressure ($1/p$)					

i. Complete the table by determine the reciprocal of pressure. (2mks)

ii. Plot a graph of volume against reciprocal of pressure. (3mks)

iii. Use the graph to determine the volume of gas P at a pressure of 3.2 atmosphere. (1mk)

iv. Calculate the pressure of gas P which has a volume of 5 litres. (2mks)

v. A given volume of nitrogen gas requires 68.3 seconds to diffuse through a tinny hole in a chamber. Under the same conditions another unknown gas requires 85.6 seconds for the same volume to diffuse. What is the molecular mass of this gas?($r=14$) (3mks)

4. In an experiment to determine the molar heat of neutralization of hydrochloric acid with sodium hydroxide, students of Anestar Secondary school reacted 100cm^3 of 1M hydrochloric acid with 50cm^3 of 2M sodium hydroxide solution. They obtained the following results.

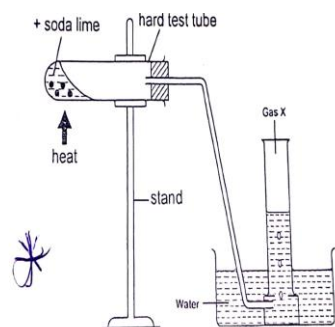
Initial temperature of acid = 25.0°C

Initial temperature of base = 25.0°C

Highest temperature reached (acid +alkali mixture) = 34.0°C

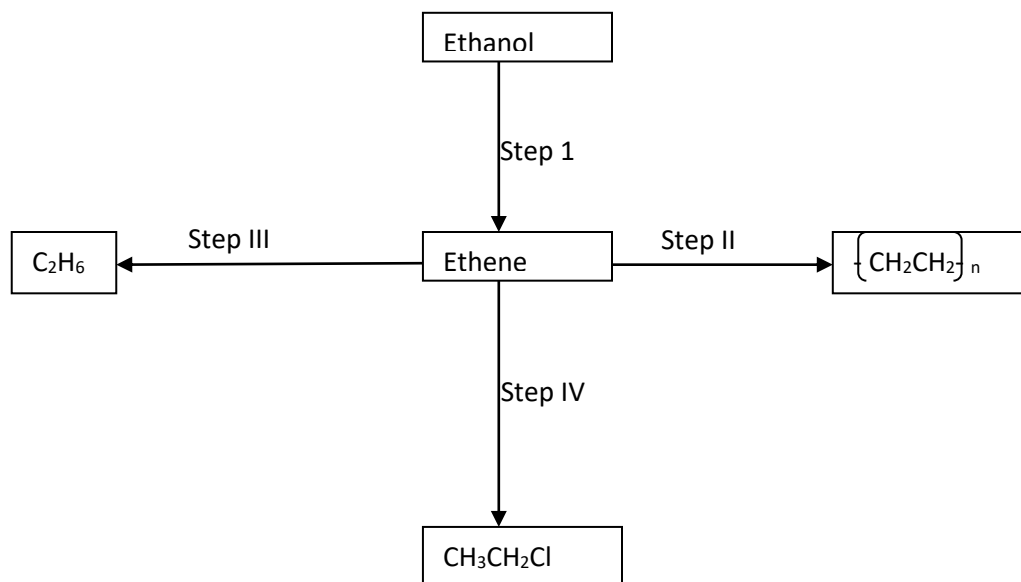
- a) Define the term molar heat of neutralization. (1mk)
- b) Write an ionic equation for the neutralization reaction between hydrochloric acid and sodium hydroxide. (1mk)
- c) Calculate:
 - i. The change in temperature (ΔT)
 - ii. The amount of heat produced during the reaction (specific heat capacity = $4.2\text{KJkg}^{-1}\text{K}^{-1}$)
 - iii. The molar heat of neutralization of sodium hydroxide.
- d) Write the thermochemical equation for the reaction. (1mk)
- e) Draw an energy level diagram for the reaction. (2mks)
- f) Explain why the enthalpy of neutralization of ethanoic acid with sodium hydroxide

5. a) The diagram below was used to prepare a gas X in the laboratory. Study it answer the questions that follow.



- Name gas x. (1mk)
- Write an equation to show the production of gas x. (1mk)

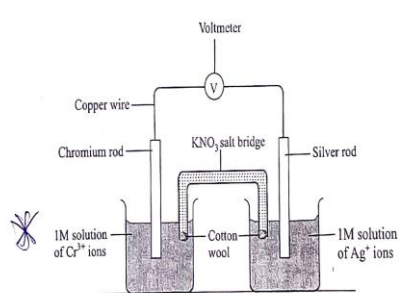
- b) Study the scheme diagram below and answer the questions that follow.



- Name the catalyst that is suitable to carry out the reaction in step 1. (1mk)

- ii. Name the process that takes place in step II. (1mk)
 - iii. State the conditions necessary for the reaction in step III to occur. (1mk)
 - iv. Write down the equation for the reaction that takes place in step IV. (1mk)
- c) Other than using burning, describe how you would distinguish between ethane and ethyne.
- d) Draw and name all structures of the isomers of the compound with molecular formula C_4H_8 . (3mks)

6. The diagram below shows a voltaic cell formed between half cells $Cr^{3+}(aq)/Cr(s)$ $E^{\circ}=+0.80$
Study it and answer the questions that follow.



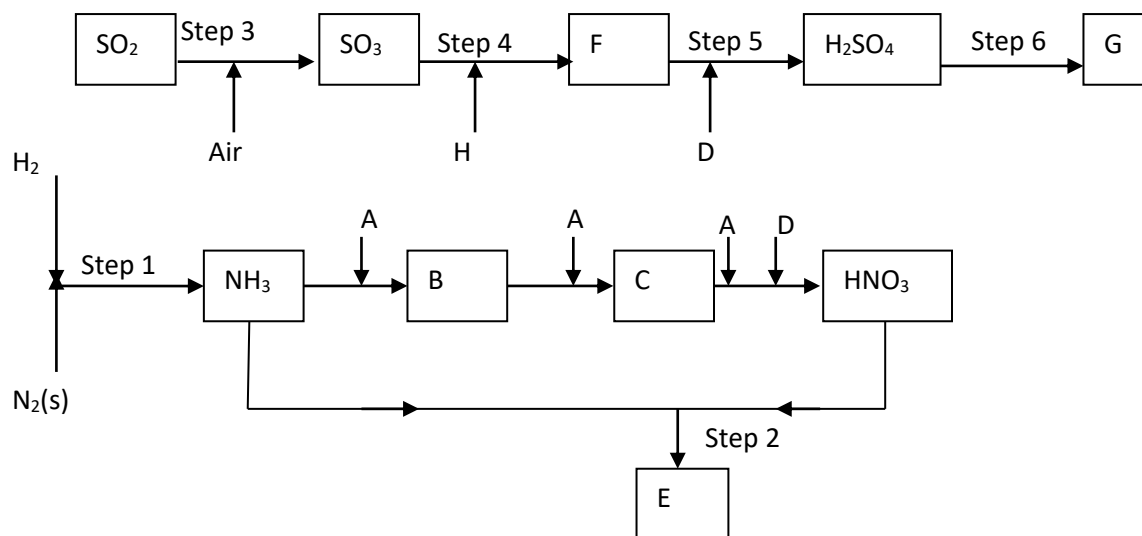
- a) What is the e.m.f of the cell? (1mk)
- b) State the direction of movement of electrons. (1mk)
- c) Which electrode is the anode? Explain. (1mk)

d) State the half cell in which reduction occurs and give the equation for the reaction. (2mks)

e) What will happen to the electrodes during the operation of the cell? (2mks)

f) State two function of the salt bridge. (2mks)

7. Study the flow chart below and use it to answer the questions that follow.



a) Name substance A,B,D, and F. (2mks)

b) Substance E and ammonium sulphate have one common use. State the use.(1mk)

c) Name the suitable catalyst in step 3. (1mk)

d) Write the chemical equation in step 4. (1mk)

- e) Identify two gaseous environmental pollutants from the above flow chart. (1mk)
- f) State the observation when potassium hydroxide is warmed with substance G.
(1mk)
- g) Write a chemical equation where concentrated sulphuric (VI) acid is used as an oxidizing agent.
(2mks)
- h) Write type of reaction is shown in the equation: (1mk)
 $\text{KNO}_3(\text{aq}) + \text{H}_2\text{SO}_4(\text{l}) + \text{HNO}_3(\text{g})$
- i) Carbon (IV) oxide reacts with red hot carbon to produce a colourless gas P. Name gas P and state and explain the precaution you take when preparing this colourless gas P.
(2mks)

SERIES 19

1. The table below gives information about some elements. The letters do not represent the actual symbols of the elements. Study the information and answer the questions that follow.

Element	Atomic radius(nm)	Ionic radius nm	Formula of oxide	Melting point(⁰ c)
M	0.364	0.421	M ₂ O	-119
K	0.830	0.711	KO ₂	837
P	0.592	0.485	P ₂ O ₃	1466
R	0.381	0.446	R ₂ O ₃	242
Q	0.762	0.676	QO	1054

- a) Identify two elements that are non-metals. Give a reason? (2mks)

.....
.....

- b) I) State the valency of elements Q and R. (1mk)

Q.....

R.....

- II) Write a formula of a compound formed when Q combines with M. (1mk)

.....

- III) What type of bond exists between Q and K. (1mk)

.....

- c) The melting point of the oxide of R is lower than that of the oxide of P. Explain. (2mks)

.....
.....

- d) Identify two elements that would react with each other most vigorously. Give a reason(2mks)

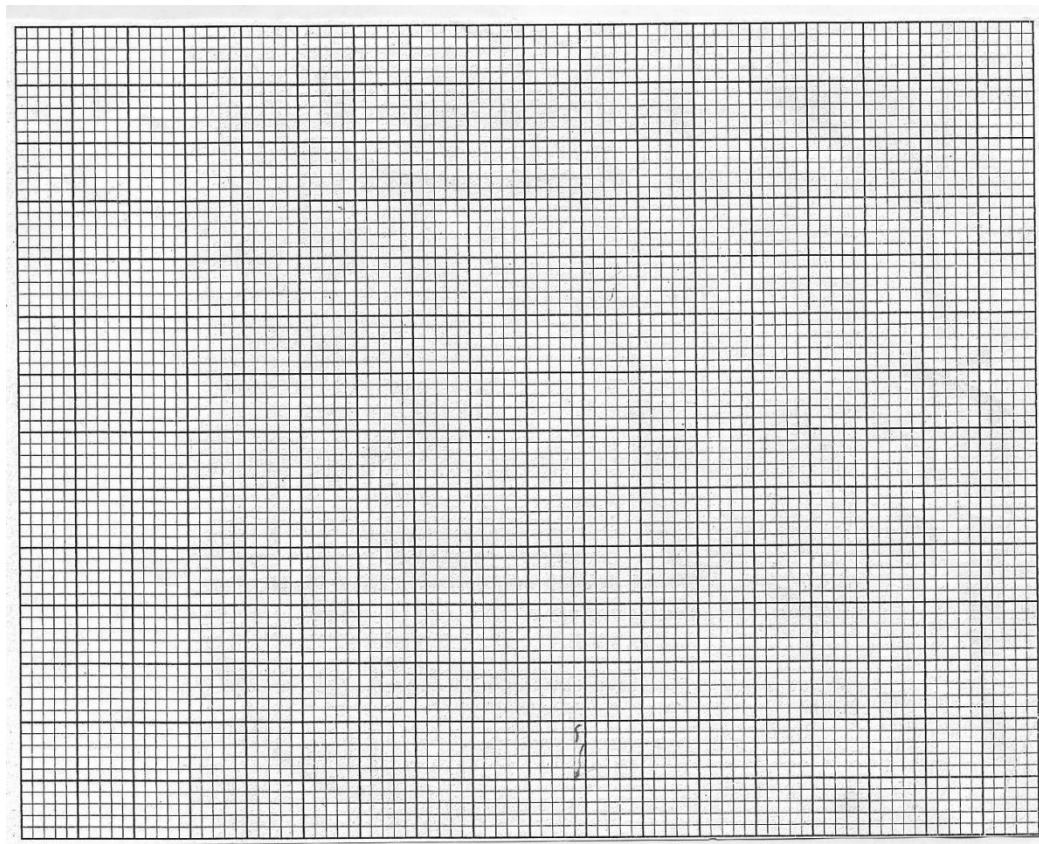
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- e) Element P would be suitable for making utensils for boiling water. State two properties that make the element suitable for the use. (2mks)

-
-
2. a) The table below gives the solubility of hydrated Copper (II) Sulphate in mol dm^{-3} at different temperatures.

Temperature($^{\circ}\text{C}$)	Solubility (mol dm^{-3})
15	6×10^{-2}
40	12×10^{-2}
60	16×10^{-2}
80	22×10^{-2}
90	27×10^{-2}
100	30×10^{-2}

- i. On the grid provided plot a graph of solubility of Copper(II) Sulphate (vertical axis) against temperature. (3mks)



- ii. From the graph, determine the mass of copper(II) Sulphate pentahydrate deposited when the solution is cooled from 90⁰c to 60⁰. (Cu=64, S=32, O=16, H=1). (3mks)

.....

b). In an experiment to determine the solubility of sodium chloride ,5.0 cm³ of a saturated solution of sodium chloride weighing 5.35g were placed in a volumetric flask and diluted to a total volume of 250cm³.

25.0 cm³ of the dilute solution of sodium chloride completely reacted with 24.1 cm³ of 0.1 M silver nitrate solution.



Calculate;

- i. Moles of silver nitrate in 24.1cm³ of solution. (1mk)

.....

.....

.....

- ii. Moles of sodium chloride in 25.0cm³ of solution. (1mk)

.....

.....

.....

- iii. Moles of sodium chloride in 250cm³ of solution. (1mk)

.....

..... iv.

Mass of sodium chloride in 5.0cm³ of saturated chloride solution (Na=23.0

Cl=35.5). (1mk)

.....
.....
.....
v. Mass of water in 5.0 cm^3 of saturated solution of sodium chloride. (1mk)

.....
.....
.....
vi. The solubility of sodium chloride in g/100 g of water. (2mks)

.....
.....
.....
3. In order to find the portion by volume of one of the main constituents of air, a sample of air was passed through two wash bottles; the first containing aqueous sodium hydroxide and the second containing concentrated Sulphuric (VI) acid and was then collected in a gas syringe. a) Suggest a reason for passing air through:

i. Aqueous sodium hydroxide. (1mk)

.....
ii. Concentrated Sulphuric (VI) acid. (1mk)

.....
b) The volume of the gas collected in the syringe was 80 cm^3 . This was passed several times over hot copper powder until no further contraction of volume took place. After cooling to the original temperature, the volume was found to be reduced to 63.2 cm^3 .

i. Explain the change in appearance of copper powder as the experiment progressed. (2mks)

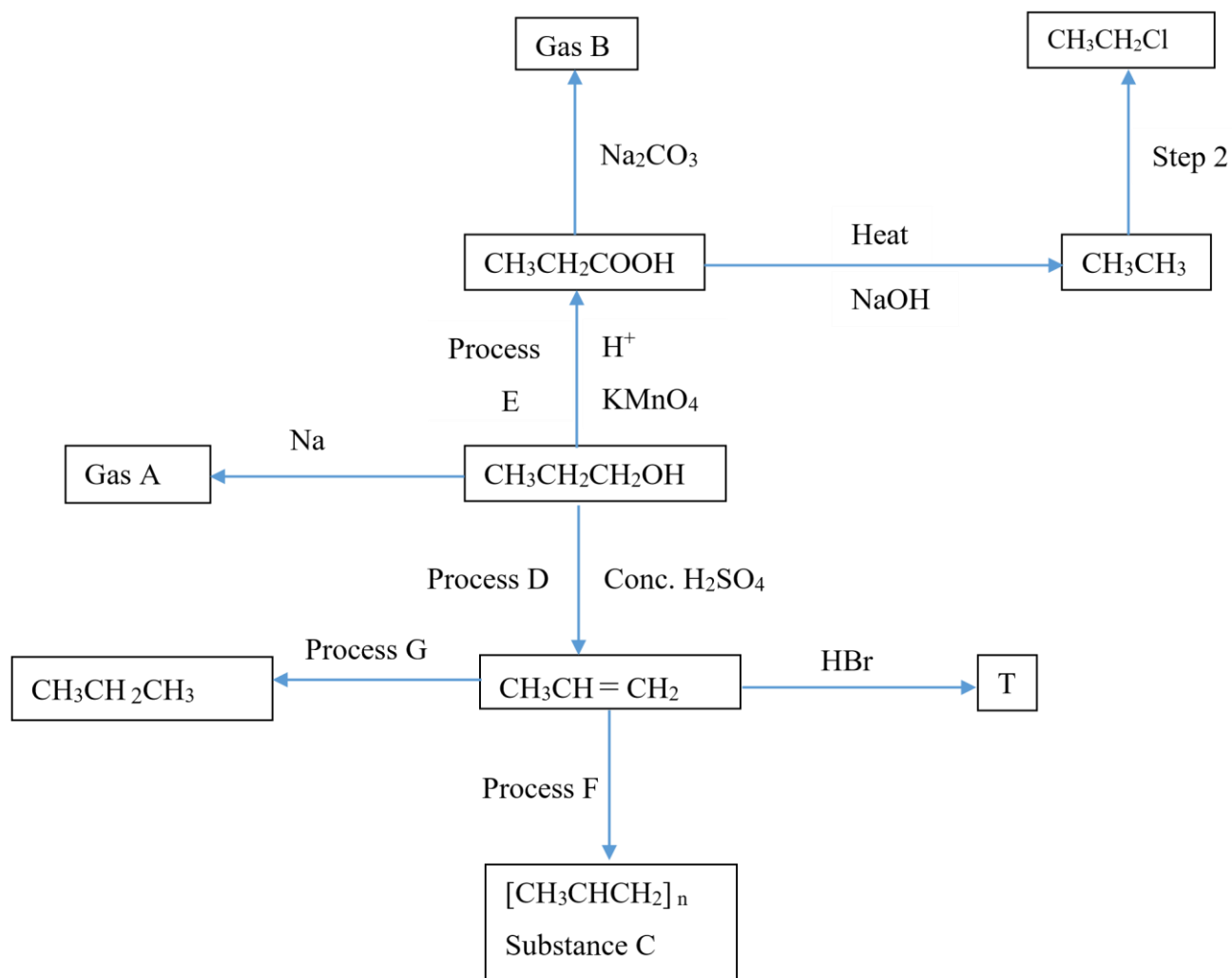
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ii. Calculate the percentage of the air used up. (2mks)

.....
.....
iii. Name the main gas remaining in the syringe. (1mk)

.....
iv. Explain the purity of the main gas remaining in the syringe. (2mks)

.....
c) A piece of sodium metal was exposed to air for some time. Write an equation for any one reaction that occurred. (1mk)

.....
4. Study the flow chart below and answer the questions that follow.



a) Name:

- I. Gas A (1mk)
- II. Gas B (1mk)
- III. Substance C (1mk)

b) Give the structural formula and name of **T** (2mks)

Structural Formula

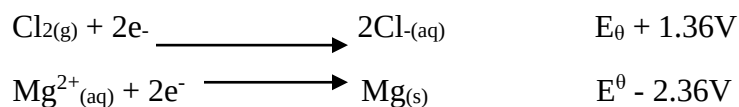
Name.....

c) Identify process

D (1mk)

- E (1mk)
- F (1mk)
- G (1mk)
- d) Name the condition and reagent for Step 2 (2mks)
- Condition
- Reagent
- e) Write equation for the complete combustion of the product of process G. (1mk)
-
- f) To what class of compounds does the products of process D and E belong?
- D (1mk)
- E (1mk)
- g) If the relative molecular mass of C is 63,000, determine n (C = 12, H = 1) (1mk)
-
-
-

5. a) The standard electrode potential for the elements chlorine and magnesium are: -



- i. Which one of the two elements will act as an oxidizing agent? Explain. (2mks)
-
-
- ii. Calculate the electromotive force of a cell where the overall reaction is: - (1mk)



b) The table below gives the reduction standard electrode potentials for divalent metals. The letters are not their actual symbols. Use them to answer the questions that follow: -

<u>Metal</u>	<u>E^θ (volts)</u>
P	+1.50
Q	- 0.44
R	+0.34
S	+0.76

- i. Select **two** metals whose half cells can produce the highest voltage when connected.

.....(1mk)

- ii. Draw a well labelled diagram of electrochemical cell formed by half-cells of metals **P** and **Q**.
(2mks)

- iii. Calculate the voltage produced by the cell in **(ii)** above.
(1mk)

.....

.....

.....

- c) When nitrate solution of a certain metal **X** was electrolysed, 1.174g of metal **X** was deposited by a current of 4 amperes flowing for 16minutes. Determine the formula of the metal nitrate. (1F= 96,500, R.A.M of **X**= 59). (3mks)

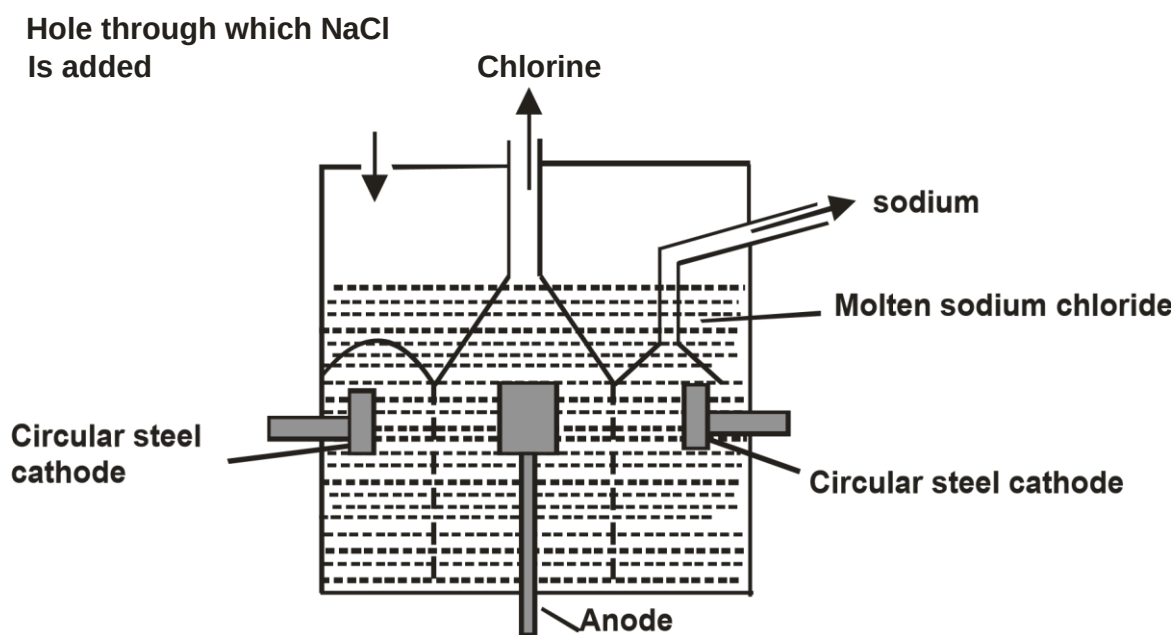
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6. a) Below is a simplified diagram of the Down's cell used for the manufacture of sodium. Study it and answer the questions that follow.



- i. What material is the anode made of? Give a reason. (2mks)

.....

.....

ii. What precautions is taken to prevent chlorine and sodium from re-combining.

.....(1mk)

iii. Write an ionic equation for the reaction in which chlorine gas is formed.

(1mk)

.....

b) In the Down's process, 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.

(1mk)

.....

ii). State why it is necessary to lower the temperature.

(1mk)

.....

c). Explain why aqueous sodium chloride is not suitable as an electrolyte for the manufacture of sodium in the Downs process. (2mks)

.....

.....

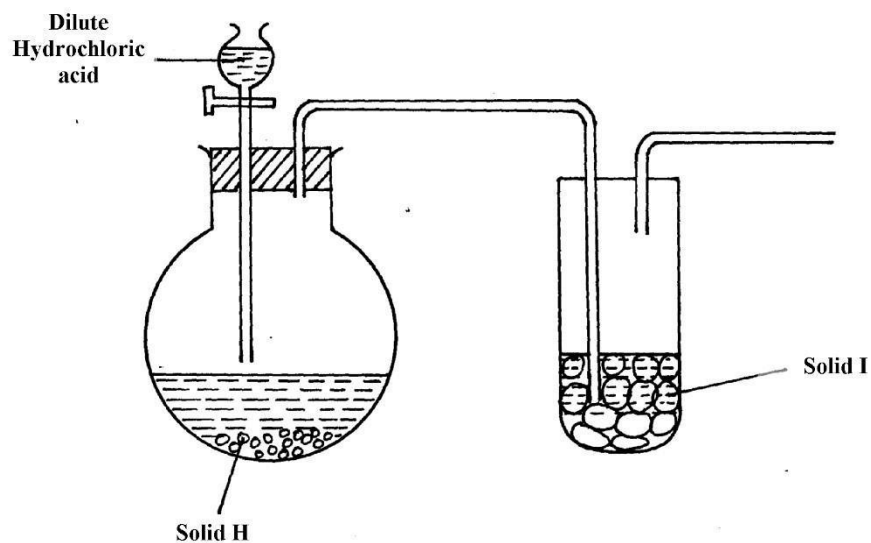
d). State two uses of sodium metal.

(2mks)

.....

.....

7. The set-up below was used to prepare dry sample of hydrogen Sulphide gas



(a) (i) Complete the diagram to show how the gas was collected. (1mk)

(ii) Identify the following: - (2mks)

I. Solid H

II. Solid I

(iii) Write an equation for the reaction that occurred in the flask between solid **H** and dilute Hydrochloric acid. (1mk)

.....

(b) When hydrogen Sulphide gas was passed through a solution of Iron (III) chloride, the following observations were made: -

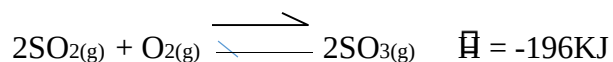
(i) the color of the solution changed from reddish-brown to green and

(ii) a yellow solid was deposited. Explain the observations. (2mks)

.....

.....

(c) In the manufacture of Sulphuric (VI) acid by contact process Sulphur (IV) oxide is made to react with air to form Sulphur (VI) oxide as shown: -



(i) Name the catalyst in this reaction. (1mk)

.....

(ii) State and explain the effect of the following changes on the yield of Sulphur (VI) oxide

I. Increasing the pressure. (1mk)

.....

.....

II. Using a catalyst. (1mk)

.....

.....

III. Explain why sulphur (VI) oxide gas is absorbed in concentrated sulphuric (VI) acid before dilution. (1mk)

.....

.....

SERIES 20

1.

R								
	V						Y	
L			M	B			G	Z
S	F						A	
T								

a) State the name given to the groups the following elements belong; (1mk)

i) Z

ii) Y, G and A

b) **Compare** the following;

i) The atomic and ionic radius of element V. (1 ½ mk)

ii) The melting points of elements G and Z (1 ½ mk)

c) The oxide of M reacts with both dilute acids and alkalis. Write a balanced chemical equation to show how the oxide reacts with dilute sodium hydroxide solution. (1mk)

d) Choose the letter that represents the element that is ; (1mk)

i) the most reactive metal ---

ii) the strongest oxidizing agent----

e) Elements L and M are good conductors of electricity but M is a better conductor than L.

Explain. (1mk)

f) Explain how sodium hydrogen carbonate solid can be used to differentiate between solutions of the chlorides of L and B. (2mk)

g) 4.1 grams of the nitrate of F was strongly heated until a constant mass was obtained.

i) Write a balanced chemical equation for the reaction that took place. (1mk)

ii) List any observation made during the heating (1mk)

iii) Calculate the total volume of the gaseous products obtained if the reaction took place at room temperature and pressure. (1mole of gas at RTP=24dm³, N=14, O=16, F= 40). (2mk)

2. The table below shows the solubilities of potassium nitrate at different temperatures.

Temperature °C	10	20	30	40	50	60	70	80	90	100
Solubility g/100g of water	80	88	96	104	114	124	136	148	162	180

a) Plot a graph of solubilities of potassium nitrate against temperature. (3mk)

b) From your graph determine;

i) the solubility of the potassium nitrate at 65°C. (1mk)

ii) the mass of potassium nitrate that would **dissolve in 50g of water at 82°C**. (2mk)

c) Determine the molar concentration of potassium nitrate at 37°C. (N=14, O= 16, K= 39. Assume the density of solution to be 1g/cm³) (3mk)

d) 130g of potassium nitrate salt was added to 100g of water and heated to 90°C. It was then cooled to 15°C.

i) At what temperature were the crystals first formed? (1mk)

ii) Calculate the mass of crystals formed. (1mk)

e) $C_{17}H_{35}COONa$ is cleansing agent used to remove dirt from clothes. It is manufactured by hydrolyzing vegetable oil using 4M NaOH hydroxide solution. After boiling for sometime, adding small amounts of distilled water and stirring, a certain compound is added.

i) Name the compound added and state its role. (2mk)

ii) Describe the mode of action of the cleansing agent.
(3mk)

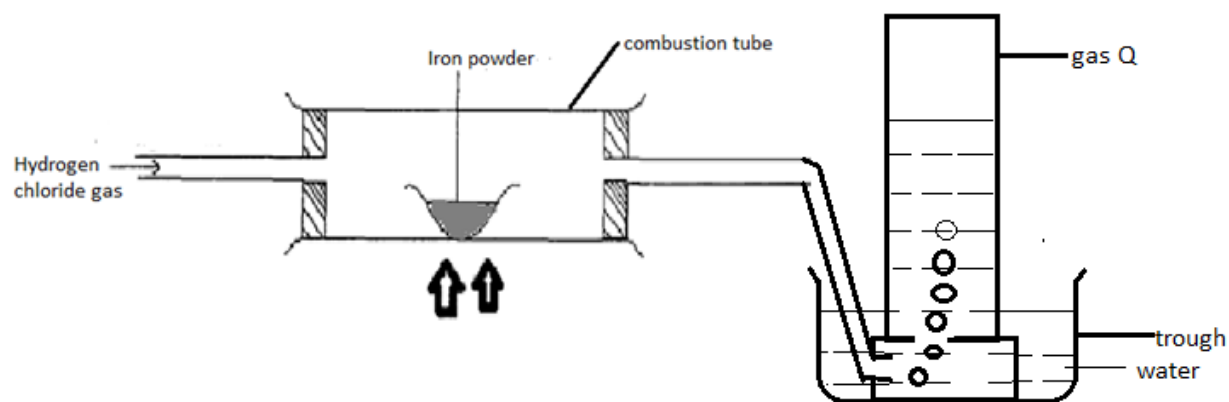
3. a) Chlorine gas is prepared in the laboratory by reacting concentrated hydrochloric acid with an oxidizing agent like potassium manganate (VII)

i) List other two oxidizing agents that can be used in place of $KMnO_4$ (1mk)

ii) Freshly cut blue flower petals were placed in a gas jar containing oxygen and another containing chlorine gas. Explain the differences in the observations made. (2mks)

iii) State any two uses of hydrochloric acid (1mk)

b) Hydrogen chloride gas was passed over heated iron powder as shown in the diagram below. Study it and answer the questions that follow.



i) **State** and **explain** the observations made in the combustion tube. (2mk)

ii) Blue litmus paper was placed in the trough with water and it turned red, explain this observation. (1mk)

iii) Describe the chemical test for gas Q (1mk)

4. a) i) State any two adaptations of the burette to perform its functions. (2mk)

ii) The Bunsen burner produces two types of flames. The non-luminous flame is mostly preferred for heating. Under what condition is the other type of flame produced and what two reasons makes it not suitable for heating.

Condition- (1mk)

Reasons - (1mk)

b) An agriculture student wanted to determine the pH of a soil sample in order to know the fertilizer to add to the soil upon planting. Describe the procedure the student would have followed to determine this soil pH. (2mk)

c) The table below shows different properties of mixtures. Study it and answer the questions that follow.

Liquid	Q	J
Water	Immiscible	Miscible
Ethanol	Miscible	Miscible

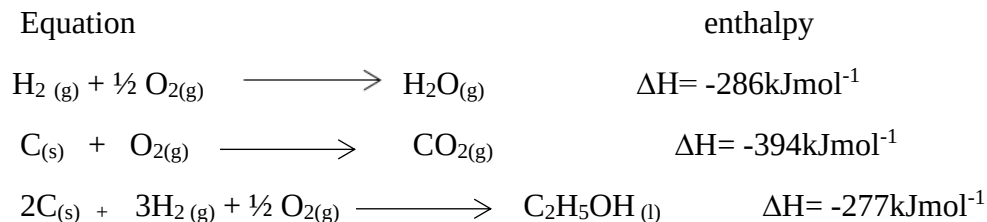
i) What physical property is used when choosing the method to separate a mixture of ethanol and J (1mk)

ii) Name two methods used to separate mixture of water and Q (1mk)

d) Use **well labelled diagrams** to show how a mixture of potassium chloride, anhydrous iron (iii) chloride and lead sulphate solids can be separated to acquire a pure and solid sample of each. (3mk)

5. a) i) Define the term enthalpy of formation (1mk)

ii) Use the information below to answer the questions that follow.



I) Draw an energy cycle diagram linking the above enthalpies with the molar enthalpy of combustion of ethanol. (2mk)

II) Hence calculate the molar enthalpy of combustion of ethanol. (1mk)

b) In an experiment to determine the molar enthalpy of displacement of copper, 100cm³ of 2M copper ii sulphate solution was placed in a plastic beaker and its initial temperature recorded as T₁. Excess magnesium was then added to the beaker and thoroughly stirred until no further change in temperature occurred. The highest temperature obtained was recorded as T₂.

i) Other than the temperature rise, **state** and **explain** the observations that were made during the reaction. (2mk)

ii) Calculate the heat change for the reaction above given that, T₁ = 21.5⁰c and T₂= 38⁰c.

(SHC= 4.2Jg⁻¹k⁻¹ and the density of the solution is 1gm/cm³) (1mk)

iii) Determine the molar heat of displacement of copper by magnesium. (2 mk)

iv) Write the **thermochemical equation** for the reaction that took place (1mk)

6. a i) Which type of sulphur is formed under the following conditions; (2mk)

Conditions	Type of sulphur
------------	-----------------

Below 96 ⁰ c	
Rapidly cooling sulphur vapor	
Pouring boiling sulphur in cold water	
Above 96 ⁰ c	

b) i) Fill in the gaps in the table below.
(3mk)

gas	reactants	Method of collection	Confirmatory test
	Copper, concentrated sulphuric vi acid & heat		Changes purple acidified KMnO ₄ colourless
Hydrogen Sulphide		Collected over warm water	
	Sulphur iv oxide and Oxygen gases		XXXXXXXXXXXXXX

ii) Write a balanced chemical equation for the other set of reagents that can be used to prepare sulphur iv oxide gas.
(1mk)

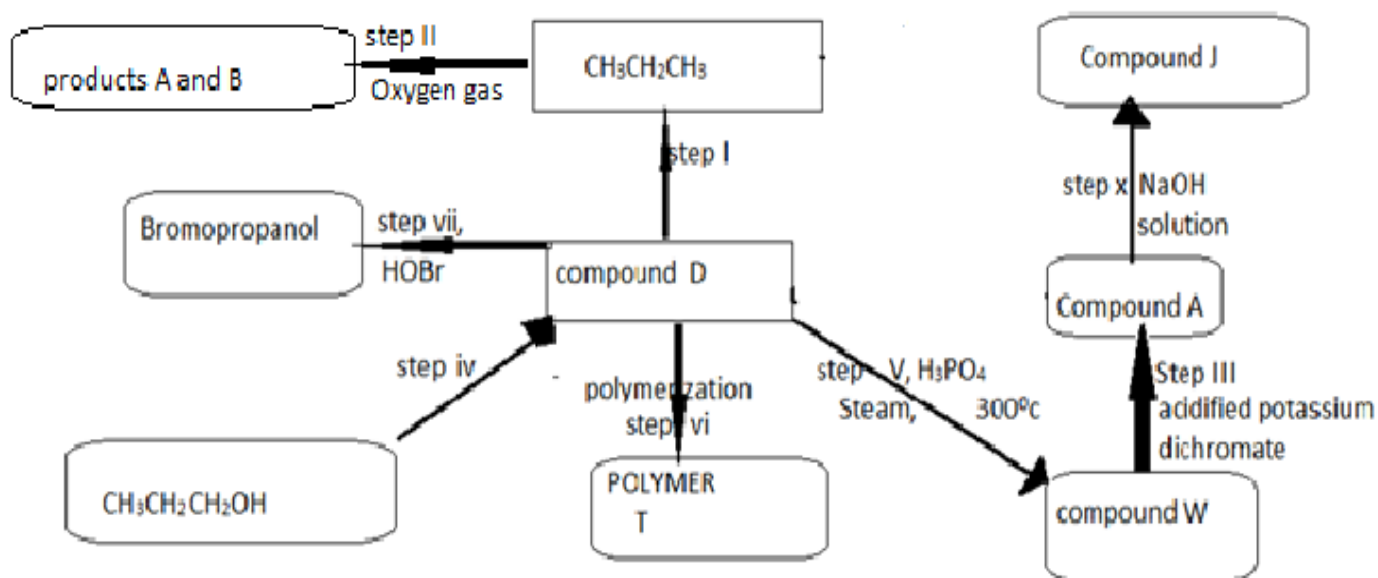
iii) State the observation made and the property of concentrated sulphuric vi acid exhibited in each of the following experiments. 2mks

Reaction of conc. H ₂ SO ₄ with;	observation	Property of concentrated H ₂ SO ₄
Sugar crystals		
Copper turnings		

c) A student from Igikiro mixed day secondary school was provided with solid G. The table below shows the procedures, observations and inferences that the student made in the lab. Study the table and fill in the missing gaps.

Test	Observations	Inferences
a) To a spatula full of solid G in a Boiling tube. Divide the Resulting solution into five portions	Dissolves to form a Colourless solution	1mk
bi) to the first portion add NaOH solution dropwise till In excess	1mk	Pb^{2+} , Zn^{2+} , Al^{3+} present
ii) to the second portion ,add ammonia solution dropwise till in excess.	White precipitate , insoluble in excess	mk $\frac{1}{2}$
iii) to the third portion, add few drops of potassium sulphate solution.	No white precipitate	mk $\frac{1}{2}$
ci) to the fourth portion add few drops of acidified lead nitrate solution.	White precipitate	mk $\frac{1}{2}$
ii) to the fifth portion add few drops of barium nitrate solution	White ppt	mk $\frac{1}{2}$

7. Study the scheme below and answer the questions that follow.



a) State the name given to the processes taking place in;

(1 ½ mk)

Step I-

Step X-

Step V-

b) Write chemical equations for the reactions taking place in steps;

(2mk)

step ii-

Step X-

c) State the observation made in;

(2mk)

i) Step VII-

ii) Step III-

d) i) Draw the structure of polymer T showing 3 repeated units.

(1mk)

ii) State any one use of polymer T

(1mk)

e) State the reagents and conditions for the following reactions;

Step	reagent	condition
I	-	-
		-
		1/2
		1mk
IV		-
		1mk