

CHEMISTRY PAPER 2

EXPECTED QUESTIONS IN KCSE

**Comprises 6 KCSE prediction set exams
(Class of KCSE March 2022).**

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**For More e-learning resources contact Kenya
Educators via the contacts above.**

PREDICTION 1

Name Adm. No.....

Candidate's Signature..... Date.....

233/2

CHEMISTRY PAPER 2

(Theory)

FORM 4 2021

2 hours

Instructions to candidates

- (a) Write your name and index number in the spaces above
- (b) Sign and write the data
- (c) Answer all the questions in the spaces provided.
- (d) **KNEC** tables and non-programmable calculators may be used.
- (e) **ALL** working must be clearly shown where necessary
- (f) **ALL** answers **MUST** be written in English.

For Examiners Use Only

Question	Maximum Score	Candidates Score
1	12	
2	13	
3	12	
4	11	
5	10	
6	11	
7	11	
Total Score	80	

1. (a). Crude oil is a source of many compounds that contain carbon and hydrogen only.
(i). Name the process used to separate the components of crude oil. (1 mark)

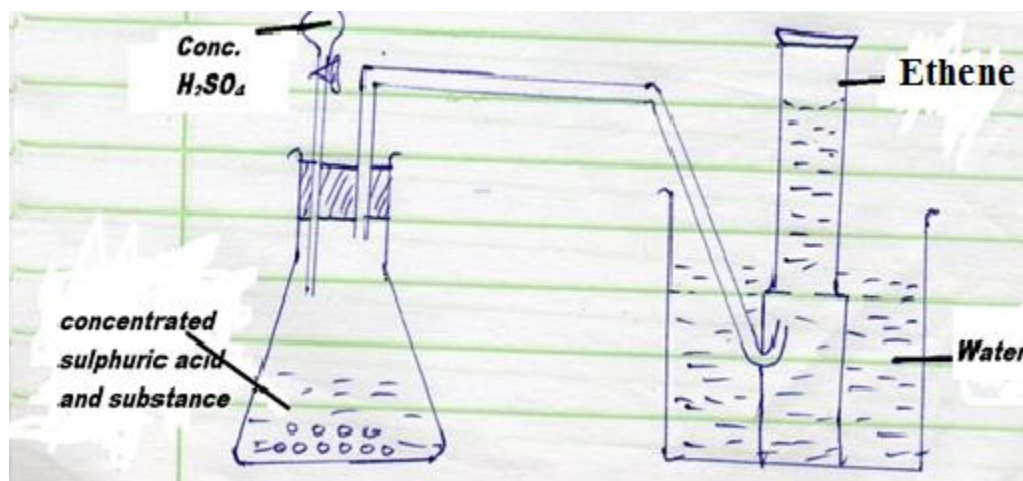
.....
.....
(ii). On what two physical properties of the above components does the separation depends.
(2 marks)

.....
.....
(b). Under certain conditions, hexane can be converted to two products. The formula of one of the products is C_3H_8 .

i) Write the formula of the other product. (1mark)

.....
.....
(ii). Describe a simple chemical test to show the difference between the two products formed in b(i) above
(2 marks)

.....
.....
(c). The set up below was used to prepare and collect ethene gas. Study it and answer the questions that follow



(i). Name the substance T. (1 mark)

.....
(ii) Give the property of ethene that allows it to be collected as shown in the set-up above
(1 mark)

.....
(d). One of the reactions undergone by ethene is addition polymerization. Give the name of the polymer and one disadvantage of the polymer it forms.
(2 marks)

Name: (1 mark)

Disadvantage of the polymer (1 mark)

2.(a) Name the method that can be used to obtain pure Iron (III) chloride from a mixture of iron (III) chloride and sodium chloride. (1 mark)

(b) A student was provided with a mixture of sunflower flour, common salt and a red dye. The characteristics of the three substances in the mixture are given in the table below. (1 mark)

Substance	Solubility in water	Solubility in ethanol
Sunflower flour	Insoluble	Insoluble
Common salt	Soluble	Insoluble
Solid red dye	Soluble	soluble

The student was provided with ethanol and any other materials needed. Describe how the student can separate the mixture into its three components. (3 marks)

(c) The diagram shows part of the periodic table. The letters do not represent the actual symbols of the elements. Use the diagram to answer the questions that follow.

								Q
R						T		
	Z		N			V	W	
Y							X	

(i) Explain why the Oxidizing power of W is more than of X. (2 marks)

(ii) How do the melting points of R and T compare. Explain. (2 marks)

(iii). Give the formula of the compounds formed between Z ad W (1mark)

(iv). Element K is in group (v) and period 2 of the periodic table. Locate the element in the grid above. (1mark)

(v) Using dots (.) and crosses (x), show the bonding between K and hydrogen. (1 mark)

(vi) Select an element that could be used:-

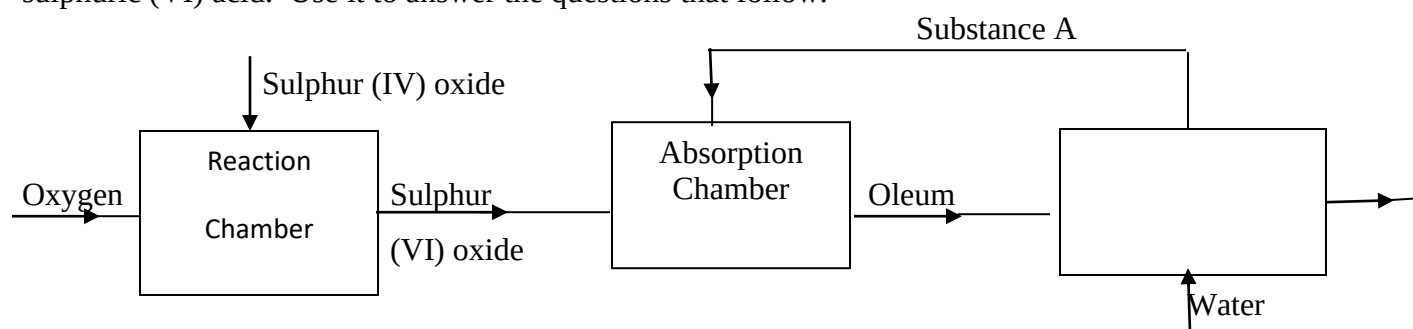
(I) in weather balloons

(1 mark)

(II). For making cooking pots.

(1 mark)

3. The flow chart below shows some of the processes involved in large scale production of sulphuric (VI) acid. Use it to answer the questions that follow.



(a). Describe how oxygen is obtained from air on large scale.

(3 marks)

(b). (i). Name substance A

(1mark)

(ii). Write an equation for the process that takes place in the absorption chamber

(1 mark)

(c). Vanadium (v) oxide is a commonly used catalyst in the contact process.

(1 mark)

(i). Name another catalysts which can be used for this process.

(1 mark)

(ii). Give two reasons why vanadium (IV) oxide is the commonly used catalyst

(1 mark)

.....
.....
(d). State and explain the observation made which concentrated sulphuric (VI) acid is added to crystals of copper (II) sulphate in the beaker. (2 marks)
.....

.....
(e) The reactions of concentration sulphuric (VI) acid with sodium chloride produces hydrogen chloride gas. State three property of concentrated sulphuric (VI) acid illustrated in this reaction. (1mark)
.....

.....
(f). Name four uses of sulphuric (VI) acid (2 marks)
.....

.....
4.(a). What is meant by molar heat of combustion? (1 mark)
.....

(b). State the Hess's law (1 mark)
.....

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

$$\Delta H^{\circ}_c (\text{Graphite}) = - 393\text{kJmol}^{-1}$$

$$\Delta H^{\circ}_c (\text{CH}_2(\text{g})) = - 286\text{kJmol}^{-1}$$

$$\Delta H^{\circ}_f (\text{C}_3\text{H}_8(\text{g})) = -104 \text{ kJmol}^{-1}$$

(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)

.....

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

(e). The molar enthalpies of neutralization of dilute hydrochloric acid and dilute nitric (V) acid are -57.2kJmol^{-1} while that of ethanoic acid is -55.2kJ/mol . Explain this observation. (2 marks)

5.(a). At 25°C , 50g of potassium nitrate were added to 100g of water to make a saturated solution. What is meant by a saturated solution? (1 mark)

(b). The table below gives the solubilities of potassium nitrate at different temperatures

Temperature ($^{\circ}\text{C}$)	12	20	28	36	44	52
Solubility g/100g of water	22	31	42	55	70	90

(i). Plot a graph of the solubility of potassium nitrate (vertical axis) against temperature. (3 marks)

(ii). Using the graph:

I. Determine the solubility of potassium nitrate at 15°C . (1 mark)

II. Determine the mass of potassium nitrate that remained undissolved given that 80g of potassium nitrate were added to 100cm^3 of water and warmed to 40°C . (2 marks)

(c). Determine the molar concentration of potassium nitrate at 15°C

(Assume there is no change in density of water at this temperature. (K=39, N=14, O=16)
 (3 marks)

.....
6.a)(i). Carbon (IV) oxide is present in soft drinks. State two roles of carbon (IV) oxide.

(1 mark)

.....
(ii). Explain the observation made when a bottle containing a soft drink is opened. (2 marks)

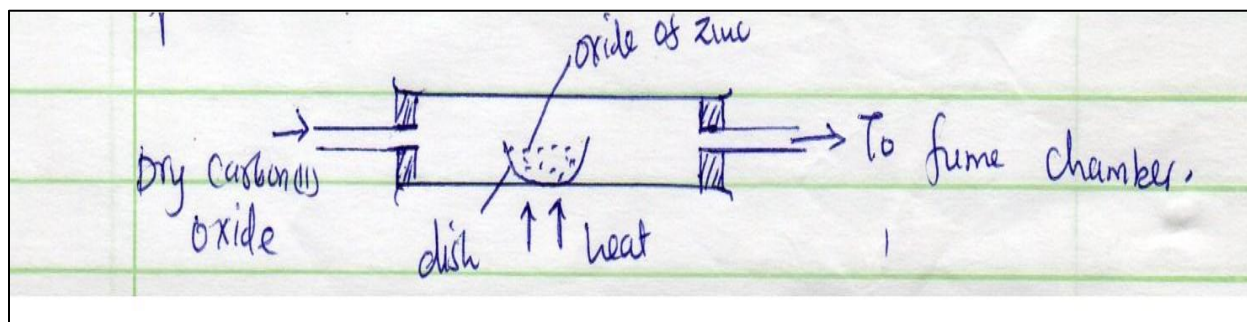
.....
(iii). Carbon (IV). Oxide dissolves slightly in water to give acidic solution. Give the formula of the acid. (1 mark)

.....
(b). Zinc oxide can be obtained by heating zinc nitrate. A student heated 5.76g of zinc nitrate.

(i). Write the equation or the reaction that occurred. (1 mark)

.....
(ii). Calculate the total volume of gases produced (Molar gas volume = 24dm^3 , Zn = 64.5, O = 16, N = 14.0) (2 marks)

.....
(c). Excess carbon (II) oxide gas was passed over a heated sample of an oxide of zinc as shown in the diagram below. Use it to answer the questions that follow.

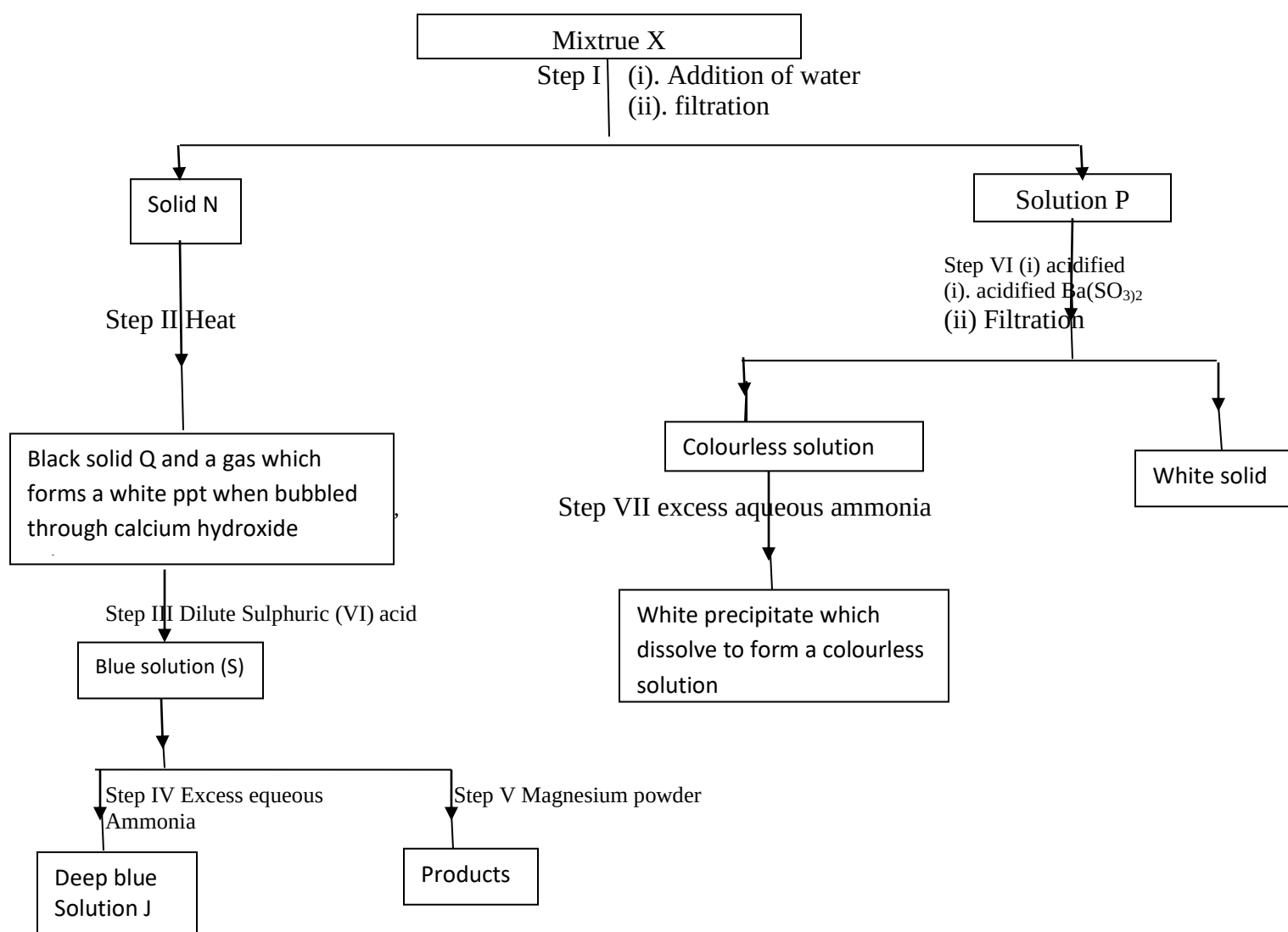


(i). State and explain the observations made in the combustion tube.

(3 marks)

(ii). Write an equation or the reaction which took place in the dish. (1 mark)

7. The flow chart below shows a sequence of reactions involving a mixture of two salts, mixture X. Study it and answer the questions that follow.



(a). Write the formula of the following

(i). anious in solid Q (1 mark)
.....
.....

(ii). The two salts present in mixruew M. (2 marks)
.....
.....

(b). Write an ionic equation for the reaction in step (VI). (1mark)
.....
.....

(c).State and explain the observations made in step (V) (3 marks)
.....
.....
.....
.....

(d)(i). Starting with lead (II) oxide,describe how a pure solid sample of lead (II) sulphate can be prepared in the laboratory. (2 marks)
.....
.....

(ii). How can one determine whether the lead (II) Sulphate prepared is pure? (2 marks)
.....
.....

PREDICTION 2

NAME DATE

INDEX NO. SIGNATURE

233/2
CHEMISTRY
PAPER 2
(THEORY)
TIME: 2 HOURS.

Kenya Certificate of Secondary Education

INSTRUCTIONS TO CANDIDATES

- Write your name and index number in the spaces provided above.
- Sign and write the date of exam in the spaces provided above.
- Answer **ALL** the questions in the spaces provided.
- Mathematical tables and silent electronic calculators may be used.
- All working **MUST** be clearly shown where necessary.

FOR EXAMINER'S USE ONLY

Questions	Maximum score	Candidates score
1	13	
2	11	
3	13	
4	10	
5	10	
6	12	
7	11	
Total score	80	

*This paper consists of 10 printed pages.
Candidates should check to ensure that all pages are printed as indicated and no questions are missing*

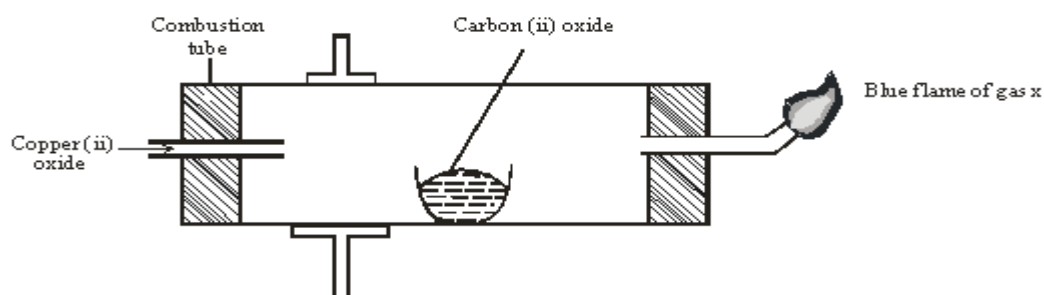
1. The grid below shows part of the periodic table. Study it and answer the questions that follow. The letters do not represent the true symbols of the elements.

					A		
I	B		C		D		E
F	G					H	

- a) Which element forms an ion of charge - 2? Explain your answer **2marks**
-
-
-
- b) What is the nature of the oxide formed by element C? **1mark**
-
- c) How does the reactivity of H compare with that of E? Explain. **2marks**
-
-
-
- d) Write the chemical equation for the reaction between B and chlorine? **1mark**
-
-
- e) Explain how the atomic radii of the following compare; **2marks**
- i) F and G
-
-
- ii) B and G
-
-
- f) The oxides of B and D are separately dissolved in water. State the effect of each product on litmus paper. **2marks**
-
-
-

- g) 20cm^3 of a solution of a hydroxide of I completely neutralizes 17.5cm^3 of 0.5M sulphuric (VI) acid. Calculate the concentration in moles/litre of solution of the hydroxide of I **3marks**

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



- a) Name one condition that is missing in the set up that must be present if the experiment to proceed. **1mark**
-
-
- b) If the experiment was carried out properly. What observation would be made in the combustion tube? **1mark**
-
-
- c) Give an equation for the reaction that occurs in the combustion tube. **1 ½ mark**
-
-
- d) Give an equation for the reaction that takes place as gas x burns. **1 ½ marks**
-
-
- e) Why is it necessary to burn gas x? **1mk**
-
-
- f) Name the reducing and oxidizing agent. **2marks**
- (i) Reducing agent
-
- (ii) Oxidising agent
-

g) Identify any other substance that would have the same effect on copper (ii) oxide as carbon (ii) oxide.

1mark

.....

.....

h) What would happen if copper (ii) oxide was replaced with sodium oxide? Explain

2mark

.....

.....

.....

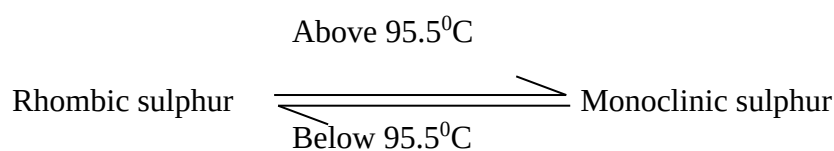
3. a) Sulphur occurs naturally in two different forms called allotropes;

(i) What are allotropes?

1mark

.....

(ii) The two allotropes of sulphur are stable at different temperatures, as shown in the equation below.

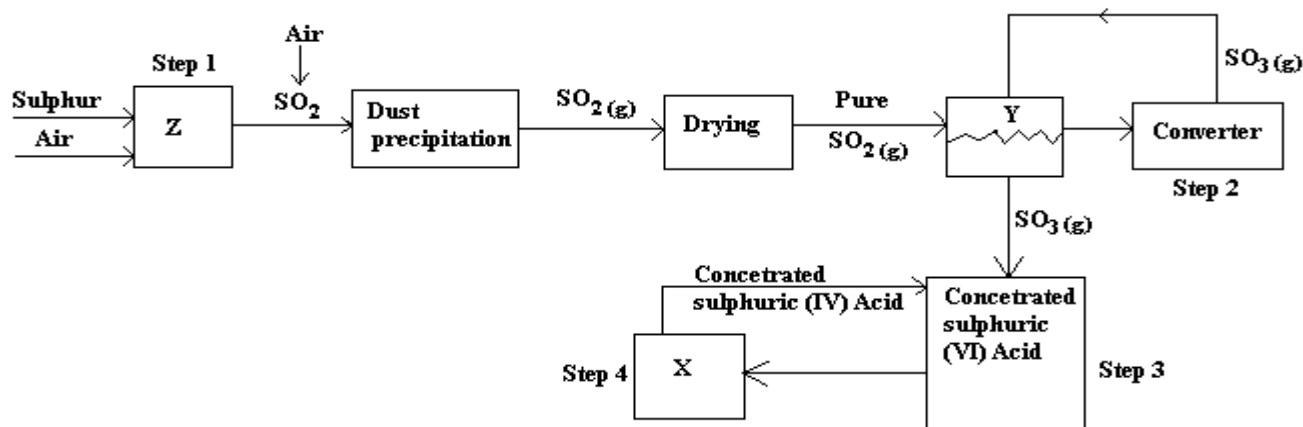


Give a name to the temperature 95.5°C

1mark

.....

b) Below is a flow chart diagram for the contact process for the manufacture of sulphuric (VI) acid.



(i) Give the name of chambers labeled

1 ½ mark

X

.....

Y

.....

Z

.....

(ii) State the three conditions in the converter.

1 ½ mark

.....

.....

.....

- (iii) Explain why gases are passed through ;
I – The dust precipitator and drying power

2marks

II- The chamber labeled Y

- (iv) Write the balanced equations for the reactions in;

3marks

Step 2:

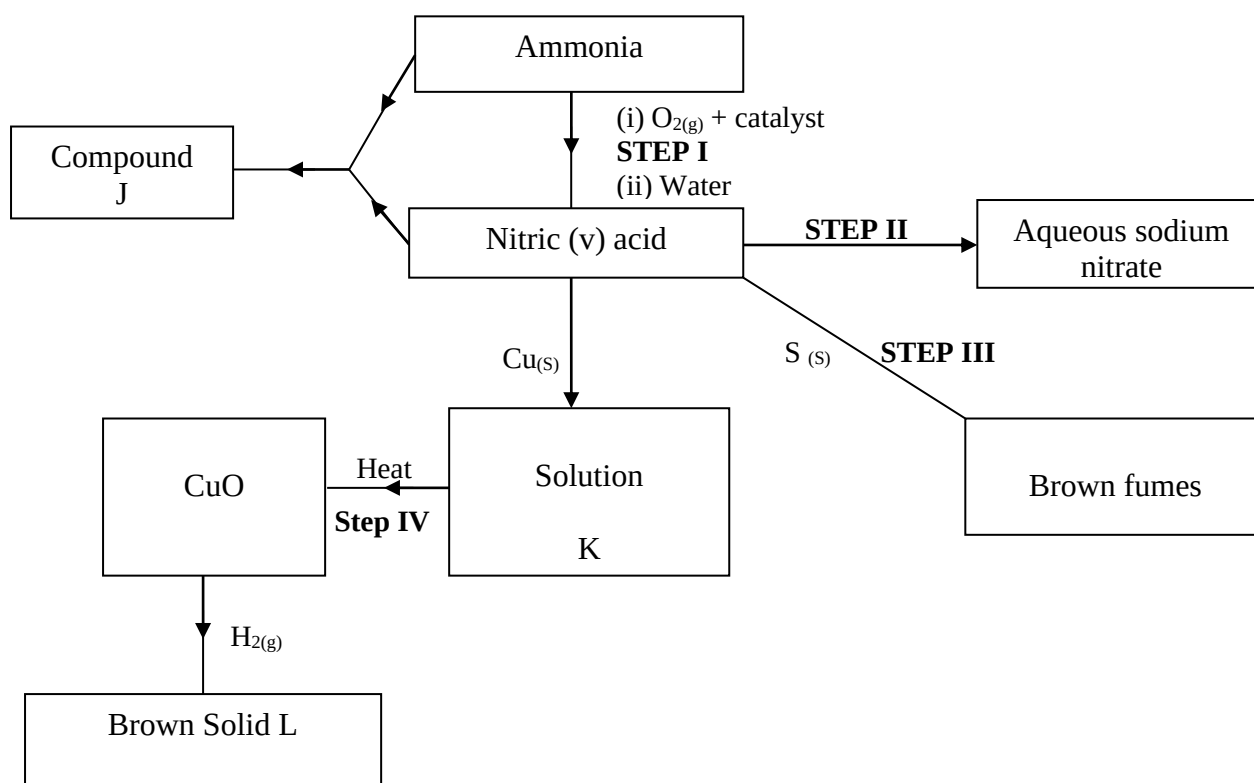
Step 3:

Step 4:

- c) Calculate the volume of sulphur (VI) oxide gas in litres that would be required to produce 178kg of Oleum in step 3. (Molar gas volume at s.t.p.=22.4l, H=1, O=16, S=32)

3marks

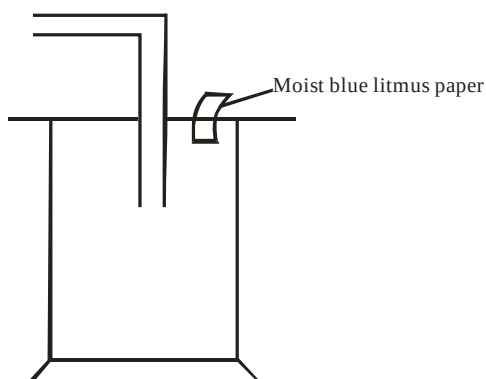
4. a) The scheme below shows various reactions starting with ammonia. Study it and answer the questions that follow.



- (i) List the raw materials used in the manufacturer of ammonia gas. **1mark**
.....
- (ii) What catalyst is used in step I? **1mark**
.....
- (iii) Write an equation for the reaction that occurs between ammonia and oxygen gas in the presence of a catalyst. **1mark**
.....
- (iv) Identify the process in step II? **1mark**
.....
- (v) Using an appropriate equation, explain how the reaction in step III occurs **(1 mark)**
.....
- (vi) What should be added to solution K to form solid L? **(1 mark)**
.....
- (vi)
- (a) I. Write the formula of compound J.
.....
- II. Calculate the mass of compound J that would contain 14g of nitrogen. (N=14, O=16, H= 1) **(2marks)**

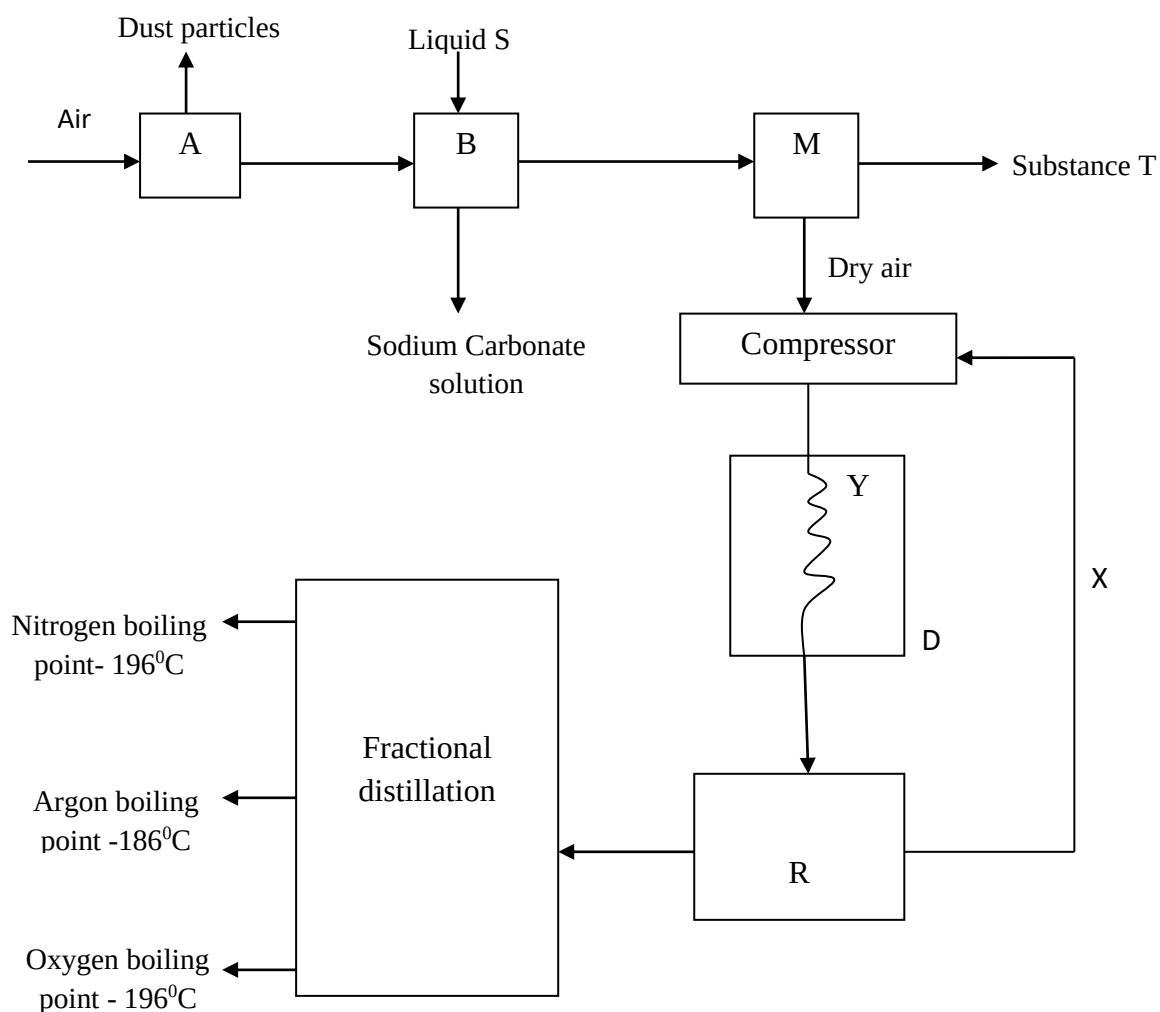
- b) Explain the advantage of using ammonium phosphate fertilizer over the other nitrogenous fertilizers. **(1mark)**
.....
.....

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



- a) Name a suitable drying agent for chlorine gas? **1mark**
.....
.....
- b) State one property of chlorine gas which facilitates this method of collection. **1mark**
.....
.....
- c) State the observations on the moist blue litmus paper. **2marks**
.....
.....
.....
- d) Chlorine gas was bubbled through distilled water. With aid of an equation show the formation of chlorine water. **1mark**
.....
.....
.....
- e) Write the formula of the compounds formed when chlorine gas reacts with warm dry phosphorous. **2marks**
.....
.....
.....
- f) Chlorine gas is mixed with moist hydrogen sulphide gas, state and explain the observations **2marks**
.....
.....
.....
- g) Give one use of chlorine gas. **1mark**
.....
.....

6. Fractional distillation of air is used in the industrial manufacture of oxygen. The diagram below shows the process.



- a) What processes are taking place in chamber A, B, M and D

2marks

A

.....

B

.....

M

.....

D

.....

- b) Name;

(i) Liquid S

.....

(ii) Substance T

.....

c) Explain why part Y in chamber D is curved?

1mark

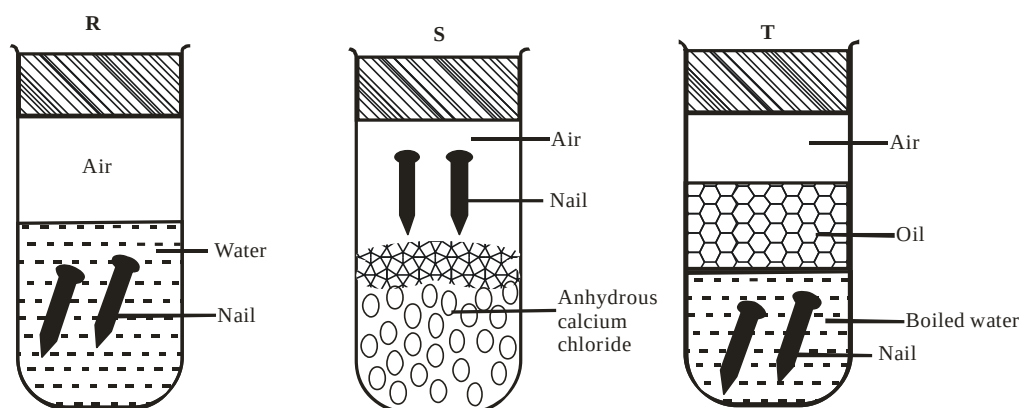
d) Give two industrial uses of oxygen gas?

2marks

e) In the laboratory preparation of oxygen, manganese (iv) oxide and hydrogen peroxide are used. Write an equation to show how oxygen gas is formed.

1mark

f) An investigation was carried out using the set-up below. Study it and answer the questions that follow.



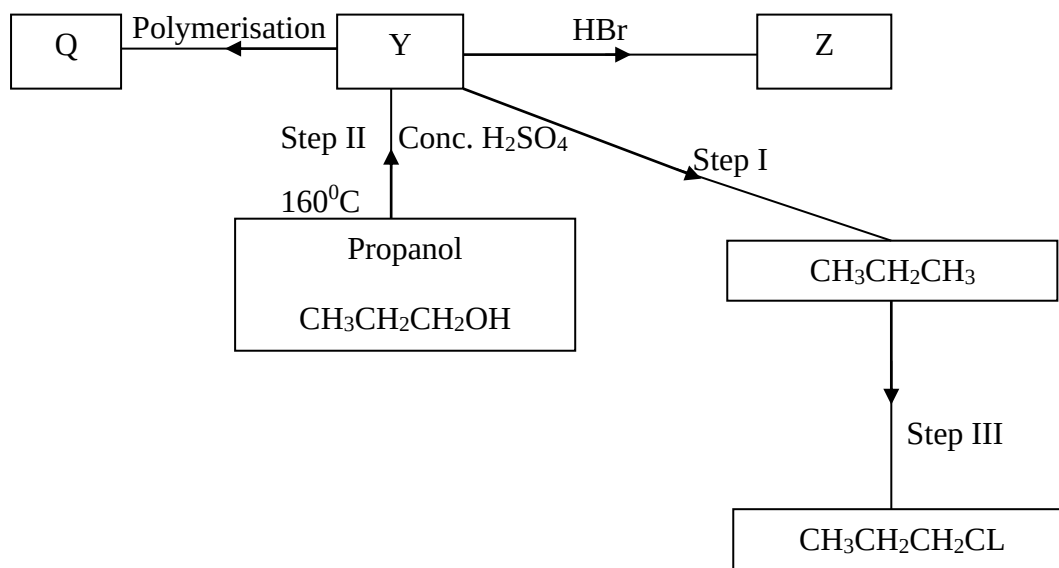
(i) State and explain what will happen in the three test-tubes R, S and T after seven days.

3marks

(ii) Give one reason why some metals are electroplated.

1mark

7. Below is a scheme of some reactions of propanol. Study it and answer the questions that follow.



- (a) State the reagents and conditions required to effect step I **3marks**
.....
.....
.....
.....
- (b) Draw the structural formulae and name product Z. **1mark**
.....
.....
.....
- (c) Name product Q **1mark**
.....
- (d) Explain how product Y can be distinguished from the product formed after step I has taken place. **2marks**
.....
.....
.....
- (e) What name is given to the process in Step II and step III **2marks**
Step II
.....
.....
Step III
.....
.....
- (f) (i) Define the term hydrocarbon **1mark**
.....
.....
- (ii) Draw the structure of 1, 2 – dibromopropane **1mark**

PREDICTION 3

NAME..... INDEX NUMBER.....

CANDIDATE SIGN DATE

KCSE PREDICTION 3

233/2

CHEMISTRY PAPER 2

TIME: 2 HOURS

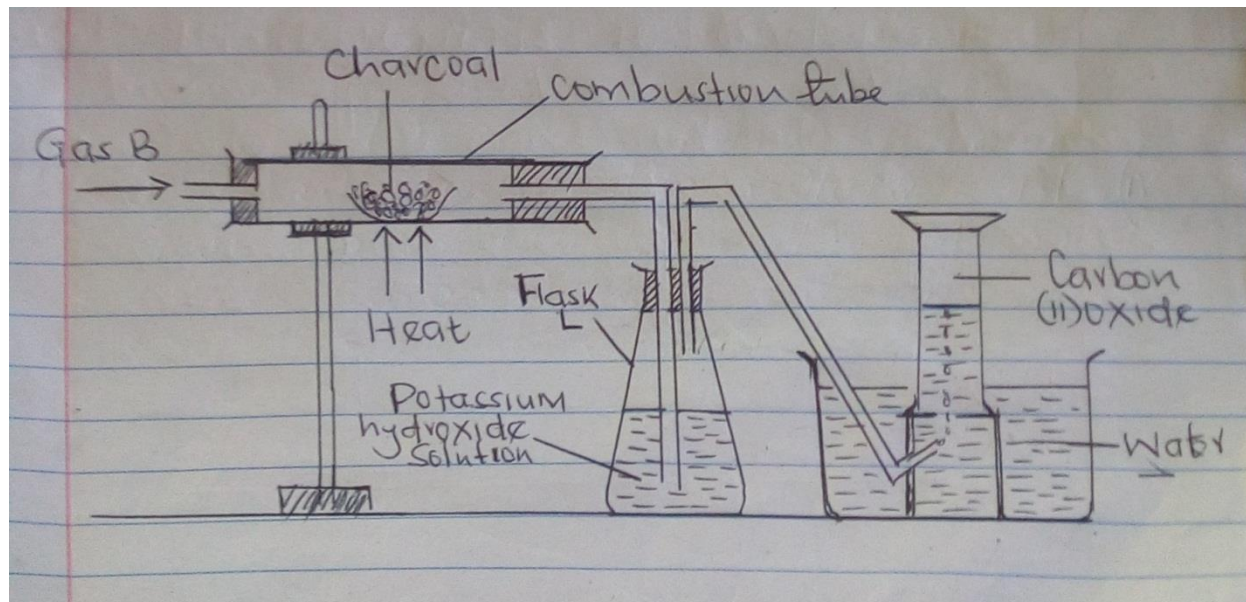
INSTRUCTIONS TO CANDIDATES

- a) Write your name and index number in the spaces provided above
- b) Answer **all** the questions in the spaces provided
- c) KNEC mathematical tables and silent electronic calculators may be used
- d) All workings must be clearly shown where necessary
- e) Candidates should answer all questions in ENGLISH

FOR EXAMINER'S USE ONLY

QUESTION	MAXIMUM SCORE	CANDIDATES SCORE
1	12	
2	14	
3	12	
4	12	
5	10	
6	10	
7	10	
Total score	80 marks	

1. A student set-up the following apparatus to prepare carbon (II) oxide from charcoal in the laboratory.



- i) State the purpose of potassium hydroxide solution (1mk)
- ii) Identify gas B (1mk)
- iii) Name two substances that react together to produce gas B (2mks)
- iv) Write balanced equations for reactions in
- i) Combustion tube (1mk)
- ii) Flask L (1mk)

v) Describe **two** simple test that you would use to distinguish between Carbon (IV) oxide and Carbon (II) oxide. (2mks)

vi) In another experiment, the student reacted charcoal with excess hot concentrated nitric (v) acid.

i) State one observation made (1mk)

ii) Write balanced equation for the reaction (1mk)

vii) State two use of Carbon (II) oxide (1mk)

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

Element	Atomic Number	M.P (⁰ c)
A	11	97.8
B	13	660
C	14	1410
D	17	-95
E	20	839

a) Write the electronic arrangement for the ions formed by elements D and A (2mks)

b) Select an element which is :

i) A poor conductor of electric current (1mk)

ii) The strongest reducing agent (1mk)

iii) Has a giant covalent structure (1mk)

iv) In which state will element B exists at 661°C Explain. (1mk)

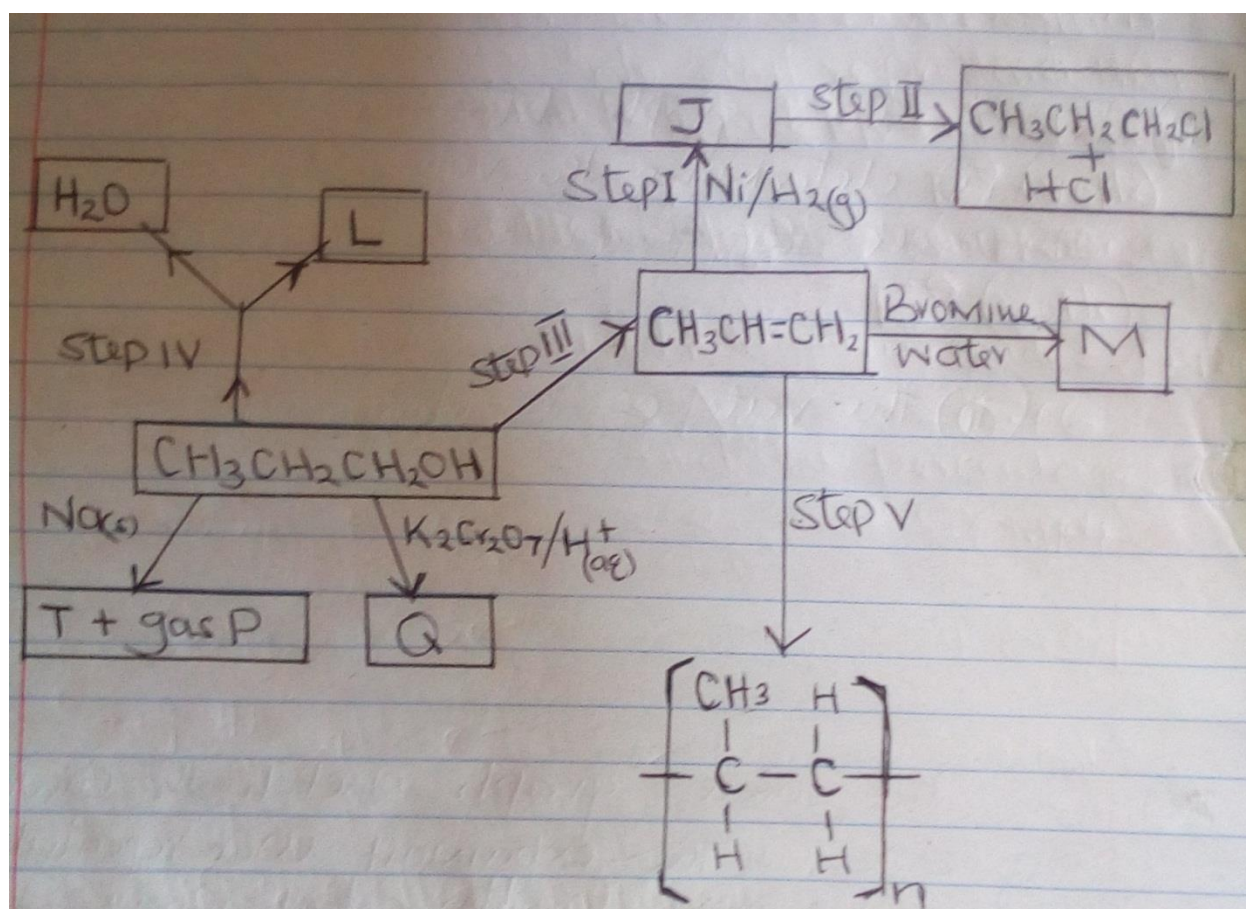
c) Compare the electrical conductivity of element A and B. Give a reason (1mk)

d) Using dots (.) and crosses (x) to represent the outermost electrons, show the bonding in the compound formed between elements C and D. (2mks)

e) Explain the difference in melting points in elements B and A (2mks)

- f) Write an equation for the reaction that takes place between element E and steam.
(1mk)
- g) Describe how a solid mixture of the Chloride of E and lead (II) Sulphate can be separated into solid sample. (2mks)

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



- (a) Name substance J and draw its structural formula: (2mks)

Name

Structural formula

(b) What reagents and conditions are necessary for:

i) Step (III) : Reagent (1mk)

Condition

ii) Step II: Reagent (1mk)

Condition

c) Name the following

i) L (1mk)

ii) Gas P (1mk)

iii) Q (1mk)

iv) M (1mk)

d) Write the equation of the reaction that occur in step (IV) (1mk)

- e) Give the name of process in step (V) (1mk)
- f) If the relative Molecular Mass of R is 21,000, determine the value of n. (C = 12.0, H = 1.0) (2mks)

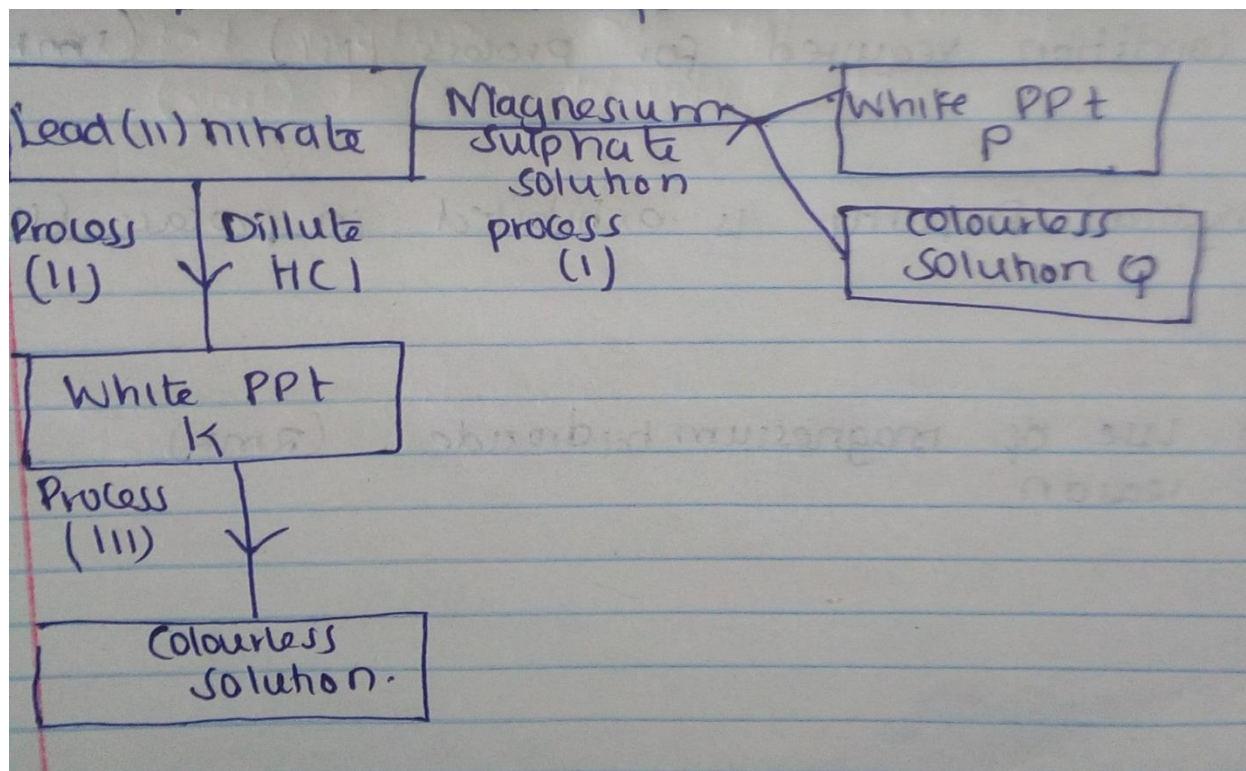
4. a) Define an electrolyte (1mk)

b) Explain why the following substances conduct an electric current (2mks)

i) Magnesium metal

ii) Molten magnesium Chloride

c) Study the reaction scheme below and answer the questions that follow.



i) Write the formula of P and Q (2mks)

ii) Write an ionic equation for the formation of P (1mk)

iii) Name process (i) (1mk)

iv) Write a balanced equation for the formation of white precipitate K (1mk)

v) State the condition required for process (III) (1mk)

vi) Which physical property is exhibited in process (III) (1mk)

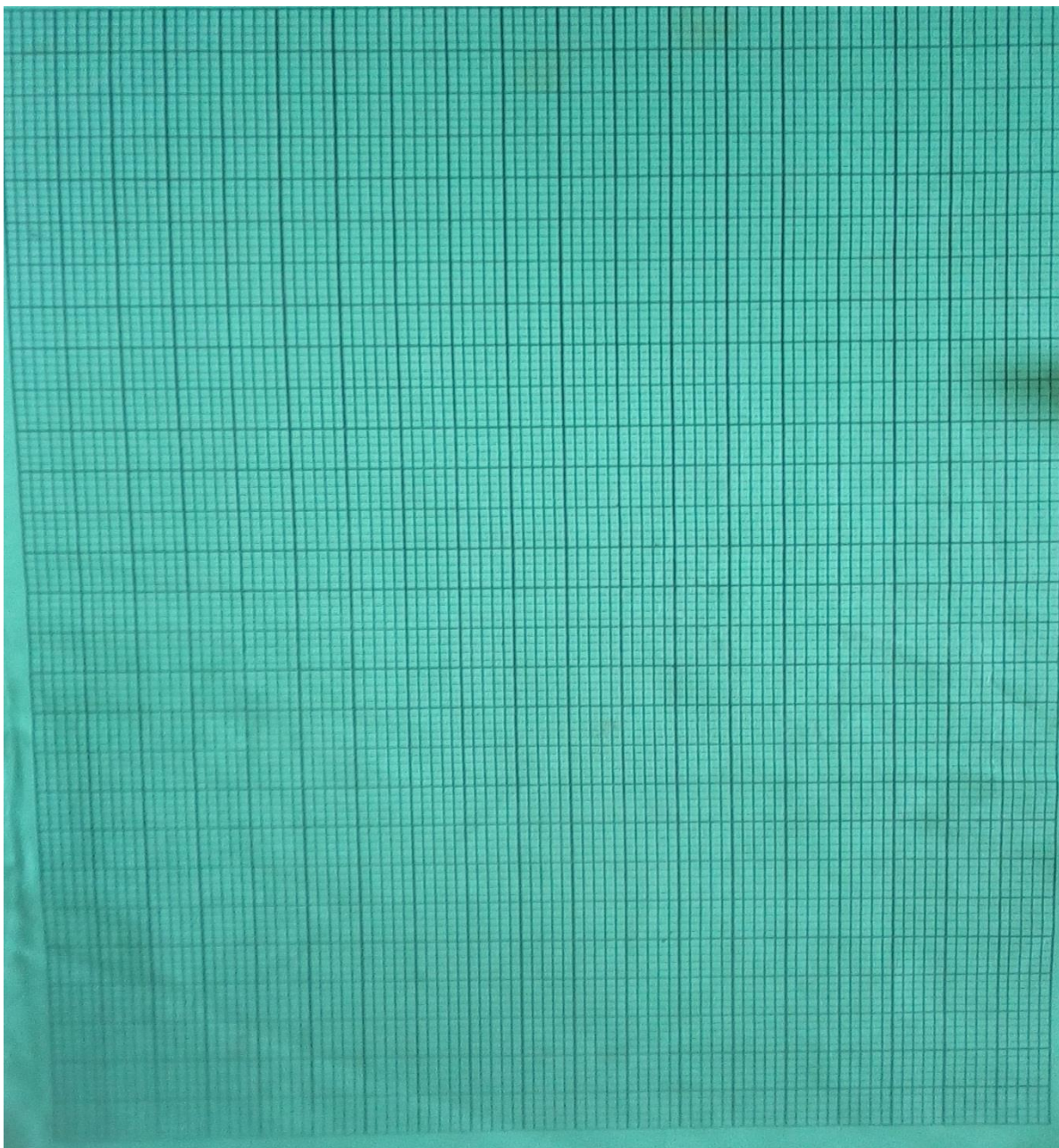
vii) State one use of magnesium hydroxide (2mks)
Give one reason

5 a) At 25⁰c, 50g of potassium nitrate were added to 100g of water to make a saturated solution.
What is meant by a saturated solution? (1mk)

b) The table below gives the solubilities of potassium nitrate at different temperatures.

Temperature ($^{\circ}\text{C}$)	12	20	28	36	44	52
Solubility g/100g of water	22	31	42	55	70	90

i) Plot a graph of the solubility of potassium nitrate (vertical axis) against temperature (3mks)



ii) Using the graph

i) Determine the solubility of potassium nitrate at 15°C . (1mk)

ii) Determine the mass of potassium nitrate that remained undissolved given that 80g of potassium nitrate were added to 100cm^3 of water and water to 40°C . (2mks)

- c) Determine the molar Concentration of potassium nitrate at 15°C .
(Assume there is no change in density of water at this temperature)
(K = 39.0, N = 14.0, O = 16.0) (3mks)

6 a) Aluminium oxide reacts with both acids and bases

i) Write an equation for the reaction between aluminium oxide and hydrochloric acid (1mk)

ii) Using the equation in (a) above, calculate the number of moles of hydrochloric acid that would react completely with 153.0g of aluminium oxide (Al = 27.0, O = 16.0) (3mks)

b) Sodium hydroxide pellet were accidentally mixed with sodium chloride, 8.8g of the mixture were dissolved in water to make one litre of solution. 50cm^3 of the solution was neutralized by 20.0cm^3 of 0.25M Sulphuric (vi) acid.

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

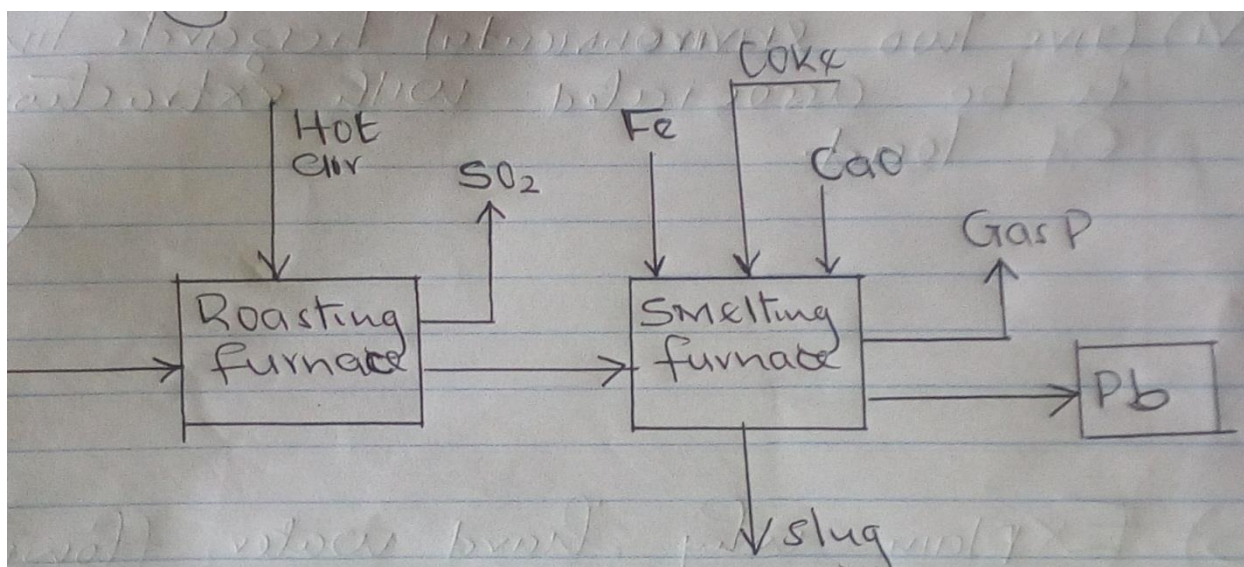
ii) Calculate the:

i) Number of moles of the substance that reacted with Sulphuric (vi) acid (2mks)

ii) Number of moles of the substance that would react with Sulphuric (vi) acid in the one litre solution. (1mk)

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

7. The flow chart below illustrates the industrial extraction of lead metal. Study it and answer the questions that follow.



a) i) Name the ore that is commonly used in the process (1mk)

ii) Explain what takes place in the roasting furnace (1mk)

iii) Identify gas P (1mk)

iv) Write the equation for the main reaction that takes place in the smelting furnace. (1mk)

- v) What is the purpose of adding iron in the smelting furnace? (1mk)
- vi) Give two environmental hazards likely to be associated with extraction of lead.
(2mks)
- b) Explain why hard water flowing in lead pipes may be safer for drinking than soft water flowing in the same. (2mks)
- c) State one use of lead other than the making of lead pipes (1mk)

PREDICTION 4

Name Index No.....

School..... Date.....

233/2
CHEMISTRY
Paper 2
THEORY
2 hours

KCSE PREDICTION 4 Kenya Certificate of Secondary Education

Instructions

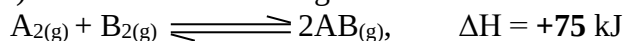
Write your name, Index number and class in the spaces provided above.
Answer **ALL** the questions in the spaces provided.
Mathematical tables and silent electronic calculators may be used.
All working **MUST** be clearly shown where necessary.

For Examiner's use only

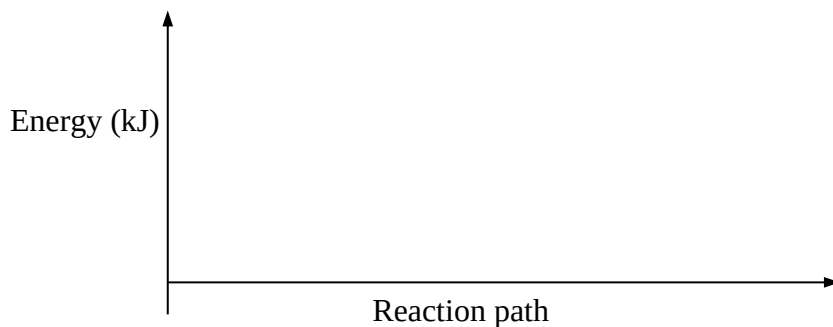
Question	Maximum Score	Candidate's Score
1	11	
2	12	
3	12	
4	12	
5	11	
6	11	
7	11	
Total	80	

*This question paper has 10 printed pages.
Confirm that all the pages are printed as indicated and
No questions are missing.*

1. a) Consider the following reaction:



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



b) Given that; $\Delta H_f (\text{Al}_2\text{O}_3) = -1590 \text{ kJmol}^{-1}$

$$\Delta H_f (\text{Cr}_2\text{O}_3) = -1134 \text{ kJmol}^{-1}$$

Calculate the heat of reaction for; $2\text{Al}_{(s)} + \text{Cr}_2\text{O}_{3(s)} \longrightarrow \text{Al}_2\text{O}_3 + 2\text{Cr}_{(s)}$ **(2mks)**

c) The following data was obtained during an experiment

Mass of ethanol burnt = 0.2g

Mass of water in the calorimeter = 200g

Specific heat capacity of water = $4.2 \text{ Jg}^{-1}\text{K}^{-1}$

Initial temperature of water = 23.5°C

Final temperature of water = 28.0°C

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

.....

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

.....

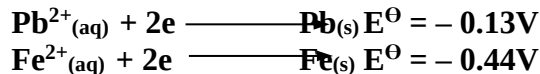
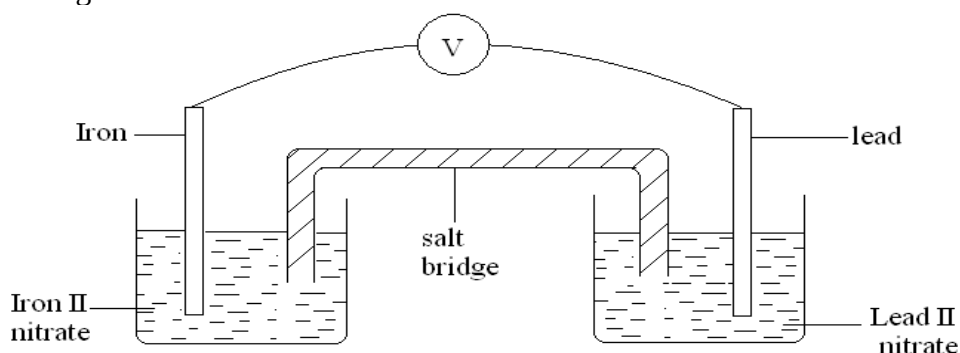
iii) Two assumptions were made in calculating the enthalpy of combustion for ethanol. **State them.** (1mk)

.....

iv) **Determine** the molar enthalpy of combustion of ethanol. (C= 12, H=1, O=16) (2mks)

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

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



- a) **Calculate** the e.m.f of the cell. (1mk)
- b) **Sodium chloride is used as the salt bridge. State the** two functions of the salt bridge. (2mks)
- c) **Show** the direction of the electron flow in the external circuit. (1mk)
- d) The e.m.f of the cell will reduce with time. Give a reason for this. (1mk)

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

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

Anode. (2mks)

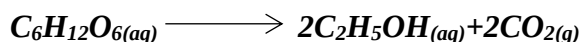
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Cathode. (2mks)

.....
.....

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

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



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

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

.....
.....

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

.....
.....

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

.....
.....

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

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

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

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

Compound	Formulae
A	$\text{C}_2\text{H}_4\text{O}_2$
B	$\text{C}_2\text{H}_6\text{O}$
C	C_2H_6

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

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

.....

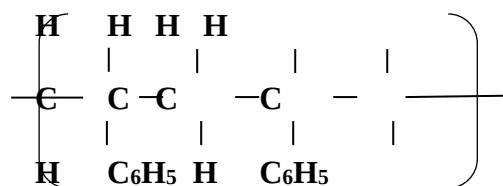
- ii) Gives effervescence with sodium hydrogen carbonate. (1mk)

.....

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

.....

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



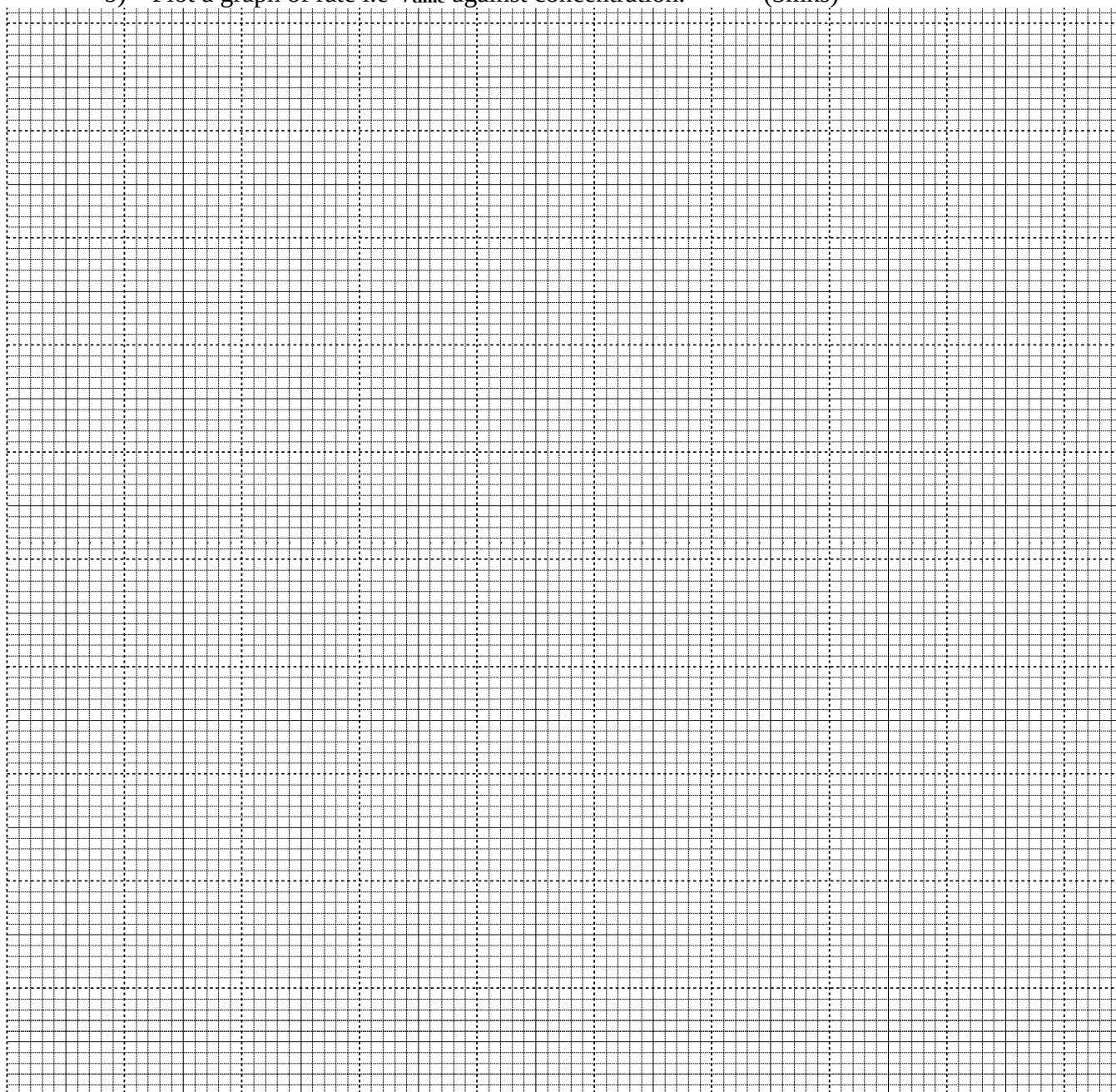
- (i) Draw the structure of the monomer unit of polystyrene. (1mk)

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

4. An experiment was carried out using magnesium ribbon and dilute hydrochloric acid of different concentrations. The time needed to produce 50cm³ of the gas for every experiment was recorded in a table.

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

- a) Complete the table above for $\frac{1}{\text{time}}$. (4mks)
b) Plot a graph of rate i.e $\frac{1}{\text{time}}$ against concentration. (3mks)



- c) From your graph determine the concentration needed to produce 50cm³ of hydrogen gas when time is 15.0 seconds (1mks)

.....

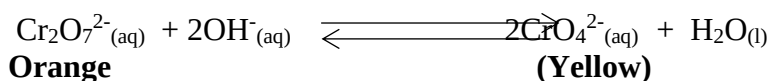
.....

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

.....

.....

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



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

.....

.....

.....

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

.....

.....

.....

.....

.....

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

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

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

.....

.....

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

.....

.....

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

.....

.....

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

.....

.....

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

				Q				
X			B	H		M	T	
Y		A					V	
Z							S	

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

.....

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

.....

.....

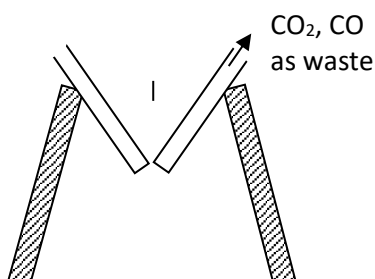
- c) **Explain** why the atomic radius of T is smaller than that of M. (2mks)

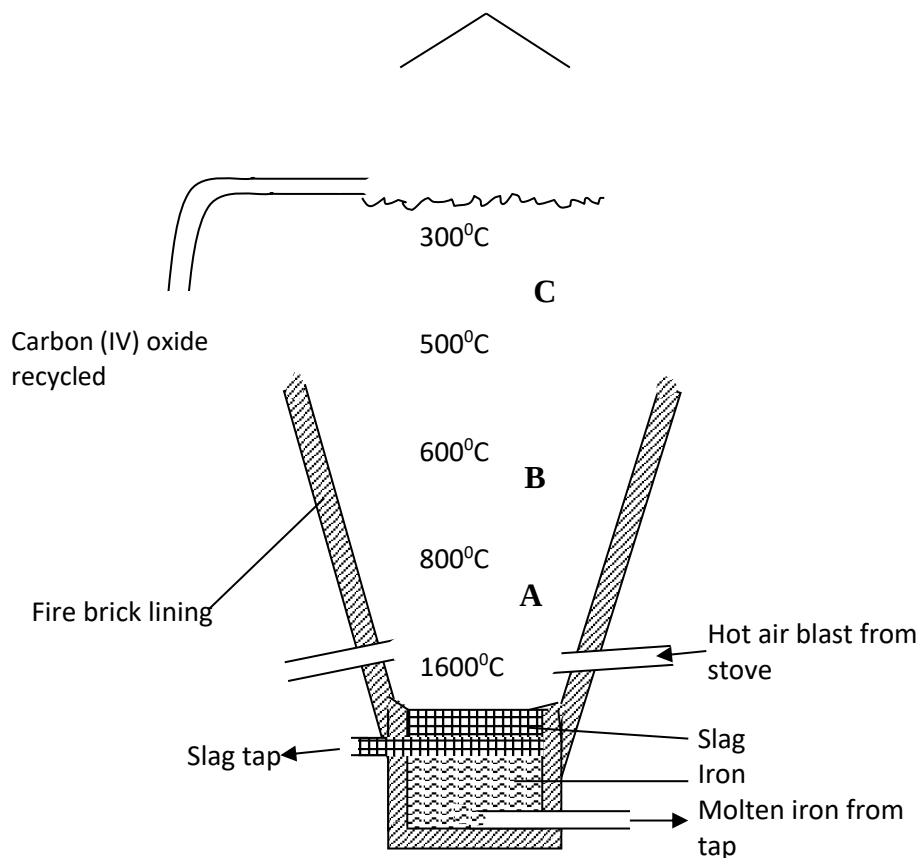
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.....

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

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





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

.....

.....

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

.....

.....

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

.....

.....

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

A.....

B.....

C

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

.....

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

.....

.....

.....

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

.....

.....

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

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

a) Identify gas L (1mk)

.....

.....

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

.....

.....

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

.....

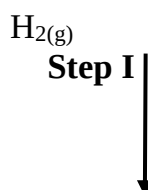
d) Write an ionic equation for the reaction with copper(II) sulphate forming the deep blue solution (1mk)

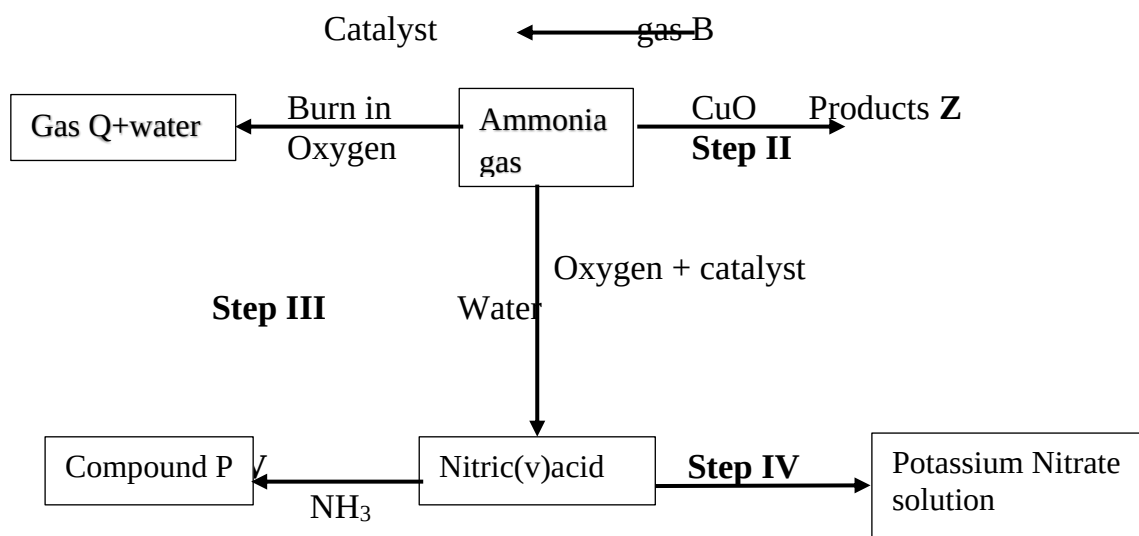
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b) Study the flow chart below and answer questions that follow:





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

.....

.....

(ii) Name the catalysts used in; (1mk)

a) Step I

.....

b) Step III

.....

(iii) Write chemical equations for reactions in; (3mks)

a) Step I

.....

b) Step II

.....

c) Step V

.....

(iv) Identify any other gas that can be used instead of Ammonia in step II (1mk)

.....

(v) State one use of gas Q (1mk)

.....

.....

PREDICTION 5

Name..... Adm no.....

233/2

CHEMISTRY

PAPER 2

(THEORY)

TIME: 2 HOURS

KCSE PREDICTION 5

Kenya Certificate of Secondary Education (K.C.S.E)

INSTRUCTIONS:

- Write your name and admission number in spaces provided above
- Answer **ALL** the questions in the spaces provided
- Mathematical tables and electronic calculators may be used
- All working must be clearly shown where necessary.

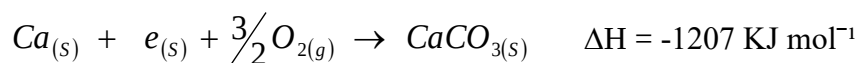
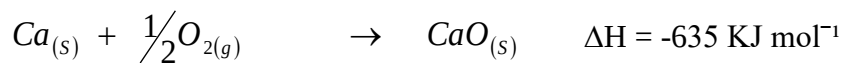
FOR EXAMINERS USE ONLY

Question	Maximum Score	Candidates score
1	12	
2	13	
3	13	
4	10	
5	12	
6	10	
7	10	
TOTAL SCORE	80	

This paper consists of 12 printed pages.

Candidates should check to ensure that all pages are printed as indicated and no questions are missing

1. (a) Use the information below to answer the questions that follow.



Calculate the enthalpy change for the reaction.



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

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

Volume of water used = 500cm³

Initial temperature of water = 25°C

Final temperature of water = 44.5°C

Mass of ethanol + lamp before burning = 121.5g

Mass of ethanol + lamp after burning = 120.0g

Calculate the

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

(1 mark)

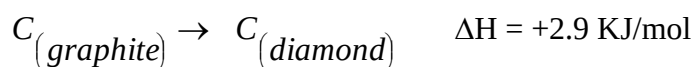
(ii) Molar heat of combustion of ethanol (C = 12, O = 16, H = 1).

(2 marks)

(d) Write the thermo equation for the complete combustion of ethanol.

(1 mark)

(e) At 298K and one atmosphere pressure, graphite changes into diamond according to the equation.



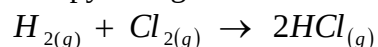
In the space provided, sketch a simple energy level diagram for the above change.

(2 marks)

(f). Study the information in the table below then answer the questions that follows.

Bond	Bond energy (kJmol ⁻¹)
H – H	435
Cl – Cl	243
H – Cl	431

Calculate the enthalpy change for the reaction.



(2 marks)

2. (a) At 25°C 50g of substance X were added to 100g of water to make a saturated solution.

What is meant a saturated solution?

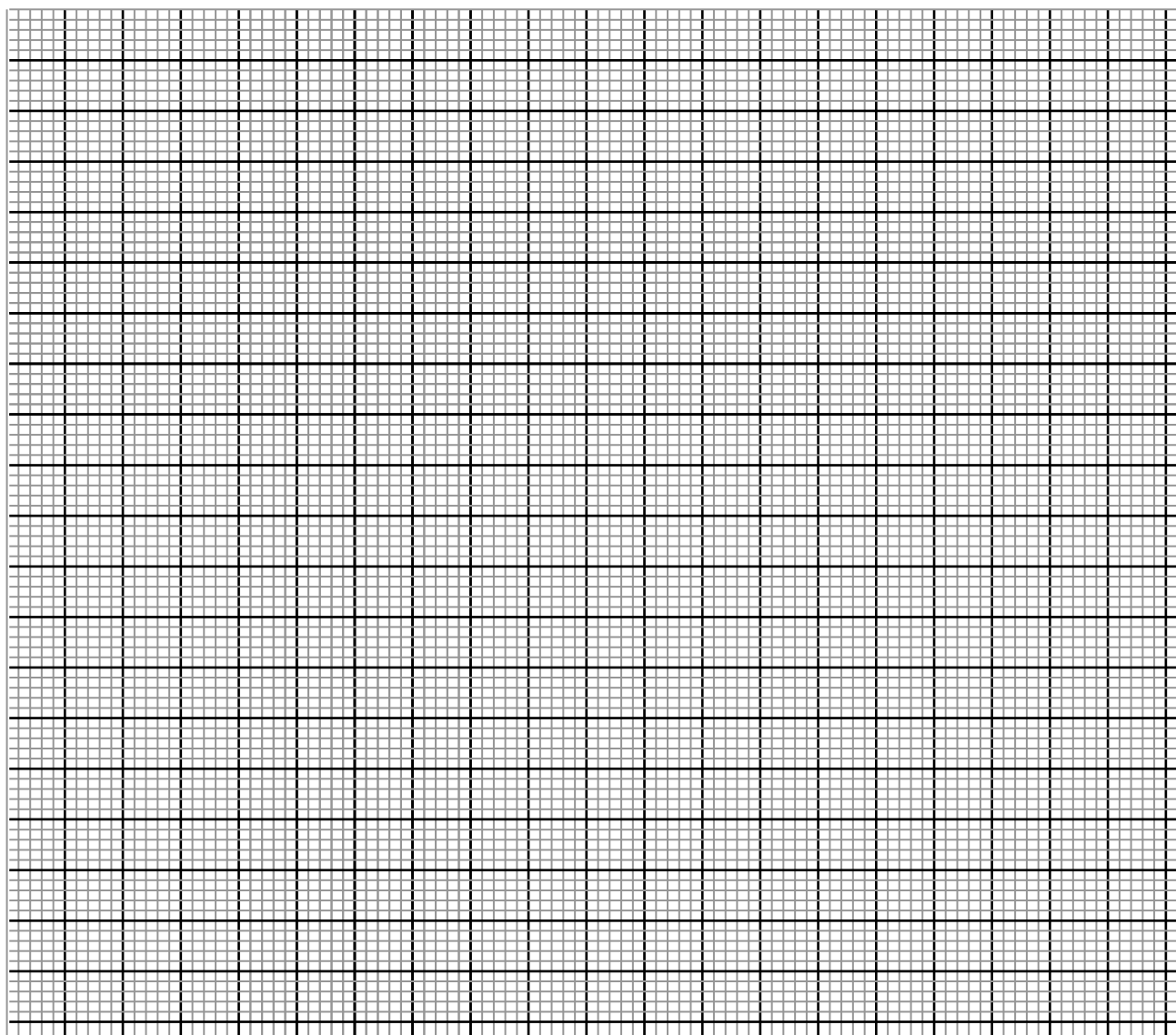
(1 mark)

(b) The table **below** gives the solubilities of substance X at different temperatures.

Temperature °C	14	24	33	40	46	52
Solubility g/100g H ₂ O	24	36	50	62	72	90

(i). Plot a graph of the solubility of substance X (vertical axis) against temperature.

(3 marks)

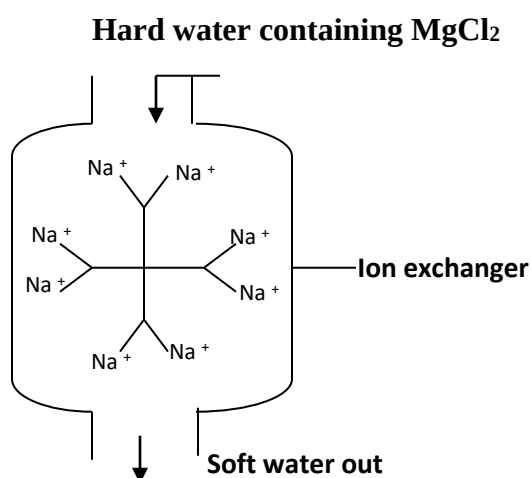


(ii) Using the graph.

- I. Determine the solubility of substance X at 20°C. **(1 mark)**
- II. Determine the mass of substance X that remained undissolved given that 90g of substance X were added to 100cm³ of water and warmed to 35°C. **(2 marks)**

III. Calculate the molarity of the solution at 30°C. (Relative formula mass of X = 122.5). **(3 marks)**

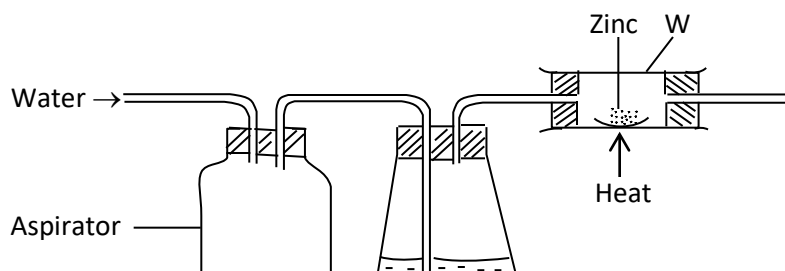
(c) The figure below shows an ion exchanger used to soften hard water



(i) Draw the ion exchanger and show how it will appear at the end of softening process. **(2 marks)**

(ii) How is the ion exchanger recharged after exhaustion **(1 mark)**

3.(a) Below is an incomplete diagram of a set-up of the apparatus used to obtain nitrogen gas from the air.



(i) Complete the diagram to show how nitrogen gas is collected. (1 mark)

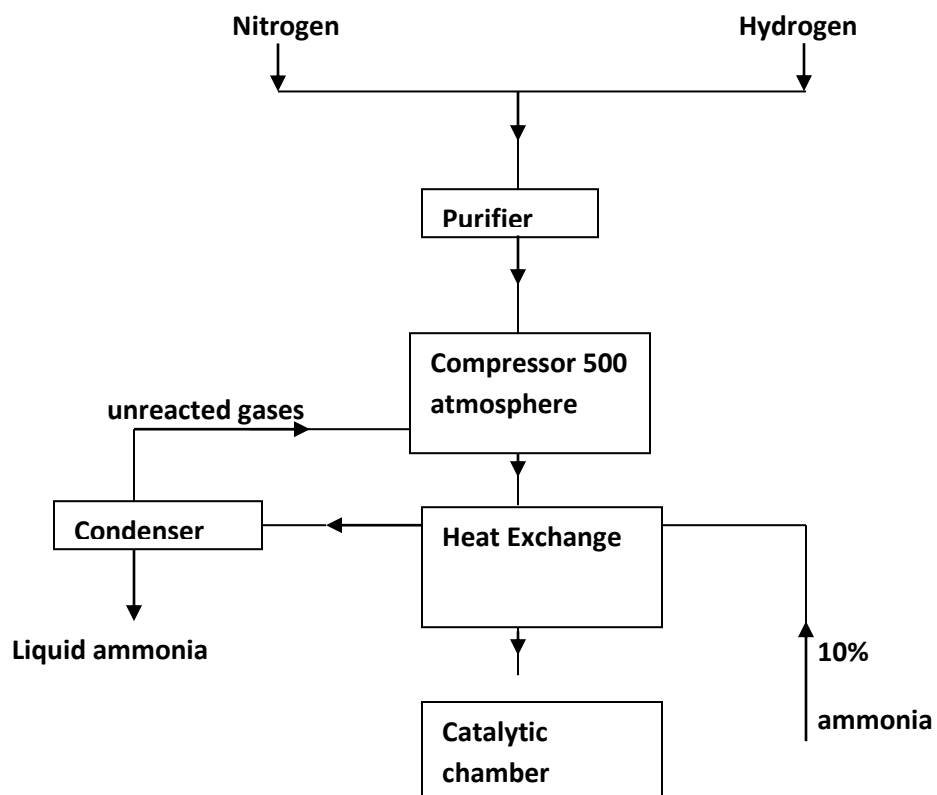
(ii) State the role of the following:

I Water entering the aspirator. (1 mark)

II Potassium hydroxide solution. (1 mark)

(iii).Write a chemical equation for the reaction that takes place in combustion tube. (1 mark)

(b).The diagram below represents the Haber's process for the manufacture of ammonia. Study it and answer the questions that follow.



(i) Name any **two** impurities removed by the purifier. _____ (2 marks)

(ii) Name the catalyst used in the process (1 mark)

(iii) In the Haber's process the conversion of nitrogen and hydrogen into ammonia is only 10%.

The remaining unreacted gases are recycled. What is the advantage of recycling. (1mark)

iv) A part from the catalyst and pressure of 500 atmospheres, name any other condition required for this process. (1mark)

(c) Give any **two** uses of ammonia (1 mark)

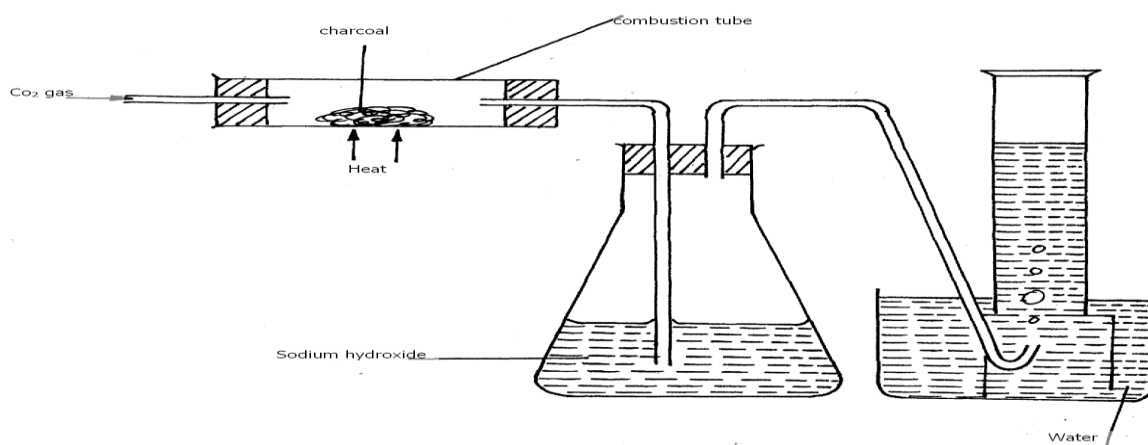
d) In the manufacture of nitric (V) Acid from ammonia and air, ammonia is catalytically oxidized to nitrogen (II) oxide

(i) Name the catalyst used in the reaction. (1mark)

(ii) Write a balanced chemical equation for the reaction between ammonia and air. (1mark)

(iii) State **one** environmental problem likely to be faced in an area where nitric (v) acid manufacturing plant is located. (1 mark)

4. 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. (1 mark)

(ii) Name another chemical substance that can be instead of sodium hydroxide . **(1 mark)**

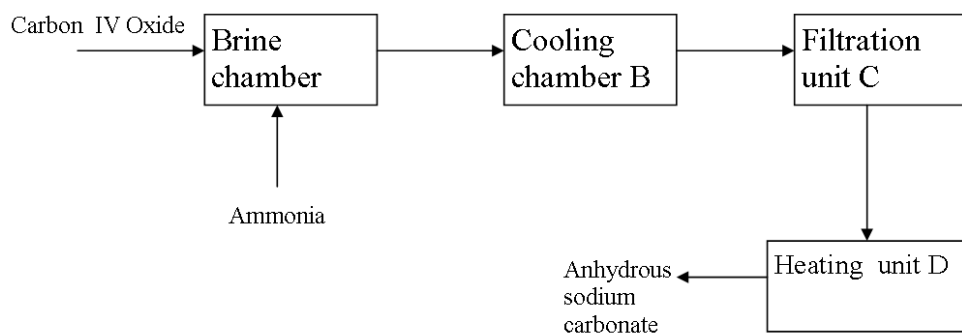
(iii) Describe a simple chemical test to distinguish between carbon (II) Oxide and carbon (IV) Oxide **(2 marks)**

(iv) What is the purpose of sodium hydroxide in the above set-up **(1 mark)**

(v) What property of the gas makes it possible to be collected as shown above? **(1 mark)**

(vi) State one use of carbon (II) oxide **(1 mark)**

(b) In order to prepare sodium carbonate in the laboratory, students passed carbon (IV) oxide and ammonia gas into brine as shown in the flow diagram below. Use it to answer the questions that follow:

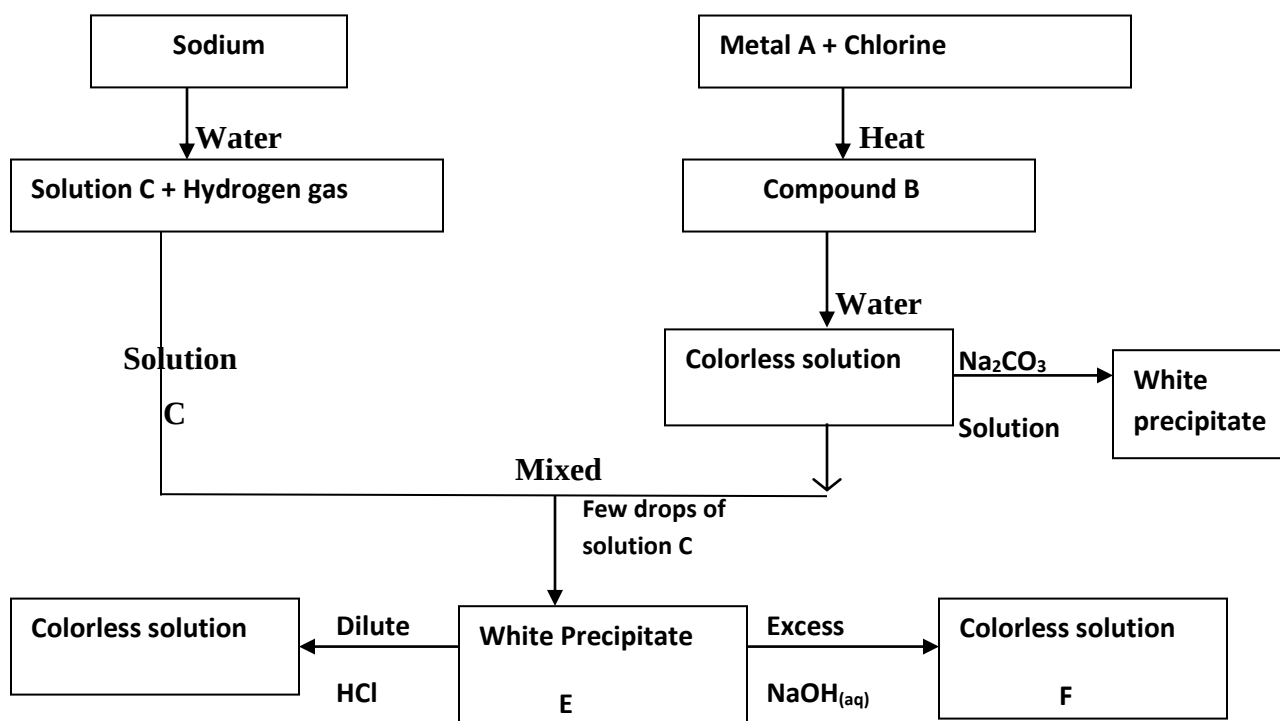


(i) Why is the mixture obtained in chamber A cooled down in chamber B? **(1 mark)**

(ii) Write an equation for the reaction that occurs in the heating chamber D **(1 mark)**

(iii) Give a reason why it is difficult to prepare potassium carbonate by the same method. **(1 mark)**

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



(a) Give the name and formula of the following.

(i) White precipitate **E**

Name

(1 mark)

Formula

(1 mark)

(ii) Colourless solution **F**

Name

(1 mark)

Formula

(1 mark)

(b) What property is exhibited by white precipitate E when it reacts with Sodium hydroxide and HCl acid.

(1mark)

(c) Write an ionic equation for the reaction between white precipitate E and excess sodium hydroxide solution.

(1 mark)

(d) You are provided with.

- i) Potassium carbonate solid
- ii) Zinc hydroxide
- iii) Nitric (v) acid
- iv) Distilled water

State briefly how you would prepare solid zinc carbonate using the reagents given.

(3 marks)

.....

.....

.....

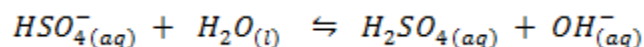
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(e) Distinguish between a weak acid and a strong acid giving an example of each.

(1 mark)

(f). Identify an acid in the forward reaction given by the equation below:



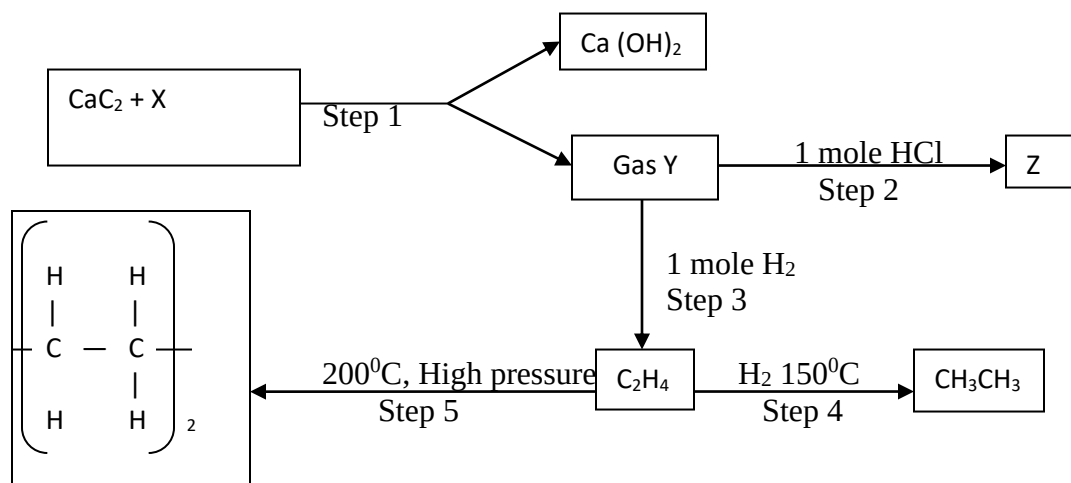
(1 mark)

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

				S	U	V	
P	R			T	X	W	
Q							

- (a) Which of the elements has the largest atomic radius? Explain. (2 marks)
- (b) Identify the most reactive non-metal. Explain. (2 marks)
- (c) Compare the atomic radius of P and R. (1 mark)
- (d) Give the formula of one stable ion with an electron arrangement of 2.8 which is:
- (i) Negativity charged divalent ion. (2 marks)
- (ii) Positively charged monovalent. (1 mark)
- (e) Given that the mass number of W is 40. Write down the composition of its nucleus. (1 mark)
- (f) Write the formula of the compounds formed between.
- (i) Element R and X. (1 mark)
- (ii) Give **one** property of the structure formed when R and X bond. (1 mark)

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

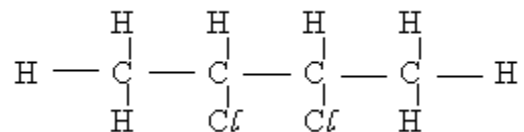


- (i) Identify reagent X. (1 mark)
- (ii) Draw the structural formula of gas Y. (1 mark)

(iii) What name is given to the process that takes place in step 5?

(1 mark)

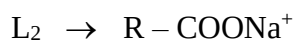
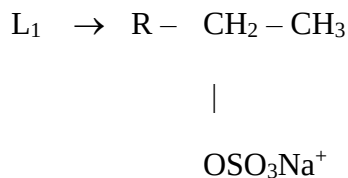
(b) An organic compound T reacts with chlorine gas in the presence of u.v light to form compound U. The structural formula of compound U is shown below.



Name the organic compound T and draw its structural formula.

(2marks)

(c).The structure below represents two cleansing agents, L₁ and L₂.



(i) Identify each of the two cleansing agents, L₁ and L₂.

L₁

(½mark)

L₂

(½mark)

(ii). State a disadvantage of each of the above cleansing agents.

L₁

(½mark)

L₂

(½mark)

(d) In an experiment an organic compound was reacted with absolute ethanol in the presence of concentrated sulphuric (VI) acid to form a compound whose formula is CH₃ CH₂ CH₂ COOCH₂ CH₃. Name

I. The type of reaction that took place.

(1 mark)

II. The name of the organic compound to which the compound belonged.

(1 mark)

(e) Write the structural formula and give the systematic name of the acid used in the above experiment.

(1 mark)

PREDICTION 6

NAME: INDEX NO:

233/2

CHEMISTRY

PAPER 2

TIME: 2 HOURS

KCSE PREDICTION 6

Kenya Certificate of Secondary Education

INSTRUCTIONS TO CANDIDATES

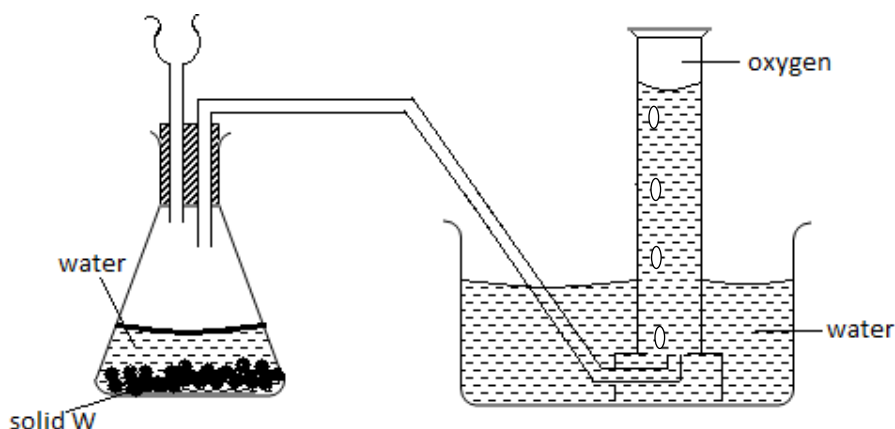
- Write your name and index number in the spaces provided.
- Answer **all** questions in the spaces provided
- KNEC mathematical tables and silent electronic calculators **may** be used for calculations.
- All workings **must** be clearly shown where necessary.
- Candidates should check the question paper to ascertain all the pages are printed as indicated and no questions are missing.

For Examiners Use Only

Questions	Maximum Score	Score
1		
2		
3		
4		
5		
6		
7		
8		
TOTAL	80	

*This paper consists of **12** printed pages. Candidates should check the question paper to ascertain that all pages are printed as indicated and that no pages are missing.*

1. The diagram below shows a set up used by a student in an attempt to prepare collect oxygen gas



- a) i) Identify and correct the mistakes in the set up to enable the preparation and collection of the gas. (2mks)

.....

.....

- ii) Identify solid w. (1mk)

.....

- b) A piece of phosphorous was burnt in excess air. And the product dissolved in hot water to make a solution.

- i) Write an equation for the burning of phosphorous in excess air. (1mk)

.....

- ii) The solution obtained in (b) above was found to have a pH of 2.0. Give reasons for this observation. (1mks)

.....

.....

- c) Explain why cooking pots made of aluminium do not corrode easily when exposed to air. (1mk)

.....

.....

.....

- d) The reaction between sulphure (IV) Oxide and oxygen to form Sulphur (VI) Oxide is an exothermic reaction, which can be represented by the equation below;



A factory manufacturing sulphuric (VI) acid by contact process produces 350kg of sulphur(VI)oxide per day (conditions for the reaction; catalyst, 2 atmospheres pressure and temperatures between 400 – 500 °C.)

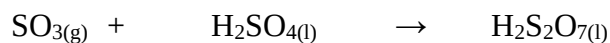
i) What is meant by an exothermic reaction? (1mk)

.....

ii) How would the yield per day of sulphur trioxide be affected if temperatures lower than 400°C are used? Explain. (1mk)

.....

iii) All the sulphur (VI) Oxide produced was absorbed in concentrated sulphuric acid to form oleum.



Calculate the mass of oleum that was produced per day. (S = 32.0, O= 16: H = 1.0)(3mks)

2. Study the table below and answer the questions that follow:

Compounds	Melting point °C	Boiling points °C
C ₂ H ₄ O ₂	16.6	118
C ₃ H ₆	-185.0	-47.7
C ₃ H ₈ O	-127	97.2
C ₅ H ₁₂	-130	36.3
C ₆ H ₁₄	-95.3	68.7

(a) (i) Which of the compounds is a solid at 10°C. Explain (1mk)

-
-
- (ii) Choose two compounds which are members of the same homologous series and explain the difference in their melting points (3mks)

-
-
-
- (iii) The compound C_3H_8O is an alcohol. How does its solubility in water differ from the solubility of C_5H_{12} in water? Explain (2mks)

-
-
- (b) Complete combustion of one mole of a hydrocarbon produces four moles of carbon (IV) oxide and four moles of water.

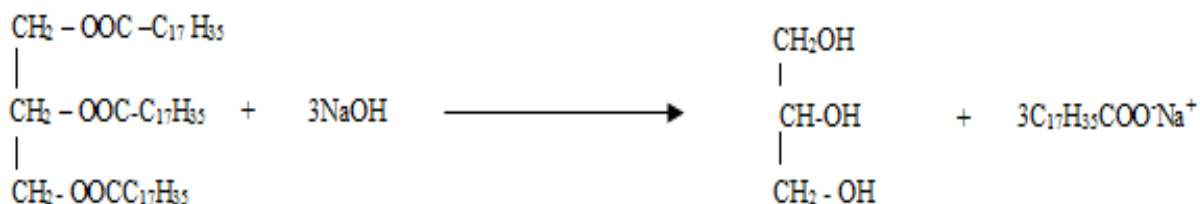
- (i) Write the formula of the hydrocarbon (1mk)

-
- (ii) Write the equation for the complete combustion (1mk)

-
- (c) (i) In a reaction, an alcohol "J" was converted to hex -1-ene. Give the structural formula of alcohol "J" (1mk)

-
- (ii) Name the reagent and conditions necessary for the reaction in C (ii) above (1mk)

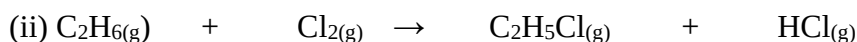
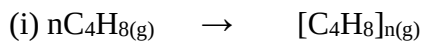
-
- (d) Compound K reacts with sodium hydroxide as shown below



- (i) What type of reaction is represented by the equation above (1mk)

.....
(ii) To what class of compound does “K” belong? (1mk)
.....

(e) The following equations represent two different types of reactions



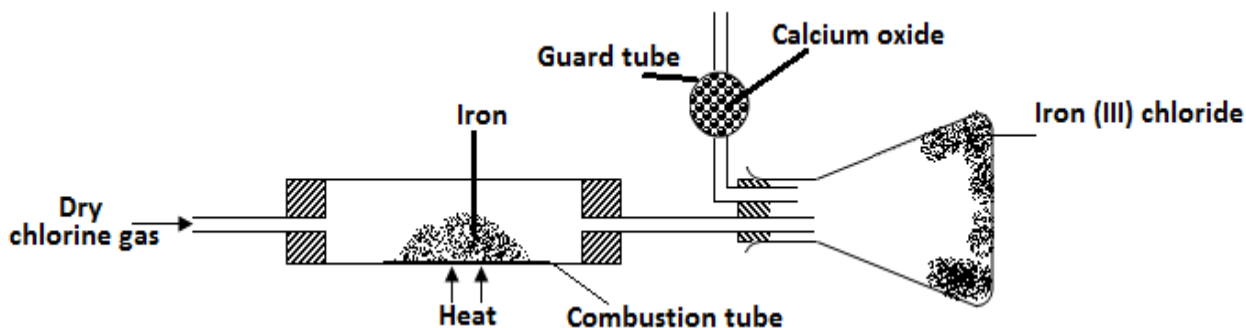
State the type of reaction represented by (i) and (ii) (1mk)

i)

ii)

3. (a) Give the name of one reagent which when reacted with concentrated hydrochloric acid produces chlorine gas (1mk)

.....
(b) A student set out to prepare iron (III) chloride using apparatus shown in the diagram below



(i) Explain why it is necessary to pass chlorine gas through the apparatus before heating begins? (1mk)
.....
.....

(ii) What property of iron (III) chloride makes it possible to be collected as shown in the diagram (1mk)
.....

- (iii) The total mass of iron (III) chloride formed was found to be 0.5g. Calculate the volume of chlorine gas that reacted with iron. (Fe = 56, Cl = 35.5 and molar gas volume at r.t.p is 24,000 cm³) (3mks)

- (c) When hydrogen sulphide gas passed through a solution of iron (III) chloride the following observation was made;
The colour of the solution changed from reddish brown to green and yellow solid was deposited. Explain these observations (2mks)

.....
.....

- (d) State and explain the observations that would be made if a moist blue-litmus paper was placed in a gas jar full of chlorine gas (2mks)

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

- (e) Study the information to answer the questions that follow. The letters do not represent the actual symbols of the elements.

Elements	Atomic number	Melting point (°C)
L	11	97.8
M	13	660
N	14	1410
C	17	-101
R	19	63.7

- a) i) Write the electron arrangement for the ions formed by elements “M” and “C” (1mk)

M

C

ii) State the type of the bond that will be formed when M and C react. (1mk)

.....

iii) In which group and period of the periodic table does element “R” belongs? (1mk)

.....

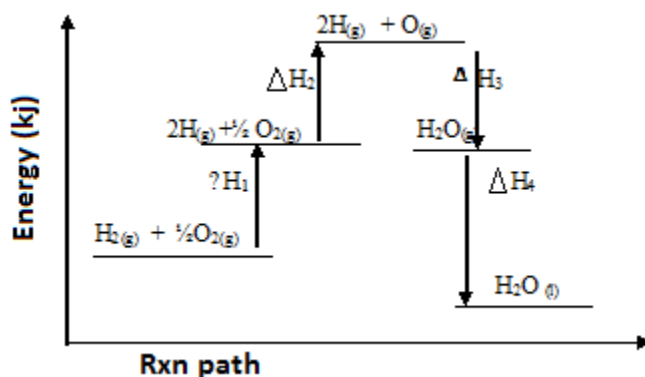
iv) Element R loses its outermost electrons more readily than “L”. Explain (1mk)

.....

.....

v) Using dots and crosses to represent electrons, show bonding in the compound formed between N and C. (2mks)

4. Study the energy level diagram below and answer the questions that follow.



(a) (i) Which ΔH values have a positive sign. (1mk)

.....

(ii) Which ΔH values have a negative sign (1mk)

.....

(iii) What chemical changes is being represented by (2mks)

ΔH_1

ΔH_4

(b) The hydration energy of Al^{3+} and Cl^- are -4690 and -364kJ mol^{-1} respectively. The heat of solution of aluminium chloride is -332kJ mol^{-1} .

(i) Calculate the lattice energy of aluminium chloride (2mks)

(ii) Draw an energy level diagram for dissolving of aluminium chloride (2mks)

(c) When one mole of butanol is burnt, 2676kJ are liberated

(i) Write a chemical reaction for combustion of butanol. (1mk)

.....

(ii) Considering the following heats of combustion

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

$$\Delta H^\circ \text{C (H}_2\text{)}_{(g)} = -286\text{kJ mol}^{-1}$$

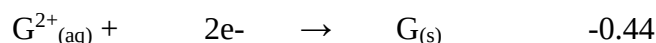
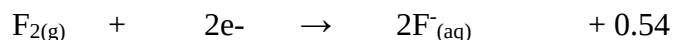
$$\Delta H^\circ \text{C (Butanol)} = -2676\text{kJ mol}^{-1}$$

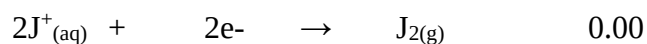
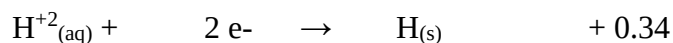
Draw an energy cycle for the above energy changes (2mks)

(iii) Calculate the heat of formation of butanol (2mks)

5. (a) The equations below shows the standard reduction potential for four half cell. Study it and answer the questions that follow. Letters are not actual symbols of the element.

E° Volts

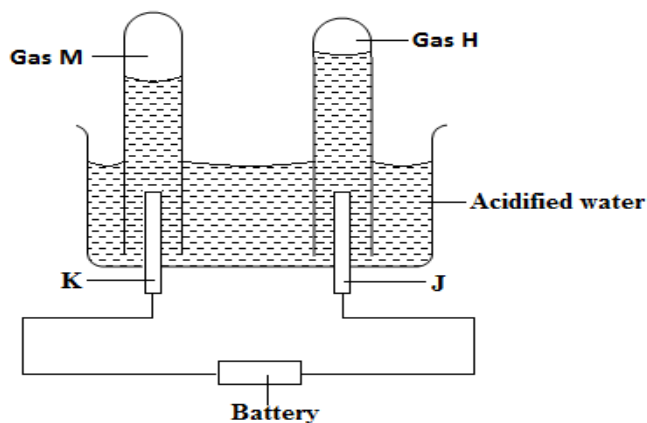




- i. Write the equation for the reaction which takes place when solid “G” is added to a solution containing H^{2+} (ions) (1mk)
-

- ii. Calculate the E° value for the reaction in (ii) above (1mk)

(b) The diagram below shows the apparatus used to electrolyze acidified water to obtain hydrogen and oxygen gases. Study it and answer the questions that follows?



- i. Identify the electrodes marked K and J (1mk)

K

J

- ii. Write the equation that led to the production of gas (1mk)

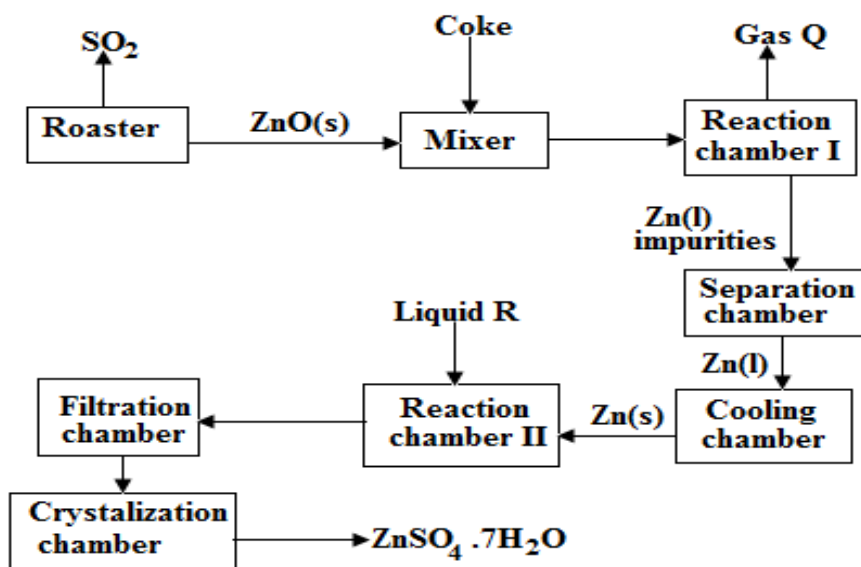
M

H

- iii. Explain why hydrochloric acid is not used to acidify the water (1mk)
-
-

- (c) During electrolysis of aqueous copper (II) sulphate 144750 coulombs of electricity were used. Calculate the mass of copper metal that was obtained ($\text{Cu} = 64$, 1 Faraday = 96500 Coulombs) (2mks)

6. The flow chart illustrates the extraction of zinc and preparation of Zinc (II) sulphate crystals. Study it and answer the questions that follow



(a)(i) Name

- I. Gas Q (1mk)
- II. Liquid R (1mk)

(ii) Write an equation for the reaction that takes place in

Chamber I (1mk)

The Roster (1mk)

Chamber II (1mk)

(iii) Given that the zinc sulphide ore contain 45% of Zinc sulphide by mass, calculate

- I. The mass in grains of Zinc sulphide that would be obtained from 250 kg of the ore. (1mk)

II. The volume of sulphur (IV) oxide (SO₂) that would be obtained from the above mass of zinc sulphide at room temperature and pressure (S = 32.0, molar gas volume = 24 dm³). (2mks)

III. The mass of zinc metal that would be obtained in lab above (Zn = 65.4) (1mk)

(b) In such an experiment sulphur (IV) Oxide may keep escaping to the atmosphere. Explain how this could affect the environment. (1mk)

.....

(c) Suggest one other manufacturing plant that could be set up near Zinc extraction plant. (1mk)

.....

7. (a) State the difference between chemical and nuclear reactions (1mks)

.....

(b) Below is a radioactive decay series starting from

$^{214}_{83}\text{Bi}$ and ending at $^{206}_{82}\text{Pb}$. Study it and answer the questions that follow



(i) Identify the particle emitted in step I and III. (2mks)

I

II

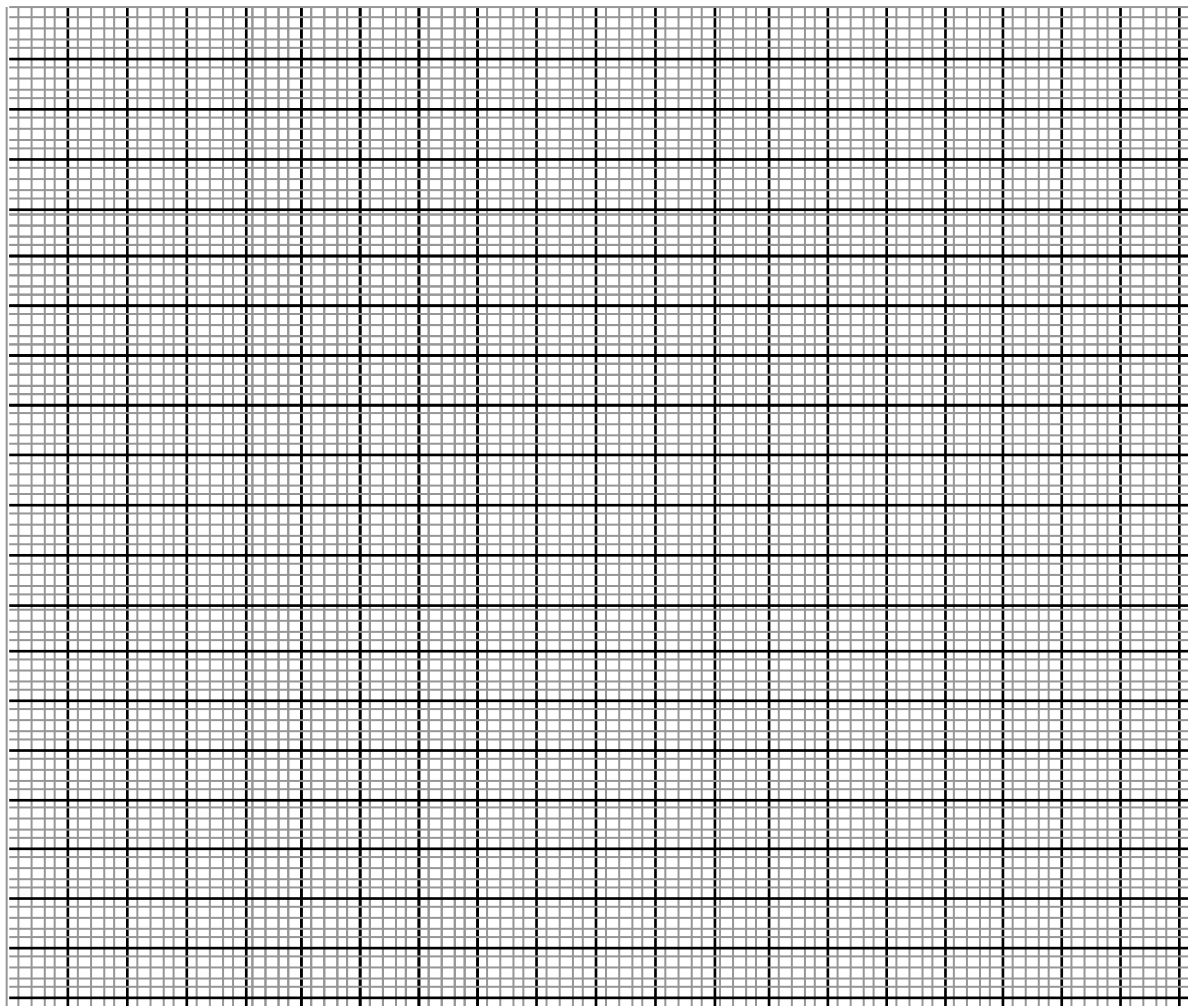
(ii) Write the nuclear equation for the reaction which takes place in step V (1mk)

.....

- (c) The table below gives the percentage of radioactive isotope of Bismuth that remains after decaying at different times.

Time (min)	0	6	12	22	38	62	100
Percentage of Bismuth	100	81	65	46	29	12	3

- (i) On the grid provided below, plot a graph of the percentage of bismuth remaining (vertical axis) against time (3mks)



- (ii) Use the graph, determine the
- Half life of the Bismuth (1mk)
.....
 - Original mass of bismuth isotope given that the mass remained after 70 minutes was 0.16g (1mks)
.....
- d. Give one use of radioactive isotope in medicine (1mk)
.....