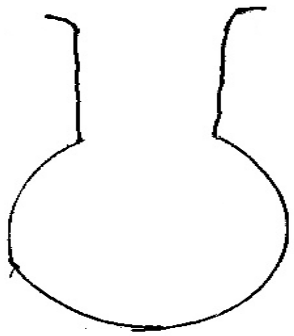
BUTULA SUB-COUNTY JOINT EVALUATION EXAM - 2021.
233/1
CHEMISTRY PAPER I

1. (a) Give two reasons why glass apparatus are used for heating in the laboratory. (2marks)
   (b) The diagram below shows a laboratory apparatus.



   (a) Name the apparatus (1 mark)

2.
   (a) State Graham's law of gaseous diffusion (1 mark)
   (b) 60 cm^3 of ozone (O_3) diffused through a semi permeable membrane in 80 seconds. Calculate the time taken for 90 cm^3 of nitrogen (IV) oxide (NO_2) to diffuse under the same conditions. (O=16, N=14). (3marks)

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

A			D	E			H	I
B	C		M		F	G		J

   a) What is the name given to the chemical family of element **C**? (1 mark)
   b) Compare the ionization energies of **B** and **M**. Explain. (2 marks)

4. Describe how a sample of Lead (II) chloride can be prepared using the following reagents dilute nitric (V) acid; dilute hydrochloric acid and lead carbonate (3marks)

5. a) Distinguish between nuclear fission and nuclear fusion. (1 mark)
   b) Calculate the values of P and Q in the following nuclear equation.

   $^{239}_{92}U \rightarrow {}^{p}_{Q}Th + 2\alpha + 2\beta$ (2 marks)

6. I. When aqueous solution of Iron(II)chloride and potassium thiocyanate are mixed, the equilibrium below was achieved:

$$Fe^{3+}_{(aq)} + CNS^{-}_{(aq)} \rightleftharpoons Fe(CNS)^{2+}_{(aq)}$$
(brown)(colourless) (blood red)

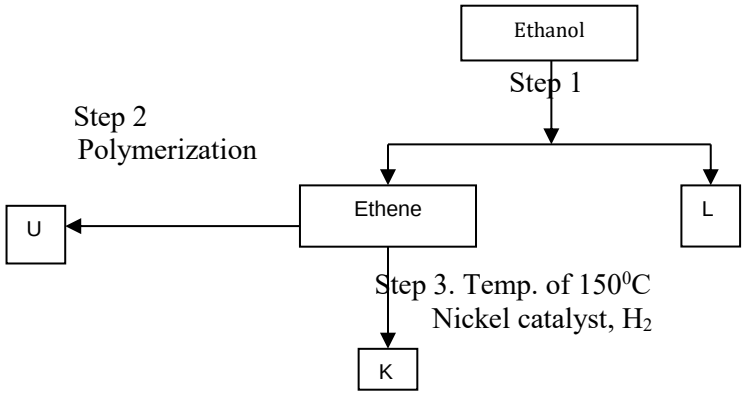
State and explain the effect of adding a few drops of potassium hydroxide to the equilibrium mixture. (2marks)

   II. Given the reaction below

$$Zn_{(s)} + 2HCl_{(aq)} \longrightarrow ZnCl_{2(aq)} + H_{2(g)}$$

   State how the following factors affect the rate of reaction giving explanation
   (a) Using Zinc powder instead of granules (1mark)
   (b) Heating the reactants (1mark)

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



(a) Identify substances : K, U, L (1 mark)
(b) State the conditions for the reaction in step 1 to occur. (1 mark)

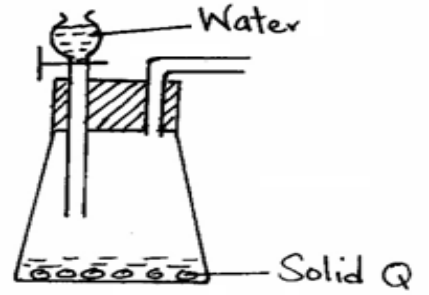
8. The following data refer to an element X.

Isotope	**P**	**Q**	**R**
Mass	54	56	57
%abundance	6	92	2

Calculate the relative atomic mass of element X (2mks)

9. a) State Faraday's law of electrolysis (1 mark)
b) When a current of 2.5 amperes was passed through a cell containing N^{2+} ions of a metal for 25minutes, the mass of the cathode increased by 0.36g. Determine the relative atomic mass of element N. (*1 Faraday = 96500 coulombs*) (3 marks)

10. The diagram below represents a set-up used to prepare oxygen gas.



(a) Name substance Q. (½ mark)
(b) Complete the set-up to show how dry oxygen gas is collected. (1½ marks)
(c) Write the equation for the reaction that occurs when magnesium burns in air (1 mark)

11. In an experiment to investigate the reaction between acids and metal carbonates, a student reacted zinc carbonate with dilute hydrochloric acid, and the resulting gas was bubbled in excess through lime water in a boiling tube.
(a) State and explain the observations made in the boiling tube at the end of the experiment. (2 marks)
(b) Write an equation for the reaction took place at the end of the experiment. (1 mark).

12. Use the thermo-chemical equations below to answer the questions that follow.

$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)} \quad {}_{\Delta}H = -406KJ\ mol^{-1}$

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

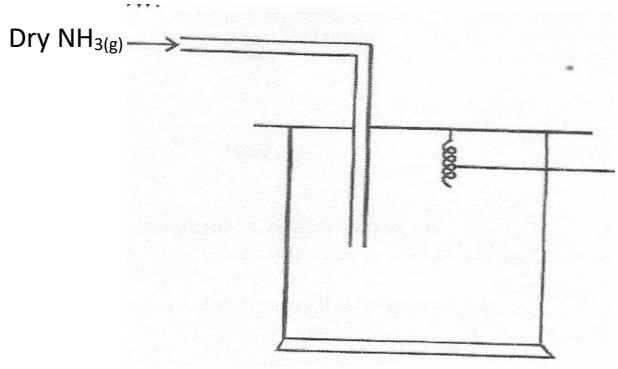
$C_3H_{8(g)} + 5O_{2(s)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(l)} \Delta H = -2209KJmol^{-1}$

Draw an energy cycle diagram and use it to calculate the heat of formation of propane. (3 marks)

13. A student mixed equal volumes of Ethanol and ethanoic acid. He added a few drops of concentrated Sulphuric (VI) acid and warmed the mixture.

(i) Name and write the formula of the main products (1 mark)
Name……..……
Formula……..…..

(ii) Which homologous series does the product named in (i) above belong? (1mark) The apparatus below was set up to show the catalytic oxidation of ammonia. Study the diagram and answer the questions that follow



(i) Write an equation for the reaction that takes place in the gas jar (1mark)
(ii) What is the role of hot nichrome wire? (1mark)
(iii) Write the formula of the complex ion formed when excess ammonia gas is passed through a solution containing Zn^{2+} ions. (1mark)

14. a) Define the term allotrope (1mark)
b). Name two non-crystalline allotropes of sulphur (1mark)
c) Diamond and graphite are both allotropes of carbon. Explain why graphite is used as a lubricant whereas diamond is used as an abrasive. (1 mark)

15. The table below shows PH values of some solutions

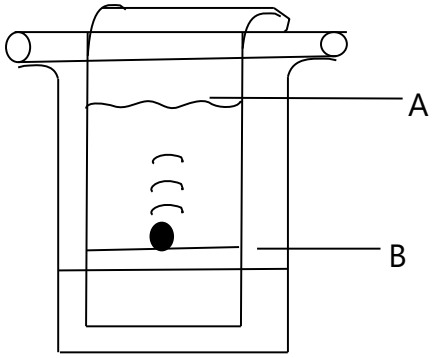
Solution	A	B	C	D
PH values	13	7	1	6.5

(a) What solution reacts vigorously with Magnesium metal? (1mark)
(b) Industrial Hydrochloric acid (1mark)
(c) Which solution forms complex ions with zinc (II) oxide? (1mark)

16. Draw the structural formula for each of the following compounds
(a) 4,4-dimethylpent-2-ene (1mark)
(b) Give the systematic IUPAC name of the following substances
ii) CH_3 CH Br CH Br CH_3 (1mark)

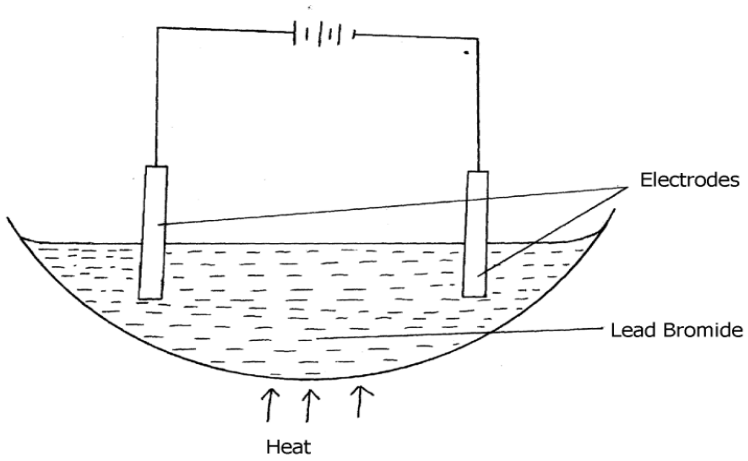
17. A hydrated salt has the following composition by mass. Iron is 20.2%, oxygen is 23.0% sulphur is 11.5%, water 45.3%. Its relative formula mass is 278. Determine the formula of the hydrated salt.
(Fe=56, S=32.0, O=16, H=1) (2marks)

18. The diagram shows the apparatus used to separate different dyes in food colouring.



I Name the parts labeled A & B (1 mark)

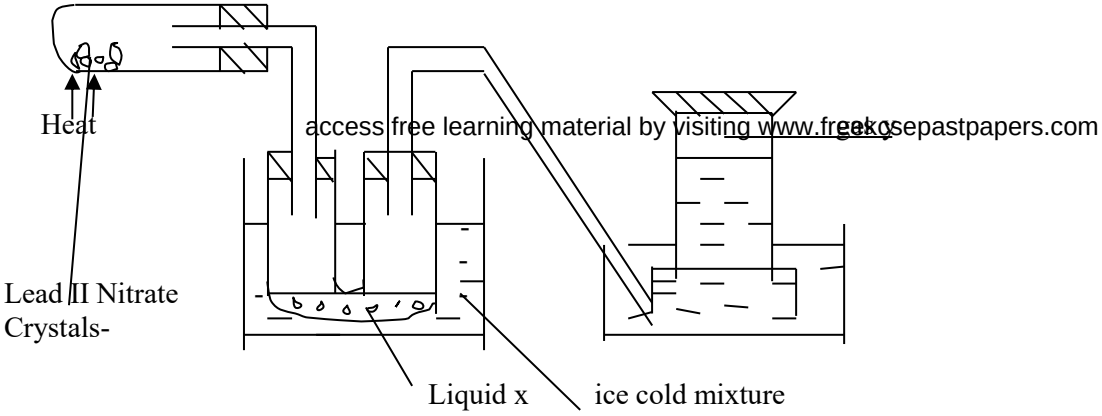
II The diagram below shows electrolysis of lead bromide



a) Label the anode and cathode (1mark)

b) Write half equations to shows reactions at cathode. (1mark)

19. The set-up below shows the products formed when solid lead (ii) nitrate is heated.



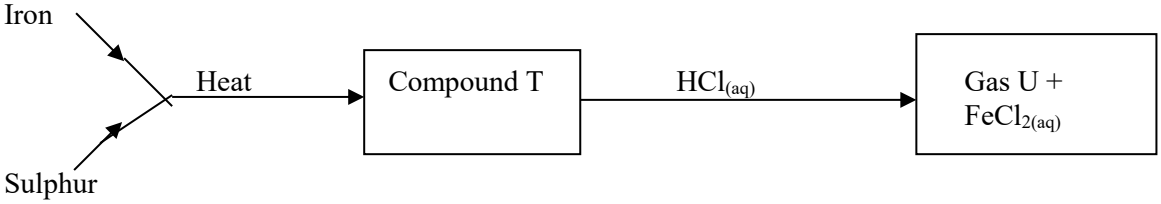
a) Identify:

(i) Liquid x …… (½ mark)

(ii) Gas y…… (½ mark)

(iii) Write an equation for the reaction taking place in the combustion tube. (1 mark)

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



(a) Name: (i) Compound T _____ (½ mark)

(ii) Gas U _____ (½ mark)

(b) State a physical property that you could use to identify gas U. (1 mark)

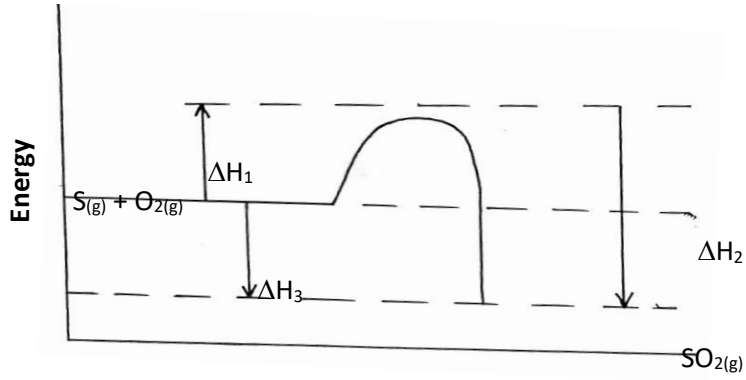
21. (a) The melting point of phosphorous trichloride is -918^0 C and that of sodium chloride is 801^0 C. Explain the huge difference in their melting points. (2marks)

22. The electronic arrangement of two stable ions Q^{2+} and P^{2-} are 2.8.8 and 2.8.8 respectively.
    (a) Write the electron arrangement of neutral atoms **Q** and **P**. (1 mark)
    (b) What is the most likely structure of an oxide element **P**? (1 mark)

23. The structures shown below represents two cleansing agents A and B.

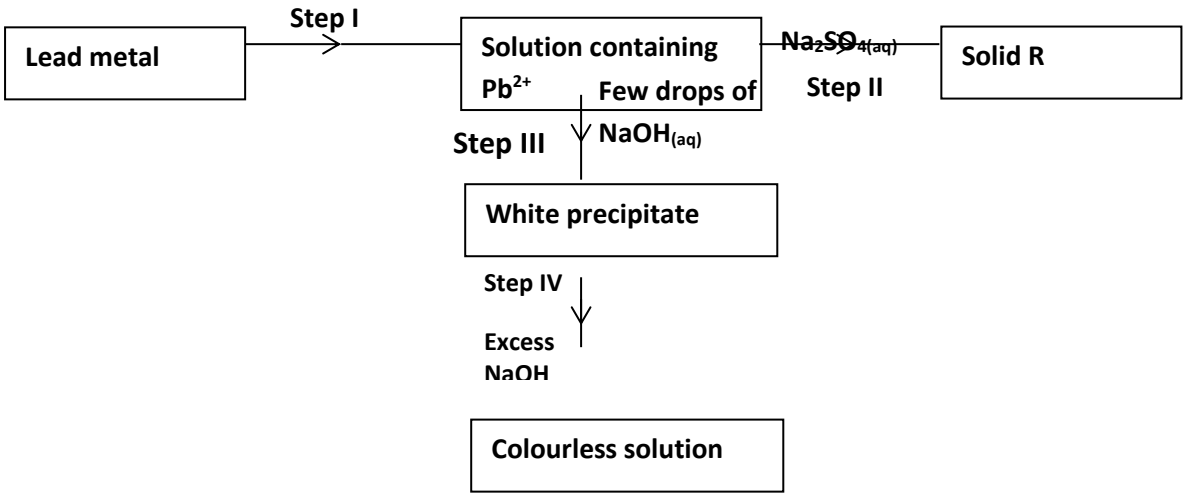
    (i) Identify the cleansing agents A and B (1 mark)
    (ii) Explain how the cleaning properties of the above cleansing agents can be improved. (1 mark)

24. Sulphur burns in air to form sulpur (IV) oxide. A simple energy level energy level diagram for the reaction is given below. Study the diagram and answer the questions that follow:



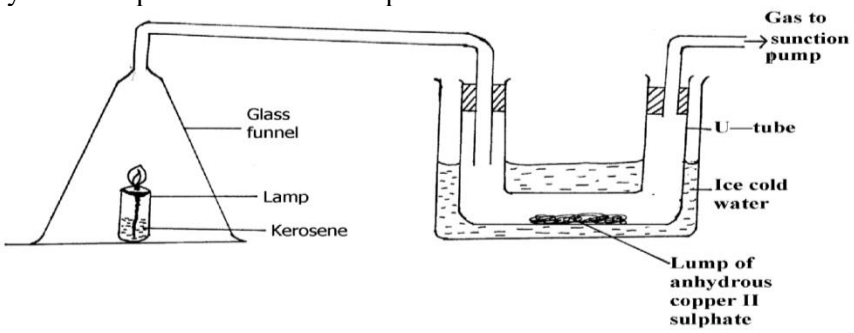
    (a) On the diagram indicate the activation energy (1 mark)
    (b) Write an expression for ΔH_3 in terms of ΔH_1 and ΔH_2 (1mark)

25. Study the flow chart below and use it to answer the questions that follow:



    (a) Identify the reagent used in step **I.** (1mark)
    (b) Name solid **R**. (1mark)
    (c) Explain the observation in step **IV**. (1mark)

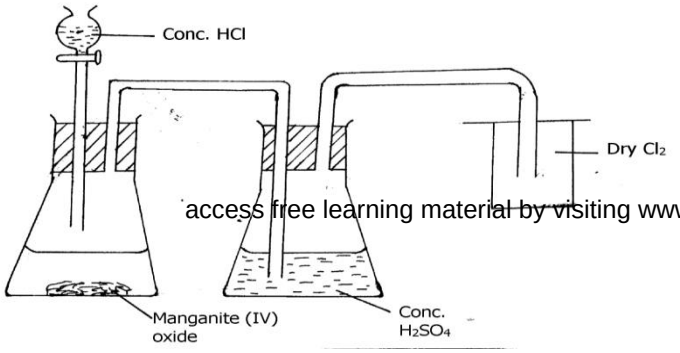
26. Study the set- up below and answer questions that follows.



a) State and explain the observation made in the U- tube. (1½ marks)
b) Explain what will happen to lamp when the suction pump is turned off. (1½ marks)

27. Using dot (•) and crosses (x) diagram to represent electrons in the outer most energy levels only show bonding in;
(a) Phosphine molecule.PH^{+}_{4}. (P = 15, H = 1) (1 mark)
(b) Ammonia (NH_3) (1 mark)

28. The set up below was used to prepare dry sample of chlorine gas.



a) What is the function of manganese (IV) oxide in the preparation of chloride (1mark)
b) Write a chemical equation for the formation of chlorine gas. (1 mark)
c) Explain the observations made when chlorine gas is bubbled through a solution of iron II sulphate. (2marks)

BUTULA SUB-COUNTY JOINT EVALUATION 2021
233/2
THEORY PAPER
DECEMBER 2021

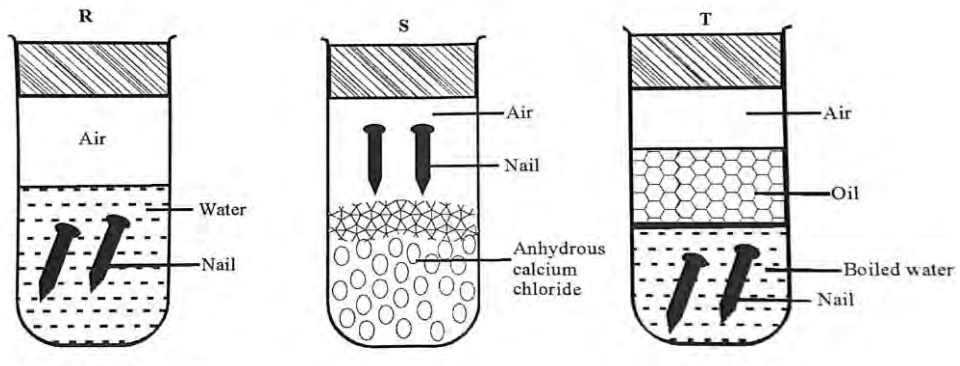
1. The grid below forms part of the periodic table. Study it and answer the questions that follow. The letters do not represent the actual symbols of the elements

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

a) What is the name of the chemical family to which element P belongs? (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 (1mk)
i. P and W ……
ii. T and Y ……

e) Compare the melting points of element Q and S. Explain. (2mks)
f) Give **two** advantages that element S has over element Q in making electric cables. (2mks)
g) Draw (a) dot (.) and cross (x) diagram to represent the bonding in compound formed between T and Y (2mks)

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



ii) State and explain what will happen in two test-tubes R and T after seven days. (2mks)
iii) Give one reason why some metals are electroplated. (1mk)

The reduction potential of elements K, L, M, and P are as given below

IONS	REDUCTION POTENTIAL
K^+	-1.46v
L^{2+}	+0.49v
M^{2+}	-2.69v
N^+	+0.52v
P^+	-0.86v

i) Which letter represents the, strongest reducing agent? Give a reason. (2mks)
ii) Which **two** letters represent elements whose half cells would form an electrochemical cell with the largest e.m.f? (1mk)
iii) Calculate the e.m.f of the cell formed in (ii) above (2mks)

(d) During the electrolysis of a molten chloride of metal Q, a current of 0.25A was passed though the molten chloride for 2 hours and 10minutes. Given that 0.9grams of metal Q were deposited at the cathode.
i) Calculate the quantity of electricity passed (1mk)
ii) Charge carried by the ions of metal Q given that R.A.M of metal Q is 84 (2mks)

3. (a) (i) Name the allotropies of sulphur (1mk)
(ii) Sulphur is mined using the Frasch process which uses super-heated water at 170^0c and hot compressed air.

(b) Explain how water at 170^0c is obtained. (1mk)
(c) State one role of the super-heated water (1mk)
(d) State and explain what happens when wet petals of red flowers are put in a gas jar full of sulphur (IV) oxide (2marks)
(e) Write an equation for the reaction of sulphur(IV) oxide and concentrated Nitric (V) acid (1mark)
(f) (i) Name the catalyst used in contact process (1mark)
(ii) An equilibrium exists as

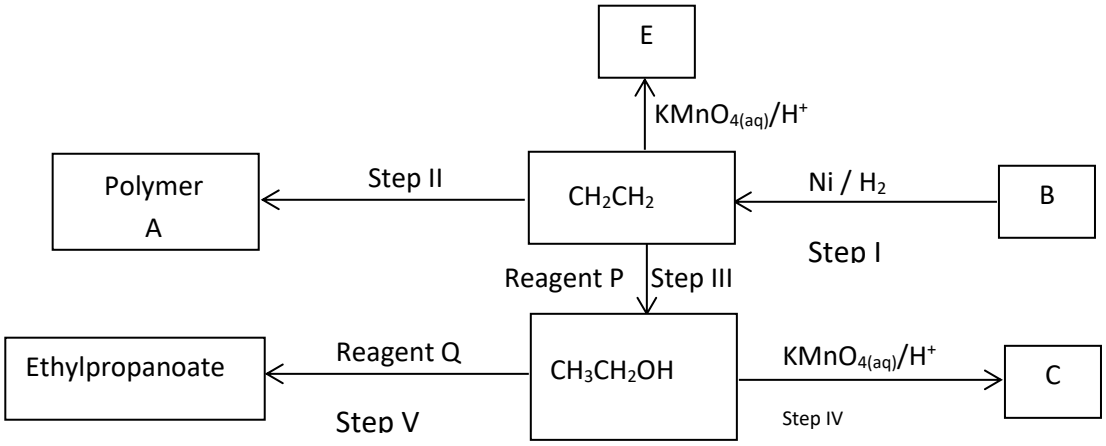
$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$$

State and explain what happens if more oxygen is added to the system (2 marks)

4. (a) A hydrocarbon contains 85% carbon. Its molecular mass is 70g.
(i) Determine its empirical and molecular formula. (C = 12, H = 1). (4mks)
(ii) Draw **two** positional isomers of the hydrocarbon. (1mk)

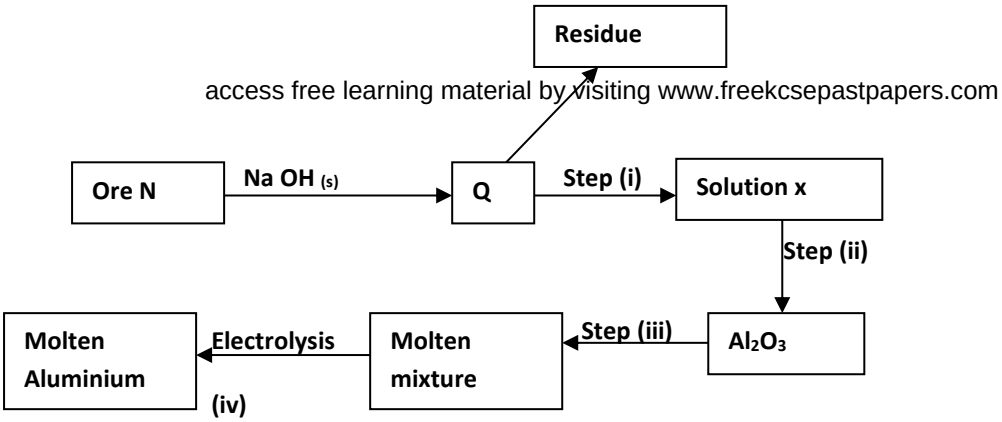
(b) In an experiment an organic compound was reacted with absolute ethanol in the presence of concentrated sulphuric (VI) acid to form a compound whose formula is
$CH_3\ CH_2CH_2\ COOCH_2\ CH_3$
(i) Name
I The type of reaction that took place. (1mk)
II What is the role of concentrated sulphuric (VI) acid in the experiment? (½mk)
(ii) Write the structural formula and give the systematic name of the acid used in the above experiment. (2mks)

(c) Study the flow diagram **below** and answer the questions that follow.



i) Identify the following compounds. C, A & E (2mk)
ii) Name the process in steps. I, II & IV (2mk)
iii) Reagent P & Q (1mk)

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



a) Name one Ore of **N.** (1mk)
b) Explain why the ore is first dissolved in excess sodium hydroxide solution (1mk)
c) Name the major compound present in the residue. (1mk)
d) Give the formula of the aluminum compound present in solution **X** (1mk)
e) Explain how to obtain aluminum hydroxide from solution **X** (2mks)
f) (i) Write an equation of the reaction that takes place in (e) above (1mk)
(ii) What is the role of cryolite ($Na_3\ AlF_6$) in the extraction of Aluminium: (1mk)
(iii) Explain why Na^+ and F^-ions are not discharged during electrolysis in step (iv) (1mk)
(iv) Aluminium is a good conductor of electricity. State **two** uses of aluminum based on that property. (2mks)

6. I. State Le chateliers principle on equilibrium? (1mk)
II. Bromine reacts with water in accordance with the following ionic equation.

$$Br_{2\,(aq)} + H_2O(l) \rightleftharpoons Br^-_{(aq)} + OBr^-_{(aq)} + 2H^+_{(aq)}$$

Explain how addition of sodium hydroxide solution would affect the given equilibrium. (2mks)

b) 3g of a powdered carbonate of metal **X** of formula XCO_3 were mixed with 13.2cm^3 of 2M hydrochloric acid. The mass of the reaction vessel and its contents was recorded at various times. From these readings, the total loss in mass of the reaction vessel and its contents was calculated and recorded as shown in the table below

Time (sec)	30	60	90	120	150	180	210
Total loss in mass (g)	0.08	0.37	0.90	1.19	1.28	1.32	1.32

On the grid provided below, draw a graph of total loss in mass (y-axis) against time (3mks)

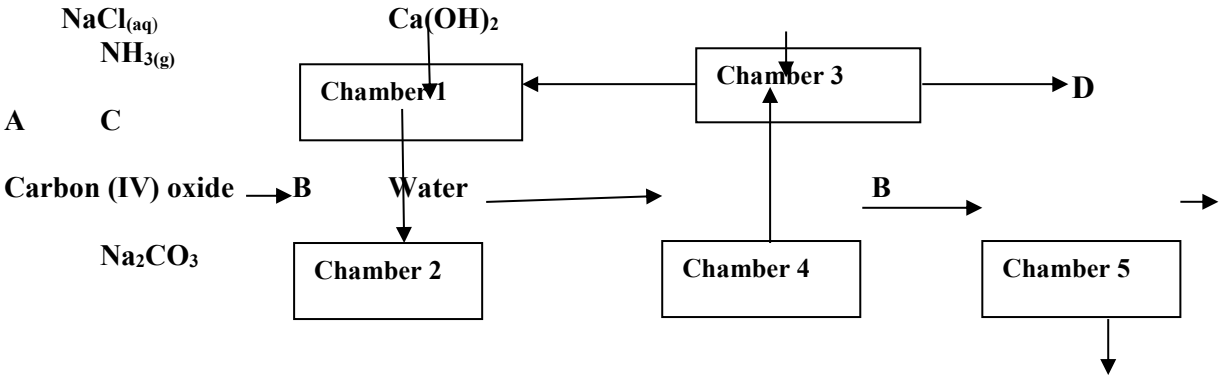
i) Calculate the rate of reaction at the 120th second. (2mks)

ii) Explain why there is no change in mass between 180 and 210 seconds. (1mk)

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

iv) Calculate the relative atomic mass of X (C=12.0, O=16.0) (2mks)

7. The flow chart below shows industrial manufacture of sodium carbonate.
Study it and answer the questions that follow.



(a) Name substances **A**, **B**, **C** and **D**. (2mks)

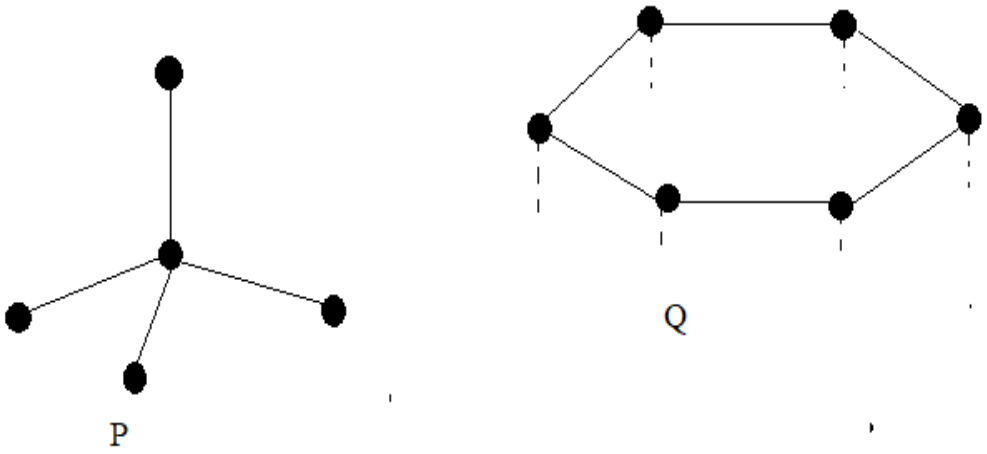
(b) Write equation for the reactions taking place in chamber 3. (1mk)
Chamber 3

(c) Name the physical process in chamber 4 and 5. (2mks)
Chamber 4
Chamber 5

(d) Name **one** source of cheap carbon (IV) oxide for Solvay process. (1mk)

(e) Briefly explain how sodium chloride required for this process is obtained from sea water. (2mks)

f) Below are allotropes of carbon.



(i) Identify the allotropes
P ½mk
Q ½mk
(ii) Allotrope Q can be used as a lubricant. Explain. (2mks)
iii) Give a reason why burning charcoal jiko in a poorly ventilated room is dangerous. (1mk)

BUTULA SUB – COUNTY JOINT EXAM.
CHEMISTRY – 233/3
PAPER 3

CONFIDENTIAL
In addition to the fitting and apparatus found in the Chemistry laboratory, each student will require the following

1. Solution **A**; About 150ml of 0.02M acidified potassium manganate(VII)
2. Solution **B**; About 100ml of ammonium iron (II) sulphate.
3. Solution **C**; About 70ml of 0.25M oxalic acid
4. Solid **P**; Mixture of zinc carbonate($ZnCO_3$) and sodium sulphite (Na_2SO_3) in the ratio 1:1
5. Solid **T**; maleic acid
6. Burette
7. Pipette
8. 250ml Conical flask (2)
9. 10ml measuring cylinder
10. Thermometer
11. Boiling tube
12. Test tubes(6)
13. Filter funnel
14. Filter paper
15. Nichrome wire
16. Distilled water
17. Spatula
18. P^H chart
19. Test tube holder

Access
- 2M sodium hydroxide
- 2M ammonia solution
- Barium nitrate solution
- Dilute nitric (V) acid
- Acidified potassium manganate (VII) solution
- Universal indicator
- Solid Sodium hydrogen carbonate
- Source of heat
- Warm water bath.

Note:

1. Solution **A** is prepared by dissolving 3.2g of $KMnO_4$ in 400cm^3 of 1M sulphuric (VI) and diluting to one litre of solution using distilled water.(0.02M)
2. Solution **B** is prepared by dissolving 23.52grams of hexahydrous ammonium iron (II) sulphate in 400cm^3 of distilled water and diluting to one litre of solution.(0.06M)
3. Solution **C** is made by dissolving 31.5grams of oxalic in about 400cm^3 of distilled water and diluting to one litre of solution.(0.25M)

BUTULA SUB – COUNTY JOINT EXAM- 2021
233/3
CHEMISTRY (PRACTICAL)
PAPER 3
TIME: 2 ¼ HOURS

1. You are provided with;
   - Solution **A**: 0.02M acidified potassium manganate (VII) solution.
   - Solution **B**, which is prepared by dissolving 5.88g of ammonium iron (II) sulphate in 250cm^3 of distilled water.
   - Solution **C**: 0.25M oxalic acid.

You are required to:

(i) Determine the number of moles of **B** that react with one of potassium manganate (VII)
(ii) Determine the rate of reaction between solution **C** and **A** at different temperatures.

Procedure I.

Fill the burette with solution **A**. using a clean pipette, place 25.0cm^3 of solution **B** into a clean conical flask, and titrate with solution **A** until the solution becomes permanent pink. Record your results in table I below. Repeat the procedure two more times to complete table I.**(RETAIN THE REMAINING SOLUTION A FOR USE IN PROCEDURE II)**

a) Table I.

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

(4 marks)

b) Calculate the:
   (i) Average volume of solution **A** used. (1 mark)
   (ii) Number of moles of solution **A** used. (1 mark)
   (iii) Concentration of solution **B** in moles per litre. (RFM of **B** is **392**) (1 mark)

c) Calculate the number of moles of **B**:
   (i) In 25.0cm^3 of solution. (1 mark)
   (ii) Which react with one mole of solution **A(** Acidified potassium manganite (VII) **)** (1 mark)

Procedure II.

Place 5 test tube on a test tube rack. Fill the burette with solution **A**. To each test tube place 10.0cm^3 of solution A from the burette. Using a clean 10ml measuring cylinder, place 10.0cm^3 of solution **C** into a clean boiling tube. Insert a thermometer in solution **C** in the boiling tube. Heat solution C in the warm water bath until it attains a temperature of **40^{0}C**.

Remove the boiling tube from the water bath and place it in a test tube rack. Add the first portion of solution **A** and immediately start a stop watch. Record the time taken for the purple colour of the mixture to decolourise in

table 2 below. Repeat the experiment by using 10.0cm^{3}of solution **C** at temperature of**40^{0}C, 500C, 600C, 700Cand 80^{0}C**.Record the time taken in each case in table 2 below.

d) Table 2

Temperature	**40**	**50**	**60**	**70**	**80**
Time taken in seconds					
$\frac{1}{Time}(\sec^{-1})$					

(3$\frac{1}{2}$ marks)

e) Complete the table by computing $\frac{1}{Time}(\sec^{-1})$ (2$\frac{1}{2}$ marks)

f) Plot a graph of $\frac{1}{Time}(\sec^{-1})$ against temperature. (3 marks)

g) From the graph determine the time that would be taken if the temperature was 52.0^{0}C. (1 mark)

h) How does the rate of reaction of acidified potassium manganate (VII) with oxalic vary with temperature? (1 mark)

2. You are provided with solid **P** which is a mixture of two salts. You are required to carry out the tests below on solid **P**. Write you observations and inferences in the spaces provided.

(a) Place the entire solid in a boiling tube. Add about 10cm^3 of distilled water and shake. Filter the mixture. Retain both the residue and the filtrate.

Observation	Inference
(1mark)	(1mark)

(b) Divide the filtrate into four portions.

I. To the first portion, add sodium hydroxide solution drop wise until in excess.

Observation	Inference
(1mark)	(1 mark)

II. Dip a nichrome wire loop into the second portion. Hold the wire in a non-luminous Bunsen burner flame.

Observation	Inference
($\frac{1}{2}$ mark)	($\frac{1}{2}$ mark)

III. To the third portion, add 2 drops of Barium nitrate.

Observation	Inference
(1mark)	(1mark)

IV. To the fourth portion, add 2 drops of acidified potassium manganate (VII)

Observation	Inference
(1mark)	(1*mark*)

(c) (i) Scrap the residue from the filter paper and put it in a test tube. Add about 5cm^3 of dilute nitric (V) acid.

Observation	Inference
(1mark)	(1mark)

(ii) To about $2cm^3$ of the resultant solution in C(i), add2M ammonia solution dropwise until in excess.

Observation	Inference
(1mark)	$(1mark)$

3. You are provided with an organic compound labeled **solid T**. Carry out the tests indicated below and write your observations and inferences in the spaces provided.

a) Put half of **solid T** on a clean metallic spatula and ignite.

Observations	Inferences
(1 mark)	(1 mark)

b) Put the remaining **solid T** in a boiling tube. Add $10cm^3$ of distilled water and shake. Divide the mixture into four portions.

i) Using the first portion, determine the P^H of solution T

Observations	Inferences
$(\frac{1}{2}mark)$	$(\frac{1}{2}mark)$

ii) To the second portion, add sodium hydrogen carbonate solid.

Observations	Inferences
(1 mark)	(1 mark)

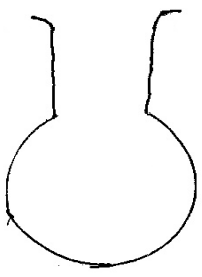
iii) To the third portion, add two drops of acidified potassium manganate (VII).

Observations	Inferences
(1 mark)	(1mark)

BUTULA SUB-COUNTY JOINT EVALUATION EXAM - 2021.
231/1
CHEMISTRY
MARKING SCHEME

1. (a) Give two reasons why glass apparatus are used for heating in the laboratory. (2 marks)
Have high m.p and b.p
Are good conductors of heat

b) The diagram below shows a laboratory apparatus.



(b) Name the apparatus (1 mark)
Round-bottomed flask√ 1½

2. (a) State Graham's law of gaseous diffusion (1 mark)
The rate of diffusion of a gas is inversely proportional to the square root of its density *under* the same conditions of temperature and pressure.

(b) 60 cm^3 of ozone (O_3) diffused through a semi permeable membrane in 80 seconds. Calculate the time taken for 90 cm^3 of nitrogen (IV) oxide (NO_2) to diffuse under the same conditions. (O=16, N=14).
(3mks)

60cm3 of ozone takes 80seconds
90cm3 of ozone takes 120seconds
NO2 =56 O3 = 48

$$\frac{TNO2}{TO3} = \frac{\sqrt{RMM.\ NO2}}{\sqrt{RMM.\ O3}}$$

$$TNO2 = \frac{120\sqrt{56}}{\sqrt{48}} = 129.6 \text{ seconds}$$

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

A			D	E			H	I
B	C		M		F	G		J

(a) What is the name given to the chemical family of element **C**? (1 mark)
Alkaline earth metals

b) Compare the ionization energies of **B** and **M**. Explain. (2 marks)
M has higher ionization energy than B
M has smaller atomic radius with a stronger nuclear force of attraction thus more energy is required to remove an electron in its outermost energy level.

4. Describe how a sample of lead (II) nitrate can be prepared using the following reagents dilute nitric (V) acid; dilute hydrochloric acid and lead carbonate
(3mks)

React excess lead carbonate with dilute nitric (v) acid√ ½ . Filter √½ to obtain lead nitrate as filtrate ; react the filtrate with dilute hydrochloric acid ; a precipitate of lead (ii) chloride is formed ; wash the residue of $pbCl_2$ and dry between filter papers.

5. a) Distinguish between nuclear fission and nuclear fusion. (1 mark)

Nuclear fission ***is the splitting process a heavy nuclide undergoes when bombarded by a fast-moving neutron while nuclear fusion occurs when nuclei combine together when they are made to collide at high velocity resulting in the formation of a heavy nucleus and release of energy***.

b) Calculate the values of P and Q in the following nuclear equation.
$^{239}_{92}U \longrightarrow {}^{p}_{Q}Th + 2\alpha + 2\beta$ (2 marks)
239 = p + (2*4) + 0 ✓ ½
p =239 – 8.
P = 231 ✓ ½
92 = Q + (2*2) + (2*-1) ✓ ½
92 = Q + 2
Q = 92 – 2
Q = 90 ✓ ½

6. I. When aqueous solution of Iron(II)chloride and potassium thiocyanate are mixed, the equilibrium below was achieved:

$Fe^{3+}_{(aq)}$ + $CNS^{-}_{(aq)}$ ⇌ $Fe(CNS)^{2+}_{(aq)}$
(brown)(colourless) (blood red)

State and explain the effect of adding a few drops of potasium hydroxide to the equilibrium mixture. (2marks)

Equilibrium will shift to the ✓ ½ left/ backward reaction favoured // more brown will be formed OH^- ions precipitates Fe^{3+} ions in form of $Fe(OH)_3$

II. Given the reaction below

$Zn_{(s)} + 2HCl_{(aq)} \longrightarrow ZnCl_{2(aq)} + H_{2(g)}$

State how the following factors affect the rate of reaction giving explanation

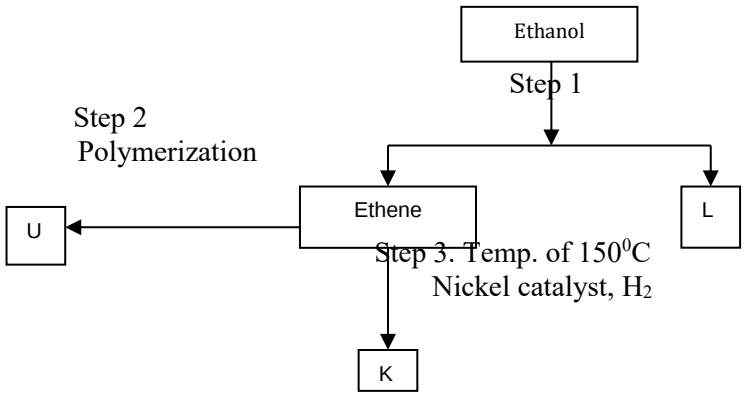
(a) Using Zinc powder instead of granules (1mk)

Increase the rate of reaction. Because it increases the surface area of contact with hydrochloric acid.√1

(b) Heating the reactants (1mk)

Increases the rate of reaction because increase in temperature increase kinetic energy resulting in higher frequency of collision of particles.√1

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



(a) Identify substances : K, U, L (1 mark)

K – Ethane ✓ ½

U - Polythene✓ ½

L – Water

Any two correct answers

(b) State the conditions for the reaction in step 1 to occur. (1 mark)

Temperature – 180^0C ✓ ½

Conc. Sulphuric vi acid✓ ½

8. The following data refer to an element X.

Isotope	**P**	**Q**	**R**
Mass	54	56	57
%abundance	6	92	2

Calculate the relative atomic mass of element X (2mks)

$$\frac{(54*6) + (56*92) + (57*2)}{100}$$

55.9 ✓ ½

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

The mass of a substance produced during electrolysis is directly proportional to the quantity of electricity passed.

b) When a current of 2.5 amperes was passed through a cell containing N^{2+} ions of a metal for 25minutes, the mass of the cathode increased by 0.36g. Determine the relative atomic mass of element N.
(*1 Faraday = 96500 coulombs*) (3mks)

Q = It

Q = 2.5 x 25 x 60 = 3750C √ ½

N^{2+} - 2 faradays √ ½

1 faraday – 96500 x 2 √ ½
3750C -= 0.36g
∴ 96500 x 2 = $\frac{0.36}{3850}$ x 96500 x2
= 18.528
= 18.5 √ ½

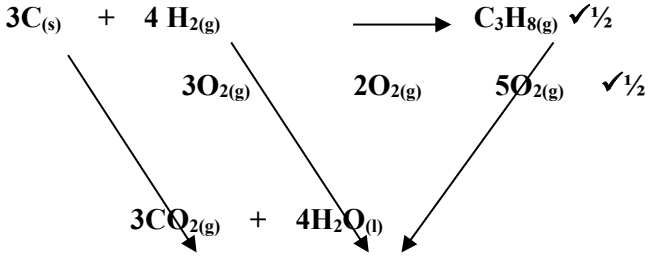
10. The diagram below represents a set-up used to prepare oxygen gas.
    (a) Name substance Q. (½ mark)
    Sodium Peroxide
    (b) Complete the set-up to show how dry oxygen gas is collected. (1½ marks)
    (c) Write the equation for the reaction that occurs when magnesium burns in air (1 mark)
    $2Na_2O_2$ + $2H_2O$ ⟶ $4NaOH$ + O_2
    (aq) (l) (aq) (g)

11. In an experiment to investigate the reaction between acids and metal carbonates, a student reacted zinc carbonate with dilute hydrochloric acid, and the resulting gas was bubbled in excess through lime water in a boiling tube.
    (a) State and explain the observations made in the boiling tube at the end of the experiment (2 marks)
    The white precipitate dissolves to form a colourless solution. ✓ 1 This is due to formation of soluble calcium hydrogen carbonate. ✓ 1

    (b) Write an equation for the reaction took place at the end of the experiment. (1 mark).
    $CaCO_3(s) + H_2O(l) + CO_2(g)$ ⟶ $Ca(HCO_3)_2(aq)$ ✓ 1

12. Use the thermo-chemical equations below to answer the questions that follow.
    $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ $\quad \Delta H = -406KJ\ mol^{-1}$
    $H_{2(g)} + ½\ O_{2(g)} \longrightarrow H_2O_{(l)}$ $\quad \Delta H = -286KJmol^{-1}$
    $C_3H_{8(g)} + 5O_{2(s)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(l)}$ $\quad \Delta H = -2209KJmol^{-1}$

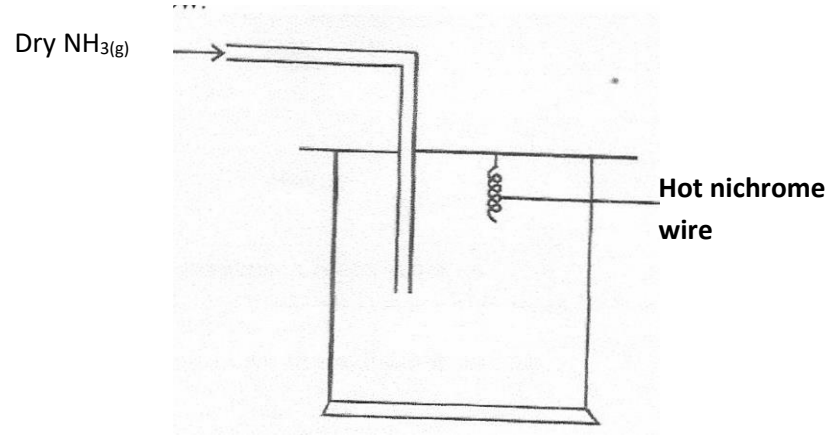
    Draw an energy cycle diagram and use it to calculate the heat of formation of propane. (3 marks)



ΔH_f = [3(-406) + 4(-286)] – [-2209] ✓1
= [-1218 – 1144] + [2209]
= -153 KJmol^{-1} ✓1

13. A student mixed equal volumes of Ethanol and ethanoic acid. He added a few drops of concentrated Sulphuric (VI) acid and warmed the mixture.
    (i) Name and write the formula of the main products (1 mark)
    Name **Ethylethanoate**
    Formula **$CH_3COOCH_2CH_3$**
    (ii) Which homologous series does the product named in (i) above belong? (1mk)
    Esters

14. The apparatus below was set up to show the catalytic oxidation of ammonia. Study the diagram and answer the questions that follow



(i) Write an equation for the reaction that takes place in the gas jar (1mk)
$4NH_{3(g)} + 5O_{2\ (g)} \rightarrow 4NO_{(g)} + 6H_2O_{(g)}$

(ii) What is the role of hot nichrome wire? (1mk)
Hot nichrome wire catalyses the reaction between ammonia and oxygen / oxidation of NH_3 √1.

(iii) Write the formula of the complex ion formed when excess ammonia gas is passed through a solution containing Zn^{2+} ions. (1mk)

$\left[Zn(NH_3)_4 \right]^{2+}$ √1

15. a) Define the term allotrope (1mk)

Existence of an element in different forms but in the same physical state.

(b) Name two non-crystalline allotropes of sulphur (1mk)
Rhombic
Monoclinic

(c) Diamond and graphite are both allotropes of carbon. Explain why graphite is used as a lubricant whereas diamond is used as an abrassive . (1 mark)
Van der waal forces in graphite white in diamond there is strong covalent bonds

16. The table below shows PH values of some solutions

Solution	A	B	C	D
PH values	13	7	1	6.5

(a) What solution reacts vigorously with Magnesium metal? (1 mark)
C

(b) Industrial Hydrochloric acid (1 mark)
C

(c) Which solution forms complex ions with zinc (II) oxide? (1 mark)
C

17. Draw the structural formula for each of the following compounds

(a) 4,4-dimethylpent-2-ene (1mk)

(b) Give the systematic IUPAC name of the following substances

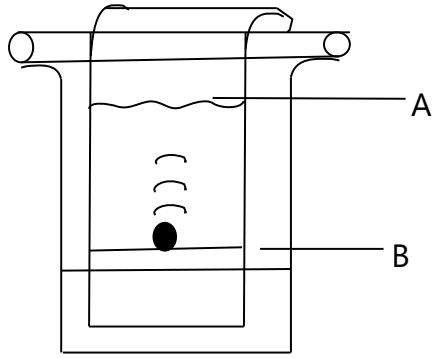
ii) $CH_3\ CH\ Br\ CH\ Br\ CH_3$ (1mk)
2, 3 – dibromobutane

18. A hydrated salt has the following composition by mass. Iron is 20.2%, oxygen is 23.0% sulphur is 11.5%, water 45.3%. Its relative formula mass is 278. Determine the formula of the hydrated salt.
(Fe=56, S=32.0, O=16, H=1) (3mks)

	Fe	O	S	H_2O
Mass	**20.2**	**23.0**	**11.5**	**45.3**
R.A.M	**56**	**16**	**32**	**18**
Moles	**0.36**	**1.44**	**0.36**	**2.52**
Mole Ratio	**1 :**	**4 :**	**1 :**	**7**

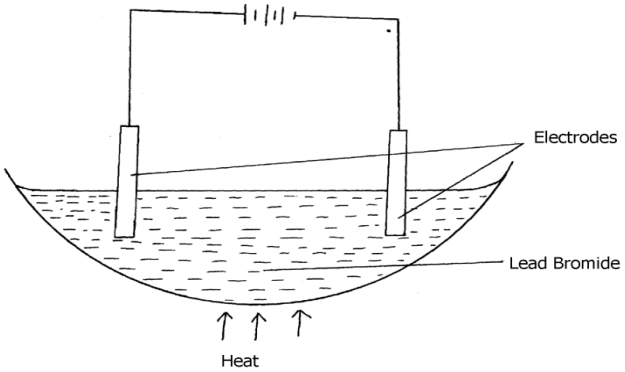
Empirical Formula FeSO4.7H2O **Molecular formula FeSO4.7H2O**

19. The diagram shows the apparatus used to separate different dyes in food colouring.



I Name the parts labeled A & B (1 mark)
A: **Solvent front**
B: **Baseline**

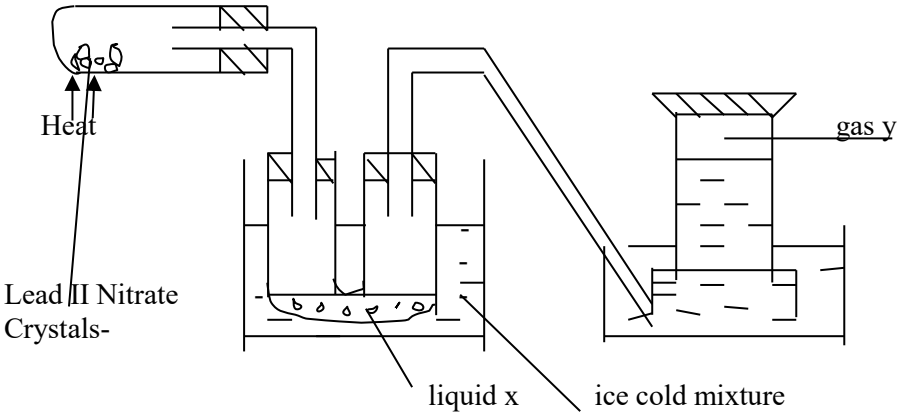
II The diagram below shows electrolysis of lead bromide



a) Label the anode and cathode (1mk)
On the diagram (left hand electrode – Anode, right hand electrode – Cathode)

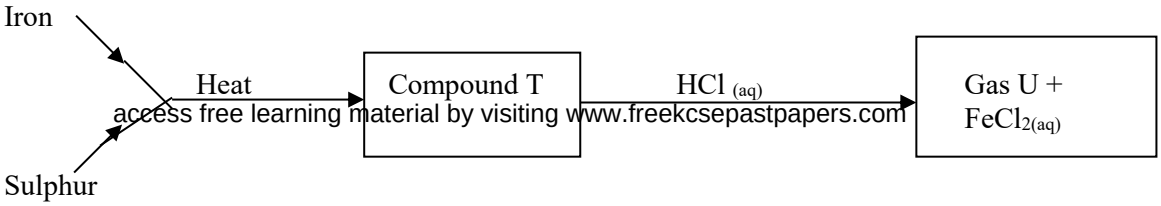
b) Write half equations to shows reactions at cathode. (1mk)
$Pb^{2+}_{(l)} + 2e^- \longrightarrow Pb_{(s)}$

20. The set-up below shows the products formed when solid lead (ii) nitrate is heated.



a) Identify:
   (i) Liquid x …… (½ mark)
   Dinitrogen tetraoxide / N_2O_4 ✓ ½
   ii) Gas y…… (½ mark)
   Oxygen/ O_2 ✓ ½
   iii) Write an equation for the reaction taking place in the combustion tube. (1 mark)

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

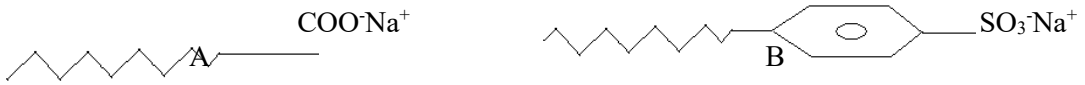


   (a) Name : (i) Compound T
   Iron (II) sulphide √ ½
   (ii) Gas U
   Hydrogen sulphide √ ½
   (b) State a physical property that you could use to identify gas U. (1 mark)
   Gas has a characteristic smell of rotten eggs √1

22. (a) The melting point of phosphorous trichloride is -918^0 C and that of sodium chloride is 801^0 C. Explain the huge difference in their melting points. (2mks)
   PCl_3 has simple molecular structure held by weak van der waals forces wit require less energy to break. While NaCl has strong ionic bonds with giant ionic structure that require more energy to break.

23. The electronic arrangement of two stable ions Q^{2+} and P^{2-} are 2.8.8 and 2.8.8 respectively.
   (a) Write the electron arrangement of neutral atoms **Q** and **P**. (1 mark)
   Q – 2.8.8.2
   P – 2.8.6
   (b) What is the most likely structure of an oxide element **P**? (1 mark)
   Simple molecular structure

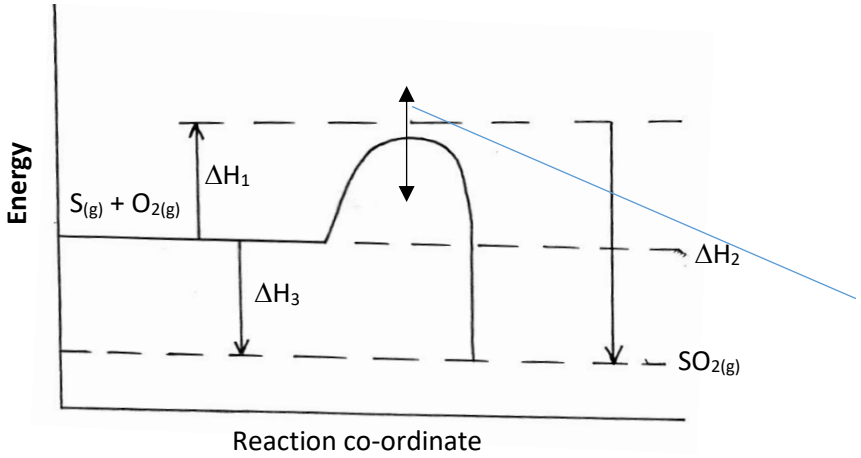
24. The structures shown below represents two cleansing agents A and B.



(i) Identify the cleansing agents A and B (1 mark)
A – **soapy detergent**
B – **soapless detergent**

(ii) Explain how the cleaning properties of the above cleansing agents can be improved. (1 mark)
Tetraoxophosphate materials/compounds are added to the cleansing agents. ✓ The compounds **prevent formation** of compounds with **Ca^{2+}, Mg^{2+}** ions hence **no scum is formed**. ✓

25. Sulphur burns in air to form sulpur (IV) oxide. A simple energy level energy level diagram for the reaction is given below. Study the diagram and answer the questions that follow:



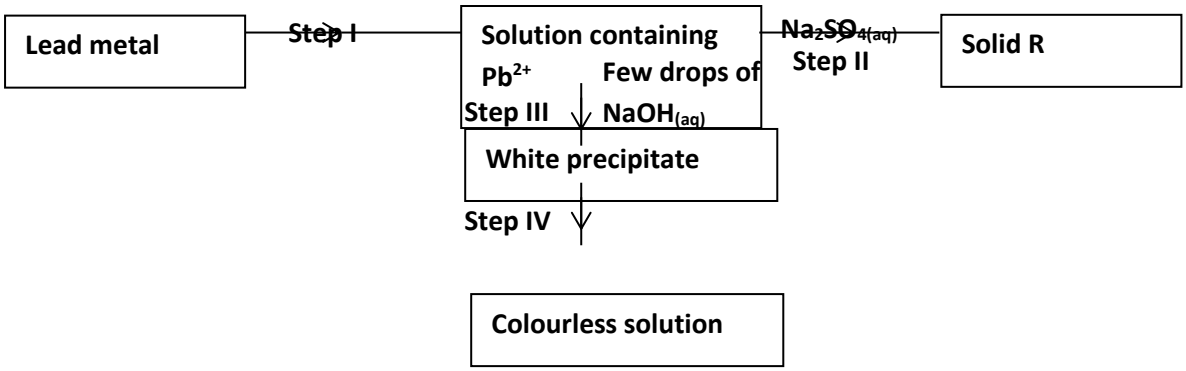
Activation Enaergy

(a) On the diagram indicate the activation energy (1 mark)

(b) Write an expression for ΔH_3 in terms of ΔH_1 and ΔH_2 (1 mark)

$\Delta H_3 = \Delta H_1 - \Delta H_2$

26. Study the flow chart below and use it to answer the questions that follow:

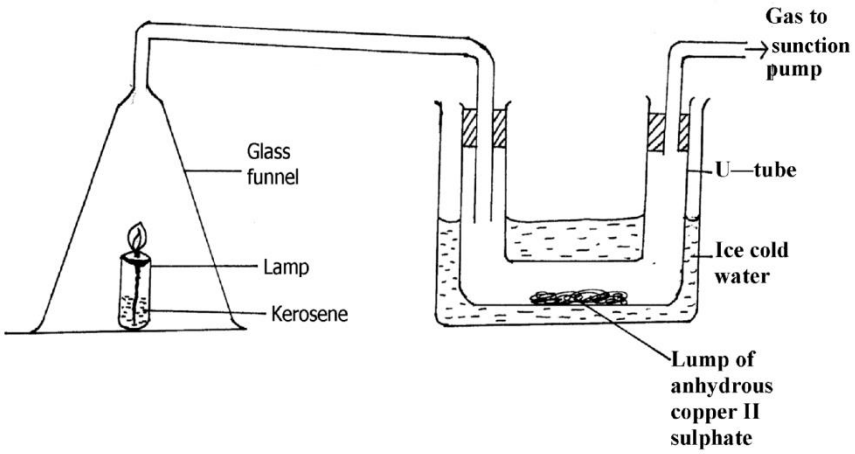


(a) Identify the reagent used in step **I.** (1mk)
Dilute Nitric v acid

(b) Name solid **R**. (1mk)
Lead II Sulphate

(c) Explain the observation in step **IV**. (1mk)
Amphoteric lead hydroxide reacts with basic sodium hydroxide forming a complex ion. (tetrahydroxo lead II ions) which are colourless.

27. Study the set- up below and answer questions that follows.

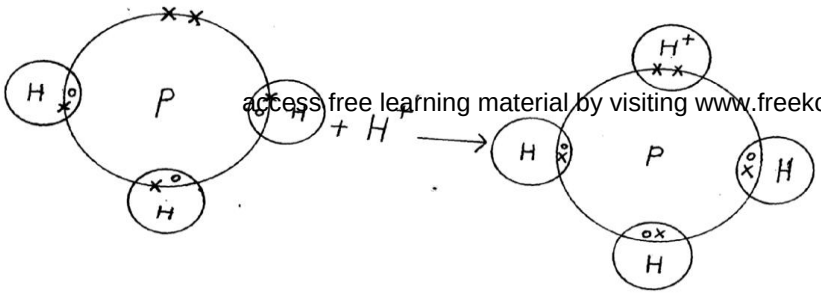


a) State and explain the observation made in the U- tube. (1½ marks)
Colour of anhydrous copper II sulphate changes from white to blue ✓1. The kerosene lamp burns to produce CO_2 and H_2O water combines with anhydrous copper II sulphate (white) to form hydrated copper (II) sulphate blue.

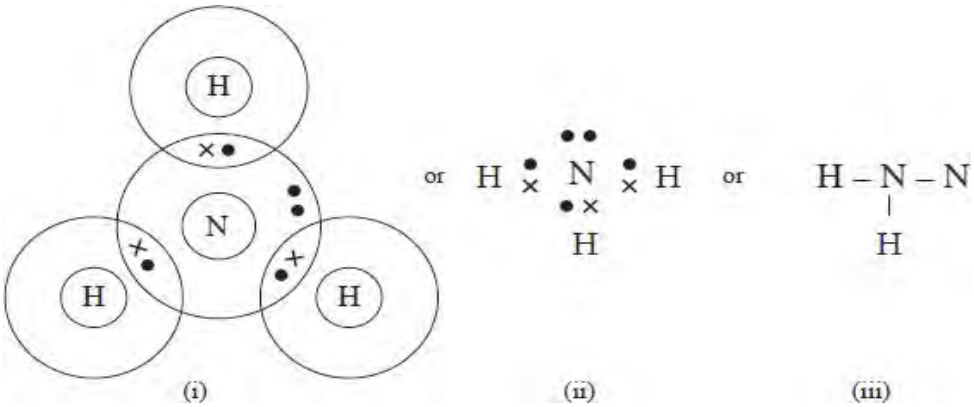
b) Explain what will happen to lamp when the sunction pump is turned off. (1½ marks)
The lamp goes off .This is due to accumulation of CO_2 which is denser than air.

28. Using dot (•) and crosses (x) diagram to represent electrons in the outer most energy levels only show bonding in;

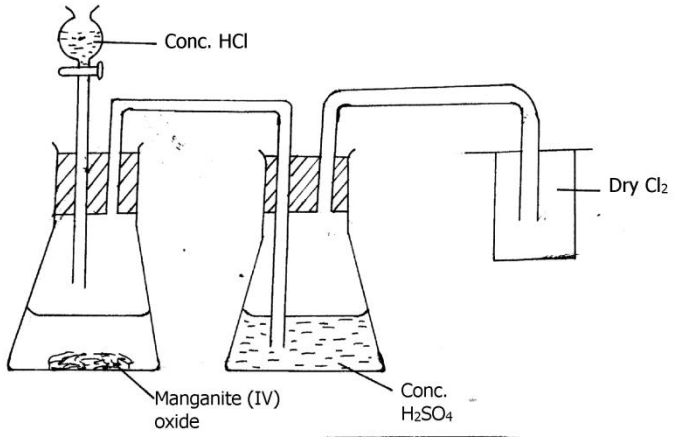
(a) Phosphine molecule.PH^+_4.(P = 15 , H = 1) (1 mark)



(b) Ammonia (NH_3) (1 mark)



29. The set up below was used to prepare dry sample of chlorine gas.



a) What is the function of manganese (IV) oxide in the preparation of chloride (1 mark)
It is an oxidizing agent.

b) Write a chemical equation for the formation of chlorine gas. (1 mark)

c) Explain the observations made when chlorine gas is bubbled through a solution of iron II sulphate. (2 marks)
The colour of iron II sulphate changes from pale green to red brown.
Chlorine gas oxidizes Iron II ions to Iron III ions

BUTULA SUB-COUNTY JOINT EVALUATION EXAM - 2021.
231/2
CHEMISTRY
MARKING SCHEME

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	N√1	X		
	R						Z	

a). What is the name of the chemical family to which element P belongs? (1mk)
Alkali metals√1

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 2.8.5√1

c). Compare the size of the atom of R and that of its ion. Explain your answer. (2mks)

- The atom of R is larger than its ion √1
- The atom of R has 4 occupied energy levels while its ion has 3.√1
- OR, the ion of R has a stronger nuclear charge than its atom.

d). Give the formula of the compound formed between (1mk)

i). P and W P_2W √1

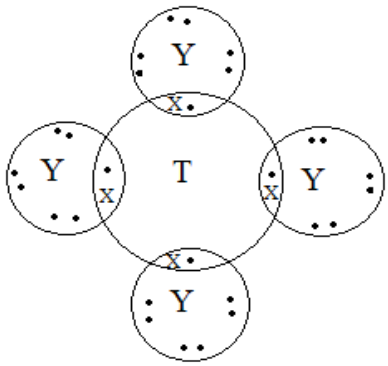
ii). T and Y TY_4√1

e). Compare the melting points of element Q and S. Explain. (2mks)

- S has a higher melting point than that of Q. √1
- Because S has smaller atomic radius hence stronger metallic bonds than in Q.√1 OR
- S contributes 3 electrons to the metallic lattice while Q contributes 2 hence stronger metallic bonds in S√1. Or vice versa.

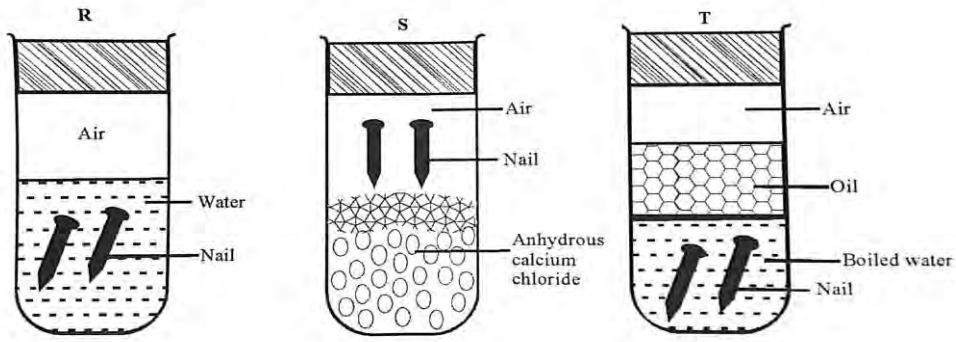
f). Give **two** advantages that element S has over element Q in making electric cables. (2mks)

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



√2

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



ii) State and explain what will happen in two test-tubes R and T after seven days . (2 mks)

In R a brown coating forms on the nails√½, due to presence of oxygen and water√½. In T no brown coating is formed on the surface of the nails√½ due to absence of oxygen√½

ii) Give one reason why some metals are electroplated. (1mk)

To improve their appearance √1

OR to prevent corrosion√1

OR to prevent those made of iron from rusting√1

(b) The reduction potential of elements K, L, M, and P are as given below

IONS	REDUCTION POTENTIAL
K^+	-1.46v
L^{2+}	+0.49v
M^{2+}	-2.69v
N^+	+0.52v
P^+	-0.86v

(i) Which letter represents the, strongest reducing agent? Give a reason. (2mks)
M√1
Most negative electrode potential√1

(ii) Which **two** letters represent elements whose half cells would form an electrochemical cell with the largest e.m.f? (1mk)
M and N√1

(iii) Calculate the e.m.f of the cell formed in (ii) above (2mks)
E.m.f $= E_{reduced} - E_{oxidised}$
$= 0.52 - (-2.69)$√1
$= +3.21$v√1

(d) During the electrolysis of a molten chloride of metal Q, a current of 0.25A was passed though the molten chloride for 2 hours and 10minutes. Given that 0.9grams of metal Q were deposited at the cathode.

i). Calculate the quantity of electricity passed (1mk)
Q = It
= 0.25A x (7200 + 600)s√½
= 1950c√½

ii). Charge carried by the ions of metal Q given that R.A.M of metal Q is 84 (2mks)

Moles of Q $= \frac{\text{mass}}{\text{R.A.M}}$; $= \frac{0.9}{84}$; $= 0.0107$moles√½

From Faradays law, 1F = 96500c

? = 1950c

$\frac{1950 \times 1}{96500} = 0.02021$√½

Thus Charge on Q $= \frac{0.02021}{0.0107}$√½

$= 1.88$ approx. $+2$ √½

3. (a)(i) Name the allotropies of sulphur (1mk)
Rhombic sulphur√½
Monoclinic sulphur √½

(ii) Sulphur is mined using the Frasch process which uses super-heated water at 170^0c and hot compressed air.

(I) Explain how water at 170^0c is obtained. (1mk)
Heating water at 10 atmosphere pressure √1
OR
Heating water at high pressure.√1

(II) State one role of the super-heated water (1mk)
To melt the sulphur deposits√1

b). State and explain what happens when wet petals of red flowers are put in a gas jar full of sulphur (IV) oxide (2marks)

The red petals turn white√1
Sulphur (IV) oxides bleaches the flower petals √1

c). Write an equation for the reaction of sulphur(IV) oxide and concentrated Nitric (V) acid (1mark)

$2HNO_3(aq) + SO_2(g) \longrightarrow 2NO_2(g) + H_2SO_4(aq)$ √1

d). (i) Name the catalyst used in contact process (1mark)
Vanadium (V) oxide √1
OR Platinum√1

(ii) An equilibrium exists as
$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$

State and explain what happens if more oxygen is added to the system (2 marks)

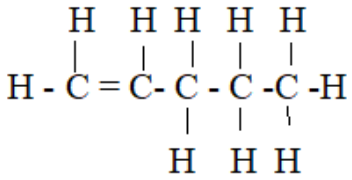
– The yield of sulphur (VI) oxide increases√1 OR, The equilibrium shifts to the right√1
– Because adding more oxygen increase the concentration of reactants in the forward reaction√1

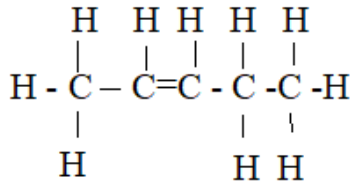
4. (a) A hydrocarbon contains 85% carbon. Its molecular mass is 70g.
(i) Determine its empirical and molecular formula. (C = 12, H = 1). (4mks)

C	H
85	15
12	1
7.083	15√½
1	2√½
$CH_{2\sqrt{1}}$	

n (E. F. M) = M. F. M
14n = 70
n = 5√1
Molecular formula is C_5H_{10}√1

(ii) Draw **two** positional isomers of the hydrocarbon. (1mk)





b). 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
$CH_3\ CH_2\ CH_2\ COOCH_2\ CH_3$

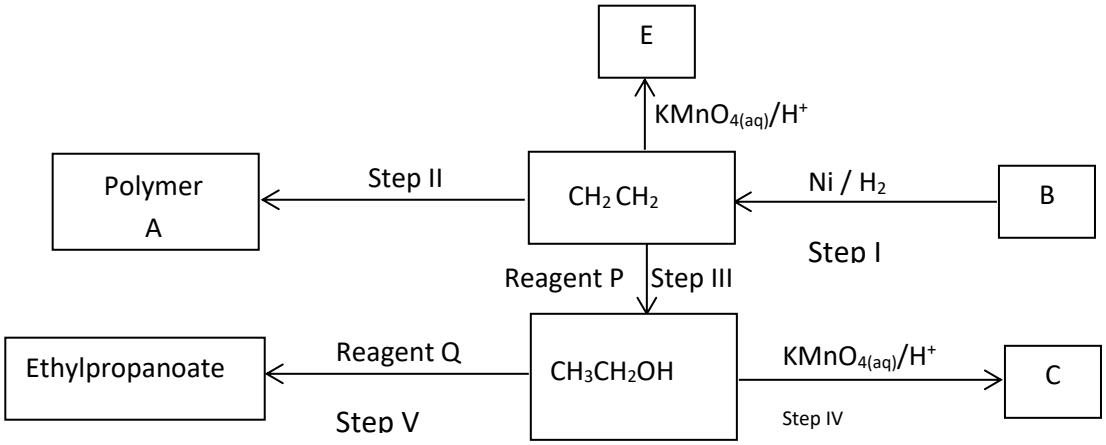
(i) Name
I The type of reaction that took place. (1mk)
Esterification√1
II What is the role of concentrated sulphuric (VI) acid in the experiment
It speeds up the rate of reaction(½mk)
Acc. Catalyst.

(iii) Write the structural formula and give the systematic name of the acid used in the above experiment. (2mks)

$CH_3CH_2CH_2COOH$, OR , $CH_3(CH_2)_2COOH$√1 Acc. Correct open structure

Butanoic acid √1

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



i). Identify the following compounds.

B Ethane (½mk)

C Ethanoic acid (½mk)

A Polythene acc. polyethene (½mk)

E Ethan-1,2-diol (½mk) Acc. Correct formula

ii). Name the process in steps.

I Hydrogenation (½mk)

II _Polymerisation (½mk)

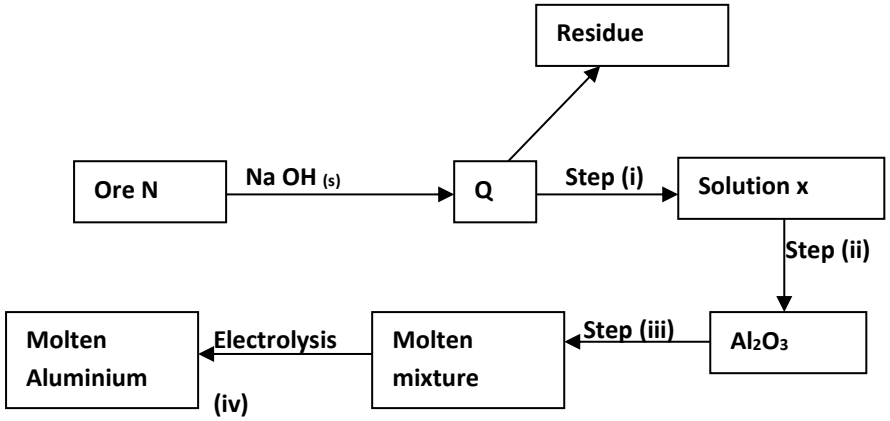
IV Oxidation (½mk)

iii). Reagent

P _Water (½mk)

Q Propanoic acid (½mk)

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



a). Name one Ore of **N.** (1mk)

- Bauxite√1 OR
- Corundum√1
- Mica√1

Rej. Chemical formula

b). Explain why the ore is first dissolved in excess sodium hydroxide solution (1mk)

To remove iron (III) oxide impurity√1

c). Name the major compound present in the residue. (1mk)
Iron (III) Oxide√1

d). Give the formula of the aluminium compound present in solution **X** (1mk)
$[Al(OH)_4]^-$ √1

e). Explain how to obtain aluminium hydroxide from solution **X** (2mks)
Seeding√**1**, where solid aluminium hydroxide is used to precipitate aluminium hydroxide from the solution√**1** OR
Bubbling carbon (IV) oxide through solution X to precipitate aluminium hydroxide.√**2**

f). (i) Write an equation of the reaction that takes place in (e) above (1mk)

$$2[Al(OH)_4]^-(aq) + CO_2(g) \longrightarrow 2Al(OH)_3(s) + CO_3^{2-}(aq) + H_2O(l)$$ √1 OR

$$Al(OH)_4^-(aq) \xrightarrow[Seed]{Al(OH)_3(s)} Al(OH)_3(s) + OH^-(aq)$$

(ii) What is the role of cryolite (Na_3AlF_6) in the extraction of Aluminium: (1mk)
Lower the melting point of aluminium oxide√1

(iii) Explain why Na^+ and F^- ions are not discharged during electrolysis in step (iv) (1mk)
Because their concentration is low√1

(iv) Aluminium is a good conductor of electricity. State **two** uses of aluminium based on that property. (2mks)
Making of overhead electric cables.√1
Manufacture of Electrical appliances√1

6. I. State Le chateliers principle on equilibrium? (1mk)
When a system at equilibrium is subjected to changes in conditions, the system adjusts so as to oppose the change√1
OWTTE

II. Bromine reacts with water in accordance with the following ionic equation.

$$Br_{2\,(aq)} + H_2O(l) \rightleftharpoons Br^-_{(aq)} + OBr^-_{(aq)} + 2H^+_{(aq)}$$

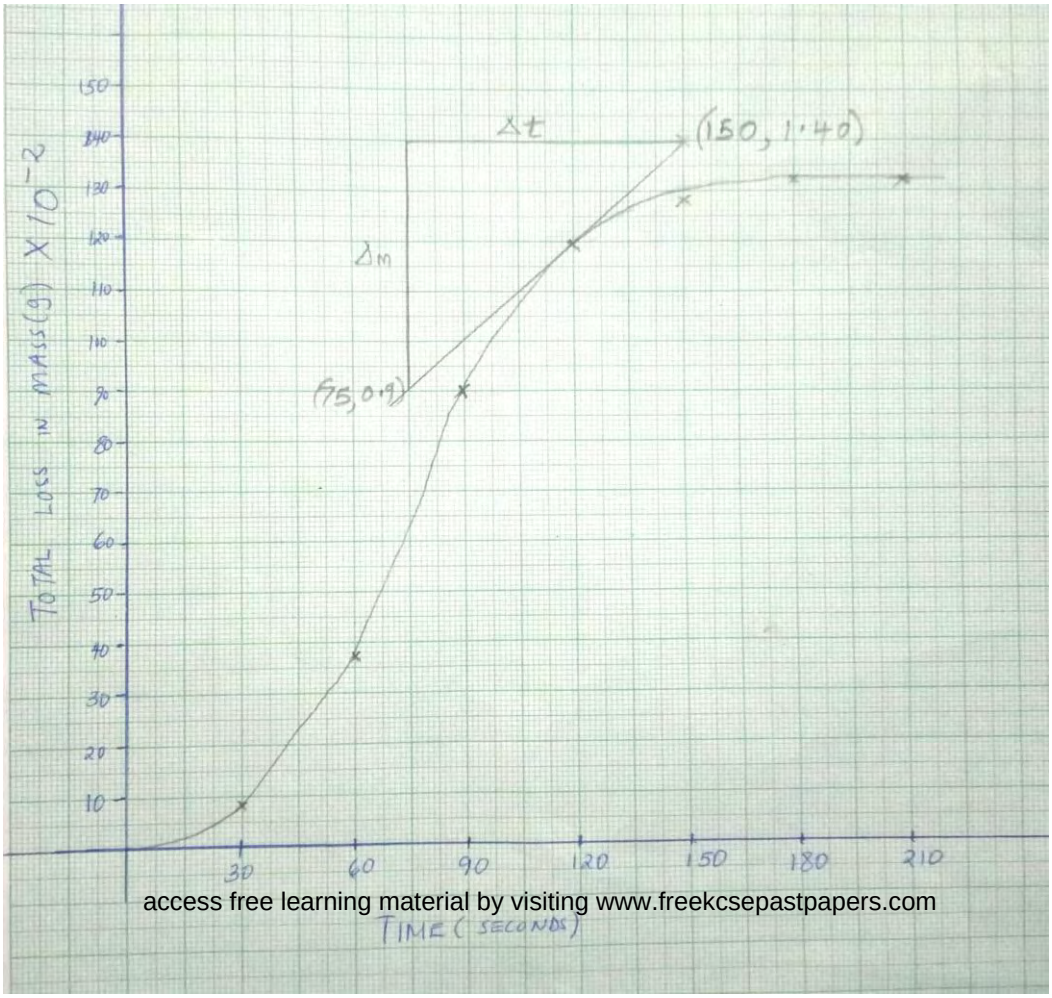
Explain how addition of sodium hydroxide solution would affect the given equilibrium. (2mks)

The equilibrium shifts to the right√1
Since the OH^- reacts with H^+ reducing the concentration of the later.√1

b) 3g of a powdered carbonate of metal **X** of formula XCO_3 were mixed with 13.2cm^3 of 2M hydrochloric acid. The mass of the reaction vessel and its contents was recorded at various times. From these readings, the total loss in mass of the reaction vessel and its contents was calculated and recorded as shown in the table below

Time (sec)	30	60	90	120	150	180	210
Total loss in mass (g)	0.08	0.37	0.90	1.19	1.28	1.32	1.32

i) On the grid provided below, draw a graph of total loss in mass (y-axis) against time (3mks)



i) Calculate the rate of reaction at the 120th second. (2mks)

$$\text{Rate} = \frac{\text{Change in Mass}}{\text{Change in time}}$$
$$= \frac{1.40 - 0.90}{150 - 75}$$
$$= 0.00667\text{g/s}$$

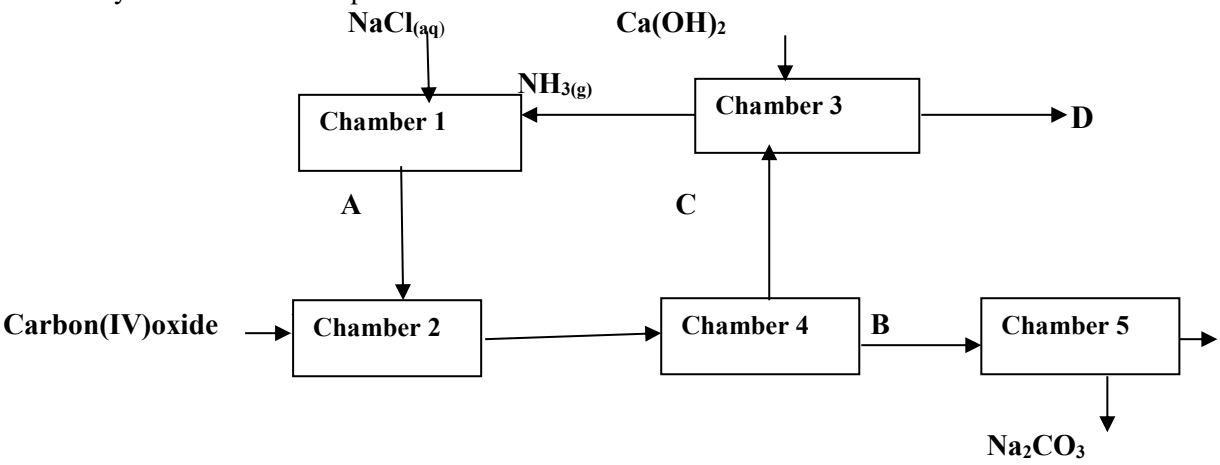
ii) Explain why there is no change in mass between 180 and 210 seconds. (1mk)
All the metal carbonate had been used up√1

iii) Write an equation for the reaction that takes place. (1mk)
$XCO_3(s) + 2HCl(aq) \longrightarrow XCl_2(aq) + CO_2(g) + H_2O(l)$√1

iv) Calculate the relative atomic mass of X (C=12.0, O=16.0) (2mks)

$$\text{Moles of HCl} = \frac{2 \times 13.2}{1000}$$
$$= 0.0264\text{moles}$$
$$\text{Moles of } XCO_3 = 0.0264 \times \tfrac{1}{2}$$
$$= 0.0132\text{moles}$$
$$\text{R.F.M} = \frac{1.32}{0.0132}$$
$$= 100$$
$$M + 12 + 48 = 100$$
$$M = 40$$

7. The flow chart below shows industrial manufacture of sodium carbonate.
Study it and answer the questions that follow.



(a) Name substances **A**, **B**, **C** and **D**. (2mks)

A Ammoniacal brine√½
B Sodium hydrogen carbonate√½
C Ammonium chloride√½
D Calcium chloride√½

(b) Write equation for the reactions taking place in chamber 3. (1mk)

Chamber 3

$2NH_4Cl_{(aq)} + Ca(OH)_{2(aq)} \longrightarrow 2NH_3(g) + CaCl_{2(aq)} + 2H_2O_{(l)}$√1

(c) Name the physical process in chamber 4 and 5. (2mks)

Chamber 4
Filtration√1
Chamber 5
Thermal decomposition√1

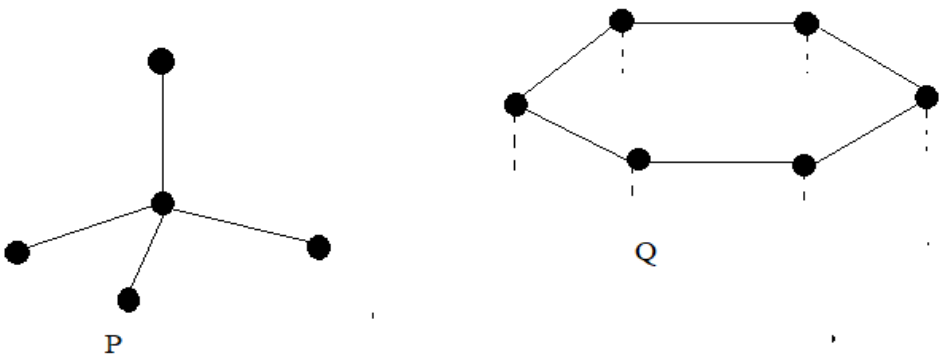
(d) Name **one** source of cheap carbon (IV) oxide for Solvay process. (1mk)

Thermal decomposition of limestone √1

(e) Briefly explain how sodium chloride required for this process is obtained from sea water. (2mks)

At low temperature sodium chloride becomes less soluble in sea water and crystalizes out. It is then dug from the sea bed by bucket dredgers.√2

f) Below are allotropes of carbon.



(i) Identify the allotropes

P Diamond ½mk
Q Graphite½mk

(ii) Allotrope Q can be used as a lubricant. Explain. (2mks)
In its structure the weak van der Waals forces√**1** allow its layers to slide over each other when pressed giving it its slippery feel √**1**thus reducing friction between moving parts.

iv) Give a reason why burning charcoal jiko in a poorly ventilated room is dangerous. (1mk)
Carbon undergoes incomplete combustion forming carbon (II) oxide which is poisonous. √1

BUTULA SUB – COUNTY JOINT EXAM.
CHEMISTRY – 233/3
MARKING SCHEME- PAPER 3.

1. PROCEDURE 1

Table 1

	I	II	III
Final burette reading (cm³)	16.7	16.8	16.6
Initial burette reading (cm³)	0.0	0.0	0.0
Volume of solution A used (cm³)	16.7	16.8	16.6

Award a total of 5 marks distributed as follows.

A. **COMPLETE TABLE ……** (1 mark)
i) Complete table with 3 titres and no error. (1 mark)
ii) Incomplete table with 2 titrations done award. (½ mark)
iii) Incomplete table with 1 titration done. (0 mark)

Penalties
i) Wrong arithmetic / subtraction.
ii) Inverted table.
iii) Burette reading beyond 50cm² unless / explained.
iv) Unrealistic value is less than 1cm or ≥ 100cm³

Note
Penalise ½ mk each to a maximum of ½mark

B. **USE OF DECIMALS** …… 1 mark
[Tied to 1st and 2nd rows only]
i) Accept 1 or 2d.p used consistency otherwise penalise FULLY
ii) If 2d.p are used the 2nd d.p digits should be 0.5 otherwise penalise FULLY.
iii) Accept inconsistently in teh use of zero is initial burette reading i.e. 0, 0.0, 0.00

C. **ACCURACY.**
Compare the candidates correct titre value with the S.V.
Conditions.
i) If at least the value is within ± 0.1 cm³ of S.V award.
ii) If no value is within ± 0.1cm³ of S.V but within ± 0.2cm³ of S.V. award . . . (½ mark)
iii) If none is within ± 0.2cm³ award zero. (0 mark)

d) **PRINCIPLES OF AVERAGING** . . . . . (1 mark)
Conditions.
i) If 3 consistent titration done and averaged award (1 mark)
ii) If 3 titrations are done but ONLY 2 are consistent and averaged award . . . . (1 mark)

iii) If only 2 titrations are done, are consistent and averaged . . . . . (1 mark)
iv) 3 titrations are done are consistent but only are averaged award . . . . . (0 marks)
v) 3 titrations done, inconsistent and averaged award. . . . (0 marks)

Penalties
i) Penalise ½mk for wrong arithmetic in the answer if error is outside ± 2 units in the 2nd d.p.
ii) Penalise ½ mk if no working is shown and answer given is correct.
iii) Penalise FULLY if no working is shown and answer given is wrong.
iv) Accept rounding off of answer to the 2nd d.p and truncation to 2dp but not to 1dp or whole number. Otherwise penalise ½mk for rounding off to 1dp or to a whole number.

NB
Accept the average volume if it works out exactly to a whole number or to 1d.p.

E. **FINAL ACCURACY**…… (1 mark)
(Tied to average titre)
Compare the candidates correct average titre to the S.V.
Condition.
i) If within ± 0.1cm³ of S.V award (1 mark)
ii) If not within ± 0.1cm³ of S.V but within ± 0.2cm³ award . . . . (½ mark)
iii) If beyond ± 0.2 cm³ of S.V award (0 mark)

B. I.

II. Number of moles of solution A used.

$$= \left[\frac{0.02 \times average\ titre}{1000}\right]$$

$$= correct\ Ans$$

III. Concentration of solution B in moles / litre.
250cm³ = 5.88g
1000cm³ = ?

$$= \left[\frac{1000 \times 5.88}{250}\right] g/litre$$

$$= 23.52 g/litres$$

Concentration of solution B

$$= \left[\frac{23.52}{392}\right] mole/litre$$

$$= 0.06 moles/litre$$

C.
I. Number of moles of B in 25.0cm³

$$= \left[\frac{2.5 \times 0.06}{1000}\right] moles$$

$$= 0.015 moles$$

II. Number of moles of B which react with 1 mole of solution A

$$= \frac{0.0015}{Ans\ in\ Qn1bIIIabove} = correct\ \ ans$$

$$= \left[\frac{1000 \times 5.89}{250}\right] g/litre$$

$$= 23.52 g/litres$$

$$= \left[\frac{1000 \times 5.89}{250}\right] g/litre$$

$$= 23.52 g/litres$$

PROCEDURE 2
Table 2 . . . . . 6 marks
DISTRIBUTION OF THE MARKS.

A. **Completing table ……..** **(3 marks)**
Conditions
i) Complete table with 12 correct entries .. . 3 marks)
ii) Incomplete table with 6 times with 4.5 correct rates. . . . . (2½ marks)
iii) Incomplete table with 6 times with 3 correct rates. . . . . (2 marks)
iv) Incomplete table with 6 time with less than 3 correct rates . . . . . (1½ marks)
v) Incomplete table with 4.5 times with 4 second correct rates. (1 mark)
vi) Incomplete table with 4.5 time with 3 correct rates. . . . . (½ mark)
vii) Incomplete table with 4.5 time with less than 3 correct rates . . . . . (½ mark)
viii) Incomplete table with 3 time with 3 correct rates. . . . . (½ mark)
ix) Incomplete table with 3 times with less than 3 correct rates . . . . . (0 mark)
x) Where values are constant in time column award a maximum of ½ mark for complete table.

B. Use of decimals……. (1 mark)
Tied to time subject to at least 2 reading of time in each case.
2. Accept whole numbers or 1 or 2 decimal places used consistently for time column otherwise penalise FULLY (award 0 mark)

C. Accuracy …… (1 mark)
[Tied to time column only]
Compare the candidates time readings.
When temperature = 40°C with the school value.
i) If within ± 2.0 seconds of S.V award . . . . (1 mark)
otherwise penalise FULLY. . . . award. (0 mark)

D. **Trend……** **(1 mark)**
[Tied to time column only]
- Decrease in time from temp = 40^0C to temp =80°C.
Otherwise penalise FULLY..award. (0 marks)

PROCEDURE 2
b) GRAPH. . . . . (3 marks)
Awards as follows:

A. Labelling
Award ½ if both axes are correctly labelled
[$^1/_{Time}$ sec $^{-1}$ on vertical axis and temperature in °C on the horizontal axis.

Penalties.
i) Penalise FULLY for inverted axes.
ii) Penalise FULLY if wrong units are used otherwise ignore if units are omitted.

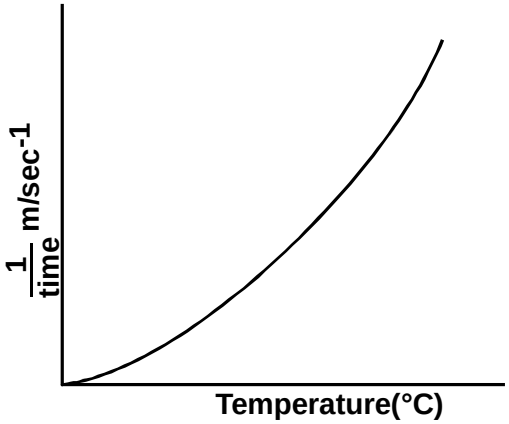
B. Scale
Conditions.
i) Area covered by the actual plots must be ½ of the grid provided for each axis.
ii) Scale intervals must be consistent.
iii) Scale chosen must accommodate ALL plots.

Note
Penalise fully if any of the above condition not met.

c) Plotting . . . . . (1 mark)

i) If 6 to 5 plots are correctly plotted. (1 mark)
ii) If only 3 - 4 are correctly plotted. (½ mark)

d) Lines / . . . . . (1 mark)
Accept a curve passing through atleast 3 correctly plotted points as shown award.
(1 mark)



(f) 2 marks awarded as follows
- For showing $^1/_T$ currently on the graph (½ mark)
- For stating the correct reading . . . .½ mark
- for using it (correct reading . . . . . .½ mark
- Correct answer.

g) Rate of reaction is directly proportional to increase in temperature.

NB- Correct answer MUST be tied to the correct trend otherwise penalise fully. (0 mark)

2.

Observation	Inference
a) - White residue✓½ - Colourless filtrate✓½	- Solid P contains a soluble and insoluble salt.✓½ - Coloured ions (Fe^{2+}, Fe^{3+}, Cu^{2+}) absent✓½
b) i) No white ppt formed✓I	$Zn^{2+}, Al^{3+}, Pb^{2+}, Mg^{2+}, Ba^{2+}$ absent Atleast 4 correctly inferred – 1mark 2 -3 correctly inferred – ½ mark 0 – 1 0mark Penalize ½ mark for any contradictory ion to a maximium of 1mark
ii) Burns with yellow flame✓I	Na^+ confirmed✓I
iii) White ppt	$SO_4^{2-}, SO_3^{2-}, CO_3^{2-}$
iv) Purple acidified potassium manganate (VI) decolourised.✓I - Penalise if the purple colour of acidified potassium manganate(VII) is not mentioned	SO_3^{2-} *confirmed*✓½

c) i) Effervescence//production of gas bubbles//fizzing✓½ - colourless solution formed✓½	SO_3^{2-}, CO_3^{2-} ✓½ - Coloured ions (Fe^{2+}, Fe^{3+}, Cu^{2+}) absent✓½ -
ii) white ppt✓½; soluble✓½	Zn^{2+}✓½

3.

Observation	Inference
a) Burns with a yellow sooty flame//smoky//luminous✓I	>C=C< —C≡C —
b) i) *P^H of 1,2,3*✓½	Strongly acidic✓½
ii)) Effervescence//production of gas bubbles//fizzing✓I	Acidic ✓I
iii) Purple acidified potassium manganate (VI) decolourised.✓I - Penalise if the purple colour of acidified potassium manganate(VII) is not mentioned	>C=C<, —C≡C —, R-OH

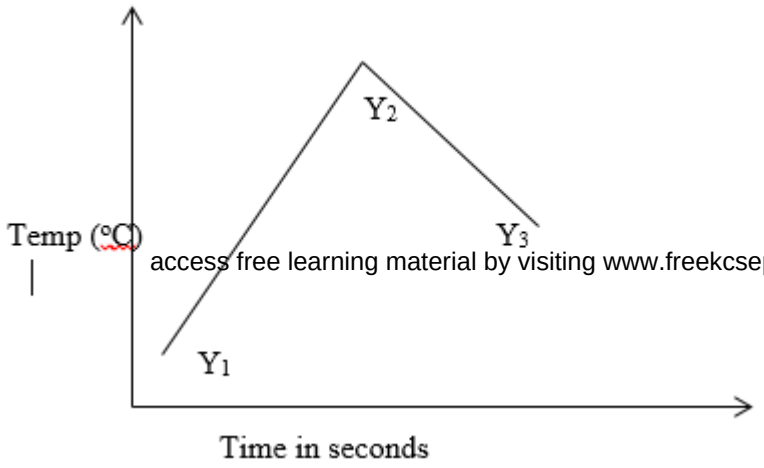
SAMIA SUB-COUNTY JOINT EXAMINATION-2021
233/1
CHEMISTRY PAPER 1
(THEORY)

1.
   a. Define the term **half-life** as used in radioactivity. (1mk)
   b. 100g of radioactive substance was reduced to 12.5g in 15.6years. **Calculate** the half-life of the substance. (2mks)

2. You are provided with water and usual laboratory apparatus. Describe how you would fully separate solid lead (II) carbonate from a mixture of iron fillings, lead (II) carbonate and sodium carbonate. (3mks)

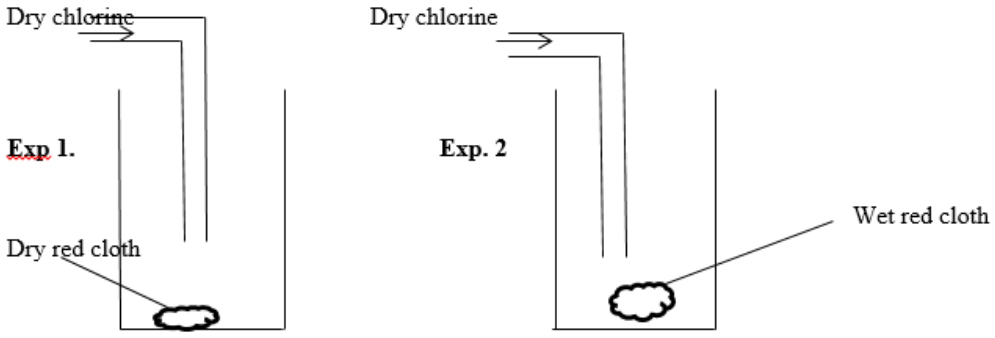
3. In order to determine the molar heat of neutralization of sodium hydroxide, $100cm^3$ of 1M NaOH and $100cm^3$ of 1M HCI both at the same initial temperature were mixed and stirred continuously with a thermometer. The temperature of the resulting solution was recorded after every 30 seconds until the highest temperature was attained. Thereafter the temperature of the solution was recorded for further two minutes.

   a. Write the ionic equation for the reaction which took place. (1mk)
   b. The sketch below was obtained when the temperature of the mixture were plotted against time. Study it and answer the questions that follow.



   i) What is the significance of point Y_2 (1mk)
   ii) **Explain** the temperature change;
   Between Y_1 and Y_2 (1mk)
   Between Y2 and Y3 (1mk)

4. Dry chlorine gas was passed through two pipes of coloured cotton cloth as shown below.



a. **State** what is observed in each of the experiment;
   Experiment 1 (1mk)
   Experiment 2 (1mk)
b. Explain your observation using an equation. (1mk)

5. Two elements **A** and **B** have electronic configuration 2.8.3 and 2.6 respectively.
   a. To which group and period does element B belong? (1mk)
   b. If the two react, what is the formula of the compound they form? (1mk)
6. Iron fillings react with steam according to the equation given below.

$$3Fe_{(s)} + 4H_2O_{(g)} \rightleftharpoons Fe_3O_{4(s)} + 4H_{2\,(g)}$$

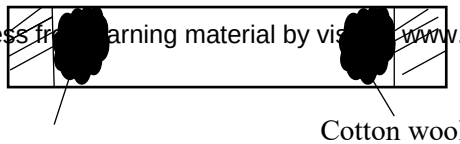
State and **explain** the effects of each of the following on the equilibrium.
   i. Increase in pressure (2mks)
   ii. Addition of magnesium ribbon to the equilibrium mixture. (2mks)

7. Unknown substances had PH values as shown in the table below.

Substance	PH values
A	6.0
B	2.0
C	8.0

State which substance is likely to be;
   i. Lemon juice (1mk)
   ii. Phosphoric (v) acid (1mk)
   iii. **Identify** a substance that would be a better electrolyte? (1mk)

8. In an experiment to study diffusion of gases, the following set up was used.



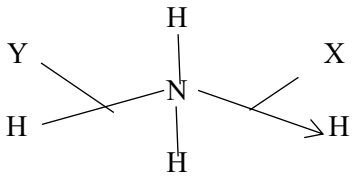
Cotton wool Soaked in Conc Ammonia

Cotton wool soaked in Conc hydrolic acid

   i) **State** and **explain** the observations made in the experiment. (2mks)
   ii) Write an equation for the reaction that occurs in the experiment. (1mk)

9. An electric current was passed through molten potassium fluoride using inert electrodes.
   a. Name the products at;
      Anode (1mk)
      Cathode (1mk)
   b. Write an equation for the reaction at the anode. (1mk)
10. During the extraction of copper and zinc from their ores, some of the processes include;
   i. Crushing
   ii. Mixing of the crushed ore with oil and water and bubbling air through it.
   a.
   i) Name the process (ii) above. (1mk)
   ii) What is the purpose of process (ii) above? (1mk)
   b. Bronze is an alloy of copper and another metal. **Identify** the other metal. (1mk)
11. Name **another** gas which is used together with oxygen in welding. (1mk)

12. The structure of ammonium ion is shown below.



a. Name the type of bond represented by X and Y (2mk)
b. How many electrons are used in bonding in the ammonium ion? (1mk)

13. A dibasic acid $H_2C_2O_4nH_2O$ of concentration 6.3g/dm^3 was titrated against NaOH solution. 25cm$_3$ of the acid solution required 15.6cm^3 of 0.16MNaOH for complete neutralization. **Calculate** the value of n in the formula. (H=1, O=16, C=12) (3mks)

14. The table below shows the solubility of potassium nitrate and potassium chlorite at various temperatures.

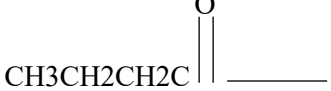
Salt	Solubility at various temperatures	
	50^{o}c	20^{o}C
KNO_3	86g	31g
$KClO_3$	18g	8g

A mixture of salts contains 20g of KNO3 and 18g of $KClO_3$ in 100g of water at 50^{o}C.

a. **State** the method which may be used to separate the mixture. (1mk)
b. If the mixture was cooled from 50^{o}C to 20^{o}C, **state** and **explain** what would be observe. (2mk)

15.

a. Name the following organic compounds.



(1mk)

CH3CH2CH2CH3 (1mk)

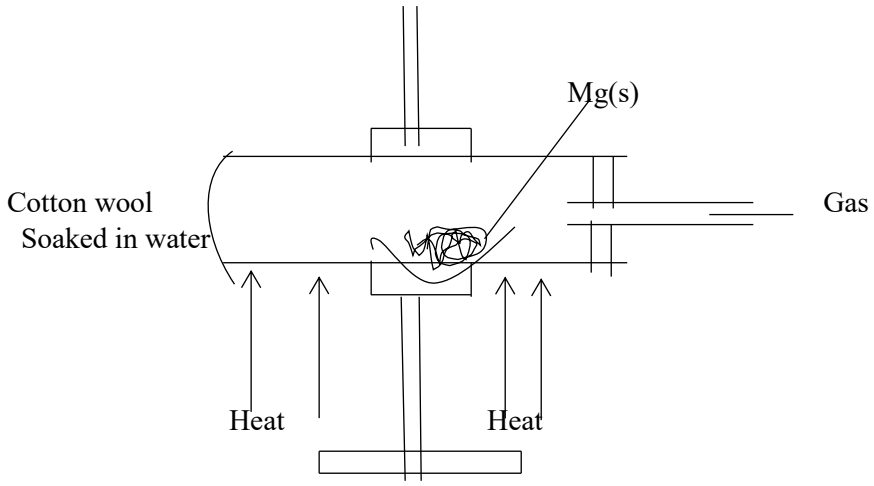
b. Below is a simple representation of a soap molecule.

Polar head Non polar head

Using the structure above show how soap removes an oil smear from the fabric below .(2mks)

16. Explain how a sample of lead(ii) chloride can be prepared using the following reagents.
i. Dilute nitric (v) acid
ii. Dilute hydrochloric acid
iii. Lead (ii) carbonate (3mks)

17. The diagram below represents a set up used to react magnesium with steam. Study it and answer the questions that follow below.

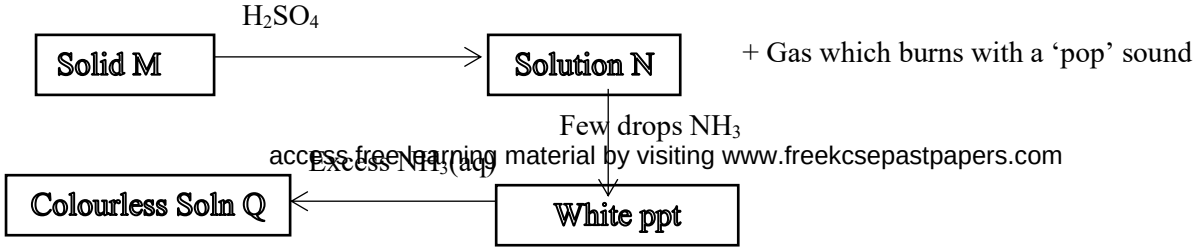


i) **State** the observation made in the combustion tube. (1mk)

ii) Why would it not be advisable to use potassium in place of magnesium In the above set up. (1mk)

iii) Explain **why** cotton wool is heated prior to heating magnesium (1mk)

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



i) Name solid **M** (1mk)

ii) Write the formula of a complex ion present in solution **Q** (1mk)

iii) Write an ionic equation of the reaction between Barium nitrate and solution **N**.(1mk)

19.

a. Below are standard reduction potentials of **3** electrodes.

Fe2+(aq) + 2e	⟶	Fe(s)	-0.44v
Zn2+(aq) +2e	⟶	Zn(s)	-0.76v
Sn2+(aq) + 2e	⟶	Sn(s)	-0.14v

Calculate the electromotive force of a cell formed between Fe/Fe2+ half-cell and Zn/Zn2+ half-cell. (2mks

b. Draw a clearly labeled diagram of a set up you would use to electroplate an iron spoon with silver metal. (2mks)

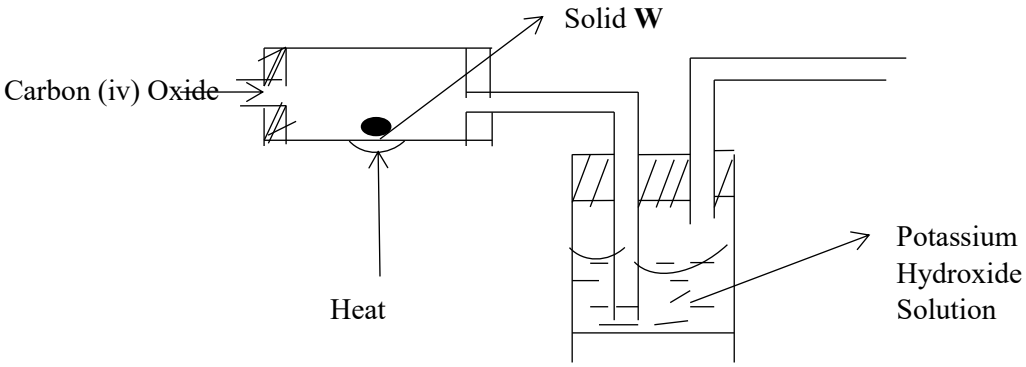
20.

a. Name the **process** of extracting Sulphur. (1mk)

b. What is the **role** of super-heated water? (1mk

c. State **two** uses of sulphur (1mk)

21. The diagram below shows how carbon (ii) oxide can be prepared starting with carbon (iv) oxide and solid W. study it and answer the questions that follow.



a. With reasons, **state** a suitable location where such an experiment should be rightly conducted. (1mk)

b. What is the purpose of concentrated potassium hydroxide? (1mk)

c. Identify solid **W** (1mk)

22.

a. Explain how you would separate a mixture of nitrogen and oxygen. (2mks)

b. **Draw** a well labeled diagram to show the percentage composition of oxygen in air can be determined. (2mks)

23. Use the information below to answer the questions that follow.

$H2(g) + {}^{1}{}_{2}O_2 \longrightarrow H_2O(l)$ $\Delta H_1 = -286KJ/Mol$

$C(s) + O_2(g) \longrightarrow CO_2(g)$ $\Delta H_2 = -384KJ/Mol$

$C(s) + 4H_2(g) + {}^{1}{}_{2}O_2(g) \longrightarrow C_3H_7OH$ $\Delta H3 = -2686.6KJ/Mol$

a. Define '**enthalpy** of formation' (1mk)

b. Determine the molar enthalpy of formation of propanol. (2mks)

24. Most natural water occurs as permanent hard water or temporary hard water.

a. Name **two** compounds that cause;

i. Temporary hardness (1mk)

ii. Permanent hardness (1mk)

b. How is temporary hardness removed from water? (1mk)

c. State **one** disadvantage of using hard water in boilers. (1mk)

25. Both Sodium and Aluminum are metals in period 3 yet sodium has much lower melting point than aluminum. **Explain**. (2mks)

26. Determine the values of X and Y in the equation below.

$${}^{236}{}_{92}U + {}^{x}{}_{Y}Ba \longrightarrow {}^{92}{}_{36}Kr + {}^{1}{}_{0}Z + \text{Energy}$$

x……. Y…….. (1mk)

27. State **two** effects of emitting SO_2 in the environment. (1mk)

SAMIA SUB-COUNTY JOINT EXAMINATION-2021
233/2
CHEMISTRY PAPER 2
(THEORY)

1.

a. The information below relates to element N, P,Q, Rand S . Study it and answer the questions that follow. The letters are not the actual symbols for the elements.

Element	Atomic radius(mm)	Ionic radius(mm)	Formula of oxide	Melting point of oxide
N	0.364	0.421	N_2O	-119
P	0.830	0.711	PO_2	837
Q	0.592	0.485	Q_2O_3	1466
R	0.381	0.446	R_2O_5	242
S	0.762	0.676	SO	1054

i) Name the elements that are metal. **Give** a reason. (2mks)
ii) Compare the melting points of the oxides of S and R in terms of structure and bonding. (2mks)
iii) Name the pair of elements that would react most vigorously with each other?
Explain (2mks)

b. The table bedlow has information about chlorides of elements in period 3 of the periodic table: Sulphur to sulphur

Chloride	NaCI	$MgCI_2$	$AICI_3$	$SiCI_4$	PCI_5
Melting point (ºC)	801	712	Sublimes at 183	-70	-80

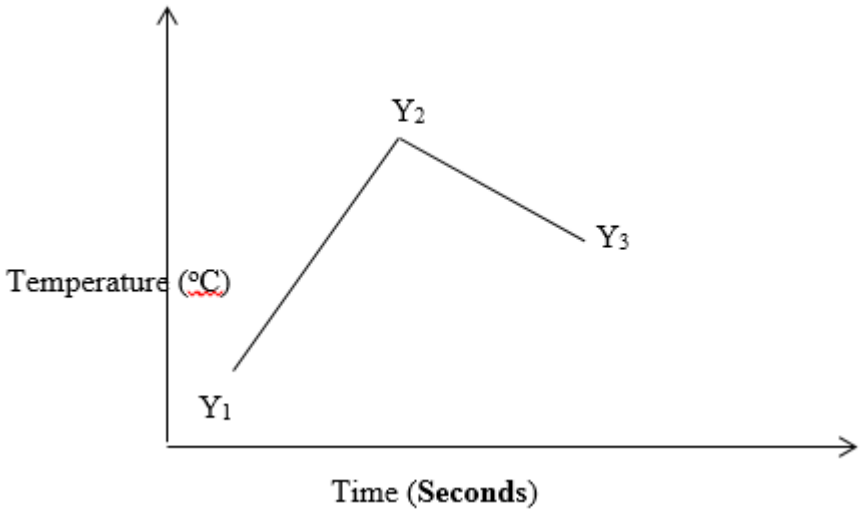
What are the possible PH values of the solutions formed when the following chlorides are dissolved in water? Explain
$MgCI_2$ (1mk)
$AICI_3$ (1mk)

c. The molecular formula of Aluminum chloride is AI2CI6. Draw the structural (not dot and cross diagram) of Aluminum chloride indicating clearly the different types of bonds present. (2mks)

d. Using dot ( ) and cross (×), draw a diagram to show bonding in sodium chloride. (Na=11, CI=17) (2mks)

2.

a. What is the molar enthalpy of neutralization? (1mk)
b. In order to determine the molar heat of neutralization of sodium hydroxide, 100cm3 of 1M sodium hydroxide and 1M of hydrochloric acid both at the initial temperature were mixed and stirred continuously using a thermometer. The temperature of the resulting solution was recorded after every 30seconds until the highest temperature was attained. Thereafter the temperature of the solution was recorded for a further two minutes.
i. Why was it necessary to stir the mixture of the two solutions? (1mk)
ii. Write an ionic equation for the reaction that took place. (1mk)
iii. The sketch below was obtained when temperature of the mixture was plotted against time. Study it and answer the questions that follow.



Explain the temperature changes between points

Y_1 and Y_2 (1mk)

Y_2 and Y_3 (1mk)

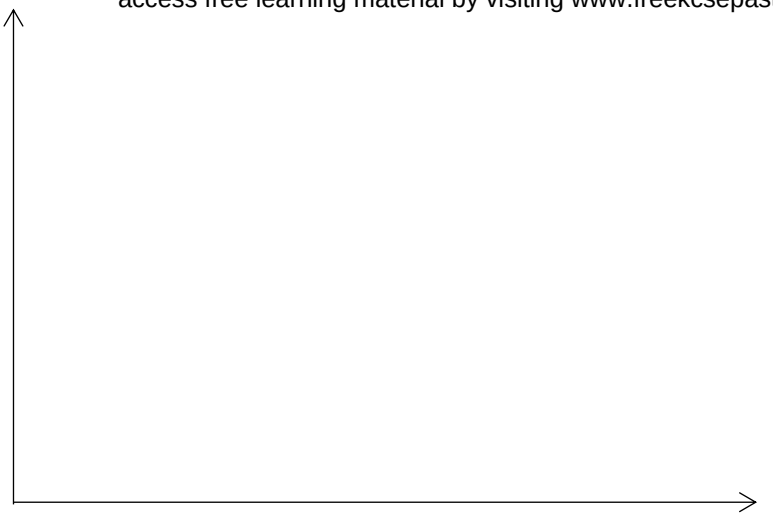
iv. If the initial temperature for both solution was 25ºC and the highest temperature was 31.4ºC for the mixture. **Calculate;**

Heat change for the reaction (Specific heat capacity of solution=$42Hg^{-1}K^{-1}$, Density of the solution =$1gcm^{-3}$) (2mks)

Molar heat of neutralization of sodium hydroxide. (2mks)

v. **Explain** how the molar heat of neutralization obtained in this experiment would compare with one that would be obtained using 1.0M ethanoic acid and $100cm^3$ of 1M sodium hydroxide solution.(2mks)

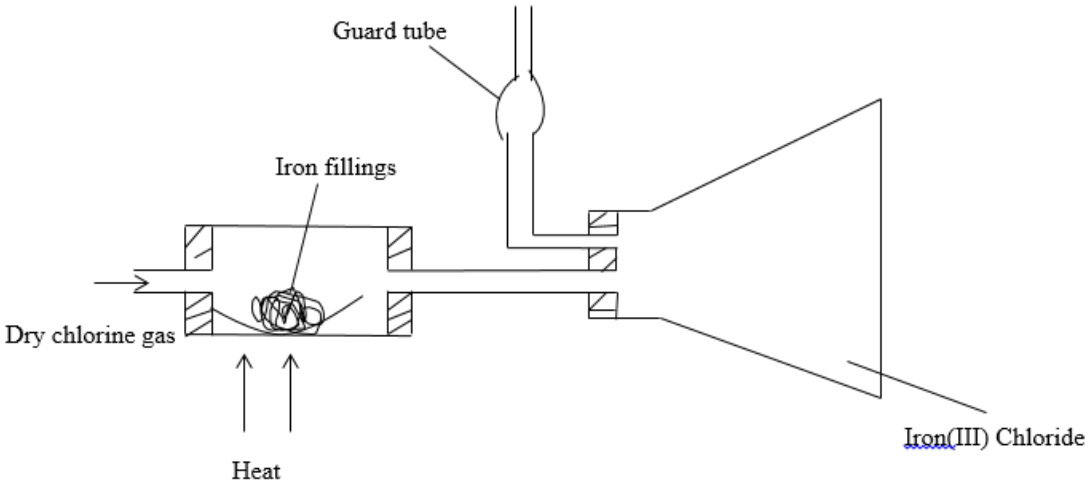
Draw an Energy level diagram for the reaction represented by reaction between hydrochloric acid and sodium hydroxide solution. (3mks)



3.

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

b. The set up below was used to prepare iron (III) chloride using the apparatus shown in the diagram below.



i) State **one** precaution that should be taken in carrying out the above experiment. (1mk)

ii) Explain why
Calcium oxide would be preferred to calcium chloride in the guard tube. (2mks)

It is necessary to pass chlorine gas through the apparatus before heating begins. (2mks)

i) Write a **chemical** equation for the reaction that took place in the guard tube. (1mk)

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

iii) During the reaction in the combustion tube, the total mass of iron (III) chloride formed was found to be 1.5g. **Calculate** the volume of chlorine gas that reacted with iron. (Fe=56.0, CI=35.5 and molar gas volume at 298k is 24,000cm^3) (3mks)

c. **Draw** and **name** the structure of the compound formed when excess chlorine gas is reacted with ethane gas. (2mks)

d. State **one** use of chlorine gas. (1mk)

4.

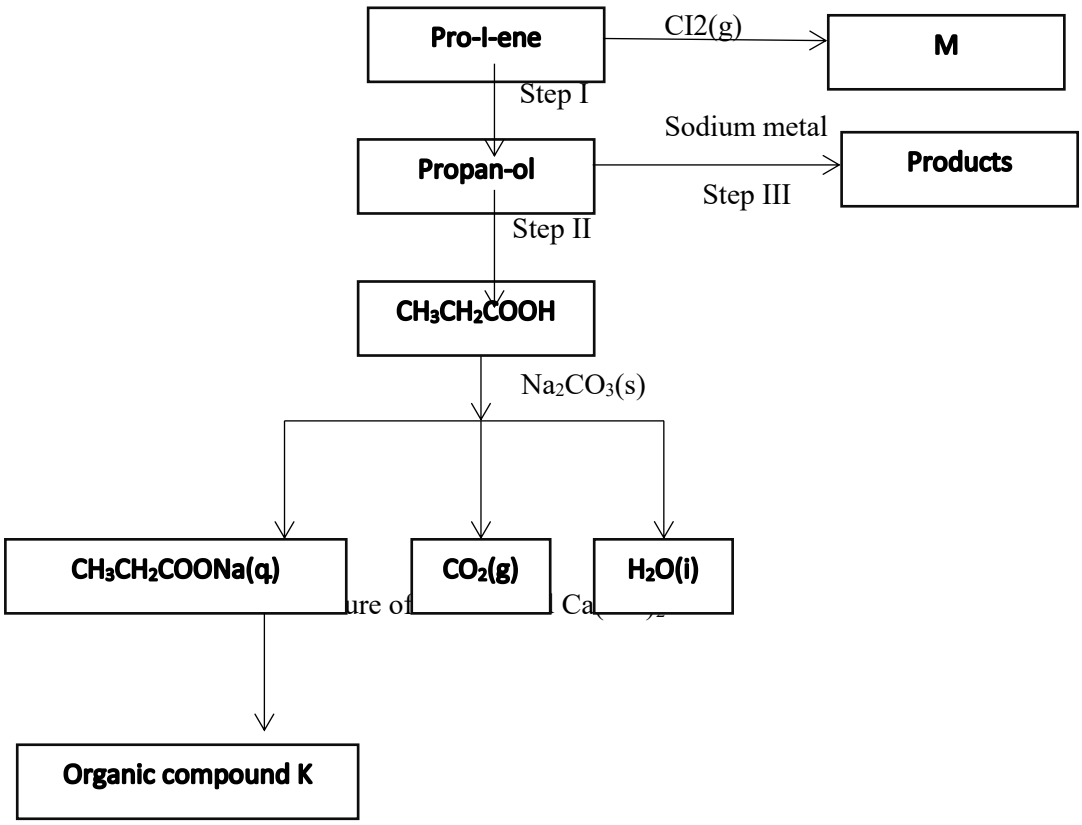
a. Give the systematic names for the following compounds

i) $HCOOCH_2CH_3$ (1mk)

ii) $CH_3CH_2CH_2CHCH2$ (1mk)

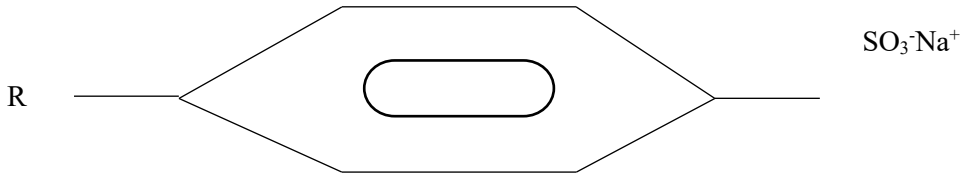
iii) CH C CH_2 CH_3 (1mk)

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



i) Identify the organic compound **K** (1mk)
ii) Write the formula of **M** (1mk)
iii) Give **one** reagent that can be used in
Step I (1mk)
Step II (1mk)
iv) Write the equations for the reaction in **step II** (1mk)

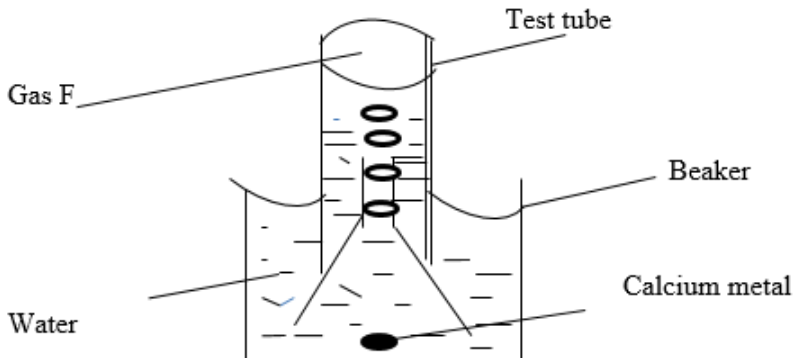
c. The structure below represents a type of cleansing agent.



Describe how the cleansing agent removes grease from a piece of cloth. (3mks)

5.

a. The set up below was used to collect gas F, produces by the reaction between water and calcium metal



i. Name gas **F** (1mk)

ii. At the end of the experiment, the solution in the beaker was found to be a week base. **Explain** why the solution is a weak base. (2mks)

iii. Give **one** laboratory use of the solution formed in the beaker (1mk)

b. When excess calcium metal was added to 50cm3 of 2 M aqueous copper (II)nitrate in a beaker, a brown solid and bubbles of gas were observed.

i. Write **two** equations for the reactions which occurred in the beaker. (2mks)

ii. **Explain** why it is not advisable to use sodium metal for this reaction. (2mks)

c. **Calculate** the mass of calcium metal reacted with copper(II)nitrate solution (Relative atomic mass of Ca=40 (2mks

6.

a. Write the **formula** of the complex Ion formed in each of the reactions below.

i. Lead metal dissolves in hot alkaline solution. (1mk)

ii. Zinc hydroxide dissolves ammonia solution. (1mk)

b. Give the name of each of the processes described below which takes place when the salts are exposed to air for some time.

i. Anhydrous copper (II) sulphate becomes wet. (1mk)

ii. Iron (III) chloride forms an aqueous solution. (1mk)

iii. Fresh crystals of sodium carbonate decahydrate become covered with a powder of solution of carbonate monohydrate. (1mk)

c. A certain hydrate salt has the following composition by mass. Iron 20.2%, sulphur 11.5%, water 45.5% and the rest oxygen. Its relative formula mass is 278.

i. **Determine** the formula of the hydrated salt (Fe=56,S=52, O=16, H=1) (3mks)

ii. 6.95g of the hydrated salt were dissolved in distilled water and the total volume made to 250cm^3 of solution. **Calculate** the concentration of the salt solution. (2mks)

7. The table below shows solubility of potassium nitrate and lead nitrate

Temperature ^oC	**0**	**20**	**40**	**60**	**80**	**100**
Solubility of KNO_3 in 100g of H_2O	12.5	32.5	62.5	110.0	137.5	
Solubility of $Pb(NO_3)$in 100g of H_2O	37.5	52.5	69.0	87.5	110.0	131.0

i) Draw the solubility curves for both salts on the same axis. (Temperature on the x-axix) (3mks)

ii) A solution of lead nitrate contains 90g of the salt dissolved in 100g of water at 100^{o}C. This solution is allowed to cool to 25^{o}C

At what temperature will crystals first appear? (1mk)

What mass of crystals will be present at 25^{o}C (1mk)

i) Which of the **two** salts is more soluble at 30°C (1mk)

ii) Determine the concentration of lead nitrate in moles per litre when the solubility of the two salts are the same. **(Pb=207.0, O=16.0, K=39.0, N=14.0)** (3mks)

SAMIA SUB-COUNTY 2021
233/3
CONFIDENTIAL

Apart from the usual laboratory fittings, each student should have the following:

1. About 0.5g of solid A in a stoppered container
2. About 0.5g of solid B in a stoppered container
3. 100cm^3 of solution R
4. 150cm^3 of solution Q
5. 150cm^3 of solution P
6. Distilled water in a wash bottle
7. About a spatula end –full of solid Calcium Hydroxide
8. Red and blue litimus papers
9. Three 250ml conical flasks
10. One burette0-50ml
11. One pipette 25ml
12. One 50ml measuring cylinder
13. One 10ml measuring cylinder
14. One 25cm^3 volumetric flask
15. Phenolphthalein indicator
16. Labels (2)
17. Stop watch
18. Two boiling tubes
19. One metallic spatula
20. Five test tubes on a test-tube rack
21. Wooden splint

22. Test tube holder
23. 100ml glass beaker
24. 1g sodium hydrogen carbonate
25. White paper
26. Filter funnel

The student should also get access to:

1. 10% Hydrogen peroxide (freshly prepared + dropper).
2. 2M Barium nitrate solution +dropper
3. 0.5M Hydrochloric acid + dropper
4. Source of heat
5. Acidified potassium manganite (VII)
6. Acidified potassium dichromate (VI)
7. 2M dilute sulphuric (VI) acid
8. Ethanol with a dropper

NOTES

- *Solid A is Hydrated ferrous ammonium sulphate*
- *Solution B is Melleic acid*
- *Solution R is prepared by welghing exactly 4.8g of sodium carbonate dissolves it to make 1dm^3 of solution*
- *Solution Q is prepared by weighing exactly 172cm^3 of hydrochloric acid (35-37% sp.gr 1.18)and dissolving to make 1d^{m3} of solution*
- *Solution P is prepared by weighing exactly 37.2g of sodium thiosulphste pentahydrate and dissolving to make 1dm^3 of solution.*

SAMIA SUB-COUNTY JOINT EXAMINATION-2021
233/3
CHEMISTRY PAPER 3
(PRACTICAL)

1. You are provided with :
   Solution **Q**, 2M Hydrochloric acid.
   Solution **P**, 0.15M Sodium thiosulphate
   Solution **R**, Sodium carbonate

Procedure 1

Measure 20cm^3 of 0.15M Sodium thiosulphate (solution **P**) into a 100cm^3 a glass beaker. Place the beaker on a white piece of paper with **ink mark 'X'** on it. Measure 20cm^3 of 2M hydrochloric acid solution **Q** using a 50cm^3 measuring cylinder. Put the acid into the glass beaker containing Sodium thiosulphate and immediately start off the stop watch. Determine the time taken for the **marks 'X'** to become invisible/obscured when viewed from above. Repeat the procedure by measuring different volumes of the acid and adding the volume of the distilled water to complete table 1 below.

Table 1

Volume of acid(cm^3)	**Volume of water(cm^3)**	**Volume of sodium thiosulphate (cm^3)**	**Time taken for mark 'X' to be invisible/obscured(seconds)**	**Reciprocal of time (sec^{-1}) $\frac{I}{t}$**
20	0	20		
18	2	20		
16	4	20		
14	6	20		
12	8	20		
10	10	20		

a. Complete the table below (6mks)
b. Plot a graph of $\frac{I}{t}$ against volume of acid used (3mks)

c. Explain the shape of your graph (1mk)
d. From the graph determine;
   i. Time taken for the cross to be obscured/invisible when the volume of the acid is:
      15cm^3 (1mk)
      8cm^3 (1mk)
   ii. The volume of the acid used if the time taken for the cross to be obscured/invisible is:
      40seconds (1mk)
      43 seconds (1mk)

Procedure 2

Using a 10cm^3 measuring cylinder, place 10cm^3 of solution **Q** into a **250ml** volumetric flask. Add about 200cm^3 of distilled water. Shake well. Add more distilled water to top up to the mark. Labeled this solution **T**. Fill the burette with solution **T**. using a pipette and pipette filler, pipette 25cm^3 of solution **R** into a conical flask. Add **3 drops** of phenolphthalein and titrate with solution T.

- Record your results in the table
- Repeat the titration two more times and complete the table

Table 2

	I	II	III
Final burette reading(cm^3)			
Initial burette reading(cm^3)			
Volume of solution T (cm^3) added			

(4mks)

a. Determine the :

Average volume of solution **T** used (1mk)
Moles of the acid in the average volume of solution **T** used. (2mk)
Concentration of solution **R** in moles per litre. (2mks)

2.

a) Put a spatula end-full of **solid A** into a boiling tube and about $10cm^3$ of distilled water. Shake the mixture well. Divide the resultant solution into **4 equal** portions.

Observation	**Inferences**
(½mk)	(1mk)

b. To the first portion, add a little calcium hydroxide solid and warm. Test any gases produced using both blue and red litimus paper.

Observation	**Inferences**
(1mk)	(1mk)

c. To the second portion, **add 4** drops of hydrogen peroxide solution. Test the gas produced using a glowing splint.

Observation	**Inferences**
(1mk)	(1mk)

d.

i. The solution is suspected to contain sulphite ions. Using separate acidified potassium manganate (VII) solution and dilute hydrochloric acid solution. **Describe** how you would confirm presence of the sulphite ions.

Observation	**Inferences**
(1mk)	(1mk)

ii. Carry out the actual test as described in (d) (i) above

Observation	**Inferences**
(1mk)	(1mk)

B You are provided with solid **B**. carry out the tests below and record your observation and inferences in the spaces provided.

i. Place one third of solid **B** on a metallic spatula. Burn it in a non-luminous flame of the Bunsen burner.

Observation	**Inferences**
(1mk)	(1mk)

ii. Place the remaining solid in a test-tube. Add about **$6cm^3$** of distilled water and shake the mixture well. Divide the resulting mixture into 4 portions.

Observation	**Inferences**
(½mk)	(½mk)

a. To the first portion, **add 2** drops of acidified potassium manganite (VII)

Observation	**Inferences**
(1mk)	(1mk)

b. To the second portion, **add 3** drops of acidified potassium dichromate (VI) and warm

Observation	**Inferences**
(1mk)	(1mk)

c. To the third portion, **add 1g** of solid sodium hydrogen carbonate.

Observation	**Inferences**
(½mk)	(½mk)

d. To the fourth portion, **add 5 drops** of ethanol followed by few drops of dilute sulphuric (VI)acid and warm

Observation	**Inferences**
(½mk)	(½mk)

SAMIA SUB-COUNTY JOINT EXAMINATION 2021
CHEMISTRY PAPER 1
MARKING SCHEME

1.
a. Time taken for half the amount of radio isotope to decay (1mk)

b. 100 $\xrightarrow{1}$ 50 $\xrightarrow{2}$ 25 $\xrightarrow{3}$ 12.5 (1mk)
3=15.6years

1=$\frac{15.6}{3}$ =5.2 years (1mk)

2.
a. Pass a magnet through the mixture to attract iron which is magnetic. Lead (ii)carbonate and sodium carbonate remains. (½mk)
b. Add water to the mixture of sodium carbonate and lead(ii)carbonate and stir. (1mk)
c. Sodium carbonate dissolves unlike lead(ii)carbonate
d. Filter to obtain lead(ii)carbonate as the residue to rinse it, allow to dry (½mk)
e. Run water through the residue to rinse it, allow to dry. (½mk)
(reject : dissolve the mixture in water)

3.
a. $H^+_{(aq)} + OH^-_{(aq)} \longrightarrow H_2O_{(l)}$ (1mk)
b. Y2 complete neutralization/end point (1mk)
Y1 and Y2 neutralization is taking place producing heat (1mk)
Y2 and Y3 reaction has come to end; products are cooling releasing heat to the surrounding (1mk)

4.
a. Exp 1-No change on the dry cloth (½mk) due to the absence of hypochlorous acid (½mk)
Exp 2-The cloth turns to white /bleached due to the presence of chloric (i)acid/hypochlorous acid.

(1mk)
b. $CI_{2(g)} + H_2O_{(l)} \longrightarrow HCI_{(aq)} + HOCI_{(aq)}$ (1mk)
Dye $+ HOCI_{(aq)} \longrightarrow$ (Dye +O) $+ HCI_{(aq)}$ (1mk)

5.
a. Group VI, period 2 (1mk)
b. A_2B_3 (1mk)

6.
i. No effect on position of equilibrium. The volume of gaseous reactants and products is the same. (1mk)
ii. There is more formation of iron(iii)oxide, magnesium is more reactive than iron thus reacts with steam at the expanse of iron and this lowers concentration of water molecules. (1mk)
iii. Equilibrium shifts to the left, steam will react with Mg i.e remove steam. (1mk)

7.
i. A (1mk)
ii. B (1mk)
iii. C (1mk)

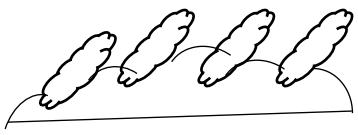
8.
– A white solid was formed (1mk) inside combustion tube closer to the cotton wool soaked in concentrated hydrochloric acid. Ammonia is less dense hence diffuse faster. (1mk)

$NH_{3(g)} + HCI_{(g)} \longrightarrow NH_4CI_{(s)}$ (1mk)

9. a. Fluorine (1mk)
Potassium (1mk)
b. Anode $2F^-_{(l)} \longrightarrow F2_{(g)} + 2^{e-}$ (1mk)
Cathode $2K+_{(I)} + 2^{e-} \longrightarrow 2K_{(I)}$

10. a.
    - Froth floatation
    - Concentrating the mineral ore by making impurities to sink at the bottom. (1mk)
    - Tin (1mk)
11. Acetylene /Hydrogen (1mk)
12. a. Dative bond/Coordinate bond (1mk)
    Covalent bond (1mk)
    b. 8 electrons (1mk)
13. Value of n in the formula
    Moles of NaOH=$\frac{15.6*0.16}{1000}$ =0.002496moles (½mk)
    Mole ratio of acid: base =1:2
    Thus moles of acid =$\frac{0.002496}{2}$ =0.001248moles (½mk)

    If 25cm^3 $\longrightarrow$ 0.002428moles
    1000cm^3 $\longrightarrow$ $\frac{1000*0.001248}{25}$ =0.04992M (½mk)
    Thus RFM; $\frac{6.3}{0.04992}$ = 126 (½mk)
    $H_2C_2O_4.nH2O$=126,
    90+18n=126,
    18n=36
    n=2 (1mk)
14.
    a. Fractional crystallization (1mk)
    b. Observation 10g of potassium Chlorate (18-8=10g)crystallizes while no KNO_3 crystallizes. (1mk)
    Reason : The solubility of one salt has no effect on the solubility of other salt. (1mk)
15.
    a. Butanoic acid (1mk)
    Butane (1mk)
    b.



(1mk)

16. Add excess lead(ii) carbonate to the nitric(v) acid: warm to form lead(ii) nitrate, water and carbon (iv)oxide (1mk)

$PbCO_{3(s)} + 2HNO_{3(aq)} \longrightarrow Pb(NO_3)_{2\ (aq)} + H_2O_{(I)} + CO_{2(g)}$

    - Filter off excess lead(ii) carbonate (½mk)
    - To the filtrate, add dilute hydrochloric acid and stir (½mk)
    - Filter to obtain lead(ii)chloride as residue. All the residue to dry (½mk)
17.
    - Magnesium burns with a white bright flame. White solid formed White residue is formed (1mk) (Any one)
    - ii.Potassium will react explosively (1mk)
    - If magnesium is heated first it reacts with air in the setup, to generate steam that reacts with magnesium. (1mk)

18.

i. Zinc/Zinc metal (1mk)

ii. $Zn(NH_3)^{2+}_4$ (1mk)

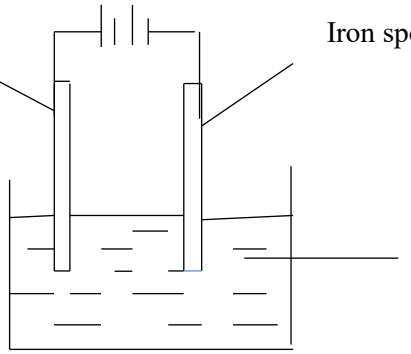
iii. $Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \longrightarrow BaSO_4(s)$ (1mk)

19. a. $E.M.F = E_{reduction} - E_{oxidation}$

(-0.44)-(-0.76)

-0.44 + 0.76=+0.32V (2mks)

b.



20. a. Frasch process (1mk)

b. To melt sulphur deposit (1mk)

c.

– Vulcanization
– Manufacture of sulphuric acid
– Any other/Sulphur based drugs (Any two correct) (1mk)

21. Fume chamber (1mk)

To dissolve /remove carbon (iv) oxide (1mk)

Carbon /coke (1mk)

22. a. Compress to 2000 ATM then cool to -200ºC. Then carry out fractional distillation .(2mks)

b. Any appropriate diagram but labeled (2mks)

23. Heat change that occurs when 1M of a substance is made from its constituent elements under STP conditions. (1mk)

ii. Heat of combustion = -2296 + -2686 (1mk)

= $-4976KJmol^{-1}$ (1mk)

24.

a. i. Magnessium hydrogen carbonate and calcium hydrogen carbonate (1mk)

ii. Calcium sulphate, calcium chloride, magnesium sulphate, magnesium chloride . (1mk)

b. By boiling during which magnesium or calcium ions are precipitated out as their respective carbonate (1mk)

c. Results to the formation of kettle fur/furring which reduces heat and electrical conductivity of the boilers hence reduced efficiency. (1mk)

d. Formation of scum with soap which leads to soap wastage and destruction of some fabrics such a as silk (1mk)

25. Aluminium has more protons in nucleus than sodium; leading into higher nuclear charge hence nuclear attraction; thus leads to stronger metallic bond in aluminium than in sodium.

26. Value of X=143 (½mk)

Y=56 (½mk)

27.

– Cause respiratory problems (½mk)
– Leads to formation of acidic rain which has adverse effects on living organism.

SAMIA SUB-COUNTY JOINT EXAMINATION-2021
233/2
CHEMISTRY Paper 2
(THEORY)

1.

a

i Name the elements that are metal. **Give** a reason. (2mks)

– PQRS; Ionic radius is smaller than atomic radius

ii. Compare the melting points of the oxides of S and R in terms of structure and bonding. (2mks)

– S has higher melting point than R; SO has a simple molecular structure(or in terms of bonds)

iii.Name the pair of elements that would react most vigorously with each other?

Explain (2mks)

– P and N; P is a metal with the smallest atomic radius ;

– N is a non-metal with the smallest atomic radius

b).

What are the possible PH values of the solutions formed when the following chlorides are dissolved in water? Explain

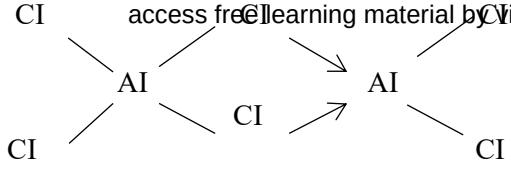
$MgCI_2$ (1mk)

– PH 7.0; a chloride of group II element.

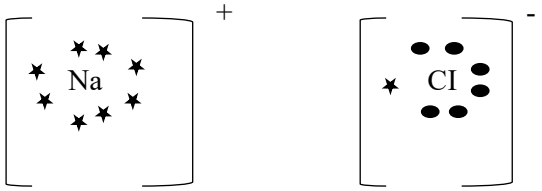
$AICI_3$ (1mk)

– PH 3.0; It hydrolyses in water to form HCI acid.

c). The molecular formula of Aluminum chloride is AI2CI6. Draw the structural (not dot and cross diagram) of Aluminum chloride indicating clearly the different types of bonds present. (2mks)



d). Using dot ( ) and cross (×), draw a diagram to show bonding in sodium chloride. (Na=11, CI=17) (2mks)



2.

a). What is the molar enthalpy of neutralization? (1mk)

– The enthalpy change/ heat change when one mole of H^+ ions react with one mole of OH^- ions to form one mole of water; OWTTE

b).

i). Why was it necessary to stir the mixture of the two solutions? (1mk)

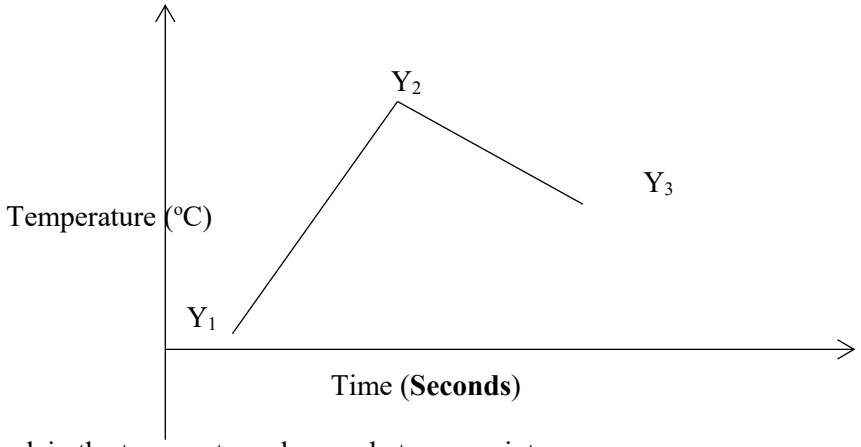
– To obtain a uniform mixture of reagents; uniform distribution of heat;

ii). Write an ionic equation for the reaction that took place. (1mk)

$H^+_{(aq)} + OH^-_{(aq)} \longrightarrow H_2O_{(l)}$

$H_3O^+_{(aq)} + OH^-_{(aq)} \longrightarrow 2H_2O_{(l)}$ Penalise ½mk for missing SS

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



Explain the temperature changes between points

Y_1 and Y_2 (1mk)

Reaction is taking place ; producing heat;/Reaction is exothermic;

Y_2 and Y_3 (1mk)

Reaction has come to an end; the mixture is cooling;

iv). If the initial temperature for both solution was 25ºC and the highest temperature was 31.4ºC for the mixture.

Calculate;

Heat change for the reaction (Specific heat capacity of solution=$42Hg^{-1}K^{-1}$, Density of the solution =$1gcm^{-3}$) (2mks)

DT=31.4-25=6.4ºC

Heat change =200×6.4×4.2

=5376J//5.376KJ

Molar heat of neutralization of sodium hydroxide. (2mks)

Moles of NaOH =$\frac{100}{1000} \times 1$ =0.1Moles

0.1 moles=5376

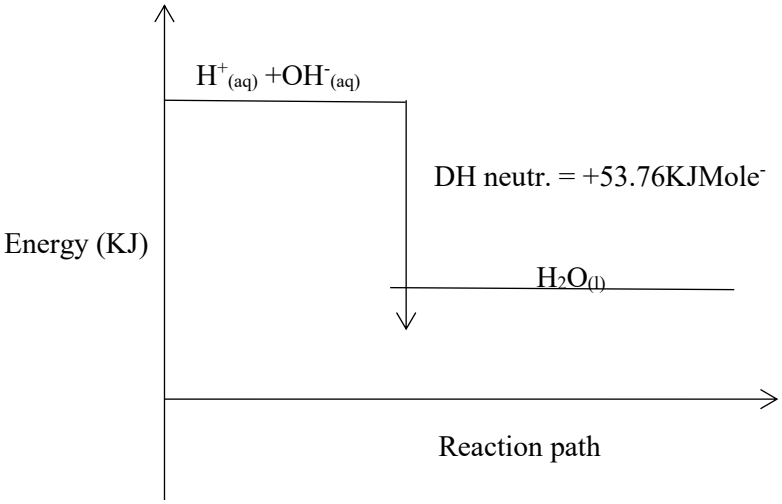
1mole=$\frac{5376}{0.1} \times \frac{1}{1000}$

=53.76KJ/Mole

v). Explain how the molar heat of neutralization obtained in this experiment would compare with one that would be obtained using 1.0M ethanoic acid and $100cm^3$ of 1M sodium hydroxide solution (2mks)

– Lower; Ethanoic acid is partially ionized/dissociated;//week acid// fewer H^+ions thus some energy is used to change the unionised molecules into ions first;

Draw an Energy level diagram for the reaction represented by reaction between hydrochloric acid and sodium hydroxide solution. (3mks)



3).

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

– Potassium manganite(vii)//Manganese(iv)oxide//Lead (iv)oxide//Calcium hypochlorite
ALC $KMnO_4$//MnO_2/PbO_2/$CaOCI_2$

b).

i. State **one** precaution that should be taken in carrying out the above experiment . (1mk)

– The experiment should be carried out in a fume cupboard; CI_2 should not be allowed to escape into the environment since it's poisonous/toxic.

ii. Explain why
Calcium oxide would be preferred to calcium chloride in the guard tube. (2mks)
CaO absorbs CI_2 and moisture; while $CaCI_2$ only absorb moisture;
CaO absorbs only CI_2 } award 1mark
$CaCI_2$ absorbs only moisture }

It is necessary to pass chlorine gas through the apparatus before heating begins. (2mks)

– To remove all air/oxygen; which would react with iron //form Iron (III) oxide; instead of Iron (III) Chloride.

iii. Write a **chemical** equation for the reaction that took place in the guard tube .(1mk)
$CaO_{(s)} + H_2O(l) \longrightarrow Ca(OH)_{2(s)/(aq)}$
$//CaO_{(s)} + CI_2(g) \longrightarrow CaOCI_2(s)$
$//Ca(OH)_{2(s)} + CI_{2(g)} \longrightarrow CaOCI_2.H_2O_{(s)}$

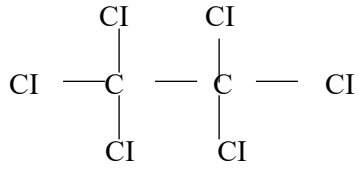
iv. What property of Iron (III) chloride makes it possible to be collected as shown in the diagram?
(1mk)

– It sublimes

v. During the reaction in the combustion tube, the total mass of iron (III) chloride formed was found to be 1.5g. **Calculate** the volume of chlorine gas that reacted with iron. (Fe=56.0, CI=35.5 and molar gas volume at 298k is 24,000cm^3) (3mks)
$2Fe_{(s)} + 3CI_{2(g)} \longrightarrow 2FeCI_{3(s)}$ Ignore ss
RFM of $FeCI_3$=162.5
Moles of $FeCI_3 = \frac{1.5}{16.3} = 0.0092$
Moles of $CI_2 = 3/2 \times 0.0092 = 0.0138$
Volume of $CI_2 = 0.0138 \times 24000$
$= 332.31cm^3$
$// 2Fe_{(s)} + 3CI_2 \longrightarrow 2FeCI_3(s)$
$3 \times 24000 = 162.5 \times 2$

$\frac{3\times24000\times15}{162.5\times2} = 332.31cm^3$

c). Draw and **name** the structure of the compound formed when excess chlorine gas is reacted with ethane gas. (2mks)



Account any other possible structure

Reject condense S.F

d). State **one** use of chlorine gas. (1mk)

- Manufacture of hydrochloric acid
- Treatment of Cvuter
- Manufacture of PVC

Any other possible use

4.

d. Give the systematic names for the following compounds

$HCOOCH_2CH_3$ (1mk)

- Propanoic acid/Propan –l-IOC acid

$CH_3CH_2CH_2CHCH_2$ (1mk)

- Pent -l-eneRj. Structural formular/ 1-pentene

CH C CH_2 CH_3 (1mk)

- But-l-yne RjS.F/l-Butyne

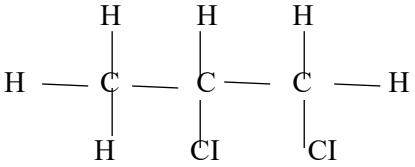
e. Study the flow chart below and use it to answer the questions that follow

i) Identify the organic compound **K** (1mk)

Ethane

ii) Write the formula of **M** (1mk)

C3H6CI2 //



Any other correct S.F

iii) Give **one** reagent that can be used in

Step I (1mk)

- Water/steam/conc. Sulphuric (vi) acid; Rej. Dillute Sulphuri (vi)acid
- Sulphuric acid award ½ mark only

Step II (1mk)

- Acidified Potassium manganite (vii)/Acidified potassium chromate(vii)

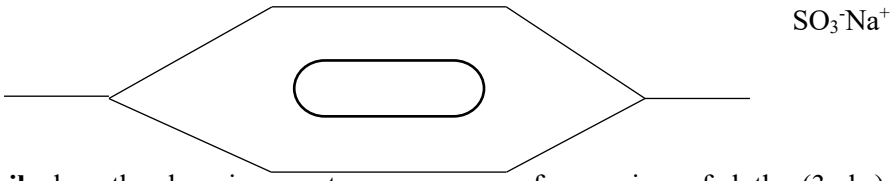
$H^{+(aq)}/KMnO_{4(aq)}$ $H^{+}_{(aq)}/K_2CrO_{7(aq)}$

iv) Write the equations for the reaction in **step II** (1mk)

$2CH_3CH_2CH_2OH + 2Na \longrightarrow 2CH_3CH_2CH_2ONa + H_2$

Ignore SS unless wrongly committed

f. The structure below represents a type of cleansing agent.



Describe how the cleansing agent removes grease from a piece of cloth. (3mks)

– Cleansing agent has a polar end / hydrophilic; and non-polar/hydrophobic end; polar end/ hydrophilic end; is attracted to water while non-polar/hydrophobic end; to grease; Results in formation of micelles//lower surface tension of water//emulsification of grease;

5.

a. The set up below was used to collect gas F, produces by the reaction between water and calcium metal

i. Name gas **F** (1mk)
Hydrogen;

ii. At the end of the experiment, the solution in the beaker was found to be a week base. **Explain** why the solution is a weak base. (2mks)

– $Ca(OH)_2$ formed is slightly soluble in water hence only a few OH^- ions are produced in solution

iii. Give **one** laboratory use of the solution formed in the beaker (1mk)

– Used for testing the presence of CO_2 gas.

b. When excess calcium metal was added to 50cm3 of 2 M aqueous copper (II)nitrate in a beaker, a brown solid and bubbles of gas were observed.

i. Write **two** equations for the reactions which occurred in the beaker. (2mks)

$Ca_{(s)} + 2H_2O_{(l)} \longrightarrow Ca(OH)_{2\,(aq)} + H_{2(g)}$

$Ca(s) + Cu(NO_3)_{2(l)} \longrightarrow Ca(NO_3)_2(aq) + Cu(s)$

// $Ca(s) + Cu2+(aq) \rightarrow Ca^{2+}_{(aq)} + Cu_{(s)}$

ii. **Explain** why it is not advisable to use sodium metal for this reaction. (2mks)

– The reaction is explosive /highly enothermic;

– Advice; sodium is more reactive than calcium

c. **Calculate** the mass of calcium metal reacted with copper(II)nitrate solution (Relative atomic mass of Ca=400 (2mks)

Moles of Cu(NO3)2 $= \frac{50 \times 2}{1000} = 0.1$moles

Moles ratio from equation above= 1:1

Moles of Ca=0.1

Moles of Ca=0.1 × 40

= 4g

6.

a. Write the **formula** of the complex Ion formed in each of the reactions below.

i. Lead metal dissolves in hot alkaline solution. (1mk)

$[Pb(OH)_4]^{2-}$

ii. Zinc hydroxide dissolves ammonia solution. (1mk)

$[Zn(NH_3)_4]^{2+}$

b. Give the name of each of the processes described below which takes place when the salts are exposed to air for some time.

i. Anhydrous copper (II) sulphate becomes wet. (1mk)

– Hygrosiopy

ii. Iron (III) chloride forms an aqueous solution. (1mk)

– Deliquence

iii. Fresh crystals of sodium carbonate decahydrate become covered with a powder of solution of carbonate monohydrate. (1mk)

– Efflorence

c. A certain hydrate salt has the following composition by mass. Iron 20.2%, sulphur 11.5%, water 45.5% and the rest oxygen. Its relative formula mass is 278.

i. **Determine** the formula of the hydrated salt (Fe=56,S=52, O=16, H=1) (3mks)

Element	Fe	S	O	H_2O
% Composition	20.2	11.5	22.8	45.5
R.A.M	56	32	16	18
Ratio %	$\frac{20.2}{56}=0.36$ $\frac{0.36}{0.36}=1$	$\frac{11.5}{32}=0.36$ $\frac{0.36}{0.36}=1$	$\frac{22.8}{16}$ $\frac{1.43}{0.36}=4$	$\frac{45.5}{18}=2.5$ $\frac{2.5}{0.36}=7$

$FeSO\ 4.7H_2O$

ii. 6.95g of the hydrated salt were dissolved in distilled water and the total volume made to $250cm^3$ of solution. **Calculate** the concentration of the salt solution (2mks)

6.95g in $250cm^3$

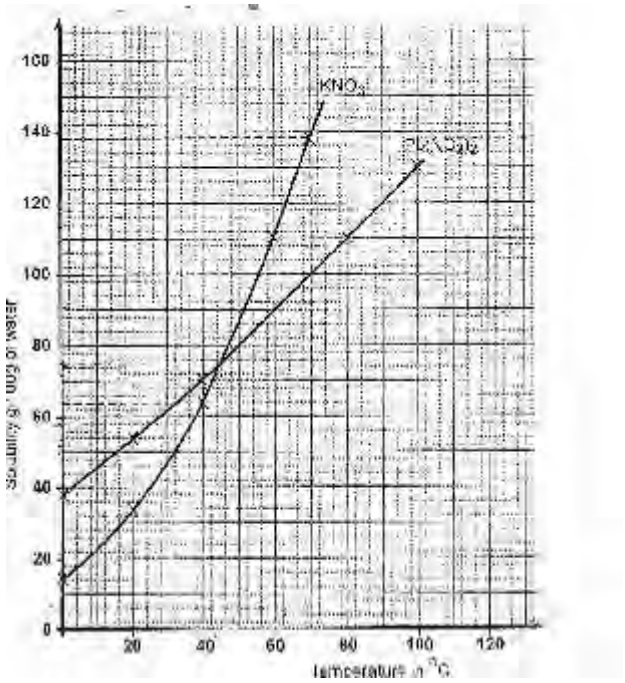
$X=1000cm^3$

$= \frac{6.95 \times 4000cm^3}{250cm^3 \times 278} = 0.1M$

7. The table below shows solubility of potassium nitrate and lead nitrate

Temperature ^oC	**0**	**20**	**40**	**60**	**80**	**100**
Solubility of KNO_3 in 100g of H_2O	12.5	32.5	62.5	110.0	137.5	
Solubility of $Pb(NO_3)$in 100g of H_2O	37.5	52.5	69.0	87.5	110.0	131.0

i. Draw the solubility curves for both salts on the same axis. (Temperature on the x-axis) (3mks)



ii. A solution of lead nitrate contains 90g of the salt dissolved in 100g of water at 100°C. This solution is allowed to cool to 25°C
At what temperature will crystals first appear? (1mk)
60°C
What mass of crystals will be present at **25°C** (1mk)
90g-58=32g
Correct value of solubility at 25°C

iii. Which of the **two** salts is more soluble at 30°C (1mk)
Lead nitrate $Pb(NO_3)_2$

iv. Determine the concentration of lead nitrate in moles per litre when the solubility of the two salts are the same. **(Pb=207.0, O=16.0, K=39.0, N=14.0)** (3mks)

Solubility of $Pb(NO_3)_2$ =75g/100water
Value read from the graph
Mass of $P(NO_3)_2$ in $100cm^3$ $= \frac{75 \times 100}{100}$

$\frac{\text{Value from graph} \times 100}{100}$

=75g
Molar mass of $Pb(NO_3)_2$ =331
Conc. Of $Pb(NO_3)_2$ $= \frac{75}{331}$ =0.2266M // $\frac{\text{answer (i)}}{331}$ =answer(ii) M

SAMIA SUB-COUNTY JOINT EXAMINATION-2021
CHEMISTRY PAPER 3
MARKING SCHEME

a. You are provided with :
Solution **Q**, 2M Hydrochloric acid.
Solution **P**, 0.15M Sodium thiosulphate
Solution **R**, Sodium carbonate

Procedure 1

Measure 20cm^3 of 0.15M Sodium thiosulphate (solution **P**) into a 100cm^3 a glass beaker. Place the beaker on a white piece of paper with **ink mark 'X'** on it. Measure 20cm^3 of 2M hydrochloric acid solution **Q** using a 50cm^3 measuring cylinder. Put the acid into the glass beaker containing Sodium thiosulphate and immediately start off the stop watch. Determine the time taken for the **marks 'X'** to become invisible/obscured when viewed from above. Repeat the procedure by measuring different volumes of the acid and adding the volume of the distilled water to complete table 1 below.

Table 1

Volume of acid(cm^3)	**Volume of water(cm^3)**	**Volume of sodium thiosulphate (cm^3)**	**Time taken for mark 'X' to be invisible/obscured(seconds)**	**Reciprocal of time (sec^{-1}) $\frac{I}{t}$**
20	0	20	33	0.0301
18	2	20	37	0.0270
16	4	20	41	0.0240
14	6	20	47	0.0210
12	8	20	57	0.0180
10	10	20	63	0.0160

e. Complete the table below (6mks)
CT 1
DP ½
AC ½
TREND 1
Calculations of R ½ for each calculation done correctly.

f. Plot a graph of I/t **(rate)** against volume of acid used. (3mks)
L ½
S ½
P ½
Line 1
03
The graph must be a straight line from the origin, otherwise award zero for the line

c. Explain the shape of your graph (1mk)
– Straight line graph from the origin ½ increase in volume of HCI increases rate of reaction $\frac{I}{t}$
– This is due to increase in the number of reacting particles hence more successful collisions. ½

d. From the graph determine;
iii. Time taken for the cross to be obscured/invisible when the volume of the acid is:
15cm^3 (1mk)
– Showing on a correctly plotted graph
– If graph is not correctly plotted, penalize fully
8cm^3 (1mk)
– Some applies as in (i) above.
iv. The volume of the acid used if the time taken for the cross to be obscured/invisible is:
40seconds (1mk)
– Same to (i)
43 seconds (1mk)
– Same to (i)

Procedure 2

Using a 10cm^3 measuring cylinder, place 10cm^3 of solution **Q** into a **250ml** volumetric flask. Add about 200cm^3 of distilled water. Shake well. Add more distilled water to top up to the mark. Labeled this solution **T**. Fill the burette with solution **T**. using a pipette and pipette filler, pipette 25cm^3 of solution **R** into a conical flask. Add **3 drops** of phenolphthalein and titrate with solution T.

- Record your results in the table
- Repeat the titration two more times and complete the table

Table 2

Final burette reading(cm^3)	15.0	15.0	15.0
Initial burette reading(cm^3)	0.0	0.0	0.0
Volume of solution T (cm^3) added	15.0 I	15.0 II	15.0 III

(4mks)

a. Determine the :

Average volume of solution **T** used (1mk)

$\frac{15.0 + 15.0 + 15.0}{3}$ ½

$= 15.0\text{cm}^3$ ½

Moles of the acid in the average volume of solution **T** used. (2mk)

$M_1V_1 = M_2V_2$

$M_2 = \frac{10 \times 2}{250\text{cm}^3}$ ½

$= 0.08\text{M}$ ½

No. of moles $= \frac{0.08 \times 15.0}{1000}$ ½

$= 0.0012\text{moles}$ ½

Accept any other correct method

Concentration of solution R in moles per litre. **(2mks)**

$Na_2CO_{3(s)} + 2HCI_{(aq)} \longrightarrow 2NaCI_{(aq)} + CO_{2(g)} + H_2O_{(I)}$

No. of moles in $Na_2CO_3 = \frac{0.0012}{2}$

$= 0.0006$ moles ½

Or answer in (iii) $= \frac{\text{answer in (ii)}}{2}$

$M = \frac{0.0006 \times 1000}{25}$ 1mark

$= 0.024\text{M}$ ½

2

a. Put a spatula end-full of **solid A** into a boiling tube and about 10cm^3 of distilled water. Shake the mixture well. Divide the resultant solution into **4 equal** portions.

Observation	**Inferences**
Solid A dissolves to form a pale green solution. (½mk)	Cu^{2+} and Fe^{2+} present (1mk)

b. To the first portion, add a little calcium hydroxide solid and warm. Test any gases produced using both blue and red litimus paper.

Observation	**Inferences**
Red litmus paper turns ½ Blue litmus paper venaire blue ½ (1mk)	NH_4^+ present (1mk)

c. To the second portion, **add 4** drops of hydrogen peroxide solution. Test the gas produced using a glowing splint.

Observation	**Inferences**
– Pale green solution turns brown ½ – Colourless gas relights a glowing splint ½ (1mk)	Fe^{2+} oxidized to Fe^{3+} (must have appeared in (a) and tied to pale green turns brown in observation) (1mk)

d.

iii. The solution is also suspected to contain sulphite ions. Using Barium nitrate solution and dilute hydrochloric acid solution. **Describe** how you would confirm presence of the sulphite ions.

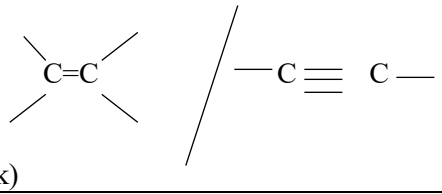
Observation	**Inferences**
– To the third portion add 3 drops of $Ba(NO_3)_2$ followed by 3 drops of HCI(aq) ½ (1mk)	White precipitate soluble on addition of dilute $HCI_{(aq)}$ (1mk)

iv. Carry out the actual test as described in (d) (i) above

Observation	**Inferences**
White precipitate insoluble on addition of HCI (1mk)	SO_4^{2-} Present (1mk)

e. You are provided with solid **B**. carry out the tests below and record your observation and inferences in the spaces provided.

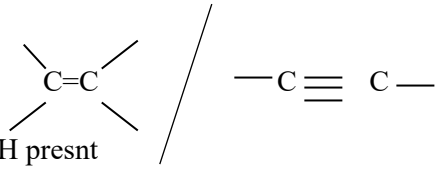
iii. Place one third of solid **B** on a metallic spatula. Burn it in a non-luminous flame of the Bunsen burner.

Observation	**Inferences**
Solid B melts and burns with yellow sooty flame (1mk)	 (1mk)

iv. Place the remaining solid in a test-tube. Add about **$6cm^3$** of distilled water and shake the mixture well. Divide the resulting mixture into 4 portions.

Observation	**Inferences**
Solid B dissolves to form a colourless solution (½mk)	Polar organic compound. (½mk)

e. To the first portion, **add 2** drops of acidified potassium manganite (VII)

Observation	**Inferences**
Purple $KMnO_4/H^+$ turns colourless Or Purple $KMnO_4/H^+$ is decolourised (1mk)	 R-OH presnt (1mk)

f. To the second portion, **add 3** drops of acidified potassium dichromate (VI) and warm

Observation	**Inferences**
Orange colour of $K_2Cr_2O_7/H^+$ is retained/persists/remains orange/Does not turn to green (1mk)	R-OH absent (1mk)

g. To the third portion, **add 1g** of solid sodium hydrogen carbonate.

Observation	**Inferences**
Effervescence/bubbles/fizzing **Reject** Fizzling Hissing (½mk)	H+/R-COOH/H_3O^+ present (½mk)

h. To the fourth portion, **add 5 drops** of ethanol followed by few drops of dilute sulphuric (VI)acid and warm

Observation	**Inferences**
Pleasant smell Fruity smell **Reject :** Sweet smell (½mk)	R-COOH Present (½mk)

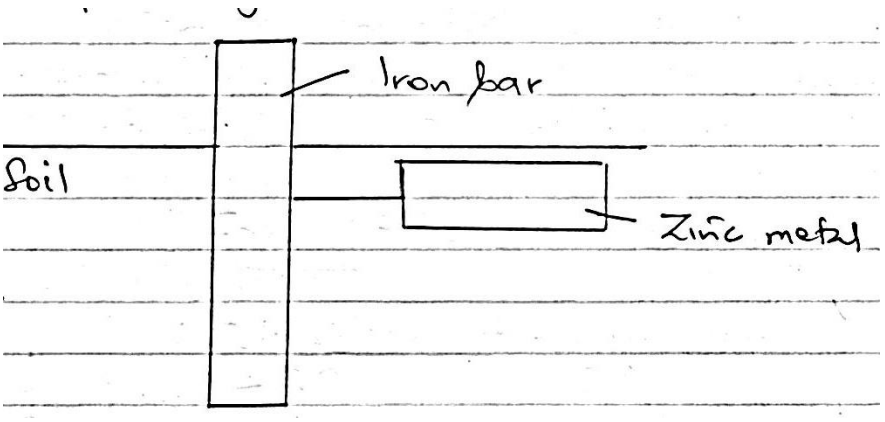
KIRINYAGA CENTRAL SUB-COUNTY
CHEMISTRY PAPER 1
THEORY

1. Which processes are involved in the following changes .
   a) Water to water vapour. (1mk)
   b) Iodine to iodine vapour. (1mk)
   c) Solid ice to liquid. (1 mk)

2. State two reasons why a non- luminous flame is preferred for heating in the laboratory. (2mks)

3. a) Name the method used in separating coloured mixtures. (1mk)
   b) The separation of the coloured mixtures using the method above is based on two properties. Name the properties. (2mks)

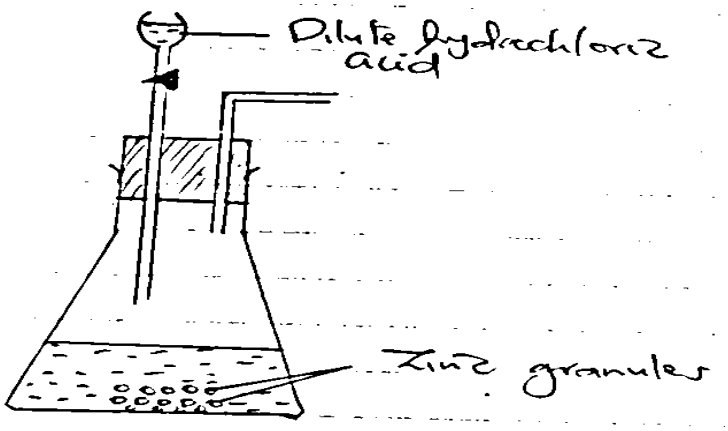
4. The diagram below shows an iron bar which supports a bridge. The iron bar is connected to a piece of zinc metal.



Explain why it is necessary to connect Zinc metal to the iron bar. (2mks)

5. Explain how you would prepare simple acid – base indicator from hibiscus flowers. (3mks

6. The set up below was used to prepare hydrogen gas.



   a) Complete the diagram to show how a dry sample of hydrogen gas can be collected. (2mks)
   b) Write an equation for the reaction that takes placed when hydrogen burns in air. (1mk)

7. The table below shows the 1st ionization energies for metallic elements A, B, C and D. (The letters do not represent the actual symbols of the elements).

Element	A	B	C	D
Ionization energy($KJmol^{-1}$)	494	418	519	376

   a) What is meant by 1st ionization energy. (1mk)
   b) Arrange the elements in order of increasing reactivity. Explain (2mks)

8. When 34.8g of hydrated sodium carbonate($Na_2CO_3.nH_2O$) were heated to a constant mass, 15.9g of anhydrous sodium carbonate were formed. Find the value of n.
(Na = 23, O = 16, C = 12, H = 1) (3mks)

9. An oxide of element P has the formula as P_2O_3.
a) State the valency of element P. (1mk)
b) To which group of the periodic table does element P belong. (1mk)

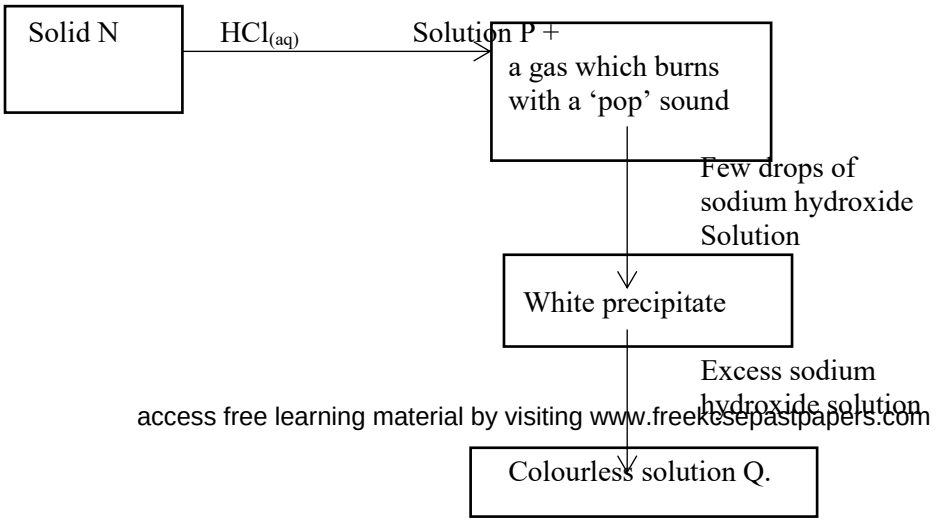
10. Using dots (.) and crosses (x) to represent the outermost energy level electrons, show bonding in an Ammonium ion((NH_4^+)). (N = 14, H=1) (2mks

11. A carbonate of metal T reacts with dilute hydrochloric acid as shown in the equation below.
$TCO_{3(s)} + 2HCl_{(aq} \longrightarrow TCl_{2\,(aq)} + CO_{2(g)} + H_2O_{(l)}$
If 1g of the carbonate reacts completely with $20cm^3$ of 1M hydrochloric acid, calculate the relative atomic mass (R.A.M) of T. (3mks)

12. In the space provided below, draw a labelled diagram of the set- up of the apparatus that can be used to electrolyse molten lead (II) iodide. (3mks)

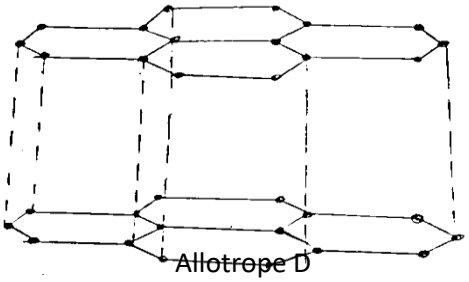
13. Starting with copper turnings, describe how copper (II) sulphate crystals can be prepared. (3mks)

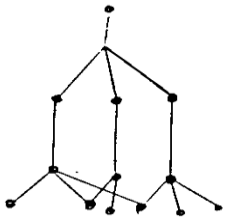
14. The scheme below shows reaction sequence starting with solid N.



a) Identify solid N. (1mk)
b) Write an ionic equation for the reaction in which the white precipitate is formed. (1mk)
c) Write the formula of the complex ion present in solution Q. (1mk)

15. a) Carbon has two allotropes. What is meant by the term allotropy. (1mk)
b) The diagram below show the structures of two allotropes of carbon. Study them and answer the questions that follow.

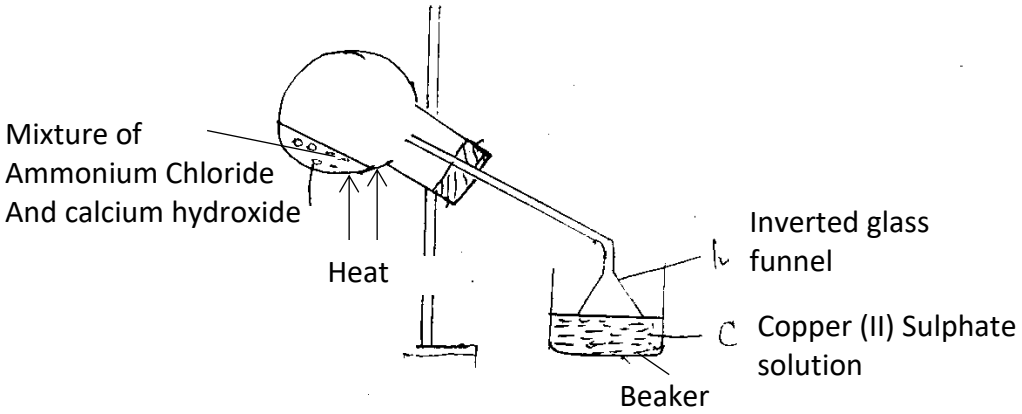

Allotrope D


Allotrope E

(i) Name allotrope:
D - _____ ($^1/_2$mk)
E - _____ ($^1/_2$mk)
(ii) Which allotrope does not conduct electricity.
Explain (1mk)

16. a) State the Graham's law of diffusion. (1mk)
b) $100cm^3$ of gas x takes 30 seconds to diffuse through a porous plug. $300cm^3$ of oxygen gas takes 120 second to diffuse through the same plug. Calculate the relative molecular mass of gas x. (O= 16) (2mks)

17. A student prepared ammonia gas and bubbled it into a solution of copper(II) sulphate as shown below.



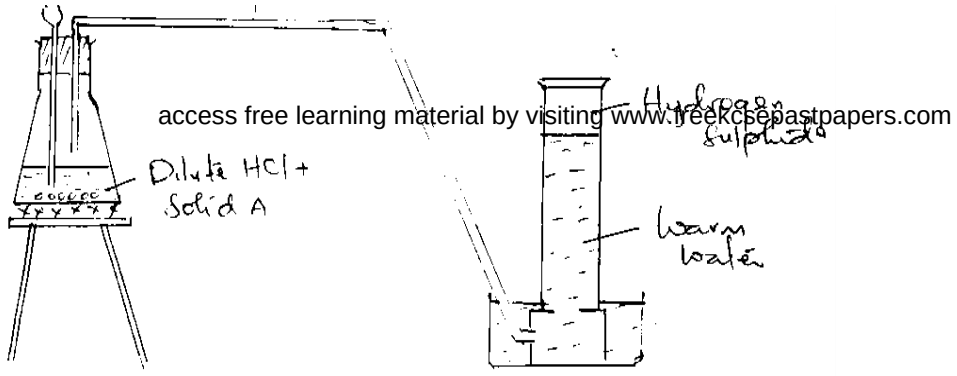
a) State the observation made in the beaker after:
   i. A short period (1mk)
   ii. A long period. (1mk)

b) Write the formula of the ion formed in a (ii) above. (1mk)

18. a) The half life of a radioisotope M is 7 days. Determine the mass of M remaining if 100g decayed in 35 days. (2mks)

b) State one use of radioisotope in industries. (1mk)

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



a) Identify solid A. (1mk)

b) Give a reason why warm water is used. (1mk)

c) What observation would be made if hydrogen sulphide gas was bubbled into a solution of lead (II) nitrate. (1mk)

20. a) Define the term isomerism. (1mk)

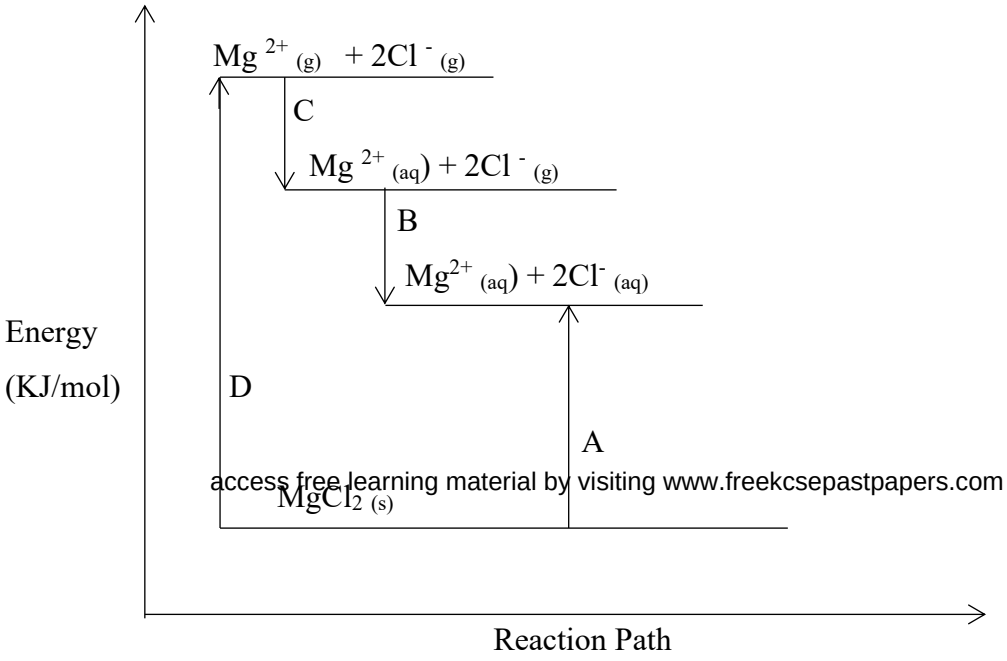
b) The molecular formula of compound T is $C_2H_2Br_4$. Draw two structural formula of the compound. (2mks)

21. The table below shows the standard electrode potentials for metals represented by the letters D, E, F and G. Study it and answer the questions that follow.

Metal	Standard electrode potential (V)
D	-0.13
E	+0.85
F	+0.34
G	-0.76

a) Identify the strongest oxidizing agent. Give a reason. (1mk)
b) Which metal cannot be displaced from a solution of the ions by any other metal in the table. Give a reason. (2mks)

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

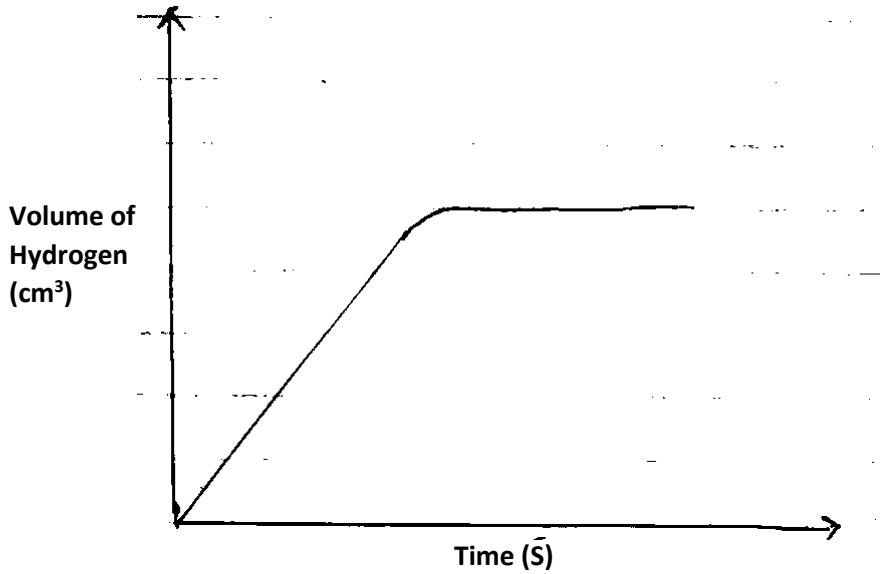


i. Which of the letters A, B, C and D represents :
I . Hydration energy of magnesium. (1mk)
II. Lattice energy of magnesium chloride. (1mk)
ii. According to the diagram, is the heat of solution of magnesium chloride endothermic or exothermic. (1mk)

23. Chlorofluorocarbons (CFCs) have a wide range of uses but they also have harmful effects of the environment.
State one :
a) Use of CFCs (1mk)
b) Harmful effect of CFCs on the environment. (1mk)

24. a) Name two ores from the which copper is extracted. (2mks)
b) During the extraction of copper metal, the ore is subjected to froth floatation. Give a reason why the process is necessary. (1mk)

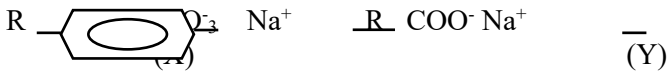
25. In an experiment to monitor the rate of reaction of Magnesium and hydrochloric acid, a student recorded the volume of hydrogen produced at regular intervals and obtained the graph below.



a) On the same axes, sketch the curve expected if the experiment is repeated with a few crystals of copper (II) sulphate added to the reactants. (1mk)

b) Explain the shape of the curve in (a) above. (2mks)

26. The structures below represents two cleansing agent X and Y.



a) Which cleansing agent that would be suitable for washing in water containing calcium chloride.

Give a reason. (2mks)

b) Give one advantage of using hard water for domestic purposes. (1mk)

27. During electrolysis of silver nitrate solution, a current of 5.0A was passed through the electrolyte for 3 hours using inert electrodes.

a) Write the ionic equation for the reaction which took place at the anode. (1mk)

b) Calculate the mass of silver deposited. (2mk)
(Ag = 108, 1F = 96,500)

28. Explain the following observations.

a) Atomic radii generally decreases across a period. (1mk)

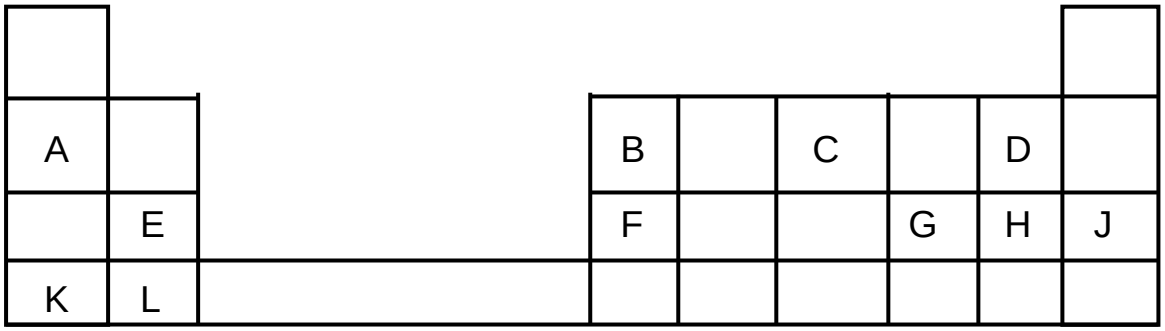
b) Aluminium is a better conductor of electricity than sodium. (1mk)

29. a) Name **two** reagents that can be used to prepare ethyne gas. (1mk)

b) State **one** use of ethyne. (1mk)

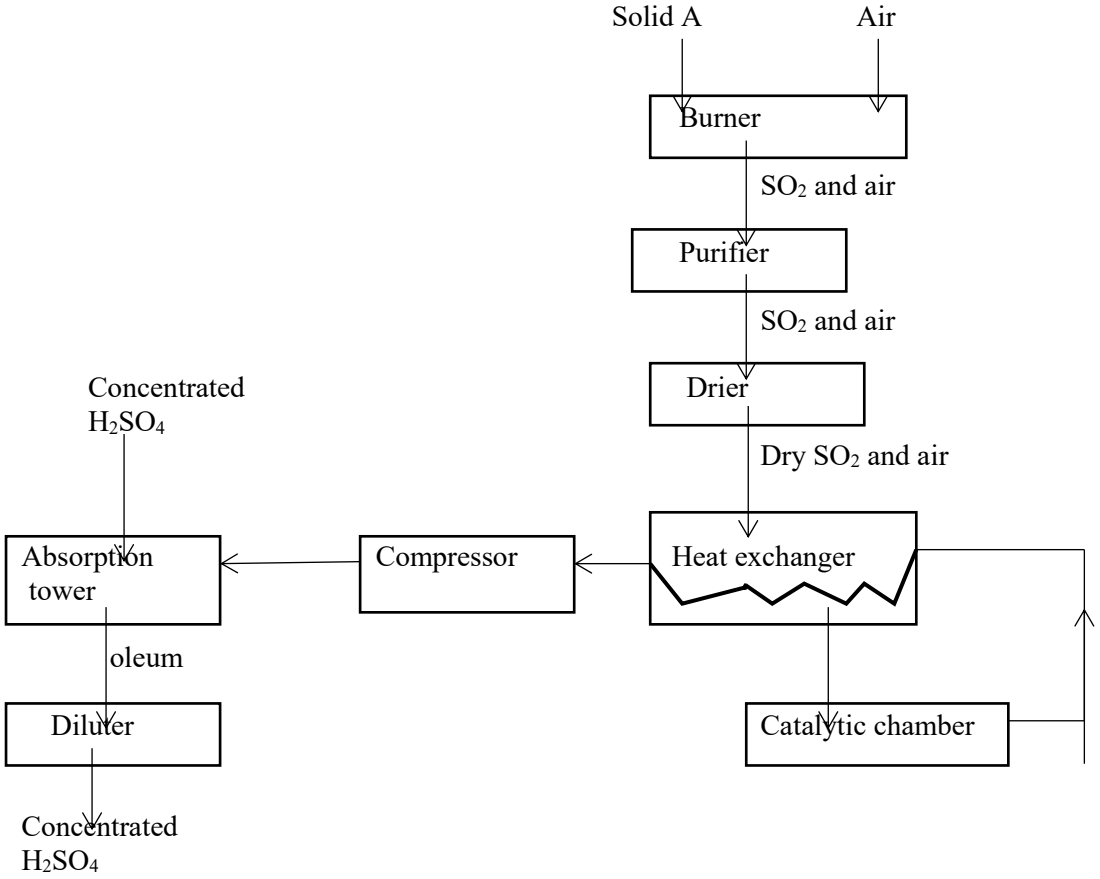
KIRINYAGA CENTRAL SUB-COUNTY
CHEMISTRY
233/2
DECEMBER 2021

1. The grid below shows a section of the periodic tale. Study it and answer the questions that follow. (The letters do not represent the actual symbols of the elements.)



a) Which letter represents the ;
   i. Most reactive non metal? Explain your answer. (2mks)
   ii. Most reactive metal? Explain your answer. (2mks)
b) What name is given to the family into which element E belongs? (1mk)
c) Write the formula of the compound formed between;
   i. F and G (1mk)
   ii. K and oxygen (1mk)
d) How does the atomic radius of E compare with that of L? Explain (2mks)
e) In terms of structure and bonding explain why the oxide of F has a high melting point. (2mks)
f) State one possible use of ;
   i. Element J (1mk)
   ii. Element E (1mk)

2. The following scheme represents the steps followed in the contact process. Study it and answer the questions which follow.



a) i. Name the possible identities of solid A. (2mks)
ii. Name two impurities removed by the purifier. (2mks)
iii. Why is it necessary to remove the impurities? (1mk)

b) The following chemical equation shows the reaction that takes place in the catalytic chamber.

$$2SO_{2\,(g)} + O_{2\,(g)} \rightleftharpoons 2SO_{3\,(g)} \quad \Delta H = -196Kj$$

I. How would the following factors affect the yield of sulphuric (VI) oxide?
i. Increase in temperature. (1 ½ mk)
ii. Decrease in pressure. (1 ½ mk)

c) Name the catalyst which is commonly used in this process and give a reason why it is preferred. (2mks)

d) State one environmental effect of sulphur (IV) oxide in the atmosphere. (1mk)

3. a) What is meant by a dynamic equilibrium. (1mk)

b) State the Le Chatelier's Principle. (1mk)

c) Carbon (IV) oxide reacts with water to form methanol and oxygen as shown.

$$2CO_{2\,(g)} + 4\,H_20_{\,(l)} \rightleftharpoons 2CH_3OH_{\,(l)} + 3O_{2\,(g)}$$

What would be the effects on yield of methanol if pressure is increased .
Explain (2mks)

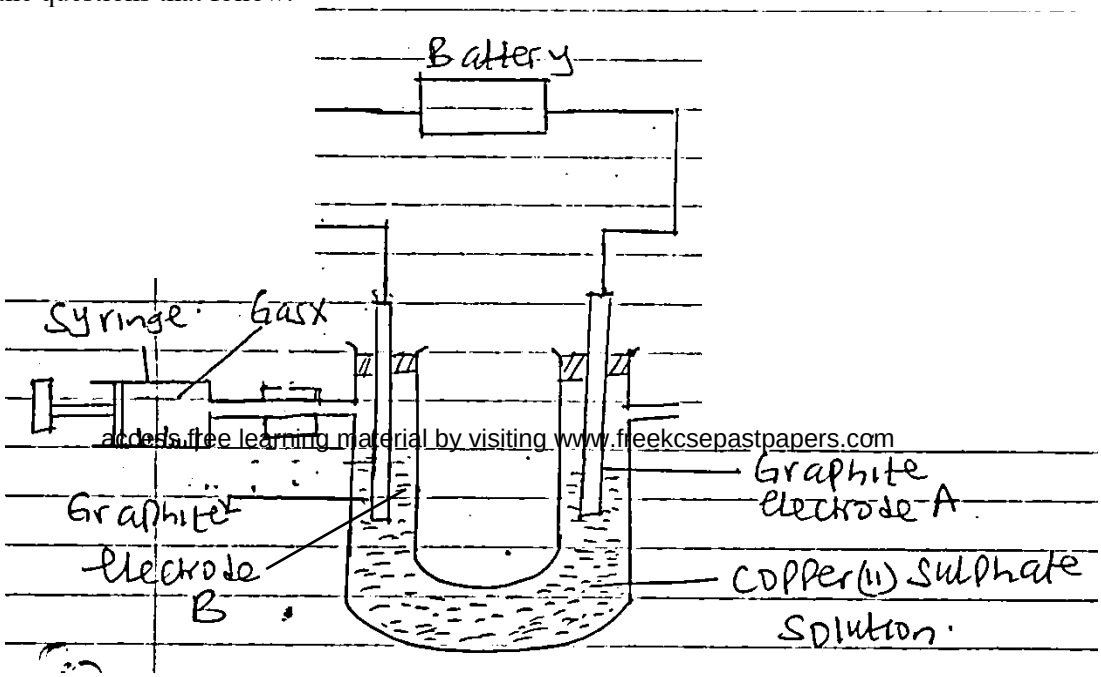
d) The table below shows the volume of oxygen gas produced at different times when hydrogen peroxide decomposed in the presence of a catalyst.

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

i. Name the catalyst used. (1mk)
ii. On the grid provided, plot a graph of volume of oxygen produced (vertical axis) against time. (3mks)

iii. Using the graph, determine the rate of decomposition of hydrogen peroxide at 24 seconds. (2mks)
v. Give a reason why the volume of oxygen gas produced after 50 seconds remains constant. (1mk)

4. The diagram below represents a set up that was used for electrolysis of aqueous copper (II) sulphate. Study it and answer the questions that follow.



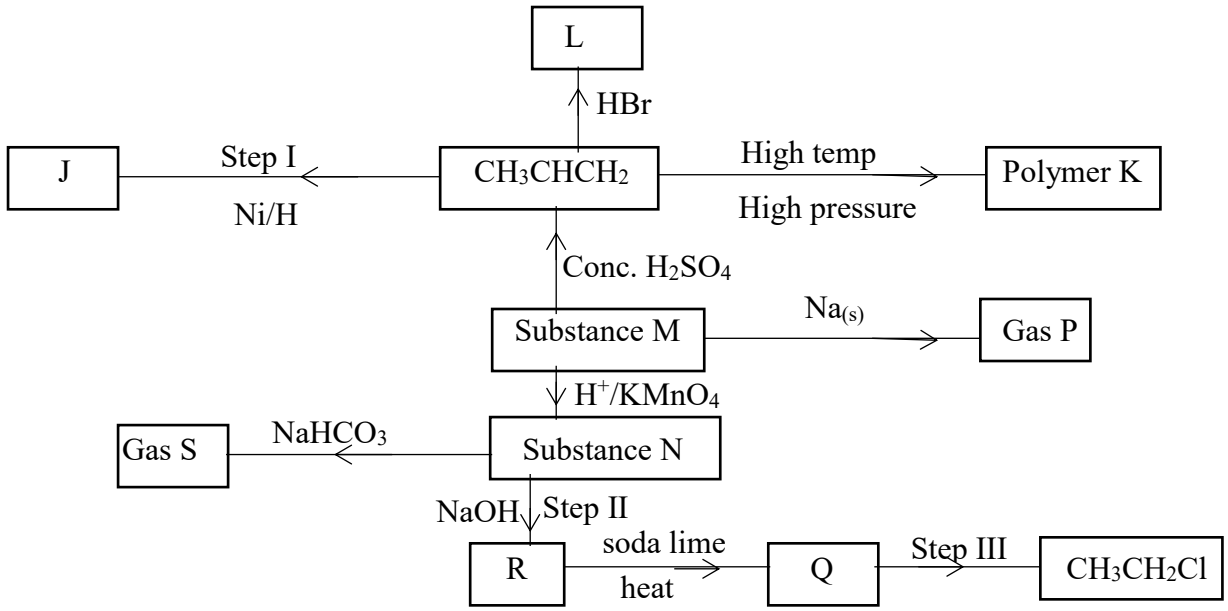
a) A gas that relights a glowing splint was produced at electrode A.
i. Which electrode is the cathode? Explain (2mks)
ii. State another suitable method for collecting gas x. (1mk
iii. Write an ionic equations to show the reactions that take place at:
Anode (1mk)
Cathode (1mk)
iv. Calculate the mass of copper deposited if a constant current of 5A was passed for 3 hours. (Cu = 63.5, 1F = 96500C) (2mks)

b) The following are standard electrode potentials for some elements. The letters do not represent the actual symbols at the elements.

Element			E^{Θ} (Volts)
$A^{2+}_{(aq)} + 2e^-$	$\rightleftharpoons$	$A_{(s)}$	-2.93
$B^{2+}_{(aq)} + 2e^-$	$\rightleftharpoons$	$B_{(s)}$	-2.38
$C^{2+}_{(aq)} + 2e^-$	$\rightleftharpoons$	$C_{(s)}$	0.00
$D^{2+}_{(aq)} + 2e^-$	$\rightleftharpoons$	$D_{(s)}$	+0.34
$E^{+}_{(aq)} + e^-$	$\rightleftharpoons$	E(s)	+2.87

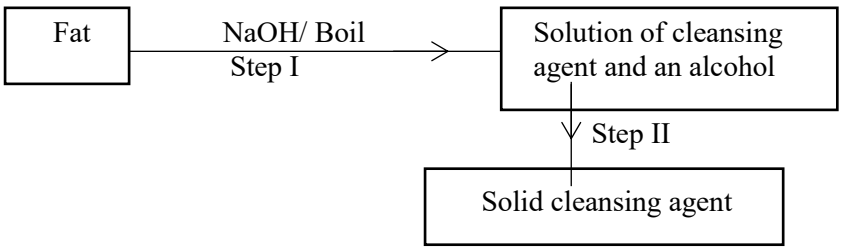
i. Which is the strongest reducing agent. Explain (2mks)
ii. Write the cell representation for the electrochemical cell obtained by combining the half cell of B and D. (1mk)
iii. Calculate the e.m.f of the cell in (ii) above. (2mks)

5. Use the flow chart below to answer the questions that follow.



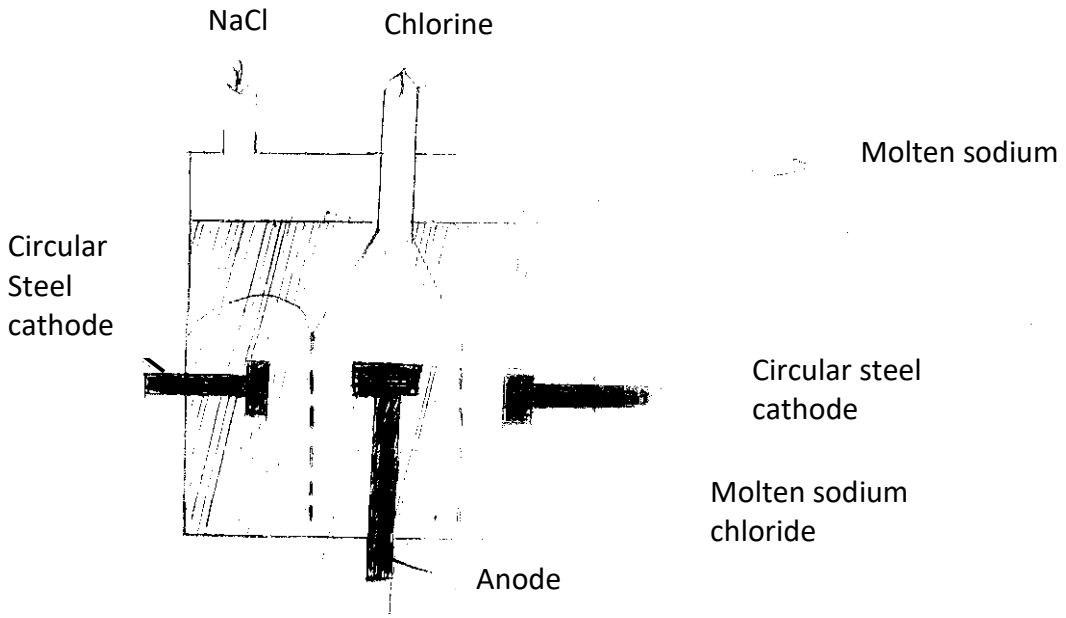
a) Name the following. (1 1/2mks)
i. Gas S _____
ii. Gas P _____
iii. Substance J _____

b) Name the process taking place in: (1 1/2mks)
i. Step I _____
ii. Step II _____
iii. Step III _____
c) Draw the structural isomers of compound L. (2mks
d) Write a chemical equation for the complete combustion of substance M. (1mk)
e) Name the reagent and condition in step III. (1mk)
f) The scheme below was used to prepare a cleansing agent. Study it and answer the question that follow.



i. What name is given to the type of cleansing agent prepared by the method above? (1mk)
ii. Name one chemical substance added in step II. (1mk)
iii. What is the purpose of adding the chemical substance named in f(ii) above? (1mk)

6. a) Below is a simplified diagram of the Down's cell used for the extraction of sodium. Study it and answer the question that follow.



i. Which material is the anode made of? Give a reason (2mks)
ii. What precautions are taken to prevent chlorine and sodium from recombining. (1mk)
iii. Write an ionic equation for the reaction in which chlorine is formed. (1mk)

b) In the Down's cell a certain salt is added to lower the melting point of sodium chloride from about 600^0C.
i. Name the salt added. (1mk)
ii. Why is it necessary to lower the melting point of sodium chloride. (1mk)

c) Aluminium is also extracted by electrolysis.
i. Name the ore from which aluminium is extracted. (1mk)
ii. State two ways in which the extraction of aluminium negatively affects the environment. (2mks)
iii. A typical electrolytic cell uses current of 40, 000amperes. Calculate the mass (in kilograms) of aluminium produced in one hour.(IF = 96500C, Al =27) (3mks)

7. In an experiment to determine the enthalpy of displacement when zinc is reacted with copper(II) sulphate solution, excess zinc powder was added to 125cm^3 of 0.75M copper(II) sulphate solution in a beaker. The temperature of the mixture rose from 24^0C to 29^0C. (Assuming that the density of the solution was 1g/cm^3 and its specific heat capacity was 4.2$Jg^{-1}k^{-1}$.)

a) Write a chemical equation of the reaction that occurred. (1mk)
b) Why was it necessary to use excess zinc powder? (1mk)
c) State and explain one observation made by the end of the experiment. (2mks)
d) Determine the enthalpy change in the reaction that occurred. (2mks)
e) Determine the molar enthalpy of displacement of copper (II) ions by zinc. (2mks)
f) Represent the reaction on an energy level diagram. (2mks)
g) State one reason why the experiment value obtained in (e) above is lower than the expected theoretical value. (1mk)

KIRINYAGA CENTRAL
233/3 CHEMISTRY PAPER 3 PRACTICAL
CONFIDENTIAL

Besides the apparatus and reagents found in the laboratory, each candidate should have the following;-

1. 4.5g solid G accurately weighed.
2. 1.0g solid H accurately weighed.
3. 1.0g solid M.
4. 15cm^3 of liquid P.
5. About 80cm^3 of solution F.
6. Universal indicator paper and PH chart (1 – 14).
7. 500ml distilled water.
8. Burette (0 – 50ml).
9. Pipette (25ml)
10. Thermometer (-10^{0}C – 110^{0}C)
11. 50ml measuring cylinder.
12. 10ml measuring cylinder.
13. 250ml volumetric flask.
14. 250ml beaker.
15. 2 conical flasks (250ml)
16. Boiling tube and 6 test- tube in a rack.
17. Glass rod
18. Test tube holder.
19. Metallic spatula..
20. One filter paper.
21. Filter funnel.
22. Complete retort stand.
23. White tile.
24. One label.

Access to

1. Source of heat. (Can be shared between two candidates)
2. Phenolphalein indicator.
3. 2M Sodium Hydroxide solution
4. 2M Aqueous ammonia
5. Acidified Barium Chloride
6. 1M Hydrochloric acid
7. 2 M Nitric (V) acid
8. Acidified potassium dichromate (VI)
9. Concentrated Sulphuric (VI) acid (4M)
10. Ethanol

NOTES.

1. Solid G is oxalic acid.
2. Solid H is anhydrous sodium carbonate.
3. Solid M (a mixture of magnesium sulphate and copper (II) carbonate in ratio of 1:1).
4. Liquid P is ethanoic acid.
5. Solution F which is 0.1M sodium hydroxide.
6. Acidified Barium chloride is prepared by dissolving 20.8g in 800cm^3 distilled water and then top up to 1000cm^3 using 2M hydrochloric acid.
7. Acidified potassium dichromate (vi) is prepared by dissolving 29.4g of potassium dichromate (VI) in 800cm^3 distilled water and then top up 2M sulphuric (VI) acid) upto 1000cm^3.

KIRINYAGA CENTRAL SUB-COUNTY
233/3
CHEMISTRY PAPER 3
PRACTICAL

1. You are provided with:
i. 4.5g of solid G which is oxalic acid [$H_2C_2O_4.nH_2O$]
ii. 1.0g of solid H which is anhydrous sodium carbonate.
iii. Solution F which is 0.1M sodium hydroxide solution.

You are required to determine:
i. Solubility of solid G at different temperatures.
ii. The value of n in the formula $H_2C_2O_4.nH_2O$

Procedure I.
(i). Fill the burette with distilled water. Put all solid G in a boiling tube and add 6cm^3 of distilled water using the burette. Heat the mixture using a non – luminous flame while stirring with the thermometer until all the solid dissolves.
(ii). Allow the solution to cool while stirring with the thermometer and note the temperature at which crystals of G start to appear. To ensure faster cooling, carefully run a continuous stream of tap water over the wall of the boiling tube. Record the temperature at which crystals of G start to appear in table 1 below.
(iii). Using the burette, add 2cm^3 of distilled water to the contents of the boiling tube. Heat the mixture again until all solid G dissolves. Allow the solution to cool while stirring with thermometer and note the temperature at which crystals of G start to appear. Record the temperature in table 1 below.
(iv). Repeat procedure (iii) three more time with different volumes of distilled water as indicated in table 1 then fill table 1.

N/B: **RETAIN** the contents of the boiling tube for use in procedure II.

(v). Complete table 1 by calculating the solubility of G at different temperatures.

Table 1.

Volume of distilled water In the boiling tube (cm^3)	Temperature at which crystals of solid G appear(^{0}C)	Solubility of solid G g/100g of water
6		
8		
10		
12		
14		

(5mks)

a) On the grid below plot a graph of solubility of solid G against temperature. (3mks
b) Use your graph to determine;
i. The temperature at which 80g of solid G would saturate 100g of water. (1mk)
ii. The solubility of solid G at 50^{0}C. (1mk)

Procedure II.
i) Put all the contents of the boiling tube from procedure I in the 250ml beaker and add distilled water to the mixture to make 100cm^3 of a solution G. Stir the mixture with a glass rod to ensure that oxalic acid dissolves completely.
ii) Divide the solution G into 2 equal portions of 50cm^3 each. Retaining one portion in the beaker. Add all solid H to solution G in the beaker and swirl the mixture until effervescence stops.
iii) Transfer the mixture in the beaker to a 250cm^3 volumetric flask and top up the volumetric flask to the mark with distilled water.

Label this solution J.
iv) Pipette 25cm^3 of solution J and put it in a conical flask, add three drops of phenolphthalein indicator.

v) Fill the burette with solution F. Titrate solution J with solution F until a permanent pink colour appears and record your results in the table 2 below.

Table 2.

	1	2	3	
Final Burette reading (cm^3)				
Initial burette reading (cm^3)				
Volume of solution F used cm^3				

(3mks)

a) Calculate the :
   i. Average volume of solution F used. (1mk)
   ii. Number of moles of sodium hydroxide, solution F in the average volume used (1mk)

b) Given the equation.
$H_2C_2O_4.nH_2O_{(aq)} + 2\ NaOH_{(aq)} \longrightarrow Na_2C_2O_{4(aq)} + 2H_2O_{(l)} + nH_2O_{(l)}$

Determine the :
   i) Number of moles of the acid present in $25cm^3$ of solution J. (1mk)
   ii) Moles of acid present in $250cm^3$ of solution J. (1mk)
   iii) Molarity of the original acid, solution G. (1mk)

c) Calculate the relative formula mass of oxalic acid. (1mk)

d) Determine the value of n in the acid $H_2C_2O_4.nH_2O$ (1mk)
(H=1.0, C= 12.0, O=16.0)

2. You are provided with solid M. Carry out the experiments in the table below and record your results in the spaces provided.

A. Put all solid M in a boiling tube. Add $10cm^3$ distilled water and shake well, filter the mixture and divide the filtrate into three portions. RETAIN the residue.

i. To the first portion of the filtrate, add a few drops of 2M sodium hydroxide then in excess.

Observation	Inference
(1mk)	(1mk)

ii. To the second portion add a few drops of 2M ammonia solution then in excess.

Observation	inference
(1mk)	(1mk)

iii. To the third portion add about $2cm^3$ 0.1M acidified barium chloride.

Observation	Inference
($^1/_2$mk	($^1/_2$mk)

B. To half of the residue in a test – tube add about $4cm^3$, 1M hydrochloric acid and divide the resulting solution into two portions and carry out the experiments below.

i. To portion one, add three drops of 2M sodium hydroxide then excess.

Observation	inference
(1mk)	

ii. To the second portion add two drops of 2M ammonia solution then excess.

Observation	**inference**
(1mk)	($^1/_2$mk)

C. To half of the remaining residue in a test tube add about 2cm^3 of dilute Nitric(V) acid drop wise.

Observation	**inference**
(1mk)	(1mk)

3. You are provided with liquid P. Carry out the test below and record your observations and inferences in the spaces provided.

a) To about 1cm^3 of liquid P in a test tube, add about 1cm^3 of distilled water and shake thoroughly.

Observation	**Inference**
(1mk)	($^1/_2$ mk)

b) To about 1cm^3 of liquid P in a test tube, add three drops of bromine water.

Observation	**inference**
($^1/_2$ mk)	($^1/_2$ mk)

c) To about 2cm^3 of liquid P in a test tube, add about 1cm^3 of acidified potassium dichromate(vi). Warm gently and allow it to stand for a minute.

Observation	**inference**
(1mk)	($^1/_2$ mk)

d) You are provided with the universal indicator paper. Describe how you can test for the pH of liquid P and then test using the described procedure.

Test	**Observation**	**Inference**
(1mk)	(1mk)	(1mk)

e) To about 2cm^3 of liquid P in a test tube, add 2cm^3 of ethanol followed by 2 drops of concentrated sulphuric(VI) acid. Warm the mixture gently.

Observation	**Inference**
(1mk)	(1mk)

KIRINYAGA CENTRAL SUB-COUNTY
CHEMISTRY P1 MARKING S HEME

1. a) Evaporation (1mk)
b) Sublimation (1mk)
c) Melting (1mk)

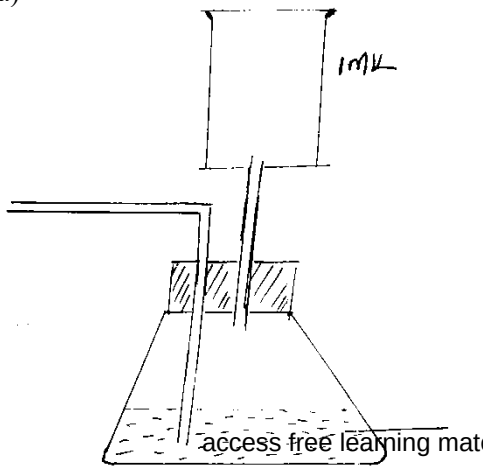
2. It is hotter than lumininous flame.
It produces less soot than luminous flame. (1mk each)

3. a) Chromatography (1mk)
b) Stickness/ Absorption
Solubility in the solvent (1mk each)

4. Zinc is above iron (1mk) in the reactivity series/ more reactive hence reacts with oxygen// is preferentially oxidized .(1mk)

5. Collect fresh hibiscus flower petal, cut into small pieces and transfer into a mortar, crush (1mk) using pestle, add ethanol , continue crushing with little addition of the ethanol (1mk), decant (1/2mk) the solution . Test ($^1/_2$mk) the solution in an acid and an alkali.

6. a)



Workability - ½ mk

Method of gas collection – 1mk

Drying agent – ½ mk

Anydrous calcium chloride/calcium oxide in a U-tube may be used as a drying agent.

Conc. H_2SO_4 or anhydrous $CaCl_2$ 1mk

b) $2H_{2\,(g)} + O_{2\,(g)} \longrightarrow$ [illegible]

7. a) The minimum amount of energy required to remove one electron from the outermost energy level of an atom in gaseous state. (1mk)

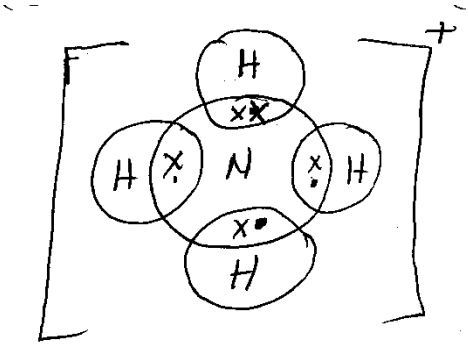
b) C A B D
$\longrightarrow$ (1mk)
increasing reactivity
The lower the ionization energy the higher the reactivity // The higher the ionization energy the lower the reactivity. (1mk)

8.

	Na_2CO_3	H_2O	
i.	$\frac{15.9}{106}$	$\frac{18.9}{18}$	(1mk) n= 7 (1mk)
ii.	$\frac{0.15}{0.15}$	$\frac{1.05}{0.15}$	(1mk)
	1	7	

9. a) valency = 3 (1mk)
b) group = III (1mk)

10.



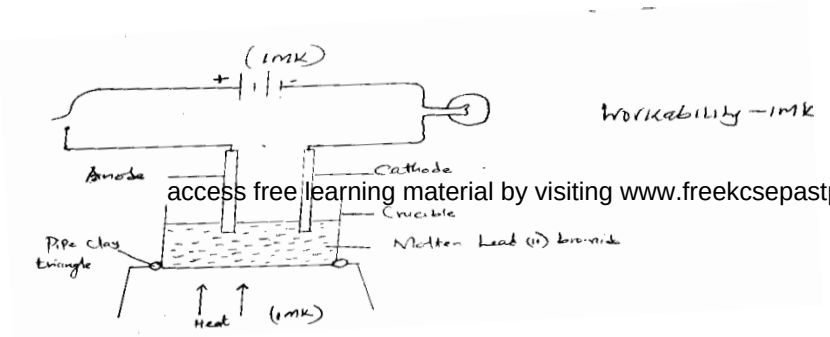
Correct diagram — 1MK.
Labelled atoms — 1MK

11. moles of HCL = $\frac{20 \times 1}{1000}$ = 0.02moles ($^1/_2$mk)

TCO_3 : HCL
1 : 2

Moles of TCO_3 = $^{0.02}/_2$ = 0.01 moles ($^1/_2$mk)
R.A.M of TCO_3 = $^1/_{0.01}$ = 100 ($^1/_2$mk)
R.A.M of T = 100 – 12 + (16 x 3) ($^1/_2$mk)
= 100 – 60 = 40
($^1/_2$mk)

12.



13. Heat copper metal in a crucible to form CuO ($^1/_2$mk). Add excess CuO into dilute H_2SO_4 ($^1/_2$mk). Filter ($^1/_2$mk) to obtain copper(II) sulphate as the fitrate. Heat ($^1/_2$mk) the filtrate until crystals starts to form. Cool the filtrate for copper(II) sulphate crystals to form. Dry ($^1/_2$mk) the crystals in between filter papers.

14. a) Zn (1mk)
b) $Zn^{2+}_{(aq)} + 2OH^-_{(aq)} \longrightarrow Zn(OH)^2_{(s)}$ (white ppt)
c) $[Zn(OH)_4]^{2-}$ (1mk)

15. a) Existence of an element in more than one crystalline form in the same physical state.
b) i. D - Graphite
E – Diamond
ii. E – has no delocalized electrons // all electrons in diamond are used in bonding.

16. The rate of diffusion of a gas at constant pressure and temperature is inversely proportional to the square root of its density. (1mk)
$Rx = {}^{100}/_{30} = 3.33cm^3\ s^{-1}$ ($^1/_2$mk) ($^1/_2$mk)
$RO_2 = {}^{300}/_{720} = 2.5cm^3\ s^{-1}$ ($^1/_2$mk) (1/2mk)

$\frac{Rx}{RO_2} = \frac{\sqrt{MO_2}}{\sqrt{MX}}$

$\frac{3.33}{2.5} = \frac{\sqrt{32}}{\sqrt{Mx}}$ ($^1/_2$mk)

$\sqrt{MX} = \frac{2.5 \times \sqrt{32}}{3.33}$

=4.424

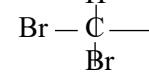
Mx = 4.24^2

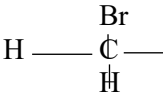
= 18.03 ($^1/_2$mk)

17. a) i. Blue precipitate (1mk)
ii. A deep blue solution (1mk)
b) $[Cu(NH_3)_4]^{2+}$ (1mk)

18. a) No. of half lives
$^{35}/_7 = 5$ half lives ($^1/_2$mk)
1^{st} 2^{nd} 3^{rd} 4^{th} 5^{th}
100 → 50 → 25 → 12.5 → 6.25 → 3.125
= 3.125g ($^1/_2$mk)
b) To control thickness of paper, metal sheets. (1mk)

19. a) Iron(II) sulphide (1mk)
b) Hydrogen sulphide is less soluble in warm water. (1mk)
c) Black precipitate is formed. (1mk)

20. a) Existence / occurrence of organic compound with the same molecular formula but different structural formula. (1mk)
b)

1,1,2,2 – tetrabromo ethane ($^1/_2$mk) ($^1/_2$mk)


1,1,1,2 – Tetrabromo ethane ($^1/_2$mk) ($^1/_2$mk)

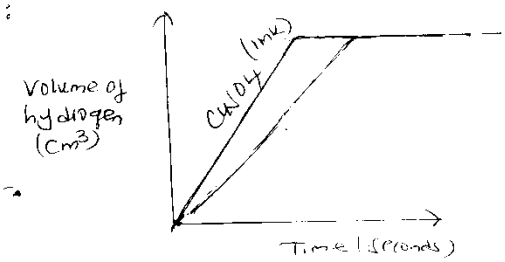
21. a) E (1mk) it has the most positive electrode potential. (1mk)
b) G (1mk) it is the strongest reducing agent // has the most negative electrode potential/most reactive (1mk)

22. i. I) C (1mk) II)D (1mk)
ii. Endothermic (1mk)

23. a) – In refrigerators and air conditioners

- In aerosal sprays.
- in foaming agents (1mk for any)
b) Depletion of the ozone. (1mk)

24. a) copper pyrites and malachite/ chalcolite/cuprite/ Azurite (2mks for any 2)
b) in order to concentrate the metal ore. (1mk)

25. a)


b) Copper(ii) sulphate is a catalyst (1mk)
hence making more volume of hydrogen to be produced per unit time . (1mk)

26. a) X (1mk) – does not form scum with water containing calcium chloride. (1mk)
b) Provide calcium (Ca^{2+}) for strong bones and teeth.

27. a) $4OH^-_{(aq)} \longrightarrow 2H_2O_{(l)} + O_{2\,(g)} + 4e^-$ (1mk)

b) Mass = $\frac{108 \times 5.0 \times 3 \times 60 \times 60}{96500}$ (1mk)
= 60.435g (1mk)

28. a) Across the period the number of protons increases/ strength of nuclear forces of attraction increases. (1mk)

b) Aluminium has more delocalized/ valence electrons than sodium (1mk)

29. a) Calcium carbide and water
b) - In welding
- As an intermediate in manufacture of PVC.
- Manufacture of organic solvents

KIRINYAGA CENTRAL SUB-COUNTY
EFFECTIVE 40 EXAMS 2021
CHEMISTRY P2 MARKING SCHEME

1.

a) i. D (1mk) – Its most electronegative (1mk)
ii. K (1mk) – its most electropositive (1mk)
b) Alkaline earth metals (1mk)
c) i. F_2 G_3 (1mk)
Accept Al_2O_3
ii. K_2O (1mk)
d) Atomic radius of F is larger than G(i). G has higher nuclear charge hence electrons are pulled towards the nucleus more strongly. (1mk)
e) has giant ionic structure with strong ionic bonds. (1mk)
f) i. its used in light bulbs to provide an inert environment to prevent oxidation of the filament.
Used in arch welding (1mk)
ANY ONE CORRECT (1mk)
ii. Used in manufacture of magnesium hydroxide which is used as anti – acid tablets / medicine.
A low density alloy with aluminum is used in airplane construction.

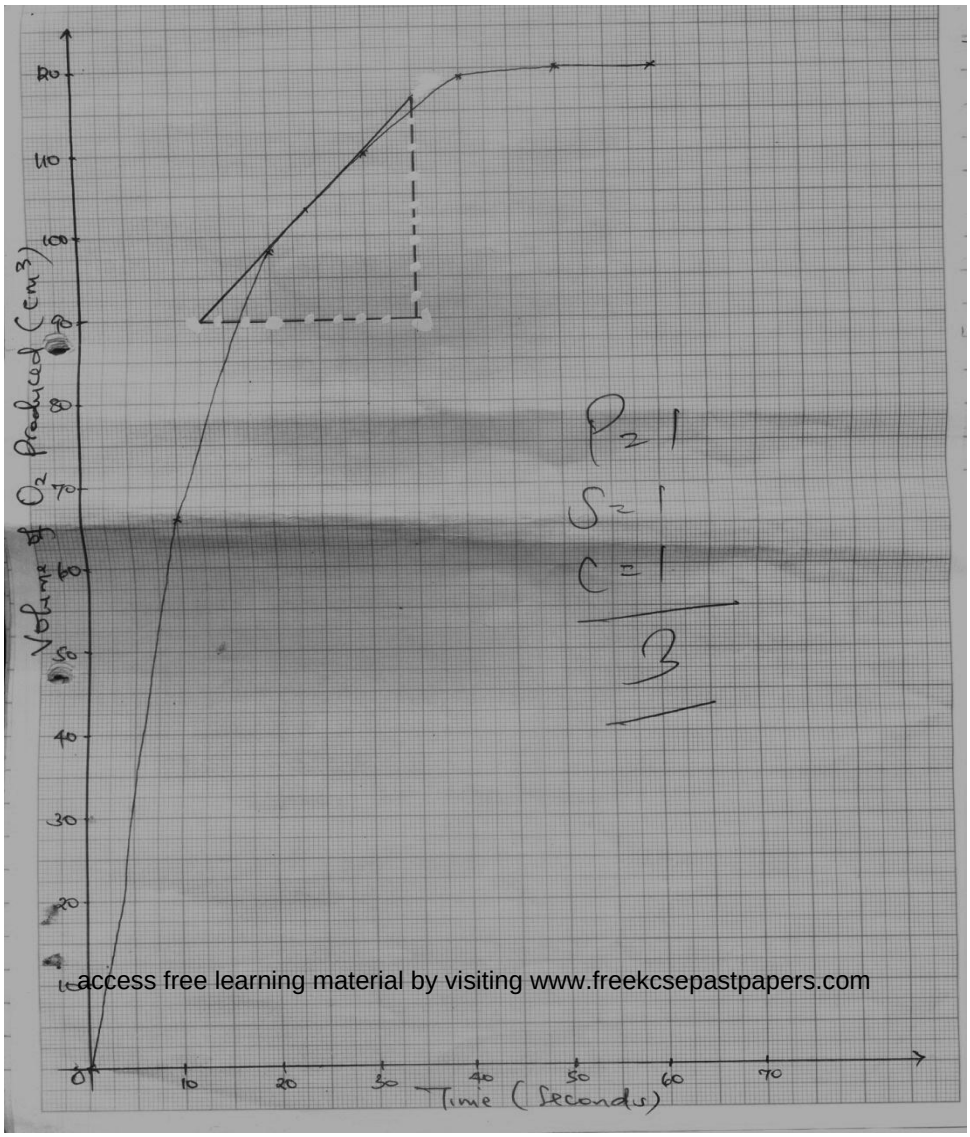
2.

a) i. Sulphur, zinc sulphide(zinc blende)
Lead sulphide(Galena), iron pyrites.
Any two correct (2mks)
ii. Dust particles (1mk)
Arsenic compounds/ Arsenic oxides. (1mk)
iii. To prevent poisoning of the catalyst (1mk)
b) I i. Lowers the yield of SO_3 since the equilibrium shifts to the left / ($^1/_2$mk)
favours backward reaction.
(ii) Increases (1mk) the yield of SO_3 since the equilibrium shifts to the right/
Favours forward reaction. ($^1/_2$mk)
c) Vanadium(v) oxide (V_5O_5) (1mk)
– cheaper
– less easily poised (1mk)

d) i. SO_2 dissolves in rain water forming acid rain (1mk) which destroys metallic roofs and stone works.
SO_2 causes respiratory diseases (1mk for any correct)

3.

a) A state of balance where the forward and backward reactions are taking place at the same rate (OWTTE)
b) When a change in condition is applied to a system in equilibrium, the system moves so as to oppose that change.
c) The yield of methanol decreases.✓1 Increase causes the equilibrium to shift to the left/ favours the backward reaction ✓$^1/_2$ where there is less volume/ less molecules of gases ✓$^1/_2$
d) i. Manganese (iv) oxide
ii



iii. $\frac{116.5 - 90}{35 - 12.5}$ ✓1

$= 1.178 cm^3/s$ ✓1

iv. All the hydrogen peroxide had decomposed.

4. a) i. B (1mk) oxygen gas is liberated at the positive electrode which is electrode A hence B becomes the cathode. (1mk)

ii. over water (1mk)

iii. Anode : $4OH^-_{(aq)} \longrightarrow 2H_2O_{(l)} + O_{2(g)} + 4\ e^-$ (1mk)

Cathode : $Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu_{(s)}$

iv. $Q = It$

$= 5 \times 3\ 60 \times 60$

$= 54000C$ ($^1/_2$mk)

$Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu_{(s)}$

$2 \times 96500 = 193000C$

$193000C \longrightarrow 63.5g$

$54000c \longrightarrow ?$

$\frac{54000 \times 63.5}{193000}$ ($^1/_2$mk)

$= 17.77g$ (1mk)

b) i. $A_{(s)}$ (1mk) has the most negative electrode potential (1mk)

ii. $B_{(s)} / B^{2+}_{(aq)} // D^{2+}_{(aq)} / D_{(s)}$ (1mk)

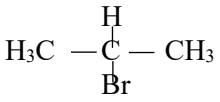
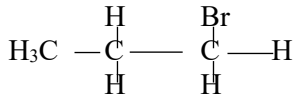
iii. E^Θ = E reduced – E oxidised

$= +0.34 - (-2.38)$ (1mk)

$= +2.72V$ (1mk)

5. a) i. Carbon(IV) oxide ($^1/_2$mk)
ii. Hydrogen ($^1/_2$mk)
iii. Propane ($^1/_2$mk)

b) i. Hydrogenation ($^1/_2$mk)
ii. Neutralisation ($^1/_2$mk)
iii. Substitution ($^1/_2$mk)

c)  (1mk)  (1mk)

d) $2C_3H_7OH_{(l)} + 9O_{2(l)} \longrightarrow 6CO_{2(g)} + 8H_2O_{(l)}$ (1mk)

e) Reagent chlorine gas (1mk)
Condition
ultraviolent light / sunlight (1mk)

f) i. Soapy detergent / soap (1mk)
ii. sodium chloride / potassium chloride (1mk)
iii. To precipitate out the soap (1mk)

6. a) i. Carbon/ graphite ✓1
- It does not react with Cl_2 formed ✓1
ii. Anode and cathode are separated by a steel gauze diaphragm
iii. $2\ Cl^-_{(l)} \longrightarrow Cl_{2(g)} + 2\ e^-$

b) i. Calcium chloride
ii. Reduce the amount of electricity used hence making the process economical.

c) i. Bauxite
ii. – CO_2 emitted causes global warming.
– Gapping holes.
– Noise pollution by machines.
– Release of dust causing air pollution.

iii. Q = It
= 40000 x 60 x 60 ✓$^1/_2$
=144,000,000C
3 x 96500c produces 279 of Al

$$\frac{144,000,000 \times 27V}{3 \times 96500}$$ ✓$^1/_2$

$$= \frac{13490g}{1000} = 13.43 \text{ Kgs}$$ ✓$^1/_2$

7. a) $Zn_{(s)} + CuSO_{4(aq)} \longrightarrow ZnSO_{4\,(aq)} + Cu_{(s)}$ (1mk)

b) To ensure that all the copper(II) sulphate solution reacts.

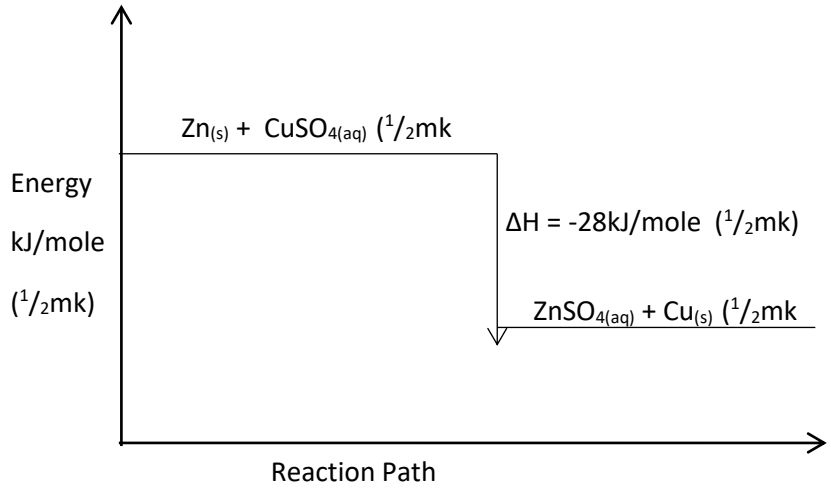
c) Blue colour of copper(II) sulphate solution fades (1mk) because copper(II) ions responsible for the blue colour are displaced from the solution (1mk) // Brown solid is deposited(1mk) because copper(II) ions are reduced to copper(1mk- metal which is a brown solid.

d) $\Delta H = MC\Delta T$
$= 125 \times 4.2 \times 5$ (1mk)
$= 2625j$
$= \frac{2625}{1000} = -2.625KJ$
$= -2.625kJ$ (1mk)

e) moles of $Cu^{2+} = \frac{0.75 \times 125}{1000}$ ($^1/_2$mk)
$= 0.09375$ moles ($^1/_2$mk)
0.09375 moles $\longrightarrow$ 2.625KJ
1mole $\longrightarrow$?

$\frac{1 \times 2.625}{0.09375} = -28KJmol^{-1}$ ($^1/_2$mk) ($^1/_2$mk)

f)



g) Some heat is lost to the surrounding.
Some heat is absorbed by the apparatus.
(1mk for any one)

KIRINYAGA CENTRAL SUB-COUNTY
EFFECTIVE 40 EXAMS 2021
CHEMISTRY P3 MARKING SCHEME

1. Table 1.

Volume of water in The boiling tube cm	Temperature which crystals of G appear(°C)	Solubility of solid G (g/100g of water)
6	58	75
8	42	56.25
10	37	45
12	31	37.5
14	28	32.14

Marking Points

Complete table – 1 mark
Trend - 1 mark (Tied to the temperature column only)
Consistent use of decimals – ½ mark(Tied to the temperature column only)
Accuracy – ½ mark (Tied to the 1st temperature recorded ± 2^0C)
Correct calculations of solubility(all 5) – 2marks
5 marks 5marks

– Penalise ½ mark for every wrong value of solubility upto maximum of 2 marks marks.

b) i. 62.5^{O}C . ½ ± 1 ^{O}C . ½ mark for showing on graph 1mark
ii. 65.5g/100g of water ± 0.5g (1/2mark), ½ mark for showing graph 1mark

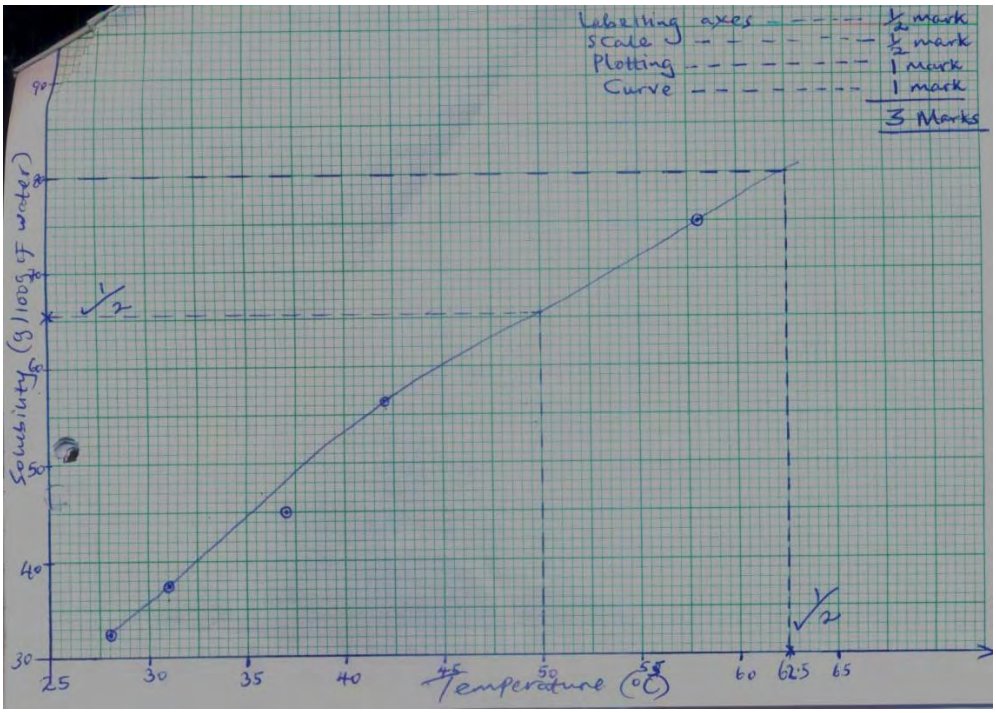


TABLE 2.

	1	2	3
Final burette reading(cm^3) 19.1	38.1	18.9	
Initial burette reading(cm^3)	0.0	19.1	0.0

Volume of solution F used cm^3 19.1 19.0 18.9

Complete table …….. 1mark
Consistent decimals …… 1mark (Tied to row 1 & 2 only)
Accuracy …… 1 mark
Principe of averaging …….. 1mark

4 mark

a) i. $\frac{19.1 + 19.0 + 18.9}{3}$ ✓½ = 19.0 cm^3 ✓½ (principle of averaging) (1mark)

ii. 0.1 mol – 1000 cm^3 ✓½

? – 19.0 cm^3

or $\frac{0.1 \times 19}{1000}$ = 0.0019moles ✓½ (1mark)

b) i. $H_2C_2O_4.nH_2O$: 2NaOH

$\frac{0.0019}{2}$ ✓½ 0.0019 = 0.00095 mol ✓½ (1 mark)

ii. 25cm^3 – 0.0095 or $\frac{250 \times 0.00095}{25}$ or 0.00095 x 10

250cm^3 – ?

= 0.0095 mol✓½ (1mark)

iii. 0.0095 mol – $50cm^3$ ✓½ or $\frac{0.0095 \times 1000}{50}$

? - $1000cm^3$

= 0.19M ✓½ (unit must be provided) (1mark)

c) 4.5g --- 100cm 45g/l = 0.19mol/l

$1000cm^3$ 4.5g 0.19 mol ✓½ (1mark)

$\frac{4.5 \times 100}{100}$ = 4.5g/litre $\frac{45 \times 1}{0.19} = 236.8$ ✓½

d) $H_2C_2O_4.nH_2O$

$(2 \times 1) + (2 \times 12) + (4 \times 16) + 18n = 236.8$

$90 + 18n = 236.8$ ✓½

$18n = 236. - 90$

$18n = 146.8$

$n = 8.2$

**Answer for value of n*
Should be a whole number
** Award ½ mark for answer of*
Value of n if $2 \leq n \leq 10$

$n = 8$✓½

2.

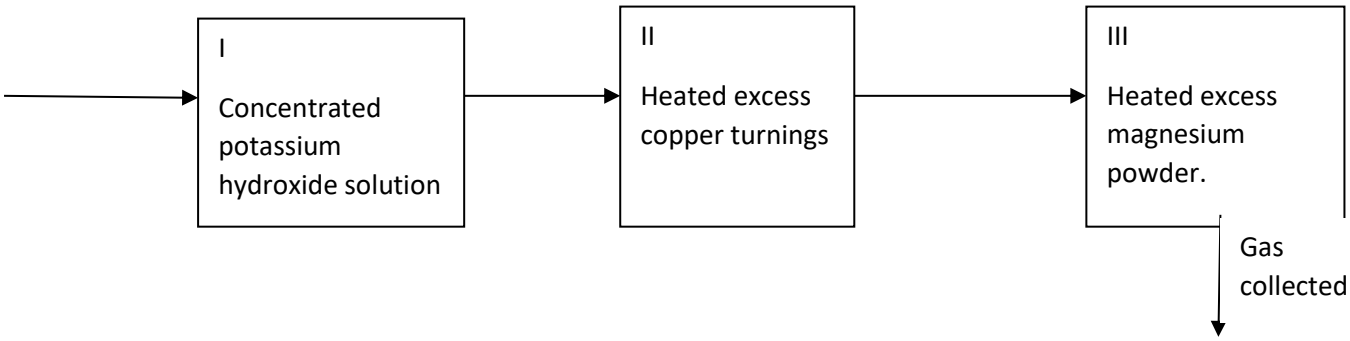
a) i.	**Observation** white ppt ✓½ insoluble in excess ✓½ present	**inference** Ca^{2+} ✓½ or Mg^{2+}✓½ (tied to insoluble ppt in excess)	**condition** any other ion given is contradictory. penalise ½ mk to a maximum of 1 mk.
ii.	White ppt✓½ insoluble in in excess ✓½	Mg^{2+} ✓1 present (tied to insoluble ppt in excess)	penalise fully for contradictory ion on the inference
iii.	white ppt ✓½	SO^{2-}_4 present✓1	penalise fully for contradictory ion on inference
B. i.	Blue ppt ✓½	Cu^{2+} present✓½	penalise fully for contradictory ion on Inference
ii.	Blue ppt✓½ Dissolves forming deep-blue solution ✓½	Cu^{2+} present✓½	Inference tied to dissolves forming deep-blue solution penalise fully for contradictory ion on
C.	Effervescence of a colourless gas ✓½	SO^{2-}_3 ✓½ or CO_3^{2-}✓½ Present	penalise ½ mk for contradictory ion to a maximum of 1mk

3.	Observation	Inference	condition
a)	Dissolves to form a colourless solution/ homogenous layer ✓1	polar organic liquid ✓1	inference tied to dissolving
b)	Yellow bromine water not decolourised ✓$^1/_2$	c = c or – c = c- ✓$^1/_2$ absent	accept any for full credit. Penalise for any contradictory functional group.
c)	Orange colour of Potassium dichromate (VI) persists or orange potassium dichromate IV does not turn green ✓1	R-OH ✓$^1/_2$ absent	penalise fully for contradictory functional Inference tied to correct observation.

d)	TEST	OBSERVATION	INFERENCE
	Put a piece of the universal Indicator ✓1 Paper into liquid P Match the colour of the Indicator paper with the pH chart ✓$^1/_2$	pH = 4 or pH = 5 (Tied to correct test Procedure) accept any	weakly acidic accept ✓$^1/_2$ Do not range in pH value
e)	Oily liquid with a pleasant/fruity smell ✓1 * Reject sweet smell	RC(=O)OH or ✓1 RCOOH present	penalise fully for any contradictory group

KANGUNDO CLUSTER
233/1
CHEMISTRY PAPER 1

1. Air passed through several reagents as shown below

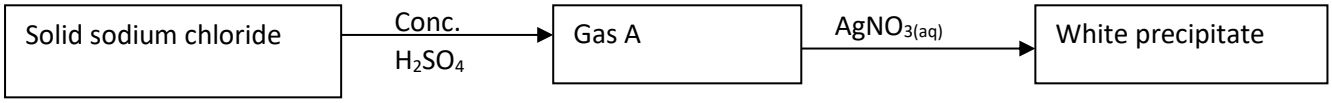


   a) What is the role of conc potassium hydroxide? (1mk)
   b) Write an equation that takes place in step III with Magnesium powder . (1mk)
   c) Name one gas that was collected from the process. (1mk)
2. Name two examples of physical changes. (2mks)
3. A gas at 27^0C and 750mmHg pressure was found to occupy 360cm^3. Calculate the temperature at which the same mass of gas will occupy twice the volume at a pressure of 1000mmHg. (2mks)
4. a) In the equation below, identify the reagent that acts as a base. (1mk)

$$H_2O_{2(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + HO_2^-$$

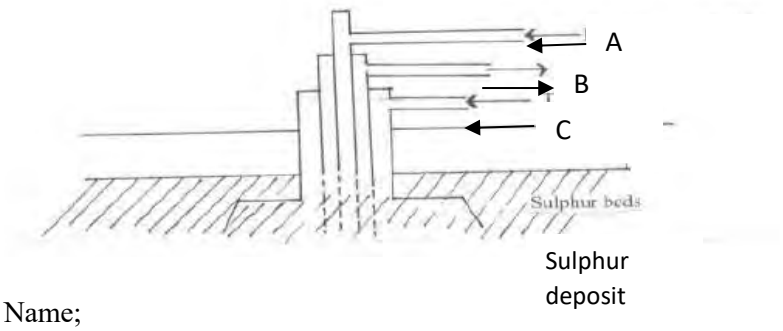
   b) Give a reason for your answer in (a) above (1mk)
5. a) When left in the open air, anhydrous calcium chloride increases in mass. Explain (1mk)
   b) What name is given to the process in a above? (1mk)

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



   a) Identify
      i) Gas A (1mk)
      ii) White precipitate. (1mk)
   b) Write an ionic equation for the formation of white precipitate. (1mk)
7. A student was supplied with a colourless liquid suspected to be water. Describe a chemical test that would be carried out to show that the liquid was water .(1mk)
8. In an experiment to determine solubility of sodium chloride, 13.2g of saturated sodium chloride solution at 18^0C was evaporated to dryness. 3.6g of the salt was left after complete evaporation of water.Determine the solubility of sodium chloride at 18^0C.(3mks)
9. a) State Graham's law of diffusion. (1mk)
   c) A volume of 120cm^3 of nitrogen gas diffused through a membrane in 40 seconds, how long will 240cm^3 of carbon (IV) Oxide take to diffuse through the membrane under the same conditions. (2mks)
10. A student was carrying out an experiment using Barium sulphate. The salt accidentally got mixed up with sodium sulphate. Describe how the student would get a dry sample of Barium sulphate. (3mks)

11. The diagram below represents the Frasch process. Study it and answer the questions that follow



a) Name;
A (½mk)
B (½mk)
C (½mk)

b) Why is C pumped to the Sulphur deposit. (½ mk)

c) Which property of sulphur enables it to be extracted by the method above .(1mk)

12. An element A has two isotopes ^{50}A and ^{52}A. The relative atomic mass of A is 51.5

i) Determine the percentage abundance of each isotope. (2mks)

ii) Define the term isotopy (1mk)

13. Study the table below and answer the questions that follow. The letters are not the actual chemical symbols of the elements.

Element	Atomic number	Atomic mass
W	20	40
X	9	19
Y	10	20
Z	17	35.5

i) Identify elements that belong to the same group and give a reason. (2mks)

ii) Which element is a metal. (1mk)

14. Study the information given in the table below and answer the questions that follow

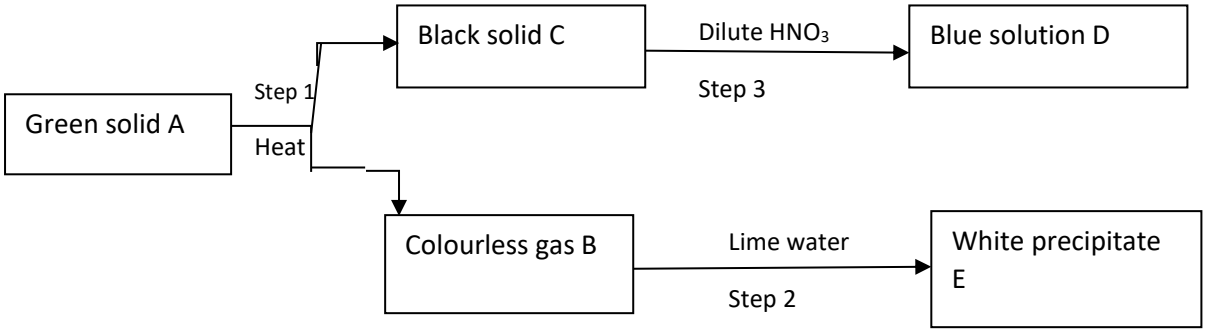
Bond	C - H	Cl - Cl	C - Cl	H - Cl
Average bond enthalpy ($KJmol^{-1}$) Breaking of bond)	414	244	326	431

a) Calculate the enthalpy change for the reaction (3mks)

$CH_{4(g)} + Cl_{2(g)} \xrightarrow{uv\ light} CH_3Cl_{(g)} + HCl_{(g}$

b) Is the reaction exothermic or endothermic?
Explain your answer. (1mk)

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



a) Write the chemical formulae of the following;
   i) Green solid A (1mk)
   ii) White precipitate E (1mk)
b) Write a chemical equation for the reaction taking place in the following steps.
   i) Step 1 (½ mk)
   ii) Step 3 (½ mk)

16. Soap solution was added to the three samples of water and the amount of soap required to form lather with 1 litre of each sample of water before and after boiling was recorded as shown below.

	I	II	III
Volume of soap before water is boiled	30	5	12
Volume of soap after boiling	30	5	5

   a) Explain the change in the volume of soap solution used in experiment III .(1mk)
   b) Why was the volume of soap used in experiment II so low. (1mk)

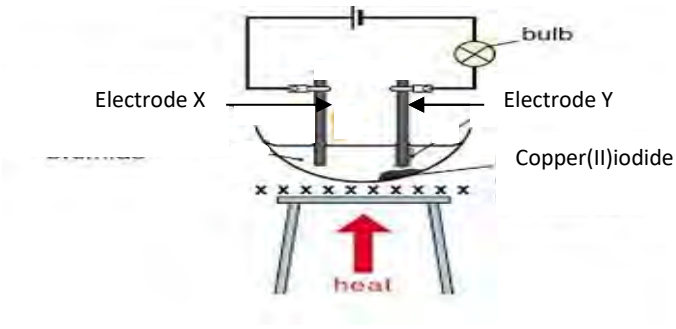
17. a) State Avogadro's law (1mk)
   b) 100cm^3 of hydrogen was mixed with 300cm^3 of chlorine and the mixture allowed to react. Determine the maximum volume of hydrogen chloride gas that would form .(2mks)

18. The table below shows the tests that were carried out on solid R and the observations made

Test	Observations
i)Solid R was heated.	Solid R turned from white to yellow.
ii)Dilute hydrochloric acid was added to solid R.	Colourless solution was formed.
iii)To the colourless solution obtained in test II excess sodium hydroxide solution was added.	A white precipitate was formed which dissolved to form a colourless solution.

Write the formula of cation in;
   a) Solid N (1mk)
   b) Colourless solution formed in test III (1mk)

19. The diagram below is a set up of apparatus used during electrolysis of molten copper(II) iodide



   i) List all ions present in the electrolyte. (2mks)
   ii) Write half equations for reactions in electrodes;
      a) X (1mk)
      b) Y

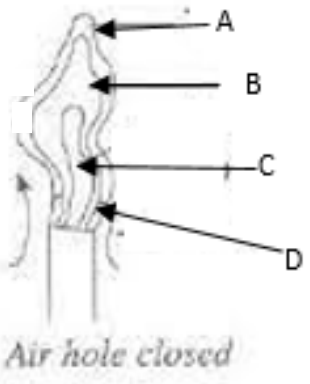
20. 2.4 g of magnesium were reacted with excess dilute hydrochloric acid at room temperature and pressure. Calculate the volume of hydrogen that was formed (Molar gas volume at R.T.P = 24dm^3 Mg = 24) (3mks)

21. Write the chemical formula of sodium sulphate. (1mk)
22. Sulphuric (VI) acid is manufactured using the contact process.
    a) State the catalyst used in the process. (1mk)
    b) State the optimum conditions for the process. (1mk)
    c) Explain how environmental pollution by the process is minimized. (1mk)
23. A student had 2 g of sodium hydroxide and 2 grammes of sulphuric (VI) acid. Which of the compound contain more of hydrogen atoms. (3mks)
    (H =1, S = 32, O = 16, Na =23)
24. State and explain the observations made when concentrated sulphuric (VI) acid is added to glucose.(2mks)
25. Name an ion which must be present in acidic solution. (1mk)
26. Dry blue litmus paper was put into a gas jar of dry hydrogen chloride gas. State and explain the observations made. (2mks)
27. $250cm^3$ of water was added to $300cm^3$ of 2M sulphuric vi acid. determine the new concentration of the solution (2mks)
28. Liquid P and Q mix forming a solution and have different boiling points.
    i) Name a suitable method of separation that would be used to separate the two liquids.(1mk)
    ii) Briefly describe the method stated in (i) above. (1mk)
29. Describe a chemical test for chlorine. (2mks)
30. Describe how zinc sulphate crystals can be prepared starting with zinc metal. (2mks)
31. Use the information in the table to answer questions that follow. (The letters are not the actual chemical symbols of the element)

Element	Atomic radius (nm)	Ionic radius (nm)
M	0.158	0.097
N	0.202	0.132
L	0.133	0.061

    a) Do these elements belong to a metallic or a non – metallic group? Give a reason. (2mks)
    b) Which element is the most reactive? Explain. (1mk)

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



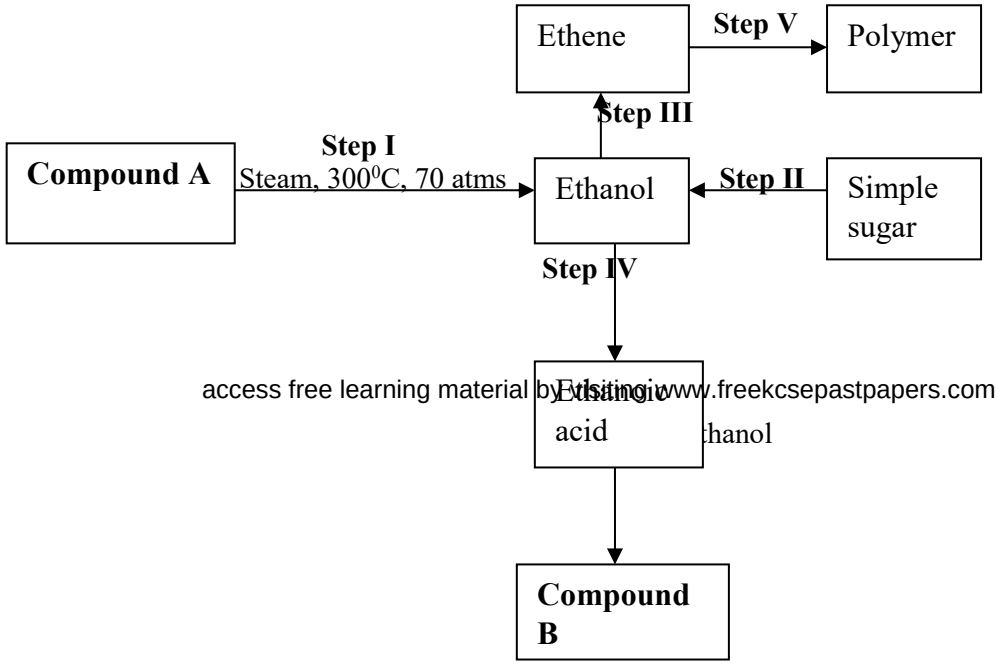
(a) Air hole closed

    a) Name the flame above (1mk)
    b) Name parts A,B,C and D of the flame (2mks)

KANGUNDO CLUSTER
233/2
CHEMISTRY
PAPER 2

1. (a) Alkenes and alkynes are unsaturated hydrocarbons.
   (i) What are unsaturated hydrocarbons? (1 mark)
   (ii) Draw the structure of the second member of the alkene homologous series and name it. (2 marks)

   (b) The alkene, **ethene**, is one of the products formed when an alkane with seven carbon atoms is heated to high temperature.
   (i) Write the equation for the reaction. (1 mark)
   (ii) Name the conversion process described in (b). (1 mark)
   (c) Study the flow chart below and answer the questions that follow.



(i) Name compound A. (1 mark)
(ii) Identify the processes that take place in the following steps . (2marks)
Step II : ……
Step III : ……
Step IV : ……
Step V : ……
(iii) State the reagents and conditions for:
Step III:
Reagent :…….. (1 mark)
Condition:……. (1 mark)
Step IV:
Reagent :…….. (1 mark)
Condition:……. (1 mark)
(iv) State one physical property of compound B. (1 mark)
(v) Draw the structure of the polymer formed in step V representing **three** repeat units. (1 mark)

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

G								
J				**N**	**P**	**T**		
K	**L**		**M**					
R								

(i) Select elements which belong to the same chemical family. (1 mark)

(ii) Select a letter which represents an element that loses electrons most readily. Give a reason for your answer. (2 marks)

(b) The first ionization energies of elements K and M at random are **570 kJmol^{-1}** and **490 kJmol^{-1}**.

(i) Write equations for the first ionization energies for elements K and M and indicate the energies. (1 mark)

(ii) Explain your answer in (b) (i). (1 mark)

(iii) Write the formula of the compound formed when L and P react . (1 mark)

(c) Element J reacts with water at room temperature to produce 200 cm^3 of gas. Determine the mass of J which reacted with water. (Molar gas volume at room temperature is 24000 cm^3, R.A.M of J = 7). (3 marks)

(d) (i) State another group that element G can be placed in the grid. Explain your answer. (2marks)

(ii) The chloride of element M easily vaporizes while its oxide has a high melting point. Explain. (2 marks)

3. (a) (i) What is meant by the term ' Enthalpy of formation'? (1 mark)

(ii) The enthalpies of combustion of carbon, methane and hydrogen are indicated below.

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

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

Enthalpy of combustion of $CH_4 = -890$ kJmol^{-1}.

I. Draw an energy cycle diagram that links the enthalpy of formation of methane with enthalpies of combustion of carbon, hydrogen and methane. (2 marks)

II. Determine the enthalpy of formation of methane. (1 mark)

(b) Methanol is manufactured from carbon (IV) oxide and hydrogen gas in the presence of chromium catalyst according to the equation below.

$CO_{2\,(g)} + 3H_{2\,(g)} \leftrightharpoons CH3OH_{(g)} + H_2O_{(g)}$

(i) What is a dynamic equilibrium? (1 mark)

(ii) State and explain the effect of each of the following on the position of the equilibrium.

I. Reduction in pressure. (2 marks)

II. Using a more efficient catalyst. (2 marks)

(c) Hydrogen peroxide decomposes according to the equation shown below.

$2H_2O_{2\,(aq)} \longrightarrow 2\,H_2O_{(l)} + O_{2\,(g)}$

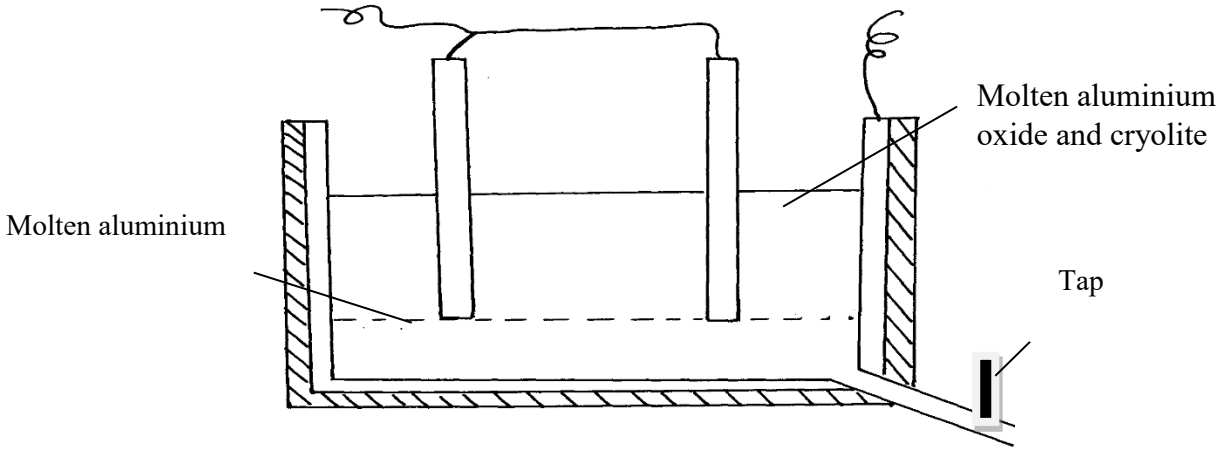
In a certain experiment, the rate of decomposition of hydrogen peroxide was found to be 4.0×10^{-8} moldm^{-3}s^{-1}.

(i) Calculate the number of moles per dm^3 of hydrogen peroxide that had decomposed within the first 2 minutes. (2 marks)

(ii) Write the formula of a suitable catalyst used to increase the rate of decomposition of hydrogen peroxide. (1mark)

(iii) Other than the use of the catalyst, explain **one other** factor that will increase the rate of decomposition of hydrogen peroxide. (2 marks)

4. The diagram below represents a set-up of an electrolytic cell that can be used in the production of aluminium.



(a) (i) Give the name of the major ore from where aluminium is extracted and give its formula.(1 mark)
Name
Formula

(ii) Identify two main impurities found in the ore. (2 marks)

(i) On the diagram, label the anode. (1 mark)

(ii) Write an equation for the reaction that takes place at the anode. (1mark)

(iii) Explain why the anode should be replaced regularly. (1 mark)

(b) Aluminium oxide is first heated before it is electrolysed. Explain. (1 mark)

(c) What is the role of cryolite in the extraction of aluminium? (1 mark)

(d) Explain why the production of aluminium is not carried out using reduction . (1 mark)

(e) State **two** uses of aluminium. (1 mark)

(f) State two environmental effects caused by the extraction of aluminium. (2 marks)

5. (a) Describe one method that can be used to distinguish between sodium sulphate and sodium hydrogen sulphate. (2 marks)

(b) Describe how a pure sample of lead (II) sulphate can be prepared in the laboratory starting lead metal. (3 marks

(c) When a white solid A was strongly heated, a yellow solid B and a colourless gas G were formed. The colourless gas formed a white precipitate when bubbled through calcium hydroxide solution. When dilute hydrochloric was added to solid B, colourless solution C was formed. Solution C was divided into two portions. To the first portion, silver nitrate solution was added. A white solid D was observed. To the second portion, aqueous ammonia was added dropwise till in excess. A white precipitate E was observed which dissolved in excess ammonia forming a colourless solution F.

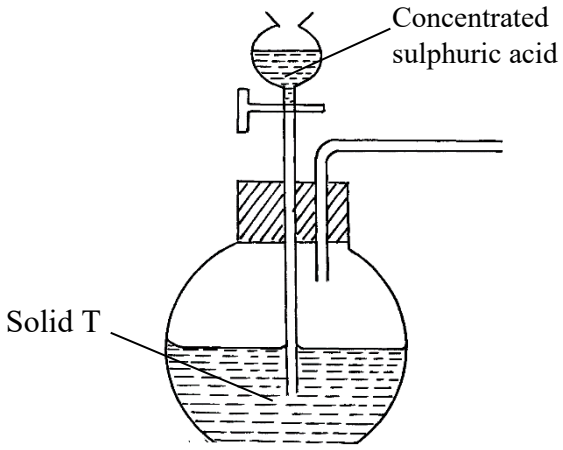
(i) Write the **formula** of:
Solid A**:**……. (1 mark)
Anion in solid B**:**…… . (1 mark)
Cation in solid D**:**…… (1 mark)
Complex ion in solution F**:**…… . (1 mark)
White precipitate E**:**…… 1 mark)

(ii) Write a chemical equation for the reaction that occurs when**:**
Solid A is heated**:** (1 mark)
Solid B reacts with hydrochloric acid**:** (1 mark)

(iii) Write an ionic equation for the reaction that produces solid D. (1 mark)

(iv) What would be observed if gas G was bubbled through calcium hydroxide solution for a longer time? (1 mark)

6. (a) The diagram below represents a set up that can be used to prepare and collect dry Sulphur (IV) oxide gas.



(i) Name solid T. (1 mark)
(ii) Complete the diagram to show how a dry sample of the gas can be collected. (2 marks)
(iii) Write an equation for the reaction that took place in the flask containing solid T. (1 mark)
(iv) State and explain one harmful effect of Sulphur (IV) oxide on the environment. (1 mark)

(b) Sulphur (IV) oxide is a major raw material in an **industrial process** to manufacture sulphuric (VI) acid.

(i) What name is given to this industrial process? (1 mark)

(ii) Complete the table below by writing down the observations made when concentrated sulphuric acid is added to the substances shown. (2 marks)

Substance	Observation
Iron filings	
Crystals of white sugar	

(iii) Give reasons for the observations made on:
I. Iron filings. (1mark)
II. Crystals of white sugar. (1 mark)

(c) Name one fertilizer made from sulphuric acid. (1 mark)
(d) Suggest a reason why barium sulphate (A pigment made from sulphuric acid) is suitable for making paint for cars. (1 mark)
(e) Other than in the manufacture of sulphuric (VI) acid, state **two** uses of Sulphur (IV) oxide. (1 mark)

KANGUNDO CLUSTER
END OF TERM 2, 2021
CHEMISTRY PRACTICALS,
233/3,

1. You are provided with:
– 1.9 g of solid S, which is a dibasic acid, H_2A.
– Solution T, 0.5 M solution of the dibasic acid, H_2A.
– Sodium hydroxide solution, solution R.

You are required to**:**

(a) Determine:
  (i) The molar heat of solution of solid S.
  (ii) The heat of reaction of one mole of the dibasic acid with sodium hydroxide.
(b) Calculate the heat of reaction of solid T with aqueous sodium hydroxide.

Procedure 1

Using a burette, transfer 30 cm^3 of distilled water into a 100 ml plastic beaker. Measure the initial temperature of the water and record it in table 1 below. Add all of the solid S at once. Stir the mixture carefully with the thermometer until all the solid dissolves.

(a) Measure the final temperature reached and record in table 1 below. (2 marks)

Table 1

Final temperature (^0C)	
Initial temperature (^0C)	

(b) Determine the change in temperature, ΔT. (1 mark)

(c) Calculate the:
  (i) Heat change when H_2A dissolves in water. (Specific heat capacity of solution is 4.2 $J/g/^0C$ and density of solution is 1 g/cm^3). (2 marks)
  (ii) Number of moles of the acid that were used. (Relative formula mass of H_2A is 126). (1 mark)
  (iii) Molar heat of solution, ΔH_1 of the acid H_2A. (1 mark)

Procedure 2

Using a measuring cylinder, transfer 30 cm^3 of solution T into a 100 ml plastic beaker. Measure the initial temperature, T_1 of solution T and record it in table 2 below. Using a clean measuring cylinder, measure 30 cm^3 of solution R and note its initial temperature, T_2 while still in the measuring cylinder. Add all solution R at once into the beaker containing solution T. Stir the mixture with the thermometer and record the final temperature reached, T_3.

(a) Table 2.

(b)

Final temperature of mixture, T_3 (^0C)	
Initial temperature of solution R, T_2 (^0C)	
Initial temperature of solution T, T_1 (^0C)	

(3 marks)

(c) (i) Determine the initial temperature of the mixture. (1 mark)
  (ii) Calculate the temperature change, ΔT. (1 mark)

(d) Determine the:
(i) Heat change for the reaction. (Specific heat capacity of solution is 4.2 J/g/^{0}C and density of solution is 1 g/cm^3). (1 mark)
(ii) Number of moles of the acid, H_2A that were used. (1 mark)
(iii) Heat of reaction, ΔH_2 of one mole of the acid, H_2A with sodium hydroxide. (1 mark)

(e) Given that**:**
$\Delta\mathbf{H_1}$ is the heat for the reaction, $H_2A_{(s\ )} \longrightarrow 2H^+_{(aq)} + A^{2-}_{(aq)}$
$\Delta\mathbf{H_2}$ is the heat for the reaction, $2H^+_{(aq)} + 2OH^-_{(aq)} \longrightarrow 2H_2O_{(l)}$
Calculate $\Delta\mathbf{H_3}$ for the reaction, $H_2A_{(s)} + 2OH^-_{(aq)} \longrightarrow 2H_2O_{(l)} + A^{2-}_{(aq)}$. (2 marks)

2. You are provided with **solid E**. Carry out the following tests on solid E. Write your observations and inferences in the spaces provided.

(a) Place about one third of solid E in a dry test tube and heat strongly. Test any gas produced using hydrochloric acid on a glass rod.

Observations	Inferences
(2marks)	(1mark)

(b) Place the rest of solid E in a boiling tube. Add about 10 cm^3 of distilled water and shake. Use 2 cm^3 portions for each of the tests below.

(i) To the first portion, add about 1 cm^3 of hydrochloric acid.

Observations	Inferences
(1mark)	(1½ marks)

(ii)To the second portion, add 3 drops of aqueous lead (II) nitrate and heat the mixture to boiling.

Observations	Inferences
(1mark)	(½ mark)

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

Observations	Inferences
(1mark)	(1mark)

(iv) Using the fourth portion and one of the reagents provided, describe a test that can be used to confirm the presence of Zn^{2+}.

Test	Expected observation.
(1mark)	(1mark)

(v) Carry out the test described above.

Observations	Inferences
(1mark)	(1mark)

3. You are provided with **liquid F.** Carry out the following tests and record the observations and inferences in the spaces provided.

(a) Place 2 drops of liquid F on a clean spatula and ignite the liquid on a bunsen burner.

Observations	Inferences
(1mark)	(1mark)

(b) Place about 2 cm^3 of liquid F in a test tube. Add about 2 cm^3 of distilled water and shake the mixture.

Observations	Inferences
(1mark)	(1mark)

(c) To about 2 cm^3 of liquid F in a test tube, add all the solid sodium hydrogen carbonate provided.

Observations	Inferences
(1mark)	(1mark)

(d) To another 2 cm^3 portion of liquid F in a test tube, add 3 drops of bromine water.

Observations	Inferences
(1mark)	(1mark)

(e) To about 2 cm^3 of liquid F in a test tube, add 3 drops of acidified potassium dichromate (VI) and warm the mixture.

Observations	Inferences
(1mark)	(1mark)

KANGUNDO CLUSTER
233/1
CHEMISTRY
PAPER 1
MARKING SCHEME

1. Air passed through several reagents as shown below
   a). What is the role of conc potassium hydroxide? (1mk)
   To remove CO_2 from air by reacting with it
   b). Write an equation that takes place in step III with Magnesium powder. (1mk)
   $3Mg_{(s)} + N_{2(g)} \longrightarrow Mg_3N_{2(s)}$

   c). Name one gas that was collected from the process. (1mk)
   Argon
   Neon
   Helium
   xenon

2. Name two examples of physical changes. (2mks)
   - ***Melting***
   - ***Sublimatation***
   - ***Vapourization***
   - ***Heat ZnO***
   - ***Heating PbO***

3. A gas at 27^0C and 750mmHg pressure was found to occupy 360cm^3. Calculate the temperature at which the same mass of gas will occupy twice the volume at a pressure of 1000mmHg. (2mks)
   T_1 = 300k
   P_1 = 750mmHg
   V_1 = 360cm^3
   T_2 =
   V2 = 720cm^3
   P_2 = 1000mmHg

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{750x360}{300} = \frac{1000\times 720}{T_2}$$

T2 = $\dfrac{1000\times 720\times 300}{750\times 360}$

= 800k
527^0C

4. a) In the equation below, identify the reagent that acts as a base. (1mk)
   $H_2O_{2(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + HO_2^-{}_{(aq)}$

   H_2O it accepts a proton from H_2O_2
   b) Give a reason for your answer in (a) above (1mk)
   from it accepts a protonH_2O_2
5. a) When left in the open air, anhydrous calcium chloride increases in mass.Explain(1mk)
   it absorbed water from the atmosphere to form a solution
   b) What name is given to the process in**a** above? (1mk)
   deliquescence
6. Study the chart below and answer the questions that follow.
   a). Identify
   i). Gas A **HCl or hydrogen chloride gas** (1mk
   ii). White precipitate. **Silver chloride / Ag_2CO_3** (1mk)

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

$2Ag^{+}_{(aq)} + CO_3^{2-}{}_{(aq)} \longrightarrow Ag_2CO_{3(s)}$

7. A student was supplied with a colourless liquid suspected to be water. Describe a chemical test that would be carried out to show that the liquid was water .(1mk)
Add the liquid to anhydrous $CUSO_4$ if it turns from white to blue the liquid is water
NB anhydrous $C0CL_2$ can also be use

8. In an experiment to determine solubility of sodium chloride, 13.2g of saturated sodium chloride solution at 18^0C was evaporated to dryness. 3.6g of the salt was left after complete evaporation of water.Determine the solubility of sodium chloride at 18^0C. (3mks)

13.2

3.6

9.6

9.6g – 3.6

100 - $\frac{3.6\times100}{9.6}$ = 37.5g/100g of H_2O penalize ½ if unit not given

9. a) State Graham's law of diffusion. (1mk)
the rate of diffusion of a gas is inversely proportional to the square root of its density at constant temp and pressure.

b). A volume of 120cm^3 of nitrogen gas diffused through a membrane in 40 seconds, how long will 240cm^3 of carbon (IV) Oxide take to diffuse through the membrane under the same conditions. (3mks)

$$\frac{TN_2}{\sqrt{RmmN_2}} = \frac{TCO_2}{\sqrt{RmmCO_2}} \qquad TCO_2 = \frac{80\times\sqrt{44}}{\sqrt{28}}$$

=100.29sec

$$\frac{80}{\sqrt{28}} = \frac{TCO_2}{\sqrt{44}}$$

$$\frac{RN\sqrt{RMMN_2} = RCO_2\sqrt{RmmN_2}}{\sqrt{28}}$$

$$3\sqrt{28} = \frac{240}{T}\sqrt{44}$$

TCO_2 $\frac{240\times\sqrt{44}}{3\times\sqrt{28}}$

100.29

10. A student was carrying out an experiment using Barium sulphate. The salt accidentally got mixed up with sodium sulphate. Describe how the student would get a dry sample of Barium sulphate. (3mks)
- **Add water to the mixture and stir**
- **Filter the resulting mixture $BaSO_4$ is collected as residue while Na_2SO_4 solution is collected as filtrate**
- **Rinse the residue with distilled water**
- **Dry the residue between filter paper**

11. The diagram below represents the Frasch process. Study it and answer the questions that follow

a). Name;

A **Hot compressed air** (½mk)

B **Molten sulphur/water mixture** (½mk)

C **supper heated water at 170^0C** (½mk)

b). Why is C pumped to the sulphurdeposit. (½ mk)

To melt sulphur

c). Which property of sulphur enables it to be extracted by the method above .(1mk)

It has a low melting point

12. An element A has two isotopes ^{50}A and ^{52}A. The relative atomic mass of A is 51.5

i). Determine the percentage abundance of each isotope. (2mks)

$$\frac{50x + 52(100 - x)}{100} = 51.5$$

$$50x + 5200 - 52x = 5150$$

-2x = -50

x = 25

^{50}A – 25%

^{52}A – 75^0C

ii). Define the term isotopy (1mk)

Existence of atoms with the same atomic number but with different mass numbers

13. Study the table below and answer the questions that follow. The letters are not the actual chemical symbols of the elements.

Element	Atomic number	Atomic mass
W	20	40
X	9	19
Y	10	20
Z	17	35.5

i). Identify elements that belong to the same group and give a reason .(2mks)

X and Z because they both have 7 electrons in the outermost occupied energy level

ii). Which element is a metal. (1mk)

W

14. Study the information given in the table below and answer the questions that follow

Bond	C - H	Cl - Cl	C - Cl	H – Cl
Average bond enthalpy ($KJmol^{-1}$) Breaking of bond)	414	244	326	431

a). Calculate the enthalpy change for the reaction (3mks)

$CH_{4(g)} + Cl_{2(g)} \xrightarrow{\text{uv light}} CH_3Cl_{(g)} + HCl_{(g)}$

Bond broken	**energy required**
C – H	**414**
Cl – Cl	**244**
	658
Bond formed	**energy lost**
C- cl	**326**
H – cl	**431**
	757

ΔH = -(759 – 658)

= - 99kj

b). Is the reaction exothermic or endothermic?
Explain your answer. (1mk)
Exothermic energy given out during bond formation is greater than energy gained during bond breaking

15. Study the flow chart below and answer the questions that follow
a). Write the chemical formulae of the following;
i). Green solution E (1mk)
$Fe(NO_3)_2$
ii). White precipitate E (1mk)
$CaCO_3$
b). Write a chemical equation for the reaction taking place in the following steps.

i). Step 1 **$FeCO_{3(s)} \longrightarrow FeO_{(s)} + CO_{2(g)}$** (½ mk)

ii). Step 3 **$FeO_{(s)} + 2HNO_{3(aq)} \longrightarrow Fe(NO_3)_{2(aq)} + H_2O_{(l)}$** (½ mk)

16. Soap solution was added to the three samples of water and the amount of soap required to form lather with 1 litre of each sample of water before and after boiling was recorded as shown below.

	I	II	III
Volume of soap before water is boiled	30	5	12
Volume of soap after boiling	30	5	5

a). Explain the change in the volume of soap solution used in experiment III .(1mk)
The sample of water was temporary hard and therefore when boiled the hardness was removed.
b). Why was the volume of soap used in experiment II so low. (1mk)
The sample of water was softwater

17. a) State Avogadro's law (1mk)
at constant temperature and pressure equal volumes of gas contain equal number of molecules

b). $100cm^3$ of hydrogen was mixed with $300cm^3$ of chlorine and the mixture allowed to react. Determine the maximum volume of hydrogen chloride gas that would form .(2mks)

$H_2 + Cl_{2(g)} \longrightarrow 2HCl_{(g)}$
100 100 200cm^3

18. The table below shows the tests that were carried out on solid R and the observations made

Test	Observations
i)Solid R was heated.	Solid R turned from white to yellow.
ii)Dilute hydrochloric acid was added to solid R.	Colourless solution was formed.
iii)To the colourless solution obtained in test II excess sodium hydroxide solution was added.	A white precipitate was formed which dissolved to form a colourless solution.

Write the formula of cation in;
a).Solid N (1mk)
Zn^{2+}
b). Colourless solution formed in test III (1mk)
Na^+

19. The diagram below is a set up of apparatus used during electrolysis of molten copper(II) iodide
i). List all ions present in the electrolyte. (2mks)
CU^{2+} and I^- ions
ii). Write half equations for reactions in electrodes;
c) X **$2J^- \longrightarrow I_{2(g)} + 2e^-$** (1mk)
d) Y $CU^{2+}_{(l)} + 2e^-$ $Cu_{(s)}$

20. 2.4 g of magnesium were reacted with excess dilute hydrochloric acid at room temperature and pressure. Calculate the volume of hydrogen that was formed (Molar gas volume at R.T.P = 24dm^3 Mg = 24) (3mks)

    $\frac{2.4}{24}$ = 0.1moles

    $2HCl_{(aq)} + Mg_{(s)} \longrightarrow MgCl_{(2)(aq)} + H_{2(g)}$

    0.2moles 0.1moles 0.1moles0.1moles

    1 mole of H_2 – 24dm^3

    0.1moles – $\frac{2.4 \times 0.1}{1}$ = 2.4dm^3

21. Write the chemical formula of sodium sulphate. (1mk)

    Na_2SO_4

22. Sulphuric (VI) acid is manufactured using the contact process.

    a). State the catalyst used in the process. (1mk)

    Vanadium(V) oxide/ V_2O_5// platinized asbestos

    b). State the optimum conditions for the process. (1mk)

    450^0C

    c). Explain how environmental pollution by the process is minimized. (1mk)

    Scrubbing the exhaust fume by passing them through a chimney packed with calium hydroxide

23. A student had 2 g of sodium hydroxide and 2grammes of sulphuric (VI) acid. Which of the compound contain more of hydrogen atoms. (3mks)

    (H =1, S = 32, O = 16, Na =23)

    NaoH H_2SO_4

    $\frac{2}{40}$ $\frac{2}{98}$

    Moles of substance 0.05 moles 0.02041

    Moles of hydrogen atoms 0.05 moles 0.04082 moles

    2g of NaOH

24. State and explain the observations made when concentrated sulphuric (VI) acid is added to glucose.(2mks)

    The solid changed from white to black .con. H_2SO_4 acid dehydrate glucose to carbon.

25. Name an ion which must be present in acidic solution. (1mk)

    Hydrogen ion

26. Dry blue litmus paper was put into a gas jar of dry hydrogen chloride gas. State and explain the observations made. (2mks)

    The blue litmus retain its colour. HCl does not have acidic when dry

27. M1V1=M2V2

    $\frac{2 \times 300}{550}$ = 1.091M

28. Liquid P and Q mix forming a solution and have different boiling points.

    i).Name a suitable method of separation that would be used to separate the two liquids. (1mk)

    Fractional distillation/simple distillation

    ii). Briefly describe the method stated in (i) above.(1mk)

    The mixture is heated until the liquid with the lower boiling point evaporates,leaving behind the one with a higher bp

29. Describe a chemical test for chlorine. (2mks)

    - ***Introduce a moist blue litmus paper to the gas***
    - ***The paper turned red and the white***

30. Describe how zinc sulphate crystals can be prepared starting with zinc metal. (2mks)

    -Add excess zinc to dil.sulphuric (VI) acid

    -Filter the mixture $ZnSO_{4(aq)}$ is collected as filtrate

    -Heat the solution to evaporate water until the solution is saturated

    -Leave the solution to cool for crystals to grow

    -Filter the crystals and dry them between filter papers

31. Use the information in the table to answer questions that follow. (The letters are not the actual chemical symbols of the element)

Element	Atomic radius (nm)	Ionic radius (nm)
M	0.158	0.097
N	0.202	0.132
L	0.133	0.061

a).Do these elements belong to a metallic or a non – metallic group? Give a reason.(2mks)

Metals ionic radius is shorter than the atomic radius

b). Which element is the most reactive? Explain. (1mk)

N. it has the longest atomic radius and therefore has lest ionization energy

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

a). Name the flame above (1mk)

luminous

b). Name parts A,B,C and D of the flame (2mks)

A **Thin outer region**

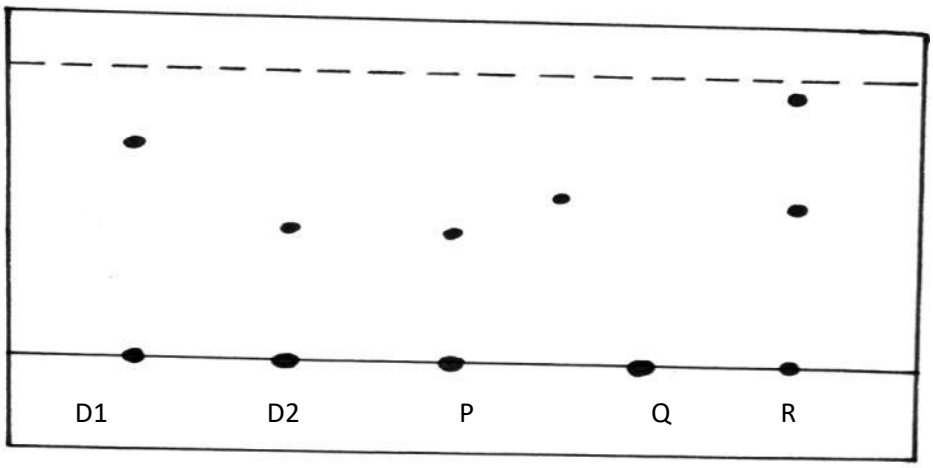
B **Bright – yellow region**

C – **Almost colourles**

D – **Blue region**

GATUNDU SOUTH
233/1
CHEMISTRY
END TERM 2-2021
PAPER 1

1. Samples of urine from three participants **P, Q**, and **R** at a national police recruitment exercise were spotted onto a chromatography paper alongside two illegal drugs D1 and D2. A chromatogram was run using Ethanol. The figure below shows the chromatogram.



   a). Identify the participant who had used an illegal drug. (1mk)
   b). Which drug is less soluble in Ethanol. (1mk)
   c). label on the diagram the baseline and solvent front. (1mk)
2. a) Hydrogen can reduce copper (II) Oxide but not aluminium oxide. Explain. (1mk)

   b) When water reacts with potassium metal, the hydrogen produced ignites explosively on the surface of water.
   i. What causes this ignition? (1mark)
   Write an equation to show how this ignition occurs (1mark)
3. In an experiment an unknown mass of anhydrous sodium carbonate was dissolved in water and the solution made up to $250cm^3$. $25cm^3$ of this solution neutralized $20cm^3$ of 0.25M nitric acid. Calculate the mass of unknown sodium carbonate used. (3mks)
4. An element X has two naturally occurring isotopes, **X-20** and **X-22** that occur in ratio 1:4**.** Calculate the relative atomic mass of X. (2mks)
5. Carbon and silicon belong to the same group of the periodic table, yet carbon (IV) oxide is a gas while silicon (IV) oxide is a solid with a high melting point. Explain this difference (2mks)
6. An ion of oxygen is larger than oxygen atom. Explain. (2mks)
7. a) Work out the oxidation number of phosphorous in H_3PO_3. (1mk)
   b) Study the equation below:
   $Mg_{(s)} + 2H_2O_{(l)} \longrightarrow Mg(OH)_{2\,(aq)} + H_{2\,(g)}$

   Which species has undergone oxidation? Explain. (2mks)
8. Starting with lead (II) carbonate explains how you would prepare a pure sample of lead (II) sulphate. (3mks)
9. Draw a dot (**.**) and cross (x) diagrams to show bonding in:-
   a) Ammonium ion, NH_4^+ (N=7.0, H=1.0) (1mk)
   b) Silane, SiH_4 (Si=14.0 H=1.0) (1mk)
10. Sodium carbonate decahydrate crystals, $Na_2CO_3.10H_2O$, were left exposed in the atmosphere on a watch glass for two days.
   a) State the observation made on the crystals after two days. (1mk)
   b) Name the property of salts investigated in the above experiment. (1mk)
11. a) What is meant by the term solubility of salts? (1mk)
   b) Calculate the solubility of a salt given that 15g of the salt can saturate $25cm^3$ of water. (1mk)

12. a) State the Graham's law. (1mk)
    b). A 100cm^3 of carbon (IV) oxide gas diffused through a porous partition in 30 seconds. How long would it take 150cm^3 of nitrogen (IV) oxide to diffuse through the same partition under the same conditions? (C=12.0, N=14.0, O=16.0) (2mks)

13. The $_P$H values of some solutions labeled E to I are given in the table below. Use the information to answer the questions that follow.

$_P$H	14.0	1.0	8.0	6.5	7.0
Solution	E	F	G	H	I

    (a) Identify the solution with the highest concentration of hydroxide ions (1mk)
    (b). Which solution can be used as a remedy for acid indigestion in the stomach? (1 mark)
    (c) Which solution would react most vigorously with magnesium metal? (1mk)

14. When sulphur is heated in a boiling tube in absence of air, the yellow crystals melts into golden yellow mobile liquid at 113°C. The liquid changes at 180°C into a dark brown very viscous liquid. More heating to about 400°C, produces a brown less viscous liquid.
    (a) Draw the molecular structure of sulphur in the yellow crystals. (1mk)
    (b) Explain why the molten liquid becomes viscous. (1mk)
    (c) If the brown liquid at 400°C is cooled rapidly by pouring it into cold water, which form of sulphur is produced? (1mk)

15. Draw and name two possible isomers of C_4H_{10} (3mks)

16. A gas cylinder contains about 1.12dm^3 of butane measured at 0^0 and 1 atm.given that 25% of heat is lost, what is the maximum volume of water at room temperature which can be boiled to 100^0C in order to make some coffee?

    $C_4H_{10\,(g)} + 6\frac{1}{2}O_{(g)} \longrightarrow 4CO_{2(g)} + 5H_2O_{(l)}; \quad \Delta H^\theta = -3{,}000 kJmol^{-1}$

    (3mks)

    (specified heat capacity of water =4.2J g^{-1}C^{-1}, density of water 1 gcm^{-3} Molar gas volume 22.4 at s.t.p)

17. Given this reaction; $RNH_2 + H_2O \rightleftharpoons RNH_3^+ + OH^-$ (2mks)

18. In an experiment, soap solution was added to three samples of water. The results below show the volume of soap solution required to lather with 500cm^3 of each water sample before and after boiling.

	Sample 1	**Sample 2**	**Sample 3**
Volume of soap used before water boiled	26.0	14.0	4.0
Volume of soap after water boiled	26.0	4.0	4.0

    a) Which water samples are likely to be soft? (1mk)
    b) Explain the change in volume of soap solution used in sample 2 (1mk)

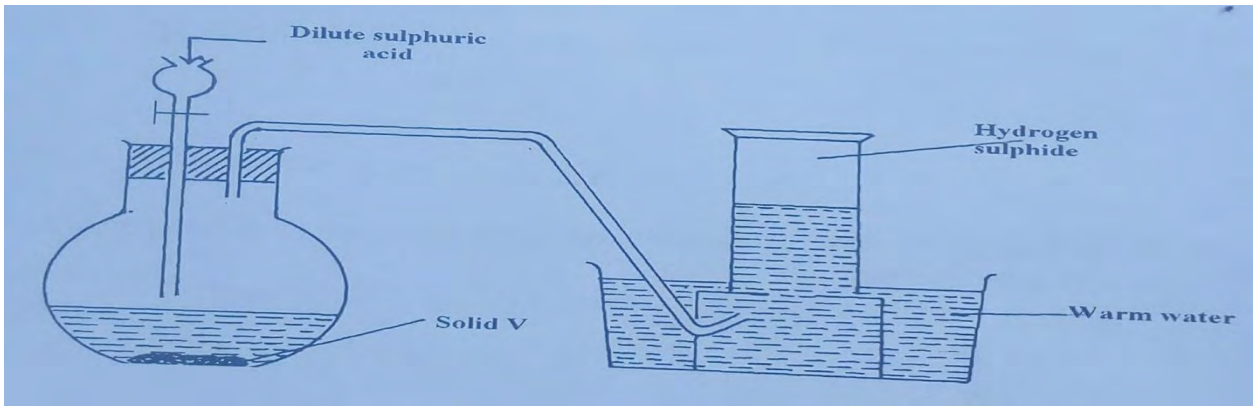
Study the electrode potentials in the table below and answer the questions that follow:
(Letters are not the actual symbols of elements)

(E^θ /Volts)

$H^{2+}_{(aq)} + 2e^- \longrightarrow H_{(s)} + 0.34$
$Z^{2}_{(aq)} + 2e^- \longrightarrow Z_{(S)} - 2.38$
$G^{+}_{(aq)}\ 2e^- \longrightarrow G_{(s)} + 0.80$
$T^{2+}\ 2e^- \longrightarrow T_{(s)} - 2.87$

    a) Which one is the strongest reducing agent? (1mk)
    b) Write the ionic equation for the reaction that takes place when Z is dipped in a solution of G^+ ions. (1mk)
    c) Calculate the E^θ Cell value of the reaction in (b) above. (1mk)

19. The set-up below was used to prepare and collect hydrogen sulphide gas. Study it and answer the questions that follow.

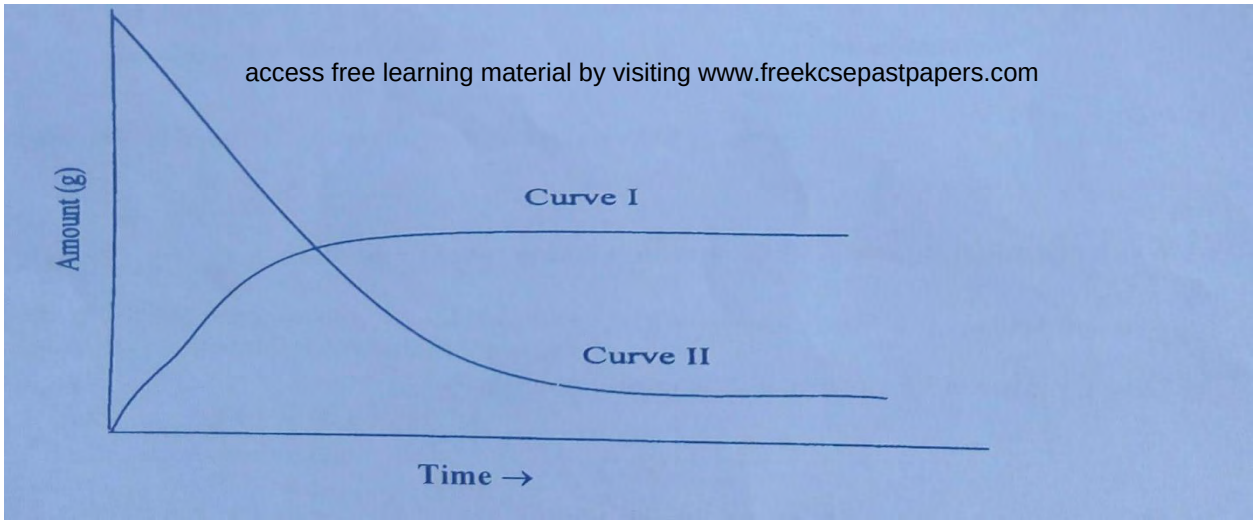


a) Name solid V. (1mark)
b) Write chemical equation of the reaction taking place in the flask. (1mark)
c) Give a reason why warm water is used in the set-up. (1mark)

20. (a) Define the term half-life [1mk]
(b) The half-life of a radioactive nuclide is 3 hours. Given that its initial mass is 288g, determine the remaining mass after 12 hours. [2mks]

The graph below shows the amount of calcium carbonate and calcium chloride varying with time in the reactions:

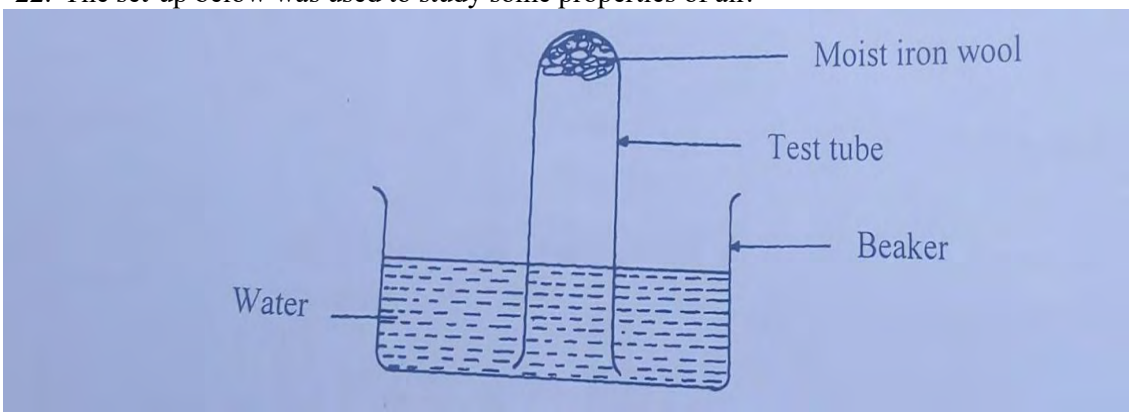
$CaCO_{3(S)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + H_2O_{(g)} + CO_{2(g)}$



a) Which curve shows the amount of calcium chloride varying with time? (1mk)
b) Explain why the two curves become horizontal after a given period of time. (1mk)
c) Sketch on the graph how curve II would appear if the experiment was repeated using a more dilute hydrochloric acid solution. (1mk)

21. Heated iron can react with both chlorine gas and hydrogen chloride gas.
a) Write equations for the reactions. (2mks)
b) Chlorine gas has no effect on dry blue litmus paper. Explain (1mk)

22. The set-up below was used to study some properties of air.



State and explain two observations that would be made at the end of the experiment. (2mks)

25. Most lab apparatus are made of glass. Give two reasons why glass is preferred over any other material. (2 mks)

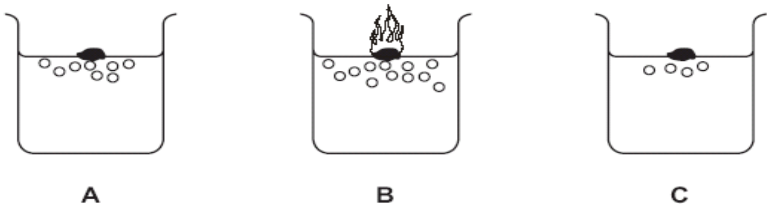
26. Sodium carbonate is manufactured in large scale by Solvay process.
    a) Carbon (iv) oxide is one of the ingredients required in this process. State its source. (1mk)
    b) Write the equation of the main reaction in the solvay process (1mks)
    c) One of the by-products is calcium chloride, state one use of this by-product. (1mk)

27. Use the information in the table about group 1 elements to answer the questions that follow

Element	Atomic radius(nm)
Lithium	0.123
Sodium	0.157
Potassium	0.203

.

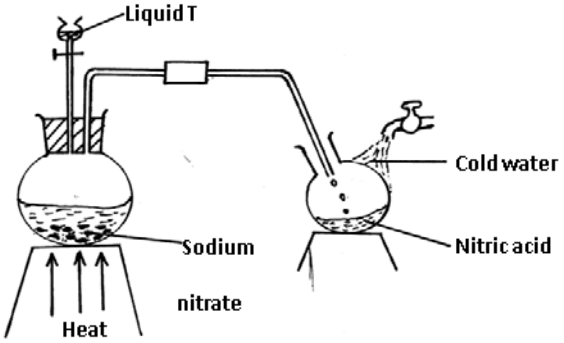
When the group 1 elements react with water, hydrogen gas is given off. The diagram shows the reaction of the above three elements with water



(a) What is the general name of the group one elements (1mk)
(b) Which one of these elements A, B or C is Lithium? (1mk)
(c) Apart from fizzing state another observation that you would see when sodium reacts with water. (1mk)

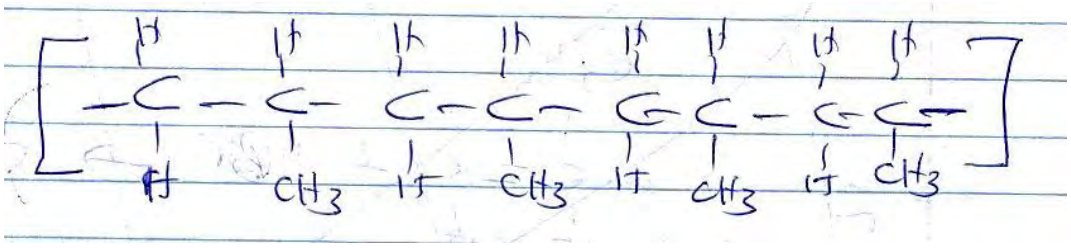
28. Explain why molten sodium chloride conducts electricity, but solid sodium chloride does not (2mks)

29. The set-up below was used to prepare Nitric(V) acid in the laboratory.



a) Name liquid T. (1mk)
b) Write an equation for th reaction taking place in the flask. (1mk)
c) State the reason why nitric(V) acid collected is yellow in colour and explain how the yellow colour can be removed. (1mk)

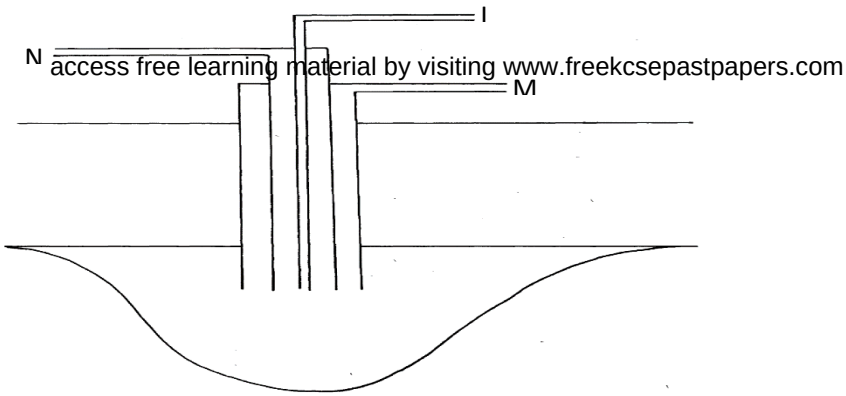
30. A polymer can be represented as



(a) Draw the structure of the monomer (1mk)
(b) What type of polymerization occurs in the above case? (1mk)
(c) Given that the molecular mass of the polymer is 25620, how many units of the monomer make the polymer (2mk)

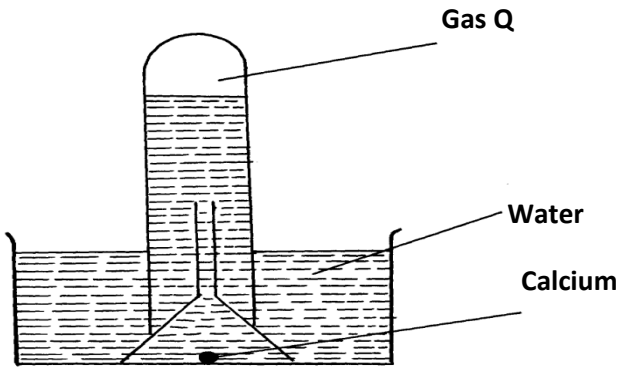
GATUNDU SOUTH
233/2
CHEMISTRY PAPER 2
END TERM 2-2021

1. a) The diagram below shows the extraction of sulphur.



i) Name the process illustrated in the diagram. (1mk)
ii) Identify the pipe through which molten sulphur flows. (1mk)
iii) Supper heated water is used in this process. How is superheated water obtained? (1mk)

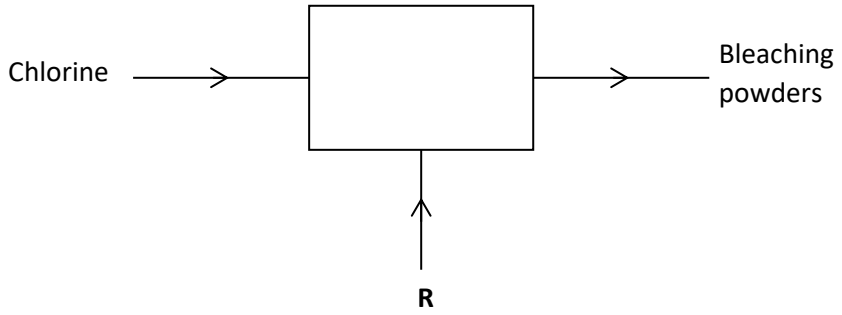
b) The reaction of water and calcium gave gas Q collected as in the diagram below



(i) Identify gas **Q** (1mk)

(ii) Explain why the solution left after the reaction is a weak base. (2mks)

c) The diagram below outlines industrial preparation of bleaching powder.



(i) Give the chemical name of bleaching powder (1mk)

(ii) Identify substance R (1mk)

(iii) Explain why water in which bleaching powder has been added needs a lot of soap during washing. (2mks)

(b) The equation below shows the oxidation of sulphur(IV) oxide to sulphur (VI) oxide in contact process.

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)} \quad \Delta H = -196 Kj^{mol-1}$$

State and explain the effect on the yield of sulphur (VI) oxide when

I the temperature is increased (1mk)

II the amount of oxygen is increased (1mk) (1mk)

2. The table below gives the solubilities of potassium chloride and potassium nitrate at various temperatures.

Temp. (°c)		0	10	20	30	40	50	60	70	80
Solubility g/100g of water	KCl	27.6	31.0	34.0	37.0	40.0	42.6	45.5	48.5	51.0
	KNO_3	13.3	21.0	31.5	46.0	64.0	83.5	110.0	138.0	169.0

a) On the same pair of axes plot the solubility curves for potassium chloride and potassium nitrate on the graph paper provide. (5mks)

b) At what temperatures are the solubilities of the salt each 36.0g/100g of water

(i) Potassium chloride (1mk)

(ii) Potassium nitrate (1mk)

c) A boiling tube contains 4.0g of potassium Chloride and 4.0g of potassium nitrate in $10cm^3$ of distilled water at 80°C. If the content of the boiling tube is placed into a freezing mixture, determine the:

(i) Temperature at which crystals will first appear. (2mks)

(ii) Composition of the crystal deposited by mass at 10°C (1mks)

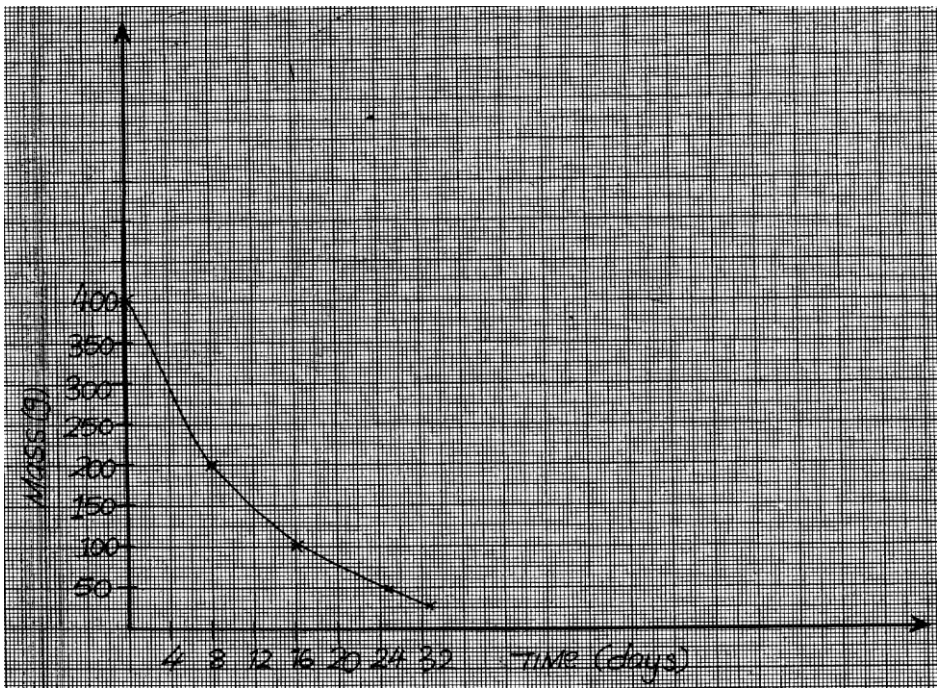
3. The grid given below represents part of the periodic table. Study it and answer the questions that follow. The letters are not the actual symbols of the elements.

									A
B				G		H	E		
	J		I	L				C	
D							M		
Y									

(i) What name is given to the family of elements to which A and C belong? (1 mark)
(ii) Write the chemical formula of the sulphate of element D. (1 mark)
(iii) Which letter represents the most reactive (2 marks)
(a) Metal
(b) Non-metal
(iv) Name the bond formed when B and H react. Explain your answer. (2 marks)
(v) Select one element that belong to period 4. (1 mark)
(vi) Ionic radius of element E is bigger than the atomic radius. Explain. (2 marks)
(vii) The electron configuration of a divalent anion of element N is 2.8.8. Induce the position of element N on the periodic table drawn above. (1 mark)
(viii) The oxide of G has a lower melting point than the oxide of L. Explain. (1 mark)
(ix) How do the atomic radii of I and C compare. Explain. (2 marks)
(x) Explain the trend in the 1st ionization energies of the elements J, I and L. (1 mark)

4. Define the following terms
(i) Nuclear fission (1mk)
(ii) Nuclear fussion. (1mk)

b) The graph below shows the decay for a sample of 400g of iodine -131. Study is and answer question that follow.



Decay curve of Iodine 13%

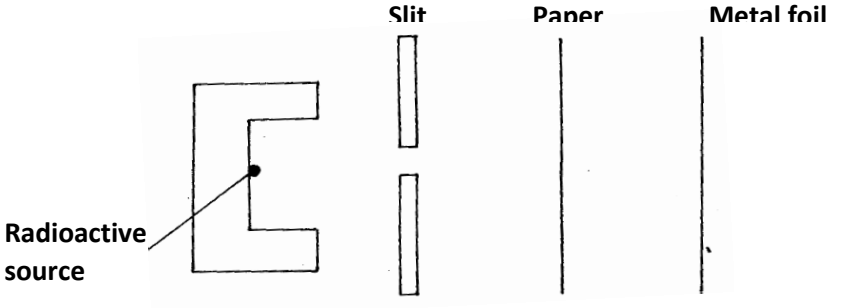
(i) Use the graph to determine the half-life of the sample (1mks)

(ii) Using a dotted line extend the graph to show what eventually happens if the sample continues decaying. (1mk)

(iii) Define the radioactive decay (1mk)

(iv) What fraction of the original sample remains after 16.2 days. (2mks)

(c) (i) Alpha (α) and Beta (β) particles can be distinguished using paper and metal foil.



Complete the diagram below to show how this is done. (2mks)

ii) Below is radioactive decay series starting from and ending at

$$^{210}_{82}Pb \xrightarrow{\text{Step 1}} {}^{210}_{83}Bi \xrightarrow{\text{Step 11}} {}^{210}_{83}Pb \xrightarrow{\text{Step 111}} {}^{206}_{81}Pb$$

(i) Identify the particles emitted at step I and step II (2mks)

(ii) Write nuclear equations for reaction which takes place at step III (1mk)

e) 50g of a radioisotope $^{233}_{91}Pa$ was reduced to 6.25g after 45.5 days. Determine its half-life (2mks)

f) State **two** ways in which radioisotopes poses danger to the environment. (2mks)

5. (a) Draw the structural formulae of the following compounds (3mks)

(i) 2 methyl propene

(ii) Butan –2-ol

(iii) 2-3-di methyl Butane

b) State the observation made when compound (ii) in (a) above is reacted with a piece of Sodium metal (1mk)

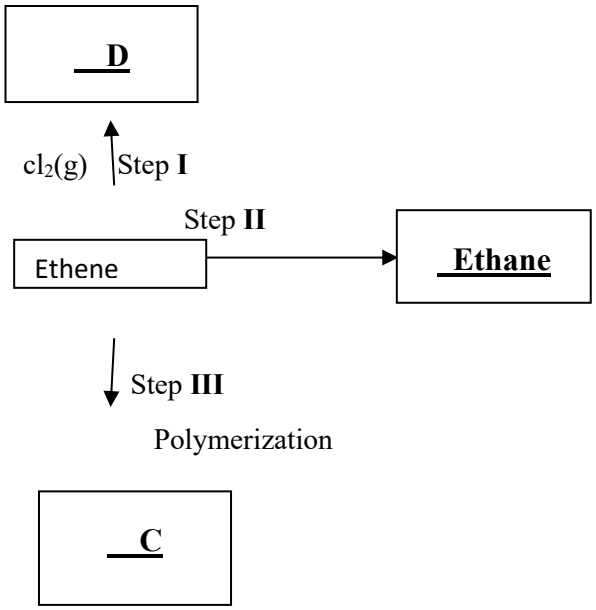
c) Compounds (i) and (ii) in (a) above belong to different homologous series

I. what is a homologous series (1mk)

II. Give a chemical test that will distinguish Butan-2-ol from butanoic acid (2mks)

(a) Write an equation for the complete combustion of ethane gas. (1mk)

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



(i) Give the reagents and conditions for step **II** to occur (2mks)
(ii) Give the industrial importance of step **II** (1mk)
(iii) Name the compounds C and D (2mks)

6. In an experiment to determine the molar heat of neutralization of hydrochloric acid with sodium hydroride, students of Furaha 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 = 25.0^0C
Highest temperature reached
With the acid – alkali mixture = 34.0^0C

(a) Define the term molar heat of neutralization. (1 mark)
(b) Write an ionic equation for the neutralization reaction between hydrochloric acid and sodium hydroxide. (1 mark)
(c) Calculate :
(i) The change in temperature. (ΔT) (1 mark)
(ii) The amount of heat produced during the reaction. (Specific heat capacity of solution = 4.2 $kJkg^{-1}k^{-1}$) (2 marks
(iii) The molar heat of neutralization of sodium hydroxide. (2 marks)
(d) Write the thermo chemical equation for the reaction. (1 mark)
(e) Draw an energy level diagram for the reaction. (2 marks)
(f) (i). draw the energy cycle diagram for the formation of propane from the information below (2 Marks)

$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$, $\Delta H = -406 KJmol^{-1}$
$H_{2(g)} + ½\ O_{2(g)} \longrightarrow H_2O_{(l)}$, $\Delta H = -286 KJmol^{-1}$
$C_3H_{8(g)} + 5O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(l)}$, $\Delta H = -2209 KJmol^{-1}$

ii) Calculate the heat of formation of propane from the above data (2mks)

GATUNDU SOUTH
REQUIREMENTS FOR THE CANDIDATES

1. 4.5 g solid A.
2. 110 cm^3 of solution B.
3. Burette
4. Pipette
5. Distilled water in awash bottle
6. Thermometer
7. Volumetric flask (250ml)
8. Two conical flasks
9. Boiling tubes
10. 8 clean dry test tubes
11. 0.4 g of solid H (supplied on the morning of the examination)
12. Clean spatula
13. Test tube holder
14. 0.5 g of solid W
15. Red and blue litmus paper
16. 10 cm^3 of measuring cylinder
17. 0.2 g of sodium carbonate
18. Label

Access to

1. 2 M hydrochloric acid
2. 2 M sodium hydroxide solution
3. 2 M barium chloride solution
4. Source of Heat
5. Acidified potassium manganate (vii) solution
6. Universal indicator and pH chart
7. Tripod stand and wire gauze
8. 20 volume hydrogen peroxide

Notes

a) Solution B is prepared by dissolving 9.48 g of potassium manganate (vii) in 400 cm^3 of 2 M sulphuric (vi) acids and diluting to one litre of the solution with distilled water.
b) Solid H is hydrated iron (iii) sulphate
c) Solid W is citric acid
d) Solid A is Oxalic acid

GATUNDU SOUTH
233/3
CHEMISTRY PAPER 3
PRACTICAL

1. You are provided with

- 4.5 g of solid A in a boiling tube
- Solution B,0.06 M of acidified potassium manganate (vii)

You are required to determine

1) The solubility of solid A at different temperatures
2) The number of moles of water of crystallization in solid A

Procedure

a) Using a burette, add 4 cm^3 of distilled water to solid A in the boiling tube, Heat the mixture while stirring with the thermometer to about 70^0c,When all the solid has dissolved, allow the solution to cool while stirring with the thermometer. Note the temperature at which crystals of solid A first appear. Record this temperature in Table 1.

b) Using the burette, add 2cm^3 of distilled water to the contents of the boiling tube, warm the mixture while stirring with the thermometer until all the solid dissolves, allow the mixture to cool while stirring, Note and record the temperature at which crystals of solid A first appear.

c) Repeat the procedure (b) two more times and record the temperatures in table 1.Retain the contents of the boiling tube for use in procedure (e)

d) (i) Complete the table by calculating the solubility of solid A at the different temperatures.

Volume of water In the boiling tube (cm^3)	Temperature at which crystals of solid appear (^{0}c)	Solubility of solid A (g/100g of water)
4		
6		
8		
10		

ii) On the grid provided, plot a graph of solubility of solid A (vertical axis) against temperature. (3mks)

(iii) Using your graph, determine the temperature at which 100 g of solid A would dissolve in 100 cm^3 0f water (1mk)

e) Transfer the contents of the boiling tube into a 250 ml volumetric flask. Rinse both the boiling tube and the thermometer with distilled water and add to the volumetric flask. Add more distilled water to make up to the mark. Label this solution A. Fill a burette with solution B. Using a pipette and pipette filler, place 25.0 cm^3 of solution A into a conical flask. Warm the mixture to about 60^0c.Titrate the hot solution A with solution B until a permanent pink colour persists. Record your readings in table 2.Repeat the titration two more times and complete table 2.(retain the remaining solution B for use in question 3 b(i)

(4mks)

	i	ii	iii
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution B Used (cm^3)			

i)Calculate the

i) Average volume of solution B (1mk)

ii) The number of moles of potassium mangante (vii) used (1mk)

iii) The number of moles of A in 25 cm^3 of solution A given that 2 moles of potassium manganate react completely with 5 moles of A. (1mk)

iv) Relative formula mass of A (2mks

v) The formula of A has the form D.xH_2O.Determine the value of X in the formula, given that the relative formula mass of D is 90.0.(O=16, H=1) (1mk)

2. You are provided with solution H.Carry out the tests below and write your observations and inferences in the spaces provided

a. Place about half of solid H in a clean dry test tube, Heat the solid gently and then strongly ,Test any gas produced using both blue and red litmus papers

Observations (2mks)	Inferences(1mk)

b. Dissolve the remaining portion of solid H in about 8 cm^3 of distilled water contained in a boiling tube, divide the solution into three portions. To the first portion add aqueous sodium hydroxide drop wise until in excess

Observations (1mk)	Inferences (1mk)

c. To the second portion, add two drops of hydrogen peroxide and then add aqueous sodium hydroxide drop wise until in excess

Observations (1 ½ mks)	inference)1mk)

d. To the third portion add 2-3 drops of barium chloride solution

Observations (1mk)	Inference (1mk)

e. To the mixture in (d) above add about 2 cm^3 of 2 M aqueous hydrochloric acid.

Observations (1mk)	Inferences (1mk)

3. You are provided with solid W.Carry out the following tests and record the observations and inferences in the spaces provided.

I. Place one third of solid W on a clean metallic spatula and burn it in a Bunsen burner flame

Observations (1mk)	Inference (1mk)

II. Place the remaining amount of solid W in a boiling tube, add 10 cm^3 of distilled water and shake. Use the mixture for test (i) to(iii) below

Observations (1mk)	Inference (1mk)

III. To about 2 cm^3 of the mixture in a test tube add two or three drops of acidified potassium manganate (vii) then warm.

Observations (1mk)	Inference (1mk)

IV. Using about 2cm^3 of the mixture in a test tube determine the pH using universal indicator

Observations (1/2mk)	Inference (1mk)

V. To about 2cm^3 of the mixture in a test tube add sodium carbonate.

Observations(1mk)	Inferences (1mk)

GATUNDU SOUTH
CHEMISTRY (THEORY)
PAPER 1 SAMPLE 1

1

a). Identify the participant who had used an illegal drug. (1mk)
P………

b). Which drug is less soluble in Ethanol. (1mk)
D2……

c). label on the diagram the baseline and solvent front. (1 mk)

2. a) Hydrogen can reduce copper (II) Oxide but not aluminium oxide. Explain. (1mark)
Hydrogen is above Cu and below Al in the reactivity series of elements

b) When water reacts with potassium metal, the hydrogen produced ignites explosively on the surface of water.

ii. What causes this ignition? (1mark)
the reaction is too exothermic that a lot of heat is produced causing ignition of hydrogen in presence of oxygen

iii. Write an equation to show how this ignition occurs (1mark)
$2H_{2\,(g)} + O_{2(g)} \longrightarrow 2H_2O_{\,(g)}$

3.

$Na_2CO_{3(aq)} + 2HNO_{3(aq)} \longrightarrow 2NaNO_{3(aq)} + CO_{2(g)} + H_2O_{\,(l)}$

mole ratio $NaCO_3$: HNO_3 = 1:2
mole of HNO_3 in $20cm^3$ = 20/1000 x 0.25=0.005 moles
moles of Na_2CO_3 in $25cm^3$ = ½ of 0.005 = 0.0025 moles
if 250cm3 =?
$\frac{250x0.0025}{25}$ **= 0.025moles**
RFM of $NaCO_3$ = 106
1 mole of Na_2CO_3 =106g
0.025 moles=?
$\frac{0.025\ x\ 106}{1}$ **=2.65g of Na_2CO_3**

4.

1/5(20)+4/5(22)
=4+17.6=21.6

5.

***Silicon* (*IV*) Oxide has giant atomic structure, with strong covelent bond, holding the atom together. These require a lot of energy to break, hence it has high melting point. Carbon (IV) Oxide has simple molecular structure, with weak Vn Der Waals forces holding the molecules together which require little energy to break, hence is a gas at room temperature and pressure.**

6.

the oxide ions has 2 extra electrons that causes greater electron repulsion than in oxygen atom

7.

+3 +P = (-2x3)= 0, +3+P-6=0, P= +3

b) Study the equation below:
$Mg_{\,(s)} + 2H_2O_{\,(l)} \longrightarrow Mg(OH)_{2\,(aq)} + H_{2\,(g)}$
Which species has undergone oxidation? Explain. (2marks)

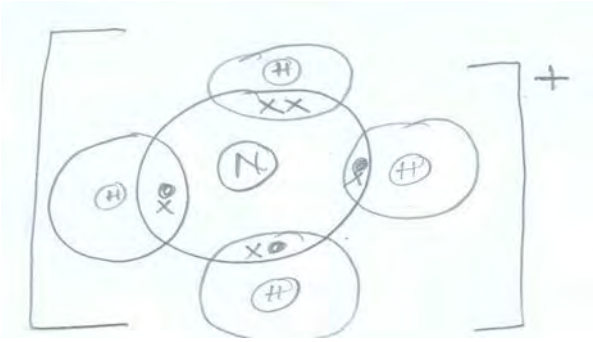
Mg – its oxidation state increases from zero to +2

8. Starting with lead (II) carbonate explains how you would prepare a pure sample of lead (II) sulphate. (3marks)

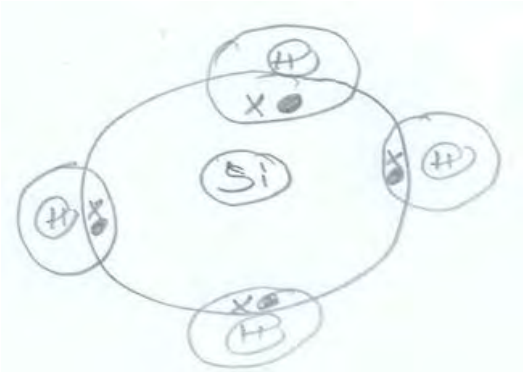
Add dilute nitric acid to lead (II) carbonate.
$pbCO3\ (s) + 2HNO_{3\,(aq)} \longrightarrow pb(NO_{3)2\,(aq)} + CO_{2(g)} + H_2O_{\,(l)}$
React the resulting solution of sodium sulphate or dilute sulphuric acid.
$Na_2SO_{4\,(aq)} + Pb(NO_{3)2(aq)}$ $PbSO_{4(s)} + 2NaNO_{3(aq)}$

filter to obtain lead (II) sulphate as residue
dry the salt of lead (II) sulphate in between the filter papers or in sunshine.

9. Draw a dot (.) and cross (x) diagrams to show bonding in:-
   a). Ammonium ion, NH_4^+ (N=7.0, H=1.0) (1mark)



   b). Silane, SiH_4 (Si=14.0 H=1.0) (1mark)



10. Sodium carbonate decahydrate crystals, $Na_2CO_3.10H_2O$, were left exposed in the atmosphere on a watch glass
   a). State the observation made on the crystals after two days. (1mark)
   … **They became covered with a white powder**
   b). Name the property of salts investigated in the above experiment. (1mark)
   ……**Efflorescence**
11. What is meant by the term solubility of salts? (1mark)
   This the maximum mass of a salt that will dissolve in 100g of water at a given temperature
   b) Calculate the solubility of a salt given that 15g of the salt can saturate 25cm^3 of water. (1mark)
   …**15g dissolve in** $\frac{(15x100)}{25}$ **= 60g/100g water**
12. ***Grahams law states: under the same conditions of pressure and temperature, the rate of diffusion of a gas is inversely proportional to the square root of its density***
   a). A 100cm^3 of carbon (IV) oxide gas diffused through a porous partition in 30 seconds. How long would it take 150cm^3 of nitrogen (IV) oxide to diffuse through the same partition under the same conditions? (C=12.0, N=14.0, O=16.0) (2marks)

$$\frac{time\ CO2}{time\ NO2} = \frac{MCO2}{MNO2}$$

Where 100cm3 of co2 takes 30seconds
;150cm3 of CO2 takes $^{30}/_{100}$ ***x 150= 45seconds***

$$\frac{45}{TNO2} = \frac{44}{46}$$

$$TNO_2 = \frac{45}{44}\ x\ 46\ sec = 47.05\ sec$$

OR

$$\frac{RCO2}{RNO2} = \frac{MNO2}{MCO2}$$

But $RCO_2 = \frac{100cm3}{30s} = 3.333cm^2$ ***per sec***

$$\frac{3.333}{RNO2} = \frac{46}{44}$$

$$RNO2 = \frac{44\ x\ 3.333}{46}$$

$= 3.188cm^2$ *per second*

Time for $No_2 = \frac{150cm3}{3.188\ cmsec-1}$ $= 47.05$ *sec*

13. The pH values of some solutions labeled E to I are given in the table below. Use the information to answer the questions that follow.

pH	14.0	1.0	8.0	6.5	7.0
Solution	E	F	G	H	I

(a) Identify the solution with the highest concentration of hydroxide ions (1 mark)

……**E**…….

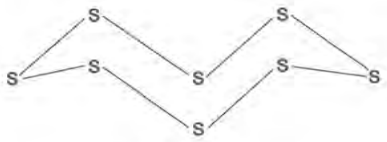
(b).Which solution can be used as a remedy for acid indigestion in the stomach?(1 mark)

G

(b) Which solution would react most vigorously with magnesium metal? (1 mark)

…**F**…

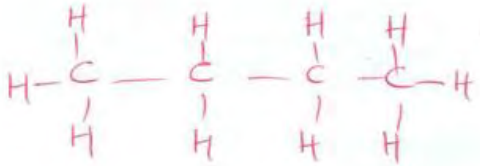
14. (a) Draw the molecular structure of sulphur in the yellow crystals. (1mk)



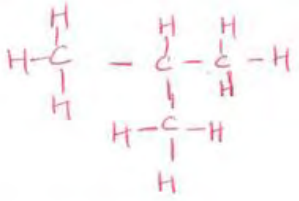
(b) Explain why the molten liquid becomes viscous. (1mk)
The broken S8 rings entangles with one another

(c) If the brown liquid at 400°C is cooled rapidly by pouring it into cold water, which form of sulphur is produced? (1mk)
flower of sulphur/plastic sulphur

15. Draw and name two possible isomers of C_4H_{10} (3 marks)



n-butane



2-methylpropane

16. A gas cylinder contains about 1.12dm^3 of butane measured at 0^0 and 1 atm.given that 25% of heat is lost, what is the maximum volume of water at room temperature which can be boiled to 100^0C in order to make some coffee?

$C_4H_{10\,(g)} + 6^1/_2O_{(g)} \longrightarrow 4CO_{2(g)} + 5H_2O_{(l)}$; $\Delta H^\theta = -3{,}000 kJmol^{-1}$ (3mks)

(specified heat capacity of water =4.2J $g^{-1}0C^{-1}$, density of water 1 gcm^{-3} Molar gas volume 22.4 at s.t.p)

Moles C4H10 $= \frac{1.12}{22.4} = 0.05mol$

Heat produced 0.05x3000 =150kj

Useful heat = 75x $\frac{150}{100}$ ***112.5kj***

Let mass of water = m

Room temperature = 25°C

Boiling point = 100℃

Change in temperature, $\Delta T = 100 - 25 = 75$

$$\Delta H = \Delta T \times m \times C$$

$\frac{75 \times m \times 4.2}{1000} =$ ***112.5***

$m = \frac{112.5 \times 1000}{75 \times 4.2}$

M = 357.1 g

Volume $= \frac{mass}{Density} = \frac{357.1g}{1g/cm^3} =$ ***357.1g***

17. In an experiment, soap solution was added to three samples of water. The results below show the volume of soap solution required to lather with 500cm^3 of each water sample before and after boiling.

	Sample 1	**Sample 2**	**Sample 3**
Volume of soap used before water boiled	26.0	14.0	4.0
Volume of soap after water boiled	26.0	4.0	4.0

a). Which water samples are likely to be soft? (1mark)

……***Sample 3***……

b). Explain the change in volume of soap solution used in sample 2 (1mark)

Sample 2 contained ions that caused temporary hardness, therefore required large volume of soap solution before boiling, but after boiling the temporary hardness was removed, thus required very little volume of soap solution to lather.

18. Study the electrode potentials in the table below and answer the questions that follow:
(Letters are not the actual symbols of elements)

(E^{θ} /Volts)

$H^{2+}_{(aq)} + 2e^- \longrightarrow H_{(s)} + 0.34$

$Z^{2}_{(aq)} + 2e^- \longrightarrow Z_{(S)} - 2.38$

$G^{+}_{(aq)}\ 2e^- \longrightarrow G_{(s)} + 0.80$

$T^{2+} 2e^- \longrightarrow T_{(s)} -2.87$

a).Which one is the strongest reducing agent? (1mark)

Z

b).Write the ionic equation for the reaction that takes place when Z is dipped in a solution of G^+ ions. (1mark)

$Z_{(s)} + 2G^{+}_{(aq)} \longrightarrow 2G_{(s)} + Z^{2+}_{(aq)}$

c). Calculate the E^{θ} Cell value of the reaction in (b) above. (1mark)

$E\theta cell = Ered. - Eox.$

$= 0.08-(-2.38) = +3.18$

19. The set-up below was used to prepare and collect hydrogen sulphide gas. Study it and answer the questions that follow.

a).Name solid V. (1mark)

Iron (II) sulphide or any suitable metal sulphide reject PbS

b).Write chemical equation of the reaction taking place in the flask. (1mark)

$FeS_{(s)} + H_2SO_{4\,(aq)} \longrightarrow FeSO_{4(aq)} + H_2S_{(g)}$

c). Give a reason why warm water is used in the set-up. (1mark)

Hydrogen sulphide is less soluble in warm water compared to cold water.

20. (a) Define the term half-life [1mk]

It's the time taken for a given mass or number of nuclides to decay to half its original mass or number..

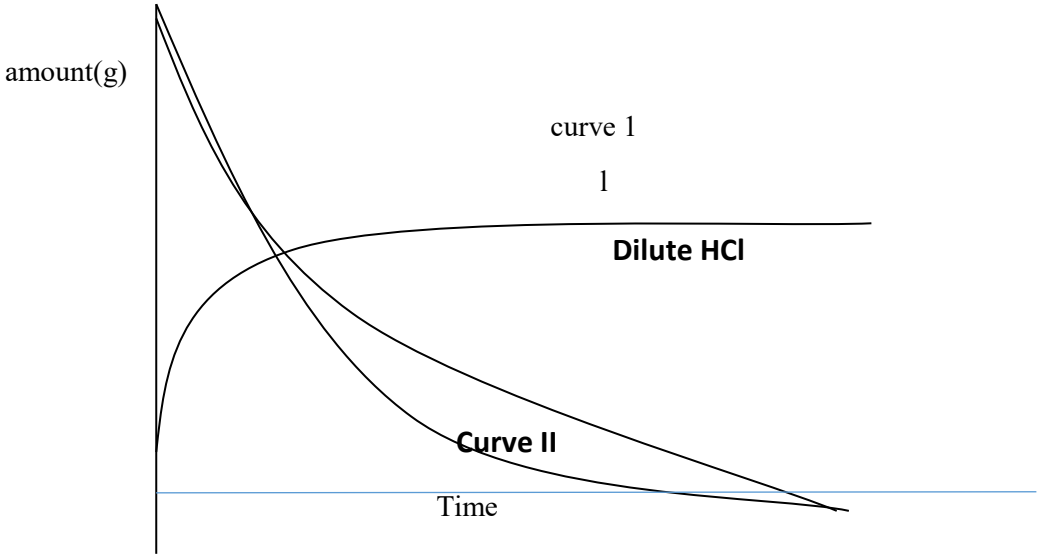
(b) The half-life of a radioactive nuclide is 3 hours. Given that its initial mass is 288g, determine the remaining mass after 12 hours. [2mks]

Number of half lifes = 12/3= 4

Mass remaining = $(1/2)^4$* 288 = 18g

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

$CaCO_{3(S)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + H_2O_{(g)} + CO_{2(g)}$



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

……***Curve I***……

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

Reaction is complete/ reactants are used up

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

22. Heated iron can react with both chlorine gas and hydrogen chloride gas.

a) Write equations for the reactions. (2marks)

$2Fe_{(s)} + 3Cl_{2(g)} \longrightarrow 2FeCl_{3(g)}$

$Fe_{(s)} + 2HCl_{(g)} \longrightarrow FeCl_2 + H_{2(g)}$

N.B: must be balanced

State symbol must be correct

Chemical symbols must be correct

b) Chlorine gas has no effect on dry blue litmus paper. Explain (1mark)

in absence of moisture, chlorine cannot form HOCl, chloric (I) acid solution, responsible for its bleaching property.

23. The set-up below was used to study some properties of air.

State and explain two observations that would be made at the end of the experiment. (2marks)

Water rose up the test-tube to occupy the space of active air or oxygen, which has been used in rusting

Iron wool turned red-brown, due to formation of hydrated iron (III) oxide

25. Most lab apparatus are made of glass. Give two reasons why glass is preferred over any other material. (2 marks)

Glass enables one to see clearly when experiment is taking place

Glass is easy to clean

Glass does not react with most laboratory chemicals (Any two)

26. Sodium carbonate is manufactured in large scale by Solvay process.

a) Carbon (iv) oxide is one of the ingredients required in this process. State its source. (1mark)

Burning coke in air

Decomposition of limestone/ Calcium Carbonate

b) Write the equation of the main reaction in the Solvay process (1marks)

$.NaCl_{(aq)} + NH_{3(g)} + CO_{2(g)} + H_2O_{(l)} \longrightarrow NaHCO_{3(aq)} + NH_4Cl_{(aq)}$

c) One of the by-products is calcium chloride, state one use of this by-product. (1 mark)

- ***Used in extraction of sodium to lower melting point of Rock salt***
- ***Defrosting of roads in cold countries.***
- ***When anhydrous, it is used as drying agent for gases***

27. Use the information in the table about group 1 elements to answer the questions that follow

Element	Atomic radius(nm)
Lithium	0.123
Sodium	0.157
Potassium	0.203

When the group 1 elements react with water, hydrogen gas is given off. The diagram shows the reaction of the above three elements with water

a).What is the general name of the group one elements (1 mark)

Alkali metals

b).Which one of these elements A, B or C is Lithium? (1 mark)

C

c) Apart from fizzing state another observation that you would see when sodium reacts with water. (1 marks)

It darts over the surface

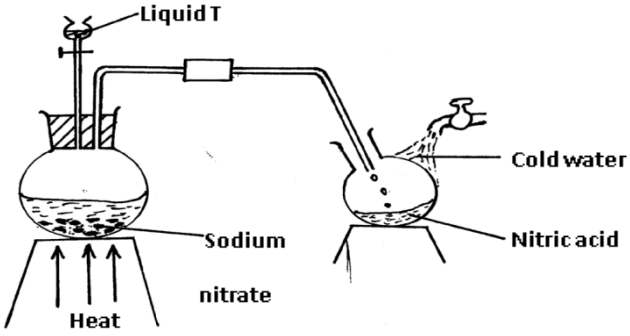
It melts into a silvery ball

Resulting solution has a soapy feeling

28. Explain why molten sodium chloride conducts electricity, but solid sodium chloride does not (2marks)

In molten state, sodium chloride has free ions while in solid state the ions are in fixed position, hence cannot conduct electricity.

29. The set-up below was used to prepare Nitric(V) acid in the laboratory.



a). Name liquid T. (1 mark)

Concentrated Sulphuric(VI) Acid

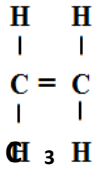
b). Write an equation for the reaction taking place in the flask. (1 mark)

$NaNO_{3(s)} + H_2SO_{4\,(l)} \longrightarrow NaHSO_{4\,(aq)} + HNO_{3\,(aq)}$

c). State the reason why nitric(V) acid collected is yellow in colour and explain how the yellow colour can be removed. (1 mark)

Because it contains fumes of Nitrogen IV oxide. The yellow colour can be removed by bubbling air in the solution.

30. A polymer can be represented as
(a) Draw the structure of the monomer (1 mark)



Propene

(b) What type of polymerization occurs in the above case? (1mark)

Addition Polymerization

(c) Given that the molecular mass of the polymer is 25620, how many units of the monomer make the polymer (2 mark)

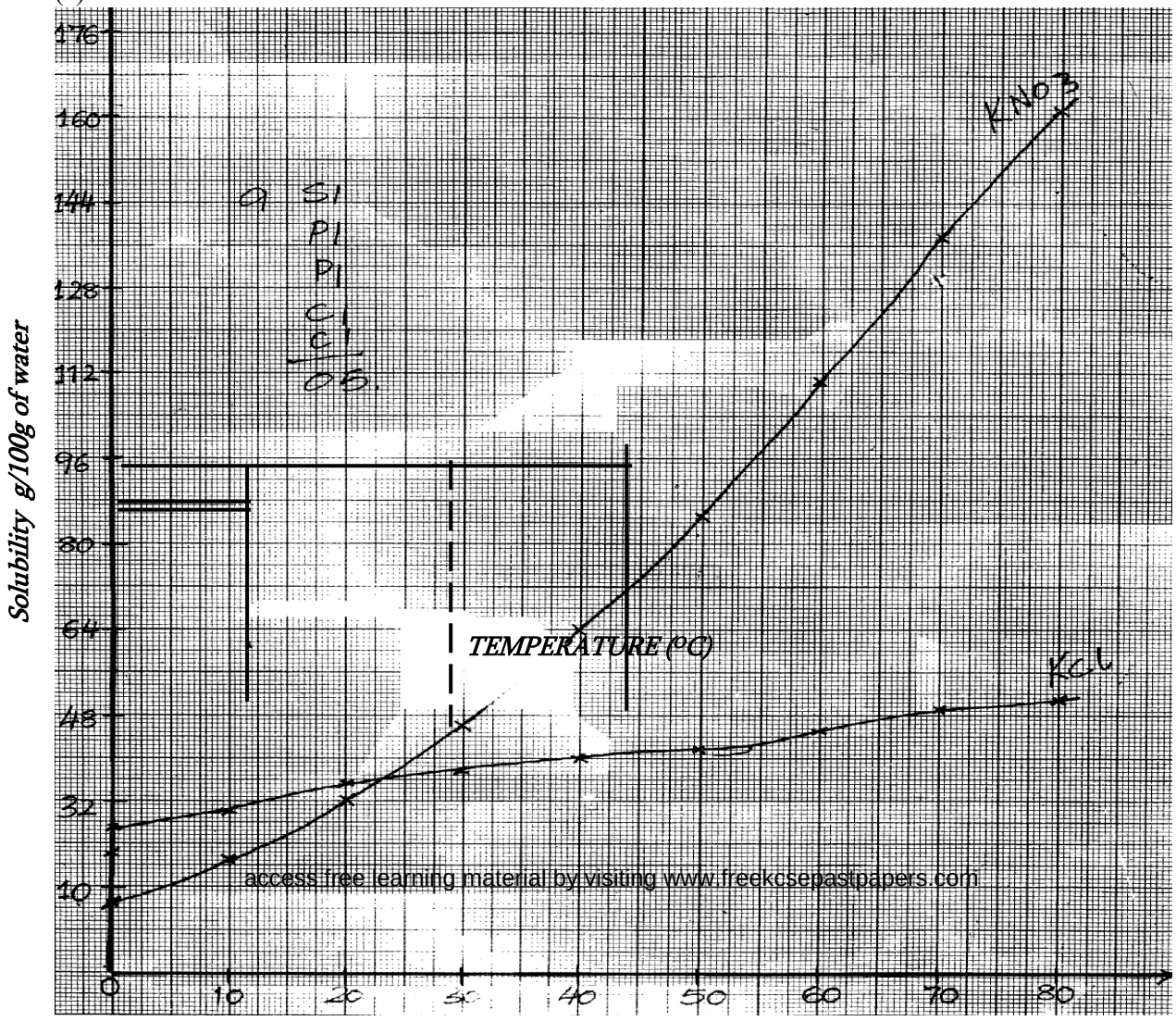
42n = 25620
n = 25620 / 42
= 610 units

GATUNDU SOUTH
CHEMISTRY
233/2 MARKING SCHEME 2021

1. (a) (i) Frasch process;
(ii) Pipe 1;

(iii) Heating of water at higher pressure;
(b) (i) Hydrogen;
(ii) Calcium hydroxide formed is slightly soluble in water; hydroxide ion formed are few;
(c) (i) Contains $Cu^{2+}_{(aq)}$; that reacts with soap before lathering can take place;
(ii) Calcium hypochlorite;
(iii) Calcium hydroxide;
I yield decreases extra heat decomposes SO_3 /forward rxh is exothermic/equilibrium shifts to the left.
II Yields increases since extra oxygen is used

2. (a)



(b) KCl = 25°C ± 1 (1mk)
KNO3 = 23°C ± (1mk)

(c) (i) 10g = 4.0g
100g = 100 x 4 =40g/100g of water √ (1mk)
10
Crystals of KCl appear at 40°C √ (1mk) KNO_3 appear at 26°C

(ii) 100g of water → KCl = 40.0√(½mk) – 31.0 = 9.0g√ (½mk)
10g of water = 0.9g√(½mk) of KCl
100g of water KNO_3 = 40.0 √(½mk)– 21.0 = 19√(½mk)
10g of water = 1.9 g√(½mk) KNO_3

3. (i) Noble gases √1
(ii) D2SO4 √1
(iii) (a) Y √1
(b) E √1
(iv) Ionic bond √1 – Because B reacts by losing an electron (s) which are gained by H. √1
(v) D//M √1 Any one, one mark
(vi) Because E reacts by gaining an extra electron which reduces √1 the electrostatic pull by the positive nucleus making the ionic radius increase. wtte
(vii) At Period III Group IV
(viii) Because of the increase in the strength of the molecular bonds in the oxide of L as

compared to that of G. √1 w.t.t.e

(ix) C has a smaller atomic √1 radius than I because of the increase in the strength of the nucleus on the valency electrons in C as the number of protons increase √1 w.t.t.e

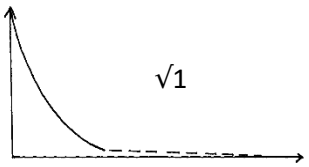
(x) 1st ionization energies increases from J – L across the period due to addition of an extra proton in the nucleus increasing the attraction of the valency electrons √1

4. (a) (i) Large unstable nuclide splits √½mk up to give smaller √½mk more stable nuclides

(ii) smaller and lighter nuclides combine √½mk to form heavy nuclide √½mk

(b) (i) 8.1 from the graph (½ x 400 = 200)

(ii)

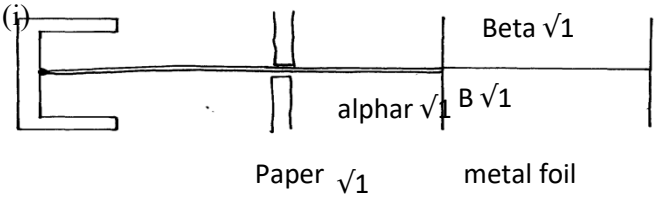


(iii) The spontaneous disintegration of the radioactive nuclides √1mk

(iv) Reading mass after 16.2days from graph = 100g

$^{100}/_{400} = ¼$

(c) (i)



(d) step I: Beta particles (β)√1mk

Step II: gamma rays (ɣ)√1mk

(ii) $^{210}Pb \rightarrow {}^{4}He + {}^{206}Pb$

(e) $= (½)^n$

$6.25 = (½)^n \times 5$

$(½)^n = \frac{6.25}{50} = 0.125$

$n = \frac{\log 0.125}{\log 0.5} = 3$ √½mk

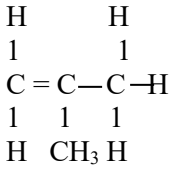
45.3 ÷5 √½mk = 15days √½mk

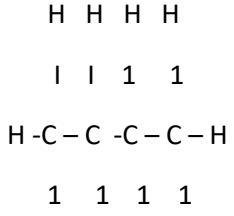
(f)

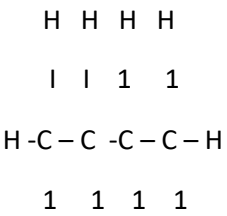
- can cause cancer
- Causes biological damage to human tissues
- Cause somatic and genetic mutation in living things
- Causes physiological and biological disorders in living cells

5. (a)

(i)







Note: reject condensed formulae

(b) Bubbles of colourless gas given off.

(c) **I** Compounds with similar chemical properties and shows gradual change in Physical properties.

II (i) Add to both Na_2CO_3 solid no reaction in butan-2-ol

(ii) Add acidified $KMnO_4$ to Butanol, purple colour disappears, but no observable Change butanoic acid

– or any correct test

– both observations must be given

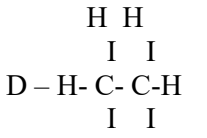
(d) $2C_2H_{6(g)} + 7O_{2(g)} \longrightarrow 4CO_{2(g)} + 6H_2O_{(l)}$

(e) (i) reagents – H2 (g) √

conditions – Ni catalyst, √ 150°C-250°C Note: both must be given

(ii) Manufacture of solid fats

(iii) C- polyethene



or 1,2-dichloroethane

Accept formula

6 (a) Enthalpy change when 1 mole of water is formed from the reaction between hydrogen and hydrogen ions √1 (a base and an acid)

(b) $H^+_{(aq)} + OH^-_{(aq)} \longrightarrow H2O_{(l)}$ √1

(c) (i) $\left(\frac{25.0 + 25.0}{2}\right) = \left(\frac{50}{2}\right)^0C = 250C$ √ ½

$\Delta T = (34 - 25)^0C$

$= 9.00C$ √ ½

(ii) $\Delta H = Mc\,\Delta T$

Total volume = $(100 + 50)cm^3$

$= 150cm^3$

Mass = $150cm^3 \times 1gcm^{-3}$

$= 150g$

$\Delta H = \frac{150\ kg}{1000} \times 4.2\ kJkg\text{-}1k\text{-}1 \times 9k$ √

$= 5.67\ kJ$ √

(iii) The molar heat of neutralization of sodium hydroxide

If $1000cm^3 = 2M$
$50cm^3 = ?$

$= \frac{50}{1000} \times \frac{1}{2} \times 2 = \frac{1}{10} = 0.1$ moles

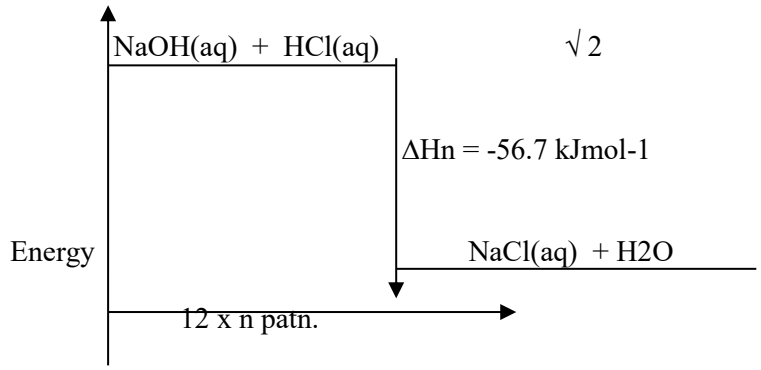
If 5.67kj is liberated when 0.1 moles are neutralized then to neutralize 1 mole we have

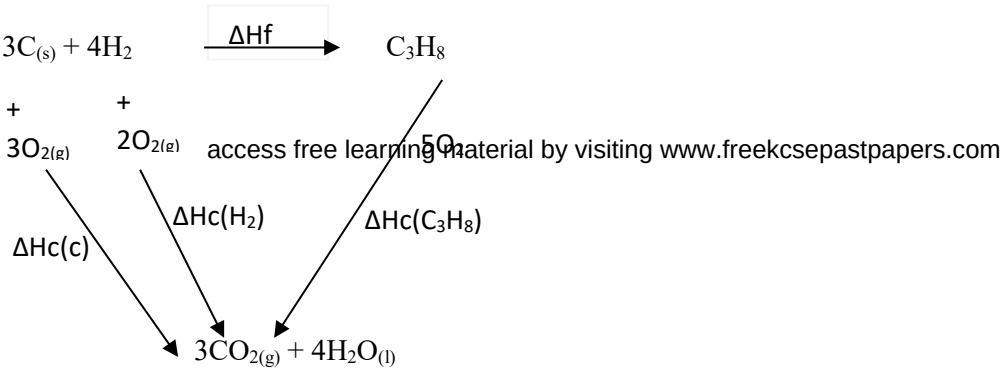
$\frac{1}{0.1} \times 5.67kJ$ √

$= 5.67$ kJ mol √

(d) $H^+(aq) + OH^-(aq) \longrightarrow H_2O(l)$ √ ΔH neut = -56.7 kJmol-1

(e)





$\Delta Hf + \Delta Hc(C_3H_8) = \Delta Hc(C) + \Delta Hc(H_2)$

$\Delta Hf = \Delta Hc(C) + \Delta Hc(H_2) - (\Delta)Hc(C_3H_8)$

$= 3 \times -406KJ + 4 \times -286KJ - (-2209)KJ$

$= -1218KJ - 1144KJ + 2209KJ$

$= -2362KJ +$

$= -153KJmol^{-1}$

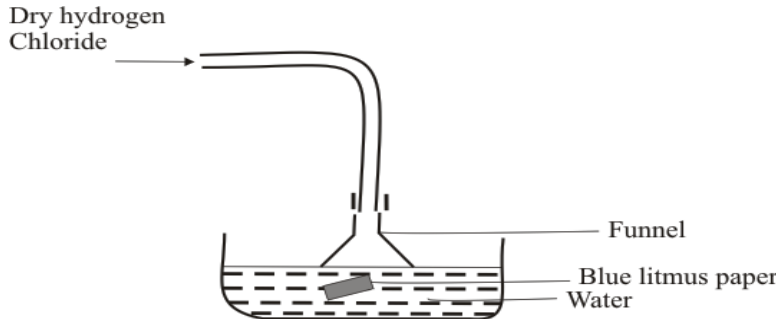
LANGA'TA / KIBRA CLUSTER
233/1
CHEMISTRY PAPER 1
(THEORY)

1. Explain why burning magnesium continues to burn in a gas jar full of sulphur (IV) oxide while a burning splint would be extinguished. (3 marks)
2. Calculate the heat of formation of carbon (II) oxide from the following data. (2 marks)

$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)} \quad \Delta H_1 = -394$ kJ/mol

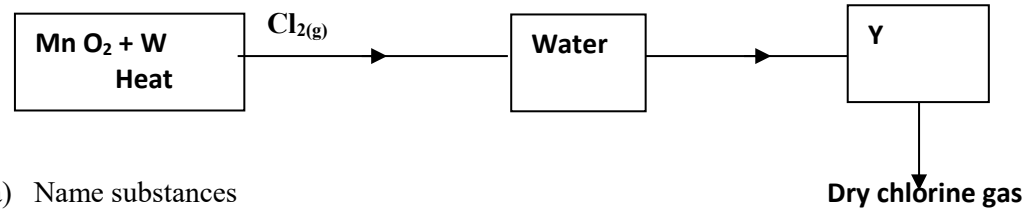
$CO_{(g)} + \frac{1}{2} O_{2(g)} \longrightarrow CO_{2(g)} \quad \Delta H_2 = -285.6$ kJ/mol^{-1}

3. Dry Hydrogen chloride gas was made to dissolve in water using the set of apparatus shown below



(a) What is the use of the inverted funnel? (1 mark)
(b) State and explain the observations made on the litmus paper (1 mark)
(c) State and explain the observation made on the litmus paper if methylbenzene is used instead of water in the above set up. (1 mark)

4. Using sodium hydroxide solution, describe a chemical test that can be used to distinguish between copper (II) ions and iron (II) ions (2 marks)
5. The flow chart below shows laboratory preparation of chlorine gas. Study it and answer the questions that follow: (2 marks)



(a) Name substances
W
Y
(b) What is the function of water in the above set up? (1 mark)

6. An unknown mass of anhydrous potassium carbonate was dissolved in water and the solution made up to 200cm^3. 25cm^3 of this solution neutralized 18.0cm^3 of 0.22M nitric (v) acid. Calculate the unknown mass of potassium carbonate (**K**=39, **C**=12, **O**=1) (3 marks)
7. The following are some half cell electrode potentials with respect to copper

	E/V
$K^+_{(aq)} + e^- \longrightarrow K_{(s)}$	-2.99
$Na^+_{(aq)} + e^- \longrightarrow Na_{(s)}$	-2.75
$Ca^{2+}_{(aq)} + 2e^- \longrightarrow Ca_{(s)}$	-2.86
$Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu_{(s)}$	0.00
$Hg^{2+}_{(aq)} + 2e^- \longrightarrow Hg_{(l)}$	+0.87
$Ag^+_{(aq)} + e^- \longrightarrow Ag_{(s)}$	+0.79

(a) Explain why the electrode potential of copper is zero (1 mark)

(b) Identify the weakest oxidizing agent (1 mark)

(c) Work out the e.m.f of a cell represented (1 mark)

$$Na_{(s)} \mid Na^{+}_{(aq)} \;//\; Ag^{+}_{(aq)} \mid Ag_{(s)}$$

…… ……

8. Below is a sample of the periodic table

I						Q	M	
	J						N	
K	L		P					

(a) Give the family name to which elements **M** and **N** belong (1 mark)

(b) Compare the reactivity of elements **I** and **K**. Give a reason (1 mark)

(c) Write the formular of the compound formed when **P r**eacts with **Q** **(1 mark)**

9. Study the reaction equation given below

$$H_{2(g)} + Br_{2(g)} \rightleftharpoons 2HBr(g)$$

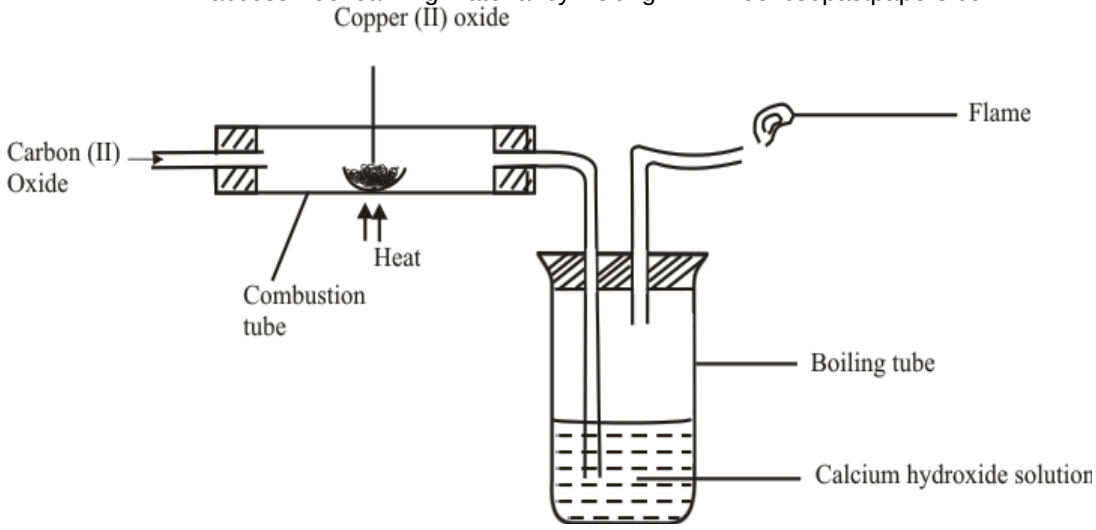
(a) $\Delta H = -74.4k\ J$

On the same axes

(a) Draw an energy level diagram showing the catalysed and uncatalysed reaction (2 marks)

(b) State the effect on formation of hydrogen bromide if pressure was increased in the reaction above. Explain (2 marks)

10. Study the experimental set up of apparatus shown below.



(i) State two observations made in the set up as the experiment progressed (2 marks)

(ii) Using an equation, explain the change that occurred in the boiling tube (1 mark)

(iii) Why was the gas burned in the flame? (1 mark)

11. (a) What is half-life? (1 mark)

(b) If a radioactive isotope has a half-life of 2.5 hours, how long will it take for its mass to reduce to ⅛ (2 marks)

12. Calculate the solubility of sugar in water at 40°C from the following information. (3 marks)

Mass of evaporating dish =23.0g

Mass of evaporating dish + saturated solution =192.0g

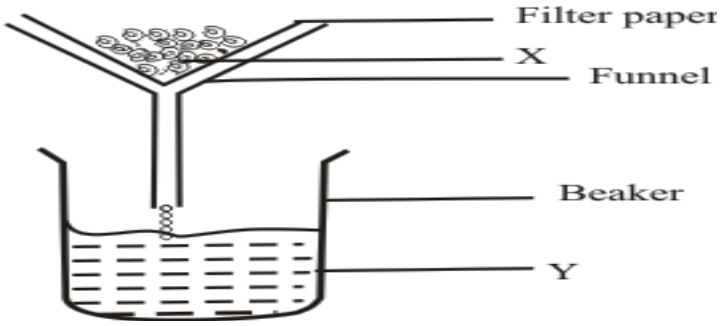
Mass of evaporating dish + solid after evaporation of solution =142.0g

13. Painting, oiling, galvanizing and tin plating are methods of rust prevention.
    (a) Explain the similarity of these methods in the way they prevent rusting (1 mark)
    (b) Explain why galvanized iron objects are better protected even when scratched (1mark)
14. The chemical equations below are the main reactions in large scale manufacture of sodium carbonate.

$$NH_{3(g)} + CO_{2(g)} + H_2O_{(l)} \longrightarrow NH_4HCO_{3(aq)}$$

$$NH_4HCO_{3(aq)} + NaCl_{(aq)} \longrightarrow NaHCO_{3(s)} + NH_4Cl_{(aq)}$$

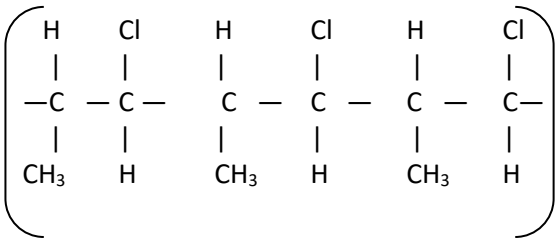
    (a) Explain how the two products $NaHCO_3$ and NH_4Cl are separated (1 mark)
    (b) How sodium carbonate is finally obtained? (1 mark)
    (c) Explain how ammonia is recovered in this process. (1 mark)
15. 80 cm^3 of oxygen gas diffused through a porous hole in 50 seconds. How long will it take 120cm^3 of Nitrogen (IV) oxide to diffuse through the same hole under the same conditions?
    (N =14, O=16) (3 marks)
16. Filtration is carried out in the apparatus shown



    Name **X** (1 mark)
    Y (1 mark)
17. Two carbonates **P** and **Q** are weighed before and after heating. The results are given in the table below.

Carbonate	Mass in grams	
	Before heating	After heating
P	15.0	15.0
Q	15.0	10.0

    Which one is likely to be sodium carbonate? (2 marks)
18. The structure given below is for a certain polymer

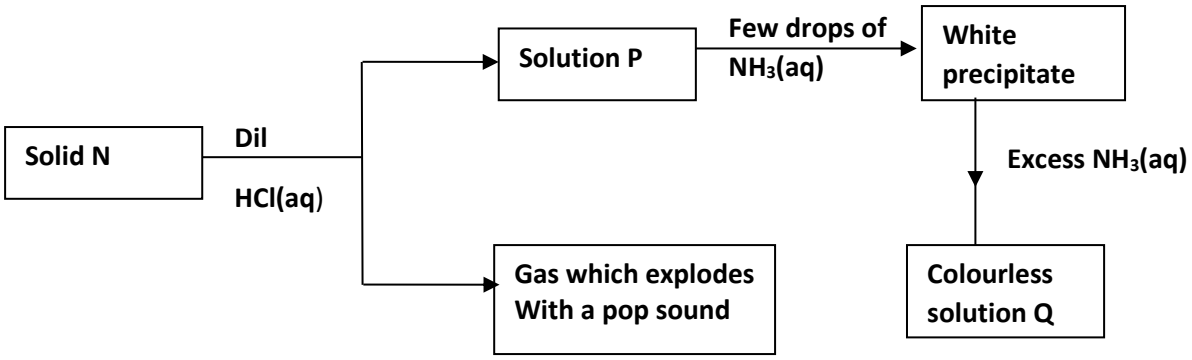


    (a) Draw the structure of the monomer (1 mark)
    (b) Given that the molecular mass of the polymer is 4590, calculate the number of monomers present in the polymer (C=12.0, H=1.0. Cl=35.5) (2 marks)

19. Describe how you would separate a solid mixture of lead(II) chloride and copper(II) oxide (3 marks)

20. The general formula for a homologous series of organic compounds in $C_nH_{2n+1}OH$
    (a) Give the name and structural formula of the fourth member of the series (2 marks)
        (i) Name
        (ii) Structural formula
    (b) Write an equation for the reaction between the molecule in (ii) above and propanoic acid. (1mark)

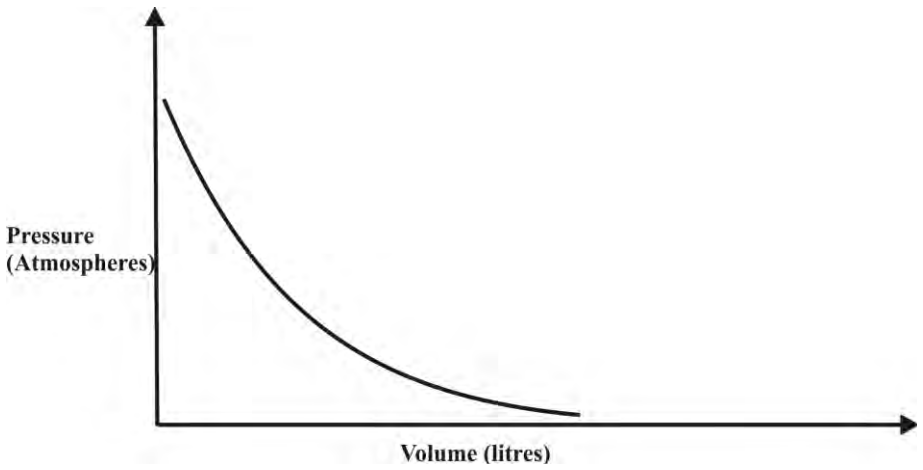
21. The scheme below shows some reactions sequence starting with solid **N**. Study it and answer the questions that follow:



    (a) Identify solid N
    (b) Write the equation for the formation of the colourless solution Q (1 mark)

22. In an experiment, a gas jar containing moist sulphur (IV) oxide was inverted over another gas jar containing hydrogen sulphide gas.
    (a) State and explain the observation that was made (2 marks)
    (b) State the precautions that should be taken when carrying out this experiment (1 mark)

23. The graph below shows the behaviour of a fixed mass of a gas at constant temperature



    (a) What is the relationship between the volume and pressure of the gas? (1 mark)
    (b) 3 litres of oxygen gas at one atmosphere pressure were compressed to two atmospheres at constant temperature. Calculate the new volume occupied by the oxygen gas. (2 marks)

24. The table below shows the relative atomic masses and percentages abundance of the isotopes $\mathbf{M_1}$ and $\mathbf{M_2}$ of element **M**

	Relative abundance	% abundance
M_1	**60.57**	**59.71**
M_2	**62.83**	**40.29**

Calculate the relative atomic mass of element **M** (2 marks)

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

Bond	Bond energy ($kJmo1^{-1}$)
C-H	414
Cl – Cl	244
C – Cl	326
H – Cl	431

Calculate the enthalpy change of the reaction (3 marks)

$$CH_{4(g)} + Cl_{2(g)} \longrightarrow CH_3Cl_{(g)} + HCl_{(g)}$$

26. In the redox reaction below.

$$2H^+_{(aq)} + Cr_2O_7^{2-}{}_{(aq)} + 3SO_{2(g)} \longrightarrow Cr^{3+}_{(aq)} + 3SO_4^{2-}{}_{(aq)} + H_2O_{(l)}$$

Identify the reducing agent, explain your answer (2 marks)

27. The table below shows the pH values of solutions **A,B,C** and **D**

solution	A	B	C	D
pH	2	7	11	14

(a) Which solution is likely to be that of calcium hydroxide (1 mark)

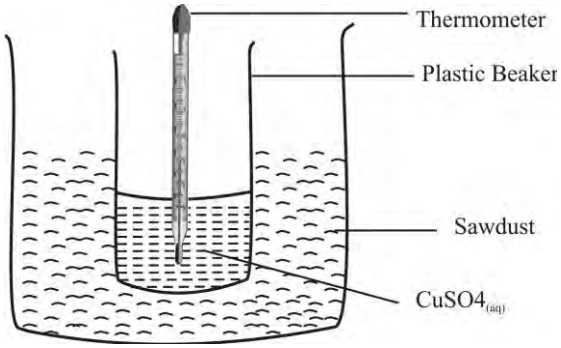
(b) Select the solution in which a sample of aluminum oxide is likely to dissolve. Give a reason for your answer (1 mark)

28. Name one property of neon that makes it possible to be used in electric lamps. (1mark)

29. Distinguish between ionic bond and covalent bond (2 marks)
30. Explain why the boiling point of ethanol is higher than that of hexane. (relative molecular mass of ethanol is **46** while that of hexane is **86**) (2 marks)
31. When a student was stung by a nettle plant, a teacher applied an aqueous solution of ammonia to the affected area of the skin and the student was relieved of pain. Explain (2 marks)

LANGA'TA / KIBRA CLUSTER
233/2
CHEMISTRY
Paper 2
(THEORY)
DECEMBER 2021

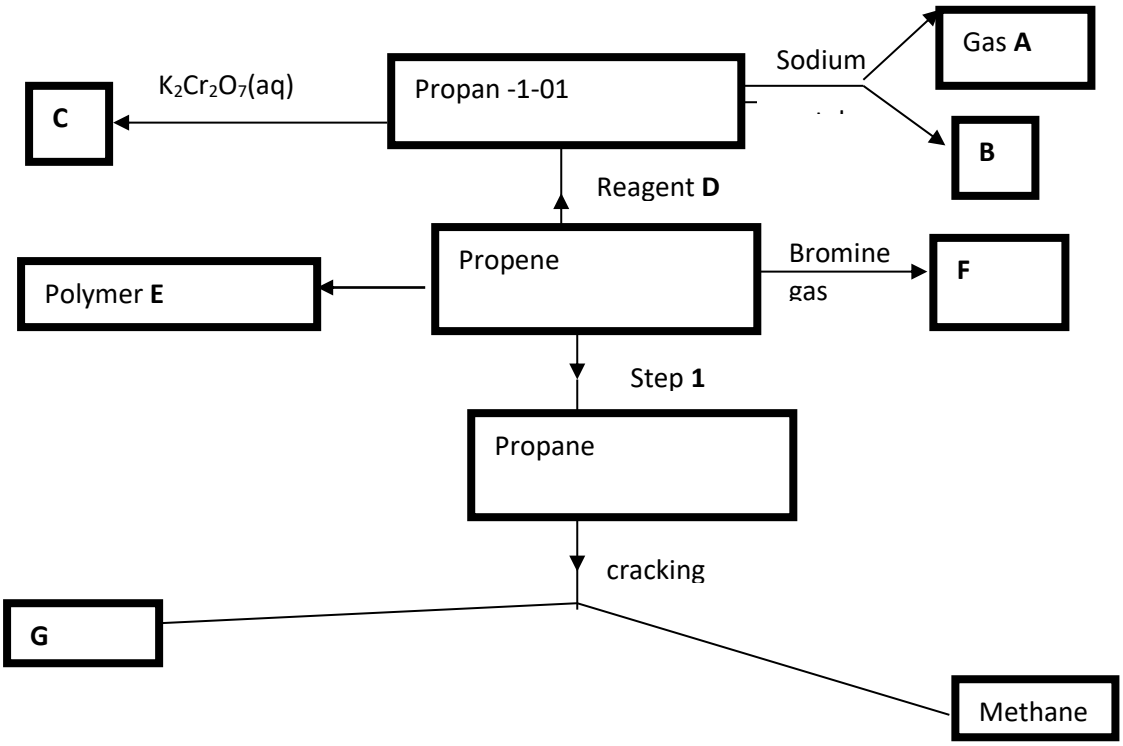
1. The diagram below shows a set up for the determination of enthalpy of displacement for the reaction between zinc metal and copper (II) sulphate solution



(a) Define molar heat of displacement (1 mark)
(b) Write an ionic equation for the reaction that takes place in this experiment (1 mark)
(c) What is the function of the saw dust in the set up (1 mark)
(d) State and explain two observations made at the end of this experiment other than rise in temperature (3 marks)
(e) 4 g of the zinc powder were added to $50cm^3$ of 0.25M copper (II) sulphate solution. The mixture was stirred with the thermometer and the highest temperature recorded.

Final temperature = 34.5°C
Initial temperature = 22.0°C
Calculate the molar heat of displacement of copper by zinc (Zn=65) (4marks)
(f) Sketch an energy level diagram for the above reaction (2 marks)

2. The scheme below shows a series of reactions and compounds. Study it and use it to answer the questions that follow.



(a) Identify the following compounds and products (6marks)
A B C E F G
(b) State 2 conditions for **step 1** to occur (1mark)
(c) Write an equation leading to reaction of propene to form compound **F** (1 mark)
(d) Identify reagent **D** (1 mark)
(e) State one industrial use of methane (1 mark)
(f) Name the following organic compounds (3 marks)
(i) C_3H_4

(ii) $CH_3CH_2\ CH_2\ CH\quad CH_2\ CH_3$

|

OH

(iii) $CH_2 = C - CH_3$

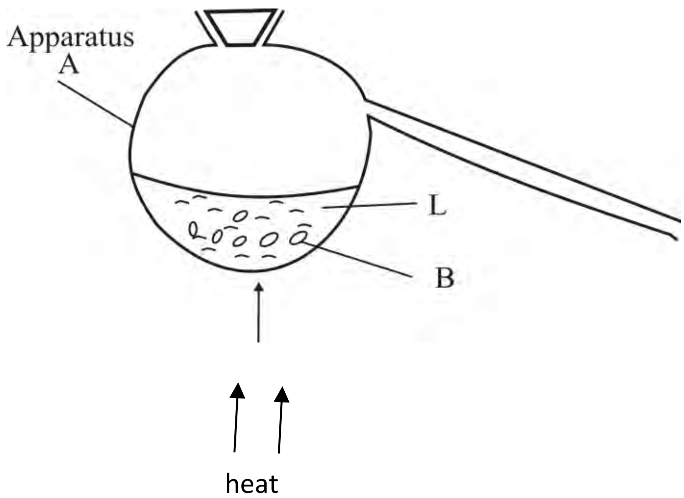
|

3. Study the data below and answer the questions that follow. The letters don't represent the actual symbols of the elements

Elements	No of protons	Melting point oC	Boiling point oC
P	11	98	890
Q	12	650	1110
R	13	660	2450
S	14	1410	2680
T	15	443 590	280
U	16	113	445
V	17	-101	-35
W	18	-189	-186

(a) Write the electronic configuration of
(i) element **S** (1 mark)
(ii) ion of **R** (1 mark)
(b) State and explain the trend in the melting point of elements **P, Q** and **R** (3 marks)
(c) Why does element **T** have 2 melting point values (2 marks)
(d) Write the formula of the nitrate of element **R** (1 mark)
(e) In terms of structure and bonding, explain why element **S** has a high melting point (2 marks)
(f) What is the nature of the oxide of element **U**? Explain (2 marks)
(g) State one use of element **U**

4.



The above set up is used to prepare Nitric (V) acid in the laboratory.

(a) Complete the set-up (3 marks)

(b) Name substances

B…….. L…… (2 marks)

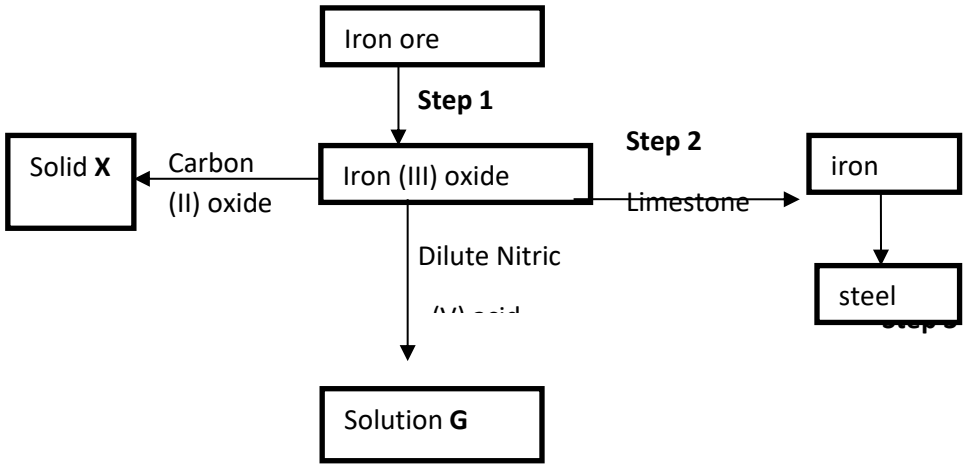
(c) Name apparatus **A** . (1 marks)

(d) Write an equation between substances **B** and **L** (1 mark)

(e) During preparation of hydrogen gas Nitric (V) acid is not used. Explain (2 marks)

(f) Give two commercial use of Nitrogen (2 marks)

5. The chart below shows reactions starting with iron ore. Study it and answer the questions that Follow



i) Where does step **2** occur (1 mark)

ii) What is removed in step **1** (1 mark)

iii) Write an equation for the formation of solid **X** (1 mark)

iv) Identify what is added in step **3** (1mark)

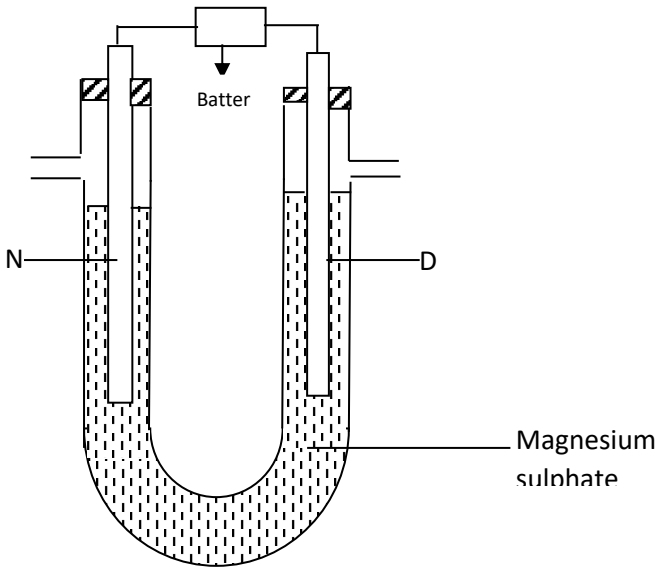
v) 5cm^3 sodium sulphite solutions was added to solution **G** and warmed. State and explain the Obs ervations made. (3 marks)

II (a) Name two major ores that are used in extraction of aluminum (2 marks)

(b) In the electrolysis process during aluminum extraction, write the two equations of the reactions taking place at the anode (2 marks)

(c) Give one industrial use of aluminum (1 mark)

6. Study the information below and answer the questions that follow. When an electric current is passed through magnesium sulphate as shown in the diagram, a gas that re-lights a glowing splint is produced at electrode **N**



(i) Which of the electrodes is the anode? Give a reason (2 marks)
(ii) Write an equation for the reaction taking place at electrode **N** (1 mark)
(iii) State and explain the observation made at electrode **D** (2 marks)
(iv) How is the product at **D** collected (1 mark)
(v) 0.45A of current was passed for 72 minutes during electrolysis in (i) above. Determine the volume of gas produced at electrode **N. (1 faraday =96 500 coulombs, molar gas volume is 22.4 litres)** (3 marks)
(vi) State one use of electrolysis (1 mark)

7. (a) The following is a radioactive decay series starting with $^{214}_{83}Bi$ it and answer the questions that follow

Identify the particles emitted in: (2 marks)
Step 1 ……
Step 2 ……
(ii) Write the nuclear equation for step 1 (2 marks)

(b) (i) 160g of Bi -214 has a half -life of 4 days and decays for 16 days. On the grid provided, plot a graph of the mass of Bi -214 against time (3 marks)
(ii) Using the graph determine the mass of **Bi** after 10 days (2 marks)
(iii) How is radioactivity used in paper industry (1 mark)

LANGA'TA / KIBRA CLUSTER
233/3
CHEMISTRY PRACTICAL
PAPER 3

1. Solution A is prepared by dissolving 6.3g of the organic acid $H_2C_2O_4.nH_2O$ in water to make a litre of the solution.
Solution B: 0.1M NaOH solution
Phenolphthalein indicator
Clamp and stand
Burette and pipette.
You are required to determine the value of n in the organic acid $H_2C_2O_4.\ nH_2O$

Procedure.
Fill the burette with solution A and adjust the volume to zero mark.
Add 2 to 3 drops of phenolphthalein indicator and titrate solution A against solution B until thecolour just permanently changes. Record your results in the table below. Repeat the procedure two more times to obtain concordant results.

a)

Titration	**1**	**2**	**3**
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution A used (cm^3)			

4marks

b) Calculate the average volume of solution A used. **1mark**
c) Calculate the moles of sodium hydroxide in the volume of solution B used. **2marks**
d) Given that solution B - Sodium hydroxide and solution A organic acid react in the ration of 2:1, calculate the number of moles of the organic acid –solution A used? **2marks**
e) Calculate the moles of organic acid solution A used per litre of solution **2marks**
f) Calculate the relative formula masses of the organic acid solution A **3marks**
g) Calculate the value of n in $H_2C_2O_4.nH_2O$(H=1, C=12, O=16) **3marks**

2. You are provided with CBI. Carry out the test below. Write your observation and inferences in the spaces provided.

a) Using a clean spatula, heat about one third of the solid CBI in a non- luminous Bunsen burner flame.
Observation **Inference**
1mark **1mark**

b) Put a half spatula endful of CBI in a test tube. Heat gently and then strongly. Test for any gas produced using litmus papers.
Observation **Inference**
1mark **1mark**

c) Put 2cm^3 of dilute hydrochloric acid into a test tube. Add ¼ endful of CBI into the test tube.
Test for any gas procedure.
Observation Inference
2marks **2marks**

3. You are provided with solid Q, carry out the test below. Record your observations and inferences in the table. Identify any gas (es) evolved.
Place all the solid Q provided into boiling tube and add distilled water until the tube is ¼ full. Divide it into five portions.

a) To the 1st portion add ammonia solution drop wise until excess.
Observation Inferences
1mark **1mark**

b) (i) To the 2nd portion add sodium hydroxide solution dropwise until in excess. Keep the resulting mixture for the next test.
Observation **Inference**
1mark **1mark**

ii) Warm the preserved mixture from b (i) above
Observation **Inferences**
1mark **1mark**

c) i) To the 3rd portion add silver nitrate solution. Preserve the mixture for the next test.
Observation **Inferences**
1mark **1mark**

ii) To the preserved mixture in c (i) above add diluted nitric acid.
Observation **Inferences**
1mark **1mark**

d) To the 4th portion add dilute Barium nitrate solution followed by dilute nitric acid.
Observation **Inferences**
1mark **1mark**

e) To the 5th portion add 2-3 drops of conc. Nitric acid.
Warm the mixture and allow to cool. Add sodium hydroxide solution dropwise until in excess.
Observation **Inferences**

1mark

LANGA'TA / KIBRA CLUSTER
233/3
CHEMISTRY PAPER 3
(PRACTICAL)
CONFIDENTIAL

Per Student

1. Solution A (100ml)
2. Solution B (100ml)
3. Phenolphthalein indicator
4. 3 conical flasks
5. Funnel
6. Burette
7. Pipette
8. Clamp
9. Stand
10. CBI (g) – $NaHCO_{3(s)}$
11. Clean spatula
12. Test- tubes (5)
13. Litmus papers (2 blue and 2 red)
14. Distilled water
15. Solid Q – 1g $(NH4)_2\ SO_4.FeSO_4.\ 6H_2O$ and NaCl (ration 1:1)
16. 1 boiling tub

Access to;

17. 2M ammonia solution
18. 2M Sodium hydroxide solution
19. Source of heat
20. Silver nitrate solution (0.05M)
21. Dilute nitric acid (0.1M)
22. Dilute hydrochloric acid (0.1M)

23. Dilute Barium nitrate solution (0.1M)
24. Conc. Nitric acid in dropper bottles
25. White tile
26. Test tube holder

- Solution A is prepared by dissolving 6.3g of $H_2C_2O_4.\ 2H_2O$ in $400cm^3$ of water and topped upto one litre of solution.
- Solution B is prepared by dissolving 4g of Sodium hydroxide in $400cm^3$ of water and topped upto one litre of solution.

LANGA'TA / KIBRA CLUSTER
CHEMISTRY MARKING
SCHEME PAPER 1

1. Heat from magnesium splits✓1 sulphur (iv) oxide into sulphur and oxygen, the oxygen ✓1 supports burning. Heat from burning splint is not hot ✓1 enough to split sulphuric oxide
2. $-DH_2 + DH_1$
   285.6 – 394✓1 = -108.4 KJmol$^-$✓1
3. (a) to prevent sucking back of water✓1
   (b) litmus paper changes red✓½ hydrogen chloride ionizes into $H^+_{(aq)}$ ✓½
   (c) Litmus paper remains✓½red; Hcl does not ionise½
4. When $NaOH_{(aq)}$ is added to $Cu^{2+}_{(aq)}$ a blue✓1 precipitate is obtained while a green✓1 precipitate is formed when NaOH is added to $Fe^{2+}_{(aq)}$
5. W – hydrochloric acid✓1
   Y – Concentrated sulphuric(VI) acid✓1
   (b) Absorb Hcl fumes✓1
6. Mols of HNO_3 $\frac{18\ x\ 0.22}{1000}$ = 0.00396 ✓½moles
   $K_2CO_3 + 2HNO_{3(aq)} \longrightarrow 2KNO_{3(aq)} + H_20_{(l)} + CO_{2(g)}$ ✓½

moles of K_2CO_3 in $25cm^3$ soln $= \frac{0.000396}{2} = 0.00198$ moles✓½

moles of K_2CO_3 in $200cm^3$ soln $= \frac{0.00198 \times 200}{25} = 0.01584$✓½

$K_2CO_3 = 138g$✓½

Mass of $K_2CO_3 = 138 \times 0.01584 = 2.186$ g✓½

7 (a) It is the reference electrode✓1

(b) K/potassium✓1 reject K^+

(c) E oxidized - E reduced = e.m.f

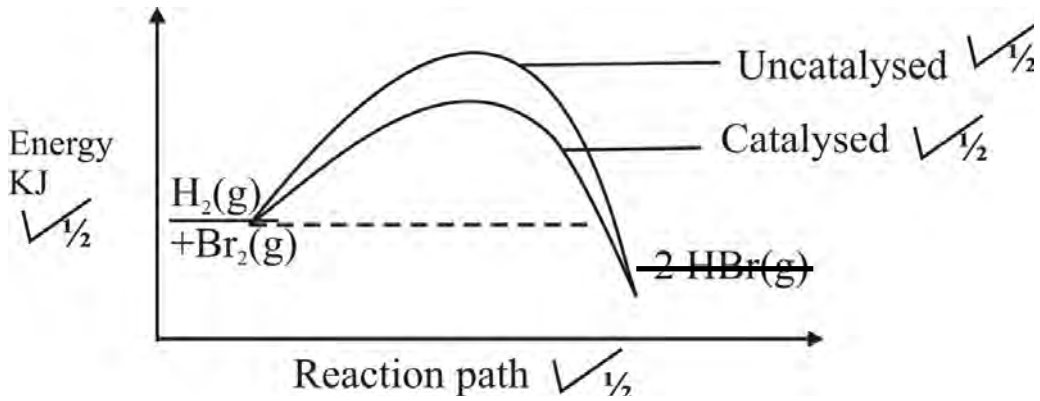
0.79 - (-2.75) ✓½ = +3.54 v ✓½

8 (a) Halogens✓½

(b) K is more reactive than ✓½ **I**; valence electron is **K** is lost more✓½ easily than in **I**

(c) P_2Q_3✓

9(a)



(b) No✓1 effect, both reactants and product✓1 occur equal no of moles/volume

10 (i) copper (II) oxide changes from black to red✓½

White precipitate in the boiling tube✓½

(ii) $Ca(OH)_{2(aq)} + CO_{2(g)} \longrightarrow CaCO_{3(s)}$ ✓1

(iii) It is burned to avoid air pollution✓1

11 (a) time taken for a sample of radioactive isotope to decay to half the original mass

(b) 1 $\xrightarrow{\text{2.5 Hrs}}$ ½ $\xrightarrow{\text{2.5 Hrs}}$ ¼ $\xrightarrow{\text{2.5 Hrs}}$ ⅛

Time taken = 7.5 Hrs

12 Mass of solution 192 – 23 = 169g✓½

Mass of solid 142 – 23 = 119g✓½

Mass of water 169 – 119 = 50g✓½

Solubility of salt $= \frac{119}{50}$ x 100✓

= 238g/✓½ 100gH_2O

13 (a) prevent contact of iron with water✓1

(b) zinc corrodes✓½ its more✓½ reactive than iron

14 (a) by filtration✓½

(b) heating✓ ½NaaHCO₃/ accept correct equation.

(c) Ammonium chloride is heated with calcium oxide✓½

15 $\frac{T\ O_2}{T\ NO_2} = \sqrt{\frac{MO_2}{NO_2}}$ ✓½

$80cm^3$ O2 ⟶ 50 sec. $O_2 = 32$

$120cm^3$ O_2 ⟶ 75 sec. ✓½ $NO_2 = 44$ ✓½

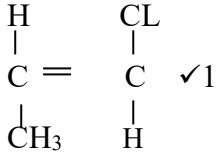
$\frac{75}{T NO_2} = \sqrt{\frac{32}{44}}$ ✓½

$TNO_2 = 87.94$ sec. ✓½

16. X:---------- Residue ✓½
Y …….Filtrate ✓½

17 P✓; not decomposed ✓1 by heat

18 (a)



(b)Molar ✓½

No of monomers $=\frac{4590}{76.5}$ ✓
$= 60$✓½

19 Add✓½water; warm✓½$PbCl_2$ dissolves,½ ✓ filter. ✓½ allow to cool. ✓½ filter✓½ recrystalised $Pbcl_2$

20 (a)(i) Butanol✓1
(ii) C_4H_9OH✓1
(b) $C_4H_9OH + C_4H_5COOH \longrightarrow C_2H_5COOC_4H_9 + H_20$✓1

21 (a) zinc✓½
(b) $Zn(OH)_{2(s)} + 4NH_{3(aq)} \longrightarrow Zn(NH_3)_4^{2+} + 2OH^-_{(aq)}$

22 (a) Yellow solid deposited✓1; sulphur(IV) oxide is reduced✓½ to sulphur and H_2S oxidised✓½ to sulphur
(b) should be done in the fume chamber/ open air

23 (a) volume decreases with increase in ✓1 pressure/volume is inversely proportional to Pressure.

(b) $P_1V_1 = P_2V_2$ ✓½ ; $V_2 = \frac{P_1V_1}{P_2}$

$V_2 = \frac{1 \times 3}{2}$✓
$= 1.5$ litres ✓½

24 **R .a.M** $= \frac{(60.57 \times 59.71) + (62.83 \times 40.29)}{100}$✓
$= 61.48$✓

25

Energy of bond breaking		*energy of bond formation*	
C –H	……. 414	C - CL	… 326
CL – CL	……244	H – Cl	….431
	+658kJ ✓½		-757kJ✓½

ΔH= 658-757✓
= -99Kj✓½

26 SO_2✓1
Oxidation number of S increases from +4 to +6✓½

27 (a) C✓1
(b) A✓½, it is ½✓strongly acidic/D; it is strongly alkaline

28 It is inert✓1

29 In ionic bond there is complete transfer✓1 of valence electrons
In covalent bond there is sharing ✓1 of valence electrons

30 In addition to vander waals forces, hexanol has strong hydrogen✓1 bonds; hexane has only ✓vander waals forces.

31 Sting from nettle plant contains acidic✓1 substance which causes itching. Ammonia solution neutralizes✓1 the acid.

LANGA'TA / KIBRA CLUSTER
MARKING SCHEME
233/2 CHEMISTRY PAPER 2

1. (a) Molar heat of displacement is heat given out when 1 mole of a substance is displaced from a solution✓**1**
   (b) $Cu^{2+}_{(aq)} + Zn_{(s)} \longrightarrow Zn_{(aq)}^{2+} + Cu_{(s)}$ ✓**1** **Penalise ½ mark for wrong or missing state symbols.**
   (c) To prevent heat loss to environment✓**1**
   (d) – Brown ✓½deposits –copper is deposited✓**1**
   - blue colour ✓½ fades//disappears – cu^{2+} ✓**1** ions removed
   H = MCDT✓½ (can be implied)

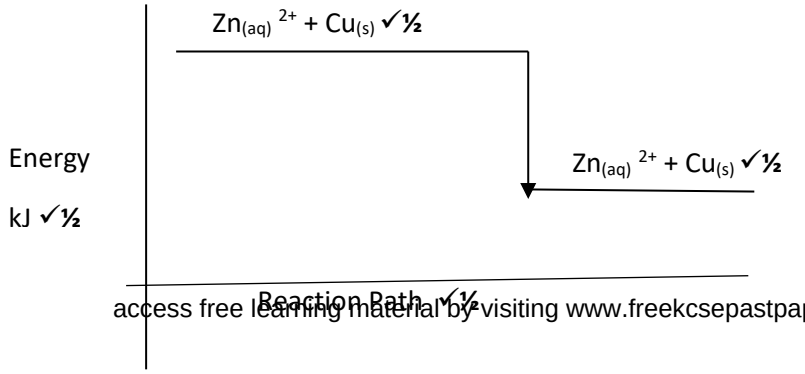
(e)

$$H = \frac{50 \times 4.2 \times 12.5}{1000} \qquad \text{moles} = \frac{0.25 \times 50}{1000}$$

$$\frac{20}{} \qquad \frac{20}{}$$

= 2.625 kj✓**1** = 0.0125✓**1**

(f)



2. (a) **A** – H_2 / Hydrogen
   B-Sodium propoxide
   C-Propanoic acid
   E – Polypropene
   F – $C_3H_6Br_2$ / 1, 1-di-bromopropane
   G- C_2H_4 / ethene

   (b) Ni catalyst, H_2, / High temperature✓½ **each**

   (c) $C_3H_6 + Br_2 \longrightarrow C_3H_6Br_2$✓**1** **ignore state symbols**

   (d) Con. H_2SO_4✓**1**

   (e) Manufacture of Black carbon✓**1**

   (f)(i) Propyne ✓**1** (ii) Hexan – 3 –ol✓**1** (iii) 3 –methyl propene✓**1**

3 (a)(i) S – 2,8,4✓**1**
   (ii) R^{3+}- 2,8✓**1**

   (b) It increases across✓ a period, due to increase in ✓**1** valence electrons, metallic bonds ✓**1** become stronger

   (c) **T** has 2 allotropes✓**1**

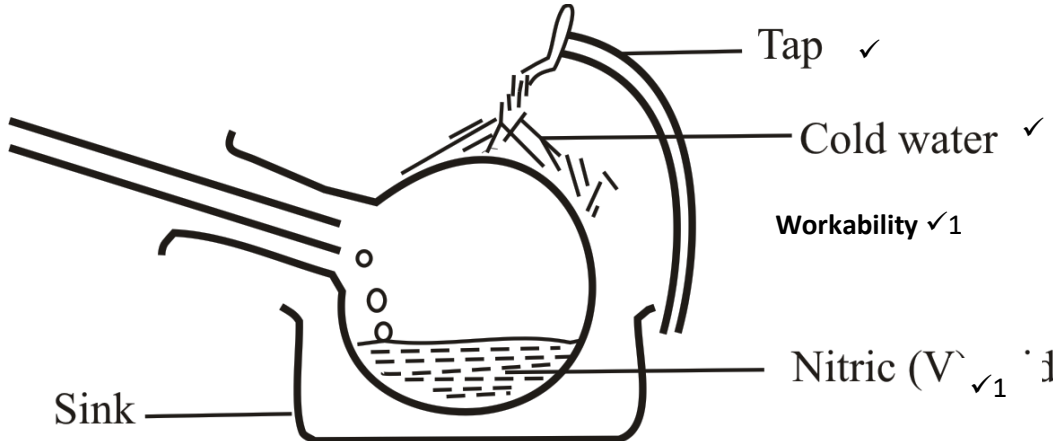
   (d) **R** $(NO_3)_3$/ $Al(NO_3)_3$✓**1**

(e) **S** has a giant atomic ✓½ structure. **S** atoms are joined by strong covalent ✓1 bonds which required a lot ✓½of heat to break. (2 marks)

(f) Acidic, **U** is a non-metal✓**1**

(f) Manufacture of sulphuric (vi) acid✓1

4



(b) **B** – Sodium Nitrate/KNO_3✓**1**

L – Conc. H_2SO_4✓**1**

(c) **A** – Retort Flask✓**1**

(d) $NaNO_{3(s)} + H_2SO_{4\,(l)} \longrightarrow HNO_{3(aq)} + NaHSO_{4(aq)}$ ✓1

(e) HNO_3 is a powerful ✓1oxidizing agent. It oxides H_2 ✓1 to water.

(f) A I semen storage✓1
- Haber process✓1

5 (i) in a blast furnace✓1
(ii) carbonates/sulphides✓1
(iii) $2Fe_2O_{3(s)} + 3CO_{(g)} \longrightarrow 4Fe_{(s)} + 3CO_{2(g)}$ ✓1
(iv) Manganese/carbon/nickel✓1
(v) brown/yellow ✓1solution turns pale, green ✓1 Fe^{3+} is reduced to✓1 Fe^{2+}
II (a) Bauxite, ✓1 mica✓1
(b) $2O^{2-}_{(l)} \longrightarrow O_{2(g)} + 4e$✓1

$0_{2(g)} + C_{(s)} \longrightarrow CO_{2(g)}$ ✓1

(c) Aircraft✓1

6 (i) N, ✓1 O_2 is produced due to discharge✓1 of OH^-

(ii) $4OH^-_{(aq)} \longrightarrow O_{2(g)} + 2H_2O_{(l)} + 4e$ ✓1

(iii) Bubbles✓1 of a colourless gas given off. Hydrogen gas H^+ ✓1 discharged/ correct equation

(iv) Use of a syringe ✓1

(v)

Q= 0.45 x 72 x 60

= 1944 C ✓1

96500 C IF

1944 C 1 x 1944

96500

= 0.02F✓1

7 (i) Step 1 α alpha $^{4}_{2}$He✓1

Step 2 β Beta $^{0}_{-}$e✓1

(ii)

$^{214}_{}Bi \longrightarrow {}^{210}\times{}^{4}+ {}_{}He$✓1

(b)(i)

Mass	160	80	40	20	10
	0	4	8	12	16

✓1 table, graph ✓3

(ii) from graph ✓2

(iii) Control in thickness of paper

LANGA'TA / KIBRA CLUSTER
233/3
CHEMISTRY PAPER 3
PRACTICAL
MARKING SCHEME

Question one

(a)

i. Complete table √1mk
Complete table with 3 titres √1mk
Incomplete table with 2 titres √½ mk
Incomplete table with 1 titre −0 mk
Conditions

✓ *Penalize ½ mk for unrealistic values unless where explained*
✓ *Penalize ½ mk for any inversion of table*
✓ *Penalize ½ mk for any arithmetic error*
NB: penalize a maximum of ½ mk for any of the conditions above.

ii. Decimal √1mk
Award 1mk for 1d.p. or 2 d.p used consistently
If 2d.p used, 2nd d.p. can only be "0" or "5"

iii. Accuracy √1mk
Award 1mk for any value ± 0.1 of s.v.

Award ½ mk for any value ± 0.2 of s.v.
Award 0mk (penalize fully) for any value beyond ± 0.2 of s.v.

iv. Principles of averaging √1mk
Values averaged must be consistent
If 3 titres but only 2 are consistent and averaged award 1mk
If 3 titres done and averaged award 1mk
If 3 titres done and inconsistent and averaged award 0mk
If 3 titres done and all are consistent but only 2 are averaged award 0mk

v. Final answer √1mk
Award 1mk for ans. ± 0.1 of s.v.
Award ½mk for ans. ± 0.2 of s.v.
Award 0mk ifansnot within ± 0.2 of s.v.
Marks awarder as follows: CT 1mk
D 1mk
A 1mk
PA 1mk
FA 1mk
5mks

(b) Average titre $= \frac{t_1 + t_2 + t_3}{3}$ = (√½ mk)*Correct Ans ½ mk*

(c) Moles of NAOH = $\frac{M \times V}{1000}$
= $\frac{0.1 \times 25}{1000}$ √*1mk* = 0.0025moles √*1mk*

(d) $2\,NaOH_{(aq)} + H_2C_2O_{4\,(aq)} \longrightarrow Na_2C_2O_4\,(aq) + 2H_2O_{(l)}$

Moles ratio = 2:1
Therefore moles of organic acid = ½ x 0.0025 moles √*1mk*
= 0.00125 moles √*1mk*

(e) Ans (b) cm^3 ⟶ has 0.00125moles
1000cm^3 ⟶ ?
= $\frac{0.00125 \times 1000}{\text{Ans (b)}}$ √*1mk*
= Correct answer √*1mk*

(f) Ans (e) moles / L ⟶ has 6.3g/l
1mole ⟶ ? √*1mk*
= $\frac{6.3}{\text{Ans (e)}} \times 1$ √*1mk*
= Correct answer √*1mk*

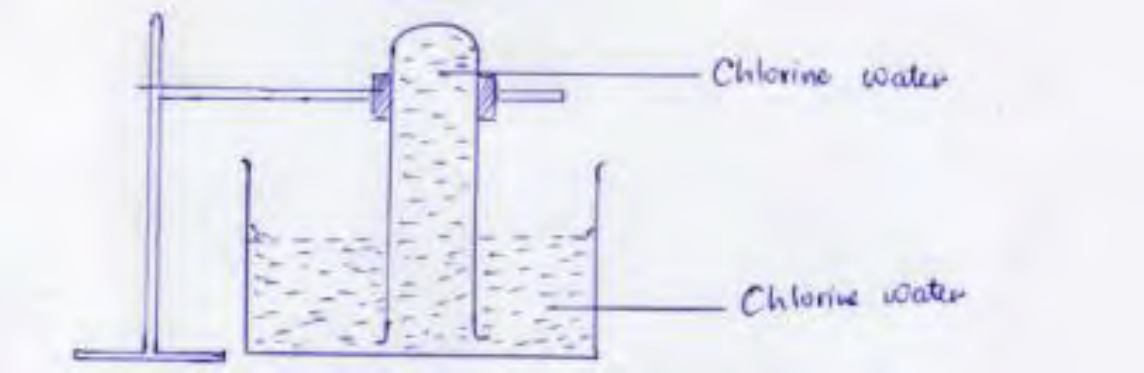
(g) Value of n
Ans (f) = $H_2C_2O_4.\,nH_2O$
Ans (f) = 2 + 24 + 64 + 18n √*1mk*
N = $\frac{\text{ans f} - 90}{18}$ √*1mk*
= correct ans √*1mk*

Question two

	Observation	**Inferences**
a)	Yellow flame √*1mk*	Na^+ ions √*1mk*
b)	- Colourless, odourless gas produced - Gas turns moist blue litmus paper red - Red litmus paper remains red - Droplets of colourless liquid on cooler parts of test tube *Any 2 x ½ = √1mk*	Gas acidic CO_3^{2-} , HCO_3^- ions Hydrated salt / water of crystallization *Any 2 correct x ½ = √1mk*
c)	- Effervescence / bubbles - Colourless , odourless gas produced - Gas turns moist blue litmus paper red - Red litmus paper remains red *Any 4 x ½ = √2mks*	CO_3^{2-} , HCO_3^- ions Gas acidic *Any 2 x 1 = √2mks*
	Observation	**Inferences**
3. (a)	Pale green ppt√½ mk insoluble in excess √½ mk	Fe^{2+}√*1mk*
(b) (i)	Pale green ppt√*½ mk* Insoluble in excess √*½ mk*	Fe^{2+}√*1mk*
(ii)	- Gas with pungent . chocking smell 1mk - Moist red litmus paper turns to blue 1mk - Blue litmus paper remains blue *any 2 x 1 = √2mks*	Gas basic √*½ mk* NH_4^+ ions present√*½ mk*
C.(i)	White ppt	CO_3^{2-}, Cl^-ions , SO_3^{2-}
(ii)	White ppt√*½ mk* Insoluble / persists √*½ mk*	Cl^- ions √*1mk* Confirmed
D.	White ppt√*½ mk* Insoluble √*½ mk*	SO_4^{2-} ions √*1mk*
E.	Pale green solution turns to yellow solution √*1mk* Brown ppt insoluble in excess √*1mk*	Fe^{2+} oxidized to Fe^{3+} ions √*½ mk* Fe^{3+} ions confirmed √*½ mk*

AMUKURA CATHOLIC JOINT EXAMINATION- CASPA
233/1
CHEMISTRY THEORY
PAPER 1

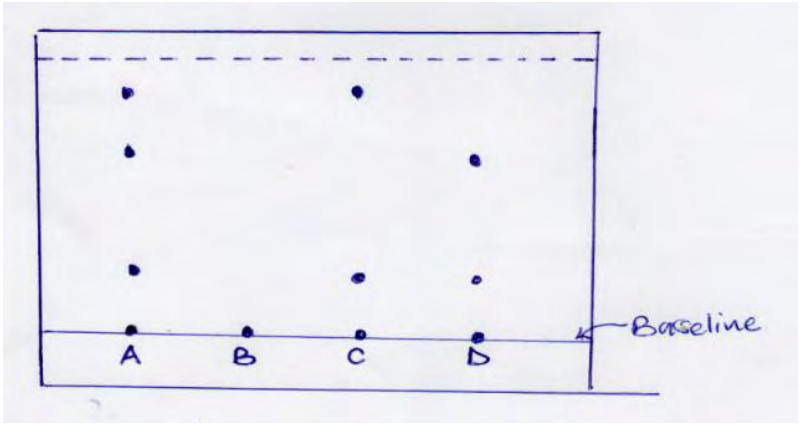
1. Air is a mixture of several different gases, which parts of air; (3Mks)
   a) Supports combustion?
   b) Puts of a burning splint?
   c) Makes up almost 80% of air?
2. In an experiment a test tube full of chlorine water was inverted in chlorine water to as shown in the diagram below and the set up was left in sunlight.



After one day, a gas was found to have collected in the test tube.
(a) Identify the gas (1Mk)
(b) What will happen to the PH of the solution in the beaker after one day? Give an explanation. (2Mks

3. Draw the structure and give names of three alkanes having themolecular formula of C_5H_{10}. (3Mks)
4. (a) Using electrons in the outermost energy level draw the dot(.)and cross(X) diagram for the molecules H_2O and CH_4(H=1, C=12) (2Mks)
   (1)H_2O
   (2)CH_4

5. The following chromatogram was obtained in an experiment to investigate the components present in certain dyes.



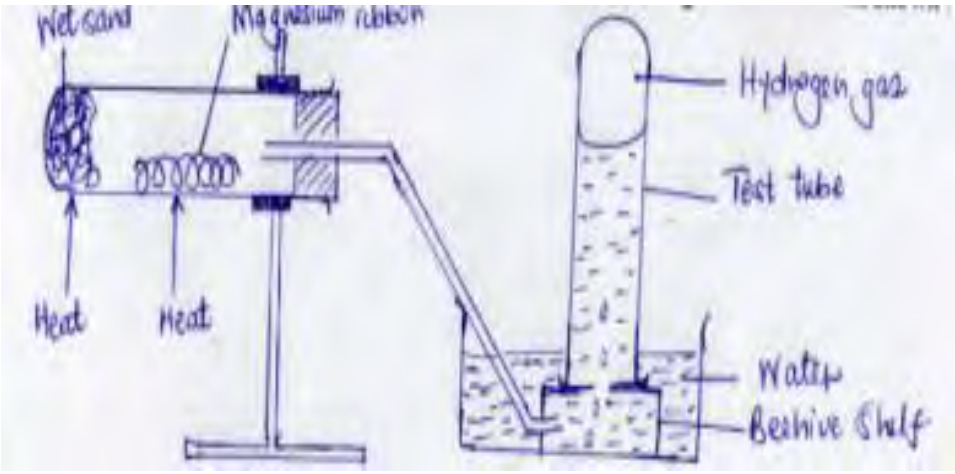
(a) Which two dyes when mixed would produce dyeA (1Mk)
(b) Identify the pure dye. (1Mk)
(C)Define solvent front? (1Mk)
(B) Indicate the solvent front in the diagram using the **letter E**.

6. A given element **F** has atomic number 14 and consist of isotopes as shown below.

Isotopes	G	H	J
Isotopes Mass	28	29	30
Percentage abundance	92.2	4.7	3.4

(a) Determine the relative atomic mass of **element F.** (2Mks)
(b) State the group and the period to which element **F** belongs. (1Mk)

7. Hdrogen gas can be prepared by passing steam over heated magnesium ribbon as shown .

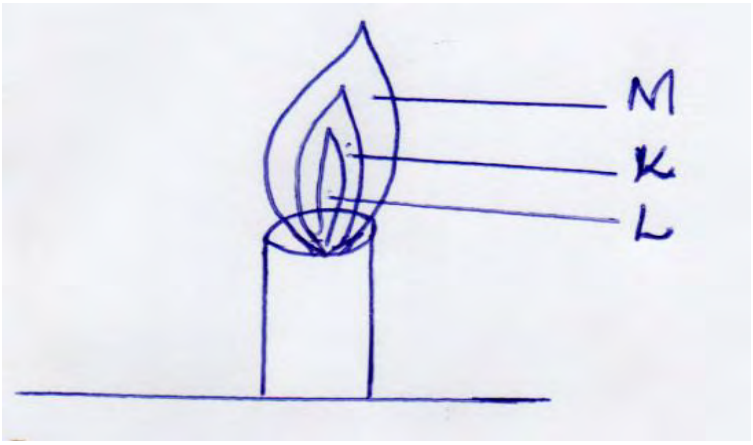


(a) Write an equation for the reaction that produce hydrogen gas. (1Mk)
(b) Explain why the delivery tube must be removed from beneath the water before heating is stopped. (1Mk)
(c) Name the method of gas collection used in the experiment. Give a reason. (1Mk)

8. (a) State Charles's law (1Mk)
(b) A gas occupies 450cm^3 at 27^{0}C.What volume would the gas occupy at 177^{0}C.If its pressure remains constant? (Give the answer in Kelvin) (2Mks)

9. A certain match stick head contains potassium chlorate and sulphur. On striking, the two substances react to produce potassium chloride and sulphur(IV)oxide respectively.
(a) Write an equation to show formation of sulphur (iv)oxide. (1Mks)
(b) Explain the environmental effect of using such matches in large numbers (2MKS)

10. The figure below shows a flame obtained from a Bunsen burner.



(a) Name the type of flame. (1Mk)
(b) A match stick head was placed at **region L** will not ignite. Explain (1Mk)
(c) Name **region K .**(1Mk)

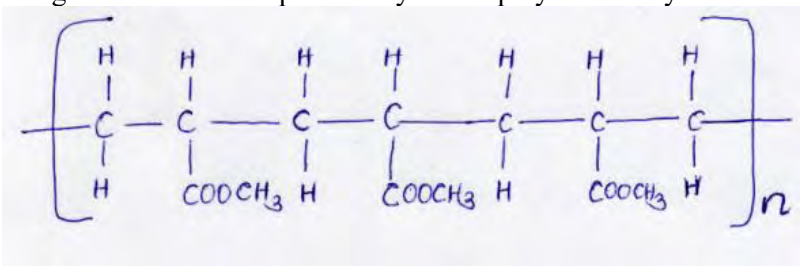
11. Solutions can be classified as Acids, Bases or Neural. The table below shows solutions and their P^H values.

Solution	P^H values
N	1.5
Q	7.0
P	13.0

(a) Select any pairs that would react to form a solution of P^H 7.0 (1Mk)

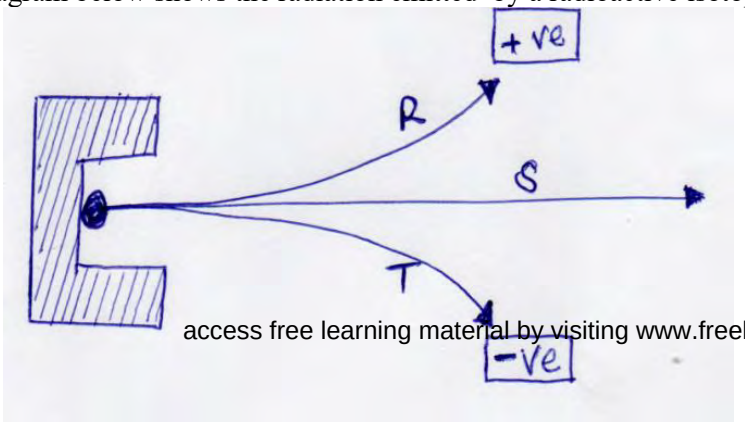
(b) Identify **two**solution that would react with Aluminium hydroxide. Explain. (2Mks)

12. The diagram below shows part of a synthetic polymer. Study it and answer the questions that follows;



(a) Draw the structure of the monomer (1Mk)

13.The diagram below shows the radiation emitted by a radioactive isotope.



Name the radiations. (3mks)

R:

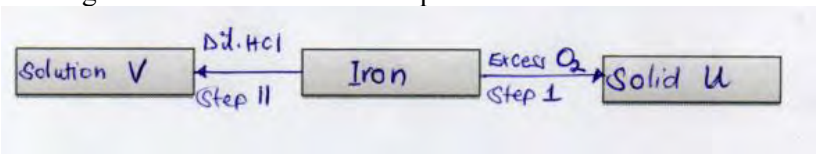
S:

T:

14. (a) Distinguish between a deliquescent and a hygroscopic substance. (2Mks)

(b) Give one use of a deliquescent substance In the laboratory. (1Mk)

15. Study the flow diagram below and answer the question that follow.



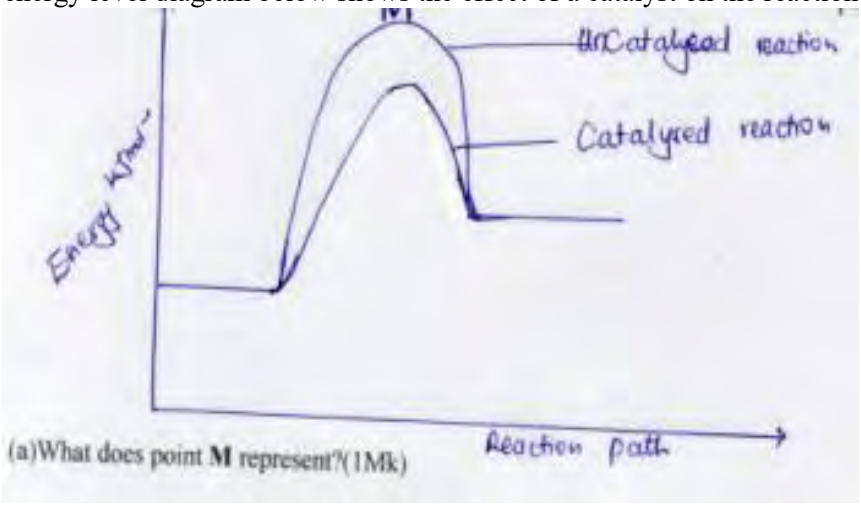
(a) Write an equation for the reaction taking place in **step 1.** (1Mk)

(b) Name **solution V.** (1Mk)

16. (a) state and exaplain two observations made when magnesium ribbon is lowered into a as jar full of carbon (iv) oxide (3mk)

b) Write a balanced chemical equation or the reaction that took place in a) above (1mk)

17. The energy level diagram below shows the effect of a catalyst on the reaction path.



(b) With reference to the energy level diagram, explain how a catalyst increases the rate of reaction. (2Mks)

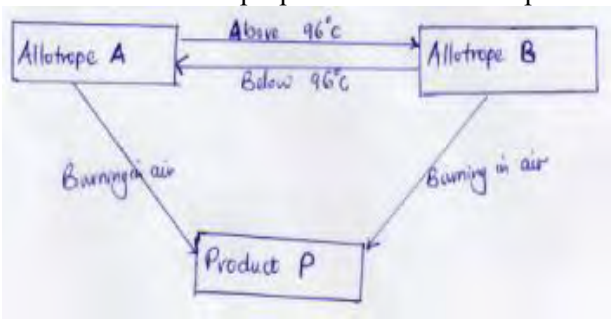
18. The table shoes behaviour of metals R, X , Y and Z study it and answer the questions.

Metal	Appearance on exposure to air	Reaction in water	Reaction with dilute hydrochloric acid
R	Slowly tarnishes	Slow	Vigorous
X	Slowly turns white	Vigorous	Violet
Y	No change	Does not react	Does not change
Z	No change	No reaction	Reacts moderately

(a) Arrange the metals in the order of reactivity starting with the **most reactive** (2Mks)
(b) Name a metal which is likely to be ; (2Mks)
1) X:

11) Y:

20. The following chart below shows some properties of two allotropes of **element P**

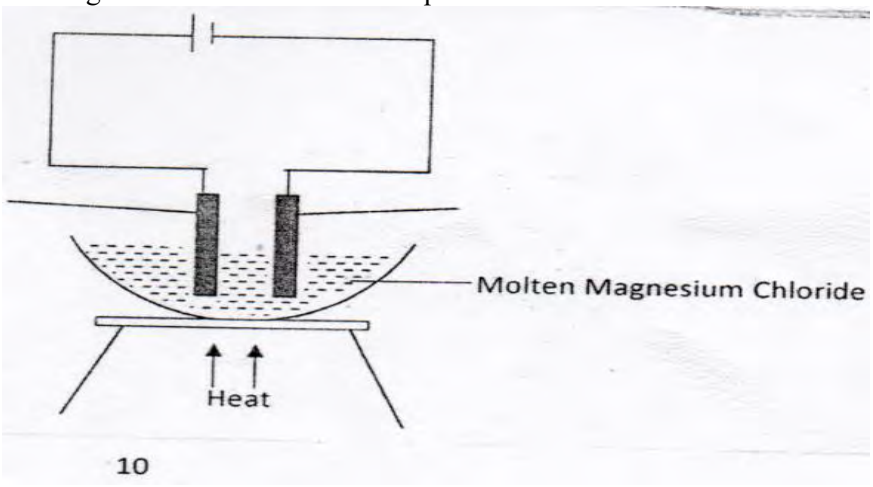


(a) Name allotrope A (1Mk)
(b) Write an equation to show formation of product P (1Mk)
(c) What does 96 ^{0}C represent? (1Mk)

21. Complete the following table by filling in the missing test and observations (3Mks)

NO	Gas	Test	Observation
I.	Ammonia	Put a moist red, then blue litmus into the gas	
2	Sulphuric(V) oxide		Paper turns green
3	Butene	Add a drop of bromine water	

22. An organic compound contains 24.24%carbon,4.04% hydrogen and the rest chlorine.If its relative molecular mass is 99.What is its molecular formula ?(C=12,H=1 ,Cl=35.5) (3Mks)
23. Study the diagram below and answer the questions that follows

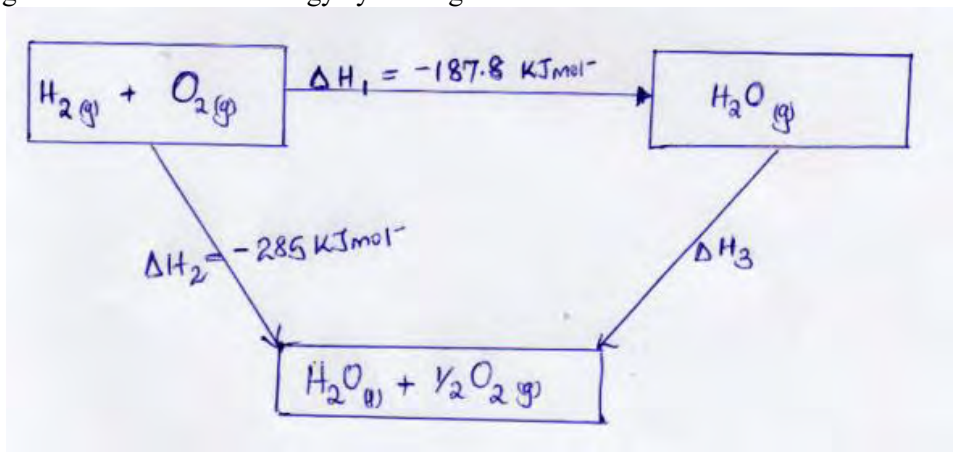


(a) Define the term electrolysis. (2mks)
(b) On the diagram, label the Anode and the Cathode. (1Mks)
(c) Write the equation for reaction taking place at the Cathode. (1Mk)

24. Hardness of water may be removed by either boiling or addition of chemicals
(a) Name the two types of water hardness. (2Mks)
(b) A sample of river water was divided into three portions, the table shows the test carried out on the portion and observations made. Complete the table by filling the inferences. (3Mks)

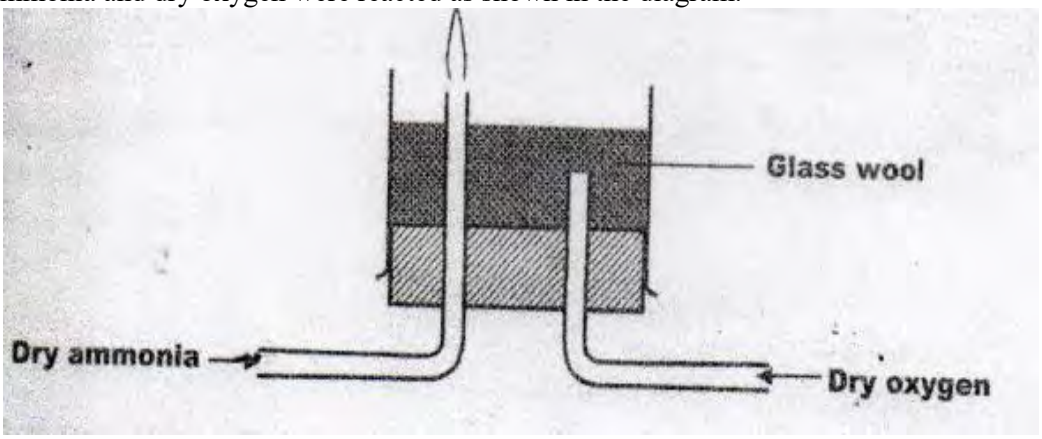
Test	Observation	Inference
To the first portion,1cm^3 of soap solution was added.	No lather formed	
The second portion was boiled ,cooled and 1cm^3 of soap solution was added.	No lather was formed	
To the third portion ,3cm^3 of aqueous sodium carbonate was added ,the mixture filtered and 1cm^3 of soap solution added to the filtrate.	Lather formed immediately	

25. The figure below shows an energy cycle diagram.



(a) Give the name of the enthalpy change H1 (1Mk)
(b) Determine the value of H3 (2Mks)

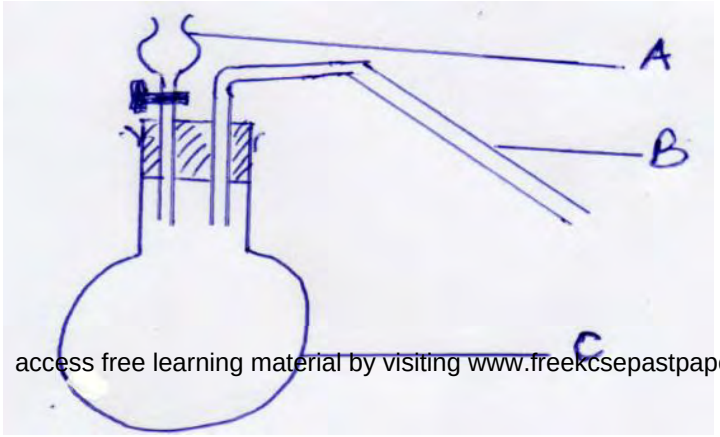
26. Dry ammonia and dry oxygen were reacted as shown in the diagram.



(a) What is the purpose of the glass wool? (1Mk)

(b) What product would be formed if red- hot platinum was introduced in to a mixture of ammonia and oxygen? (1Mk)

27 .Study the diagram below.



Identify apparatus A ,B and C. (3mks)

28. Explain why high temperature is required for Nitrogen to react with Oxygen. (2mks)

AMUKURA PARISH J O I N T E X A M I N A T I O N - 2021
233/2
CHEMISTRY PAPER 2

1. The grid given below represents part of the periodic table. Study it and answer the questions that follow. The letters are n actual symbols of the elements.

								A
B				G		H	E	
	J		I	L				C
D							M	
Y								

i) What name is given to the family of elements to which A and C belong? (1 mark)
ii) Write the chemical formula of the sulphate of element D. (1 mark)
iii) Which letter represents the most reactive (2 marks)
   (a) Metal
   (b) Non-metal
iv) Name the bond formed when B and H react. Explain your answer. (2 marks)
v) Select one element that belong to period 4. (1 mark)
vi) Ionic radius of element E is bigger than the atomic radius. Explain. (2 marks)
vii) The electron configuration of a divalent anion of element N is 2.8.8. Induce the Position of element N on the periodic drawn above. (1 mark)
viii) The oxide of G has a lower melting point than the oxide of L. Explain. (1 mark)
ix) How do the atomic radii of I and C compare. Explain. (2 marks)
x) Explain the trend in the 1st ionization energies of the elements J, I and L. (1mark)

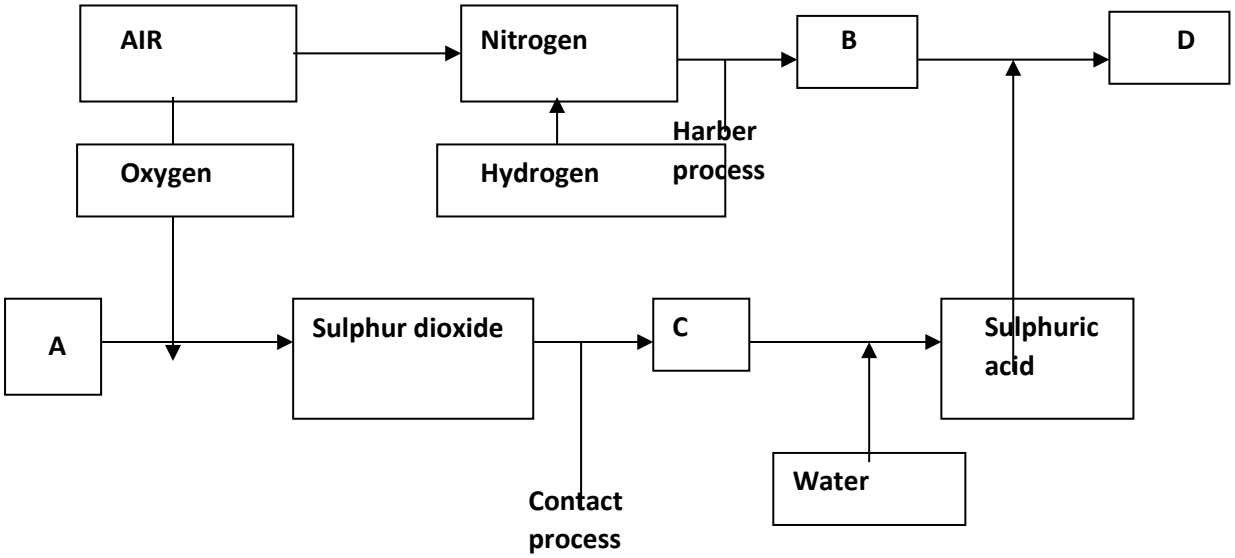
2 a) define the following terms
   i) Saturated solution (1mk)
   ii) Fractional crystallization (1mk)
   b) Solubility of salt X and Y were determined at different temperatures as shown in the following data.

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

i. On the grid provided, plot a graph of solubility (vertical axis) against temperature. (4mks)
ii. From the graph determine the solubility of each at 50ºC.
   X (1mk)
   Y (1mk)
iii. At what temperature was the solubility of both salts equal. (1mk)

b) i. What is permanent hardness of water? (1mk)

3. 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.



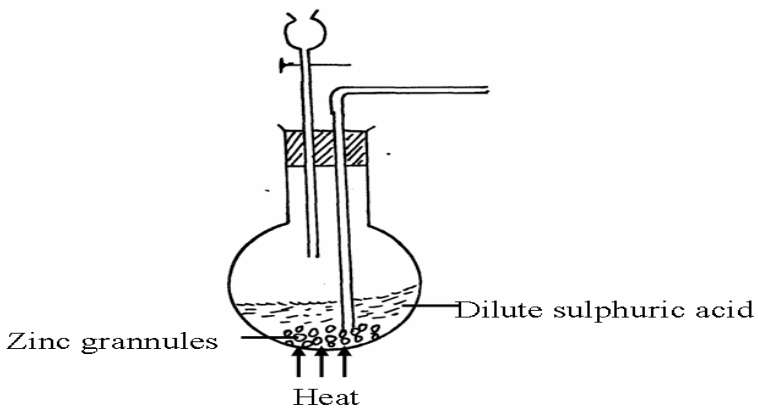
a) (i) Give the name of the process by which air is separated into oxygen and nitrogen. (1 mk)
(ii) Apart from oxygen and nitrogen gas produced from process a(i) name any other gas produced in the process above. (1 mk)

b) Name the substances which are represented by the letter. A, B, C, D. (4 mks)

c) Name the catalyst used in;
(i) The Haber process (1 mk)
(ii) The contact process (1 mk)
(iii) Explain the role of the catalyst in both the Haber and contact process. (2 mks)

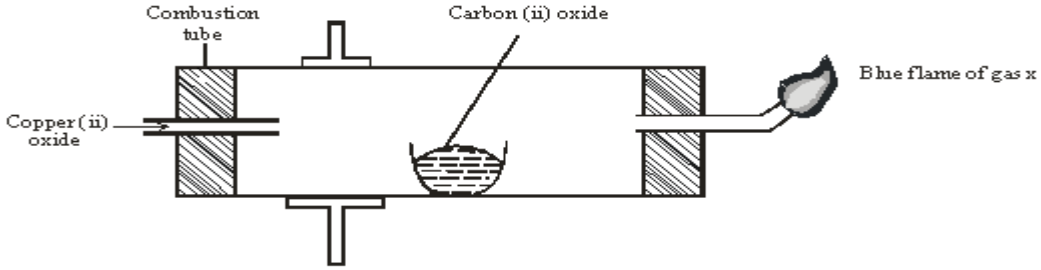
d) (i) Write a balanced equation for formation of compound D. (1 mk)
(ii) Calculate the percentage by mass of nitrogen present in compound D
(N = 14.0, H = 1.0, S = 32.0, O = 16.0) (2 mks)
(iii) Give one use of compound D. (1 mk)

4. A student set-up the arrangement below to prepare and collect dry hydrogen gas



(a) Identify two errors from the section of the arrangement shown above (2mks)
(b) Complete the diagram to show how dry hydrogen gas can be collected. (2mks)
(c) (i) Explain why hydrogen was collected by the method shown above (1mk)
(ii) Write a balanced chemical equation for the reaction that takes place when hydrogen gas is burnt in air. (1mk)
(e) Determine the relative atomic mass of zinc, given that when 6.54g of zinc was used, 2.4litres of hydrogen gas was produced. (Molar gas volume = 24 litres) (3mks)
(f) State any **two non**-industrial uses of hydrogen gas (2mks)

5. 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 mark**

d) Give an equation for the reaction that takes place as gas x burns. **1 marks**

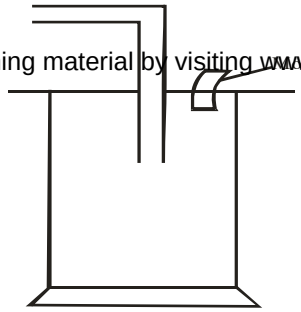
e) Why is it necessary to burn gas x? **1mk**

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**

6. 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 made on the moist blue litmus paper. **(2marks)**

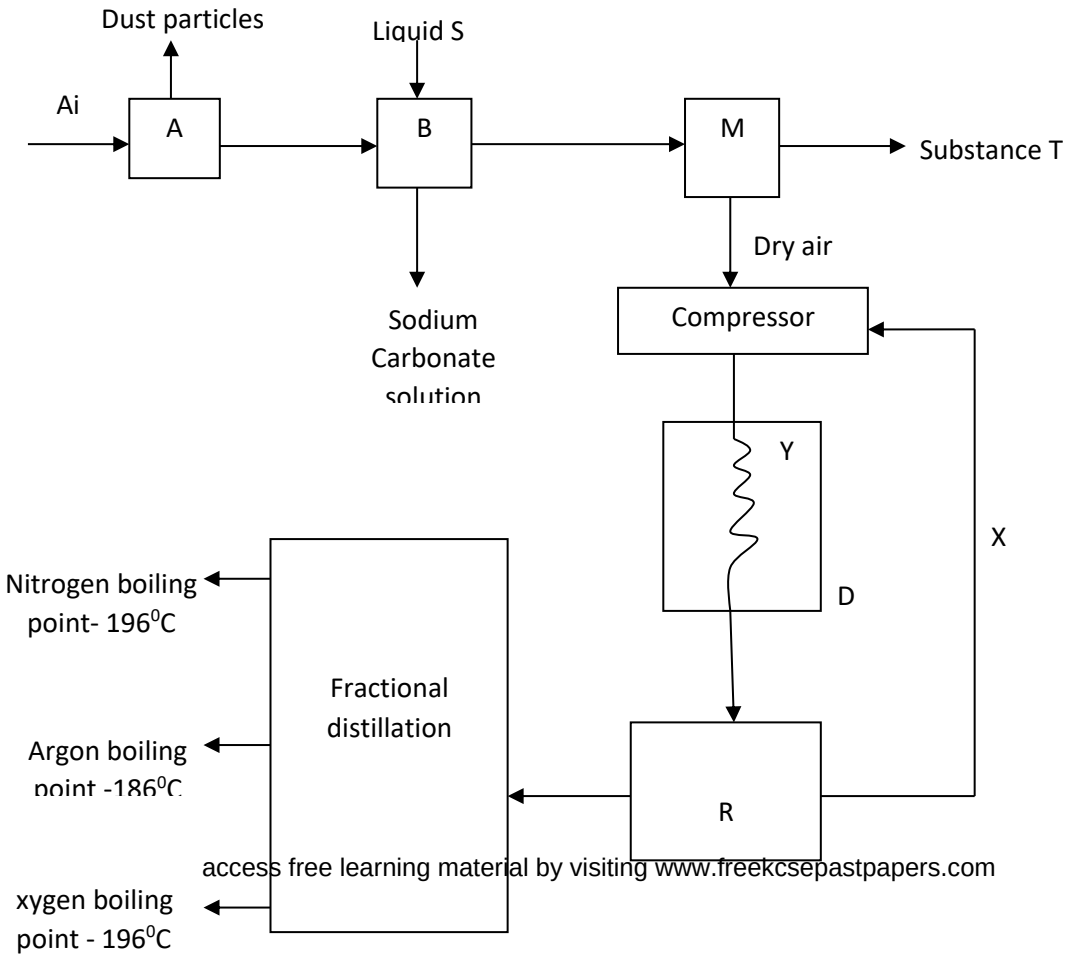
d) Chlorine gas was bubbled through distilled water. With aid of an equation show the formation of chlorine water. **(1mark)**

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**

7. 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**

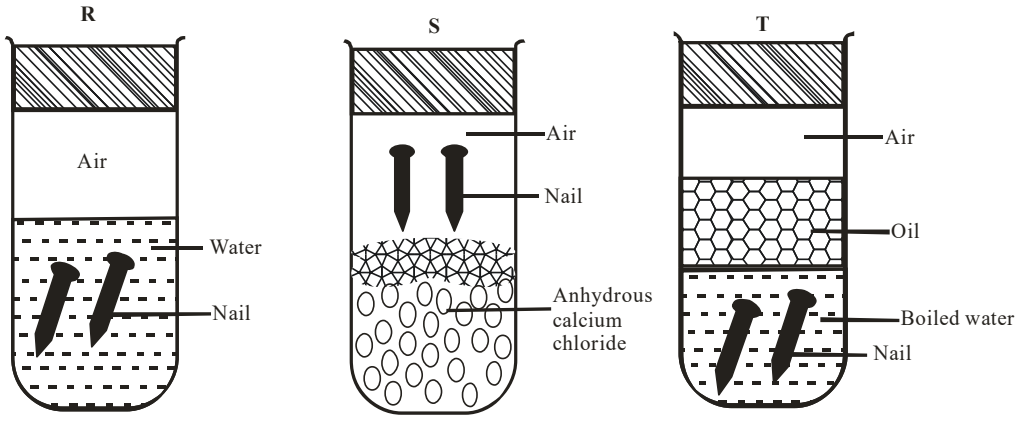
b) Name;
   (i) Liquid S (1mk)
   (ii) Substance T (1mk)

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. **2marks**
(ii) Give one reason why some metals are electroplated. **1mark**

CASPA AMUKURA PARISH
233/3
CHEMISTRY PAPER 3

1 **You are provided with;**

- Solution K, hydrochloric acid
- Solution L, containing 2g per litre of sodium hydroxide.
- 0.5 g of an impure calcium carbonate, solid **N.**
- You are required to determine the :

(a) Concentration of solution K in moles per litre.
(b) Percentage purity of calcium carbonate, solid **N**

Procedure I

Fill the burette with hydrochloric acid, solution K. pipette 25cm^3 of sodium hydroxide, solution L into a conical flask. Add 2-3 drops of phenolphthalein indicator and titrate. Record the results in the table. Repeat the procedure two more times.

Table 1

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

4mks

a) What is the average volume of solution **K** used (1mk)
b) Determine the concentration of solution L in moles per litre. (1mk(Na= 23,O = 16, H = 1)
c) Determine the number of moles of solution L that reacted with solution K (1mk)
d) Write the equation of the reaction that took place (1mk)
e) Calculate the number of moles of solution K that reacted (1mk)
(f) Calculate the concentration of solution K in moles per litre. (1mk)

Procedure II

Using a measuring cylinder, measure out 100cm^3 of solid K into a 250ml beaker. Add all of solid N into the beaker containing solution K. Swirl the mixture and allow the reaction to proceed until offervescence stops. Label this as solution P. Fill the burette with solution P. pipette 25cm^3 of solution L into a conical flask. Add 2-3 drops of phenolhthalein indicator and titrate. Record your results in table II below repeat the titration two more times and complete the table

Table II	I	II	III
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution Pused (cm^3)			

4mks

(a) Determine the average volume of solution **P** used. 1mk
(b) Calculate the number of moles of hydrochloric acid in solution P used. (1mk)

c) Determine the number of moles of hydrochloric acid in $100cm^3$ of solution P. (1mk)

d) Calculate the:

(i) Moles of hydrochloric acid in $100cm^3$ of the original hydrochloric acid solution K (1mk)

(ii) Moles of the hydrochloric acid that were used up in the reaction with solid N. (1mk)

(iii) Moles of calcium carbonate that reacted with hydrochloric acid. (1mk)

e) Given that the relative formula mass of calcium carbonate is 100,calculate the:

(i) Mass of the calcium carbonate that reacted. (1mk)

(ii) Percentage purity of the calcium carbonate, solid N. (1mk)

2 You are provided with solid T. Carry out the following tests and write your observations and inferences in the spaces provided.

Place all solid T in a boiling tube. Add about $6cm^3$ of distilled water to the solid T and shake the mixture well. Retain the mixture for use in the following tests.

a) Dip a clean glass rod in the mixture obtained above and burn it on a Bunsen burner flame.

Observation	Inference
(1 mark)	(1 mark)

b) Divide the mixture in the boiling tube into 3 portions.

(i) To the 1st portion, add about $1cm^3$ of barium chloride solution. Retain the resulting mixture for use in (iii) below.

Observation	Inference
(1 mark)	(1 mark)

(ii) To the mixture in (ii) above, add about $4cm^3$ of dilute hydrochloric acid.

Observation	Inference
(1 mark)	(1 mark)

(iii) To the 3rd portion, add about 3 drops of acidified potassium manganate (VII) solution.

Observation	Inference
(1 mark)	(1 mark)

3. You are provided with solid J. Carry out the test below to identify the compound.

(a) Place ½ spatula of solid J in a hard test tube and heat strongly until no further change. Test the gas produced with litmus paper.

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

(b) Place the remaining solid J into a clean boiling tube. Half fill it with distilled water and shake well. Divide the solution into four portions.

(i) To the first portion add dilute sodium hydroxide solution dropwise till in excess.

Observation	Inference
(1 mark)	(1 mark)

(ii) To the second portion add ammonia solution dropwise till in excess.

Observation	Inference
(1 mark)	(1 mark)

(iii) To the third portion add drops of dilute barium nitrate.

Observation	Inference
(1 mark)	(1 mark)

(iv) To the fourth portion add a few drops of dilute nitric acid followed by lead (II) nitrate solution and warm.

Observation	Inference
(1 mark)	(1 mark)

Identify Compound J……..… (1 mark)

CONFIDENTIAL

CASPA AMUKURA PARISH
233/3
CHEMISTRY PRATICAL
CONFIDENTIAL INSTRUCTIONS TO SCHOOLS
In addition to fittings and apparatus found in a chemistry laboratory, each candidate will need the following.

Question one.

- Burette
- Pipette
- Filter Funnel
- Retort stand and clamp
- Conical flask, 250ml
- White tile
- Phenolphthalein indicator
- 100cm^3 of Solution K, 0.1M hydrochloric acid
- 100cm^3Solution L 2g per litre of sodium hydroxide.
- Solid **N** 0.5 g of an impure calcium carbonate, (**N** is made by mixing $CaCO_3$ and Sodium Chloride in the ratio 4:1)
- An empty 250ml beaker

Question two and three

- Solid T **sodium sulphite**
- Solid J mixture of ammonium sulphate and hydrated zinc sulphate ratio 1:1

Access to

- Distilled water in wash bottle
- Barium chloride solution
- 2M hydrochloric acid
- Acidified potassium manganate vii
- Source of heating
- Barium nitrate
- 2M nitric v acid
- Lead ii nitrate
- 2M NaOH
- Aqueous ammonia solution
- Litmus papers

CASPA AMUKURA PARISH
MARKING SCHEME

3.
a

Observation	Inference
A gas is given out which turns blue litmus paper red (1 mark)	**SO_4^{2-},CO_3^{2-} Present (1 mark)**

B(i)

Observation	Inference
White ppt is formed which dissolves in addition of exess. (1 mark)	**Al^{3+},Zn^{2+},pb^{2+} presen (1 mark)**

(ii)

Observation	Inference
White ppt is formed which dissolves in addition of exess. (1 mark)	**Zn^{2+} present (1 mark)**

(iii)

Observation	Inference
White ppt is formed (1 mark)	**SO_4^{2-}** present **(1 mark)**

(iv)

Observation	Inference
White ppt is formed which does not dissolve on warming(1 mark)	**SO_4^{2-} present / SO_3^{2-}absent (1 mark)**

AMUKURA CATHOLIC JOINT EXAMINATION CASPA
CHEMISTRY THEORY
PAPER 1

MARKING SCHEME

1. Air is a mixture of several different gases in air, which parts of air; (3mks)
   a) Supportscombustion**.....*Oxygen*.....**
   b) Puts off aburningsplint?.....***Carbon(VI)Oxide***.....
   c) Makes up almost 80% of air**?.....*Nitrogen***.....
2. In an experiment a test tube full of chlorine water was inverted in chlorine water to as shown in the diagram below and the set up was left in sunlight.
   After one day, a gas was found to have collected in the test tube.
   (a) Identify the gas.....***Oxygen*****.....** ***.(***1mk)
   (b) What will happen to the PH of the solution in the beaker after one day? Give an explanation. (2mks)
   P^H decreases.
   Chlorine water /Hypochlorous acid/Chloric (V) acid decomposes to Hydrochloric acid which has a P^H value less than 7.
3. Draw the structure and give names of three alkanes having themolecular formula of C_5H_{10}. (3mks)
4. (a) Using electrons in the outermost energy level draw the dot(.)and cross(X)diagram for the molecules H_2O and CH_4(H=1, C=12) (2mks)
   (1) H_2O
   (2) CH_4
5. The following chromatogram was obtained in an experiment to investigate the components present in certain dyes.
   (a) Which **two** dyes when mixed would produce dyeA . (1mk)
   C and D
   (b) Identify the pure dye.***B***
   (c) Define solvent front? (1mk)
   The furthest the Solvent reaches on the adsorbent material.
   B) Indicate the solvent front in the diagram using the **letter E**.
6. A diagram element **F** has atomic number 14 and consist of isotopes as shown below.

Isotopes	G	H	J
Isotopes Mass	28	29	30
Percentage abundance	92.2	4.7	3.4

   (a) Determine the relative atomic mass of **element F.** (2mks)
   (b) State the group and the period to which element **F** belongs. (1mk)
   Group 4 and period 3 ½ m each
7. Hydrogen gas can be prepared by passing steam over heated magnesium ribbon as shown.
   (a) Write an equation for the reaction that produces hydrogen gas. (1mk)
   (b) Explain why the delivery tube must be removed from beneath the water before heating is stopped. (1mk)
   To avoid sucking back of water which may cause breaking of the boiling tube.
   (c) Name the method of gas collection used in the experiment a bove. Give a reason.
   Over water method .Hydrogen gas is slightly soluble in water (1mk)
8. (a) State Charle's law (1mk)
   The volume of a given mass of gas is directly proportional to its absolute temperature at constant pressure
   (b) A gas occupies 450cm^3 at 27^{0}C.What volume would the gas occupy at 177^{0}C.If its pressure remains constant?(Give the answer in Kelvin) (2mks)
9. A certain match stick head contains potassium chlorate and sulphur. On striking, the two **substances react to produce potassium chloride and sulphur(IV)oxide respectively.**
   (a) Write an equation to show formation of sulphur (VI)oxide. (1mk)
   (b) Explain the environmental effect of using such matches in large numbers. (2mks)
   A large volume of Sulphur (IV) Oxide shall be emitted into the atmosphere .The gas dissolves in atmospheric moisture/water to form Sulphuric (VI) acid which falls down as acid rain .The acid is destructive to human health ,metallic and stone structures and plants.
10. The figure below shows a flame obtained from a Bunsen burner.
    (a) Name the type of flame. (1mk)
    Non –luminous flame

(b) A match stick head was placed at **region L** will not ignite. Explain (1mk)
Is not hot /Unburnt gas region/has pure unburnt laboratory gas

(c) Name region K . (1mk)
Grenish –blue region

11. Solutions can be classified as Acids, Bases or Neural. The table below shows solutions and their P^H values.

Solution	P^H values
N	1.5
Q	7.0
P	13.0

(a) Select any pairs that would react to form a solution of P^H 7.0 (1mk)
N and P

(b) Identify **two** solutions that would react with Aluminium hydroxide. Explain. (2mks)
Nand P
Aluminium hydroxide displays amphoterism,thus reacts with acids and bases

12. The diagram below shows part of a synthetic polymer. Study it and answer the questions that follow;
(a) Draw the structure of the monomer (1mk)

13. The diagram below shows the radiation emitted by a radioactive isotope.
Name the radiations.(3mks)
R: .....Beta particles
S: .....Gamma rays
T: .....Alpha particles

14. (a) Distinguish between a deliquescent and a hygroscopic substance. (2mks)
Deliquescent substance absorbs water from the atmosphere to form a solution while a hygroscopic substance absorbs water from the atmosphere but do not dissolve to form a solution .

(b) (i) Give one use of a deliquescent substance In the laboratory. (1mk)
Drying agent during preparation of gases

(ii) Give one example of a hygroscopic substance
Potassium nitrate/anhydrous Cobalt (II) chloride/anhydrous Copper (II) sulphate

15. Study the flow diagram below and answer the question that follow.

(a) Write an equation for the reaction taking place in **step 1.** (1mk)
$4\,Fe\,(s) + 3O_{2\,(g)} \longrightarrow 2Fe_2O_{3(s)}$

(b) Name **solution V.** (1mk)
Iron (II) Chloride

16. (a) I)white powder of magnesium oxide is formed
ii) black specks of carbon are seen
b) $2\,Mg + Co_2 \longrightarrow 2MgO + C$

17. The energy level diagram below shows the effect of a catalyst on the reaction path.
(a) What does point **M** represent? (1mk)
Maximum energy required to initiate a reaction/activation energy

(b) With reference to the energy level diagram, explain how a catalyst increases the rate of reaction. (2mks)
A catalyst lowers the activation and increases the rate of collisions of the reacting **particles.**

18. The table shoes behaviour of metals R, X , Y and Z study it and answer the questions.

Metal	Appearance on exposure to air	Reaction in water	Reaction with dilute hydrochloric acid
R	Slowly tarnishes	Slow	Vigorous
X	Slowly turns white	Vigorous	Violet
Y	No change	Does not react	Does not change
Z	No change	No reaction	Reacts moderately

(a) Arrange the metals in the order of reactivity starting with the **most reactive** (2mks)
R,X,Z,Y.

(b) Name a metal which is likely to be ; (2mks)
1)X:***Sodium metal***
11)Y:***Copper metal***

20. The following chart below shows some properties of two allotropes of **element P**.
    (a) Name allotrope A (1mk)
    Rhombic Sulphur
    (b) Write an equation to show formation of product P (1mk)
    (c) What does 96 ^{0}C represent?
    Transition temperature

21. Complete the following table by filling in the missing test and observations.

NO	Gas	Test	Observation
II.	Ammonia	Put a moist red, then blue litmus into the gas	***Red litmus turns blue while blue remains blue***
2	Sulphuric(V) oxide	***Potassium dichromate paper***	Paper turns green
3	Butene	Add a drop of bromine water	***Yellow bromine water turns colourless***

22. An organic compound contains 24.24%carbon,4.04% hydrogen and the rest chlorine.If its relative molecular mass is 99.What is its molecular formula ?(C=12,H=1,Cl:35.5) (3mks)
23. Study the diagram below and answer the questions that follow
    (a) Define the term electrolysis. (1mk)
    Is the process of decomposing an electrolyte by passing an electric current through it
    (b) On the diagram, label the Anode and the Cathode. (2mks)
    (c) Write the equation for reaction taking placeat the Cathode. (1mk)
24. Hardness of water may be removed by either boiling or addition of chemicals
    (a) Name the two types of water hardness. (2mks)
    - ***.Permanent water hardness***
    - ***Temporary water hardness***

    (b) A sample of river water was divided into three portions, the table shows the test carried out on the portion and observations made. Complete the table by filling the inferences. (3mks)

Test	Observation	Inference
To the first portion,1cm^3 of soap solution was added.	No lather formed	***Hard water***
The second portion was boiled ,cooled and 1cm^3 of soap solution was added.	No lather was formed	***Permanent hardness***
To the third portion ,3cm^3 of aqueous sodium carbonate was added ,the mixture filtered and 1cm^3 of soap solution added to the filtrate.	Lather formed immediately	***Ca^{2+},Mg^{2+} ions are removed through precipitation***

25. The figure below shows an energy cycle diagram.
    (a) Give the name of the enthalpy change H1
    Enthalpy of Combustion of hydrogen
    (b) Determine the value of H3 (2mks)
26. Dry ammonia and dry oxygen were reacted as shown in the diagram.
    (a) What is the purpose of the glass wool? (1mk)
    To spread out the Oxygen gas.
    (b) What product would be formed if red- hot platinum was introduced in to a mixture of ammonia and oxygen? (1mk)
27. Study the diagram below.
    Identify apparatus A ,B and C. (3mks)
    A: Thistle funnel
    B: Delivery tube
    C:Round –bottomed flask
28. Explain why Nitrogen gas requires a lot of heat when reacting with Oxygen. (2mks)

AMUKURA PARISH JOINT EXAM 2021
CHEM PP2 MARKING SCHEME

1. (i) Noble gases √1
   (ii) D_2SO_4 √1
   (iii) (a) Y √1
   (b) E √1
   (iv) Ionic bond √1 – Because B reacts by losing an electron (s) which are gained by H. √1 accept transfer of electrons from a metal to non metal
   (v) D//M √1 Any ½ mark each
   (vi) Because E reacts by gaining an extra electron which reduces √1 the electrostatic pull by the positive nucleus making the ionic radius increase. Or incoming electron causes increased repulsion wtte
   (vii) At Period III Group IV
   (viii) Because of the increase in the strength of the molecular bonds in the oxide of L as compared to that of G. √1 w.t.t.e
   (ix) C has a smaller atomic √1 radius than I because of the increase in the strength of the Nucleur foce of attraction in C as the number of protons increase √1 w.t.t.e
   (x) 1st ionization energies increases from J – L across the period due to addition of an extra proton in the nucleus increasing the attraction of the valency electrons √

2 a) i) A solution that cannot dissolve any more of the solute at that particular temperature. ✓ 1mk
   ii) Scientific technique used to separate substances due to their differences in their crystallization temperature. ✓ 1mk or w.t.t.e

b) i) on the scanned graph

   ii) x=100g/100ml, y=40g/100ml
   iii) 5°c
   iv) type of hardness that cannot be removed by boiling

3. a) (i) Fractional distillation✓ 1mk
   (ii) Argon//neon/xenon//krypton✓ 1mk

   b) A Sulphur✓1mk
   B Ammonia gas✓1mk
   C sulphur (vi) oxide✓1mk
   D Ammonium sulphate✓1mk

   c) (i) Finely divided iron✓1mk
   (ii) Vanadium (v) oxide✓1mk
   (iii) The catalysts <u>fasten</u>✓1mk the Haber & contact processes by <u>lowering the activation energy</u>✓1mk of the reactions//the <u>rate of production</u> is increased.

   d) (i) $H_2SO_{4(aq)} + 2NH_{3(g)} \longrightarrow (NH_4)_2SO_{4(aq)}$✓1mk
   (ii) Formula mass of $(NH_4)_2SO_4$ = 2(14+4) + 32 + 4(16)
   = 132grams✓ ½ mk

$$\% \text{ of N} = \frac{28}{132} \times 100 \checkmark 1mk$$

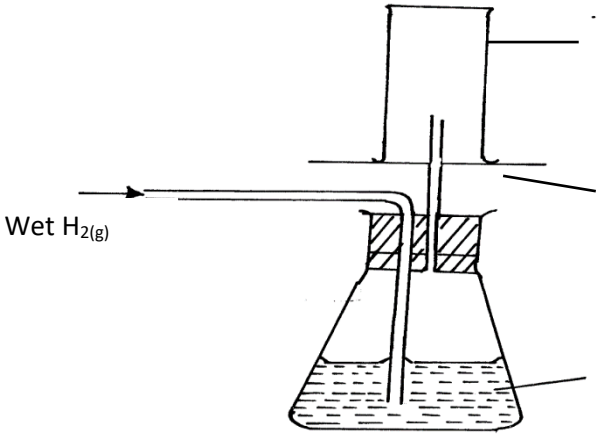
   = 21.212%✓ ½ mk

   (iii) Use as a fertilizer✓1mk

4. a) I: The outlet delivery tube should not dip into the Zinc/dilute Sulphuric acid mixture in the round buttoned flask. ✓ 1mk

II: The use of heat is not required ✓ 1mk

b)



c) i) It is denser than air ✓1 mk

ii) $H_{2(g)} + ½ O_{2(g)} \xrightarrow{ht} H_2O_{(g)}$✓ balancing½ mark, states ½ mark

d) $Zn_{2(s)} + H_2SO_{4(aq)} \longrightarrow ZnSO_{4\,(aq)} + H_{2(g)}$ balancing ½ mk, states ½ mk

1vol 1 vol 1vol

$\left[\frac{6.54}{R}\right]$ $\left[\frac{2.4}{24}\right]$

Therefore, $\left[\frac{6.54}{R}\right] = \frac{2.4}{24}$, ✓1mk $where R = R.A.M\ of\ Zinc$

$$R = \frac{24 \times 6.54}{2.4}$$

Or R = 65.4 ✓ 1mk

e) $H_{2(g)}$ is used in balloons by meteorologists ✓1mk

It is used as rocket fuel ✓ 1mk

5.

(a) Heating copper (ii) oxide √*1mk*

(b) Black solid would turn brown √*1mk*

(c) $CuO_{(s)} + CO_{(g)} \longrightarrow Cu_{(s)} + Co_{2(g)}$ √*1 ½ mk*

(d) $2CO_{(g)} + O_{2(g)} \longrightarrow 2CO_{2(g)}$ √*1 ½ mk*

(e) It is poisonous √*1mk*

(f) (i) Reducing agent - Carbon(ii) oxide √*1mk*

(ii) Oxidisingagent -Copper (ii) oxide √*1mk*

(g) Hydrogen / ammonia gas (Any one) √*1mk*

(h) There would be no observable change √*1mk.* This is because sodium is higher than carbon in the reactivity series and therefore has higher affinity of oxygen √*1mk*

6.

a) Concentrated sulphuric (vi) acid √*1mk*

b) It is denser than air √*1mk*

c) It turns red then white. √*1mk*

It turns white / it gets bleached √*1mk*

d) $Cl_{2(g)} + H_2O_{(l)} \longrightarrow HOCl_{(aq)} + HCl_{(aq)}$ √*1mk*

e) PCl_3 √*1mk*
PCl_5 √*1mk*

f) A yellow deposit of sulphur is formed / seen √*1mk*
Chlorine oxidizes sulphideions to solid sulphur √*1mk*

g)
- Manufacture of hydrochloric acid √*1mk*
- Manufacture of bleaching agents such as chlorate used in the cotton and paper industries
- Chlorine is used in the treatment of water and sewage plants
- Manufacture of chloroform as an anaesthetic
- Manufacture of solvents such as trichloroethane

Any one

7.

a) A - Filtration √*1 ½ mk*
B - Absorption √*1 ½ mk*
M - Isolation of water √*1 ½ mk*
D - Cooling √*1 ½ mk*

b) Liquids – NaOH (aq) / KOH (aq) √*1mk*
Substance T – Ice / water √*1mk*

c) To increase surface area forcooling √*1 mk*

d) (i) Oxygen is used to remove impurities during steel making √*1 mk*
(ii) Is used in cutting and welding of metals √*1 mk*

e) $2H_2O_{2(l)} \xrightarrow{MnO_{2(S)}} 2H_2O_{(l)} + O_{2(g)}$ √*1 mk*

f) (i) R -Rusting occurred √*1 ½ mk* because of air and water being present √*½ mk*
S - No rusting √*½ mk* Water is absent √*½ mk*
T - No rusting √ *½ mk* Air is absent √*½ mk*
(ii) To prevent rusting √*1mk*
To increase aesthetic value of the metal

(1 Mark)	(1 Mark)

3. You are provided with **Solid J**. Carry out the tests below and record your observations and inferences in the spaces provided.

a) Burn half of **Solid J** on a non-luminous flame of a Bunsen burner.

Observation	**Inference**
(1 Mark)	(1 Mark)

b) Put the remaining amount of **Solid J** in a boiling tube. Add about $10cm^3$ of distilled water and shake thoroughly. Divide the mixture into 2 portions. To the 1st portion, add 3 drops of $NaHCO_3$ solution.

Observation	**Inference**
(1 Mark)	(1 Mark)

c) To the 2nd portion, add 3 drops of acidified potassium manganate (VII) solution.

Observation	**Inference**
(1 Mark)	(1 Mark)

BSJE 2021
CHEMISTRY PAPER 3
23313
MARKING SCHEME

TABLE 1

Volume of water in the boiling tube	4	6	8	0
Temperature when crystals first appear	75	72	65	54
Solubility g/100g of water	112.5	75	56.25	45

5 marks

Graph

TEMPERATURE (°C)
Read from the graph at 68°C

TABLE 2a

TEMPERATURE (°C)	**80**	**70**	**60**	**50**
TIME(s)	**5**	**10**	**20**	**40**
1/t (s	**0.200**	**0.100**	**0.050**	**0.025**

5marks

Graph

TOTAL-3

ii) State and explain the shape the your graph
Ans. The graph is an exponential curve; rate of reaction increases exponentially with increase in temperature
iii) What does 1/t represent in your graph?
Ans. Rate of reaction
iv) From the graph determine the time the mixture will decolorize if the experiment is carried out at 65°C
At 65°C, 1/t =y
t=1/y

Q 02

OBSERVATIONS	**INFERENCES**
a) White solid dissolves in distilled water to form a colorless solution	**Absence of colorless ions e.g. Fe, Fe^{3+}** or Cu // soluble salt
b) i.No white precipitate is formed	Ca ,Mg Al^{3+} Zn or Pb absent
ii. No white precipitate is formed	SO_4 SO_3 or CO_3 absent
iii. Yellow precipitate is formed	I^- Present
iv Lilac/ bluish purple/purple flame	**K^+** Present
v. Dark brown solution is formed	I^- Present

Q 03

(i)Melts and burns with yellow sooty/smokey flame	= C =C= // ---C≡C---Present // Unsaturated Organic compound// Long chain hydrocarbon
(ii) Gas bubbles/Effervescence/Fizzing	---COOH/R—COOH/H^+ /H_3O^+ Present
(iii) Purple acidified KMnO$_4$ (aq). Decolorizes	C=C= // --C≡C- present

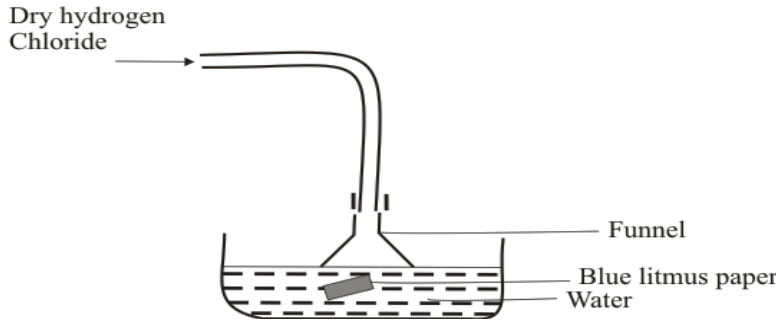
LANGA'TA / KIBRA CLUSTER
233/1
CHEMISTRY PAPER 1
(THEORY)

1. Explain why burning magnesium continues to burn in a gas jar full of sulphur (IV) oxide while a burning splint would be extinguished. (3 marks)
2. Calculate the heat of formation of carbon (II) oxide from the following data. (2 marks)

$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)} \quad \Delta H_1 = -394$ kJ/mol

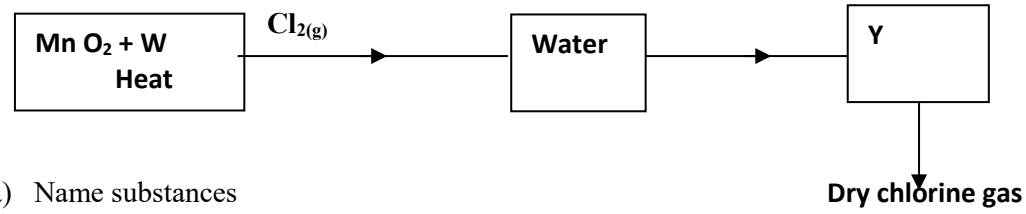
$CO_{(g)} + \frac{1}{2} O_{2(g)} \longrightarrow CO_{2(g)} \quad \Delta H_2 = -285.6$ kJ/mol^{-1}

3. Dry Hydrogen chloride gas was made to dissolve in water using the set of apparatus shown below



(a) What is the use of the inverted funnel? (1 mark)
(b) State and explain the observations made on the litmus paper (1 mark)
(c) State and explain the observation made on the litmus paper if methylbenzene is used instead of water in the above set up. (1 mark)

4. Using sodium hydroxide solution, describe a chemical test that can be used to distinguish between copper (II) ions and iron (II) ions (2 marks)
5. The flow chart below shows laboratory preparation of chlorine gas. Study it and answer the questions that follow: (2 marks)



(a) Name substances
W
Y
(b) What is the function of water in the above set up? (1 mark)

6. An unknown mass of anhydrous potassium carbonate was dissolved in water and the solution made up to 200cm^3. 25cm^3 of this solution neutralized 18.0cm^3 of 0.22M nitric (v) acid. Calculate the unknown mass of potassium carbonate (**K**=39, **C**=12, **O**=1) (3 marks)
7. The following are some half cell electrode potentials with respect to copper

	E/V
$K^+_{(aq)} + e^- \longrightarrow K_{(s)}$	-2.99
$Na^+_{(aq)} + e^- \longrightarrow Na_{(s)}$	-2.75
$Ca^{2+}_{(aq)} + 2e^- \longrightarrow Ca_{(s)}$	-2.86
$Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu_{(s)}$	0.00
$Hg^{2+}_{(aq)} + 2e^- \longrightarrow Hg_{(l)}$	+0.87
$Ag^+_{(aq)} + e^- \longrightarrow Ag_{(s)}$	+0.79

(a) Explain why the electrode potential of copper is zero (1 mark)

(b) Identify the weakest oxidizing agent (1 mark)

(c) Work out the e.m.f of a cell represented (1 mark)

$$Na_{(s)} \mid Na^{+}_{(aq)} \;//\; Ag^{+}_{(aq)} \mid Ag_{(s)}$$

…… ……

8. Below is a sample of the periodic table

I						Q	M	
	J						N	
K	L		P					

(a) Give the family name to which elements **M** and **N** belong (1 mark)

(b) Compare the reactivity of elements **I** and **K**. Give a reason (1 mark)

(c) Write the formular of the compound formed when **P r**eacts with **Q** **(1 mark)**

9. Study the reaction equation given below

$$H_{2(g)} + Br_{2(g)} \rightleftharpoons 2HBr(g)$$

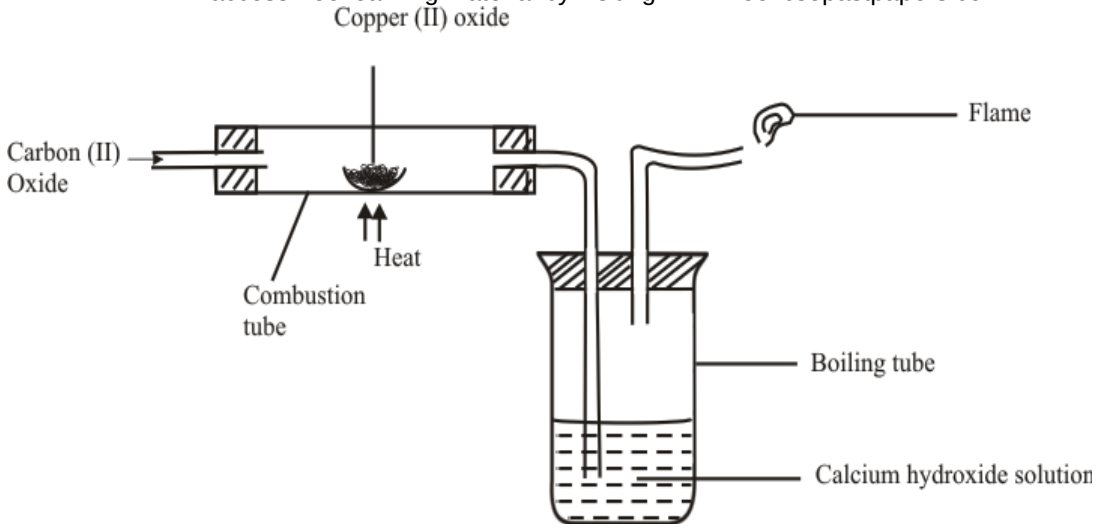
(a) $\Delta H = -74.4k\ J$

On the same axes

(a) Draw an energy level diagram showing the catalysed and uncatalysed reaction (2 marks)

(b) State the effect on formation of hydrogen bromide if pressure was increased in the reaction above. Explain (2 marks)

10. Study the experimental set up of apparatus shown below.



(i) State two observations made in the set up as the experiment progressed (2 marks)

(ii) Using an equation, explain the change that occurred in the boiling tube (1 mark)

(iii) Why was the gas burned in the flame? (1 mark)

11. (a) What is half-life? (1 mark)

(b) If a radioactive isotope has a half-life of 2.5 hours, how long will it take for its mass to reduce to ⅛ (2 marks)

12. Calculate the solubility of sugar in water at 40°C from the following information. (3 marks)

Mass of evaporating dish =23.0g

Mass of evaporating dish + saturated solution =192.0g

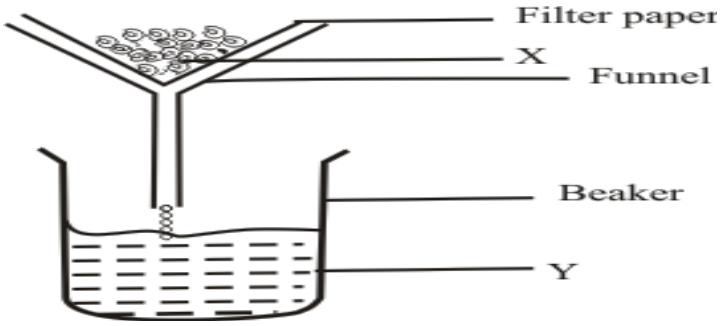
Mass of evaporating dish + solid after evaporation of solution =142.0g

13. Painting, oiling, galvanizing and tin plating are methods of rust prevention.
    (a) Explain the similarity of these methods in the way they prevent rusting (1 mark)
    (b) Explain why galvanized iron objects are better protected even when scratched (1mark)
14. The chemical equations below are the main reactions in large scale manufacture of sodium carbonate.

$$NH_{3(g)} + CO_{2(g)} + H_2O_{(l)} \longrightarrow NH_4HCO_{3(aq)}$$

$$NH_4HCO_{3(aq)} + NaCl_{(aq)} \longrightarrow NaHCO_{3(s)} + NH_4Cl_{(aq)}$$

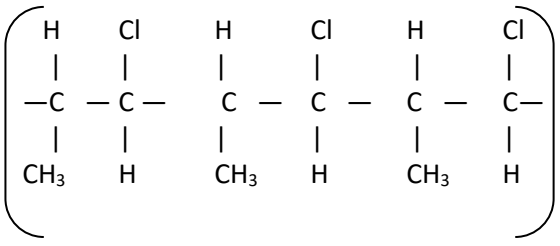
    (a) Explain how the two products $NaHCO_3$ and NH_4Cl are separated (1 mark)
    (b) How sodium carbonate is finally obtained? (1 mark)
    (c) Explain how ammonia is recovered in this process. (1 mark)
15. 80 cm^3 of oxygen gas diffused through a porous hole in 50 seconds. How long will it take 120cm^3 of Nitrogen (IV) oxide to diffuse through the same hole under the same conditions?
    (N =14, O=16) (3 marks)
16. Filtration is carried out in the apparatus shown



    Name **X** (1 mark)
    Y (1 mark)
17. Two carbonates **P** and **Q** are weighed before and after heating. The results are given in the table below.

Carbonate	Mass in grams	
	Before heating	After heating
P	15.0	15.0
Q	15.0	10.0

    Which one is likely to be sodium carbonate? (2 marks)
18. The structure given below is for a certain polymer

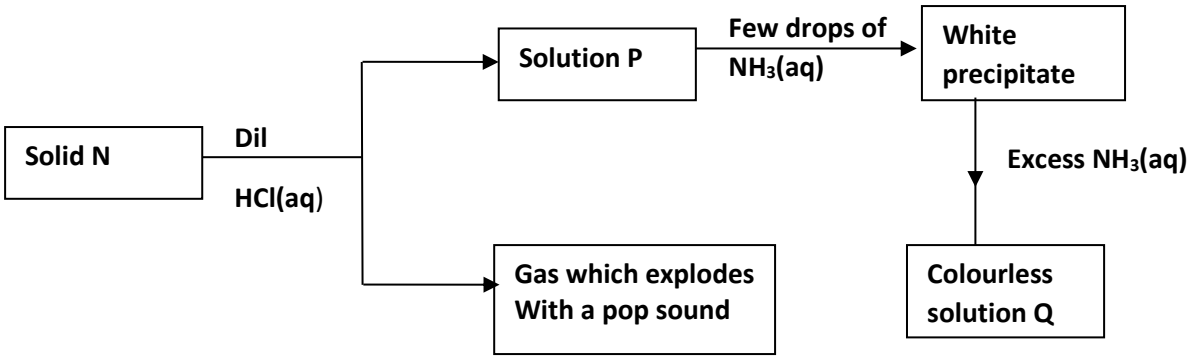


    (a) Draw the structure of the monomer (1 mark)
    (b) Given that the molecular mass of the polymer is 4590, calculate the number of monomers present in the polymer (C=12.0, H=1.0. Cl=35.5) (2 marks)

19. Describe how you would separate a solid mixture of lead(II) chloride and copper(II) oxide (3 marks)

20. The general formula for a homologous series of organic compounds in $C_nH_{2n+1}OH$
    (a) Give the name and structural formula of the fourth member of the series (2 marks)
        (i) Name
        (ii) Structural formula
    (b) Write an equation for the reaction between the molecule in (ii) above and propanoic acid. (1mark)

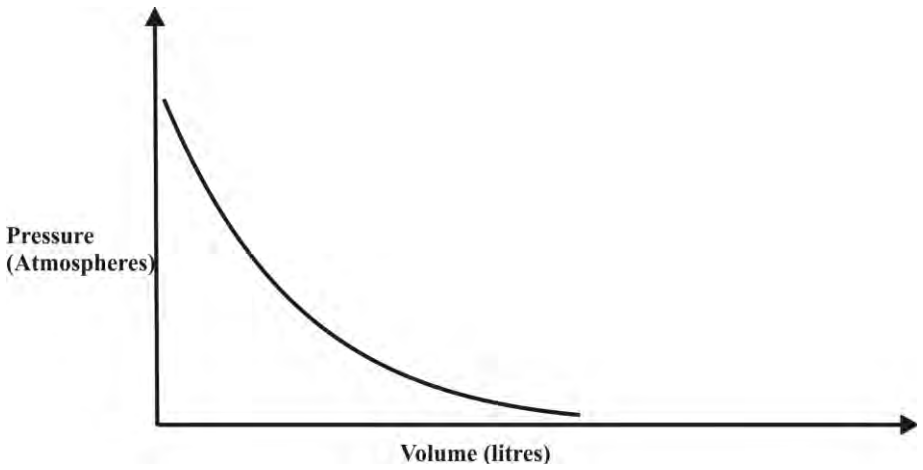
21. The scheme below shows some reactions sequence starting with solid **N**. Study it and answer the questions that follow:



    (a) Identify solid N
    (b) Write the equation for the formation of the colourless solution Q (1 mark)

22. In an experiment, a gas jar containing moist sulphur (IV) oxide was inverted over another gas jar containing hydrogen sulphide gas.
    (a) State and explain the observation that was made (2 marks)
    (b) State the precautions that should be taken when carrying out this experiment (1 mark)

23. The graph below shows the behaviour of a fixed mass of a gas at constant temperature



    (a) What is the relationship between the volume and pressure of the gas? (1 mark)
    (b) 3 litres of oxygen gas at one atmosphere pressure were compressed to two atmospheres at constant temperature. Calculate the new volume occupied by the oxygen gas. (2 marks)

24. The table below shows the relative atomic masses and percentages abundance of the isotopes $\mathbf{M_1}$ and $\mathbf{M_2}$ of element **M**

	Relative abundance	% abundance
M_1	**60.57**	**59.71**
M_2	**62.83**	**40.29**

Calculate the relative atomic mass of element **M** (2 marks)

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

Bond	Bond energy ($kJmo1^{-1}$)
C-H	414
Cl – Cl	244
C – Cl	326
H – Cl	431

Calculate the enthalpy change of the reaction (3 marks)

$$CH_{4(g)} + Cl_{2(g)} \longrightarrow CH_3Cl_{(g)} + HCl_{(g)}$$

26. In the redox reaction below.

$$2H^+_{(aq)} + Cr_2O_7^{2-}{}_{(aq)} + 3SO_{2(g)} \longrightarrow Cr^{3+}_{(aq)} + 3SO_4^{2-}{}_{(aq)} + H_2O_{(l)}$$

Identify the reducing agent, explain your answer (2 marks)

27. The table below shows the pH values of solutions **A,B,C** and **D**

solution	A	B	C	D
pH	2	7	11	14

(a) Which solution is likely to be that of calcium hydroxide (1 mark)

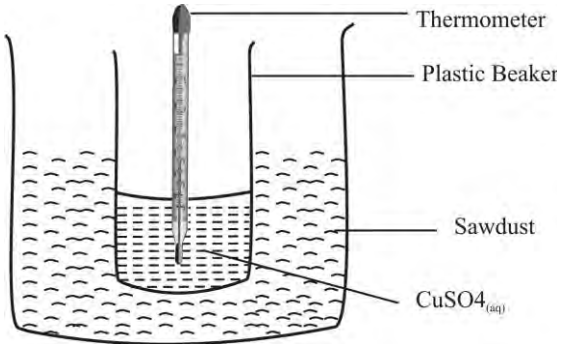
(b) Select the solution in which a sample of aluminum oxide is likely to dissolve. Give a reason for your answer (1 mark)

28. Name one property of neon that makes it possible to be used in electric lamps. (1mark)

29. Distinguish between ionic bond and covalent bond (2 marks)
30. Explain why the boiling point of ethanol is higher than that of hexane. (relative molecular mass of ethanol is **46** while that of hexane is **86**) (2 marks)
31. When a student was stung by a nettle plant, a teacher applied an aqueous solution of ammonia to the affected area of the skin and the student was relieved of pain. Explain (2 marks)

LANGA'TA / KIBRA CLUSTER
233/2
CHEMISTRY
Paper 2
(THEORY)
DECEMBER 2021

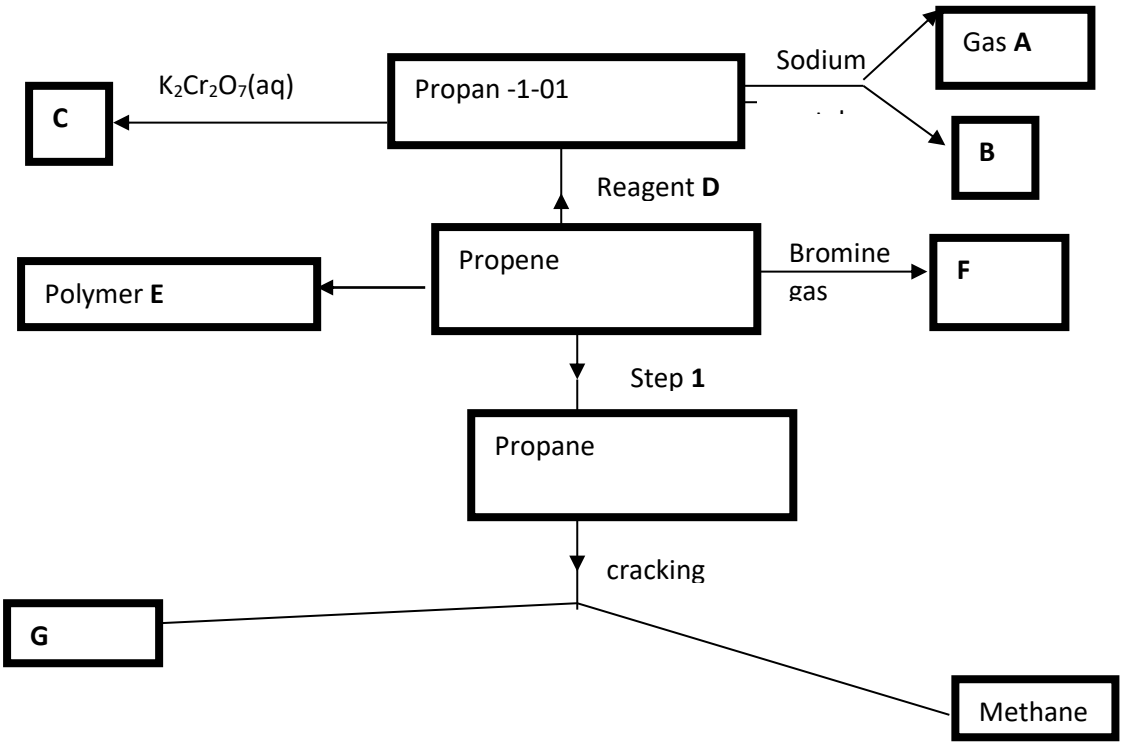
1. The diagram below shows a set up for the determination of enthalpy of displacement for the reaction between zinc metal and copper (II) sulphate solution



(a) Define molar heat of displacement (1 mark)
(b) Write an ionic equation for the reaction that takes place in this experiment (1 mark)
(c) What is the function of the saw dust in the set up (1 mark)
(d) State and explain two observations made at the end of this experiment other than rise in temperature (3 marks)
(e) 4 g of the zinc powder were added to $50cm^3$ of 0.25M copper (II) sulphate solution. The mixture was stirred with the thermometer and the highest temperature recorded.

Final temperature = 34.5°C
Initial temperature = 22.0°C
Calculate the molar heat of displacement of copper by zinc (Zn=65) (4marks)
(f) Sketch an energy level diagram for the above reaction (2 marks)

2. The scheme below shows a series of reactions and compounds. Study it and use it to answer the questions that follow.



(a) Identify the following compounds and products (6marks)
A B C E F G
(b) State 2 conditions for **step 1** to occur (1mark)
(c) Write an equation leading to reaction of propene to form compound **F** (1 mark)
(d) Identify reagent **D** (1 mark)
(e) State one industrial use of methane (1 mark)
(f) Name the following organic compounds (3 marks)
(i) C_3H_4

(ii) $CH_3CH_2\ CH_2\ CH\quad CH_2\ CH_3$

|

OH

(iii) $CH_2 = C - CH_3$

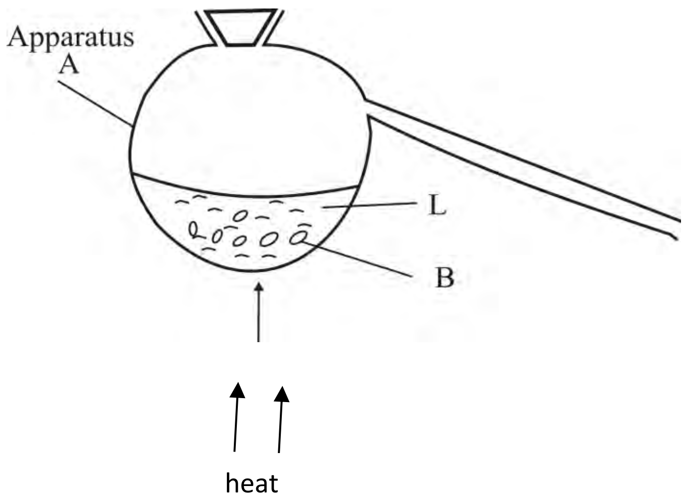
|

3. Study the data below and answer the questions that follow. The letters don't represent the actual symbols of the elements

Elements	No of protons	Melting point oC	Boiling point oC
P	11	98	890
Q	12	650	1110
R	13	660	2450
S	14	1410	2680
T	15	443 590	280
U	16	113	445
V	17	-101	-35
W	18	-189	-186

(a) Write the electronic configuration of
(i) element **S** (1 mark)
(ii) ion of **R** (1 mark)
(b) State and explain the trend in the melting point of elements **P, Q** and **R** (3 marks)
(c) Why does element **T** have 2 melting point values (2 marks)
(d) Write the formula of the nitrate of element **R** (1 mark)
(e) In terms of structure and bonding, explain why element **S** has a high melting point (2 marks)
(f) What is the nature of the oxide of element **U**? Explain (2 marks)
(g) State one use of element **U**

4.



The above set up is used to prepare Nitric (V) acid in the laboratory.

(a) Complete the set-up (3 marks)

(b) Name substances

B…….. L…… (2 marks)

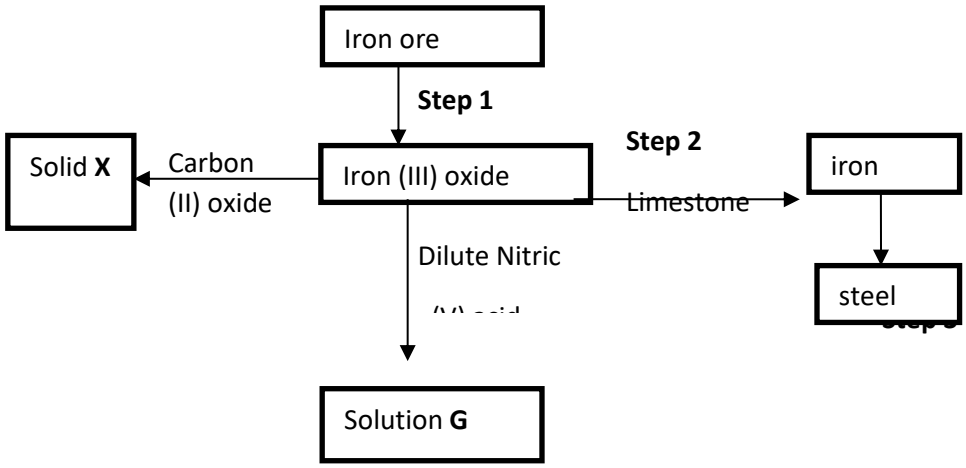
(c) Name apparatus **A** . (1 marks)

(d) Write an equation between substances **B** and **L** (1 mark)

(e) During preparation of hydrogen gas Nitric (V) acid is not used. Explain (2 marks)

(f) Give two commercial use of Nitrogen (2 marks)

5. The chart below shows reactions starting with iron ore. Study it and answer the questions that Follow



i) Where does step **2** occur (1 mark)

ii) What is removed in step **1** (1 mark)

iii) Write an equation for the formation of solid **X** (1 mark)

iv) Identify what is added in step **3** (1mark)

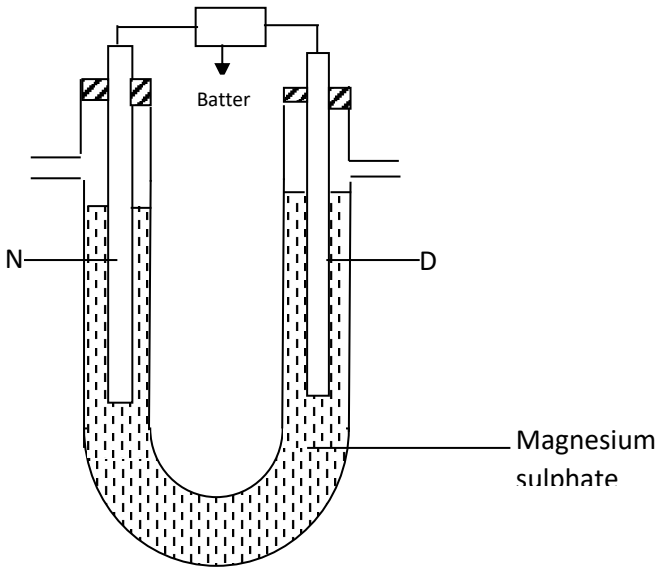
v) 5cm^3 sodium sulphite solutions was added to solution **G** and warmed. State and explain the Obs ervations made. (3 marks)

II (a) Name two major ores that are used in extraction of aluminum (2 marks)

(b) In the electrolysis process during aluminum extraction, write the two equations of the reactions taking place at the anode (2 marks)

(c) Give one industrial use of aluminum (1 mark)

6. Study the information below and answer the questions that follow. When an electric current is passed through magnesium sulphate as shown in the diagram, a gas that re-lights a glowing splint is produced at electrode **N**



(i) Which of the electrodes is the anode? Give a reason (2 marks)
(ii) Write an equation for the reaction taking place at electrode **N** (1 mark)
(iii) State and explain the observation made at electrode **D** (2 marks)
(iv) How is the product at **D** collected (1 mark)
(v) 0.45A of current was passed for 72 minutes during electrolysis in (i) above. Determine the volume of gas produced at electrode **N. (1 faraday =96 500 coulombs, molar gas volume is 22.4 litres)** (3 marks)
(vi) State one use of electrolysis (1 mark)

7. (a) The following is a radioactive decay series starting with $^{214}_{83}Bi$ it and answer the questions that follow

Identify the particles emitted in: (2 marks)
Step 1 ……
Step 2 ……
(ii) Write the nuclear equation for step 1 (2 marks)

(b) (i) 160g of Bi -214 has a half -life of 4 days and decays for 16 days. On the grid provided, plot a graph of the mass of Bi -214 against time (3 marks)
(ii) Using the graph determine the mass of **Bi** after 10 days (2 marks)
(iii) How is radioactivity used in paper industry (1 mark)

LANGA'TA / KIBRA CLUSTER
233/3
CHEMISTRY PRACTICAL
PAPER 3

1. Solution A is prepared by dissolving 6.3g of the organic acid $H_2C_2O_4.nH_2O$ in water to make a litre of the solution.
Solution B: 0.1M NaOH solution
Phenolphthalein indicator
Clamp and stand
Burette and pipette.
You are required to determine the value of n in the organic acid $H_2C_2O_4.\ nH_2O$

Procedure.
Fill the burette with solution A and adjust the volume to zero mark.
Add 2 to 3 drops of phenolphthalein indicator and titrate solution A against solution B until thecolour just permanently changes. Record your results in the table below. Repeat the procedure two more times to obtain concordant results.

a)

Titration	**1**	**2**	**3**
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution A used (cm^3)			

4marks

b) Calculate the average volume of solution A used. **1mark**
c) Calculate the moles of sodium hydroxide in the volume of solution B used. **2marks**
d) Given that solution B - Sodium hydroxide and solution A organic acid react in the ration of 2:1, calculate the number of moles of the organic acid –solution A used? **2marks**
e) Calculate the moles of organic acid solution A used per litre of solution **2marks**
f) Calculate the relative formula masses of the organic acid solution A **3marks**
g) Calculate the value of n in $H_2C_2O_4.nH_2O$(H=1, C=12, O=16) **3marks**

2. You are provided with CBI. Carry out the test below. Write your observation and inferences in the spaces provided.

a) Using a clean spatula, heat about one third of the solid CBI in a non- luminous Bunsen burner flame.
Observation **Inference**
1mark **1mark**

b) Put a half spatula endful of CBI in a test tube. Heat gently and then strongly. Test for any gas produced using litmus papers.
Observation **Inference**
1mark **1mark**

c) Put 2cm^3 of dilute hydrochloric acid into a test tube. Add ¼ endful of CBI into the test tube.
Test for any gas procedure.
Observation Inference
2marks **2marks**

3. You are provided with solid Q, carry out the test below. Record your observations and inferences in the table. Identify any gas (es) evolved.
Place all the solid Q provided into boiling tube and add distilled water until the tube is ¼ full. Divide it into five portions.

a) To the 1st portion add ammonia solution drop wise until excess.
Observation Inferences
1mark **1mark**

b) (i) To the 2nd portion add sodium hydroxide solution dropwise until in excess. Keep the resulting mixture for the next test.
Observation **Inference**
1mark **1mark**

ii) Warm the preserved mixture from b (i) above
Observation **Inferences**
1mark **1mark**

c) i) To the 3rd portion add silver nitrate solution. Preserve the mixture for the next test.
Observation **Inferences**
1mark **1mark**

ii) To the preserved mixture in c (i) above add diluted nitric acid.
Observation **Inferences**
1mark **1mark**

d) To the 4th portion add dilute Barium nitrate solution followed by dilute nitric acid.
Observation **Inferences**
1mark **1mark**

e) To the 5th portion add 2-3 drops of conc. Nitric acid.
Warm the mixture and allow to cool. Add sodium hydroxide solution dropwise until in excess.
Observation **Inferences**

1mark

LANGA'TA / KIBRA CLUSTER
233/3
CHEMISTRY PAPER 3
(PRACTICAL)
CONFIDENTIAL

Per Student

1. Solution A (100ml)
2. Solution B (100ml)
3. Phenolphthalein indicator
4. 3 conical flasks
5. Funnel
6. Burette
7. Pipette
8. Clamp
9. Stand
10. CBI (g) – $NaHCO_{3(s)}$
11. Clean spatula
12. Test- tubes (5)
13. Litmus papers (2 blue and 2 red)
14. Distilled water
15. Solid Q – 1g $(NH4)_2\ SO_4.FeSO_4.\ 6H_2O$ and NaCl (ration 1:1)
16. 1 boiling tub

Access to;

17. 2M ammonia solution
18. 2M Sodium hydroxide solution
19. Source of heat
20. Silver nitrate solution (0.05M)
21. Dilute nitric acid (0.1M)
22. Dilute hydrochloric acid (0.1M)

23. Dilute Barium nitrate solution (0.1M)
24. Conc. Nitric acid in dropper bottles
25. White tile
26. Test tube holder

- Solution A is prepared by dissolving 6.3g of $H_2C_2O_4.\ 2H_2O$ in $400cm^3$ of water and topped upto one litre of solution.
- Solution B is prepared by dissolving 4g of Sodium hydroxide in $400cm^3$ of water and topped upto one litre of solution.

LANGA'TA / KIBRA CLUSTER
CHEMISTRY MARKING
SCHEME PAPER 1

1. Heat from magnesium splits✓1 sulphur (iv) oxide into sulphur and oxygen, the oxygen ✓1 supports burning. Heat from burning splint is not hot ✓1 enough to split sulphuric oxide
2. $-DH_2 + DH_1$
   285.6 – 394✓1 = -108.4 KJmol$^-$✓1
3. (a) to prevent sucking back of water✓1
   (b) litmus paper changes red✓½ hydrogen chloride ionizes into $H^+_{(aq)}$ ✓½
   (c) Litmus paper remains✓½red; Hcl does not ionise½
4. When $NaOH_{(aq)}$ is added to $Cu^{2+}_{(aq)}$ a blue✓1 precipitate is obtained while a green✓1 precipitate is formed when NaOH is added to $Fe^{2+}_{(aq)}$
5. W – hydrochloric acid✓1
   Y – Concentrated sulphuric(VI) acid✓1
   (b) Absorb Hcl fumes✓1
6. Mols of HNO_3 $\frac{18\ x\ 0.22}{1000}$ = 0.00396 ✓½moles
   $K_2CO_3 + 2HNO_{3(aq)} \longrightarrow 2KNO_{3(aq)} + H_20_{(l)} + CO_{2(g)}$ ✓½

moles of K_2CO_3 in $25cm^3$ soln $= \frac{0.000396}{2} = 0.00198$ moles✓½

moles of K_2CO_3 in $200cm^3$ soln $= \frac{0.00198 \times 200}{25} = 0.01584$✓½

$K_2CO_3 = 138g$✓½

Mass of $K_2CO_3 = 138 \times 0.01584 = 2.186$ g✓½

7 (a) It is the reference electrode✓1

(b) K/potassium✓1 reject K^+

(c) E oxidized - E reduced = e.m.f

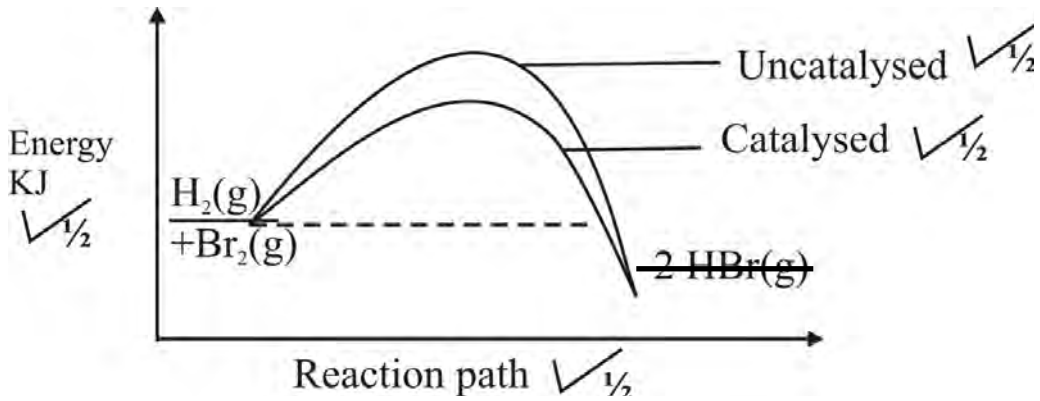
0.79 - (-2.75) ✓½ = +3.54 v ✓½

8 (a) Halogens✓½

(b) K is more reactive than ✓½ **I**; valence electron is **K** is lost more✓½ easily than in **I**

(c) P_2Q_3✓

9(a)



(b) No✓1 effect, both reactants and product✓1 occur equal no of moles/volume

10 (i) copper (II) oxide changes from black to red✓½

White precipitate in the boiling tube✓½

(ii) $Ca(OH)_{2(aq)} + CO_{2(g)} \longrightarrow CaCO_{3(s)}$ ✓1

(iii) It is burned to avoid air pollution✓1

11 (a) time taken for a sample of radioactive isotope to decay to half the original mass

(b) 1 $\xrightarrow{\text{2.5 Hrs}}$ ½ $\xrightarrow{\text{2.5 Hrs}}$ ¼ $\xrightarrow{\text{2.5 Hrs}}$ ⅛

Time taken = 7.5 Hrs

12 Mass of solution 192 – 23 = 169g✓½

Mass of solid 142 – 23 = 119g✓½

Mass of water 169 – 119 = 50g✓½

Solubility of salt $= \frac{119}{50}$ x 100✓

= 238g/✓½ 100gH_2O

13 (a) prevent contact of iron with water✓1

(b) zinc corrodes✓½ its more✓½ reactive than iron

14 (a) by filtration✓½

(b) heating✓ ½NaaHCO₃/ accept correct equation.

(c) Ammonium chloride is heated with calcium oxide✓½

15 $\frac{T\ O_2}{T\ NO_2} = \sqrt{\frac{MO_2}{NO_2}}$ ✓½

$80cm^3$ O2 ⟶ 50 sec. $O_2 = 32$

$120cm^3$ O_2 ⟶ 75 sec. ✓½ $NO_2 = 44$ ✓½

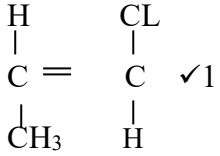
$\frac{75}{T NO_2} = \sqrt{\frac{32}{44}}$ ✓½

$TNO_2 = 87.94$ sec. ✓½

16. X:---------- Residue ✓½
Y …….Filtrate ✓½

17 P✓; not decomposed ✓1 by heat

18 (a)



(b)Molar ✓½

No of monomers $=\frac{4590}{76.5}$ ✓
$= 60$✓½

19 Add✓½water; warm✓½$PbCl_2$ dissolves,½ ✓ filter. ✓½ allow to cool. ✓½ filter✓½ recrystalised $Pbcl_2$

20 (a)(i) Butanol✓1
(ii) C_4H_9OH✓1
(b) $C_4H_9OH + C_4H_5COOH \longrightarrow C_2H_5COOC_4H_9 + H_20$✓1

21 (a) zinc✓½
(b) $Zn(OH)_{2(s)} + 4NH_{3(aq)} \longrightarrow Zn(NH_3)_4^{2+} + 2OH^-_{(aq)}$

22 (a) Yellow solid deposited✓1; sulphur(IV) oxide is reduced✓½ to sulphur and H_2S oxidised✓½ to sulphur
(b) should be done in the fume chamber/ open air

23 (a) volume decreases with increase in ✓1 pressure/volume is inversely proportional to Pressure.

(b) $P_1V_1 = P_2V_2$ ✓½ ; $V_2 = \frac{P_1V_1}{P_2}$

$V_2 = \frac{1 \times 3}{2}$✓
$= 1.5$ litres ✓½

24 **R .a.M** $= \frac{(60.57 \times 59.71) + (62.83 \times 40.29)}{100}$✓
$= 61.48$✓

25

Energy of bond breaking		*energy of bond formation*	
C –H	……. 414	C - CL	… 326
CL – CL	……244	H – Cl	….431
	+658kJ ✓½		-757kJ✓½

ΔH= 658-757✓
= -99Kj✓½

26 SO_2✓1
Oxidation number of S increases from +4 to +6✓½

27 (a) C✓1
(b) A✓½, it is ½✓strongly acidic/D; it is strongly alkaline

28 It is inert✓1

29 In ionic bond there is complete transfer✓1 of valence electrons
In covalent bond there is sharing ✓1 of valence electrons

30 In addition to vander waals forces, hexanol has strong hydrogen✓1 bonds; hexane has only ✓vander waals forces.

31 Sting from nettle plant contains acidic✓1 substance which causes itching. Ammonia solution neutralizes✓1 the acid.

LANGA'TA / KIBRA CLUSTER
MARKING SCHEME
233/2 CHEMISTRY PAPER 2

1. (a) Molar heat of displacement is heat given out when 1 mole of a substance is displaced from a solution✓**1**
   (b) $Cu^{2+}_{(aq)} + Zn_{(s)} \longrightarrow Zn_{(aq)}^{2+} + Cu_{(s)}$ ✓**1** **Penalise ½ mark for wrong or missing state symbols.**
   (c) To prevent heat loss to environment✓**1**
   (d) – Brown ✓½deposits –copper is deposited✓**1**
   - blue colour ✓½ fades//disappears – cu^{2+} ✓**1** ions removed
   H = MCDT✓½ (can be implied)

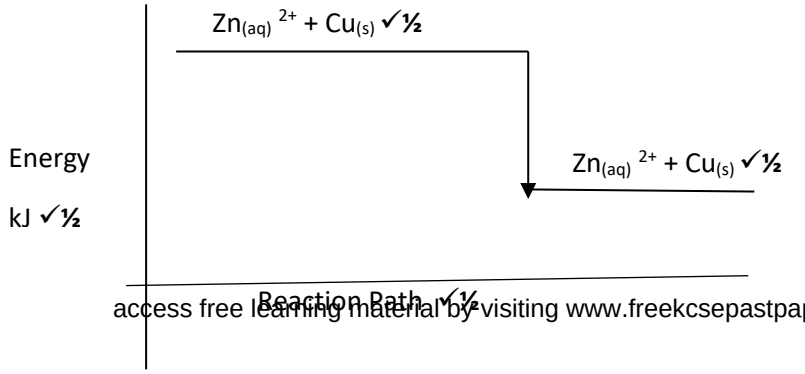
(e)

$$H = \frac{50 \times 4.2 \times 12.5}{1000} \qquad \text{moles} = \frac{0.25 \times 50}{1000}$$

$$\frac{20}{} \qquad \frac{20}{}$$

= 2.625 kj✓**1** = 0.0125✓**1**

(f)



2. (a) **A** – H_2 / Hydrogen
   B-Sodium propoxide
   C-Propanoic acid
   E – Polypropene
   F – $C_3H_6Br_2$ / 1, 1-di-bromopropane
   G- C_2H_4 / ethene

   (b) Ni catalyst, H_2, / High temperature✓½ **each**

   (c) $C_3H_6 + Br_2 \longrightarrow C_3H_6Br_2$✓**1** **ignore state symbols**

   (d) Con. H_2SO_4✓**1**

   (e) Manufacture of Black carbon✓**1**

   (f)(i) Propyne ✓**1** (ii) Hexan – 3 –ol✓**1** (iii) 3 –methyl propene✓**1**

3 (a)(i) S – 2,8,4✓**1**
   (ii) R^{3+}- 2,8✓**1**

   (b) It increases across✓ a period, due to increase in ✓**1** valence electrons, metallic bonds ✓**1** become stronger

   (c) **T** has 2 allotropes✓**1**

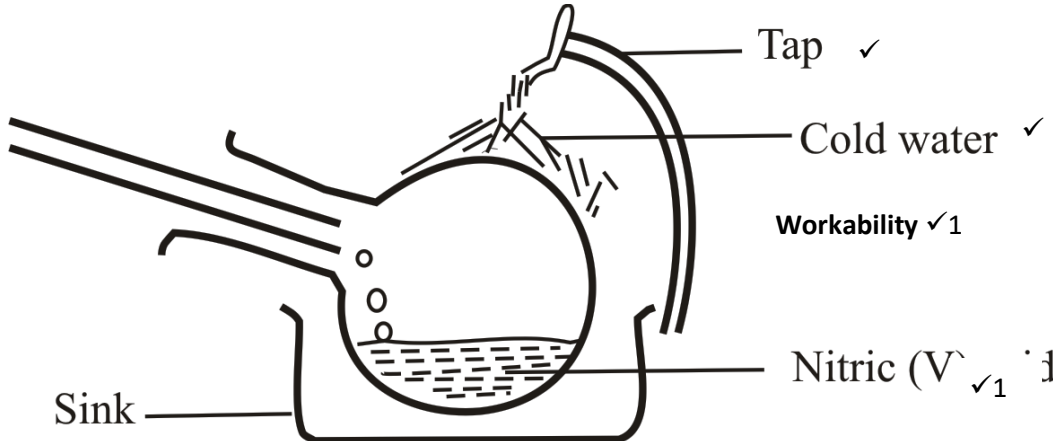
   (d) **R** $(NO_3)_3$/ $Al(NO_3)_3$✓**1**

(e) **S** has a giant atomic ✓½ structure. **S** atoms are joined by strong covalent ✓1 bonds which required a lot ✓½of heat to break. (2 marks)

(f) Acidic, **U** is a non-metal✓**1**

(f) Manufacture of sulphuric (vi) acid✓1

4



(b) **B** – Sodium Nitrate/KNO_3✓**1**

L – Conc. H_2SO_4✓**1**

(c) **A** – Retort Flask✓**1**

(d) $NaNO_{3(s)} + H_2SO_{4\,(l)} \longrightarrow HNO_{3(aq)} + NaHSO_{4(aq)}$ ✓1

(e) HNO_3 is a powerful ✓1oxidizing agent. It oxides H_2 ✓1 to water.

(f) A I semen storage✓1
- Haber process✓1

5 (i) in a blast furnace✓1
(ii) carbonates/sulphides✓1
(iii) $2Fe_2O_{3(s)} + 3CO_{(g)} \longrightarrow 4Fe_{(s)} + 3CO_{2(g)}$ ✓1
(iv) Manganese/carbon/nickel✓1
(v) brown/yellow ✓1solution turns pale, green ✓1 Fe^{3+} is reduced to✓1 Fe^{2+}
II (a) Bauxite, ✓1 mica✓1
(b) $2O^{2-}_{(l)} \longrightarrow O_{2(g)} + 4e$✓1

$0_{2(g)} + C_{(s)} \longrightarrow CO_{2(g)}$ ✓1

(c) Aircraft✓1

6 (i) N, ✓1 O_2 is produced due to discharge✓1 of OH^-

(ii) $4OH^-_{(aq)} \longrightarrow O_{2(g)} + 2H_2O_{(l)} + 4e$ ✓1

(iii) Bubbles✓1 of a colourless gas given off. Hydrogen gas H^+ ✓1 discharged/ correct equation

(iv) Use of a syringe ✓1

(v)

Q= 0.45 x 72 x 60

= 1944 C ✓1

96500 C IF

1944 C 1 x 1944

96500

= 0.02F✓1

7 (i) Step 1 α alpha $^{4}_{2}$He✓1

Step 2 β Beta $^{0}_{-}$e✓1

(ii)

$^{214}_{}Bi \longrightarrow {}^{210}\times{}^{4}+ {}_{}He$✓1

(b)(i)

Mass	160	80	40	20	10
	0	4	8	12	16

✓1 table, graph ✓3

(ii) from graph ✓2

(iii) Control in thickness of paper

LANGA'TA / KIBRA CLUSTER
233/3
CHEMISTRY PAPER 3
PRACTICAL
MARKING SCHEME

Question one

(a)

i. Complete table √1mk
Complete table with 3 titres √1mk
Incomplete table with 2 titres √½ mk
Incomplete table with 1 titre −0 mk
Conditions

✓ *Penalize ½ mk for unrealistic values unless where explained*
✓ *Penalize ½ mk for any inversion of table*
✓ *Penalize ½ mk for any arithmetic error*
NB: penalize a maximum of ½ mk for any of the conditions above.

ii. Decimal √1mk
Award 1mk for 1d.p. or 2 d.p used consistently
If 2d.p used, 2nd d.p. can only be "0" or "5"

iii. Accuracy √1mk
Award 1mk for any value ± 0.1 of s.v.

Award ½ mk for any value ± 0.2 of s.v.
Award 0mk (penalize fully) for any value beyond ± 0.2 of s.v.

iv. Principles of averaging √1mk
Values averaged must be consistent
If 3 titres but only 2 are consistent and averaged award 1mk
If 3 titres done and averaged award 1mk
If 3 titres done and inconsistent and averaged award 0mk
If 3 titres done and all are consistent but only 2 are averaged award 0mk

v. Final answer √1mk
Award 1mk for ans. ± 0.1 of s.v.
Award ½mk for ans. ± 0.2 of s.v.
Award 0mk ifansnot within ± 0.2 of s.v.
Marks awarder as follows: CT 1mk
D 1mk
A 1mk
PA 1mk
FA 1mk
5mks

(b) Average titre $= \frac{t_1 + t_2 + t_3}{3}$ = (√½ mk)*Correct Ans ½ mk*

(c) Moles of NAOH = $\frac{M \times V}{1000}$
= $\frac{0.1 \times 25}{1000}$ √*1mk* = 0.0025moles √*1mk*

(d) $2\,NaOH_{(aq)} + H_2C_2O_{4\,(aq)} \longrightarrow Na_2C_2O_4\,(aq) + 2H_2O_{(l)}$

Moles ratio = 2:1
Therefore moles of organic acid = ½ x 0.0025 moles √*1mk*
= 0.00125 moles √*1mk*

(e) Ans (b) cm^3 ⟶ has 0.00125moles
1000cm^3 ⟶ ?
= $\frac{0.00125 \times 1000}{\text{Ans (b)}}$ √*1mk*
= Correct answer √*1mk*

(f) Ans (e) moles / L ⟶ has 6.3g/l
1mole ⟶ ? √*1mk*
= $\frac{6.3}{\text{Ans (e)}} \times 1$ √*1mk*
= Correct answer √*1mk*

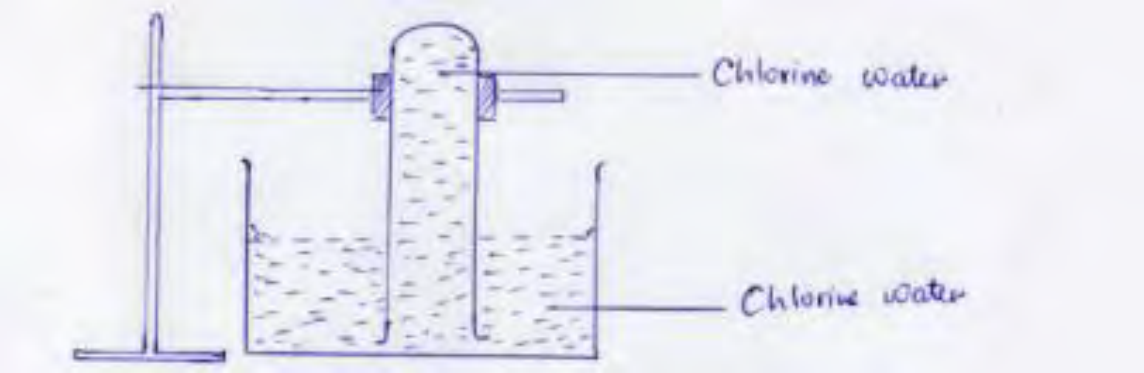
(g) Value of n
Ans (f) = $H_2C_2O_4.\,nH_2O$
Ans (f) = 2 + 24 + 64 + 18n √*1mk*
N = $\frac{\text{ans f} - 90}{18}$ √*1mk*
= correct ans √*1mk*

Question two

	Observation	**Inferences**
a)	Yellow flame √*1mk*	Na^+ ions √*1mk*
b)	- Colourless, odourless gas produced - Gas turns moist blue litmus paper red - Red litmus paper remains red - Droplets of colourless liquid on cooler parts of test tube *Any 2 x ½ = √1mk*	Gas acidic CO_3^{2-} , HCO_3^- ions Hydrated salt / water of crystallization *Any 2 correct x ½ = √1mk*
c)	- Effervescence / bubbles - Colourless , odourless gas produced - Gas turns moist blue litmus paper red - Red litmus paper remains red *Any 4 x ½ = √2mks*	CO_3^{2-} , HCO_3^- ions Gas acidic *Any 2 x 1 = √2mks*
	Observation	**Inferences**
3. (a)	Pale green ppt√½ mk insoluble in excess √½ mk	Fe^{2+}√*1mk*
(b) (i)	Pale green ppt√*½ mk* Insoluble in excess √*½ mk*	Fe^{2+}√*1mk*
(ii)	- Gas with pungent . chocking smell 1mk - Moist red litmus paper turns to blue 1mk - Blue litmus paper remains blue *any 2 x 1 = √2mks*	Gas basic √*½ mk* NH_4^+ ions present√*½ mk*
C.(i)	White ppt	CO_3^{2-}, Cl^-ions , SO_3^{2-}
(ii)	White ppt√*½ mk* Insoluble / persists √*½ mk*	Cl^- ions √*1mk* Confirmed
D.	White ppt√*½ mk* Insoluble √*½ mk*	SO_4^{2-} ions √*1mk*
E.	Pale green solution turns to yellow solution √*1mk* Brown ppt insoluble in excess √*1mk*	Fe^{2+} oxidized to Fe^{3+} ions √*½ mk* Fe^{3+} ions confirmed √*½ mk*

AMUKURA CATHOLIC JOINT EXAMINATION- CASPA
233/1
CHEMISTRY THEORY
PAPER 1

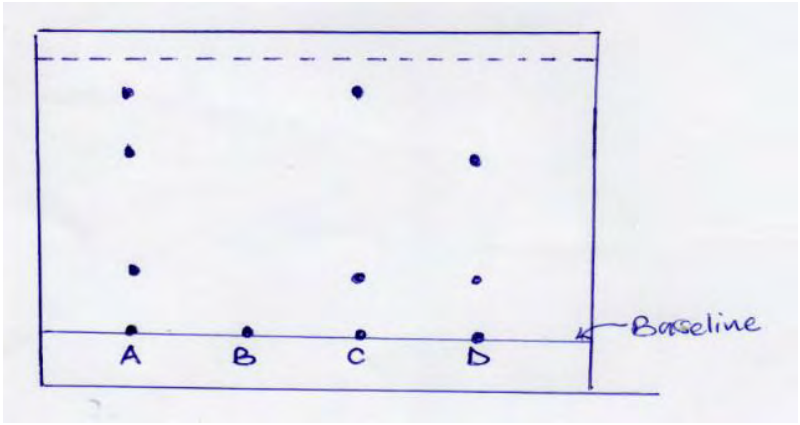
1. Air is a mixture of several different gases, which parts of air; (3Mks)
   a) Supports combustion?
   b) Puts of a burning splint?
   c) Makes up almost 80% of air?
2. In an experiment a test tube full of chlorine water was inverted in chlorine water to as shown in the diagram below and the set up was left in sunlight.



After one day, a gas was found to have collected in the test tube.
(a) Identify the gas (1Mk)
(b) What will happen to the PH of the solution in the beaker after one day? Give an explanation. (2Mks

3. Draw the structure and give names of three alkanes having themolecular formula of C_5H_{10}. (3Mks)
4. (a) Using electrons in the outermost energy level draw the dot(.)and cross(X) diagram for the molecules H_2O and CH_4(H=1, C=12) (2Mks)
   (1)H_2O
   (2)CH_4

5. The following chromatogram was obtained in an experiment to investigate the components present in certain dyes.



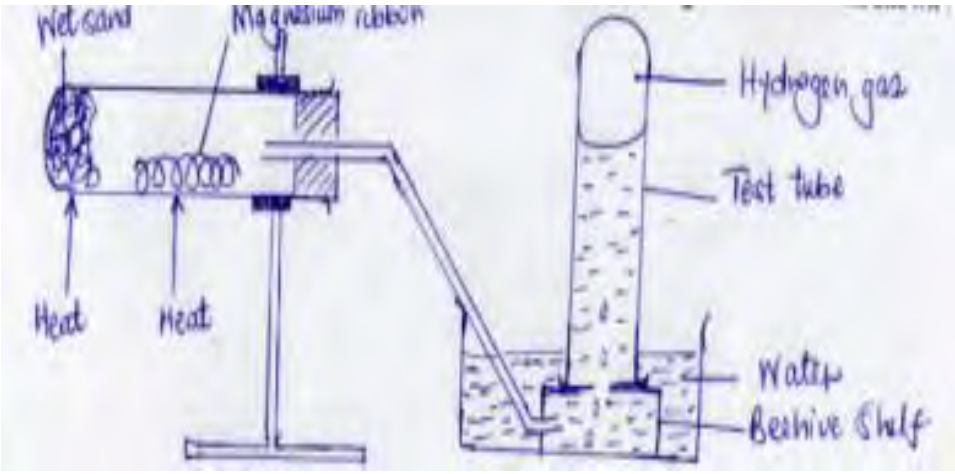
(a) Which two dyes when mixed would produce dyeA (1Mk)
(b) Identify the pure dye. (1Mk)
(C)Define solvent front? (1Mk)
(B) Indicate the solvent front in the diagram using the **letter E**.

6. A given element **F** has atomic number 14 and consist of isotopes as shown below.

Isotopes	G	H	J
Isotopes Mass	28	29	30
Percentage abundance	92.2	4.7	3.4

(a) Determine the relative atomic mass of **element F.** (2Mks)
(b) State the group and the period to which element **F** belongs. (1Mk)

7. Hdrogen gas can be prepared by passing steam over heated magnesium ribbon as shown .

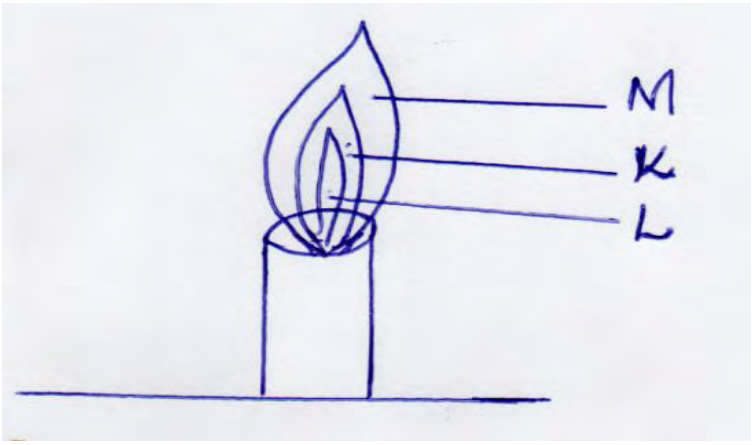


(a) Write an equation for the reaction that produce hydrogen gas. (1Mk)
(b) Explain why the delivery tube must be removed from beneath the water before heating is stopped. (1Mk)
(c) Name the method of gas collection used in the experiment. Give a reason. (1Mk)

8. (a) State Charles's law (1Mk)
(b) A gas occupies 450cm^3 at 27^{0}C.What volume would the gas occupy at 177^{0}C.If its pressure remains constant? (Give the answer in Kelvin) (2Mks)

9. A certain match stick head contains potassium chlorate and sulphur. On striking, the two substances react to produce potassium chloride and sulphur(IV)oxide respectively.
(a) Write an equation to show formation of sulphur (iv)oxide. (1Mks)
(b) Explain the environmental effect of using such matches in large numbers (2MKS)

10. The figure below shows a flame obtained from a Bunsen burner.



(a) Name the type of flame. (1Mk)
(b) A match stick head was placed at **region L** will not ignite. Explain (1Mk)
(c) Name **region K .**(1Mk)

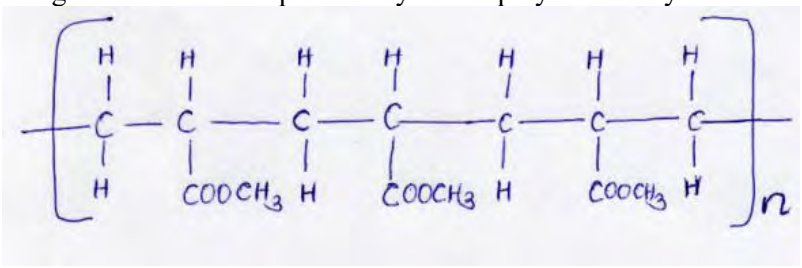
11. Solutions can be classified as Acids, Bases or Neural. The table below shows solutions and their P^H values.

Solution	P^H values
N	1.5
Q	7.0
P	13.0

(a) Select any pairs that would react to form a solution of P^H 7.0 (1Mk)

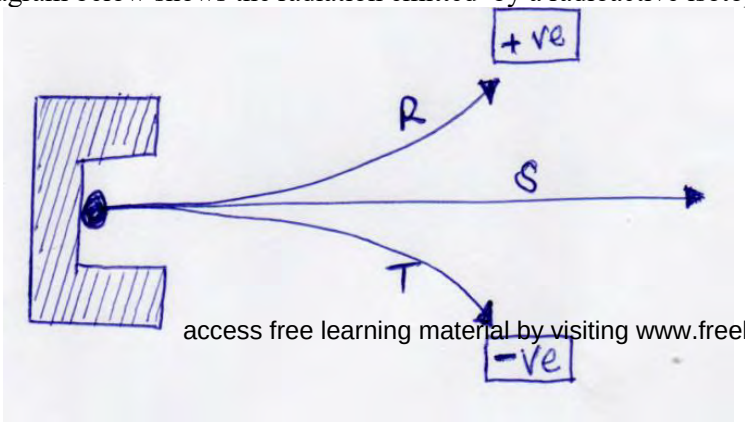
(b) Identify **two**solution that would react with Aluminium hydroxide. Explain. (2Mks)

12. The diagram below shows part of a synthetic polymer. Study it and answer the questions that follows;



(a) Draw the structure of the monomer (1Mk)

13.The diagram below shows the radiation emitted by a radioactive isotope.



Name the radiations. (3mks)

R:

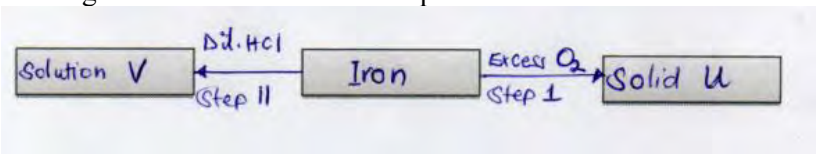
S:

T:

14. (a) Distinguish between a deliquescent and a hygroscopic substance. (2Mks)

(b) Give one use of a deliquescent substance In the laboratory. (1Mk)

15. Study the flow diagram below and answer the question that follow.



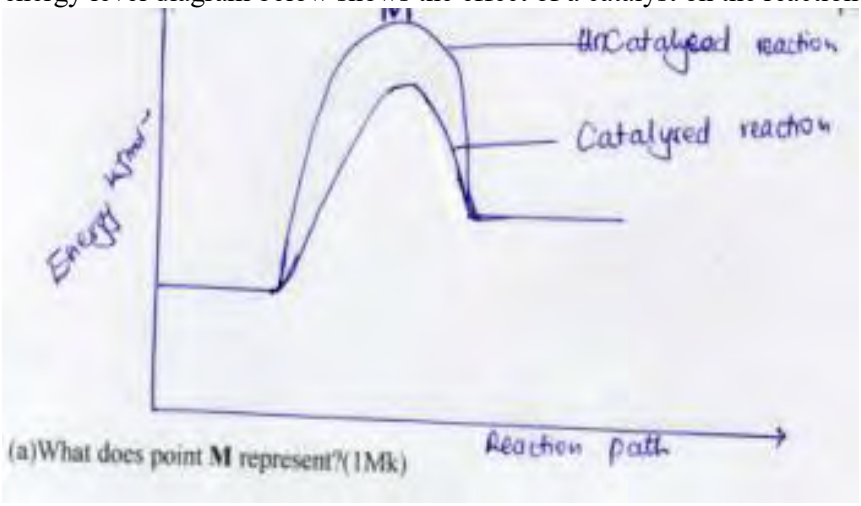
(a) Write an equation for the reaction taking place in **step 1.** (1Mk)

(b) Name **solution V.** (1Mk)

16. (a) state and exaplain two observations made when magnesium ribbon is lowered into a as jar full of carbon (iv) oxide (3mk)

b) Write a balanced chemical equation or the reaction that took place in a) above (1mk)

17. The energy level diagram below shows the effect of a catalyst on the reaction path.



(b) With reference to the energy level diagram, explain how a catalyst increases the rate of reaction. (2Mks)

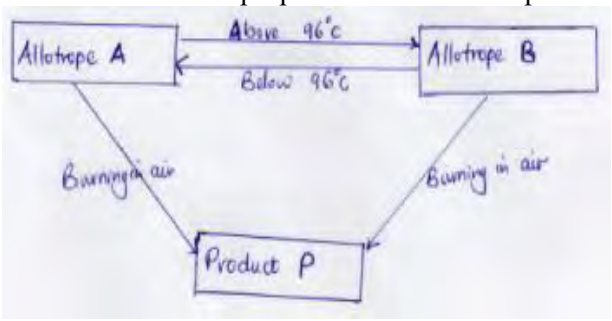
18. The table shoes behaviour of metals R, X , Y and Z study it and answer the questions.

Metal	Appearance on exposure to air	Reaction in water	Reaction with dilute hydrochloric acid
R	Slowly tarnishes	Slow	Vigorous
X	Slowly turns white	Vigorous	Violet
Y	No change	Does not react	Does not change
Z	No change	No reaction	Reacts moderately

(a) Arrange the metals in the order of reactivity starting with the **most reactive** (2Mks)
(b) Name a metal which is likely to be ; (2Mks)
1) X:

11) Y:

20. The following chart below shows some properties of two allotropes of **element P**

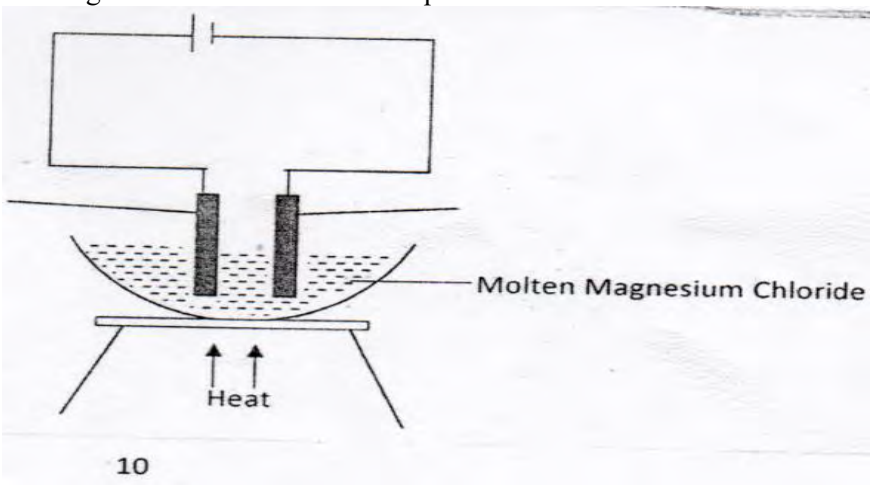


(a) Name allotrope A (1Mk)
(b) Write an equation to show formation of product P (1Mk)
(c) What does 96 ^{0}C represent? (1Mk)

21. Complete the following table by filling in the missing test and observations (3Mks)

NO	Gas	Test	Observation
I.	Ammonia	Put a moist red, then blue litmus into the gas	
2	Sulphuric(V) oxide		Paper turns green
3	Butene	Add a drop of bromine water	

22. An organic compound contains 24.24%carbon,4.04% hydrogen and the rest chlorine.If its relative molecular mass is 99.What is its molecular formula ?(C=12,H=1 ,Cl=35.5) (3Mks)
23. Study the diagram below and answer the questions that follows

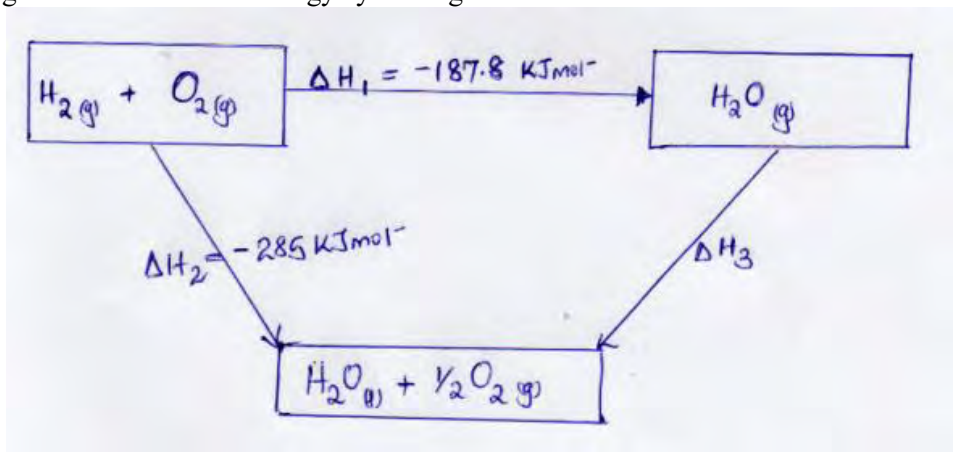


(a) Define the term electrolysis. (2mks)
(b) On the diagram, label the Anode and the Cathode. (1Mks)
(c) Write the equation for reaction taking place at the Cathode. (1Mk)

24. Hardness of water may be removed by either boiling or addition of chemicals
(a) Name the two types of water hardness. (2Mks)
(b) A sample of river water was divided into three portions, the table shows the test carried out on the portion and observations made. Complete the table by filling the inferences. (3Mks)

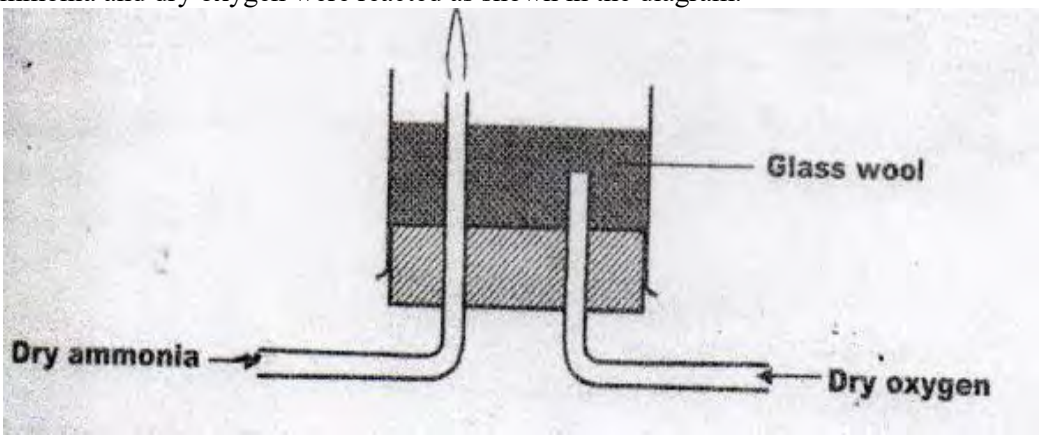
Test	Observation	Inference
To the first portion,1cm^3 of soap solution was added.	No lather formed	
The second portion was boiled ,cooled and 1cm^3 of soap solution was added.	No lather was formed	
To the third portion ,3cm^3 of aqueous sodium carbonate was added ,the mixture filtered and 1cm^3 of soap solution added to the filtrate.	Lather formed immediately	

25. The figure below shows an energy cycle diagram.



(a) Give the name of the enthalpy change H1 (1Mk)
(b) Determine the value of H3 (2Mks)

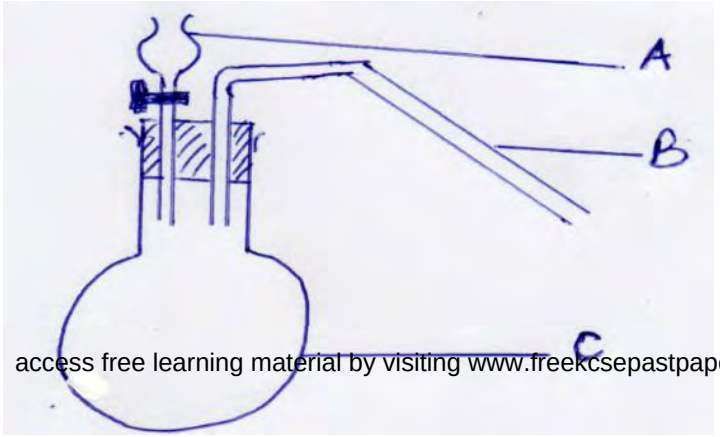
26. Dry ammonia and dry oxygen were reacted as shown in the diagram.



(a) What is the purpose of the glass wool? (1Mk)

(b) What product would be formed if red- hot platinum was introduced in to a mixture of ammonia and oxygen? (1Mk)

27 .Study the diagram below.



Identify apparatus A ,B and C. (3mks)

28. Explain why high temperature is required for Nitrogen to react with Oxygen. (2mks)

AMUKURA PARISH J O I N T E X A M I N A T I O N - 2021
233/2
CHEMISTRY PAPER 2

1. The grid given below represents part of the periodic table. Study it and answer the questions that follow. The letters are n actual symbols of the elements.

								A
B				G		H	E	
	J		I	L				C
D							M	
Y								

i) What name is given to the family of elements to which A and C belong? (1 mark)
ii) Write the chemical formula of the sulphate of element D. (1 mark)
iii) Which letter represents the most reactive (2 marks)
   (a) Metal
   (b) Non-metal
iv) Name the bond formed when B and H react. Explain your answer. (2 marks)
v) Select one element that belong to period 4. (1 mark)
vi) Ionic radius of element E is bigger than the atomic radius. Explain. (2 marks)
vii) The electron configuration of a divalent anion of element N is 2.8.8. Induce the Position of element N on the periodic drawn above. (1 mark)
viii) The oxide of G has a lower melting point than the oxide of L. Explain. (1 mark)
ix) How do the atomic radii of I and C compare. Explain. (2 marks)
x) Explain the trend in the 1st ionization energies of the elements J, I and L. (1mark)

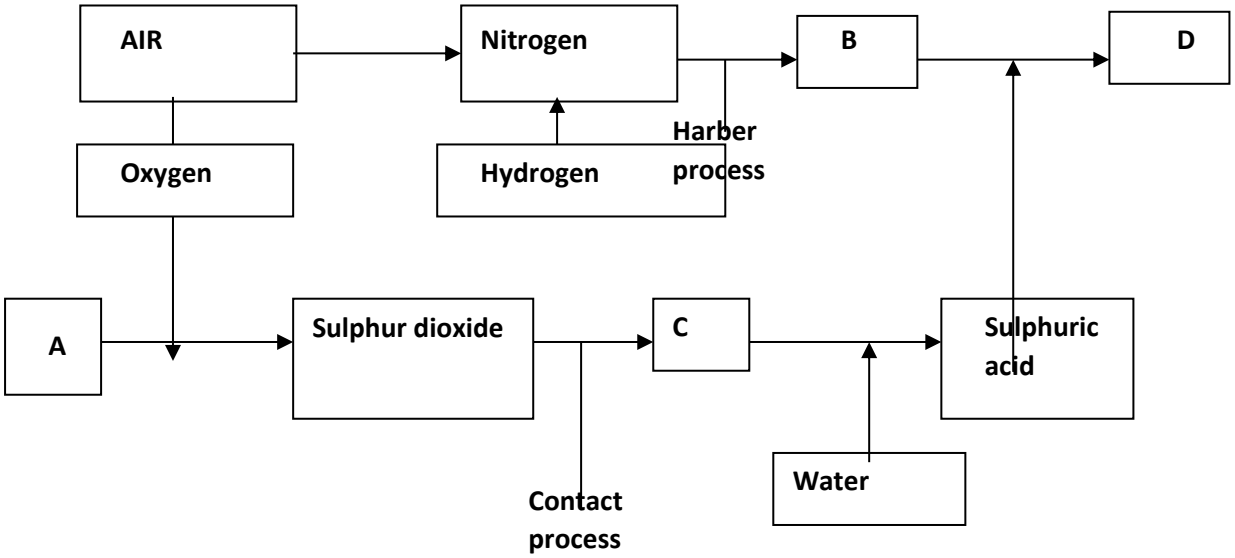
2 a) define the following terms
   i) Saturated solution (1mk)
   ii) Fractional crystallization (1mk)
   b) Solubility of salt X and Y were determined at different temperatures as shown in the following data.

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

i. On the grid provided, plot a graph of solubility (vertical axis) against temperature. (4mks)
ii. From the graph determine the solubility of each at 50ºC.
   X (1mk)
   Y (1mk)
iii. At what temperature was the solubility of both salts equal. (1mk)

b) i. What is permanent hardness of water? (1mk)

3. 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.



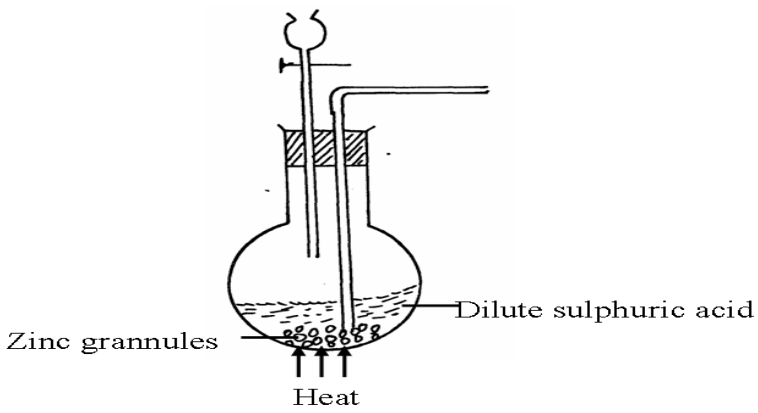
a) (i) Give the name of the process by which air is separated into oxygen and nitrogen. (1 mk)
(ii) Apart from oxygen and nitrogen gas produced from process a(i) name any other gas produced in the process above. (1 mk)

b) Name the substances which are represented by the letter. A, B, C, D. (4 mks)

c) Name the catalyst used in;
(i) The Haber process (1 mk)
(ii) The contact process (1 mk)
(iii) Explain the role of the catalyst in both the Haber and contact process. (2 mks)

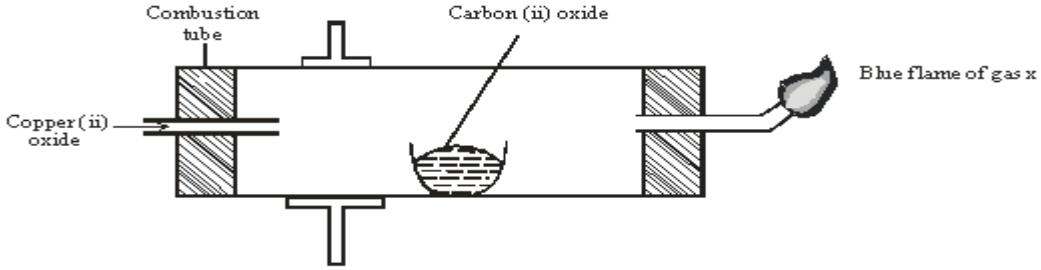
d) (i) Write a balanced equation for formation of compound D. (1 mk)
(ii) Calculate the percentage by mass of nitrogen present in compound D
(N = 14.0, H = 1.0, S = 32.0, O = 16.0) (2 mks)
(iii) Give one use of compound D. (1 mk)

4. A student set-up the arrangement below to prepare and collect dry hydrogen gas



(a) Identify two errors from the section of the arrangement shown above (2mks)
(b) Complete the diagram to show how dry hydrogen gas can be collected. (2mks)
(c) (i) Explain why hydrogen was collected by the method shown above (1mk)
(ii) Write a balanced chemical equation for the reaction that takes place when hydrogen gas is burnt in air. (1mk)
(e) Determine the relative atomic mass of zinc, given that when 6.54g of zinc was used, 2.4litres of hydrogen gas was produced. (Molar gas volume = 24 litres) (3mks)
(f) State any **two non**-industrial uses of hydrogen gas (2mks)

5. 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 mark**

d) Give an equation for the reaction that takes place as gas x burns. **1 marks**

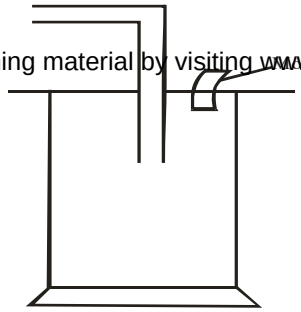
e) Why is it necessary to burn gas x? **1mk**

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**

6. 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 made on the moist blue litmus paper. **(2marks)**

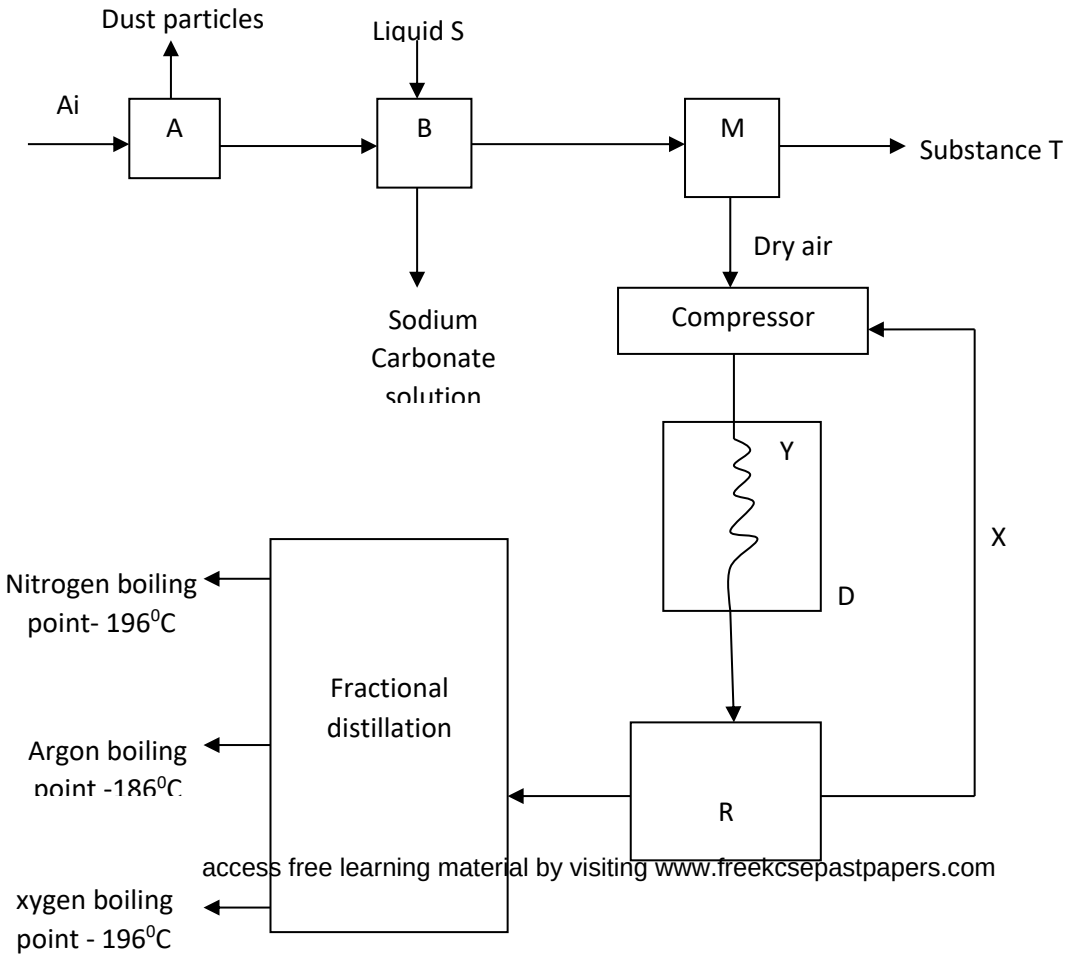
d) Chlorine gas was bubbled through distilled water. With aid of an equation show the formation of chlorine water. **(1mark)**

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**

7. 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**

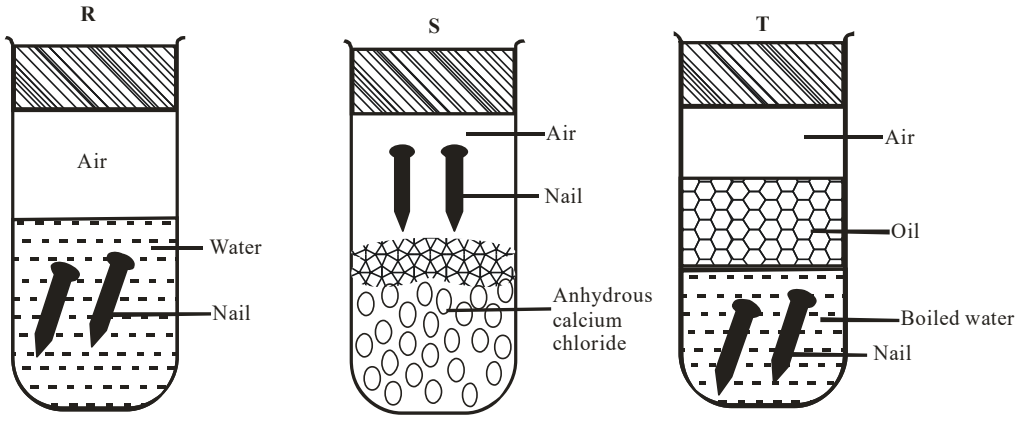
b) Name;
   (i) Liquid S (1mk)
   (ii) Substance T (1mk)

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. **2marks**
(ii) Give one reason why some metals are electroplated. **1mark**

CASPA AMUKURA PARISH
233/3
CHEMISTRY PAPER 3

1 **You are provided with;**

- Solution K, hydrochloric acid
- Solution L, containing 2g per litre of sodium hydroxide.
- 0.5 g of an impure calcium carbonate, solid **N.**
- You are required to determine the :

(a) Concentration of solution K in moles per litre.
(b) Percentage purity of calcium carbonate, solid **N**

Procedure I

Fill the burette with hydrochloric acid, solution K. pipette 25cm^3 of sodium hydroxide, solution L into a conical flask. Add 2-3 drops of phenolphthalein indicator and titrate. Record the results in the table. Repeat the procedure two more times.

Table 1

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

4mks

a) What is the average volume of solution **K** used (1mk)
b) Determine the concentration of solution L in moles per litre. (1mk(Na= 23,O = 16, H = 1)
c) Determine the number of moles of solution L that reacted with solution K (1mk)
d) Write the equation of the reaction that took place (1mk)
e) Calculate the number of moles of solution K that reacted (1mk)
(f) Calculate the concentration of solution K in moles per litre. (1mk)

Procedure II

Using a measuring cylinder, measure out 100cm^3 of solid K into a 250ml beaker. Add all of solid N into the beaker containing solution K. Swirl the mixture and allow the reaction to proceed until offervescence stops. Label this as solution P. Fill the burette with solution P. pipette 25cm^3 of solution L into a conical flask. Add 2-3 drops of phenolhthalein indicator and titrate. Record your results in table II below repeat the titration two more times and complete the table

Table II	I	II	III
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution Pused (cm^3)			

4mks

(a) Determine the average volume of solution **P** used. 1mk
(b) Calculate the number of moles of hydrochloric acid in solution P used. (1mk)

c) Determine the number of moles of hydrochloric acid in $100cm^3$ of solution P. (1mk)

d) Calculate the:

(i) Moles of hydrochloric acid in $100cm^3$ of the original hydrochloric acid solution K (1mk)

(ii) Moles of the hydrochloric acid that were used up in the reaction with solid N. (1mk)

(iii) Moles of calcium carbonate that reacted with hydrochloric acid. (1mk)

e) Given that the relative formula mass of calcium carbonate is 100,calculate the:

(i) Mass of the calcium carbonate that reacted. (1mk)

(ii) Percentage purity of the calcium carbonate, solid N. (1mk)

2 You are provided with solid T. Carry out the following tests and write your observations and inferences in the spaces provided.

Place all solid T in a boiling tube. Add about $6cm^3$ of distilled water to the solid T and shake the mixture well. Retain the mixture for use in the following tests.

a) Dip a clean glass rod in the mixture obtained above and burn it on a Bunsen burner flame.

Observation	Inference
(1 mark)	(1 mark)

b) Divide the mixture in the boiling tube into 3 portions.

(i) To the 1st portion, add about $1cm^3$ of barium chloride solution. Retain the resulting mixture for use in (iii) below.

Observation	Inference
(1 mark)	(1 mark)

(ii) To the mixture in (ii) above, add about $4cm^3$ of dilute hydrochloric acid.

Observation	Inference
(1 mark)	(1 mark)

(iii) To the 3rd portion, add about 3 drops of acidified potassium manganate (VII) solution.

Observation	Inference
(1 mark)	(1 mark)

3. You are provided with solid J. Carry out the test below to identify the compound.

(a) Place ½ spatula of solid J in a hard test tube and heat strongly until no further change. Test the gas produced with litmus paper.

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

(b) Place the remaining solid J into a clean boiling tube. Half fill it with distilled water and shake well. Divide the solution into four portions.

(i) To the first portion add dilute sodium hydroxide solution dropwise till in excess.

Observation	Inference
(1 mark)	(1 mark)

(ii) To the second portion add ammonia solution dropwise till in excess.

Observation	Inference
(1 mark)	(1 mark)

(iii) To the third portion add drops of dilute barium nitrate.

Observation	Inference
(1 mark)	(1 mark)

(iv) To the fourth portion add a few drops of dilute nitric acid followed by lead (II) nitrate solution and warm.

Observation	Inference
(1 mark)	(1 mark)

Identify Compound J……..… (1 mark)

CONFIDENTIAL

CASPA AMUKURA PARISH
233/3
CHEMISTRY PRATICAL
CONFIDENTIAL INSTRUCTIONS TO SCHOOLS
In addition to fittings and apparatus found in a chemistry laboratory, each candidate will need the following.

Question one.

- Burette
- Pipette
- Filter Funnel
- Retort stand and clamp
- Conical flask, 250ml
- White tile
- Phenolphthalein indicator
- 100cm^3 of Solution K, 0.1M hydrochloric acid
- 100cm^3Solution L 2g per litre of sodium hydroxide.
- Solid **N** 0.5 g of an impure calcium carbonate, (**N** is made by mixing $CaCO_3$ and Sodium Chloride in the ratio 4:1)
- An empty 250ml beaker

Question two and three

- Solid T **sodium sulphite**
- Solid J mixture of ammonium sulphate and hydrated zinc sulphate ratio 1:1

Access to

- Distilled water in wash bottle
- Barium chloride solution
- 2M hydrochloric acid
- Acidified potassium manganate vii
- Source of heating
- Barium nitrate
- 2M nitric v acid
- Lead ii nitrate
- 2M NaOH
- Aqueous ammonia solution
- Litmus papers

CASPA AMUKURA PARISH
MARKING SCHEME

3.
a

Observation	Inference
A gas is given out which turns blue litmus paper red (1 mark)	**SO_4^{2-},CO_3^{2-} Present (1 mark)**

B(i)

Observation	Inference
White ppt is formed which dissolves in addition of exess. (1 mark)	**Al^{3+},Zn^{2+},pb^{2+} presen (1 mark)**

(ii)

Observation	Inference
White ppt is formed which dissolves in addition of exess. (1 mark)	**Zn^{2+} present (1 mark)**

(iii)

Observation	Inference
White ppt is formed (1 mark)	**SO_4^{2-}** present **(1 mark)**

(iv)

Observation	Inference
White ppt is formed which does not dissolve on warming(1 mark)	**SO_4^{2-} present / SO_3^{2-}absent (1 mark)**

AMUKURA CATHOLIC JOINT EXAMINATION CASPA
CHEMISTRY THEORY
PAPER 1

MARKING SCHEME

1. Air is a mixture of several different gases in air, which parts of air; (3mks)
   a) Supportscombustion**.....*Oxygen*.....**
   b) Puts off aburningsplint?.....***Carbon(VI)Oxide***.....
   c) Makes up almost 80% of air**?.....*Nitrogen***.....
2. In an experiment a test tube full of chlorine water was inverted in chlorine water to as shown in the diagram below and the set up was left in sunlight.
   After one day, a gas was found to have collected in the test tube.
   (a) Identify the gas.....***Oxygen*****.....** ***.(***1mk)
   (b) What will happen to the PH of the solution in the beaker after one day? Give an explanation. (2mks)
   P^H decreases.
   Chlorine water /Hypochlorous acid/Chloric (V) acid decomposes to Hydrochloric acid which has a P^H value less than 7.
3. Draw the structure and give names of three alkanes having themolecular formula of C_5H_{10}. (3mks)
4. (a) Using electrons in the outermost energy level draw the dot(.)and cross(X)diagram for the molecules H_2O and CH_4(H=1, C=12) (2mks)
   (1) H_2O
   (2) CH_4
5. The following chromatogram was obtained in an experiment to investigate the components present in certain dyes.
   (a) Which **two** dyes when mixed would produce dyeA . (1mk)
   C and D
   (b) Identify the pure dye.***B***
   (c) Define solvent front? (1mk)
   The furthest the Solvent reaches on the adsorbent material.
   B) Indicate the solvent front in the diagram using the **letter E**.
6. A diagram element **F** has atomic number 14 and consist of isotopes as shown below.

Isotopes	G	H	J
Isotopes Mass	28	29	30
Percentage abundance	92.2	4.7	3.4

   (a) Determine the relative atomic mass of **element F.** (2mks)
   (b) State the group and the period to which element **F** belongs. (1mk)
   Group 4 and period 3 ½ m each
7. Hydrogen gas can be prepared by passing steam over heated magnesium ribbon as shown.
   (a) Write an equation for the reaction that produces hydrogen gas. (1mk)
   (b) Explain why the delivery tube must be removed from beneath the water before heating is stopped. (1mk)
   To avoid sucking back of water which may cause breaking of the boiling tube.
   (c) Name the method of gas collection used in the experiment a bove. Give a reason.
   Over water method .Hydrogen gas is slightly soluble in water (1mk)
8. (a) State Charle's law (1mk)
   The volume of a given mass of gas is directly proportional to its absolute temperature at constant pressure
   (b) A gas occupies 450cm^3 at 27^{0}C.What volume would the gas occupy at 177^{0}C.If its pressure remains constant?(Give the answer in Kelvin) (2mks)
9. A certain match stick head contains potassium chlorate and sulphur. On striking, the two **substances react to produce potassium chloride and sulphur(IV)oxide respectively.**
   (a) Write an equation to show formation of sulphur (VI)oxide. (1mk)
   (b) Explain the environmental effect of using such matches in large numbers. (2mks)
   A large volume of Sulphur (IV) Oxide shall be emitted into the atmosphere .The gas dissolves in atmospheric moisture/water to form Sulphuric (VI) acid which falls down as acid rain .The acid is destructive to human health ,metallic and stone structures and plants.
10. The figure below shows a flame obtained from a Bunsen burner.
    (a) Name the type of flame. (1mk)
    Non –luminous flame

(b) A match stick head was placed at **region L** will not ignite. Explain (1mk)
Is not hot /Unburnt gas region/has pure unburnt laboratory gas

(c) Name region K . (1mk)
Grenish –blue region

11. Solutions can be classified as Acids, Bases or Neural. The table below shows solutions and their P^H values.

Solution	P^H values
N	1.5
Q	7.0
P	13.0

(a) Select any pairs that would react to form a solution of P^H 7.0 (1mk)
N and P

(b) Identify **two** solutions that would react with Aluminium hydroxide. Explain. (2mks)
Nand P
Aluminium hydroxide displays amphoterism,thus reacts with acids and bases

12. The diagram below shows part of a synthetic polymer. Study it and answer the questions that follow;
(a) Draw the structure of the monomer (1mk)

13. The diagram below shows the radiation emitted by a radioactive isotope.
Name the radiations.(3mks)
R: .....Beta particles
S: .....Gamma rays
T: .....Alpha particles

14. (a) Distinguish between a deliquescent and a hygroscopic substance. (2mks)
Deliquescent substance absorbs water from the atmosphere to form a solution while a hygroscopic substance absorbs water from the atmosphere but do not dissolve to form a solution .

(b) (i) Give one use of a deliquescent substance In the laboratory. (1mk)
Drying agent during preparation of gases

(ii) Give one example of a hygroscopic substance
Potassium nitrate/anhydrous Cobalt (II) chloride/anhydrous Copper (II) sulphate

15. Study the flow diagram below and answer the question that follow.

(a) Write an equation for the reaction taking place in **step 1.** (1mk)
$4\,Fe\,(s) + 3O_{2\,(g)} \longrightarrow 2Fe_2O_{3(s)}$

(b) Name **solution V.** (1mk)
Iron (II) Chloride

16. (a) I)white powder of magnesium oxide is formed
ii) black specks of carbon are seen
b) $2\,Mg + Co_2 \longrightarrow 2MgO + C$

17. The energy level diagram below shows the effect of a catalyst on the reaction path.
(a) What does point **M** represent? (1mk)
Maximum energy required to initiate a reaction/activation energy

(b) With reference to the energy level diagram, explain how a catalyst increases the rate of reaction. (2mks)
A catalyst lowers the activation and increases the rate of collisions of the reacting **particles.**

18. The table shoes behaviour of metals R, X , Y and Z study it and answer the questions.

Metal	Appearance on exposure to air	Reaction in water	Reaction with dilute hydrochloric acid
R	Slowly tarnishes	Slow	Vigorous
X	Slowly turns white	Vigorous	Violet
Y	No change	Does not react	Does not change
Z	No change	No reaction	Reacts moderately

(a) Arrange the metals in the order of reactivity starting with the **most reactive** (2mks)
R,X,Z,Y.

(b) Name a metal which is likely to be ; (2mks)
1)X:***Sodium metal***
11)Y:***Copper metal***

20. The following chart below shows some properties of two allotropes of **element P**.
    (a) Name allotrope A (1mk)
    Rhombic Sulphur
    (b) Write an equation to show formation of product P (1mk)
    (c) What does 96 ^{0}C represent?
    Transition temperature

21. Complete the following table by filling in the missing test and observations.

NO	Gas	Test	Observation
II.	Ammonia	Put a moist red, then blue litmus into the gas	***Red litmus turns blue while blue remains blue***
2	Sulphuric(V) oxide	***Potassium dichromate paper***	Paper turns green
3	Butene	Add a drop of bromine water	***Yellow bromine water turns colourless***

22. An organic compound contains 24.24%carbon,4.04% hydrogen and the rest chlorine.If its relative molecular mass is 99.What is its molecular formula ?(C=12,H=1,Cl:35.5) (3mks)
23. Study the diagram below and answer the questions that follow
    (a) Define the term electrolysis. (1mk)
    Is the process of decomposing an electrolyte by passing an electric current through it
    (b) On the diagram, label the Anode and the Cathode. (2mks)
    (c) Write the equation for reaction taking placeat the Cathode. (1mk)
24. Hardness of water may be removed by either boiling or addition of chemicals
    (a) Name the two types of water hardness. (2mks)
    - ***.Permanent water hardness***
    - ***Temporary water hardness***

    (b) A sample of river water was divided into three portions, the table shows the test carried out on the portion and observations made. Complete the table by filling the inferences. (3mks)

Test	Observation	Inference
To the first portion,1cm^3 of soap solution was added.	No lather formed	***Hard water***
The second portion was boiled ,cooled and 1cm^3 of soap solution was added.	No lather was formed	***Permanent hardness***
To the third portion ,3cm^3 of aqueous sodium carbonate was added ,the mixture filtered and 1cm^3 of soap solution added to the filtrate.	Lather formed immediately	***Ca^{2+},Mg^{2+} ions are removed through precipitation***

25. The figure below shows an energy cycle diagram.
    (a) Give the name of the enthalpy change H1
    Enthalpy of Combustion of hydrogen
    (b) Determine the value of H3 (2mks)
26. Dry ammonia and dry oxygen were reacted as shown in the diagram.
    (a) What is the purpose of the glass wool? (1mk)
    To spread out the Oxygen gas.
    (b) What product would be formed if red- hot platinum was introduced in to a mixture of ammonia and oxygen? (1mk)
27. Study the diagram below.
    Identify apparatus A ,B and C. (3mks)
    A: Thistle funnel
    B: Delivery tube
    C:Round –bottomed flask
28. Explain why Nitrogen gas requires a lot of heat when reacting with Oxygen. (2mks)

AMUKURA PARISH JOINT EXAM 2021
CHEM PP2 MARKING SCHEME

1. (i) Noble gases √1
   (ii) D_2SO_4 √1
   (iii) (a) Y √1
   (b) E √1
   (iv) Ionic bond √1 – Because B reacts by losing an electron (s) which are gained by H. √1 accept transfer of electrons from a metal to non metal
   (v) D//M √1 Any ½ mark each
   (vi) Because E reacts by gaining an extra electron which reduces √1 the electrostatic pull by the positive nucleus making the ionic radius increase. Or incoming electron causes increased repulsion wtte
   (vii) At Period III Group IV
   (viii) Because of the increase in the strength of the molecular bonds in the oxide of L as compared to that of G. √1 w.t.t.e
   (ix) C has a smaller atomic √1 radius than I because of the increase in the strength of the Nucleur foce of attraction in C as the number of protons increase √1 w.t.t.e
   (x) 1st ionization energies increases from J – L across the period due to addition of an extra proton in the nucleus increasing the attraction of the valency electrons √

2 a) i) A solution that cannot dissolve any more of the solute at that particular temperature. ✓ 1mk
   ii) Scientific technique used to separate substances due to their differences in their crystallization temperature. ✓ 1mk or w.t.t.e

b) i) on the scanned graph

   ii) x=100g/100ml, y=40g/100ml
   iii) 5°c
   iv) type of hardness that cannot be removed by boiling

3. a) (i) Fractional distillation✓ 1mk
   (ii) Argon//neon/xenon//krypton✓ 1mk

   b) A Sulphur✓1mk
   B Ammonia gas✓1mk
   C sulphur (vi) oxide✓1mk
   D Ammonium sulphate✓1mk

   c) (i) Finely divided iron✓1mk
   (ii) Vanadium (v) oxide✓1mk
   (iii) The catalysts <u>fasten</u>✓1mk the Haber & contact processes by <u>lowering the activation energy</u>✓1mk of the reactions//the <u>rate of production</u> is increased.

   d) (i) $H_2SO_{4(aq)} + 2NH_{3(g)} \longrightarrow (NH_4)_2SO_{4(aq)}$✓1mk
   (ii) Formula mass of $(NH_4)_2SO_4$ = 2(14+4) + 32 + 4(16)
   = 132grams✓ ½ mk

$$\% \text{ of N} = \frac{28}{132} \times 100 \checkmark 1mk$$

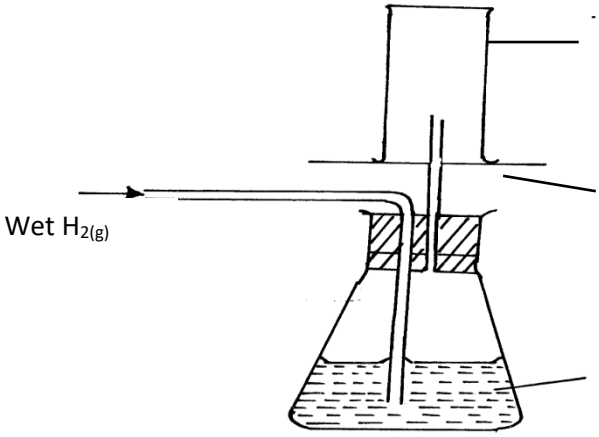
   = 21.212%✓ ½ mk

   (iii) Use as a fertilizer✓1mk

4. a) I: The outlet delivery tube should not dip into the Zinc/dilute Sulphuric acid mixture in the round buttoned flask. ✓ 1mk

II: The use of heat is not required ✓ 1mk

b)



c) i) It is denser than air ✓1 mk

ii) $H_{2(g)} + ½ O_{2(g)} \xrightarrow{ht} H_2O_{(g)}$✓ balancing½ mark, states ½ mark

d) $Zn_{2(s)} + H_2SO_{4(aq)} \longrightarrow ZnSO_{4\,(aq)} + H_{2(g)}$ balancing ½ mk, states ½ mk

1vol 1 vol 1vol

$\left[\frac{6.54}{R}\right]$ $\left[\frac{2.4}{24}\right]$

Therefore, $\left[\frac{6.54}{R}\right] = \frac{2.4}{24}$, ✓1mk $where R = R.A.M\ of\ Zinc$

$$R = \frac{24 \times 6.54}{2.4}$$

Or R = 65.4 ✓ 1mk

e) $H_{2(g)}$ is used in balloons by meteorologists ✓1mk

It is used as rocket fuel ✓ 1mk

5.

(a) Heating copper (ii) oxide √*1mk*

(b) Black solid would turn brown √*1mk*

(c) $CuO_{(s)} + CO_{(g)} \longrightarrow Cu_{(s)} + Co_{2(g)}$ √*1 ½ mk*

(d) $2CO_{(g)} + O_{2(g)} \longrightarrow 2CO_{2(g)}$ √*1 ½ mk*

(e) It is poisonous √*1mk*

(f) (i) Reducing agent - Carbon(ii) oxide √*1mk*

(ii) Oxidisingagent -Copper (ii) oxide √*1mk*

(g) Hydrogen / ammonia gas (Any one) √*1mk*

(h) There would be no observable change √*1mk.* This is because sodium is higher than carbon in the reactivity series and therefore has higher affinity of oxygen √*1mk*

6.

a) Concentrated sulphuric (vi) acid √*1mk*

b) It is denser than air √*1mk*

c) It turns red then white. √*1mk*

It turns white / it gets bleached √*1mk*

d) $Cl_{2(g)} + H_2O_{(l)} \longrightarrow HOCl_{(aq)} + HCl_{(aq)}$ √*1mk*

e) PCl_3 √*1mk*
PCl_5 √*1mk*

f) A yellow deposit of sulphur is formed / seen √*1mk*
Chlorine oxidizes sulphideions to solid sulphur √*1mk*

g)
- Manufacture of hydrochloric acid √*1mk*
- Manufacture of bleaching agents such as chlorate used in the cotton and paper industries
- Chlorine is used in the treatment of water and sewage plants
- Manufacture of chloroform as an anaesthetic
- Manufacture of solvents such as trichloroethane

Any one

7.

a) A - Filtration √*1 ½ mk*
B - Absorption √*1 ½ mk*
M - Isolation of water √*1 ½ mk*
D - Cooling √*1 ½ mk*

b) Liquids – NaOH (aq) / KOH (aq) √*1mk*
Substance T – Ice / water √*1mk*

c) To increase surface area forcooling √*1 mk*

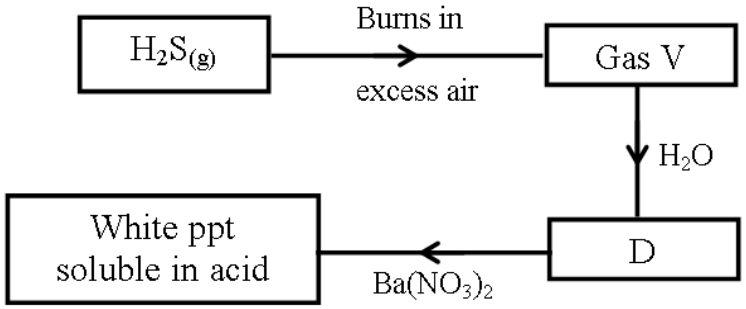
d) (i) Oxygen is used to remove impurities during steel making √*1 mk*
(ii) Is used in cutting and welding of metals √*1 mk*

e) $2H_2O_{2(l)} \xrightarrow{MnO_{2(S)}} 2H_2O_{(l)} + O_{2(g)}$ √*1 mk*

f) (i) R -Rusting occurred √*1 ½ mk* because of air and water being present √*½ mk*
S - No rusting √*½ mk* Water is absent √*½ mk*
T - No rusting √ *½ mk* Air is absent √*½ mk*
(ii) To prevent rusting √*1mk*
To increase aesthetic value of the metal

MURANG'A SOUTH
233/1
CHEMISTRY PAPER 1
(THEORY)

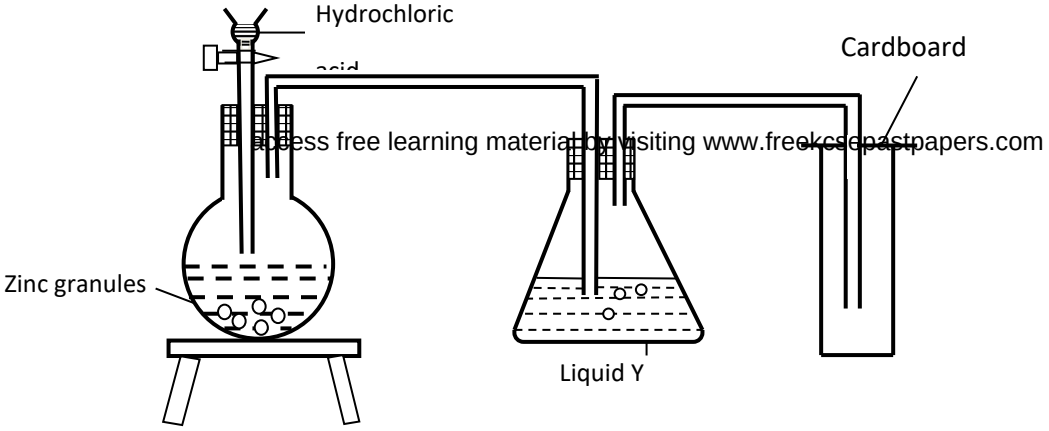
1. Describe how a sample of pure sodium chloride can be obtained from a mixture of iodine,sodium chloride and sand. (3mks)
2. Study the flowchart below and answer the questions that follow.



I. Name (2mks)
Gas V
D

II. Write an ionic equation for the formation of white precipitation. (1mk)

3. The set up below was used to prepare dry hydrogen gas. Study it and answer the questions that follow.



i) Identify a mistake in the set up (1mk)
ii) Write an equation for the reaction for the reaction that produces hydrogen gas (1mk)
iii) State one use of liquid Y (1mk)

4. The grid below is part of the periodic table. Use it to answer the questions that follow. (The letters do not represent the actual symbols of elements.)

						R	**S**	
N	**Q**						**T**	**U**
P								

(a) Indicate in the grid the position of an element represented by letter V, whose atomic number is 14. (1mk)

(b) Select a letter which represents a monoatomic gas. (1mk)

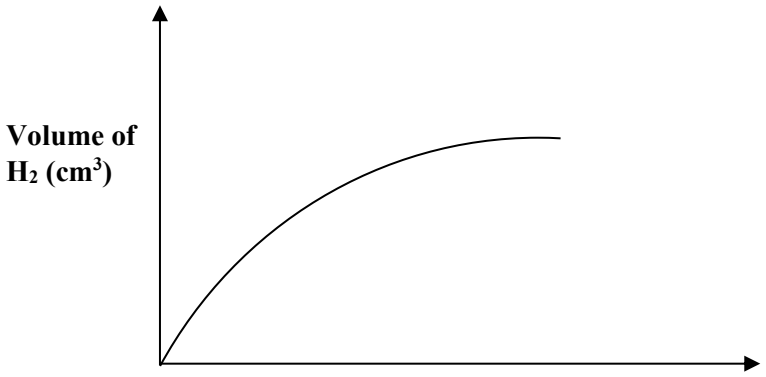
(c) write an equation for the reaction between Q and T (1mk)

5. Describe how a solid sample of Lead(II) Chloride can be prepared using the following reagents:Dilute Nitric Acid, Dilute Hydrochloric Acid and Lead Carbonate. (3mks)

6. (a) State Graham's law of diffusion. (1mk)

(b) $50cm^3$ ammonia gas diffuses through a small orifice in 20 seconds.How long will it take a similar volume of propane (C_3H_8) to diffuse through the same orifice under the same conditions of temperature and pressure? (C=12.0, H =1.0, N=14.0) (3mks)

7. A student reacted 0.2g of zinc granules with 2M hydrochloric acid and volume of hydrogen Gasproduced was measured at various time intervals. A sketch graph of volume against time is as shown below.



(i) Explain why the graph is steepest at the beginning. (1mk)

(ii) On the same axis given above, draw a sketch graph of the reaction when 0.2g of zinc powder was used instead of zinc granules. Label it I (1mk)

(iii) Give a reason for the choice of your graph in (ii) above (1mk)

8. Dry carbon (II) oxide gas reacts with heated lead(ii)oxide as shown in the equation below.

$PbO_{(s)} + CO_{(g)} \longrightarrow Pb_{(s)} + CO_{2(g)}$

(a) Name the process undergone by the lead(ii)oxide. (1mk)

(b) Give a reason for your answer in (a) above. (1mk)

(c) Name another gas that can be used to perform the same function as carbon(II)oxide gas in the above reaction. (1mk)

9. Ammonia gas is manufactured by reacting nitrogen and hydrogen under the following conditions; a temperature of 450^0C, a pressure of 200 atmospheres and finely divided iron catalyst. The reaction that takes place is:

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$: $\Delta H = -92KJ$.

(a). How would the yield be affected by increasing the temperature to 650^0C? Give a reason (2mks)

(b). Give two uses of ammonia (1mks)

10. The table below shows ammeter readings recorded when two equimolar solutions were tested separately.

Electrolyte	Current (A)
Dilute Sulphuric (VI) Acid	7.2
Ethanoic Acid	4.0

Explain the difference in the ammeter readings. (1mk

11. The table below gives atomic numbers of elements represented by the letters A, B, C and D.

Element	A	B	C	D
Atomic number	15	16	17	20

Use the information to answer the questions that follow.

(a) Name the type of bonding that exists in the compound formed when A and D react. (1mk)

(b) Select the letter which represents the best oxidizing agent.
Give a reason for your answer. (1mk)

(c) Give a reason why phosphorous is stored under water. (1mk

12. 12.0cm^3 of 0.05m hydrochloric acid reacted with calcium hydrogen carbonate to form calcium chloride, water and carbon IV oxide.

(a) Write the chemical equation for the reaction. (1mk)

(b) Calculate the number of moles of hydrochloric acid used. (2mks)

(c) Determine the number of moles of calcium hydrogencarbonate used. (1mk)

13. Study the information in the table below and answer the question the table below the table.

Bond	Bond energy (kJmol-
C-H	414
Cl-Cl	244
C-Cl	326
H-Cl	431

Calculate the enthalpy change for the reaction (3mks)

$$CH_{4\,(g)} + Cl_{2\,(g)} \xrightarrow{uv} CH_3Cl_{(g)} + HCl_{(g)}$$

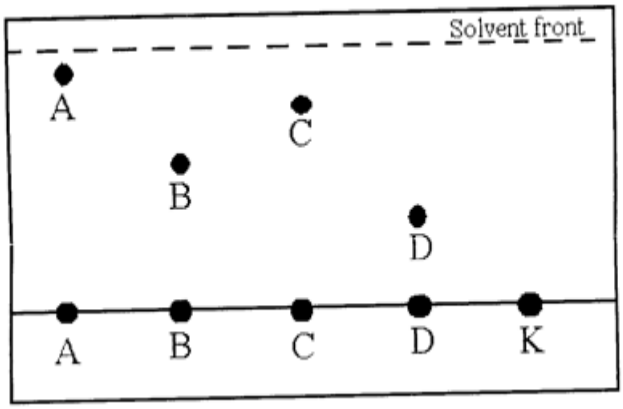
14. Polyvinylchloride (PVC) is an example of an addition polymer whose monomer is Chloroethene.

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

(b). What is meant by addition polymerisation? (1mk)

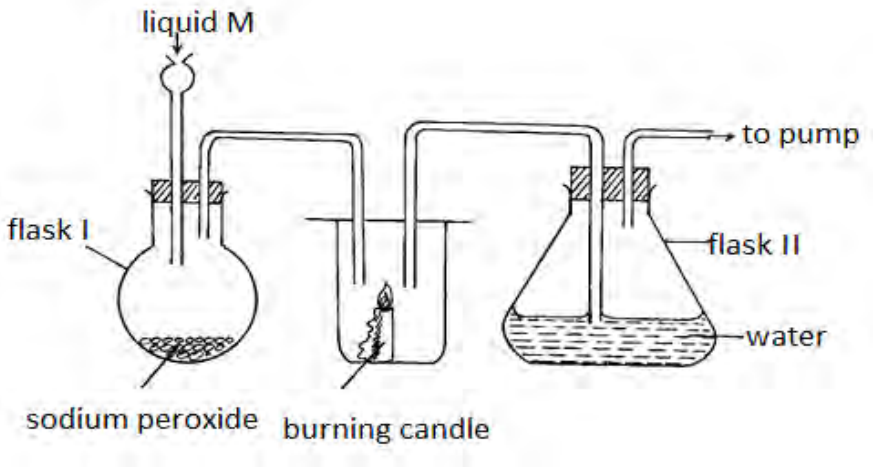
(c). Using 2 molecules, draw the structure of PVC. (1mk)

15. The diagram below represents a paper chromatograph of pure A, B, C and D. A mixture of K contains A and D only



Indicate on the diagram the chromatograph of K (1mk)

16. The diagram below shows a set up of apparatus used to prepare oxygen gas and pass it over burning candle. The experiment was allowed to run for several minutes.



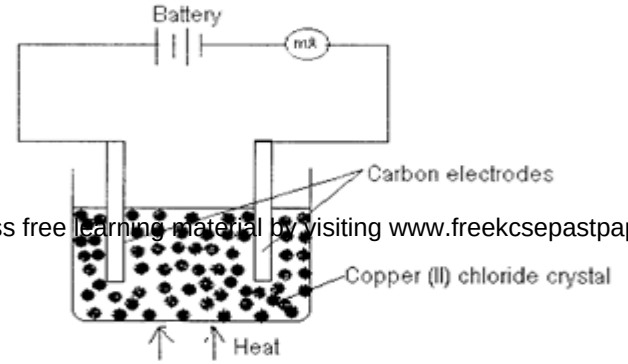
(i) Identify liquid M. (1mk)

(ii) Write an equation for the reaction that forms oxygen gas in the set up. (1mk)

(ii) The pH of the solution in flask II was found to be less than 7. Explain. (2mks)

17. Give two reasons why a luminous flame is not used for heating purposes (2mks)

18. The diagram below shows copper (II) chloride crystals being heated until all has melted.



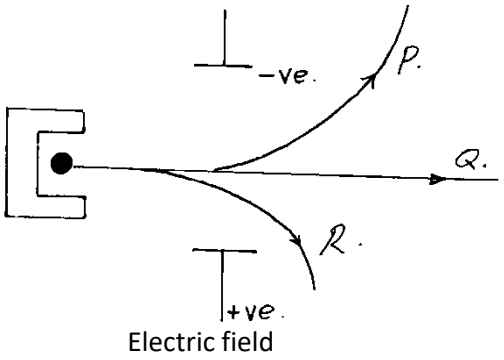
(a) State what was observed in the millimeter

(i) At the beginning. (1mk)

(ii) As copper (II) chloride was melted

(b) Explain your answer in (a) above. (2 marks)

19. The figure below shows the behaviour of emissions by a radioactive isotope X



(a) Identify the radiations P,Q,R (1½mks)

(b) Which of the radiations (P, Q, R) produces the strongest damage to human tissues. Explain (1mk)

20. The standard electrode potentials for the elements chlorine and magnesium

$Cl_{2(aq)} + 2\bar{e} \longrightarrow 2Cl^-_{(aq)}, \quad E^o = +1.36V$

$Mg^{2+}_{aq} + 2\bar{e} \longrightarrow Mg_{(s)}, E^o = -2.36V$

i) Which one of the two elements will act as an oxidizing agent?Explain your choice (2mks)

ii). Calculate the electromotive force of a cell where the overall reaction is

$Cl_{2(aq)} + Mg_{(g)} \longrightarrow Mg\,Cl_{2(aq)}$ (1mk)

21. Briefly describe how the Ph of soil sample can be tested to ascertain whether it is suitable for growing sugarcane. (3mks)

22. A form four student wanted to determine the solubility of PotassiumNitrate. He obtained the following results as shown below.

Mass of evaporating dish	15.13g
Mass of evaporating dish and solution	36.51g
Mass of evaporating dish and salt	19.41g

Use the information above to calculate the solubility of Potassium Nitrate. (3mks)

23.. An equilibrium exists between the reaction of bromine and bromide ions as represented by the equation.

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

What effect would addition of sodium hydroxide solution have on the above equilibrium? Explain your answer (2mks)

24. Use the information below to answer the questions that follow:

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

Calculate the molar enthalpy of combustion of ethanol. Given that

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

25. (a) Define the term isomerism. (1mk)

(b) Draw and name two isomers of pentene. (2mks)

26. The table below shows the observations made when various salts are heated. Study it and answer the questions that follow.

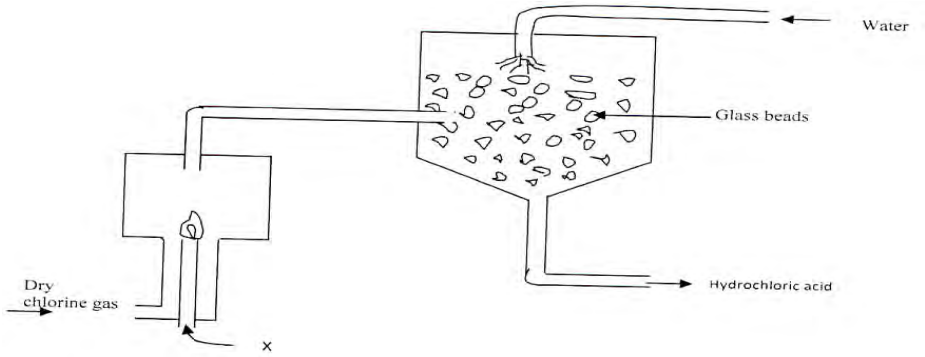
Salt	Mass before heating (Grams)	Mass after heating (Grams)	Other obserations
P	2.34	2.34	No change is observed
Q	7.9	5.14	Colourless gas, turns lime water to a white ppt
R	1.83	0.962	White fumes
S	1.09	0.579	Brown gas

(i) Which salt is likely to be anhydrous sodium carbonate? Explain (1mk)

(ii) Identify lead(ii)nitate. (1mk)

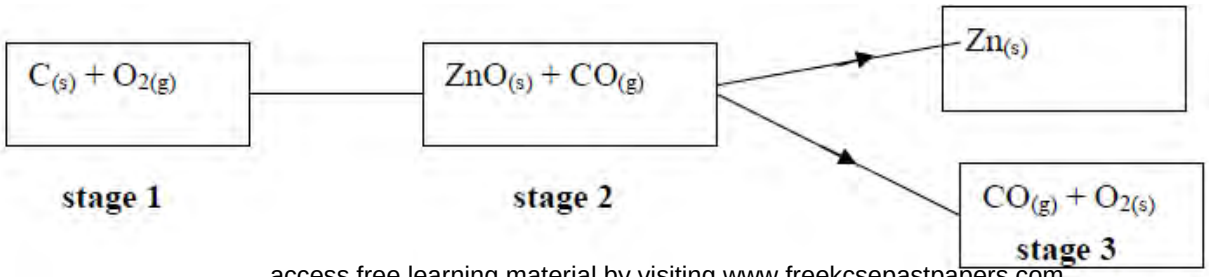
(iii) Which salt reacts with an acid to form carbon (iv)oxide (1mk)

27. .The diagram below represents a set up used for the large scale manufacture of hydrochloric acid.



(a) Name substance X (1Mark)
(b) What is the purpose of the glass beads? (1Mark)
(c) Give one use of hydrochloric acid (1 Mark)

28. The stages shown in the following diagram can be used to extract zinc from its oxide:-
Name the stage and the process taking place in it:-



Stage 1…… (1mk)
Stage 2..... (1mk)
Stage 3..... (1mk)

29. Study the information in the table below and answer the questions that follow.
(The letters do not represent the actual symbols of the elements)

Element	Electronic configuration	Ionization energy Kj/mol)
P	2.2	1800
Q	2.8.2	1450
R	2.8.8.2	1150

(a) What is the general name given to the group in which elements **P, Q** and **R** belong? (1mk)
(b) Explain why **P** has the highest ionization energy (1mk)
(c) Write a balanced chemical equation for the reaction between element**Q** and water (1mk)

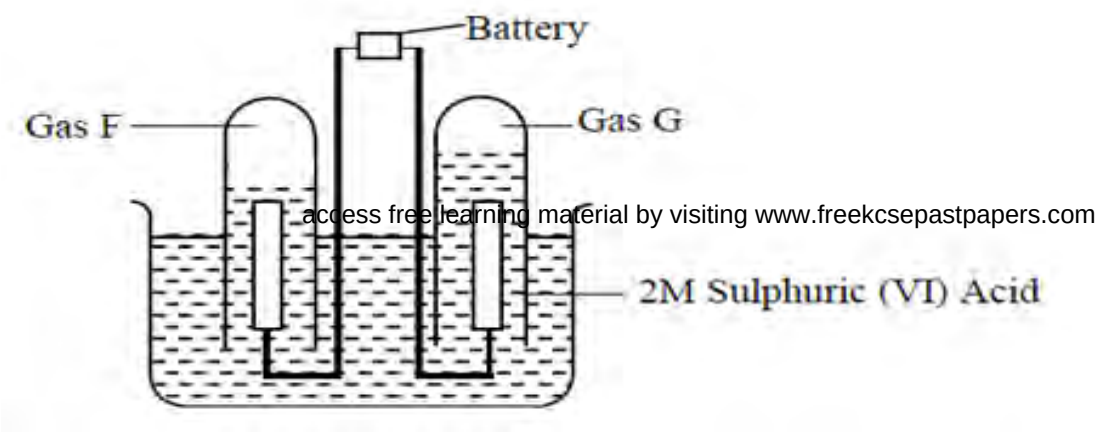
MURANG'A SOUTH
CHEMISTRY PAPER 2
END OF TERM 2

1. (a) The following table gives the standard electrode potentials for some half cell reactions

Half cell reations	**E^{θ} (v)**
$I.\quad A^{2+}_{(aq)} + 2e^- \longrightarrow A_{(s)}$	-0.76
$II.\quad B^{2+}_{(aq)} + 2e^- \longrightarrow B_{(s)}$	-0.44
$III.\ C_{2(aq)} + 2e^- \longrightarrow 2C^-_{(aq)}$	$+0.54$
$IV.\ D^{3+}_{(aq)} + e^- \longrightarrow D^{2+}_{(aq)}$	$+0.77$
$V.\ 2E^+_{(aq)} + 2e^- \longrightarrow E_{2(g)}$	0.00

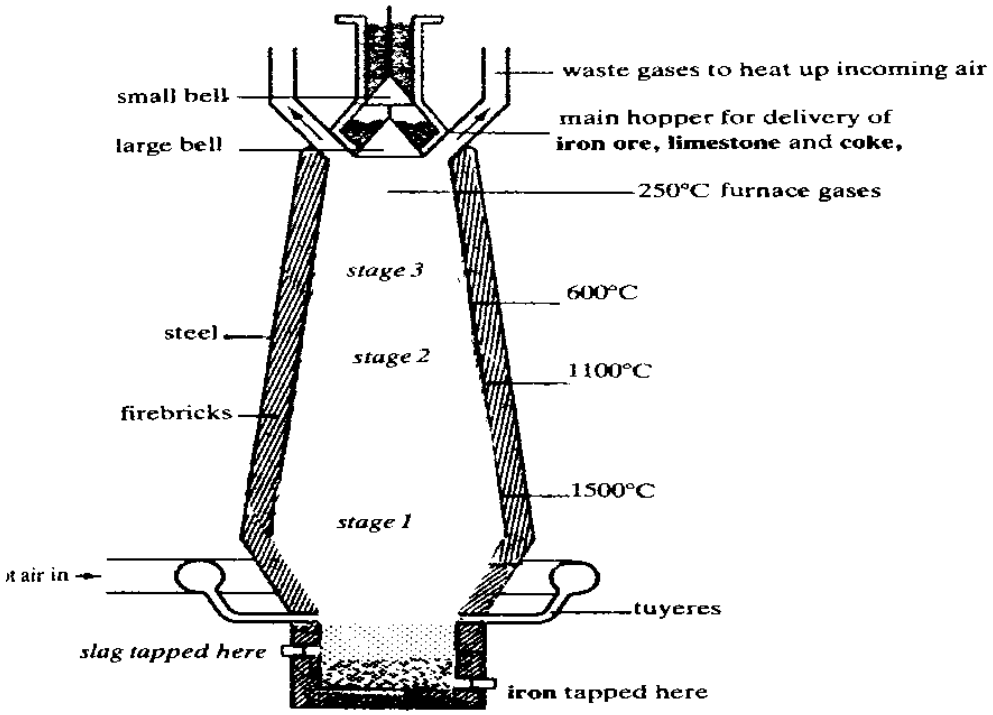
i) Identify the strongest reducing agent. (1mk)
ii) Calculate the EMF of a cell made by combining the half cells of A and B. (1mk)
iii). Identify the substances that can oxidize C^- ions to C_2. (1mark)
(iv) Draw an electrochemical cell comprising half cells I and IV. (3marks)

b). The apparatus below shows the set up that was used in the electrolysis of 2M Sulphuric (VI) acid. Study it and answer the questions that follow



c) Write an equation for the reaction that produce gas F. (1 mark)
ii) Describe how gas G can be identified (1 mark)
c) 1.9g of a metal F was deposited when its aqueous salt was electrolysed by passing a current of 0.6A for 1.5hours. Determine the charge on the ion of F.(RAM of F = 113, 1F = 96500C) (3mks)

3. The diagram below shows a blast furnace which is used for the extraction of iron. Study it and answer the questions that follow.



a) Name two major ores from which iron can be extracted from (1mk)
b) Give a reason why the temperature at the bottom of the furnace is very high (1mark)
c) State two properties of slag that allows it to be separated from molten iron. (2mark)
d) Write an equation for the reaction responsible for the fall in temperature at stage 2. (1mark)
e) Write an equation in which iron is formed. (1mk)
f) State two uses of iron (1mark)
g) State the effect of iron extraction on the environment (1mark)
h) Sulphuric (VI)acid is manufactured by the contact process .The equation below shows one step involved in the contact

$2SO_2(g) + O_2(g) \rightleftharpoons 2\ SO_3\ (g)\ \ \Delta H = -97kJ/mol$

I. State giving reasons how an increase in temperature would affect the amount of sulphur VI) oxide gas. (2MK)
II. Name the catalyst used in the above process (1mark)
III. State any two uses of sulphuric(VI) acid (1mark)

3. The table below shows some elements in the periodic table. Use it to answer the questions that follow. The letters are not the actual symbols of the elements.

								F
A	**G**		**E**		**B**		**D**	
C								

a) (i) Show the electron arrangement of elements:
A (½ mk)
D (½ mk)

(ii) Using dots (.) and crosses (X) to represent electrons, draw diagrams to show how elements C and oxygen combine to form a compound.(O= 8) (1mk)

b) Show on the grid above an element **Y** belonging to Period 4 and group (VI). (1mk)

c). Compare the following with explanations:

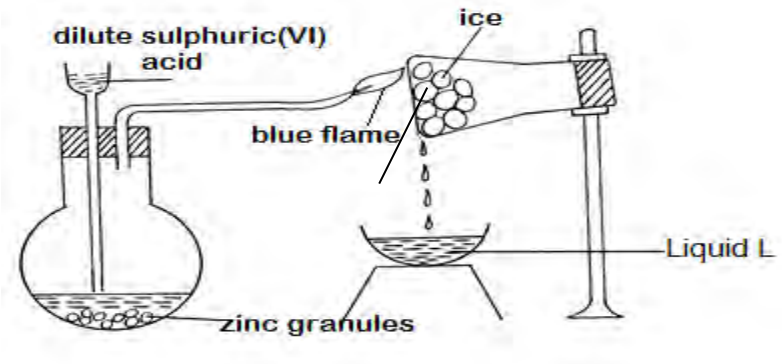
(i) The reactivity of **A** and **C** (2mks)

(ii) Atomic radii of elements **A** and **B** (2mks)

(iii) **The melting point** point of the oxide of element **G** and and the oxide of **D** (2MKS)

c) Calculate the volume of the gas produced when 0.92g of element A is reacted with excess dilute hydrochloric acid at room temperature and pressure. (MGV= 24dm3 , A= 23). (3MKS)

4. The diagram below shows a set-up of apparatus that was used to prepare hydrogen gas.

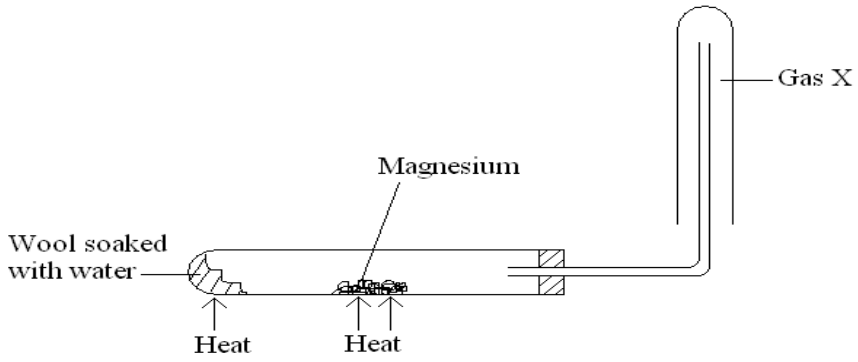


a) Explain the observations that would be made if calcium turnings were used instead of zinc granules in the above experiment. (2mk)

b) (i) Explain how liquid L can be identified by chemical means. (2mks)

(ii) How could the purity of liquid L be confirmed? (1mk)

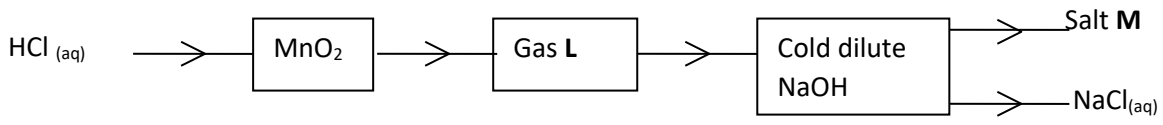
(d) When magnesium is heated in steam it reacts rapidly forming a white solid and gas X.



(i) Write an equation that took place in the heated test tube. (1mk)

(ii). Why is the gas X collected as shown in the diagram above? (1mk)

5. Study the flow diagram below and answer the questions that follow:

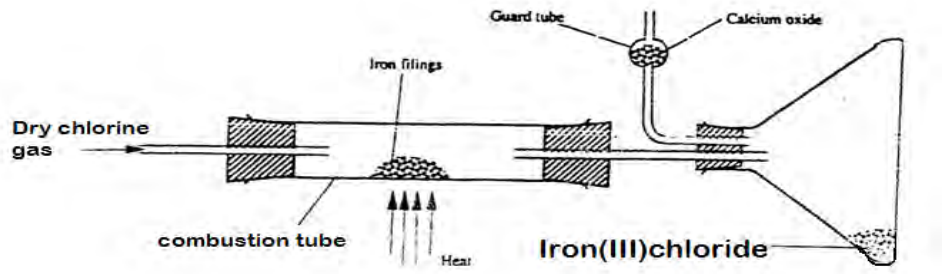


(a) Write a balanced equation for the reaction between hydrochloric acid and manganese (IV) oxide that produces gas L (1mk)

(b) State and Explain what happens to a blue litmus when dropped into a solution of gas L **(3mk)**

(c) Name the salt that will be formed if the experiment was repeated with hot concentrated NaOH (1mk)

(d). A student carried out an experiment to prepare iron III chloride using the apparatus shown in the diagram below



i) Explain why:
   I. It is necessary to pass chlorine gas through the apparatus before heating begins .(1mk)
   II) Calcium oxide would be preferred to calcium chloride in the guard tube. (1mk)
   III. The iron iii chloride is collected away from the reaction point. (1mk)

ii) Calculate the mass of the product that would be formed when 4000cm^3 of chlorine gas reacts completely with excess iron fillings (Fe= 56.0, C1 = 35.5, MGV 24 litres at room temperature and pressure.). (2MKS)

6. Study the decay series below and answer the questions that follow.

$$^{238}_{92}U \xrightarrow{I} {}^{234}_{90}Th \xrightarrow{II} {}^{234}_{91}Pa \xrightarrow{III} {}^{234}_{92}U \xrightarrow{IV} {}^{230}_{90}Th \downarrow V$$

$$^{214}_{83}BI \xleftarrow{IX} {}^{214}_{82}Pb \xleftarrow{VII} {}^{218}_{84}PO \xleftarrow{VII} {}^{222}_{86}Rn \xleftarrow{VI} {}^{226}_{88}Ra$$

$\downarrow X$

$$^{214}_{84}Po \xrightarrow{XI} {}^{210}_{82}Pb \xrightarrow{XII} {}^{210}_{83}BI \xrightarrow{XIII} {}^{206}_{81}BI \xrightarrow{XIV} {}^{206}_{82}Pb$$

a) Define the term radioactivity (1mk)

b)

(i). Identify the particles emitted in
steps (I) (1mk)
steps (IX) (1mark)

ii). Write the nuclear equation for the reactions which take place in step(V) (1mark)

iv) Calculate the mass of a radioactive element W that would remain after 30 days if it has a half life of 6 days and the original mass is 48gramms. (2mks)

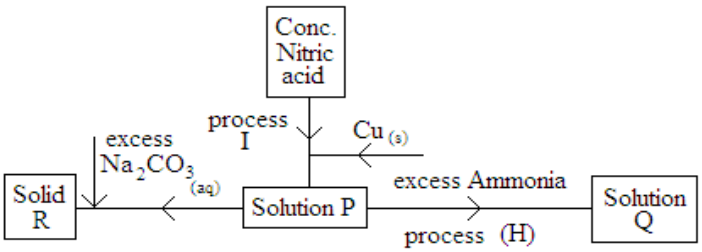
c) Explain any two applications of radioactivity in medicine .(2mks)

7. In an experiment to study the rate of the reaction ,1gram of lamps of calcium carbonate was added to 300cm^3 of 2M hydrochloric acid at 25^0 c. The volume of the carbon(iv) oxide produced was measured at 10 second intervals . The results obtained were recorded in the table below.

TIME (SECONDS)	0	20	40	60	80	100	120	140	160	180
VOLUME (CM^3)	0	120	180	210	224	232	236	240	240	240

a) Plot a graph of volume of the gas produced against time . (3mks)
b) Use the graph to find the ;
   i) Volume of gas produced **after** 50 seconds. (1mk)
   ii) Time needed to produce 155 cm^3 of carbon (iv) oxide. (1mk)
c) EXPLAIN why the volume of carbon (iv) oxide produced does not exceed 240cm^3 (2mk)
d) Calculate rate of the reaction at the 55th minute. (3mks)
e) LIST any two ways in which the reaction above can be fastened .(2mk)

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



i). Write a chemical equation to show how solid R is formed. (1mk)
ii) State the observation that would be made in process H if ammonia solution was replaced with excess sodium hydroxide solution .(1mk)
iii) State any two observations made in process I (2mk)
iv) Write the two ionic equations that led to the formation of solution Q (2MK)
v) State any two uses nitric (v) acid (2mk)

MURANG'A SOUTH
233/3
CHEMISTRY
PRACTICAL

CONFIDENTIAL INSTRUCTIONS TO SCHOOLS

In addition to the normal fittings and apparatus in the laboratory, each candidate would need the following:

- 150 mls of solution **A**
- 200 mls of solution **B**.
- 25 mls pipette
- 50 ml burette
- Pipette filler
- Thermometer (-10^{0}c – 110^0 c)
- Stop-watch
- At least six test-tubes
- Two boiling tubes
- 250ml Distilled water in a wash bottle
- Five labels
- 2 conical flasks
- 10 ml measuring cylinder
- 50 ml measuring cylinder
- 10 cm^3 of solution **C**
- **20cm^3 of 2M NaOH**
- Two filter paper
- 0.2g of solid **D**
- pH chart

- white tile
- filter funnel
- clamp and stand

Access to the following:-

(a) Source of heat
(b) Water bath
(c) 2M Nitric (V) Acid
(d) 2M Sodium Hydroxide
(e) 2M Ammonia solution
(f) 0.1M Potassium iodide
(g) 0.5M acidified Barium Nitrate (Acidified with Nitric (V) Acid)
(h) Bromine water
(i) Sodium hydrogen carbonate solid.
(j) Universal indicator solution.

Notes

- Solid **D** is maleic acid.
- Solution **C** is a mixture of Copper (II) Sulphate and Aluminium Sulphate. It is prepared by mixing two grams of each in water to make 20 $cm^3$of solution. (Prepare as per the number of candidates.)
- Solution **A** is prepared by dissolving 3.16 g of $KMnO_4$ and topping up to one litre.
- Solution **B** is prepared by mixing 5g of oxalic acid ad 2.86g of sodium oxalate and dissolve in one litre.

MURANG'A SOUTH
233/3 - CHEMISTRY - PAPER 3
(Practical)
END TERM 2 2021

QUESTION 1

- Solution A; which is 0.02M acidified Potassium Manganate (VII).
- Solution B; which is a mixture of Sodium Oxalate, $Na_2C_2O_4$ and oxalic acid, $H_2C_2O_4$

You are required to:-

i) Determine the solubility of Sodium Oxalate at room temperature.
ii) Determine the effect of temperature on the rate of reaction of Potassium Manganate (VII) and Oxalic acid.

Procedure I

i) Fill the burette with solution B .Pipette 25.0cm^3 of solution A into a clean conical flask. Heat the contents of the conical to about 70^0c.
ii) Titrate the hot solution against solution B to a colourless end point.

Record your results in table I below

iii) Repeat steps (i) and (ii) two more times to fill the table I below.

Keep the remaining solution B and A for procedure II

Table I

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

(4 mks)

(a) Work out the average volume of solution B used. (1 mk)
(b) (i) Calculate the number of moles of potassium manganate (vii) in 25.0 cm^3 of solution A. (1 mk)

(ii) Given the following reactions:-

$Na_2C_2O_{4(aq)} \longrightarrow 2Na^+_{(aq)} + C_2O_4^{2-}{}_{(aq)}$

$C_2O_4^{2-}{}_{(aq)} + 2H^+_{(aq)} \longrightarrow H_2C_2O_{4(aq)}$

$2KMnO_{4(aq)} + 5H_2C_2O_{4(aq)} + 3H_2SO_{4(aq)} \longrightarrow K_2SO_{4(aq)} + 2MnSO_{4(aq)} + 8H_2O_{(l)} + 10CO_{2(g)}$

I. Calculate the number of moles of oxalic acid that reacted with Potassium Manganate (VII) (1 mk)

II. Determine the mass of oxalic acid in the average volume used.
($H_2C_2O_4.2H_2O$) (H= 1.0, C= 12.0, O = 16.0) (1 mk)

(c) Given that solution B was prepared by dissolving 7.68 g of the mixture of oxalic acid and Sodium oxalate in 1000cm^3 of a solution.

(i) Using your answer in b (II) to work out the mass of oxalic acid in 1000 cm^3 of solution B. (1 mk)
(ii) From your answer above, calculate the mass of sodium oxalate in 1000 cm^3 of the mixture. (1 mk)
(iii) Hence calculate the solubility of sodium oxalate in g/100g of water. (1mks

Procedure II

i) Using a measuring cylinder, transfer 5.0 cm^3 of solution A into a clean boiling tube.
ii) Label five test tubes 1-5
iii) Using the burette measure 5 cm^3 of oxalic acid, solution B into five test tubes labelled 1 – 5
iv) Heat solution A until it reaches 80^0C.

v) To the hot solution in (iii) add 5.0 cm^3 of solution B from test tube 1 and start the stop watch at the same time. Stir the mixture using the thermometer and record time taken for the purple color to disappear.

vi) Repeat procedure (i) – (iv) at the temperatures shown using contents of test tubes 2, 3, 4 and 5 respectively.

Table II

Temperature before mixing 0^0c	80	70	60	50	40
Time taken for purple colour to disappear in (sec)					
$1/_{time}$(sec^{-1})					

(5 mks)

(d) On the grid provided, plot a graph of $1/_t$ (y – axis) against temperature at which the purple colour disappear. (3mks)

(e) From the graph:

i) Determine the time taken for the purple colour to disappear at 47.5^0C. (1mk)

ii) How does temperature change affect $1/_t$ in this experiment? Explain. (1 mk)

QUESTION TWO:

You are provided with 10 cm^3 of solution C, which contains two cations and one anion. Carry out the tests below and record your observations and inferences in the spaces provided.

a) Add 20 $cm^3$of 2M aqueous sodium hydroxide to all of solution C provided. Shake well and filter the mixture into conical flask. Retain both the residue (on the filter paper) and filtrate.

Observations	**Inferences**
(1 mk)	(1 mk)

b) i) To about 2cm^3 of the filtrate, add 2M Nitric acid drop wise until in excess. (i.e. about 1cm^3 of the acid).. Retain the mixture.

Observations	**Inferences**
	(1 mk)

Divide the mixture in b (i) above into two portions.

ii) To the first portion, add aqueous sodium hydroxide drop wise until in excess.

Observations	**Inferences**
(1 mk)	(1 mk)

iii) To the second portion, add aqueous ammonia drop wise until in excess.

Observations	**Inferences**
(1 mk)	(1mk)

(c) To 2 cm^3 of the filtrate, add 3 drops of Potassium iodide

Observations	**Inferences**
(1 mk)	(1 mk)

(d) To 2 cm^3 of the filtrate, add 3 drops of acidified Barium nitrate solutions.

Observations	**Inferences**
(1 mk)	(1 mk)

(e) To the residue in (a), add 8 cm^3 of dilute nitric acid and allow it to filter into a boiling tube.

i) To 2 cm^3 of this filtrate, add aqueous ammonia drop wise until in excess.

Observations	**Inferences**
(1 mk)	(1 mk)

QUESTION THREE:

You are provided with solid D. Place all the solid D in the boiling tube. Add 10 cm^3 of distilled water and shake well. Divide the resulting mixture into four portions.

Observations	Inferences
(½ mk)	(½ mk)

a) To the first portion add 2 drops of universal indicator. Compare the result with the P^H chart.

Observations	Inferences
(½ mk)	(½ mk)

b) To the second portion add two drops of Bromine water.

Observations	Inferences
(½ mk)	(½ mk)

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

Observations	Inferences
(1 mk)	(1 mk)

d) To the fourth portion add, a little amount of $NaHCO_3$

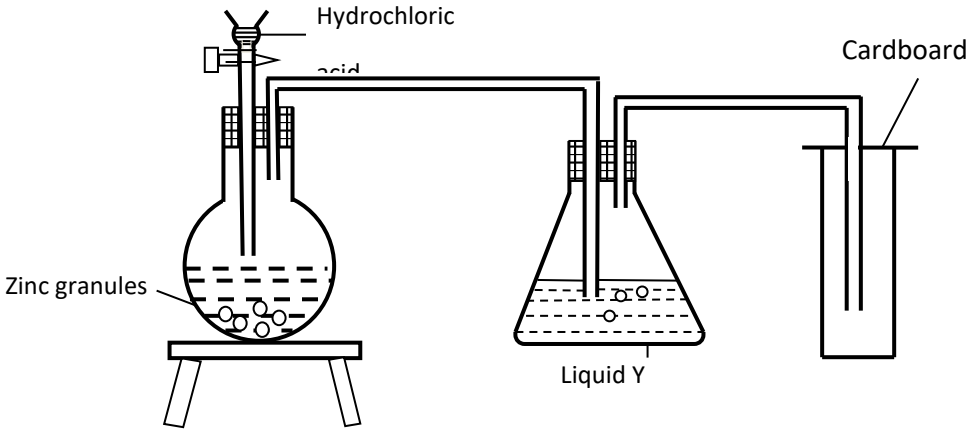
Observations	Inferences
(½ mk)	(½ mk)

MURANGA SOUTH
FORM 4 END
PAPER 1 MARKING SCHEME

1. Describe how a sample of pure sodium chloride can be obtained from a mixture of iodine,sodium chloride and sand. (3mks)
   heat the mixture to sublime iodine and collect it on cooler parts of the apparatus. Add water to the mixture to dissolve sodium chloride and filter to separate sand residue. Evaporate the filtrate to obtain sodium chloride.

2. Study the flowchart below and answer the questions that follow.
   I. Name (2mks)
   Gas V**- sulphur (iv) oxide**
   D **–sulpuric (iv) acid**
   II. Write an ionic equation for the formation of white precipitation. (1mk)
   $Ba^{2+}(aq) + SO_3^{2-}(aq) \rightarrow BaSO_3(s)$

3.The set up below was used to prepare dry hydrogen gas. Study it and answer the questions that follow.



(i) Identify a mistake in the set up (1mk)

hydrogen gas is collected by downward delivery and its less dense than air

(ii) Write an equation for the reaction for the reaction that produces hydrogen gas (1mk)

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

(iii) State one use of liquid Y (1mk)

drying agent

4. The grid below is part of the periodic table. Use it to answer the questions that follow. (The letters do not represent the actual symbols of elements.)

						R	**S**	
N	**Q**			✓			**T**	**U**
P								

(a) Indicate in the grid the position of an element represented by letter V, whose atomic number is 14. (1mk)

(b) Select a letter which represents a monoatomic gas. (1mk)

U

(c) write an equation for the reaction between Q and T (1mk)

$Q(s) + T_2(g) \rightarrow QT_2(s)$

5.Describe how a solid sample of Lead(II) Chloride can be prepared using the following reagents:Dilute Nitric Acid, Dilute Hydrochloric Acid and Lead Carbonate. (3mks)

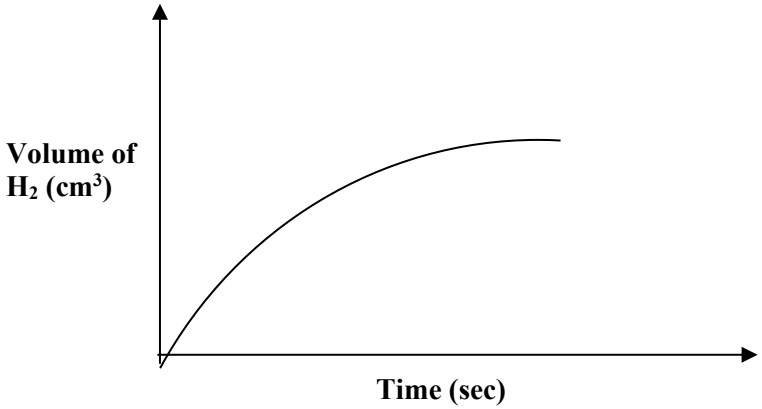
-add lead carbonate to dil. Nitric acid, a little at a time until effervescence stops and filter excess carbonate. Add dil. Hydrochloric acid to the filtrate to precipitate lead (ii) chloride. Filter, wash and dry the residue.

6. (a) State Graham's law of diffusion. (1mk)

-Under the same conditions of temperature and pressure , the rate of diffusion of a gas is inversely proportional to the square root of its density.

(b) $50cm^3$ ammonia gas diffuses through a small orifice in 20 seconds.How long will it take a similar volume of propane (C_3H_8) to diffuse through the same orifice under the same conditions of temperature and pressure? (C=12.0, H =1.0, N=14.0) (3mks)

7. A student reacted 0.2g of zinc granules with 2M hydrochloric acid and volume of hydrogen Gasproduced was measured at various time intervals. A sketch graph of volume against time is as shown below.



(i). Explain why the graph is steepest at the beginning. (1mk)

-the concentration of reactants is higher at the beginning leading to more collisions.

(ii). On the same axis given above, draw a sketch graph of the reaction when 0.2g of zinc powder was used instead of zinc granules. Label it I (1mk)

graph to start at the origin,curve above the line shown and level at the same point as the first one

(iii) Give a reason for the choice of your graph in (ii) above (1mk)

-reacts faster as there is greater surface area for contact with the acid

8. Dry carbon (II) oxide gas reacts with heated lead(ii)oxide as shown in the equation below.

$PbO_{(s)} + CO_{(g)} \longrightarrow Pb_{(s)} + CO_{2(g)}$

(a) Name the process undergone by the lead(ii)oxide. (1mk)

-reduction

(b) Give a reason for your answer in (a) above. (1mk)

-lead(ii)oxide is reduced to lead metal, i.e loses oxygen to CO .

(c) Name another gas that can be used to perform the same function as carbon(II)oxide gas in the above reaction. (1mk)

Hydrogen gas

9. Ammonia gas is manufactured by reacting nitrogen and hydrogen under the following conditions; a temperature of 450^0C, a pressure of 200 atmospheres and finely divided iron catalyst. The reaction that takes place is:

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$: $\Delta H = -92KJ$.

(a). How would the yield be affected by increasing the temperature to 650^0C? Give a reason.

- **the yield is reduced. High temperatures decompose ammonia gas to nitrogen and hydrogen** (2mks)

(b). Give two uses of ammonia (1mks)

-Manufacture of fertilizers

-removal of stains in laundry work

(any other relevant use)

10. The table below shows ammeter readings recorded when two equimolar solutions were tested separately.

Electrolyte	Current (A)
Dilute Sulphuric (VI) Acid	7.2
Ethanoic Acid	4.0

Explain the difference in the ammeter readings. (1mk)

dil.sulphuric acid is a strong acid fullyionized hence more ions to conduct an electric current unlike ethanoic acid which is partially ionized with few hydrogen ions.

11.The table below gives atomic numbers of elements represented by the letters A, B, C and D.

Element	A	B	C	D
Atomic number	15	16	17	20

Use the information to answer the questions that follow.

(a) Name the type of bonding that exists in the compound formed when A and D react. (1mk)

Ionic

(b) Select the letter which represents the best oxidizing agent.
Give a reason for your answer. (1mk)

C. Reacts by gaining one electron

(c) Give a reason why phosphorous is stored under water. (1mk

-smoulders/reacts with atmospheric oxygen to form an oxide.

12. 12.0cm^3 of 0.05m hydrochloric acid reacted with calcium hydrogen carbonate.

(a) Write the chemical equation for the reaction. (1mk)

$Ca(HCO_3)_2(aq) + 2HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + 2H_2O(l)$

(b) Calculate the number of moles of hydrochloric acid used. (2mks)

(12 x 0.05)/1000 = 0.0006 mole.

(c) Determine the number of moles of calcium hydrogencarbonate used. (1mk)

0.5 x 0.0006 = 0.0003 mole

13. Study the information in the table below and answer the question the table below the table.

Bond	Bond energy (kJmol-)
C-H	414
Cl-Cl	244
C-Cl	326
H-Cl	431

Calculate the enthalpy change for the reaction (3mks)

$$CH_{4\,(g)} + Cl_{2\,(g)} \xrightarrow{uv} CH_3Cl_{(g)} + HCl_{(g)}$$

Bonds broken **bonds formed** **Enthalpy change**

4 x 414 = 1656 **3 x 414 =1242** **1900-1999 = 999kJ**

1 x 244 = 244 **1 x 326 =326**

Total=1900kJ **1 x 431 = 431**

Total=1999kJ

14.Polyvinylchloride (PVC) is an example of an addition polymer whose monomer is Chloroethene.

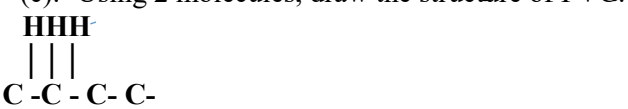
(a).What is a polymer?

a long chain molecule made of short unsaturated molecules called monomers (1mk)

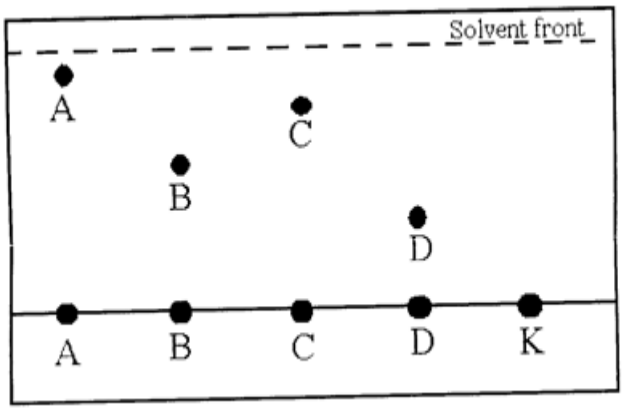
(b). What are the conditions ofpolymerisation? (1mk)

high temperature, high pressure and special catalyst.

(c). Using 2 molecules, draw the structure of PVC. (1mk)

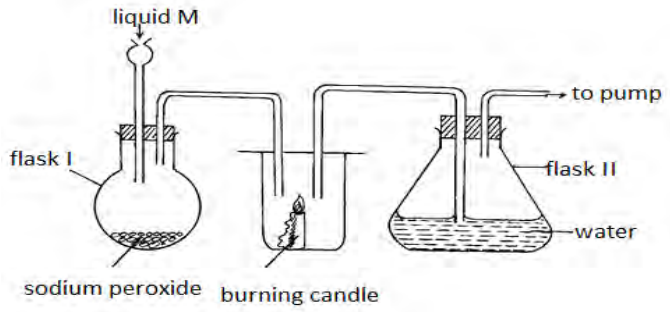


15. The diagram below represents a paper chromatograph of pure A, B, C and D. A mixture of K contains A and D only



Indicate on the diagram the chromatograph of K (1mk)

16.The diagram below shows a set up of apparatus used to prepare oxygen gas and pass it over burning candle. The experiment was allowed to run for several minutes.



(i) Identify liquid M. (1mk)
water

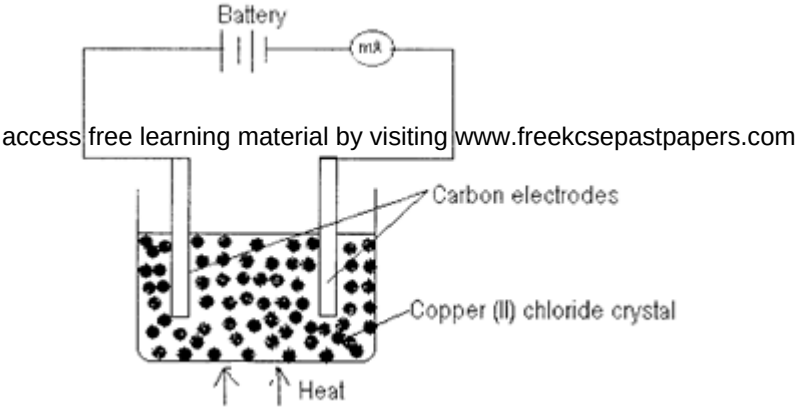
(ii) Write an equation for the reaction that forms oxygen gas in the set up. (1mk)
Na_2O_2 (s) + H_2O (l) →2NaOH (aq) + O_2(g)

(ii) The pH of the solution in flask II was found to be less than 7. Explain. (2mks)

- **sodium hydroxide is formed and is basic due to hydroxide ions formed.**

17. Give two reasons why a luminous flame is not used for heating purposes (2mks)
produces more heat tha luminous flame
does not produce soot that make the apparatus dirty

18. The diagram below shows copper (II) chloride crystals being heated until all has melted.



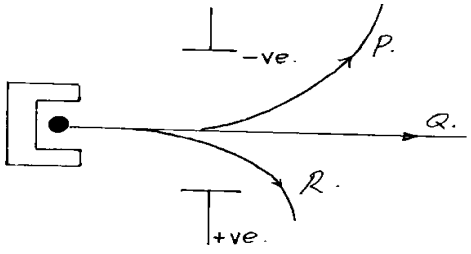
(a) State what was observed in the millimeter

(i) At the beginning. (1mk)
the milliametre did not show any reading

(ii) As copper (II) chloride was melted
milliameter started showing some reading as copper(ii)chloride melted.

(b) Explain your answer in (a) above. (2 marks)
When copper (ii)chloride melts, its ions become mobile thus conducts electric current

19. The figure below shows the behaviour of emissions by a radioactive isotope X



Electric field

(a) Identify the radiations (1½mks)

P **Alpha**

Q**Gamma**

R **Beta**

Which of the radiations (P, Q, R) produces the strongest damage to human tissues. Explain (1mk)

Gamma radiations. They have high penetrative power

20. The standard electrode potentials for the elements chlorine and magnesium

$Cl_{2(aq)} + 2\bar{e} \longrightarrow 2Cl^-_{(aq)}, \ E^o = +1.36V$

$Mg^{2+}_{aq} + 2\bar{e} \longrightarrow Mg_{(s)}, E^o = -2.36V$

i) Which one of the two elements will act as an oxidizing agent?Explain your choice

$Cl_{2(aq)}$ has a positive reduction potential (2mks)

ii). Calculate the electromotive force of a cell where the overall reaction is

$Cl_{2(aq)} + Mg_{(g)} \longrightarrow Mg\ Cl_{2(aq)}$ (1mk)

+1.36- -2.36 =3.72V

21. Briefly describe ho,w the Ph of soil sample can be tested to ascertain whether it is suitable for growing sugarcane. (3mks)

grind a soil sample and add water. Filter .to a sample of the filtrate, add 2-3 the drops of universal indicator and compare the colour on a pH chart. Note and record the soil pH.

22. A form four student wanted to determine the solubility of PotassiumNitrate. He obtained the following results as shown below.

Mass of evaporating dish	15.13g
Mass of evaporating dish and solution	36.51g
Mass of evaporating dish and salt	19.41g

Use the information above to calculate the solubility of Potassium Nitrate. (3mks)

Mass of salt: 19.41-15.13 =4.28g

Mass of water: 36.51-19.41 =17.1g

Solubility: (4.28 x100)/17.1 = 25.0292g/100g of water.

23. An equilibrium exists between the reaction of bromine and bromide ions as represented by the equation.

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

What effect would addition of sodium hydroxide solution have on the above equilibrium? Explain your answer (2mks)

. **Equilibrium will shift forward// to the right** ✔

The concentration of $H^+_{(aq)}$ will decrease hence the equilibrium shift to the right to replace the H^+ ions that will have reacted with hydroxides ions. ✔

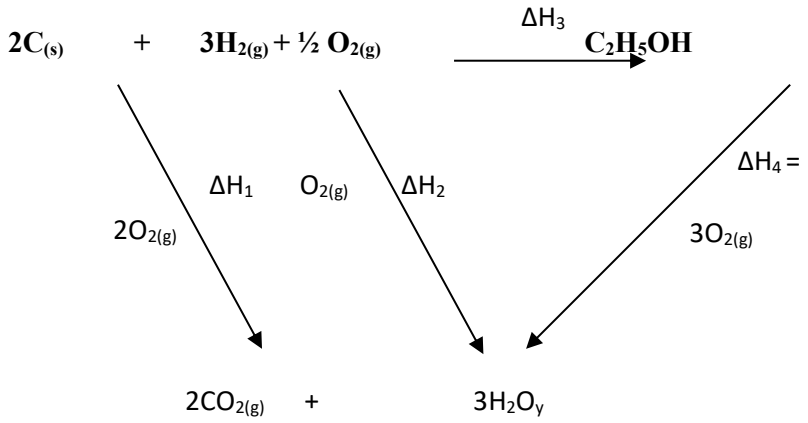
24. Use the information below to answer the questions that follow:

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

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

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

From the energy cycle diagram:-



$\Delta H_1 + \Delta H_2 = \Delta H_3 + \Delta H_4$ ✓1
Then
$\Delta H_3 = \Delta H_1 + \Delta H_2 - \Delta H_4$
$\Delta H_3 = (2 \times -394) + (3 \times -286) - (-277)$ ✓ 1
$= -788 + 853 - -277$
$= -788 - 853 + 277$
$\Delta H_3 = -1646 + 277 = -1369$
$\Delta H_3 = -1369$ KJMOI^{-1}✓ 1

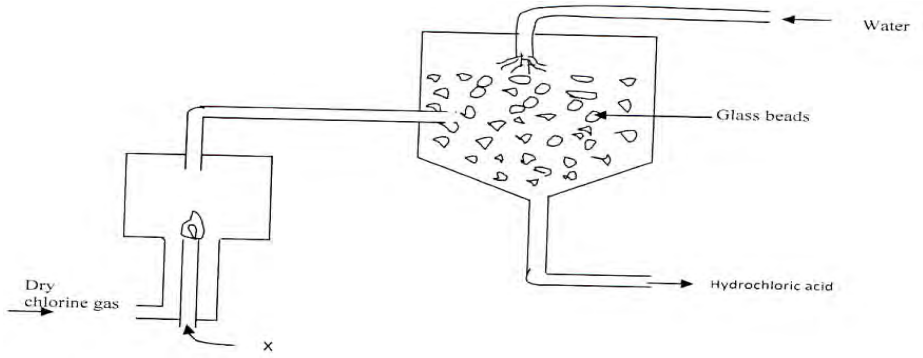
25 .(a) Define the term isomerism. (1mk)
Existence of a compound in more than one form but in the same physical state.
(b) Draw and name two isomers of pentene. (2mks)

26. The table below shows the observations made when various salts are heated. Study it and answer the questions that follow.

Salt	Mass before heating (Grams)	Mass after heating (Grams)	Other obserations
P	2.34	2.34	No change is observed
Q	7.9	5.14	Colourless gas, turns lime water to a white ppt
R	1.83	0.962	White fumes
S	1.09	0.579	Brown gas

(i) Which salt is likely to be anhydrous sodium carbonate? Explain (1mk)
P. does not decompose on heating
(ii) Identify lead(ii)nitate. (1mk)
S
(iii) Which salt reacts with an acid to form carbon (iv)oxide (1mk)
P or Q

27. .The diagram below represents a set up used for the large scale manufacture of hydrochloric acid.



(a) Name substance X (1Mark)

Hydrogen gas

(b) What is the purpose of the glass beads? (1Mark)

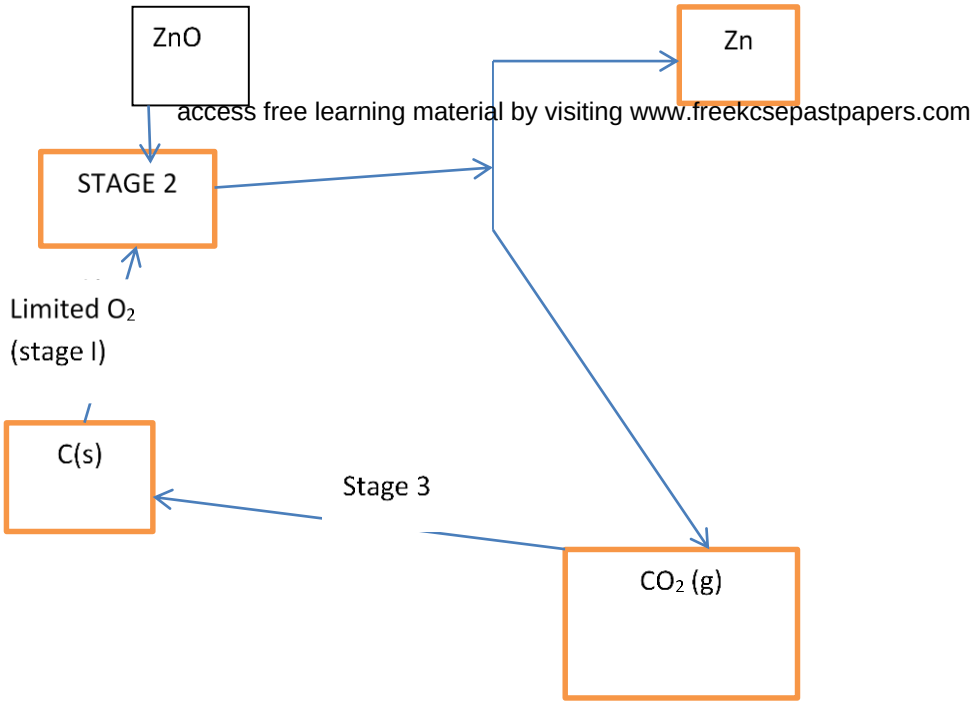
Increases the surface area for dissolution of hydrogen chloride gas

(c) Give one use of hydrochloric acid (1 Mark)

pickling of metals

making dyes, photographic materials,drugsetc

28. The stages shown in the following diagram can be used to extract zinc from its oxide:-
Name the stage and the process taking place in it:-



Stage 1 **oxidation; Coke is oxidized to CO** **(1mk)**

Stage 2 **Reduction: zinc is reduced to Zinc metal (1mk)**

Stage 3. **Recycling stage; CO2 is reduced to regenerate CO**(1mk)

29. Study the information in the table below and answer the questions that follow.
(The letters do not represent the actual symbols of the elements)

Element	Electronic configuration	Ionization energy Kj/mol)
P	2.2	1800
Q	2.8.2	1450
R	2.8.8.2	1150

(a) What is the general name given to the group in which elements **P, Q** and **R** belong? (1mk)
alkaline earth metals(reject alkali earth metals

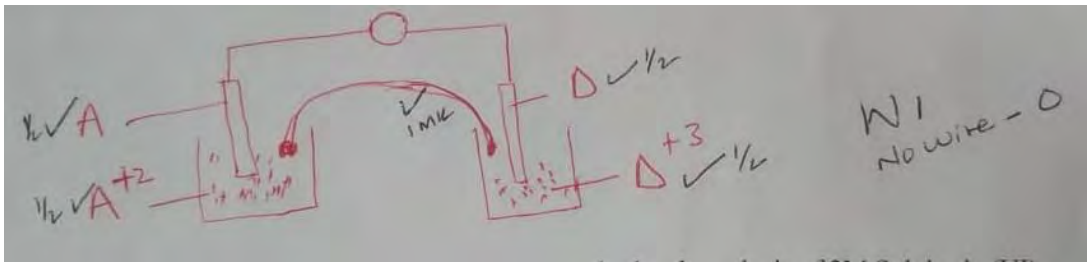
(b) Explain why **P** has the highest ionization energy (1mk)
has few energy levels hence valency electrons are strongly attracted by the positive nucleus therefore difficult to remove hence more ionization energy.

(c) Write a balanced chemical equation for the reaction between element**Q** and water (1mk)
$Q(s) + 2H_2O(l) \rightarrow Q(OH)_2(aq) + H_2(g)$

MURANG'A SOUTH
FORM FOUR END TERM 2 - 2021
PAPER 2 MARKING SCHEME
CHEMISTRY FORM 4.

1.

(a) (i) A
(ii) -0.44- -0.76{ ½)
=0.32V { ½)
(iii) A B,E NB/ all 1mk, any 2 ½
(iv)



(b) (i)
$2H_{(aq)}^{+} + 2e \rightarrow H_{2(g}$
(ii) Introduce a glowing splint and it will relight.

(c) Mass deposited=QRAM/FC
Let charge be C
1.9=[0.6x1.5x60x60] x113/[96500*C]
C=[0.6x1.5x60x60x113]/[1.9x96500]
C=1.9968 or ~ +2

OR

Q= IT
0.6X1.5X60X60=3240
If 3240=1.9$_g$
? =113
[3240X113]/1.9=192694.73c
192694/96500=1.9968
~+2

2.

(a)

- **Haematite**
- Magnetite

(b) reaction of coke with oxygen is highly exothermic

(c)

- Low density.
- Immiscible with iron.

(d) $CO_2 + C$ …… $2CO$

(e) $2Fe_2O_3 + 3C$ …….$4Fe + 3CO_2$

f) cast iron is used to make manhole covers
used as a catalyst in harber process
making cutlery and surgical equipments

(g) SO2 causes acidic rain
CO2 Causes global warming

(h) (i) It would decrease{1mks},increase in temperature favours endothermic reactions ½ and therefore reverse reaction is favoured ½

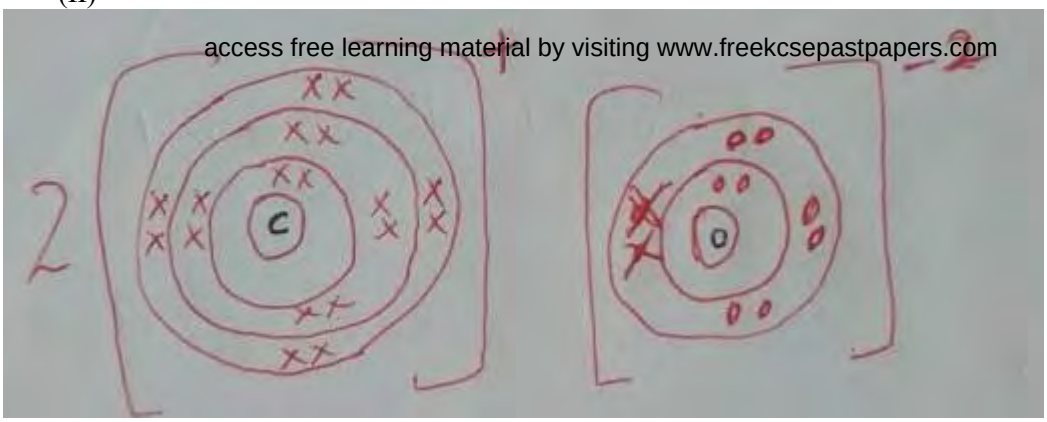
(ii) Vanadium (iv) oxide ~**reject platinum.**

(iii Manufacture of dyes{1/2mks}

Filling batteries{1/2mks}
Any other correct answer

3. (a) (i) A 2,8,1
D 2,8,7

(II)



(b) **Yshown in the table,period4 group vi**

(c) (i)C is more reactive than A{1mks}
C has a larger atomic radius/lower ionization energy and therefore easily loose the outer most electron{1mks}
(ii)
A has a larger atomic radius than B /B has a shorter atomic radius than A[{1mks}B has more protons than A and therefore energy level attracted strongly towards the nucleus.{!mks}
(iii)
Oxide of G has the higher melting point than the oxide of D.{1mks} Because oxide of G has a giant ionic structure with strong ionic bond while oxide of D has simple molecular structure with weak van der waals forces.{1mks}

(c) **2**Na +2HCl → 2NaCl +H_2 1mk
Moles of A =

0.92/23 (½)
=0.04moles
Mole ratio
2 : 1
Moles of hydrogen
0.04/2
= 0.02 (½)
Volume of hydrogen
0.02 X24 = 0.48dm^3 or 480cm^3

4. (a) The reaction would start and then stop immediately {1mks}
Because calcium sulphate formed is insoluble and therefore forms a coating on calcium preventing further reaction (1mk)
(b) (i) Add a sample to;
White anhydrous **copper (ii) sulphate**, it would turn to blue.
OR
Blue anhydrous **cobalt (ii) chloride**, it would to pink.
NB/ REAGENT 1MK, CORRECT COLOUR CHANGES 1MK

(ii) Boil ½ , If it boils at a **constant/fixed** temperature. ½ **REJ 100^0 C**

(c) (i) $Mg_{(s)} + H_2O_{(g)} \rightarrow MgO_{(s)} + H_{2(g)}$
(ii) It is less dense than air.

5. (a) $MnO_{2(s)} + 4HCl_{(aq)} \rightarrow MnCl_{2(aq)} + Cl_{(g)} + 2H_2O_{(l)}$
(b)
- It turns red then white{1mks}
- Red because the solution is acidic{1mks}
- White because the **HOCl** bleaches the dye in the litmus{1mks}

(c) sodium chlorate
(d) I) (i) To expel the air that was inside so that its oxygen doesn't react with chlorine.
(ii) It would absorb both water moisture and un-reacted chlorine.
II) moles of chlorine gas=4000/24000
= 0.16677moles
$2Fe + 3Cl_2 \rightarrow 2FeCl_3$ {1mks}
Mole ratio
Cl_2 : $FeCl_3$
3 : 2

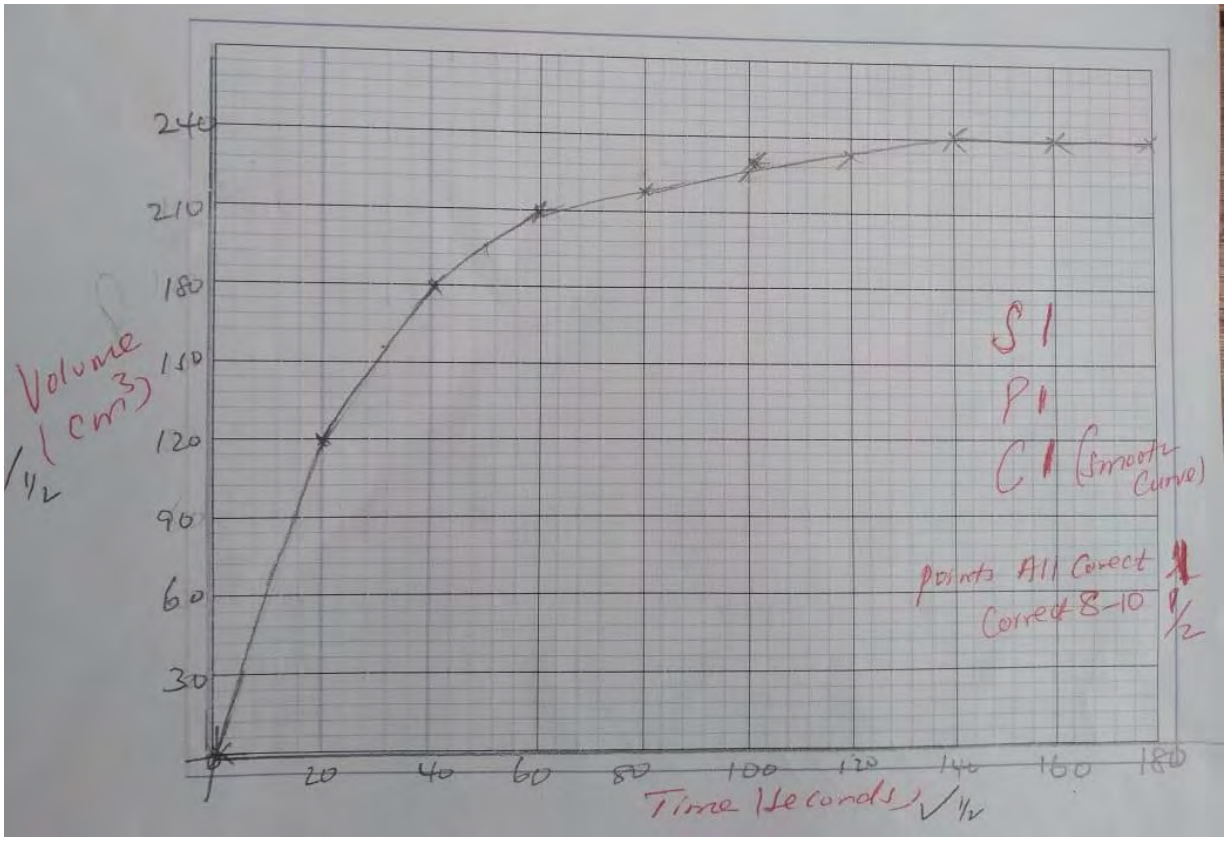
Moles of product
If 3→0.1667
2→?
2×0.1667/3
=0.11111moles
Mass of product=moles × RMM
0.11111×162.5
=18.0538g

6. (a) It is the spontaneous disentigration of an unstable nuclide to form a stable nuclide.
(b) (i) Step (I) Alpha α
Step (ix) Beta β
(ii) $_{90}{}^{230}Th \rightarrow {}_{88}{}^{226}Ra + {}_{2}{}^{4}He$

(iii) 30/6 = 5
48→24→12 ----- 6→3→1.5g
=1.5g

(c).

7. (a)



(b) (i) 240 - value at 50 {1mks} Answer {1mks}
(ii) value to be read across the graph

(c) Because 1g of calcium carbonate can only produce $240cm^3$(1mk)
That is 1/100 = 0.01 (½)
Moles of CO2

$CaCO_3$; CO_2
1 : 1
0.01×24000
$=240cm^3$

(d) Tangent at 55^{th} minute (1MK)
Dy/dx {1mks}
– Answer with units {1mks}
– Answer with no units{1/2mks}

(e) Use powdered calcium carbonate.
Warm the acid.

8. (i) $Cu(NO_3)_{2(aq)} + Na_2CO_{3(aq)} \rightarrow CuCO_{3(S)} + 2NaNO_{3(aq).}$ {1mks}
(ii) A blue precipitate, ½ Insoluble in excess.{ ½ mks}

(iii) Brown copper solid dissolves forming a blue solution.
Brown fumes are seen escaping.

(iv) $Cu_{(aq)}^{+2} + 2OH_{(aq)}^{-} \rightarrow Cu(OH)_2$
$Cu(OH)_{2(S)} + 4NH_{3(aq)} \rightarrow [Cu(NH_3)_4]_{(aq)}^{+2} + 2OH^-_{(aq)}$

V) To clean metals.
Manufacture of nitrogeneous fertilizers

Any other relevant

CHEMISTRY PAPER 3
MARKING SCHEME
QUESTION I
PROCEDURE 1

Table 1 …….. (5mks)
Distributed as follows:-

(a) Complete table …… (1 mk)
Conditions:
(i) Complete table with 3 readings ……(1 mk)
(ii) Incomplete table with 2 readings …… (½ mk)
(iii) Incomplete table with 1 reading ……..(0 mk)

Penalties

Penalize ½ mk once for any of the following;
- Wrong arithmetic
- Inverted table
- Reading beyond 50 cm^3 unexplained.
- Titre values less than 1 cm^3

(b) Use of decimals …….. (1 mk)
- It's tied to the 1st and 2nd rows only.
- Accept 1 or 2 d.pls used consistently otherwise penalize fully.
- If the second decimal place is used, it must be a 'zero' or a 'five' otherwise penalize fully.

(c) Accuracy …….. (1 mk)
Compare the candidate's titre values to the school values and award as follows:-
- If any within $\pm$0.1 of S.V. …….. (1 mk)
- If non within $\pm$ 0.1 but within $\pm$ 0.2 of S.V. award …… (½ mk)
- If non is within $\pm$ 0.2 of S.V. ……. (0 mk)

(d) Principles of averaging ……. (1 mk)
Conditions:
(i) If 3 consistent values are averaged …… (1 mm)
(ii) If 3 titrations done, only two are consistent and averaged …….. (1 mk)
(iii) If only two titrations done and are consistent and averaged ……. (1 mk)
(iv) If 3 titrations are done, are consistent and only two are averaged……. (0 mk)
(v) If 3 titrations are done, all are consistent, yet averaged.……(0 mk)

Penalties:
- Wrong arithmetic, error outside $\pm$ 2 units in the 2ns d.pl. penalize ½ mk.
- If no working shown but answer given is correct penalize ½ mk.
- If answer is rounded off to the 1st d.pl. penalize ½ mk unless if it works out exactly.
- If no working is shown and the answer given is wrong, penalize fully.

(e) Final answer …….. (1mk)
Compare the school values with the correct titre average.
Conditions:
- If within $\pm$0.1 ……(1mk)
- If answer is within $\pm$0.2…….. (½ mk)
- If beyond $\pm$ 0.2, the award '0' marks

N/B
a) Final answer mark to the correct principles of averaging otherwise penalize fully.
Calculations;

b (i) Moles of mnO^-_4 = $\frac{25 \times 0.02}{1000}$ $^{\surd}$ ½
= 0.0005$^{\surd}$ ½

N/B

- No. of moles in b (i) must be exact as above, otherwise penalize fully.

b (ii) (I) Moles of oxalic acid

$= 0.0005 \times \frac{5}{2}$ √ ½

I

= 0.00125 moles √ ½

OR

= 0.0005 x 2.5 √ ½

= 0.00125 moles √ ½

(II) Mass of oxalic = R.F.M. x Ans b(i) I

= 126 x√ ½ Ans b (i) I

I

= 0.1575 g √ ½

c (i) Mass of oxalic acid in 1000 cm^3

$\frac{\text{Ans b(ii) II} \times 1000}{\text{Average titre}}$ √ ½ **I**

= Corr. Ans. √ ½

(ii) Mass of Sodium Oxalate in 1000 cm^3 = 7.68 – Ans c(i) √ ½

= Corr. Ans. √ ½ **I**

(iii) Solubility of sodium oxalate

$= \frac{\text{Ans.c(ii)} \times 100}{1000}$ √ ½

= Corr. Ans. √ ½ **2**

Penalties

(i) All answers in b(i) – b(ii) must be exact as indicated, otherwise penalize fully.

(ii) For c(i) – c (iii) Accept rounding off upto the 4th decimal place, otherwise penalize ½ mk on the answer.

(iii) Units must be correct if they are shown otherwise penalize ½ mk on the answer.

(iv) For c (iii) the units must be shown and be correct otherwise penalize ½ mk on the answer.

(v) Penalize fully for the strange values if they are used.

PROCEDURE II

Table II…… (5 mks)

Distributed as follows:-

(a) Complete table …… (2 mks)

(i) Complete table with 5 readings…… (2mks)

(ii) Incomplete table with 3-4 readings award …… (1 mk)

(iii) Incomplete table with 2…… (½ mk)

(iv) Incomplete table with less than 2 readings …… (0 mk)

Conditions and penalties

- Accept $\frac{1}{t}$ values to at least 3 d.pl. unless if it works out exactly to less than 3 d.pl.
- Place a tick (√) or cross x) on ½ values accordingly.
- Penalize ½ mk for each wrong 1/t values to a maximum of 1 mk.

(b) Decimals ……. 1 mk

Accept time recorded in seconds as whole numbers, 1 dp or 2 d.p. recorded consistently, otherwise penalize fully.

(c) Accuracy…….. 1 mk

Tied to the time at temperature $80^{0c.}$

Compare the students time value at 80^0 to the school value at the same temperature and award as follows:

(i)Value with ± 5 seconds of s.v……1 mk
(ii) Value not within ± 5 seconds ……(0 mk)

(d) Trend ……(1 mk)
Accept time values increasing continuously for full credit, otherwise penalize fully.

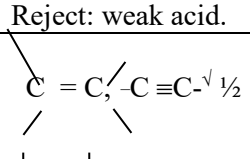
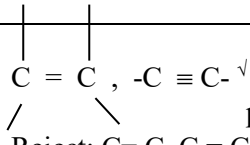
(e) GRAPH …… 3 mks
Distributed as follows:-
(i) Scale …….. 1/2 mk
The plots should cover at least ½ of the graph paper otherwise penalize fully.
Scale intervals should be uniform otherwise penalize fully.
(ii) Labeling …… (½ mk)
Accept for full credit if the axes are correctly labelled, otherwise penalize fully.
(iii) Plotting …… (1 mk)
Accept at least 3 -4 correct plots for ……. (1 mk)
2 correct readings plotted ……. (½ mk)
(iv) Shape of the curve ……. (1 mk)
Accept the shape of its curve with an increasing gradient for full credit, otherwise penalize fully.

(f) (i) Showing√ ½ **I**
Stating with √ ½correct conversion. ½
(ii) Increase in temp√ ½ leads to an increase in rate of reaction.
Explanation : with increase **I** in temp. reacting particles gain kinetic energy, more movement leading to more collisions.

Q2.

OBSERVATIONS	**INFERENCES**
a) Blue precipitate/ residue √ ½ colourless filtrate√ ½	- Cu^{2+} present. √ ½ - Absence of coloured ions. $Fe^{2+,}$ Fe^{3+}, Cu^{2+} √ ½ **NOTE:** If the ions are mentioned all the 3 must be present. Otherwise penalize fully.
bi) White ppt. formed. √ ½ Soluble in excess acid. √ ½	
ii) White ppt. formed √ ½ Soluble in excess √ ½	Pb^2, Al^{3+}, Zn^{2+} present **Note:** 3 correctly mentioned. √ 1 2 ions correctly mentioned√1 Only one correctly mentioned (0) Penalize ½ mk for any contradictory ion to a max of 1mk
iii) White ppt. formed √ ½ Insoluble in excess √ ½	Al^{3+} or Pb^2+ present √ 1 **Note:** 1 ion correctly mentioned √ ½ 2 ions correctly mentioned √ 1 Penalize fully for any contradictory ion.
c) No yellow ppt. √ 1	Al^{3+} present √ 1 Pb^{2+} Absent √ ½ For any credit the ion must be inferred correctly above
d) White ppt. formed. √ 1	SO_4^{2-} present √ 1 Penalize fully for any contradictory ion mentioned.
e) Blue ppt. √ ½ dissolves to form a deep blue solution. √ 1	Cu^{2+} confirmed. √ ½ Contradict fully for any contradictory ion mentioned.

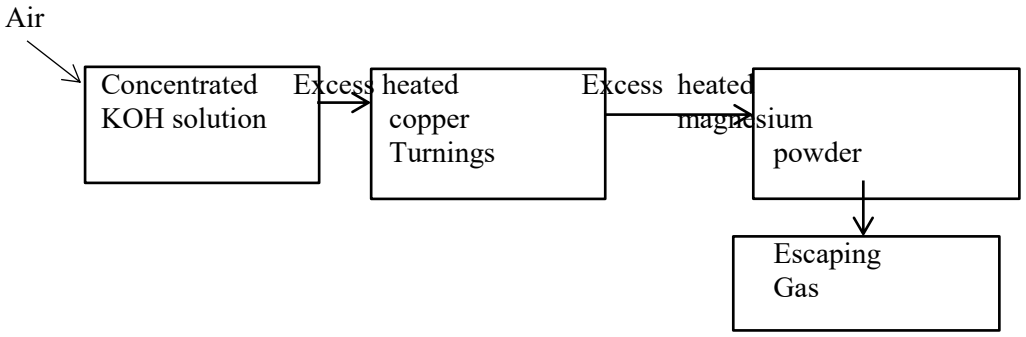
Q3.

OBSERVATIONS	**INFERENCES**
Solid dissolves to form a colourless solution √ ½	Solid K is a polar substance. √ ½ Ignore soluble substance i.e. absence of coloured ions.
a) P^H 4, 5, & 6. √ ½ reject: 4 -5, 5 – 6.	Weakly acidic. √ ½ Reject: weak acid.
b) Yellow bromine water decolourised. √ ½ Reject: Solution decolourises.	 √ ½
c) Purple $KMnO_4$ decolourised. Reject :solution decolourised.	 √ ½ present Reject; C≡ C, C = C
d) Effervescence /fizzing / √ ½ bubbles of a colourless gas. Reject: hissing/fizzling	R—COOH √ ½ Ignore H^+ ions

KIRINYAGA WEST
233/1
CHEMISTRY PAPER 1
THEORY
DECEMBER 2021

1. A weighed sample of crystalline sodium carbonate Na_2CO_3. nH**2**O was heated in a crucible until there was no further change in mass. Calculate the number of the mole (n) of water of crystallization given that the percentage by mass of anhydrous sodium carbonate is 85.5 while the rest is water.
(Na = 23, H = 1, C =12, 0 = 16) (3mks)

2. Study the scheme below and answer the question that follow.



a) Write an equation for the reaction that takes place in the chamber with magnesium powder. (1mk)

b) Name one gas which escapes from the chamber containing magnesium powder. (1mk)
Give a reason. (1mk)

3. The list below gives the formulae of some organic compounds.
Use it to answer the questions that follow.

M_1 CH_3CH_2OH
M_2 $CH_3CH_2CH_2CH3$
M_3 $CH_3CH = CH_2$

M_4 $CH_3CH_2CH_2COH$ (O double-bonded)
M_5 CH_3CH_3

a) Select two compounds which:
i. Are not hydrocarbons (1mk)
ii. Belong to the same homologous series. (1mk)

b) Identify the compound that is likely to undergo addition polymerization.
Give a reason for your answer. (1 mk)

4. An ion of element x is represented as $^{24}_{12}X^{2+}$

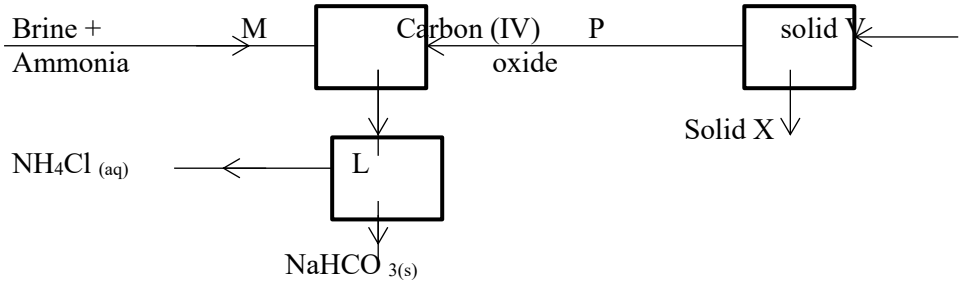
i) Write the electron arrangement of ion X. (1mk)
ii) To which group does element x belong? (1mk)
iii) Write down the formula of nitrate of X. (1mk)

5. The first step in the industrial manufacture of nitric(V) acid is the catalytic oxidation of ammonia.
a) What name is given to the catalyst? (1mk)
b) Write the equation for the catalytic oxidation of ammonia. (1 mk)
c) When excess ammonia gas is bubbled through a solution of zinc nitrate solution a white precipitate is formed first then it dissolves. Write down the formula of the final product. (1 mk)

6. a) State and explain the observation made when a few drops of concentrated sulphuric (VI) acid are added to a small sample of hydrated copper (II) sulphate. (2 mks)

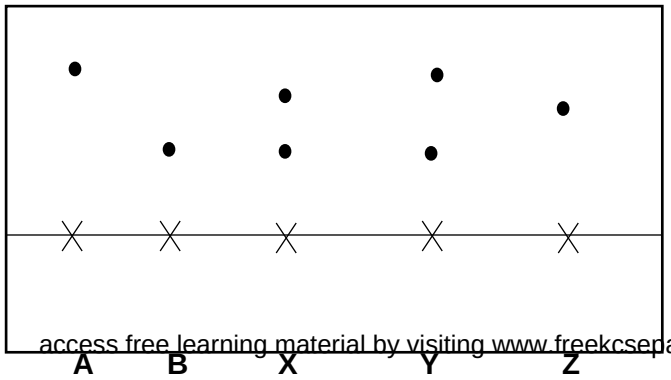
b) List down one use of sulphuric (VI) acid. (1 mk)

7. The diagram below shows part of a Solvay process.



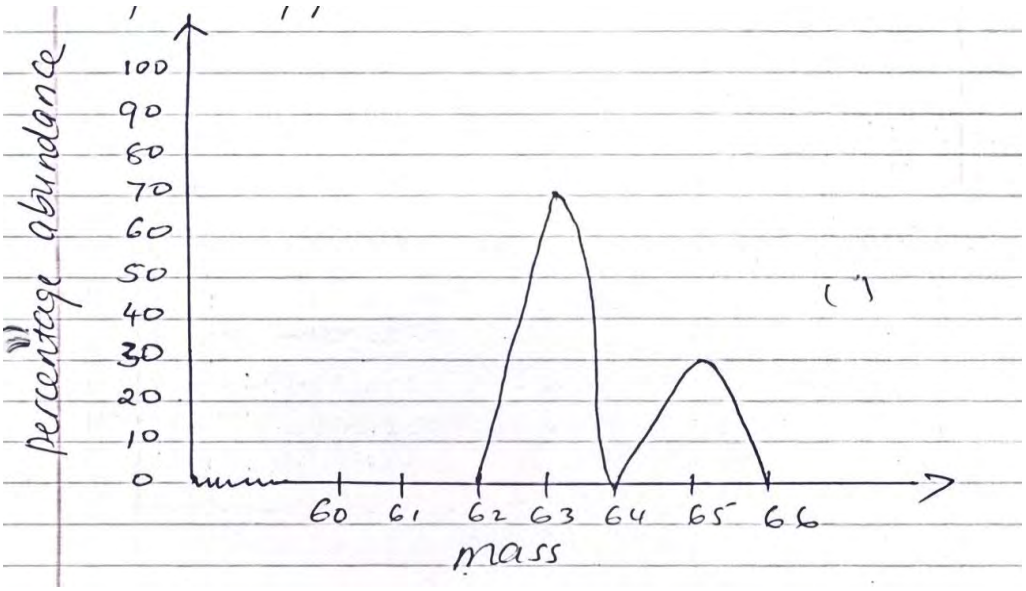
(i) Name solid x. (1 mk)
(ii) State the process taking place in chamber L (1 mk)
(iii) Write down a balanced chemical equation taking place in chamber P. (1mk)

5. Samples of urine from three form four students X, Y,Z from Kangi secondary school were spotted onto chromatogram paper alongside two from illegal drugs A and B. A chromatogram was run using propanol. The figure below shows the chromatogram.



i) Identify the student who had not used any of the two drugs. (1 mk)
ii) Which drug is more soluble in the solvent. (1 mk)
iii) Show the solvent front line on the diagram. (1 mk)

9. The diagram below shows the percentage abundance of the Isotope of copper.

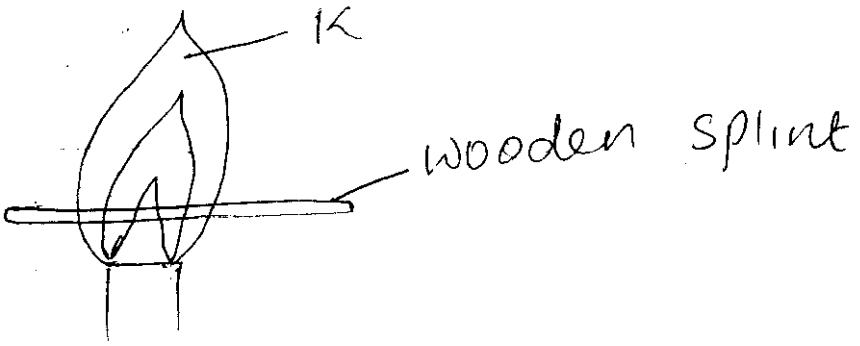


a) Calculate the relative atomic mass of copper from the information on the graph. (2mks)

b) Write the isotope formula of the most abundant isotope of copper showing mass number and atomic number. (Copper has 29 protons) (1 mk)

10. Calculate the solubility of glucose at 40^0C from the following information.
Mass of the evaporating dish = 25.0g
Mass of the evaporating dish + saturated solution = 194.0g
Mass of the evaporating dish + solid after evaporation = 144.0g (3mks)

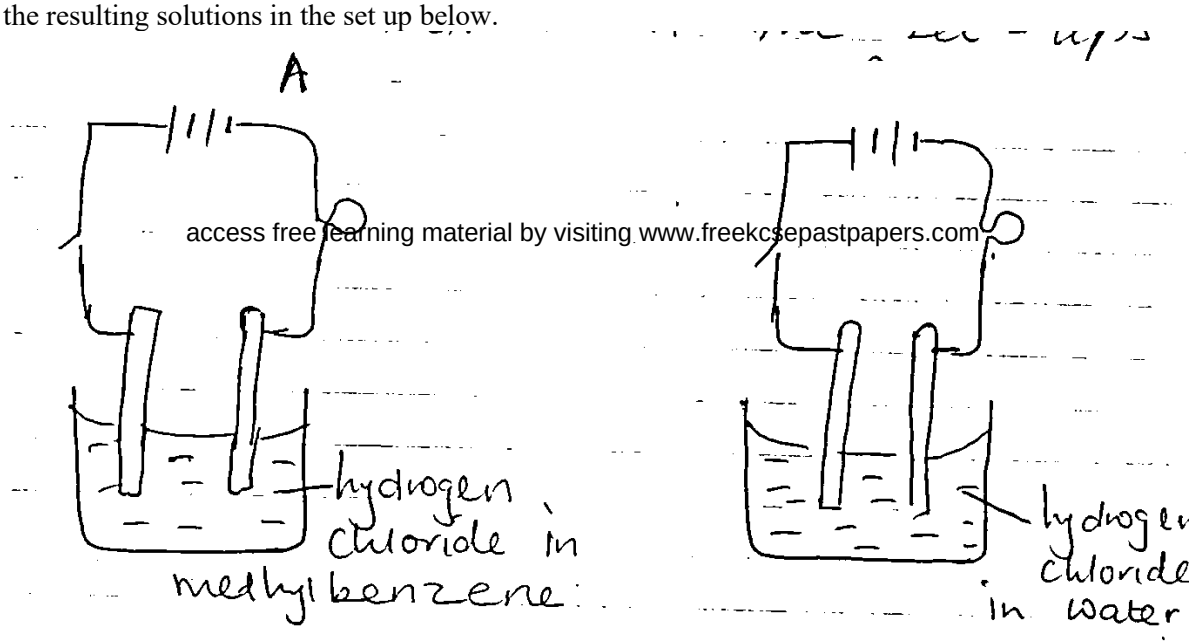
11. Study the diagram below and answer the questions that follow.



a) The wooden splint was slipped and removed. Draw and label the wooden splint after the experiment. (2mks)

b) What name do we give the zone of the flame above indicated by letter K. (1mk)

12. Two form four students bubbled hydrogen chloride gas through water and methylbenzene separately. They used the resulting solutions in the set up below.



State and explain the observations made in the set up A and B.
When the switch was closed. (3mks)

13. Bottles of sodium carbonate, sodium chloride and sugar lost their labels. A student prepares and tests an aqueous solution of each of the bottle sample. The results obtained were as follows.

Bottle	PH	Electrical conductivity	Correct label
A	7	Conducts	
B	7	does not conduct	
C	10	conducts	

Fill in the correct label of the bottles A, B and C in the table above. (3mks)

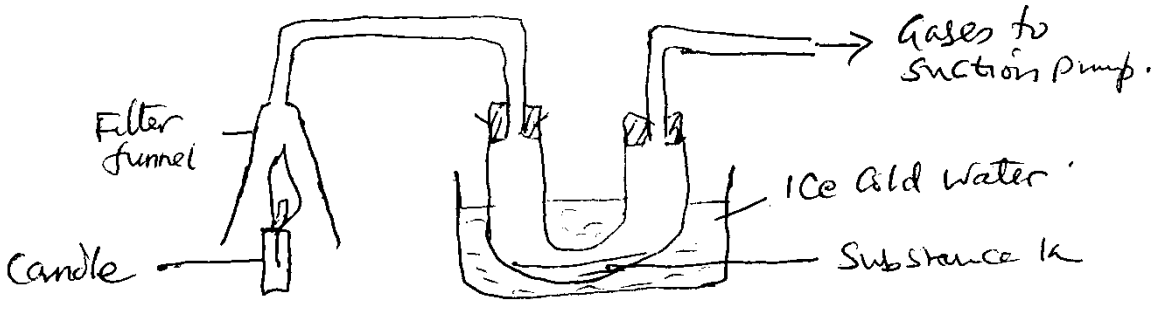
14. 80cm^3 of nitrogen(iv) oxide diffused from a certain porous plug in 100 seconds. Calculate the time taken by 80 cm^3 of carbon (ii) oxide to diffuse under the same conditions. (H= 14, C = 12, C = 16) (3mks)

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

Element	Atomic number	Melting point (^{0}C)
C	11	97.8
D	12	650.0
E	15	44.0
F	17	-102
G	18	-189
H	19	64.0

a) Explain how the reactivity of H with oxygen gas compare with that of C. (1mk)
b) Write the formulae of the compound formed when D and E react. (1mk)
c) State the observations made when element c is dropped into a trough of water. (1mk)

16. An experiment was set up as shown in the diagram below.

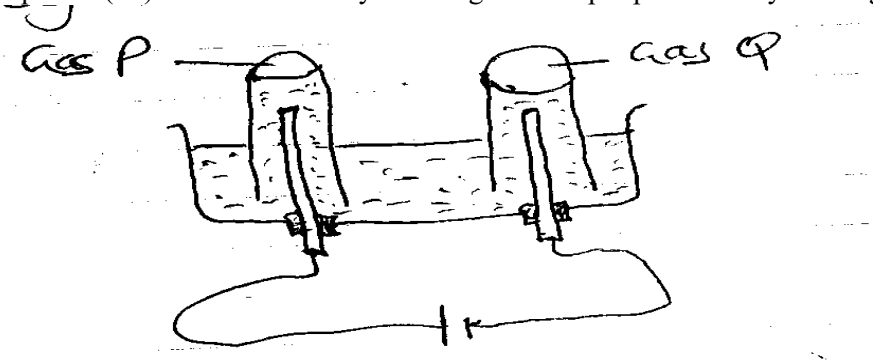


i) What would happen to the burning candle if the suction pump is put off (1mk)
ii) State one physical test that would show the substance k is water. (1mk)
iii) The PH of substance K was found to below 7 at the end of the experiment. Explain. (1 mk)

17. A plant used nitric (v) acid and ammonia gas as the only reactants for a certain fertilizer. If the production of the fertilizer per day is 3200kg.
Calculate the mass of nitric (V) acid used per day.
(N = 14, O = 16, H = 1) (3mks)

18. Given that the atomic numbers of X, Y, W and Z are 6, 8, 12 and 17 respectively.
a) Draw the dot(●) and cross (**x**) diagrams for the compounds formed when
i. W and Z combine. (1mk)
ii. X and Z combine. (1 mk)
b) State how the melting points of the compounds formed by W and Z.
Compare with that formed when X and Z react. (1mark)

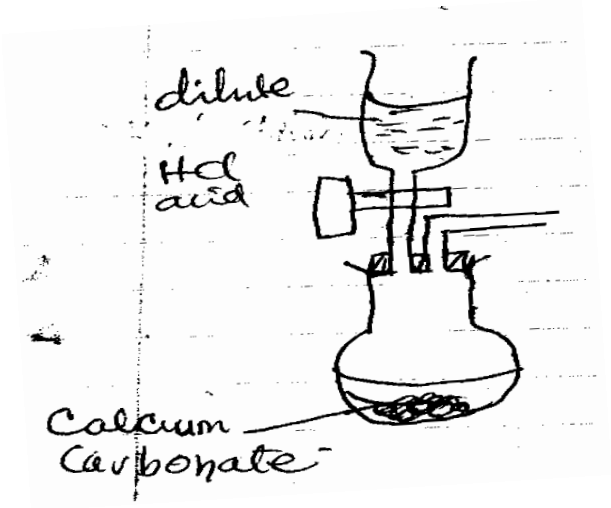
19. 200cm^3 of 2M Sulphuric (VI) acid was electrolysed using the set up represented by the diagram below.



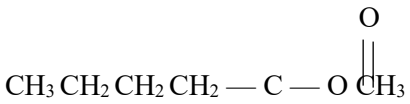
a) Explain using equations why the volume of gas Q is twice the volume of gas P. (2mks)
b) Describe how gas P can be identified. (1mk)

20. Hydrogen reacts with Pentene to Pentane . Calculate the volume of hydrogen gas required to convert 35g of pentene to Pentane at R.t.p.
(C = 12.0, H = 1 and molar gas volume at R.t.p is 24 litres) (3mks)

21. The diagram below shows laboratory preparation of carbon (IV) oxide gas. Complete the diagram to show how dry carbon (IV) oxide gas can be collected. (3mks)



22. The structure below show a pleasant smelling compound.



$$CH_3CH_2CH_2CH_2 - \overset{\overset{O}{\|}}{C} - O\,CH_3$$

a) Name the compound represented the formula above. (1mk)
b) Give the names of the two compounds that can be used to prepare the above compound in the laboratory. (2mks)

23. When a current of 2 amphere was passed through a cell containing dilute sulphuric (v) acid for 15 minutes, a gas x was produced at anode.
i. Name gas x. (1mk)
ii. Calculate the volume of gas x passed at the end of the experiment at s.t.p.
(1 Faraday = 96500, 1 mole of gas at s.t.p = 22400 cm^3) (2mks)

24. Chemical tests were carried out on separate samples of water drawn from a lake. The observation made were recorded as shown in the table below.

Test	Observation
i. Addition of sodium hydroxide solution dropwise until in excess	white precipitate dissolves
ii. Addition of aqueous ammonia solution dropwise until in excess	white precipitate doesn't dissolve
iii. Addition of few drops of acidified barium chloride	white precipitate

a) Name the cation and anion present in the water. (2mks)
b) Write an ionic equation for the reaction test (ii). (1mk)

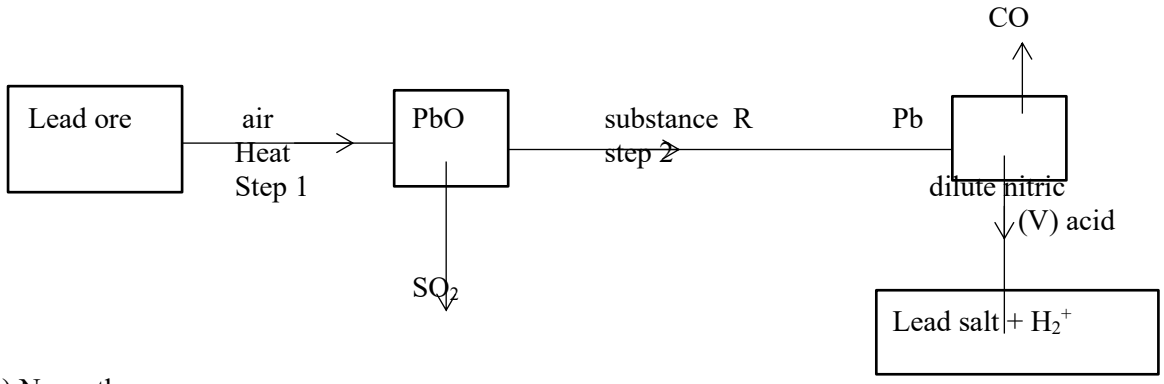
25. The equation shows an equilibrium between dichromate (vi) and chromate ions. Study it and answer the questions that follow,

$$\underset{\text{(orange)}}{Cr_2O_7^{2-}{}_{(aq)} + 2OH^-{}_{(aq)}} \rightleftharpoons \underset{\text{(yellow)}}{2\,CrO_4^{2-}{}_{(aq)} + H_2O\ (l)}$$

State and explain the observation that would be made if a few drops of dilute hydrochloric acid is added to the equilibrium mixture. (3mks)

26. 144g of a radioactive substance decayed to the 18g in 30 days.
Calculate the half life of the radioactive substance. (2mks)

27. The flow chart below shows how a salt of lead can be prepared from lead ore.
Study it and answer the questions that follow.



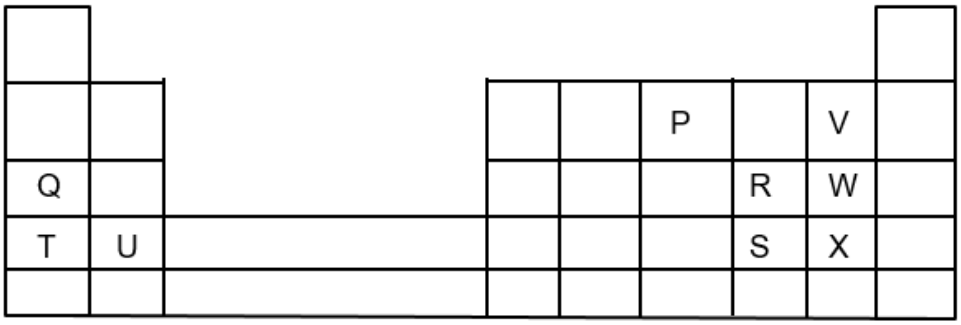
a) Name the ;
- i. lead ore - ($^1/_2$mk)
- ii. Lead salt ($^1/_2$mk)
- iii. Substance R ($^1/_2$mk)

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

c) Name one use of lead. ($^1/_2$mk)

KIRINYAGA WEST
233/2
CHEMISTRY
DECEMBER 2021

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



i) Select an element that would form an ion with a charge of -2. (1mk)
ii) What type of structure will the chloride of Q have? (1mk)
iii) Explain how the reactivity of V and X .
iv) Compare (2mks)
v) Compare the atomic radius of T and S. Explain. (2mks)

b) 4.9g of Q react completely with 1.2dm^3 of gas R at s.t.p.
i) Write a balanced equation for the reaction between Q and R. (1mk)
ii) Determine the R.A.M of Q.(Molar gas, volume = 22.4 dm^3) (2mks)

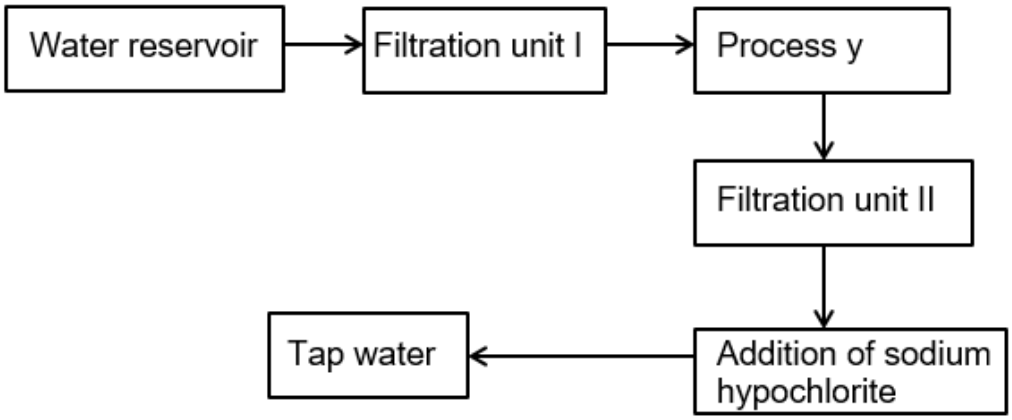
c) Study the information below and answer the questions that follow.

Formula of compound	NaCl	$MgCl_2$	Al_2Cl_6	$SiCl_4$	PCl_3	SCl_3
Boiling point (^{0}C)	1470	1420	sublime	60	75	60
Melting point (^{0}C)	800	710	800	-70	-90	-80

i. Why is the formula of aluminium chloride given as Al_2Cl_6 instead of $AlCl_3$.? (1mk)
ii. Give two chlorides that are liquids at room temperature. Give a reason for your answer. (2mks)
iii. Give a reason why Al_2Cl_6 has a lower melting point than $MgCl_2$ although both are chloride of metals. (1mk)

2. A student was supplied with colourless liquid suspected to be water.
a) I. Describe one chemical test that could be used to show that the liquid is water. (2mks)
II. On testing tap water it was conformed that magnesium sulphate was present.
i) What type of hardness was present in this water? (1mk)
ii) Explain how the hardness can be removed. (2mks)
iii) Describe how presence of sulphate ion in this water can be determined. (2mks)

b) The flow chart below shows the various stages of water treatment.



i. Which substances are likely to be removed in filtration unit I? (1mk)
ii. What is the purpose of process Y? (1mk)
iii. What is the purpose of adding sodium hypochlorite? (1mk)

3. a) Define the term hydrocarbon. (1mk)
b) Hexane was accidentally mixed with water. Describe a simple laboratory method that could be used to separate the mixture. (2mks)
c) The molecular formula of a hydrocarbon is C_6H_{14}.The hydrocarbon can be converted into two other hydrocarbon as shown below.

$$C_6H_{14} \longrightarrow X + C_3H_8$$

i. What is the name of this process. (1mk)
ii. Name and draw the possible structural formula of X. (2mks)
Name _____

Structural formula _____
iii. State and explain the observation that would be made if a few drops of bromine water were added to a sample of X. (1mk)
iv. Write an equation for the complete combustion of C_3H_8. (1mk)

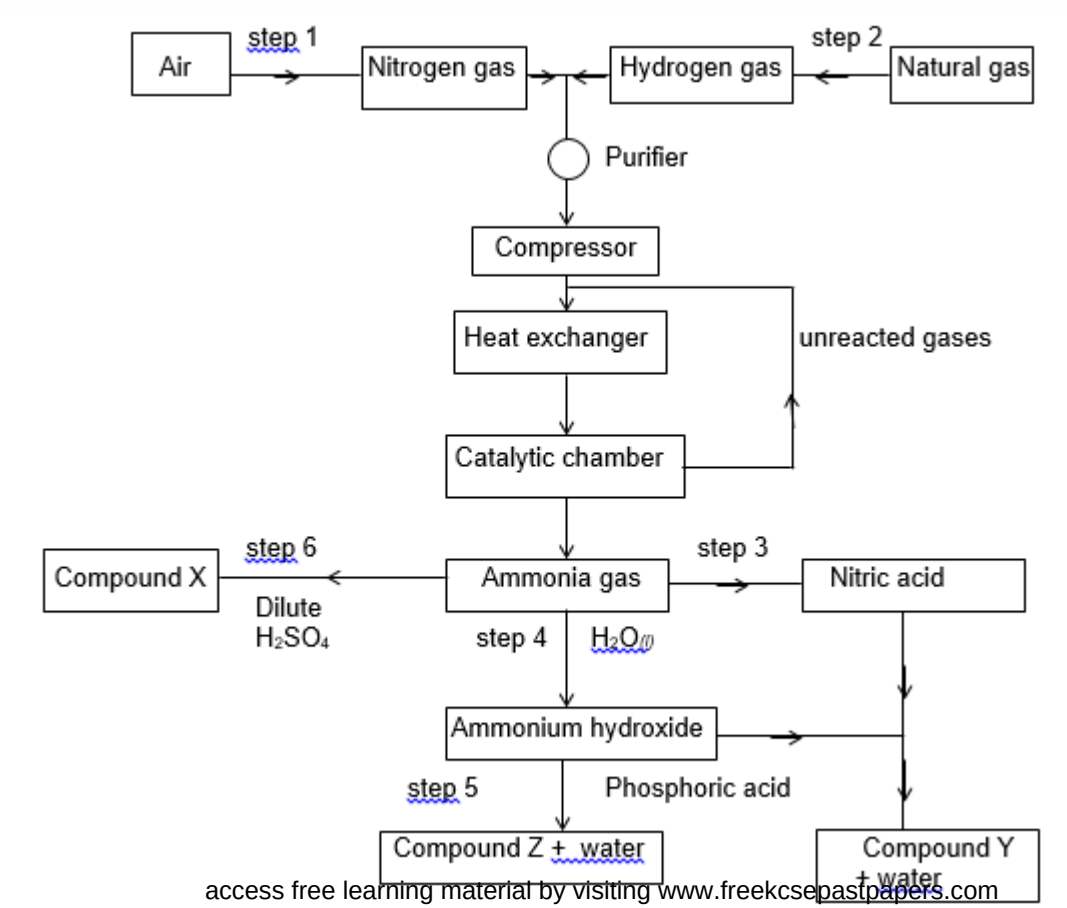
d) The following equations represents two different reactions.

i. $nC_4H_{8\,(aq)} \longrightarrow (C_4H_8)_{n\,(s)}$
ii. $C_2H_{6\,(g)} + Cl_{2(g} \longrightarrow C_2H_5Cl_{\,(g)} + HCl_{\,(g)}$

State the type of reaction represented by:
i. _____ (1mk)
ii. _____ (1mk)

e)
i. When one mole of ethanol is completely burnt in air, 1370kg of heat energy is released. Given that 1 litre of ethanol is 780g.
Calculate the amount of heat
energy released when 1 litre of ethanol is completely burnt. (C = 12, H = 1,O = 16) (2mks)
ii. Other than as an alcoholic drink. State two other uses of ethanol (1mk)

4. The flow chart below shows industrial preparation of ammonia and the process used in the manufacture of some ammonium compounds. Study it and answer the questions that follow.



a) Apart from natural gas name another
   i) Source of hydrogen gas (1mk)
   ii) Name other two substance obtained in step 1. (1mk)
   iii) Give the name of the
      I. Process in step 1 (1mk)
      II. Reaction that takes place in step 5. (1mk)

b) Explain why it is necessary to compress nitrogen and hydrogen in this process. (2mks)

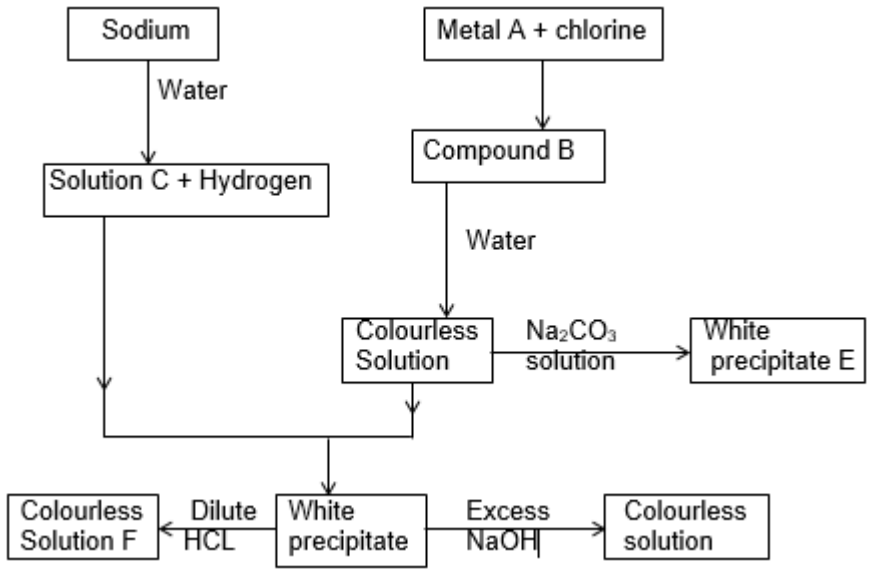
c) Write an equation for the reaction which takes place in step 6. (1mk)

d) Name the catalyst and reagents used in step 3.
   Catalyst (1mk)
   Reagents (1mk)

e) Name compounds (2mks)
   X _____
   Y _____

f) Give one commercial use of compounds Z. (1mk)

5. Study the reaction scheme shown below and use it to answer the questions that follow.



a) Give the name and formula of the following.
   i. White precipitate E - Name (1mk)
      Formula (1mk)
   ii. Colourless solution F- Name
      Formula (1mk)

b) What property is exhibited by white precipitate E when it reacts with both sodium hydroxide and dilute hydrochloric acid? (1mk)

c) Write an equation for the reaction between the white precipitate E and dilute hydrochloric acid. (1mk)

d) You are provided with solid potassium carbonate, zinc hydroxide, nitric (v) acid and distilled water. Describe briefly how you would prepare solid zinc carbonate using the reagents given. (3mks)

e) The table below gives the solubilities of potassium bromide and potassium sulphate at 0^0C and 40^0C.

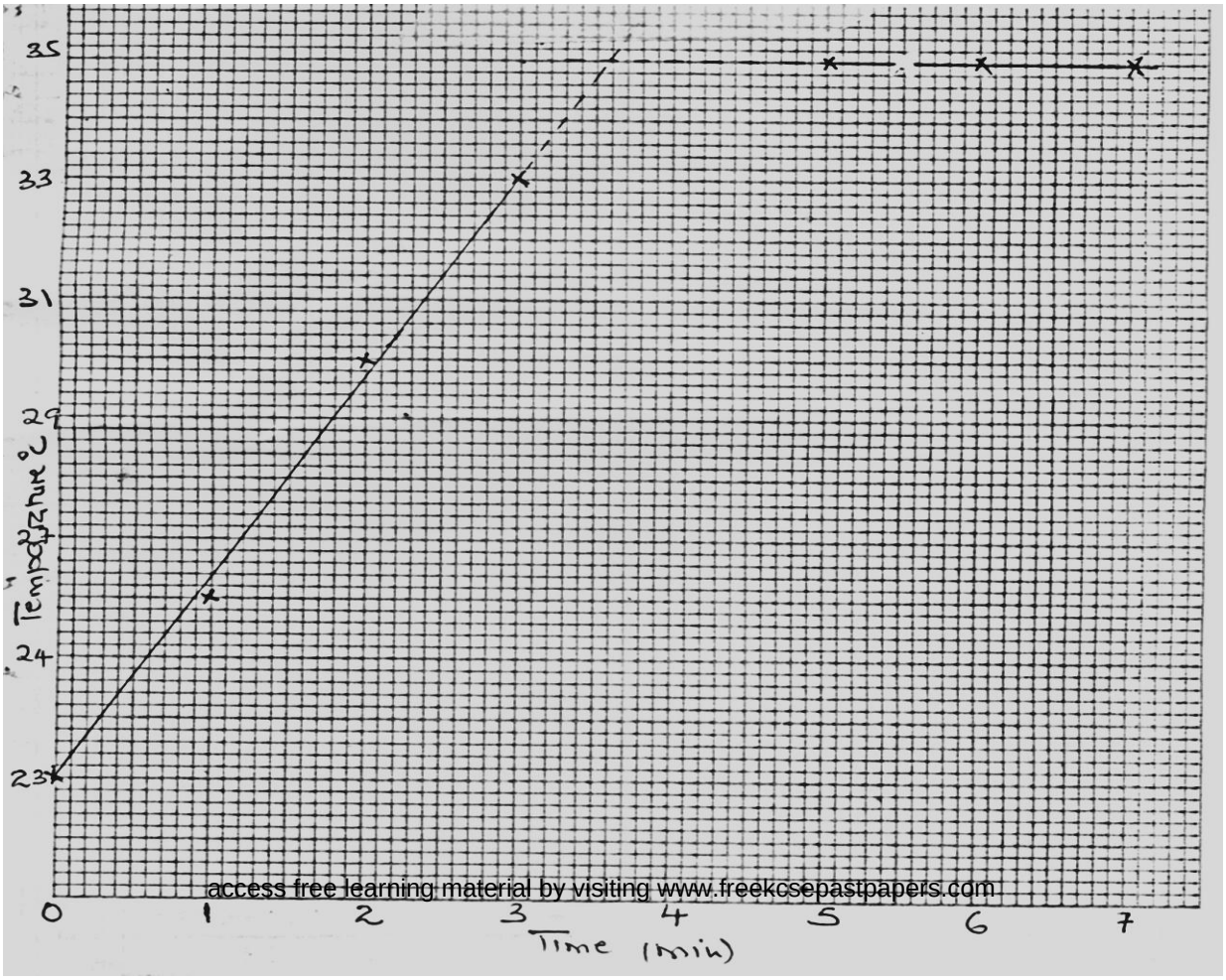
	Solubility(g/100g of water) at	
Substance	0^0C	40^0C
Potassium bromide	55	75
Potassium sulphate	10	12

When an aqueous mixture containing 60g of potassium bromide and 7g of potassium sulphate in 100g of water at 40^0C was cooled to 0^0C. Some crystals were formed.

   i. Identify the crystals. (1mk)
   ii. Determine the mass of the crystals formed. (2mks)

6. a) Define the term molar heat of displacement. (1mk)

b) In an experiment to determine the enthalpy of displacement of copper by iron, 2g of iron was added is $50cm^3$ of 1M copper (II) sulphate solution. The results of the experiment was used to plot a graph shown below.



From the graph determine;

i) The highest change in temperature Δt. (1mk)

ii) The time taken for the reaction to be completed. (1mk)

iii) Calculate the molar heat of displacement for the reaction.
(take specific heat capacity of the solution = $4.2Jg^{-1}k^{-1}$ density of solution = $1gcm^{-3}$) (2mks)

c) Write an ionic equation for the reaction that took place. (1mk)

d) Draw an energy level diagram to represent it's reaction. (2mks)

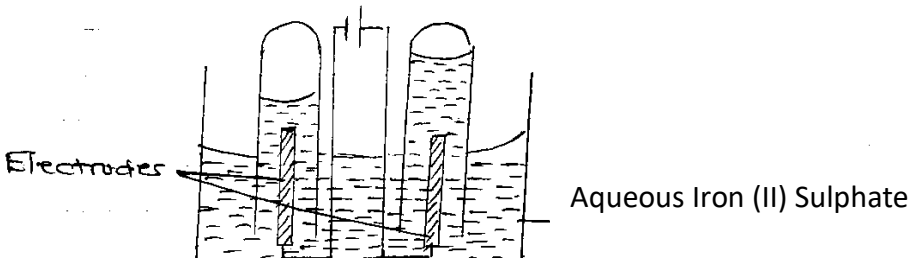
e) Use the table below showing bond dissociation energies and answer its question that follow.

Bond	Bond dissociation energy (kj/mol)
C - C	343
C - H	414
H - H	435
C = C	612

Calculate the heat of reaction for

$C_2H_{4(g)} + H_{2(g} \longrightarrow C_2H_{6(g)}$ (3mks)

7. a) The set –up below was used during the electrolysis of aqueous iron (II) sulphate using their inert electrodes. Study it and answer its questions that follow.



i) Name a suitable material for the pair of electrodes for the experiment. (1mk)

ii) Identify the anions present in the solution. (1mk)

iii) On the diagram label the cathode. (1mk)

iv) Write ionic equation of the reaction that took place at the anode. (1mk)

v) Explain the change in concentration of iron (ii) sulphate that occurred during the experiment. (1mk)

b) The table below shows the standard reduction potentials of four half cells. Study it and answers the questions that follow. (Letters do not represent the actual symbols of the elements.

	E^{θ} (volts)
$F_{2\,(aq)} + 2\,e^- \longrightarrow 2F^-_{(aq)}$	+0.54
$G^{2+}_{(aq)} + 2\,e^- \longrightarrow G_{(s)}$	-0.44
$H^{2+}_{(aq)} + 2e^- \longrightarrow H_{(s)}$	+0.34
$2Y^{+}_{(aq)} + 2e^- \longrightarrow Y_{2\,(g)}$	0.00

i) Identify the strongest reducing agent. Explain (1mk)

ii) Write the equation of the reaction that took place when solid G is added to a solution containing H^{2+} ions. (1mk)

iii) Calculate the E^{θ} value of the reaction in (ii) above. (1mk)

iv) If element G becomes the reference electrode, calculate the new standard electrode potential for element H. (1mk)

KIRINYAGA WEST
233/3 CHEMISTRY PAPER 3
PRACTICAL

Confidential

In addition to the equipment, apparatus and chemicals found in a chemistry laboratory, each candidate will require the following;

- Solution P ; about 100cm^3
- Solution Q; about 50cm^3
- Solution R; about 60cm^3
- Distilled water in a wash bottle
- One filter funnel
- 50ml burette
- 25ml pipette
- 250ml beaker
- A clamp and stand
- 1 conical flask
- White tile
- 10ml measuring cylinder
- 1 label
- Metallic spatula
- 100ml measuring cylinder
- A blue and red litmus papers
- 5 test tubes in a rack.
- 1 boiling tube
- Solid sodium hydrogen carbonate (0.2g)
- Solid Y
- Solid L

Access to ;

- Phenolphthalein indicator
- Bunsen burner
- Bromine water with a dropper
- Acidified potassium manganate (VII) with a dropper.
- Acidified potassium dichromate (VI) with a dropper.
- 2M sodium hydroxide solution with a dropper.
- 0.5M sodium sulphate solution with a dropper.
- 0.1M lead (ii) nitrate solution with a dropper.
- 0.5M barium nitrate solution with a dropper.

NOTES.

i. Solution P is prepared by dissolving 17.2 cm^3 of concentrated hydrochloric acid in about 250cm^3 of distilled water and adding water to the mark to make 1 litre.
ii. Solution Q is prepared by dissolving 64g of sodium hydroxide pellets in about 250cm^3 of distilled water and making it to 1 litre of solution.
iii. Solution R is prepared is prepared by dissolving 13.75cm^3 of concentrated sulphuric (VI) acid in about 250cm^3 of distilled water and making it to 1 litre.
iv. Solid Y is 1gram calcium chloride.
v. Solid L is one spatulaful of maleic acid.

KIRINYAGA WEST
233/3
CHEMISTRY PAPER 3
PRACTICAL

Question 1

You are provided with:

- Solution P, 0.2M hydrochloric acid.
- Solution Q, sodium hydroxide solution.
- Solution R, containing 49g/ litre of a dibasic acid, H_2A

You are required to:

i. Dilute solution Q with distilled water.
ii. Standardize the diluted solution Q with solution P.
iii. Determine the relative formula mass of A.

Procedure 1.

Using a pipette place 25cm^3 of solution Q into a clean 250ml beaker. Using a 100ml measuring cylinder measure 175cm^3 of distilled water and add it to solution Q in the beaker and shake well.

Label this as solution S. Keep solution S for further tests in procedure I and II. pipette 25cm^3 of solution S into a clean dry conical flask. Add 2 drops of phenolphthalein indicator and titrate with solution P from the burette. Record your results in the table 1 below. Repeat the procedure two more times to complete the table 1 below.

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

Volume of solution P used (cm^3) (4mks)

a) Determine the average volume of solution P used. (1mk)

b) i. Find the number of moles of solution P used to react with 25cm^3 of diluted solution S. (1mk)
ii. Find the number of moles of sodium hydroxide in 25cm^3 of the diluted solution S. (2mk)
iii. Determine the number of moles of sodium hydroxide contained in 200cm^3 of solution S. (2mks)

c) Using your results in b(iii) above determine the concentration in moles per litres of the original sodium hydroxide, solution Q. (1mk)

Procedure II.

Using a pipette, place 25cm3 of the standardized solution S into a clean conical flask. Empty your burette completely of solution P and rinse it with some water. Now fill the burette with solution R. Add 2 drops of phenolphthalein indicator into the contents of the conical flask. Titrate solution S with solution R from the burette and record your results in the table II below. Repeat the procedure two more times to complete the table II with consistent titres.

Table 1

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

(4mks)

d) Determine the average volume of solution R used. (1mk)

e) Determine the number of moles of sodium hydroxide in $25cm^2$ of solution S used, hence moles of solution R used. (3mks)

f) Find the concentration in moles per litres of solution R. (1mk)

g) Given that H = 1.0;

i. Find the relative formula mass of the dibasic acid, H_2A (1mk)

ii. Determine the relative atomic mass of A in the formula H_2A. (2mk)

Question 2.

You are provided with solid Y. Carry out the following tests and write your observations and inference in the spaces provided.

Place the solid Y in a clean boiling tube. Add about 10 cm^3 of distilled water and shake well.

i. To about $2cm^3$ of the solution in a test tube, add sodium hydroxide solution drop wise till in excess.

Observations (1mk) **Inferences** (1mk)

ii. To about $2cm^3$ of solution Y in a test tube add about 3 drops of sodium sulphate solution.

Observations (1mk) **Inferences** (1mk)

iii. To about $2cm^3$ of solution Y in a test tube add about 3 drops of barium nitrate solution.

Observations (1mk) **Inferences** (1mk)

iv. To about $2cm^3$ of solution Y in a test tube, add 3 drops of lead (II) nitrate solution and heat the mixture to boiling.

Observations (1mk) **Inferences** (1mk)

Question 3.

You are provided with solid L. Carry out the tests below and write observations and inferences in the spaces provided.

a) Place about a third of solid L in a test tube and add 4 cm^3 of sodium hydroxide solution.

Observations (½ mk) **Inferences** (½ mk)

b) Place another third of solid L on a clean metallic spatula and ignite it on a Bunsen burner flame.

Observations (½ mk) **Inferences** (½ mk)

c) Place the remaining portion of solid L in a boiling tube and add $10cm^3$ of distilled water.

Observations (1 mk) **Inferences** (½ mk)

d) Divide the resulting solution into 5 portions.

i. To the first portion add three drops of potassium dichromate (VI) solution.

Observations (½ mk) **Inferences** (½ mk)

ii. To the second portion add 3 drops of acidified potassium manganate (VII) solution.

Observations (½ mk) **Inferences** (½ mk)

iii. To the third portion add 3 drops of bromine water.

Observations **Inferences**

(½ mk) (½ mk)

iv. To the fourth portion, add solid sodium hydrogen carbonate.

Observations **Inferences**

(½ mk) (½ mk)

v. To the fifth portion insert a blue and red litmus paper.

Observations **Inferences**

(1 mk) (½ mk)

KIRINYAGA WEST
SCHOOL BASED EXAMINATION 2021
FORM 4 CHEMISTRY
Paper 1 marking scheme.

1. RMM of H_2O (2 + 16) = 18 ✓ $^1/_2$
RMM of Na_2CO_3 {(23 x 2) +12 + (16 x 3)} = 106 ✓ $^1/_2$

	Na_2CO_3	H_2O
% Mass	85.5	14.5
RMM	106	18
Mass	85.5	14.5
	106	18 ✓1
	0.807	0.806
	0.806	0.806
	1	1 ✓1

.: n = 1 ✓1 (3mks)

2. a) $3Mg_{(s)} + N_{2(g)} \longrightarrow Mg_3N_{2(s)}$ ✓1
b) Argon/ Neon/ Helium ✓1
Its inert did not react with hot magnesium powder. ✓1 (3mks)

3. M_1 and M_4 ✓1
M_2 and M_5 ✓1
M_3 ✓ ½ double covalent bond is broken setting electrons free, that are used to bond with neighbouring molecules. ✓ $^1/_2$ (3mks)

4. i. 2,8
ii. Group II ✓1
iii. $X(NO_3)_2$ ✓1 (3mks)

5. a) platinum ✓1
b) $4NH_{3(aq)} + 5O_{2(g)} \longrightarrow 4NO_{(g)} + 6H_2O(l)$ ✓1

c) $[Zn(NH_3)_4]^{2+}$ ✓1

6. a) Colour changes from blue to white ✓1
b) Concentrated sulphuric (VI) acid remove water of crstallisation (dehydrates) (2mks)

b) used in manufacture of fertilizers ✓1
used in manufacture of paints ✓1 (1mk) any
detergents ✓1

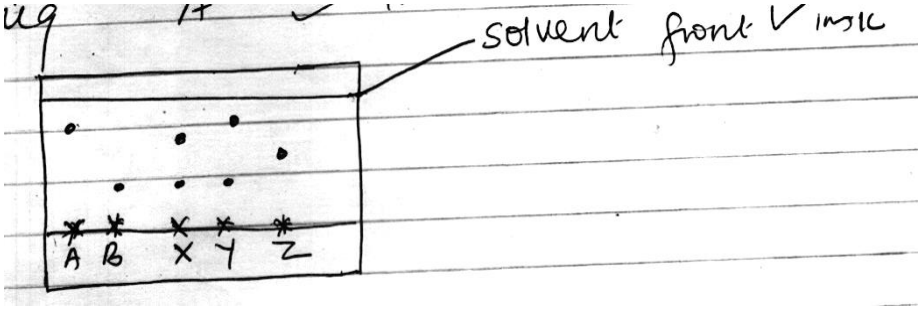
7. i. Calcium oxide. ✓1
ii. Fitration ✓1

iii. $CaCO_{3(s)} \longrightarrow CaO_{(s)} + CO_{2(g)}$ (3mks)

8. i. Student Z ✓1 (1mk)

ii. drug A ✓1 (1mk)

iii.



9. a) $\frac{63 + 70}{100} + \frac{65 \times 30}{100} = RAM$ ✓1

$44.1 + 19.5 = 63.6$ ✓1

b) $^{64}_{29}Cu$✓ (1mk)

10. Mass of the glucose = 144.0 – 25.00 = 119g ✓1

Mass of the solvent = 194 – 144 = 50g ✓1

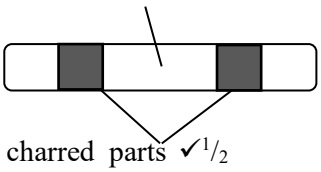
119g - 50g of water

? ----100g of water

$\frac{119 \times 100}{50}$ ✓½

= 238g/100g of water ✓½ (3mks)

11. a)



b) pale blue zone ✓1

12. A – The bulb did not light hydrogen chloride dissolves ✓1
in the methylbenzene but does not ionise ✓1
thus forming non electrolyte.

B – The bulb lights. ✓1
Hydrogen chloride dissolves ✓½ and ionizes ✓½ forming an electrolyte.

(3mks)

13.

Bottle	PH	Electrical conductivity	Correct label
1	7	conducts	sodium chloride ✓1
2	7	does not conduct	sugar ✓1
3	10	conducts	sodium carbonate ✓1

(3mks)

14. RFM of $NO_2 = 14 + 32 = 46$

'' $CO = 12 + 16 = 28$

$$\frac{T_{NO_2}}{T_{CO}} = \sqrt{\frac{M_{NO_2}}{M_{CO}}}$$

$$\frac{100}{Tco} = \sqrt{\frac{46}{28}}$$

$$Tco = \frac{100}{\sqrt{\frac{46}{28}}}$$

$= 78.019$ seconds

15. a)H is more reactive ✓$^1/_2$ with oxygen than C because H is larger thus loses electrons more easily.

b) D_3E_2

c) Darts on the surface of water.
Floats on the surface of water
Melts into a silvery ball
Produces a hissing sound mark any two correct points

16. i. Candle goes off due to accumulation of carbon(iv) oxide.
ii. The substance k must boil with a sharp boiling point // boils at 100^0C at sea level.
iii. Carbon (iv) oxide gas dissolves in water to form carbonic acid which is a weak acid.

17. RFM of $NH4NO_3 = 28 + 4 + 48$
$= 80$

No of moles of $NH_4NO_3 = \frac{3200000}{80}$ ✓$^1/_2$
$= 40000$moles

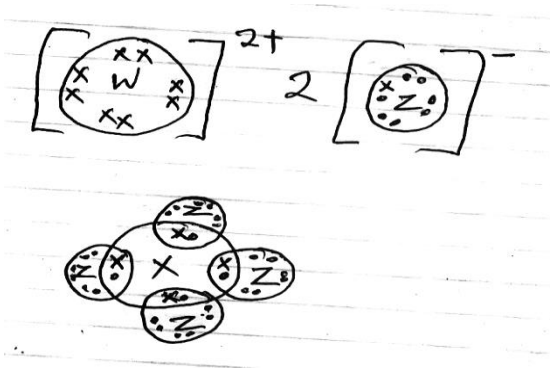
$NH_{3(g)} + HNO_{3\,(aq)} \longrightarrow NH4NO_{3\,(aq)}$ ✓$^1/_2$
1 : 1

No of moles of $HNO_3 = 40000$ moles

RFM OF $HNO_3 = 63$

Mass of nitric (v) acid $= \frac{40000 \times 63}{1000}$ ✓$^1/_2$
$= 2520$ kg ✓$^1/_2$

18. a) i.



b) Compound formed by W and Z has higher melting point than compound formed by X and Z.

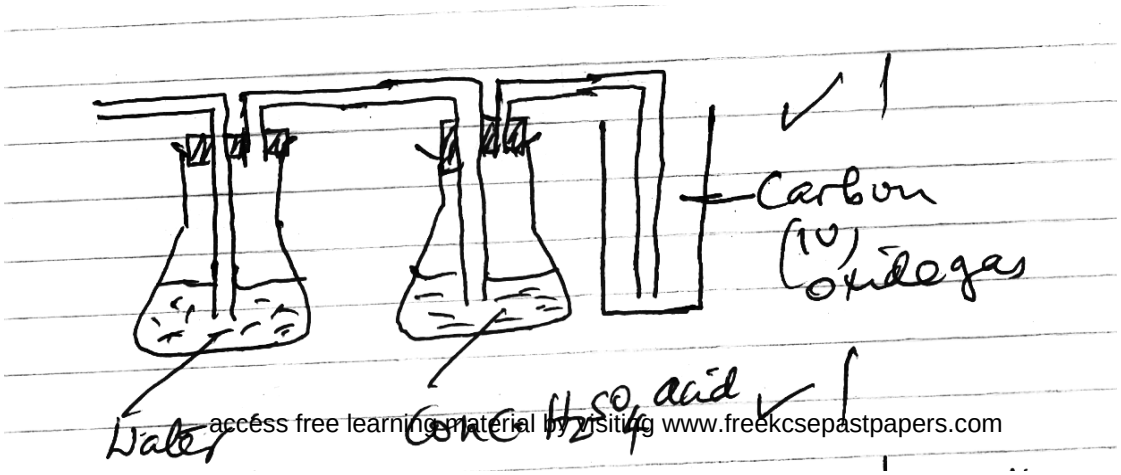
19. a) $4H^+_{(aq)} + 4e^- \longrightarrow 2H_{2(g)}$ ✓1
$4OH^-_{(aq)} \longrightarrow 2H_2O_{(l)} + O_{2(g)} + 4e$ ✓1

b) Collect the gas P in the test tube ✓½
Introduce a glowing splint into the test tube
The glowing splint is relit / rekindled ✓½
This shows the presence of oxygen

20. No of moles of pentene = $^{35}/_{70}$ ✓½ = 0.5 ✓½ moles of H_2 = 0.5 ✓½
C_5H_{10} = (12 x 5) + (1 x 10)
= 60 +10
= 70 ✓½
Volume of H_2 = 0.5 x 24✓½
= 12 litres

$C_5H_{10} + H_2 \longrightarrow C_5H_{12}$
1 : 1 ✓½

21.



WORKABILITY = 1MARK)

22. a) Methylpentanoate ✓1
b) Methanol and Pentanoic acid ✓1

23. i. Oxygen gas
ii. $4\ OH^-_{(aq)} \longrightarrow 2H_2O_{(l)} + O_{2(g)} + 4\ e^-$
Volume of the oxygen gas = $\frac{2 \times 15 \times 22400}{4 \times 96500}$
= 1.7409 cm3

24. a) Cation – Aluminium ions
Anion – Sulphate ions

b) $Al^{3+}_{(aq)} + 3\ OH^-_{(aq)} \longrightarrow Al(OH)_{3\ (s)}$

NB: Reject lead (II) ions because lead (II) sulphate can be present in water.

25. Orange colour intensifies. ✓1 Addition of hydrogen ions in the mixture increases the concentration of water ✓1 thus equilibrium shifts to the left. ✓1

26. $t^{1}/_{2}$ $t^{1}/_{2}$ $t^{1}/_{2}$
144g → 72g → 36g . 18g →
3 $t^{1}/_{2}$ = 30 days
$t^{1}/_{2}$ = $^{30}/_{3}$

= 10days

27. a) i. Galena
ii. lead (ii) nitrate
iii. Coke /carbon

b) $2\ PbS_{(s)} + 3\ O_{2(g)} \longrightarrow 2PbO_{(s)} + 2\ SO_{2\ (g)}$

c) Manufacture of lead pipes
Radioactive shielding
Lead acid accumulators
Making of roofs
Making of plumb bob.

KIRINYAGA WEST SCHOOL BASED EXAMINATION 2021
CHEMISTRY
PAPER 2 MARKING SCHEME.

Q1. i. R or S ✓1 ` Any one for 1 mk
ii. Giant ionic structure ✓1
iii. V is more reactive than x. ✓1
This is because V has a smaller atom and
gains electrons more easily readily than x. ✓1 *Comparison to be brought out clearly*
iv. T has a larger atomic radius than S ✓1

This is because S has a higher nuclear charge ✓1
so electrons are pulled closer to its nucleus making it smaller
Comparison to be brought out clearly

b) i. $4\ Q_{(s)} + R_{2(g)} \longrightarrow 2Q_2R_{(s)}$ ✓1
ii. Q : R
4 1
moles of R = $^{12}/_{22.4} = 0.0536$ ✓$^1/_2$

moles of Q = 0.0536 x 4 = 0.2144 ✓$^1/_2$
0.2144 = 2.5g
1 mol = $\frac{4.9 \times 1}{0.2144}$ ✓$^1/_2$ = 22.85 ✓$^1/_2$
R.A.M = 23

c) i. Aluminium chloride exists as a dimmer. ✓$^1/_2$
ii. $SiCl_4$ / PCl_3 / SCl_2. ✓1 M pt is below room temperature and Bpt above the room temperature.
iii. Al_2Cl_6 has simple molecular structure while $MgCl_2$ has a giant ionic structure✓$^1/_2$
Therefore Al_2Cl_6 has weak molecular forces that need less energy compared to $MgCl_2$ with strong ionic bonds that need more energy to break.

Q2. a) I. put the liquid to an anhydrous $CuSO_4$. It turns blue from white. ✓1 It is water // use equation // use blue cobalt (ii) chloride paper. If it turns blue to pink it is water // equation
2marks

II) I – Permanent hardness ✓1 1mark
II – Addition of Na_2CO_3 (soda ash) ✓1 which precipitates Mg^{2+} & Ca^{2+} ions as $MgCO_3$ /$CaCO_3$ /// ion exchange where Mg^{2+} / Ca^{2+} are exchanged with Na^+. 2marks

III. Add few drops of $Pb(NO_3)_2$ ✓$^1/_2$ / $Ba(NO_3)_2$ to the sample.
White precipitate forms. ✓1 ✓$^1/_2$

To the white precipitate ✓1/2 add few drops of HCl/ HNO_3.
If the white precipitate does not dissolve then SO_4^{2-} ✓1/2 is confirmed present.
2marks

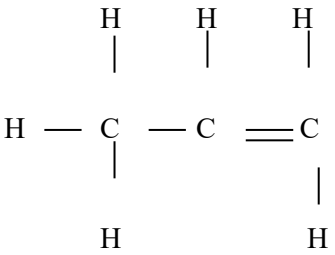
b) i. Large solid particles // soil // sand // leaves // papers ✓1 1mark
ii. To cause small particles suspected in water to settle. ✓1 1mark
iii. To release chlorine which kills germs // chlorination. ✓1 1mark
11

Q3. Compound made up of carbon and hydrogen only. ✓1 1mark

b) Pour the mixture in a separating funnel ✓1
Hexane and water being immiscible to form 2 layers. ✓1
Open the tap and draw off water and hexane is left in the funnel. 2marks

c) i. Thermol / catalytic decomposition of alkanes. ✓1 .
1mark

ii. propene ✓1



/ $CH_3CH = CH_2$ ✓1 1mark

iii. bromine water changes from yellow to colourless(decolourised) ✓1because x is an unsaturated has a double bond. 2marks

iv. $C_3H_{8(s)} + 5O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(l)}$ ✓1 1mark

d) i) Polymerization✓1
ii) Substitution ✓1

e) i. $CH_3CH_2CH = 46$

46g – 1 mole

780g – ? $^{780}/_{46}$ ✓1 = 16.956 moles✓1
1mole = 1370
16.956 mole x $\frac{1370 \times 16.956}{1}$ ✓1
= 23230.43 KJ ✓1/2 3marks

ii. As antiseptic ✓1/2 ½ mark
Solvent in industries ✓1/2 ½ mark

4. a) i) Electrolysis of brine / cracking of long chain alkanes. ✓1 1mark
Electrolysis of water .
ii. Oxygen✓1/2
Argon ✓1/2 1mark

iii. I - Fractional distillation of liquid air. ✓1 1mark
Ii – Neutralisation. ✓1 1mark

b) High pressure brings the molecules ✓1closer/ increases the rate of collision of gas molecules./
High pressure shifts the equilibrium ✓1 to the right / yield of ammonia increases. 2marks

c) $2NH_{3(g)} + H_2SO_{4(aq)} \longrightarrow (NH_4)_2SO_{4(aq)}$ 1mark

d) Catalyst = platinum/ platinum – Rhodium✓1
Reagents – water ✓1/2 and oxygen✓1/2 2marks

e) X- Ammonium Sulphate✓1
Y – Ammonium Nitrate ✓1 2marks

F) As a fertilizer ✓1 1 mark

12

5. a) i. Name – Zinc Carbonate✓1
Formula – $ZnCO_3$ ✓1
ii. Name – zinc chloride ✓1
Formula – $ZnCl_2$ ✓1
b) It is amphoteric // amphoterism ✓1

c) $ZnCO_{3(s)} + 2HCl_{(aq)} \longrightarrow ZNCl_{2(aq)} + H_2O_{(l)}$ ✓1 Penalise ½ mark for missing/ wrong states

d)
- Add excess Zinc hydroxide to the dilute nitric (v) acid. Filter. ✓½
- Dissolve some solid potassium carbonate in distilled water. ✓½
- Mix the potassium carbonate solution with its filtrate in i. ✓½
- Filter the mixture to obtain Zinc Carbonate as a residue. ✓½ Wash it and it dry✓½

e) i. Potassium bromide crystals ✓½
iii. Mass = 60 – 55 ✓½
= 5G KBBr ✓½

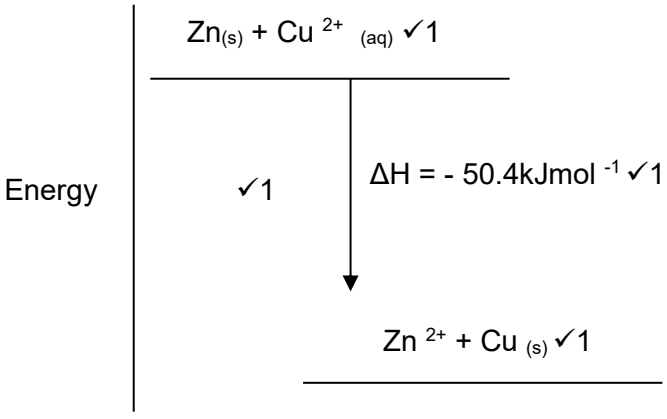
12mark

6. a) The euthalpy change that occur when one mole <u>of a substance is displaced</u> from a solution of its ions. ✓1
b) i. $\Delta T = 35 - 23$✓½ $= 12^{O}c$
ii. 3.6 ± 0.1 min ✓1
iii. $Q = MC\Delta T$
$= 50 \times 4.2 \times 12 = 2520J$ ✓½
moles of CuSO4 = $1x \frac{50}{1000} = 0.05$ mol✓½
0.05 mol = 2520 ✓½
1 mol = ?
$t = \frac{2520 \times 1}{0.05}$ ✓½ $= 50400J$
$= 50.4kJ$

$\Delta H = -50.4kJ\ mol^{-1}$ ✓½ Penalise ½ mark if negative sign missing

c) $Zn(s) + Cu^{2+}_{(aq)} \longrightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$ ✓1

d)



To be marked Consequentially form b iii above

e) $C_2H_{4\,(g)} + H_{2(g)} \longrightarrow C_2H_{6\,(g)}$

Bond broken			Bond formed			
C	C	612	C	C		343
H	H	+435	2(C	H)	414 x 2 =	+828
		1047			1171	

$\Delta H = -1171 + 1047 = -124kJ$

7. a) i. Graphite/ Platinum/ Titanium ✓1 Reject carbon
Any one @ ½ mark

ii. $SO^{2-}_{4\,(aq)}$ and $OH^{-}_{(aq)}$

iii. Cathode (connected to the –ve term that of cell)

iv. $4\,OH^{-}_{(aq)} \longrightarrow 2H_2O_{(l)} + O_{2\,(g)} + 4\,e^{-}$ Penalise ½ mark for wrong/ missing stales

v. Solution became **more concentrated** ✓½ the electrolysis results in the **removal of water** ✓½

b) i. G ✓½ has the highest ✓½ negative E value

ii. $G_{(s)} + 2H^{+}_{(aq)} \longrightarrow G^{2+}_{(aq)} + H_{2\,(g)}$ ✓1

iii. $E^{Ø}$ = + 0.34 – (-0.44)+0.44 +0.34 ✓½

$E^{Ø}$ = +0.34 + 0.44

= 0.78V ✓½

iv. It would be 0.00 - (-0.44)

0.00 + 0.44

+ 0.44v ✓1

KIRINYAGA WEST
SCHOOL BASED EXAMINATION 2021
FORM 4 CHEMISTRY
Paper 3 marking scheme.

Q1. Procedure 1.

Table 1 4mks

Distributed as follows :-

a) Complete table 1mk

Conditions :-

i. Complete table with 3 readings 1mk

ii Incomplete table with 2 readings ½ mk

iii. Incomplete table with 1 reading 0mk

Penalties

Penalise ½ mk once for any of the following;

- wrong arithmetic
- Inverted table
- Reading beyond 50cm^3 and is unexplained
- Titre values less 1cm^3

b) Use of decimals. 1mk

(It is tied to 1st and 2nd rows only)

Accept 1 or 2 decimal places used consistently, otherwise penalise fully.

If the second decimal place is used, it must be a 'zero' or a 'five', otherwise penalise fully.

c) Accuracy. 1mk

Compare the candidates titre values to the school value and award as follows:

If any within± 0.1 of school value 1mk

If none within ± 0.1 but within ± 0.2 of s.v ½ mk

If none within ± 0.2 of school value 0mk

d) Principles of averaging 1mk

Conditions.

i. If 3 consistent values are averaged 1mk

ii. If 3 titrations done, only two consistent are averaged 1mk

iii. If only 2 titrations are done, are consistent and only 2 are averaged 0mk

iv. If 3 titrations are done, all inconsistent, yet averaged 0mk

Penalties.

- Wrong arithmetic, i.e error outside ± 2 units in the 2nd decimal place penalise ½ mk
- If no working shown but answer given is correct, penalise ½ mk.
- If answer is rounded off to 1st d.p penalise 1/2mk unless if it works out exactly.
- If no working is shown and the answer given is wrong penalise fully.

e) Final answer. 1mk

Compare the correct titre average with the school value.

Conditions.

- If answer is within ± 0.2 ½ mk
- If beyond ± 0.2 award zero

N/B Final answer is tied to correct principles of averaging, otherwise penalise fully.

Procedure II.

Table II 5mks

N/B Marked as table 1 above.

Calculations.

B(i) moles of solution P = $\frac{\text{Average titre} \times 0.2}{1000}$ ✓½ mk

= correct ans. ✓½ mk

ii. Mole ratio, NaOH : HCL = 1:1 ✓½ mk

Moles of NaOH in solution S = $^1/_1$ x ans b(i)

= correct ans

iii. 25cm^3 of solution S ⟶ moles in Ans b(ii)

200cm^3 of solution S ⟶ ?

= $\frac{200 \times \text{Ans b(ii)}}{25}$

= correct ans ✓½ mk

C) Moles of Q in 25cm^3 ⟶ ans b(iii)

Moles of Q in 1000cm^3 ⟶ ?

= $\frac{1000 \times \text{Ans b(iii)}}{25}$ ✓½ mk

= correct Ans ✓½ mk

e) Moles of S = 25 $\frac{\times \text{correct ans C}}{1000}$ ✓½ mk

= correct ans

Mole ratio NaOH : H_2A = 2: 1 ✓½ mk

Moles of R = ½ x final correct ans above

f) $\frac{1000 \times \text{final correct ans (e)}}{\text{Average titre}}$ ✓½ mk
= correct Ans ✓½ mk

g) i. $RFM = \frac{49 \times 1}{\text{Ans f}}$
= correct ans ✓½ mk

ii. 2 + A = ans g(i) ✓½ mk
A = ans g(i) – 2
= correct ans ✓1

Question 2.

i.

Observations	**Inferences**	
White precipitate insoluble in excess	Ca^{2+} , Mg^{2+}, Ba^{2+} present	
	3 ions	1mk
	2ions	1/2mk
	1 ion	0mk
(1mk)		(1mk)

ii.

Observations	**Inferences**	
White precipitate	Ca^{2+} , Ba^{2+} present	
	2 ions	1 mk
	1 ion	½ mk
(1mk)		(1mk)

iii.

Observations	**Inferences**
No white precipitate	SO_4^{2-}, SO_3^{2-}, CO_3^{2-} absent
(1mk)	(1mk)

iv.

Observations	**Inferences**
White precipitate dissolves on boiling and reappears on cooling	Cl^- present
(1mk)	(1mk)

Question 3.

a)

Observations	**Inferences**
Dissolves to form a colourless solution	L is acidic
($^1/_2$ mk)	($^1/_2$mk)

b)

Observations	**Inferences**
Burns with a yellow sooty// smoky flame	C = C or – C ≡ C present
(½ mk)	any one (½ mk)

c)

Observations	**Inferences**
Dissolve S to form a colourless solution	L is a polar substance

(1 mk) (½ mk)

d) i. **Observations** | **Inferences**

Orange acidified $K_2Cr_2O_7$ remaining orange | R-OH absent

(½ mk) (½ mk)

ii. **Observations** | **Inferences**

Acidified $KMnO_4$ decolourise
or purple $KMnO_4$
Or purple $KMnO_4$ turns colourless | $-\overset{|}{\underset{|}{C}}=\overset{|}{\underset{|}{C}}-$ or $-\overset{|}{\underset{|}{C}}=\overset{|}{\underset{|}{C}}-$ ~~pre~~sent
Any one (1mk)

(½ mk)

iii. **Observations** | **Inferences**

Bromine water decolourises // yellow
Bromine water turns colourless
Ref: Brown bromine water turns colourless | $-\overset{|}{\underset{|}{C}}=\overset{|}{\underset{|}{C}}-$ or $-\overset{|}{\underset{|}{C}}=\overset{|}{\underset{|}{C}}-$ present
any one

(½ mk) (½ mk)

iv. **Observations** | **Inferences**

Production of bubbles of a colourless gas // | HF, H_2O, R-COOH present
Effervescence occurs // fizzing occur | any one

(½ mk) (½ mk)

v. **Observations** | **Inferences**

Blue litmus paper turns red while red litmus | solution is acidic
Paper remains red

(1 mk) (½ mk)