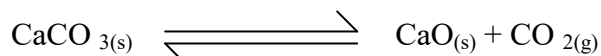**KIRINYAGA WEST SCHOOL BASED FORM IV EXAMINATION 2018**
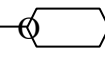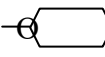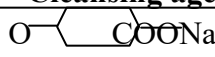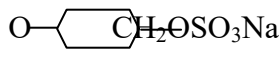**33/1**
CHEMISTRY
Paper 1 (THEORY)

1. a) State Le'Chateliers principle (1mk)
   b) When Calcium carbonate is heated the equilibrium shown below is established.

   $$CaCO_{3(s)} \rightleftharpoons CaO_{(s)} + CO_{2(g)}$$

   How would the position of the equilibrium be affected if the pressure is increased. Explain (2mks)

2. R $-O\langle\rangle-COONa$ and R $-O\langle\rangle-CH_2OSO_3Na$ represent two types of cleansing agents. i) Name the class of cleansing agent to which each belong. (1mk)

Cleansing agent	Class
R O $\langle\rangle$ COONa	
R O $\langle\rangle$ CH$_2$OSO$_3$Na	

   ii) Which one of cleansing agents would be more preferred to use when using hardwater? Give a reason for your answer. (2mks)

3. A certain carbonate KCO_3, reacts with 40cm^3 of 1M nitric (V) acid according to the equation given below:

   $$KCO_3 + 2HNO_{3(aq)} \longrightarrow K(NO_3)_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$$

   If 2 g of the carbonate reacts completely with 40cm^3 of 1M hydrochloric acid.
   Calculate the relative atomic mass of K (C = 12, O = 16) (3mks)

4. When a few drops of aqueous Sodium hydroxide, were added to aluminium sulphate solution, a white precipitate was formed on addition of more aqueous sodium hydroxide a colourless solution was formed. Write the formula of the substance responsible for the:
   a) White precipitate (1mk)
   b) Colourless solution (1mk)

5. Below are chromatograms of different components of compound L administered to an HIV patient as anti-retroviral. Use it to answer the questions that follow.
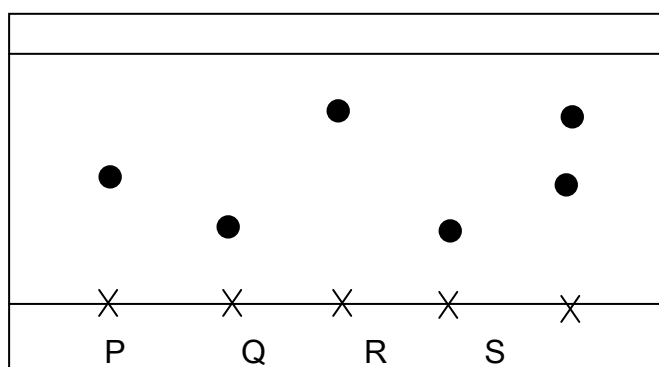
   i) State the components of the anti-retroviral drug. (1mk)
   ii) On the diagram label:
   a) Solvent front line (2mks)
   b) Base line

6. Nitrogen is inert. State two uses of the gas based on this property. (2mks)

7. a) Write an equation for the reaction that takes place where hydrogen peroxide decomposition in presence of Manganese (IV) oxide. (1mk)

1

b)   Describe a test that can be used to identify oxygen gas.   (2mks)

8.   The salts A_1, A_2 and A_3 were Zinc chloride, Lead (II) nitrate and Magnesium sulphate.

Substance	Silver nitrate	Barium chloride	Hydrochloric
Salt A_1	No ppt	White ppt	No ppt
Salt A_2	White ppt	No ppt	No ppt
Salt A_3	No ppt	White ppt	White ppt

                                                                                (3mks)

Identify

Salt A_1 _____

Salt A_2 _____

Salt A_3 _____

**9.**   Study the information in the table below and answer the questions that follow:-

Number of carbon atoms per molecule	Relative molecular mass of hydrocarbon
2	26
3	40
4	54

i)   Name the class of hydrocarbons that the members shown in the table belong.   (1mk)

ii) Predict the relative molecular mass of the sixth member of this class.   (1mk)
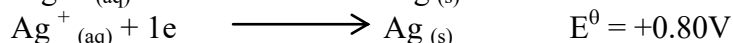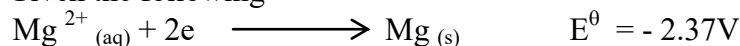
iii) State the observation made when one member of class mentioned in (i) above is bubbled through
     bromine water.   (1mk)

10.   Below is a representation of an electrochemical cell.

$Mg_{(s)} / Mg^{2+}_{(aq)} // Ag^{+}_{(aq)} / Ag_{(s)}$
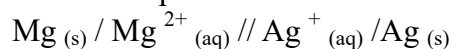
a) What does // represent?   (1mk)

b) Given the following

$Mg^{2+}_{(aq)} + 2e \longrightarrow Mg_{(s)}$ $E^{\theta} = -2.37V$

$Ag^{+}_{(aq)} + 1e \longrightarrow Ag_{(s)}$ $E^{\theta} = +0.80V$

Calculate the E.M.F. of the electrochemical cell formed when the two half cells are combined.

                                                                                (2mks)

11.   Study the flow chart below and answer the questions that follow.
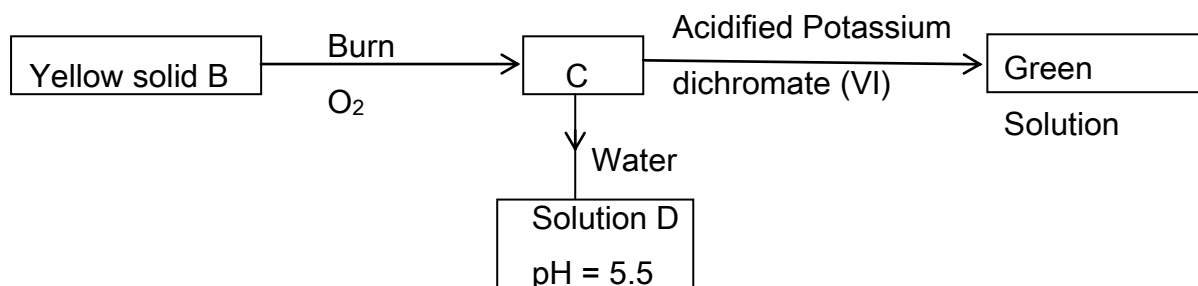
i)   Identify B and C .   (2mks)

ii)   Write an equation for the reaction that takes place when C reacts with water.   (2mks)

12.   The date given below was recorded when metal E was completely burnt in air. E is not the actual
     symbol

of the metal. (R.A.M. E = 56, O = 16.0)

Mass of empty crucible and lid = 11.34g

Mass of crucible, lid and metal E = 11.452g

Mass of crucible, lid and metal oxide = 11.500g

a) Determine the mass of
    i) Metal E   ($^1/_2$mk)
    ii) Oxygen   ($^1/_2$mk)
b) Determine the empirical formula of the metal oxide.   (2mks)

13. a) In the extraction of sodium metal, calcium chloride metal is added to the sodium chloride.
        Explain the   role of calcium chloride in the process.   (1mk)

    b) State two properties of sodium metal that makes it possible for it extracted from it ore.   (2mks)

14. If it takes 30 seconds for 100cm^3 of carbon (IV) oxide to diffuse across a porous plate, how long
    will it take 150cm^3 of nitrogen (IV) oxide to diffuse across the same plate under similar conditions.
    (C = 12.0, N = 14.0, O = 16.0)   (3mks)

15. Study the information in the table below and answer the questions that follow.
    The letters do not represent the actual symbols of the element.

Element	Electrical conductivity	Ductility	Action of water
Z	Good	Good	No reaction
X	Good	Poor	No reaction
W	Good	Good	Reacts

    Select an element which
   i)   Is likely to be in ground II of the periodic table.   (1mk)
    ii) Could be used to make electric cables.   (1mk)
    iii) Is likely to be graphite.   (1mk)

16. The table below gives solubilities of P and R at 0^{0}C and 50^{0}C.

Substance	Solubility g/100g water at	
	0^{0}C	50^{0}C
P	55	75
R	10	10

    When an aqueous mixture containing 70g of P and 8g in 100g of water at 70^{0}C was cooled to 0^{0}C.
    Some crystals were crystallised out.
    i)   Identify the crystals.   (1mk)
    ii) Determine the mass of crystals crystallised out.   (1mk)
    iii) Name the method used to obtain the crystals.   (1mk)

17. The diagram below represents the structure of aluminium chloride molecule.
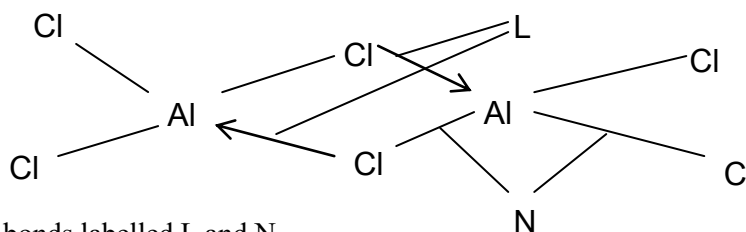
    a) Identify the bonds labelled L and N.   (2mks)
    b) How many electrons are used for bonding in the molecules?   (1mk)

18. The table below shows the first ionization energies of elements S$_1$ and S$_2$.

Element	Ionisation Energy kJ/mol
S$_1$	494
S$_2$	418

    a) What is ionization energy?   (1mk)
    b) Which of the two elements is the least reactive? Explain.   (2mks)

3

19. The nature isotopes of silicon occur in the following percentages by mass.

Isotope	Percentage by mass
Silicon – 28	92
Silicon – 29	5
Silicon – 30	3

     a) Calculate the relative atomic mass of silicon.   (2mks)
     b) Identify the most stable isotope of silicon.   (1mk)

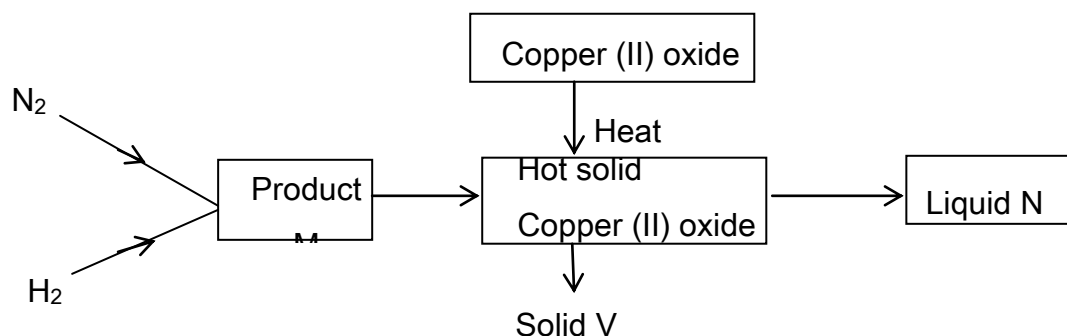**20.** The following data gives pH values of solution I, II, III.

Solutions	pH
I	12
II	7
III	2.5

     a) Which solutions would produce hydrogen gas with calcium metal? Give a reason. $(1\frac{1}{2}$mks)
     b) What would be the colour of solution I if a few drops of methyl orange was added? $(\frac{1}{2}$mk)
     c) Which solutions would react with aluminium hydroxide? Give a reason.   (1mk)

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

  i) Name   (1mk)
    a) product M _____
    b) liquid N _____
  ii) Name two sources of hydrogen gas used in the process above.   (1mk)
  iii) State one observation likely to be made when product M is reacted with hot solid copper (II)oxide.

     (1mk)

22. Sulphur consists of two allotropes.
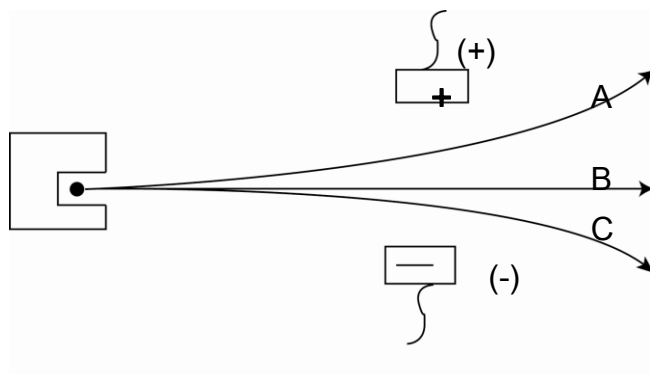   a) Name the allotropes   (1mk)
    b) Concentrated sulphuric (VI) acid reacts with sugar and zinc. State property of the acid shown in
   each case.   (1mk)
    i) Sugar
    ii) Zinc

23. A radioactive material emitted radiations as shown below.

 i) Identify A and B   (1mk)
 ii) Which radiation
   a) has the lowest ionizing power?   (1mk)
   b) contains helium particles?   (1mk)

24. Below are heats of combustion of carbon, hydrogen and ethanol.
 ΔH_C (carbon) = - 393kJ/mol
 ΔH_C (hydrogen) = - 268kJ/mol
 ΔH_C (ethanol) = - 1368kJ/mol
 Calculate the heat of formation of ethanol.   (3mks)

25. A student performed two experiments as shown below.
 Experiment I; a certain volume of air was passed repeatedly from syringe A to syringe B over heated zinc powder.
 Experiment II; The same volume of air was passed repeatedly from syringe A to syringe B over heated excess magnesium powder.
 a) In which experiment was change in volume of air greater?   (1mk)
 b) Explain your answer in (a) above.   ` (2mks)

26. Starting with barium chloride, describe how a pure sample of barium sulphite can be prepared in the Laboratory.   (3mks)

**27.** The set up shown below was used to investigate a property of carbon (IV) oxide gas.
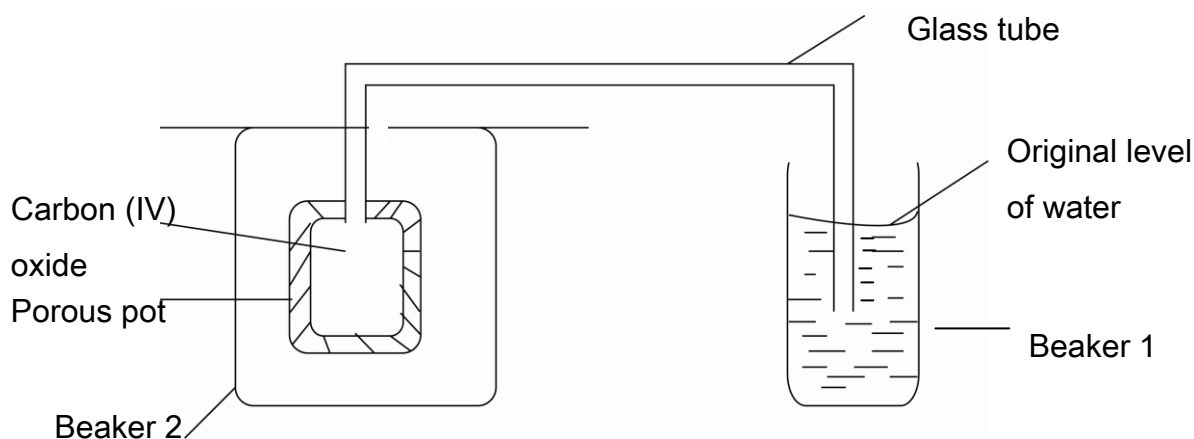
 State and explain the observation that would be made in glass tube if beaker 2 was filled with air. (3mks)

28. The process in which a gas changes directly into a solid is called _____ (1mk)

KIRINYAGA WEST
233/2
CHEMISTRY
Paper 2
(THEORY)
SECTION A

1. a) The diagram below shows a set-up that was used to prepare oxygen gas and passing it over a burning candle. The experiment was allowed to run for sometime.
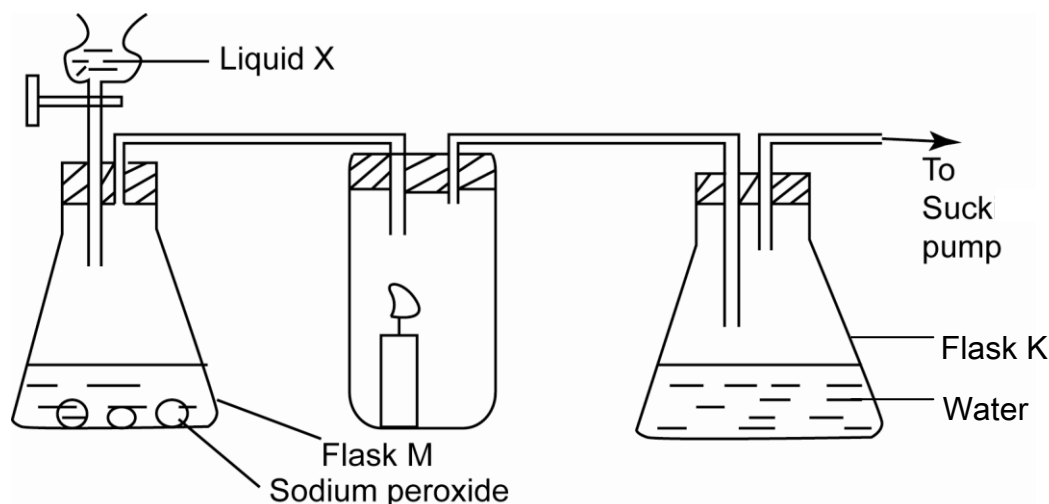

   i) Name liquid X. (1mk)
   ii) Suggest the pH of the solution in flask K. Explain. (2mks)
   iii) Write equation for the reaction taking place in flask M. (1mk)

   b) State and explain the two observations made when hydrogen sulphide is bubbled into the solution containing iron (III) chloride. (2mks)
   c) i) Describe a simple chemical test that can be used to distinguish carbon (IV) oxide and carbon (II) oxide. (1mk)
   ii) Explain why dry ice (solid carbon (IV) oxide) is preffered in ice cream vendor box than ordinary ice. (1mk)
   d) A form two student inverted a gas jar full of carbon (IV) oxide over water and sodium hydroxide solution separately. Draw the diagram to show the observation made and explain. (3mks)

2. In the preparation of Magnesium carbonate, magnesium was burnt in air and the product collected. Dilute Sulphuric (VI) acid was added and the mixture filtered and cooled. Sodium carbonate was added to the filtrate and the content filtrated. The residue was washed and dried to give a white powder.
   a) Give the name of the product formed when magnesium burns in air. (1mk)
   b) Write a chemical equation for the formation of the product (a) above. (1mk)
   c) i) Name the filtrate collected after sodium carbonate was added. (1mk)
       ii) Name the white powder. (1mk)
   d) Write chemical equation for the reaction between product in (a) and acid. (1mk)
   e) Name the ions present in the filtrate after addition of sodium carbonate. (1mk)
   f) Write an ionic equation to show the formation of the white powder. (1mk)
   g) If the white powder is strongly heated explain what happens to its mass. (2mks)

6

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

Electrode reaction	E^θ Volts
$C^{2+}_{(aq)} + 2e- \rightleftharpoons C_{(s)}$	0.34
$D^{2+}_{(aq)} + 2e- \rightleftharpoons D_{(s)}$	+0.44
$E^{+}_{(aq)} + e- \rightleftharpoons E_{(s)}$	-2.92
$Fe^{2+}_{(aq)} + 2e- \rightleftharpoons Fe_{(s)}$	-2.71
$G^{2}_{+(aq)} + 2e- \rightleftharpoons G_{(s)}$	-0.14
$^1/_2H_{2(g)} + e- \rightleftharpoons H^-(aq)$	+2.87
$^1/_2K_{2(g)} + e- \rightleftharpoons K^-(aq)$	+1.09
$L^{+}_{(aq)} + e- \rightleftharpoons {}^1/_2L_2$	0.00

a) i) Identify the strongest reducing agent and strongest oxidizing agent.
   Give reasons.   (2mks)
   Strongest reducing agent - _____
   Reason _____
   Strongest oxidizing agent - _____
   Reason_____

ii) Calculate the e.m.f of the cell formed by connecting half cells C and D.   (1mk)

b) Draw and label a diagram of a cell formed by connecting half cells of E and D. On the diagram
   indicate the flow of electrons.   (3mks)

c) 100cm³ of 2m sulphuric (VI) acid was electrolyzed using the set up represented by the diagram below.
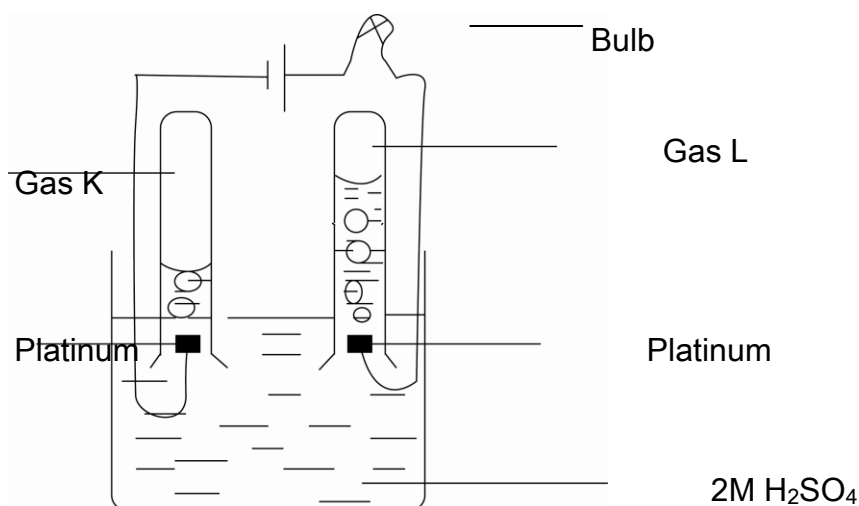
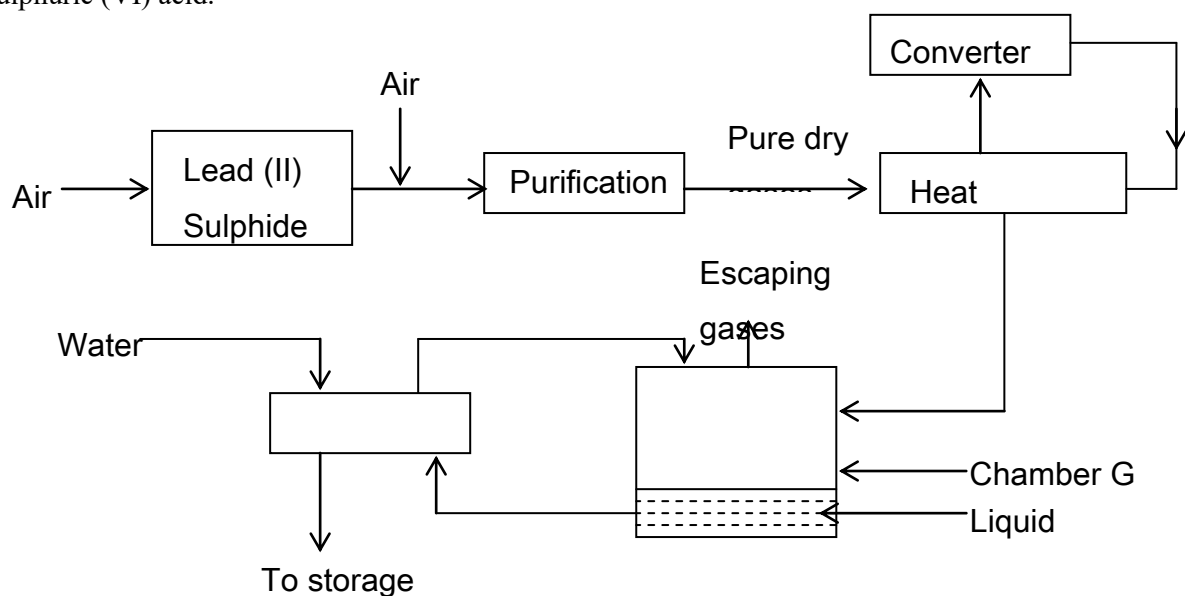i)   Write an equation for the reaction that produces gas L.   (1mk)
ii) Describe the test for gas K.   (2mks)
iii) Account for the difference in volume of gases produced at the electrodes.   (2mks)
iv) If 100cm³ of 2m ethanoic acid was used in place of sulphuric acid comment on brightness of the bulb. (2mks)

7

4. The grid below represents part of the periodic table. Study it and answer the questions that follows.

    i)   Select the element that can form an ion with a charge of -2. Explain.   (2mks)

    ii)   What type of structure would the oxide of C have? Explain.   (2mks)

    iii) Compare reactivity of H and E. Explain.   (2mks)

b)   1.3g of B reacts completely when heated with 1.21 litres of chlorine gas at s.t.p.

    (1 mole of gas at s.t.p. occupies 22.4 litres)

    i)   Write a balanced equation for the reaction between B and chlorine gas.   (1mk)

    ii)   Determine the relative atomic mass of B.   (2mks)

c)   Explain how you would expect the following to compare.

    I)   Atomic radii of F and G.   (1mk)

    II)   The pH values of aqueous solution of oxides of B and D.   (1mk)

5.   a) The diagram below shows some processes that takes place during the industrial manufacture of sulphuric (VI) acid.


    i)   Write the equation for the reaction in which sulphur (IV) oxide gas is produced.   (1mk)

    ii)   Why is it necessary to keep the gases pure and dry?   (1mk)

    iii) Describe the process that takes place in chamber G.   (1mk)

    iv) Name the gases that escapes into the environment.   (1mk)

    v)   State and explain the harmful effect on the environment of one of the gases named in (iv) above. (1mk)

    vi) Give one reason why it is necessary to use a pressure of 2-3 atmosphere and not more.   (1mk)

b)   i)   Complete the table below to show the observation made when concentrated sulphuric acid is added to the substances shown.   (2mks)

Substance	Observations
Iron filings	
Crystals of white sugar	

    ii) Give reasons for the observations made using

      I) Iron fillings   (1mk)

8

        II   Crystals of white sugar.   (1mk)

  c)   Name one fertilizer made from sulphuric (VI) acid.   (1mk)

  d)   Suggest a reason why $BaSO_4$ (A pigment made from sulphuric (VI) would be suitable in making paints in cars.   (1mk)

6.   a) Ethyne is the first member of the alkyne family.

      i) Name the two reagents that can be used in the laboratory to prepare the gas.   (1mk)

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

  b) The following scheme represents various reactions starting with ethyne.
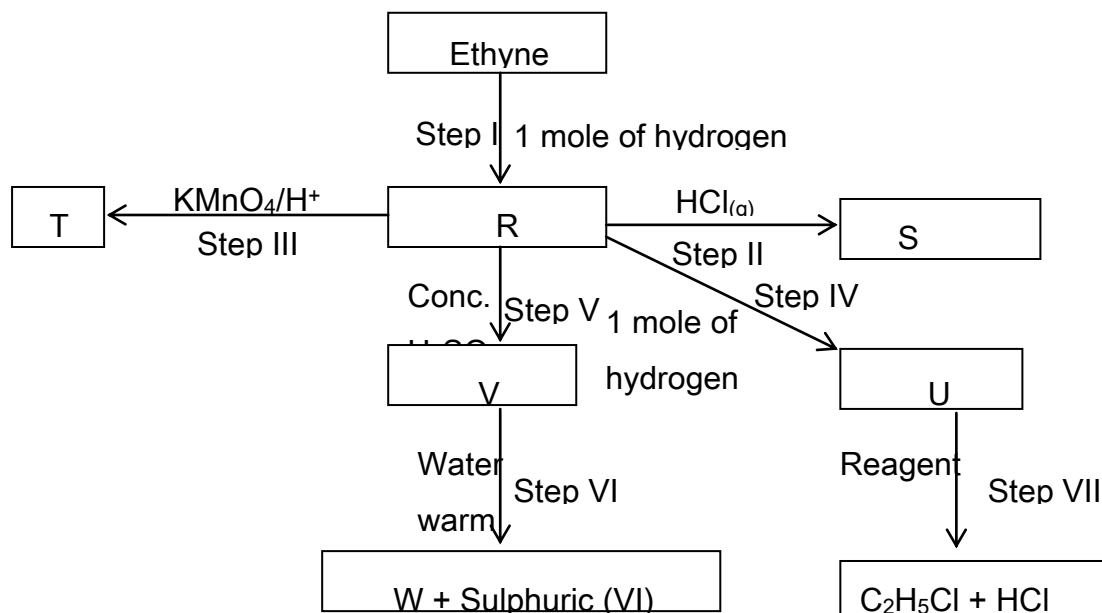
    i)   Name the substances.   (2mks)

       R _____   U _____

       S _____   V _____

       T _____   W _____

    ii)   Name the reagent X and condition required for the reaction in step VII to occur.   (2mks)

       X _____

       Condition _____

    iii) Name the type of reaction that occurred in   (2mks)

       Step I _____

       Step VII _____

  c) i)   Draw and name two structural Isomers of Butane.   (2mks)

     ii)   Describe a chemical test that can used to differentiate between butene and butane.   (2mks

7.   In an experiment to study the rate of reaction between duralumin (an alloy of aluminium, magnesium and copper) and hydrochloric acid, 0.5g of alloy were reacted with excess 4 M hydrochloric acid. The data below was recorded.

Time in Min	0.0	1.0	2.0	3.0	4.0	5.0	6.0	7.0
Volume of gas (cm^3)	0.0	220.0	410.0	540.0	620.0	640.0	640.0	640.0

  a)   i) Plot a graph of total volume of gas produced against time.   (3mks)

      ii) From the graph determine the volume of the gas produced at the end of $2\frac{1}{2}$ minutes.   (1mk)

  b)   Determine the rate of reaction between the 3rd and 4th minute.   (2mks)

  c)   Give a reason why some solid remained at the end of the experiment.   (2mks)

  d)   Give that 1.25cm^3 of the total volume of gas was from the reaction between magnesium and hydrochloric acid. Calculate the percentage by mass of aluminium present in 0.5g of alloy.

(Al = 27, Molar gas volume = 2400cm^3).   (3mks)

KIRINYAGA WEST
233/3
CHEMISTRY
Paper 3
(PRACTICAL)
1.   You are provided with:
- Solution K containing 6.0g of NaOH in 750cm^3 solution.
- Dilute acid J made by dissolving 13.9g of $H_2C_2O_4.XH_2O$ in 700cm^3 of water and diluting the solution to 1 litre.
- Phenolphthalein indicator.

You are required to determine the value of X in $H_2C_2O_4.XH_2O$

Procedure

Fill the burette with solution K using a pipette and pipette filler, pipette 25cm3 of J into a clean conical flask. Add 2-3 drops of Phenolphthalein indicator. Titrate this solution with solution K from the burette until a **permanent pink** colour first appears. Fill the result in the table below. Repeat this procedure two more times and complete table 1 below.

Table 1   (4 marks)

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

                                                                               (4mks)
a) Determine the average volume of K used.   (1mk)
b) Determine number of moles of K used.   (2mks)
c) Determine number of moles of solution J used.   (2mks)
d) Determine the concentration of J in moles per litre.   (2mks)
e) The relative formula mass of $H_2C_2O_4.XH_2O$ (2mks)

f) Determine the value of X in the $H_2C_2O_4.XH_2O$ (H = 1, C = 12, O = 16)   (2mks)
2.   You are provided with
- Magnesium ribbon labeled solid C
- 2.0M Sulphuric (VI) acid labeled solution D.
- A stop watch

You are required to determine the rate of reaction between Magnesium and Sulphuric (VI) acid at different concentrations.

Procedure:

Place five test tubes in a test tube rack and label then 1, 2, 3, 4 and 5. Using a 10cm^3 measuring cylinder, measure out the volume of 2.0M Sulphuric (VI) acid solution D as shown in the table 2. Pour into the corresponding test tubes. To each test tube, add the volume of water as shown in table 2. Cut out five pieces of Magnesium ribbon, solid C each exactly 1cm long. Transfer all the solution in test tube 1 into a 100cm^3 beaker. Place one piece of magnesium into the beaker and start a stop watch immediately. Swirl the beaker continuously ensuring that the magnesium is always inside the solution. Record the time taken for magnesium to disappear in table 2 below. Wash the beaker and repeat procedure above for each of the solution in test tube 2, 3, 4 and 5 and complete table 2.

Table 2

Test tube number	1	2	3	4	5
Volume of solution D (cm^3)	10	9	8	7	6
Volume of water (cm^3)	0	1	2	3	4

Time taken (Sec)					
Rate of reaction (1/time)S^{-1}					

(5mks)

a) Plot a graph of rate of reaction of ($\frac{1}{t}$) (y-axis) against volume of solution D. (3mks)

b) Use the graph to determine the time that would be taken for a 1cm length magnesium ribbon to disappear if the volume of the acid solution D used was 8.5cm^3. (1mk)

c) In terms of rates of reactions, explain the shape of your graph. (1mk)

3. a) You are provided with:
- Solution P
- Acidified potassium manganite (VII)
- Sodium hydrogen carbonate
- Acidified potassium dichromate (VI)
- Bromine water

Solid P was suspected to be a **saturated alkanol**. From the reagents provided, select and describe four tests that could be carried out consecutively to confirm if solid P is a **saturated alkanol**. Write the tests and the expected observations in the spaces provided.

Test1

Observations	Expected Observations
(1mk)	(1mk)

Test 2

Observations	Expected Observations
($^1/_2$mk)	($^1/_2$mk)

Test 3

Observations	Expected Observations
(1mk)	(1mk)

Test 4

Observations	Expected Observations
(1mk)	(1mk)

b) Carry out the tests described in (a) using solid P and record the observations and inferences in the spaces provided.

Test 1

Observations	Inferences
(1mk)	(1mk)

Test 2

Observations	Inferences
(1mk)	(1mk)

Test 3

Observations	Inferences
(1mk)	(1mk)

Test 4

Observations	Inferences
(1mk)	(1mk)

Kirinyaga West
SCHOOL BASED FORM 4 EXAMINATION 2018
CHEMISTRY PAPER 3 233/3
CONFIDENTIAL
Instructions to schools:
The information contained in this paper is to enable the teacher in charge of chemistry to make preparation for the chemistry practical examination.
In addition to the chemicals and apparatus found in a chemistry laboratory, each candidate will require the following:

1. 50ml burette
2. 25ml pipette
3. Clamp and stand
4. Pipette filler
5. 2 Conical flask
6. White tile
7. Filter funnel
8. 120cm^3 solution K, 0.2M NaOH
9. 100cm^3 solution J, 0.11M Oxalic acid
10. Six test tubes
11. 5 labels
12. Test tube rack
13. A stop watch
14. 10cm3 measuring cylinder

15. 500ml distilled water
16. 100cm3 glass beaker
17. 7cm Magnesium ribbon, solid C
18. About 50cm3 of solution D (2.0M Sulphuric (VI) acid)
19. 12cm3 Maleic acid, Solution P
20. Solid Sodium hydrogen carbonate (approximate) 0.5g
21. Ruler

Access to:
1. Phenolphthalein indicator with a dropper
2. Bromine water with a dropper
3. Acidified potassium manganite (VII) with a dropper.
4. Acidified potassium dichromate (VI) with a dropper.

NB:
- Maleic acid, solution P is prepared by dissolving 100 grams in 1 litre of distilled water.
- Acidified potassium manganite (VII) is prepared by dissolving 3.2g in 400cm^3 of 1M H_2SO_4 then diluting to 1 litre.
- Acidified potassium dichromate (VI) is prepared by dissolving 4.6g in 400 cm^3 of 1M H2SO4 then diluting to 1 litre.

KISII CLUSTER
233/1
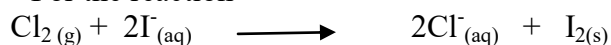**CHEMISTRY**
Paper 1(THEORY)
JUNE, 2018
2 hours

SECTION 1

1. Study the following nuclear reaction and complete it by giving the values of m and n. (2mks)

$$^{232}_{92}X \longrightarrow {}^{m}_{n}Y \quad + \quad 2\,{}^{0}_{-1}e^- \quad + \quad {}^{4}_{2}He$$

2. For the reaction

$$Cl_{2(g)} + 2I^-_{(aq)} \longrightarrow 2Cl^-_{(aq)} + I_{2(s)}$$

   Using oxidation numbers determine the reducing agent. (2mks)

3. When aqueous sodium hydroxide solution was added to freshly prepared acidified iron (II) sulphate solution, a green precipitate was formed. When hydrogen peroxide was first added to iron (II)sulphate solution followed by sodium hydroxide solution, a brown precipitate was formed. Explain these observations. (3mks)

4. Substances X and Y consist of molecules X_2 and Y_2 respectively. When the two elements react, they form a molecule XY. The X-X bonds are as strong as the Y-Y bonds but X-Y bonds are stronger than either X-X or Y-Y. The equation for the reaction for the reaction is.

   $$X_{2(g)} + Y_{2(g)} \longrightarrow 2XY_{(g)}$$
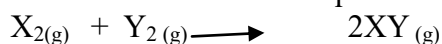
   (a) Is the reaction exothermic or endothermic? Give a reason for your answer. (2mks)
   (b) Draw an energy level diagram for the reaction in (a) above. (2mks)

5. Pentane is a saturated hydrocarbon.
   (a) What does the term saturated hydrocarbon mean? (1mk)
   (b) Give the equation for complete combustion of pentane when burnt in plentiful supply of air. (2mks)

6. A solution of potassium chloride was added to a solution containing a lot of lead (II) nitrate. A precipitate that weighed 5.56g was formed. Find the amount of potassium chloride in the solution. (Pb=207, Cl=35.5, K=39) (3mks)..
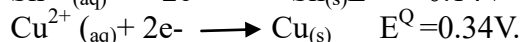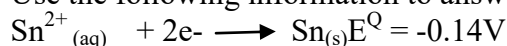
7. Aluminium chloride vapour combines readily with ammonia gas to form a solid compound of formula $(AlCl_3.NH_3)$. Explain in terms of structure and stability of atoms why this reaction occurs. (2mks)

8. (a) Give the systematic name of the following monomer and draw the structure of the polymer it forms. (2mks)
 CH_2CHCl .
   Structure of polymer
   (b) State one use of the polymer in (a) (1mk)

9. Gas A is 16 times denser than gas B. 100cm3 of A diffuses through a hole in 20 seconds. Calculate the volume of B that will diffuse through the hole in 30 seconds. (3mks)

10. Use the following information to answer the questions that follow.
    $$Sn^{2+}_{(aq)} + 2e- \longrightarrow Sn_{(s)} \quad E^Q = -0.14V$$
    $$Cu^{2+}_{(aq)} + 2e- \longrightarrow Cu_{(s)} \quad E^Q = 0.34V.$$
    (a) Write the cell representation for the cell made up of two half cells. (1mk)
    (b) Write an equation for the cell reaction. (1mk)
    (c) Calculate the E^Q value for the cell. (1mk)

11. A solution of hydrogen bromide in benzene does not react with sodium carbonate while an aqueous solution of hydrogen bromide reacts with carbonates. Explain this observation.
    (2mks)

12. A student prepared ammonia gas and led it into a solution of zinc sulphate using the arrangement shown below.
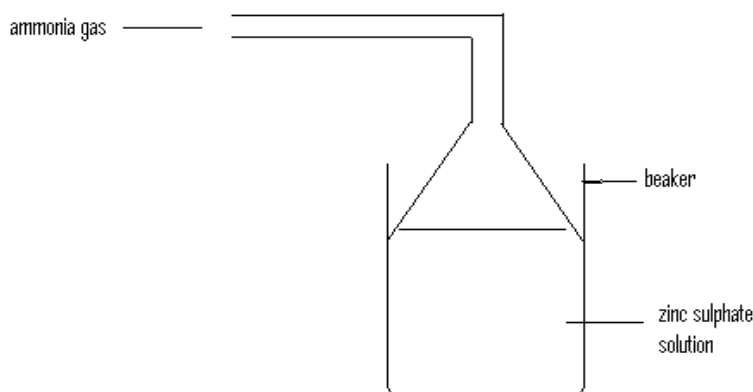

(a) State and explain the observations that were made in the beaker.   (2mks)
(b) Write the ionic equation for the reaction involving zinc ions.   (1mk)

13. A solid mixture consists of substances Y, Y, and Z whose solubilities at room temperature are shown in the table below.

| Substance | Solubility (g/100g water) | |
	At 25°C	At 60°C
X	0.02	0.02
Y	63	82
Z	48	64

Describe how you would separate X Y and Z.   (3mks)

14. When a hydrated sample of calcium sulphate $CaSO_4.XH_2O$ was heated until all the water was lost, the following data was recorded.
Mass of crucible= 30.296g
   Mass of crucible + hydrated salt= 33.111g
   Mass of crucible + anhydrous salt = 32.781g
   Determine the empirical formula of the hydrated salt (RAM: $CaSO_4$= 136, H_2O= 18)   (3mks)..

15. Zinc reacts with both concentrated and dilute sulphuric(VI) acid. Write equations for the two reactions.   (2mks)

16. Starting with copper metal, describe how a sample of copper (II) chloride may be prepared in the laboratory.   (3mks)

17. The atomic number of sulphur is 16. Write the electron arrangement of sulphur on the following.   (2mks)

(a) H_2S...
(b) SO_3^{2-}...

18. Usingdots (.) and crosses (X) show bonding in:
(a) The compound formed between phosphorus and hydrogen. (P=15, H= 1)   (1mk)
(b) carbon(II)oxide.(C=6, O=8)   (1mk)

26

19. Hydrogen and oxygen can be obtained by electrolysis of acidified water. Using equation for the reaction at the electrodes, explain why the volume of hydrogen obtained is twice that of oxygen.   (2mks)

20. The energy level diagram below shows the effect of catalyst on the reaction path.
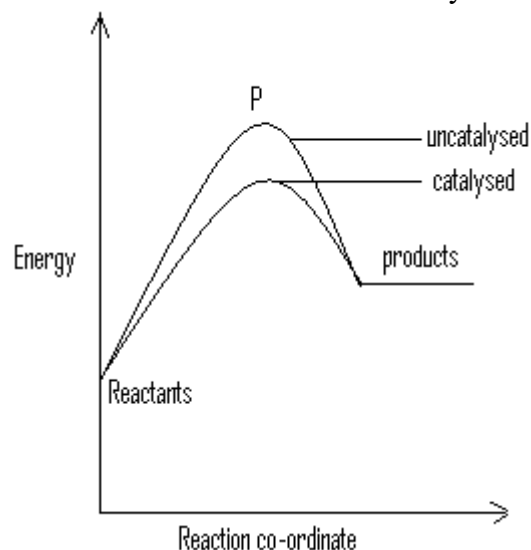
(a) What does point P represent?   (1mk)
(b) With reference to the energy level diagram, explain how a catalyst increases the rate of a
    reaction.   (2mks)
21. (a)   What is meant by a strong acid?   (1mk)
    (b)   In an experiment $40cm^3$ of 0.5M sulphuric acid was reacted with excess sodium carbonate and the volume of carbon (IV) oxide produced recorded with time. In another experiment, the same volume and concentration ofethanedioic acid was also reacted with excess sodium carbonate and the volume of carbon (IV) oxide produced recorded with time. On the grid below, sketch and label the curves if the volumes of carbon (IV) oxide were plotted against time.   (2mks)
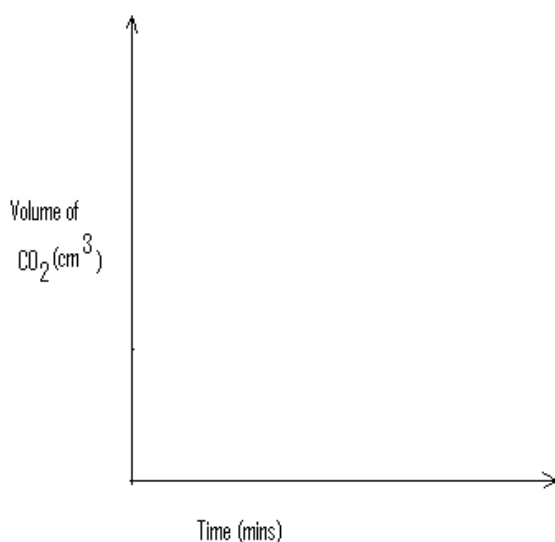
22. (a) State Gay Lussac's law.   (1mk)
    (b) $10cm^3$of a gaseous hydrocarbon, C_xH_y required $30cm^3$ of oxygen for complete combustion. If steam and 20cm3 of carbon (IV) oxide were produced, what is the value of X?   (2mks)
23. (a) Explain why permanent hardness in water cannot be removed by boiling   (2mks)
    (b) Name two methods that can be used to remove permanent hardness from water.   (2mks)
24. (a)Distinguish between nuclear fission and nuclear fusion.   (2mks) .

27

(b) Describe how solid wastes containing radioactive substances should be disposed of.   (2mks)

25. Study the information below and answer the questions that follow.

Ions	Electronic arrangement	Ionic radius
Na^+	2.8	0.095
K^+	2.8.8	0.133
Mg^{2+}	2.8	0.65

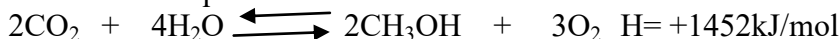Explain why ionic radius of:
(a) K^+ is greater than that of Na^+ (1mk)
(b) Mg^{2+} is smaller than that of Na^+ (2mks) 26. In the industrial extraction of lead metal, the ore is first roasted in a furnace. The solid mixture obtained is then fed into another furnace together with coke, limestone and scrap iron. State the function of each of the following in this process.
a.   Coke   (1mk)
b.   Limestone   (1mk)
c.   Scrap iron   (1mk)

27.   (a) State Le-Chateliar's principle.   (1mk)
(b) Under certain conditions, carbon (IV) oxidereacts with water to form methanol and oxygen as shown in the equation below.
$2CO_2$ + $4H_2O$ ⇌ $2CH_3OH$ + $3O_2$ H= +1452kJ/mol
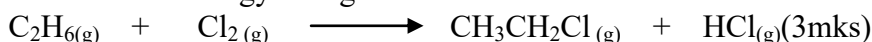What would be the effect on yield of methanol if the temperature of the reaction mixture is decreased? Explain.   (2mks)
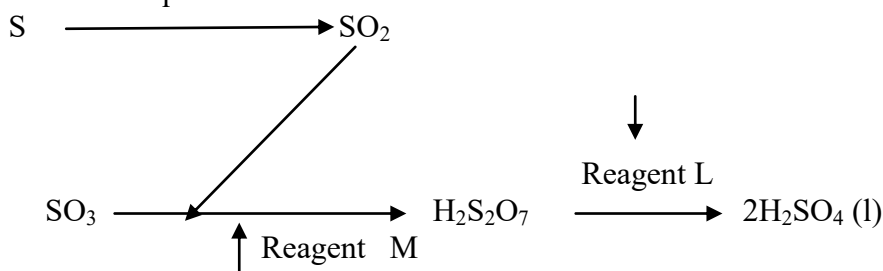
28.   Some average bond energies are given below.

Bond	**Energy(kJ/mol)**
C-C	348
C-H	414
Cl-Cl	243
C-Cl	432
H-Cl	340

Calculate the energy change for the reaction below:
$C_2H_{6(g)}$ + $Cl_{2\,(g)}$ ⟶ $CH_3CH_2Cl_{\,(g)}$ + $HCl_{(g)}$(3mks)

29.   Study the flow chart below showing the reaction involved in the preparation of sulphuric acid and answer the questions that follow.

S ⟶ SO_2

⟶ Reagent L

SO_3 ⟶ $H_2S_2O_7$ ⟶ $2H_2SO_4$ (l)

↑ Reagent M

(a)   Name the reagents.
        L.. ($^1/_2$mk)   M... ($^1/_2$mk)
(b)   Write the equation for the reaction between reagent M   and $H_2S_2O_7$ (1mk)
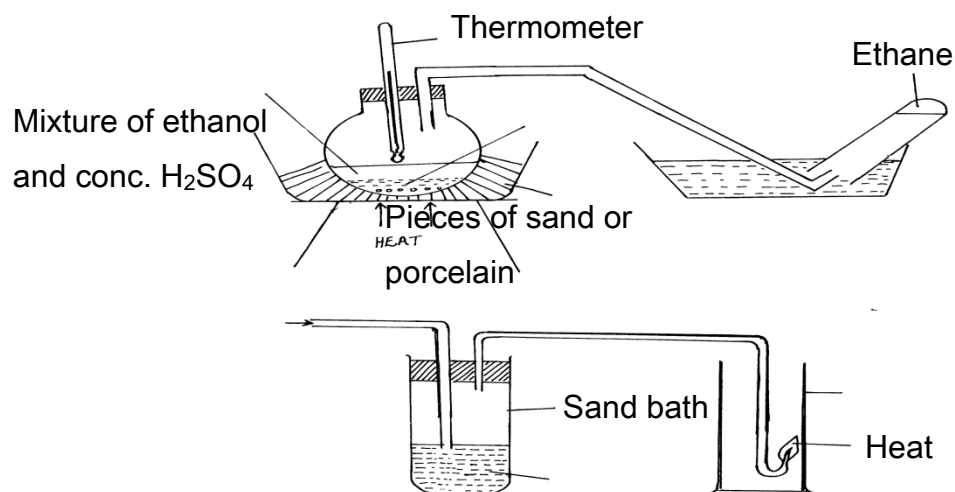
KISII CLUSTER
**233/2**
CHEMISTRY
PAPER 2
(THEORY)

SECTION A

1. The diagram below is an arrangement for the preparation of ethane. Study the diagram and answer the questions that follow.


a) Draw the structure / formula of ethanol. (1mk)
b) State an important property of concentrated sulphuric (VI) acid useful in the preparation of ethane from ethanol. (1mk)
   (1mk)
g) Write equations of the reactions in (f) (i) & (ii) above. (2mks)
c) What is the purpose of the
   (i) Sand bath? (1mk)
   (ii) Porcelain or sand? (1mk)
d) Name two other compounds that may be used in the place of concentrated sulphuric (VI) acid. (2mks)
e) Write a full chemical equation of the reaction including the condition of temperature in the preparation of ethane. (2mks)
f) What is observed when the gas collected in the gas jar is tested with acidified potassium manganate (vii)?

2. The flow chart below shows the extraction of copper metal from its ore. Study it and answer questions that flow.
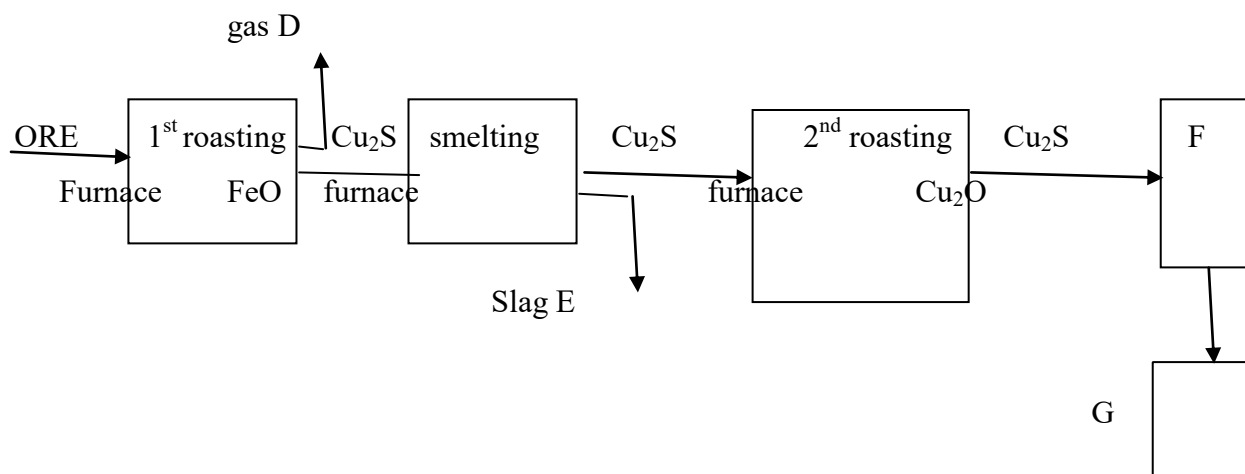
Impure   copper
a) Identify the ore used in the extraction. (1mk)
b) Name
(i) gas D (1mk)
(ii) Slag E (1mk)
c) Write an equation for the reaction which is taking place in chamber F. (1mk)
d) Explain how impure copper in chamber G can be purified. (2mks)
e) In the industrial extraction of copper a steady of 8amps was used. Calculate the time taken in hours to deposit 24kg of copper. (Cu = 64, IF=96500C) (3mks)
f) Give two uses of copper. (2mks)

3.   a) Study the diagram below and answer the questions that follow.

Hydrogen
sulphide
A gas jar
Boiling tube
Pale blue flame
Concentrated
sulphuric (VI)
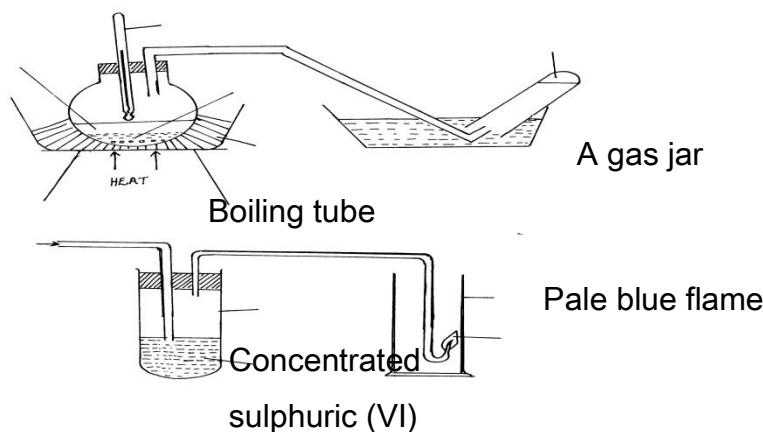
(i) It is observed that a yellow solid is formed in the boiling tube. Explain this observation. (2mks)
(ii) Name a substance that is used to dry Hydrogen sulphide. (1mk)
(iii) State the observation to be made when hydrogen sulphide is burnt in a limited supply of air in the gas jar. (1mk)
(iv) Write an equation for the burning of Hydrogen sulphide in the gas jar. (1mk)
(v) List any two properties of hydrogen sulphide gas that are demonstrated in this experiment. (2mks)
(vi) What precaution should be taken in carrying out this experiment? Give a reason. (2mks)
b) In another experiment, a gas jar containing moist sulphur (IV) oxide is inverted over another gas jar containing hydrogen sulphide gas. State and explain the observation that is made. (2mks)

4.   a) A student set up the apparatus below to prepare and collect carbon (IV) oxide gas.
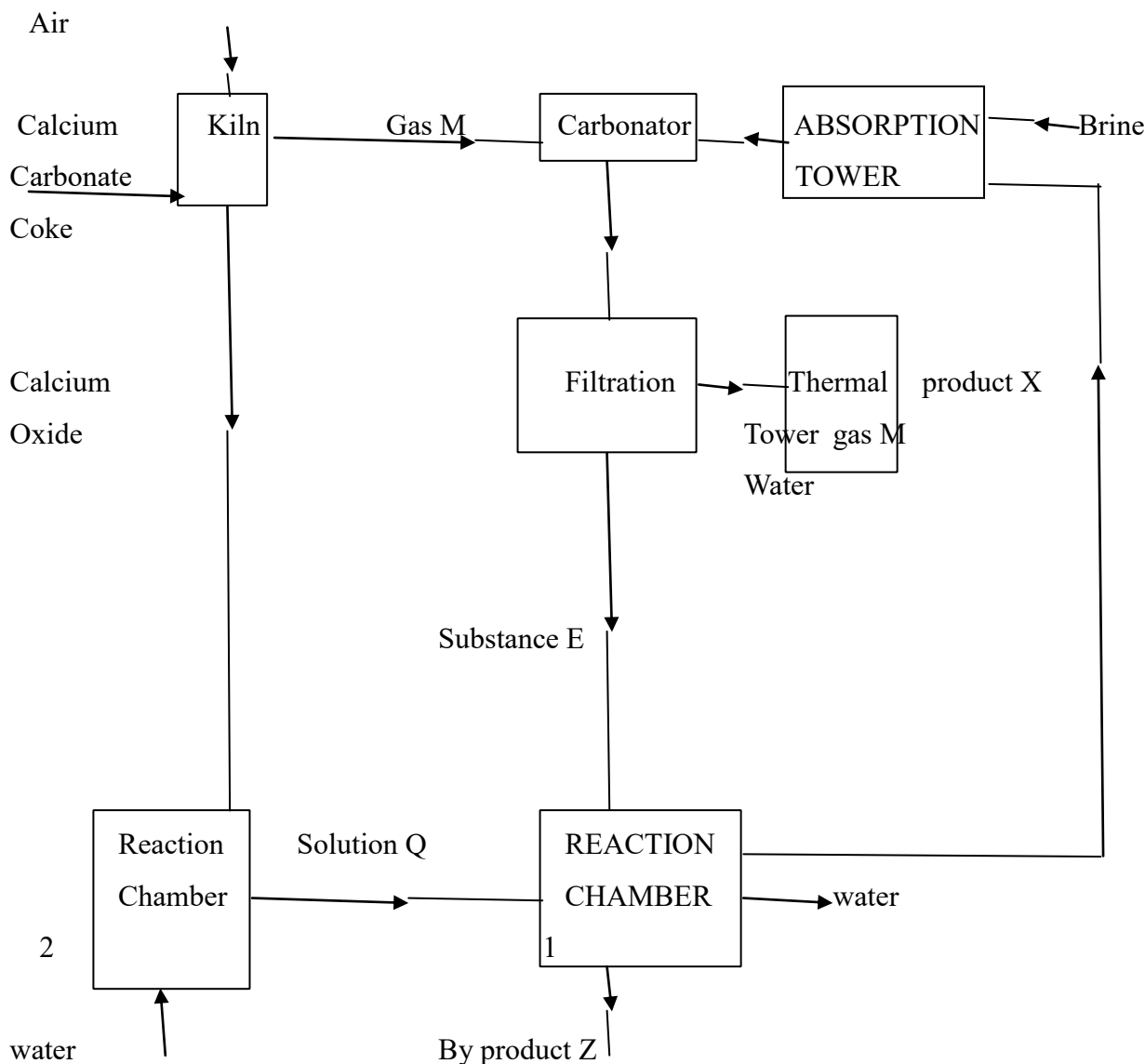

dil H_2SO_4
cork
gas jar
X Y
Calcium carbonate
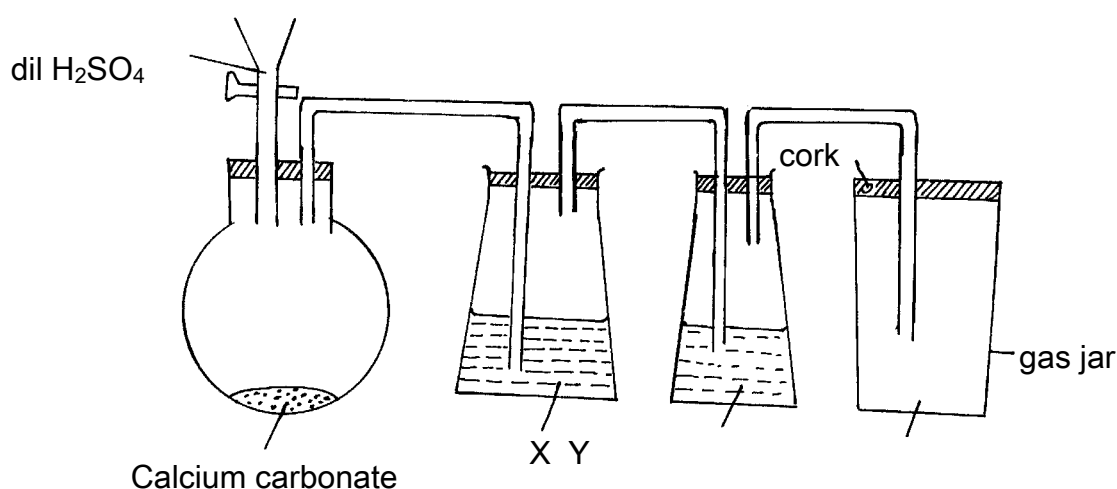
(a) Identify two mistakes in the set up. (2mks)
(b) Name liquid y. (1mk)
(c) What is the purpose of liquid x. (1mk)

30

(d)   State one use of carbon (IV) oxide related to the collection method shown above.   (1mk)

b) The flow chart below shows the steps in the manufacture of sodium carbonate (Solvay process). Study it and answer questions that follow.

a)   Name substances labelled X and E.   (1mk)
b)   Write a chemical equation for the reaction taking place in the carbonator   (2mks)
c) The carbonator is usually cooled by running cold water in metallic pipes. Why is this cooling necessary?   (1mk)
d) Give one commercial use of sodium carbonate.   (1mk)
e) (i) Name the by-product Z.   (1mk)
     (ii) State one use of Z.   (1mk)
(f) Identify two gases which are recycled in the process.   (1mk)

5.   The table below gives the solubility's of two salts; A and B at various temperature.

Temp ^{0}C	0	20	40	60	80	100
Solubility of A g/100g water	10	20	40	65	100	160
Solubility of B g/100g water	20	32	43	60	79	112

(a) (i) On the grid provided, plot a graph of solubility of A and B (y-axis) against temperature.   (4mks)

(ii) A solution containing 68g of salt B is 100g of water is cooled from 100^0c. At what temperature will the crystals of salt B first form? (1mk)

(iii) Find the mass of crystals formed when the solution m (ii) above is cooled to 30^0C. (1mk)

(iv) From your graph; state the temperature at which both salts have the same solubility. (1mk)

(v) Calculate the total mass of the solution at temperature obtained in (iv) above. (2mks)

b) Use the information below on solubility to answer questions that follow.

Salt	Solubility at	
	70^0C	35^0C
$CuSO_4$	38	28
$Pb(NO_3)_2$	78	79

A mixture of 38g of copper (II) sulphate and 78g of lead nitrate in 100g of water at 70^0C is cooled to 35^0C.

(i) Which of the two salts will crystallize? Explain. (1mk)

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

(iii) State the salt that will be unsaturated at 35^0C. (1mk)

(iv) How much of the salt in (iii) above would be required to make a saturated solution at 35^0C. (1mk)

6. Study the scheme below and answer the questions that follows.
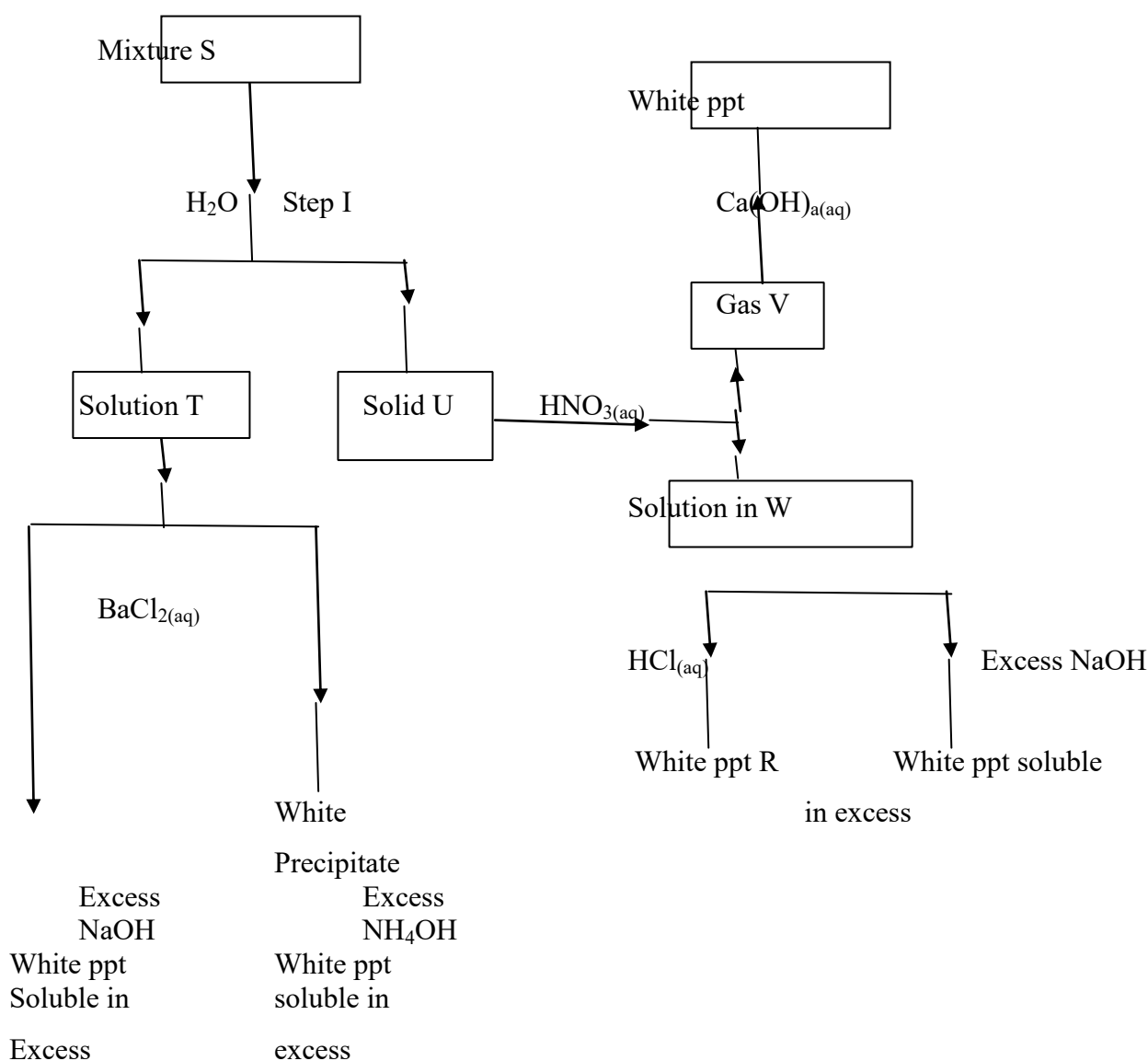
(a) What property of mixture S is shown in step 1. (1mk)
(b) Identify the following.
Solid U ……………………………………………………………
Gas V ……………………………………………………............
Solution T ………………………………………………………..
Write precipitate R ……………………………………………….
(c) Identify the ions present in solution T. (1mk)
 (d) Write an ionic equation for the reaction between.
    (i)   Solution T and Barium chloride solution. (1mk)
    (ii)   Solution W and Hydrochloric acid. (1mk)
 (e) Identify mixture S. (2mks)
7.   Study the table below. The letters do not represent the actual symbols of the elements.

Element	Atomic Number	Boiling point (K)
A	3	1603
B	13	2743
C	16	718
D	18	87
E	19	1047

a) Select the elements to which belong to the same: (1mk)
  (i) Group ……………………………………………………………………………….
  (ii) Period ……………………………………………………………………………..
b) Which element
(i) is in gaseous state at room temperature. Explain. (Room temperature taken as 25^0C) (2mks)
(ii) does not for an oxide. (1mk)
c) Write the:
(i) formula of the Nitrate of element. (1mk)
(ii) Equation for the reaction between element B and oxygen gas. (1mk)
d) What type of bond would exist in the compound formed when elements A and C react? Give a reason. (2mks)
e) Using dots (.) and crosses (x) to represent outermost electrons, show bonding in the compound formed between elements E and C. (1mk)
f) Explain why the boiling point element B is greater than that of element E. (1mk)
g) Write a balanced equation when A reacts with cold water. (1mk)

KISII CLUSTER
233/3
CHEMISTRY
PAPER 3
(PRACTICAL)

1.   You are provided with:
        - Solution Q sulphuric acid
        - Magnesium ribbon labelled solid R
        - 1.5m sodium hydroxide – solution S
        - Phenopthalein indicator

      You are required to:
(i)   determine the rate of reaction between magnesium ribbon – solid R and sulphuric acid solution Q
(ii)   Determine the concentration of sulphuric acid in moles per litre.
(a)   **Procedure I**
I.   Using a measuring cylinder, measure 50cm^3 of solution Q and transfer it into a clean 100ml beaker.
II.   Use a ruler and scapel / knife to cut out five pieces, each of exactly 1cm length of magnesium ribbon.
III.   Place one piece of magnesium into the beaker containing solution Q and start a stop clock/watch immediately . Swirl the beaker gently ensuring that the piece is always inside the solution. Record in the table the time taken for the magnesium ribbon to disappear.
IV.   Repeat procedure III for each of the remaining 4 pieces to the same solution Q and complete table 1 below.
      N/B: Keep solution Q for use in procedure II

      b) Table 1

Length of solid R added cm (Magnesium ribbon)	1	2	3	4	5
Time taken in seconds					
Rate of reaction = $^1/_{time}$					

                                                                        (6mks)

      c)   (i) Plot a graph of rate of reaction $^1/_{time}$ (y-axis) against length of solid R added.   (3mks)
              (ii) Use the graph to determine the time that would be taken for 3.5cm of solid R to disappear. (2mks)
              (iii) In terms of rate of reaction, explain the shape of your graph.   (1mk)
      d)   Given that the mass of solid R used was 0.13g and relative atomic mass of magnesium is 24. Calculate the number of moles of solution Q that were used up during the reaction.   (2mks)
      e)   **Procedure II**
      (i)   Place all the solution obtained in procedure I in 100ml measuring cylinder. Add distilled water to make 100cm^3 of solution in the measuring cylinder. Transfer this solution into a 100ml beaker and stir well. Label this solution T.
      ii)   Fill the burette with solution S. Using a pipette and a pipette filler, place 25.ocm^3 of solution T into a conical flask. Add 2 – 3 drops of phenolphthalein indicator into solution T and Titrate it with solution S. Record your readings in table 2. Repeat the titration two more times and complete table
2.

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

                                                                        (4mks)

(iii)   Calculate the :
I. Average volume of solution S used.   (1mk)
II. Number of moles of sodium hydroxide – solution S used.   (1mk)
III. Number of moles of sulphuric acid in 25.0cm^3 of solution T.   (1 ½ mks)
IV. Number of moles of sulphuric acid in 100cm^3 of solution T.   (1mk)

(iv) Using your answer in 1 (d) above, determine the number of moles of sulphuric acid in 50cm^3 of solution Q.

                                                                                          34

(1 ½ mks)

(v) Calculate the concentration of the original sulphuric acid-solution Q in moles per litre.   (1mk)

2.   You are provided with solid U. Carry out the following tests on it and record your observations and inferences.

a)   Using a spatula put about half of solid U provided into a boiling tube. Add 20cm^3 of distilled water and shake well.

b)   Divide solution formed in (a) into five portions of 2cm^3 each in separate test tubes.

(i)   To first portion add ammonia solution dropwise till in excess.

Observations	Inferences
(1mk)	
	(1mk)

(ii)   To the second portion add 2cm^3 of sodium sulphate solution.

Observations	Inferences
(1mk)	(2mks)

(iii)   To the third portion add 2cm^3 of lead (II) nitrate solution.

Observations	Inferences
(1mk)	(2mk)

(iv)   To the fourth portion add 2cm^3 of Barium nitrate solution.

Observations	Inferences
(1mk)	(2mk)

(v)   To the fifth portion add blue and red litmus papers.

Observations	Inferences
(1mk)	(1mk)

COMPLIANT II
**CHEMISTRY**
Paper 1 (Theory)

1. Give **two** reasons why a luminous flame is not used for heating purposes. (2marks)
2. (a) Define Graham's law of diffusion. (1mark)
   (b) Equal volumes of Carbon (II) oxide and carbon (IV) oxide are allowed to diffuse through the same
       medium. Calculate the relative rate of diffusion of carbon (II) oxide C = 12.0, 0 = 16.0. (3marks)
3. (a) Define an isotope. (1mark)
   (b) Determine the number of neutrons in $^{37}_{17}Cl$ ————————————————— (1mark)

4. Describe how you would prepare a dry sample of lead (II) chloride starting with lead (II) carbonate. (3marks)
5. Concentrated sulphuric acid is slowly added to a mixture of freshly prepared solution of iron (II)
   sulphate and potassium nitrate as below.
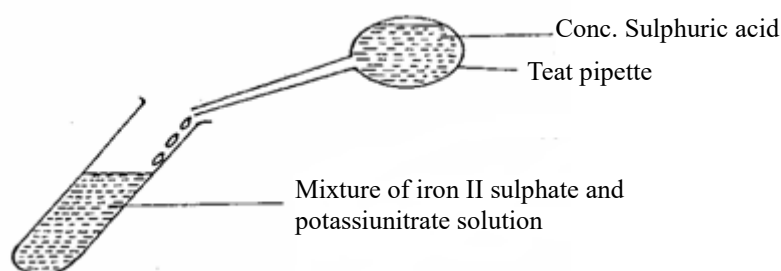
   (i)   State the observation made. (1mark)
   (ii)   Identify the complex salt formed. (1mark)
6. Study the set-up below.
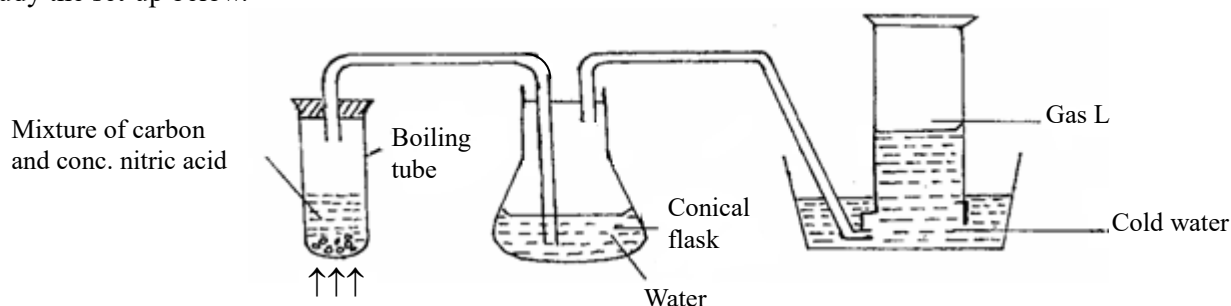
   (a)   State the observations made in the boiling tube. (1mark)
   (b)   Name gas L. (1mark
   (c)   Write a balanced equation for the reaction that occurred in the boiling tube. (1mark)
7. When one mole of hydrocarbon M was completely burned in air, four moles of carbon (IV) oxide and three
   moles of water vapour were formed.
   (a)   Work out the formula of the hydrocarbon. (1mark)
   (b)   Draw and name two structural formula of hydrocarbon M. (2marks)
8. In an experiment a test-tube full of chlorine water was inverted in chlorine water as shown in the diagram and
   the set-up left in sunlight for one day.
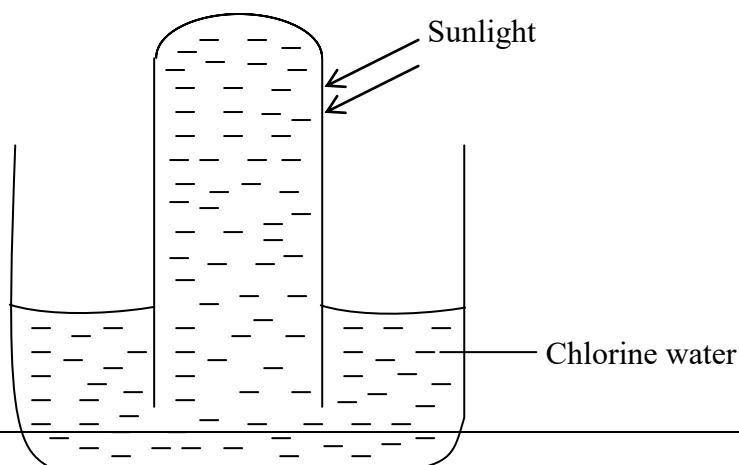
After one day a gas was found to have collected in the test-tube.

(a) Identify the gas. ………………………………………………………… (1mark)

(b) What will happen to the PH of the solution in the beaker after one day?
   Give an explanation. (2marks)

9. Two samples of hard water, A and B were boiled for some time and allowed to cool. Soap solution was stirred with each of the samples. Samples B readily formed lather with soap but sample A required much more soap to form lather.

(i) Write the formula of two salts likely to have caused hardness in each of the samples. (1mark)
   I   Sample A:
   II Sample B:

(ii) Which one of the water samples can be softened by using slakes lime? Explain. (2marks)

10. The peaks below show the mass spectrum of element Q.
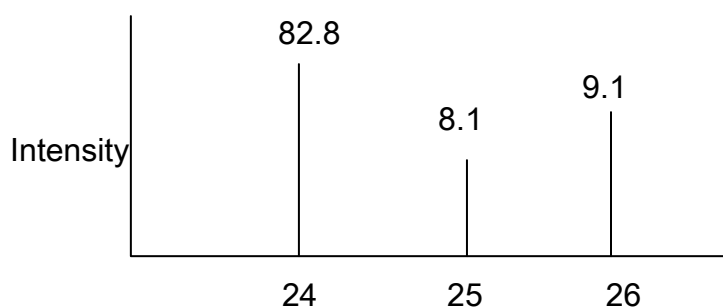
Calculate the Relative Atomic Mass (R.A.M) of Q. (3marks)

11. A mixture X contains three colourless substances which are; alum, camphor and sugar. The solubility of these substances in the different solvents is as follows.

	Water	Ethanol	Ether
Alum	Soluble	Insoluble	Insoluble
Camphor	Insoluble	Soluble	Very soluble
Sugar	Soluble	Soluble	Insoluble

(a) What is the quickest way of getting a pure sample of alum from the mixture? (2marks)
(b) How would you set a pure sugar from the mixture? (2marks)

COMPLIANT II
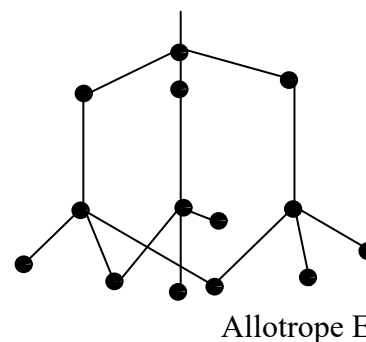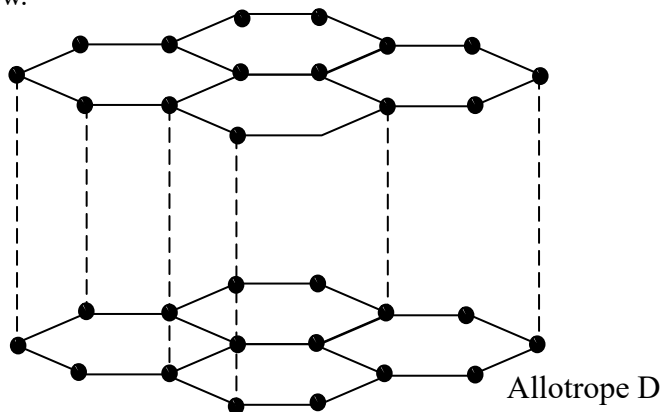**233/2**
CHEMISTRY
Paper 2
(THEORY)
SECTION A

1. (a) Carbon has two allotropes. What is meant by the allotropy? (1 mark)
   (b) The following diagrams show the structures of two allotropes of carbon. Study them and answer the questions
   that follow.

Allotrope E

Allotrope D

   (i) Name the allotrope. (2 marks)

   D
   E
   (ii) Give **one** use of **D**. (1 mark)
   (iii) Which allotrope does not conduct electricity? Explain. (2 marks)
   (c) State **two** properties of carbon (IV) oxide that make it suitable for use in fire extinguishers. (2 marks)
   (d) In an experiment, carbon (IV) oxide gas was passed over heated coke and the gas produced collected as shown in the diagram **below**.

Coke

Dry $CO_{2(g)}$ $\longrightarrow$

$CO_{(g)}$

Heat

Conc.
Potassium
hydroxide

Water
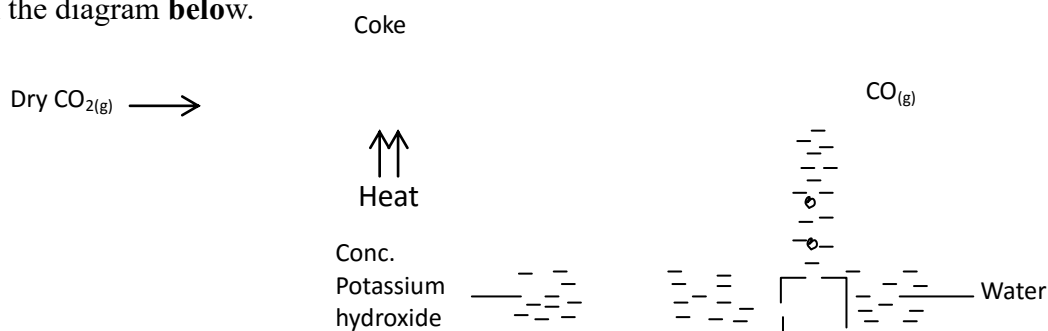
   (i) Write an equation for the reaction that took place in the combustion tube. (1 mark)
   (ii) Name another substance that can be used instead of potassium hydroxide. (1 mark)
   (iii) Describe a simple chemical test that can be used to distinguish carbon (II) oxide and carbon (IV) oxide.
   (2 marks)
   (iv) Give **one** use of carbon (II) oxide. (1 mark)

49

2.   A study the diagram **below** that is used to prepare a gas **Q**.
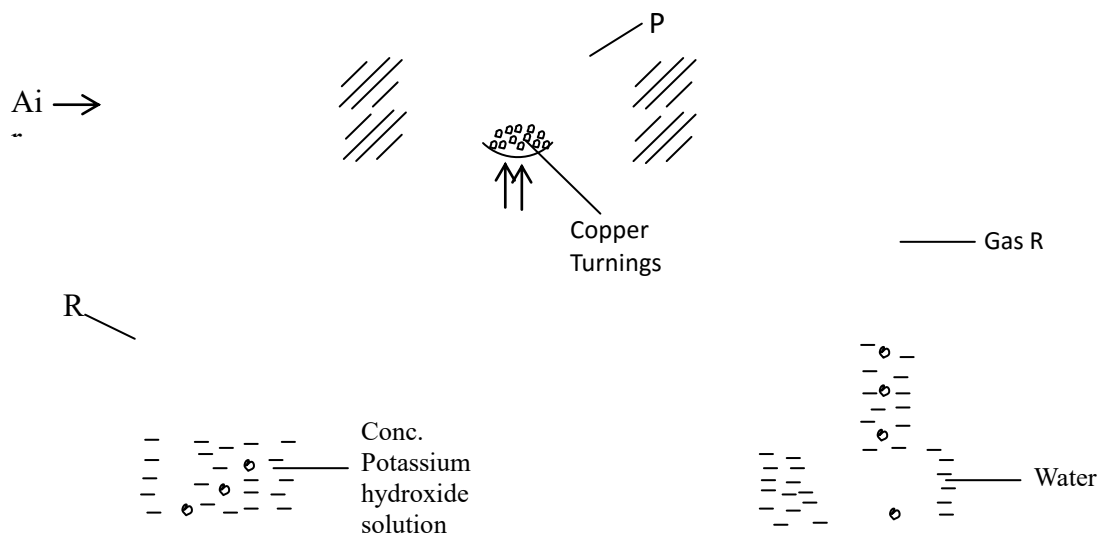
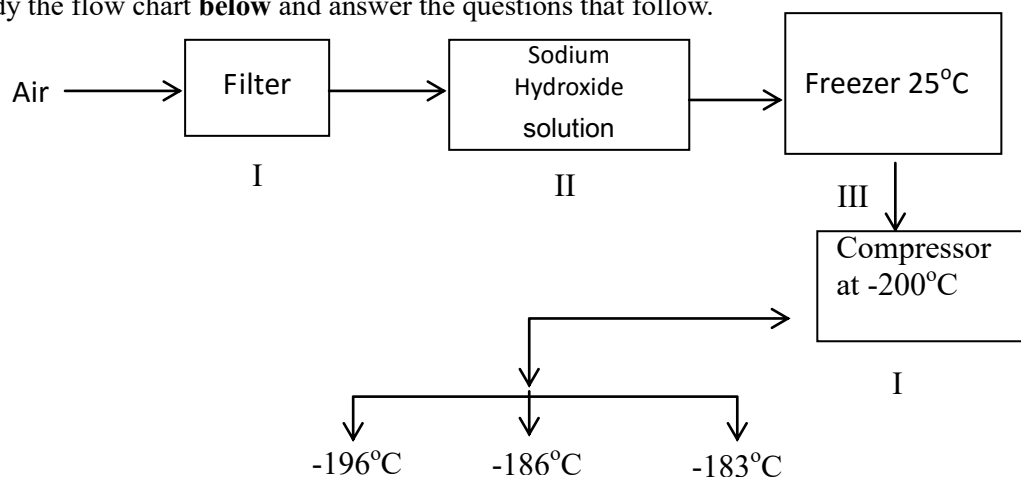**A**.   (a)   (i) What component of air is eliminated in wash bottle labeled **R**?   (1 mark)

     (b)   (i) Write the equation for the reaction that eliminates the component of air in **(i) above**.   (1 mark)
          (ii) What component of air is removed in hard glass tube labeled **P**?   (1 mark)
          (iii)Identify gas **Q**……………………………………………………………………   (1 mark)

B.   In an experiment 1.54g of nitrogen reacted with 3.53g of oxygen to form a compound.
      (N = 14, 0 = 16)
     (i) Calculate the moles of nitrogen and oxygen that reacted.   (2 marks)
         Determine the simplest formula of the compound formed between nitrogen and oxygen.   (2 marks)
         Comment on the melting and boiling points of the compound in **B(ii) above**, explain.

3.   Study the flow chart and answer the questions that follow:-
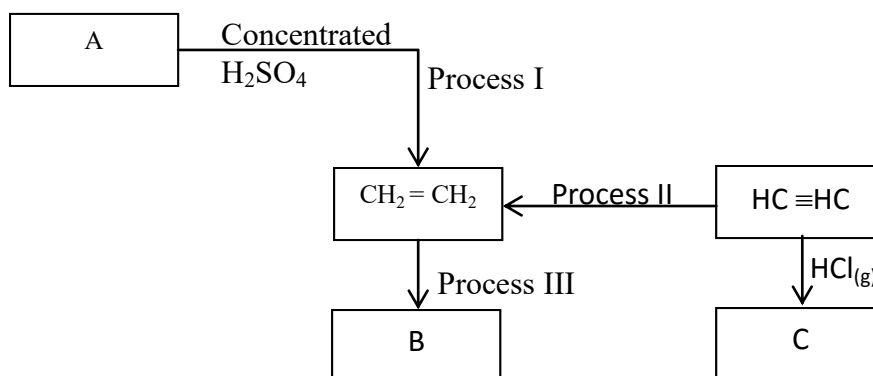
(a)   (i)   Name process **I**   (1 mark)
      (ii)   Give the conditions necessary for process **I** to occur.   (1 mark)
      (iii)   Name compound **C**……………………………………………………………………..(1 mark)
      (iv)   Name the reagent **A** ……………………………………………………………………   (1 mark)
(b)   Give the general formula of the homologous series to which **A** belongs.   (1 mark)
(c)   Molecules of $CH_2 = CH_2$ polymerize to form a large molecule B called polymer.
      (i)   Draw the structure of the polymer B.   (1 mark)
      (ii)   Give the name of the molecule formed in **c (i) above**.   (1 mark)
 (d)   An organic compound T contains 50% oxygen, 12.5% hydrogen and 37.5% carbon.
       The compound has a relative molecular mass of 32.
      (i)   Determine the molecular formula of the compound T.   (4 marks)

50

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

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

Air → Filter (I) → Sodium Hydroxide solution (II) → Freezer 25°C (III) → Compressor at -200°C (I)

Compressor → -196°C   -186°C   -183°C

(a) (i) Name the substances removed in steps **I**, **II**an**III**. (3 marks)

    I

    II
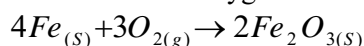
    III

  (ii) Name the gases obtained with respect to their boiling points. (3 marks)

    -196ºC

    -186ºC

    -183ºC

(b)   With the aid of labeled diagrams explain how you would show that for rusting to occur, oxygen is necessary.

    (2 marks)

(c) Iron reacts with oxygen according to the equation **below**.

$$4Fe_{(S)} + 3O_{2(g)} \rightarrow 2Fe_2O_{3(S)}$$

How many moles of Fe_2O_3 would be formed if 1kg of iron reacts with excess oxygen?

(Fe = 56, O = 16). (2 marks)

5.   The grid **below** represents periodic table. Study it and answer the questions that follow.

The letters do not represent the actual symbols of the elements.

								A
B				G		H	E	C
	J		I	L				
D							M	

I   (a)   Indicate on the grid the position of an element represented by letter N whose electronic configuration

    of a divalent cation is 2:8:8. (1 mark)

    (b)   Name the bond formed when**D** and **H** react. Explain your answer. (2 marks)

    (c)   Write an equation for the reaction between **B** and water. (1 mark)

    (d)   How do the atomic radii of **I** and **L** compare. Explain. (2 marks)

    (e)   In terms of structure and bonding explain why the oxide of **G** has lower melting point than oxide of **L**. (2 marks)

II   Study the information given **below** and answer the questions that follow:

Formula compound N	NaCl	$MgCl_2$	Al_2Cl_6	$SiCl_4$	PCl_3	SCl_2
B.P(ºC)	1470	1420	Sublimes	60	75	60
M.P(ºC)	800	710	At 800ºC	-70	90	-80

51

(a) Why is the formula of aluminium chloride given as Al_2Cl_6 and not $AlCl_3$? (1 mark)

(b) Give **two** chlorides that are liquid at room temperature. Give a reason for the answer. (2 marks)

(c) Give a reason why Al_2Cl_6 has a lower melting point than M_gCl_2 although both Al and Mg are metals. (1 mark)

(d) Which of the chlorides would remain in liquid state for the highest temperature range explain why? (2 marks)

6. The reaction between bromine and methanoic acid at 30ºC proceeds according to the information given **below**.

$$Br_{2(aq)} + HCOOH_{(aq)} \xrightarrow{H^+_{(aq)}} 2Br^+_{(aq)} + CO_{2(g)}$$
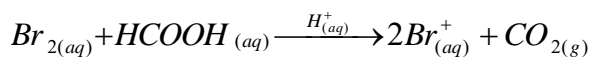
Concentration of $Br_{2(aq)}$ (Mol dm⁻³) × 10⁻³	10.0	8.1	6.6	4.4	3.0	2.0	1.3
Time (minutes)	0	1	2	4	6	8	10

(a) Plot a graph of concentration of bromine (vertical axis) against time. (3 marks)

(b) From the graph determine:
   (i) The concentration of bromine at the end of 3 minutes. (1 mark)
   (ii) The rate of reaction at time t where t = 1½ minutes. (2 marks)

(c) Explain how the concentration of bromine affects the rate of the reaction. (2 marks)

(d) On the same axis, sketch the curve that would be obtained if the reaction was carried out at 20ºC and label the curve as curve II. Give a reason for your answer. (2 marks)

7. (i) Study the structure **below**.

—— Covalent bond

●—— Sulphur atom
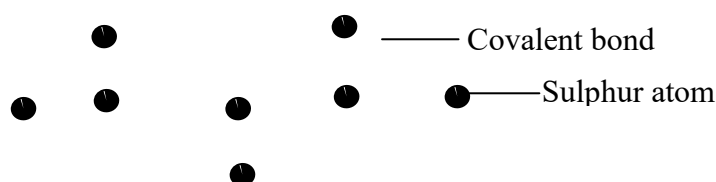
(a) What observation is made when the molecule above is heated to a temperature of 113ºC? (2 marks)

(b) Write an equation for the reaction of the atom of the above structure with hydrogen. (1 mark)

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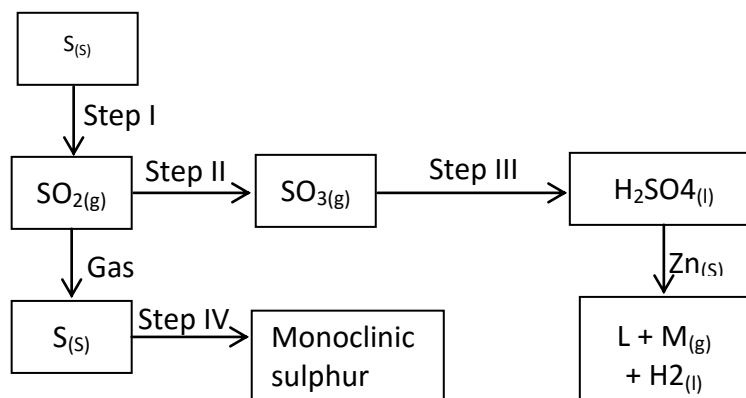

(a) Name:
   (i) Gas **K** ……………………………………………………………………………… (1 mark)

  (ii) Gas **M** …………………………………………………………………………………… (1 mark)
(b) (i) State the observation made in step **I**. (2 marks)
  (ii) Step **I** and step **III** occurs in contact process. State optimum conditions necessary for step **II** to occur. (2 marks)
  (iii) Name the reagent used in step **IV**. (1 mark)
  (iv) Explain why water is not used in step **III**. (1 mark)
(c) Write an equation to show how pollution effect of sulphur (IV) oxide is controlled in contact process. (1 mark)
(d) Explain the role of sulphur in vulcanization of rubber. (2 marks)

12. The table below shows the solubility's of salt A and B at different temperatures.

Temp 0°C	Salt	0	10	20	30	40	50
Solubility g/100gm of water	A	3.0	5.0	7.4	10.0	14.0	19.0
	B	15.0	17.0	20.7	28.7	29.9	33.3

(a) If both A and B were present in 100cm³ of a saturated solution at 50°C, what would be the total mass of crystals formed if the solution is cooled to 20°C. (2marks)
(b) A certain salt, C dissolves with absorption of heat from the surroundings. How would its solubility change with an increase in temperature. Explain. (1mark)

13. Give the name and structural formula of the product formed when ethane gas reacts with:-
(a) Bromine. (1mark)
(b) Steam in the presence of phosphoric acid. (1mark)
(c) Hydrogen in the presence of platinum catalyst at 200°C. (1mark)

14. The diagram below shows a structure of water molecules. (1mark)
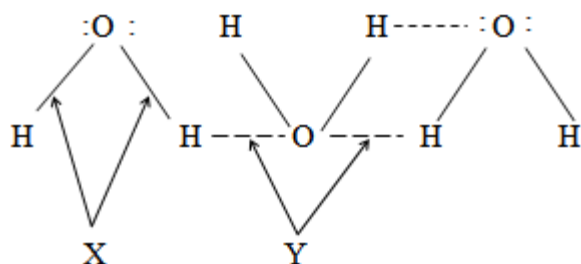
(a) Name the bonds. (1mark)
  X: _____
  Y: _____
(b) Using dot (.) and cross (x) diagram show the bonding in the compound phosphonium PH_4^+ (P = 15.0, H = 1.0). (2marks)

15. When 2.23g of lead (II) oxide were heated in a stream of dry hydrogen gas 2.07g of lead were formed and 0.18g of water was collected. Calculate the mass of hydrogen which combines with one mole of oxygen atoms (Pb = 207, 0 =16, H = 1) (3marks)

16. Name the process which takes place when:
(i) Iodine changes directly from solid to gas. _____ (1mark)
(ii) $Fe^{2+}_{(aq)}$ changes to $Fe^{3+}_{(aq)}$ _____ (1mark)
(iii) White sugar changes to black solid when mixed with excess concentrated sulphuric acid. (1mark)

17. Study the reaction scheme below that shows industrial manufacture of hydrochloric acid.
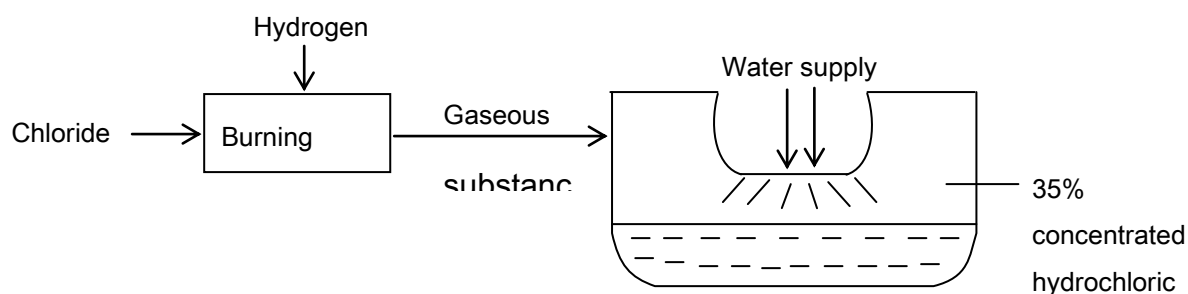
(a) Write an equation for the reaction in the burning chamber. (1mark)

(b) State **one** use of concentrated hydrochloric acid. (1mark)

18. The following results were obtained in an experiment.

I beginning   II end
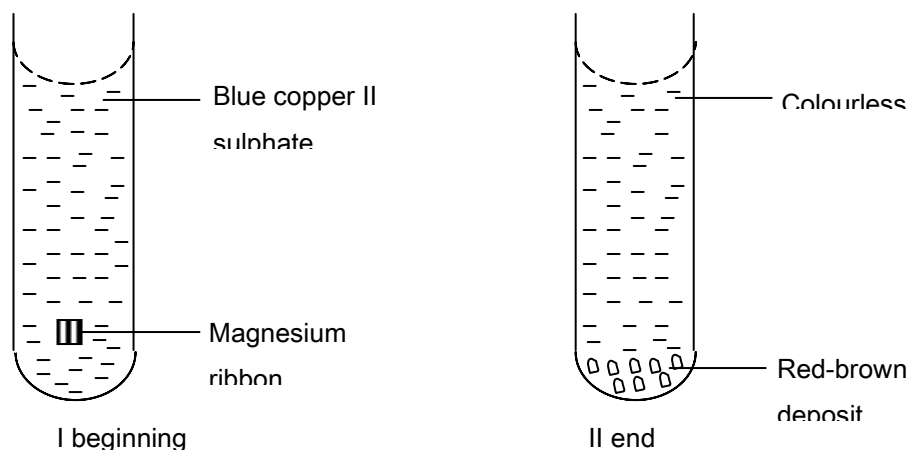
Identify:

(i) Red-brown deposit………………………………………………………………… (½mark)

(ii) The colourless solution. ………………………………………………………….. (½mark)

(iii) Write an ionic equation for the reaction between copper (II) sulphate and magnesium ribbon.

(1mark)

19. A green solid D was heated until there was no further change. The following observations were made.

(i) A colourless liquid condensed on the cooler part of the test-tube.

(ii) A colourless gas which turns acidified potassium dichromate (VI) green was formed.

(iii) Red-brown residue S was left.

(a) Give the identity of solid **D**. (1mark)

(b) How can you identify the colourless liquid? (1mark)

(c) Name the residue **S**. ……………………………………………… (1mark)

20. Explain why the reaction between 1g of sodium carbonate and 2M hydrochloric acid is faster than the reaction is faster between 1g of sodium carbonate and 2M ethanoic acid. (3marks)

21. Explain why one feels colder when ethanol is put on one's skin than when water is put. (2marks)

22. Use the set-up below to answer questions that follow:

H_2O_2 Δ   Sulphur

↑↑↑
Heat

B

Acidified potassium manganated (VII)

MnO_2
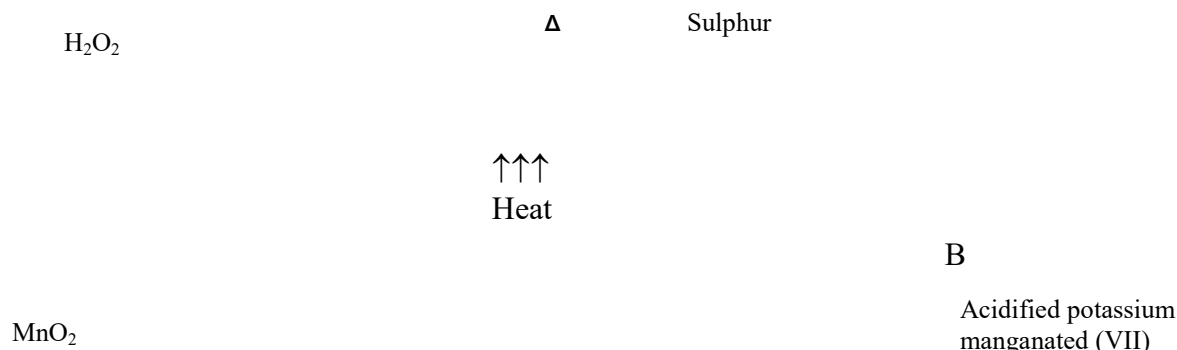
(i) What is the role of manganese (IV) oxide? (1mark)

(ii) State and explain the observation made in the tube B. (2marks)

23. The information in the table below relates to elements in the same group of the periodic table.

54

Study it and answer the question that follows.

Element   Atomic size
A   0.19
B   0.23
C   0.15

Which element has the lowest ionization energy? Give a reason.   (2marks)

24.   The rate of reaction of powdered marble with 0.1 MHCl was determined at three separate temperatures 20°C, 30°C and 40°C. X grams of calcium carbonate were used and the volume of carbon (IV) oxide evolved were measured at suitable intervals.
      (a)   Draw a labelled diagram of the suitable apparatus used for carrying out this experiment.
      (b)   After 20 seconds the volumes produced at the three temperatures were 20, 40 and 80cm³ respectively.
            After 1 minute the volumes were 180, 224, 224cm³ respectively.
            What do you deduce from the above information?   (1mark)

25.   Hydrogen and nitrogen combine to form ammonia according to the equation given below in the Haber process.

$$N_{2(g)} + 3 H_{2(g)} \rightleftharpoons 2NH_{3(g)} \qquad \Delta H = -92KJ$$

Explain how the following would affect the yield of ammonia.

(i)   A decrease in pressure.   (1mark)
(ii)   An increase in temperature.   (1mark)

26.   Study the flow chart shown below and answer the questions that follow:
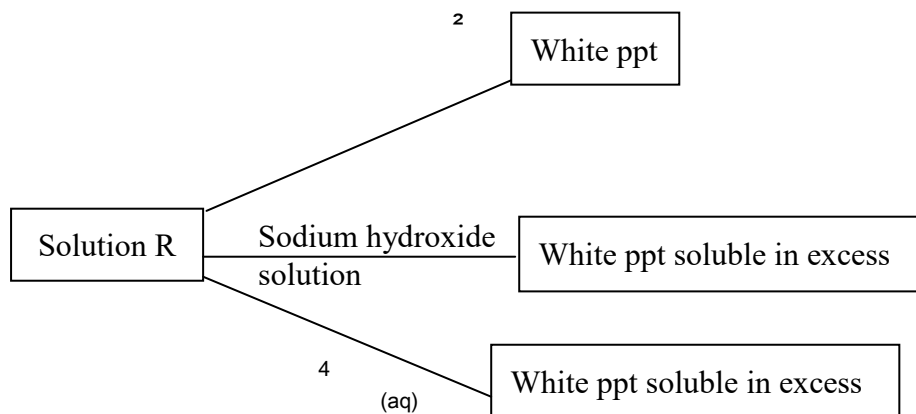
(i) Identify the cation and anion present in solution R.   (1mark)
(ii) Write ionic equation to show how barium chloride solution reacts with solution R.   (1mark)
(iii)Name the white ppt formed (ii) above.   (1mark)

27.   Classify liquids into four categories in terms of their ability to conduct electricity some are filled for you.

	Class	How they conduct
1	Conductors	Have mobile electrons, conducts but is not decomposed
2		
3		Contains few ions they conduct poorly.
4	Non-electrolytes	

(3marks)

28.   The diagram below shows the heating of ammonium chloride.
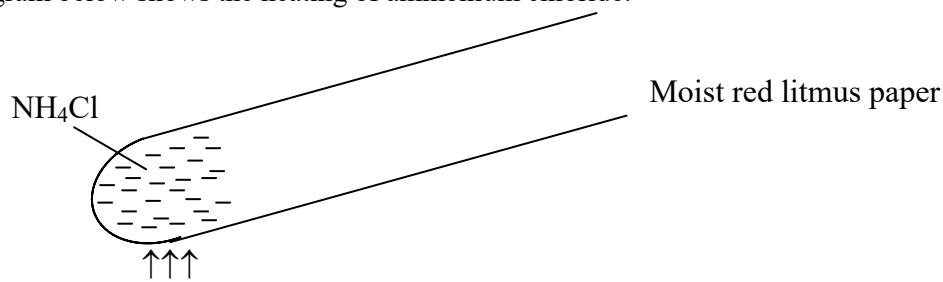
State the observations during the experiment. Explain these observations.   (3marks)

55

COMPLIANT II
233/3
CHEMISTRY
Paper 3
1. You are provided with:
   Solution C (sulphuric acid) which contains 6.115g in 250cm³.
   0.5M sodium hydroxide, solution D.

   You are required to determine the
(a) Concentration of sulphuric acid in moles per litre.
(b) Determine the R.F.M of the acid.

Procedure:
Fill the burette with solution C.
Pipette 25cm³ of solution D into a clean conical flask.
Add 2-3 drops of phenolphthalein indicator and titrate with solution C.
Repeat the procedure for two more times to get three consistent results and record your results in **table I below**.

TABLE I	I	II	III
Final burette reading (cm³)			
Initial burette reading (cm³)			
Volume of solution C used (cm³)			

(5 marks)

(a) Determine the average volume of solution C used. (1 mark)
(b) Calculate the number of moles of solution D, sodium hydroxide used. (1 mark)
(c) Determine the number of moles of sulphuric acid that reacted. (2 marks)
(d) Determine:
   (i) the molarity of sulphuric acid in moles per dm³. (2 marks)
   (ii) Calculate the relative formula mass of solution C, sulphuric acid. (2 marks)

2. You are provided with:
   - Sodium hydroxide solution labeled K.
   - Solution L, 30g of acid L per litre of solution.
   You are required to determine the relative formula mass of acid L.
   Procedure:
   Using a burette, transfer 25.0cm³ of solution K into a 100ml beaker. Measure the temperature, T_1 of solution K and record it in table II.
   Pipette 25.0cm³ of solution L into another 100ml beaker.
   Measure the temperature T_2 of solution L and record it in table II. Add all the solution K at once to solution L. Stir carefully with the thermometer.
   Measure the highest temperature T_3, of the mixture and record it in table II. Repeat the procedure and complete table II.

TABLE II	I	II
Initial temperature of solution K, T, (ºC)		
Initial temperature of solution L, T_2 (ºC)		
Highest temperature of mixture T_3 (ºC)		
Average initial temperature (ºC)		
Change in temperature ΔT (ºC)		

Calculate:
(i) Average ΔT value. (1 mark)
(ii) Heat change for the reaction.

(Assume density of the solution = 1g/cm³ and specific heat capacity is $4.2Jg^{-1}K^{-1}$) (2 marks)

(iii) Number of moles of acid L used given that the heat change for one mole of acid L reacting with sodium hydroxide solution is 134.4KJ. (2 marks)

(iv) Concentration of acid L in moles per litre. (2 marks)

(v) Relative formula mass of acid L. (2 marks)

3. You are provided with solid Q.

You are required to carry out the tests below to determine the identity of Q.

(a) Put all the solid Q in a boiling tube and add 12cm³ of distilled water and shake thoroughly.

Divide the resulting solution into six portions.

Observation	Inferences
(1 mark)	(½ mark)

(b) To the first portion add NaOH dropwise till in excess.

Observation	Inferences
(1 mark)	(1 mark)

(c) Insert a nichrome wire to the second and burn it in a non-luminous flame.

Observation	Inferences
(1 mark)	(1 mark)

(d) To the third portion add lead (II) nitrate solution.

Observation	Inferences
(½ mark)	(1 mark)

(e) To the fourth portion, add barium nitrate followed by dilute nitric acid.

Observation	Inferences
	(½ mark)
(1 mark)	

(f) To the fifth portion add acidified potassium permanganate.

Observation	Inferences
(1 mark)	
	(½ mark)

(g) To the sixth portion add acidified potassium dichromate.

Observation	Inferences

(1 mark)	(1 mark)

COMPLIANT II
233/3
CHEMISTRY
Practical
PAPER 3
CONFIDENTIAL
Requirements for candidates
   In addition to the apparatus and fittings found in a chemistry laboratory, each candidate will require the following:

Requirements
1. **Each candidates should be provided with:-**
   – Burette
   – Pipette
   – 3 Conical flasks
   – 90cm³ of colution C (sulphuric acid)
   – 90cm³ of solution D (0.5M NaOH)
   – About 60cm³ of solution K.
   – About 60cm³ of solution L.
   – Two beakers.
   – One thermometer.
   – About 500ml of distilled water.
   – Phenolphthalein indicator.
   – White sheet of paper/white tile.
   – 6 test tubes in a rack.
   – 1 boiling tube.
   – Source of heat.
   – 1g of solid Q (Sodium sulphite, Na_2SO_3)
   – 15cm of Nichrome wire.

2. **Each candidate should have access to:**
   – 2M sodium hydroxide.
   – 2M lead (II) nitrate solution.
   – Aqueous barium nitrate.
   – Acidified potassium permanganate.
   – Acidified potassium dichromate.
   – Dilute nitric acid.

   Preparation of solutions:
   – Solution C is prepared by measuring 13.6cm³ of 98% concentrated sulphuric acid (density 1.84g/cm³) and diluting it to one litre.
   – Solution D is made by dissolving 20g of sodium hydroxide in 250cm³ of distilled water and diluting it to one litre.
   – Solution K – 0.8M Sodium hydroxide.
   – Solution L – 0.8M Hydrochloric acid.

BUURI EXAMS
233/1/
CHEMISTRY
PAPER 1
(THEORY)

SECTION 1

1. In an experiment, soap solution was added to three samples of water. The table below shows the volumes of soap solutions required to form lather with $100cm^3$ of each sample of water before and after boiling.

	Sample 1	Sample II	Sample III
Volume of soap before water is boiled (cm³)	27.0	3.0	10.6
Volume of soap[after water is boiled (cm³)	27.0	3.0	3.0

   a) Which water sample is likely to be soft? Explain.   (2mks)
   b) Name the cause of change in the volume of soap solution used in sample III.   (1mk)

2. The diagram below shows a Bunsen burner when in use.
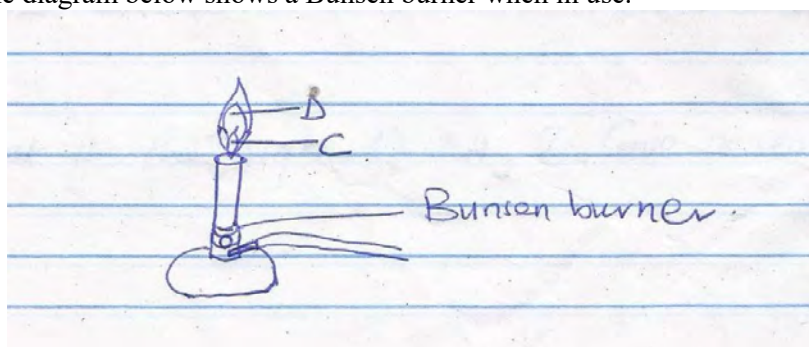
   (a) Name the regions labeled C and D.   (2mks)
   (b) Explain how the hotness of a Bunsen burner flame can be increased.   (1mk)

3. a) Write the electron configuration of calcium (atomic number 20) and Beryllium
      (atomic number 4)   (1mk)
   b) Why is calcium more reactive than beryllium?   (2mks)

4. The scheme below shows the energy that are involved between ice, water and water and steam. Study it and answer the questions that follow.

$$H_2 0 \xrightleftharpoons[\Delta H_4]{\Delta H_I} H_2 0 \xrightleftharpoons[\Delta H_3]{\Delta H_2} H_2 0$$
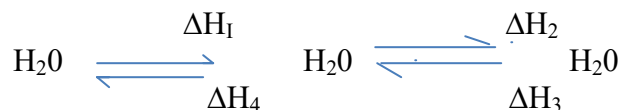
   a) What name is given to the energy change, ΔH_4?   (1mk)
   b) What is the sign of ΔH_3? Give a reason.   (2mks)

5. Study the flow chart below and answer the questions that follow.
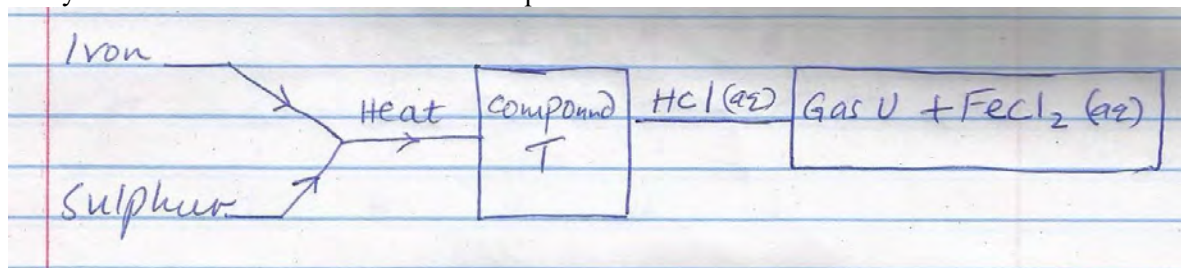
a) Name
   i) Compound T.   (1mk)
   ii) Gas U.   (1mk)
b)   Give a chemical test that you could use to identify gas U.   (1mk)

6. The table below shows the relative atomic masses and the percentage abundance of the isotopes L_1 and L_2 of element L.

	Relative atomic mass	% abundance
L_1	62.93	69.09
L_2	64.93	30.91

Calculate the relative atomic mass of element L.   (3mks)

7. Compound L reacts with hydrogen bromide gas to give another compound whose structure is

```
    H   H   H   H   H
    |   |   |   |   |
H – C – C – C – C – C -H
    |   |   |   |   |
    H   H   H   H   H
```
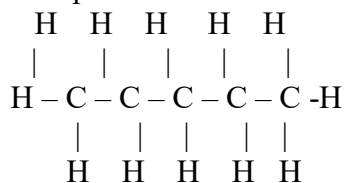
a) Give the structural formula and name of compound L.   (2mks)
b) Write an equation for the reaction which takes place between ethyne and excess chlorine gas.

8. The set-up below was used to study some properties of air.
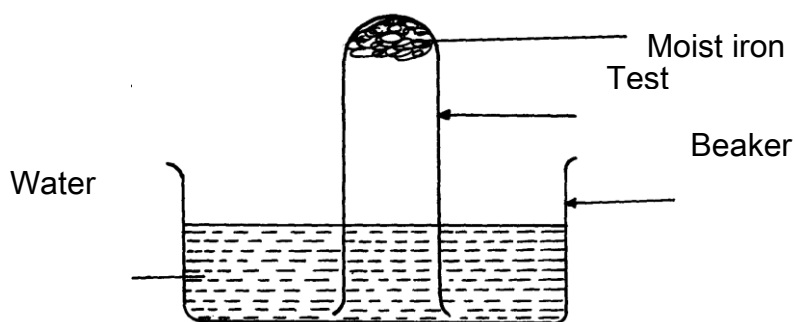
State and explain two observations that would be made at the end of the experiment.   (3mks)

9. Use the cell representation below to answer the questions that follow.
$Cr_{(s)}/Cr^{3+}_{(aq)} // Fe^{2+}_{(aq)} / Fe_{(s)}$
a) Write the equation for the cell reaction.   (1mk)
b) If the E.m.f of the cell is 0.30volts and the $E^{\ominus}$ values for $Fe^{2+}_{(aq)} /Fe_{(s)}$ is – 044 volts, calculate the $E^{\ominus}$ value for $Cr^{3+}_{(aq)/} Cr_{(s)}$ (2mks)
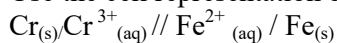
10. Starting with copper metal, describe how a solid sample of copper (ii) carbonate can be prepared. (3mks)

11. A student let up the apparatus shown below to prepare ammonia gas and react it with copper (II) sulphate solution.
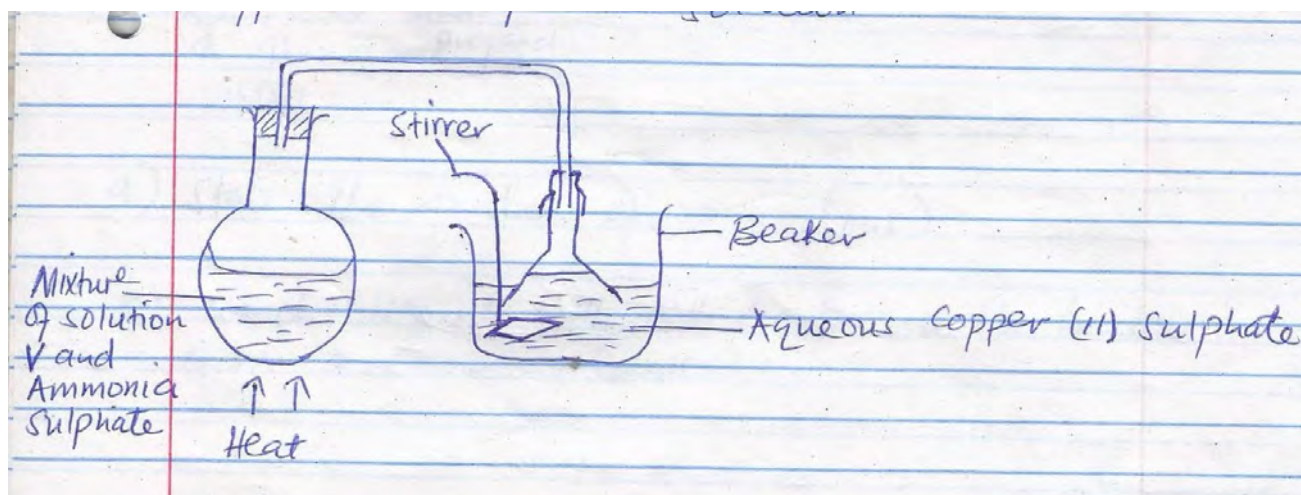
a) Identify solution V. (1mk)

b) State the observations which were made in the beaker. (2mks)

12. The set-up below was used to separate a mixture of methanol and propanol. Study it and answer the questions that follow.
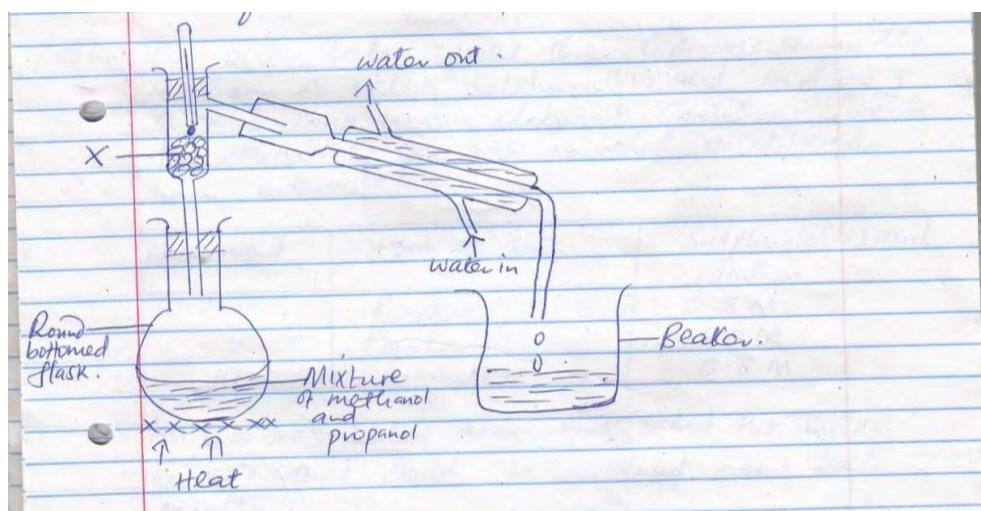
a) State the function of **X** (1mk)

b) Which liquid will collect first in the beaker? Give a reason. (2mks)

13. Charcoal is a fuel that is commonly used in cooking. When it burns it forms two oxides.

a) Name the two oxides. (2mks)

b) State one use of the two oxides. (1mk)

14. The table below gives three experiments on the reaction of excess sulphuric(VI) acid and 0.5g of Zinc done under different conditions. In each the volume of gas was recorded at different time intervals.

Experiment	Form of Zinc	Sulphuric (VI) Acid solution.
I	Powder	0.8M
II	Powder	1.0M
III	Granules	0.8M

On the axis below draw and label the three curves that could be obtained from such results. (3mks)
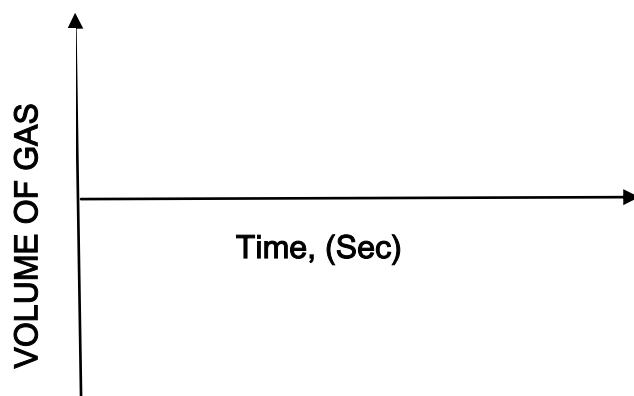
15. a) State the Graham's law of diffusion. (1mk)
    b) The molar masses of gases W and **X** are 16.0 and 44.0 respectively. If the rate of diffusion of W through a porous material is $12cm^3s^{-1}$ calculate the rate of diffusion of **x** through the same material. (2mks)

16. The diagram below represents a set-up that was used to react lithium with water. Study it and answer the questions that follow.
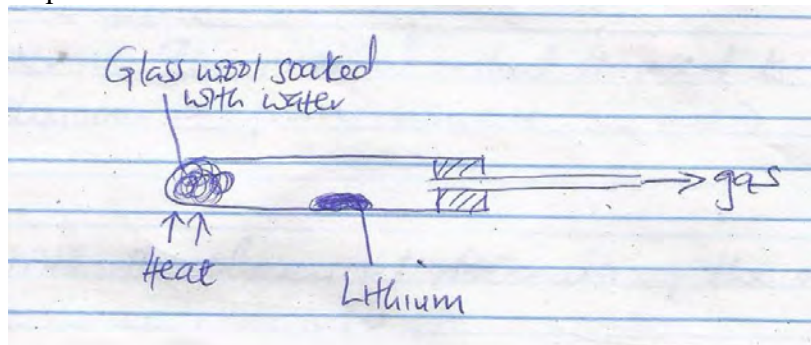
a) Write an equation for the reaction that takes place given that the atomic number of lithium is 3. (1mk)

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

c) State the purpose of heating the wet glass wool. (1mk)

17. The structure of methanoic acid is
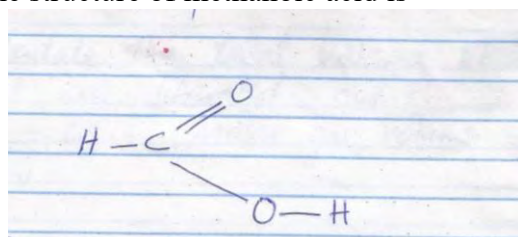
What is the total number of electrons used for bonding in a molecule of methanoic acid? Give reasons. (2mks)

18. The basic raw material for extraction of aluminum is bauxite.
    a) Name the method that is used to extract aluminium from bauxite. (1mk)
    b) Write the chemical formula of the major components of bauxite. (1mk)
    c) Name one impurity in bauxite. (1mk)

19. Zinc metal and hydrochloric acid reacts according to the following equation.
    $$Zn_{(S)} + 2HCl_{(aq)} \longrightarrow ZnCl_{2\ (aq)} + H_2(g)$$
    1.96 g of zinc metal were reacted with $100cm^3$ of 0.2M HCl acid.

70

a) Determine the reagent that was in excess. (2mks)

b) Calculate the total volume of hydrogen gas that was liberated at s.t.p.
(Zn = 65.4; Molar gas volume = 22.4 litres at s.t.p) (2mks)

20. A students investigated the effects of an electron current by passing it through some substances. The student used inert electrodes and connected a bulb to the circuit. The table below shows the substances used and their states.

Experiment	Substances	State
1	Potassium carbonate	Solid
2	Copper (II) sulphate	Solution
3	sugar	Solution
4	Lead (II) iodide	molten

a) In which experiment did the bulb not light? (1mk)

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

21. a) 100g of radioactive ^{233}Pa was reduced to 12.5g after 81 days. Determine

the half life of pa. $_{91}$ (2mks)

b) ^{233} Pa decays by beta emission what is the mass number of the element $_{91}$ formed. (1mk)

22. The first step in the industrial manufacture of nitric (V) acid is the catalytic oxidation of ammonia gas.

a) What is the name of the catalyst used? (1mk)

b) Nitric (V) acid is used to make ammonium nitrate, state two uses of ammonium nitrate. (1mk)

c) Why is nitric (V) acid stored in dark bottles? (1mk)

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

				G				
				H			I	
F								

a) Select the:
   i) Element which has the largest atomic radius . (1mk)
   ii) Most reactive non-metal. (1mk)

b) Show on the grid the position of the element J which forms J^{2+} ions with electronic configuration 2,8,8. (1mk)

24. In an experiment, chlorine gas was passed into moist hydrogen sulphide in a boiling tube as shown in the diagram.
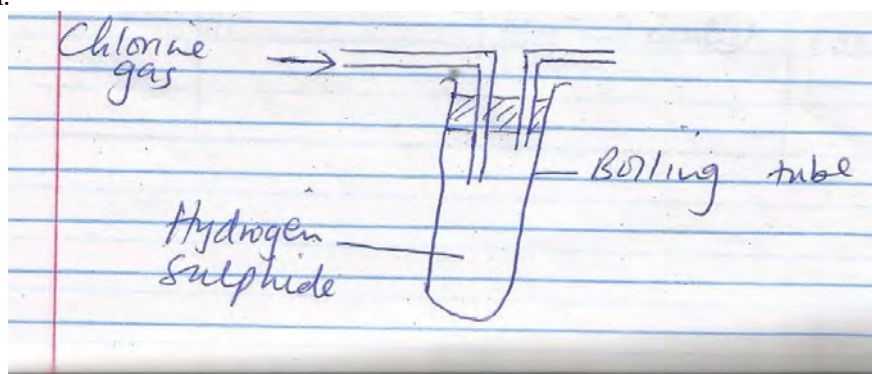
(a) What observation was made in the boiling tube? (1mk)

(b) Write an equation for the reaction which took place in the tube. (1mk)

(c) What precautions should be taken in carrying out this experiment? Give a reason. (1mk)

25. The table below gives some information about the electrical conductivity and the likely bonding in substances N, P, and Q. Complete the table by inserting the missing information in the spaces numbered 1, II,III.   (3mks)

Substance	Likely type of bonding present	Electrical conductivity	
		solid	Molten
N	Metallic	I ………………….	Conducts
P	II………………….	Does not conduct	conducts
Q	III…………………..	Does not conduct	Does not conduct

26. The diagram below is part of a set up used in laboratory preparations of a gas.
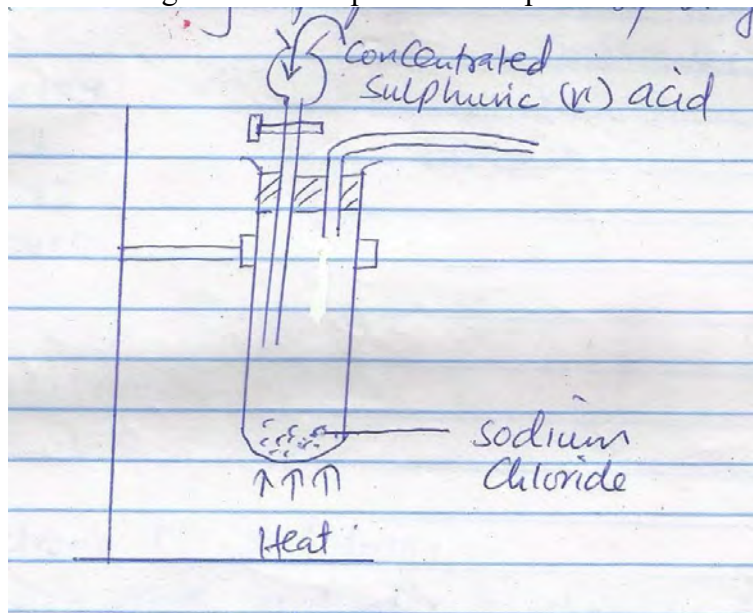
Complete the diagram to show how a dry sample of the gas can be collected.   (3mks)
27. An oxide of element F has the formula F_2O_5.
    a) Determine the oxidation state of F.   (1mk)
    c) In which group of the periodic table is element F.   (1mk)

BUURI EAST
233/2
CHEMISTRY
PAPER 2
(THEORY)

SECTION A

1. a) The figure below shows the changes that takes place between states of matter. Some of them have been identified and others labeled.
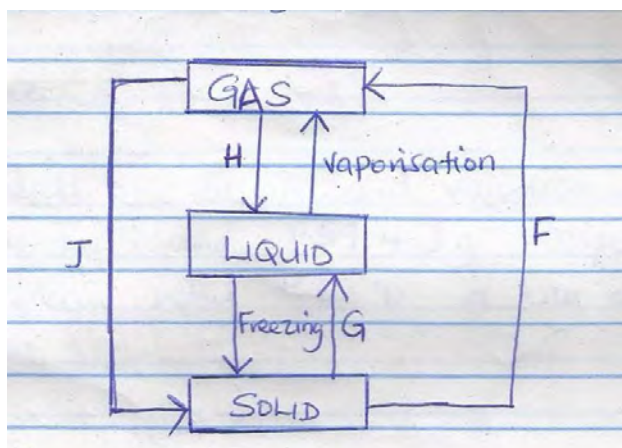
   i) Give the names of the process.
   I . **H** (1mk)
   II. **G** (1mk)

   ii) Name one substance that can undergo process F when left in an open container in the laboratory. (1mk)

   iii) The process J is called deposition. Using water as an example, write an equation that represents the process of deposition. (1mk)

   b) The figure below shows the heating curve for water.
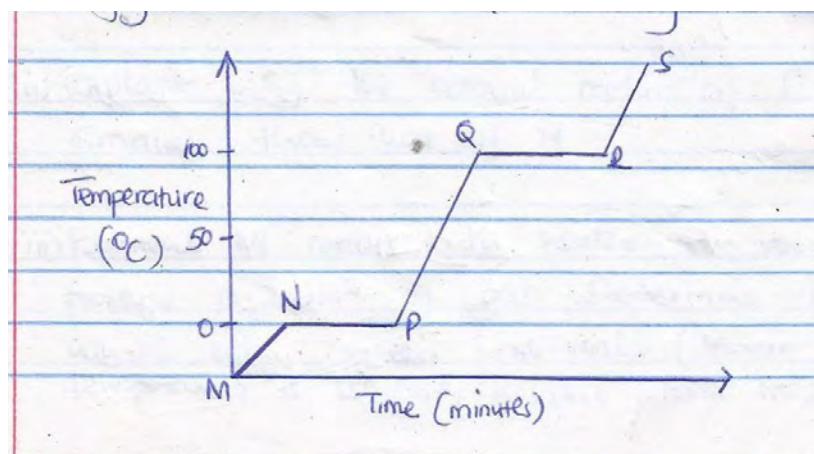
   i) Give the names of the intermolecular forces of attraction in the segments. (1mk)
   I   **MN** (1mk)
   II   **RS** (1mk)

   ii) The heats of fusion and vaporization of water are 334.4 Jg-1 and 1159.4 Jg^{-1} respectively .
   I Explain why there is a big difference between the two. (2mks)
   II How is the difference reflected in the curve? (1mk)

73

2. The grid below represents part of the periodic table study it and answer the questions that follow. The letters so not represents actual symbols of element.

M				N	P	T		
R								

   i) Select a letter which represents an element that loses electrons most readily. Give a reason for your answer. (2mks)
   ii) Explain why the atomic radius of **P** is found to be smaller than that of **N**. (2mks)
   iii) Element **M** reacts with water at room temperature to produce $0.2dm^3$ of gas. Determine the mass of **M** which was reacted with water (molar gas volume at room temperature is $24dm^3$, Relative atomic mass of **M**=7 (3mks)

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

Element	State of oxide at room temperature	Type of oxide	Bonding oxide
U	Solid	Acidic	Covalent
W	Solid	Basic	Ionic
X	liquid	Neutral	Covalent
Y	Gas	Neutral	Covalent

Identify a letter which represents an element in the table that could be calcium, carbon or sulphur. Give a reason in each case.
   i) Calcium (2mks)
      Reason
   ii) Carbon (2mks)
      Reason
   iii) Sulphur (2mks)
      Reason

3. a) Give the names of the following compounds.

   CH₃
   |
   i)CH₃-C-CH₃ (1mk)
      |
      CH₃

   ii) $CH_3 C \equiv CCH_2 CH_3$ (1mk)

   b) Describe a chemical test that can be carried out to distinguish between.

   CH₃
   |
   CH₃-C-CH₃   and $CH_3C\equiv CCH_2CH_3$ (2mks)
   |
   CH₃

74
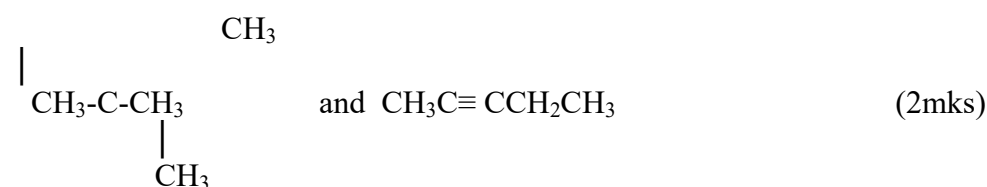
c) Study the flow chart below and answer the questions that follow.
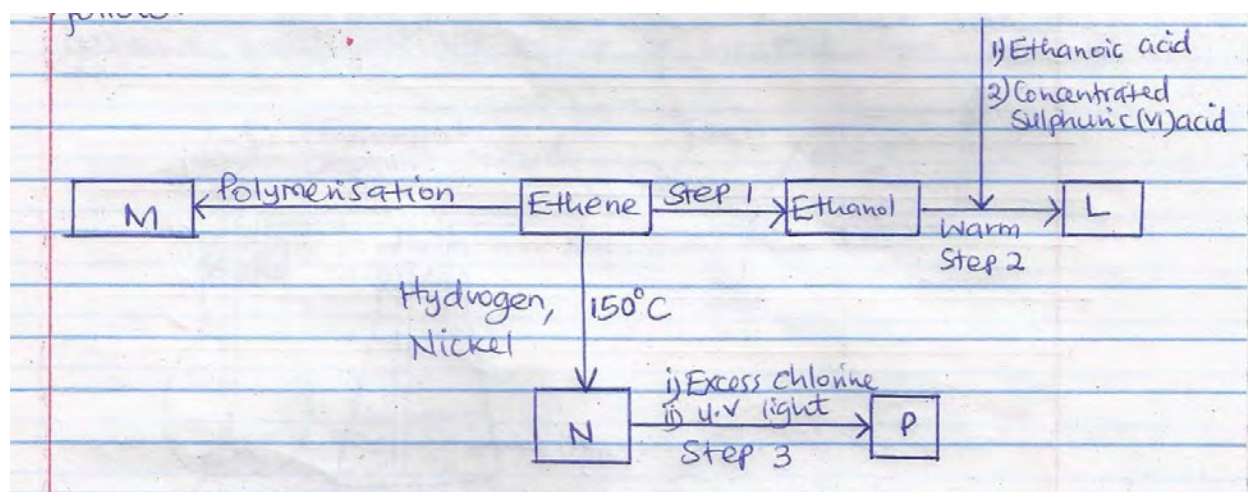
i) Name the compounds   L, N   (2mks)
ii) Draw the structural formula of compound M showing two repeat units.   (1mk)
iii)Give the reagent and the condition used in step I.   (2mks)
Reagent …………………………
Condition …………………………
iv)State the type of reaction that takes place in :
I) Step 2   (1mk)
II) Step 3   (1mk)

d) The molecular formula of compound P is $C_2H_2Cl_4$. Draw the structural formula of compound P.
(1mk)

4. The set up below was used to prepare dry hydrogen chloride gas and investigate its effects on heated iron fillings.
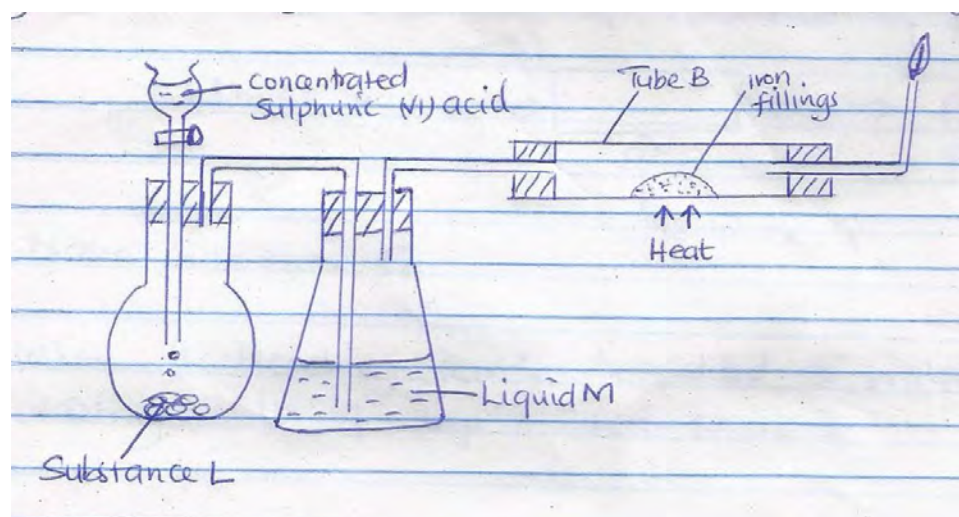
i) Name substance **L**   (1mk)
ii) Name Liquid **M**   (1mk)
iii) What will be observed in tube **B**?   (1mk)
iv) Write an equation for the reaction that occurs in tube B.   (1mk)
v) Why is the gas from tube **B** burnt?   (1mk)
b)   i)Explain the following observations.
    I)   A white precipitate is formed when hydrogen chloride gas is passed through aqueous silver nitrate.
(1mk)
    II) Hydrogen chloride gas fumes in ammonia gas.   (1mk)
  ii)   State two uses of hydrogen chloride gas.   (1mk)

c) The diagram below is a representation of an industrial process for the manufacture of a bleaching powder.
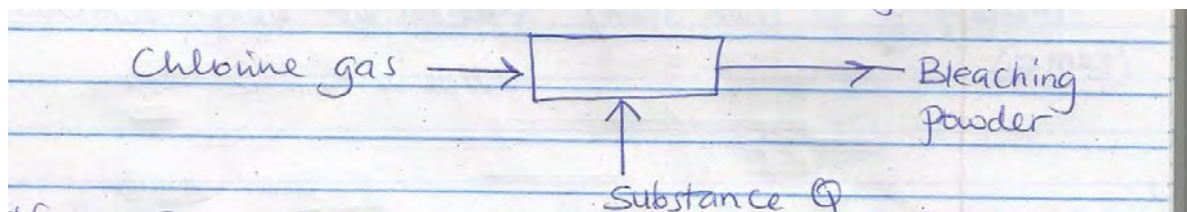
i) Name substance **Q** (1mk)
ii) When the bleaching powder is added to water during washing, a lot of soap is used. Explain (1mk)

d) The diagram below shows the Frasch process used for extraction of sulphur. Use it to answer the questions that follows.
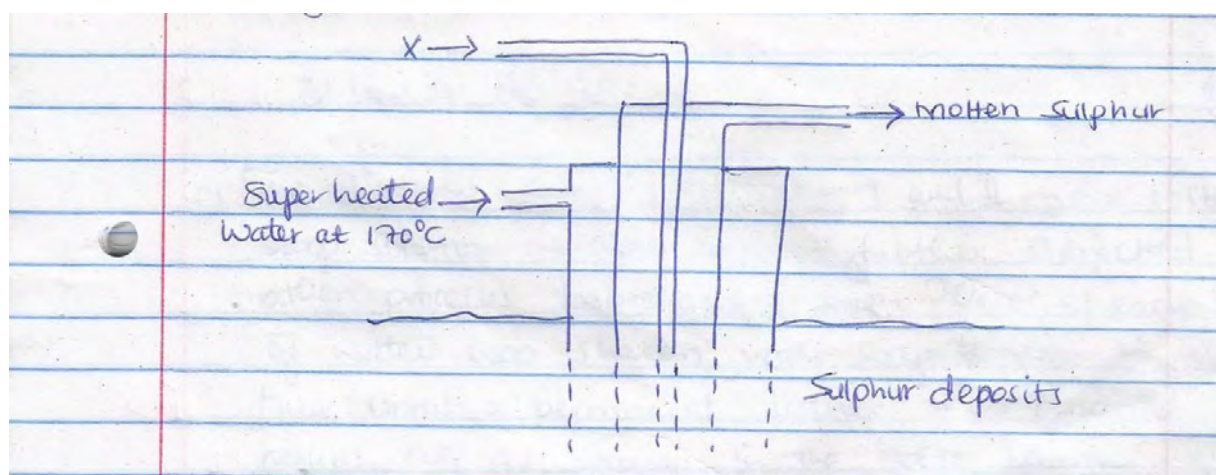
i) Identify **X** (1mk)
ii) Why is it necessary to use superheated water in this process? (1mk)
iii) State one property of sulphur that makes it possible to be extracted by this method. (1mk)

5. a) Naturally occurring magnesium consists of three isotopes. 78.6% ^{24}Mg, 10%^{25}Mg and ^{26}Mg. Calculate to one decimal place, the relative atomic mass of magnesium. (2mks)

b) When magnesium burns in air, it forms a white solid and a grey –green solid. When a few drops of water are added to the mixture, a gas that turns red litmus paper blue is evolved.
Identify the:
i) White solid (1mk)
ii) Gas evolved and state its use,
I) Name of gas (1mk)
II) Use of the Gas (1mk)

c) Two different samples of water, **I** and **II**, were tested with soap solution. Sample II was further subjected to two other processes before adding soap. 20cm^3 of each sample of water was shaken with soap solution in a boiling tube until a permanent lather was obtained. The results are as shown in the table below.

Water Sample	Volume of soap solution needed cm^3	
	Before boiling	*After boiling*
I	10	5
II	6	6
II After filtering	6	6

II after distilling	2	2

i) Identify the water sample that had temporary hardness. Explain your answer. (2mks)
ii) Explain why the results for sample II are different after distilling but remain unchanged after filtering. (2mks)
iii. State two disadvantages of using both water samples for domestic purpose. (2mks)

6. a) i)   What is meant by the term _Enthalpy of formation? (1mk)
    ii)   The enthalpies of combustion of carbon, methane and hydrogen are indicated below.

$$C_{(s)} + O_{2(g)} \longrightarrow CO_{2\ (g)}\ \Delta H = -393kJmol^{-1}$$
$$H_{2(g)} + \tfrac{1}{2}\ O_{2(g)} \longrightarrow H_2O_{(g)}\ \Delta H = -286\ kJmol^{-1}$$
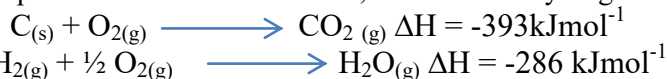
Enthalpy of combustion of CH_4 = -890kJmol^{-1}

   I   Draw an energy cycle diagram that links the enthalpy of formation of methane to the enthalpies of combustion of carbon, hydrogen and methane. (2mks)
   II   Determine the enthalpy of formation of methane. (2mks)

   b)   Ethanol can be manufactured from ethane and steam as shown in the equation below.

$$C_2H_{4\ (g)} + H_2O_{(g)} \rightleftharpoons CH_3CH_2OH_{(g)}$$

Temperature and pressure will affect the position of equilibrium of the above reaction. Name the other factor that will affect the position of the equilibrium of the above reaction? (1mk)

   c)   In an experiment to determine the rate reaction between calcium carbonate and dilute hydrochloric acid, 2g of calcium carbonate were reacted with excess 2M hydrochloric acid. The volume of carbon (IV) oxide evolved was recorded at regular intervals of one minutes for six minutes. The results are shown in the table below.

Time (Minutes)	1	2	3	4	5	6
Volume of carbon (iv) oxide (cm^3)	170	296	405	465	480	480

i) Plot a graph of time in minutes on the horizontal axis against volume of carbon (IV) oxide on the vertical axis. (3mks)
ii)   Determine the rate of reaction at 4 minutes. (2mks)

7.   The set-up below was used by a student to investigate the products formed when aqueous copper(ii) chloride was electrolyzed using carbon electrodes.
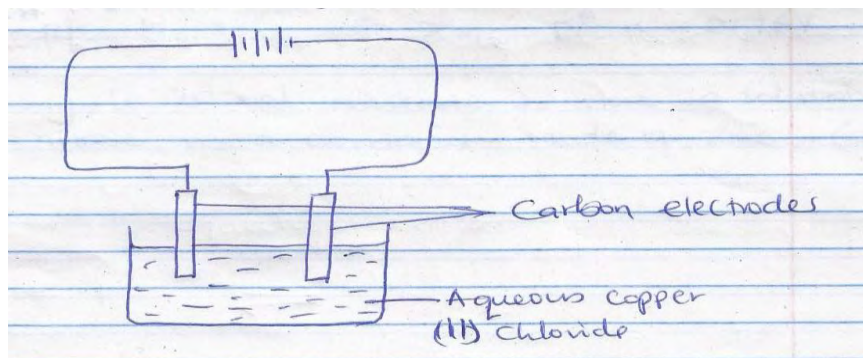
a)   i)   Write an equation for the reaction that takes place at the cathode. (1mk)
    ii)   Name and describe a chemical test for the products initially formed at the anode when a highly concentrated solution of copper (ii) chloride is electrolyzed. (3mks)
    iii)   How would the mass of the anode change if the carbon anode was replaced with copper metal? Explain. (2mks)

b)   0.6g metal **B** was deposited when a current of 0.45A was passed through an electrolyte for 72minutes. Determine the charge on the ion of metal B. (RAM of B=59, 1 faraday = 96500coulombs) (3mks)

c)   The electrodes potential for cadmium and Zinc are given below.

$$Cd^{2+}_{(aq)} + 2e^- \rightleftharpoons Cd_{(s)} \quad E^\Theta = -0.4V$$

$$Zn^{2+}_{(aq)} + 2e^- \rightleftharpoons Zn_{(s)} \quad E^\Theta = -0.76V$$
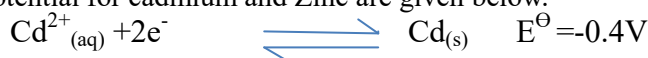
Explain why it is not advisable to store a solution of cadmium nitrate in a container made of Zinc. (2mks)

BUURI EAST
233/3/
CHEMISTY
PAPER 3
(PRACTICAL)

CONFIDENTIAL
INSTRUCTIONS TO SCHOOLS

In addition to the fittings and apparatus found in chemistry laboratory, each student will require:
− 1.5g of solid **T** accurately weighed.
− About 250cm^3 of solution **B**.
− About 150cm^3 of solution **R**.
− About 400cm^3 of distilled water.
− One burette.
− One pipette filler.
− One pipette (25cm^3)
− One 100cm^3 measuring cylinder.
− One filter paper.
− One filter funnel
− 4 conical flasks(250ml)
− One thermometer
− About 0.5g of solid **F**.
− About 0.5g of solid **H**.
− One 10cm^3 measuring cylinder.
− 1 glass rod.
− About 0.5g NaHCO$_3$.
− A piece of universal indicators paper
− PH chart.

ACESS TO:
− 2M Sodium hydroxide
− 2M Ammonia solution.
− Aqueous Barium Nitrate.
− 2M Nitric acid.
− Bromine water.
− Acidified potassium chromate (VI)
− Acidified potassium manganite (VII)
− Bunsen burner.

Note :
✓ Solid **T** = Benzoic acid
✓ Solid **F** = sodium carbonate.
✓ Solid **H** = Oxalic acid.
Preparation of solutions

Solution R (0.01M H$_2$SO$_4$)
i) Dissolve 56cm^3 of conc. H$_2$So$_4$ in about 500cm^3 of distilled water. Shake well and make it up to 1 litre.
ii) Take 10cm^3 of the solution of H$_2$SO$_4$ prepared in (i) above and dilute it with distilled water to make it up to 1 litre of solution **R**.

Solution B: (O.02M NaOH)
i) Dissolve 4.0g of NaOH in distilled water and make it up to 1 litre of solution.
ii) Take 200cm^3 of sodium hydroxide solution prepared in (i) above and dilute it with distilled water to make up one litre solution **B**.

BUURI EAST
CHEMISTRY
PAPER 3
(PRACTICALS)
JULY/AUGUST 2018
2 ¼ HOURS

You are provided with;
➢   A monobasic acid **solid T**.
➢   Sodium Hydroxide **Solution B**.
➢   0.0 M **solution R** of a dibasic acid H_2A.

You are required to:
 i.   Prepare a saturated solution of **solid T**.
 ii.   Standardize sodium hydroxide **solution B**.
iii.   Determine the solubility of **solid T** in water at room temperature

PROCEDURE.

a)   Place all the **solid T** provided into a dry conical flask. Measure out $100cm^3$ of distilled water using a measuring cylinder and add it to solid **T**. Shake thoroughly and leave it to stand.

b)   Fill the burette with solution **B** pipette $25cm^3$ of solution **R** into a conical flask. Add **2** or **3** drops of phenolphthalein indicator and titrate against solution **B** until a permanent pink colour appears. Record the readings in the table below. Repeat to obtain three accurate readings.

Table A.   (4mks)

	1	2	3
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution **B** used (cm^3)			

(a)   Calculate the average titre.   (1mk)

(b)   i) Write the equation for the reaction of the dibasic acid and sodium hydroxide.   (1mk)
         ii) Calculate the concentration of sodium hydroxide, solution **B**   in moles per litre. (3mks)

c)   Measure the temperature of the solution of solid **T.** using a dry filler paper and dry filter funnel filter the solution into a dry conical flask. Pipette $25cm^3$ of the filtrate into a conical flask. Add **2** or **3** drops of phenolphthalein indicator and titrate against sodium hydroxide, solution **B** until a permanent pink Colour appears. Record the readings in the table below. Repeat to obtain three accurate readings.

Temperature of the solution of solid T =…………….. ^{0}C.   (1mk)

	1	2	3
Final burette reading (cm^3)			
Initial burette reading $(cm)^3$			
Volume of solution **B** used *(cm^3)*			

                                                                                                                           (4mks)

d)   Calculate the average titre.   (1mk)
e)   Calculate:
i)   the number of moles of acid T in $25cm^3$ of the filtrate.   (2mks)
ii)   the number of moles of acid T in $100cm^3$ of solution of acid **T**. (1mk)
iii)   Given that the molecular formula of acid T is $C_9H_6O_2$, calculate the solubility of the acid in grammes per

100cm³ of water.

(C=12.0, H = 1.0, 0=16.0)   (1¹/₂ marks)

2.   You are provided with solid **F.** Solid **F** is suspected to be sodium sulphate. Use materials provided below to show the steps you would follow to test for sodium and sulphate ions.

−   2M ammonia solution.

−   2M Nitric acid.

−   2M Sodium hydroxide solution.

−   Aqueous Barium Nitrate solution

−   Glass rod.

−   Non luminous Bunsen flame

−   Distilled water.

Describe the procedure and the expected observations.

Procedure	*Expected Observation.*

5.   b)   Use the materials provided to carry out the tests you have described in (a) above.

i)   Test 1

Observations	Inferences
(½ mark)	(½ mark)

ii)   Test 2

Observations	Inferences
(½ mark)	(½ mark)

iii)   Test 3

Observations	Inferences
	(½ mark)
(½mark)	

iv)   Test 4

Observations	Inferences
(½mark)	(½ mark)

v)   Test 5

Observations	Inferences
(1mark)	(½mark)

3.   You are provided with solid **H**. Carry out the tests described and note down your observations and inferences.

a)   Place a spatulaful of solid **H** in a clean boiling tube. Add about 6cm³ of distilled water and shake to dissolve. Divide the resulting solution into **5** portions.

Observations	Inferences
(½ mark)	(½ mark)

b)   To the 1ˢᵗ portion add **2-3** drops of acidified potassium chromate VI.

Observations	Inferences

80

(1mk)   (1mk)

c)   To the second portion add **2-3** drop of acidified potassium manganate (VII)

Observations   Inferences

(1mk)   (1mk)

d)   To the **3ʳᵈ** portion add **2-3** drops of Bromine water.

Observations   Inferences

(1mk)   (1mk)

e)   Place a quarter spatulaful of sodium hydrogen carbonate in a dry test tube. Add the **4ᵗʰ** portion to the $NaHCO_3$ in the test tube.

Observations   Inferences

(½ mark)   (½ mark)

f)   Determine the PH of the **5ᵗʰ** portion.

Observations   Inferences

($^{1}/_{2}$mks)   ($^{1}/_{2}$mks)

CEKENA MOCK
233/1
FORM FOUR
CHEMISTRY PAPER 1
THEORY

1. a) State 2 apparatus used to measure fixed and accurate volume of liquids   (2 mks)
    b) Draw **one** of the apparatus named in 1 (a) above   (1 mk)
2. Using the equation given below, identify the reducing agent and explain using oxidation numbers.   (3 mks)
    $$2H_2S_{(g)} + SO_{2(g)} \longrightarrow 2H_2O_{(l)} + 3S_{(s)}$$
3. Illustrate using a diagram how to separate a mixture of Iodine and Sodium Chloride   (3 mks)
4. (i)   State the law of combining volumes of gases   (1 mk)
    (ii) What volume of methane would remain if a burner containing $40cm^3$ of methane burns in $40cm^3$ of enclosed air? (Assume oxygen is 20% by volume of air   (2 mks)
5. Dry chlorine gas was passed through two pieces of coloured cotton cloth as shown
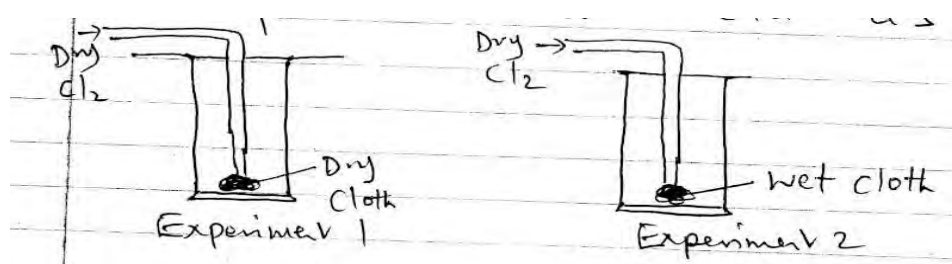
    a) State what is observed in each experiment   (2 mks)
        Experiment 1.
        Experiment 2.
    b) Write equations to show the reaction that will take place in experiment 2 if Sulphur (iv) oxide is used instead of Chlorine   (2 mks)
6. Potassium exists as a radioactive isotope ^{40}K as well as ^{39}K.
    a) State how the two isotopes differ from each other with respect to their nuclear composition   (1 mk)
    b) The product of a radioactive decay of ^{40}K is $^{40}_{20}Ca$. Explain the type of radioactive decay it undergoes   (1 mk)
    c) If the half-life of the radioactive isotopes $^{40}_{19}K$ is 1.3×10^9 years. Determine the time it will take for 4g of the isotope to disintegrate to 1g   (1 mk)
7. a) lead is a conductor but not an electrolyte. Explain this statement   (1 mk)
    b) State how copper metal and molten copper (ii) Chloride conduct electric current   (2 mks)

8. The structure of ethanoic acid is

    What is the total number of electrons used for bonding in a molecule of ethanoic above   (1 mk)
9. A gaseous compound consists of 86% carbon, and 14% Hydrogen by mass. At S.t.P $3.2dm^3$ of the compound had a mass of 6g. Calculate:-
    a) Its empirical formula (c = 12, H = 1 molar gas volume at S.t.p = $22.4dm^3$)   (2 mks)
    b) Its molecular formula   (2 mks)

10. a) A certain solution K was analysed using various testing reagents. The table below shows the tests and observations made

Test	Observation
(i) Addition of 3 drops of $Pb(NO_3)_2$	White precipitate formed
(ii) Addition of 3 drops of $Ba(NO_3)_2$	White precipitate formed
(iii) Addition of 5cm^3 of 2M HCL acid	Effervescence of gas observed
(iv) Additionof 2cm^3 acidified potassium chromate(vi)	Change of colour from orange to green

    (i)   Identify the anion present in the solution   (1 mk)
    (ii)   Write an ionic equation for the reaction that takes place in test (ii)   (1 mk)
    b)   Solid Aluminium hydroxide can be prepared by reacting excess ammonia solution with aluminium chloride solution. Explain why excess sodium hydroxide can not be used   (1 mk)

11. Below is a diagram of a flame. Study it and answer questions that follow

    a) Name regions X and Z   (1 mk)
    b) How does region Z arise   (1 mk)

12. Two elements A and B have electronic configurations 2:8:3 and 2:6 respectively.
    a)   To which group and period does B belongs   (1 mk)
    b)   If the two react, what is the formula of the compound they form?   (1 mk)

13. Given the following bond energies
    C – H   414 Kj/mol
    Cl – Cl   244 Kj/mol
    C – Cl   326 Kj/mol
    H – Cl   431 Kj/mol
    Calculate the enthalpy change that occurs when methane reacts with excess chlorine   (3 mks)

14. Paper chromatography is a method of separating colours or dyes. What two properties should the components of a mixture have that would make the separation possible?   (2 mks)

15. 60cm^3 of oxygen gas diffused through a porous portion in 50 seconds. How long would it take 60cm^3 of Sulphur(iv) oxide gas to diffuse through the same portion under the same conditions
    (S = 32.0, O = 16.0)   (3 mks)

16. The reaction below refers to preparation of an insoluble salt of lead starting with lead metal.

    Lead $\xrightarrow{\text{Reagents}}$ Solution X $\xrightarrow{\text{Sodium}}$ Mixture $\xrightarrow{\text{Filter}}$ Residue Q
    a)   Name the type of reaction between solution X and Sodium sulphate solution.   (1 mk)
    b)   Write the ionic equation for the reaction in (a) above.   (1 mk)
    c)   Explain why it is not possible to prepare residue Q using lead metal and Sodium sulphate solution (1 mk)

17. An equilibrium exists between the reaction of Chromate(vi) ion and dichromate(vi) ions
    $2CrO_4^{2-}{}_{(aq)} + 2H^+{}_{(aq)} \rightleftharpoons Cr_2O_7^{2-}{}_{(aq)} + H_2O_{(l)}$
    Yellow   Orange
    State and explain observation made when aqueous HCl is added to the above system at equilibrium (2 mks)

18. a) Name the type of artificial radioactivity represented by each of the following nuclear equations
    (i)   H + H $\longrightarrow$ He +   n + Energy   (1 mk)
    (ii)   U + n $\longrightarrow$ Ba +   Kr + 3   n + Energy   (1 mk)
   b)   Give one difference between nuclear reactions and chemical reactions   (1 mk)

19. Dacron is a synthetic fibre formed by polymerization reaction between a alkanoic acid and diol (alkanol with two functional groups)

    HOOC – C_6H_4 - COOH   OH – CH_2 – CH_2 - OH

    a) Show how polymerization between the two occurs (2 mks)
    b) Name the type of polymerization involved in forming dacron (1 mk)

20. Given elements W has atomic number 14 and consist of isotopes as shown below.

Isotope	A	B	C
Isotope mass	28	29	30
Percentage abundance	92.2	4.7	3.1

    a) What are isotopes (1 mk)
    b) Determine the relative atomic mass of W. (2 mks)

21. The set up below shows how dry chlorine gas is prepared in the lab.
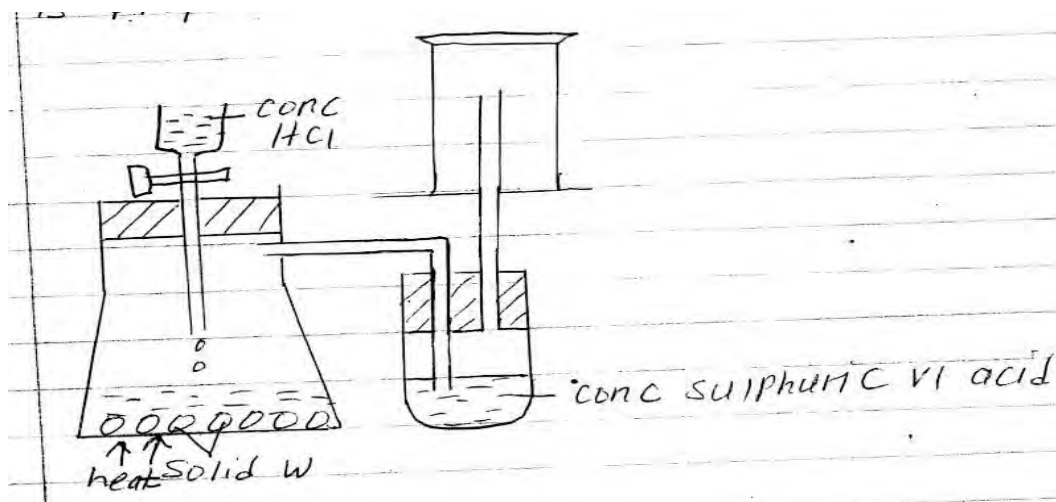
    a) Identify solid W (1 mk)
    b) Identify another drying agent that can be used to dry the gas. (1 mk)
    c) Identify mistakes made in the set up above. (1 mk)

22. State and explain the observations made when burning magnesium is lowered in a gas jar full of carbon (iv) oxide. (3 mks)

23. Jepkemoi performed an experiment to determine the solubility of potassium chlorate in water at 30^0C. She obtained the following results.

    Mass of dish   =   15.86g
    Mass of dish + saturated solution   =   26.86g
    Mass of dish + solid potassium chlorate after evaporation to dryness = 16.86g
    Calculate the solubility of potassium chlorate (3 mks)

24. The structure below represents a cleansing agent
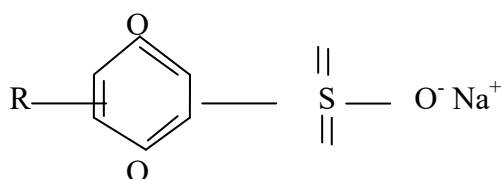
    (i) Which type of cleansing agent is represented above (1 mk)
    (ii) State one advantage & disadvantage of using the cleansing agent above (2 mks)
    Advantage
    Disadvantage

25. Describe a physical test to distinguish between methanol and hexanol (2 mks)
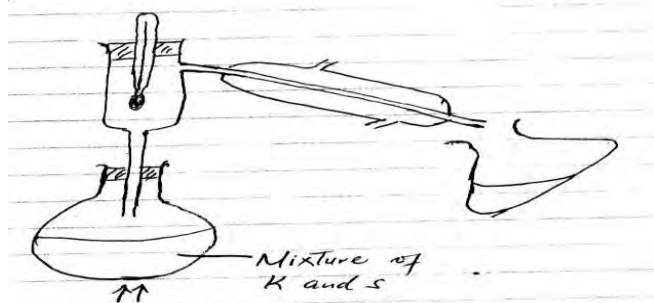26. The diagram below shows the effect of heat on copper (II) nitrate
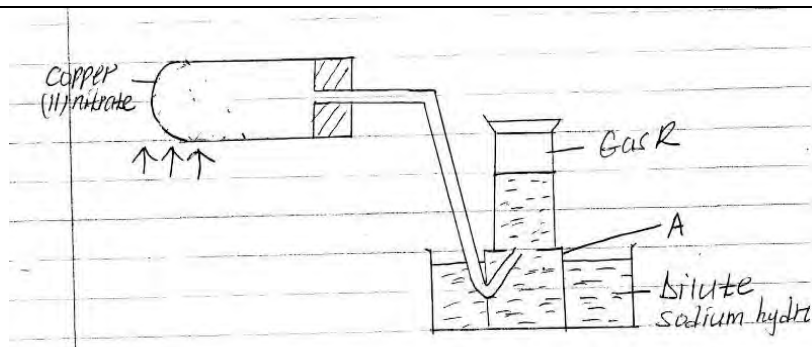
(i) Write an equation for the reaction taking place in the boiling tube. (1 mk)
(ii) Identify: gas R (1 mk)
(iii) State observations made in the boiling tube (1 mk)

27. Complete the table below to show the colour of the given indicators in acidic and basic Solutions (2 mks)

Indicator	Colour in acidic solution	Basic solution
Methyl orange	a) _____	Yellow
phenolphthalein	colourless	ii) _____

28. Using the thermochemical equation below, draw an energy level diagram (2 mks)

$$C_2H_{6(g)} + {}^7/_2O_{2(g)} \longrightarrow 2CO_{2(g)} + 3H_2O_{(g)} \quad \Delta H = {}^-1560Kjmol^1$$
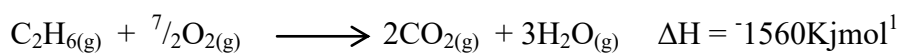
29. The set up below was used to separate a mixture containing liquid K boiling point 88^0C and liquid S (b.p, $= 102^0C$). Study it and answer the questions that follow:-

a) Name the method used (1 mk)
b) Identify the liquid to be collected first. Explain (1 mk)
c) On the diagram indicate the direction of the flow of water (1 mk)

CENA MOCK
233/2
FORM FOUR
CHEMISTRY PAPER 2
THEORY

SECTION A

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

Element	Atomic number	melting point ^0C
Q	11	97.8
R	13	660
S	14	1410
T	17	-101
U	19	63.7

   a) Write the electronic arrangement for the ions formed by the elements R and T (1 mk)
   b) Select an element which is
      (i) A semi-conductor of electricity (1 mk)
      (ii) The most reactive metal (1 mk)
   c) To which group of the periodic table does Q belong (1 mk)
   d) Compare the atomic radius of Q and R (1 mk)
   e) Use dots (.) and crosses (x) to represent the outermost electrons and show the bonding formed between S and T (1 mk)
   f) Explain why the melting point of element R is higher than that of element Q (2 mks)
   g) Write an equation for the reaction that takes place between T and water (1 mk)

2. The diagram below shows a set up by a student in an attempt to prepare and collect dry oxygen gas
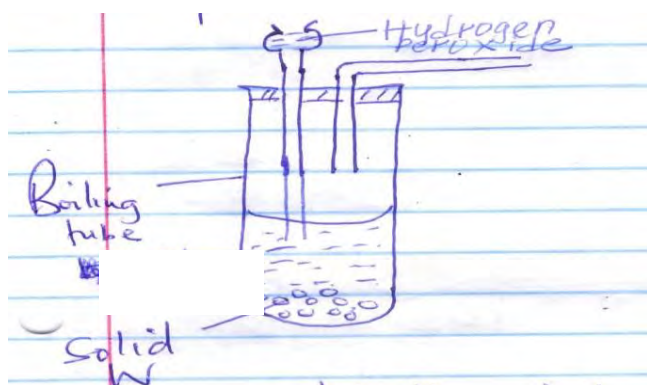
   a) (i) complete the diagram to show how dry oxygen can be collected (2 mks)
      (ii) Identify solid W (1 mk)
      (iii) Write a chemical equation for the reaction talking place in the boiling tube (1 mk)
   b) State one use of oxygen gas (1 mk)
   c) A piece of phosphorous was burnt in excess air and the product obtained was shaken with small amount of hot water to make a solution.
      (i) Write an equation for the burning phosphorous in excess air (1 mk)
   d) Explain why cooking pots made of aluminium do not corrode easily when exposed to air (1 mk)

95

e)

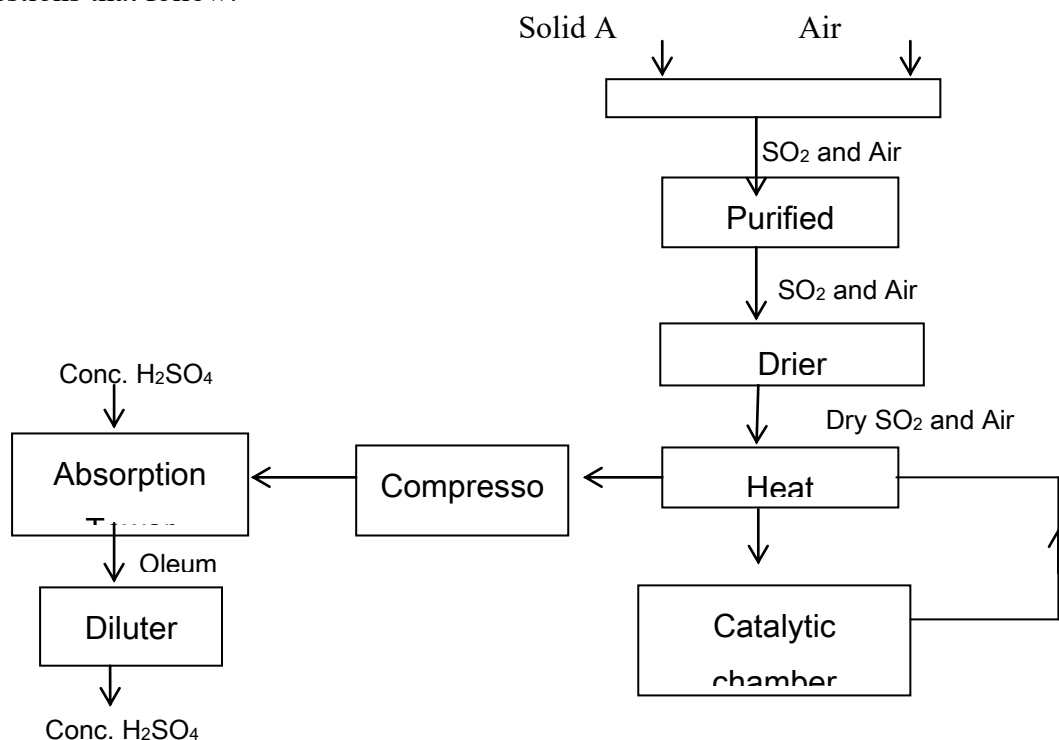3. The following schem represents various reactions starting with ethanol
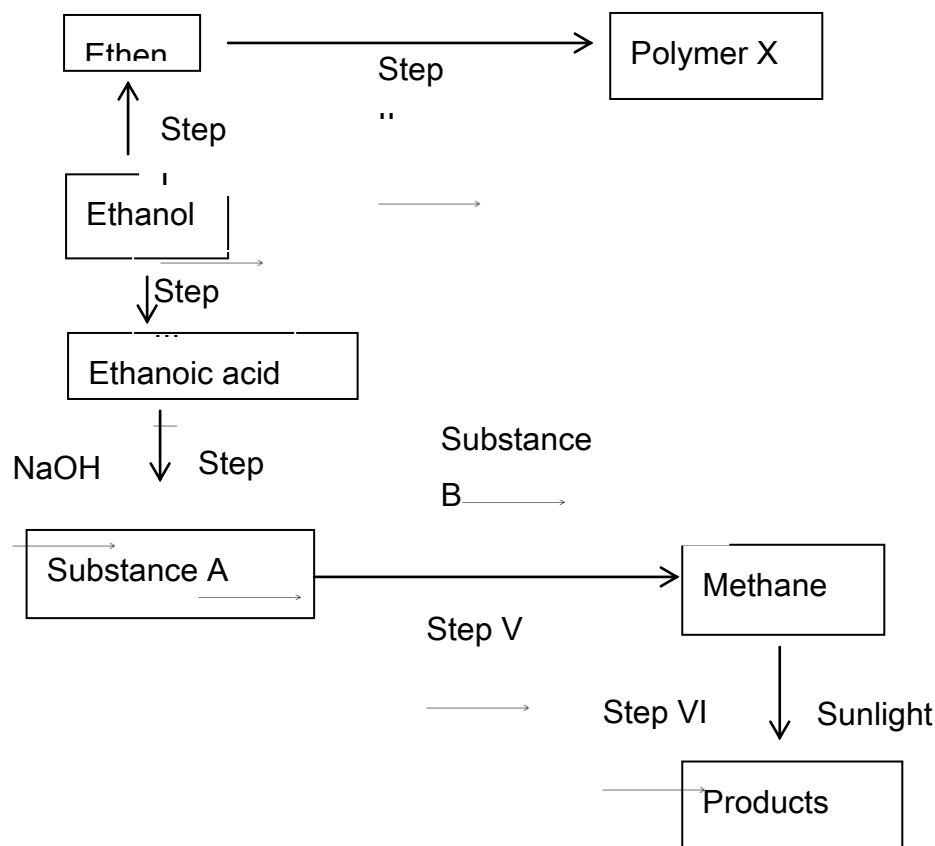
a) (i) Name one substance that can be used in step I
    (ii) Name the reaction taking place in step III & VI   (2 mks)
        Step III
        Step VI
    (iii) Give the structure of polymer X   (1 mk)
    (iv) Write an equation for the reaction taking place in step VI   (1 mk)
    (v) Identify substance B   (1 mk)
b)
    (i)   Draw the structural formula for all the isomers of $C_2H_3Cl_3$ (2 mks)
    (ii)   What would be observed if a few drops of acidified potassium manganite (VII) were added to oil
         obtained from nut seeds? Explain   (2 mks)
    (iii) Compounds A & B have the same molecular formula C3H6O2. Compound A liberates carbon (iv)
         oxide on addition of aqueous potassium carbonate while compound B does not. Compound B has a
         pleasant fruity smell. Draw the possible structures of :-
         Compound A.   (1 mk)
         Compound B   (1 mk)
4. Read the following passage and answer the questions.
    A salt K was heated with slaked lime (calcium hydroxide). A colourless gas L with a characteristic smell was
    evolved. A large quantity of this gas was passed through an inverted filter funnel into water, and a colourless
    solution M was obtained. M was treated with an equivalent volume of dilute sulphuric acid and the resulting
    solution was evaporated. A white solid N was obtained.
    a) Identify gas L   (1 mk)
    b) What is K most likely to be?   (1 mk)
    c) Write an equation for the reaction between K and slaked lime   (1 mk)

96

d) Explain why gas L is passed into water through an inverted funnel (2 mks)

e) (i) identify M and N (1 mk)

(ii) Write an equation for the reaction between M and Sulphuric acid (1 mk)

f) In industry, the gas L is obtained by direct combination of two gases D and E, by passing them over a catalyst F at 450^0C and high pressure

(i) Name the gases D and E (2 mks)

(ii) Name the catalyst F (1 mk)

(iii) Write an equation for the reaction between the gases D and E (1 mk)

(iv) Copper (II) oxide was heated in a pure sample of gas L. State and explain the observation you would make (2 mks)

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

E^θ volts

$$G^+_{(aq)} + e \; \rightleftharpoons \; G_{(s)} \qquad\qquad -2.71$$
$$M^{2+}_{(aq)} + 2e \; \rightleftharpoons \; M_{(s)} \qquad\qquad -2.37$$
$$2N^+_{(aq)} + 2e \; \rightleftharpoons \; N_{2(g)} \qquad\qquad 0.00$$
$$P^{2+}_{(aq)} + 2e \; \rightleftharpoons \; P_{(s)} \qquad\qquad +0.34$$
$$^1/_2O_{2(g)} + e \; \rightleftharpoons \; Q_{(g)} \qquad\qquad +2.87$$

a) (i) Which elements is likely to be hydrogen? Give a reason to your answer (2 mks)

(ii) What is the E^θ of the strongest oxidizing agent (1 mk)

(iii) Draw a well labeled diagram of the electrochemical cell that would be obtained when half cells of M and P are combined (3 mks)

(iv) Calculate the E^θ value of the electric chemical cell constructed in (iii) above (2 mks)

b) During electrolysis of aqueous copper (II) sulphate using copper electrodes a current of 0.8 amphere was passed through the cell for 10 hours.

(i) Write ionic equation for the reaction that took place at the cathode (1 mk)

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

6. (a) The diagram below represent the extraction of sulphur by the frash process

(i) Identify and state the use of the substances that pass through tube A and C (2 mks)

(ii) Rhombic and monoclinic are allotropes of sulphur. They are interconvertible as shown below

Rhombic $\rightleftharpoons$ Monoclinic
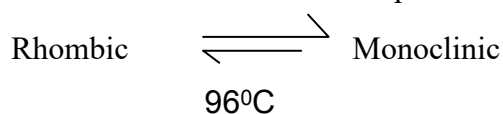
96^0C

What does temperature 96^0C represent (1 mk)

(iii) State the differences in crystalline appearances between rhombic and monoclinic crystals (1 mk)

(b) The following scheme represents the steps followed in the contact process. Study it and then answer the questions that follow:-

```
        Solid A              Air
           ↓                  ↓
        ┌─────────────────────────┐
        │                         │
        └─────────────────────────┘
              │ SO₂ and Air
              ↓
        ┌─────────────┐
        │  Purified   │
        └─────────────┘
              │ SO₂ and Air
              ↓
        ┌─────────────┐
        │   Drier     │
        └─────────────┘
              │ Dry SO₂ and Air
              ↓
Conc. H₂SO₄
    ↓
┌──────────┐   ┌──────────┐   ┌─────────┐
│Absorption│ ← │Compresso │ ← │  Heat   │───┐
│  Tower   │   └──────────┘   └─────────┘   │
└──────────┘                      ↓         │
    │ Oleum                                 ↑
    ↓                          ┌──────────┐ │
┌──────────┐                   │ Catalytic│─┘
│  Diluter │                   │ chamber  │
└──────────┘                   └──────────┘
    ↓
Conc. H₂SO₄
```

    (i) Name two possible indentities of solid A.   (1 mk)
    (ii) Name one impurity removed by the purifier   (1 mk)
    (iii) Why is it necessary to remove impurities?   (1 mk)

(c) The following chemical equation shows a reaction taking place in the catalytic chamber/converter.

$$2SO_{2(s)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)} \qquad DH^0 = -197 kjmol^{-1}$$

    How would the following factors affect the production of sulphur (vi) oxide
    (i) Increase in temperature   (1 mk)
    (ii) Decrease in pressure   (1 mk)
    (iii) Name the catalyst which is commonly used in this process and why?   (1 mk)
    (iv) State and explain one environmental effect of sulphur (iv) oxide in the atmosphere (2 mks)

7.   The reaction between 0.65g of Zinc granules and excess 0.5m hydrochloric acid was followed by measuring the amount of gas produced. The following results were obtained.

Time (sec)	0	30	60	90	120	150	180	210	240
Total vol. of gas at r.t.p(cm^3)	0	80	140	190	220	230	240	240	240

(a) Plot the graph of volume of a gas against time   (3 mks)
(b) (i) Write an equation for the reaction taking place   (1 mk)
    (ii) How would the gas produced be identified?   (1 mk)
    (iii) Why is an excess of acid used?   (1 mk)
(c)   From the graph
    (i) What is the volume of the gas evolved at 75 seconds   (1 mk)
    (ii) Account for the shape of the curve   (2 mks)
(d) On the same graph, sketch the curves that you expect if the experiment was repeated under the same conditions but using 0.4M hydrochloric acid instead of 0.5M hydrochloric acid label X   (1 mk)
(e) Calculate the rate of reaction at the 100th sec   (2 mks)

(f)   Calculate the volume that would be produced at r.t.p from 13g of Zinc
       (Zn = 65.0, molar gas volume at r.t.p= 24dm^3)   (3 mks)

CENEKA MOCKS
233/3
CHEMISTRY PAPER 3
(CONFIDENTIAL)
1.   Solution A
2.   Solution B
3.   Solution C
4.   100ml measuring cylinder
5.   100ml measuring beaker
6.   Burette (0 – 50ml)
7.   Thermometer (-10 – 100^{0}C)
8.   1g Solid Q in a stoppered container
9.   Metallic spatula
10.   Boiling tube
11.   3 test tubes
12.   Dist. Water in a wash bottle
13.   10ml measuring cylinder
14.   0.5g Solid R (about) in a stoppered container
15.   About 5cm^3 of absolute ethanol in a dry test tube
16.   About 0.2g of Sodium Hydrogen Carbonate

Access to :
1.   Source of heat
2.   Acidified Potassium dichromate(VI)
3.   20v hydrogen peroxide
4.   2M sodium hydroxide
5.   Barium nitrate solution
6.   2M Nitric (V) acid

NB: *the access solutions, each to be provided with a dropper.*
Preparation of solutions
1.   Solution A   - 1M HCl
2.   Solution B   - 1M Ethanoic acid
3.   Solution C   - 1M NaOH
4.   Solid Q   - Hydrated Iron (II) Sulphate
5.   Solid R   - Maleic acid

CEKENA MOCKS
232/3
FORM FOUR
CHEMISTRY PAPER 3
PRACTICAL

For examiner's use only.

Q1. You are provided with

- 1M Hydrochloric acid labeled solution A

- 1M Ethanoic acid labeled solution B

- Sodium hydroxide solution labeled solution C

You are required to compare the molar enthalpy of neutralization of the two acids when reacted with sodium hydroxide

Procedure I

- Using a measuring cylinder transfer $50.0cm^3$ of aqueous sodium hydroxide into a $100cm^3$ plastic beaker

- Measure its temperature and record it in the table 1 below.

- Fill the burette with Acid A to the $0.0cm^3$ mark.

- Add $5.0cm^3$ of Acid A to the sodium hydroxide and stir with the thermometer. Measure and record the highest temperature reached in the table 1 below. Add a further $5.0cm^3$ of Acid A to the contents in the beaker and stir. Measure and record in the table the highest temperature reached.

- Continue to add $5.0cm^3$ portions of Acid A until total volume of $40.0cm^3$ of acidA has been added. Stir after each addition and measure and record the highest temperature reached in the table 1 below.

Table 1

Volume of Acid A (cm^3)	Maximum temperature (^0C)
0.0	
5.0	
10.0	
15.0	
20.0	
25.0	
30.0	
35.0	
40.0	

(3 mks)

Procedure II

- Empty the burette and rinse it thoroughly with distilled water

- Fill the burette with Acid B

- Pour the contents in the beaker. Rinse it and transfer $50.0cm^3$ of sodium hydroxide solution into it.

- Repeat activity in procedure I, using Acid B in place of Acid A.

- Record your results in table 2 below

Table 2

Volume of Acid B (cm^3)	Maximum temperature (^0C)
0.0	

100

5.0	
10.0	
15.0	
20.0	
25.0	
30.0	
35.0	
40.0	

(3 mks)

On the grid below draw graphs of temperature against volume for the two experiments on the same axes
 (4 mks)
(a)   Use your graphs
(i)   To determine the highest change in temperature (ΔT) for the two acids
I Acid A...   (1 mk)
II Acid B ....   (1 mk)
(ii)   Determine the volume of Acid A and Acid B used in the two experiments   (1 mk)
(b)   Use yor values in (a) (i) above to calculate the Molar enthalpy of neutralization for the two acids
  (density of solution = 1g/cm^3,   c = 4.2J/g/k)
Acid A   (2 mks)
Acid B   (2 mks)
(c)   Explain the difference in the values obtained in (b) above   (2 mks)
(d)   Draw an energy level diagram for the Molar enthalpy of neutralization of Acid A   (2 mks)
(e)   Identify source of error in procedure II above given than the value you have obtained in (b) above is less than
        the theoretical value   (1 mk)

Q2. (a) Suppose you are provided with
➢   Solid P
➢   2M Sodium hydroxide
➢   Aqueous Sodium sulphate
➢   Aqueous Lead (II) Nitrate
➢   Distilled water

Solip P is suspected to be Barium chloride
From the reagents provided, select and describe three tests that could be carried out **Consecutively** to confirm if solid
        P is Barium chloride. Write the tests and expected observations in the spaces provided.

	Test	Expected observation
(i)	Test 1	Expected observation
	1mk	1 mk
(ii)	Test 2	Expected observation
	1mk	1 mk
(iii)	Test 3	Expected observation
(iv)		

101

1mk   1 mk

(b)   You are provided with inorganic solid Q. carry out the tests and record your observations and inferences in the spaces provided

(i)   Place solid Q into a boiling tube and add about $8cm^3$ of distilled water. Shake the mixture. To about $2cm^3$ of solution Q in a test tube add 3 drops of Acidified potassium dichromate (vi) solution

(ii) _____

Observation	inferences
1mk	1 mk

(iii)   To about $2cm^3$ of solution Q in a test tube, add $2cm^3$ of hydrogen peroxide followed by sodium hydroxide dropwise until in excess

Observation	inferences
1mk	1 mk

(iv)   To about $2cm^3$ of solution Q in a test tube, add 2 drops of Barium nitrate solution followed by 3 drops of dilute nitric (V) acid

Observation	inferences
1mk	1 mk

Q3. You are provided with organic solid R. carry out the tests and record your observations and inferences in the spaces provided.

(a)   Using a metallic spatula ignite about half of solid R in a Bunsen burner flame

Observation	inferences
1mk	1 mk

(b)   (i) Place the other half of solid R in a test tube containing $5cm^3$ of absolute ethanol provided. Shake the mixture. Retain the mixture for use in part (II) below.

Observation	inferences
1mk	1 mk

(ii)   Add solid sodium hydrogen carbonate provided to the mixture in part b(i) above

Observation	inferences
1mk	1 mk

COMPLIANT I
233/1
CHEMISTRY
PAPER 1
THEORY

1. Study the figure below and answer questions that follow.
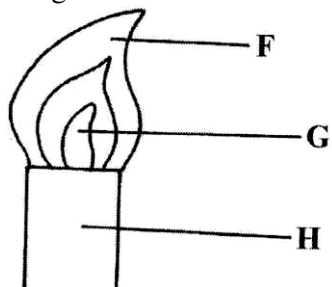
   Name the parts labelled **F** and **G**. (1mk)

2. The table below gives information on four elements represented by K, L, M and N. Study it and answer the questions that follow. The letters do not represent the actual symbols of the elements.

Element	Electron arrangement	Atomic radius	Ionic radius
K	2, 8, 2	0.136	0.065
L	2, 8, 7	0.099	0.181
M	2, 8, 8, 1	0.203	0.133
N	2, 8, 8, 2	0.174	0.099

   (a) Which **two** elements have similar chemical properties? Explain. (2mks)

3. 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)

4. $Na^+_{(g)} + Cl^-_{(g)} \longrightarrow NaCl_{(s)}$ $\Delta H_1 = -781 KJmol^{-1}$

   $NaCl_{(s)} \xrightarrow{H_2O_{(l)}} Na^+_{(aq)} + Cl^-_{(aq)}$ $\Delta H_2 = +7 KJmol^{-1}$
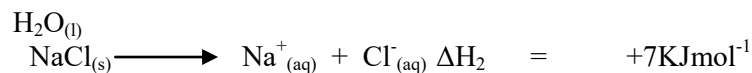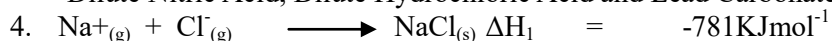
   (a) What is the name of ΔH_1? (1mk)
   (b) Calculate the heat change for the process: (2mks)

   $Na^+_{(aq)} + Cl^-_{(aq)} \xrightarrow{H_2O_{(l)}} Na^+_{(aq)} + Cl^-_{(aq)}$

5. The table below gives the solubility of potassium bromide and potassium sulphate at 0^0C and 40^0C.

Substance	Solubility g/100g H_2O at	
	0^0C	40^0C
Potassium bromide	55	75
Potassium sulphate	10	12

   When an aqueous mixture containing 60g of potassium bromide and 7g potassium sulphate in 100g of water at 80^0C was cooled to 0^0C, some crystals were formed.

(a) Identify the crystals. (1mk)
(b) Determine the mass of the crystals. (1mk)

6. The graph below shows the amount of calcium carbonate and calcium chloride varying with time in the reaction.
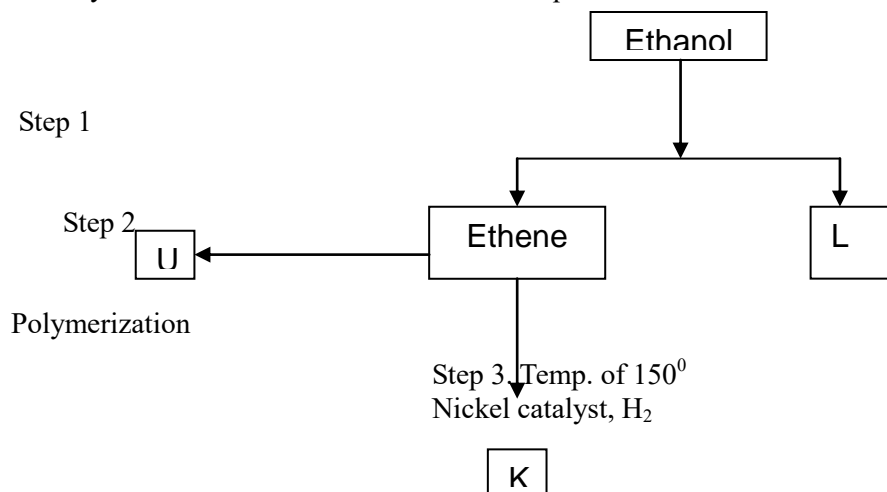 $CaCO_{3(s)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + H_2O + CO_{2(g)}$
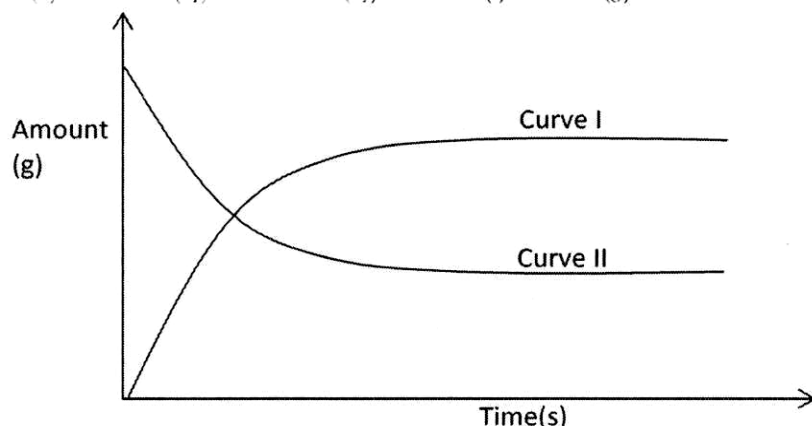
(a) Which curve shows the amount of calcium chloride varying with time? (1mk)
(b) Explain why the two curves become horizontal after a given period of time. (1mk)
(c) Sketch on the graph, how curve II would appear if the experiment was repeated using a more dilute hydrochloric acid solution. (1mk)

7. $200cm^3$ of Nitrogen (I) Oxide (N_2O) pass through a porous plug in 2 minute 15 seconds. How long will it take the same volume of Sulphur (IV) Oxide (SO_2) gas to diffuse through the same plug under the same conditions? (N = 14, O = 16, S = 32) (3mks)

8. An organic compound contains carbon and hydrogen only. When this compound was completely burnt in excess air, it gave 9.6g of Carbon (IV) Oxide and 4.9g of water vapour. The molecular mass of the hydrocarbon is 58. Determine the molecular formula. (C = 12, O = 16, H = 1) (3mks)

9. Study the flow chart below and answer the questions that follow.
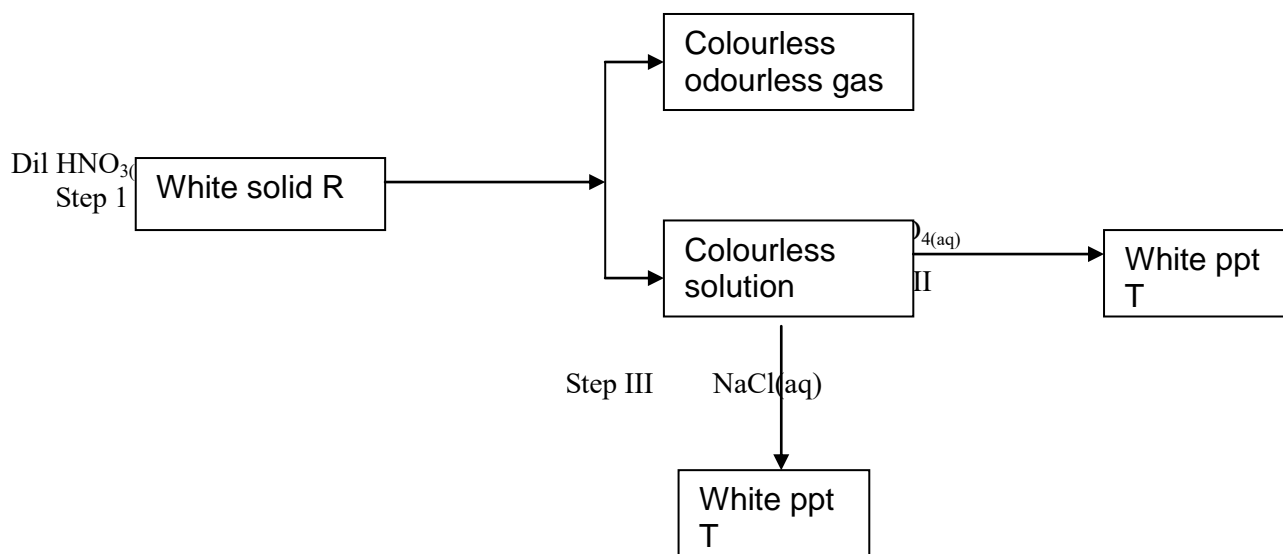
(a) Identify solid R. (1mk)
(b) Write a balanced equation for step II and ionic equation for step III.
Step II …………………………………………………………………………………… (1mk)
Step III …………………………………………………………………………………... (1mk)

10. In an experiment to study properties of carbon, a small amount of charcoal is placed in a boiling tube. $5.0cm^3$ of concentrated nitric acid is added. The mixture is then heated.
(a) What observations are made? (1mk)
(b) Write an equation for the reaction that took place in the boiling tube. (1mk)
(c) What property of carbon is shown in this reaction? (1mk)

11. Both diamond and graphite have giant atomic structures. Explain why diamond is hard while graphite is soft. (2mks)

12. (a) Define the term oxidation state. (1mk)
(b) Calculate the oxidation states of chromium and manganese in the following ions. (2mks)
(i) Chromium in $Cr_2O_7^{2-}$
(ii) Manganese in MnO_4^-

115

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

Ethanol

Step 1

Step 2

U ← Ethene ← L

Polymerization

Step 3. Temp. of 150^0
Nickel catalyst, H_2

K

   (a) Identify substances:

      K:…………………………………………………   (½mk)
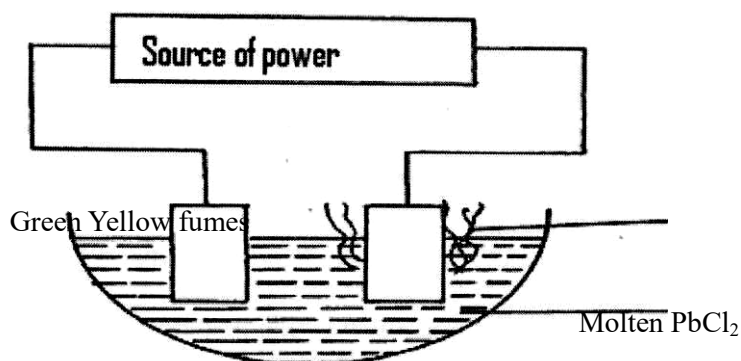   U:…………………………………………………   (½mk)
      L:…………………………………………………   (½mk)
   (b) State the conditions for the reaction in step 1 to occur.   (2mks)

   (c) Give **one** disadvantage of continued use of substances such as U.   (½mk)

14. Use the set up below to answer the questions that follow.

Source of power

Green Yellow fumes

Molten $PbCl_2$

   (a)   On the diagram, label the cathode.   (1mk)
   (b)   Write the equation for the reaction on the cathode.   (1mk)

15. Use the bond energy value given below for the question that follows.

Bond	Bond energy (kJmol^{-1})
H – H	432
C = C	610
C – C	346
C – H	413

Determine the enthalpy change for the conversion of butene to butane by hydrogen.   (3mks)

16. The peaks below show the mass spectrum of element X.
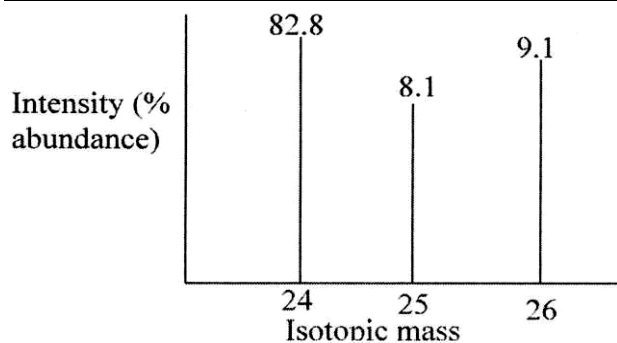
Calculate the relative atomic mass of X. (2mks)

17. In an experiment, concentrated sulphuric (VI) acid was put in a beaker and exposed to air for one week as shown below.
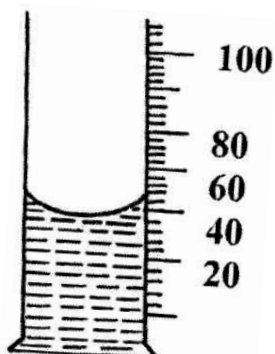
(i) What observation was made after one week? Explain. (2mks)
(ii) What property of sulphuric (VI) acid was being investigated in the experiment? (1mk)

18. Below is a set-up of apparatus used to prepare hydrogen gas in the laboratory. Study it and answer the questions that follow.
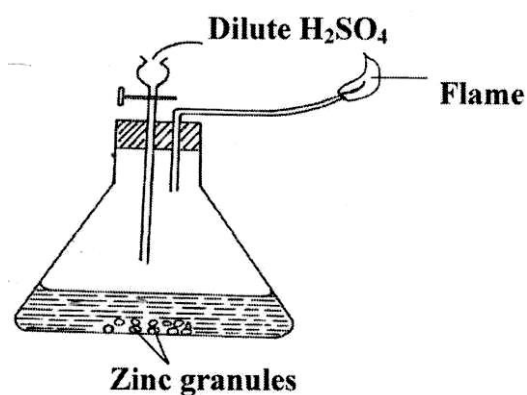
(a) Write a chemical equation for the two reactions taking place in he above set-up. (2mks)
(b) State the chemical test for hydrogen gas. (1mk)
State **three** reasons why air is considered to be a mixture but not a compound. (3mks)

19. Study the set up below and answer the questions that follow.
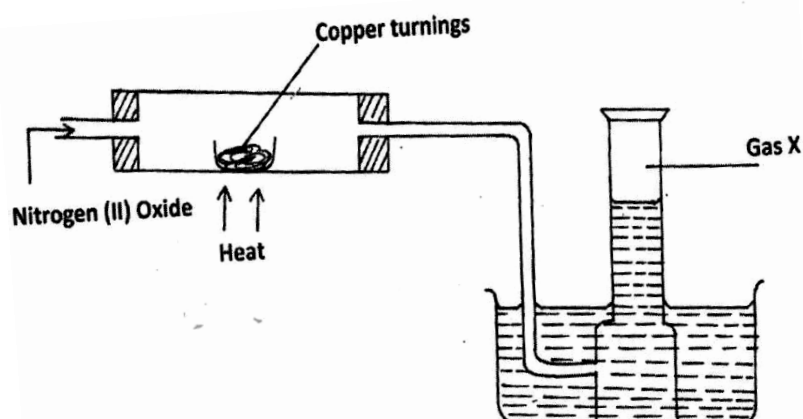
(a) Identify gas X. (1mk)
(b) State the observation made in the combustion tube. (1mk)
(c) Write equation for the reaction in combustion tube. (1mk)

20. The set-up below shows the catalytic oxidation of ammonia in the laboratory.
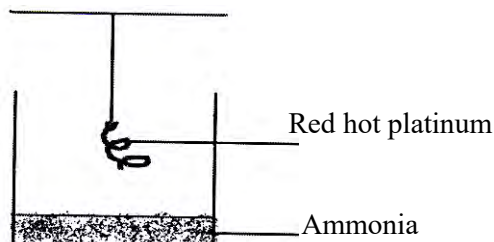
(a) State and explain the observation made. (2mks)
(b) Write a chemical equation for the first reaction taking place in the beaker. (1mk)

21. When sulphur is heated in a boiling tube in absence of air, the yellow crystals melts into golden yellow mobile liquid at 113^0C. The liquid changes at 180^0C into a dark brown very viscous liquid. More heating to about 400^0C, produces a brownless 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 400^0C is cooled rapidly by pouring it into cold water, which form of sulphur is produced? (1mk)

22. An experiment was set up using chlorine water as shown below.
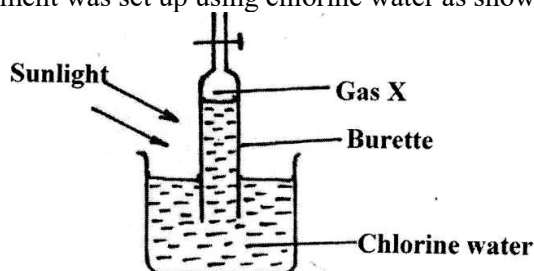
(i) Identify gas X. (1mk)
(ii) Write an equation for the production of gas X. (2mks)

23. The 1st, 2nd and 3rd ionization energies in KJ/Mol of elements G and R are given below.

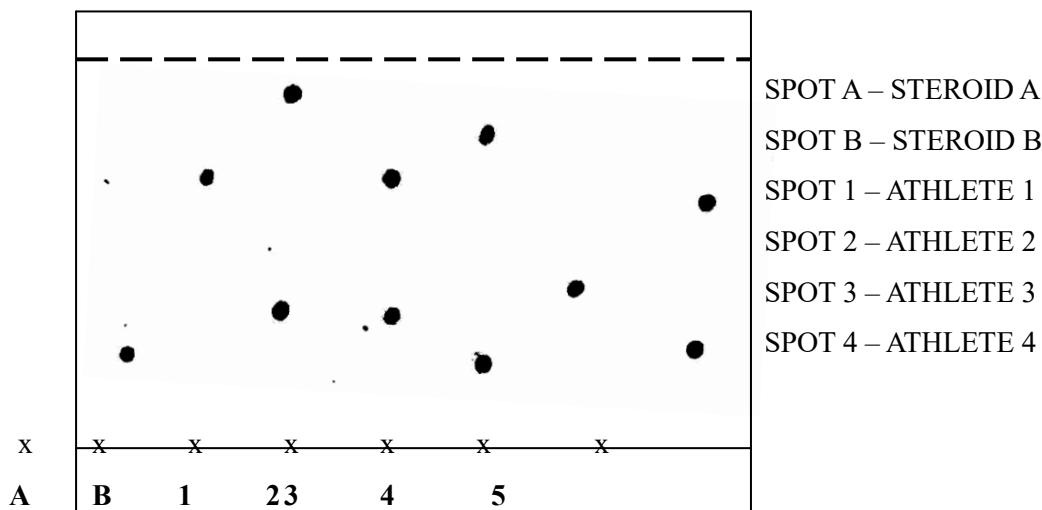| Element	1st I.E	2nd I.E	3rd I.E
G	520	7,300	9,500
R	420	3,100	4,800

(i) Define the term 1st ionization energy. (1mk)
(ii) Apart from the decrease in energy levels, explain the big difference between the 1st and 2nd ionization energies. (1mk)
(iii) Calculate the amount of energy for the process: (1mk)
$$R_{(g)} \longrightarrow R^{3+}_{(g)} + 3e^-$$

24. A gaseous compound consists of 86% carbon and 14% hydrogen by mass. At s.t.p. $3.2dm^3$ of the compound had a mass of 6g. Calculate its molecular formula. (1 mole of a gas at s.t.p. = $22.4dm^3$) (3mks)

25. The table below shows the pH values of some solutions.

Solution	J	K	L	M	N
pH	6	13	2	10	7

   (a)   Which solution is likely to be:
   (i)   Potassium hydroxide   (1mk)
   (ii) Lemon juice   (1mk)
   (b)   Explain why a solution of hydrogen chloride gas in methyl benzene was identified as N.   (1mk)
26. Using dots (•) and crosses (x) to represent electrons, show bonding in the compound formed when the following elements reacts.   (N = 14, H = 1).
   Nitrogen and Hydrogen.   (1mk)
27. Some salts may be classified as double salts or basic salts. Trona with the formula $Na_2CO_3.NaHCO_3$ is an example of a double salt. An example of a basic salt is basic magnesium carbonate with formula $MgCO_3.Mg(OH)_2$.
(a) What is meant by a double salt?   (1mk)
(b) Write equations of reactions that occur when dilute hydrochloric acid is reacted with: (2mks)
   (i)   Trona
   (ii) Basic magnesium carbonate.
28. During Olympics, urine sample of five short distance runners were taken and tested for the presence of two illegal steroids by paper chromatography. Methanol was used as the solvent. A chromatogram from the test appeared as shown below. Study the chromatogram and answer the questions that follow.

KEY

SPOT A – STEROID A

SPOT B – STEROID B

SPOT 1 – ATHLETE 1

SPOT 2 – ATHLETE 2

SPOT 3 – ATHLETE 3

SPOT 4 – ATHLETE 4

   (a) Which of the two steroids is most likely to be more soluble in methanol? Give a reason.   (1mk)
   (b) Identify the athletes that tested positive for the illegal steroids.   (2mks)
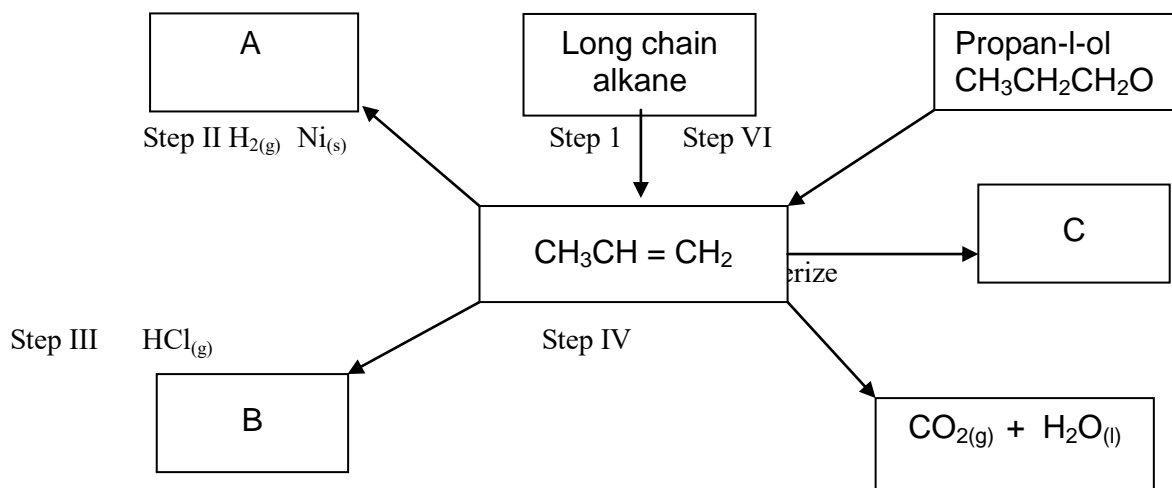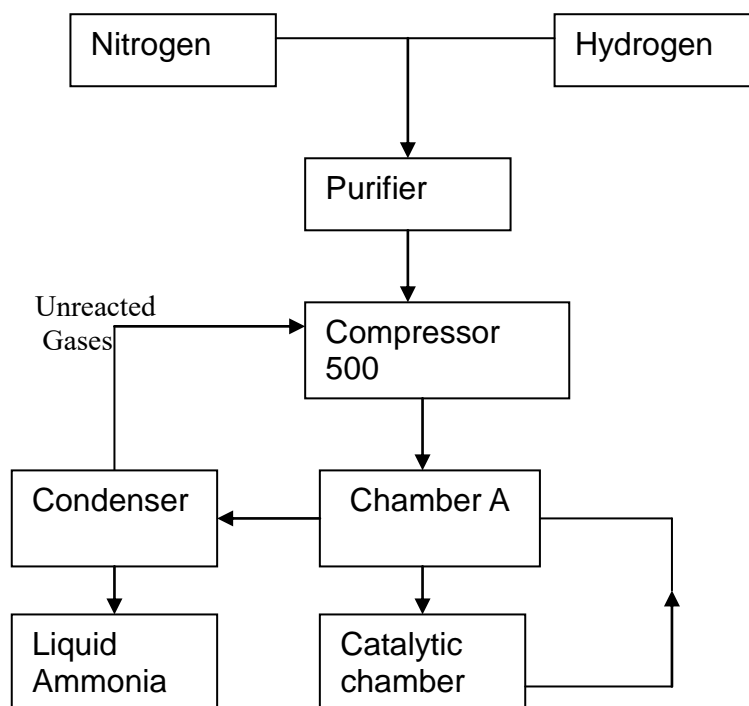
COMPLIANT I
33/2
CHEMISTRY
PAPER 2
THEORY

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


```
        A                  Long chain          Propan-l-ol
                            alkane             CH₃CH₂CH₂O

Step II H₂(g)  Ni(s)    Step 1    Step VI

                                                        C
                      CH₃CH = CH₂        erize

Step III    HCl(g)              Step IV

        B                              CO₂(g)  +  H₂O(l)
```

   (i)   Name the process taking place in step (I).   (1mk)
   (ii)   Describe chemical test that can be carried out to show the identity of organic compound A.   (2mks)
   (iii) Give the name of the following: (2mks)
          I.   A:……………………………………………………………………………………………
          II.   B:……………………………………………………………………………………………
   (iv)   Give the structural formulae of substance C.   (1mk)
   (v)   Name the type of reaction that occurs in:
          I.   Step IV   (1mk)
          II.   Step VI
   (vi)   Give the reagent and the condition necessary for step VI.   (1mk)
          Reagent:…………………………………………………………………………………………
          Condition:………………………………………………………………………………………
   (b) Give the systematic names of the following compounds:
          I. $CH_2CHCHCH_2CH_3$ (1mk)
          II. $CH C C H_3$ (1mk)

2. The flow chart below shows the Haber process in the large scale manufacture of Ammonia gas. Use it to answer the questions that follow.

```
        ┌────────────┐              ┌────────────┐
        │  Nitrogen  │──────────────│  Hydrogen  │
        └────────────┘              └────────────┘
               │
               ▼
        ┌────────────┐
        │  Purifier  │
        └────────────┘
               │
Unreacted      ▼
Gases   ┌──────────────┐
   ─────│  Compressor  │
   │    │  500         │
   │    └──────────────┘
   │           │
   ▼           ▼
┌──────────┐ ┌────────────┐
│ Condenser│◄│  Chamber A │─────┐
└──────────┘ └────────────┘     │
     │            │             │
     ▼            ▼             │
┌──────────┐ ┌────────────┐     │
│ Liquid   │ │ Catalytic  │─────┘
│ Ammonia  │ │ chamber    │
└──────────┘ └────────────┘
```

(a) Describe how nitrogen is obtained from air on a large scale.   (3mks)
(b) (i)   Name **one** source of hydrogen gas used as a raw material in the above process.   (1mk)
    (ii)   Name chamber A.   (1mk)
    (iii) Write an equation for the reaction taking place in the catalytic chamber.   (1mk)
    (iv)   In the Haber process optimum temperature of 500^0C and 200 atmospheres of pressure are used to get optimum yield of Ammonia. Why can't lower temperatures and higher pressure be used? (2mks)
(c) Give **two** reasons why finely divided iron is the commonly used catalyst.   (1mk)
(d) State and explain the observation made when dry ammonia gas is passed over heated copper (II) Oxide in a combustion tube.   (2mks)
(e) Give **two** uses of ammonia gas.   (1mk)

3. (a) In a reaction to determine the rate of a reaction between magnesium ribbon and dilute hydrochloric acid 2g of magnesium ribbon were reacted with excess 2M hydrochloric acid. The volume of hydrogen gas evolved was recorded at regular intervals of one minute for eight minutes. The results are as shown in the table below.

Time (minutes)	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0
Volume of Hydrogen gas (cm^3)	95	160	210	237.5	260	272.5	275	275

(i)   Plot the graph of time in minutes on the horizontal axis against volume of hydrogen gas on the vertical axis.   (3mks)
(ii) Name the factor that was investigated in this experiment.   (1mk)
(iii) Use the graph to determine the volume of hydrogen gas that was produced between 2¾ minute and 5.0 minutes.   (2mks)
(iv) Explain the shape of the graph between minutes 7.0 and 8.0.   (2mks)

(b)   Hydrogen gas reacts with chlorine gas to form hydrogen chloride gas as shown in the equation below.

$$H_{2(g)} + Cl_{(g)} \rightleftharpoons 2HCl_{(g)}$$

(i)   Explain the effect on the yield of $HCl_{(g)}$ by lowering the pressure for this reaction.   (2mks)
(ii) Using a well labeled diagram, describe how a solution of hydrogen chloride can be prepared in the laboratory.   (2mks)
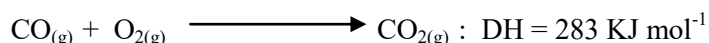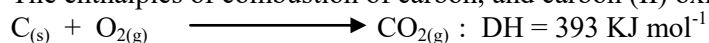
4. The diagram below shows a set up which was used by student to investigate effect of electricity on solid Molten Lead (II) Bromide. Study it and answer the questions that follow.
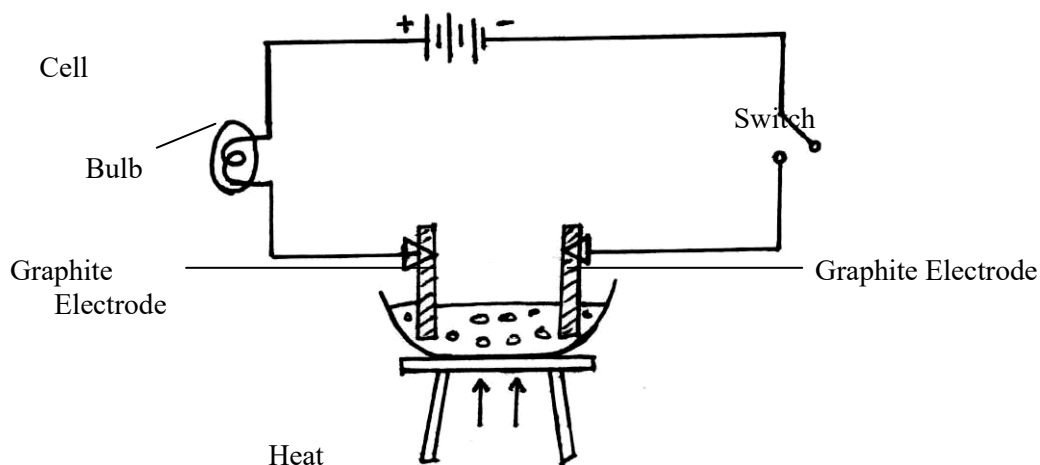

(a) (i)   State and explain the observation at the anode when the switch is switched on.   (2mks)
    (ii) What precaution should be taken when carrying out this experiment?   (1mk)
    (iii) Write the equation of the reaction taking place at the Anode.   (1mk)
    (iv) Why are graphite electrodes used in the experiment?   (1mk)
    (v)   On the diagram, indicate the direction of flow of electrons.
    (vi) The students noted that the bulb only produced light after the Lead (II) Bromide had melted. Explain this observation.   (2mks)
(b) State the difference in conduction of electric current between Molten Lead (II) Bromide and Lead Metal. (1mk)
(c) Explain why it is not advisable to store Copper (II) Sulphate solution in a can made of Zinc metal.(2mks)
(d) State **two** applications of electrolysis.   (1mk)

4. (a) What is meant by molar heat of solution?   (1mk)
    (b) The enthalpies of combustion of carbon, and carbon (II) oxide are indicated below.

    $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$: DH = 393 KJ mol^{-1}

    $CO_{(g)} + O_{2(g)} \longrightarrow CO_{2(g)}$: DH = 283 KJ mol^{-1}

    (i) Draw an energy level diagram that links the enthalpy of formation of Carbon (II) Oxide to enthalpies of combustion of carbon and Carbon (II) Oxide.   (2mks)
    (ii) Determine the enthalpy of formation of Carbon (II) Oxide.   (2mks)
    (c) The set up below was used by a student to determine the enthalpy of combustion of ethanol (CH_3CH_2OH). Study it and answer the questions that follow.
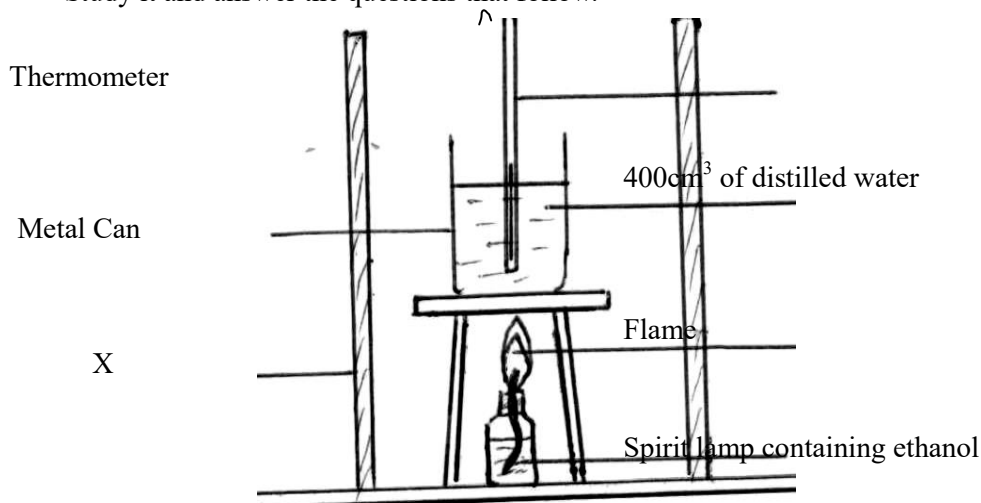
The following data was collected from the experiment:

Initial temperature of water	12^0C
Final temperature of water	22^0C
Initial mass of spirit lamp	11.42g
Final mass of spirit lamp	10.50g
Specific heat capacity of water	$4.20Jg^{-1}k^{-1}$

    (i)   What is the function of the part labeled X.   (1mk)

    (ii) Using the data above, calculate the change in heat of combustion of ethanol, assuming density of water is $1g/cm^3$.   (2mks)

    (iii) Calculate the molar heat of combustion of Ethanol (C = 12, O = 16, H = 1)   (2mks)

    (iv) Find the heating value of ethanol.   (2mks)

  (d) Give **two** precautions necessary when using fuels.   (1mk)

5. (a) Starting with a solid sample of calcium carbonate, describe how a pure dry sample of calcium sulphate can be prepared in the laboratory.   (3mks)

  (b) The flow chart below shows a sequence of reactions involving a mixture of two salts, mixture Z. Study it and answer the questions that follow.
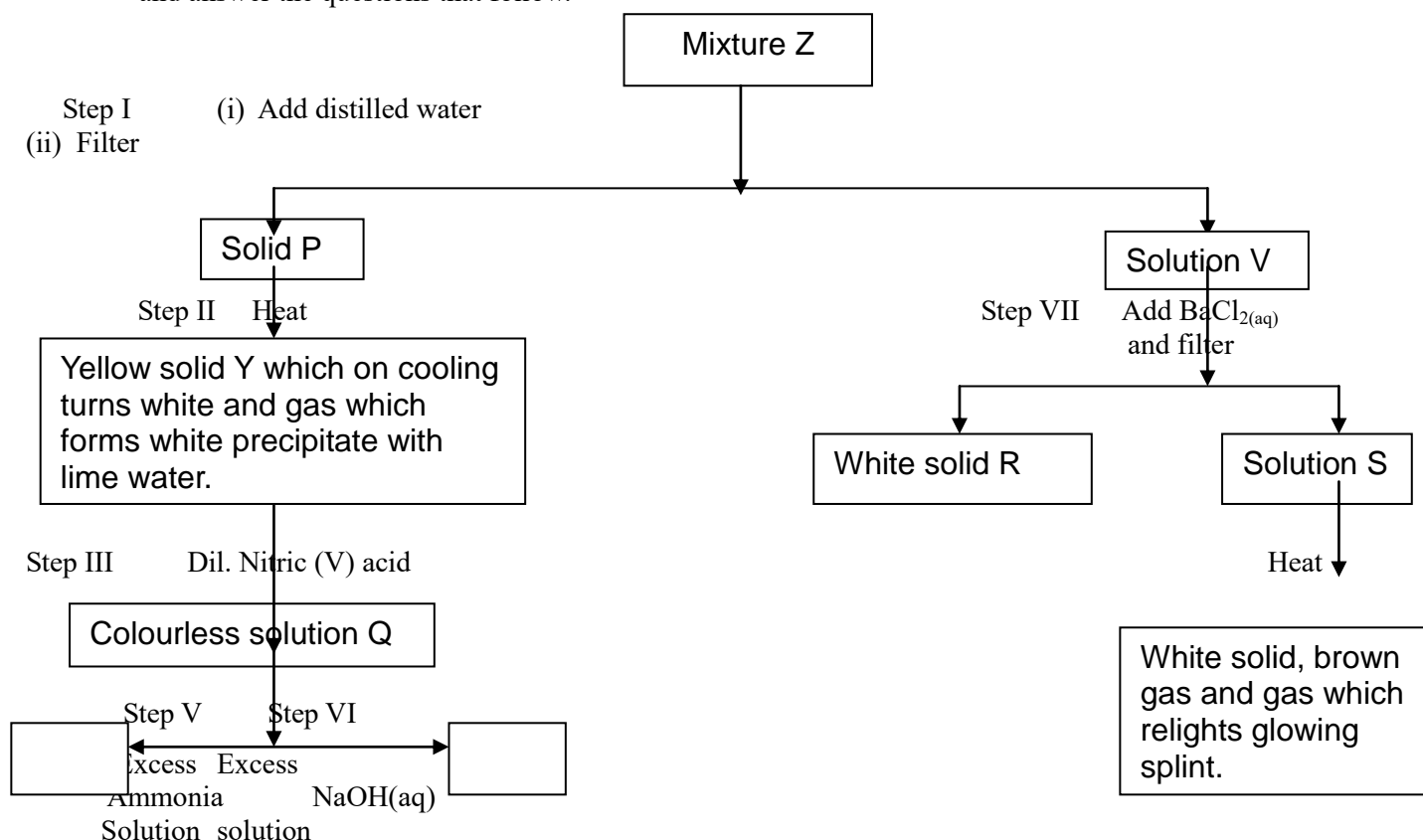
Write the formulae of the two salts present in mixture Z.   (2mks)

(c) Write an ionic equation for the reaction in step VII.   (1mk)

(d) State and explain the observation in Step (V) and (VI).   (3mks)

    (i) Step (V)

    (ii) Step (VI)

(e) Write an equation showing the effect of heating a sample of anhydrous copper (II) suphate in a test tube.   (1mk)

123

29. The grid below forms part of the Periodic Table. Use it to answer the questions that follow.
The letters do not represent the actual symbols of element.

					C	M	D	E	F
A									
	B			H	I		J	K	
	G								

(a) (i) What name is given to the group of elements where B and G belong?   (1mk)
(ii) Select a letter which represents an element that gain electrons most readily. Give a reason for your
answer.   (2mks)
(iii) Explain why the atomic radius of K is smaller than its ionic radius.   (2mks)
(iv) Using dots (•) and crosses(x) show the bonding between element G and M.   (2mks)
(v) A carbonate of element G react with dilute sulphuric (VI) acid at s.t.p to produce $0.4dm^3$ of gas.
Determine the mass of G which was reacted with the acid. (Molar gas volume at s.t.p is $22.4dm^3$. (Relative
atomic mass of G = 24 and C = 12, O = 16)   (2mks)
(b) Explain why sodium chloride has melting point of 1074^0C whereas silicon tetrachloride has a melting point
of 203^0C under the same conditions.   (2mks)

COMPLIANT I
233/3
 CHEMISTRY PRACTICALS
CONFIDENTIAL
INSTRUCTIONS TO SCHOOLS

Each candidate will require the following in addition to the apparatus and fittings in a Chemistry Laboratory:-
1. $100cm^2$ of solution Q.
2.   Accurately weighed 0.4g of hydrated euthanedioic acid – Solution T.
3.   One burette – 50ml.
4.   One pipette – 25ml.
5.   One pipette filler.
6.   One 250ml volumetric flask.
7.   One thermometer – 10^0C – 110^0C.
8.   One boiling tube.
9.   Six test-tubes in a rack.
10.   One metallic spatula.
11. $400cm^2$ of distilled water.
12.   Means of labeling.
13.   About 1g of $NaHCO_3$ – Solid A.
14. $5cm^3$ of solution D.
15.   About 1g of solid R.
16.   Bunsen burner.

Access to:-
•   2M aqueous ammonia solution supplied with a dropper.
•   Phenolphthalein indicator supplied with a dropper.
•   0.5M KI solution.
•   2M HCL
•   2M NaOH
•   Zinc granules.
•   Acidified $KMnO_4$ supplied with a dropper.
•   Acidified $K_2Cr_2O_7$ supplied with a dropper.
•   Solution D is a mixture of $Pb(NO_3)_2$ and $Cu(NO_3)_2$
•   Solid R is a maleic acid.

COMPLIANT I
233/3
CHEMISTRY
PAPER 3
PRACTICAL
1. You are provided with:-
•   4.5g of solid P in a boiling tube.
•   Solution Q, 0.2M sodium hydroxide.
•   Phenolphthalein indicator.
You are required to determine:
(i)   Solubility of solid **P** at different temperatures.
(ii)   The value of **n** in the formula $(HX)_n \cdot 2H_2O$ of solid P.

Procedure I
(i)   (a) Fill the burette with distilled water. Using the burette, add $4.0cm^3$ of distilled water to solid P in
           a boiling tube. Heat the mixture in a water bath while stirring with a thermometer to about 70^0C until all the
           solid dissolves.
      (b) Allow the solution to cool while stirring with the thermometer and note the temperature at which crystals of
           solid P start to appear. Record this temperature in table I.

125

(c) Using the burette, add 2.0cm^3 of distilled water to the contents of the boiling tube. Heat the mixture while stirring with the thermometer until all the solid dissolves while in the water bath.

(d) Allow the mixture to cool while stirring and note the temperature at which crystals of solid P start to appear.

(e) Repeat the procedure (c) and (d) three more times, heating the solution in a water bath and record the temperature in the table I. *Retain the contents of the boiling tube for use in procedure II.*

(ii) Complete the table by calculating the solubility of solid P at the different temperatures. (The solubility of substance is the mass of that substance that dissolves in 100cm^3 (100gm) of water at a particular temperature.

TABLE I

Volume of water in boiling tube (cm^3)	Temperatures at which crystals of solid P first appear (^{0}C)	Solubility of solid P (g/100g) of water
4		
6		
8		
10		
12		

(6mks)

(i) On the grid provided, plot a graph of solubility P against temperature.   (3mks)

(ii) Using your graph, determine the temperature at which 100g of solid P would dissolve in 100cm^3 of water.
(1mk)

(iii) Determine the solubility of solid P at 55^{0}C.   (1mk)

Procedure II

• Transfer the contents of the boiling tube from Procedure I into 250ml volumetric flask. Rinse the boiling tube and the thermometer with distilled water and add to the volumetric flask.

• Add more distilled water to make up the mark. Label this solution P.

• Fill the burette with solution P. Using a pipette and pipette filler place 25.0cm^3 of solution Q into a conical flask.

• Titrate solution Q with solution P using phenolphthalein indicator.

Table II

	I	II	III
Final burette reading cm^3			
Initial burette reading cm^3			
Volume of **P** used cm^3			

(4mks)

Calculate the:
(i)   Average volume of solution P used in the experiment.   (1mk)
(ii)   Number of moles of sodium hydroxide used in solution Q.   (2mks)
(iii)   Number of moles of solution P given that the relative formula mass of P, $(HX)_n\cdot2H_2O$ is 126.   (2mks)
(iv)   The number of moles of sodium hydroxide required to react with one mole of P. Hence find the value of n in the formula $(HX)_n\cdot2H_2O$.   (2mks)

2.   You are provided with solid **W** and solution **K**. You are required to carry out the tests prescribed in solid **W** and solution **K**. Write your observation and inferences accordingly.
       (a) Place all solid **W** in a boiling tube.
(i)   Add about 10cm^3 of distilled water to solid W, and shake.

Observations	Inference
(1mk)	(1mk)

  (ii)   Divide the product in (i) into four equal portions. Add 5 drops of 2M sodium hydroxide solution to the first portion.

Observation	Inference
(1mk)	(1mk)

(iii)   Add 2 – 3 drops of lead (II) nitrate solution to the second portion.

Observation	Inference
(1mk)	(1mk)

(iv)   To the third portion, add 2 – 3 drops of barium (II) chloride provided followed by 5 drops of 2M hydrochloric acid. Shake the mixture well.

Observation	Inferences
(1mk)	(1mk)

(v)   Add 5 drops of acidified potassium chromate (VI) to the fourth portion.

Observation	Inferences

127

(1mk)   (1mk)

(b)

(i)   To about 2cm^3 of solution K, add few drops of sodium hydroxide till in excess.

Observation	Inference
(1mk)	(1mk)

(ii)   To about 2cm^3 of solution K, add 2 – 3 drops of Barium chloride solution.

Observation	Inference
(1mk)	(1mk)

(I)   To about 2cm^3 of solution K, add 2cm^3 of bromine water provided.

Observation	Inference
(1mk)	(1mk)

(II)   To about 2cm^3 of solution K, add 2 – 3 drops of lead (II) nitrate solution.

Observation	Inferences
(1mk)	(1mk)

KIGUMO EXAMS
CHEMISTRY
231/1
SECTION A

1. Study the nuclides below

Nuclide	Mass number	Atomic Number	No. of Neutrons	%Abudance
A1	36	18	-	0.34
A2	38	18	-	0.06
A3	40	18	-	99.6

   (i)   Calculate the number neutrons on each isotopes (1mk)
   (ii)   Calculate the relative atomic mass of nuclide A (2mk)
   (iii)   Give two commercial uses of Oxygen (1mk)

2. In terms of electron define the following terms
   (i)   Oxidation (1mk)
   (ii)   Reduction (1mk)

3. (a) Differentiate between a strong acid and a concentrated acid. (2mk)
   (b) State the types of hardness in water. (1mk)

4. The table below gives the solubilities of salts Q and P at O°C and 40°C

Salt	Solubility g/100g of water	
Q	55	75
P	10	12

When an aqueous mixture of 60g of Q and 7g of P in 100g of water at 80°C was cooled to O°C some crystals were formed.
  i. Identify the crystals formed. (1MK)
  ii. How much crystals in grams were formed. (1MK)

5. When 5.04g of mixture of anhydrous Sodium carbonate and sodium hydrogen carbonate were heated to a constant mass of 4.11g residue.
   a.Write an equation for the reaction that takes place when the mixture is heated. (1MK)
   b.   Calculate the percentage of anhydrous sodium carbonate in the mixture. (2MKS)

6. One mole hydrogen chloride gas reacts with an organic compound Z to give a simple product with structural formula shown below
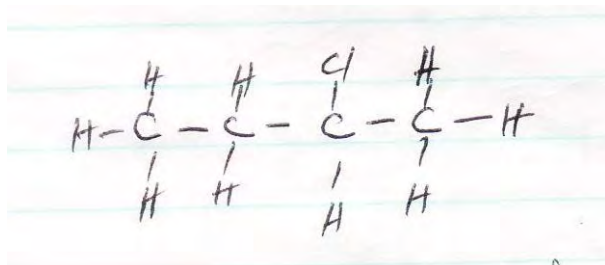
   a. Name the product (1MK)
   b.   Draw the structural formula of the compound Z (1MK)
   c. To which homologous series does compound Z belong? (1MK)

7. What is meant by the term enthalpy of neutralization (1MK)

8 a) State Graham's law of diffusion (2MKS)

b) A certain volume of gas P takes 180 seconds to diffuse through a porous plug. Molar mass of P is 18g. Equal volume of gas Q takes 240 seconds. Calculate the molar mass of Q. (2MKS)

9. Calcium nitrate is a nitrogenous fertilizer. Calculate the percentage of nitrogen in the fertilizer. (2MKS) (Ca=40,N=14,O=16.)

10. a) Distinguish between nuclear fission and nuclear fusion (1MKS)
    b) K grammes of a radio-active isotope decay to 6.5g in 100 days. The half-life of the isotope is 25 days
    i. What is meant by half-life (1MK)
    ii. Calculate the initial mass of isotope K (2 MKS)

11. Study the scheme below and answer the questions that follow

```
        ┌─────────────────────────────────┐
        │   Solid G + ca (OH)₂ PASTE      │
        └─────────────────────────────────┘
                        │
    Step 1              │  Warm
                        ▼
        ┌─────────────────────────────────┐
        │         Ammonia gas             │
        └─────────────────────────────────┘
                        │
    Step ii             │  Bubble over Aluminum
                        │      Sulphate
                        ▼
        ┌─────────────────────────────────┐
        │          Solid H                │
        └─────────────────────────────────┘
```
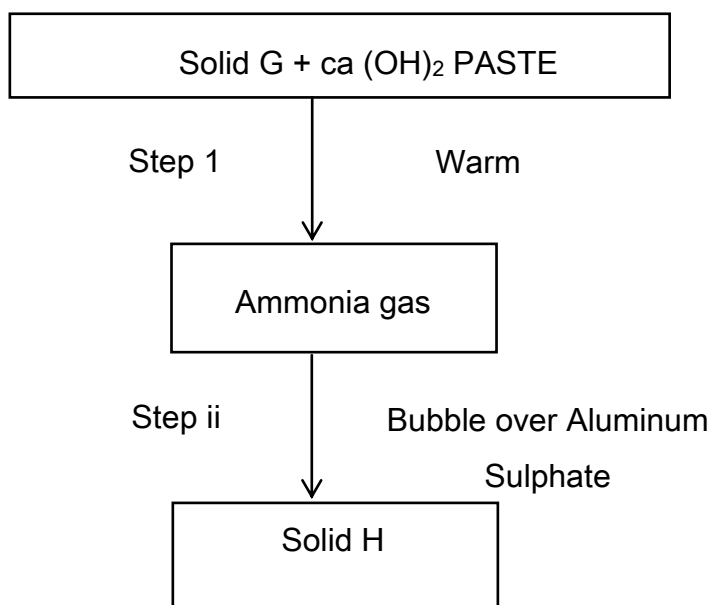
a. Identify solid G (1MK)
b. Write an ionic equation for the reaction in step II that produces solid H (1MK)

12. Study the standard electrode potentials for the half cells given below and answer the questions that follow. The letters do not represent the actual symbols of the element.

$$N^+_{(aq)} + e^- \longrightarrow N_{(S)} \quad -2.92$$
$$J^+_{(aq)} + e^- \longrightarrow J_{(s)} \quad +0.52$$
$$K^+_{(aq)} + e^- \longrightarrow \tfrac{1}{2} K_2 \quad 0.00$$
$$\tfrac{1}{2} G_{2(g)} + e^- \longrightarrow G^-_{(aq)} \quad +1.36$$
$$M^{2+}_{(aq)} + 2 e^- \longrightarrow M_{(s)} \quad +0.44$$

a. Which is the strongest reducing agent? Give a reason for your answer (1MK)
b. Which of the two half-cells would produce the highest potential difference when connected? (1MK)
c. Calculate the E.M.F of the cell in (b) above (1MK)

13. A hydrated salt has the following composition by mass Iron 20.2%, Oxygen 23.0% sulphur 11.5 % and the rest is water. If its relative formula mass is 278,. Determine the formula of the hydrated salt
(3MKS)

14. a) Name the two crystalline allotropes of sulphur (1MK)
    b) Why is sulphur (VI) oxide not absorbed directly into water in the contact process (1MK)

15. Study the arrangement below and answer the questions that follow.
    Explain what will be observed after sometime. (2MKS)

16. Study the flow chart below and answer the questions that follow
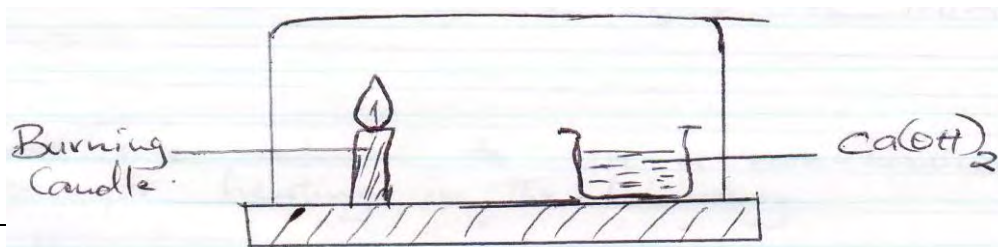
Solid P →
  Yellow solid | colorless soln Add → → Insoluble salt → Add
                 Brown
                 Dil. HNO₃   HCL
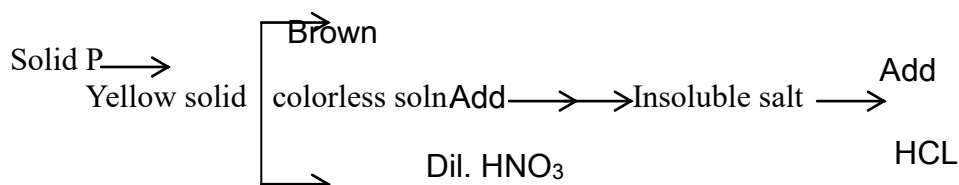
   a. Identify two ions present in solid P
      i. Anion-
      ii. Cation-
   b.   Write the ionic equation for the reaction that takes place during the formation of insoluble
         salt.   (1MK)
17. Sodium chloride is accidentally mixed with lead (II) sulphate. Explain how sodium chloride crystals can be
    obtained from the mixture.   (2MKS)
18. Students are advised to use a non-luminous flame for heating in the laboratory
    a. How does a Bunsen burner produce a non-luminous flame   (1MK)
    b. Give one reason why the advice is given to students.   (1MK)
19. In the last stage of Solvay process a mixture of sodium hydrogen carbonate and ammonium chloride is formed.
    (i) State the method of separation used   (1MK)
    (ii) Write an equation showing how lime is slaked   (1Mk)
20. a) State and explain why Magnesium ribbon continues to burn in a gas jar full of sulphur (IV) oxide although
    the gas does not support combustion   (2MK)
    b) Chorine gas is passed through a solution of potassium bromide in water as shown below.
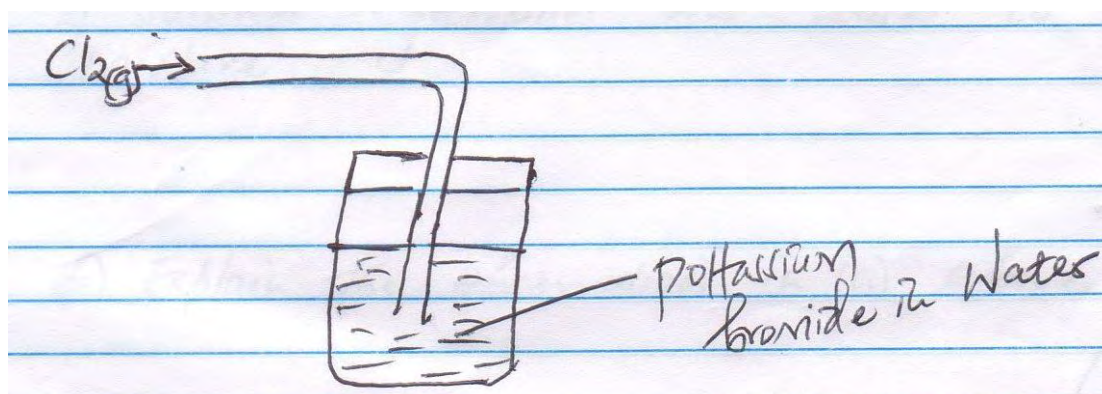
    State and explain the observation made   (2MKS)
21. Aluminium is extracted from its ore by the process of electrolysis.
     (i) Name the ore from which aluminium is normally extracted   (1MK)
     (ii) Graphite electrodes are used in the above process. Give the advantage of using graphite? (1MK)
22. Study the reversible reaction below
    $2\ CrO_{4(aq)}^{-} + 2H^{+}_{(aq)} \rightleftharpoons Cr_2 O_{7(aq)}^{2-} + H_2O_{(l)}$
     (Yellow)   (Orange)

    (i) State the colour change if few drops of sodium hydroxide was added to the mixture. (1MK)
    (ii) Explain the observation in (a) above   (1MK)

23. Study the table and answer the questions that follow

Formulae of ion	Electronic configuration of ion
A^{2+}	2
B^{-}	2.8
C^{2-}	2.8.8
D^{3+}	2.8

E^{2+} 2.8

Select the elements in
i. Same group   (1/2 MKS)
ii. Period II   (1/2 MKS)

Write the electronic configuration of elements
i. C   (1/2 MKS)
ii. D   (1/2 MKS)

24. Use the bond energies given below to calculate the enthalpy change for the reaction

Bond	Energy kj/mole
C – H	413
C – Br	280
Br – Br	193
H – Br	365

$C_2 H_{6 (g)} + Br_{2(g)} \longrightarrow C_2H_5 Br_{(g)} + HBr_{(g)}$ (2MKS)
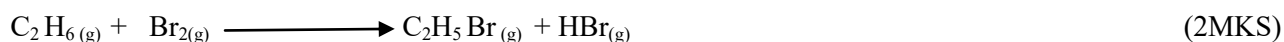
25. Study the organic compound below
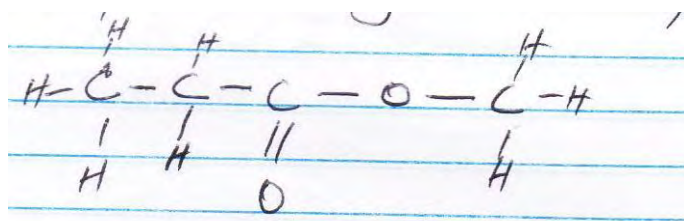
a.   In which homologous series does the compound belong to?   (1MKS)
b. Name and draw the structure of two compounds that can be used to prepare the above compound
(2MKS)
26. The grid below shows a section of the periodic table. The letters do not represent the actual symbols for elements. Study it and answer the question that follows.
a) Give the name of the family in which element H and I belong.   (1MK)

141

b) Compare the atomic radii of elements.
   i)   F and G explain   (1MK)
   ii) D and I Explain   (1MK)

27. The set-up below was used to prepare hydrogen gas. Study it and answer the questions that follow
   i. What would be liquid G   (1MK)
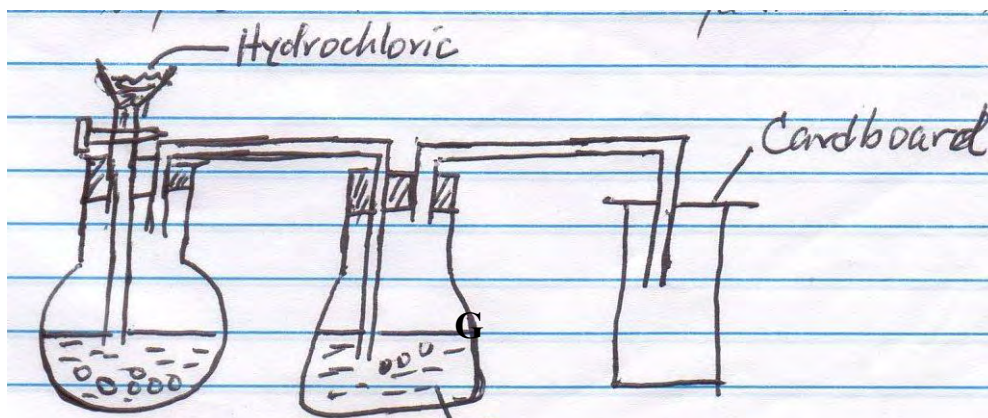
   ii. Is the method of collecting the gas correct? Give a reason   (1MK)
   iii. Give two physical properties of hydrogen gas   (1MK)

28 . Given sodium carbonate, Lead (ii) nitrate solid and water, explain how you can obtain a solid sample of lead (ii) carbonate.   (3MK)

29. Solution can be classified as acid ,base and neutral. The table below shows solutions and their pH value.

Solution	PH value
R	2.5
S	6.9
T	13.5

   Identify two solutions that would react with Aluminum Oxide. Explain   (2MKS)

142

KIGUMO CLUSTER
CHEMISTRY
PP2

1. (a) Define an electrolyte. **(1mark)**
   (b) The set-up below was used to carry out electrolysis of an aqueous solution of magnesium sulphate using carbon electrodes.
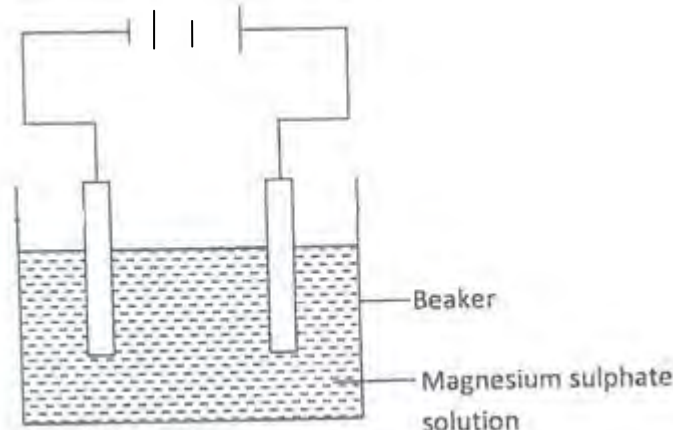
   i) State and explain the observation made at the cathode. **(1 mark)**
   (ii) Write down an equation for the reaction that occurs at the anode. **(1mark)**
   (iii) What change occurred to the concentration of magnesium sulphate solution during the experiment? Explain. **(3 marks)**

   (c) During the electrolysis of dilute copper (II) chloride, the mass of the platinum cathode increased by 3.2g. If a current of 2.5 amperes was passed through the solution for some time, calculate the time taken. (Cu= 64.0; 1 faraday = 96,500 Coulombs) **(3 marks)**

   (d) Use the information below to answer the question that follows.
   $Al^{3+}(aq) + 3e \longrightarrow Al(s)$ $E^\theta = -1.66v$
   $Fe^{2+}(aq) + 2e^- \rightleftharpoons Fe(s)$ $E^\theta = -0.44v$
   Why is it not advisable to keep a solution of iron (II) nitrate in a container made of aluminium? **(2 marks)**

   (e) Other than electroplating, give one application of electrolysis. **(1 mark)**

2. a) Draw the structural formula of . **(3 marks)**
   (i) Propan-1-ol
   (ii) Pent-2-yne
   (iii) 2,3-dimethylbutane

   (b) Study the reaction scheme below and answer the questions that follow.
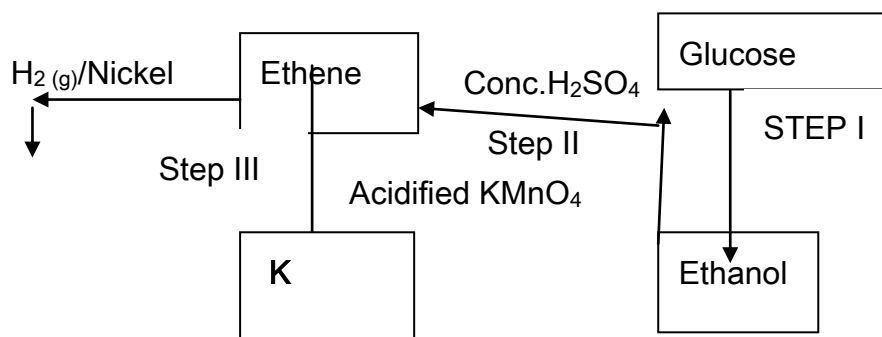
   (i) Name the process in step I **(1 mark)**
   (ii) Give the two conditions necessary in step II **(2 marks)**
   (iii) State the observation made in step III. **(1 mark)**
   (iv) Name compound J. **(1 mark)**
   (v) Draw the structural formula of compound K. **(1 mark)**

143

(c) Water is added dropwise to calcium carbide in a conical flask.
   (i)Identify the gas produced. **(1 mark)**
  (ii)Write a chemical equation for the reaction that occurs. **(1 mark)**

(d) Part of a polymer is required below.

$$\begin{array}{ccccccc} & H & & H & & H & & H \\ & | & & | & & | & & | \\ -\!\!\!-\, & C & -\!\!\!- & C & -\!\!\!- & C & -\!\!\!- & C & -\!\!\!- \\ & | & & | & & | & & | \\ & H & & CH_3 & & H & & CH_3 \end{array}$$
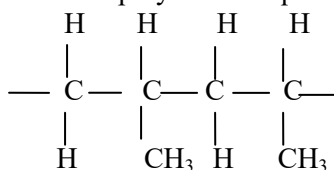
  (i) Draw the structural formula of the monomer of this polymer. **(1 mark)**
  (ii) State one use of this polymer. **(1 mark)**

3. 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 the elements.

Y	R					Q	X	
	V		W					U

(a) Select an element whose oxide is amphoteric. **(1 mark)**
(b) On the grid indicate with letter J the position of element J which is in period 3 and forms a stable ion J^{2-}.
  (1 mark)
(c) Draw a dot-cross diagram to show bonding in the compound consisting of elements V and X only. **(2 marks)**
(d) Write an equation to show the formation of an ion of R. **(1 mark)**
(e) Which is the least reactive element? Give a reason for your answer. **(2 marks)**
(f) Write an equation for the reaction that occurs when element Y is placed in water. **(1 mark)**
(g) How does the atomic radius of W compare with that of V? Explain. **(2 marks)**
(h) Name the chemical family to which elements R and V belong. **(1 mark)**

4. a) Use the chart below to answer the questions that follow.

Iron —Steam→ Gas N → Lead (II) oxide /heat → Solid
Iron —Steam→ Solid P
Solid ⊥ Liquid L
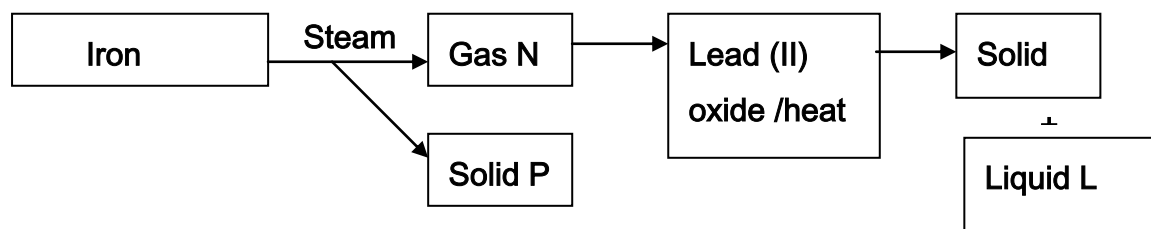
Identify:
Gas **N** …………………………………………………………………………. **(½ mark)**
Solid **P** ……………………………………………………………………….. **(½ mark)**
Solid M………………………………………………………………………… **(½ mark)**
Liquid **L**………………………………………………………………….. **(½ mark)**

b) Name the method that can be used to extract oil from castor oil seeds. **(1 mark)**
c) i) In the method named above, state the property of oil that enables the extraction to take   place. (**1 mark**)
  ii) Describe an experimental procedure that can be used to extract oil from the seeds. **(3 marks)**
d) How is phosphorus stored in the laboratory? Explain your answer. **(1 mark)**
e) i) In the fractional distillation of liquid air water is removed, name two other substances that are removed.
  (1 mark)
  ii) Why must water be removed? **(1 mark)**
  iii) State the processes involved in fractional distillation of liquid air. **(2 marks)**

5. Study the flow chart below showing the Solvay process and use it to answer the questions that follow.
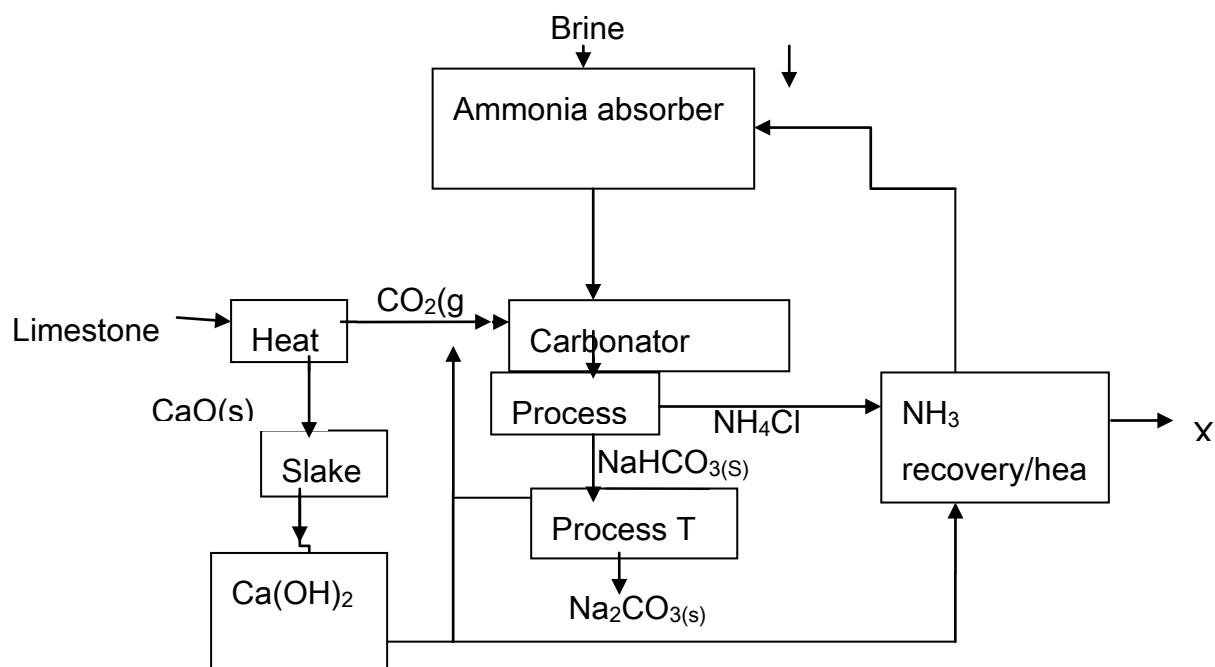
a) Write the equation for the reaction producing substance X. **(1 mark)**
b) Name processes Y and T. **(1 mark)**
c) In the carbonator, two reactions take place. Write the two equations for the reactions. **(2 marks)**
d) Explain why the Solvay process is said to be one of the most efficient industrial process. **(1 marks)**
e) 16.8g of sodium hydrogen carbonate are completely decomposed by heating. Calculate;
   i) the mass of the resulting solid produced. **(3 marks)**
   ii) the volume in litres of the gas produced at s.t.p **(2 marks)**

   (Molar Gas Volume at s.t.p =22400 cm^3, Na=23.0, C=12.0, H= 1.0, O=16.0)
f) Give two industrial uses of sodium carbonate. **(1 mark)**

6. The diagram below shows the electrolysis process in the extraction of aluminium. Study it and answer the questions
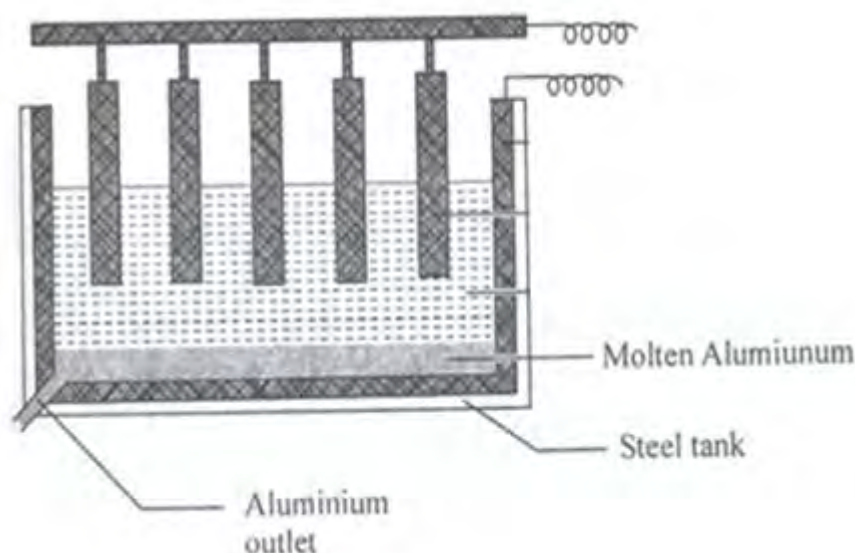
that follow.
a) i) Name the main ore from which aluminium is extracted from. **(1 mark)**
   .ii) Explain how the impurities present in the ore are removed. **(3 marks)**
b) Label on the diagram the anode and the cathode. **(1 mark)**

145

c) The melting point of aluminium oxide is $2015^{\circ}C$ but the electrolysis is carried out at temperature of around $800^{\circ}C$.

    i) Why is the electrolysis not carried out at $2015^{\circ}C$? **(1 mark)**

    ii) How is the temperature lowered to about $800^{\circ}C$? **(1 mark)**

d) Duralumin (an alloy of aluminium) is preferred to pure aluminium in the construction of aeroplane bodies.
Give **two** properties that make it suitable for making the aeroplane bodies. **(2 marks)**

7. a) State two reasons why wood charcoal is not a suitable fuel for cooking. **(1 mark)**

    b) The diagram below represents a set up that was used to determine the molar heat of combustion of ethanol.
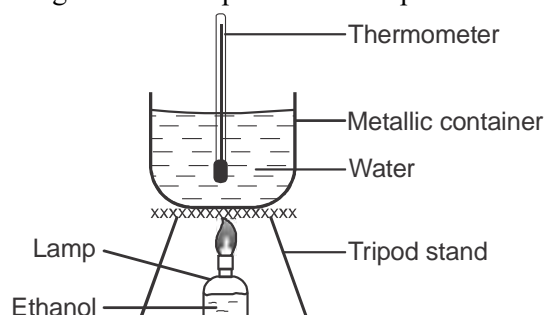
    During the experiment the data given below was recorded :
Volume of water = $450cm^3$
Initial temperature of water = $24.0^{\circ}C$
Final temperature of water = $45.5^{\circ}C$
Mass of ethanol + lamp before burning = 113.5g
Mass of ethanol + lamp after burning = 112.0g

I. Calculate the :
i)Heat evolved during the experiment (density of water = $1g/cm^3$, specific heat capacity of water = $4.2Jg^{-1}K^{-1}$) **(2 marks)**

ii)Molar heat of combustion of ethanol. (C = 12.0, O = 16.0, H = 1.0) **(1½ marks)**

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

III. The value of the molar heat of combustion of ethanol obtained in b(ii) above is lower than the theoretical value. State two reasons which lead to this. **(2 marks)**

IV. On the axis below, draw an energy level diagram for combustion of ethanol. **(1½ marks)**

c) In order to determine the molar enthalpy of neutralization of sodium hydroxide, $50cm^3$ of 2M sodium hydroxide and $50cm^3$ of 2M hydrochloric acid both at the same initial temperature were mixed and stirred continuously with a thermometer. The temperature of the resulting solution was recorded after every 15 seconds until the highest temperature of the solution was attained. Thereafter the temperature of the solution was recorded for a further two minutes.
The sketch below was obtained when the temperature of the mixture were plotted against time. Study and answer the questions that follow.

146
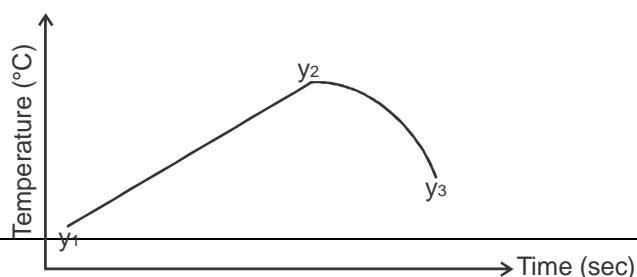
i)What is the significance of point y_2 **(1mark)**

(1 mark)

ii) Explain why there is a temperature change between points y_1 and **y_2** **(1 mark)**

iii) Explain how the value of temperature rise obtained in this experiment would compare with the one that would be obtained if the experiment was repeated using 50cm^3 of 2M methanoic acid instead of hydrochloric acid.

(2 marks)

KIGUMO CLUSTER EXAMINATION
TERM II
FORM 4 EXAM
CHEMISTRY PRACTICAL CONFIDENTIAL

Besides the usual laboratory fittings and equipment's each student requires
-sulphuric (VI) acid solution P 60cm^3
0.7 M sodium hydroxide 100cm^3
Magnesium powder 0.24 g weighed exactly
Solid c(approx. 1g)
Metallic spatula
Thermometer
Burette
Pipette
2 Conical flasks
Measuring cylinder 100ml
Measuring cylinder 10ml
Plastic beaker 100ml
Stop watch/wall clock
250ml volumetric flask
1 label
Litmus papers (blue and red)
Solid c about (1g)
1boiling tube
6 test tubes in a rack
Distilled water in a wash bottle
2 cm Universal indicator paper and chart
Sodium hydrogen carbonate (about 0.5g)

ACCESS TO
Source of heat
Phenolphthalein indicator
NH_3 (aq
Lead (ii) nitrate
HNO3 ((aq)
Ba $(NO)_3$ (aq)
Acidified kKMnO$_4$
Acidified K_2CrO_7
_NB each access solution should be supplied with dropper
SolutionP is 2M sulphuric (VI) acid
Solid C is hydrated alumunium ammonium sulphate
Solid z is table sugar. Should be in a stoppered container

KIGUMO CLUSTER EXAMINATION
CHEMISTRY
PP3
You are provided with the following;
-.07 M Sodium hydroxide
-0.24 g Mg powder
-Sulphuric (VI) acid solution P
You are required to determine the concentration of the acid

PROCEDURE 1
Using a measuring cylinder Place 50cm^3 of the acid in a plastic beaker
Using a thermometer measurethe temperature of the acid and record it in table below
Continue measuring the temperature of the acid after ever thirty seconds and record it until one and a half minute.
At exactly two minutes add all the magnesium into the acid. Stir and .continue measuring the temperature and
        recording it after every thirty seconds until the sixth minute

Time(minutes)	o	½	1	1½	2	2½	3	3½	4	4½	5	5½	6
Temperature(^{o}C)					X								

4mks

a)   on the grid below draw a graph of temperature (Y axis) against time.   (3mks)
b)   on your graph show the highest change in temperature(ΔT)   (1mk)
c)   use your value in (b) above to calculate the heat change for the reaction.
       (c=4.2J/g/kdensity of solution =1g/cm^3)   (2mks)
d)   use the energy level diagram below to calculate the moles of acid that reacted   (1mk)

H_2SO_4 (aq) + Mg (s)

$\triangle$H = -252kJ/mole

MgSO$_4$ (aq) + H$_2$ (g)

Energy kJ

Reaction path
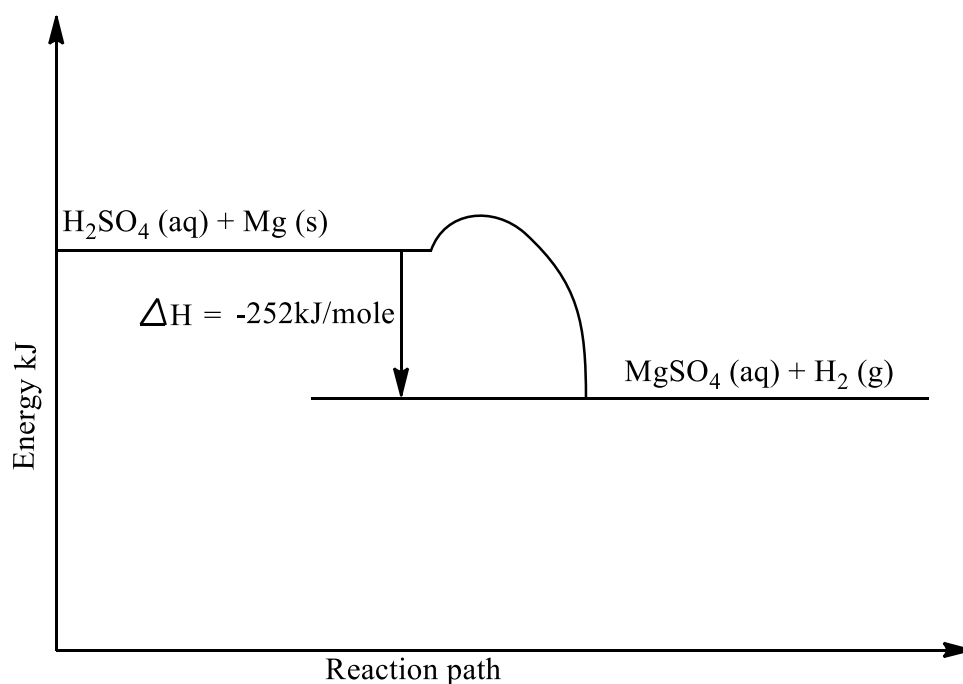
PROCEDURE 2

Transfer all the contents in the beaker into a 250ml volumetric flaskAdd distilled water as you shake to 250ml mark. Label this solution Q

Fill the burette with sodium hydroxide.

Pipette 25cm³ of Q into a clean conical flask

Carry out titration using phenolphthalein indicator

	1	2	3
Final burette reading(cm³)⁾			
Initial burette reading(cm³)			
Volume of sodium hydroxide used(cm³)			

(4mks)

e)   calculate:

(i)   the average titre volume   (1mk)

ii)   the moles ofsodium hydroxide used   (1mk)

iii)   Moles of sulphuric (vi) acid used   (1mk)

iv)   molarity of sulphuric (vi) acid in solution P   (2mk)

2.   You are provided with solid C. Carry out the following tests and write your observations and inferences in the spaces provided

a) Place a spatulaful of solid C in a boiling tube. Heat it gently then strongly. Test the gas produced if any using moist litmus papers

Observation s	inferences
1mk	1mk

b.) Put the rest of solid C in a boiling tube .Add 10cm³ of distilled water and shake. Divide the resulting solution into four portions

i) To the first portion add sodium hydroxide drop wise till in excess then warm and test any gas given off using moist pH indicator paper

Observations	inferences
1mk	1mk

ii) To the second portion add ammonia solution drop wise till in excess

observations	inferences
1mk	1mk

iii) To the third portion add a few drops of lead (ii) nitrate and warm

observations	inferences

149

1mk	1mk

a. To the fourth portion add dilute nitric (V) acid followed by barium nitrate

observations	inferences
1mk	1mk

3. You are provided with solid z. carry out the tests described below and record your observations and inferences in the spaces provided'

   ii) Ignite half a spatulaful of Z on a non luminous flame

observation	inference
1mk	1mk

   iii) Place the remaining solid in boiling tube and add $6cm^3$ of water and shake. Divide the resulting mixture into 3 portions

   iv) To the first portion add acidified potassium manganate(vII) and warm

Observation	inferences
1mk	1mk

   v) To the second portion add acidified potassium dichromate (VI) and warm.

observations	inferences
1mk	1mk

   vi) i) Using the remaining portion and the unused reagent, describe a procedure that can be used to test whether the solid is an organic acid and give expected observations if test is positive

description	observations
1mk	1mk

ii) Carry out the test you have described in e (i) above and record your observation and inferences in the spaces provided

observations	inferences
1mk	1mk

150

MURANGA SOUTH EXAMINATION
233/1
CHEMISTRY
PAPER 1

SECTION A

1. a) What is a hydrocarbon? (1mk)

    b) Give the IUPAC names of the following compounds (2mks)

$$CH_3 \quad H \quad\quad H \quad F$$
$$\quad | \quad\quad | \quad\quad | \quad\quad |$$
$$OH- \;\; C - C - \; C - \; C \quad —H$$
$$\quad | \quad\quad | \quad\quad | \quad\quad |$$
$$CH_3 \;\; CL \;\; OH \;\; H$$

$$CL \quad\quad H \quad H \quad\quad H$$
$$\;| \quad\quad\quad | \quad | \quad\quad |$$
$$H \quad C \; - \; C = C \quad C - C \text{-}H$$
$$\;| \quad\quad\quad\quad\quad\quad | \quad\quad |$$
$$H \quad\quad\quad\quad\quad\quad Br \quad H$$
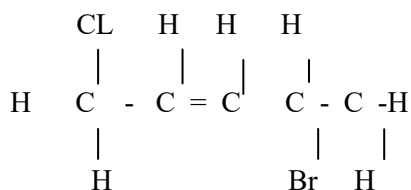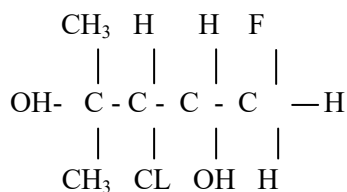
2. a) Define half-life P (1mk)

    b) 100g of a radioactive isotope was reduced to 12.5g after 81 days. Calculate the half-life of the radioisotope
    (2mks)

3. a) State Graham's law of diffusion (1mk)

    b) Hydrogen gas diffuses through a porous plug in 80 seconds. The same volume of gas W diffuses through the same aperture in 300 seconds. Calculate the molecular mass of gas W (3mks)

4. Explain why the pH of 0.1M Hydrochloric acid is lower than that of 0.1M Carbonic acid (2mks)

5. a) State Gay Lussac's law (1mk)

    b) 30cm of a hydrocarbon which is in gaseous form reacted completely with $90cm^3$ of oxygen to form $60cm^3$ of carbon (IV) oxide. Given that all the volumes were measured at the same conditions of temperature and pressure, determine the formula of the hydrocarbon (3mks)

6. a) Define allotropy (1mk)

    b) Carbon has two allotropes. Give their names and in each case state two uses (3mks)

Allotrope	Uses

7. Below is the structure of aluminium chloride
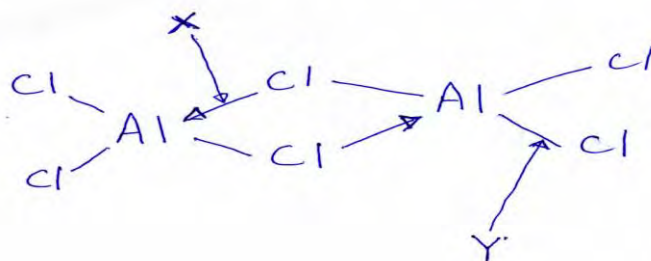
a) Identify the types of bonds labeled

    x -   (1/2 mks)

    y -   (1/2 mks)

b) When aluminium chloride is dissolved in water, the resulting solution has apH of 3. Explain (1mk)

c) Using a dot(.) and cross(x) diagram, show the bonding in a phosphine ion PH_4^+

    (P=15,H=1) (2mks)

8. The table below gives the first ionization energy of four elements. Study it and answer the questions that follow.

Element	I	II	III	IV
Ionization energy KJmol^{-1}	44	418	51	376

a) What is ionization energy? (1mk)

b) If the elements were metals, arrange them in the order of their reactivity starting with the most reactive (2mks)

9. a) Define a binary electrolyte (1mk)

  b) Study the electrode potentials below and answer the questions that follow

$$A^{2+}_{(aq)} + 2e^- \longrightarrow A_{(s)} \quad E\theta = -2.90v$$
$$B^{2+}_{(aq)} + 2e^- \longrightarrow B_{(s)} \quad E\theta = -2.38v$$
$$2C^+_{(aq)} + 2e^- \longrightarrow C_{2(g)} \quad E\theta = 0.00v$$
$$D^{2+}_{(aq)} + 2e^- \longrightarrow D_{(s)} \quad E\theta = +0.34v$$
$$\tfrac{1}{2} F_{2(g)} + e^- \longrightarrow F^-_{(aq)} \quad E\theta = +2.87v$$
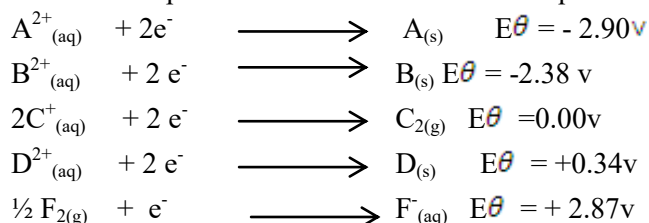
    i) Identify the strongest oxidizing agent . (1/2 mk)

    ii) Identify the half cells that will produce the highest e.m.f if they are used to form a cell (1/2mk)

    iii) Write down the cell notation for the cell identified in (ii) above (1mk)

10. Copper (II) oxide was found to be contaminated with sodium chloride crystals and iron filling. Describe how a sample of copper(II)oxide can be obtained from the mixture (3mks)

11. a) Element U has isotopes with relative abundances as shown below

isotope	% abundance
$^{10}_{5}U$	18.69
$^{11}_{5}U$	81.31

  Calculate the relative atomic mass of U. (2mks)

  b) What are isotopes (1mk)

12. a) A piece of burning magnesium was introduced into a gas jar of nitrogen gas. State the observation made. (1mk)

  b) Using a balanced equation, state and explain the observation made when water is added to the product in (a) above and the resulting solution tested with blue and red litmus papers (2mks)

13. Hydrogen Sulphide gas and Sulphur(IV) Oxide gas react as shown in the equation below.

$$2H_2S_{(g)} + SO_{2(g)} \longrightarrow 3S_{(s)} + 2H_2O_{(l)}$$

a) State one condition necessary for the reaction above to take place (1mk)

b) What property of Sulphur (IV) Oxide is illustrated above (1mk)

c) Give two uses of Sulphur (IV) Oxide (2mks)

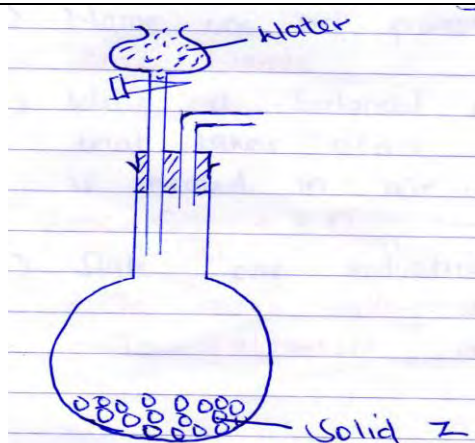14. Study the flow chart below and answer the questions that follow
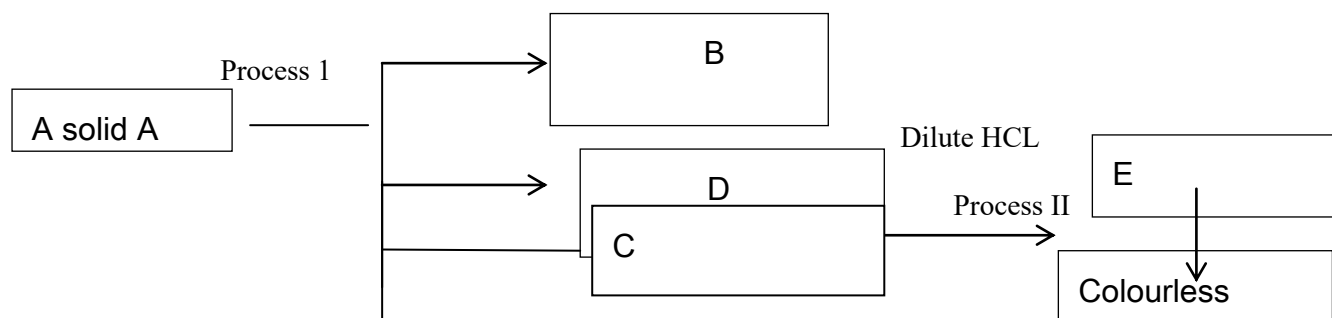
a) Identify substances ($2\frac{1}{2}$ mks)

    A -   B –
    C –   D –
    E –

b) Name process 1   (1/2 mks)

c) Write a balanced chemical equation to show the formation of B,C and D from solid A   (1mk)

d) Write down an ionic equation to show formation of the white precipitate   (1mk)

e) What does process (II) indicate about solubility of E?   (1mk)

15. The diagram below shows reaction between magnesium and steam. Study it and answer the question that follow
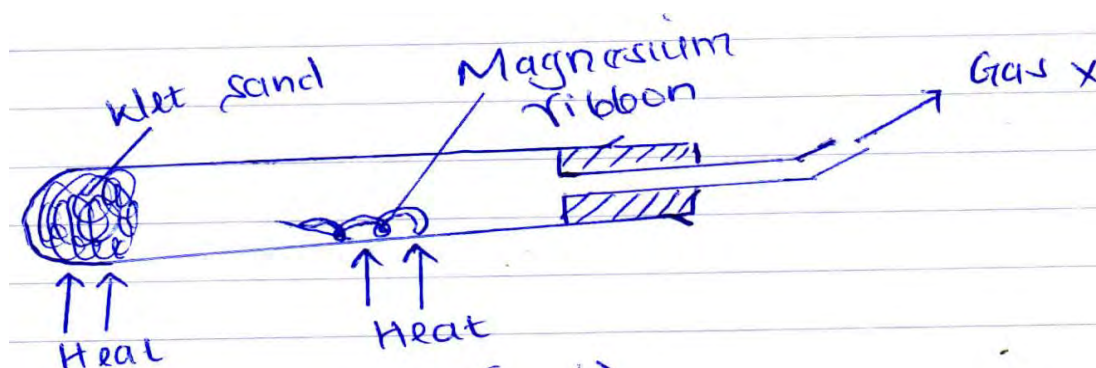
(a) Identify gas x   (1mk)

(b) Write a balanced chemical equation to show how gas x is formed (1mk)

(c) Explain how gas x can be tested in the laboratory (1mk)

16. The thermal chemical equation for a reaction between x and y is as shown below

$2X_{2(g)} + Y_{2(g)} \rightleftharpoons 2X_2Y_{(g)}$ $\Delta_{H =}$ -197kJmol^{-1}

a) Other than change in temperature, suggest two other ways in which the yield of X_2Y can be increased
                                                                      (2mks)

b) Draw a well labeled energy level diagram for the forward reaction   (2mks)

17. When a reversible reaction is taking place, the rate of the forward reaction keeps on decreasing while the rate of the backward reaction increases. A time comes when the rate of the forward reaction equals that of the backward reaction. What is the name given to this state in a reaction?   (1mk)

18. (a) Some of the uses of chlorine gas is manufacture of hydrochloric acid and CFC's

    (i)   What is meant by CFC's   (1mk)

    (ii)   State ways in which CFC's pollute the environment   (1mk)

  (b) Explain why during manufacture of hydrochloric acid a small amount of hydrogen gas is allowed to burn in chlorine   (1mk)

19. The diagram below was used by a form 2 student to prepare and collect oxygen gas.

(a) Name solid z (1mk)

(b) Complete the diagram to show how oxygen gas can be collected (2mks)

20. The flow chart below outlines some of the process involved during the extractions of zinc . study it and answer the questions that follow
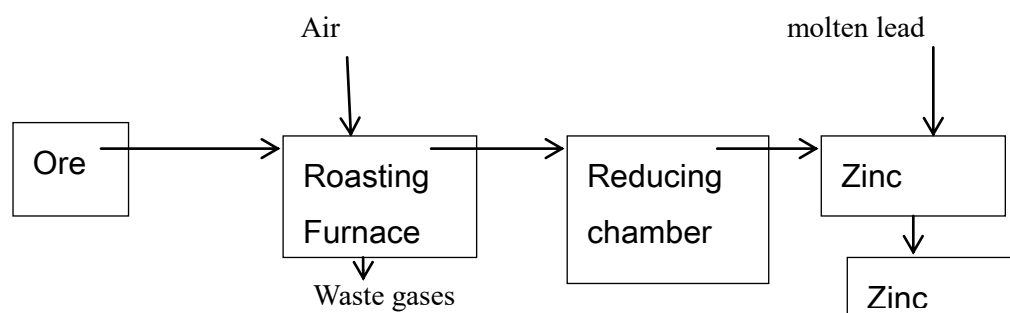
a) Name one ore from which zinc is extracted. (1mk)

b) Write a balanced chemical equation for the reaction that takes place when the ore named in (i) above is heated in air (1mk)

c) State one industrial use of zinc metal (1mk)

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

hollow tube
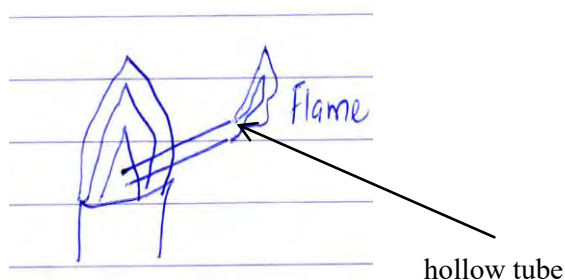
a) What does this experiment show? (1mk)

b) Name this type of flame (1mk)

c) Give one other characteristics of this flame other than the one shown (1mk)

22.   The pH values of solutions K,L,M, N and P are as shown below

Solution	K	L	M	N	P
pH value	5	2	10	7	14

a) Which solution reacts most vigorously with zinc carbonate to liberate carbon (IV) oxide (1mk)

b) A solution X reacts with both L and P. Explain (1mk)

c) When a form four students was stung by a bee, he applied solution M on the affected area. Explain (1mk)

23. a) Draw the structure of the following compound
    (i)   Sodium Ethoxide   (1mk)
    (ii)   Butanedioic acid   (1mk)

    b) Alkanols react with alkanoic acids to form a sweet smelling substance. What is the condition necessary for this reaction to take place?   (1mk)

24. Define lattice energy   (1mk)

25. (a) A student heated a platinum wire and held it in a conical flask containing concentrated ammonia as shown

(i)   What will be observed when the hot platinum wire was lowered into the conical flask   (1mk)

(c) What is the purpose of the platinum wire in this experiment?   (1mk)

(c) Write a balanced chemical equation for the reaction on the wire?   (2mks)

MURANGA SOUTH EXAMS
233/2
CHEMISTRY
PAPER 2
FORM 4
JULY/AUGUST 2018
2 HOURS

ANSWER ALL QUESTIONS IN THE SPACES PROVIDED.

1. The grid below represents part of the periodic table. Each letter represents an element but not the actual symbol of the element. Use the information provided in the grid to answer the questions that follow

G		←	elements X	→											I	J	
	H											P		M	N	Q
K	L					R										
	O															

a) What is the general name given to elements 'X' (1mk)
b) Explain how the reaction between chlorine and each of the following elements would compare
    (i) K and L (2mks)
    (ii) H and L (2mks)
c) How does reactivity of I and M compare? Give a reason for your answer (2mks)
d) Indicate the position of element W whose atomic number is 15 on the grid. Explain (2mks)
e) What type of bonding would you predict for an oxide of P? Give a reason for your answer (2mks)
f) Predict the pH of an aqueous solution of the oxide of M. Give a reason for your answer (2mks)
g) A pupil discovered that the empirical formula for the chloride of R was the same as that of the bromide of P. What would the formula of the oxide of R be? Explain (2mks)
h) Write the electron arrangement of H and Q (1mk)
i) Explain why Q does not react with oxygen gas (1mk)

2. In an experiment to the reaction between German silver (an alloy of nickel, zinc and copper) and excess Sulphuric (IV) acid, the data below was recorded. It showed the volume of gas collected after every 1 minute. Use it to answer the questions that follow

Time (minutes)	0	1	2	3	4	5	6	7	8
Total volume of gas (cm^3)	0	110	205	270	310	330	340	340	340

a) Plot the graph of volume of gas produced against time (3mks)
b) Use the graph to determine the volume of gas produced at the end of $3\frac{1}{2}$ minutes (1mk)
c) Explain why some solid remained at the end of the experiment (2mks)
d) Determine the rate of reaction between the third and fourth minutes (2mks)
e) Write a well-balanced chemical equation for reaction taking place between the alloy and Sulphuric (IV) acid.

(2mks)

3. (a) Draw the structure of the following compounds (2mks)
    (i)   2-methylbut-2-ene
    (ii) Heptanoic acid
    (b) Describe a chemical test that can be carried out to show the identity of
    (i)   2-methylbut-2-ene
    (ii) Heptanoic acid
c) Describe a physical test that can be used to distinguish between methanol and hexanol (2mks)
d) Study the flow chart below and use it to answer the questions that follow
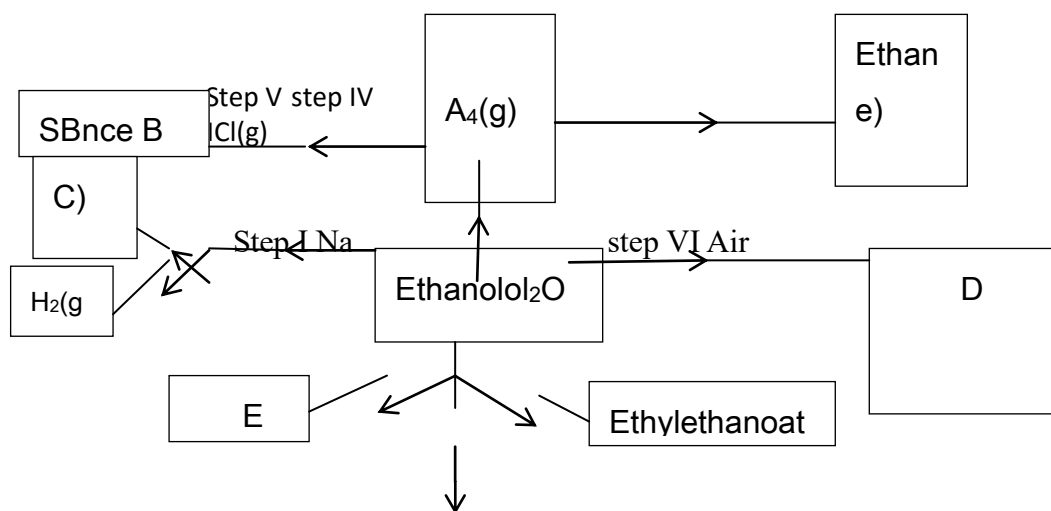
    (i)   Name
        I.   The type of reaction that occurs in step II (1mk)
        II.   Substance B (1mk)
    (ii)   Give the formula of substance C (1mk)
    (iii)   Give reagents and conditions necessary for the reaction in step IV (2mks)
            Reagents:
            Condition:

4. The diagram below shows a structure in extraction of iron metal
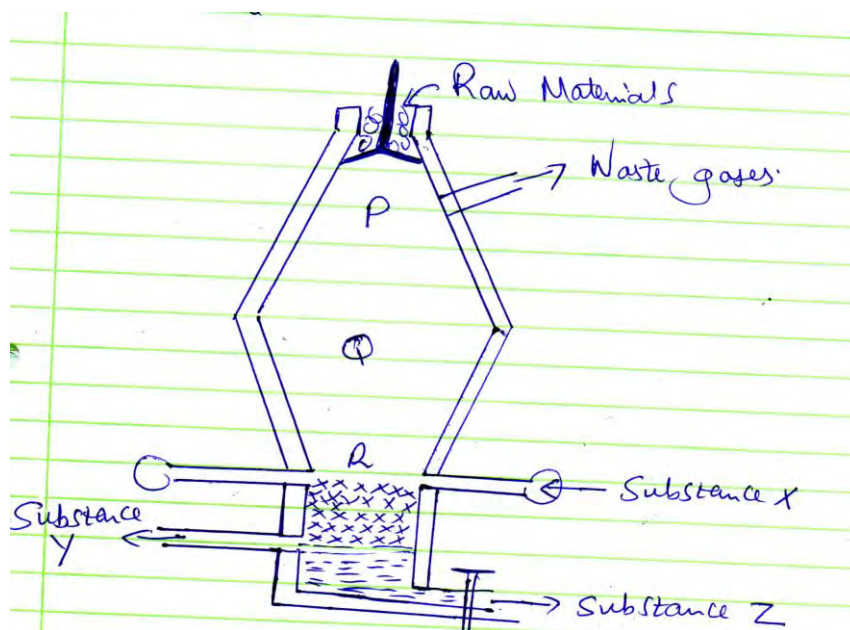
    (a) What name is given to the above structure? (1mk)

171

(b) Name the raw materials used in the process (3mks)
(c) Identify substances X,Y and Z (3mks)
(d) Give equation for the reaction leading to formation of substances Y and Z (2mks)
(e) Identify the part where temperatures are lowest (1mk)
(f) Name the waste gases in the process (2mks)

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

Half cell $E\theta$ (volts)

$A^{2+}_{(aq)} + 2e^- \longrightarrow A_{(s)}$ -2.90
$B^{2+}_{(aq)} + 2e^- \longrightarrow B_{(s)}$ -2.38
$C^{+}_{(aq)} + e^- \longrightarrow \frac{1}{2} C_{2(g)}$ 0.00
$D^{2+}_{(aq)} + 2e^- \longrightarrow D_{(s)}$ +0.34
$\frac{1}{2} F_{2(g)} + e^- \longrightarrow F^-_{(aq)}$ +2.87
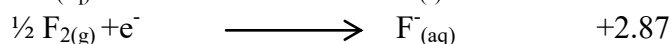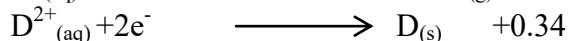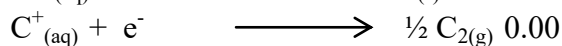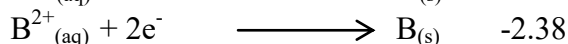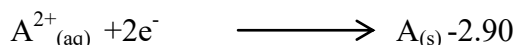
(a) Which element is likely to be hydrogen? Give a reason for your answer (2mks)
(b) What is the $E\theta$ value for the strongest reducing agent? (1mk)
(c) Draw a well labeled diagram of the electrochemical cell that would be obtained when the half-cell of B and D are combined (3mks)
(d) Calculate the $E\theta$ value of the cell in (c) above (2mks)
(e) During electrolysis of aqueous copper (II) sulphate using copper electrodes, a current of 0.2A was passed through the cell for 8hrs
  (i) Write the ionic equation for the reaction that took place at the anode (1mk)
  (ii) Determine the change in mass of the anode. (Cu = 63.5, IF =96,500C) (3mks)

6. The flow chart below illustrates two industrial processes; Haber process and Contact process
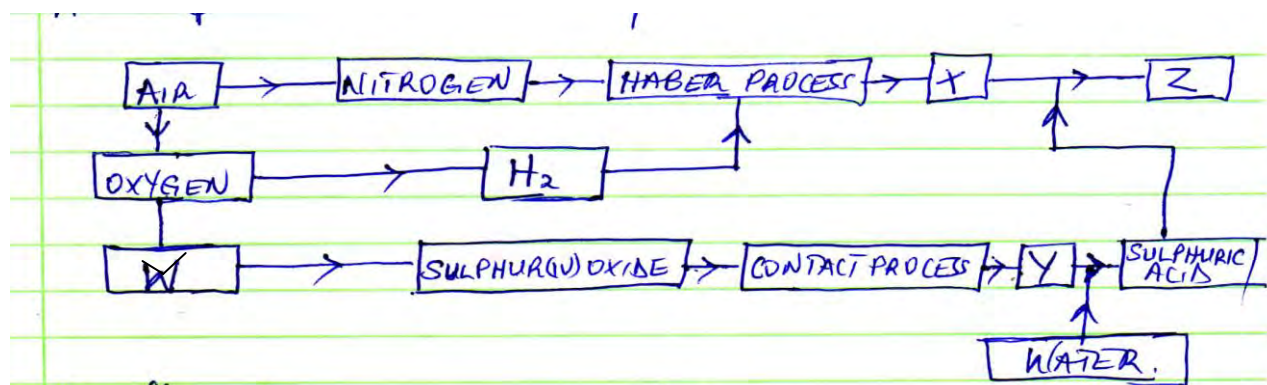
(a) (i) What process can be used to separate air into oxygen and nitrogen? (1mk)
   (iii) Apart from oxygen and nitrogen produced in the process named in (a) (i) above, name the other gas produced (1mk)
(b) Name the substances labeled (4mks)
   W-
   X-
   Y-
   Z-
(c) Name the catalyst used in (2mks)
   (i) Haber process –
   (ii) Contact process –
(d) State the role of a catalyst in both Haber and Contact process (1mk)
(e) Write a chemical equation for the formation of compound Z (1mk)
(f) Calculate the percentage mass of nitrogen in compound Z. (N=14,O=16.H=1, S=32) 3mks)
(g) Give the major use of compound Z (1mk)
(h) State the nature of ammonia gas on dissolving in water (1mk).

172

MURANGA SOUTH
233/3
CHEMISTRY
PAPER 3

1. You are provided with:
- Solution P- 0.02M acidified potassium manganate (VII)
- SolutionM – a reducing agent containing 23.5g/litre

You are required to determine the number of moles of reducing agent that react with one mole of acidified potassium manganate (VII)

Procedure

(i) Fill the burette with solution P.

(ii) Prepare 25cm^3 of solution M into a conical flask. Titrate solution M with solution P until a pink colour just appears.

(iii) Record your results in the table 1 below. Repeat the titration to complete the table 1

Table I   (4mks)

Burette readings	I	II	III
Final readings(cm^3)			
Initial readings (cm^3)			
Volume of solution p(cm^3)			

(i) Determine the average volume of solution P used   (1mk)
(ii) Determine the number of moles of potassium manganite (VII) reacting   (2mks)
(iii) Determine the concentration of solution M used in mole per dm^3(R.F.M of M=391)   (2mks)
(iv) Determine the number of moles of M in 25cm^3 solution   (2mks)
(v) Determine the number of moles of M which reacts with one mole of potassium manganate (VII)
                                                                                                                                      (1mk)

2. You are provided with the following:

i) Solution K with 0.05M Sodium thiosulphate
ii) Solution L with 2M Hydrochloric acid
iii) Distilled water

You are required to find out the effect of change of concentration on the rate of reaction between Sodium thiosulphate ($Na_2S_2O_3$) and Hydrochloric acid

Procedure

Measure 10cm^3 of sodium thiosulphate into each of the five 100ml beakers provided. Measure 15cm^3 of the 2M hydrochloric acid into a clean beaker. Make a mark (x) on a piece of paper and place the beaker containing the hydrochloric acid on the mark. Observe the cross(x) directly from above the solution in the beaker. Record the time it takes for the cross(x) to become invisible: repeat the procedure using several other volumes of hydrochloric acid and distilled water as shown in table 2

Table 2

Experiment number	1	2	3	4	5	6	7
Volume of sodium thiosulphate (cm^3)	10	10	10	10	10	10	10
Volume of 2m hydrochloric acid (cm^3)	15	13	10	8	6	4	2
Volume of water (cm^3)	0	2	5	7	9	11	13
Time taken for the cross to disappear (sec)							
Reciprocal of time (1/t) sec-1							

a) Plot a graph of volume (in cm^3) of hydrochloric against time (in seconds) taken for the cross to be invisible
                                                                                                                                      (4mks)

b) Use the graph in (a) above to estimate the;
(i) Average rate of reaction for the first four experiments   (2mks)
(ii) Rate of reaction in the fourth experiment   (2mks)
(iii) Determine the time it takes for the cross to disappear when the volume of the acid is 12cm^3 (1mk)

3. You have been provided with solid R. you are required to carry out the test below.
(a) (i) Place a spatula of solid R in a dry test-tube. Heat gently then strongly

173

Observations	Inference
(1mk)	(1mk)

(ii) Place the remaining portion in a test-tube and add water to fill it to two third. Divide the resulting solution into three equal portions.

(iii)   Add sodium hydroxide to the first portion drop- wise until in excess

Observations	Inference
(1mk)	(1mk)

iv) Add aqueous ammonia to the second portion drop- wise until in excess

Observations	Inference
(1mk)	(1mk)

(v) Add sodium sulphate drop- wise to the third portion

Observations	Inference
(1mk)	(1mk)

(b) You are provided with liquid C. Carry out the following tests and record your observations and inference in the table below. Divide the liquid into 4 portions.

(i)   To the first portion add 2 or 3 drops of acidified potassium manganate

Observations	Inference
(1mk)	(1mk)

(ii)   To the second portion add few drops of potassium dichromate (VI) solution

Observations	Inference
(1mk)	(1mk)

(iii)   To the third portion add half spatula endful of sodium hydrogen carbonate

Observations	Inference
(1/2mk)	(1/2mk)

(iv)   Place the fourth portion on a clean metallic spatula and ignite it on a Bunsen Burner flame.

Observations	Inference

174

iv) Liquid C burns with pale blue flame	R – OH present

GRAPHICS EXAMS
233/1
CHEMISTRY
PAPER 1 (THEORY)
JULY/AUGUST 2018
Time: 2 Hours

1. a) Name two major components of air? (2marks)
   b) Write an equation for the reaction that would take place when one of the components of air named in (a) above is passed over heated magnesium. (1mark)
2. Study the information given below and use it to answer the questions that follow;
   Red dye is more soluble than green dye, green is more soluble than yellow whereas blue dye is the least soluble.
   i) Represent the three dyes on a round paper chromatography. (2marks)
   ii) Name one industrial application of chromatography. (1mark)
3. a) What is a fuel? (1mark)
   b) Calculate the heat value of ethanol if its molar enthalpy of combustion is-1360kjmol^{-1}
   (C=12.0, O=16.0, H=1.0) (2marks)
4. Study the set up below and use it to answer the questions that follow.

   a) What physical property of calcium metal is demonstrated in the diagram above? (1mark)
   b) What would be observed if water was replaced with Sulphuric (VI) acid? (2marks)
5. i) What is electroplating? (1mark)
   ii) Draw a well labeled diagram to show how an iron spoon can be electroplated with silver. (2marks)
6. A hydrocarbon decolorizes chlorine gas in presence of ultra violet light but does not decolorize acidified potassium manganate (VII) solution.
   i) Name the homologous series to which the hydrocarbon belongs. (1mark)
   ii) Draw the structural formula and name the fourth member of the homologous series to which the hydrocarbon belongs? (2marks)
7. Explain why a solution of hydrogen chloride in water turns blue litmus paper red but a solution of hydrogen chloride in methylbenzene has no effect on litmus papers.

   (3marks)
8. The diagram below represents a cross section of the apparatus used to extract sulphur from its deposits. Study it and answer the questions that follow.

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

   i) A (1mark)

   ii) C (1mark)

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

183

9. Study the equation below and answer the questions which follow.

$$H_2O_{(s)} \xrightarrow[\Delta H_4]{\Delta H_1} H_2O_{(l)} \xrightarrow[\Delta H_3]{\Delta H_2} H_2O_{(g)}$$

    i) What name is given to the energy change ΔH_2? (1mark)

    ii) Indicate the sign for ΔH_1. Give a reason. (2marks)

10. Explain how you would obtain magnesium carbonate from a mixture of magnesium carbonate and sodium carbonate. (2marks)

11. 20g of potassium carbonate were dissolved in $50cm^3$ of water in a conical flask. Lemon juice was then added drop wise while shaking until there was no further observable change.
    a) Explain the observation that was made in the conical flask when the reaction was in progress. (1mark)
    b) What observation would be made if lemon juice had been added to copper turnings in a conical flask? Give a reason. (2marks)

12. Explain why a burning magnesium continues to burn in a gas jar full of carbon (IV) oxide while a burning candle would be extinguished. (3marks)

13. a) Give the names of any two reagents that when reacted with concentrated hydrochloric acid produces chlorine gas. (1mark)
    b) With the aid of an equation, explain the observation made when chlorine gas is reacted with ammonia. (2marks)

14. 8.4g of carbon (IV) oxide and 3.42g of water are formed when a hydrocarbon is burnt completely in oxygen. Determine the empirical formula of the hydrocarbon.

(H=1.0; C=12.0; O=16.0) (3marks)

15. The melting point of nitrogen is -196^0C while that of sodium is 98^0C, in terms of structure and bonding explain the differences in the melting points of nitrogen and sodium. (3marks)

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

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

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

17. The following tests were carried out on three separate portion of a colourless solution H.
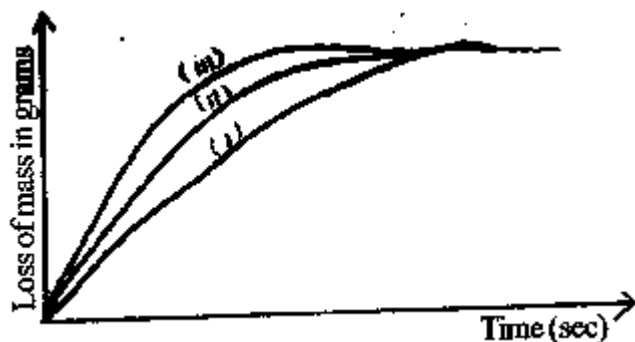
Test	Observation
i) Addition of dilute hydrochloric acid to the first portion of solution H.	Colourless gas evolved with effervescence
ii) Addition of aqueous sodium sulphate solution to the second portion of H.	No observable change
iii) Addition of aqueous sodium hydroxide solution to the third portion of solution H	White precipitate was formed which dissolved in excess sodium hydroxide solution

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

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

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

18. Sulphur forms many compounds in which its oxidation state varies.

    a) What is meant by oxidation state? (1mark)

    b) Determine the oxidation state of sulphur in $NaHSO_3$. (2marks)

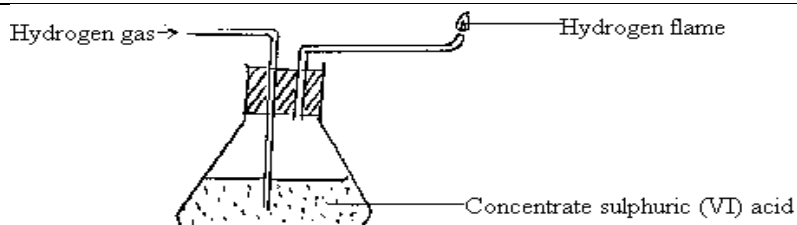19. In the industrial manufacture of ammonia gas by Harber process, Nitrogen and hydrogen gases are reacted together.

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

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

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

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

21. Distinguish between atomic mass and relative atomic mass. (2marks)

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

a) State the observation that would be made in the crucible when the circuit is switched on. (1mark)

b) Write an ionic equation for the reaction at anode. (1mark)

c) Give a reason why this experiment should be performed in the fume chamber.
(1mark)

23. The following curves are obtained from reacting the same amount of marble chips lumps with acids of different concentrations.

a) Which curve represents the reaction with;

i) Least concentrated acid? (1mark)

ii) Most concentrated acid? (1mark)

b) Which curve did the reaction complete last? (1mark)

24. a) State Charle's Law. (1mark)

b) Explain how the density of gas N compare with that of oxygen given that the time taken for equal volumes of oxygen and gas N to diffuse through the same hole is 35 seconds and 42seconds respectively. (2marks)

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

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

    i)   Physical property.   (½mark)

    ii)   Chemical property.   (½mark)

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

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

26. Elements Q, R and S have the following electronic arrangements.

    Q=2,3; R = 2,8,3 and S = 2,8,8,3

  i)   Are the elements metals or non-metals?   (1mark)

  ii) Give the formula of the compound formed when elements R reacts with a sulphate radical.   (1mark)

  iii) Selects the element that is most reactive.   (1mark)

27. Below is the structural formula of a given polymer. Use it to answer the questions that follow:

a) Name the monomer.   (1mark)

  b) State one use of the above polymer.   (1mark)

28. Sodium and magnesium fall on the same period in the periodic table and both of them are metals. Explain why magnesium is a better conductor than sodium.   (2marks)

GRAPHICS EXAMS
233/2
CHEMISTRY
Paper 2
(THEORY)
TIME 2 HOURS

1. a) The diagram below shows spot of pure substances X, Y and Z on a chromatography paper. Spot Q is that of a mixture.
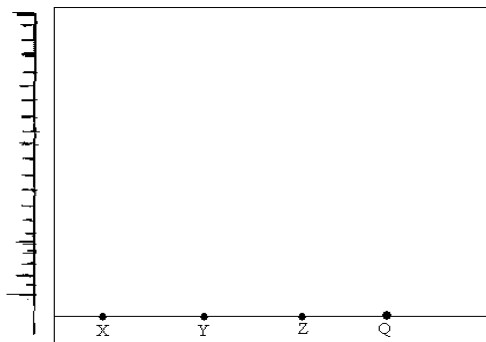
After development X, Y and Z were found to have moved 8cm, 3cm and 6cm respectively Q had separated into three spots which had moved 5cm, 6cm and 8cm.
i) On the diagram,
I. Label the baseline. (1mark)
II. Show the positions of all the spots after development. (3marks)
ii) Identify the substances present in the mixture Q. (2marks)

b) Describe how solid ammonium chloride can be separated from a solid mixture of ammonium chloride and anhydrous calcium chloride. (2marks)

c) The table below shows liquids that are miscible and those that are immiscible.

Liquid	A	B
C	Miscible	Miscible
D	Miscible	Immiscible

Use the information given to answer the questions that follow:
i) Name the method that can be used to separate A and C from a mixture of the two. (1mark)

ii) Describe how a mixture of B and D can be separated. (2marks)

2. a) Sodium hydroxide pellets were accidentally mixed with sodium chloride-18.2g of the mixture were dissolve in water to make one liter of solution. 100cm^3 of the solution was neutralized by 50cm^3 of 0.45M Sulphuric acid.
i) Write an equation for the reaction that took place. (1mark)

ii) Calculate the;
I. Number of moles of the substance that reacted with sulphuric acid. (2mark)

II. Number of moles of the substance that would react with sulphuric acid in the one litre of solution. (1mark)

III. Mass of the unreacted substance in the one litre of solution. (2marks)
(H = 1.0, Na = 23.0, Cl = 35.5, O = 16.0)

b) The diagram below shows an incomplete set-up used to prepare and collect ammonia gas.

i) Name solid P. (1mark)

187

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

c) In an experiment, excess ammonia gas was passed over heated copper (II) oxide in a combustion tube.

) State the observation that was made in the combustion tube at the end of the experiment. (1mark)

ii) What property of ammonia is shown in the above reaction?
(1mark)

iii) Give one use of ammonia. (1mark)

3. a) An atom Z can be represented as
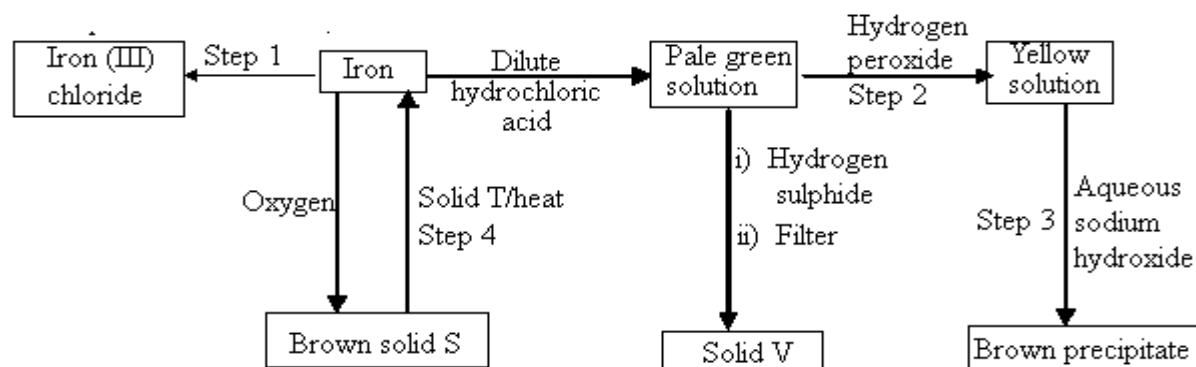
$$^{39}_{19}Z$$

What does the number 39 represent? (1mark)

b) Study the information in the table below and answer the questions that follow. (Letters are not the actual symbols of the elements).

Element	Electron arrangement of stable ion	Atomic radius (nm)	Ionic radius (nm)
L	2.8	0.072	0.136
M	2	0.152	0.068
N	2.8	0.186	0.095
O	2.8	0.160	0.065
P	2.8.8	0.099	0.181
Q	2.8.8	0.197	0.099

    i) Write the formula of the compound formed when P reacts with Q Atomic numbers are;(P = 17, Q = 20) (1mark)

    ii Identify the elements which belong to the third period of the periodic table. Explain. (2marks)

    iii) Which of the elements identified in b(ii) above comes first in the third period? (2marks)

    iv) Select two elements which are non-metals. (1mark)

c) The table below gives some properties of substances A, B, C and D. study it and answer the questions that follow;

Substance	Electrical conductivity		MP (°C)	BP (°C)
	Solid	Molten		
B	Does not conduct	Conducts	701	1320
B	Conducts	Conducts	550	1100
C	Does not conduct	Does not conduct	1600	2100
D	Does not conduct	Does not conduct	113	440

i) What type of bonding exists in substances A and B? (2marks)

ii) Which substance is likely to be sulphur? Explain (2marks)

4. a) The flow chart below shows a sequence of reactions starting with iron. Study it and answer the questions that follow;

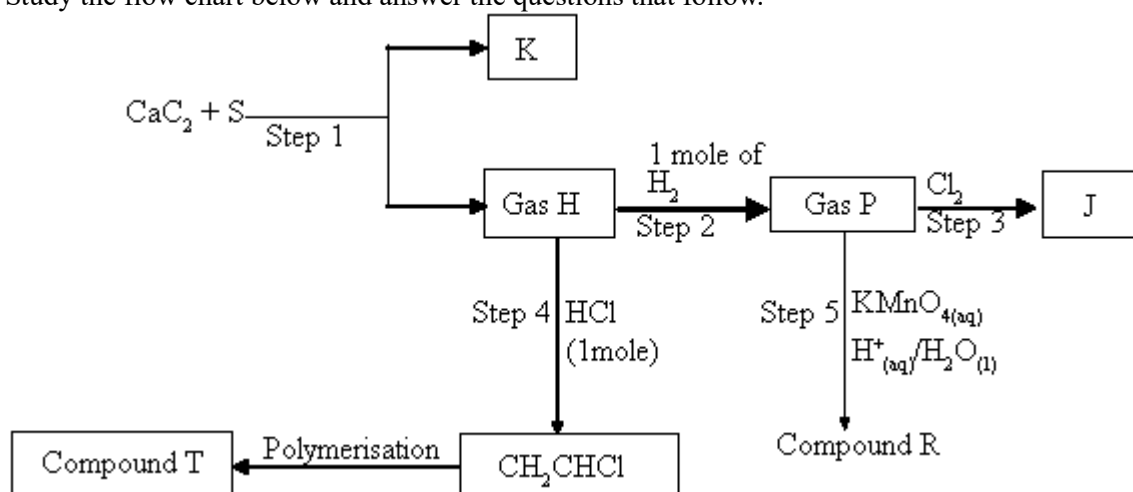i) Name the reagents and state the condition for the reaction in Step 1. (2marks)

Reagent

Condition ....

ii) Give the names of the following. (3marks)
    I. Solid S
    II. Solid V
    III) Solid T   ....

....

    iii) Give reasons for the colour change in step 2. (2marks)

    iv) Write an ionic equation for the reaction which takes place in step 3. (1mark)

    v) Name one other substance that could be used instead of sodium hydroxide in Step 3. .(1mark)

b) In an experiment, 3.36g of iron fillings were added to excess aqueous copper (II) sulphate, Calculate the mass of copper that was deposited. (Cu = 63.5, Fe = 56.0) (3marks)

5. The table below shows the variation of solubility of substances P and Q in $g/100gH_2O$ with temperature (^0C).

Temperature	0	20	40	60	80	100
Solubility of P (g/100g of water)	10	15	20	40	63	100
Solubility of Q (g/100g of water)	30	34	37	40	44	48

a) i) Using the information above plot a graph of solubility of P and Q against temperature on the graph paper provided. (5marks)

    ii) What is observed when a solution containing 30g of P in 100g of water is cooled from 80^0C to 10^0(1mark)

    iii) Calculate the mass of substance P that saturate 25g of water at 92^0C. (2marks)

b) i) At what temperature do substances P and Q have the same solubility? (1mark)

    ii) How would you make a saturated solution containing 35g of substance Q? (2marks)

c) Given a mixture containing 45g of P and 45g of Q dissolved in 100g of water, how would you obtain a pure sample of substance Q? (2marks)

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

a) Identify reagent S. (1mark)
b) Write the equation for the reaction taking place in Step 1. (1mark)
c) Identify substance K. (1mark)
d) What name are given to processes below;
    i)   Process in Step 3. (1mark)
    ii)   Step 2. (1mark)
e) State two conditions necessary for step 2. (2marks)

 f) Write the equation for the reaction in Step 3. (1mark)

 g) Draw the structural formula of gas H. (1mark)

 h) Describe one chemical test that can differentiate gas H from ethane gas. (3marks)

7. a) Define enthalpy change. (2mark)

 b) Use the following bond energies to answer the questions that follow;

Bond	Bond energy kJ/mol
C – H	413
Cl – Cl	239
C – Cl	346
H – Cl	428

 i) Write a balanced equation for the reaction between chlorine and methane to give chloromethane.

  (1mark)

 ii) Calculate the enthalpy change for the reaction leading to formation of chloromethane from chlorine and methane. (3marks)

 iii) Write the thermochemical equation for the reaction. (2mark)

 iv) List three factors to consider when choosing a fuel. (3marks)

190

GRAPHICS
233/3
CHEMISTRY PRACTICAL
CONFIDENTIAL

In addition to the apparatus and fittings found in the Chemistry Laboratory, each candidate will require the following;

1. 150cm^3 of solution C
2. 150cm^3 of solution D
3. 60cm^3 of Copper (II) sulphate (2 molar)
4. 50cm^{3}Burette
5. 25cm^3 pipette
6. Atleast 2 conical flasks
7. 100ml plastic beaker
8. (-10^{0}C = 110^{0}C) thermometer
9. Spatula
10. One boiling tube
11. 5 test tubes
12. 1g of Zinc powder (accurately measured)
13. About 0.5g of solid Q
14. Tissue paper
15. Distilled water in a wash bottle

Access to;
- Phenolphthalein indicator
- Source of heat
- 2M sodium hydroxide with a dropper
- 2M ammonia solution with a dropper
- 2M hydrochloric acid with a dropper
- 2M Barium nitrate with a dropper
- 2M nitric (v) acid with a dropper
- 2M Lead (II) nitrate with a dropper

NOTES
1. Solution C is made by dissolving 10.08g/l of ethanedioic acid (oxalic acid) in 400cm^3.
2. Solution D is made by dissolving 8.0g of Sodium hydroxide in 400cm^3 of water and made to one litre.
3. Solid Q – aluminum sulphate ($Al_2(SO_4)_3$)

233/3
CHEMISTRY
Paper 3
Time: 2 ¼ Hours
1. **You are provided with;**
   - Solution C which is solution of dibasic acid $(COOH)_2$ XH_2O containing 10.08g per litre of solution.
   - Solution D which is 0.2M solution of sodium hydroxide.
     You are required to determine the value of X in the formula $(COOH)_2. XH_2O$

     (H= 1, C = 12, O = 16)
     Procedure
   - Fill the burette to the mark with solution C.
   - Pipette $25.0cm^3$ of solution D into a clean conical flask
   - Add two drops of phenolphthalein indicator and titrate with solution C.
   - Repeat the titration to obtain consistent results and record your results in table 1 below.

   TABLE I

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

   (5 marks)
   a) Calculate the average volume of solution C used. (1mark)
   b) Calculate the number of moles of D used. (2marks)
   c) Calculate the number of moles of C used given that the reacting ratio of acid to base is 1:2 (2mks)
   d) Calculate the concentration of acid solution C in moles per litre. (2marks)
   e) Calculate the relative formula mass of the acid $(COOH)_2 X H_2 O$. (2marks)
   f) Hence, determine the value of X in $(COOH)_2 X H_2O$. (2marks)

2. You are required to determine the enthalpy of displacement of $Cu^{2+}_{(aq)}$ by Zinc.

   Procedure
   i) Wrap the plastic beaker that has been provided with a tissue paper.

   ii) Place $50cm^3$ of 0.2M Copper (II) Sulphate solution in the beaker. Dip the thermometer in the solution and note the steady temperature of the solution.

   iii) Carefully transfer all the 1.0g of Zinc powder provided into the plastic beaker and stir carefully with the thermometer.

   iv) Record the highest temperature that the solution attain.
   Record the results in the Table II below.   **Table II.**

Volume of Copper (II) Sulphate solution used (cm^3)	
Highest temperature of the mixture (^0C)	
Initial temperature of Copper (II) Sulphate Solution (^0C)	
Change in temperature (^0C)	

   (2marks)

   Specific heat capacity = $4.2kJKg^{-1}k^{-1}$

   Density of the solution = $1g/cm^3$

   a) Calculate the number of moles of Cu^{2+} ions that are in $50cm^3$ of the solution. (2marks)
   b) Calculate the amount of heat liberated in the reaction. (2marks)
   c) Determine the enthalpy of displacement of Copper. (2marks)
   d) Explain why excess Zinc powder was added into the beaker (1mark)
   e) Write the ionic equation for the reaction that takes place. Indicate the enthalpy change for the reaction.2marks)
3. You have been provided with solid Q. Perform the tests below and identify ions present in the sample.

   i) Put all the solid Q in a boiling tube and then add $8cm^3$ of distilled water a little at a time while shaking.

Divide the solution formed into five portions in test tubes.   (2 marks)

OBSERVATION	INFERENCE

ii) To the first portion add dilute sodium hydroxide dropwise until in excess.   (2 marks)

OBSERVATION	INFERENCE

iii) To the second portion add ammonia solution dropwise until in excess.   (2 marks)

OBSERVATION	INFERENCE

iv) To the third portion add dilute Hydrochloric acid and then warm.   (1 ½ marks)

OBSERVATION	INFERENCE

v) To the fourth portion add 3 drops of Barium nitrate solution (NB keep the mixture for part (vi)
                                                                        (2 marks)

OBSERVATION	INFERENCE

vi) Add 1cm^3 of nitric (V) acid (HNO$_3$) to the mixture obtained in (v) above.   (2 marks)

OBSERVATION	INFERENCE

vii) To the fifth portion add 3 drop Lead (II) nitrate   (1 ½ marks)

OBSERVATION	INFERENCE

KURIA EAST EXAMINATION
233/1
CHEMISTRY
PAPER 1 (THEORY)

1. a) Name two major components of air? (2marks)

   b) Write an equation for the reaction that would take place when one of the components of air named in (a) above is passed over heated magnesium. (1mark)

2. Study the information given below and use it to answer the questions that follow;
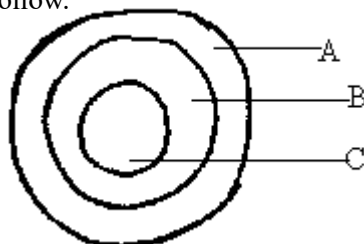
   Red dye is more soluble than green dye, green is more soluble than yellow whereas blue dye is the least soluble.

   i) Represent the three dyes on a round paper chromatography. (2marks)

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

3. a) What is a fuel? (1mark)

   b) Calculate the heat value of ethanol if its molar enthalpy of combustion is-1360kjmol^{-1}

   (C=12.0, O=16.0, H=1.0) (2marks)

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

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

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

5. i) What is electroplating? (1mark)

   ii) Draw a well labeled diagram to show how an iron spoon can be electroplated with silver. (2marks)

6. A hydrocarbon decolorizes chlorine gas in presence of ultra violet light but does not decolorize acidified potassium manganate (VII) solution.

   i) Name the homologous series to which the hydrocarbon belongs. (1mark)

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

7. Explain why a solution of hydrogen chloride in water turns blue litmus paper red but a solution of hydrogen chloride in methylbenzene has no effect on litmus papers. (3marks)

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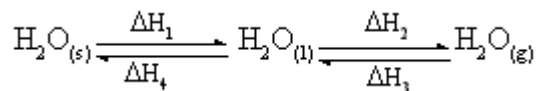

   a) State the role of the substance that is passed through;

201

    i)   A   (1mark)

    ii)   C   (1mark)

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

9. Study the equation below and answer the questions which follow.

$$H_2O_{(s)} \underset{\Delta H_4}{\overset{\Delta H_1}{\rightleftarrows}} H_2O_{(l)} \underset{\Delta H_3}{\overset{\Delta H_2}{\rightleftarrows}} H_2O_{(g)}$$

    i)   What name is given to the energy change ΔH_2?   (1mark)

    ii) Indicate the sign for ΔH_1. Give a reason.   (2marks)

10. Explain how you would obtain magnesium carbonate from a mixture of magnesium carbonate and sodium carbonate.   (2mark

11. 20g of potassium carbonate were dissolved in $50cm^3$ of water in a conical flask. Lemon juice was then added drop wise while shaking until there was no further observable change.
    a)   Explain the observation that was made in the conical flask when the reaction was in progress.   (1mark)
    b)   What observation would be made if lemon juice had been added to copper turnings in a conical flask?

    Give a reason.   (2marks)

12. Explain why a burning magnesium continues to burn in a gas jar full of carbon (IV) oxide while a burning candle would be extinguished.   (3marks)

13. a)   Give the names of any two reagents that when reacted with concentrated hydrochloric acid produces chlorine gas.   (1mark)

    b)   With the aid of an equation, explain the observation made when chlorine gas is reacted with ammonia.
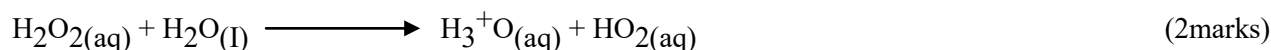
              (2marks)

14. 8.4g of carbon (IV) oxide and 3.42g of water are formed when a hydrocarbon is burnt completely in oxygen. Determine the empirical formula of the hydrocarbon.

    (H=1.0; C=12.0; O=16.0)   (3marks)

15. The melting point of nitrogen is -196^0C while that of sodium is 98^0C, in terms of structure and bonding explain the differences in the melting points of nitrogen and sodium.   (3marks)

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

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

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

17. The following tests were carried out on three separate portion of a colourless solution H.

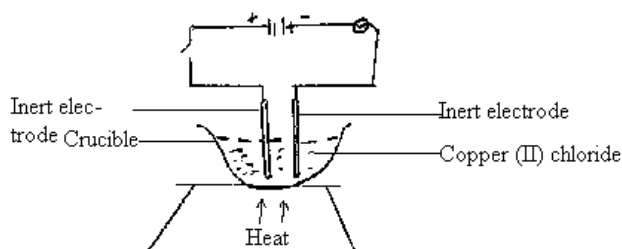| Test	Observation
i) Addition of dilute hydrochloric acid to the first portion of solution H.	Colourless gas evolved with effervescence
ii) Addition of aqueous sodium sulphate solution to the second portion of H.	No observable change
iii) Addition of aqueous sodium hydroxide solution to the third portion of solution H	White precipitate was formed which dissolved in excess sodium hydroxide solution

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

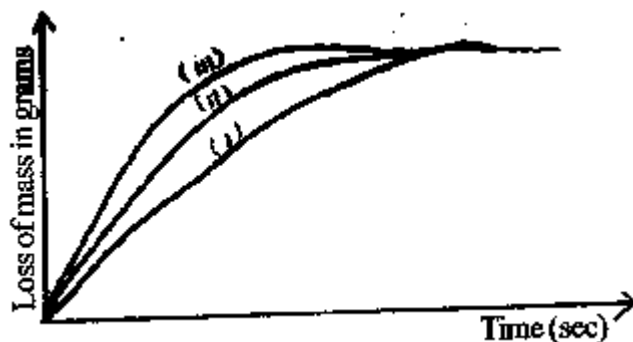   b)   Identify cations that are likely to be present in solution H.   (1mark)

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

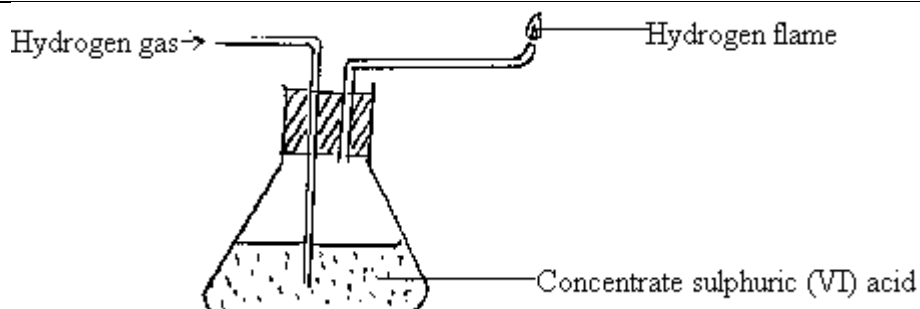18. Sulphur forms many compounds in which its oxidation state varies.

a) What is meant by oxidation state? (1mark)

b) Determine the oxidation state of sulphur in $NaHSO_3$. (2marks)

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

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

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

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

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

21. Distinguish between atomic mass and relative atomic mass. (2marks)

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

a) State the observation that would be made in the crucible when the circuit is switched on. (1mark)

b) Write an ionic equation for the reaction at anode. (1mark)

c) Give a reason why this experiment should be performed in the fume chamber. (1mark)

23. The following curves are obtained from reacting the same amount of marble chips lumps with acids of different concentrations.
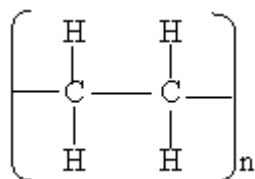

a) Which curve represents the reaction with;

i) Least concentrated acid? (1mark)

ii) Most concentrated acid? (1mark)

b) Which curve did the reaction complete last? (1mark)

24. a) State Charle's Law. (1mark)

b) Explain how the density of gas N compare with that of oxygen given that the time taken for equal volumes of oxygen and gas N to diffuse through the same hole is 35 seconds and 42seconds respectively. (2marks)

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

203

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

i)   Physical property.   (½mark)

ii) Chemical property.   (½mark)

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

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

26. Elements Q, R and S have the following electronic arrangements.

    Q=2,3; R = 2,8,3 and S = 2,8,8,3

    i)   Are the elements metals or non-metals?   (1mark)

    ii) Give the formula of the compound formed when elements R reacts with a sulphate radical.   (1mark)

    iii) Selects the element that is most reactive.   (1mark)

27. Below is the structural formula of a given polymer. Use it to answer the questions that follow:

a) Name the monomer.   (1mark)

b) State one use of the above polymer.   (1mark)

28. Sodium and magnesium fall on the same period in the periodic table and both of them are metals. Explain why magnesium is a better conductor than sodium.   (2marks)
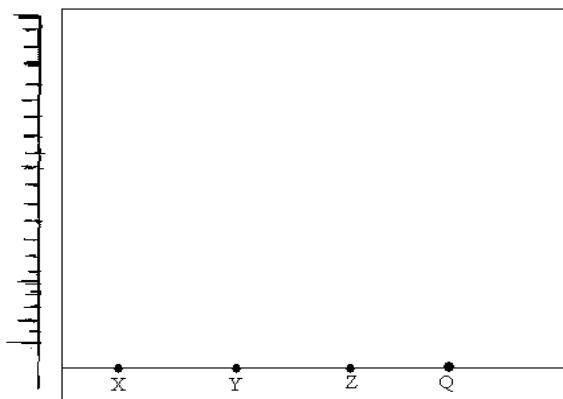
KURIA EAST
233/2
CHEMISTRY
Paper 2
(THEORY)
TIME 2 HOURS

1. a)   The diagram below shows spot of pure substances X, Y and Z on a chromatography paper. Spot Q is that of a mixture.
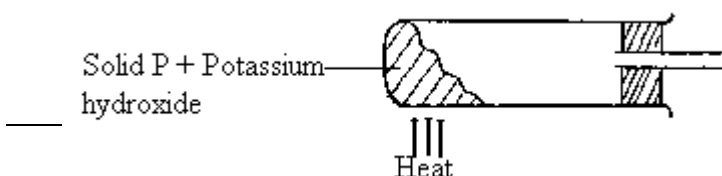

After development X, Y and Z were found to have moved 8cm, 3cm and 6cm respectively Q had separated into three spots which had moved 5cm, 6cm and 8cm.
i)   On the diagram,
I.   Label the baseline.   (1mark)
.   Show the positions of all the spots after development.   (3marks)
ii)   Identify the substances present in the mixture Q.   (2marks)

b)   Describe how solid ammonium chloride can be separated from a solid mixture of ammonium chloride and anhydrous calcium chloride.   (2marks)

c)   The table below shows liquids that are miscible and those that are immiscible.

Liquid	A	B
C	Miscible	Miscible
D	Miscible	Immiscible

Use the information given to answer the questions that follow:
i)   Name the method that can be used to separate A and C from a mixture of the two.   (1mark)

ii)   Describe how a mixture of B and D can be separated.   (2marks)

2. a)   Sodium hydroxide pellets were accidentally mixed with sodium chloride-18.2g of the mixture were dissolve in water to make one liter of solution. $100cm^3$ of the solution was neutralized by $50cm^3$ of 0.45M Sulphuric acid.
i)   Write an equation for the reaction that took place.   (1mark)

ii)   Calculate the;
I.   Number of moles of the substance that reacted with sulphuric acid.   (2mark)

II.   Number of moles of the substance that would react with sulphuric acid in the one litre of solution. (1mark)

III.   Mass of the unreacted substance in the one litre of solution.   (2marks)
   (H = 1.0, Na = 23.0, Cl = 35.5, O = 16.0)

b)   The diagram below shows an incomplete set-up used to prepare and collect ammonia gas.

Solid P + Potassium hydroxide

Heat

205

i)   Name solid P.   (1mark)

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

c)   In an experiment, excess ammonia gas was passed over heated copper (II) oxide in a combustion tube.

i)   State the observation that was made in the combustion tube at the end of the experiment.   (1mark)

ii) What property of ammonia is shown in the above reaction?   (1mark)

iii) Give one use of ammonia.   (1mark)

3. a) An atom Z can be represented as

$$^{39}_{19}Z$$

What does the number 39 represent?   (1mark)

b) Study the information in the table below and answer the questions that follow. (Letters are not the actual symbols of the elements).

Element	Electron arrangement of stable ion	Atomic radius (nm)	Ionic radius (nm)
L	2.8	0.072	0.136
M	2	0.152	0.068
N	2.8	0.186	0.095
O	2.8	0.160	0.065
P	2.8.8	0.099	0.181
Q	2.8.8	0.197	0.099

i)   Write the formula of the compound formed when P reacts with Q Atomic numbers are;(P = 17, Q = 20)

(1mark)

ii) Identify the elements which belong to the third period of the periodic table. Explain.   (2marks)

iii) Which of the elements identified in b(ii) above comes first in the third period?   (2marks)

iv) Select two elements which are non-metals.   (1mark)

c) The table below gives some properties of substances A, B, C and D. study it and answer the questions that follow;

Substance	Electrical conductivity		MP (°C)	BP (°C)
	Solid	Molten		
B	Does not conduct	Conducts	701	1320
B	Conducts	Conducts	550	1100
C	Does not conduct	Does not conduct	1600	2100
D	Does not conduct	Does not conduct	113	440

i) What type of bonding exists in substances A and B?   (2marks)

ii) Which substance is likely to be sulphur?   Explain   (2marks)

4. a) The flow chart below shows a sequence of reactions starting with iron. Study it and answer the questions that follow;
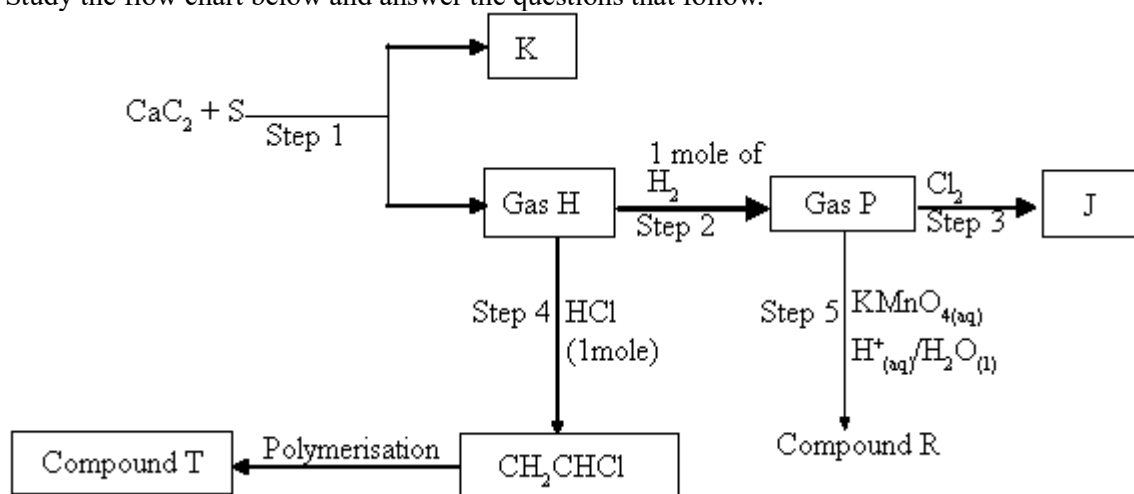
i)   Name the reagents and state the condition for the reaction in Step 1.   (2marks)
Reagent
Condition
ii) Give the names of the following.   (3marks)
I.   Solid S
II.   Solid V
III) Solid T
iii) Give reasons for the colour change in step 2.   (2marks)

iv) Write an ionic equation for the reaction which takes place in step 3.   (1mark)

v)   Name one other substance that could be used instead of sodium hydroxide in Step 3.   .(1mark)

b)   In an experiment, 3.36g of iron fillings were added to excess aqueous copper (II) sulphate, Calculate the mass of copper that was deposited. (Cu = 63.5, Fe = 56.0)   (3marks)

5. The table below shows the variation of solubility of substances P and Q in g/100gH$_2$O with temperature (^{0}C).

Temperature	0	20	40	60	80	100
Solubility of P (g/100g of water)	10	15	20	40	63	100
Solubility of Q (g/100g of water)	30	34	37	40	44	48

a) i)Using the information above plot a graph of solubility of P and Q against temperature on the graph paper provided.   (5marks)
ii) What is observed when a solution containing 30g of P in 100g of water is cooled from 80^{0}C to 10^{0}C.
                                                                                                            (1mark)

iii) Calculate the mass of substance P that saturate 25g of water at 92^{0}C.   (2marks)

b) i)At what temperature do substances P and Q have the same solubility?   (1mark)

ii) How would you make a saturated solution containing 35g of substance Q?   (2marks)

c)   Given a mixture containing 45g of P and 45g of Q dissolved in 100g of water, how would you obtain a pure sample of substance Q?
     (2marks)

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

a) Identify reagent S. (1mark)

b) Write the equation for the reaction taking place in Step 1. (1mark)

c) Identify substance K. (1mark)

d) What name are given to processes below;
   i) Process in Step 3. (1mark)

   ii) Step 2. (1mark)

 e) State two conditions necessary for step 2. (2marks)

f) Write the equation for the reaction in Step 3. (1mark)

g) Draw the structural formula of gas H. (1mark)

h) Describe one chemical test that can differentiate gas H from ethane gas. (3marks)

7. a) Define enthalpy change. (2mark)

b) Use the following bond energies to answer the questions that follow;

Bond	Bond energy kJ/mol
$C – H$	413
$Cl – Cl$	239
$C – Cl$	346
$H – Cl$	428

i) Write a balanced equation for the reaction between chlorine and methane to give chloromethane. (1mark)

ii) Calculate the enthalpy change for the reaction leading to formation of chloromethane from chlorine and methane. (3marks)

iii) Write the thermochemical equation for the reaction. (2mark)

iv) List three factors to consider when choosing a fuel. (3marks)

KURIA EAST EXAMS 233/3
CHEMISTRY PRACTICAL
CONFIDENTIAL

In addition to the apparatus and fittings found in the Chemistry Laboratory, each candidate will require the following;

16. 150cm^3 of solution C
17. 150cm^3 of solution D
18. 60cm^3 of Copper (II) sulphate (2 molar)
19. 50cm^3 Burette
20. 25cm^3 pipette
21. Atleast 2 conical flasks
22. 100ml plastic beaker
23. $(-10^0C = 110^0C)$ thermometer
24. Spatula
25. One boiling tube
26. 5 test tubes
27. 1g of Zinc powder (accurately measured)
28. About 0.5g of solid Q
29. Tissue paper
30. Distilled water in a wash bottle

Access to;

- Phenolphthalein indicator
- Source of heat
- 2M sodium hydroxide with a dropper
- 2M ammonia solution with a dropper
- 2M hydrochloric acid with a dropper
- 2M Barium nitrate with a dropper
- 2M nitric (v) acid with a dropper
- 2M Lead (II) nitrate with a dropper

NOTES

4. Solution C is made by dissolving 10.08g/l of ethanedioic acid (oxalic acid) in 400cm^3.
5. Solution D is made by dissolving 8.0g of Sodium hydroxide in 400cm^3 of water and made to one litre.
6. Solid Q – aluminum sulphate $(Al_2(SO_4)_3)$

NAKURU CLUSTER
233/1
CHEMISTRY
(THEORY)
PAPER 1
JULY 2018
TIME: 2 HOURS.

1. The diagram below shows a simple distillation to separate water and ethanol.
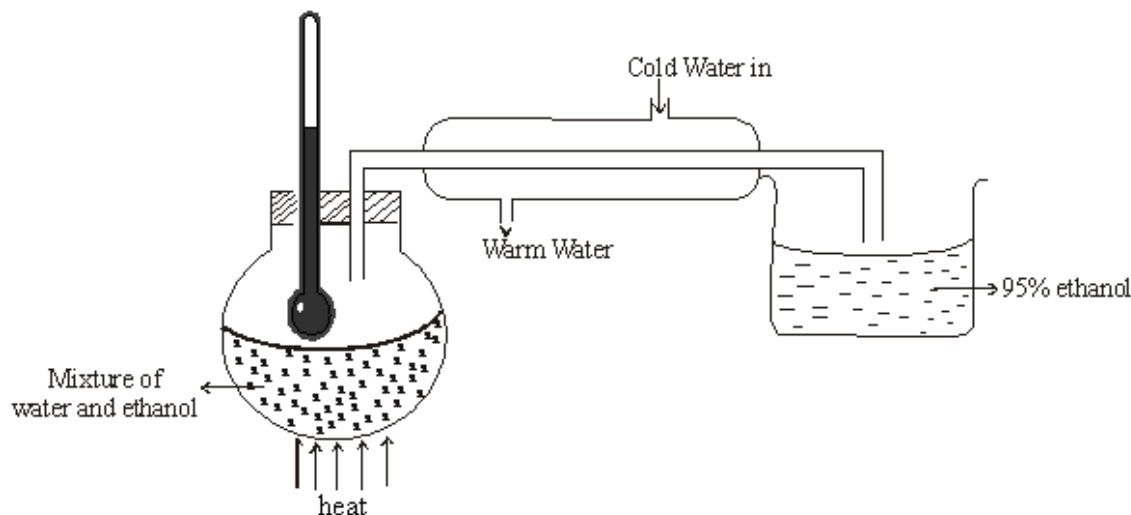
a) State one of the conditions for the above process to take place. (1mark).

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

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

Substance	Melting Point (^0C)	Boiling Point (^0C)	Electrical conductivity		Solubility
			Solid	**Liquid**	
X	37	344	Poor	Poor	Insoluble
Y	-114	-85	Poor	Poor	Good
K	1610	2230	Poor	Poor	Insoluble
L	29	685	Good	Good	Good
M	614	1382	Poor	Good	Good

(i) Select a substance from the given date which;-
  a. Has giant ionic structure (1mark)
  b. Has giant covalent structure (1mark)
  c. Is a gas at room temperature (1mark)

3. A form three student weighed a piece of plain paper, wrote her name on it and re-weighed it. The following were the results.

Mass of plain paper   =   2.804
Mass of paper with name   =   2.9053

If she wrote her name using pure graphite, determine the number of carbon atoms used to write her name.
(C=12.0, Mole constant L = 6.0 x 10^{23}) (3marks)

4. The table below shows tests carried out on a sample of water and the results obtained.

|	Test	Results
I	Addition of sodium hydroxide solution	White precipitate which dissolves in excess
II	Addition of excess aqueous ammonia	Colourless solution obtained
III	Addition of dilute hydrochloric acid and barium chloride	White precipitate

    a) Identify the anion present in the water. (1mark)
    b) Write an ionic equation for the reaction in III (1mark)
    c) Write the formula of the complex ion formed in II (1mark)

5. Solutions can be classified as acids bases or neutral. The table below shows solutions and their pH values.

Solution	PH - VALUES
K	1.5
L	7.0
M	14.0

  (i) Select any pair that would react to form a solution of pH 7. (1mark)

  (ii) Identify two solutions that would react with aluminum hydroxide.

Explain (2marks)

6. The diagram below is a set up to investigate the effect of heat on hydrated copper (ii) sulphate. Study the diagram and answer the questions that follow.
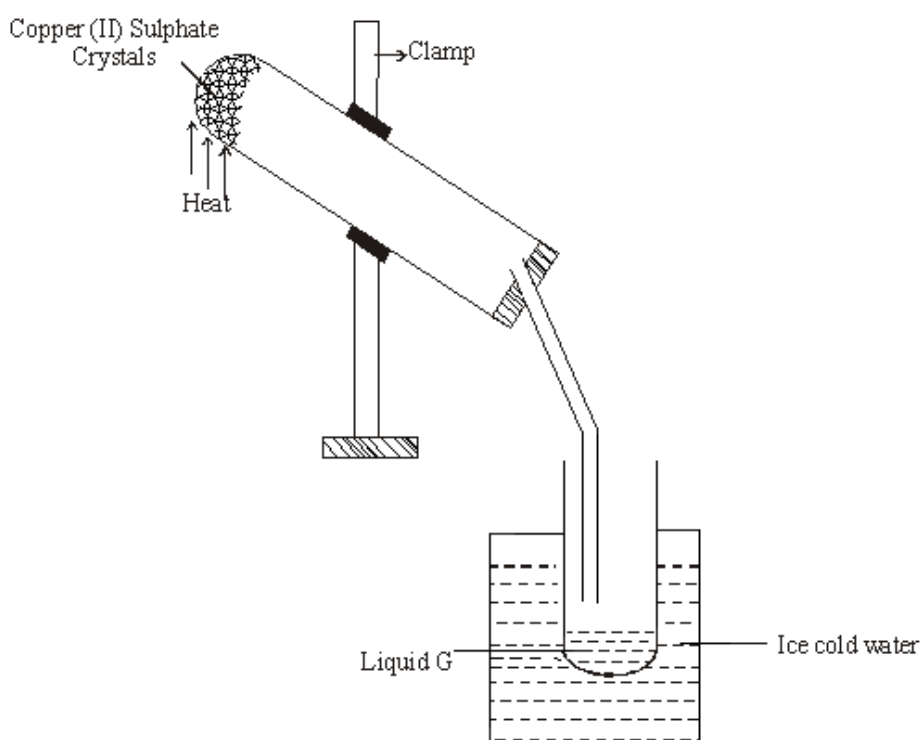
  (a) Why is the boiling tube slanted as shown (1mark)
  (b) What is observed in the boiling tube? (1mark)
  (c) Identify liquid G (1mark)
7. 1.9g of Magnesium chloride was dissolved in water. Silver nitrate solution was added till excess. Calculate the mass of silver nitrate that was added for complete reaction.
  ($MgCl_2$= 95, N=14, O=16, Ag = 108) (3marks)

218

8. Study the diagram below and answer the questions that follow.
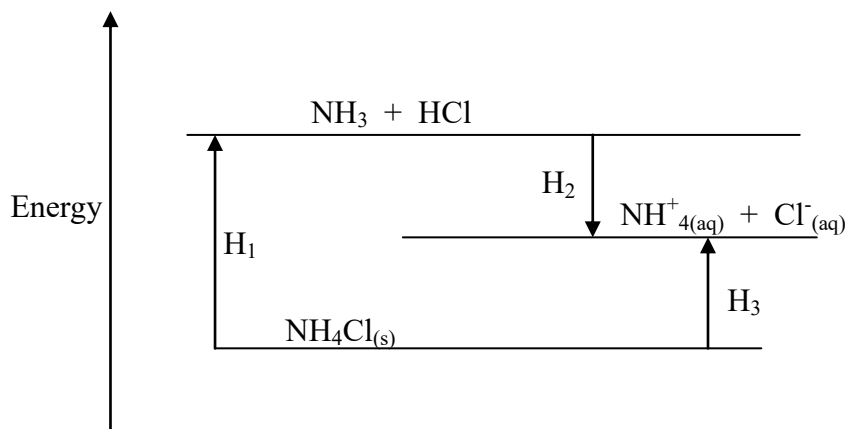
a) What does H_1, H_2 and H_3 represent.

H_1 (½ mark)

H_2 (½ mark)

H_3 (½ mark)

b) Write an expression relating H_1, H_2 and H_3 (½ mark)

9. a) State grahams law of diffusion   (1mark)

(a) The molar masses of gases X and Y are 32.0 and 44.0 respectively. The rate of diffusion of X through a porous material is $12 cm^3 S^{-1}$. Calculate the rate of diffusion of Y through the same material.   (2marks)

10. Oxygen gas can be prepared in the laboratory by heating potassium nitrate
   i) Write the equation of reaction to show the decomposition of potassium nitrate   (1mark)
   ii) State two physical properties of oxygen gas.   (1mark)
   iii) Outline one industrial use of oxygen gas.   (1mark)

11. The following are structures representing two types of detergents. Study them and answer the questions that follow:-

A

$OSO_2ON_a^+$

B

$CH_3CHOO^-Na^+$
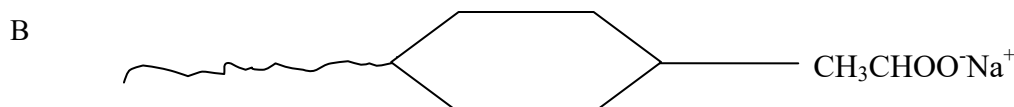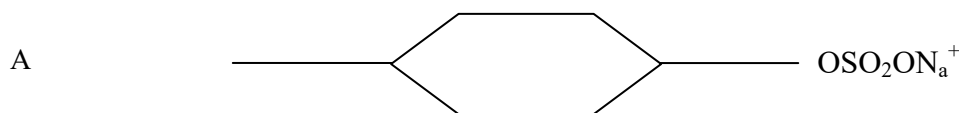
a) Identify the two types   (1mark)
   A
   B
b) What is the problem of continued use of substance B.   (1mark)

12. a) When excess carbon (II) oxide was passed over heated lead (II) oxide in a combustion tube. Lead (II) oxide was reduced to lead metal.
   b) Write an equation for the reaction that took place.   (1mark)
   c) What observation is made in the combustion tube when the reaction is complete?   (1mark)
   d) Name another gas which could be used to reduce lead (II) oxide   (1mark)

13 a) State two differences between a luminous flame and a non- luminous flame.   (2marks)
   b) The apparatus shown below is commonly used in a chemistry laboratory. Give its name and state its use.


Name   ....   (½ mark)

Use .... (½ mark)

14. a) Element P and Q have atomic numbers 13 and 17 respectively. Write down the electron arrangement of the ions.

    i) P^+ 1mk

    ii) Q^- 1mk

    b) Write down the formula of the compound formed between element P and Q.   (1mark)

15. a) In an experiment, chlorine gas was passed into moist hydrogen sulphide in a gas jar.

    b) What observation was made in the gas jar.   (1mark)

    c) Which of the reagents is a reducing agent? Explain   (2marks)

16. Boilers used for boiling hard water are normally covered with boilers scale after some time.

    a) What is a chemical name for boilers scale   (1mark)

    b) How is the boilers scale removed?   (1mark)

  c) State one advantage of using hard water.   (1mark)

17. A form one student set up the following apparatus to investigate the percentage of oxygen in air.
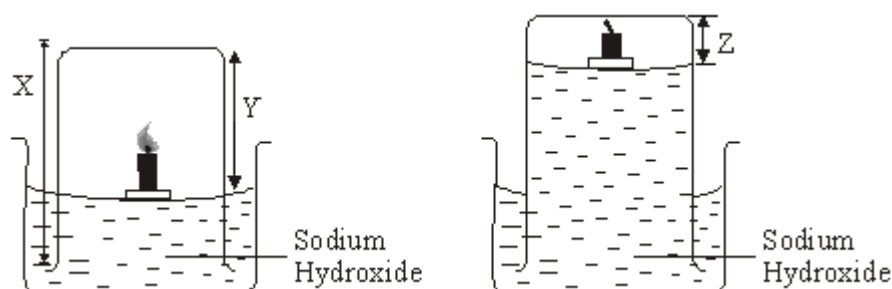
    i) Write an equation to show how the percentage can be calculated   (1mark)

    ii) Why is NaOH preferred to water in the above experiment?   (1mark)

18. The diagram below shows a section of a model of the structure of element T.
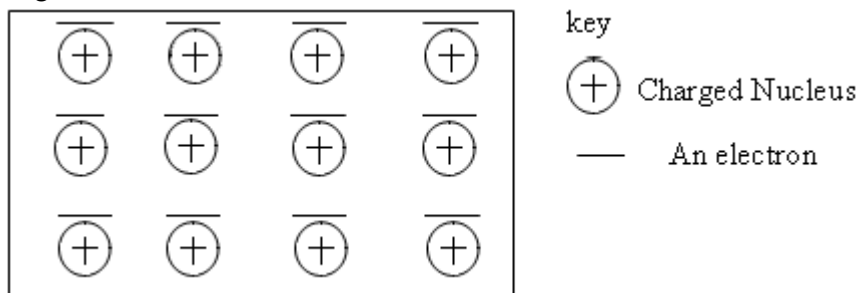
    a) State the bonding that exists in element T.   (1mark)

    b) In which group of the periodic table does T belong? Give a reason.   (2marks)

19. When a hydrocarbon was completely burnt in oxygen, 4.2g of carbon (IV) oxide and 1.71g of water were formed. Determine the empirical formula of the hydrocarbon (H=1.0, C = 12.0, O = 16.0)   (3marks)

20. Consider the following equilibrium reaction

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}; \quad \Delta H = \text{-ve}$$
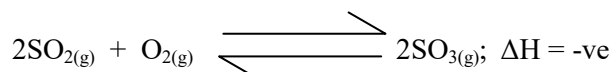
    a) What will be the effect of increasing the temperature on the yield of sulphur (VI) oxide. Explain

                                                          (3marks)

21. Using dot (.) and cross (x) diagram, show the bonding in the two compound. Phosphonium ion PH_4^+ (P = 15.0, H= 1.0)   (2marks)

220

22. The diagram below shows an incomplete set up of the laboratory preparation of dry carbon (IV) oxide. Complete it. (3marks)
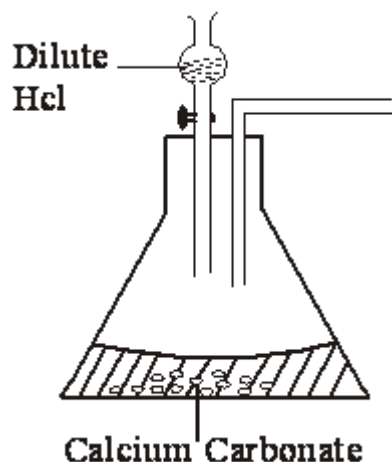
23. Study the flow chart below and answer the questions that follow.
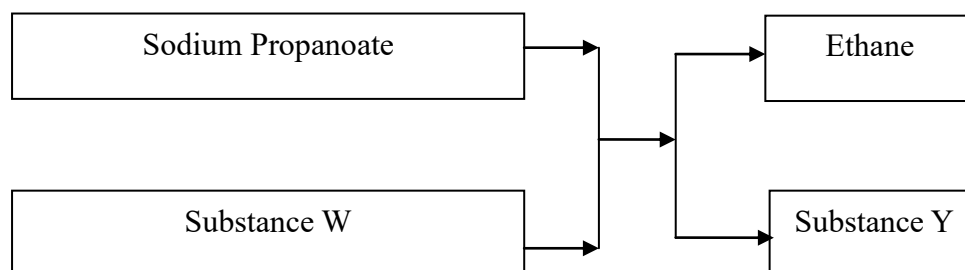
a) Name substances

W (½ mark)

Y (½ mark)

b) An organic compound K reacted with bromine to form 2,3 – dibromobutane.

Draw the structural formula of K.

24. When a candle was burnt completely, the total mass of the product was found to be greater than the original mass of the candle. Explain. (2marks)

25. Using reagents provided only, explain by means of balanced chemical equations how you would prepare a salt of zinc carbonate solid.

Zinc powder

Nitric (v) acid (dilute)

Water

Solid sodium carbonate (3marks)

26.a) Name the homologous series to which each of the following belongs.

i) CH_3CCH (1mark)

ii) CH_3CH_2COOH (½ mark)

b) Write an equation for the reaction between CH_3CCH and hydrogen gas. (1mark)

27. An element Q has a relative atomic mass of 88. When a current of 0.5 amperes were passed through the fused chloride of Q for 32minutes and 10seconds, 0.44g of Q were deposited at the cathode. Determine the charge of ion of Q. (1Faraday = 96500C) (3marks)

28. a) A compound Q is a solid with a giant ionic structure. In what form would the compound conduct an electric current. (1mark)

b) With reference to iodine distinguish between covalent bonds and van-der-waals forces. (2marks)

29. A certain radioactive source has a half-life of 15hrs. What will be the mass left after 60hrs of its initial mass of 6.0g. (1 mark)

221

NAKURU CLUSTER
**233/2**
CHEMISTRY
PAPER 2

1. a) Study the information below and answer the questions that follow;

Element	Atomic Radius (am)	Ionic radius (nm)	Formular of oxide	Melting point of oxide ^0C
A	0.364	0.421	A_2O	-119
B	0.830	0.711	BO_2	837
C	0.592	0.485	C_2O_3	1466
D	0.381	0.446	D_2O_5	242
E	0.762	0.676	EO	1054

i) Which elements are non –metals. Give a reason. (2marks)
ii) Explain why the melting point of the oxide of C is higher than that of the oxide of D. (2marks)
iii) Give two elements that would react vigorously with each other. Explain your answer. (2marks)
b) Study the information in the table below and answer the questions that follow. The letters do not represent the actual symbols of elements.

Element	Electron arrangement	Ionization Energy	
		1st I.E.	2nd I.E
P	2.2	900	1800
Q	2.8.2	736	1450
R	2.8.8.2	590	1150

i) What chemical family does elements P, Q and R belong? (½ mark)
ii) What is meant by the term ionization energy? (1mark)
iii) The 2nd ionization energy is higher than the first ionization energy of each. Explain. (1mark)
iv) When a piece of element R is placed in cold water, it sinks to the bottom and an effervescence of a colourless gas is observed.
c) Name the colourless gas. (½ mark)
d) Write a chemical equation for the reaction taking place. (1mark)

2. Butane is a gas at room temperature and pressure, it is used to melt bitumen to apply on roads.
a) Write an equation for complete combustion of butane. (1mark)
b) Define the term standard enthalpy of combustion. (1mark)

c) The set up below was used to determine the enthalpy change of combustion of butane.
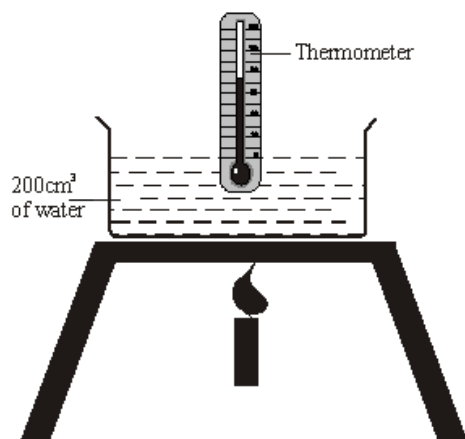
d) The temperature rose from 22^0C to 70^0C when 1g of butane was burnt. Calculate the energy change and hence the molar enthalpy (specific heat capacity 4.2kJ/Kg 1K, density of water 1 g/cm^3) (3marks)

e) Given the following enthalpies of combustion data:-
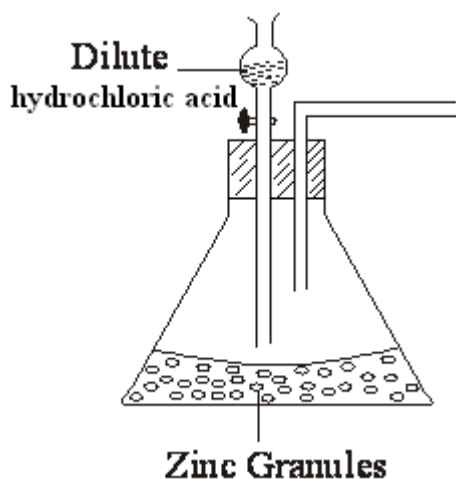
Carbon ΔH = -393KJ/mol

Hydrogen ΔH = -286 KJ/mol

Butane ΔH = -232KJ/mol

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

f) Represent the information in (d) above in an energy cycle diagram (3marks)

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

a) i) Complete the diagram to show how a dry sample of the gas can be collected. (2marks)

i) Write an equation for the reaction producing hydrogen gas. (1mark)

ii) How can the rate of production of the gas be increased in the above set up. (1mark)

b) Dry hydrogen gas was passed over heated copper (II) oxide in a combustion tube as shown below.
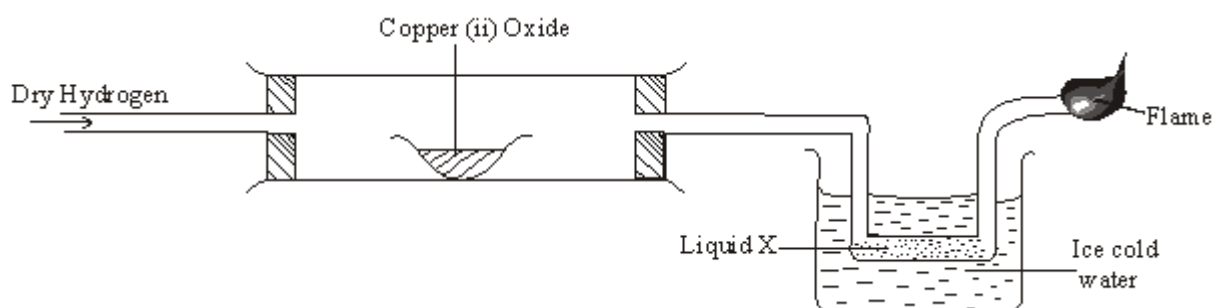
i) **State** and explain the observation made in the combustion tube. (2marks)

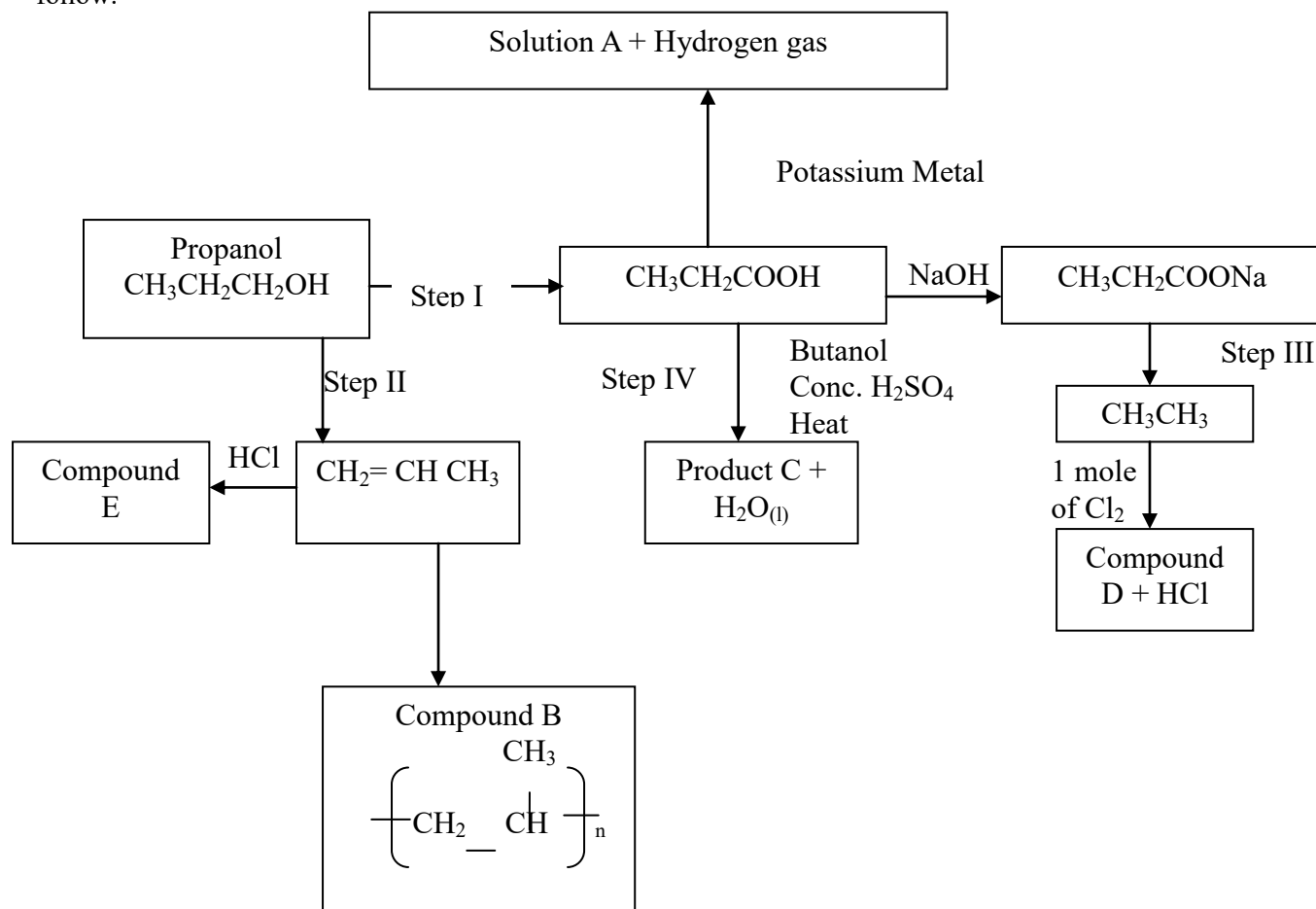ii) Write an equation for the reaction that took place in the combustion tube. (1mark)

c) i) Identify liquid X (1mark)

   ii) Give one chemical test than can be used to prove the identity of liquid X (1mark)

d) When magnesium oxide is used in place of copper (ii) oxide, no liquid is formed in the u-tube dipped in ice cold water. Explain (2marks)

e) Write an equation for the reaction at the flame point. (1mark)

223

4. The scheme below shows a series of reactions starting with propanol. Study it and answer the questions that follow.

a) Name the type of reaction in steps
   I. (½ mark)
   II. (½ mark)
b) Write the equation for the reaction that takes place in step III (1mark)
c) Name substances labelled
A (½ mark)
C (½ mark)
D (½ mark)
E (½ mark)
d) Draw the structural formula of product C (1mark)
e) Name the process in step IV (1mark)
f) Name compound B and state the type of reaction involved in its formation
   Name of B (½ mark)
   Type of reaction (½ mark)
g) If the relative molecular mass of B is 35,700 determine the value of n (2marks)

....

h) Write the equation leading to formation of substances C and D.
   i) C (1mark)
   ii) D (1mark)
5. Sodium thiosulphate solution reacts with dilute hydrochloric acid according to the equation.

$$S_2O^{2-}_{3(aq)} + 2H^+_{(aq)} \longrightarrow H_2O_{(s)} + SO_{2(g)} + S_{(s)}$$
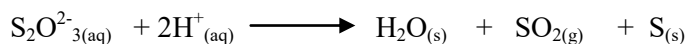
In an experiment to study how rate of reaction varies with concentration, 10cm^3 of 0.4M sodium thiosulphate was mixed with 10cm^3 of 2M Hydrochloric Acid in a flask. The flask was placed in a white paper marked with a cross X.

The time taken for the cross (x) to be invisible when viewed from the above was noted and recorded in the table below.

Experiment	Volume of 0.4M thiosulphate	Volume of water	Volume of 2MHCl	Time in seconds
1	10	0	10	16
2	7.5	2.5	10	23
3	5.0	5.0	10	32
4	2.5	7.5	10	72

(a) (i) On the grid provided, plot a graph of volume of thiosulphate (vertical axis) against time taken for cross to become invisible. (4marks)

(i) From the graph determine how long it would take for the cross to become invisible if the experiment was done.
   I.   Using 6cm^3 of 0.4M thiosulphate (1mark)

   II. Using 60cm^3 of 0.2M thiosulphate (1mark)

(b)
   i.   Using values from the experiment
   Calculate
   I.   Moles of thiosulphate used (1mark)
   II. Moles of hydrochloric acid used. (1mark)

   ii. Explain which of the two reactants in the experiment I in b(i) above controlled the rate of reaction.

(c) Give two precautions which should be taken in the experiment I controlled rate of reaction. (2marks)

6. A form four student dissolved 9.57g of potassium chloride and potassium carbonate in distilled water to make up half a litre of solution. He pipetted 20cm^3 of this solution into a conical flask and titrated it against a monobasic acid of concentration 0.25M using phenopthalein indicator.
   His results were as follows;

|	Trial	I	II	III
Final burette reading (cm^3)	15.9	31.0	46.0	15.0
Initial burette reading (cm^3)	0.0	15.9	31.0	0.0
Volume of acid used (cm^3)				

   a) What observation was made at the end point? (1mark)
   b) Complete the table. (1mark)
   c) Determine the average volume of the acid used. (1mark)
   d) Calculate the percentage of potassium chloride in the mixture. (4marks)
   e) The equation of combustion of hydrogen chloride is as follows:-
   $$H_2S_{(g)} + O_{2(g)} \longrightarrow SO_{2(g)} + H_2O_{(l)}$$
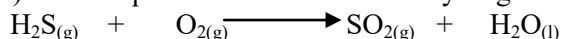
(i) Balance the equation (1mark)
(ii) What volume of sulphur (IV) oxide is produced when a mixture of 30cm^3 of hydrogen sulphide and 30cm^3 of hydrogen sulphide and 30cm^3 of oxygen is burnt in a closed vessel. (1mark)
f)   235
(i) The symbol of a radioactive isotope is   U. What is the nucleus composition of the isotope? (1mark)

225

(ii)   The isotope decays by alpha emission write a nuclear equation for the decay using the symbol of the new nucleide as X   (1mark)

(iii)   The half life of the isotope is 4500yrs determine the fraction of the radioactive material that would be remaining after 1800yrs.   (2marks)

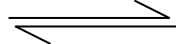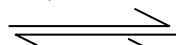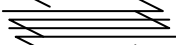7.a)Aqueous potassium sulphate was electrolyzed using platinum electrodes in a cell.
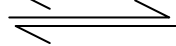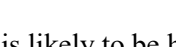
   i) Write the products formed at the anode and cathode

   Anode.   ....   (1mark)
   Cathode.   ....   (1mark)

   ii) Why would it not be advisable to electrolyze aqueous potassium sulphate using potassium metal electrodes?

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

$$E^{\theta}(volts)$$

$$A^{2+}_{(aq)} + 2e^- \rightleftharpoons A_{(s)} \qquad -2.90$$
$$B^{2+}_{(aq)} + 2e^- \rightleftharpoons B_{(s)} \qquad -2.38$$
$$C^{+}_{(aq)} + e^- \rightleftharpoons C_{(g)} \qquad -0.00$$
$$D^{2+}_{(aq)} + 2e^- \rightleftharpoons D_{(s)} \qquad +0.34$$
$$\tfrac{1}{2} F_{2(g)} + e \rightleftharpoons F^{-}_{(aq)} \qquad +2.87$$

(i)   Which element is likely to be hydrogen? Give a reason for your answer.   (1mark)

(ii)   What is the E^{θ} value of the strongest reducing agent?   (1mark)

(iii)   In the space provided draw a labelled diagram of the electrochemical cell that would be formed when half cells of elements B and D are combined   (3marks)

(iv)   Calculate the E^{θ} value of the electrochemical cell constructed in (iii) above.   (1mark)

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

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

(ii)   Determine the change in mass of the anode which occurred as a result of electrolysis.   (2marks)
       (Cu = 63.5, 1 Faraday = 96 500 c)

NAKURU CLUSTER
233/3
CHEMISTRY
PAPER 3

CONFIDENTIAL INSTRUCTIONS TO SCHOOLS.
In addition the apparatus and fittings found in a chemistry laboratory, each candidate will require the following;

−   A burette
−   A 25cm^3 pipette
−   A pipette filler
−   2 conical flasks
−   Water in a washing bottle (250ml distilled)
−   A stand and a clamp
−   150cm^3 of solution A
−   100cm^3 of solution B
−   80cm^3 of solution C
−   Exactly 2g of solid D (Oxalic Acid)
−   50ml or 100ml measuring cylinder
−   100ml plastic beaker
−   A thermometer (-10^{0}C to 110^{0}C)
−   About 1g of solid E
−   Boiling tube
−   10cm^3 measuring cylinder
−   6 test tubes in a rack
−   Test tube holder
−   Spatula holder
−   Spatula (metallic)

−   Source of heat

ACCES TO;
−   0.5M $Pb(NO_3)_2$, Lead (ii) nitrate
−   0.5M barium nitrate
−   1M nitric (v) acid
−   Acidified potassium manganate VII
−   Acidified potassium dichromate
−   Methyl orange indicator
−   1M sodium hydroxide solution

Each supplied with a dropper

NOTES
1.   Solid D is Oxalic acid
2.   Solid E is sodium sulphite (Na_2SO_3)
3.   Solution A is prepared by adding 12.9cm^3 of concentrated hydrochloric acid (specific gravity 1.18) to 500cm^3 of distilled water then top up to one litre.
4.   Solution is prepared by dissolving 4g of sodium hydroxide (NaOH) in 600cm^3 of distilled water then top up to one litre.
5.   Solution C is prepared by dissolving a mixture of 8.4g of sodium hydrogen carbonate ($NaHCO_3$) and 1.6g of Sodium chloride in about 500cm^3 of distilled water and then making it to one litre.
6.   Acidified potassium manganate VII is prepared by dissolving 3.16g of potassium manganate VII in 500cm^3 of 2M sulphuric acid and diluting to one litre of solution with distilled water.
7.   Acidified potassium dichromate VI is prepared by dissolving 3.0g potassium dichromate VI in 500cm^3 of 2M sulphuric acid and diluting to one litre of solution.

NAKURU CLUSTER
233/3
CHEMISTRY
PRACTICAL
PAPER 3
JULY 2018
TIME: 2¼ HOURS.

FORM FOUR TRIAL EXAMINATION 2018

Question 1 (21marks)

You are provided with;

- Dilute hydrochloric acid solution A
- 0.1M sodium hydroxide solution B
- 10g of a mixture of sodium hydrogen carbonate and sodium chloride per litre, solution C

You are required to determine;

i. Molarity of solution A
ii. Percentage purity by mass of Sodium hydrogen carbonate

PROCEDURE 1

Fill the burette with solution A. Pipette $25cm^3$ of 0.1M sodium hydroxide solution B into a clean conical flask and add 2 drops of methyl orange indicator and titrate with solution A until a permanent pink colour occurs. Fill in the table below. Repeat the titration two more times and complete the table 1 below.

TABLE I	1	2	3
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution A used (cm^3)			

(4marks)

a) Calculate the average volume of solution A used. (1mark)
b) Calculate the number of moles of hydrochloric acid solution A that reacted with $25cm^3$ of sodium hydroxide solution B. (2marks)
c) Calculate the concentration of solution A in moles per litre. (2marks)

PROCEDURE II

Pipette $25cm^3$ of solution C into a conical flask. Titrate with solution A using 2 drops of methyl orange indicator.

Record your results in table II below.

TABLE I	1	2	3
Final burette reading (cm^3)			
Initial burette reading (cm^3)			
Volume of solution A used (cm^3)			

(4marks)

d) Calculate the average volume of solution A used. (1mark)
e) Write an ionic equation for the reaction taking place between solution A and mixture C. (1mark)
f) Calculate
  i. Molarity of sodium hydrogen carbonate in moles per litre. (2marks)
  ii. Mass of sodium hydrogen carbonate in the mixture in grammes per litre. (1mark)
  iii. Mass of the sodium chloride in the mixture. (1mark)
  iv. The percentage purity of the sodium hydrogen carbonate. (2marks)

228

QUESTION 2   **(07Marks)**

- You are provided with exactly 2g of solid D(oxalic acid $H_2C_2O_4$. $2H_2O$)
- You are required to determine the molar heat of solution of solid D.

PROCEDURE

(i)   Place $30cm^3$ of distilled water into a 100ml plastic beaker.

(ii)   Measure the initial temperature of the water and record it in table III below. Add all the solid D at once. Stir the mixture carefully with the thermometer until all the solid dissolves. Measure the final temperature reached and record it in table III below.

TABLE III

Final temperature (^{o}C)	
Initial temperature (^{o}C)	

                                                                                  (1mark)

(i)   Determine the change in temperature, ΔT.   (1mark)

(ii)   Calculate the

I.   Heat change when solid D dissolves in water. (Assume the heat capacity of the solution is $4.2kJKg^{-1}K^{-1}$ and density solution is $1gcm^{-3}$)   (2marks)

Moles of solid D, oxalic acid ($H_2C_2O_4$. $2H_2O$) used.

(H=1, C=12, O=16)   (2marks)

II.   Molar heat of solution, ΔH of solid D, (Oxalic acid)   (1mark)

QUESTION 3   **(12marks)**

You are provided with solid E. Carry out the tests below on it to determine its identity. Record your observations and inferences in the spaces provided.

a)   Put all the solid E provided in a boiling tube and add $10cm^3$ of distilled water and shake thoroughly. Divide the resulting solution into six portions. To portion one add sodium hydroxide solution dropwise until in excess.

Observations	Inferences

b)   Insert a clean metallic spatula (or wet) to the second portion and burn it in a non-luminous flame.

Observations	Inferences

c)   To the third portion, add 4 drops of Lead (II) nitrate solution.

Observations	Inferences

d)   To the fourth portion, add 4 drops of barium nitrate solution followed by $2cm^3$ of dilute nitric (V) acid.

Observations	Inferences
1mk	1mk

e)   To the fifth portion, add 3 drops of acidified potassium manganate VII

Observations	Inferences
1mk	1mk

f)   To the sixth portion, add 3 drops of acidified potassium dichromate VI

Observations	Inferences
1mk	1mk

g)   Give the identity of solid E.   (1mark)

MERU CLUSTER
233/1
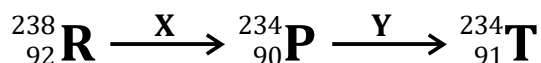**CHEMISTRY**
Paper 1
July/August
Time : 2 hours

1. Elements R - 238 decays in series forming different nuclides as shown below.

$$^{238}_{92}R \xrightarrow{\ X\ } {}^{234}_{90}P \xrightarrow{\ Y\ } {}^{234}_{91}T$$

   a) Identify the type of decay X and Y. (2 marks)

   b) Give one use of radioactive isotopes in medicine. (1 mark)

2. Chlorine can be manufactured by electrolysis of brine in a mercury cathode cell.
   a) Write equations for the electrode reactions at :
   i) Anode : (1 mark)
   ii) Cathode : (1 mark)
3. a) State Charles law. (1 mark)
   b) Sketch a graph to illustrate Charle's law. (2 marks)

4. In an experiment, 2 drops of universal indicators were added into a series of alkali.
   The table below summarises part of the results.

Alkali	Colour in universal indicator soln	pH value
Sodium hydroxide	Violet	13
Ammonia solution	Blue	9

   a) What is an alkali. 1 mark)
   b) Account for the results. 1 mark)
5. Name the process that takes place when:
   i) Ethanol reacts with concentrated sulphuric acid at 180°C to form ethene. (1 mark)
   ii) Ammonium chloride is heated and forms white powder on the cooler parts of the boiling tube. 1 mark)
   iii) Propanol reacts with propanoic acid in presence of a catalyst to form propylpropanoate. (1 mark)

6. The following reaction is in equilibrium in a closed container

$$C_{(S)} + H_2O \longrightarrow CO_{(g)} + H_2$$
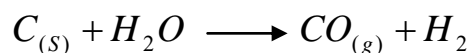
   State giving reasons how an increase in pressure would affect to amount of hydrogen produced. (2 marks)

7. The diagram below represents a flame of the Bunsen burner.

Piece of
White paper
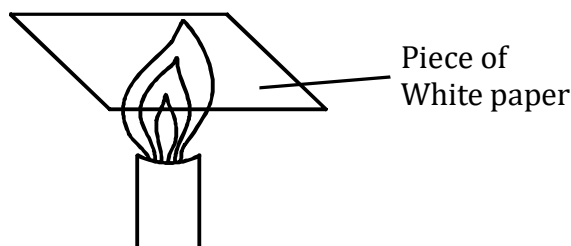
i)   A piece of paper is flipped over the flame as shown in the diagram. Draw a sketch to show the outcome.
(1 mark)
ii) State two reasons why laboratory apparatus are made of glass.   (1 mark)

8.   In the process of extracting oil from castor oil seed in a laboratory, a student first crushed the seed and then added propanone (acetone) instead of water.
i)   Why were the seed first crushed.   (1 mark)
ii) Explain how the oil can be separated from propanone.   (1 mark)
iii) Explain why propanone was added and not water.   (1 mark)

9.   The energy level diagram below shows the energy changes that occur when potassium chloride dissolves in water. Study it and answer the questions that follow.
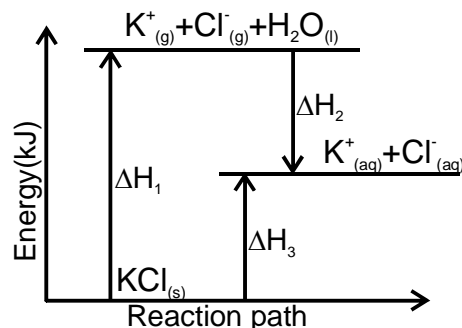

a)   Name each of the enthalpies represented by ΔH_1, ΔH_2, ΔH_3.   (1½ marks)
b)   Represent the energy level diagram above in an energy cycle linking ΔH_1, ΔH_2, ΔH_3.   (2 marks)

10. Study the flow chart below and answer the questions that follow.
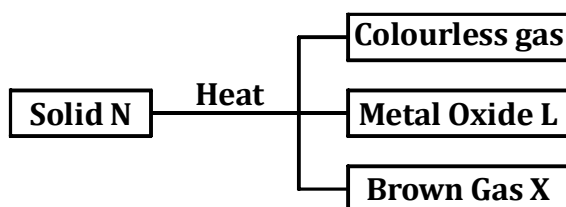
a)   Given that solid N burns in air with a red flame. Identify.

   i) Cation present in solid N.. (1 mark)

   ii) Metal oxide L.. (1 mark)

   iii) Gas X .... (1 mark)

   iv) Write down the formula of the anion present in solid N.   (1 mark)

11. 600cm² of excess oxygen gas was used to burn completely a 200cm³ gaseous hydrocarbon C_xH_Y.500cm³ of a gaseous product was formed by this combustion. The gaseous product was reduced to 100cm³ by absorbing in sodium hydroxide solution. The liquid formed by this combustion was negligible volume.
a)   Write a stoichiometric equation for the combustion reaction of this hydrocarbon.   (1 mark)
b)   Determine the molecular formula of the hydrocarbon C_xH_Y.   (3 marks)

12. a)   Name two ores from which copper is extracted.   (1 mark)
b)   During extraction of copper metal, the ore is subjected to froth floatation. Give a reason why this process is necessary.   (1 mark)
c)   Name one alloy of copper and state it use.   2mark)

13. Using dots (•) and crosses (×) to represent outer most electrons, draw diagrams to show bonding in H_3O^+ (H=1, C=6, O=8)   (2 marks)

14. The electronic configuration of the two ions X^{2+} and Y^- are 2.8 and 2.8.8 respectively.
i)   Write the electronic configuration of the atoms of X and Y.   (1 mark)
ii) Compare the atomic radii of the two elements.   (2 marks)

15. The diagram below shows a set up that can be used to obtain nitrogen gas in an experiment.

243

Copper (II) oxide

Nitrogen

Ammonia

Tube K

Ice

Liquid L

Water
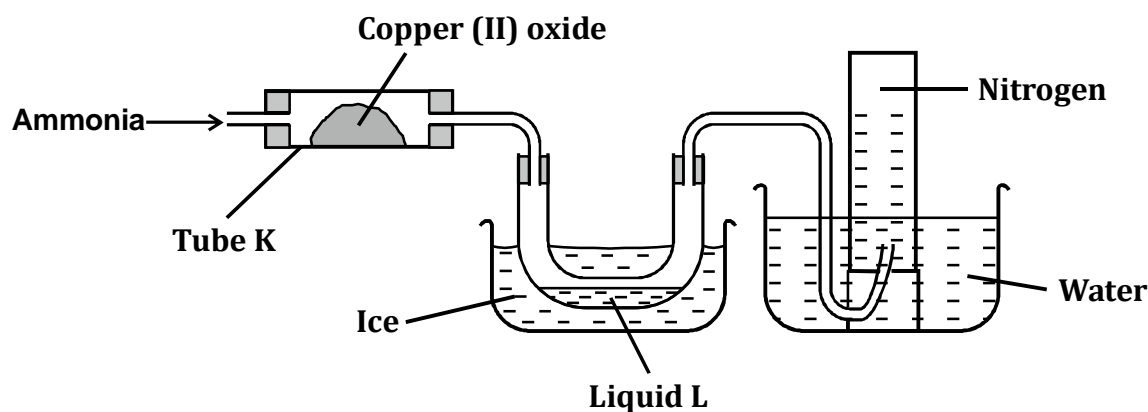
a) Name liquid L.. (½ mark)

b) What observation would be made in tube K after heating for some time. (1 mark)

c) Write an equation for the reaction that took place in tube K. (1 mark)

16. The following results were obtained during an experiment to determine the solubility of potassium nitrate in water at 30°C. Mass of dish =15.86g, mass of dish + saturated solution at 30°C = 26.86g, mass of dish + solid KNO_3 after evaporation to dryness = 16.7g. Calculate the mass of saturated solution containing 60.0g of water at 30°C
(3 marks)

17.a) Name two methods of preparing oxygen in laboratory other than decomposition of hydrogen peroxide.
(1 mark)
b) Name the catalyst used in :
i) The laboratory preparation of hydrogen. (½ mark)
ii) The laboratory preparation of oxygen from hydrogen peroxide. (½ mark)

18. The diagram below shows a cell that can be used to make electric energy.

**Magnesium Rod**

Rod of metal X, Y and Z
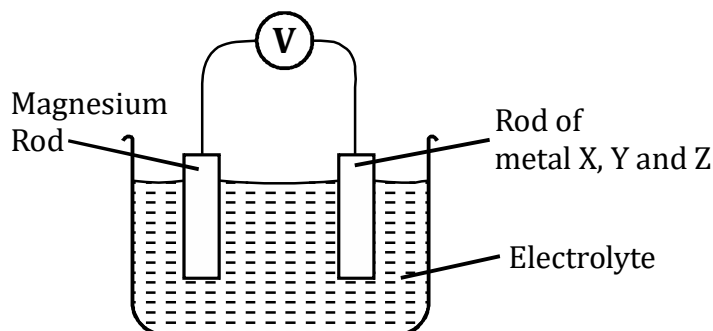
Electrolyte

a) Explain why distilled water is not used as the electrolyte. (1 mark)

b) The table below shows the results when rods of the three metals X, Y and Z are used in separate experiments. All the metals are less reactive than magnesium

Rod 1	Rod 2	Voltmeter reading (V)
Magnesium	X	2.72
Magnesium	Y	0.78
Magnesium	Z	1.10

Arrange the metals in order of starting with the most reactive. (1 mark)

19.a) Water from a town in Kenya is suspected to contain chloride ion but not sulphate ions. Describe how the presence of the chloride ion in the water can be shown. (2 marks)
b) State one advantage of drinking hard water rather than soft water. (1 mark)

20. Sulphur (IV) oxide reacts with potassium chromate (VI) according to the equation below.

$$3SO_{2(g)} + Cr_2O_{7(aq)}^{2-} + 2H_{(aq)}^+ \rightarrow 3SO_4^{2-} + 2Cr_{(aq)}^{3+} + H_2O_{(l)}$$
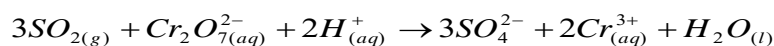
i) What is the oxidation number of chromium ion in $\quad Cr_2O_7^{2-}$ (1 mark)

ii) State and explain the observation made is the above reaction (2 marks)

21. The table below shows the observation made on tests carried out on a colourless liquid sample.

Test	Observation
Addition of excess $NH_{3(aq)}$	White precipitate
Addition in dilute $H_2SO_{4(aq)}$	White precipitate
Addition in $AgNO_{3(aq)}$	White precipitate

Identify

i) Cation in the sample (1 mark)
ii) Anion in the sample (1 mark)
22.a) Define the term isomerism (1 mark)
   b) Draw and name two isomers of butanol. (2 marks)
23. Explain each of the following properties of metals.
   i) Malleability. (1 mark)
   ii) Ductility (1 mark)
   iii) Sonorocity. (1 mark)
24. An alkanol has the following composition by mass; hydrogen 13.5%, Oxygen 21.6% and carbon 64.9%
   a) Determine the empirical formula of the alkanol. (2 marks)

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

   b) Give that empirical formular and the molecular formular of the alkanol are the same, draw the structure of the alkanol. (1 mark)
21. Explain the following observations:
   i) Graphite is a non-metal that conducts electricity. (1 mark)
   ii) Graphite rods are the most preferred electrodes. (1 mark)
   iii) Molten lead (II) iodide conducts electric current while solid lead (II) iodide does not. (1 mark)

26. Study the table below and answer the questions that follow.

| Formula of compound	X	XCl_2	Y	YCl_3	Z	ZCl_4
Boiling point	650	710	660	Sublimes at 180°C	1410	-70
Melting point	1120	1420	2450		2680	60
Electrical conductivity in liquid state	Good	Good	Good		poor	poor

Element X, Y and Z are period 3.
i) Which element has giant covalent structure. Explain. (2 marks)
ii) Explain the difference in mode of electrical conductivity in substances XCl_2 and Y. (2 marks)

245

27. When a solid R was heated in a test tube, it gave off two gases. The two gases were separated by passing them through a plug of glass wool in a test tube as shown below.

Glass Wool

Moist red
litmus paper
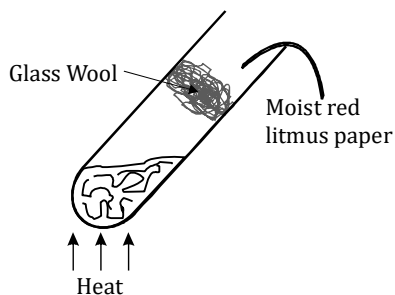
Heat

The first gas which evolved turned moist red litmus paper blue. The other gas evolved turned the litmus paper back red. Identify solid R. (1 mark)

28. When potassium chlorate (V) is heated, it decomposes according to the following equation.

$$2KClO_{3(S)} \rightarrow 2KCl_{(S)} + 3O_{2(g)}$$
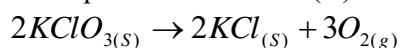
Calculate the volume of oxygen measured at r.t.p that is evolved when 2.5g of potassium chlorate (V) is heated to a constant mass. (Molar gas volume at r.t.p = 24000cm³, K=39, Cl=35.5, O=16. (3 marks)

29. Explain why hydrogen sulphide is a gas at room temperature while water is liquid at room temperature.
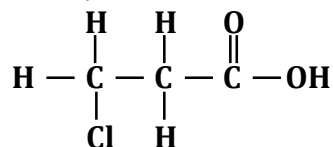
(2 marks)

MERU CLUSTER
233/2
CHEMISTRY
Paper 2
Section A

1. Study the information below and answer the question that follow, letters do not represent actual symbol of the element.

Element	Atomic No.	Melting point °C	Boiling point °C	Atomic radii	Ionic radius
L	3	-179	1340	0.08	0.100
M	9	-220	-188	0.101	0.105
N	11	98	890	0.135	0.132
P	12	650	1110	0.126	0.124
Q	13	660	2470	0.125	0.120
R	15	442/590	280	0.111	0.119
S	16	113/119	445	0.103	0.109
T	17	-101	-3	0.109	0.120
U	19	63.5	-775	0.167	0.160

a) Write the electronic configuration of an ion of element T and U (2 marks)
b) Why do the elements represented by R and S have two values of melting point. (1 mark)
c) Select an element.
   i) Which is the most electronegative. (1 mark)
   ii) That belong to period 4, explain. (2 marks)
d) Explain why
   i) Ionic radius of R is bigger than its atomic radius (1 mark)
   ii) The atomic radius of L is bigger than that of R yet they are in the same period. (1 mark)

e) Using dots (•) and cross (×) to represent outermost electrons, show bonding in the compound formed between L and M. (2 marks)
f) Write an equation for the reaction that occur between U and water. (2 marks)
g) Describe how a solid mixture of the sulphate of element N and lead (II) sulphate can be separated into solid sample of a dry lead (II) sulphate. (2 marks)

2. a) Give the systematic name for compound whose structural formula is given below. (1 mark)

$$H - \overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle Cl}{|}}{C}} - \overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}} - \overset{\overset{\displaystyle O}{\|}}{C} - OH$$

b) Draw the structural formular of the third member of alkyne homologous series. (1 mark)

c) Study the flowchart below and answer the questions that follow.
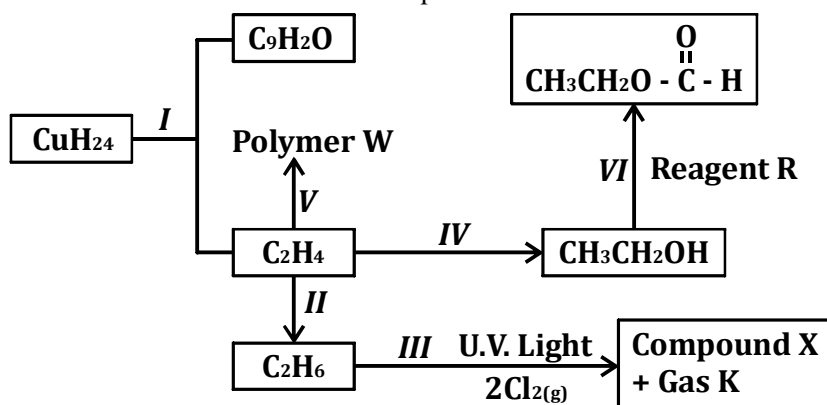
i) Name the process labelled I. (1 mark)
ii) Name the reagent R in step VI. (1 mark)
iii) Explain how acidified potassium manganate VII solution can be used to distinguish between C_2H_4 and C_2H_6. (2 marks)
iv) State one industrial application of process in step II (1 mark)
v) Write an equation for reaction in step III. (1 mark)
vi) Identify the reagent and conditions required for step IV to take place. (1 mark)
vii) State one use of polymer W. (1 mark)

d) $R-COO^-Na^+$ and $R-CH_2OSO^-_3Na^+$ represent two types of cleaning agents.
i) Name the class of cleaning agent to which $R-COO^-Na^+$ belong. (1 mark)
ii) Which two cleansing agents would be suitable to use when washing with borehole water containing dissolved calcium chloride? Explain (2 marks)

3. The diagram below shows the process of manufacturing sodium carbonate using solvay process. Study it and answer the questions below.
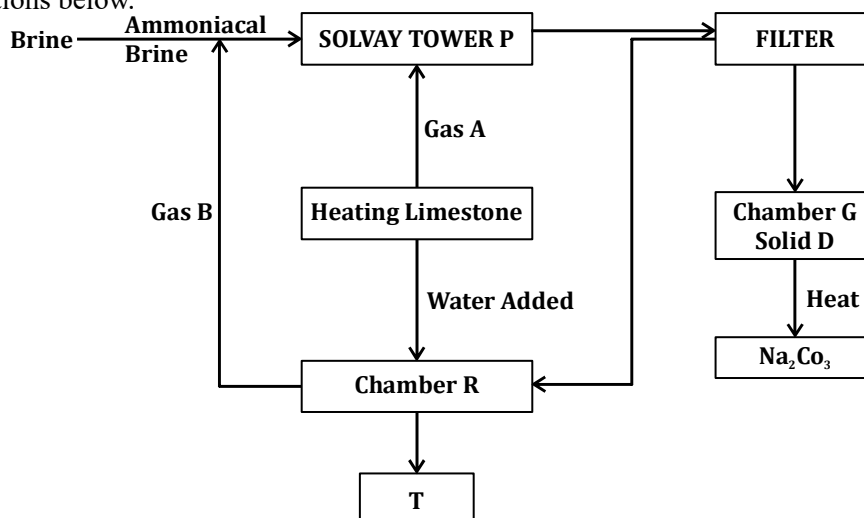
a) Name gases A and B. (2 marks)
b) Name solid D. (1 mark)
c) Write equations of the reactions in
   Tower P (1 mark
   Chamber R (1 mark)
   Chamber G (1 mark)

d) Name the product T formed at chamber R and give one of its uses. (2 marks)
e) Explain using ionic equations how Sodium Carbonate is used to soften hard water. (2 marks)

4. a) A sample of 25.0cm³ of 0.059M sodium hydroxide solution reacted with 23.5cm³ of a dibasic acid, $HOOC(CH_2)_xCOOH$ containing 3.8 grams per litre. Given that the ionic equation for the reaction is
   Calculate
   i) the molar concentration of the acid. (3 marks)

248

ii)   the relative formula mass of the acid.   (1 mark)
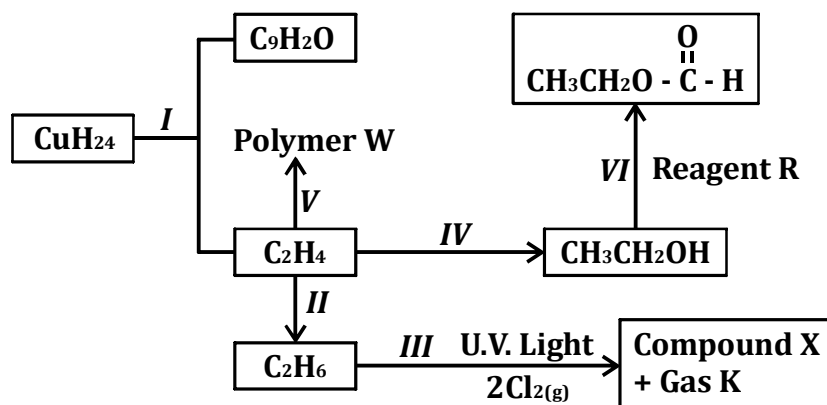
iii) the value of X (C=12, O=16, H=1)   (2 marks)
b) 50cm³ of 1 molar hydrochloric acid were added to 50cm³ of 1 molar sodium hydroxide solution. Calculate the mass of the salt formed. (H=1, O=16, Na=23, Cl=35.5)   (3 marks)
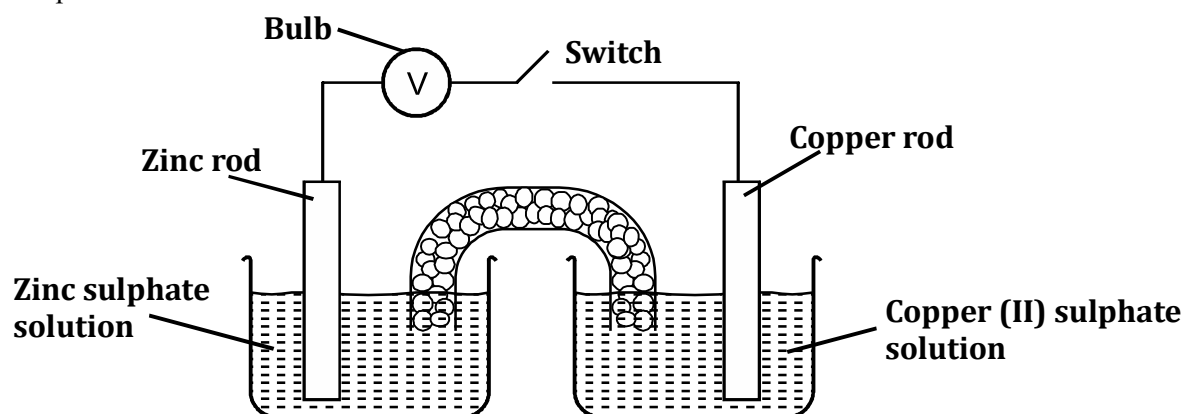c) 2.7g of iron (II) sulphate crystals (FeSO$_4$.xH$_2$O) were heated. The residue left was 1.52g. Calculate the number of moles of water of crystallization in one mole of the hydrated iron (II) sulphate.
 (H=1, O=16, S=32, Fe=56)   (3 marks)

5.   An experiment was set as shown below.

a)   What is observed on the bulb when the switch is closed?   (1 mark)
b)   Which electrode will be cathode?   (1 mark)
c)   Write down the half-cell equations for:
    i) Copper electrode.   (1 mark)
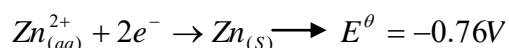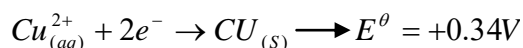   ii) Zinc electrode.   (1 mark)
d)   Write the overall ionic equation for the electrochemical cell.   (1 mark)
e)   The table below shows the electrode potentials.

$$Cu^{2+}_{(aq)} + 2e^- \rightarrow CU_{(S)} \longrightarrow E^\theta = +0.34V$$

$$Zn^{2+}_{(aq)} + 2e^- \rightarrow Zn_{(S)} \longrightarrow E^\theta = -0.76V$$

   What is the value of the voltage of the cell?   (2 marks)
f)   The switch is kept closed. State and explain the observation expected after sometime on the
i)   Zinc rod   (2 marks)
ii) Copper (II) sulphate solution.   (2 marks
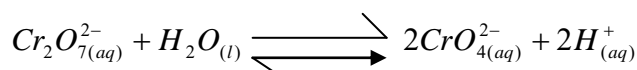**6.**   a)   State Le Chatelier's pinciple.   (2 marks)

b)   State 2 characteristics of a dynamic equilibrium.   (1 mark)

c)   The following equation represents an equilibrium reaction.

$$Cr_2O^{2-}_{7(aq)} + H_2O_{(l)} \rightleftharpoons 2CrO^{2-}_{4(aq)} + 2H^+_{(aq)}$$
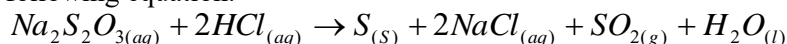
249

(orange)   (yellow)

Use Le Chatelier's principle to explain the observation that would be made when dilute hydrochloric acid is added to the equilibrium mixture.   (2 marks)

d) When sodium thiosulphate reacts with hydrochloric acid, a yellow solid sulphur forms according to the following equation.

$$Na_2S_2O_{3(aq)} + 2HCl_{(aq)} \rightarrow S_{(S)} + 2NaCl_{(aq)} + SO_{2(g)} + H_2O_{(l)}$$

The effect of temperature on the rate of reaction was studied. A 25cm³ portion of 0.02 molar solution sodium thiosulphate was run into a conical flask. A cross sign (×) was drawn on a piece of paper underneath a flask. An excess hydrochloric acid was added and temperature was noted. The time taken for cross sign to disappear was also noted. The experiment was also repeated at different temperatures. The result was as shown below.

Temperature	10	20	30	40	50	60	70
Time (S)	20	37	50	67	72	74	74

i)   Plot a graph of time against temperature on the grid provided.   (3 marks)

ii) From the graph, determine the reaction rate between 25°C and 45°C   (2 marks)

7.a) Iron pyrites, a naturally existing mineral was heated in air to give iron (III) oxide and gas X. This gas is also formed when a yellow powder is burned in limited amount of air.
i)   Identify the yellow powder.   (1 mark)
ii) Identify gas X.   (1 mark)
iii) Write a chemical equation to show the reaction between gas X and aqueous sodium hydroxide. (1 mark)

b) When a piece of metal X is placed in a solution of metal Y ions, metal Y plates out on the piece of X . Which metal:
i)   is oxidised.   (1 mark)
ii) is reduced.   (1 mark)

c) Iron windows frames corrode quickly unless carefully protected but aluminium window frames are resistant to corrosion.
i)   Give the chemical name of the substance formed when iron rusts.   (1 mark)
ii) Why does aluminium not corrode as quickly as iron?   (2 marks)
iii) Explain why galvanised iron is resistant to corrosion even when the protective surface of Zinc is broken.
                                                                                                (2 marks)

MERU CLUSTER
233/3
CHEMISTRY
Paper 3
July/August 2018
Time :2 hours
CONFIDENTIAL

Each candidate will require:

- In addition to the fitting and apparatus in the school laboratory, each student should be provided with the following:
  1. Solution C
  2. Specimen L
  3. Drinking straw
  4. Three boiling tubes with boiling tube corks / stoppers.
  5. Two empty 250ml plastic beaker.
  6. Two pieces of aluminum foil enough to wrap the boiling tubes completely.
  7. Specimen P - Ripe orange (Medium sized with seeds)
  8. Specimen Q - Mature bean pod.
  9. Solution X - Benedicts Solution.
  10. Solution Y– DCPIP.
  11. Scalpel.
  12. Hand lens.
  13. Piece of cotton thread 20 cm long.
  14. Stop watch.

NB

a) Solution C is prepared by measuring 50 Cm^3 of Bromothymol blue and dissolve it in 1000 Cm^3 of distilled water to make 5% of solution.

b) Specimen L is a twig of Cassia SP freshly obtained with 2.3 leaves.
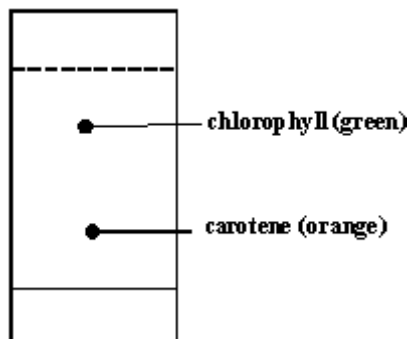
IGEMBE CENTRAL
**233/1**
CHEMISTRY
PAPER 1

TIME: 2 HRS

1. A column chromatography of a solution of spinach was done using petrol solvent. The results were as shown in the diagram below.
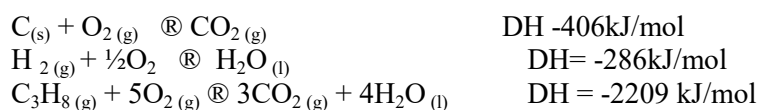

   a) Why is it possible to separate chlorophyll and carotene? (1 mk)

   b) On the diagram label the solvent front and the base line. (2 mks)

2. The chemical formula of elements P and Q is P_2Q_3, P is an element in period 3 while Q is a non-metal in period 2 Write the electronic configuration of:-
   a) An atom of P (1 mk)
   b) An ion of Q (1 mk)

   c) Write the chemical formula of a compound formed when Q reacts with element V a metal in group one.
   (1 mk)

3. A sample of hard water was divided into portions and analysed. The results of the analysis were tabulated as shown below.

Portion of water	Observations on	treating of	water with:
	Na_2CO_3 (aq)	Pb $(NO_3)_2$	$Ba(NO_3)_2$
Unboiled water	White ppt	White ppt	No ppt
Boiled water	White ppt	White ppt	No ppt

   a) Predict the type of hardness in the water. (1 mk)
   b) Suggest the compounds likely to be present in the water. (2 mks)

4. a) State Gay Lussac's law. (1 mk)

   b) $10cm^3$ of a gaseous hydrocarbon, C_2H_x require $30cm^3$ of oxygen for complete combustion. If steam and $20cm^3$ of Carbon (iv) Oxide were produced what is the value of x? (2 mks)

5. The set up in the diagram below was used to prepare oxygen gas in the laboratory.
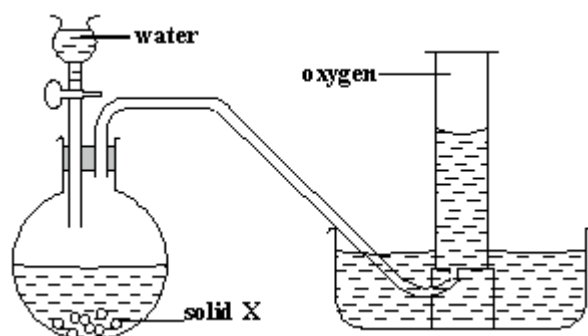
a) Identify solid x. (1 mk)

b) State any two uses of oxygen gas.

6. a) What do you understand by the term dative covalent bond? (1 mk)

b) Using dots (.) and crosses draw a diagram to show the bonding in Carbon II Oxide molecule. (1 mk)

c) State one property of ionic compounds. (1 mk)

7. The following are organic compounds belonging to different homologous series.

$CH_4, C_4H_{10}, C_2H_2, C_2H_5OH, CH_3COOH$

Which of the above compounds:-

a) Would decolourise chlorine gas in presence of U.V light but does not decolourise acidified potassium Manganate (VII). (1 mk)

b) Decolourise potassium Manganate (VII) but does not decolourise bromine water. (1 mk)

c) Does not decolourise both Potassium Manganate (VII) and bromine water. (1 mk)

8. Using the data below, draw a energy cycle diagram and use it to determine the heat of formation of propane. (2 mks)

$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ DH -406kJ/mol

$H_{2(g)} + \frac{1}{2}O_2 \rightarrow H_2O_{(l)}$ DH= -286kJ/mol

$C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(l)}$ DH = -2209 kJ/mol

9. The products formed by the action of heat on nitrates of elements A, B and C are shown below.

Nitrate	Products formed
A	Metal oxide + Nitrogen (IV) Oxide + Oxygen
B	Metal + Oxygen + Nitrogen (IV) Oxide
C	Metal Nitrite + Oxygen

a) Arrange the metals in increasing order of reactivity. (1 mk)

b) Which element forms a soluble carbonate? (1 mk)

c) Give one example of metal B. (1 mk)

10. A radio active substance emits three different particles.

a) Give the name of the particle with the highest ionising power. (1 mk)

b) Find the values of Y and Z in the equation below.

$$_{92}^{y}U + _{0}^{1}n \rightarrow _{38}^{94}Sr + _{Z}^{140}Xe + 2_{0}^{1}n$$
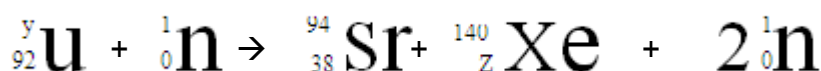
11. When Sodium Carbonate crystal $Na_2CO_3.xH_2O$ with formula mass 286 were left exposed to the air, a white powder $Na_2CO_3.H_2O$ is formed.

a) What name is given to the phenomenon? (1 mk)

b) Determine the value of x. (2 mks)

(*Na= 23, C= 12, O= 16, H=1*)

12. Study the flow chart below and answer the questions that follow.
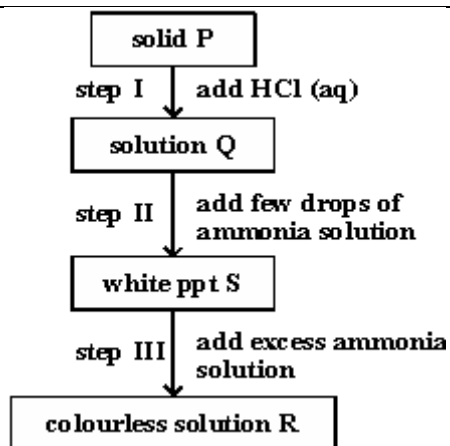
a) Identify:-
    i) Solid P.   (½ mk)
    ii) Solution Q   (½ mk)
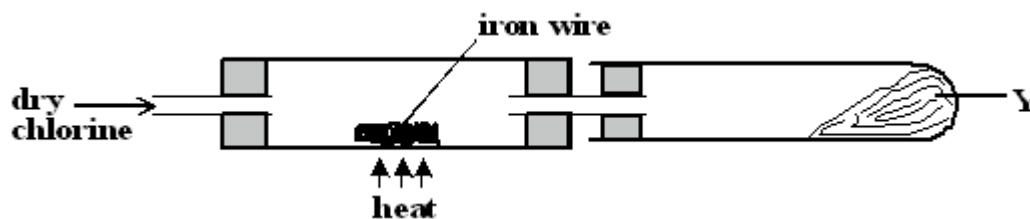b) Write an equation of the reaction leading to formation of solution Q.   (1 mk)
c) Write the formula of the complex ion present in solution R.   (1 mk)

13. Dry Chlorine was passed over heated iron wire as shown in the figure below.

a) State the observations made when Chlorine comes into contact with the hot iron.   (1 mk)
b) State the property of product Y that enables it to be collected as shown.   (1 mk)
c) Write an equation for the reaction that takes place in the combustion tube.   (1 mk)

14. In an experiment the quantity of electricity passed to deposit 3.57g of a metal M from its salt was 11580 coulombs. The R.A.M of metal M is 119. (1 Faraday = 96500 coulombs) Calculate the number of Faradays required to deposit one mole of M.   (3 mks)

15. 500g of a hydrocarbon contains 428.6g of Carbon. Its molecular mass is 84. Determine its empirical formula and its molecular formula. (C =12, H=1)   (3mks)

16. A crystalline organic compound X reacted with concentrated Sulphuric (VI) acid to produce a black substance S. After washing and drying substance S was reacted with concentrated sulphuric (VI) acid to produce two colourless gases.
a) Name the type of reaction between:-
    i) X and concentrated Sulphuric (VI) acid.   (½ mk)
    ii) S and concentrated Sulphuric (VI) acid.   (½ mk)
b) Give the identities of substances:-
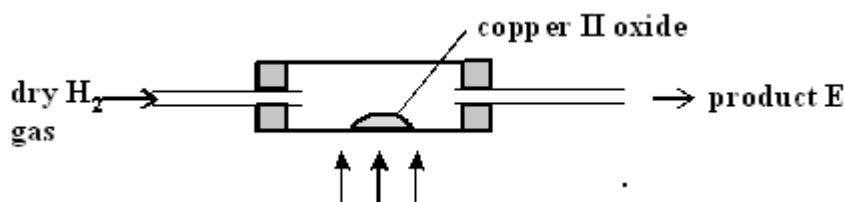   i) X _____   (1 mk)
    ii) S _____   (1 mk)

17. In a laboratory experiment hydrogen gas was passed over heated copper II Oxide as shown in the diagram below.

a) State one observation made in the combustion tube.   (1 mk)
b) Describe a chemical test that can be used to identify product E.   (1 mk)

264

c) Write a chemical equation for the reaction taking place in the combustion tube. (1 mk)

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

a) Why was Sodium Carbonate used in excess?

b) On the graph below sketch and label the curves of the volumes of Carbon (IV) Oxide produced against time.
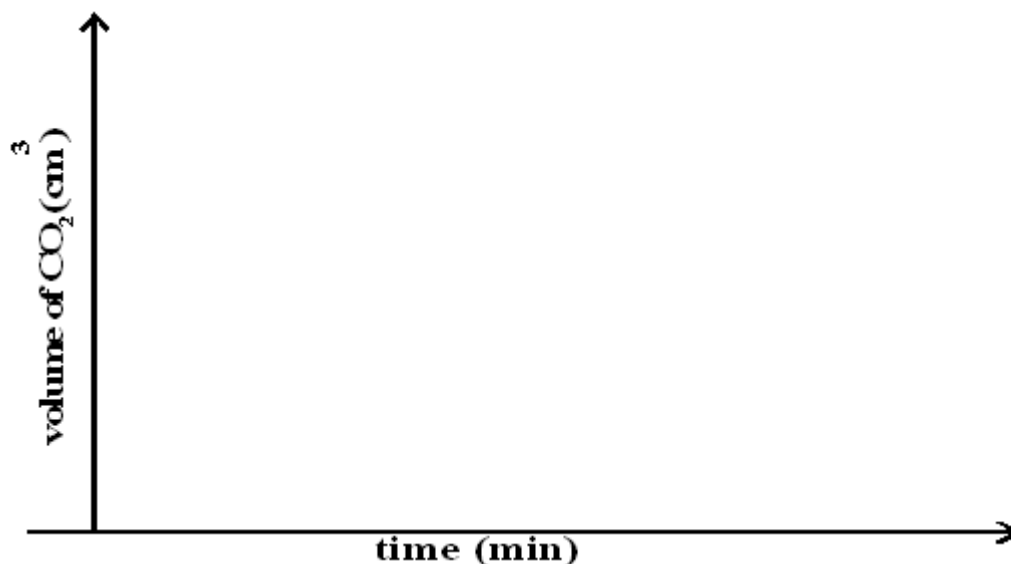
19. The set up below was used to carry out electrolysis of a bromide of metal T, TBr$_2$.
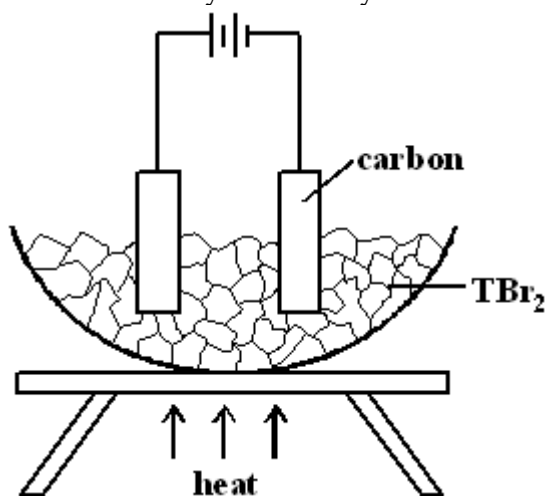
a) Write equations for the reaction taking place at the:- (2 mks)
   i) Anode
   ii) Cathode
b) Give a reason why this experiment should be carried out in a fume chamber. (1 mk)

20. Nitrogen gas reacts reversibly with hydrogen gas as shown in the equation below.

$$N_{2(g)} + 3 H_{2(g)} \rightleftharpoons 2NH_{3(g)} \qquad DH = -92 \text{ KJ/Mol}$$
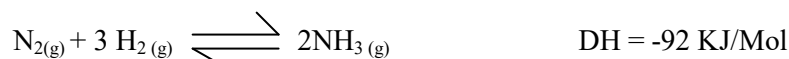
a) What would be the effect on the reaction of:-
   i) Increasing the pressure (1 mk)
   ii) Lowering the temperature. (1 mk)
b) Which catalyst is used to encourage the formation of ammonia in this reaction? (1 mk)

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

265
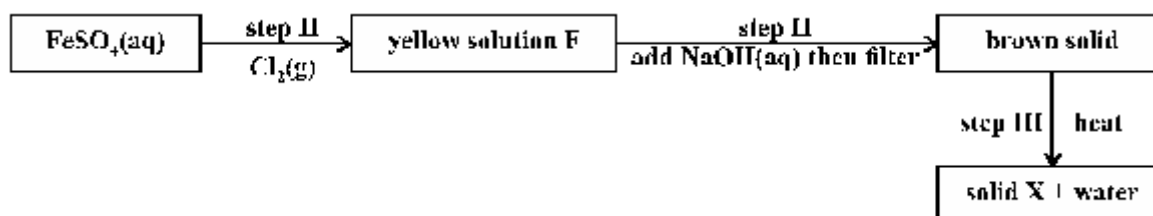
a) Write the formula of the cation present in solution F. (1 mk)

b) What property of Chlorine is shown in step I? (1 mk)

c) Write an equation for the reaction which occurs in step III. (1 mk)

22. Calculate the mass of Calcium Carbonate which would produce $480cm^3$ of Carbon (IV) Oxide when heated at room temperature and pressure.

(Molar gas volume at r.t.p =24l Ca=40, C=12, O=16) (3 mks)

23. In an experiment, ammonium Chloride was heated in a test tube. A moist red litmus paper placed at the mouth of the test tube first changes to blue litmus then to red . Explain these observation.

(3 mks)

24. Zinc is normally extracted from its natural ores like Zinc blende (ZnS) and Calamine $ZnCO_3$.

a) Explain why it is wrong to refer to these ores as Zinc Sulphide and Zinc Carbonate respectively.

(1 mk)

b) Write an equation for roasting Zinc blendes in the air. (1 mk)

c) Give one use of Zinc metal. (1 mk)

25. In an experiment the electrical conductivity of some substances and the effect of electricity on them was studied. The observations made were recorded in the table below. Study it and answer the questions that follow.

Substance	Conductivity in:	
	Solid state	Aqueous/ Molten State
Q	Does not conduct	Conducts
R	Conducts	Conducts
S	Does not conduct	Does not conduct

a) Which of the substances is likely to be :-

i) a metal? (½ mk)

ii) a substance with giant covalent structure? (½ mk)

b) Explain why substances Q conducts only when in aqueous or molten state. (2 mks)

26. Study the information in the table below and answer the questions that follow. The letters are not the actual symbols of the element.

Element	Atomic Number	Melting point (^{0}C)
U	11	97.8
V	13	660
W	14	1410
X	17	-101
Y	19	63.7

Select an element which is:-

a) The most reactive non-metal (1 mk)

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

27. $25cm^3$ of 0.15M Sodium Carbonate solution required $18cm^3$ of dilute hydrochloric acid for complete neutralisation. Determine the concentration of the hydrochloric acid solution. (1 mk)

IGEMBE CENTRAL
233/2
CHEMISTRY
PAPER 2

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

E			H				J	
	N		R					
F	G			Z		L		K
							M	

i) Name the group to which elements J and M belong.   (1 mk)
ii) Give the name of the most reactive metal. Explain.   (2 mks)
iii) Write down the equation for the reaction between G and J.   (1 mk)
iv) Explain why the atomic radius of G is larger than that of Z.   (1 mk)
v) An element P forms a compound with the formula NP_2 with N. P is not in group seven but in period 3.
   Identify the group in which element P belong and show it on the periodic table.   (2 mks)
vi) Explain why the melting point of M is higher than that of J.   (1 mk)
vii) Give the name of the bond formed between R and J and give the formula of the compound formed.
                                                                                               (1 mk)

b) The 1st, 2nd and 3rd ionization energy in kJ/mol of element W and Q are given below.

Element	1st I.E	2nd I.E	3rd I.E
W	520	7300	9500
Q	420	3000	4800

i) What is 2nd ionization energy?   (1 mk)
ii) Apart from decrease in energy levels. Explain why there is a big difference between 1st and 2nd ionization energy.   (2 mks)
iii) Calculate the amount of energy in KJ/mol for the process below.   (1 mk)
$$Q_{(g)} \longrightarrow Q^{3+}_{(g)} + 3e^-$$

2. a) The equations below shows the standard reduction potentials for four half cells. Study them and answer the questions that follow. Letters are not the actual symbols of elements.

Half reaction E^θVolts
$A^{2+}_{(aq)} + 2e^- \longrightarrow A_{(s)}$ - 2. 38
$B^+_{(aq)} + e^- \longrightarrow B_{(s)}$ + 0.80
$D^{2+}_{(aq)} + 2e^- \longrightarrow D_{(s)}$ 0.00
$E^{2+}_{(aq)} + 2e^- \longrightarrow E_{(s)}$ - 0.25

i) Identify the reference electrode. Explain   (1 mk)
ii) Draw an electrochemical cell formed when B half cell is combined with A half cell.   (3 mks)
iii) Write the cell representation for the cell in a (ii) above.   (1 mk)

iv) Calculate the Emf of the cell reaction in a (ii) above. (1 mk)

b) The diagram below shows the apparatus used to electrolyse acidified water to obtain hydrogen and oxygen gases. Study it and answer the questions that follow.

i) Name gases

X _____ (½ mk)
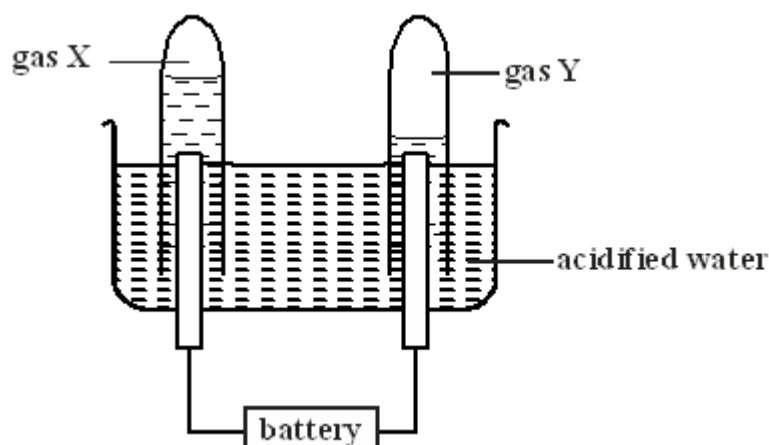
Y _____ (½ mk)

ii) Explain why it is necessary to acidify the water (2 mks)

iii) Explain why hydrochloric acid is <u>not</u> used to acidify water. (2 mks)

iv) Explain the differences in volume of gases X and Y. (2 mks)

3. Study the scheme below and answer the question that follow.
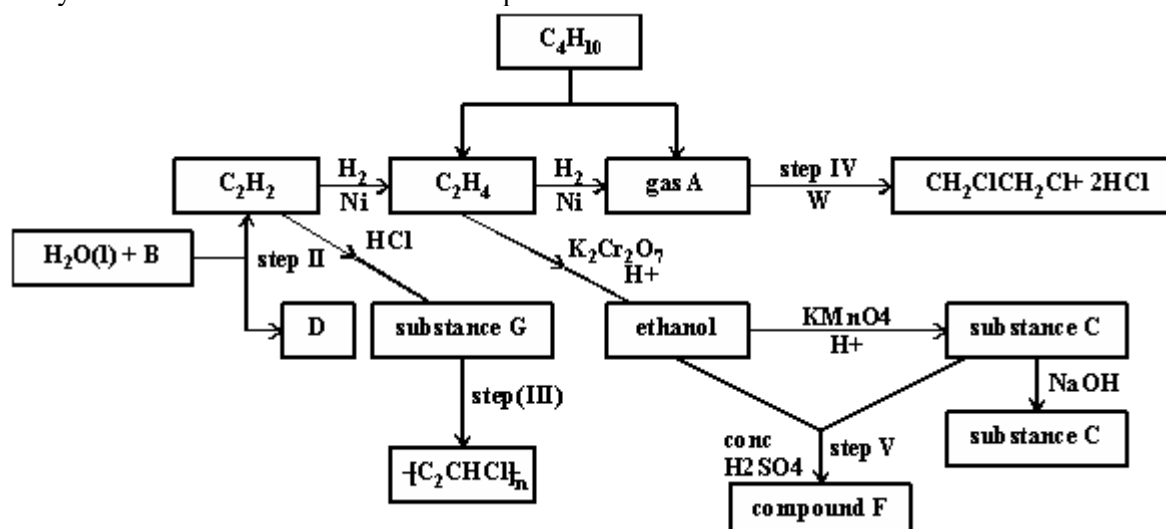
a) Identify the following;

Gas A *(½mk)*

Substance B (½mk)

Substance C (½mk)

Substance D (½mk)

Substance E (½mk)

Substance F (½mk)

Substance G (½mk)

b) Name the process involved in:-

i) Step (I) (½mk)

ii) Step (III) (½mk)

iii) Step (IV) (½mk)

iv) Step (V) (½mk)

c) List the conditions for the process in:-

   i) Step (I)   (1 mk
   ii) Step (IV)   (½ mk)
   d) Write the equation for the reaction in:
   i) Step (I)   (1 mk)
   ii) Step (IV)   (1 mk)
   e) What are the observations made when C_2H_2 and gas A are completely burnt.   (1 mk)

4. In an experiment to determine molar heat of displacement, excess Zinc was added to a 250cm^3 plastic beaker containing 100cm^3 0.5M Copper (II) Sulphate solution. The solution was stirred with thermometer. The temperature of the solution charged from 21^{0}C to 45^{0}C.
   (*Given that Zn=65, specific heat capacity =4.2jg^{-1}k^{-1}, density of the solution = 1g/cm^3*)
   a) State and explain the observations made.   (2 mks)
   b) Calculate :-
   i) Moles of $CuSO_4$ in solution.   (1 mk)
   ii) Heat of the reaction.   (1 mk)
   iii) Molar heat of displacement.   (1 mk)
   c) i) Determine the mass of Zinc used.   (1 mk)
   ii) Explain why excess Zinc was added.   (1 mk)
   d) Write the thermo chemical equation for the reaction.   (1 mk)
   e) The theoretical value is greater than the experiment value. Explain   (1 mk)
   f) Draw an energy level diagram for the reaction .   (2 mks)

5. Study the flow diagram below and answer the questions that follow.
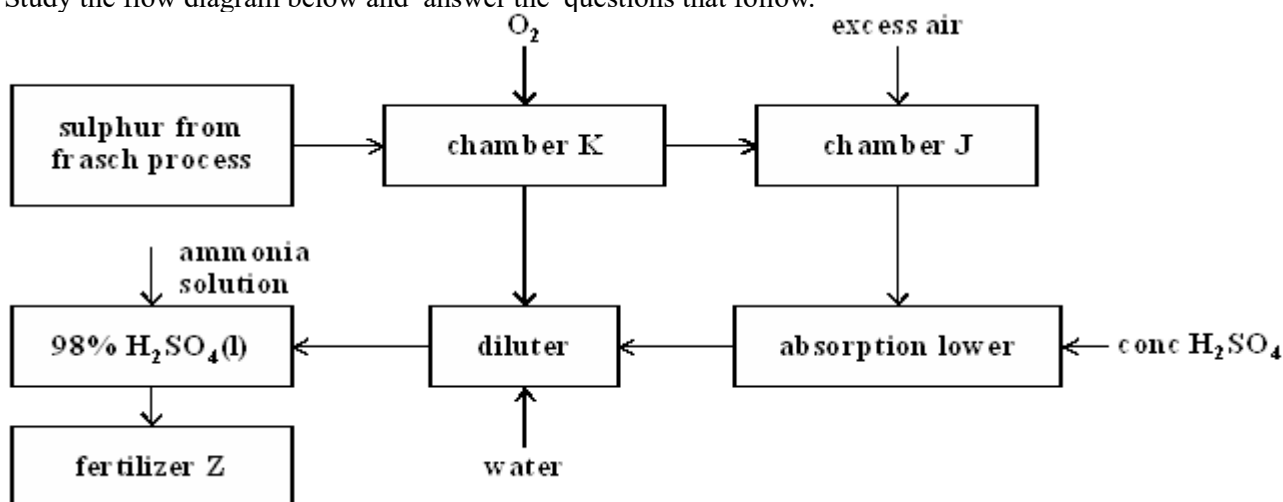
   a) Write equations occurring in the following chamber.
   i) Chamber k   (1 mk)
   ii) Absorption tower   (1 mk)
   iii) Diluter   (1 mk)
   b) The reaction taking place in chamber J is given below.

$$2SO_2 + O_2 \rightleftharpoons 2SO_3 \text{ DH= -196kJmol}$$

   i) Explain why it is necessary to use excess air in chamber J.   (2 mks)
   ii) Name another substance used in chamber J.   (1 mk)
   iii) What name is given to chamber J.   (1 mk)
   iv) State and explain the effect on the yield of Sulphur (VI) Oxide when temperature is increased

                                                                                                    (1 mk)
   c) Calculate the percentage of nitrogen on fertilizer Z. (*N=14, S=32, O=16, H=1*)   (2 mks)

6. The table below shows the solubility of two salts X and Y in g/100cm^3. Use it and answer the questions that follow.

Temperature in (^{0}C)	0	20	50	60	80	90
Solubility of X in g/100cm^3	6	10	22	35	55	65
Solubility of Y in g/100cm^3	90	40	16	10	6	5

On the grid provided plot the graphs of temperature against the solubility of salts X and Y in g/100cm^3

(5 mks)

b) From your graph determine the solubility of:
      i) Salt X at 71^{0}C. (1 mk)
      ii) Salt Y at 35^{0}C. (1 mk)
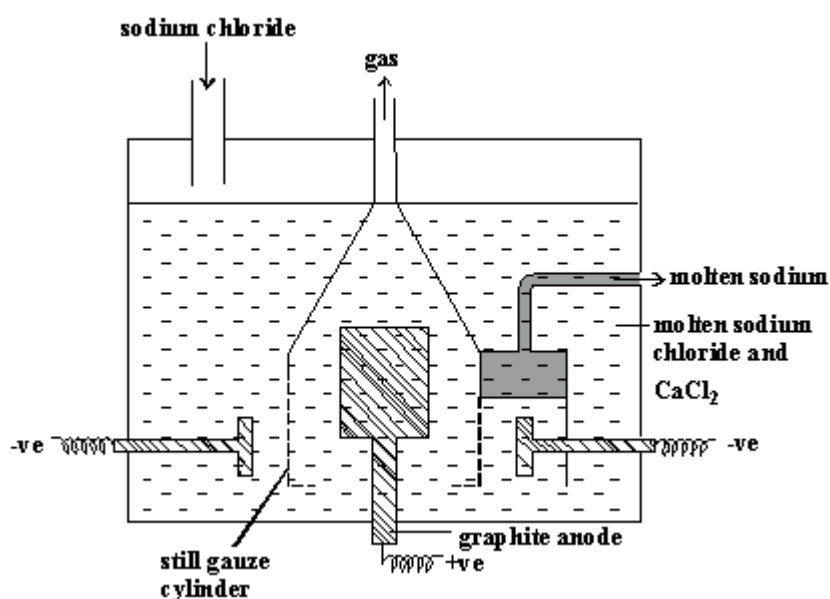c) At what temperature is the solubility of X and Y the same. (1 mk)
d) 50cm^3 of saturated solution of salt X was cooled from 70^{0}C to 30^{0}C. Calculate the mass of salt X formed.

(2 mks)

   e) State two uses of solubility. (2 mks)

7. The diagram below shows the extraction of Sodium metal using downs cells. Study it and answer the questions that follow.

a) Explain why in this process Sodium Chloride is mixed with Calcium Chloride. (2 mks)
b) Why is anode made of graphite and not steel? (2 mks)
c) State two properties of Sodium metal that makes it possible for it to be collected as shown in the diagram.

(2 mks)

d) What is the function of steel gauze cylinder? (1mk)
e) Write ionic equations for the reactions which take place at:-
i) Cathode. (1 mk)
ii) Anode (1 mk)
f) Give two industrial use of Sodium metal. (2 mks)
g) Explain why the Sodium metal is kept stored under Kerosene. (1 mk)

IGEMBE CENTRAL
233/3
CHEMISTRY
PAPER 3
PRACTICAL
Q1. You are provided with 0.06g Magnesium ribbon, solid C.
    - 2M H_2SO_4, solution D

You are required to determine the molar heat of reaction between Sulphuric (IV) acid and Magnesium ribbon.

    PROCEDURE
Using a burette, place 50.0cm³ of H_2SO_4 solution D in 100ml plastic beaker. Stir the solution gently with a thermometer measure the temperature after every one minute. Record the values in table 1 below. Fold Solid C once, at exactly 3 minutes, place Solid C into solution D in the beaker. Stir the mixture gently with the thermometer. Measure the temperature of the mixture after every one minute and record the values in table 1 below.

Table 1

Time (minutes)	0	1	2	3	4	5	6	7
Temperature (⁰C)								

(4 mks)

i) Plot a graph of temperature (x-axis) against Time on the grid provided. Show the change in temperature (DT) on the graph. (4 mks)
ii) Use your graph to determine the highest change in temperature (DT) (1 mk)
ii) Calculate the heat change for the reaction given that the specific heat capacity of the mixture is 4.2j/g/k. Assume the density of the resulting solution to be 1 g/cm³. (2 mks)
iii) Calculate the molar heat of the reaction of Magnesium with excess Sulphuric (VI) acid. (2mks)

Q2. You are provided with
    - Solution E containing 14.84g per litre of anhydrous Sodium Carbonate.
    - Hydrochloric acid, Solution F
    - Phenolphthalein Indicator
    - Methyl orange indicator

You are required to determine the morality of Solution F.
    Procedure.
a) Fill the burette with solution F.
b) Pipette 25cm³ of solution E into a conical flask
c) Add the drops of phenolphthalein indicator and titrate against solution F. **DO NOT POUR OUT THE CONTENT OF THE CONICAL FLASK.** Record the reading in table II below.
d) Add three drops of the methyl orange indicator to the content of the conical flack and continue titration with solution F.
e) Record the readings in table III below. Repeat the procedure to complete table II and III.
Table II

	I	II
Final burette reading (cm³)		
Initial burette reading (cm³)		
Volume of solution F used (cm³)		

(3½ mks)

a) Calculate the average volume of solution F used (V_1) _____ (½mk)

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

(3½ mks)

b) i) Calculate the average volume of solution F used _____ (V$_2$)   (½mk)
   ii) Calculate the total volume of solution F used (V$_1$ + V$_2$) _____   (1 mk)
c) Calculate the molarity of sodium Carbonate.
   (*Na = 23, C=12, O=16*) (1mk)
d) Calculate the moles of Sodium Carbonate in 25cm^3 of solution.   (1 mk)
e) Calculate the moles of solution F in the total volume.   (1 mk)
f) Calculate the molarity of hydrochloric acid Solution F   (2 mks)

Q3. You are provided with Solid W. Carry out the following tests on it and record your observations and inferences in the spaces provided.
a) Place all solid W in a boiling tube. To it add about 10cm^3 of distilled water and shake well. Divide resultant mixture into the 4 portions.

Observation	Inference
(1 mk)	(1 mk)

b) To the 1st portion, add 2M NaOH drop wise till in excess.

Observation	Inference
(½ mk)	(1 mk)

c) To the 2nd portion dip a glass rod in it and place it on a non-luminous flame.

Observation	Inference
(½ mk)	(½ mk)

d) To the 3rd portion, add 3 drops of Ba(NO$_3$)$_2$

Observation	Inference
(½ mk)	(1 mk)

e) To the 4th portion, add 2 drops of Pb(NO$_3$)$_2$ solution.

Observation	Inference

272

(½ mk)   (½ mk)

II. You are provided with Solid X. Carry out the test below and record your observations and inferences in spaces provided.

a) Put all the solid given in a boiling tube. To it add about $10cm^3$ of distilled water and shake well.

Observation	Inference
(½ mk)	(½ mk)

b) To about $2cm^3$ of the solution obtained in (a) above add 2 drops of potassium Manganate (VII)

Observation	Inference
(½ mk)	(½ mk)

c) To about $2cm^3$ of the solution obtained in (a) above add 2 drops of Bromine water.

Observation	Inference
(½ mk)	(½ mk)

M.C. CLUSTER OF SCHOOLS FORM 4 EVALUATION TEST – 2018
**233/1**
CHEMISTRY
PAPER 1

1. Explain why luminous flame of a Bunsen burner appears yellow?   (2marks)
2. The empirical formula of a compound is CH_2 and it has a molecular mass of 42.
    (a) What is the molecular formula of this compound?   (1mark)
    (b) Write the general formula of the homologous series to which the compound belongs.   (1mark)
    (c) Draw the structural formula of the third member of this series and give its IUPAC name.   (1mark)
3. The table below shows some elements and their atomic numbers. The letters do not represent the actual symbols
    of the elements.

Element	X	Y	Z	R	S	Q	T
Atomic Number	11	10	20	13	14	4	8

    (a) From the given letters of elements select two elements with the same chemical properties.   (1mark)
    (b) Write the formula of a compound formed when element **S** reacts with element **T**.   (1mark)
    (c) Identify the <u>most</u> stable element.   (1mark)

4. The diagram below represents an electrochemical cell.
    (a)
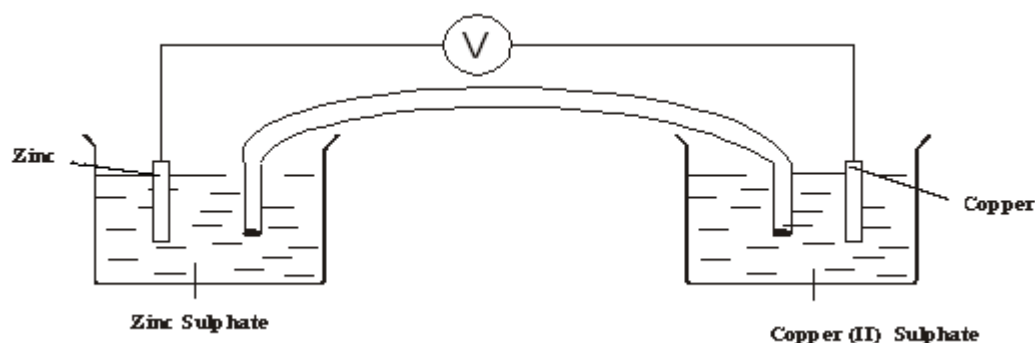
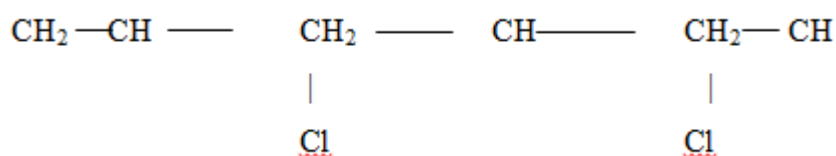   (i)   On the diagram label the salt bridge.   (1mark)
                (ii)   Show the direction of flow of electrons.   (1mark)
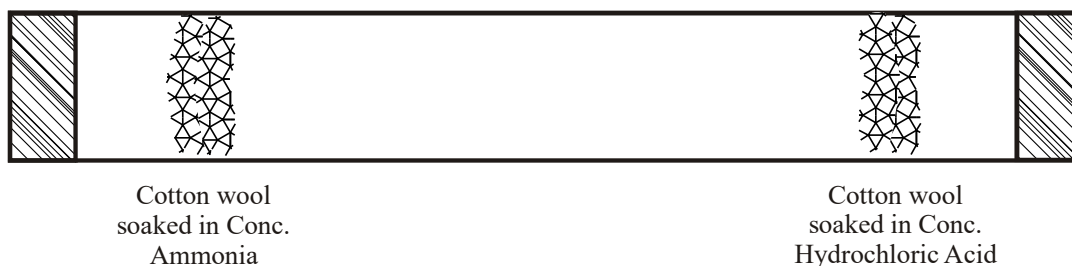
        (b)   Write the overall ionic equation.   (1mark)

5. Polyvinylchloride has the following structure.


    A sample of the polymer was found to have a molecular mass of 6750. Determine the number
    of monomers in the polymer.   (C= 12, H = 1, Cl = 35.5)   (3marks)
6. Describe how a mixture of sodium carbonate and Lead (II) carbonate can be separated.   (3marks)
7. In an experiment to study diffusion of gases, the following set up was used.

                Cotton wool   Cotton wool
               soaked in Conc.   soaked in Conc.
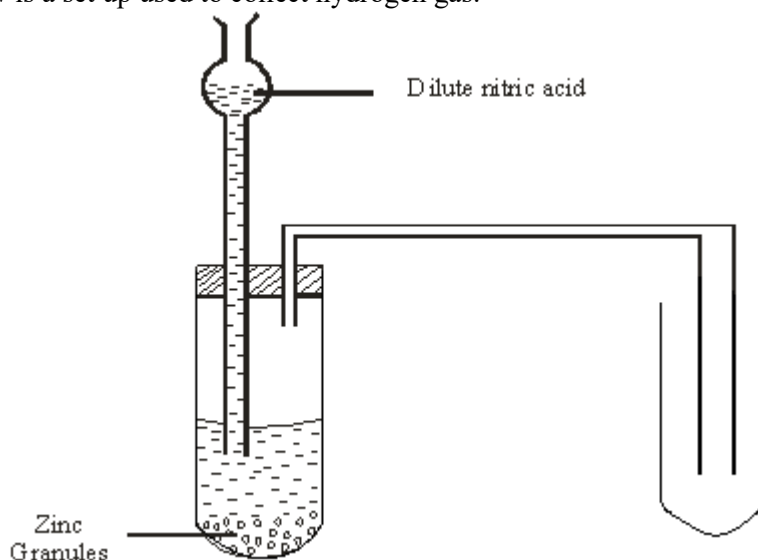   Ammonia   Hydrochloric Acid

i) State and explain observations made in the experiment. (2marks)

ii) Write an equation for the reaction that occurs in the experiment. (1mark)

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

$$2A_{(g)} + 2B_{(g)} \rightleftharpoons 2AB_{(g)}$$
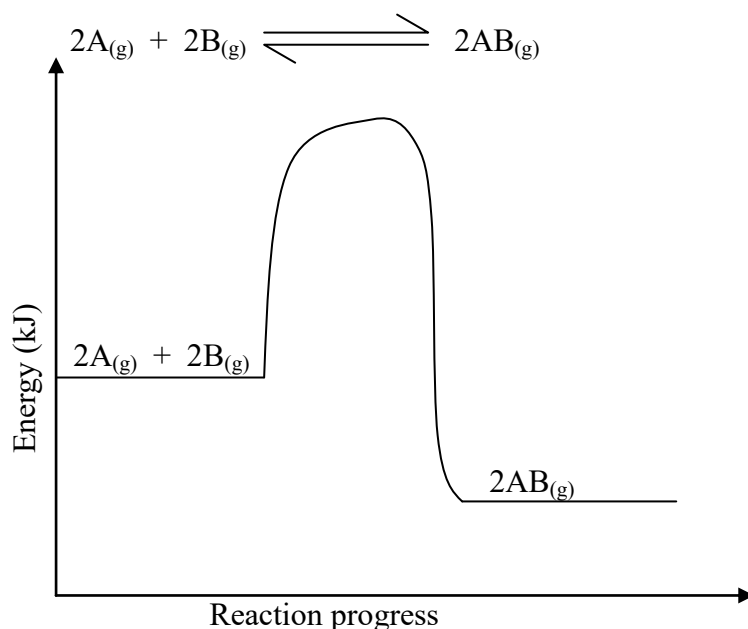
Explain how the following conditions would affect the yield of AB.

(i) Increase in pressure. (2marks)

(ii) Decrease in temperature. (2marks)

9. What is the oxidation number of chlorine in ClO_4^- (1mark)

10. Below is a set up used to collect hydrogen gas.

Dilute nitric acid

Zinc Granules

a) Identify with reasons, **two** mistakes in the set up. (2mark)

b) Explain the role of hydrogen in the manufacture of margarine. (1mark)

11. Dilute Hydrochloric acid is warmed with sodium sulphide.

a) Write an equation for the reaction that occurs. (1mark)

b) State a chemical test for the gas evolved. (1mark)

285

12. Carbon – 14 represented as $^{14}_{6}C$ which is used for radiocarbon dating decays by beta emission and has a half life of 5730 years.
    a) Given an equation for the decay process. (1mark)
    b) A fossil skull has an activity of carbon – 14, which was only 12.5 % of the activity found in living animals. How old is the fossil skull. (2marks)

13. The table below shows the observations made when an electronic current was passed though two substances A and B.

SUBSTANCE	OBSERVATION
Molten A	Conducts an electric current and a grey substance is deposited at the cathode.
Molten B	Conducts an electric current and is not decomposed.

    (a) Name the type of structure in A & B (2mark)
    (b) Name the particles that are responsible for electrical conductivity in
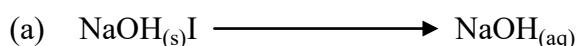   i) **A** (½ mark)
        ii) **B** (½ mark)

14. Dry chlorine gas was passed through two pieces of coloured cotton cloth as shown.
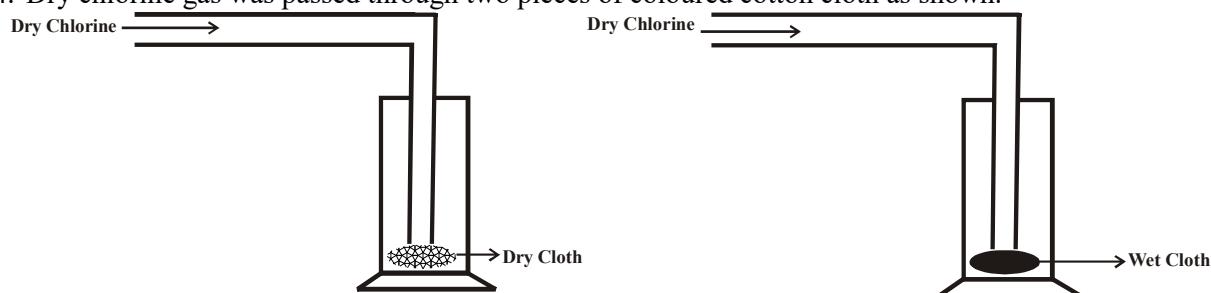
    a) State what is observed in each experiment.
       Experiment 1 (2mark)
       Experiment 2
    b) Explain your observation using an equation. (1mark)

15. A compound G reacts with 2 moles of bromine to form another compound whose graphical formula is;
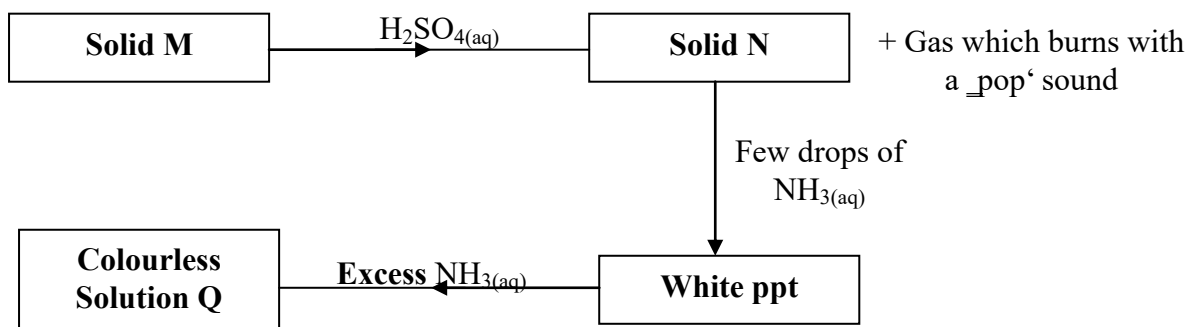
```
     H     Br    Br     H
     |     |     |      |
 H - C  -  C  -  C   -  C - H
     |     |     |      |
     H     Br    Br     H
```
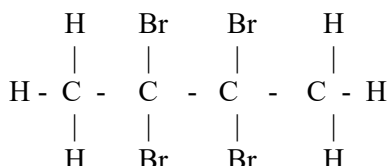
    i) What is the formula and name of compound G. (2marks)
    ii) State the observations made when acidified potassium chromate (VI) is added to compound G. (1mark)

16. 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. (1mark)
        (ii) What is the purpose of (ii) above? (1mark)
    (b) Bronze is an alloy of copper and another metal. Identify the other metal. (1mark)

17. A white solid K was heated. It produced a brown gas **A** and another gas **B** which relights a glowing splint. The residue left was yellow even after cooling.
    a) Identify gases **A** and **B**. (2marks)
    b) Write a balanced chemical equation for the decomposition of solid K. (1mark)

18. Study the following changes that took place when the following substances are exposed in air.

    (a) $NaOH_{(s)}I \xrightarrow{\hspace{2cm}} NaOH_{(aq)}$

    (b) $Na_2CO_3. 10H_2O_{(s)} \xrightarrow{\hspace{1cm}II\hspace{1cm}} Na_2CO_{3(s)} + 10H_2O_{(l)}$

    (c) $CuSO_{4(s)} + 5H_2O_{(l)} \xrightarrow{\hspace{1cm}III\hspace{1cm}} CuSO_4 . 5H_2O_{(s)}$

    Name the process I, II and III (3 mks)

286

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

| Solid M | $\xrightarrow{H_2SO_{4(aq)}}$ | Solid N | + Gas which burns with a _pop' sound |

Few drops of $NH_{3(aq)}$

| Colourless Solution Q | $\xleftarrow{\text{Excess } NH_{3(aq)}}$ | White ppt |

   a) Name solid **M**.   (1mark)
   b) Write the following of a complex ion present in solution **Q**.   (1mark)
   c) Write an ionic equation of the reaction between barium nitrate and solution **N**.   (1mark)

20. A gas at 27^0C and 750mmHg pressure was found to occupy 36cm^3. Calculate the temperature at which the same mass of gas will occupy twice the volume at a pressure of 100mmHg pressure.   (3marks)

21. (a) What is meant by solubility?   (1mark)
   (b) In an experiment to determine the solubility of solid Y in water at 30^0C the following results were obtained.

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

   Using the information, determine the solubility of solid Y at 30^0C in grams per 100g of water.

                                                                                          (2marks)

22. Oxygen is prepared by using hydrogen peroxide and manganese (IV) oxide.
   (a) Write an equation to show how oxygen is produced.   (1mark)
   (b) Explain why warm water is preferred for use to cold water in collecting oxygen gas. (1mark)
   (c)   Explain why it is important <u>not</u> to collect any gas for the first few seconds of the experiment.

                                                                                          (1mark)

23. 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. (1 *faraday = 96500 coulombs)* Determine the relative atomic mass of element N.   (3marks)

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

25. Silicon (IV) oxide exists as a solid while sulphur (IV) oxide as a gas at room temperature
   a) Write the formula of;
      i)   Silicon (IV) oxide   (½ mark)
      ii)   Sulphur (IV) oxide   (½ mark)
   b) Explain the difference in their states at r.t.p.   (2marks)

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

                                                                                          (3marks)

27. The diagram below was used to study the effect of heat on copper (II) sulphate crystals.
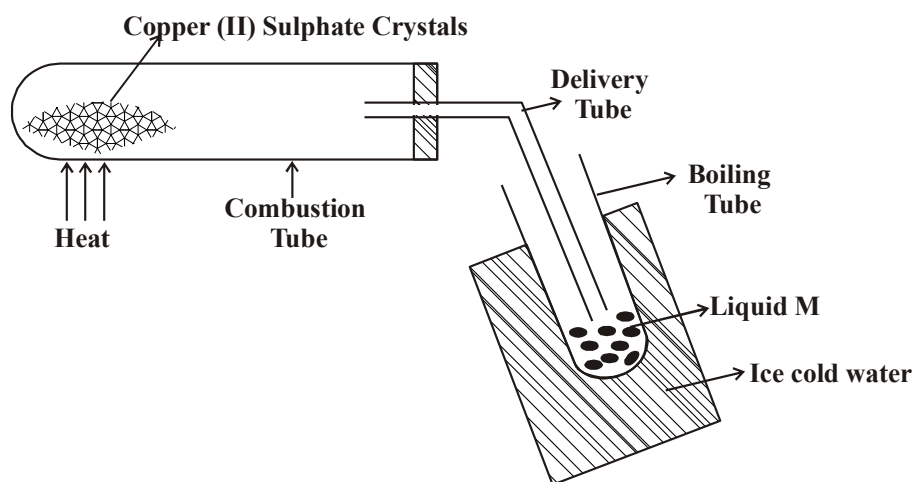
(a)   Name liquid **M**.   (1mark)
(b)   State and explain the precaution that should be taken before stopping heating.   (2marks)

28. In an experiment, a small amount of charcoal was added into a test tube and $5cm^3$ of concentrated nitric (V) acid added, then warmed.
   (i)   State the observation that was made.   (1mark)
   (ii)   Explain the observation made in (i) above.   (1mark)
   (iii)   Write an equation for the reaction that took place.   (1mark)

# M.C. CLUSTER OF SCHOOLS FORM 4 EVALUATION TEST – 2018
233/2
CHEMISTRY
PAPER 2

The letter **P**, **Q**, **R**, **S** and **T** represent some elements. These are not the usual symbols of the elements. The table below gives the formulae and electronic arrangement of the ions of the above elements.
Study it and answer the questions that follow.

Ion	Electronic arrangement
P^-	2.8
Q^{2-}	2.8.8
R^{2+}	2.8.8
S^{2-}	2.8
T^{3+}	2.8

(i) Select two elements that;
  (a) Belong to the same group of the periodic table. (1mark)
  (b) Are members of the same period of the periodic table? (1mark)
(ii) Write the formula of the sulphate of element **T**. (1mark)
(iii) Compare the reactivities of elements **Q** and **S**. (2marks)
(iv) A sample of the chloride of element **T** was dissolved in distilled water. Both red and blue litmus papers were dropped into this solution. State and explain what was observed. (2marks)
(v) A mixture contains both potassium carbonate and the carbonate of **R**. Explain how this mixture can be separated. (2marks)
(vi) What is the name given to the elements which belong to the same group of the periodic table as element **P**? (1mark)
(vii) Write down the electronic arrangement of the ion formed by the element found just below element **S** in the periodic table. (1mark)
(viii) Write down the equation for the reaction that takes place when element **R** reacts with cold water. (1mark)

2. (a) What is the molar heat of combustion of a substance? (1mark)
  b) The experiment below was set up to determine the molar heat of combustion of methanol.
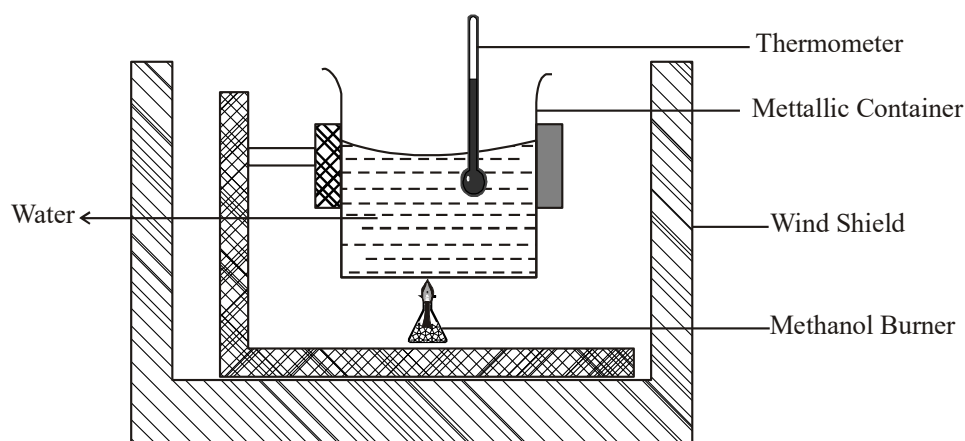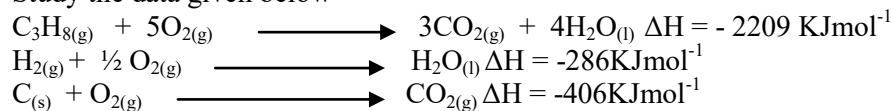

The following data was obtained from the above experiment.
Mass of burner + methanol before burning   =   62.74g
Mass of burner + methanol after burning   =   62.36g
Final temperature of water   =   38.5^{0}C
Initial temperature of water   =   23.5^{0}C
Volume of water used   =   100cm^3

i) From the above results work out the molar heat of combustion of methanol. (3marks)
(Density of water =1g/cm^3, C = 12, O=16, H= 1.0)
Specific heat capacity of solution 4.2Kj K$^{-1}_g$ K^{-1})
ii) Write a thermo chemical equation for this reaction. (1mark)
iii) Explain why the value obtained in (i) above may be lower than the actual value. (1mark)

(c) Study the data given below

$C_3H_{8(g)}$ + $5O_{2(g)}$ $\longrightarrow$ $3CO_{2(g)}$ + $4H_2O_{(l)}$ ΔH = - 2209 KJmol^{-1}
$H_{2(g)}$ + ½ $O_{2(g)}$ $\longrightarrow$ $H_2O_{(l)}$ ΔH = -286KJmol^{-1}
$C_{(s)}$ + $O_{2(g)}$ $\longrightarrow$ $CO_{2(g)}$ ΔH = -406KJmol^{-1}

Use this information to find the heat of formation of propane. (3marks)
(d) What do you understand by the term heating value of a given fuel? (1mark)
(e) State two factors you consider when choosing a fuel. (1mark)

3. (a) The diagram below represents the frasch's process for extracting sulphur.
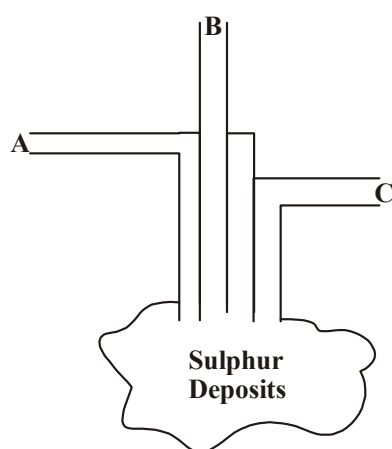
(i) State which substance passes through pipe **B**. (1mark)
(ii) What is the purpose of the substance that passes through pipe **C**? (1mark)

(b) The diagram below shows the main steps of the contact process.
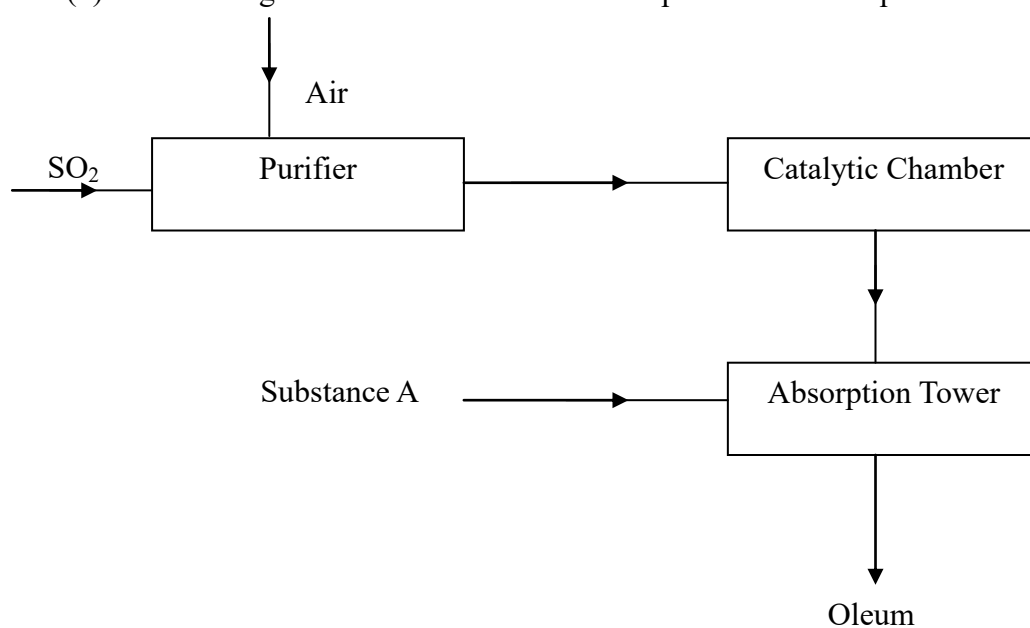
i) State the two main sources of the sulphur (IV) used in this reaction. (1mark)
ii) Platinum is one of the catalysts that can be used in this process.
   I. Name the other catalyst used in this process. (1mark)
   II. State the advantages the catalyst you have mentioned in (ii) (I) above has over

290

platinum for use in the contact process. (1mark)
iii) Name substance **A**. (1mark)
iv) Write down the equation for the reaction that takes place in the absorption tower. (1mark)
(c) Concentrated sulphuric (VI) acid is added to some cane sugar crystals in a test tube. State and explain what is observed after about 3minutes. (2marks)
(d) Write down the equation for the reaction between zinc powder and
(i) Dilute sulphuric (VI) acid. (1mark)
(ii) Concentrated sulphuric (VI) acid. (1mark)
(iii) What property of concentrated sulphuric (VI) acid is shown by the reaction in (d) (ii) above? (1mark)

4. (a) Magnesium ribbon was reacted with steam as shown in the diagram below.
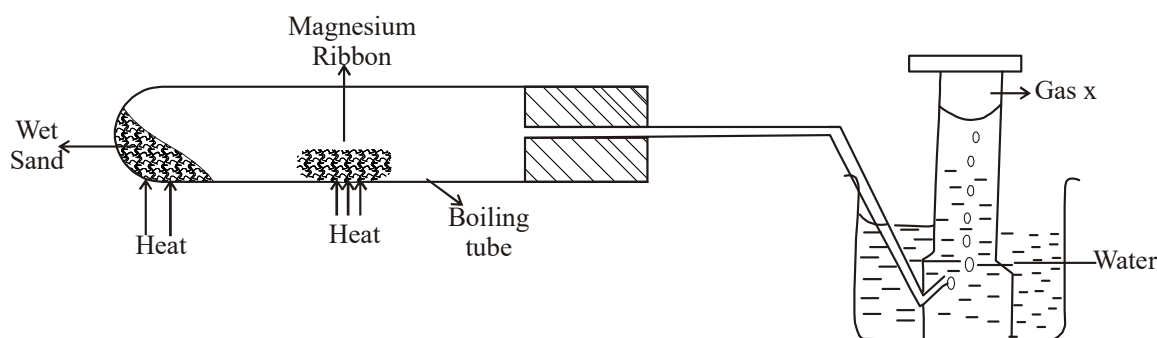
(i) State two observations in the boiling tube. (2marks)
(ii) Describe how you test for gas **X**. (2marks)
(iii) State one industrial use of the product formed in the boiling tube at the end of the experiment. (1mark)
(b) (i) Explain what is meant by the term neutralisation. (1mark)
(ii) Starting with 50cm^3 of 2M nitric (V) acid, describe how you would prepare crystals of sodium nitrate. (3marks)
(c) Complete the table below. (1mark)

Indicator	Colour in	
	Acidic solution	Alkaline solution
Phenolphthalein	_____	Pink
Methyl Orange	Pink	_____

(d) When magnesium is burnt in air two reactions take place forming two different compounds. Write down the equations for the two reactions. (2marks)

5. The scheme below shows some industrial and natural processes. Study it and answer the questions that follow.
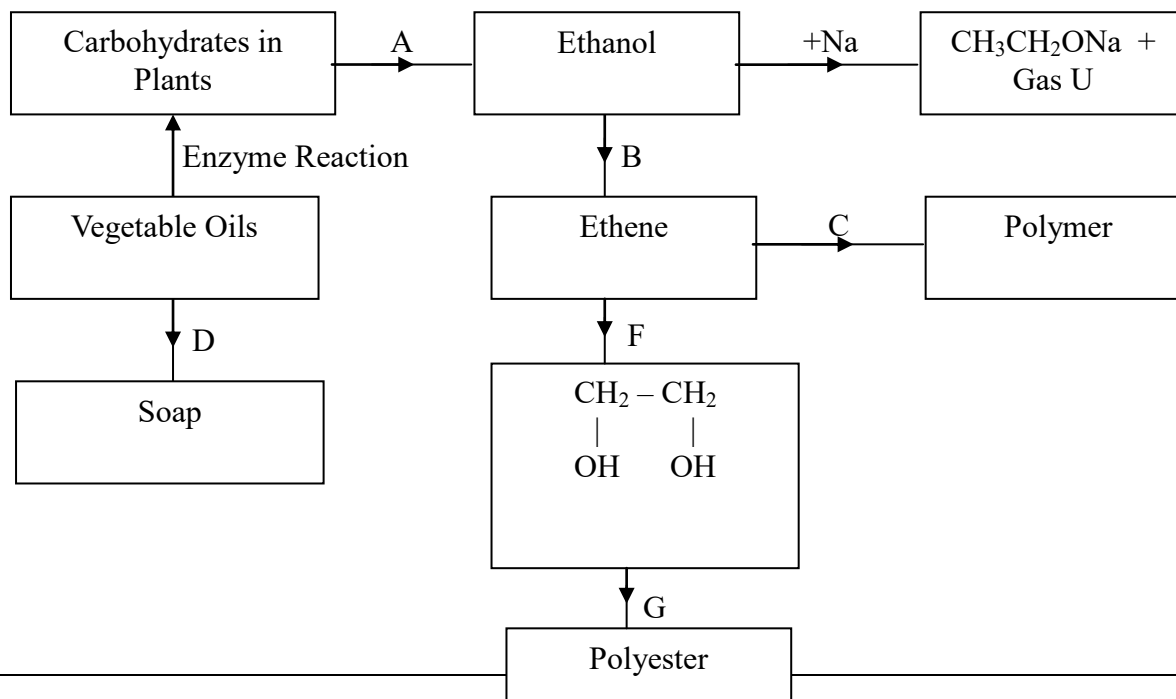
a) Identify
   (i)   Gas **U**.   (½ mark)
           Reagent **F**.   (½ mark)
   b) Name the process represented by the reaction in A, B and D   (3 mks)
   c) Name the type of polymerization shown by the steps C and G   (2 mks)
   d) Name suitable reagent (substance) for the process A and B.   (2 mks)
   e) Give one advantage of the soaps formed in step **D** over soapless ones.   (1mark)
   f) An organic compound S contains 60% carbon, 13.3% hydrogen and 26.7% Oxygen. The Relative Molecular Mass of S is 60. Determine the molecular formula of S. (C = 12.0, H = 1.0, O = 16.0)
                                                                             (3marks)

6. The set up below is used to measure the change in mass during the course of the reaction between dilute hydrochloric acid (Excess) and marble chips at 22^0C.
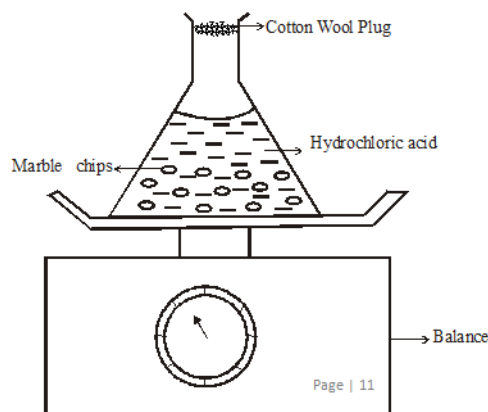

Changes in mass were noted at one minute intervals and were as follows;

Time (Min)	1	2	3	4	5	6	7
Loss in mass (g)	0.26	0.46	0.60	0.69	0.73	0.73	0.73

   a) Write an equation for the reaction taking place in the flask.   (1mark)
   b) Give a reason why the mass of the flask charged with time?   (1mark)
   c) What is the role of cotton wool at the mouth of the flask?   (1mark)
   d) Explain why it is not advisable to use dilute sulphuric (VI) acid with marble chips in this experiment.
                                                                             (1mark)
   e) Plot a graph of loss in mass (vertical axis) against time. Label the curve 22^0C.   (3marks)
   f) On the same axis in (e) above sketch the graph you would expect to obtain if the experiment was repeated at 35^0C. Label the curve 35^0C.   (1mark)
   g) State what would happen if the marble chips were replaced with the same mass of marble powder. Explain your answer.   (1mark)
   h) Determine the volume of carbon (IV) oxide produced if 0.12g of marble chips was reacted with excess dilute hydrochloric acid. (Experiment done at room temperature and pressure. Molar gas volume at r.t.p = $24dm^3$, Ca = 40.0, O = 16, C = 12.0).   (2marks)

7. The diagram below is a flow chart for the extraction of copper. Study it and answer the questions that follow.
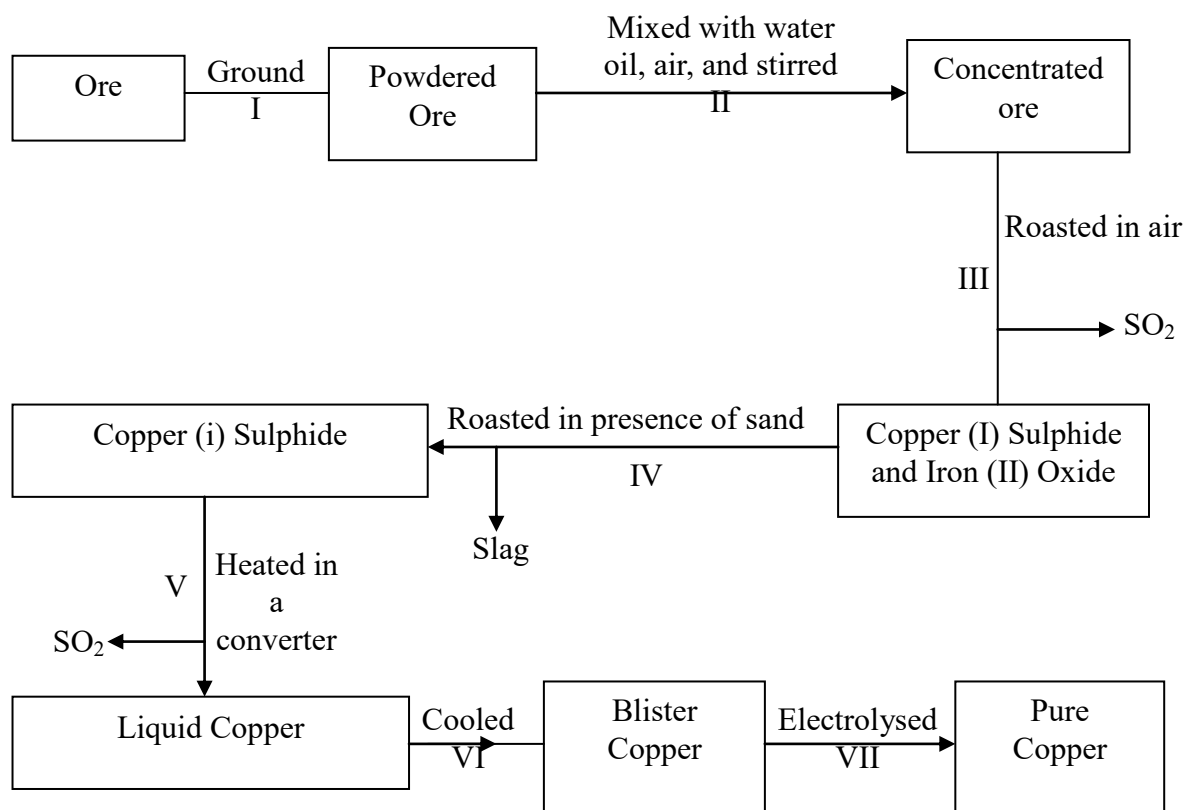
a) Give the name and formula of the major ore from which copper is extracted. (2marks)
b) Give the name of the process that is carried out in step II. (1mark)
c) Write an equation to show what takes place in step III. (1mark)
d) What is the purpose of using sand in the process? (2marks)
e) Write two equations for the two reactions that take place in step V. (2marks)
f) Draw a simple diagram showing the set up that is used in the electrolytic purification of copper. (2marks)
g) During the electrolysis of blister copper, contaminating metals like iron and zinc also go into solution as ions. Explain why they are not discharged at the cathode? (1mark)

M.C. CLUSTER OF SCHOOLS FORM 4 EVALUATION TEST – 2018

233/3
CHEMISTRY
PAPER 3
CHEMISTRY 233/3 PRACTICAL
CONFIDENTIAL TO SCHOOLS

Each candidate will require
1.   Solution A 100cm^3
2.   Solution B 150 cm^3
3.   Solution C 100cm^3
4.   Burette
5.   25ml pipette
6.   2 conical flasks
7.   Retort stand
8.   Filter funnel
9.   Pipette filler
10.   100ml of distilled water
11.   Thermometer
12.   1 Spatula – full of solid D
13.   About 10ml liquid E
14.   4g solid F (weighed exactly)
15.   2 boiling tubes
16.   Six test tubes in a rack
17.   Test tube holder
18.   Metallic spatula

ACCESS TO
-       1M NaOH
-       1M NH$_4$OH
-       0.1M NaCl
        Acidified K$_2$Cr$_2$O$_7$
-       KMnO$_4$- use some amount of solution B
-       Source of heating

NOTES
1. **Solid A**
    Dissolve 7.0g Ferrous Sulphate (FeSO$_4$.7H$_2$O) in 50ml of 1MH$_2$SO$_4$, dilute to 1dm^3 with water. (Should be prepared in the morning of the exam day)
2. **Solution B**
    Dissolve 0.8g of KMnO$_4$ in 50cm^3 of 1MH$_2$SO$_4$. Dilute to 1 dm^3 with water.
3. **Solution C**
    Measure 3cm^3 of 20vol. H$_2$O$_2$
    Dissolve in 1dm^3 of solution.
4. **1M H$_2$SO$_4$**
    Measure 55cm^3 of conc. H$_2$SO$_4$ add to about 200cm^3 of water, stir, dilute to 1 dm^3
5. **Solid D**
    Aluminium Nitrate
6. **Solid F**
    Potassium Chlorate (KClO$_3$)
7. **Acidified K$_2$Cr$_2$O$_7$**
    Dissolve 0.3g of K$_2$Cr$_2$O$_7$ in 50cm^3 of 1MH$_2$SO$_4$. Dilute to 1 dm^3 with water.

8. **Liquid E**
    Ethanol.

M.C. CLUSTER OF SCHOOLS FORM 4 EVALUATION TEST – 2018
233/3
CHEMISTRY
PAPER 3

1. You are provided with;
   - Solution A containing 6.95g of Iron II Sulphate heptahydrate R.F.M = 278 in 250cm^3 of solution.
   - Solution B of potassium manganate (VII).
   - Solution C of hydrogen peroxide.
   You are required to:
   (a) Standardize the potassium manganate (VII) solution C.
   (b) Determine the concentration of hydrogen peroxide solution C.

   PROCEDURE I
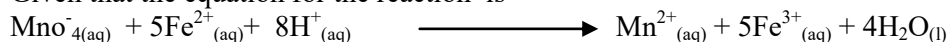   Pipette 25cm^3 of solution A into a conical flask.
   Fill the burette with solution B. Titrate this solution against solution A until the first permanent pink colour appears. Record your results in table I and repeat the procedure to fill the table 1 below.
   TABLE 1

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

(4 marks)
   (i) Calculate the average volume of solution B used   (1 marks)
   (ii) Given that the equation for the reaction is
   $$Mno^-_{4(aq)} + 5Fe^{2+}_{(aq)} + 8H^+_{(aq)} \longrightarrow Mn^{2+}_{(aq)} + 5Fe^{3+}_{(aq)} + 4H_2O_{(l)}$$

   Calculate
   a) The number of moles of Iron II sulphate solution A used.   (1mark)
   b) The number of moles of solution B that reacted.   (1mark)
   c) The concentration of the potassium manganate (VII) solution B in moles per litre.   (1mark)
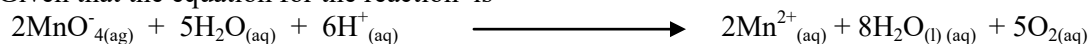
   PROCEDURE II
   Pipette 25cm^3 of hydrogen peroxide, solution C into a conical flask. Fill the burette with solution B. Titrate this solution against solution C until the first permanent pink colour appears. Record results in table II.

   TABLE II

Titre number	I	II	III
Final burette reading cm^3			
Initial burette reading cm^3			
Volume solution B used cm^3			

(4marks)
   (i) Work out average volume of potassium manganate (VII) solution B used.   (1mark)
   (ii) Given that the equation for the reaction is
   $$2MnO^-_{4(ag)} + 5H_2O_{(aq)} + 6H^+_{(aq)} \longrightarrow 2Mn^{2+}_{(aq)} + 8H_2O_{(l)\,(aq)} + 5O_{2(aq)}$$
   Calculate
   a) The number of moles of Potassium Manganate (VII) solution B that reacted.   (1mark)
   b) The number of moles of hydrogen peroxide solution C that reacted.   (1mark)
   c) The concentration of hydrogen peroxide solution C in moles per dm^3(mol dm^{-3}).   (1mark)

2. You are provided with 4g of Solid F.
   You are required to determine the solubility of solid F at different temperatures.
   PROCEDURE
   a) Carefully transfer all solid F in a clean boiling test tube and using a burette, add 15cm^3 of distilled water. Heat the mixture while stirring with a thermometer to about 85^{0}C. When all the solid has dissolved, allow the solution to cool while stirring with the thermometer. Note the temperature at which the crystals of solid F first appear. Record this temperature in Table III.

b) Transfer 5cm³ of distilled water to the contents in the boiling tube. Warm the mixture while stirring with the thermometer until the solid dissolve. Allow the mixture to cool while stirring. Note and record the temperature at which crystals first appear.

c) Repeat procedure (b) two or more times and record the temperatures in table III.

d) Complete table III by calculating the solubility of solid F at the different temperatures.

TABLE III

Volume of water in the boiling tube (cm³)	Temperature at which crystals of solid F first appear.	Solubility of solid F in g / 100g of water.
15		
20		
25		
35		
40		

(6marks)

(i) On the grid provided plot a graph of solubility of solid F (vertical axis) against temperature (horizontal axis). (3marks)

(ii) Using your graph, determine the temperature at which 15g of solid F, would dissolve in 100cm³ of water. (1mark)

3. **You are provided with solid D. carry out the following tests and write down all the observations and inferences.**

a) Place half spatula end full of solid D in a dry test tube. Heat gently then strongly until there is no further change.

Observations	inferences
(1mark)	(1mark)

b) Place the remaining solid D in a test tube, add about 10cm³ of distilled water and shake vigorously. Divide the mixture into four portions.

i. To the 1ˢᵗ portion, add 2M sodium hydroxide solution drop wise until in excess.

Observations	inferences
(1mark)	(1mark)

ii. To the 2ⁿᵈ portion, add ammonia solution drop wise till in excess.

Observations	inferences
(1mark)	(1mark)

iii. To the fourth portion add 4 drops of sodium chloride.

Observations	inferences
(1mark)	(1mark)

II. You are provided with liquid E, Carry out the following tests on it.

a) Place about one spatula end full of liquid E on a metallic spatula and ignite it in a Bunsen burner flame.

Observations	inferences
(1mark)	(1mark)

b) To 2cm³ of liquid E add 3 drops of acidified $KMnO_4$. Solution B.

Observations	inferences
(1mark)	(1mark)

c) To 2cm³ of liquid E add 3 drops of acidified $K_2Cr_2O_7$.

Observations	References
(1mark)	(1mark)

CEKENA PRE MOCK
**233/1**
FORM FOUR
CHEMISTRY PAPER 1

1. It is advisable to leave your flame in the luminous state when not in use. Give a reason   (1 mk)
2. The table below shows information about three solid substances P, R and T. study it and answer the questionthat follows.

| Solid	Cold water	Hot water
P	Soluble	Soluble
R	Insoluble	Insoluble
T	Insoluble	soluble

   Describe how you would separate the three solid from the mixture of the three   (3 mks)
3. The diagram below shows the heating curve of a pure substance. Study it and answer the question that follow
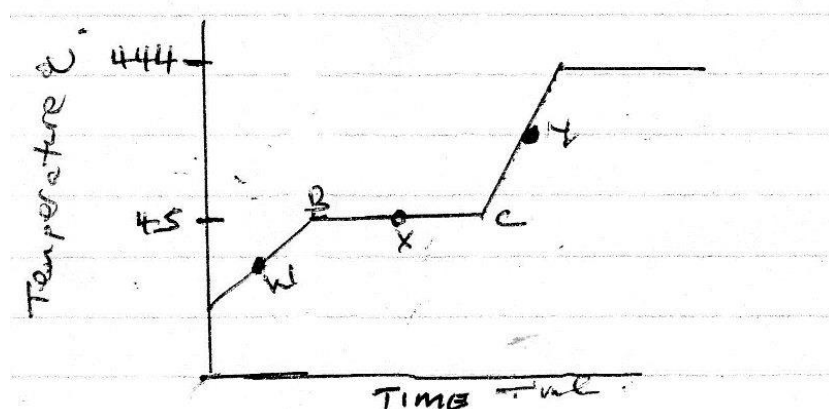
   (a) What are the physical states of the substance at point W and Y   (1 mk)
   (b) Explain why the temperature remains constant between B and C   (1 mk)
   (c) On the same axis, sketch a curve of an impure substance   (1 mk)
4.   (a)   What is meant by the term isotope   (1 mk)
   (b) Chlorine consists of two isotope, Chlorine-37 and Chlorine- 35. If the relative atomic mass of chlorine is 35.5, determine the relative abundance of each isotope   (2 mks)
5.   Sodium metal burns with a yellow flame in excess oxygen forming a yellow solid. The yellow solid liberates oxygen gas on reacting with water.
   (a)   Name the yellow solid   (1 mk)
   (b)   Write an equation for the reaction of the yellow solid with water   (1 mk)
6.   When aluminium chloride is dissolved in water the resulting solution has a Ph of 3. Explain   (2 mks)
7.   Starting with solid lead (ii) carbonate, briefly describe how a sample of lead(ii) chloride can be prepared   (3 mks)
8.   Some drops of Nitric (v) acid were added to a test solution followed by a few drops of silver nitrate solution. A white precipitate which turned violet after exposure to light was formed.
   (a) Name the anions present in the test solution   (1 mk)
   (b) Why was dilute nitric (v) added before the solution of silver nitrate was added.   (1 mks)
   (c) Write an ionic equation for the reaction that formed the white precipitate   (1 mk)

9. The set-up below was used to prepare a dry sample of hydrogen sulphide gas.
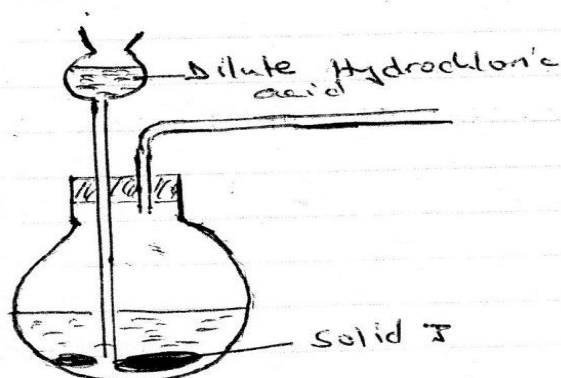
    (a) Complete the diagram to show how the gas was collected   (2 mks)

    (b) Identify solid H   (1 mk)

10.   When excess carbon (ii) oxide gas was passed over heated lead (ii) oxide in a combustion tube, lead (ii) oxide was reduced.

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

    (b) What observation was made in the combustion tube when the reaction was complete   (1 mk)

    (c) Name another gaseous compound which could be used to reduce lead (ii) oxide   (1 mk)

11.   The elements in the table below are in the same group in the periodic table

Element	Atomic radius (nm)
P	0.136
Q	0.176
R	0.154

    (a) what is ionization energy   (1 mk)

    (b) State with reason the element with the least first ionization energy.   (2 mks)

12.   Study the set-up below and answer the questions that follow;
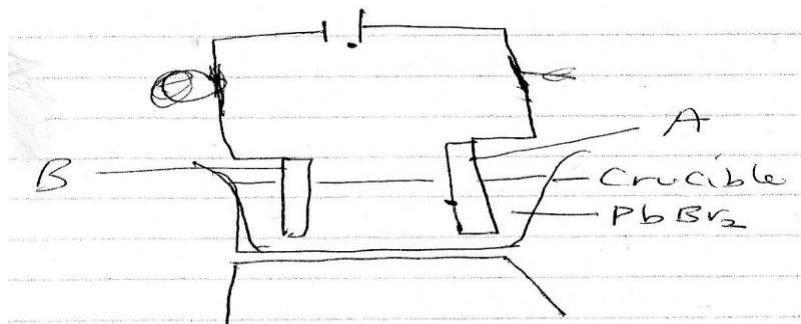
    (a) What is omitted in the diagram   (1 mk)

    (b) Write an ionic equation expected at electrode A if no omittion is done   (1 mk)

    (c) What observation is made at electrode B   (1 mk)

13. Study the information in the table below and answer the questions that follow.

Number of carbonation per Molecule	R.M.M of hydrocarbon
2	28
3	42
4	56

(i) Write the general formula of the hydrocarbons in the table (1 mk)

(ii) Predict the relative molecular mass of the hydrocarbon with 5 carbons (1 mk)

(iii) Determine the molecular formula of the hydrocarbon ii, above. Draw its structural formula (H=1 C = 12) (2 mks)

14.   The diagram below shows a fountain experiment using hydrogen chloride gas.
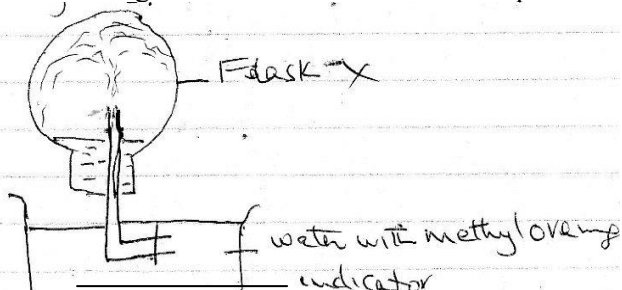
(a)   State the property of hydrogen chloride gas that makes this experiment possible. (1 mk)

(b)   What would be observed in the flask X (1 mk)

15.   3.8g of magnesium chloride was dissolved in distilled water. Lead ii nitrate solution was added until in excess. Work out the number of chloride ions precipitated.
(Mg = 24 Cl = 35.5   L = 6.0 x 10^{23}) (3 mks)

16.   A student set up the following apparatus to investigate what happens when a hot platinum wire is dipped in a conical flask containing concentrated ammonia as shown below.
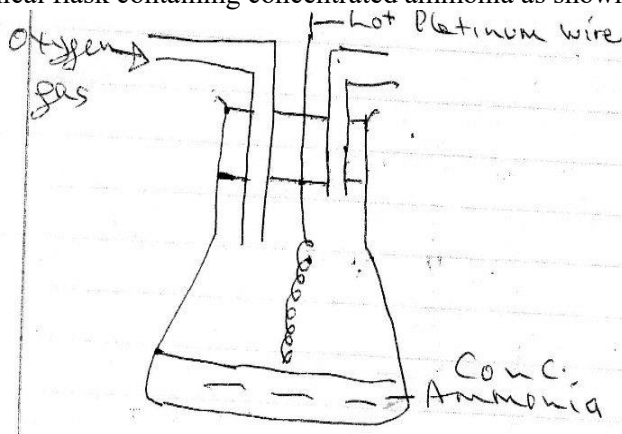
(a) State the observation made in the flask (2 mks)

(b) Explain why the platinum wire remains hot although there is no heating (1 mk)

(c) Write a chemical equation for catalytic oxidation of ammonia (1 mk)

17. The scheme below represents the manufacturer of a cleansing agent G.
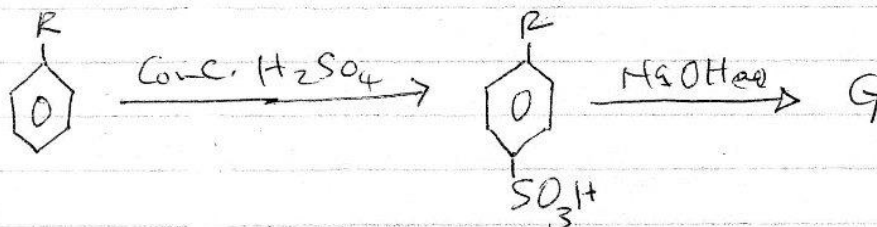
(i) Name the class of cleansing agent to which G belongs (1 mk)

(ii) State one advantage of the above cleansing agent (1 mk)

(iii) Draw the molecule of G (1 mk)

18. Study the information in the table below and answer the questions that follow.

Element	Atomic number	B.p (K)	Atomic radii

310

|			(nm)
L	19	1047	0.231
M	13	2743	0.126
N	17	238	0.099
P	11	1163	0.158
Q	16	718	0.104

(a) Identify the elements with similar chemical properties. Explain   (2 mks)

(b) Using dots (.) and crosses (x) draw a molecule of oxide of P   (2 mks)

(c) Draw a structure of a molecule of element Q   (1 mk)

19.   (a) State Grahams law of diffusion   (1 mk)

(b) Gas B take 110 seconds to diffuse through a porous pot, how long will it take for the same amount of Ammonia gas to diffuse under the same conditions of temperature and pressure?
(RMM of B = 34   N = 14   H =1)   (2 mks)

20.   Below are PH values of four types of medicine represented by letters P,Q,R and S

Medicine	PH values
P	7.0
Q	5.0
R	8.0
S	6.0

(a) It is not advisable to use S when a patient has indigestion. Explain   (1 mk)

(b) Give two harmful effects of smoking tobacco on the Kenyan youths.   (2 mks)

21. During extraction of copper metal, the ore from which copper is got undergoes processes that include:
(i) Crushing of ore
(ii) Mixing of crushed ore with oil and water and bubbling of ore
(a) Name the process in (ii) above   (1 mk)
(b) What is the purpose of the process (a) above   (1 mk)
(c) Bronze is an alloy of copper and another metal. Identify the other metal and give one use of bronze   (2 mks)

22. Use the diagram below to answer the questions that follow.
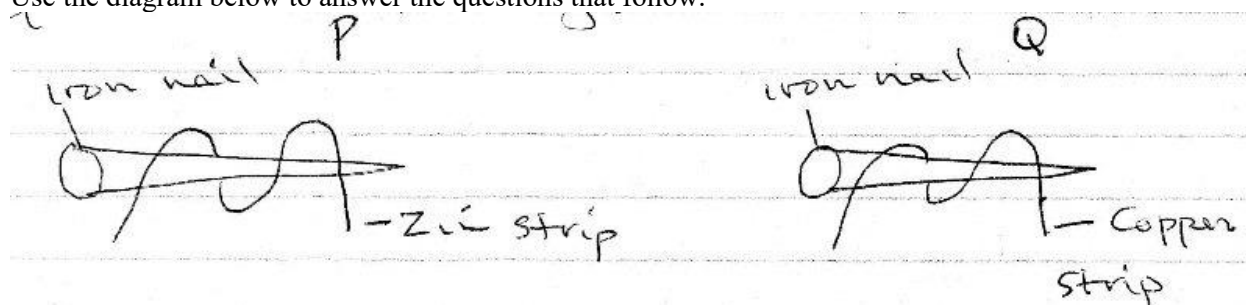
In which set up will the iron nail rust. Explain   (2 mks)

23. Magnesium reacts as shown below.
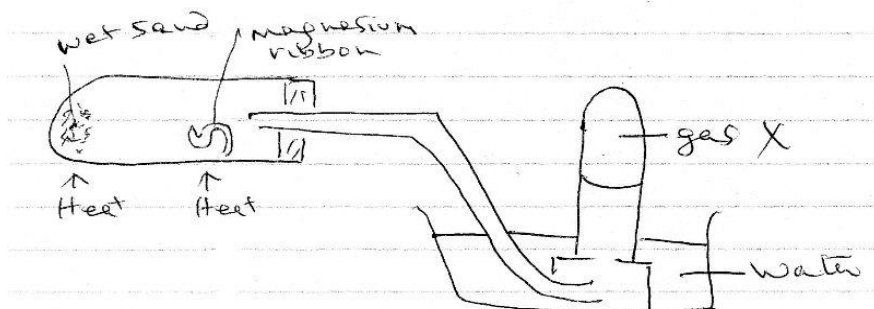
(a) Identify gas X   (1 mk)

(b) Between wet sand and magnesium, which one should be heated first? Explain   (2 mks)

24. Copper ii Sulphate reacts with Barium chloride according to equation below.

$CuSO_{4aq} + BaCl_{2aq} CuCl2_{aq} + BaSO_{4(s)}$ $\rightarrow$ Δ H = ⁻17.7 KJmol⁻¹

Calculate the temperature change when 900cm³ of 1M copper iiSulphate were added to 600cm³ of 1M Barium chloride

(S.H.C = $4.2J_g^{-1} K^{-1}$, density of solution is 1gcm⁻³)   (3 mks)

25. Study the information given in the table below and answer the questions below.

Bond	Bond energy KJ mol⁻¹
C – H	414
H- CL	431
CL – CL	244
C-CL	326

Calculate the enthalpy change for the reaction   (2 mks)

CH_4= CL_2 $\rightarrow CH_3CL_{(g)}$ + $HCL_{(g)}$

26. 20.0cm3 of a solution containing 2.7g/dm3 of an alkali XOH completely reacted with 25cm3 of 0.045M Sulphuric (vi) acid. Calculate the relative atomic mass of X   (3 mks)

(O = 16   H = 1)

27. Write an equation when the following solids are heated.   (2 mks)

(a) Zinc nitrate

(b) Silver nitrate

28. Explain the purpose of glass beads in;   (2 mks)

(a) Fractional distillation

(b) Manufacture of hydrochloric acid

CEKENA PRE MOCK
**233/2**
CHEMISTRY PAPER 2
THEORY

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

X									
				Y		C	W		
	Z		R				A		
E						D		B	

(i) Compare the atomic radii of elements
  (i) A and R. Explain (1$\frac{1}{2}$ mks)
  (ii) C and D. Explain (1$\frac{1}{2}$ mks)
(ii) Give the name of family in which elements W and A belong ($\frac{1}{2}$ mk)
(iii) Compare electrical conductivity of elements Z and R (1 mk)
(iv) Identify the element which is
  (i) Most electronegative ($\frac{1}{2}$ mk)
  (ii) Strongest reducing agent ($\frac{1}{2}$ mk)
(v) Write the formula of the oxide of X ($\frac{1}{2}$ mk)
(vi) (i) What type of bond exists in the chloride of R (1 mk)
  (ii) Draw the structure of the molecule of R in gaseous state (1 mk)
  (iii) Write an equation for the reaction between element A and water. (1 mk)
(vii) The table below shows the melting points of some oxides of elements in period 3.

Oxide	SiO_2	P_2O_5	SO_2
M.P^{0}C	1610	23.6	-72.7

Explain the difference in melting points of SiO_2 and P_2O_5 (1 mk)
(viii) Excess hydrogen gas is reacted with 4.5g of heated oxide of metal Q. 3.6g of Q is finally left in the reaction vessel. Given that O = 16, Q has a valence of 2
  (ix) Write the equation for the reaction taking (1 mk)
  (ii) Calculate the relative atomic mass of Q (2 mks)

2. (a) In an experiment, hydrogen chloride gas was prepared and reacted with aluminium turnings to form a solid A and gas R as shown in the diagram below
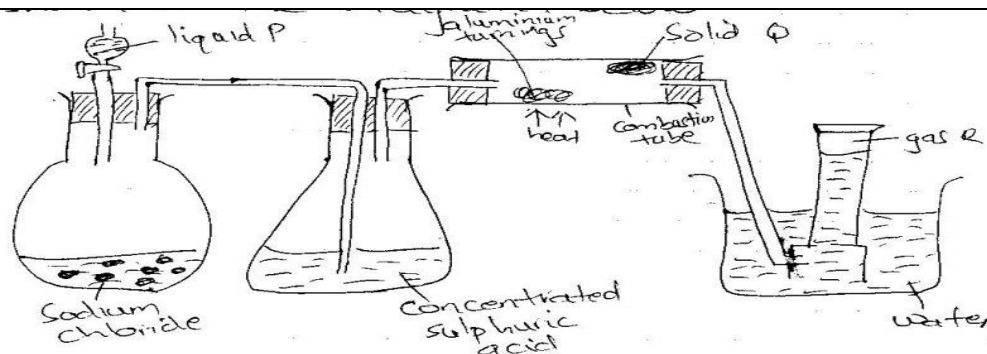
(i) Name (3 mks)

Liquid P

Solid Q

Gas R

(ii) Name another substance that could serve the same purpose as the concentrated sulphuric (vi) acid (1 mk)

(iii) Explain the following observations, when blue litmus paper was dipped into the water in the trough at the end of the experiment, it turned red (1 mk)

(iv) Explain why solid Q collects further away from the heated aluminium (1 mk)

b) (i) Write an equation for the reaction that takes place between ammonia gas and hydrogen chloride gas (1 mk)

(iii) Calculate the mass of the product that would be formed when 200cm^3 hydrogen chloride gas reacts completely with excess ammonia gas. (N = 14, H = I, CL =35.5, molar gas volume at r.t.p = 24L (2 mks)

c) Describe how you can distinguish between p_b^{2+} and Ca^{2+} in solution, using sodium chloride solution (2 mks)

3. A student carried out an experiment to determine the molar heat of combustion for methanol and obtained the results given below:

Volume of water = 100cm^3

Initial temperature of water = 22^{0}C

Final temperature of water = 38^{0}C

Initial mass of burner + methanol = 88.10g

Final mass of burner + methanol = 87.78g

Temperature rise =

Mass of methanol burnt =

Specific heat capacity of water is 4.2ks/kg/k

(a) Complete the table to show temperature rise and mass of methanol burnt (1 mk)

(b) Calculate

(i) The number of moles of methanol used in the experiment (H = 1, C = 12, O = 16) (1 mk)

(ii) The heat change in the experiment (1 mk)

(iii) The molar heat of combustion of methanol (1 mk)

(iv) Write the thermochemical equation for the combustion of methanol (1 mk)

(v) Given the equations below, determine the heat of formation of ethanol (3 mks)

$$C_s + O_{2g} \longrightarrow CO_{2g}, \qquad \triangle H = -393KJ/mol$$
$$H_{2g} + \tfrac{1}{2} O_{2g} \longrightarrow H_2O_l \qquad \triangle H = -386Kj/mol$$
$$C_2H_5OH_1 2CO_{2g} + 3H_2O_1 \qquad H = \triangle 368/KJ/mol$$

d. The diagram below shows an energy level diagram for the formation of magnesium chloride. Study it and answer the questions that follow.
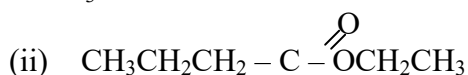
314

Reaction path
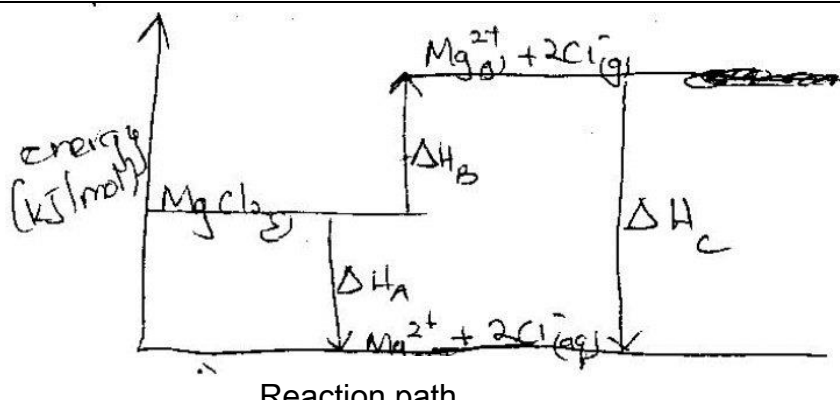
(i) State the enthalpy changes represented by

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

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

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

(ii) What is the relationship between ΔH_A, ΔH_B and ΔH_c ($\frac{1}{2}$ mk)

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

(i) $CH_3CH\ CH_2COOH$

        |

     CH_3

(ii) $CH_3CH_2CH_2 - \overset{\displaystyle O}{C} - OCH_2CH_3$

(b) Study the scheme below and answer the questions that follow.
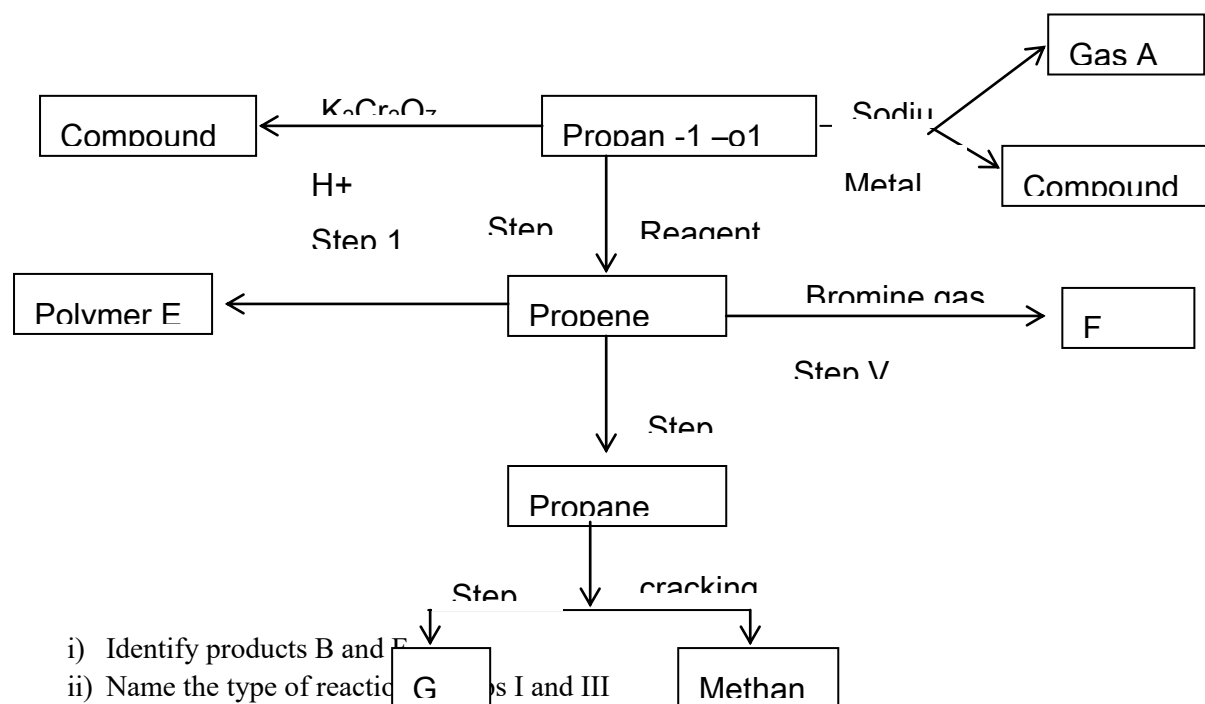
i) Identify products B and F   (2 mks)

ii) Name the type of reactions I and III   (2 mks)

iii) Give the conditions necessary for step III   (1 mk)

iv) Write an equation for the reaction taking place in step II   (1 mk)

v) Give an industrial application of step IV   (1 mk)

vi) Give a disadvantage of continued use of substance E   (1 mk)

(c) Below is a simple representation of a soap molecule

Using the structure above show how soap removes an oily smear from the fabric shown   (2 mks)

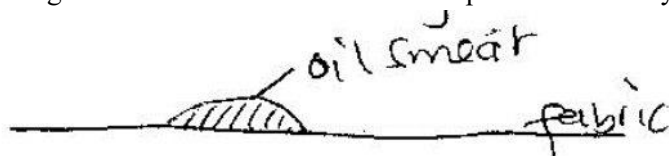(d) Describe a chemical test that can be used to distinguish an alkanol and an alkanoic acid   (2 mks)

5. i. in an experiment to investigate the solubility of solid X and Y the following results were obtained

Temperature (0C)		0	10	20	30	40	50
Solubility of Solid	X	8	13	24	38	61	98
(g/100g of water	Y	28	32	35	38	42	46

(a)   On the grid provided plot a graph of solubility of X and Y against temperature on the same axis   (4 mks)
(b)   From the graph determine
         (i) Solubility of X at room temperature   (1 mk)
         (ii) The temperature at which the solubility of X is 45g/100g of water   (1 mk)
(c)   If a solution of X contains 35g of solid in 100g of water, is cooled from 40^0C determine
         (i)   The temperature at which crystal will first form   (1 mk)
         (ii)   The mass of crystals deposited if the solution is cooled to 5^0C   (1 mk)
(d) Comment on the solubilities of X and Y in water   (1 mk)

ii. Study the information in the table below and answer the questions that follow

Salt	Solubility (g/100g water		
	At 30^0C		at 70^0C
CuSO_4	28	38	
AgNO_3	79	98	

A mixture containing 36g of $CuSO_4$ and 78g of $AgNO_3$ in 100g of water at 70^0C was cooled to 30^0C
(a)   Which salt crystallized out? Give a reason   (1 mk)
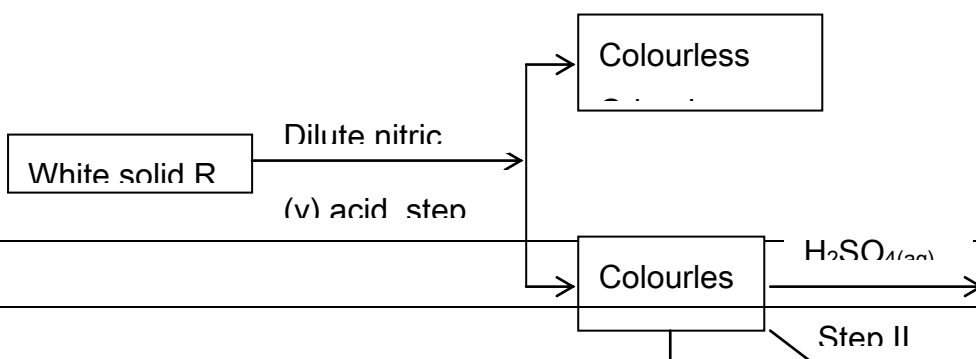(b)   Calculate the mass of the salt crystallized out   (1 mk)
Iii   (a)   Name the compound responsible for temporary water hardness   (1 mk)
      (b)   State two advantages of hard water   (1 mk)

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

White

White precipitate

(a) Identify R,S, T   (3 mks)
(b) (i) What observation is made during formation of Precipitate Q   (1 mk)
     (ii) Write an ionic equation for the formation of Q   (1 mk)
(c) Describe how the colourless odourless gas would be tested   (2 mks)
(d) Explain why O.IM HCL has a PH of 1 while O.IM ethanoic acid has a pH of 5   (2 mks)

7. The diagram below represents the blast furnace used for the extraction of iron. Study it and answer the questions that follow.
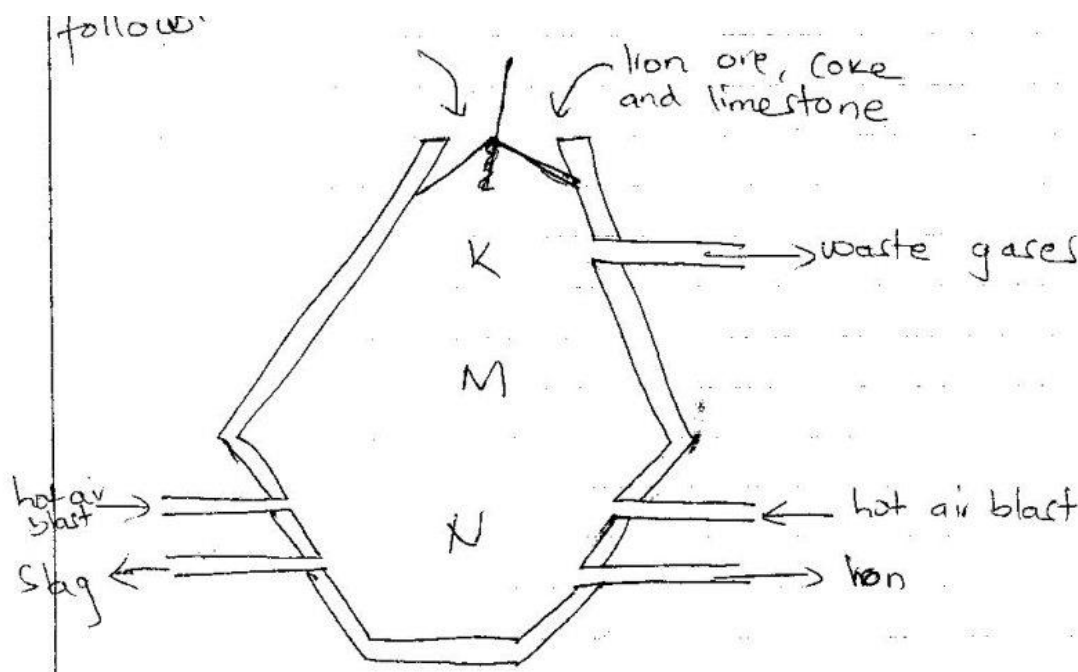
(a)   At what point N, M, K would you expect the highest temperature? Explain   (1 mk)
(b)   Write an equation for the reaction in which carbon (iv) oxide is converted into carbon (ii) oxide   (1 mk)
(c)   One of the components of the waste gases is nitrogen (iv) oxide. State the effects of this gas on the environment.
       (2 mks)
(d)   Write two equations for the reaction in which liquid iron is produced   (2 mks)
(e)   Name the compound formed when
(i)   Dilute hydrochloric acid reacts with solid iron (ii) sulphide   (1 mk)
(ii) Excess dry chlorine gas reacts with hot iron fillings   (1 mk)
(f)   Two test tubes are each half filled with solid iron (ii) oxide and the other with solid iron (iii) oxide,. State a physical test that you can use to differentiate the two   (2 mks)

CEKENA PRE MOCK
233/3
CHEMISTRY PAPER 3
PRACTICAL

You are provided with;
- ➢ A dibasic acid, labeled solutionP
- ➢ Solution R containing 5.56g per litre of potassium carbonate
- ➢ Aqueous sodium hydroxide, labeled solution T

  You are requiredto determinethe :
  - Concentration of solution P in moles per litre
  - Molar heat of neutralization of solution p with sodium hydroxide labeled solution T

A   Procedure 1
Using a pipette and a pipette filler, place $25cm^3$ of solution P into a 250ml volumetric flask. Add water to make $250cm^3$ of solution.Label this solution Q. Place solution Q in a burette. Clean the pipette and use it to place $25.0cm^3$ of solution R into a conical flask. Add 2 drops of methyl orange indicator provided and titrate with solution Q. Record your results in table 1. Repeat the titration two more time and complete the table.
Table 1

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

(4 mks)

Calculate the:
  (i)   Average volume of solution Q used   (1 mk)
  (ii) Concentration of potassium carbonate in solution R (K = 39.0, O = 16.0, C = 12.0) ((1 mk)
  (iii) Concentration of dibasic acid in solution Q   (2 mks)
  (iv) Concentration of dibasic acid in solution P   (1 mk)

Procedure 2
Clean the burette and fill it with solution T. Clean the pipette and use it to place $25.0cm^3$ of solution P into a $100cm^3$ plastic beaker. Measure the initial temperature of this solution and record it in table 2.
From the burette, place $5cm^3$ of solution T into the beaker containin $25.0cm^3$ of solution P, stir the mixture carefully with a thermometer and record the highest temperature of the mixture in table 2. Place another $5cm^3$ of solution T into the mixture in the beaker, stir carefully and record the highest temperature of this mixture in table2. Continue this procedure of placing $5cm^3$ portions of solution T and complete table 2.

Table 2

Total volume of solution T added (cm^3)	0	5	10	15	20	25	30
Volume of solution P (cm^3)	25	25	25	25	25	25	25
Temperature (^{0}C)							

(4 mks)

 (i)   On the grid provided, draw a graph of temperature (vertical axes) against volume of solution T used.

(3 mks)

 (ii) From the graph, determine
     I   The highest temperature change, $T\Delta$ (1 mk)

     II   The volume of solution T required to react with $25cm^3$ of solution P   (1 mk)
 (iii)   Calculate the ,

318

   I The number of moles of solution P used   (1 mk)

   II Molar heat of neutralization of P with sodium hydroxide solution labeled T (assume the specific heat capacity
      of the solution is $4.2Jg^{-1}K^{-1}$ and density of solution is $1.0gcm^{-3}$ (3 mks)

2.   You are provided with solid labeled M. Use it for the test below.

(a)   Put all of solid M in a clean boiling tube. Add about $10cm^3$ of distilled water and shake thoroughly. Use about
      $2cm^3$ of the resulting mixture for the test (b) to f below

Observation	inferences
(1 mk)	(1 mk)

   (b) Add a few drops of aqueous sodium hydroxide and then excess

Observation	inferences
(1 mk)	(1 mk)

(c) Add about $2cm^3$ of dilute sulphuric (vi) acid

Observation	inferences
(1 mk)	(1 mk)

   (d) Add a few drops of aqueous ammonia solution and then excess

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

   (e) Add about $2cm^3$ of acidified lead (ii) nitrate

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

   (f) Add about $2cm^3$ of barium nitrate solution

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

3.   You are provided with liquid N. Divide it into 4 portions and use it for the tests below.

   (a)Place about 3 drops of N on a clean watch glass and ignite

Observation	inferences
(1 mk)	(1 mk)

   (b) Add about 3 drops of acidified potassium manganate (vii) to the second portion

Observation	inferences

319

(1 mk)   (1 mk)

(c) Add the sodium carbonate provided to the third portion.

Observation	inferences
(^{1}/$_2$mk)	(^{1}/$_2$mk)

(d) Use sample 4 to test whether the substance is polar or not. Give the procedure for the test

Procedure	Observation	inferences
(1 mk)	(1 mk)	(1 mk)