KANDARA
233/1
CHEMISTRY

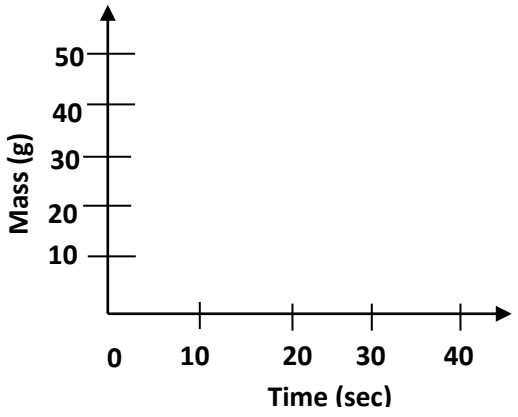
1. State **two** reasons why most apparatus in the laboratory are made of glass (2mks)
2. The following is an organic compound represented as $CH_3CH_2COOCH_2CH_3$
   (i) Name the organic acid and the alkanol used in making the compound (2mks)
   (ii) Name the organic compound and the gas formed when the alkanol in (i) above is reacted with Potassium (1mk)
3. Use the information below to answer the question that follows

   $Ca_{(s)} + ½\ O_{2(g)} \longrightarrow CaO_{(s)}$; ΔH=-635KJmol$^-$

   $C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$; Δ H= -394KJmol$^-$

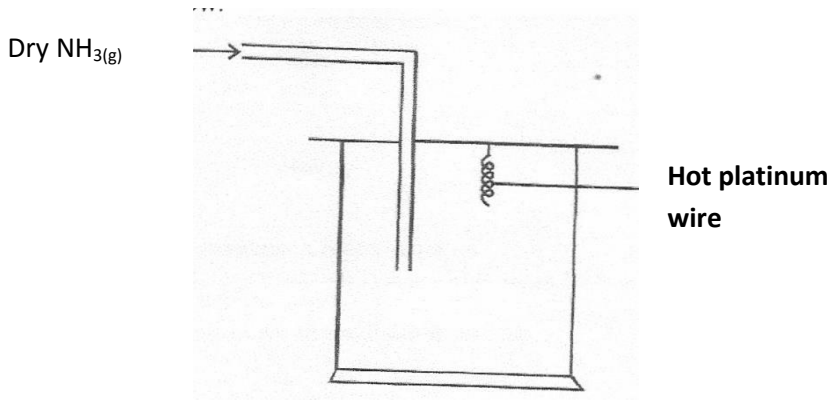
   $Ca_{(s)} + C_{(s)} + {}^3/_2O_{2(g)} \longrightarrow CaCO_{3(s)}\Delta H$= -1207 KJmol$^-$

   Calculate the enthalpy change for the reaction
4. (a) What is the role of the following parts during fractional distillation of a mixture of wate and ethanol
   (i) Fractionating column (1mk)
   (ii) Glass beads in the fractionating column (1mk)
   (b) State any one application of fractional distillation process (1mk)
5. Name the process which takes place when:
   (i) Iodine changes directly from solid to gas (1mk)
   (ii) $Fe^{2+}_{(aq)}$ changes to $Fe^{3+}_{(aq)}$ (1mk)
   (iii) White sugar changes to black solid when mixed with excess concentrated sulphuric (VI) acid (1mk)
6. The melting point of phosphorous trichloride is -91^{o}C while that of sodium chloride is 801^{o}C.
   In terms of structure and bonding. Explain the difference in their melting point (3mks)
7. (a) Name a suitable drying agent to be used to dry chlorine gas (1mk)
   (b) Chlorine reacts with red hot powder to give iron (III) chloride but not iron (II) chloride. Explain? (1mk)
   (c) Sodium hydroxide reacts with chlorine to form bleaching powder. Write a balanced equation for the reaction (1mk)
8. The electronic arrangement of elements are represented by letters A to D are as follows
   A:2.8.6 B:2.8.2 C:2,8,1 D2:8.8
   (a) Select the element which forms
   (i) Double charged cation (1mk)
   (ii) A soluble carbonate. (1mk)
   (b) Which element has the shortest atomic radius? (1mk)
9. Describe how a sample of Lead (II) chloride can be prepared using the following reagents dilute nitric (V) acid; dilute hydrochloric acid and lead carbonate (3mks)
10. A radioactive element of mass 50g has a half-life of 10 seconds
    (a) Sketch a graph of mass against time to show how the element mass varies with time (2mks)



(b) Give **one** use of radioactive in industries (1mk)

11. State and explain **one** disadvantage of using hard water in boilers (2mks)
12. Hydrogen sulphide gas was passed through a solution of iron(III) chloride
    (i) State and explain the observations made (2mks)
    (ii) Write an ionic equation for the reaction taking place in (i) above (1mk)
13. The apparatus below was set up to show the catalytic oxidation of ammonia. Study the diagram and answer the questions that follow



    (i) Write an equation for the reaction that takes place in the gas jar (1mk)
    (ii) What is the role of hot platinum wire? (1mk)
    (iii) Write the formula of the complex ion formed when excess ammonia gas is passed through a solution containing Zn^{2+} ions. (1mk)
14. A solution of silver nitrate was put in a container made of metal Q for 1 day. Given that:

$Q^{2+}_{(aq)} + 2e^- \rightleftharpoons Q_{(s)} : E^{\theta} = 0.130v$

$Ag^{+}_{(aq)} + e \rightleftharpoons Ag_{(s)} : E^{\theta} = +0.80v$

    Determine whether or not a reaction occurred between silver nitrate and metal Q (2mks)
15. The table below shows the solubility of salt at various temperatures

Temperature	Solubility g/100g of water
0	36
40	30
80	25
110	20

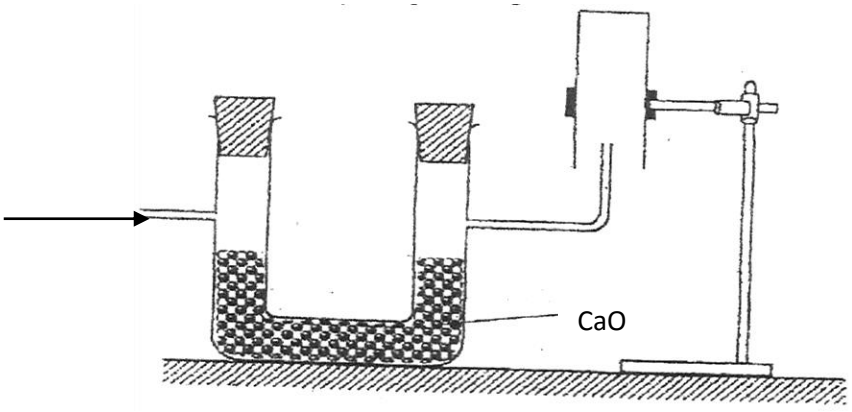
    What would happen if a sample of a saturated solution of the salt 40^{o}C is heated to 80^{o}C? Explain (2mks)
16. The equation given below represents a redox reaction

$Mg_{(s)} + 2HCl_{(aq)} \longrightarrow MgCl_{2(aq)} + H_{2(g)}$

    (i) Write the equation of the reduction process (1mk)
    (ii) Which substances is oxidized? (1mk)
17. When a current of 1.5 amperes was passed through cell containing M^{2+} ions on metal M for 15 minutes the mass of the cathode increased by 0.26g. (1F=96500C)

(i) Calculate the quantity of electricity used (1mk)
(ii) Determined the relative atomic mass of metal M (2mks)

18. State any **two** differences between luminous and non-luminous flames (2mks)
19. (a) State Graham's law of diffusion (1mk)
    (b) The molar masses of gas **U** and **V** are 16.0 and 44.0 respectively. If the rate of diffusion of **U** through the porous materials is $12cm^{3-1}$. Calculate the rate of diffusion of V through the same materials (2mks)
20. The set up below was used to collect a dry sample of a gas



Give **two** reasons why the set-up cannot be used to collect carbon (IV) oxide gas (2mks)

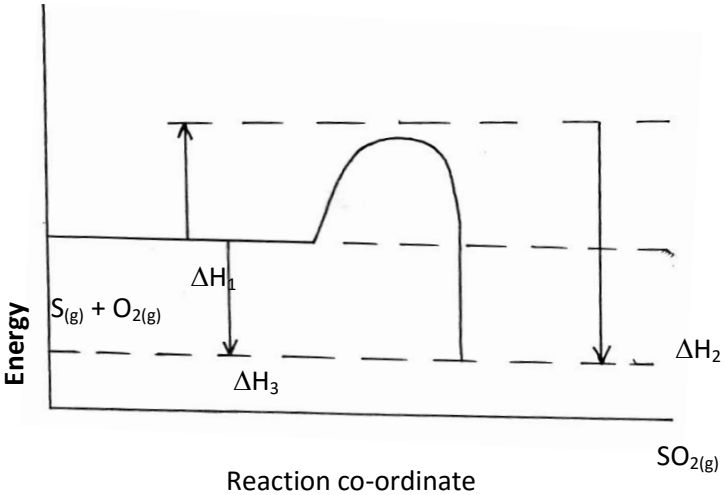
21. Dilute sulphuric (VI) acid does not react fully with calcium carbonate while dilute hydrochloric acid reacts fully with calcium carbonate liberating carbon (IV) oxide. Explain (2mks)
22. On complete combustion of 0.5g of a hydro carbon; 1.257g of carbon (IV) oxide and 0.514g of water were produced. If the relative molecular mass of the hydrocarbon is 84, determine the molecular formula (*C=12,H=1,O=16)* (3mks)

21. The conversion of SO_2 to SO_3 in the contact process is shown by the equation

$2SO_{2(g)} + O_{2(g)} \longrightarrow 2SO_{3(g)}\ \Delta H = -197KJ$

(a) What would be the effect of?
(i) Increasing the concentration of Oxygen (1mk)
(ii) Increasing the temperature (1mk)
(b) Write an equation for the sulphuric (VI) acid from Oleum (1mk)

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



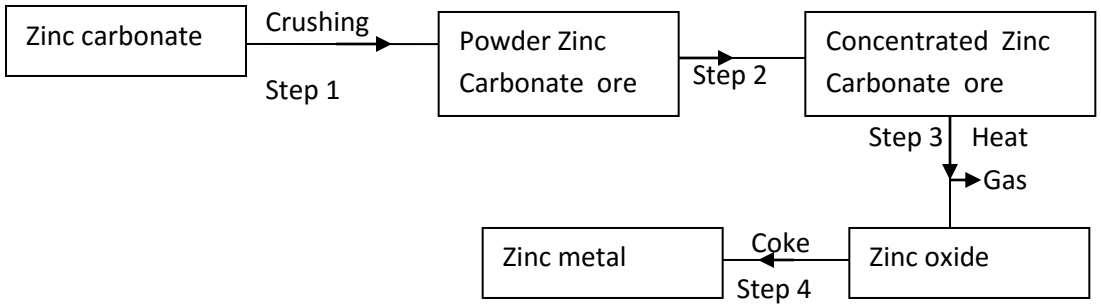
(a) What do the following represents? ΔH_1 and ΔH_3 (2mks)
(b) Write an expression for ΔH_3 in terms of ΔH_1 and ΔH_2 (1mk)

25. Given the reaction below

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

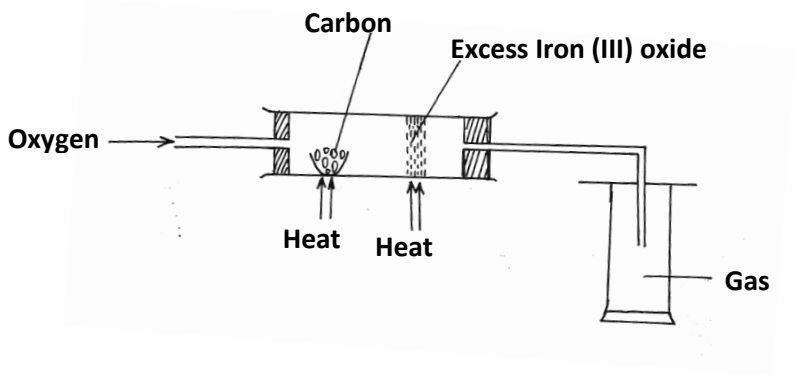
State how the following factors affect the rate of reaction giving explanation (1mk)
(a) Using Zinc powder instead of granules (1mk)
(b) Heating the reactants (1mk)

26. The flow chart below shows steps used in the extraction of zinc from one of its ores



(a) Name the process that is used in step 2 to concentrated concentrated zinc carbonate ore. (1mk)
(b) Write an equation for the reaction which takes place in step 3 (1mk)
(c) Name one use of zinc other than galvanizing (1mk)

27. The set up below used to obtain a sample of iron



(a) Identify the gas collected (½ mk)
(b) What observation is made on the excess iron (III) oxide? (½ mk)
(c) Write equations for the two reactions that take place in the combustion tube (2mks)

28. The table below shows PH values of some solutions

Solution	A	B	C	D
PH values	13	7	1	6.5

(a) What solution reacts vigorously with Magnesium metal? (1mk)
(b) Which solution is likely to be that of Lemon juice? (1mk)
(c) Which solution forms complex ions with zinc (II) oxide? (1mk)

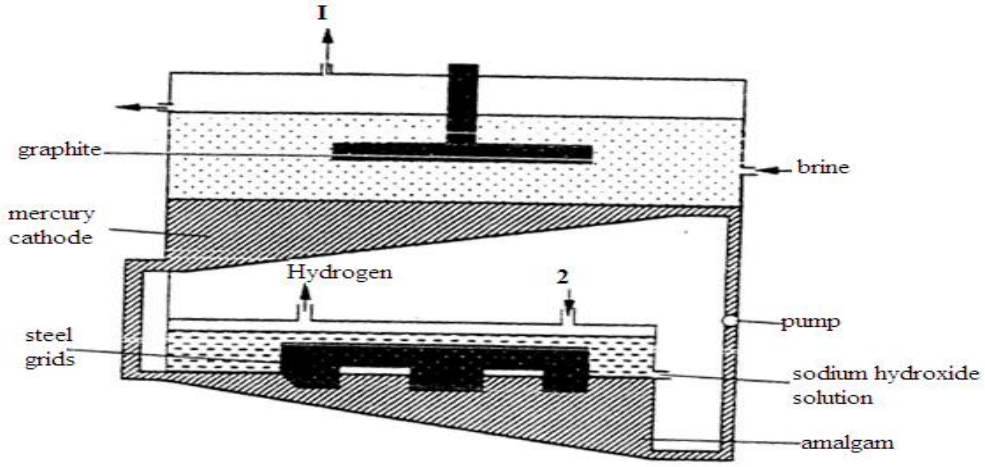
29. When a few drops of aqueous ammonia were added to Copper (II) Nitrate solution a light blue precipitate was formed. On addition of more aqueous ammonia a deep blue solution was formed. Identify the substances responsible for the:

(a) Light blue precipitate (1mk)
(b) Deep blue solution (1mk)

30. Explain why there is general increase in the first ionization energies of the elements in period 3 of the periodic table from left to right (2mks)

KANDARA
233/2
CHEMISTRY
Paper 2

1. The diagram below represents a mercury cell that can be used in the industrial manufacture of sodium hydroxide. Study it and answer the questions that follow



(a) (i) Name
I. the raw material introduced at 2. (1mk)
II. Another substance that can be used in the cell instead of graphite. (1mk)
(ii) Identify the by – product that comes out at I. (1mk)
(iii) Give
I. One use of sodium hydroxide. (1mk)
II. Two reasons why mercury is recycled. (2mks)

(b) A current of 100 amperes was passed through the cell for five (5) hours
(i) Write the equation for the reaction that occurred at the mercury cathode. (1mk)
(ii) Calculate the mass of sodium hydroxide that was produced. (3mks)
(Na = 23.0, O = 16.0, H = 1.0, 1 Faraday = 96500 Coulombs)

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

Use it to answer the questions that follow.

Time (minutes)	Total volume of gas (cm^3)
0	0
1	220
2	410
3	540
4	620
5	640
6	640

a) i) On the grid provided, plot a graph of total volume of gas produced (vertical axis) against time. (3mks)
ii) From the graph, determine the volume of gas produced at the end of 2 ½ minutes. (1mk)
b) Determine the rate of reaction between the 3^{rd} and 4^{th} minute. (2mks)
c) Give a reason why some solid remained at the end of the experiment. (1mk)
d) Given that 2.5cm^3 of the total volume of the gas was from the reaction between magnesium and aqueous hydrochloric acid,
(Al = 27.0 and Molar gas volume = 24,000cm^3 at 298K).
(i) Determine the volume of gas produced when hydrochloric acid reacted with aluminium metal. (1mk)
(ii) Write a chemical equation of the reaction in (i) above. (1mk)
(iii) Determine the percentage mass of aluminium present in 0.5g of the alloy. (3mks)
e) State two properties of duralumin that make it more suitable than aluminium in aeroplane construction. (2mks)

3.

(a) What method can be used to separate a mixture of ethanol and propanol? (1mk)
(b) Explain how a solid mixture of sulphur and sodium chloride can be separated into solid sulphur and sodium chloride crystals. (3mks)
(c) The table below gives the solubilities of potassium bromide and potassium sulphate at 0^0C and 40^0C

Substance	Solubility g/100g water at	
	40^0C	80^0C
Potassium bromide	55	75
Potassium sulphate	85	95

When an aqueous mixture containing 60g of potassium bromide and 70 g of potassium sulphate in 100g of water at 80^0C was cooled to 40^0C some crystals were formed
(i) Identify the crystals. (1mk)
(ii) Determine the mass of the crystals formed. (1mk)
(iii) Name the method used to obtain the crystals. (1mk)
(iv) Suggest one industrial application of the method named in (iii) above. (1mk)

4.

a) Give the name of the basic raw material for extraction of aluminium metal. (1mk)
b) Name the method that is used to extract aluminium from the basic raw material in (i) above. (1mk)
c) Write the chemical formula of the major component in the raw material in (i) above. (1mk)
d) i) Name two major impurities in the raw material in (i) above. (2mks)
ii) Explain how the impurities in named in (i) above are removed (3mks)
e) Cryolite is used in the extraction of aluminium from the basic raw material.
State its function (1mk)

f) Aluminium is a reactive metal yet utensils made of aluminium do not corrode easily. Explain this observation. (2mks)

5. a) The table below shows properties of chlorine, bromine and iodine.

Element	Formula	Colour and state room temperature	Solubility in water
Chlorine	Cl_2	i……	Soluble
Bromine	Br_2	Brown liquid	ii…….
Iodine	l_2	iii……	Slight soluble

Complete the table by giving the missing information in (i),(ii) and (iii). (3mks)

b) Chlorine gas is prepared by reacting concentrated hydrochloric acids with manganese (iv) oxide.
i) Write the equation for reaction between concentrated hydrochloric acid and manganese (iv) oxide. (1mk)
ii) What is the role of manganese (IV) oxide in this reaction. (1mk)

c) i) Iron (II) chloride reacts with chlorine gas to form substance E. Identify substance E. (1mk)
ii) During the reaction in c(i) above,6.30g of iron(II) chloride were converted to substance E. Calculate the volume of chlorine used. (3mks)
(Cl = 35.5, Molar gas volume at room temperature = 24000cm^3, Fe =56)

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

e) Give two industrial uses of chlorine. (2mks)

6. (a) The list below shows the formulae of some organic compounds. Use it to answer the questions that follow.

V_1. $CH_3CH_2CH_2OH$

V_2. $CH_3CH_2CH_3$

V_3. $CH_3CH_2CH_2\overset{\overset{O}{\|}}{C}-OH$

V_4. $CH_3CH_2CH = CH_2$

V_5. $CH_3CH_2CH_2CH_3$

(i) Select two compounds which
I are not hydrocarbons (1mk)
II Belong to the same homologous series (1mk)

(ii) Identify the compound that is likely to undergo polymerization. Give a reason for your answer. (2mks)

(b) The structures below represent two cleansing agents:
$R - COO^- Na^+$
$R - OSO_3^- Na^+$
In the table below, give one advantage and one disadvantage of using each one of them. (2mks)

	Advantage	Disadvantage
$R - COO^- Na^+$		
$R - OSO_3^- Na^+$		

Under certain, ethanoic acid ($C_2H_4O_2$) and ethanol (C_2H_5OH) react to form a pleasant smelling compound.

(i) What is the general name of compound to which the pleasant compound belong? (1mk)

(ii) Write the formula of the pleasant smelling compound. (1mk)

(iii) Give one use of ethanoic acid other than the formation of the pleasant smelling compounds. (1mk)

(iv) Write the equation for the reaction between dilute ethanoic acid and solid potassium carbonate (1mk)

(c) Fibres are either synthetic or natural. Give one:

(i) Example of a natural fibre (1mk)

(ii) Advantage of synthetic fibres have over natural fibres (1mk)

7. 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	NaCl	$MgCl_2$	Al_2C1_6	$SiC1_4$	$PC1_3$	$SC1_2$
B.P(°C)	1470	1420	Sublimes	60	75	60
M.P(°C)	800	710	At 800°C	-70	-90	-80

(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(25°c). Give a reason. (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)

KANDARA
233/3
CHEMISTRY
PAPER 3

1. **You are provided with**
   - 4.5g of solid S in a boiling tube
   - Solution Q, 0.06 M acidified potassium manganate (VII)

You are required to determine:

I) The solubility of solid S at different temperatures
II) The number of moles of water of crystallisation in solid S

PROCEDURE I

a) Fill the burette with distilled water. Add 4.0cm^3 of distilled water to solid S and
Heat the mixture in a water bath while stirring with a thermometer to about 80^{0}C 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 S start to appear. Record this temperature in table **I**below.
c) Add 2.0cm^3 of distilled water to the contents of the boiling tube. Heat the mixture in the water bath while stirring with the thermometer until all the solid dissolves.
d) Allow the mixture to cool while stirring and note the temperature at which crystals of solid S start to appear.
e) Repeat the procedure (c) and (d) three more times and record the temperatures in the table**I**

(Retain the contents of the boiling tube for use in procedure II)

Complete the table by calculating the solubility of solid S at the different temperatures.

TABLE I(6mks)

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

On the grid provided plot a graph of the solubility of solid S against temperature. (3mks)

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

PROCEDURE (II)

(i) Transfer the content of the boiling tube into 250ml volumetric flask. Rinse the boiling tube and the thermometer with distilled water to the volumetric flask. Add more distilled water to make up to the mark. Label this solution S. Fill the burette with solution Q

Using a pipette and pipette filler, place 25.0cm^3 of solution S into a conical flask. Warm the mixture to about 70^oC. Titrate the hot solution S with solution Q until a permanent pink colour persists. Record your readings in table 2.

Table II

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

(4marks)

(ii) Calculate the :

I. Average volume of solution Q used. (1mark)

II. Number of moles of potassium manganate (VII) used. (1mark)

III. Number of moles of **S** in 25cm^3 of solution **S**given that 2 moles of potassium manganate(VII) react completely with 5 moles of **S**(1mark)

IV. Relativeformula mass of **S.** (3marks)

(iii) The formula of S has the form $(CHO_2)_2$. $\boldsymbol{x}H_2O$. Determine the value of ***x***in the formula. (C=12, O=16, H=1) (2 marks)

2. You are provided with solid M, which is a mixture of two compounds. You are required to: Carry out the tests below.Write your observations and inferences in the spaces provided.

Procedure:

(a) Place all of solid M into a boiling tube. Add about 10cm^3 of distilled water, Shake well and filter. Keep both the filtrate and the residue.Divide the filtrate into 3 portions

(i) To the first portion add acidified Barium Chloride solution

(ii) Add sodium hydroxide solution drop wise to the second portion till in excess.

(iii) Add NH_3 solution drop wise to the third portion till in excess.

(b) (i) Scrape the solid residue from the filter paper and transfer it into a boiling tube. Add about5$cm^3$of nitric(v) acid and shake to dissolve.Divide the solution into 3 portions

(ii) To the first portion add sodium hydroxide solution drop wise till in excess.

(iii) To the second portion add ammonia solution drop wise until in excess.

(iv) Add 3 drops of hydrochloric acid to the third portion warm the mixture and allow it to cool.

3. (i) Place solid A into a boiling tube. Add 10cm^3 of distilled water and shake well.Use the solution for the following tests.Divide the solution into 3 portions

(ii) Place 1cm^3 of solution A in a test tube and determine its P^H using a P^H paper.

(iii) To about 2cm^3 of the solution obtained in (b) above, add 3drops of acidified KMnO4(aq)

KANDARA
FORM 4 CHEMISTRY
PAPER 3 (PRACTICALS)

CONFIDENTIAL INSTRUCTIONS

In addition to common fittings, apparatus and chemicals found in the laboratory,

Each candidate requires:

(1) Solid S –Oxalic acid accurately weighed (4.5g) in a clean dry test tube.
(2) Solid M – A mixture of $PbCO_3$ and $CuSO_4$ in ratio 2:1.
(3) Solid A -1spatula of Oxalic acid
(4) Universal indicator paper.

APPARATUS

1. Thermometer (-10^{o}C to 110^{o}C)
2. One Clean and dry Boiling tube
3. 80 cm^3 0f 0.06M acidified potassium manganate (VII)
4. Distilled water in a wash bottles
5. Burette
6. Pipette
7. Pipette filler
8. One 250ml volumetric flask
9. 2 conical flasks
10. One Filter paper
11. Filter funnel
12. 6 test tubes
13. A test tube holder
14. Source of heat
15. 2cm long P^H paper
16. P^H chart
17. one label
18. Complete stand
19. White tile
20. Test tube holder

Access to:

- Water bath
- cold water in a 250 ml beaker
- Acidified Barium chloride
- 2M Sodium hydroxide
- 2M Ammonia solution
- 2M Nitric(v) acid
- 2M Hydrochloric acid
- Acidified Potassium Manganate (vii)

KIRINYAGA CLUSTER
233/1
CHEMISTRY
PAPER 1 (THEORY)

1. a) Differentiate between exothermic and endothermic reaction. (1 mark)

b) The table below gives bond energies of some covalent compounds.

Bond	Bond energy kJ/Mole
C – H	413
O = O	497
C = O	804
H – O	464

Calculate the enthalpy change for the combustion of methane in excess oxygen. (2 marks)

2. A student added very dilute Sulphuric (VI) acid to three substances and recorded the observations shown in the table below.

Test	Substance	Gas given off
I	Carbon	Yes
II	Copper	No
III	Iron	No

From which tests are the observations wrong? Explain. (3 marks)

3. Describe how a pure sample of Lead (II) carbonate can be prepared starting with lead (II) oxide. (3 marks)

4. In preparation of hydrogen sulphide, hydrochloric acid is reacted with metal sulphudes.

a) Name the metal sulphide used in preparing the gas. ($^1/_2$ mark)

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

c) Give one physical test for hydrogen sulphide gas. ($^1/_2$ mark)

5. $20cm^3$ of Potassium hydroxide solution containing $7.0g/dm^3$ were required for neutralization 0,18g of H_2X acid. Calculate the relative formula mass of the acid.
(K = 39, O = 16, H = 1) (3 marks)

6. The table below shows some elements and their atomic numbers. The letters do not represent the actual symbols of the elements.

Element	E	F	G	H	I	K	L
Atomic Number	11	10	20	14	13	4	8

a) From the letters given select two elements with the same chemical properties. (1 mark)

b) Write the formula of a compound formed when element H reacts with element L. (1 mark)

c) Identify the most stable element. (1 mark)

7. A dynamic equilibrium between dichromate and chromate ions is established as shown in the equation below.

$$\underset{\text{Orange}}{Cr_2O_7^{2-}{}_{(aq)} + 2OH^-{}_{(aq)}} \rightleftharpoons \underset{\text{Yellow}}{2CrO_7^{2-}{}_{(aq)} + H_2O_{(l)}}$$

State and explain the observation made if a few drops of sodium hydroxide are added to the equilibrium mixture. (2 marks)

8. A Sample of compound T containing sulphur and oxygen requires 28 seconds to diffuse through a hole. A similar volume of oxygen gas pass through the same hole in 20 seconds. Determine the molecular mass of J.

(S = 32, O = 16) (2 marks)

9. Use the reaction scheme below to answer the questions that follow

a) Draw the structure of alkanol N. (1 mark)
b) Name the (i) Process P. ($^1/_2$ mark)
(ii) Compound M ($^1/_2$ mark)

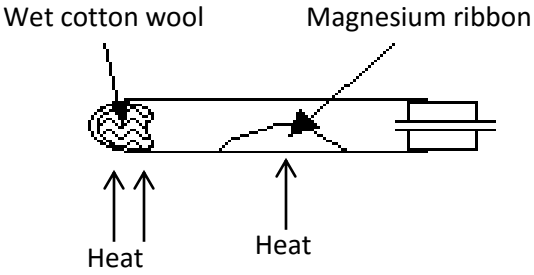
10. An oxide of potassium has molar mass of 110. If 2.75g of the oxide contains 1.95g of potassium, calculate the formula of oxide. (K = 39, O = 16.0). (3 marks)

11. The table below gives information about elements Q, R, S and W.

Element	Atomic Number	Atomic radius (nm)	Ionic radius (nm)
Q	3	0.134	0.074
R	5	0.090	0.012
S	13	0.143	0.050
W	17	0.099	0.181

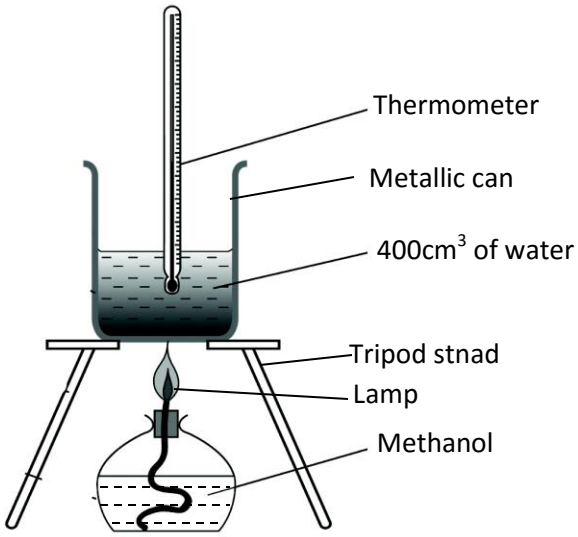
a) In which period of the periodic table is element S? Give a reason. (2 marks)
b) Explain why the atomic radius of Q is greater than that of R. (1 mark)

12. When Magnesium is reacted in steam it forms a white solid and hydrogen gas.



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

13. The diagram below shows a set up that was used to determine the molar heat of combustion of methanol.



During the experiment the data given below was recorded.
Initial temperature of water = 25^0C
Final temperature of water = 34^0C
Mass of methanol + Lamp before heating = 125.0g
Mass of methanol + Lamp after heating = 124.5g
Calculate the

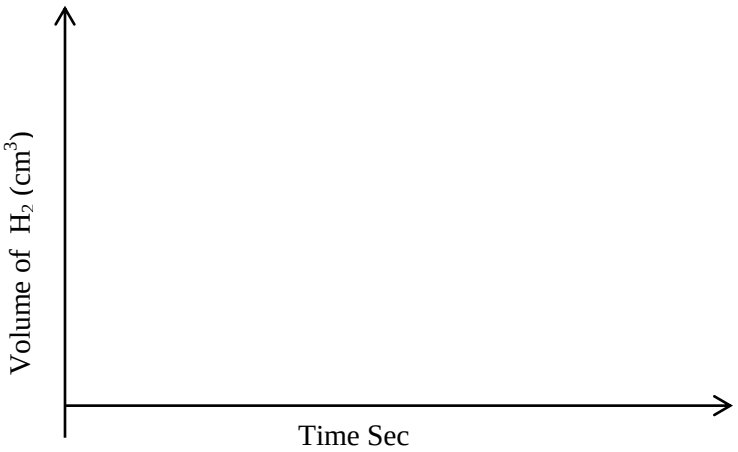
i) Heat evolved during the experiment.
(Density of water = 1g/cm^3, Specific heat capacity = 4.2Jg^{-1}k^{-1}) (1 mark)

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

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 internals

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 three curves that could be obtained from such results. (3 marks)



15. Excess marble chips (Calcium carbonate) was pour in a beaker containing 1.5M dilute hydrochloric acid. The mixture was then filtered and the filtrate in the beaker was evaporated to dryness.
Explain what happens if the beaker and its contents were left in the open overnight. (2 marks)

16. The table below shows the tests carried out on separate samples of water drawn from a river and the results obtained.

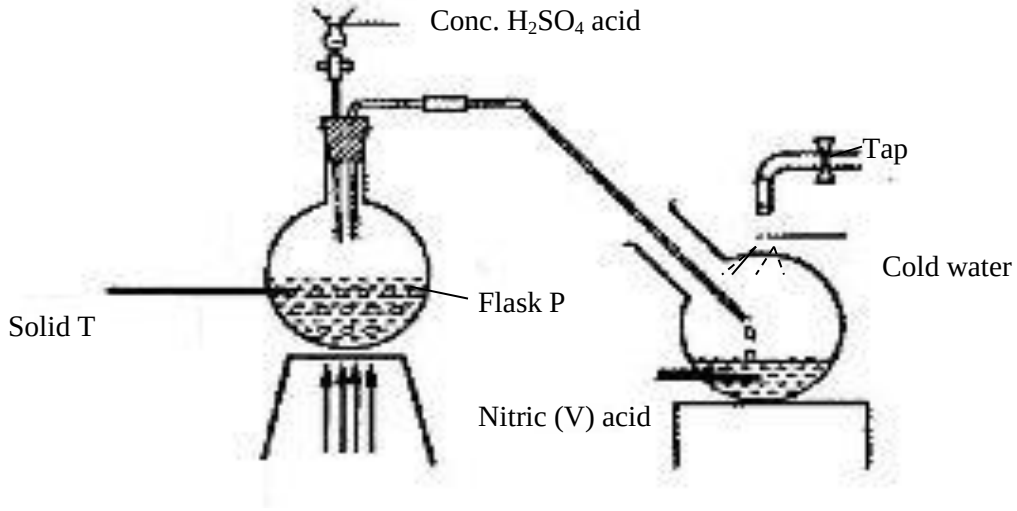
Test		Results
i)	Addition of excess sodium hydroxide solution	White ppt formed dissolves in excess
ii)	Addition of few drops of sodium carbonate	No effervescence/no bubbles/no white ppt
iii)	Addition of dilute nitric (V) acid followed by a few drops of silver nitrate	White ppt

a) Identify the cation and anion present in the water. (1 mark)
Cation - _____
Anion - _____

b) Write an ionic equation for the reaction which takes place in test (iii) above. (1 mark)

17. A scientist can determine the age of a fossil by measuring the proportion of carbon – 14 present in a fossil. If the half life of carbon – 14 is approximately 5600 years, calculate the age of a piece of wood found to contain $\frac{1}{8}$ as much carbon – 14 as in a living material. (3 marks)

18. The set up below was used to prepare nitric (V) acid.

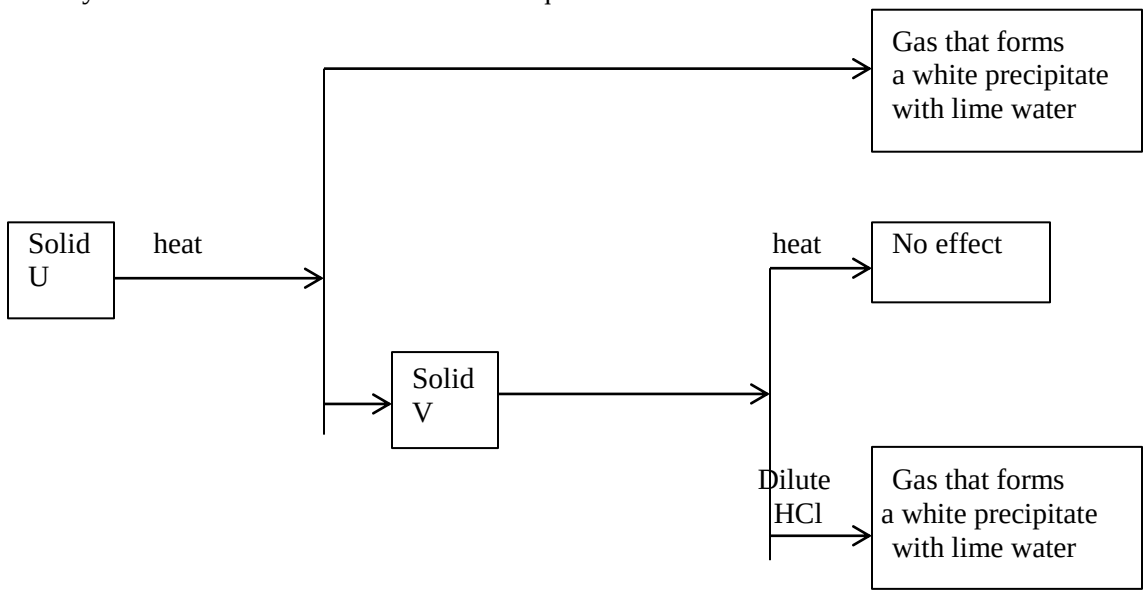


a) Give the name of solid T. (1 mark)
b) Write the equation for the reaction which took place in the flask P. (1 mark)
c) Explain why nitric (V) acid is stored in dark bottles. (1 mark)

19. Classify the following processes a either permanent or temporary. (3 marks)

Process	Type of change
a) Heating of Lead (II) oxide	
b) Obtaining Petrol from Crude oil	
c) Souring of milk	

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



a) Write down the formula of solids.U & V (1 mark)
b) Write down a balanced chemical equation between solid V and dilute hydrochloric acid. (1 mark)

21. Study the information in the table below and answer the questions that follow.

Salt	Solubility (g/100g water) at 40^0C	80^0C
$CuSO_4$	27	37
$AgNO_3$	78	97

A mixture containing 36g of $CuSO_4$ and 78g of $AgNO_3$ in 100g of water at 80^0C was cooled to 40^0C.

a) Which salt was crystallised out? (1 mark)
b) Calculate the mass of the salt that crystallised. (1 mark)
c) Name the process used to separate mixture. (1 mark)

22. Given the following half cells

$L^{2+}_{(aq)} / L_{(s)}$ E0 = -0.13V
$Q^{2+}_{(aq)} / Q_{(s)}$ E0 = +0.34V

a) Write the ionic equation for the half cell that undergoes (2 marks)
   i) Oxidation
   ii) Reducation
b) Calculate the e.m.f. of the resulting electro-chemical cell. (1 mark)

23. Study the information given below and use it to answer the questions that follows.

Substance	Reaction with acids	Melting point (^{0}C)
P	No reaction	-30
S	Reacts explosively	1190
t	No reaction	1728
r	Reacts readily	3075

Select

i) An oxide with giant atomic structure . (1 mark)
ii) An oxide which dissolves in water to form an acidic solution. (1 mark)

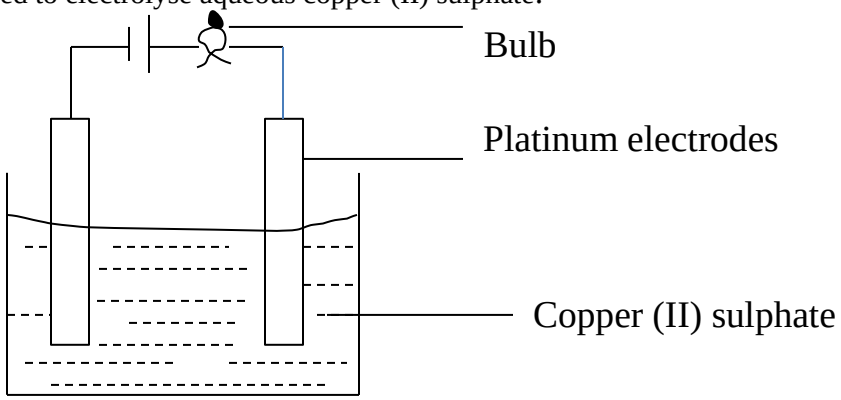
24. 5.34 g of a salt of formula N_2SO_4 was dissolved in water. The sulphate was precipitated by adding excess Barium chloride solution. The mass of precipitate formed was 4.66g.
(Ba = 56, S = 32, O = 16) (3 marks)

a) Determine the moles of sulphate ion present. (1 mark)
b) Calculate the relative atomic mass of N in N_2SO_4. (2 marks)

25. The following is an organic compound represented as $CH_3CH_2COOCH_3$.

i) Name the alkanoic acid and alkanol used in making the compound above. (1 mark)
ii) Name the class of organic compound to which the compound above belongs. (1 mark)
iii) Write an equation for reaction that takes place when the alkanol in (i) above is reacted with potassium . (1 mark)

26. The set-up below was used to electrolyse aqueous copper (II) sulphate.



a) Explain why the bulb light brightly at the beginning of the experiment and becomes dim after sometime. (2 marks)

b) Write the ionic equation of the reaction that took place at the cathode. (1 mark)

27. a) An element Z has a relative atomic mass of 44. When 0.5 A was passed through the molten chloride of Z for 18 minutes and 5 seconds, 0.22g of Z were deposited at the cathode. Determine the charge on an ion of Z. (1F = 96500C) (3 marks)

28. Name the process which takes place when :-

a) Iodine changes directly from solid to gas. (1 mark)

b) $Fe^{2+}_{(aq)}$ changes directly to $F^{3+}_{(aq)}$. (1 mark)

c) White sugar changes to black solid when mixed with excess concentrated sulphuric (VI) acid. (1 mark)

KIRINYAGA CLUSTER
233/2
Paper 2 (Theory)

1. The grid below shows part of the periodic table. Use it to answer the questions that follow.

						S	U	V
P	R		X			T		W
Q								

a) Which of the elements has the largest atomic radius? (2 marks)

b) Identify the most reactive metal.
Explain. (2 mark)

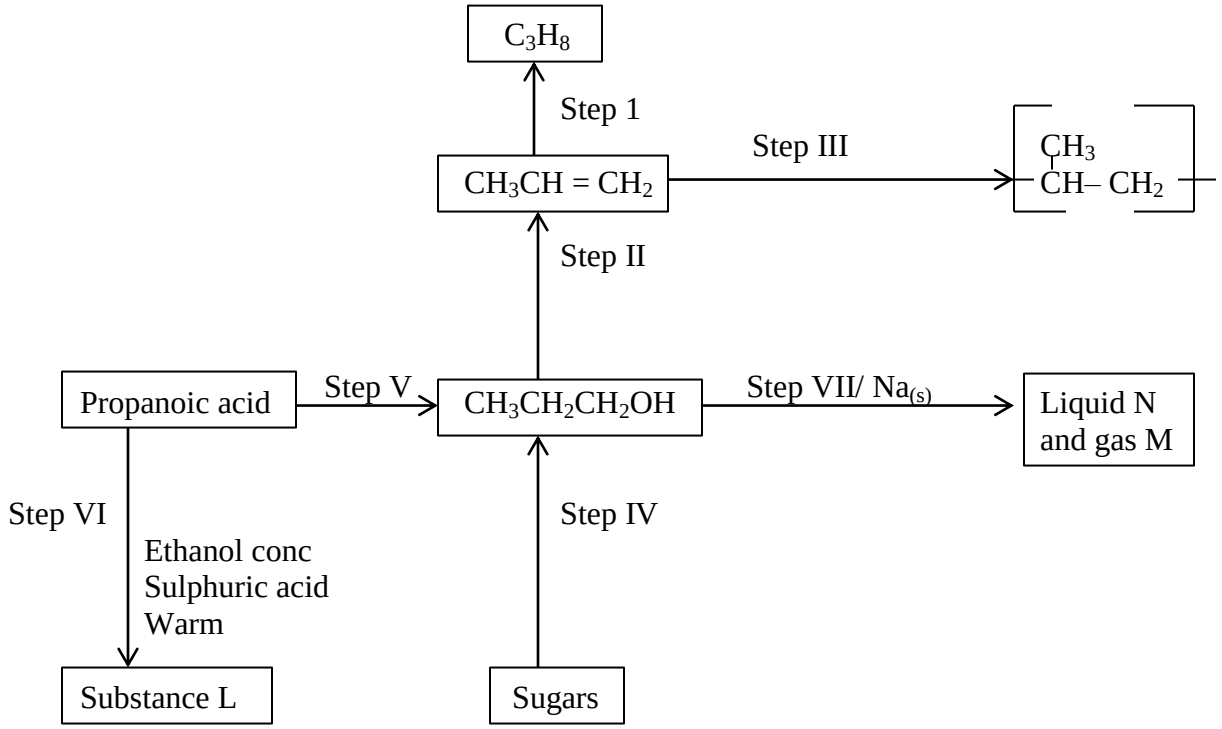
c) Name the chemical family to which P and Q belong (1 mark)

d) Compare the atomic radius of S and U.
Explain (2 marks)

e) Select an element that does not form ion.
Explain (1 mark)

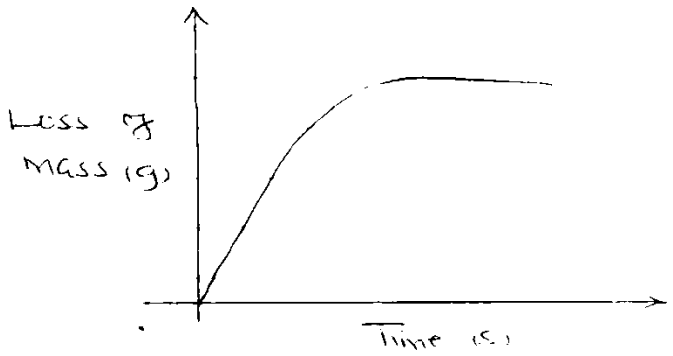
f) Give the formula of one stable cation with an electron arrangement of 2.8.8. (1 mark)
g) Draw the dot (●) and cross (X) diagram to show bonding between Q and T. (2 marks)

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



a) i) Name the type of reaction in step marked III and IV. (2 marks)
ii) Name the important reagents and conditions in steps marked I and II.
Step I _____ (1 mark)
Step II _____ (1 mark)
b) Write balanced equation for the reaction taking place in step (VI). (1 mark)
c) Identify liquid N and gas M. (2 marks)
d) Describe a chemical test that can be used to distinguish between C_3H_8 and C_3H_6. (2 marks)
e) i) If the relative molecular mass of the compound formed in step III is 42000, determine the value of n in the compound. (C = 12, O = 16, H = 1) (2 marks)
ii) State one disadvantage of the continued use of items made from the compound formed in e(i) above. (1 mark)

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



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

ii) Explain why there is loss in mass. (1 mark)

b) Sketch on the same axes, the curve obtained when:

I: Same mass of zinc powder was used under the same conditions. Label it P. (1 mark)

II: No catalyst was used. Label it N. (1 mark)

c) In the contact process, sulphur (IV) oxide is converted to sulphur (VI) oxide in the catalytic chamber in which a dynamic equilibrium is reached.

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)} \; ; \; \Delta H = -97 \text{ kJ/Mol.}$$

i) What is meant by dynamic equilibrium? (2 marks)

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

I. Decrease in pressure (2 marks)

II. Decrease in temperature (2 marks)

d) An equilibrium exists between chromate and dichromate ions as shown below.

$$\underset{\text{(Yellow)}}{2CrO_4^{2-}{}_{(aq)}} + 2H^+{}_{(aq)} \rightleftharpoons \underset{\text{(Orange)}}{Cr_2O_7^{2-}{}_{(aq)}} + H_2O_{(l)}$$

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

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

$K^+{}_{(aq)} + e \longrightarrow K_{(s)}$	-2.92
$L^+{}_{(aq)} + e \longrightarrow L_{(s)}$	+0.52
$C^+{}_{(aq)} + e \longrightarrow \frac{1}{2} C_{2\,(g)}$	0.00
$D^+{}_{(aq)} + e \longrightarrow D_{(s)}$	-0.44
$\frac{1}{2} E^+{}_{2\,(aq)} + e \longrightarrow E_{(aq)}$	+ 1.36

i) Which element is likely to be hydrogen? Explain. (1 mark)

ii) Identify the strongest oxidizing agent. Explain. (1 mark)

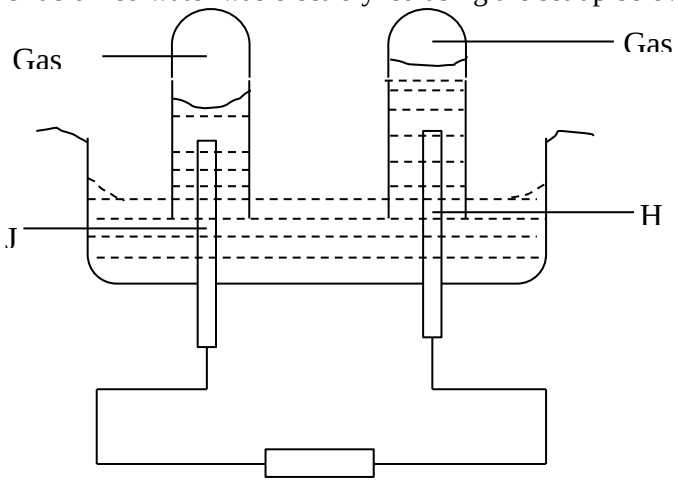
b) i) Which two half cells would produce the highest potential difference when combined? (1 mark)

ii) Draw the electrochemical cell of b(i) above.

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

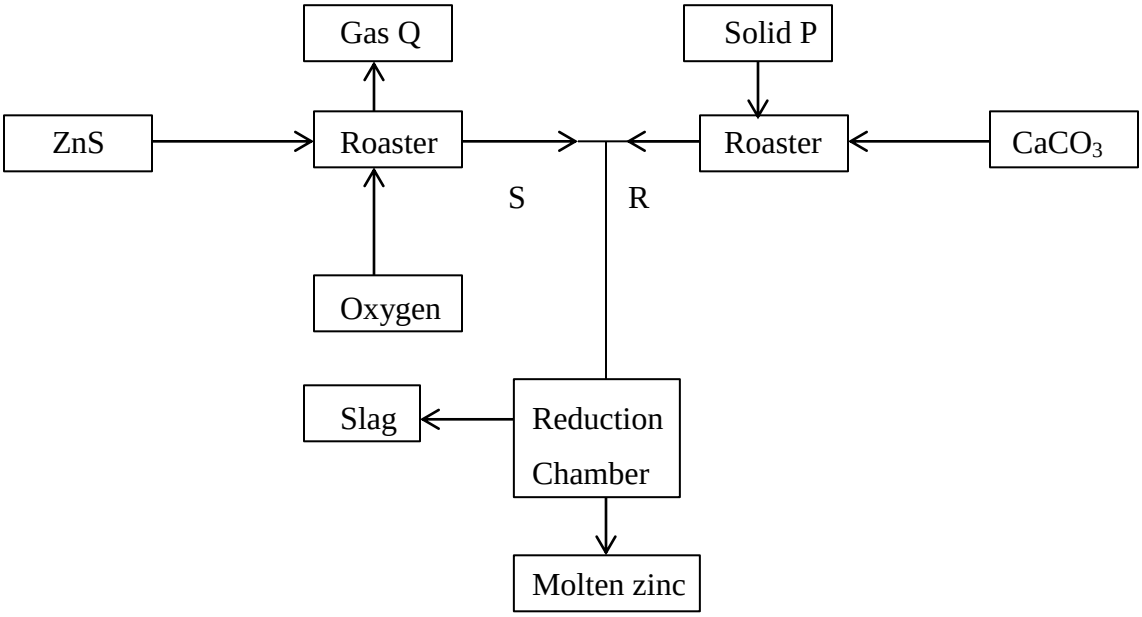
$$2A^+{}_{(aq)} + D_{(s)} \longrightarrow 2A_{(s)} + D^{2+}{}_{(aq)}$$

d) $90cm^3$ of acidified water was electrolyzed using the set up below.



i) Identify electrodes H and J. (1 mark)
ii) Describe how gas F can be identified. (2 marks)
iii) In the above experiment 5A of electricity was passed through the acidified water for 3 minutes 21 seconds. Calculate the volume of gas G produced at room temperature and pressure. (Molar gas at r.t.p = $24000cm^3$, 1F = 96500c) (3 marks)

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



a) i) Give the common names of the ore. (1 mark)
I. ZnS -
(ii) Name the gas (2 marks)
Q -
(iii) Name the solids R,S & P
b) Write the chemical equation for the reaction that produces zinc metal. (1 mark)
c) What is the purpose of adding Calcium carbonate in the reaction chamber? (1 mark)
d) Give two uses of zinc metal. (2 marks)
e) Name one other industries that can be established alongside the zinc extraction plant. (2 marks)

6. In an experiment, $50cm^3$ of 1.0M sodium hydroxide solution was placed in a suitable apparatus and $5.0cm^3$ portions of hydrochloric acid were added. The resulting mixture was stirred with a thermometer and the temperature recorded after each addition.

Volume of HCl (cm^3)	5	10	15	20	25	30	35	40	45	50
Temperature (^0C)	21.5	22.5	24.0	25.0	26.0	27.0	27.5	27.5	27	20

a) Plot a graph of temperature against volume of the acid added. (3 marks)

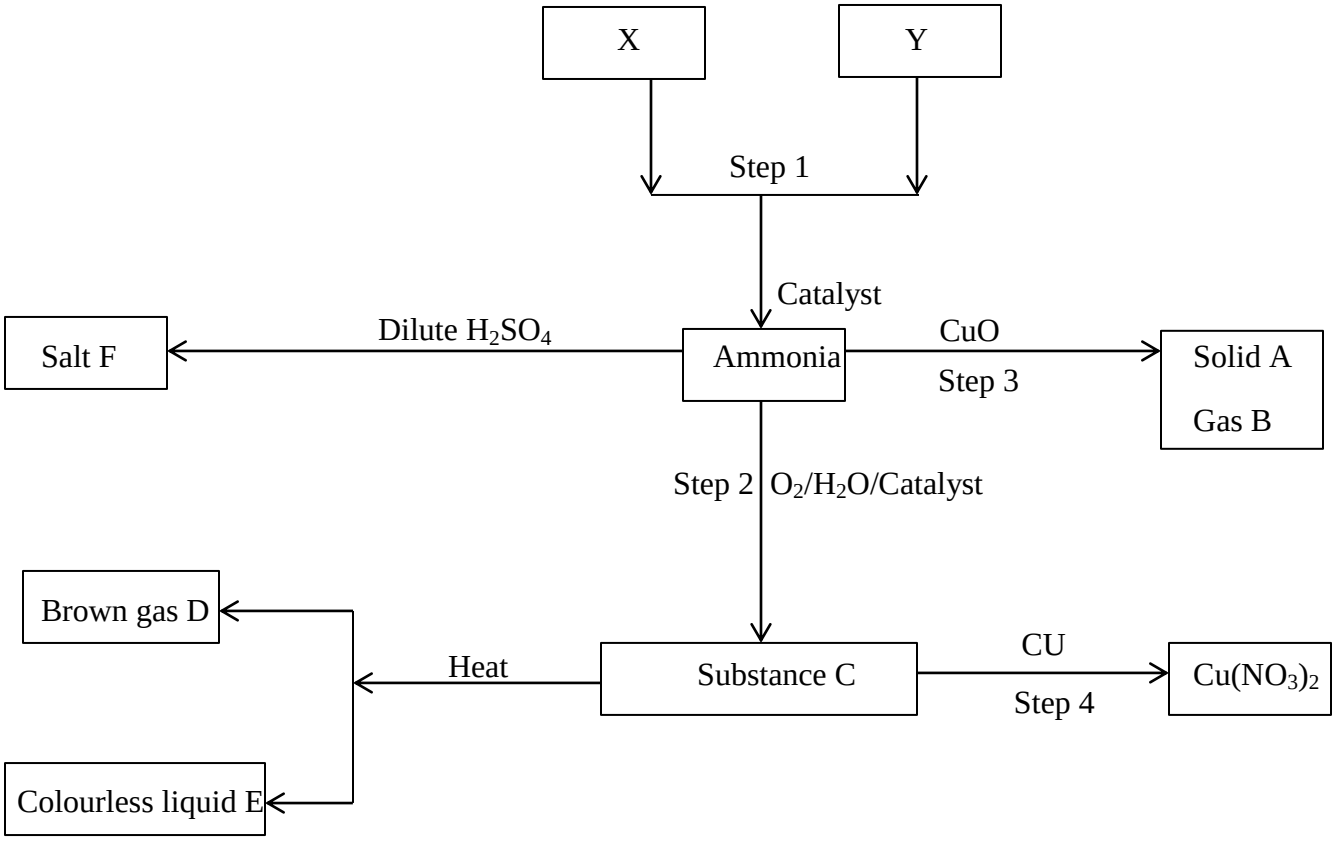
a) i) From the graph determine volume of HCl used to neutralize $50cm^3$ of 1M NaOH. (1 mark)

ii) Hence determine concentration of the HCl in moles per litre. (3 marks)

b) i) Calculate the amount of heat produced in the reaction.
(Specific heat capacity = 4.2 $kJKg^{-1}k^{-1}$ and density of the solution $1g/cm^3$) (2 marks)

ii) Hence calculate the enthalpy of neutralization. (1 mark)

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



a) Identify X and Y. (2 marks)

b) Write the reaction between X and Y. (1 mark)

c) Name the following substances. (2 marks)
i) F - ii) A -iii) B - iv) E -

d) Write chemical equation for the formation of salt F. (1 mark)

e) Name the type of reaction that takes :-

i) Place between Ammonia and CuO (1 mark)

ii) In the reaction in e (i) above which of the species undergo

I. Reduction (1 mark)

II. Oxidation (1 mark)

iii) State one economic use of substance F. (1 mark)

KIRINYAGA CLUSTER
233/3
CHEMISTRY
PAPER 3
PRACTICAL

1. You are provided with;

– Solution Q which is 2.0M Hydrochloric acid.
– Solution R containing 12g/dm^3 of sodium hydroxide contaminated with sodium nitrate.
– Phenolphthalein indicator.

You are required to

– Prepare a dilute solution of hydrochloric acid.
– Determine the percentage purity of sodium hydroxide in solution R.

(i) **I. Procedure**

Using a 50ml measuring cylinder, place 25cm^3 of solution Q into a 250ml volumetric flask. Add distilled water to make 250cm^3 of solution. Label this solution P. Pipette 25cm^3 of solution R into a 250cm^3 conical flask. Add 2 drops of Phenolphthalein indicator. Fill the burette with solution P and titrate it against solution R until it just turns colourless. Repeat the titration two more times and complete the table below.

Table 1

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

(4 mks)

(a) Determine the average volume of solution P used. (1 mk)

(b) Calculate the number of moles in;

i) 250cm^3 of solution P (2 mks)

ii) Solution P that reacted (2 marks)

c) Calculate the ;

i) Name the moles of sodium hydroxide, solution R used. (2 marks)

ii) Mass of sodium hydroxide in the 1dm^3 volume of solution R. (2 marks)

iii) Percentage purity of sodium hydroxide. (2 marks)

2. You are provide with;

i) 4.5g of solid B
ii) Distilled water

You are required to determine the solubility of solid B in 100g of water ate different temperatures.

Procedure

Fill the burette with distilled water. Put 20cm^3 of distilled water into a boiling tube with solid B. Warm the mixture while stirring with a the thermometer until all solid B dissolves. Remove the boiling tube from the Bunsen burner and continue to stir the solution with the thermometer as it cools. Note the temperature at which the crystals first appear and record it in the table II below. Add 2.0cm^3 of distilled water into the mixture and repeat the procedure. Continue adding the 2.0cm^3 of distilled water and repeat the procedure to complete the table II below. Also calculate the solubility of solid B at different volumes to complete the table

Table II

Total mass of water	20	22	24	26	28	30
Add to 4.5 of solid B						
Solubility of B per 100g of water	22.5					
Temperature at which the crystals first appear (^{0}C)						

i) Plot the graph of solubility of B against temperature at which the crystals first appear. (3 marks)
ii) From the graph determine the solubility of solid B at 45^0C. (1 mark)

3. You are provided with solid W.
Carry out the tests below and record your observation and inferences in the spaces provided.

i) Place solid W in a boiling tube and add about $10cm^3$ of distilled water and shake well.

Observations	Inferences
(1 mk)	(1 mk)

ii) To about $2cm^3$ portion add sodium hydroxide dropwise until in excess.

Observations	Inferences
(1 mk)	(1 mk)

iii) To another $2cm^3$ portion add aqueous ammonia dropwise until in excess.

Observations	Inferences
(1 mk)	(1 mk)

iv) To the third $2cm^3$ portion add 3 drops of sodium sulphate solution.

Observations	Inferences
(1 mk)	(1 mk)

v) To the fourth $2cm^3$ portion add 3 drops of potassium iodide.

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

b) You are provided with solution F. Carry out the tests below and record your observations and inferences in the spaces provided.

i) Add about $5cm^3$ of distilled water to all the solution F in a boiling tube and shake.

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

ii) To about $2cm^3$ portion of solution F, add 3 drops of acidified potassium manganite (VII).

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

iii) To about $2cm^3$ portion of solution F add sodium hydrogen carbonate solid.

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

iv) To about $2cm^3$ of solution F add 3 drops of universal indicator solution.

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

KIRINYAGA CLUSTER
233/3
CHEMISTRY PRACTICAL CONFIDENTIAL
JULY/AUGUST 2019
CONFIDENTIAL
FORM 4

In addition to the normal laboratory fittings and apparatus, each candidate should have the following;

1. 50 cm^3 of solution Q
2. 100 cm^3 of solution R
3. 250 ml volumetric flask
4. 250 ml conical flask (2)
5. 50 ml measuring cylinder
6. 50 ml burette
7. 25 ml pipette
8. One white tile
9. Complete stand
10. Solid B
11. 1 boiling tube
12. Test tube holder
13. Thermometer (-10 to 110^0C)
14. Solid W
15. 10 ml measuring cylinder
16. 5 test tube in a rack
17. Solution F
18. 500 ml distilled water
19. 0.2 g sodium hydrogen carbonate
20. 1 label

Access to;

1. Source of heat
2. 2 M sodium hydroxide solution with a dropper.
3. 2 M aqueous ammonia with a dropper.
4. 0.25 M sodium sulphate solution with a dropper.
5. 0.1 M potassium Iodide with a dropper.
6. Acidified Potassium Manganate (VII) with a dropper.
7. Universal indicator solution with a dropper.
8. Phenolphthalein indicator
9. pH chart

KASSU JET
233/1
CHEMISTRY
PAPER 1
(THEORY)

1. State two reasons why we use the non-luminous flame for heating in a laboratory instead of using the luminous flame. (1mk)
2. Chlorine has two isotopes with atomic mass **35** and **X** occurring in the ratio **3:1** respectively. The relative atomic (R.M.A) of chlorine is **35.5**. Determine the value of **X**. (3mks)
3. During an experiment sulphur (IV) oxide gas was formed to diffuse through a certain pore at a rate of $25cm^3$ per minute. When the experiment was repeated under the same conditions with another gas G, gas G was found to diffuse through the same pore at a rate of $26.26cm^3$ per minute. Work out the molecular mass of Gas G. (O=16, S=32) (3mks)
4. Calculate the volume of 0.6M sulphuric (VI) acid solution needed to neutralize $30cm^3$ of 0.2M potassium hydroxide. (2mks)
5. A state of equilibrium between dichromate (vi) and chromate ions is established as shown below

$$Cr_2O_7^{2-}(aq) + 2OH^-(aq) \rightleftharpoons 2CrO_4^{2-}(aq) + H_2O(l)$$

Orange (Yellow)

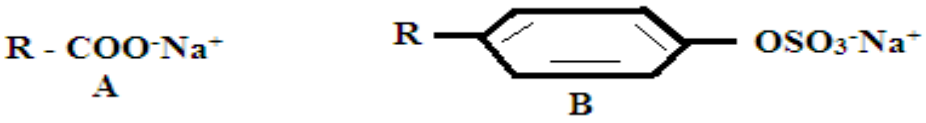
   a. What is meant by dynamic equilibrium? (1 mk)
   b. State and explain observation made, when a few pellets of Potassium Hydroxide are added to equilibrium mixture (2 mks)

6. Study the standard reduction potentials below and answer the questions that follow;The letters are not actual symbols of the elements

Half cell	E volts
$P^{2+}_{(aq)} + 2e \rightarrow P_{(s)}$	**- 0.76**
$R^{2+}_{(aq)} + 2e \rightarrow R_{(s)}$	**- 2.37**
$S^{+}_{(aq)} + 1e \rightarrow S_{(s)}$	**+ 0.80**
$T^{2+}_{(aq)} + 2e \rightarrow T_{(s)}$	**- 0.14**

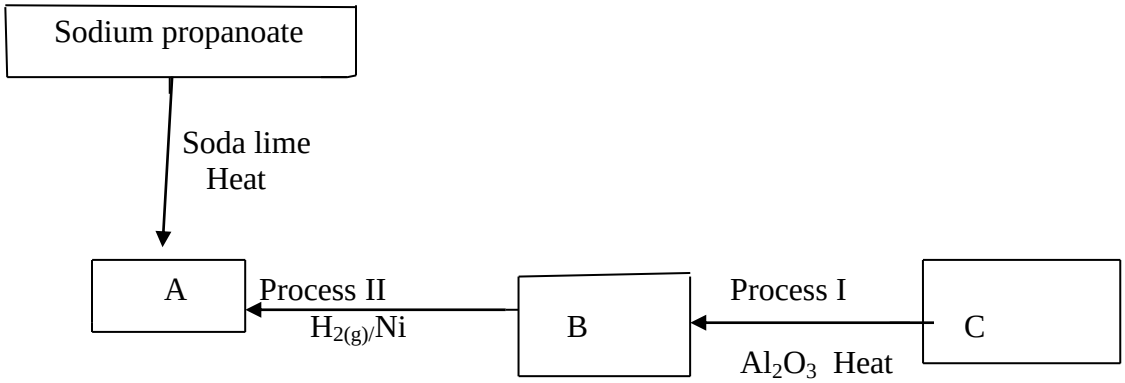
   i) Select the element which is the strongest reducing agent. Give a reason. (1mk)
   ii) Select two half cells when combined would produce the largest e.m.f (1mk)
   iii) Calculate the e.m.f of the electrochemical cell formed when the two half cells in (ii) above are combined. (1mk)

7. The structure below represents two cleansing agents A and B.



   a) Name the cleansing agents A & B (mk)
   b) State a cleansing agent that would be suitable for washing in water containing calcium chloride. Give a reason. (1mk)

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



a) Identify substances A & C (1mk)
b) Another substance D combines with one mole of hydrogen gas to form substance B. Give the structural formula of D . (1mk)
c) Explain how you would distinguish between C_2H_6O and $C_2H_4O_2$ (1mk)

9. Name the following processes;
a) When anhydrous calcium chloride is left in an open beaker overnight a solution was formed. (1mk)
b) When sodium carbonate decahydrate crystals are left in an open beaker for some days it turned into a powder. (1mk)

10. The standard enthalpies of combustion of ethyne (C_2H_2), carbon (C) and hydrogen (H_2) are **-1300** kJ/mol**,-394** kJ/mol and **-286** kJ/mol respectively. Calculate the enthalpy of formation of ethyne. (3mks)

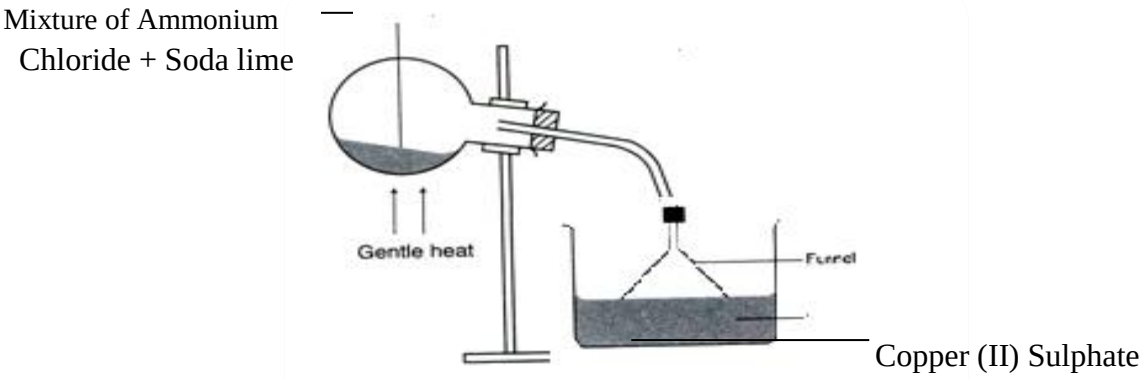
11. The following data gives the PH values of solutions A, B, C.

SOLUTION	PH
A	13.9
B	7.0
C	1.5

a) i) Which solution gives a pink colour after adding a few drops of phenolphthalein indicator?(1mk)
ii) Give the possible identity of that solution. (1mk)
b) Which solution would produce Carbon(IV)Oxide when reacted with Copper(II) Carbonate. (1mk)

12. Explain the following;
a) Oxide ion (O^{2-}) has a larger radius than oxygen atom (O). (1mk)
b) Calcium is a weaker conductor of electricity compared to aluminium. (1mk)

13. A student prepared ammonia gas and bubbled it into a solution of Copper (II) Sulphate as shown below.

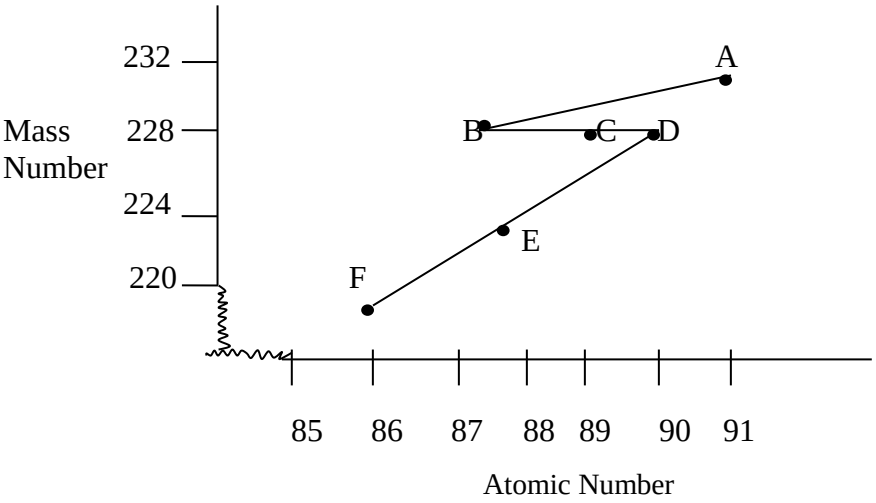


a) State one observation made in the beaker and one made in the round bottomed flask.
   i) A short while (1mk)
   ii) A long while (1mk)

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

14. a) Define the term half life (1mk)

b) The graph below represents a radio active decay series for Isotope A. Study it and answer the questions that follow;



a) Name the type of radiation involved when;
   (i) A changes to B (1mk)
   (ii) B changes to C (1mk)

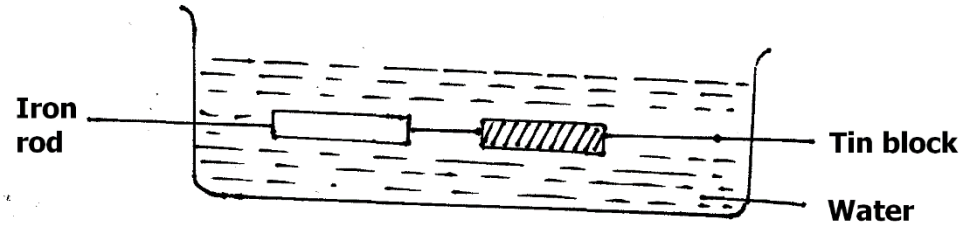
15. a) One of the uses of sulphur is in vulcanization of rubber. Define vulcanization. (1mk)
   b. State one properties that vulcanized rubber possesses. (1mk)

16. The table below shows the standard electrode potential of four elements.

Element	V	W	X	Y	
E°	-0.55	0.00	+0.20	+0.35	

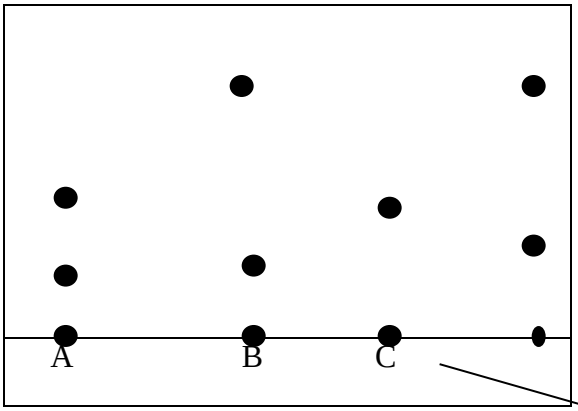
a) Arrange the elements in order of reactivity starting with the most reactive. (1mk)
b) Identify element W. Give a reason for your answer. (2mks)

17. The set – up below was used by a student to try to prevent the rusting of an Iron rod.



a) Did the student succeed in preventing the rusting of Iron using the set – up above? (1mk)
b) Which method of rust prevention was the student investigating. (1mk)

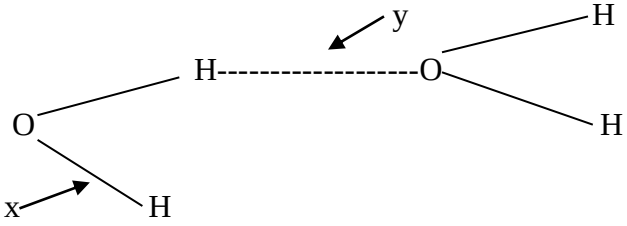
18. Ink from a signature that forged a cheque was compared with ink from pens of three suspects A, B, C using paper chromatography. The results were as follows;



Ink from forged cheque

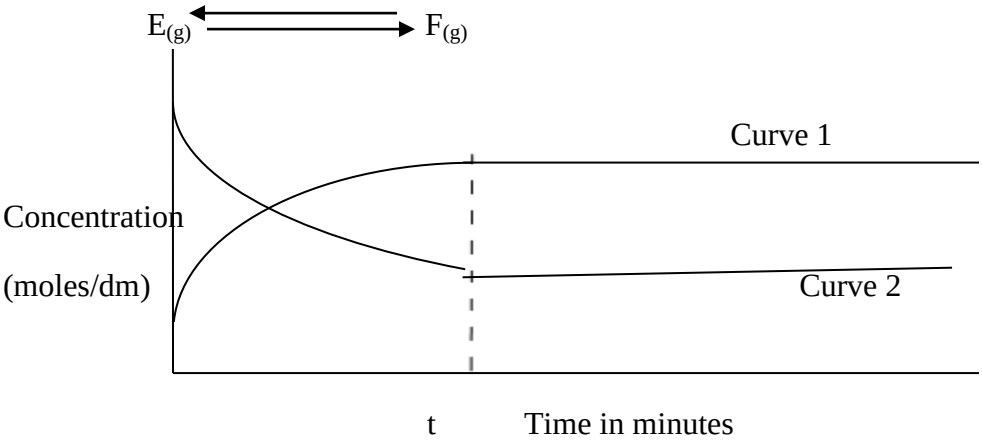
a) Describe how the ink was taken from the forged cheque. (2mks)
b) Which suspect was not guilty? (1mk)

19. The diagram below shows the structure of the molecules of water.



a) Name the types of bonds labelled x and y. (1mk)
b) Explain why water has a higher melting point than Hydrogen Sulphide. (1mk)

20. The curves below represents the changes in the concentrations of substances E and F with time in the reaction.



a) Which curve represents the changes in the concentration of substance F? Give a reason. (2mks)
b) Give a reason for the shapes of the curves after time (t) minutes. (1mk)

22. Potassium salt gave white precipitate with Barium Nitrate solution. An addition of dilute Hydrochloric Acid, the white precipitate disappear and a colourless gas that turns acidified potassium dichromate (VI) green was evolved.
a) Write the formula of the compound which formed the white precipitate. (1mk)
b) Write the equation for the reaction between dilute hydrochloric acid and the compound whose formula is written in(a) above. (1mk)

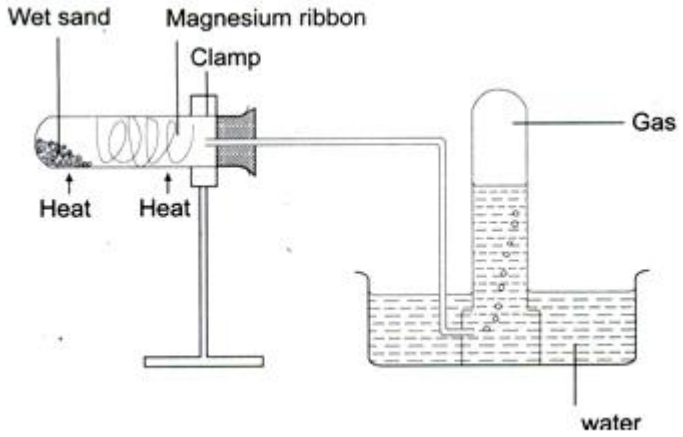
23. NO_2 and N_2O_4 gases exists in equilibrium as shown below.

$$2NO_2(g) \rightleftharpoons N_2O_4(g)$$

(Brown) (Pale yellow)

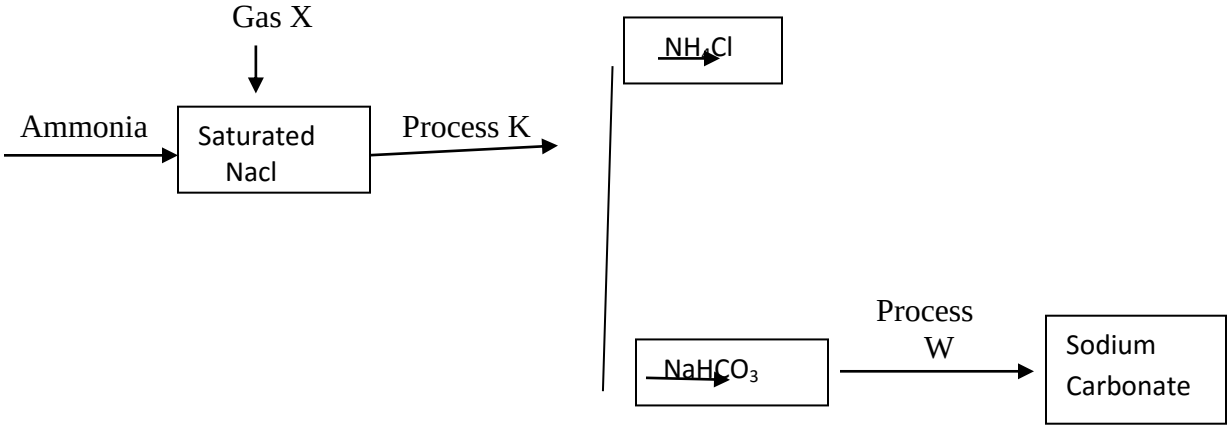
a) State LeChartliers principle (1mk)
b) State and explain the effect of increased pressure on the equilibrium . (1mk)

24. A student set up the experiment below to collect gas Q.



a) Name the gas Q. (1mk)
b) Write the equation for the reaction in the boiling tube if magnesium was replaced with iron . (1mk)
c) State two uses of gas Q (1mk)

25. The Schematic diagram is part of the Solvay process used for the manufacture of sodium carbonate.



i) Name gas x (1mk)
ii) Identify process K (1mk)
iii) Write the equation for the reaction in process W. (1mk)

26. The solubility of potassium nitrate is 85g/100g of water at 50^{o}c and 32g/100g of water at 25^{o}c.
a) Define the term solubility. (1 mark)
b) Calculate the mass of the crystals formed if a saturated solution of potassium nitrate in 50g of water at 50^{o}c is cooled to 25^{o}c. (2 marks)

27. Chlorine gas was bubbled through water and observation made after 24 hours
a) Draw a diagram to show the observation made after 24 hours. (2 marks)

b) Write an equation for the reaction that occurs when chlorine gas is bubbled into hot concentrated sodium hydroxide (1mk)

c) One of the products in (b) above is used as an antiseptic. State its other use (1mk)

28. Aluminiumm is extracted from its ore by the process of electrolysis . (1mk)

(i) Name the ore of aluminium that is normally used.

(ii) Aluminium ore in (i) above has very high melting point (2015°C) though it is electrolysed at a lower temperature of a bout 900°C. Explain how the low temperature is achieved. (1mk)

(iii) In the above process graphite electrodes are used. What is the disadvantage of using this kind of electrode. (1mk)

29. Study the reaction below and answer the questions that follow

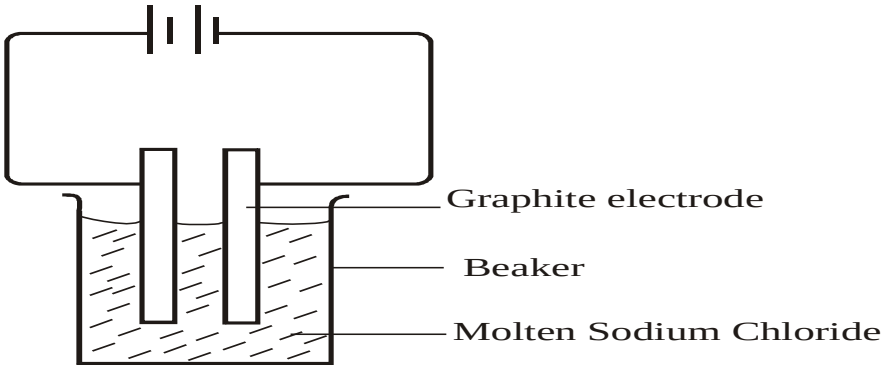
$NH_{3\,(g)} + H_2O_{(l)} \rightleftharpoons NH_4^+{}_{(aq)} + OH^-_{(aq)}$

(a) Give the Bronstad-Lowry definition of acid (1mk)

(b) Identify an acid in the backward reaction (1 mark)

30. When 34. 8g of hydrated sodium carbonate $Na_2\,Co_3.\mathbf{n}H_2O$ were heated to a constant mass. 15.9g of anhydrous sodium carbonate were obtained. Find the value of "**n**" in hydrated carbonate (Na= 23), (O = 16), (C= 12), (H = 1.0) (3 mks)

31. The diagram below represents an experiment which was carried out by a student, to investigate the effect of passing an electric current on molten sodium chloride.



a. Molten sodium chloride is a binary electrolyte. State the meaning of the term binary electrolyte. (1mk)
State two observations made at the anode (1 mk)

b. Write an equation to show what happens at the cathode. (1 mk)

32. Starting with Copper metal, describe how a solid sample of Copper (II) nitrate can be prepared. (3mks)

K A S S U J O I N T E X A M I N A T I O N - 2019
233/2
CHEMISTRY
Paper 2

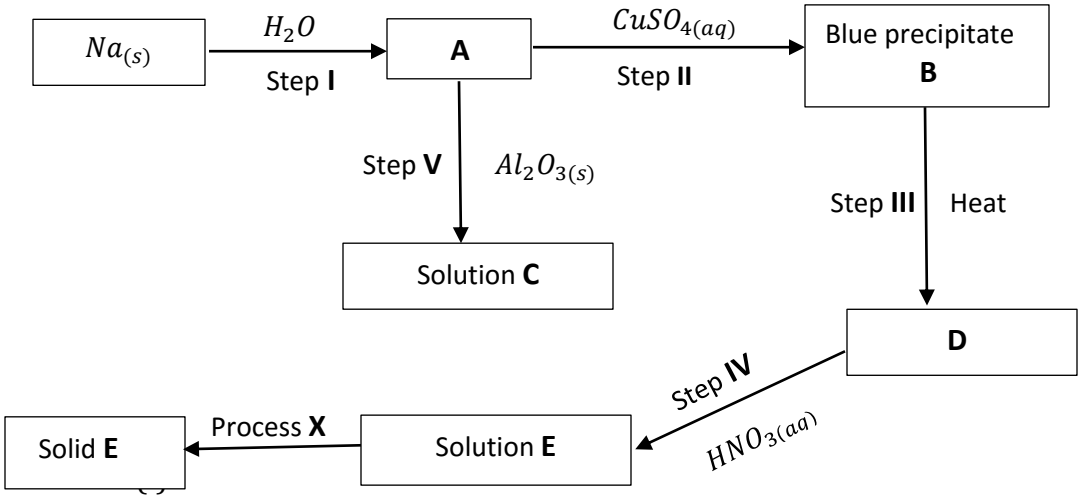
This paper consists of **12** printed pages. Candidates are advised to check and to make sure all pages are as indicated and no question is missing.

1. Use the information in the table below to answer the questions that follow. The letters do not represent the actual symbols of the elements.

Element	Atomic number	Melting point ^{0}C
R	11	97.8
S	12	650.0
T	15	44.0
U	17	-102.0
V	18	-189.0
W	19	64.0

(a) Give a reason why the melting point of;
(i) **S** is higher than that of **R**. **(2 marks)**
(ii) **V** is lower than that of **U**. **(2 marks)**
(b) How does the reactivity of **W** with chlorine compare with that of **R** with chlorine? **(2 marks)**
(c) When 0.30g or **R** was reacted with water 1600cm^3 of gas was produced. Determine the relative atomic mass of **R**. (Molar gas volume = 24000cm^3 r.t.p) **(3 marks)**
(d) Give **one** use of element **V**. **(1 mark)**
(e) Draw a structure of the compound formed when **S** reacts with **U**. **(1 mark)**
(f) Compare the atomic radius of element **S** and **V**. Give a reason. **(2 marks)**

2. (a) Give the name of the following processes.
(i) A hot saturated solution of copper (II) sulphate is cooled to form crystals of copper (II) sulphate. **(1 mark)**
(ii) A white powder is formed when concentrated sulphuric (V) acid is added to blue hydrated copper (II) sulphate. **(1 mark)**
(b) Study the flow chart below and answer the questions that follow.



(j) (i) Name substances: **(4 marks)**
(ii) Write equations for the reactions in steps; **(2 marks)**

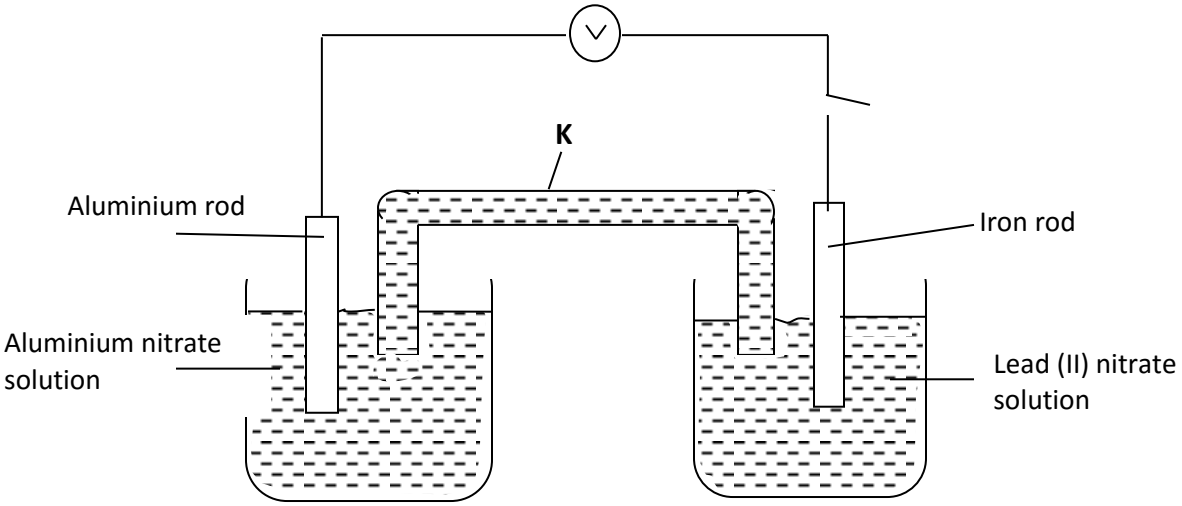
III
V

(iii) Write the ionic equation for the reaction in step **II**. **(1 mark)**
(iv) State any **two** observations made in step **I**. **(2 marks)**

(c) Write an equation to show how addition of ammonia solution is used to remove temporary water hardness. **(1 mark)**

3. 4g zinc powder was added to 200cm^3 of 1M $CuSO_{4(aq)}$. During the experiment there was a temperature rise of 10K. If the density of the solution was 1g/cm^3 and specific heat of the solution was 4.2kJ/kg/K;
(a) determine the energy change of the reaction. (Zn = 65) **(2 marks)**
(b) What would be the enthalpy change of the above reaction? **(3 marks)**
(c) Write a thermochemical equation to represent the above reaction. **(1 mark)**
(d) State **two** observations made when zinc powder is added to copper II sulphate solution. **(1 mark)**

4. (a) The diagram below shows electrochemical cell. Study it and answer the questions that follow.



Given the following:

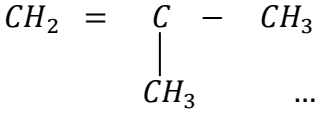
$Fe^{2+}{}_{(aq)} + 2e \longrightarrow Fe_{(s)};\ E^{\theta} = -0.44V$

$Al^{3+}{}_{(aq)} + 3e \longrightarrow Al_{(s)};\ E^{\theta} = -1.66V$

(i) On the diagram, show the direction of flow of;
(I) Electrons **(½ mark)**
(II) Current **(½ mark)**
(ii) Name a substance that is used to fill part **K**. Give a reason. **(2 marks)**
(iii) State the **two** observations made in the half cell containing iron (II) ions. **(2 marks)**
(iv) Write the half ionic equation for the reaction that results into oxidation. **(1 mark)**
(v) Write the cell diagram for this electrochemical cell. **(1 mark)**
(vi) Give any one use of the part **K**. **(1 mark)**

(b) In an experiment to electroplate iron with silver, current of 1 Ampere was passed through a silver solution of ions for 60 minutes.
(i) Give a reason why it is necessary to electroplate iron. **(1 mark)**
(ii) Calculate the mass of silver deposited on iron during the electroplating process. **(3 marks)**
(Ag = 108, IF = 96500c)

5. (a) Give the systematic names of the following compounds.

(i) 

…… **(1 mark)**

(ii) $CH_3CH_2CH_2C \equiv CH$ …… **(1 mark)**

(b) State the observations made when Propan-l-ol reacts with:

(i) Acidified potassium dichromate (VI) solution. **(1 mark)**

(c) Ethanol obtained from glucose can be converted to ethane as shown below.

$$C_6H_{12}O_6 \xrightarrow{\text{Step I}} C_2H_5OH \xrightarrow{\text{Step II}} CH_2 \equiv CH_2$$

Name and describe the process that takes place I steps I and II. **(2mark)**

(d) Compounds A and B have the same molecular formula $C_3H_6O_2$. Compound A liberates carbon (IV) oxide on addition of aqueous sodium carbonate while compound B does not. Compound B has a sweet smell. Draw the possible structures of;

(i) Compound A **(1 mark)**

(ii) Compound B **(1 mark)**

(e) Give **two** reasons why the disposal of polymers such as polychloroethane by burning pollutes the environment. **(2 marks)**

(f) Some animal and vegetable oils are used to make margarine and soap. Give the reagents and conditions necessary for converting the oils into:

(i) Margarine **(1 mark)**

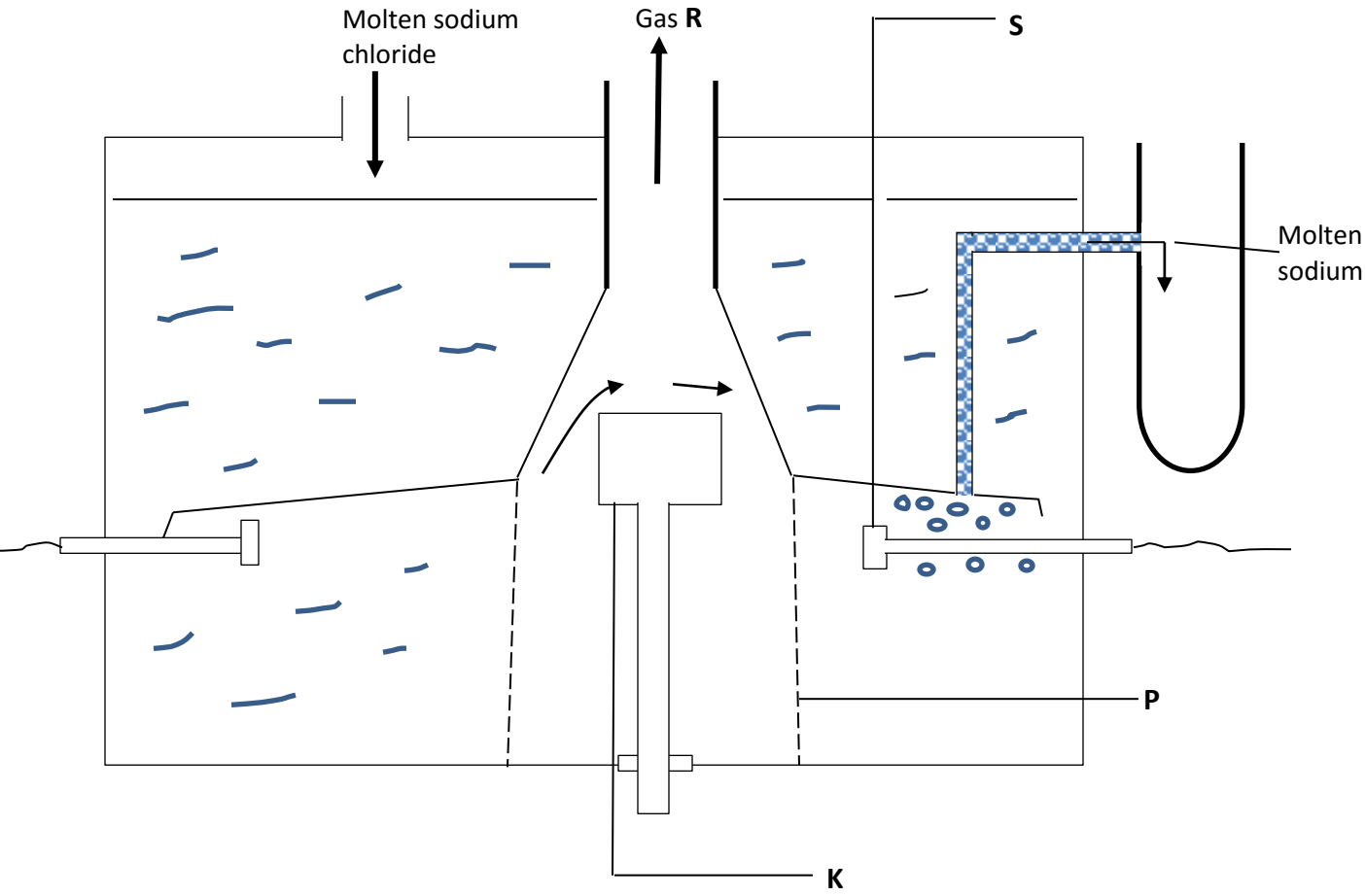
(ii) Soap **(1 mark)**

(g) (i) The use of CFCs has been linked to depletion of ozone layer. What does CFC stand for? **(1 mark)**

(ii) Explain the problem associated with the depletion of the ozone layer. **(1 mark)**

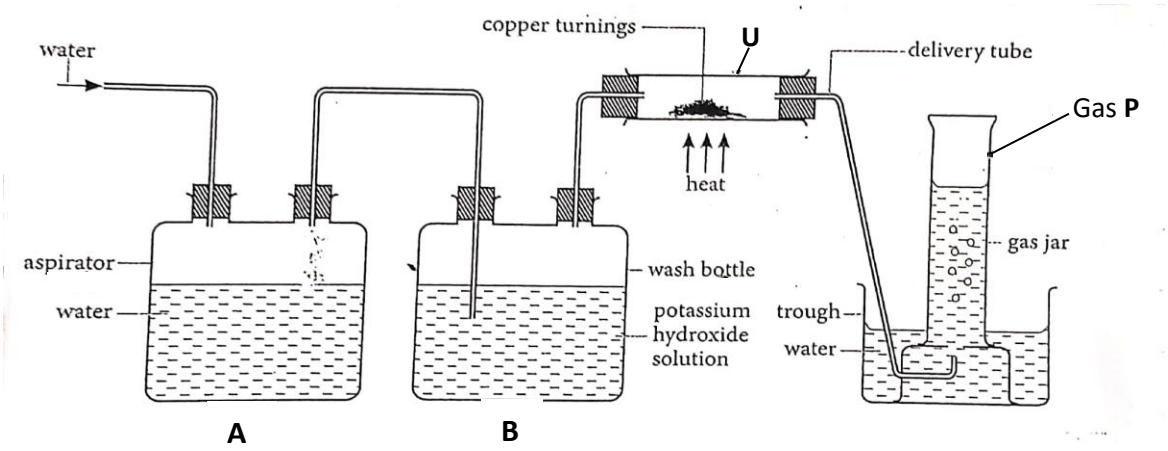
(iii) State another environment problem caused by CFCs. **(1 mark)**

6. Use the diagram below to answer the questions that follow.



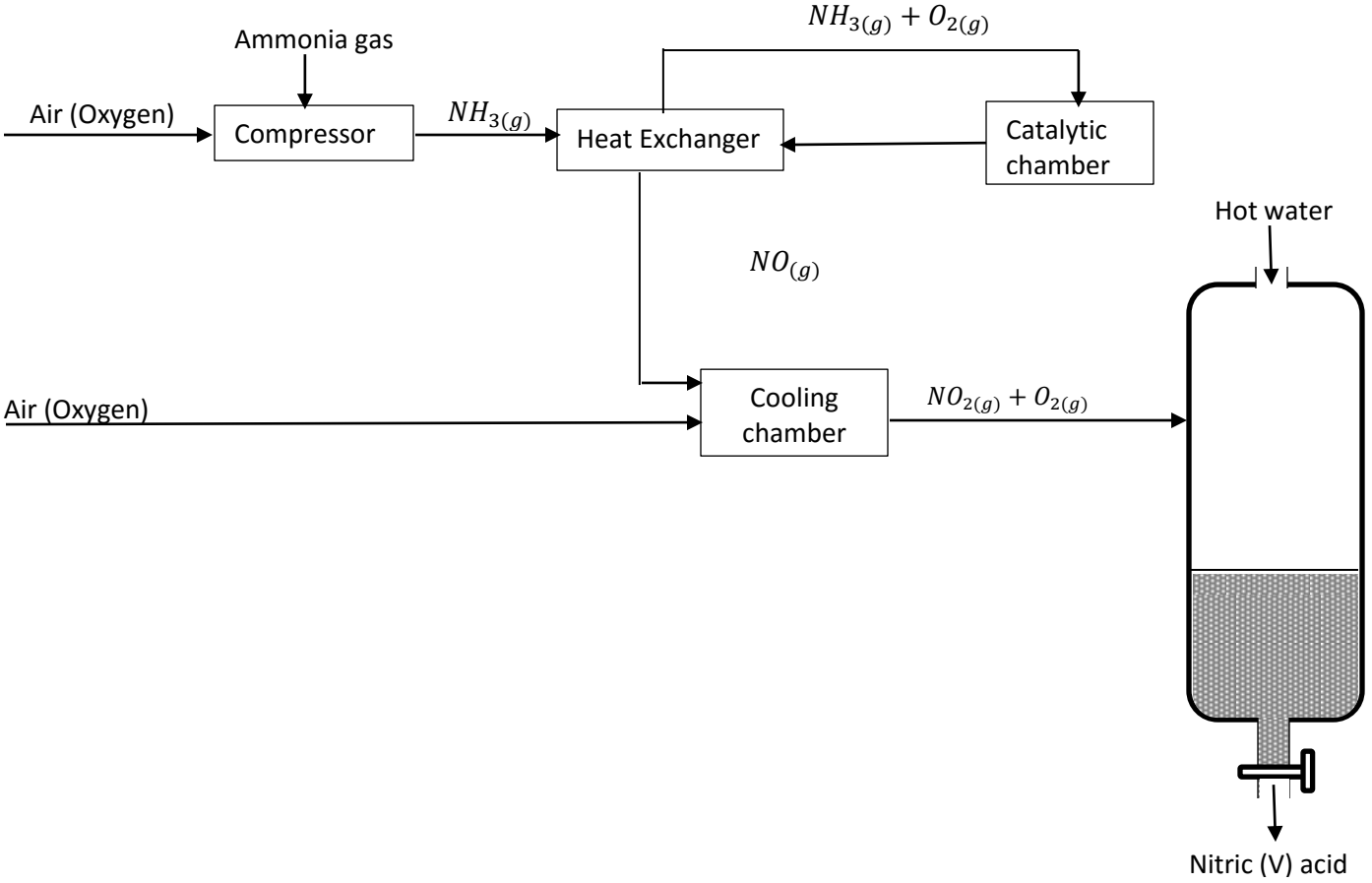
(a) Identify the substances labelled. R, S, K & P **(2 marks)**
(b) What is the function of the part labelled **P**? **(1 mark)**
(c) Write half equations at the electrodes. **(2 marks)**
(d) Why is molten sodium chloride used instead of sodium chloride solution? **(1 mark)**
(e) Why is calcium chloride added in the electrolysis of molten sodium chloride? **(1 mark)**
(f) How is the calcium eventually separated from the sodium? **(2 marks)**
(g) When sodium is left exposed in the air a white solid is formed but when sodium is burnt in oxygen, a yellow solid is formed. Explain this difference using equations. **(2 marks)**

7. (a) The diagram below was used to obtain gas P in the laboratory. Study it and answer the questions that follow.



(i) State the role of aspirator **A**. **(1 mark)**
(ii) Write an equation in wash bottle **B**. **(1 mark)**
(iv) Give the name of apparatus **U**. **(1 mark)**
(v) State and explain the observation made in apparatus **U**. **(1 mark)**
(vi) Gas **P** was found to be denser than the form obtained when heating ammonium nitrate.
I. Write an equation for decomposition of ammonium nitrate. **(1 mark)**
II. Explain the difference in densities of two gases. **(1 mark)**

(b) The chart below is used in industrial preparation of Nitric (V) acid.



(i) State the role of heat exchange. **(1 mark)**
(ii) Write the equation in the catalytic chamber. **(1 mark)**
(iii) State the conditions **three** conditions in the catalytic chamber. **(1 ½ marks)**
(iv) State observations made in cooling chamber. **(½ mark)**
(v) Name **one** method of concentrating Nitric (VI) acid obtained. **(1 mark)**
(vi) State uses of Nitric (VI) acid. **(2 marks)**

KASSU JOINT EVALUATION EXAMINATION
233/3
CHEMISTRY
PRACTICAL
PAPER 3

1. You are provided with;
   - Solution **A**, 2M Hydrochloric acid
   - Solution **B**, 0.2M Sodium hydroxide
   - 6 pieces of 2cm length of **magnesium** ribbon.

   You are required to determine the mass of magnesium ribbon that reacted with hydrochloric acid.

PROCEDURE I

i) Using clean measuring cylinder, measure $50cm^3$ of solution **A** into a 100ml glass beaker
ii) Put one piece of **magnesium ribbon** into solution **A** in the 100ml glass beaker and **simultaneously** start the stop watch
iii) Record the **time taken** by magnesium ribbon to get completely finished in the table I.
Repeat procedure (ii) and (ii) using the same solution in procedure (i) adding each piece of solution, M and

RETAIN it for procedure II (5marks)

TABLE I

Magnesium ribbon	1^{st}	2^{nd}	3^{rd}	4^{th}	5^{th}	6^{th}
Time taken(s)						
$\frac{1}{\text{time}}$ (s^{-1})						

a) Plot graph of $\frac{1}{time}$ (vertical axis) against the magnesium ribbon. (3marks)

b) From the graph determine the time that would be taken for 5cm pieces of the ribbon to get completely finished. (2marks)

PROCEDURE II

Transfer all the solution **M** from procedure I into a 250ml volumetric flask. Top up the flask to the mark with distilled water and shake. Label as solution **N.**

- Fill the burette with solution **N.**
- Using a pipette and pipette filler, place $25cm^3$ of solution **B** in a 250ml conical flask. Add 2 drops of phenolphthalein indicator and titrate with solution **N.**
- Record your results in table II. Repeat the titration two more times and complete the table.

TABLE I

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

c) Calculate the; (4marks)
   i) Average volume of solution **N** (1mk)
   ii) Mole of sodium hydroxide, solution **B** used (1mk)
   iii) Moles of hydrochloric acid, solution **N,** used. (1mk)
   iv) Moles of hydrochloric acid in 250$cm^3$of solution **N**. (1mk)
   v) Moles of hydrochloric acid in 50cm^3 of solution **A.** (1mk)
   vi) Moles of hydrochloric acid in solution **A** that reacted with all the pieces of magnesium ribbon. (1mk)
   vii) Mass of magnesium ribbon used in the reacted (Mg = 24) (2mks)

2. You have provided with solid K carry out the test below and record your observation and inferences in the spaces provided.

a) Place all of solid P in a boiling tube. Add 10cm3 of distilled water and shake. Keep the mixture for the test in part (b) below.

b) Divide the mixture from (a) above into 4 portions
   i) To the first portion, add aqueous ammonia drop wise until in excess.
   ii) Dip a clean end of glass rod into the second portion, and place in on a non-luminous flame.
   iii) To the third portion, add four drops of barium chloride solution.
   iv) To the fourth portion, add two drops of acidified potassium manganate (VII) solution

3. You are provided with liquid P. Carry out the following tests. Write your observations and inferences in the spaces provided.
   a) Place about 1cm^3 of solution **P** on a watch glass. Place a burning splint to the solution on the watch glass.
   b) Place about 2cm^3 of solution P in a test tube, add two drops of potassium dichromate (VI)
   c) Place about 2cm^3 of solution P in a 2nd test tube and add bromine water.
   d) To the 3rd portion of 2$cm^3$of solution P; add spatula of sodium carbonate provided.

KASSU JET
233/3
CHEMISTRY
PAPER 3
PRACTICALS
Confidential to schools
In addition to the fittings found in a chemistry laboratory, each candidate will require the following chemicals and apparatus

- Solutions A- 70cm^3 2MHCL
- Solution B- 100cm ^{3}NaOH 0.2
- Pipette
- Pipette filler
- Burette
- 2 labels
- White tile
- Distilled water in wash bottle
- Measuring cylinder 100 ml

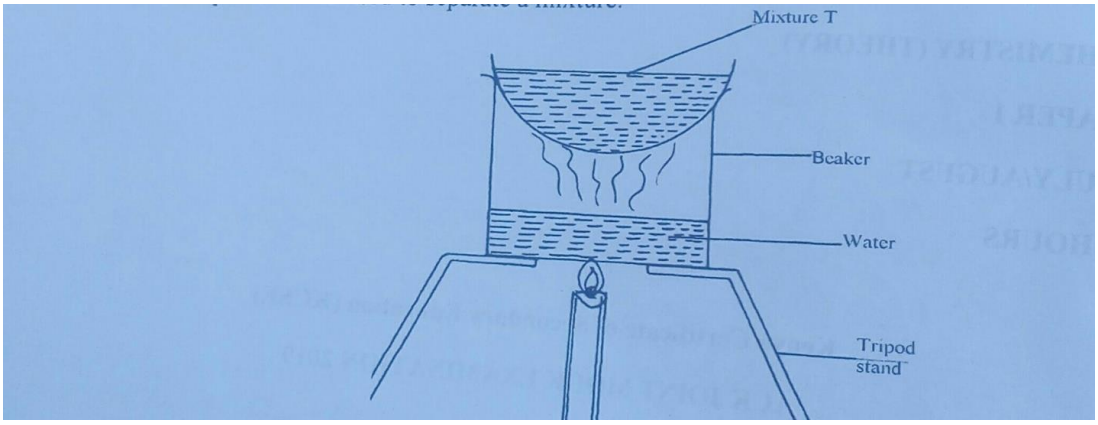
- 250ml volumetric flask
- 2 conical flask (250 ml)
- 6 dry test tubes
- Test-tube holder
- Solid K in a stoppered container - Na_2SO_3
- Liquid P about 20ml in a stoppered boiling tube
- Watch glass
- Glass rod
- 6 pieces of 2cm magnesium ribbon
- Stop watch
- Wooden splint
- About 1g of sodium carbonate
- Measuring cylinder 10ml
- Source of heat

BENCH SOLUTIONS WITH DROPPERS

- 2M aqueous ammonia
- Barium chloride solution
- Potassium manganite 9vii) solution
- Potassium dichromate (vi) solution
- Bromine water
- Phenolphthalein indicator

UASIN GISHU
233/1
CHEMISTRY (THEORY)
PAPER 1

1. An oxide of element G has the formula as G_2O_3.
   a) State the valency of element G. (1mark)
   b) In which group of the periodic table is element G? (1mark)
2. The set-up below was used to separate a mixture.

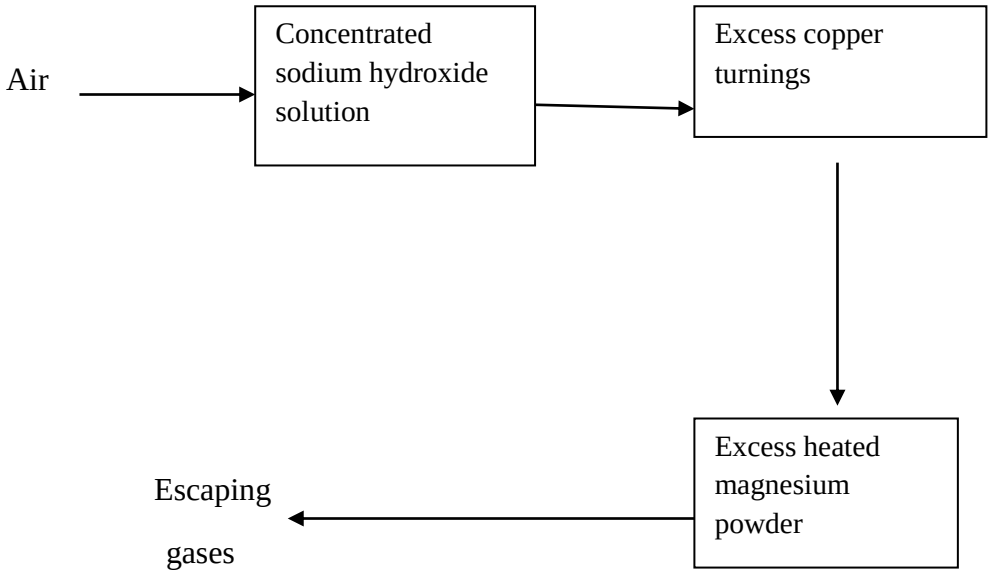


   a) Name the apparatus missing in the set-up. (1mark)
   b) Give one example of the mixture T (1mark)
   c) What is the name of this method of separation? (1mark)
3. Name the process which takes place when:
   a) Solid Carbon (iv) oxide (dry ice) changes directly into gas. (1mark)
   b) A red litmus turns white when dropped into chlorine water. (1mark)
   c) Propane gas molecules are converted into a giant molecule (1mark)
4. The information below gives PH values of solutions V,W,X,Y,Z.

solution	pH values
V	2
W	6.5
X	11
Y	14
Z	4.5

   a) Which solution is likely to be:
      i) Calcium hydroxide? (1mark)
      ii) Rain water? (1mark)
   b) Which solution will react most vigorously with zinc carbonate? (1mark)
5. Explain why very little carbonate(IV) oxide gas is evolved when dilute sulphuric (VI) acid is added to lead (II) carbonate. (1mark)

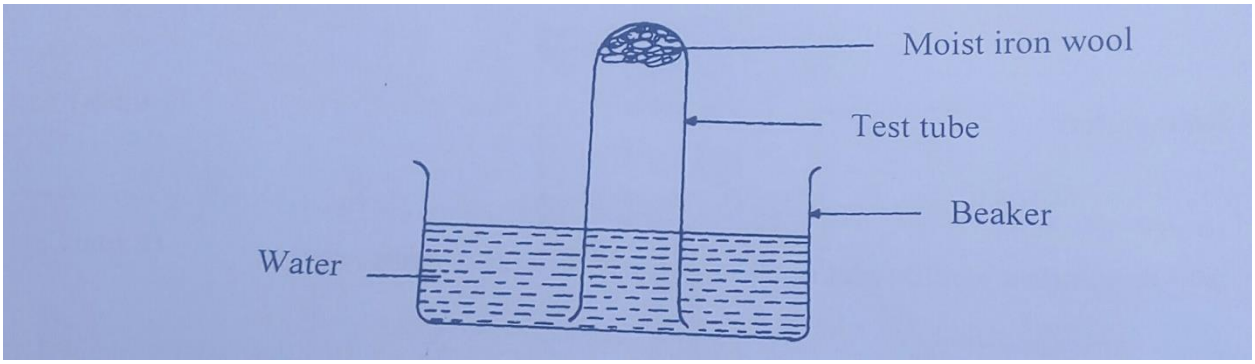
6. Air was passed through several reagents as shown below:



a) Write an equation foe the reaction which takes place in the chamber containing magnesium powder. (1mark)

b) Name one gas which escapes from the chamber containing magnesium powder. Give a reason for your answer. (2marks)

7. The set-up below was used to study some properties of air.



State and explain two observations that would be made at the end of the experiment. (2marks)

8. Below is a list of oxides.
MgO, N_2O, K_2O, CaO and Al_2O_3
Select:-
a) A neutral oxide. (1mark)
b) A highly water soluble basic oxide. (1mark)
c) An oxide which can react with both sodium hydroxide solution and dilute hydrochloric acid. (1mark)

9. a) Hydrogen can reduce copper (II) Oxide but not aluminium oxide. Explain. (1mark)
b) When water reacts with potassium metal, the hydrogen produced ignites explosively on the surface of water.

i) What causes this ignition? (1mark)
ii) Write an equation to show how this ignition occurs (1mark)

10. In an experiment an unknown mass of anhydrous sodium carbonate was dissolved in water and the solution made up to 250cm^3. 25cm^3 of this solution neutralized 20cm^3 of 0.25M nitric acid. Calculate the mass of unknown sodium carbonate used. (3marks)
11. An element M has two naturally occurring isotopes, ^{63}M and ^{65}M. calculate the percentage of each isotope if the relative atomic mass of M is 63.55. (2marks)
12. Carbon and silicon belong to the same group of the periodic table, yet carbon(IV) oxide is a gas while silicon (IV) oxide is a solid with a high melting point. Explain this difference (2marks)
13. The table below gives information about ions T^+ and Z^{2-}.

Ion	**T^+**	**Z^{2-}**
Electron arrangement	2.8	2.8.8
Number of neutrons	12	16

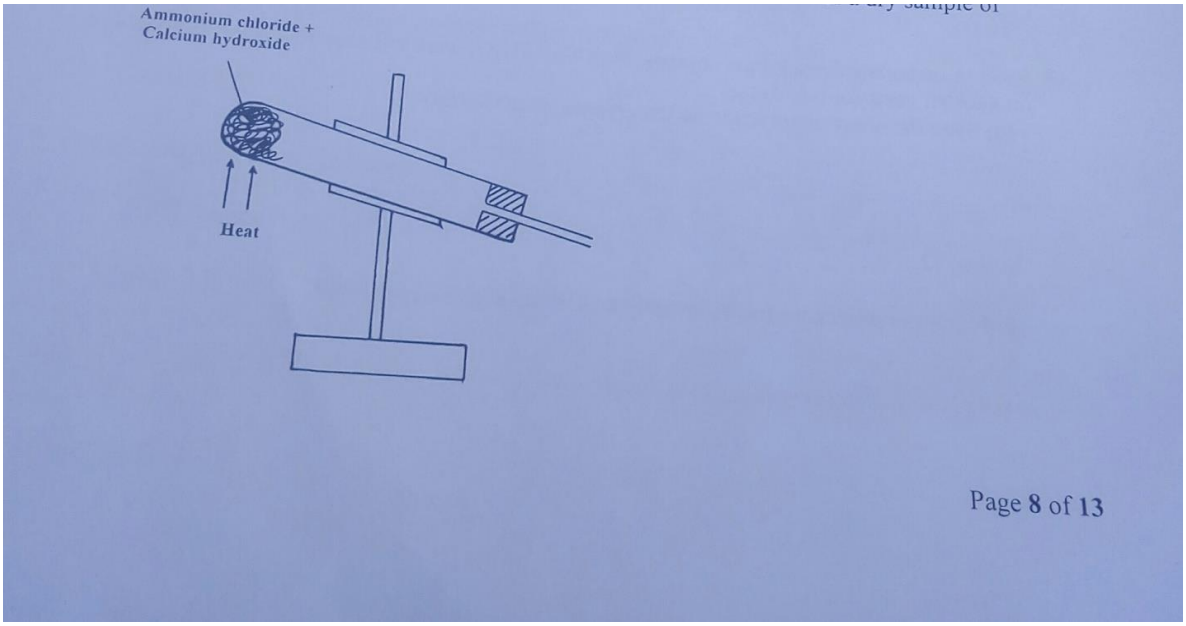
a) Determine the relative formula mass of the compound formed between T and Z. (2marks)
b) State two conditions under which the compound in a) above conduct electricity. (1mark)

14. An ion of oxygen is larger than oxygen atom. Explain. (2mks)
15. a) Work out the oxidation number of phosphorous in H_3PO_3. (1mark)
c) Study the equation below:

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

Which species has undergone oxidation? Explain. (2marks)

16. Starting with lead (II) carbonate explain how you would prepare a pure sample of lead (II) sulphate. (3marks)
17. Draw a dot (**.**) and cross (x) diagrams to show bonding in:-
a) Ammonium ion, NH_4^+ (N=7.0, H=1.0) (1mark)
b) Silane, SiH_4 (Si=14.0 H=1.0) (1mark)
18. Sodium carbonate decahydrate crystals, $Na_2CO_3.10H_2O$, were left exposed in the atmosphere on a watch glass for two days.
a) State the observation made on the crystals after two days. (1mark)
b) Name the property of salts investigated in the above experiment. (1mark)
19. What is meant by the term solubility of salts? (1mark)
b) Calculate the solubility of a salt given that 15g of the salt can saturate 25cm^3 of water. (1mark)
20. a) State the graham's law. (1mark)
b) a 100cm^3 of carbon (IV) oxide gas diffused through a porous partition in 30 seconds. How long would it take 150cm^3 of nitrogen (IV) oxide to diffuse through the same partition under the same conditions? (C=12.0, N=14.0, O=16.0) (2marks)
21. The diagram below represents an in complete set-up for preparation of a dry sample of gas R.



a) Complete the set-up to show how a dry sample of gas R is collected. (2marks)
b) Write a chemical equation for the reactive that produces gas R. (1mark)

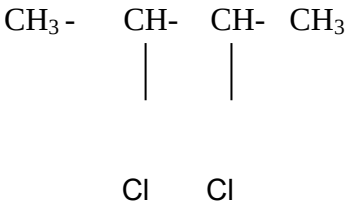
22. When sulphur powder is heated to over 400^0C the following changes are observed:-
At 113^0C it melts into light brown liquid. The liquid then darknes to become reddish- brown and very viscous at 160^0C. Above 160^0C the liquid becomes almost black. Near the boiling point (444^0C) the liquid becomes mobile. Explain these observations. (3marks)

23. A gas cylinder contains about 1.12dm^3 of butane measured at 0^0 and 1 atm.given that 25% of heat is lost, what is the maximum volume of water at room temperature which can be boiled to 100^0C in order to make some coffee?

$C_4H_{10\,(g)} + 6\frac{1}{2}O_{(g)} \longrightarrow 4CO_{2(g)} + 5H_2O_{(l)}$; $\Delta H^{\theta} = -3{,}000 kJmol^{-1}$ (3mks)

(specified heat capacity of water =4.2J $g^{-10}C^{-1}$, density of water 1 gcm^{-3} Molar gas volume 22.4 at s.t.p)

24. a) A compound W reacted with chlorine to form compound X only. The structural formula of X is shown below:



Give the structural formula and name of compound W. (1mark)
c) Draw the structure of 1-chloro-2,2-dimethylpropane. (1mark)

25. Given this reaction; $RNH_2 + H_2O \rightleftharpoons RNH_3^+ + OH^-$ (2marks)

26. In an experiment, soap solution was added to three samples of water. The results below show the volume of soap solution required to lather with 500cm^3 of each water sample before and after boiling.

	Sample 1	**Sample 2**	**Sample 3**
Volume of soap used before water boiled	26.0	14.0	4.0
Volume of soap after water boiled	26.0	4.0	4.0

a) Which water samples are likely to be soft? (1mark)
b) Explain the change in volume of soap solution used in sample 2 (1mark)

27. Study the electrode potentials in the table below and answer the questions that follow:
(Letters are not the actual symbols of elements)

(E^{θ} /Volts)

$H^{2+}_{(aq)} + 2e^- \longrightarrow H_{(s)}$ + 0.34

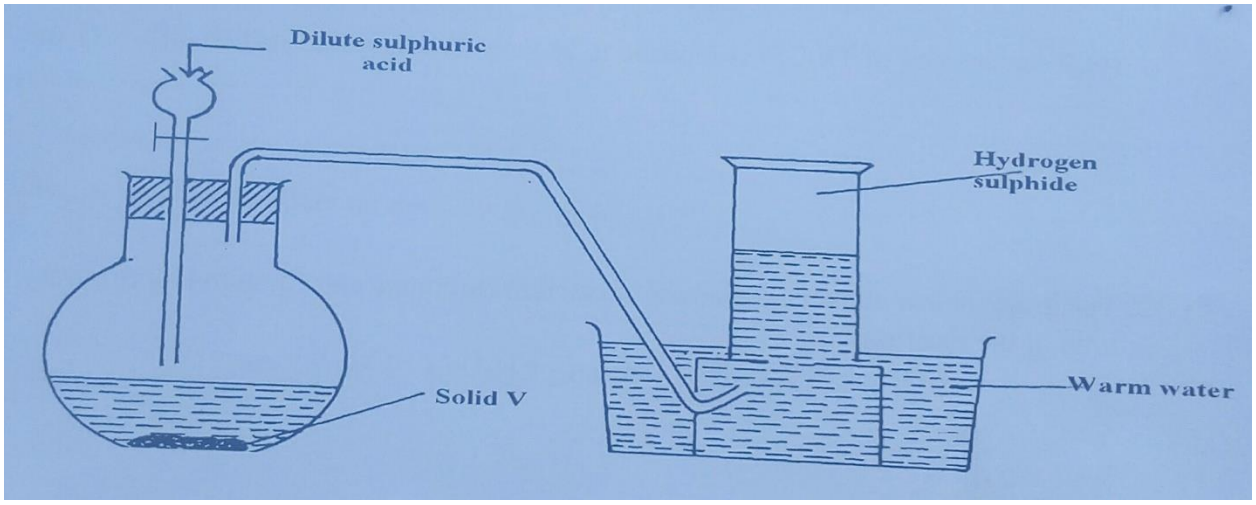
$Z^{2}_{(aq)} + 2e \longrightarrow Z_{(S)}$ – 2.38

$G^{+}_{(aq)}$ 2e- $\longrightarrow G_{(s)}$ +0.80

T^{2+} 2e- $\longrightarrow T_{(s)}$ -2.87

a) Which one is the strongest reducing agent? (1mark)
b) Write the ionic equation for the reaction that takes place when Z is dipped in a solution of G^+ ions. (1mark)
c) Calculate the E^{θ} cell value of the reaction in (b) above. (1mark)

28. The set-up below was used to prepare and collect hydrogen sulphide gas. Study it and answer the questions that follow.



a) Name solid V. (1mark)
b) Write chemical equation of the reaction taking place in the flask. (1mark)
c) Give a reason why warm water is used in the set-up. (1mark)

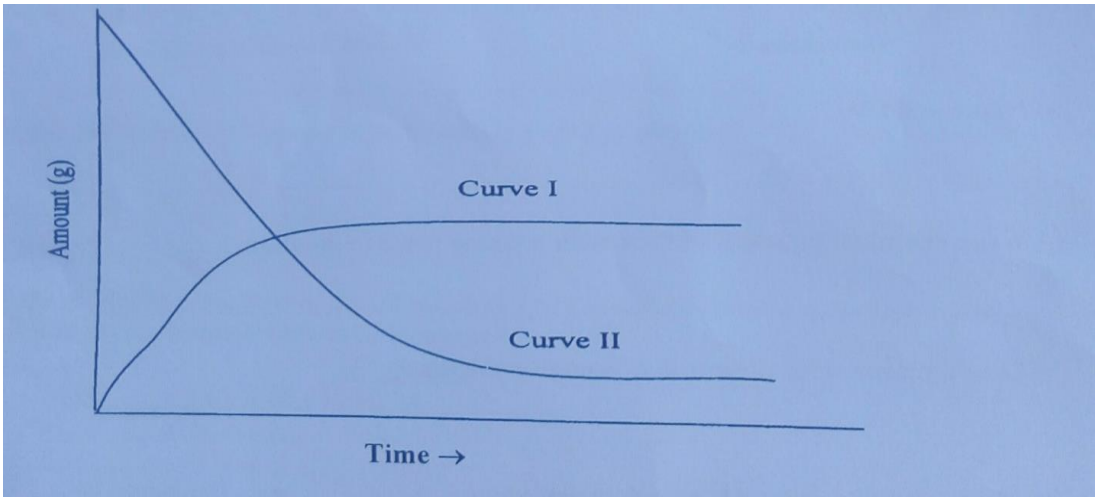
29. The following is a part of uranium decay series.

$$^{238}_{92}U \xrightarrow{\text{step 1}} {}^{234}_{90}Th \xrightarrow{\text{step II}} {}^{234}_{91}Pa \xrightarrow{\text{step III}} {}^{Z}_{A}X$$

a) Which particle is emitted in step I? (1mark)
b) If a beta particle is emitted in step III, find Z and A. (1mark)
c) If the activity of Th-234 is reduced to 25% in 48hours, find its half-life. (1mark)

30. The graph below shows the amount of calcium carbonate and calcium chloride varying with time in the reactions:

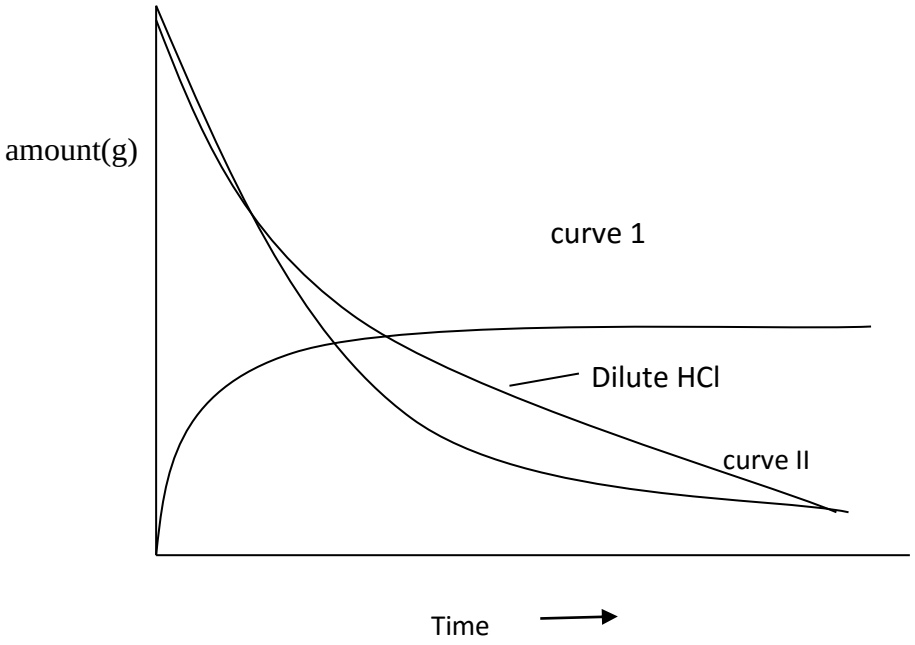
$CaCO_{3(S)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + H_2O_{(g)} + CO_{2(g)}$



a) Which curve shows the amount of calcium chloride varying with time? (1mark)
b) Explain why the two curves become horizontal after a given period of time. (1mark)
c) Sketch on the graph how curve II would appear if the experiment was repeated using a more dilute hydrochloric acid solution. (1mark)

31. Heated iron can react with both chlorine gas and hydrogen chloride gas.
a) Write equations for the reactions. (2marks)
b) Chlorine gas has no effect on dry blue litmus paper. Explain (1mark)

c)



l

31. a) $2Fe_{(s)} + 3Cl_2(g) \longrightarrow 2FeCl_{3(g)}$

$Fe_{(s)} + 2HCl_{(g)} + H_{2(g)}$

N.B: must be balanced

State symbol must be correct

Chemical symbols must be correct

b) in absence of moisture, chlorine cannot form HOCl, chloric (I) acid solution, responsible for its bleaching property.

UASIN GISHU
233/2 Chemistry
Paper 2 (Theory)

1. a) Study the table below and complete it. A & B are not the actual symbols of the elements (2 marks)

Ion	Number of protons	Number of neutrons	Mass number	Electron arrangement of the ion
A^{+2}	12	-	24	-
B^{-2}	-	8	16	-

b) the information below relates to elements in the same period of the periodic table

Element	Atomic radius (nm)	Ionic radius (nm)
C	0.136	0.102
D	0.099	0.134
E	0.181	0.202
F	0.175	0.170
G	0.065	0.076

(i) Which elements are non-metals. (2 marks)

(ii) Which is the most reactive metal. Explain. (2 marks)

(iii) Write the chemical equation for the reaction between element G which is in group VI with potassium metal. (1 mark)

(iv) What type of bond and structure are formed in (iii) above. (2 marks)

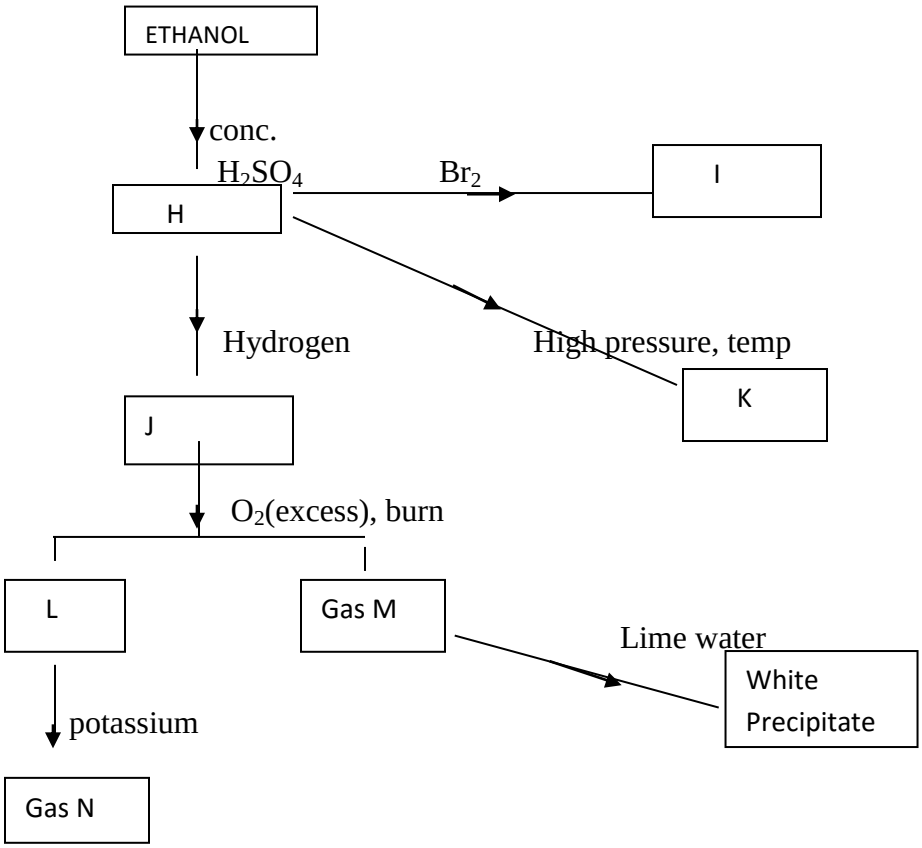
Bond ……

Structure ……

(v) Explain whether or not the compound formed conducts electricity (2 marks)

c) Element F has atomic number 6. Draw a dot-cross diagram of its most stable oxide. (2 marks)

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



a) Identify substances: (4 marks)

b) Write the equation for the formation of:

(i) Substance K (1 mark)

(ii) L and M (2 marks)

(iii) Gas N (2 marks)

c) Substance K was found to have a molecular mass of 42,000. Determine the number of molecules present in the substance. (H=1, C=12) (2 mrks)

d) State:

(ii) the condition necessary for the conversion of ethanol to substance H. (1 mk)

(ii) The catalyst required if J was to be converted to I (1 mk)

3. $50cm^3$ of 0.4M NaOH solution neutralized $20cm^3$ of 0.5M Sulphuric (VI) acid. The data below was collected

Initial temp. of alkali = 26^0C

Initial temp. of acid = 20^0C

Final temp. of the mixture = 27.5^0C

Density of the mixture = $1g/cm^3$

Specific heat capacity of water = 4.2kJ/kg/^{0}C

(i) Calculate the heat change for the reaction that occurs. (2 marks)

(ii) Use the equation below and calculate the number of moles of water formed. (3 marks)

$2NaOH_{(aq)} + H_2SO_{4(aq)} \longrightarrow Na_2SO_{4(aq)} + 2H_2O_{(l)}$

(iii) Calculate the molar heat of neutralization of sodium hydroxide by sulphuric (VI) acid. (2 marks)

(iv) Draw an energy level diagram for the reaction that occurs. (3 mark)

(iv) If ethanoic acid is used instead of sulphuric (VI) acid to neutralize sodium hydroxide, the heat of neutralization would be lower than that obtained in (iii) above. Explain. (2 marks)

4. (a) Write the formula of the complex ion formed in each of the reactions below.

(i) Lead (II) oxide dissolves in hot alkaline solution. (1 mark)

(ii) Zinc hydroxide dissolves in excess ammonia solution. (1 mark)

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

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

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

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

(c) From the redox equation below:

$$Cr_2O_7^{2-}{}_{(aq)} + 3SO_3^{2-}{}_{(aq)} + 8H^+{}_{(a} \rightleftharpoons 2C_r^{3+}{}_{(aq)} + 3SO_4^{2-}{}_{(aq)} + 4H_2O_{(l)}$$

(i) Write the oxidation half equation. (1 mark)

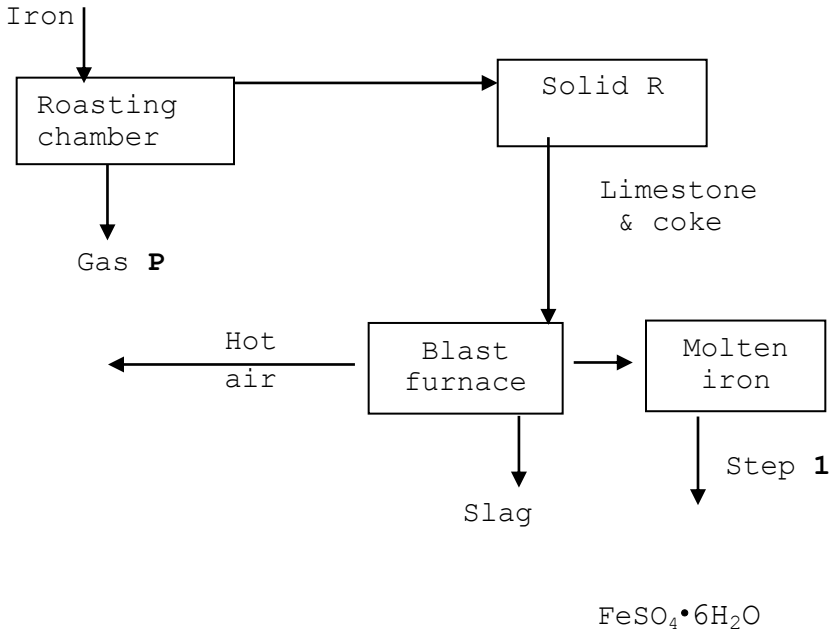
(ii) State and explain the observation that would be made when a solution of sodium hydroxide is added to the equilibrium mixture above. (2 marks)

(d) A certain hydrated salt has the following composition by mass. Iron 20.2%, Sulphur 11.5%, water 45.5% and the rest oxygen. Its relative formula mass is 278.

(i) Determine the empirical formula of the hydrated salt.Fe = 56, S = 52, O = 16, H = 1) (2 marks)

(ii) 3.475g of the hydrated salt were dissolved in distilled water and the total volume made to 125cm^3 of solution. Determine the molarity of the salt solution. (2 marks)

5. The reaction scheme below represents the process of extracting iron metal from one of its chief ores, iron pyrites and preparation of iron (II) sulphate crystals. Study it and answer the questions that follow.



(a) Write an equation for the reaction taking place in the roasting chamber. (1 mark)

(b) Name:
(i) Gas P (1 mark)
(ii) Solid R (1 mark)
(c) Explain how carbon (II) oxide used to reduce the oxide to iron metal is obtained. (2 marks)
(d) Write an equation for the reaction in which iron is formed. (1 mark)
(e) Due to the high temperature in the blast furnace, limestone decomposes to carbon (IV) oxide and quick lime. Explain the importance of quick line in this process and give an equation. (2 marks)
(f) Explain how crystals of Iron (II) Sulphate can be obtained in Step 1 starting with iron metal in the form of filings. (2 marks)

6. The table below gives information about stand and electrode potentials (E^{ϑ}) of elements 12, 13, 14, 15, 16 and 17.

Reaction	E^{ϑ}**(volts)**
$12^{2+}_{(aq)} + 2\bar{e} \longrightarrow 12_{(s)}$	+ 0.34V
$13^{2+}_{(aq)} + \bar{e} \longrightarrow 13_{2(g)}$	0.00
$14^{2+}_{(aq)} + 2\bar{e} \longrightarrow 14_{(s)}$	− 0.14
$15^{2+}_{(aq)} + 2\bar{e} \longrightarrow 15_{(s)}$	− 0.44
$16^{2+}_{(aq)} + 2\bar{e} \longrightarrow 16_{(s)}$	− 2.71
$17^{+}_{(aq)} + \bar{e} \longrightarrow 17_{(s)}$	− 2.92

(a) From the table select:
i) The element that is likely to be hydrogen. Give a reason. (2 marks)
ii) The strongest reducing agent. Explain. (2marks)
iii) The strongest oxidising agent. Explain. (2 marks)
iv) Two elements which when connected would give the highest e.m.f. (1 mark)
(b) (i) In the space below draw a well labelled diagram for a cell that would be formed from the pair of elements selected in b(iv) above. (2 marks)
(ii) Calculate the e.m.f of the cell constructed above. (2 mark)
(c) State the Faraday's law of electrolysis (1mark)

7. (I) A metal carbonate, MCO_3 was reacted with 0.5M dilute hydrochloric acid. 3 g of the granular carbonate were used with excess acid. The masses of the beaker with the contents were recorded at various times. The total loss in the mass was calculated and recorded in the table below.

Total loss in mass(Kg)	0	0.008	0.37	0.90	1.19	1.28	1.32	1.32
Time(min)	0	0.5	1	1.5	2	2.5	3	3.5

a) There is continuous loss of mass of the reaction mixture. Explain why this happens (1mark)
b) i) In which two ways can the reaction be made faster. (2marks)
ii) On the same grid sketch, graphs of total loss in mass (g) against (mins) before and after the changes in b(i) above. (1mark)
iii) Write an equation for the reaction that takes place. (1mk)

II) The table below gives the solubilities of potassium bromide and potassium sulphate at $0^{o}C$ and $40^{o}C$.
When an aqueous mixture containing 60g of potassium bromide and 7g of potassium sulphate in 100g of water at $40^{o}C$ was cooled to $0^{o}C$ some crystals were formed.
a) Identify the crystals formed. (1 mark)
b) What is the mass of the crystals formed. (2 marks)

UASIN GISHU
FORM 4

PAPER 3 (233/3)
CHEMISTRY (PRACTICAL)
QUESTION 1

You are provided with:
- Solid A 5.0g $(COOH)_2.\times H_2O$
- Solution B 0.13M $KMnO_4$

Task
a) You are supposed to determine the solubility of A at different temperatures.
b) Determine the number of moles of water of crystallization in solid A.

PROCEDURE 1
a) Using a burette, add 4cm3 of distilled water to solid A in a boiling tube.
- Head the mixture while stirring with the thermometer to about 80^0C.
- When the whole solid dissolves, allow the solution to cool while stirring with the thermometer
- Note the temperature at which crystals first appear and record this temperature in the table 1 below.

b) Using aburrete add $2cm^3$more into the content of the boiling tube and warm until the solid dissolve.
- Remove from the flame and allow the solution to cool in air while stirring.
- Record the temperature at which crystal first appear in table 1.
- Repeat procedure (b) 3 more times and complete table 1 below.
- Retain the content of the boiling tube for procedure II

Table 1

Volume of water in the boiling tube (cm^3)	**Temperature at which crystals of solid A appear (^0C)**	**Solubility o solid A g/100g of water**
4 6 8 10 12		

I. a) Draw a graph of solubility of solid A (vertical axis) against temperature (3mks)
b) From your graph determine the solubility of solid A at 60^0C (1mk)

PROCEDURE II
a)
- Transfer the contents of the boiling tube into a 250ml volumetric flask.
- Add distilled water up to the mark
- Label this solution A

b) Using a clean pipette and a pipette filler, transfer 25ml of solution A into a conical flask.
- Warm the mixture up to 60^0C
- Fill a burette with solution B
- Titrate B against the hot solution A until a permanent pink colour persist
- Read your results in Table 2 below

c) Repeat (b) 2 more times are record your results in the table 2 below.

TABLE

	I	**II**	**III**
FINAL BURETTE READING			

INITIAL BURETTE READING			
VOLUME OF SOLUTION B USED (CM^3)			

II) a) Calculate the average volume of solution B used (1mk)
b) Calculate the number of moles of B used (1mk)
c) Given 2 moles of $Kmno_4$ react with 5 moles of A, calculate the number of moles of A in $25cm^3$ (1mk)
d) Calculate the molarity of A (1mk)
e) Determine the molar mass of A (1mk)
f) Determine the value of X (1mk)
(C=12, O=16 H=1)

QUESTION 2

You are provided with solid C. Use it to carry the test below.
Dissolve the whole of C into 10cm3 of water and divide it into five portions.

a) To the 1st portion add sodium sulphate solution.

Observations	**Inferences**
(1mk)	(1½mks)

b) To the 2nd portion add Ammonia solution dropwise until in Excess.

Observations	**Inferences**
1mk)	1mk

c) To the 3rd portion add sodium Hydroxide dropwise until in Excess.

Observations	**Inferences**
(1mk)	(1mk)

d) To the forth portion add Lead (II) Nitrate solution

Observations	**Inferences**
(½mk)	(2mks)

e)To the last portion add Barium Nitrate solution

Observations	**Inferences**
(1mk)	(1mk)

QUESTION 3

You are provided with liquid D use it to carry the test below.
Divide liquid D into four equal portions

a) To the 1st portion add sodium hydrogen carbonate

Observations	**Inferences**

(1mk)	(1mk)

b) To the 2nd portion add acidified potassium manganite (VII) ($KmnO_4$)

Observations	**Inferences**
(1mk)	(1mk)

c) To the 3rd portion add Bromine water

Observations	**Inferences**
(1mk)	(1mk)

d) To the last portion add potassium dichromate(VI0 and wrm.

Observations	**Inferences**
(1mk)	(1mk)

UASIN GISHU
CHEMISTRY
FORM FOUR PAPER 3 (233/3)
(CONFIDENTIAL)

In addition to the equipment and fittings found in a chemistry laboratory. Each candidate should be provided with;

1. Solid A 5.0g measured accurately
2. About $80cm^3$ of solution B
3. About 0.5g solid C
4. About $10cm^3$ of liquid D
5. A thermometer (-10-110^0C)
6. A burette
7. A complete retort stand
8. A pipette and a pipette filler
9. 2 conical flasks
10. A 250ml volumetric flask
11. One boiling tube
12. Five (5) test tubes
13. 0.5g sodium hydrogen carbonate
14. Two labels

ACCESS TO:

i) Means of heating (Tripond stand and wire gauze)
ii) Sodium sulphate solution ($NaSO_4$)
iii) Ammonia solution 2m
iv) 2m Sodium Hydroxide
v) Lead Nitrate solution

vi) Barium Nitrate solution
vii) Acidified potassium manganite (VII) solution
viii) Bromine water
ix) Acidified potassium dichromate (VI) solution

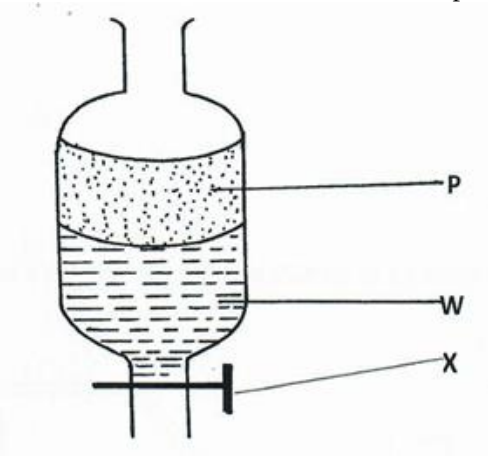
NB: i) Solid A is 5.0g of oxalic acid $(COOH)_2\ 2H_2O$
ii) Solution B is $Kmno_4$
iii) Solid C is magnesium chloride $MgCl_2$
iv) Liquid D is absolute ethanol

Preparations

i) Solution B is made by dissolving 20g of solid Kmno4 in $200cm^3$ of 2.0m H_2SO_4 and toping to $1000cm^3$ by distilled water.
ii) Sodium Hydroxide is prepared by dissolving 80g of NaOH pellets in 600cm3 of distilled water and top to $1000cm^3$ with distilled water.
iii) Ammonia solution is prepared by dissolving 150ml of conc ammonia to $600cm^3$ of distilled water then top to the mark.
iv) Barium Nitrate is prepared by dissolving 26g of solid Barium Nitrate in $600cm^3$ of water then topping to $1000cm^3$ with distilled water.
v) Lead nitrate is prepared by dissolving 30g of solid Lead Nitrate in $600cm^3$ of water then topping to $1000cm^3$ with distilled water.
vi) Sodium Sulphate is prepared by dissolving 14.2g of solid sodium sulphate in $600cm^3$ of distilled water then topping up to $1000cm^3$ with distilled water.
vii) Acidified $Kmno_4$ is prepared by dissolving 3.2g of solid $Kmno_4$ in $200cm^3$ of 2.0m H_2SO_4 acid then topping with distilled water to $1000cm^3$.
viii) Acidified $K_2Cr_2O_7$ is prepared by dissolving 25g of solid $K_2Cr_2O_7$ in $200cm^3$ of 2.0m H_2SO_4 then topping to $1000cm^3$ with distilled water.

KIRINYAGA ESAT.
233/1
CHEMISTRY
PAPER 1
(THEORY)

1. Name two apparatus used in a chemistry laboratory to give accurate volume measurements (2marks)
2. A mixture of kerosene and water was shaken and left to separate as shown in the diagram below

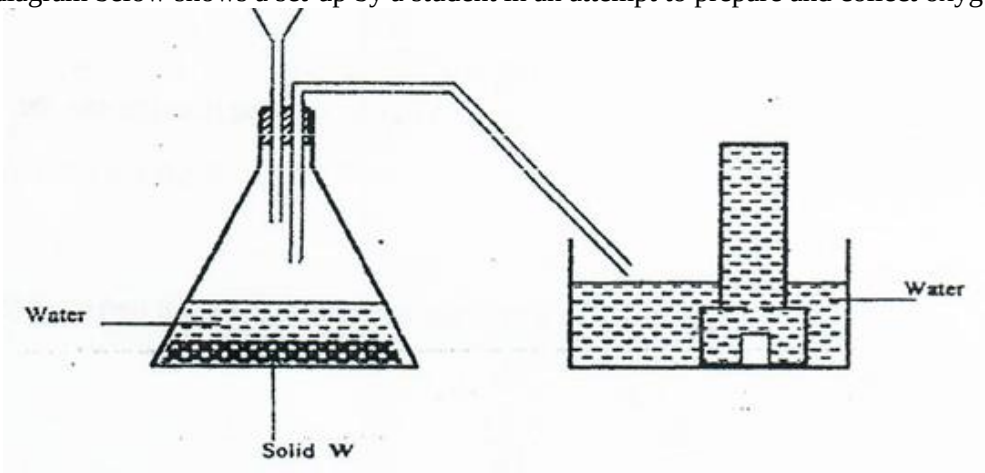


(a) State two physical properties that makes it possible to separate the two liquid as shown above (1mark)
(b) State the identity of liquid P (1mark)
(c) Name the apparatus shown above (1mark)

3. Complete the table below (3mark)

Metal	**Aluminium**	**Lead**	**Copper**
Chief ore	**Bauxite**		
Method of extraction		Reduction	
Reason for given method of extraction		Low in reactivity series thus reduced by coke or carbon	

4. Study the information given below and answer the question that follow
   Red dye is more soluble than green, green is more soluble than yellow. Whereas blue is the least soluble. Represent the four dyes on a round paper chromotagram. Label the origin and solvent front. (3mark)
5. The diagram below shows a set-up by a student in an attempt to prepare and collect oxygen gas.

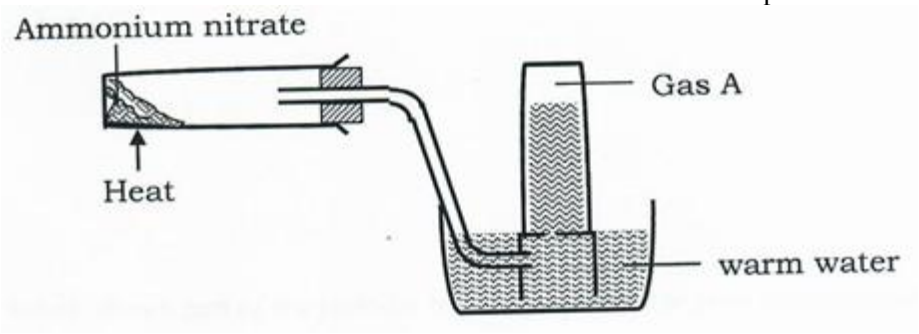


(a) Complete the diagram correcting the mistakes on it (1mark)
(b) Write an equation for the reaction taking place to produce oxygen (1mark)
(c) Give one use of oxygen (1mark)

6. (a) State the chemical name of rust (1mark)
(b) Two iron nails were coated with zinc and copper as shown below (1mark)

State and explain what was observed on each nail (2mark)

7. A mixture of ammonium nitrate was heated as shown in the set up below



(i) Identify gas A (1mark)
(ii) Write the equation of the reaction that takes place when gas A is passed over heated copper (1mark)
(iii) Give one physical property of gas A. (1mark)

8. (a) What is a fuel? (1mark)
(b) State two factors that influence the choice of fuel for domestic use (2mark)

9. (a) Use the standard reduction potentials for elements P, Q, R, S and T given below to answer the questions that follow. (The letter do not represent the actual symbols of the elements)

	E^0 (Volts)
$P_{(aq)} + 2e \rightleftharpoons P_{(s)}$	-2.90
$Q^{2+}_{(aq)} + 2e \rightleftharpoons Q_{(s)}$	-2.36
$R^{+}_{(aq)} + e \rightleftharpoons \frac{1}{2} R_{2\,(g)}$	0.00
$S^{+}_{(aq)} + 2e \rightleftharpoons S_{(s)}$	+0.33
$\frac{1}{2} T_{2\,(g)} + e \rightleftharpoons T_{2\,(g)}$	-2.86

(i) Which element is likely to be hydrogen (1/2 mk)
(ii) What is the E^0 value of the strongest reducing agent? (1/2mk)
(iii) Select two half cells that would give the highest e.m.f and work out its value. (2mark)

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

			A			B	C	D	
E	F		G						
							H		
I									

(a) Give the name of the family to which element F belong (1/2 mk)
(b) Identify an element which forms a stable divalent anion (1/2 mk)
(c) using dot (.) and cross (x) diagram, show the bonding in the compound formed between E and C (2 marks)

11. The relative atomic mass of an element is 10.28, it has two isotopes
$10_{5}R$ and $11_{5}R$
Calculate the relative percentage abundance of each isotope (3marks)

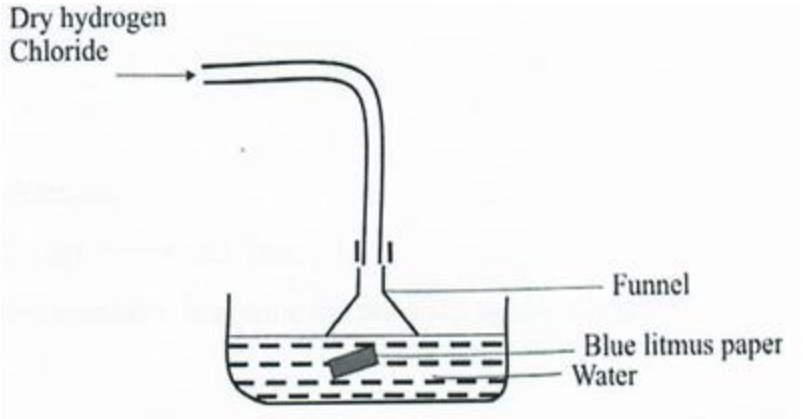
12. (a) State Grahams Law (1mark)
(b) $60cm^3$ of oxygen gas diffused through a porous partition in 50 seconds. How long will it take 120 cm^3 of sulphur (IV) oxide gas to diffuse through the same partition under the same conditions. (S = 32, O = 16)

13. Describe how a solid mixture of Zinc sulphate and lead (ii) sulphate can be separated into solid samples (3 marks)

14. Draw and name all the structural isomers of formula C_4H_{10} (3 marks)

15. (a) What is half-life? (1 mark)
(b) If a radioactive isotope has a half-life of 2.5 hours, how long will it take for its mass to reduce to 1/8 (2 marks)

16. Dry Hydrogen Chloride gas was made to dissolve in water using the set of apparatus shown below.



(a) What is the use of the inverted funnel? (1 mark)
(b) State and explain the observations made on the litmus paper (1 mark)
(c) State and explain the observation made on the litmus paper if methylbenzene is used instead of water in the above set up. (1mark)

17. Name one property of neon that makes it possible to be used in electric lamps. (1 mark)
18. Use the thermo chemical equations below to answer the questions that follow.

$$C_2H_2 + \frac{7}{2}(g) \rightarrow 2CO_{2(g)} + 3H_2O(l) \quad \Delta H = -1560 KJ/MOL$$

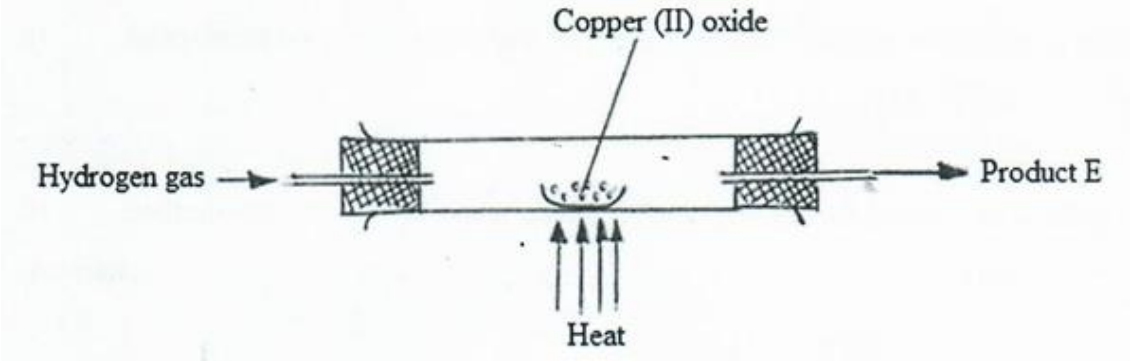
$$C_s + O_2(g) \rightarrow CO_2(g) \quad \Delta H = -394 KJ/MOL$$

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(g) \quad \Delta H = -394 KJ/MOL$$

(i) Draw an energy cycle diagram to the enthalpy of formation of ethyne (1 ½ marks)
(ii)Calculate the enthalpy of formation of ethyne (1 ½ marks
19. For the reaction
Cl_2 (g) + $2I^-$ (aq) ⟶ 2 Cl^- (aq) + I_2(s)

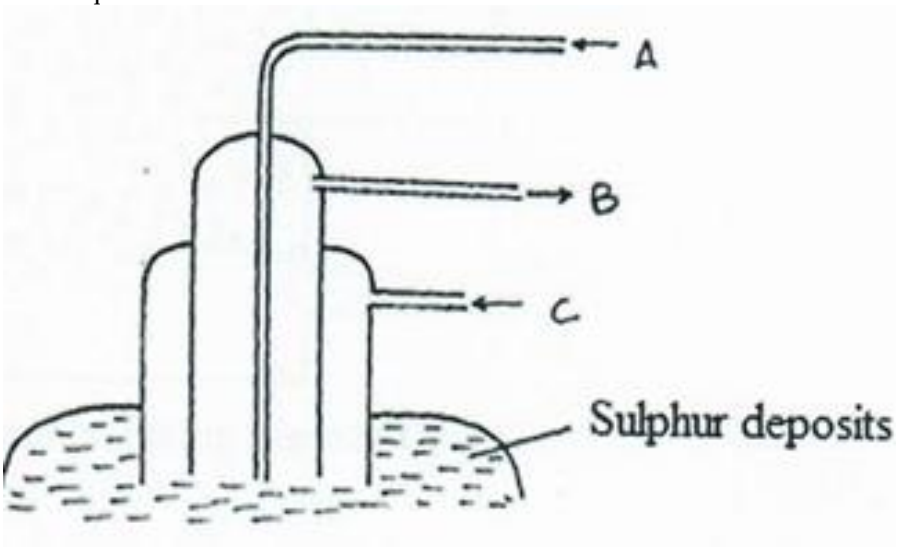
Use oxidation numbers determine the reducing agent (2 marks)

20. (a) Complete the nuclear equation below (1 mark)
$^{226}_{88}Q \longrightarrow {}^{222}_{86}P +$…….
(b) State two uses of radioisotopes in health (2 mks)
21. In an experiment hydrogen gas was passed over heated copper (ii) oxide as shown in the diagram below



(a) Write the equation for the reaction taking place in the combustion tube (1 mark)
(b) What property of hydrogen is demonstrated in this experiment (1 mark)
(c) Give one use of hydrogen (1 mark)

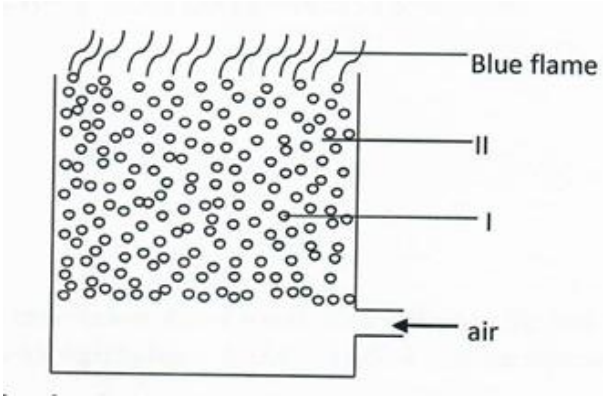
22. The diagram below shows the set up used to extract Sulphur from the underground deposits. Study it and answer the questions that follow



(a) Name the above process (1 mark)
(b) Name the substance that passes through A and C (1 mark)

23. Give the name of the following process that occur when the given salt is exposed to air
(a) Anhydrous copper (II) sulphate becomes wet and changes colour from white to blue (1 mark)
(b) Sodium carbonate – 10 water changes from transparent crystals to a white powder. (1 mark)
(c) A red litmus paper turns white when dropped into chlorine water (1 mark)

24. The diagram below represents a charcoal burner. Study it and answer the questions that follow



(i) Write an equation for the reaction taking place at I and II (1 mark)
(ii) What safety precaution should be taken when using the charcoal burner (1 mark)

25. (i) Starting with calcium oxide, describe how a solid sample of calcium carbonate can be prepared in the laboratory. (3 marks)
(ii) State one use of calcium oxide (1 mark)

26. (a) A Gaseous hydrocarbon contain 80% carbon by mass. Determine it empirical formula (C=12, H=1) (1 ½ marks)
(b) Given that 0.3g of the hydcarbon occupy a volume of 224cm^3 at s.t.p, determine, its molecula formula (C=12,H=1) Molar gas volume at s.t.p dm^3

27. The table below shows results obtained when the first four halogens of the periodic table were reacted with their halides. A Cross (x) shows no reaction and a tick (√) a reaction occurred.

Halogens	Halide ions			
	A	B	C	D
A		X	X	X
B	√		X	X
C	√	√	X	X
D	√	√	X	

(i) Which halide ion is the strongest agent (1 mark)
(ii) Arrange the halogens in order of reactivity starting with reactive (2marks)

28. Complete the table below on properties of some substances when testes with various commercial indicators.

Solution of;	**Indicator**	**Colour of indicator in the solution**	**pH**	**Strong acid or base**
Sodium hydroxide	Litmus	Blue	13	Strong base
Nitric(v) acid	Methyl orange		12	
Calcium hydroxide	Phenolphthalein		10	

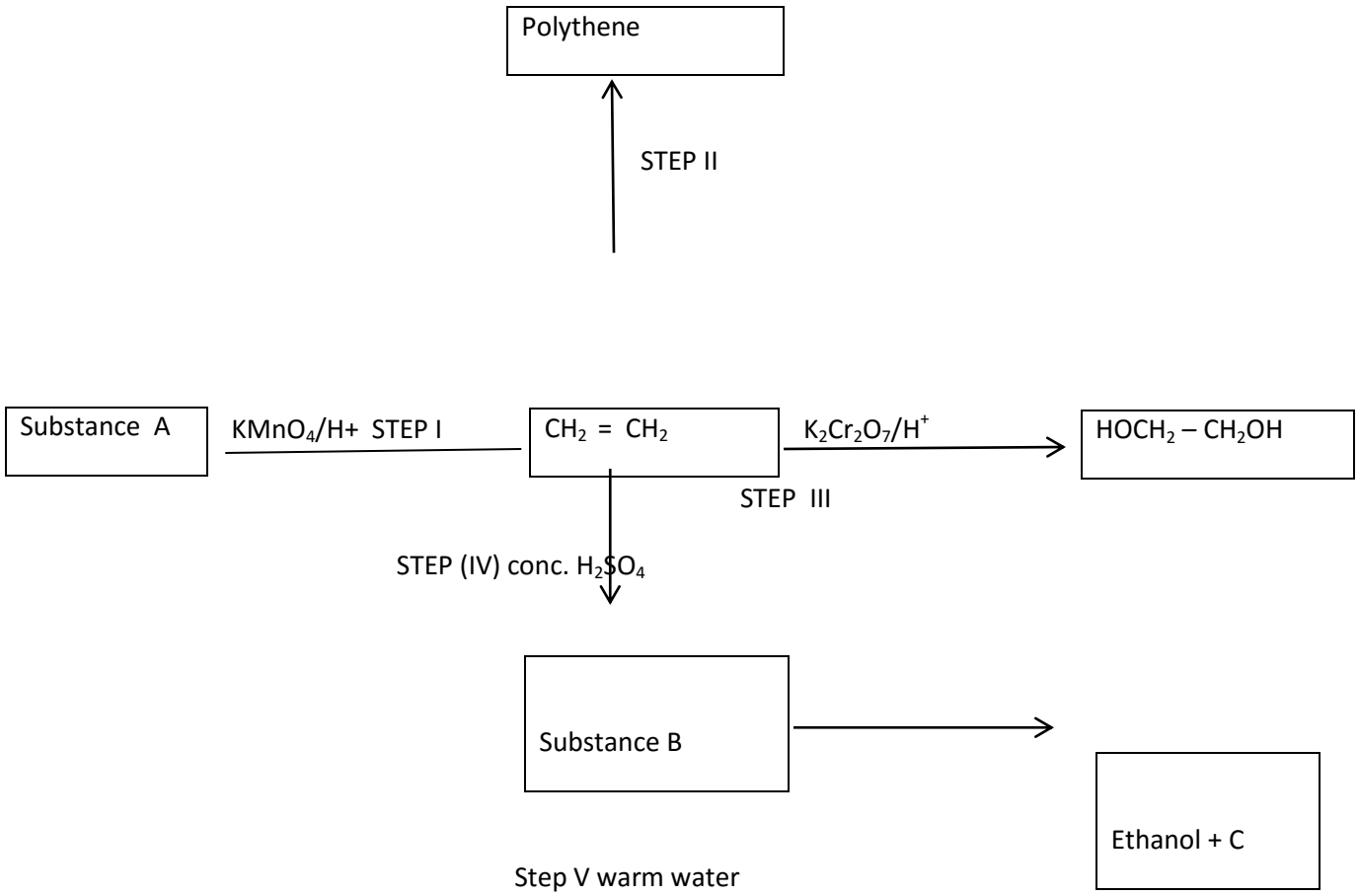
STRATEGIC SCHOOLS ALLIANCE EXAMINATION KIRINYAGA ESAT.
233/2
CHEMISTRY
PAPER 2
(THEORY)

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

Formula of ion	Electron arrangement
E^{2+}	2
D-	2.8
C-	2.8.8
B^{3+}	2.8
A^{2+}	2.8

a) i) Select a pair of elements found in the same group of the periodic table (1mk)
ii) For the pair of elements selected, compare their relative reactivities. Explain (2mks)
b) What is the family name to which element A belong (1mk)
c) Giving reasons compare the atomic radius and ionic radius of element C (2mks)
d) i) Write the formula of the compound formed when B and C react? (1mk)
ii) What type of bond is formed in the above compound? (1 mk)
e) Using dot (.) and cross (x) to represent elections draw the structure of compound formed when A and D react. (2mks)

2 The diagram below is a scheme of reactions starting with ethene. Study it and answer the questions that follow.



a) i) Name the type of reaction in step I (1mk)
ii) State and explain the observations made in step I (2mks)
iii) State one use of substance A (1mk)

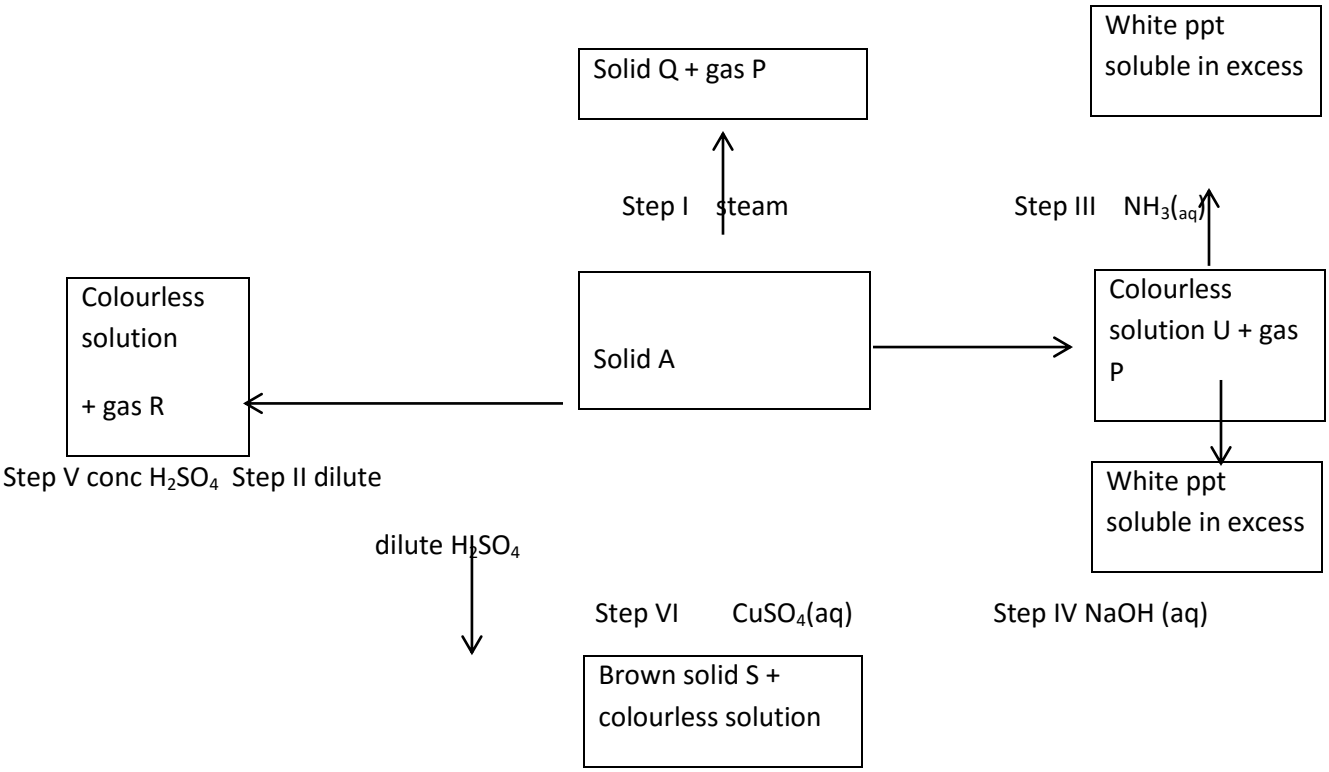
b) Name the process in step II and state the conditions for the same process
– Process
– Condition (2mks)

c) What observation is made in step III (1mk)

d) Name i) substance B (½ mk)
ii) The type of reaction represented by V (½ mk)

e) i) What name is given to the process in which crude oil is separated into its components (1mk)
ii) Give one use of the following components
I kerosene ½ mk
II Bitumen ½ mk

3 Study the scheme below and answer the questions that follow



a) Identify:
   i) Solid A
   ii) Solid Q
   iii) Gas P
   iv) Gas R
   v) Solid S
   vi) Cation present in colourless solution U (3mks)

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

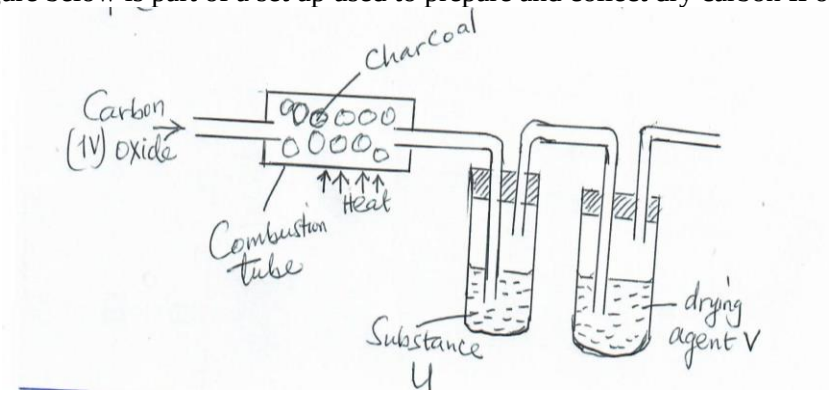
c) What property of the cation illustrated by reaction in step III and IV? (1mk)

d) Explain the difference in the reactions of solid A in step II and step V (2mks)

e) i) Name two compounds responsible for permanent hardness of water (1mk)
   ii) Explain how ion-exchange resins remove permanent hardness in water. (2mks)

4 a i) What name is given to different forms of an element which exist in same physical state (1mk)
   ii) Give two crystalline forms of carbon (1mk)

b) The figure below is part of a set up used to prepare and collect dry carbon II oxide from carbon IV oxide



i) Complete the diagram to show how dry carbons II oxide is collected (1mk)

ii) Identify

I) Substance U and state its use (2mks)

II) Drying agent Y (1mk)

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

iv) Carbon(ii) oxide is a major environmental pollutant.

I) Give one major source of carbon II oxide in the atmosphere (1mk)

II) Explain how carbon II oxide causes poisoning (1 mk)

c) State one use of carbon (ii) oxide (1mk)

5 The table below shows the volume of hydrogen gas produced when 2.0g of zinc granules reacted with $100cm^3$ of 2M hydrochloric acid HCL

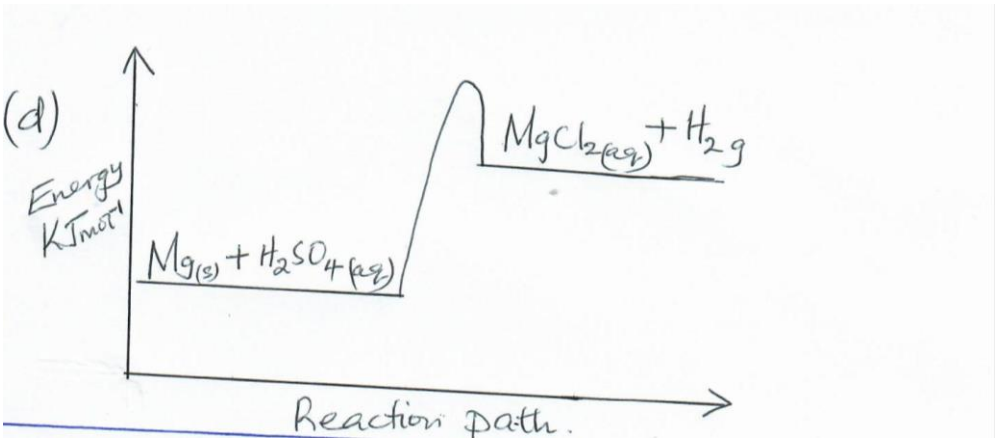
Time (min)	0	0.5	1	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
Volume(cm^3) H_2 gas	0	10	18	24	28	31	34	37	38	39	40	40	40

a) On the graph paper provided, plot the graph of hydrogen gas (Y-axis against time. (3mks)

b) From the graph determine the rate of reaction at t=3 minutes (2mks)

c) On the same axes, draw a sketch graph for the reaction between 2.0g of zinc and 1MHCL and label it curve II (1mk)

d) The energy level diagram shows a reaction profile for magnesium and dilute sulphuric VI acid.



e) Carbon (II) oxide reacts with steam to form carbon (IV) oxide and hydrogen according to the equation below.

$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2O_{(g)}$ H = +ve

State and explain the effect of:

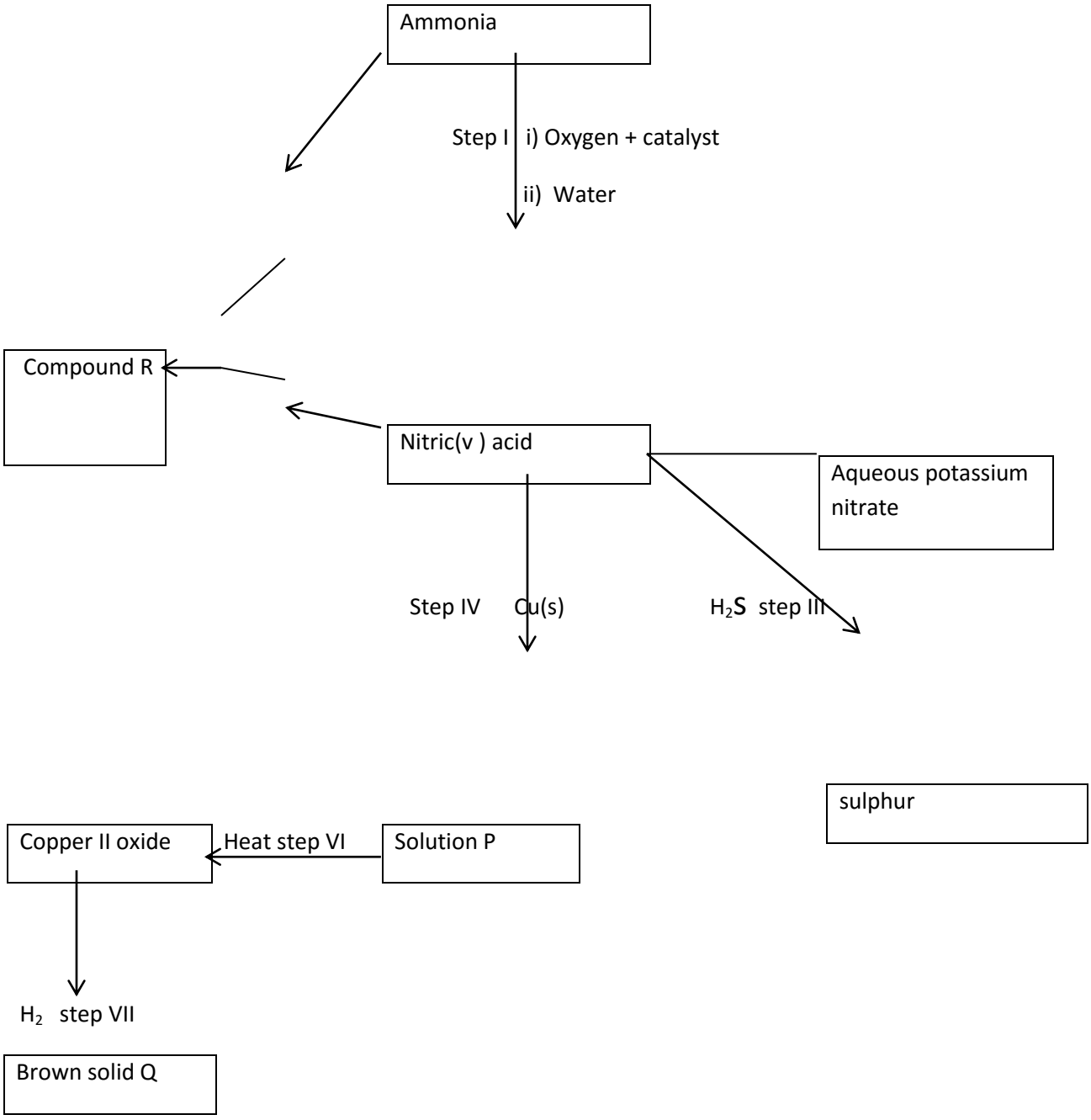
i) Increasing the amount of steam in the mixture (1mk)

ii) Increasing the pressure of the system (1mk)

i) Is the reaction exothermic or endothermic? Explain. (1mk)

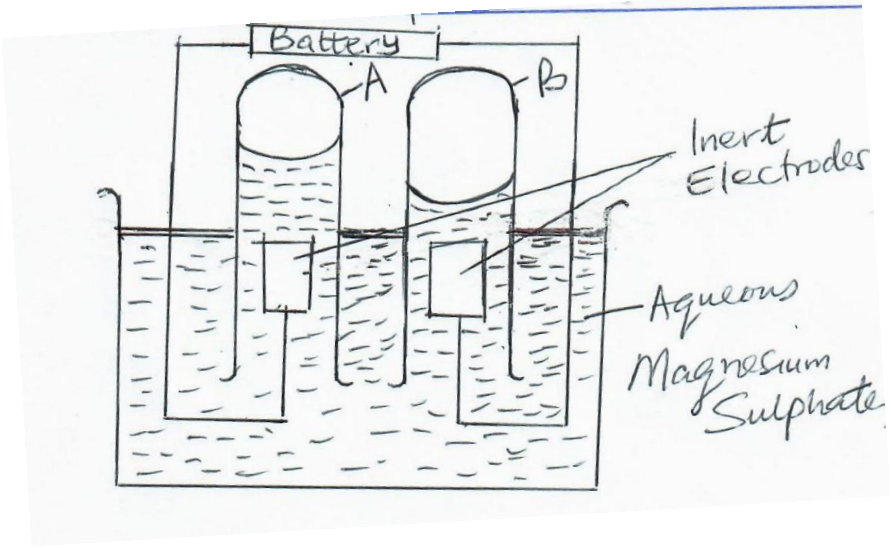
ii) On the diagram show the activation energy (1mk)

6 The scheme below shows various reactions starting with ammonia. Study it and answer the questions that Follow.



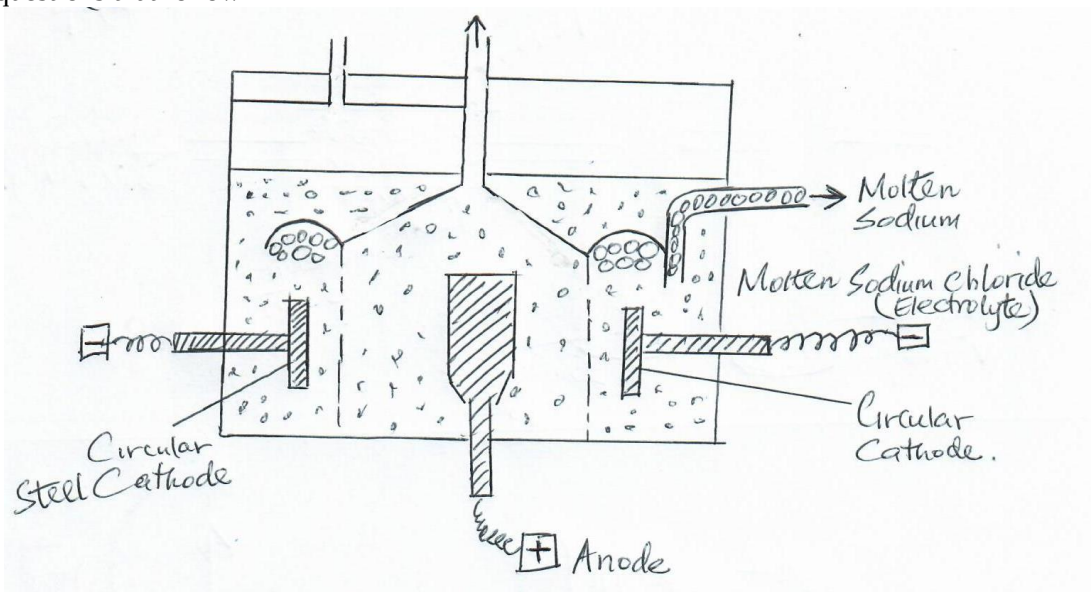
a) Name:
   i) Compound R (1mk)
   ii) Solid Q (1mk)
   iii) Catalyst used in step I (1mk)
   iv) Process taking place in step II (1mk)
b) i) What property of nitric (V) acid is demonstrated in step III (1mk)
   ii) State the precaution to be taken when carrying out reaction in step III? Give a reason (1mk)
c) Write an equation for the reaction in step VII (1mk)
d) i) Give one use of compound R (1mk)
   ii) Calculate the percentage of nitrogen by mass in compound R (N=14, H=1, 0= 16) (1mk)
e) State one commercial use of Nitric (V) acid apart from making nitrogenous fertilizers (1mk)

7 a) What is an electrolyte (1mk)
   b) The diagram below shows a set up used to electrolyse aqueous magnesium sulphate.



   i) What is meant by inert electrodes? Give an example (2mks)
   ii) During electrolysis process in the above experiment the volume of gas collected in test tube B was found to be twice that collected in test tube A. Explain these observations (2mks)
   iii) Describe a chemical test for gas in test tube B (1mk)
   iv) During electrolysis a current of 1.5 amperes was passed through the electrolyte for 42 minutes 53 seconds. Calculate the volume of gas collected in test tube A. (1 faraday = 96500 C; molar gas volume = 24.0 dm^3 at r.t.p) (3mks)
   v) State one use of electrolysis (1mk)

8 a) Below is a simplified diagram of Down's cell used for manufacture of sodium metal. Study it and answer the questions that follow



i) What material is the anode made up of? Explain (2mks)
ii) What precaution is taken to prevent chlorine and sodium form recombining? (1mk)
iii) Write an ionic equation for the reaction which occurs at the cathode. (1mk)
b) During this extraction process, calcium chloride is usually added to the electrolyte (molten sodium chloride) Give a reason for this (2mks)
c) Why is sodium collected at the top of the cathode? (1mk)
d) Explain why aqueous sodium chloride is not used for manufacture of sodium by Dawn's process. (2mks)
e) State one use of sodium metal (1mk)

STRATEGIC SCHOOLS ALLIANCE EXAMINATIONKIRINYAGA ESAT.
CONFIDENTIAL
233/3
CHEMISTRY
PAPER 3
(PRACTICAL)
JULY/AUGUST, 2019

INSTRUCTIONS TO SCHOOLS

In addition to the apparatus and the fittings found in a Chemistry laboratory, each candidate will require the following.

1 1.0g of solid A weighed accurately and supplied in a dry stoppered container
2 about 60cm^3 of solution B
3 about 130cm^3 of 0.1M sodium hydroxide solution
4 One thermometer
5 One stop watch/clock
6 One 100ml beaker
7 One burette 0 – 50 ml

8 One pipette 25ml
9 One volumetric flask 250ml
10 About 500cm^3 of distilled water supplied in a wash bottle.
11 one label or means of labeling
12 One pipette filler
13 Two conical flasks
14 About 0.5g of solid D supplied in a stoppered container
15 0.2g of solid E supplied in a stoppered container.
16 About 0.5g of solid F supplied in a stoppered container.
17 Six clean dry test – tubes
18 One blue and one red litmus paper
19 One 10ml measuring cylinder
20 One metallic spatula
21 One test – tube holder
22 2 cm mangane ribbon
23 15cm^3 of 2 M hydrochloric acid
24 One wooden splint

Access to

1 Bunsen burner
2 2M aqueous ammonia supplied with a dropper
3 Acidified potassium dichromate (vi) supplied with a dropper.
4 Acidified potassium manganate (VII) supplied with a dropper
5 Phenolphthalein indicator supplied with a dropper.

NOTES

1 Solution B is prepared by adding 86.0 cm^3. (1.18g/cm^3) of concentrated hydrochloric acid to about 500 cm^3 of distilled water and diluting to one litre of solution.
2 Acidified potassium dichromate (VI) is prepared by dissolving 25g of solid potassium dichromate (VI) in about 600cm^3 of 2M sulphuric (VI) acid and diluting to one litre of solution.
3 Solid A is magnesium powder
4 Solid D is copper (II) sulphate
5 Solid E is zinc metal
6 Solid F is Malleic acid
7 Phenolphthalein indicator is prepared by dissolving 1.75g of solid phenolphthalein in one litre of ethanol.
8 Acidified potassium manganate (VII) is prepared by dissolving 3.2g of potassium manganate (VII) in 200cm^3 of 2M sulphuric (VI) acid and diluting to one litre of solution.

STRATEGIC SCHOOLS ALLIANCE EXAMINATION
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233/3
CHEMISTRY
PAPER 3
(PRACTICAL)

1 You are provided with

- Solid A
- 1.O M hydrochloric acid solution B
- 0.1M sodium hydroxide solution

You are required to determine the enthalpy change ΔH, for the reaction between solid A and one mole of hydrochloric acid.

Procedure A

Using a burette, place 20cm^3 of 1.0 M hydrochloric acid, solution B in a 100ml beaker. Measure the temperature of the solution after every half minute and record the values in table 1. At exactly 2 ½ minutes, add all of solid A to the acid. Stir the mixture gently with the thermometer. Measure the temperature of the mixture after every half –minute and record the values in table 1 (retain the mixture for use in procedure B)

Table 1

Time (min)	0	½	1	1 ½	2	2 ½	3	3 ½	4	4 ½	5
Temperature (^OC)						x					

(4mks)

i) Plot a graph of temperature (Y-axis) against time. (3mks)
ii) Using the graph, determine the change in temperature, $T\Delta$…… (1mk)
iii) Calculate the heat change for the reaction (Assume that the specific heat capacity of the mixture is 4.2$jg^{-1}K^{-1}$ and the density of the mixture is 1g/cm^3) (2mks)

PROCEDURE B

Rinse the burette thoroughly and fill it with 0.1M sodium hydroxide solution. Transfer all the contents of the 100ml beaker used in procedure A into a 250ml volumetric flask. Add distilled water to make up to the mark. Label this solution C. Using a pipette and a pipette filler, place 25cm^3 of solution C into a 250ml. conical flask. Add two or three drops of phenolphalein indicator and titrate against sodium hydroxide. Record your results in table 2. Repeat the titration two more times and complete table 2.

Table 2

	I	II	III
Final Burette reading(cm^3)			
Initial burette reading(cm^3)			
Titre (cm^3)			

4mks

Calculate the :

i) Average volume of sodium hydroxide used (1mk)
ii) The number of moles of:
I) Sodium hydroxide used (1mk)

II) Hydrochloric acid in 25cm^3 of solution C (1mk)
III) Hydrochloric acid in 250cm^3 of solution C (1mk)
iv) Hydrochloric acid in 20.0cm^3 of solution B (1mk)
V) Hydrochloric acid that reacted with solid A (1mk)

c) Calculate the enthalpy of reaction between solid A and one mole of hydrochloric acid (show the sign of Δ H)

2 You are provided with solid D. Carry out the tests below. Write your observations and inherences in the spaces provided.

a) Place all of sodid D in a clean dry test tube and heat it strongly until no further change occurs. Test any gases produced with both blue and red litmus papers. Allow the residue to cool and use it for test (b

Observations	inferences
2mks	1mk

b) Add about 10cm^3 of 2M hydrochloric acid to the residue and shake for about three minutes. Keep the mixture for test (C)

Observations	inferences
1mk	1mk

c) i) Place about 1cm^3 of the mixture in a test-tube and add aqueous ammonia dropwise until in excess.

Observations	inferences
1 ½,mk	½ mk

ii) To the rest of the mixture, add all of solid E provided and shake the mixture well.

Observations	inferences
1mk	1mk

3. You are provided with solid F. Carry out the tests below. Write your observations and inferences in the spaces provided.

a) Place about one third of solid F on a metallic spatula and burn it using a Bunsen burner

Observations	inferences
½ mk	½ mk

b) Place the remaining of solid F in a test-tube. Add about 6cm^3 of distilled water and shake the mixture well. (Retain the mixture for use in test (c)

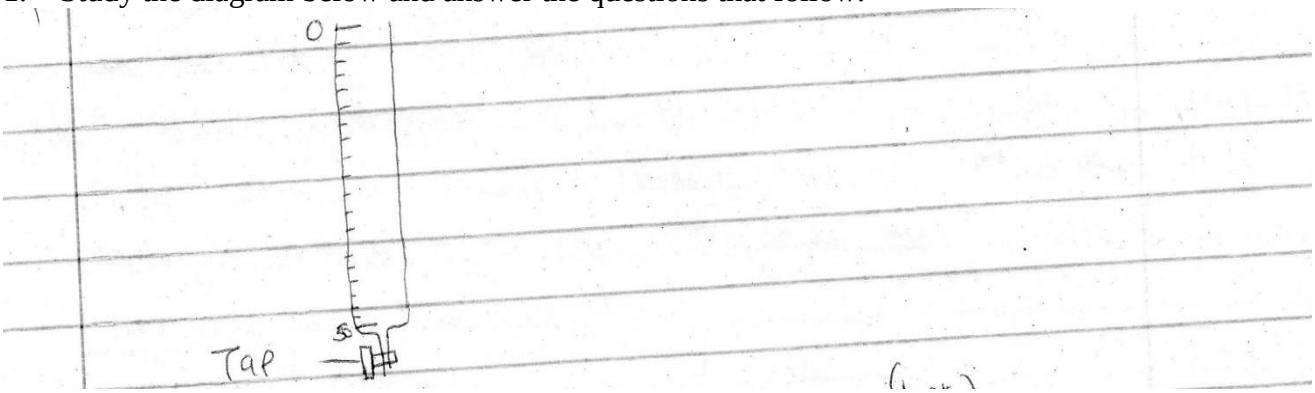
Observations	inferences
1mk	1mk

c) (i) To about 2cm^3 of the mixture, dip 2cm magnesium ribbon provided into the test-tube containing the solution and immediately test for the gas present using a burning splint.

Observations	inferences
1mk	1mk

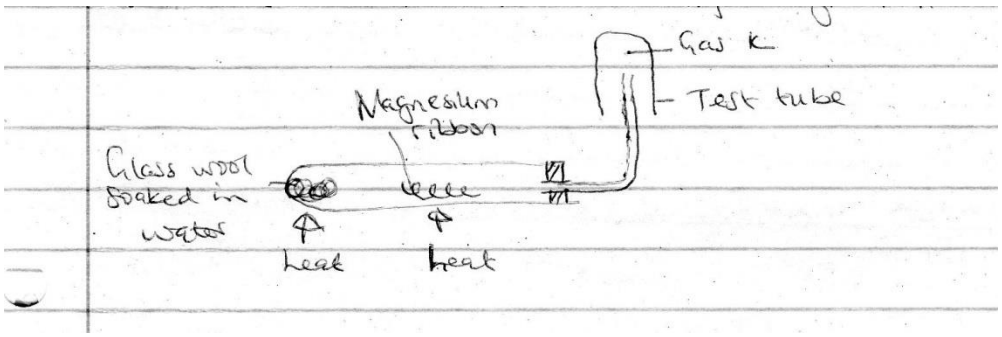
BUURI EAST STANDARDS
233/1
CHEMISTRY
JULY, 2018

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



a) Name the apparatus drawn above. (1mk)
b) State its use (1mk)

2. A student set up the experiment below to collect gas K. The glass wool was heated before heating magnesium ribbon.



a) Why was it necessary to heat moist glass wool before heating magnesium ribbon. (1mk)
b) What would happen if the magnesium ribbon was heated before heating glass wool. (1mk)

3. A given volume of sulphur (iv) oxide (SO_2) diffused from a certain apparatus in 96 seconds. Calculate the time taken by an equal volume of carbon (iv) oxide (CO_2) to diffuse under the same conditions (C = 12, O = 16, S = 32) (3mks)

4. A student investigated the effect of electric 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	**Substance**	**State**
1	Potassium carbonate	Molten
2	Copper (ii) Sulphate	Solution
3	Sugar	Solution
4	Lead (ii) Bromide	Solid

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

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

5. Using dots (.) and crosses (x) to represent electrons, draw a diagram to show bonding in sodium chloride (NaCl) (Atomic number of Na = 11, Cl = 17) (2mks)

6. The table below shows some properties of substances K, L and M. Study it and answer the questions that follow.

Substances	Mp(^{0} C)	Solubility in water	Electrical conductivity	
			Solid state	Molten State
K	-40	Insoluble	Poor	Poor
L	1510	Insoluble	Poor	Poor
M	810	Soluble	Poor	Good

Select a substance:

a) With a molecular structure (1mk)

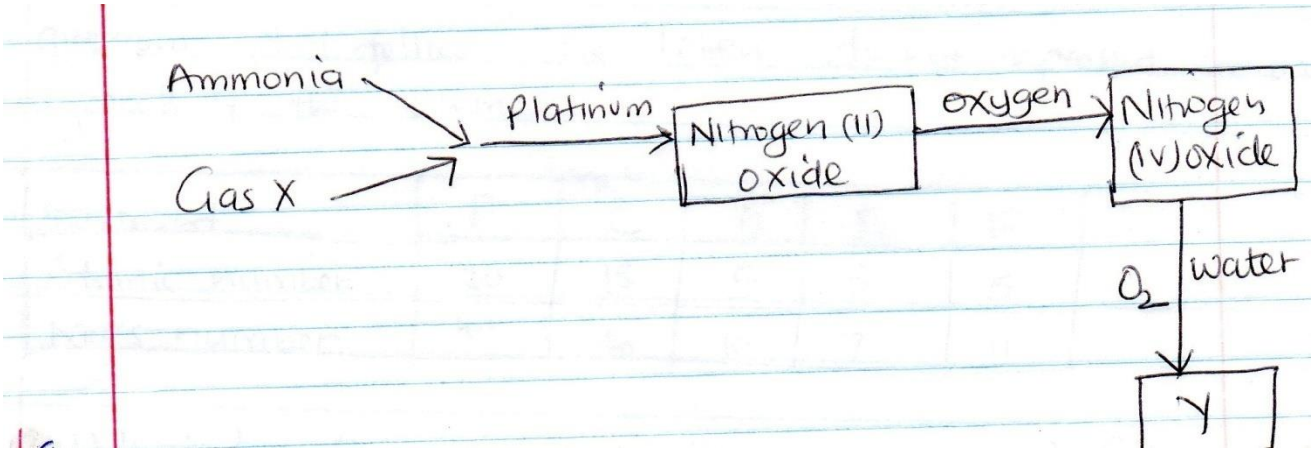
4 b) That is not likely to be an element. (1mk)

7. State and explain the observation that would be made when a few drops of concentrated sulphuric (vi) acid are added to a small sample of hydrated copper (ii) sulphate (2mks)

8. In the equation below, identify the reagent that acts as an acid, Give a reason (2mks)

$H_2O_{2(l)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + HO_2^-{}_{(aq)}$

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



a) Identify
   i) Gas X (1mk)
   ii) Compound Y (1mk)

b) What is the purpose of platinum (1mk)

10. Use the information given in the table below to answer the questions that Follow. The letters do not represent actual symbols of the elements.

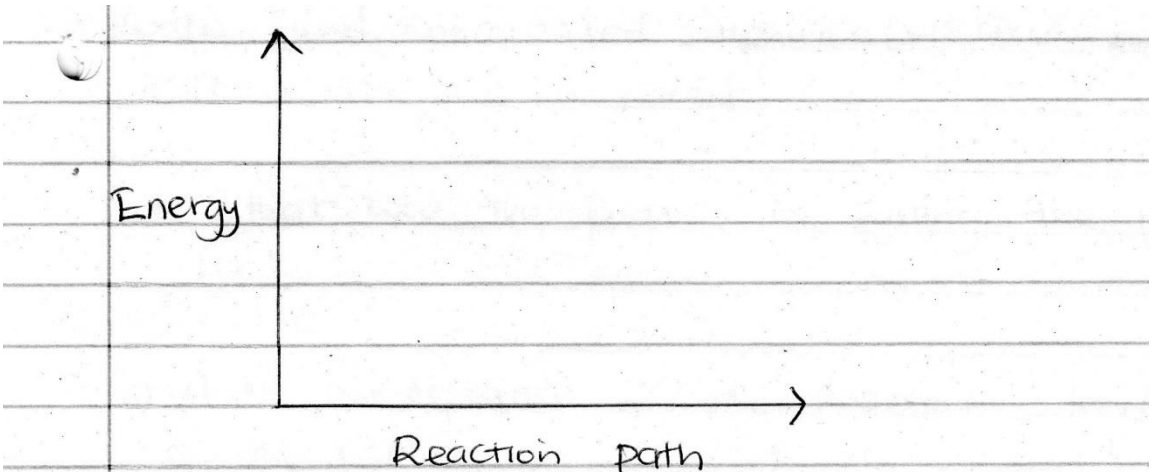
Element	**B**	**C**	**D**	**E**	**F**
Atomic number	20	18	5	3	5
Mass number	40	40	10	7	11

a) Which two letters represent the same element? Give a reason. (1mk)
b) Give the number of neutrons in an atom of E. (1mk)

11. Study the equilibrium below then answer the question that follow.

$2Q_{2(g)} + R_{2(g)} \rightleftharpoons 2Q_2\,R(g) \qquad \Delta H = -197kJmol^{-1}$

On the grid below, sketch a labelled energy level diagram for the reverse reaction. (2mks)



12. a) A radioactive cobalt $_{27}{}^{61}Co$ undergoes decay by emitting a beta particle and forms a nickel (Ni) atom. Write a decay equation for the above change. (1mk)
b) The table below gives the rate of decay for a radioactive element S.

Number of days	**Mass (g)**
0	12.8
280	0.8

Determine the half-life of the radioactive element. (2mks)

13. An oxide of element F has the formula F_2O_5.
a) Determine the oxidation number of F. (1mk)
b) In which group of the periodic table is element F. (1mk)

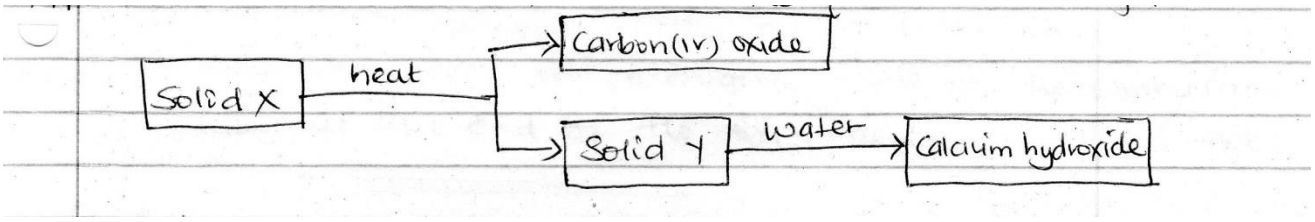
14. In an attempt to prepare a certain gas, a student added concentrated hydrochloric acid to manganese (iv) oxide and heated the mixture. The products were then passed through water and concentrated sulphuric (vi) acid separately.

a) Name the gas prepared (1mk)
b) What was the purpose of passing the products through water? (1mk)
c) Write an equation for the reaction leading to production of the gas. (1mk)

15. The reaction between sodium carbonate is faster in hot hydrochloric acid than with cold acid. Explain. (2mks)

16. Iron is extracted from its ore by the blast furnace.
a) Name **one** ore from which iron is extracted. (1mk)
b) One of the impurities in iron is removed in the from of calcium silicate. Write an equation for the reaction in which calcium silicate is produced. (1mk)

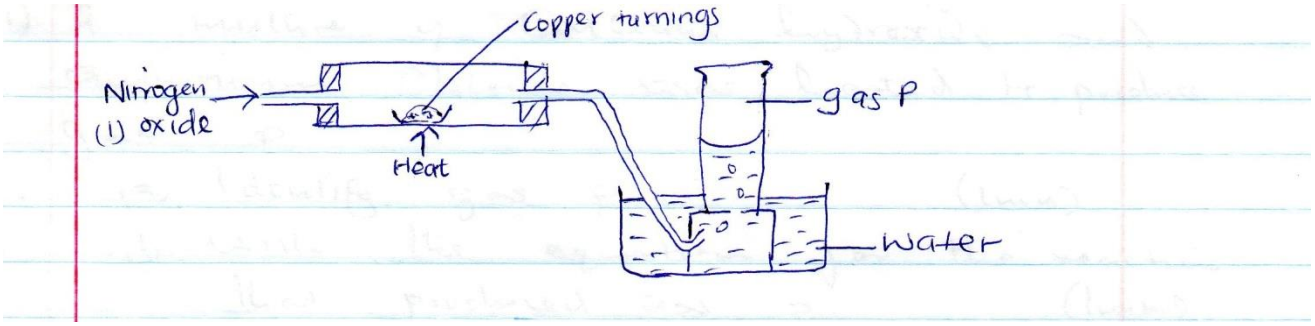
17. Use the scheme below to answer the questions that follow.



a) Identify solids. (1mk)
i) X
ii) Y
b) Describe how solid X can be prepared in the laboratory. (2mks)

18. In an experiment, a few drops of concentrated nitric (v) acid were added to aqueous iron (ii) sulphate in a test tube. Excess sodium hydroxide solution was then added to the mixture.
a) State the observation made when
i) concentrated nitric (v) acid was added to aqueous iron (ii) sulphate. (1mk)
ii) Excess sodium hydroxide was added to the mixture. (1mk)
b) Write an ionic equation for the reaction which occurred in (a) (ii) above. (1mk)

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



a) Name gas P (1mk)
b) State the observation made in the combustion tube at the end of the experiment. (1mk)

20. a) Define enthalpy of formation of a compound. (1mk)
b) Given that
$\Delta H_f (CO_2) = -394 kJmol^{-1}$

$\Delta H_f (H_2)) = - 286 kJmol^{-1}$

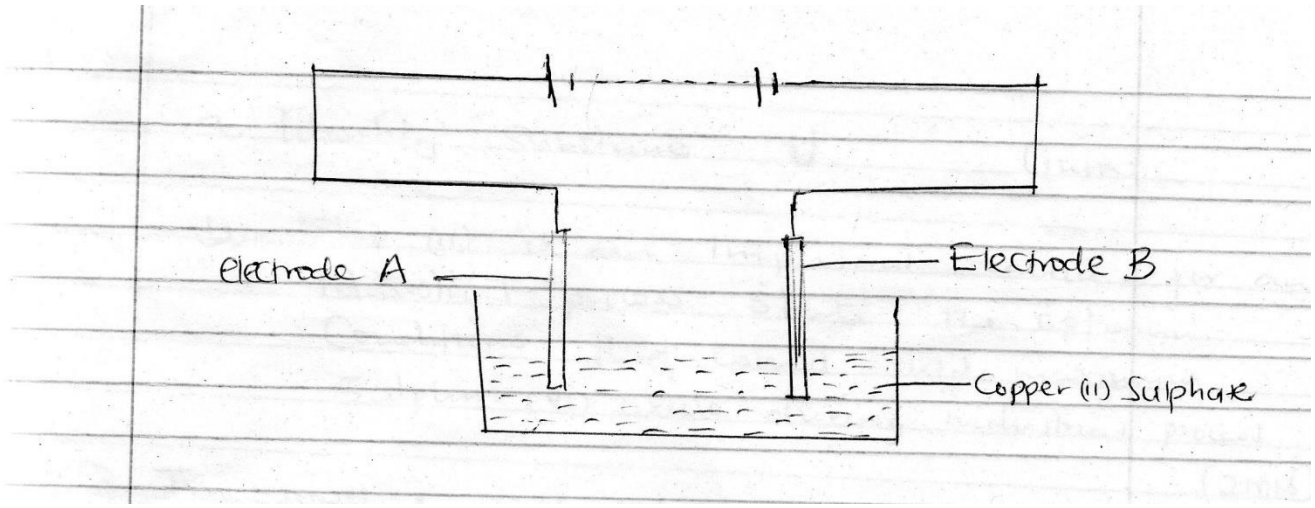
$\Delta H_c(C_4 H_{10}) = -2881 kJmol^{-1}$

Calculate the molar heat of formation of butane. (C_4H_{10}) (3mks)

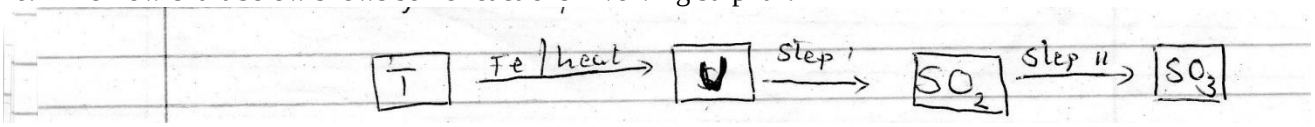
21. A mixture of calcium hydroxide and ammonium chloride was heated to produce gas P.
    a) Identify gas P (1mk)
    b) Write the equation for the reaction that produced gas P. (1mk)
    c) Draw a diagram to show how gas P can be collected. (1mk)
22. Name the method that can be used to extract the following.
    a) Common salt from a salt solution. (1mk)
    b) paraffin from crude oil (1mk)
23. a) Draw the structural formulae of the following compounds.
        i) 2 – methylpropane (1mk)
        ii) But – 2 – ene (1mk)

    b) Name the compound shown below $CH_3 - \overset{\overset{O}{\|}}{C} - O - CH_2\, CH_3$ (1mk)

24. The diagram below shows electrolysis of copper (ii) sulphate solution using coper electrodes.



    a) Which electrode loses mass and what is its polarity. (1mk)
    b) What happens to the concentration of copper (ii) sulphate electrolyte with time? Explain (1mk)
    c) Write down the equation for the reaction taking place at the cathode (1mk)
25. Oxygen gas can be prepared in the laboratory by decomposition of hydrogen peroxide.
    i) State a suitable catalyst. (1mk)
    ii) Give one use of oxygen. (1mk)
26. The flow chart below shows some reactions involving sulphur.



    a) Identify substance U (1mk)
    b) Step (ii) is an important reaction for an industrial process. State the optimum conditions that would yield maximum sulphur (vi) oxide during the industrial process. (2mks)
27. Two gases X_2 and Y_2 reacts to from gaseous products XY_3 according to the following equation.

$$X_{2(g)} + 3Y_{2(g)} \rightleftharpoons 2XY_3(g) \qquad \Delta H = -44kJ$$

    a) State two ways in which the yield of XY_3 can be increased. (2mks)

28. Calculate the volume of 0.2M hydrochloric acid that will completely neutralize 23cm^3 of 0.25M sodium hydroxide. (2mks)
29. 9.12g of a gaseous compound Q contain 8g of silicon while the rest is hydrogen . Determine the empirical formula of the compound (Si = 28, H=1) (3mks)
30. The following are half reaction for some half cells and their respective reduction potentials.

$Zn^{2+}_{(aq)} + 2e^- \longrightarrow Zn_{(s)}$ -0.76V

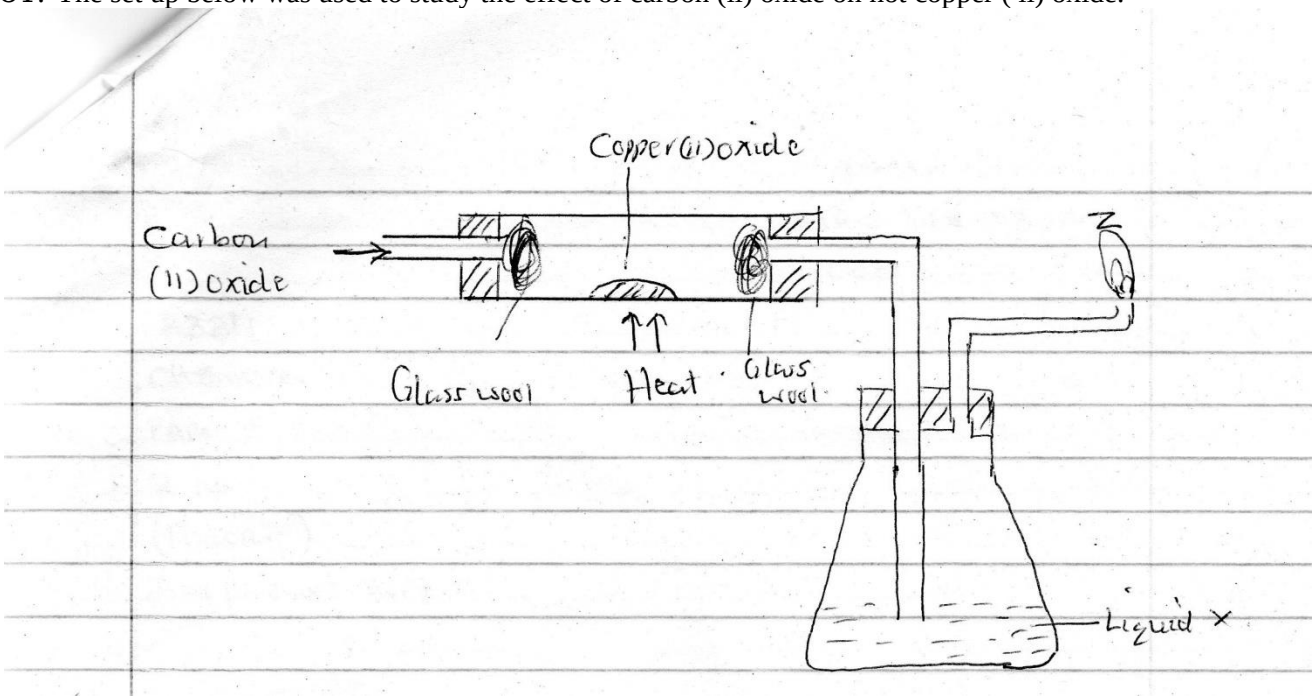
$Pb^{2+}_{(aq)} + 2e^- \longrightarrow Pb_{(s)}$ -0.13V

$Ag^{+}_{(aq)} + e^- \longrightarrow Ag_{(s)}$ +0.80V

$Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu_{(s)}$ +0.34V

a) Write the overall cell equations for two electrodes which will give the highest e.m.f (1mk)
b) Calculate the e.m.f of the cell in (a) above. (2mks)

31. The set up below was used to study the effect of carbon (ii) oxide on hot copper (ii) oxide.



a) Give the identity of substance burning at Z. (1mk)
b) What is the purpose of liquid X. (1mk)
c) Write an equation for the burning of substance in (a) above. (1mk)

32. Element T belongs to period 3 and group vii of the period table.
a) Suggest the family name that T belongs. (1mk)
b) Determine its atomic number. (1mk)

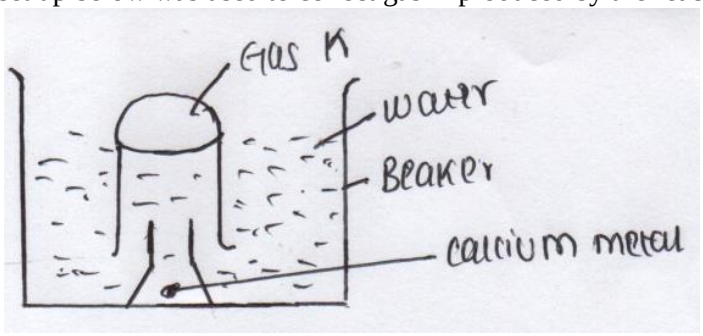
KAPSABET BOYS
233/1 CHEMISTRY (THEORY)
PAPER ONE

1. The table below shows pH values of solutions ABC and D

Solution	A	B	C	D
pH value	1	7	10	13

   a) Give solution that is;
      i) Acidic (1mk)
      ii) Weak base (1mk)
      iii) Neutral (1mk)
   b) Give the product formed when solution A react with a carbonate salt (1mk)

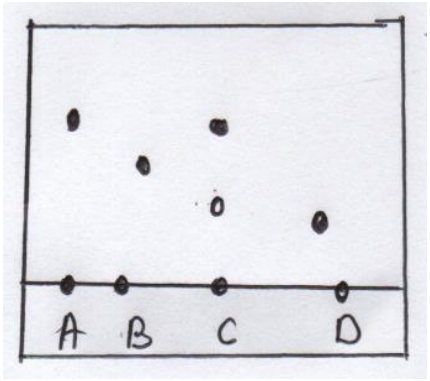
2. The set up below was used to collect gas K produced by the reaction between water and calcium metal



   a) Name gas K (1mk)

3. An organic compound P contains 64.9% carbon, 13.5 Hydrogen and the rest of the % is oxygen.
   a) Determine empirical formula of the compound (3mks)
   b) Determine the molecular formula given that the relative formula mass of P is 74 (1mk)

4. The diagram below shows spots of pure substances A, B and D on a chromatography paper. Spot C is that of the mixture.



   a) On the diagram show the following
      i) Baseline (½mk)
      ii) Solvent front (½mk)
   b) Which substances are present in C (2mks)

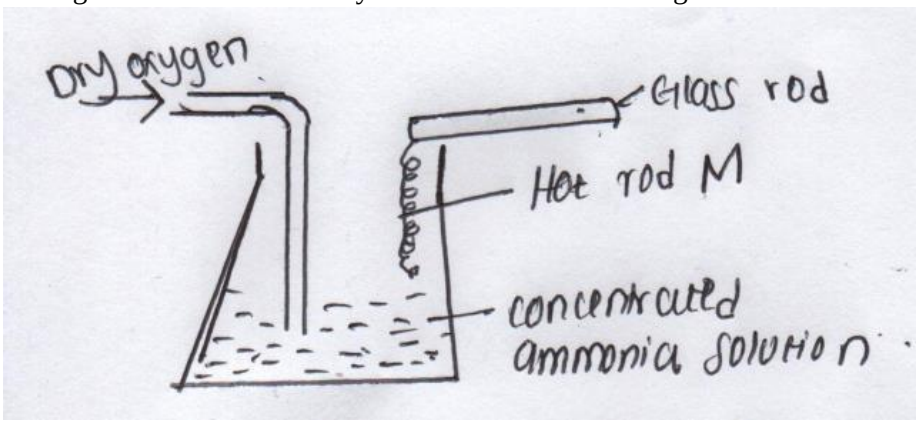
5. In a reaction $20cm^3$ of 0.1m sodium carbonate completely reacted with $13cm^3$ of dilute sulphuric (V) acid. Find h concentration of suphuric acid in moles per litres (3mks)
6. Using dots (·) and crosses (X) draw the structure of hydroxonium ion (H_3O^+) (2mks)

7. Study the information below and answer the questions that follows. Letters do not represent the actual symbol of element.

Element	Atomic No	Ionization energy kJmol
P	4	1800
Q	12	1450
R	20	1150

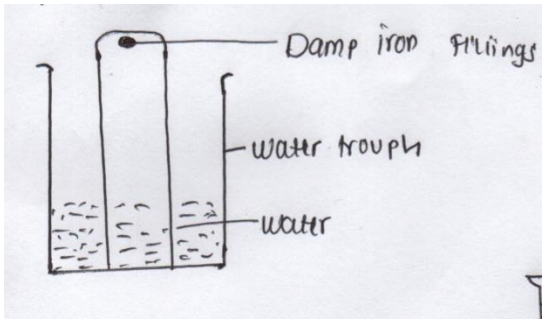
a) What is the general name given to the group in which element P, Q and R belong? (1mk)
b) Explain why P has highest ionization energy (2mks)
c) Write a balanced chemical equation for the reaction between element Q and water (1mk)

8. The diagram below shows catalytic oxidation of ammonia gas. Use it to answer the questions that follows.



a) Name metal M (1mk)
b) State and explain two observations made inside the flask (2mks)

9. In an experiment a gas jar containing some damp iron fillings was inverted in a trough containing some water and the set up was left for 3 days.



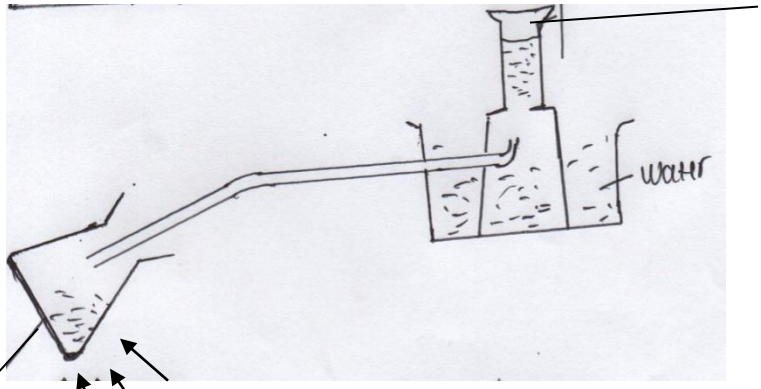
a) Why was iron fillings moistened (1mk)
b) State and explain observation made after 3 days (2mks)

10. a) Distinguish between hygroscopy and efflorescence (2mks)
b) Starting with lead (II) oxide, describe how you would prepare lead (II) sulphute (3mks)

11. a) Define the term isotope (1mk)
b) Chlorine gas has a mass of 35.5. It is made up of two isotope $^{35}_{17}Cl$ and $^{37}_{17}Cl$. Determine the relative abundance of each isotope in the chlorine gas. (2mks)

12. Explain the reason why Aluminium is used for making utensils like sufuria (1mk)
13. Describe a chemical test to differentiate between carbon (IV) oxide and carbon (II) oxide gas (2mks)
14. i) State Graham's law of diffusion (1mk)
ii) $120cm^3$ of methane gas takes 30 seconds to diffuse through a certain membrane. Determine the rate of diffusion of surphure (IV) oxide gas through the same membrane (C=12, H=1, S=32, O=16) (3mks)

15. Study the set up below and answer the questions that follow



Sodium ethanoate +calcium oxide +solid K

i) Name gas Q (1mk)
ii) Identify solid K (1mk)
iii) What is the purpose of calcium oxide in the experiment (1mk)

16. Both ions Y^{2-} and Z^{2+} have an electron configuration of 2.8.8
    a) Write the electron arrangement for:
       Y …….. (½mk)
       Z …….. (½mk)
    b) What is the mass number of atom Z given that it has 20 neutrons (1mk)
17. Magnesium ribbon was burnt in air;
    a) State the observation made (1mk)
    b) Write the equations for the reaction (2mks)
18. a) Distinguish between a weak acid and a dilute acid (2mks)
    b) Giving a reason, identify an acid in the reverse reaction below (2mks)

$H_3O^+_{(aq)} + NH_{3(g)} \rightleftharpoons NH_4^+ + H_2O_{(l)}$

Acid …… (½mk)
Reason …… (½mk)

19. What causes water hardness (1mk)
20. a) Using ionic equation, explain how sodium carbonate removes permanent hardness (1mk)
    b) State one disadvantage of using hardness in the boilers (1mk)
21. Study the equation below

$CH_3CHClCHClCH_3$

i) Give the structural formula of Q (1mk)
ii) Name the type of reaction in the equation above (1mk)
iii) To which family of hydrocarbons does Q belong? (1mk)

22. Consider the scheme below for allotropes of sulphur

Allotrope J $\rightleftharpoons$ Allotrope K

i) What is the significance of temperature 96^0C (1mk)
ii) Name allotrope J and K (2mks)

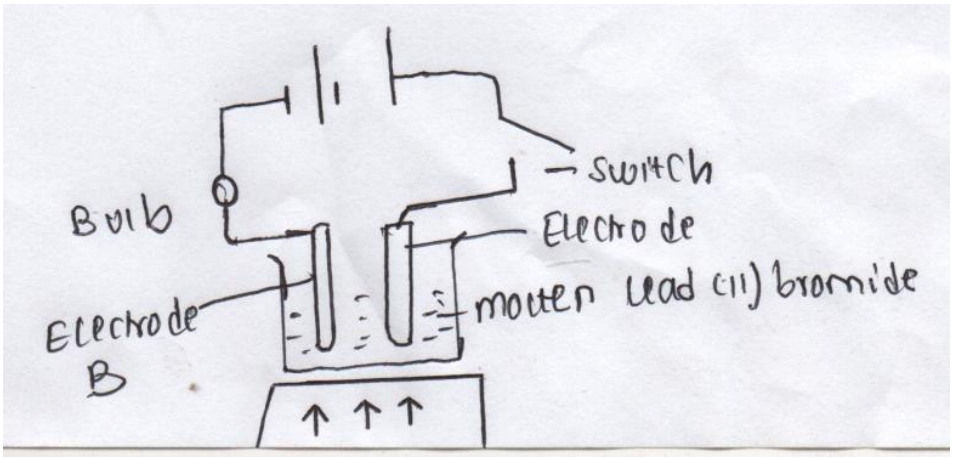
23. In term of structure and bonding explain why Diamond is used in drilling and graphite used as a lubricant (2mks)

24. The table below gives the bond energies of some compounds.

Bond	Bond energy kJ/mole
H-H	435
Cl-Cl	244
H-Cl	431

Calculate the enthalpy change for the reaction $H2_{(g)} + Cl2_{(g)} \longrightarrow 2HCl_{(g)}$ (3mks)

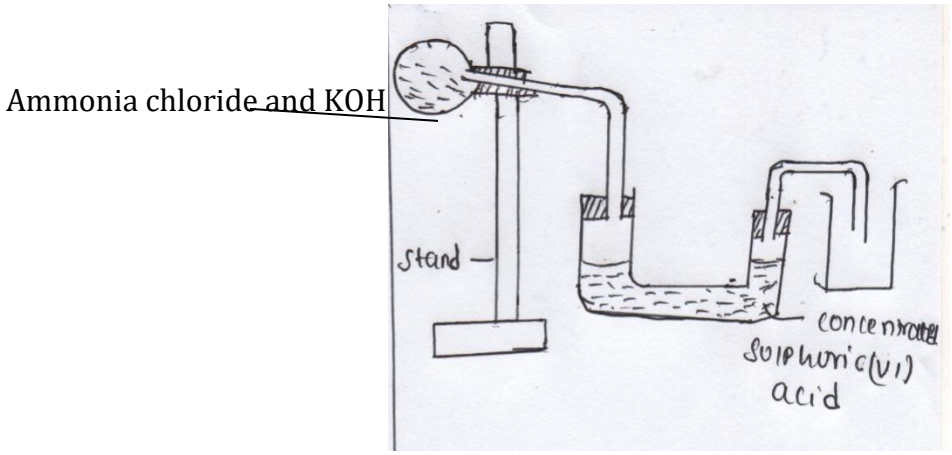
25.



The diagram above shows the effect of electric current on lead (II) bromide. Study it and use it to answer the questions that follow.

a) On the diagram, Name electrodes A and B (2mks)
b) State the observations made at electrode A (1mk)
c) Write the equation that takes place at electrode B (1mk)

26. The diagram below represents the apparatus used to prepare and collect dry ammonia gas.



a) State two mistakes in the set up of apparatus (2mks)
b) Write an equation for the reaction apparatus (2mks)

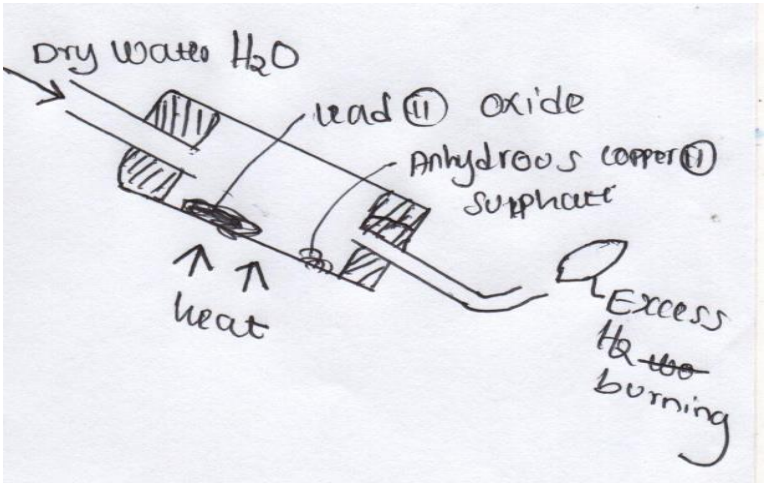
27. The table below gives the solubilities of potassium bromide and potassium sulphate at 0^0C and 40^0C.

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

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

i) Identify the crystals (1mk)
ii) Determine the mass of crystals formed (1mk)
iii) Name the method used to obtain the crystals (1mk)

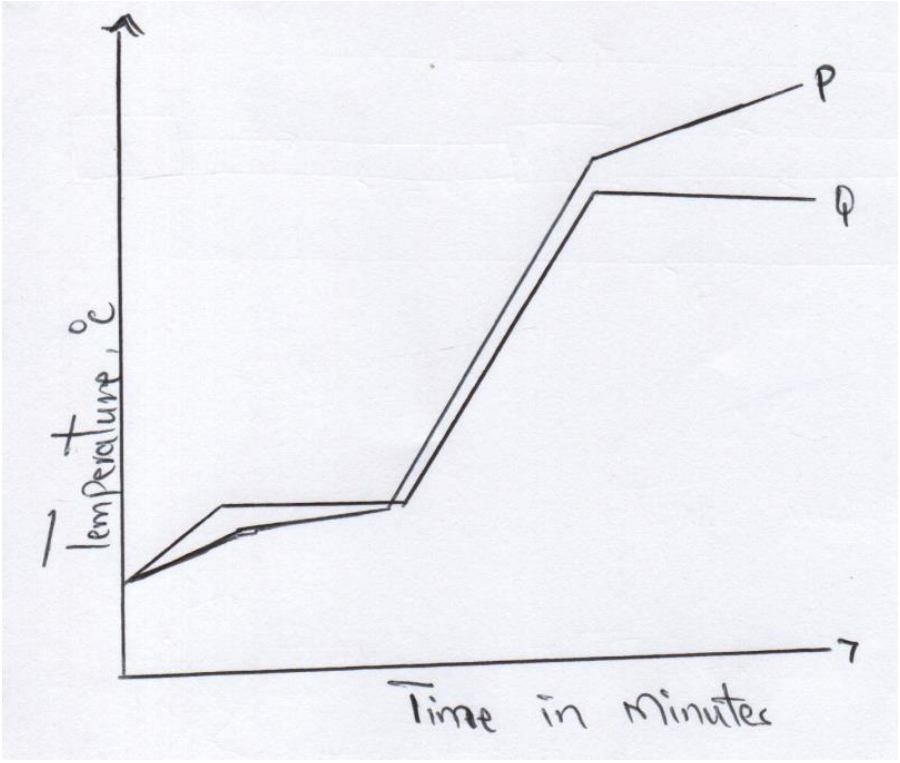
28. Study the diagram below



a) What is the observation made on anhydrous copper (II) sulphate (1mk)
b) Write an aqueous for the reaction ,between hydrogen gas and lead (II) oxide (1mk)
c) What is the property of hydrogen gas being investigated above (1mk)

KAPSABET BOYS
233/2
CHEMISTRY THEORY

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



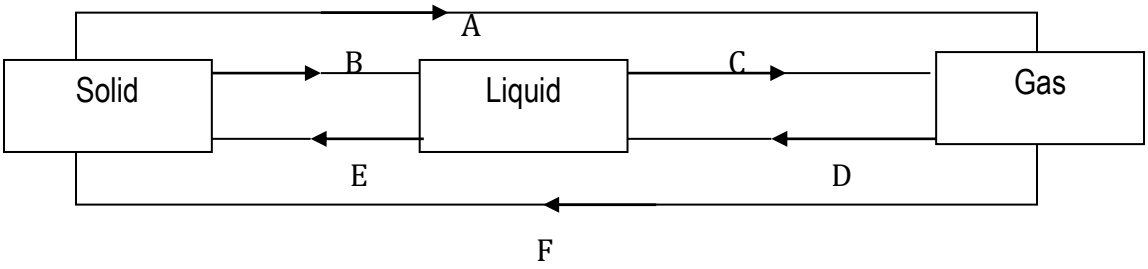
(i) (a)Which curve shows the variation in temperature for the pure solid? Explain. (2mks)

(ii) State the effect of impurities on the melting and boiling points of a pure substance.

I. Melting points ($^1/_2$ mk)

II. Boilling points ($^1/_2$ mk)

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



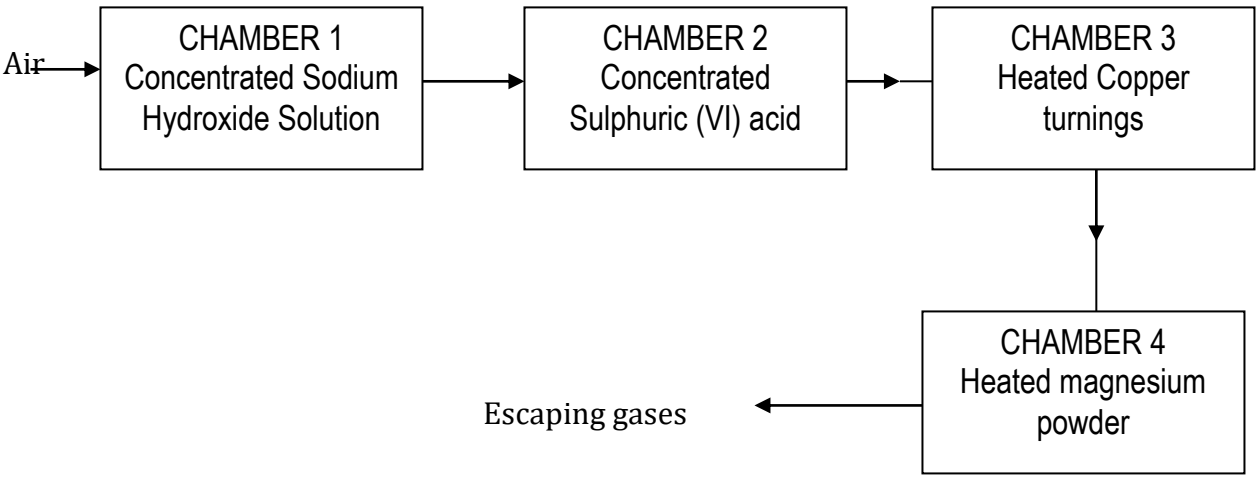
i) Identify the processes B and D. (2mks)

ii) Name process A (1mk)

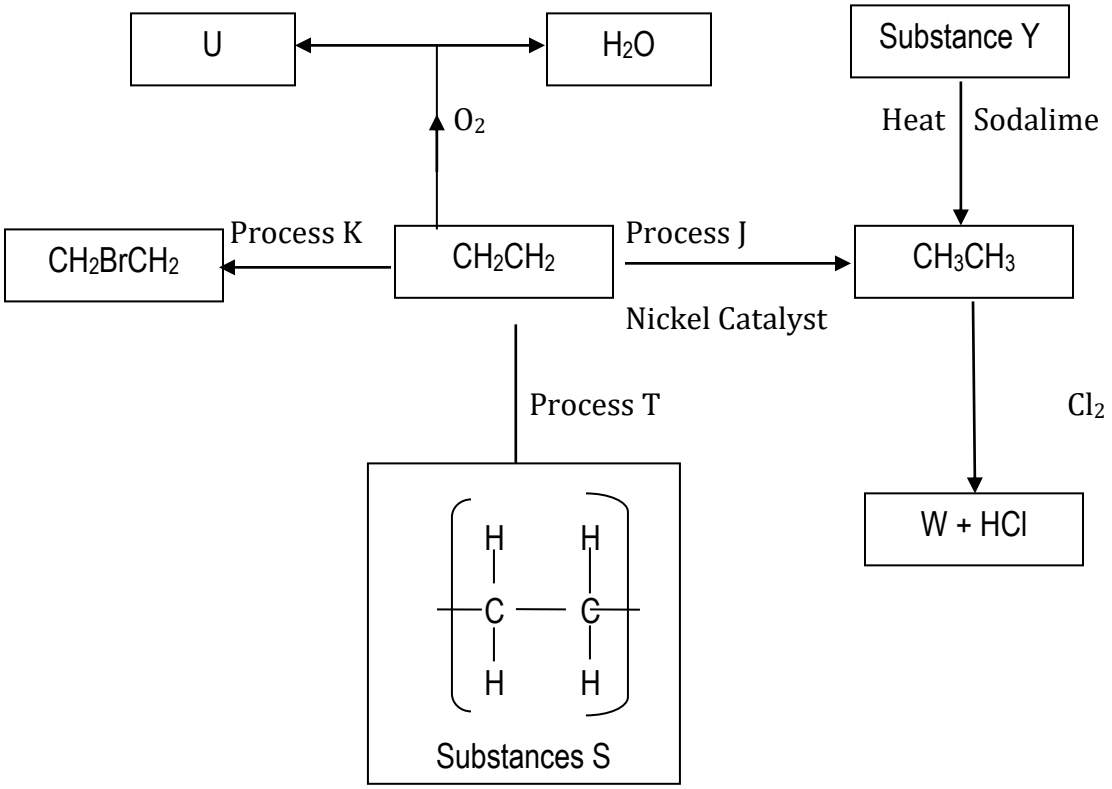
iii) State two substances in chemistry that undergo the process A (1mk)

iv) Is the process E exothermic or endothermic? Explain (1mk)

2. Air was passed through several reagents as shown below



(a) Name the main inactive component of air (1mk)
(b) Name the components of air that are removed in the following chambers (3mks)
 i) Chamber 1
 ii) Chamber 3
 iii) Chamber 4
C) What is the purpose of passing air through concentrated sulphuric (1v) acid. (1mk)
d) Write a chemical equation for thereaction which takes place in :-
 i) chamber 1 (1mk)
 ii) Chamber4 (1mk)
e) State and explain the observation made in chamber 3 during reaction (2mks)
f) Name one gas which escapes from the scheme above (1mk)
3. (a) Draw and name two isomers of Pentane (2mks)
 (B) Study the flow diagram below and then answer the questions that follow.



(i) Name process J, K and T (3mks)
(ii) State the reagents necessary for processed J and K (1mk)
(iii) Name substances U, W, S and Y (2mks)

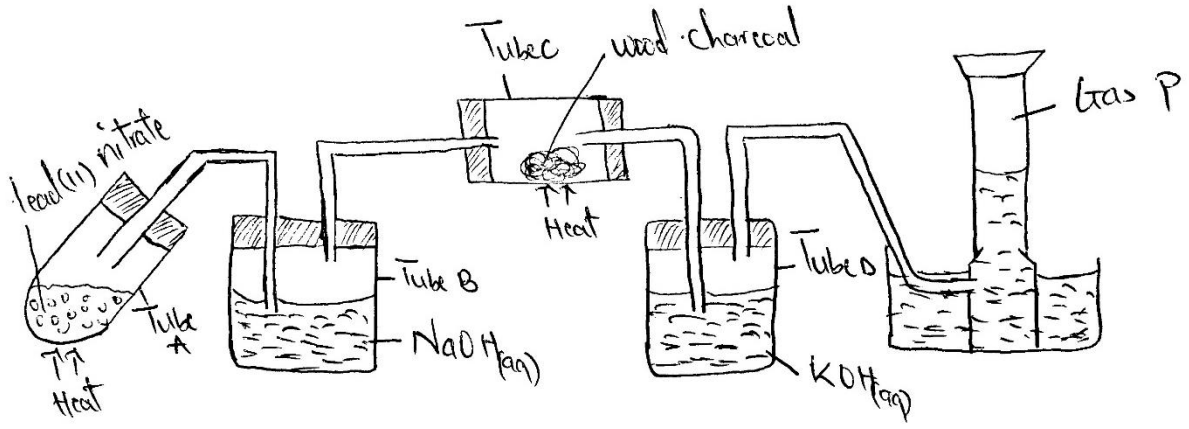
C) Describe how burning can distinguish CH_2CH_2 from CH_3CH_3 (2mks)

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

C								**T**
						U		
X	**K**		**M**			**Q**	**W**	
	Y					**P**		**Z**
J								

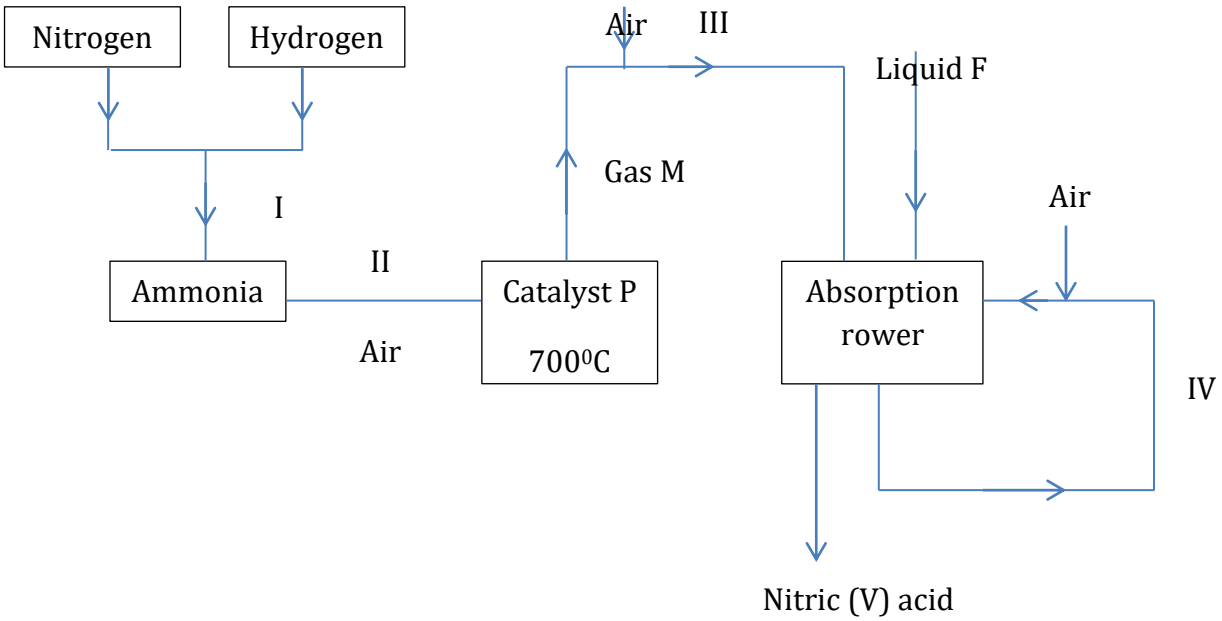
a) Identify the elements in period 1 (1mk)
b) With a reason, identify the element with the largest atomic radius (2mks)
c) Draw the atomic structure of element Q (1mks)
d) Write down the electronic configurations of elements Y and W
e) Element G forms an ion G^{3-} and its ionic configuration 2.8.8. indicate its position on the grid above (1mk)
f) Identify an element whose oxide reacts with both acids and alkalis (1mk)
g) i. Write down the chemical formular of the compound formed between elements K and W (1mk)
ii. Draw the bonding in the compound formed in (g) (i) above using dots (.) and crosses (x) to represent electrons (1mk)
h) Compare the atomic radius elements X and K. Explain (2mks)

5 (a) Study the diagram below and answer the questions that follow



i) Write a chemical equation for the reaction in tube A (1mk)
ii) Name the two salts formed in tube B (1mk)
iii) State the observation made in tube C (1mk).
iv) What is the purpose of potassium hydroxide in tube D. (1mk)
v) Name gas P (1mk)

(b) The flow chart below shows some industrial processes. Use it to answer the questions that follow



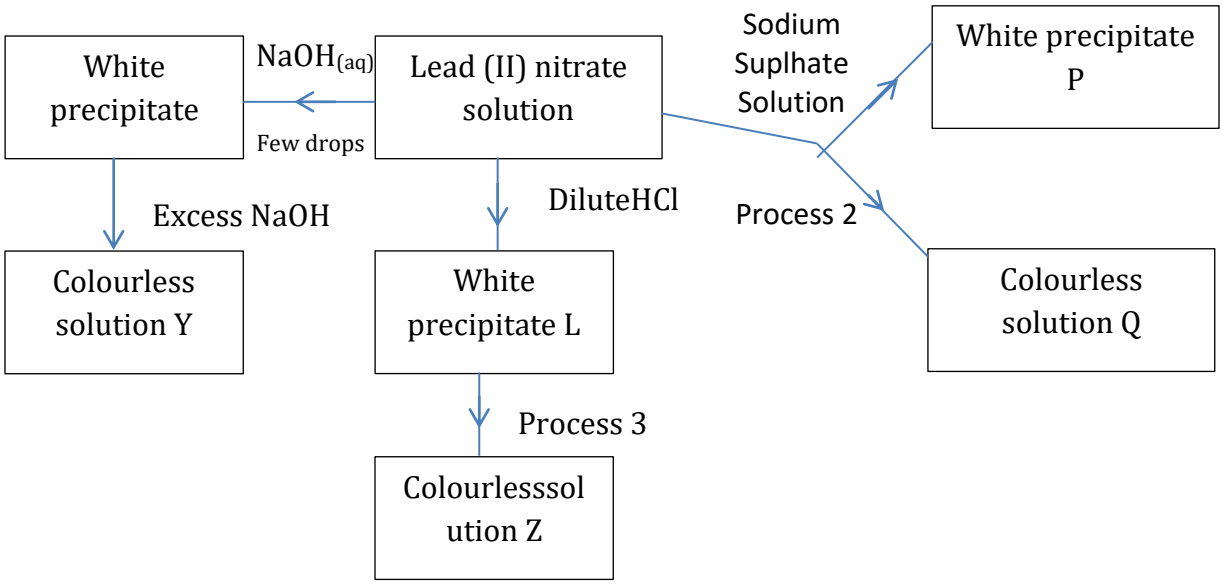
(i) Give the source of the following raw materials
  a) Nitrogen gas (½mk)
  b) Hydrogen gas (½mk)

ii) Name the following substances;
  a) Catalyst P (½ mk)
  b) Gas M (½ mk)
  c) Liquid F (½mk)

iii) Write the chemical equations for; formation of gas M. (1mk)
  The reaction in the absorption tower (1mk)

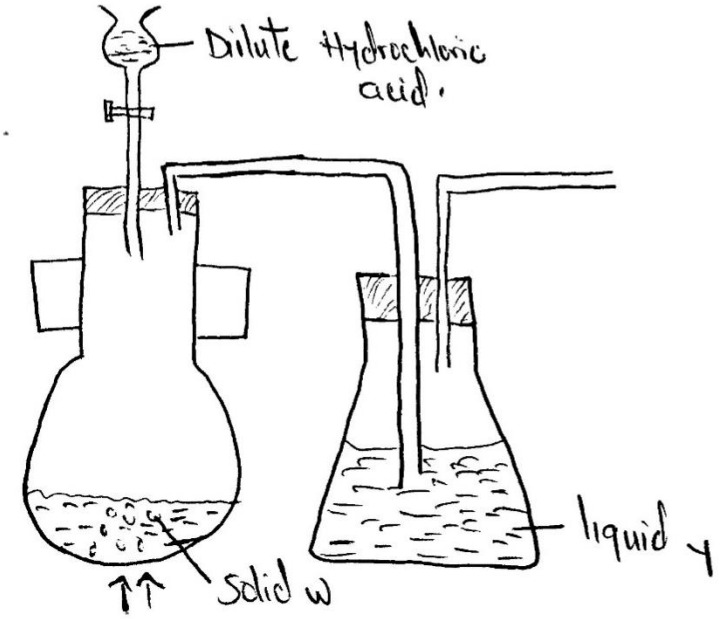
iv) State one use of nitric (v) acid (½mk)

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



a) Write the chemical formular of compounds P and Q (2mks)
b) Write an ionic equation for the process that produces white precipitate P (1mk)
C) Name process 2 (1mk)
d) Name the process that separated P and Q (1mk)
e) Write a balanced chemical equation for the formation of white precipitate L. (1mk)
f) State the condition required for process 3 (1mk)
g) What physical process is exhibited in process 3 (1mk)
h) Name the anion present in colourless solution Z (1mk)
i) Write the formula of the complex ion present in colourless solution Y (1mk)

7. Below is a set of apparatus that was used to obtain a dry sample of sulphur(iv)oxide gas



a) Name;
   i) Solid W (1mk)
   ii) The apparatus containing dilute hydrochloric acid (1mk)
b) State the role of Liquid Y (1mk)
C) Complete the diagram to show how the gas could have been collected (1mk)
d) A sample of sulphur(iv)oxide gas was passed through freshly prepared iron(III)sulphate solution. State and explain the observation made (2mks)
e) $50cm^3$ of 2M Hydrochloric acid was used during the above experiment. Determine the volume of sulphur(iv)oxide gas produced at r.t.p (molar gas volume = $24dm^3$)

8. In an experiment, $40cm^3$ of 0.1 M sodium hydroxide solution was placed in a suitable apparatus and $5.0cm^3$ portions of hydrochloric acid were added. The resulting mixture was stirred with a thermometer and the temperature taken after each addition. Both solutions were initially at 20^0c

Volume of HCL (cm^3)	5	10	15	20	25	30	35	40	45
Temperature (^oc)	21.5	22.5	24.0	25.0	26.0	27.0	27.5	27.5	27.0

a) i. Plot a graph of temperature against volume of the acid added (4mks)
ii) Use the graph to determine the concentration in moles per litre of the hydrochloric acid (2mks)
b) i) Calculate the heat change for the reaction (1½mk)
ii) Molar enthalpy of neutralization of hydrochloric acid by sodium hyndroxide solution (density of solution 1g/cm^3 specific heat capacity 4.2 kj/kg) (1½mks)
c) Write the thermochemical equation for the reaction (1mks)
d) Draw an energy level diagram for the reaction (1mk)

KAPSABET BOYS
PAPER 3 (233/3)
CHEMISTRY (PRACTICAL)

QUESTION 1

You are provided with:
- Solid A 5.0g $(COOH)_2.\times H_2O$
- Solution B 0.13M $KMnO_4$

Task
c) You are supposed to determine the solubility of A at different temperatures.
d) Determine the number of moles of water of crystallization in solid A.

PROCEDURE 1
c) Using a burette, add 4cm3 of distilled water to solid A in a boiling tube.
- Head the mixture while stirring with the thermometer to about 80^0C.
- When the whole solid dissolves, allow the solution to cool while stirring with the thermometer
- Note the temperature at which crystals first appear and record this temperature in the table 1 below.

d) Using aburrete add 2cm^3more into the content of the boiling tube and warm until the solid dissolve.
- Remove from the flame and allow the solution to cool in air while stirring.
- Record the temperature at which crystal first appear in table 1.
- Repeat procedure (b) 3 more times and complete table 1 below.
- Retain the content of the boiling tube for procedure II

Table 1

Volume of water in the boiling tube (cm^3)	**Temperature at which crystals of solid A appear (^{0}C)**	**Solubility o solid A g/100g of water**
4 6 8 10 12		

II. a) Draw a graph of solubility of solid A (vertical axis) against temperature (3mks)
b) From your graph determine the solubility of solid A at 60^0C (1mk)

PROCEDURE II

d) Transfer the contents of the boiling tube into a 250ml volumetric flask.
   - Add distilled water up to the mark
   - Label this solution A

e) Using a clean pipette and a pipette filler, transfer 25ml of solution A into a conical flask.
   - Warm the mixture up to 60^0C
   - Fill a burette with solution B
   - Titrate B against the hot solution A until a permanent pink colour persist
   - Read your results in Table 2 below

f) Repeat (b) 2 more times are record your results in the table 2 below.

TABLE 2

	I	**II**	**III**
FINAL BURETTE READING			
INITIAL BURETTE READING			
VOLUME OF SOLUTION B USED (CM^3)			

II) a) Calculate the average volume of solution B used (1mk)
   b) Calculate the number of moles of B used (1mk)
   c) Given 2 moles of $Kmno_4$ react with 5 moles of A, calculate the number of moles of A in $25cm^3$ (1mk)
   d) Calculate the molarity of A (1mk)
   e) Determine the molar mass of A (1mk)
   f) Determine the value of X (1mk)
   (C=12, O=16 H=1)

QUESTION 2

You are provided with solid C. Use it to carry the test below.
Dissolve the whole of C into 10cm3 of water and divide it into five portions.

a) To the 1st portion add sodium sulphate solution.

Observations	**Inferences**
(1mk)	(1½mks)

b) To the 2nd portion add Ammonia solution dropwise until in Excess.

Observations	**Inferences**
1mk)	1mk

c) To the 3rd portion add sodium Hydroxide dropwise until in Excess.

Observations	**Inferences**
(1mk)	(1mk)

d) To the forth portion add Lead (II) Nitrate solution

Observations	**Inferences**
(½mk)	(2mks)

e)To the last portion add Barium Nitrate solution

Observations	**Inferences**
(1mk)	(1mk)

QUESTION 3

You are provided with liquid D use it to carry the test below.

Divide liquid D into four equal portions

e) To the 1st portion add sodium hydrogen carbonate

Observations	**Inferences**
(1mk)	(1mk)

f) To the 2nd portion add acidified potassium manganite (VII) ($KmnO_4$)

Observations	**Inferences**
(1mk)	(1mk)

g) To the 3rd portion add Bromine water

Observations	**Inferences**
(1mk)	(1mk)

h) To the last portion add potassium dichromate(VI0 and wrm.

Observations	**Inferences**
(1mk)	(1mk)

KAPSABET BOYS
CHEMISTRY
FORM FOUR PAPER 3 (233/3)
INSTRUCTIONS TO SCHOOL
(CONFIDENTIAL)

In addition to the equipment and fittings found in a chemistry laboratory. Each candidate should be provided with;

1. Solid A 5.0g measured accurately
2. About $80cm^3$ of solution B
3. About 0.5g solid C
4. About $10cm^3$ of liquid D
5. A thermometer (-10-110^0C)
6. A burette
7. A complete retort stand
8. A pipette and a pipette filler
9. 2 conical flasks
10. A 250ml volumetric flask
11. One boiling tube
12. Five (5) test tubes
13. 0.5g sodium hydrogen carbonate
14. Two labels

ACCESS TO:

i) Means of heating (Tripond stand and wire gauze)
ii) Sodium sulphate solution ($NaSO_4$)
iii) Ammonia solution 2m
iv) 2m Sodium Hydroxide
v) Lead Nitrate solution

vi) Barium Nitrate solution
vii) Acidified potassium manganite (VII) solution
viii) Bromine water
ix) Acidified potassium dichromate(VI) solution

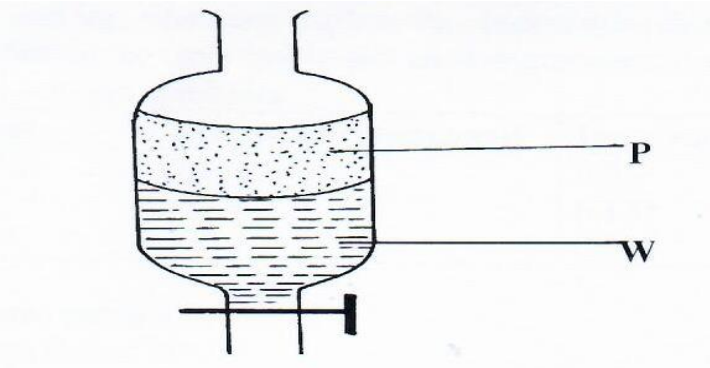
NB: i) Solid A is 5.0g of oxalic acid $(COOH)_2\ 2H_2O$
ii) Solution B is $Kmno_4$
iii) Solid C is magnesium chloride $MgCl_2$
iv) Liquid D is absolute ethanol

Preparations

i) Solution B is made by dissolving 20g of solid Kmno4 in $200cm^3$ of 2.0m H_2SO_4 and toping to $1000cm^3$ by distilled water.
ii) Sodium Hydroxide is prepared by dissolving 80g of NaOH pellets in 600cm3 of distilled water and top to $1000cm^3$ with distilled water.
iii) Ammonia solution is prepared by dissolving 150ml of conc ammonia to $600cm^3$ of distilled water then top to the mark.
iv) Barium Nitrate is prepared by dissolving 26g of solid Barium Nitrate in $600cm^3$ of water then topping to $1000cm^3$ with distilled water.
v) Lead nitrate is prepared by dissolving 30g of solid Lead Nitrate in $600cm^3$ of water then topping to $1000cm^3$ with distilled water.
vi) Sodium Sulphate is prepared by dissolving 14.2g of solid sodium sulphate in $600cm^3$ of distilled water then topping up to $1000cm^3$ with distilled water.
vii) Acidified $Kmno_4$ is prepared by dissolving 3.2g of solid $Kmno_4$ in $200cm^3$ of 2.0m H_2SO_4 acid then topping with distilled water to $1000cm^3$.
viii) Acidified $K_2Cr_2O_7$ is prepared by dissolving 25g of solid $K_2Cr_2O_7$ in $200cm^3$ of 2.0m H_2SO_4 then topping to $1000cm^3$ with distilled water.

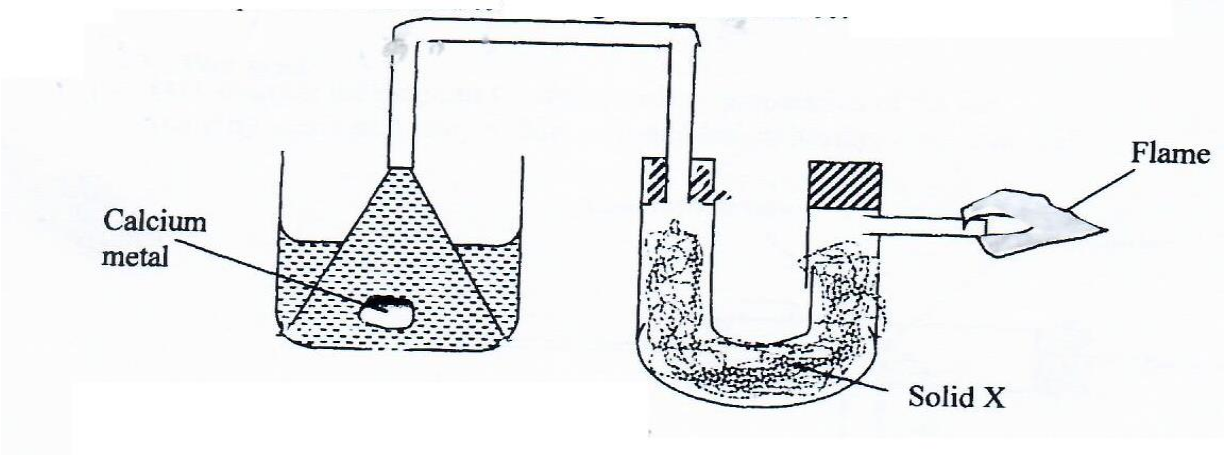
GATUNDU SOUTH JOINT EXAM
233/1
CHEMISTRY
PAPER 1
(THEORY)

1. A mixture of hexane and water was shaken and left to separate as shown in the diagram below:



State the identity of;
(i) P .....
(ii) W ..... (2mks)

2. Copper (II) oxide and charcoal are black solids. How would you distinguish between the two solids? (2mks)
3. Cooking oils comprise of a mixture of compounds which have a boiling point range of 23°C to 27°C.
   (i) What evidence is then to support the statement that cooking oil is a mixture? (1mk)
   (ii) Name another experimental technique that could be used to confirm your answer in part (i) above. (1mk)
4. State two uses of hydrogen gas that are also uses of carbon (II) oxide gas. (2mks)
5. The setup below was used to investigate the reaction between metals and water.



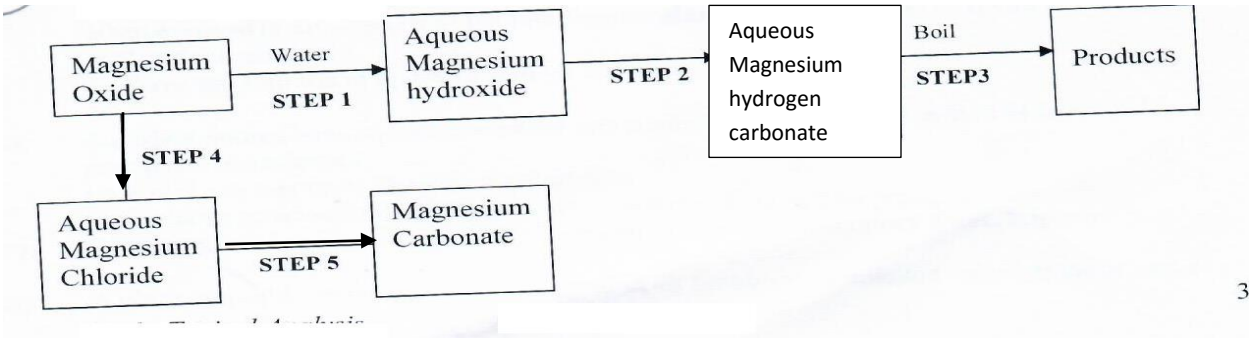
Identify solid X and state its purpose
Solid X ..... (1mk)
Purpose ..... (1mk)

6. (a) Explain why aluminium is a better conductor of electricity than magnesium (2mks)

(b) Other than cost and ability to conduct, give a reason why aluminium is used for making cables while magnesium is not (1mk)

7. Differentiate between the bleaching effect of chlorine and sulphur (IV) oxide gases. (2mks)

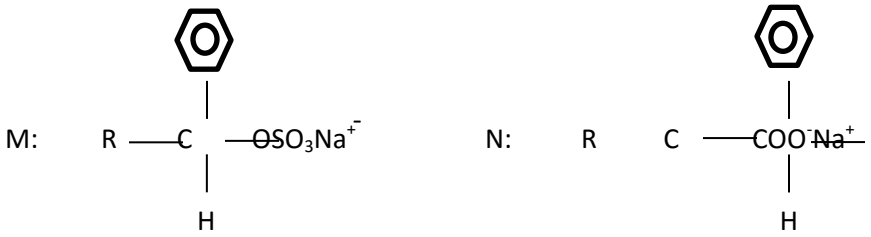
8. (a) The scheme below shows some reactions starting with magnesium oxide.
Study it and answer the questions that follow:



3

(i) Name the reagents used in **steps 2 and 4** **(**2mks**)**
Step 2……
Step 4……
(ii) Write an equation for the reaction in **step 2** **(**1mk**)**
(iii) Describe how a solid sample of anhydrous magnesium carbonate is obtained in **step 5** **(**2mks**)**

9. The formula below represents two cleaning agents M and N.



a) Identify the one that would be suitable to use with water containing calcium ions. Explain. (2mks)
b) Identify the one that has a longer pollution effect. (1mk)

10. (a) State Graham's Law of diffusion. (1mk)
(b) $240cm^3$ of oxygen diffused through an orifice in 100 seconds. How long will it take $300cm^3$ of sulphur (IV) oxide to diffuse through the same orifice? (S = 32, O = 16)(3mks)

11. A hydrated salt has the following composition by mass. Iron 20.2 %, oxygen 23.0%, sulphur 11.5%, water 45.3%. Determine the formula of the hydrated salt (Fe=56, S=32, O=16, H=1). (3mks)

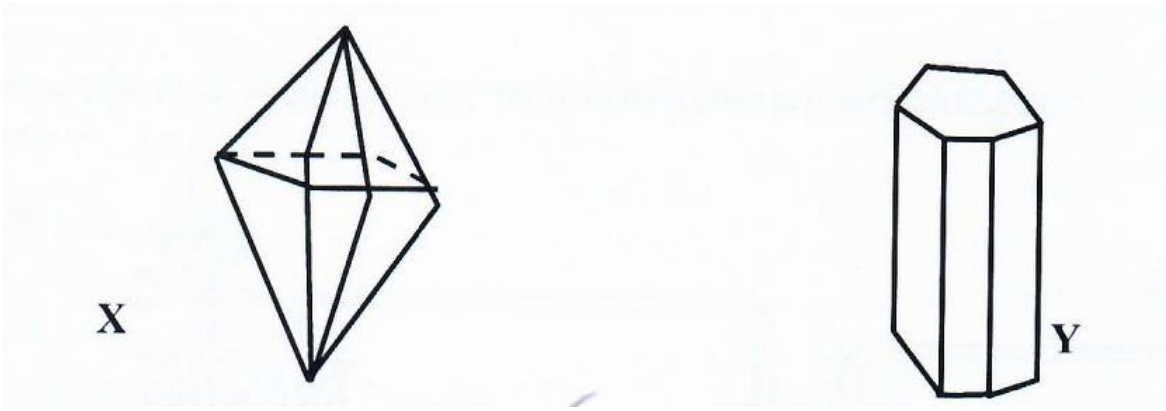
12. When propane is passed over heated broken porcelain, it decomposes into ethane and methane.
(a) What name is given to this type of reaction? (1mk)
(b) State one application of this reaction. (1mk)
(c) Name a reagent that can be used to differentiate ethane and methane. (1mk)

13. (a)Complete the nuclear equation below. (1mk)

$$^{24}_{11}Q \longrightarrow {}^{24}_{11}R + \text{\_\_\_\_\_}$$

(b) It was found that only $^{1}/_{32}$ of radioactive compound $^{131}_{53}I$ was remaining after a period of 150 days; determine the length of the half-life. (2mks)

14. The diagrams below represent two allotropes of Sulphur. Study them and answer the questions which follow:-



(i) Name the two allotropes labelled **X** and **Y.** (1mk)
(ii) Explain why a piece of burning magnesium continues to burn in a gas jar of Sulphur (IV) Oxide. (2mks)

15. Describe how you would prepare a dry sample of crystals of potassium sulphate starting with $100cm^3$ of 1M sulphuric (VI) acid. (3mks)

16. The solubility of potassium nitrate in water at 70^oc is 155g/100g H_2O while at 20^oc, the solubility is 31g/100g water. 50g of a saturated solution of potassium nitrate at 70^oc was cooled to 20^oc, calculate the mass that crystallized out. (2mks)

17. Bond energies for some bonds are tabulated below:-

BOND	BOND ENERGY KJ/mol
H-H	436
C=C	610
C-H	410
C-C	345

Use the bond energies to estimate the enthalpy for the reaction. (3mks)

$C_2H_{4\,(g)} + H_{2\,(g)} \longrightarrow C_2H_{6\,(g)}$

18. Nitrogen reacts with hydrogen according to the equation below:-

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

How would the yield of ammonia be affected by increase in:-

i) Pressure (1mk)
ii) Temperature (1mk)

19. In an electrolysis, a current of 200A was passed through molten oxide of metal **Q** for 58 minutes and 64.8g of the metal deposited. Determine;

i) Charge on metal **Q**. (RMM of Q = 27) (1mk)

ii) The volume of oxygen gas produced at standard temperature and pressure
IF = 96500C, molar gas volume s.t.p. =22.4dm^3. (2mks)

20. . Consider the reduction potentials below.

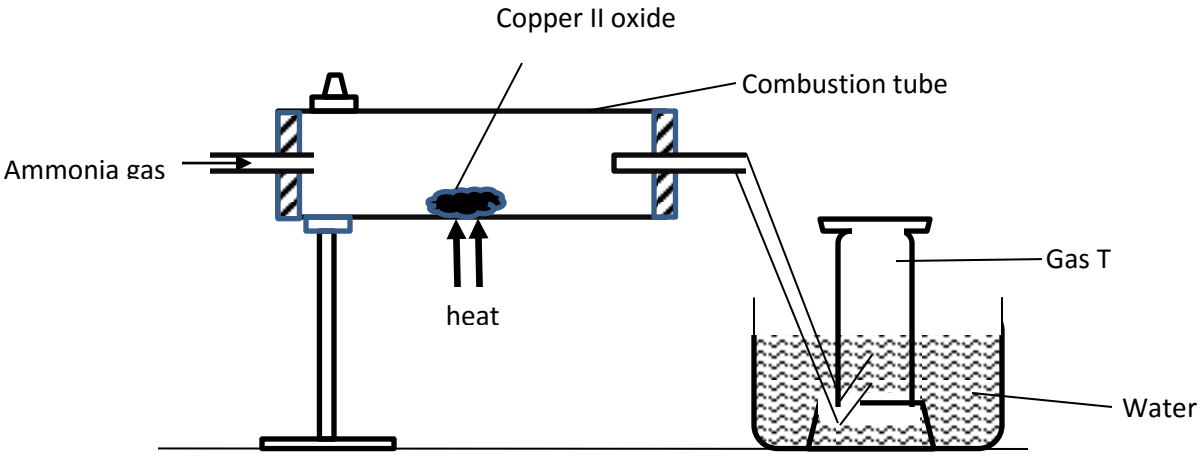
$Pb^{2+}_{(aq)} + 2e\ Pb_{(s)} = -O.13V$

$Mg^{2+}_{(aq)} + 2e\ Mg_{(s)} = -O.76V$

a) Write the overall Redox reaction that takes place when the above half cells are connected. (1mk)
b) Determine the Eθ value of the above cell. (2mks)

21. (a) CFCs have become a big pollution concern this days, what are CFCs. (1mk)
(b) State two examples of substances that contain CFCs. (1mk)
(c) State one negative effect of CFCs. (1mk)

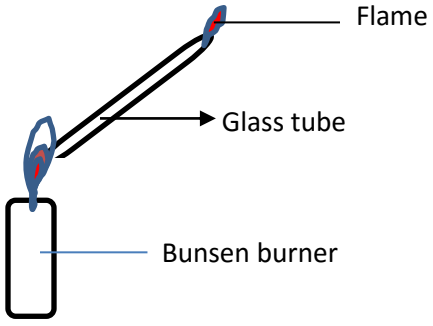
22. The set-up below was used to investigate reaction between copper (II) oxide and ammonia gas



a) Identify gas T (1mk)
b) Write an equation for the reaction that took place in the combustion tube. (1mk)
c) State the observation made in the combustion tube. (1mks)

23. a) Name the process by which propanol is converted to propanoic acid. (1mk)
b) Explain why solubility of propanol is higher than that of propane. (2mks)

24. Study the set up below and answer the questions



i) What does the experiment show? (1mk)
ii) Name the type of flame shown above (1mk)
iii) Name one characteristic of the flame (1mk)

25. a) Sodium chloride dissolves in water to give a neutral solution but aluminium chloride dissolves in water to form Acidic solution. Explain. (2mks)
b) Aluminium (III) chloride has a relative formula mass of 267 when in gaseous state. Explain (1mk)

26. Write the electronic arrangement of sulphur in the following: (s=16) (3mks)
i) SO_3^{2-}
ii) SO_3

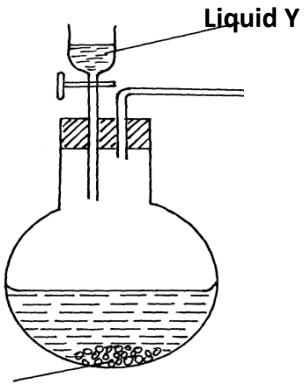
27. a) What is an acid base indicator. (1mk)
b) Explain why universal indicator may be preferred to acid base indicator. (2mks)

28. In the very cold countries, salts are sprinkled on the roads during winter.
i) Explain why this is important. (1mk)
ii) Give one negative effect of this. (1mk)

29. Chlorine gas reacts with cold dilute sodium hydroxide to form a bleaching agent W.
a) Write the formula of the substance W (1mk)
b) Write an equation to show how substance W bleaches. (1mk)

GATUNDU SOUTH JOINT EXAM
233/2
CHEMISTRY
PAPER 2
(THEORY)

1. The following diagram represents an incomplete setup of apparatus that can be used to prepare and collect dry sulphur (IV) oxide gas.



i) Complete the diagram to show how dry sulphur (IV) oxide gas may be collected (3mks)
ii) Identify Liquid Y (1mk)
iii) Write an equation for the reaction which takes place in the round-bottomed flask (2mk)
iv) State the precaution that should be taken during this experiment (1mk)

b) State and explain the observations made when a piece of burning magnesium is lowered into a gas jar full of sulphur (IV) oxide gas (2mks)

c) The following equation represents the reaction that occurs during the contact process.

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \qquad \Delta H = -197kJmol^{-1}$

i) Name the catalyst used in this reaction (1mk)

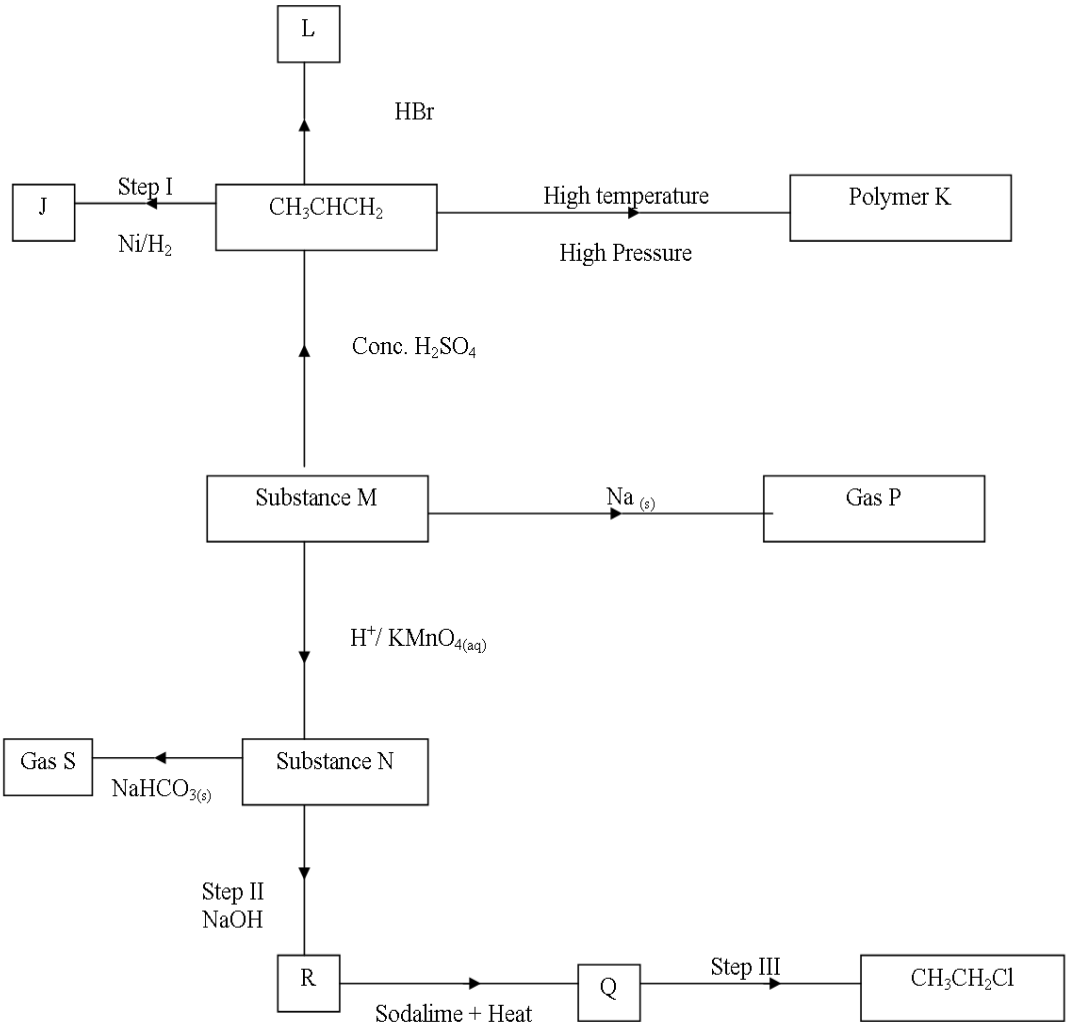
ii) State and explain the effect of increased pressure on the yield of sulphur (VI) oxide (2mks)

iii) The sulphur (VI) oxide is normally absorbed in concentrated sulphuric (VI) acid and not in water. Explain (1mk)

2. A i) Write the equation for complete combustion of one **mole** of ethane (1mk)

ii) Give one use of ethanol (1mk)

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



(a) Name the following

(i) Gas S (1mk)

(ii) Gas p (1mk)

(iii) J (1mk)

(b) Name process in

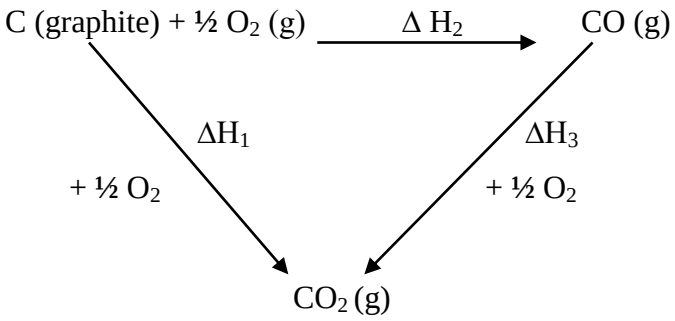
(i) Step I (1mk)

(ii) Step II (1mk)

(iii) Step III (1mk)

(c) Draw two structural Isomers of compound L. (2mks)
(d) Write a chemical equation for the complete combustion of Substance M. (1mk)
(e) Name the reagent and condition in step III.
(i) Reagent. (1mk)
(ii) Condition
(f) Calculate the mass of salt R that would be formed by using 21.9 tonnes of N when it reacts with excess Sodium hydroxide. (C=12.0, H=1.0, Na=23.0, O=16.0) (2mks)

3. a) Study the following energy cycle diagram and then answer the questions that follow.



(i) Name the enthalpy change represented by ΔH_2? (1mk)
(ii) Use the following information to calculate the value of ΔH_1 for 144g of graphite.
$\Delta H_2 = -110 kjmol^{-1}$ $\Delta H_3 = -283 kjmol^{-1}$ (2mks)

(b) The following table gives molar enthalpies of combustion of some substances. Study it and answer the questions that follow.

$C_4H_{10}(g) + \frac{13}{2} O_2(g) \longrightarrow 4CO_2(g) + 5H_2O(l)$ $\Delta H^{\theta}_c = -2877 kjmol^{-1}$

$C(s) + O_2(g) \longrightarrow CO_2(g)$ $\Delta H^{\theta}_c = -399 kjmol^{-1}$

$H_2(g) + \frac{1}{2} O_2(g) \longrightarrow H_2O(l)$ $\Delta H^{\theta}_c = -286 kjmol^{-1}$

(i) What is molar enthalpy of combustion of a substance? (1mk)
(ii) Calculate the molar enthalpy of formation of butane (C_4H_{10}) using the information given above? (3mks)

(c) The following results were obtained in an experiment to determine the heat of neutralization of 25 cm^3 of 2M sodium hydroxide using 25 cm^3 of hydrochloric acid.
Initial temperature of acid = 25.0^oC
Initial temperature of alkali = 26.0^oC
Final temperature of the mixture of acid + alkali = 38.5^oC
Density of solution = $1 gcm^{-3}$
Specific heat capacity of solution = $4.2 Jg^{-1}K^{-1}$
(i) Define molar heat of neutralization (1mk)
(ii) Write an ionic equation for the neutralization reaction involving hydrochloric acid and sodium hydroxide solution. (1mk)
(iii) Calculate
I. The enthalpy change during this experiment. (2mk)
II. The molar enthalpy of neutralization for this reaction. (2mks)

4. a) The following are standard electrode potentials for some electrodes. The letters do not represent the actual symbols of the elements.
Element

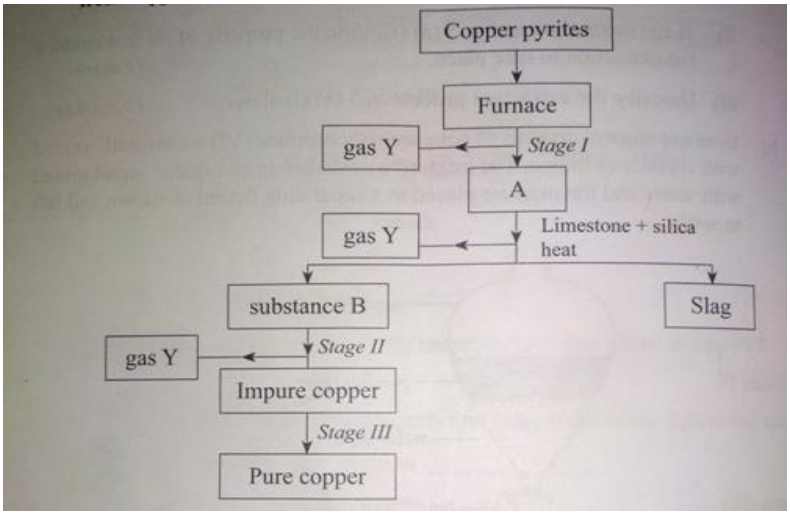
	E^{θ} Volts
$A^{2+}_{(aq)} + 2e^- \rightleftharpoons A_{(s)}$	-2.92
$B^{2+}_{(aq)} + 2e^- \rightleftharpoons B_{(s)}$	-2.28
$C^{2+}_{(aq)} + 2e^- \rightleftharpoons C_{(s)}$	0.00
$D^{2+}_{(aq)} + 2e^- \rightleftharpoons D_{(s)}$	+0.34
$E^{2+}_{(aq)} + 2e^- \rightleftharpoons E_{(s)}$	+2.87

(i) Which is the weakest reducing agent? Explain. (1 mk)
(ii) Calculate the *e.m.f* of the cell obtained by combining the half cells of B and D. (2 mks)
(iii) Write the cell representation for the electrochemical cell obtained in 2 b (ii) above. (1 mk)
(iv) Is it possible to store E nitrate in a container made of A. Give a reason for your answer. (2 mks)

(b) An element X forms a stable ion X^{2+}. 14.125g of element X was electrolyzed completely by passing a current of 1.34 A for 150 minutes. Calculate the Relative Atomic Mass (RAM) of X. (3mks)

(c) In another experiment copper was purified using electrolysis. Draw a diagram to show how the process would be carried out. (3mks)

5. The following flow chart represents the process of extraction of copper metal from copper pyrites. Study it and answer the questions that follow.



(a) Name two substances produced in the furnace. (1mk)
(b) Identify
(i) Gas Y (½mk)
(ii) Substances B (½mk)

(c) Write an equation for the reaction that occurs in stage II. (1mk)
(d) What is the role of silica in this extraction process? (1mk)
(e) Name the process that takes place stage III. (1mk)
(f) (i) Explain how copper conducts electricity. (1mk)
(ii) State the composition of bronze. (1mk)
(g) Name the gas produced when copper metal reacts with 50% concentrated nitric (iv) acid. (1mk)
(h) Give any two uses of copper. (2mks)
(i) Name one other copper ore. (1mk)

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

Element	A	B	C	D	E	F	G
Atomic radius (nm)	0.156	0.136	0.125	0.110	0.110	0.104	0.099
Ionic radius (nm)	0.095	0.065	0.050	-	-	0.184	0.181
1^{st} Ionization energy KJ/mol	492	743	790	791	1060	1063	12.54
Mpt (^oC)	97.8	650	660	1410	44.2	119	-101
Atomic number	11	12	13	14	15	16	17

I Explain why
(i) A has a larger atomic radius than its ionic radius? (½mk)
(ii) G has a smaller atomic radius than its ionic radius? (½mk)
II Comment on the trend of melting points from A to C. Explain. (1mk)
III What is the general trend of the 1^{st} ionization energies for elements A – F. Explain? (1mk)
IV Explain why D has the highest melting point. (1mk)

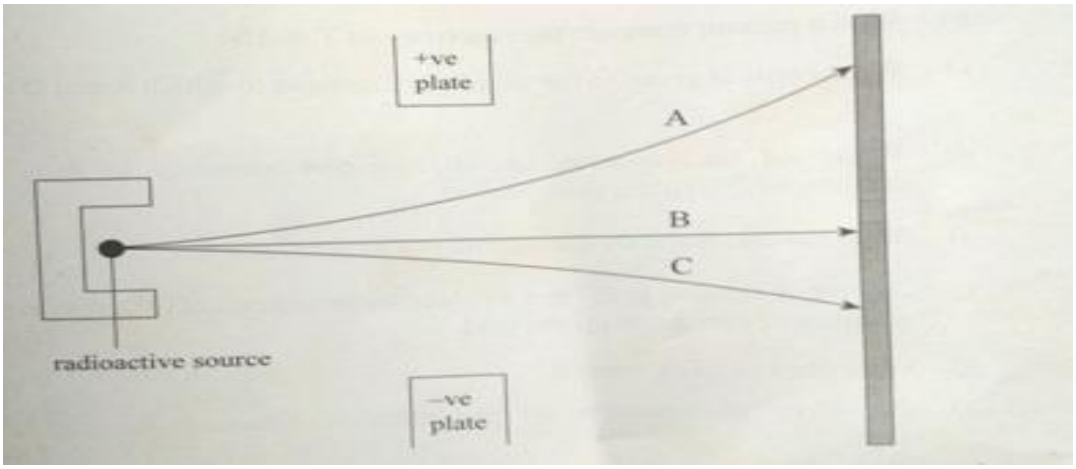
(b) The grid below is a section of the periodic table. The letters do not represent the actual symbols of the elements. Use it to answer the questions that follow.

								Q
Y				M			N	
K	L					S	O	R
							P	

(i) How does electro negativity vary from N to P? Explain (2mks)
(ii) Give the formula of the compound formed between L and P. (1mk)
iii) An oxide of Y was dissolved in water to form a solution. How would you distinguish between this solution and a solution made by dissolving an oxide of S in water? Explain. (2mks)
iv) Write the electron arrangement of the ion L^{2+} (1mk)

7. (a) Define radioactivity? (1mk)

(b) The following diagram shows the effect of an electric field on radiations from a radioactive source.



(i) Identify the radiations marked A, B and C. (3mks)
(ii) With a reason compare the deflection of the radiations A and C. (2mks)
(iii) Which of the radiations has the highest penetration power? (1mk)

(c) Give one use of radioactivity in agriculture. (1mk)

GATUNDU SOUTH JOINT EXAM
233/3
CHEMISTRY
PAPER 3
(PRACTICAL)

1. You are provided with
   - ⇨ Solution S containing 25.2g per dm^3 of a compound $H_2C_2O_4X.H_2O$.
   - ⇨ Solution W 1.99M sodium hydroxide solution.

   You are required to: -
   a) Prepare a dilute solution sodium hydroxide (solution W)
   b) Determine the value of X in $H_2C_2O_4X.H_2O$.

   PROCEDURE I:

   Using a pipette and pipette filler, place $25cm^3$ of solution W into a $250cm^3$. Volumetric flask shake well. Add more distilled water up to the mark. Label this solution Q. Fill a burette with solution S, pipette $25.0cm^3$ of solution Q into a conical flask. Add two drops of phenolphthalein indicator and titrate with solution S. Record your observations in table 1. Repeat two more times and complete the table.

   TABLE I: (4mks)

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

   Determine the:

i) Average volume of solution S used. (1mk)
ii) Concentration of solution Q in moles dm^{-3}. (1mk)
iii) Concentration of solution S in moles dm^{-3}. (2mks)
iv) The RFM (relative formula mass) of $H_2C_2O_4.XH_2O$. (1mk)
v) The value of x in $H_2C_2O_4.xH_2O$. (1mk)
(H =1, C= 12, O =16)

PROCEDURE II

You are provided with the following: -

- Hydrogen peroxide labelled solution A.
- Dilute sulphuric acid labelled solution B.
- Sodium thiosulphate labelled solution C.
- Potassium iodide labelled solution D.
- Starch solution labelled solution E.
- Distilled water in a wash bottle.

You are required to determine how the rate of hydrogen peroxide with potassium iodide varies with the concentration of hydrogen peroxide.

EXPERIMENT 1.

- Label two 200ml or 250ml beakers as beaker 1 and beaker 2.
- Using a clean burette, place 25.0cm^3 of solution A into beaker 1. Into the same beaker, add 20cm^3 of solution B using a 50ml or 100ml measuring cylinder. Shake the contents of beaker 1.
- Using a 10ml measuring cylinder, place 5cm^3 of solution C into beaker 2 followed by 5cm^3 of solution D then 2cm^3 of solution E. Shake the contents of beaker 2. Pour the contents of beaker 2 into beaker 1 and start a stop clock/watch immediately. Swirl the mixture and let it stand. Note the time taken for the blue colour to appear. Record the time in the space provided for experiment 1 in the table below. Clean beaker 1. Repeat the procedure with the volume of water solutions A, B, C D and E as shown in the table for experiments 2 to 5. Complete the table by computing $\frac{1}{time}$ sec -1. (7½mks)

a)

Experiment	Beaker 1			Beaker 2				
	Volume of water (cm^3)	Volume of hydrogen peroxide solution A (cm^3)	Volume of dilute sulphuric acid, solution B (cm^3)	Volume of sodium thiosulphate, solution C (cm^3)	Volume of potassium iodide, solution D (cm^3)	Volume of starch solution, solution E (cm^3)	Time (sec)	$\frac{1}{time}$ Sec -1.
1	0	25	20	5	5	2		
2	5	20	20	5	5	2		
3	10	15	20	5	5	2		
4	15	10	20	5	5	2		
5	20	5	20	5	5	2		

b) Plot a graph of $\frac{1}{time}$ sec $^{-1}$. (y- axis) against volume of hydrogen peroxide used (solution A) (3mks)

c) From your graph, determine the time that would be taken if the contents of beaker 1 were: 17.5cm^3 water, 7.5cm^3 solution A and 20cm^3 solution B. (2mks)

d) How does the rate of reaction of Hydrogen peroxide with potassium iodide vary with the concentration of hydrogen peroxide? (1mk)

2. (a) Place about half of the solid H in a clean dry test tube. Heat the solid gently and then strongly. Test for any gas produced using both blue and red litmus papers.

(b) Dissolve the remaining portion of solid H in about 8cm^3 of distilled water contained in a boiling tube. Divide the solution into three portions.

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

(ii) To the second portion, add two drops of solution A (hydrogen peroxide) then add aqueous sodium hydroxide drop wise until in excess.

(iii) (a)To the third portion, add 2 – 3 drops of barium chloride solution.

(b) To the mixture in (iii) (a) above, add about 2cm^3 of 2M aqueous hydrochloric acid.

3. You are provided with liquid F. Carry out the tests below. Record your observations and inferences in the spaces provided.

a) Place three or four drops of liquid F on a watch glass. Ignite the liquid using a Bunsen burner.

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

c) To about 1cm^3 of liquid F in a test tube, add a small amount of solid sodium carbonate.

d) To about 2cm^3 of liquid F in a test tube, add about 1cm^3 of acidified potassium dichromate (VI). Warm the mixture gently and allow it to stand for about one minute.

GATUNDU SOUTH JOINT EXAM
CHEMISTRY PAPER 3
JULY/AUGUST 2019

CONFIDENTIAL
REQUIREMENTS

- ⇨ Solution S – 100cm^3
- ⇨ solution W – 100cm^3
- ⇨ solution A – 120cm^3
- ⇨ solution B – 150cm^3
- ⇨ solution C – 40cm^3 supplied with a dropper
- ⇨ solution D – 40cm^3 supplied with a dropper
- ⇨ Solution E 15cm^3 supplied with a dropper
- ⇨ 250cm^3 distilled water.

- ⇨ pipette
- ⇨ burette
- ⇨ 250ml volumetric flask
- ⇨ 3 labels
- ⇨ 250ml – two beakers
- ⇨ 10ml measuring cylinder
- ⇨ stop watch
- ⇨ 50mlov 100ml measuring cylinder
- ⇨ about 0.4 g solid H (solid H hydrated iron (II) sulphate)
- ⇨ boiling tube and 6 test tubes
- ⇨ red and blue litmus paper
- ⇨ spatula
- ⇨ liquid F – 10cm^3 of ethanol (cover with foil paper)
- ⇨ watch glass (or clean bottle top)
- ⇨ 0.1g of sodium carbonate
- ⇨ conical flask

ACCESS

- ⇨ Phenolphthalein indicator
- ⇨ 2M sodium hydroxide
- ⇨ 2m hydrochloric acid
- ⇨ barium chloride
- ⇨ source of heat
- ⇨ acidified potassium dichromate

PREPARATION

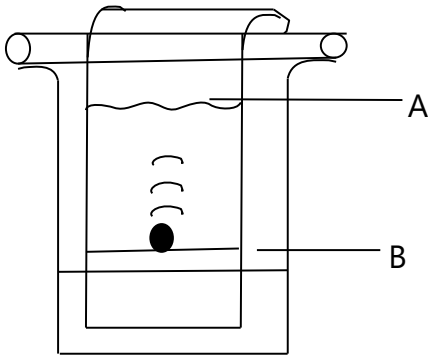
- ⇨ Solution S is prepared by dissolving 25.2 grams oxalic in 800cm^3 of water and then diluting it to litre.
- ⇨ Solution W, 1.99m Sodium hydroxide.
- ⇨ Solution A is prepared by adding 200cm^3 of fresh 20 volume hydrogen peroxide to about 600cm^3 of distilled water and diluting to one litre of solution. (this solution should be prepared one day before the day of examination, stored in Stoppard container and supplied on the morning on the examination)
- ⇨ solution B is 2M sulphuric (IV) acid
- ⇨ Solution C is prepared by dissolving 12g of solid C in about 800cm^3 of distilled water and diluting to one litre of solution. (solution C $Na_2S_2O_3$)
- ⇨ Solution D (KI) is prepared by dissolving 10g of solid D in about 700cm^3 of distilled water and diluting to one litre solution.
- ⇨ Solution E is prepared by dissolving 10gm of solid E starch in about 600cm^3 of warm distilled water and diluting with warm water to one litre of solution.

GATUNDU SOUTH JOINT EXAM
CHEMISTRY PAPER 1
MARKING SCHEME

1. (i) P – Hexane (1mk)
   (ii) W – Water (1mk)
2. To separate samples of CUO and charcoal in test tubes, dilute mineral ($^1/_{2mk}$) acid is added with shaking CUO dissolves to form blue solution ($^1/_{2mk}$) charcoal does not dissolve in dilute mineral acids (1mk)
3. i. Range of boiling points / no sharp boiling points (1mk)
   ii. Carry out fractional distillation (1mk)
4. - As a fuel (2mks)

CHEMISTRY PAPER 1

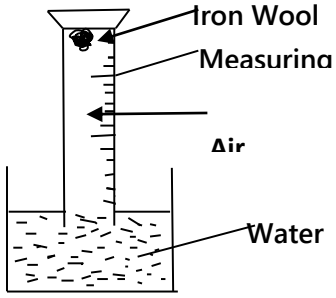
1. Chromatography can be used to test for the purity of substances.
   Describe one area in everyday life where purity of substances is important (1mark)
2. The diagram shows the apparatus used to separate different dyes in food colouring.



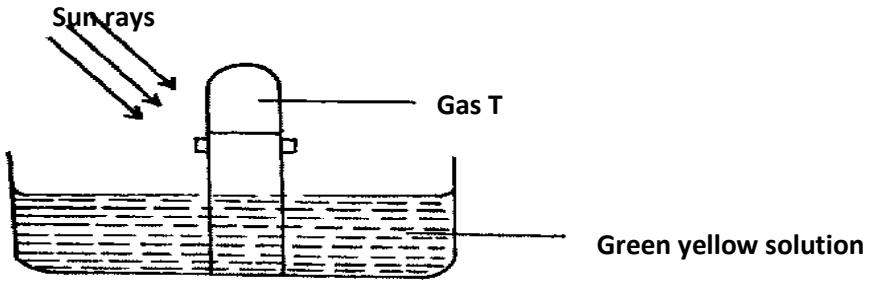
   Name the parts labeled A & B (2marks)
3. Describe how a solid sample of copper (II) carbonate can be prepared starting with copper metal. (3 marks)
4. The table below describes the reaction of some metals with water.

METAL	REACTION
Calcium	Reacts rapidly with cold water producing many bubbles of gas.
Magnesium	Reacts very slowly with cold water but reacts rapidly with steam.
Rubidium	Reacts very rapidly with cold water producing many bubbles of gas and will explode.
Zinc	Only reacts with steam when in powdered form and heated very strongly.

   Arrange these metals in order of their reactivity beginning with the most reactive. (2marks)
5. A student set up an experiment to demonstrate rusting as shown below. He made observations at the start of the experiment and after two weeks.



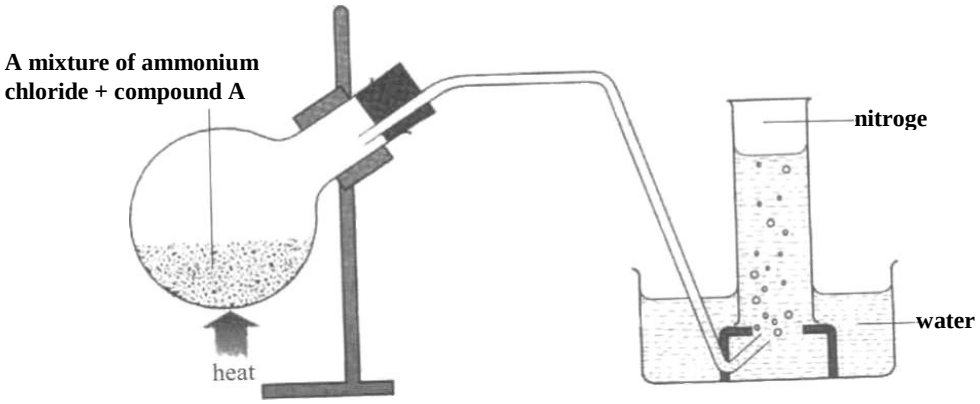
   State and explain the observations made in the measuring cylinder after two weeks. (2marks)
6. A student wanted to determine the solubility of potassium nitrate at a certain temperature. He obtained the following results.
   Mass of evaporating dish = 12.72g
   Mass of evaporating dish + saturated solution = 34.10g
   Mass of evaporating dish + salt = 17.00g
   Calculate the solubility of potassium nitrate from the results above. (3 marks)
7. Chlorine gas was bubbled through water for some time. The green yellow solution formed was poured into a long glass tube and placed in the sun as shown in the diagram below .



a) What compounds are in the green yellow solution? (1mk)
b) Write an equation to show how gas **T** is formed (1mk)
c) Give **one** use of chlorine (1mk)

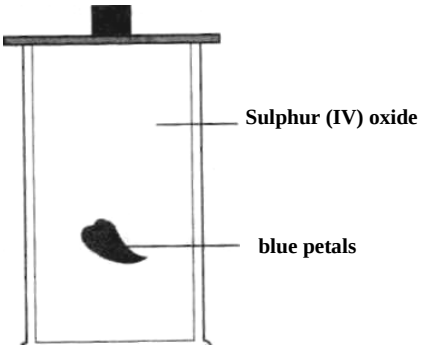
8. A gas occupies 4 litres at 250K and 152mmHg pressure. At what pressure will its volume be halved, if the temperature then is 227^0C? (3 marks)

9. The set up below shows the preparation of nitrogen gas in the laboratory. (3 marks)



a) Name compound A. (1 marks)
b) Write an equation for the reaction above. (1 marks)
c) Why is ammonium nitrite not heated directly to prepare nitrogen gas? (1 marks)

10. Blue petals were dropped into a gas jar containing sulphur (IV) oxide as show below. (4 marks)
    a) Which observation was made? (1 marks)
    b) Which property of sulphur (IV) oxide is exhibited above ? (1 marks)



    c) Write the equation for the reaction above. (1 marks)
    d) Explain the observation above. (1mk)
11. (a) State Graham's law of diffusion. (1mk)
    (b) **60cm^3** of oxygen diffused through a porous plate in **20 seconds**. How long will it take **120cm^3** of carbon (iv) oxide gas to diffuse through the same plate under the same conditions? **(C=12 , O=16)** (2mk)
12. a) State Hess law. 1mk
    b) What happens to the heat energy supplied to a liquid
    i) before it starts boiling? 1mk
    ii) when it is boiling **1mk**
13. The following tests were carried out in 3 separate portions of a colourless solutions S.

	Test	**Observation**
i	Adding dil HCL acid to solution S	No observable change
ii	Adding $Na_2CO_{3(aq)}$ to the second portion	A white precipitate is formed
iii	Adding aqueous ammonia to the third portion	A white precipitate which dissolves in excess ammonia

    a) From the information in test (i) name one cation which is not present in solution S. 1mk
    b) Identify a cation which is likely to be present in solution S. 1mk
    c) Write an ionic equation for the reaction which takes place in test (iii) 1mk

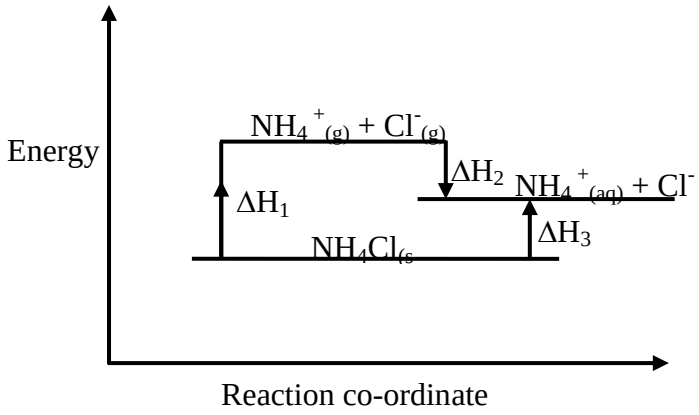
14. Zinc metal and hydrochloric acid reacts according to the following equation

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

    2.0g of Zinc metal were reacted with 100cm^3 of 0.2M Hydrochloric acid.

    a) Determine the reagent that was in excess. (Zn=65.4) 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)

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



(a) What do ΔH_1 and ΔH_2 represent. (2marks)

(b) Write an expression to show the relationship between ΔH_1, ΔH_2 and ΔH_3. (1mark)

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

$E^{2+}_{(aq)} + 2e \rightleftharpoons E_{(s)}$ -0.76V

$F^{3+}_{(aq)} + 3e \rightleftharpoons F_{(s)}$ -1.66V

$G^{2+}_{(aq)} + 2e \rightleftharpoons G_{(s)}$ -0.44V

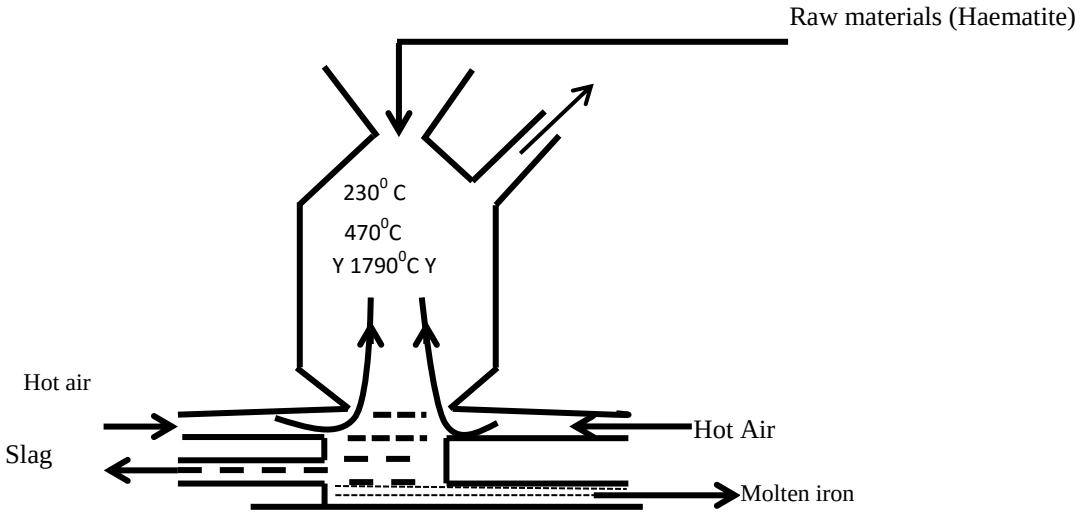
(a) Calculate the E^{θ} value for the electrochemical cell represented below. (1mark)

$F_{(s)} \mid F^{3+}_{(aq)} \parallel G^{2+}_{(aq)} \mid G_{(s)}$

(b) Arrange the elements in order of reactivity starting with the least reactive. (1mark)

(c) Explain if it would be advisable to store element G in a solution containing E^{2+} Ions. (1mark)

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



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

Name) –

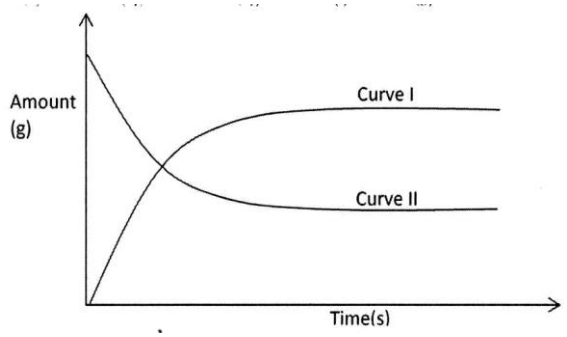
Use –

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

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

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

$CaCO_{3(s)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + H_2O + CO_{2(g)}$

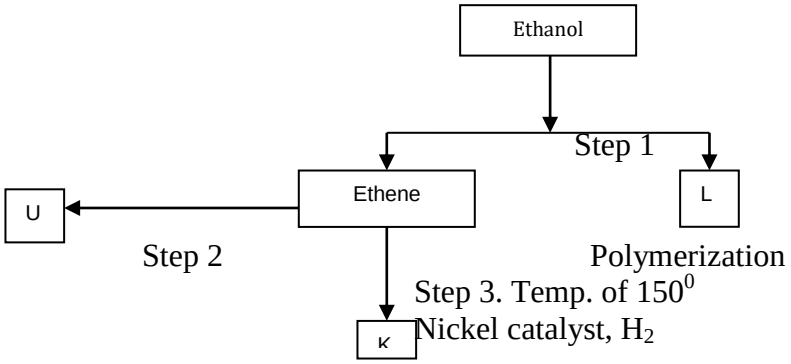


(a) Which curve shows the amount of calcium chloride varying with time? (1mk)

(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)

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



(a) Identify substances: K, U L (1½ marks)

(b) State the conditions for the reaction in step 1 to occur. (2mks)

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

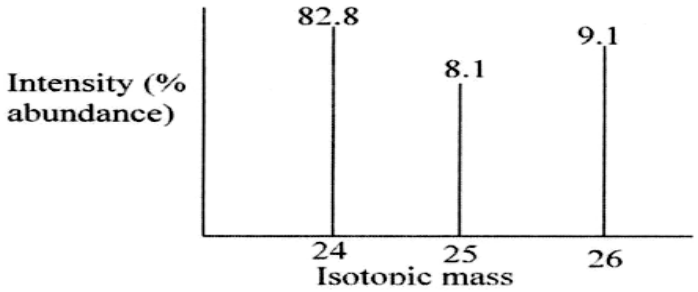
19. In an experiment to study properties of carbon, a small amount of charcoal is placed in a boiling tube. 5.0cm^3 of concentrated nitric acid is added. The mixture is then heated.

(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)

20. The peaks below show the mass spectrum of element X.



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

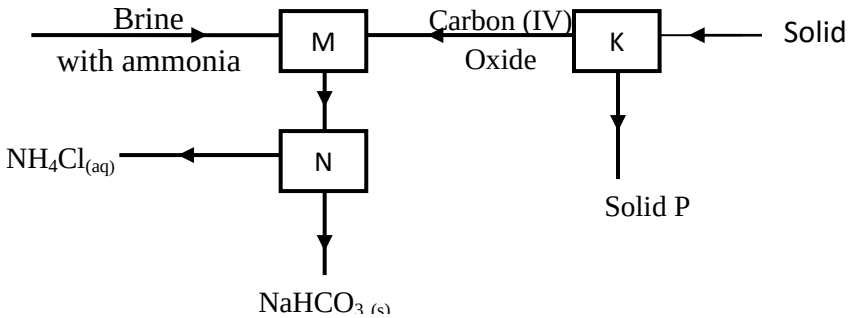
21. The equation for the reversible reaction of Bismuth (III) chloride in water is

$BiCl_{3(s)} + H_2O_{(l)} \rightleftharpoons BiOCl_{(s)} + 2H^+_{(aq)} + 2Cl^-_{(aq)}$

a) State Le chatelier's principle (1 mark)
b) What would be the effect of adding NaOH pellets to the equilibrium mixture. Explain. (2 marks)

22. Thorium $^{232}_{90}Th$ undergoes two consecutive alpha decays followed by two consecutive beta decays to form the nuclide $^{x}_{y}R$. Identify the values of x and y. (2 marks)

23. The diagram below shows part of Solvay Process.



(a) Name solid P (1 Mark)
(b) State the process taking place in chamber N. (1 mark)
(c) State two uses of calcium chloride which is a by-product in this process. (1 mark)

24. Substance L, M, N and P have the following properties.

Substance	M.P.	Solubility in water	Electrical conductivity	
			Solid state	Liquid state
L	Low	Soluble	Does not	Does not
M	High	Soluble	Does not	Conducts
N	High	Soluble	Conducts	Conducts
P	High	Insoluble	Does not	Does not

(a) Select the letter which represents a substance which is suitable for making kettle handles (1mk)
(b) Which letter represents a substance which is likely to be sodium chloride? (1mk)
(c) Name the bond structure and bond type likely to be in L. (1mk)

(i) Bond structure

(ii) Bond type

25. The table below shows some solutions and their PH values.

Solution	PH value
P	1.5
Q	6.0
R	14.0
S	8.0

Which of the above solutions.

(a) Is strongly basic. (1 mark)

(b) Reacts with sodium carbonate more vigorously. (1 mark)

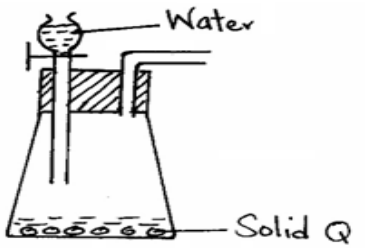
(c) Is ammonia solution. (1 mark)

26. Write the equation for decomposition of:

(a) Sodium nitrate. (1 mark)

(b) Copper (ii) Nitrate (1 mark)

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



(a) Name substance Q. (1 mark)

(b) Complete the set-up to show how oxygen gas is collected. (1 mark)

(c) Write the equation for the reaction that occurs. (1 mark)

28. When an electric current of 0.5A was passed through a molten chloride of J for 32 minutes and 10 seconds, a mass of 0.44g of J was deposited at the cathode. (IF = 96500C).

(a) Calculate the quantity of electricity used. (1 mark)

(b) Determine the value of χ if the ion of metal J is represented as $J^{\chi+}$.
(R.A.M of J = 44). (1 mark)

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

A			D	E			H	I
B	C		M		F	G		J

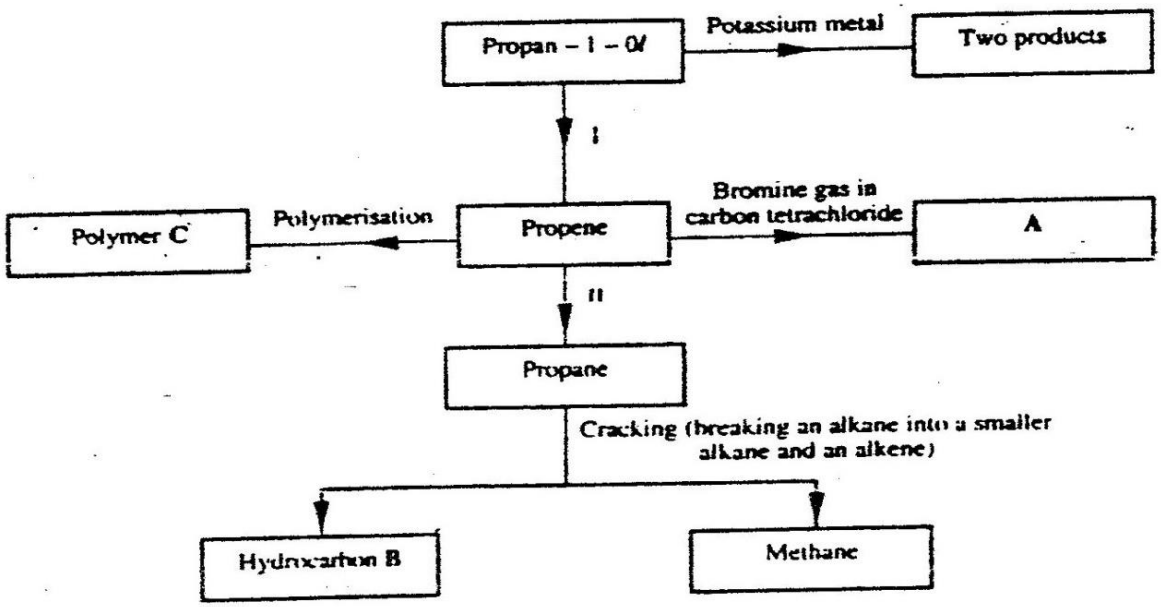
(a) What is the name given to the chemical family of element **C**? (1 mark)

(b) Would element **B** react with **J**? Explain. (1 mark)

(c) Compare the melting points of **B** and **M**. (1 mark)

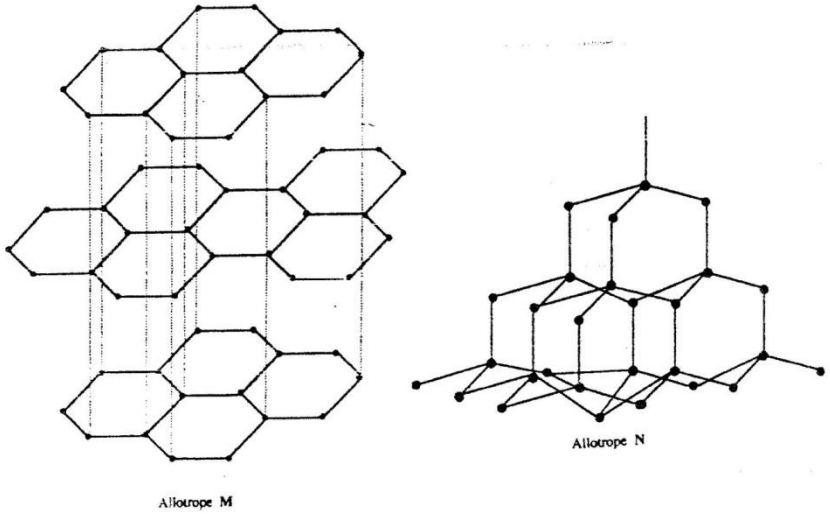
MERU SOUTH
233/2
CHEMISTRY PAPER 2
JULY/AUGUST 2019.

1. a) In which homologous series do the following compounds belong
   i) CH_3CCH (1mk)
   ii) CH_3CH_2COOH (1mk)
   b) Raw rubber is heated with sulphur in the manufacture of natural rubber.
   i) What is the name given to the process? (1mk)
   ii) Why is the process necessary? (1mk)
   c) Study the scheme given below and answer the questions that follow.



   i) Write an equation for the reaction between propan – 1 –ol and potassium metal. (1mk)
   ii) Name processes I and II (2mks)
   iii) Identify the products A and B (2mks)
   iv) Name one catalyst used in process II (1mk)
   v) Draw the structural formula of the repeating unit in the polymer C. (1mk)
   vi) State two industrial uses of methane. (2mk)

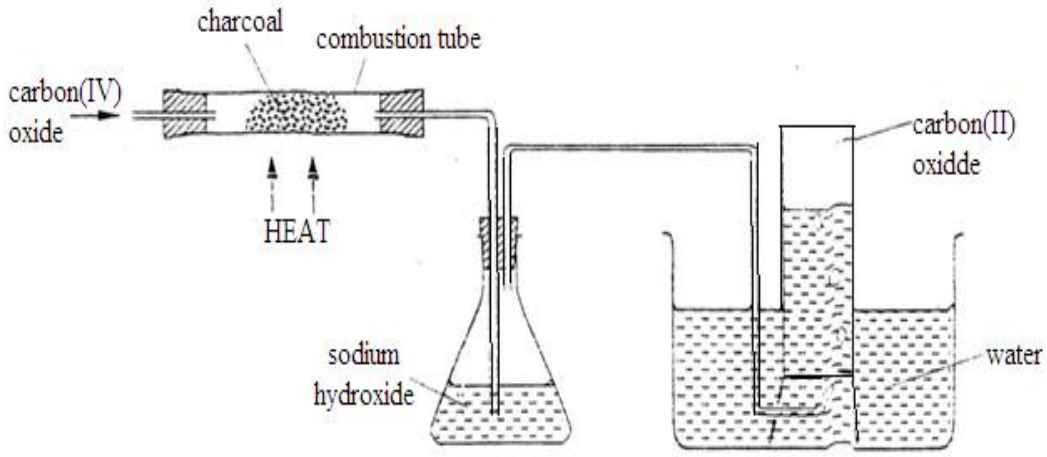
2. (a) The following diagrams show the structures of two allotropes of carbon. Study them and answer the questions that follow



Allotrope M

(i) What is meant by the term allotropy? (1mk)
(ii) Name allotrope (2mk)
(iii) Give one use of N (1mk)
(iv) Which allotrope conducts electricity? Explain (2mk)

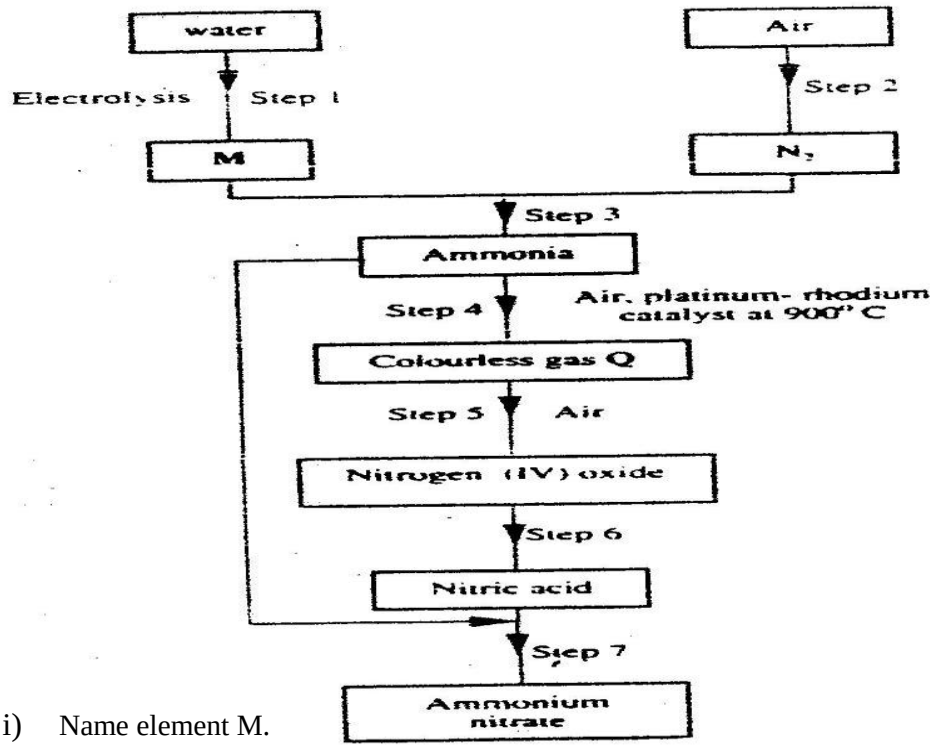
(b) In an experiment, carbon (IV) oxide gas was passed over heated charcoal and the gas produced collected as shown in the diagram below



(i) Write an equation for the reaction that took place in the combustion tube (1mk)
(ii) Name another substance that can be used instead of sodium hydroxide (1mk)
(iii) Describe a simple chemical test that can be used to distinguish between carbon (IV) oxide and carbon (II) oxide (3mk)
(iv) Give one use of carbon (II) oxide (1mk)

3. a) Fraction distillation of liquid air usually produces nitrogen and oxygen as the major products.
i) Name one substance that is used to remove carbon (IV) oxide from the air before it is changed into liquid. (1mk)
ii) Describe how nitrogen gas is obtained from the liquid air. (2mk)
(Boiling points nitrogen = - 196^{o}C, oxygen = -183^{o}C)

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



i) Name element M. (1mk)
ii) Why is it necessary to use excess air in step 4? (1mk)
iii) Identify gas Q. (1mk)
iv) Write an equation for the reaction in step 7. (1mk)
v) Give one use of ammonia nitrate. (1mk)

c) State and explain the observations that would be made if a sample of sulphur is heated with concentrated nitric acid. (2mks)

4. (a) An atom Q can be represented as $^{52}_{24}Q$.

What does the number 52 represent? (1mk)

(b) Study the information in the table below and answer the equations that follow. (Letters are not the actual symbols of the elements)

Element	Electronic arrangement of stable ion	Atomic Radius (nm)	Ionic Radius (nm)
N	2.8.8	0.197	0.099
P	2.8.8	0.099	0.181
R	2.8	0.160	0.065
S	2.8	0.186	0.095
T	2	0.152	0.068
U	2.8	0.072	0.136

(i) Write the formula of the compound formed when N reacts with P.
(Atomic numbers are N = 20; P = 17) (1mk)
(ii) Identify the elements which belong to the third period of the periodic table. Explain (2mks)
(iii) Which of the element identified in b (ii) above comes last in the third period? Explain (2mks)

(iv) Select two elements which are non- metals (1mk)

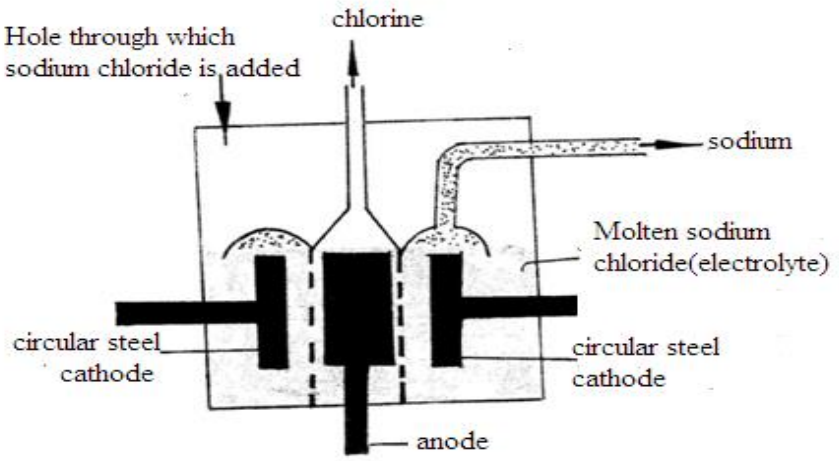
(c) The table below gives some properties of substances I, II, III, and IV. Study it and answer the questions that follow

Substance	Electrical conductivity		M.P (^{0}C)	B.P (^{0}C)
	Solid	Molten		
I	Does not conduct	Conducts	801	1420
II	Conducts	Conducts	650	1107
III	Does not conduct	Does not conduct	1700	2200
IV	Does not conduct	Does not conduct	113	440

(i) What type of bonding exists in substances I and II (1mk)

(ii) Which substances is likely to be sulphur? Explain (2mks)

5. (a) Below is a simplified diagram of the Downs Cell used for the manufacture of sodium. Study it and answer the questions that follow



(i) What material is the anode made of? Give a reason (2mks)

ii) What precaution is taken to prevent chlorine and sodium from re- combination? (1mks)

iii) Write an ionic equation for the reaction in which chlorine gas is formed (1mk)

(b) In the Downs process, (used for manufacture of sodium), a certain salt is added to lower the melting point of sodium chloride from about 800^{0}C to about 600^{0}C.

(i) Name the salt that is added (1mk)

(ii) State why it is necessary to lower the temperature (1mk)

(c) Explain why aqueous sodium chloride is not suitable as an electrolyte for the manufacture of sodium in the Downs process (2mk)

(d) Sodium metal reacts with air to form two oxides. Give the formulae of two oxides (1mk)

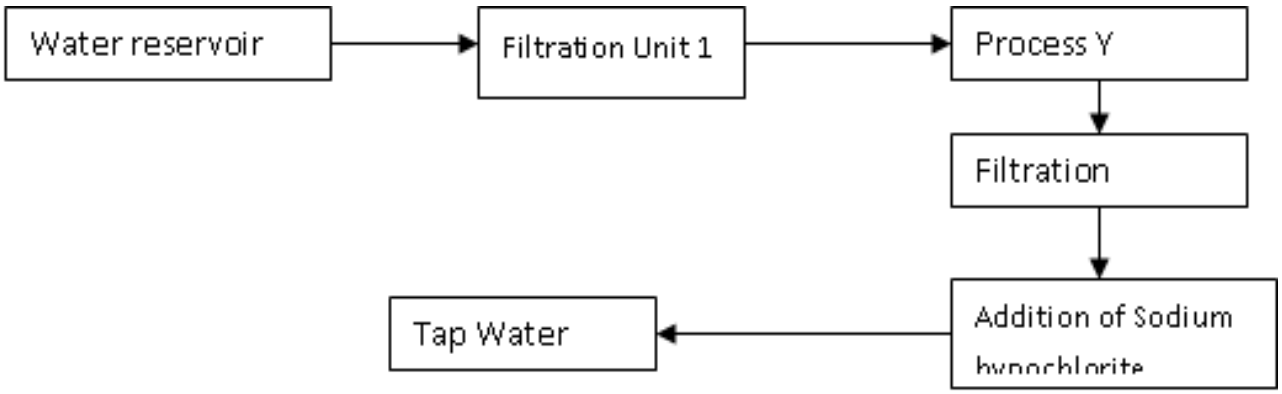
(e) State two uses of sodium (2mk)

6. (a) A student was supplied with a colourless liquid suspected to be water.

i) Describe one chemical test that could have been used to show that the liquid was water (2mk)

ii) How could it have been shown that the liquid was pure water? (1mk)

(b) The flow chart below shows the various stages of water treatment. Study it and answer the questions that follow



(i) Which substances are likely to be removed in filtration unit I? (1mk)

(ii) What is the purpose?

I. Process Y (1mk)

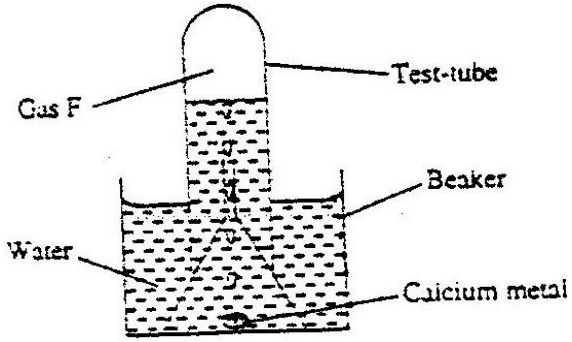
II Addition of sodium hypochlorite (1mk)

(c) It was confirmed that magnesium sulphate was present in the tap water

(i) What type of hardness was present in the water? (1mk)

(ii) Explain one method that can be used to remove the water hardness. (2mks)

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

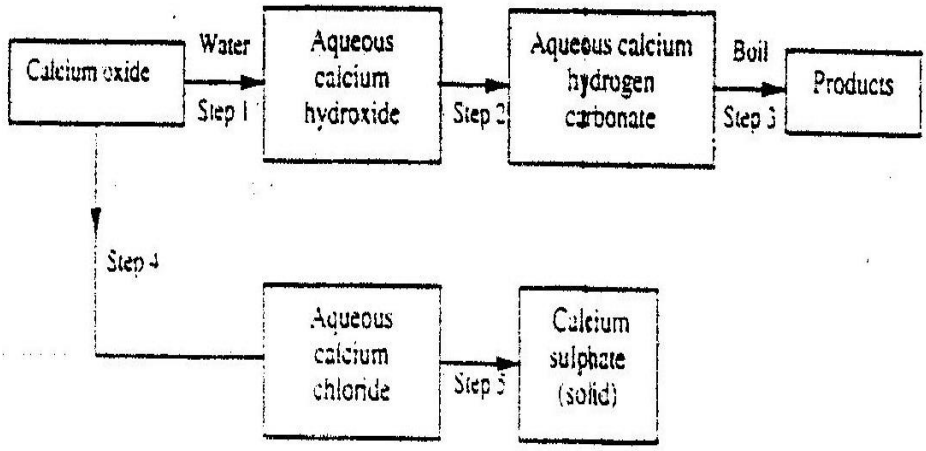


(i) Name gas F (1mk)

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

(iii) Give one laboratory use of the solution formed in a beaker. (1 mark)

(e) The scheme below shows some reactions starting with calcium oxide. Study it and answer the questions that follow.



(i) Name the reagents used in steps 2 and 4 (1mk)
Step 2
Step 4

(ii) Write an equation for the reaction in step 3. (1mk)

7. a) State two differences between chemical and nuclear reactions (2mks)

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

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

i) On the grid provided, plot a graph of the percentage of Bismuth remaining (Vertical axis) against time. (3mks)

ii) Using the graph, determine the:

I. Half – life of the Bismuth isotope (1mk)

II. Original mass of the Bismuth isotope given that the mass that remained after 70 minutes was 0.16g (2mks)

c) Give one use of radioactive isotopes in medicine (1mk)

MERU SOUTH
233/3
CHEMISTRY PAPER 3
PRACTICAL TIME: 2 ¼ HOURS
JULY 2019 FORM 4

1. **You are provided with;**

- Aqueous hydrochloric acid, solution **W**9 .
- Solution sodium **W**11 containing 6.3g of a dibasic acid $H_2C_2O_4.2H_2O$ per litre
- Aqueous sodium hydroxide, solution **W**12. 👉 Phenolphthalein indicator
- Solid M

You are required to;

- Standardize the sodium hydroxide solution **W**12
- Use the standardized solution **W**12 to determine the concentration of **W9**
- React the hydrochloric acid solution **W**9 with metal **M** and determine the mass per unit length of metal **M**.

Procedure

I. Fill a burette with solution **W**11, pipette 25.0cm^3 of solution **W**12 into a conical flask. Titrate using phenolphthalein indicator. Record your results in Table A below;

Table A.

	1st	2nd	3rd
Final Burette Reading			
Initial Burette Reading			
Volume of solution **W**11 (cm^3)			

(3 marks)

i) Average volume of solution **W**11 used (1 mark)

ii) Calculate the concentration of the dibasic solution W11 in mol^{-1}
(*C*=12, *H*=1, *O*=16) (1 mark)iii)

Calculate the concentration of the sodium hydroxide solution **W**12 in moll^{-1} (1marks)**II.**

Using a $100cm^3$ measuring cylinder measure $90cm^3$ of distilled water and place it into a $250cm^3$ beaker then add $10cm^3$ of solution **W**9 (**W**9 is supplied in a burette). Mix the solution well and label it **W**10.

Fill a burette with solution W10, pipette $25.0cm^3$ of solution W12 into a conical flask. Titrate using phenolphthalein indicator. Record your results in Table B below.

Table B.

	1st	2nd	3rd
Final Burette Reading			
Initial Burette Reading			
Volume of solution **W**10 used (cm^3)			

(3 marks)

i) Average volume of solution W10 used. (1 mark)

ii) Calculate the concentration of the diluted hydrochloric acid solution W10 in mol l^{-1}. (1 marks)

iii) Determine the concentration of the original hydrochloric acid solution W9 in mol l^{-1} (1 mark) **III**. Cut three pieces each of length 2cm from the metal **M** provided. From the burette containing **W**9 measure $10cm^3$ of **W**9 into a boiling tube. Wrap the boiling tube with tissue paper. Measure the temperature of this solution and record it in **Table C** below. Place one of the 2cm pieces of metal **M** into the hydrochloric solution **W9** in the boiling tube and measure the temperature. Record the highest temperature in table C below. Repeat this procedure using the other two, 2cm, pieces of M.

Table C.

	1st	2nd	3rd
Piece of metal M	1	2	3
Highest temperature			
Initial temperature			
Change in temperature, ΔT			

(3 marks)

i) Average change in temperature ΔT^0C (1 mark)

ii). Calculate the heat of the reaction between metal **M** and hydrochloric acid using the expression below;
heat of reaction (1 mark)

iii). Given that the heat of the reaction is 440Kj per mole of **M**. Calculate the number of moles of **M** used in this
reaction. (1 marks)

iv). Calculate the mass per unit length of metal M (M=24). (1 marks)

2. . You are provide with solid E which is suspected to be calcium nitrate . Using the reagents below, describe how you can confirm its presence

- Aqueous NaOH
- Dilute sulphuric (V) acid
- Aluminium foil
- Bunsen burner
- Red and blue litmus papers distilled water

Carry out the tests above

3. You are provided with solid F. carry out the following tests. Write your inferences and observations in the spaces provided.

a) Place all of solid F in a boiling tube. Add about 20cm of distilled water and shake until all the solid dissolves.
Label the solution F. Add about half of the solid hydrogen carbonate provided to 2 cm^3 of solution

b) i). Add about 10 cm^3 of dilute hydrochloric acid to the rest of solution F in the boiling tube. Filter the mixture. Wash the residue with about 2 cm of distilled water. Dry the residue
Between filter paper. Place about one third of the dry residue n metallic spatula and burn t on a Bunsen burner flame.

ii). Place all the remaining residue in to a boiling tube. Add about 10 cm^3 of distilled water and shake thoroughly. **Retain the mixture for the test in C**

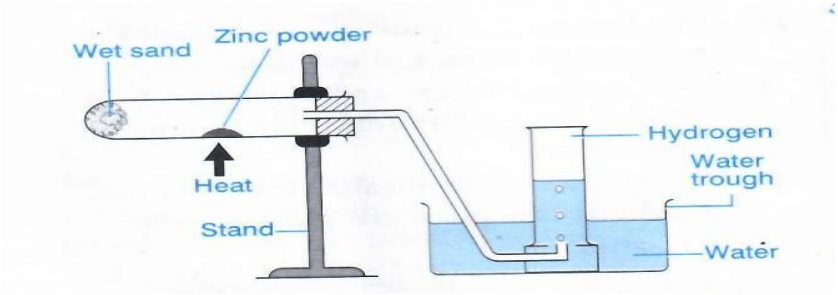
c) Divide the mixture in to two portions:
i. To the first portion add the rest of the solid sodium hydrogen carbonate.
ii. Describe a test show that the mixture above is unsaturated
Carry out the test above

Form IV
Chemistry Practical Confidential term 2 2019

1. Two 250ml conical flasks
2. One pipette filler
3. Two labels
4. 3 filter papers
5. About 75cm^3 of solution **W9**
6. About 100cm^3 of solution **W12**
7. About 150cm^3 of solution **W11 (oxalic acid)**
8. Exactly 10cm of metal **M (magnesium ribbon)**
9. One 50cm^3 burette
10. One 25cm^3 pipette
11. One filter funnel
12. Thermometer
13. 0.5g grams of solid F
14. 0.5g of solid E
15. Aluminium foil
16. Red and blue litmus papers
17. 15cm^3 of 2M HCl
18. About 0.3g of $NaHCO_3$
19. 200cm^3 of distilled water
20. Six dry test-tubes in a rack
21. Two boiling tubes
22. Tissue paper
23. Test-tube holder
24. Metallic spatula

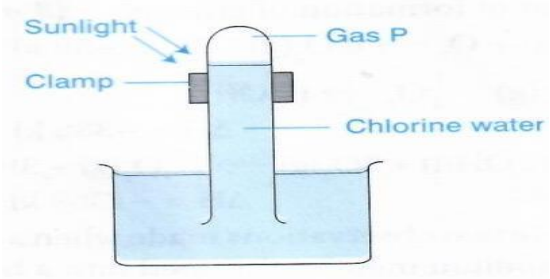
Access to:

- Dilute sulphuric (V) acid
- 2M NaOH



(a) Write down the chemical reaction that produces hydrogen gas. (1mk)
(b) Explain why hydrogen should be burned if not collected over water. (1mk)
(c) Give another metal that can be used instead of zinc. (1mk)

4. A piece of sodium metal was placed in a trough half filled with cold water. State **three observations** that were made. (3mks)
5. When 27.8g of hydrated Aluminum Oxide($Al_2O_3.XH_2O$) was heated to a constant mass,20.6 of A luminium Oxide was obtained. Determine the value of X.(H=1.0,O=16,Al=27) (3mks)
6. (a) State Graham's law of diffusion. (1mk)
   (b) Methane diffuses through a porous plug at the rate of $8cm^3S^{-1}$.Calculate the rate at which gas P,with a molecular of 28.44g will diffuse through the same material.(C=12,H=1.0) (2mks)
7. Carbon II Oxide gas was passed over heated copper II Oxide in a combustion tube.
   (a) State an **observation** that was made in the combustion tube. (1mk)
   (b) Write an equation for the reaction that's taking place. (1mk)
   (c) What characteristic of Carbon II Oxide is demonstrated from the equation? (1mk)
8. The apparatus below is used to investigate the action of sunlight on chlorine water.



(a) Identify the gas labelled P. (1mk)
(b) **State** and explain the **observation** that would be made if a blue litmus was dipped into the chlorine water. (2mks)

9. Observe the table below and use it to answer the questions that follows.

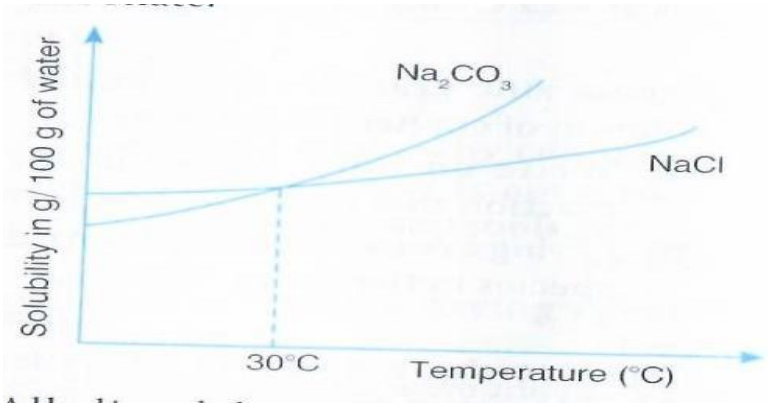
Element	Sodium	magnesium	Aluminium
Atomic radius(nm)	1.90	1.60	1.32

(a) Explain the trend in the atomic radius across the period. (2mks)
(b) Predict the the P.H of the solution of sodium Oxide. (1mk)

10.18cm^3 of dilute suphuric (vi) acid require 25cm^3 of 0.2M sodium hydroxide solution for complete neutralization.
(a) Write the equation for the reaction that took place. (1mk)
(b) Calculate moles of sodium hydroxide required to neutralize the acid. (1mk)
(c) Calculate the concentration of suphuric (vi) acid in $moldm^3$. (1mk)

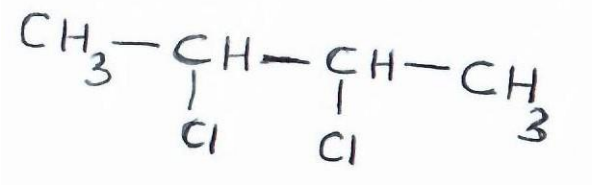
11.Excess zinc granules were added to a solution of Copper II sulphate in a beaker and stirred.
(a) Identify the **observation** that was made in the beaker after a while. (1mk)
(b) Giving ***a reason***, identify the ***oxidizing*** species in the reaction. (2mks)

12. Explain why a solution of hydrogen chloride gas in methylbenzene does not conduct electricity while the solution of the same gas in water conducts. (2mks)
13. The diagram below shows the solubility curves for sodium chloride and sodium carbonate.



(a)Name a method that can be used to separate the two salts in solution. (1mk)
(b)Identify and explain crystals that would be separated from the solution during;
(i) the day at 40^0c (1mk)
(ii) the night at 20^0c (1mk)

14. Compound P reacted with chlorine in absence of light to form compound Q.the structural formulae of compound Q is shown below.



(a) ***Name*** and give the ***structural formula*** of compound P. (2mks)
(b) Give the name of compound Q. (1mk)

15. Two gases,X2 and Y2, react to form a gaseous compound XY_3 according to the following equation.
$X_2 + 3Y_2 \longleftrightarrow 2XY_{3(g)}$ $\Delta H = -44kJ$

(a) Show the reaction on an energy level diagram. (3mks)
(b) State one way in which the yield of XY_3 can be increased. (1mk)

16. Complete the following nuclear equations. (2mks)

$^{234}_{90}Th \longrightarrow {}^{234}_{91}p +$ _____

$^{226}_{88}\text{Ra} \longrightarrow {}^{222}_{86}Rn +$ _____

17. State what would be ***observed*** if concentrated sulphuric (vi) acid was added to;
(a) Sugar crystals (1mk)
(b) Copper II sulphate crystals (1mk)
(c) What property of concentrated suphuric (vi) acid is demonstrated by the two reactions above. (1mk)

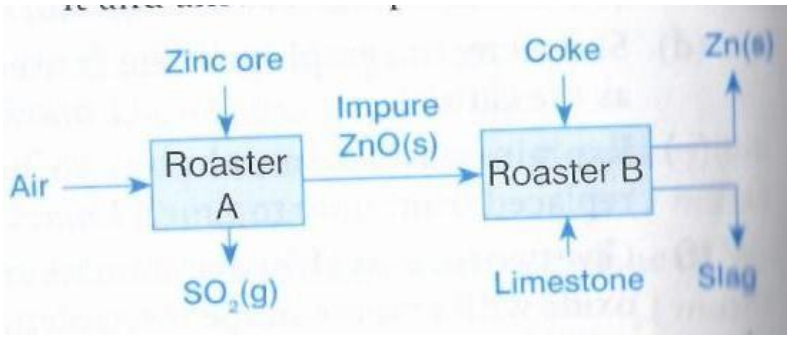
18.The P.H values of the following solutions are;1.0,5.0,7.0 and 14.0.Match the PH values with correct solution in the table below. (2mks)

Solutions	**P.H values**
Sodium chloride	
Potassium hydroxide	
Hydrochloric acid	
Lemon juice	

(b) Explain the meaning of term ***"liming"*** . (1mk)

19. A mixture of calcium hydroxide and Ammonium chloride was heated to produce gas P.
(a) Identify gas P. (1mk)
(b) Write an equation for the reaction that produces gas P. (1mk)
(c) ***Draw*** a diagram to show a method that can be used to collect the gas P. (1mk)

20.The flow chart below shows the processes involved in extraction of Zinc metal.Study it and answer the questions that follows.



(a) Name the main ore used in the extraction of Zinc. (1mk)
(b) What's the function of the limestone in roaster B.? (1mk)
(c) What do we call the process of coating an Iron metal with Zinc? (1mk)

21. ***Explain*** why sea water is not suitable for washing clothes. (2mks)

22 (a). A student reacted Lead II carbonate with dilute suphuric (vi) acid in order to prepare Lead II Sulphate salt.Explain why he was unable to prepare the salt using the above reagents. (2mks).
(b) Give one other reagent he would use in place of Lead II carbonate. (1mk)

23. What do you understand by the term "Rusting". 1mk)
(b) State ***two*** similarities between rusting and combustion. (2mks)

24. Sodium chloride was accidentally mixed with lead II sulphate.Describe how Sodium chloride crystals can be obtained. (2mks)

25. Element T whose atomic number is 16 and mass number 32,combines with Oxygen whose atomic number is 8.
(a) Determine the number of protons and neutrons in element T. (1mk)
(b) Name the type of bond formed between T and Oxygen. (1mk)
(c) State the nature of solution formed when Oxide of T is bubbled through water. (1mk)

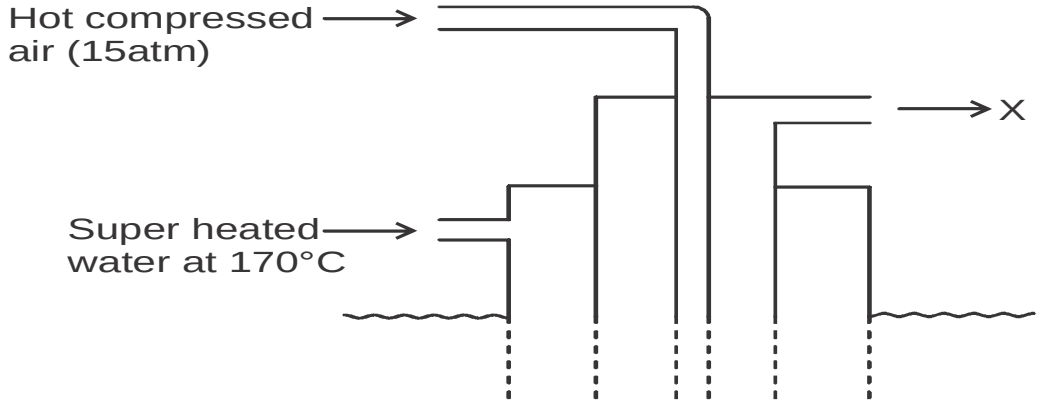
26. A piece of burning magnesium is lowered into a gas jar containing carbon (iv) Oxide .***State*** and ***Explain*** the ***observations*** made in the gas jar. (3mks)

27. Students are normally advised to use a non-luminous flame when heating in the laboratory.
(a) How does a Bunsen burner produce a non-luminous flame? (1mk)
(b) Why is the non-luminous flame preferred over the luminous flame? (1mk)

28. A current of 0.82A was passed through an aqueous solution of a salt of metal P for 5 hours.2.56g of metal P were deposited.(r.m.m of P=52, 1Faraday=96500C)
(a) Calculate the number of faradays used. (1mk)
(b) Determine the ***charge*** on the ion of metal P. (1mk)
(c) Write the equation for the formation of ion of P. (1mk)

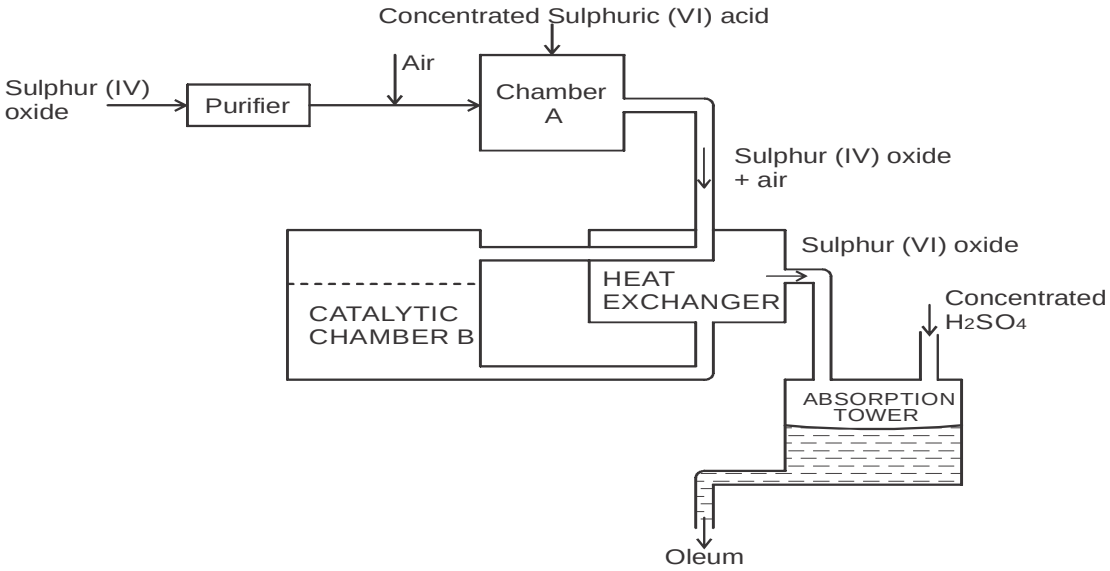
KIGUMO
CHEMISRY
PAPER 233/2
THEORY

1. The diagram below shows part of the Frasch process used for extraction of sulphur. Use it to answer the questions that follow.



i) Identify X (1mark)
ii) Why is it necessary to use superheated water and hot compressed air in this process (2mark)
iii) State two physical properties of sulphur that makes it possible for it to be extracted by this method (2marks)

b) The diagram below shows part of the process in the manufacture of sulphuric (VI) acid. Study it and answer questions that follow



i) Give two reasons why air is referred to as a mixture (2 marks)
ii) What is the role of concentrated sulphuric (VI) acid in chamber A (1mark)
iii) Name two catalysts that can be used in the catalytic chamber B (2marks)
iv) State two roles of the heat exchanger (2marks)
v) Describe the test for a Sulphite anion SO_3^{2-} (2 mark)

vi) Explain the observation made when a few drops of concentrated sulphuric (VI) acid are added to crystal of hydrated copper II sulphate? Explain your answer (2mks)

2. Use the standard electrode potential for elements G,H,J, K and L given below to answer the questions that follow

Half reactions	Electrode potential (volts)
$G^{2+}_{(aq)} + 2e^- \rightarrow G_{(s)}$	-2.90
$H^{2+}_{(aq)} + 2e^- \rightarrow H_{(s)}$	-2.38
$J^{+}_{(aq)} + e^- \rightarrow \frac{1}{2}J_{2(g)}$	0.00
$K^{2+}_{(aq)} + 2e^- \rightarrow K_{(s)}$	+0.34
$\frac{1}{2}L_{2(g)} + e^- \rightarrow L^-_{(aq)}$	+2.87

i) Which element could be hydrogen. Explain (1mark)

ii) Which two half cell would produce the highest potential difference (e.m.f) when combined (1mark)

iii) In the space provided below construct a well labelled electrochemical cell obtained when G^{2+}/G and K^{2+}/K half cells are combined (3marks)

iv) Calculate the E^{Θ} value of the electrochemical cell constructed in (iii) above (2marks)

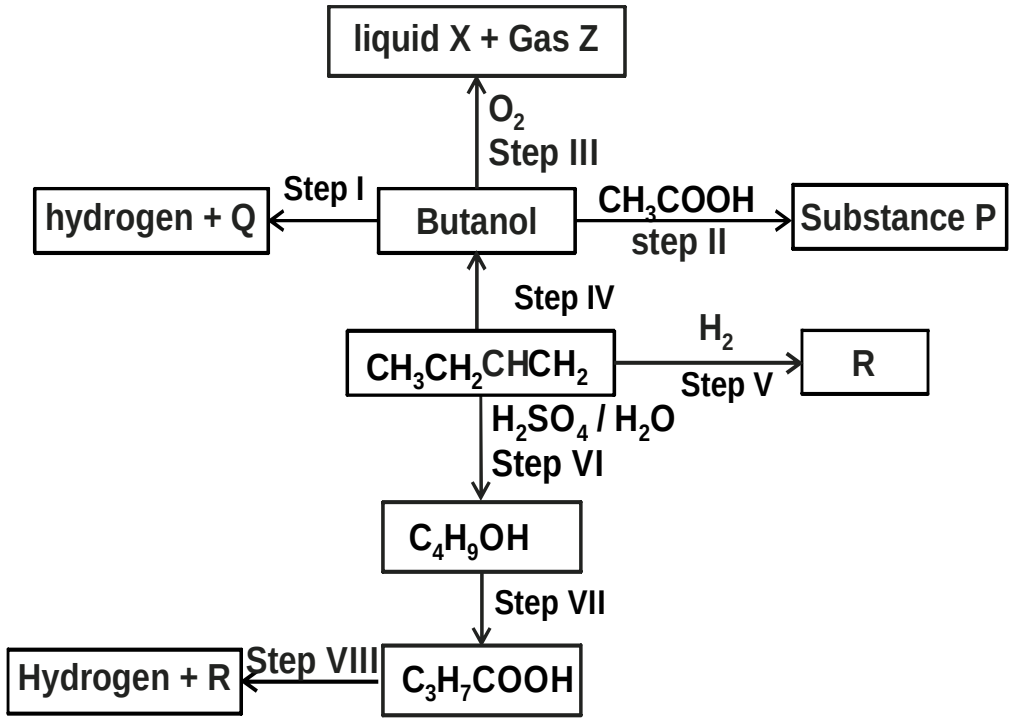
v) It is advisable to store a nitrate solution of K in a container made f H. Explain. (2marks)

b) During electrolysis of aqueous copper (II) sulphate using copper electrodes a current of 0.4 ampheres was passed through the cell for 5 hours

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

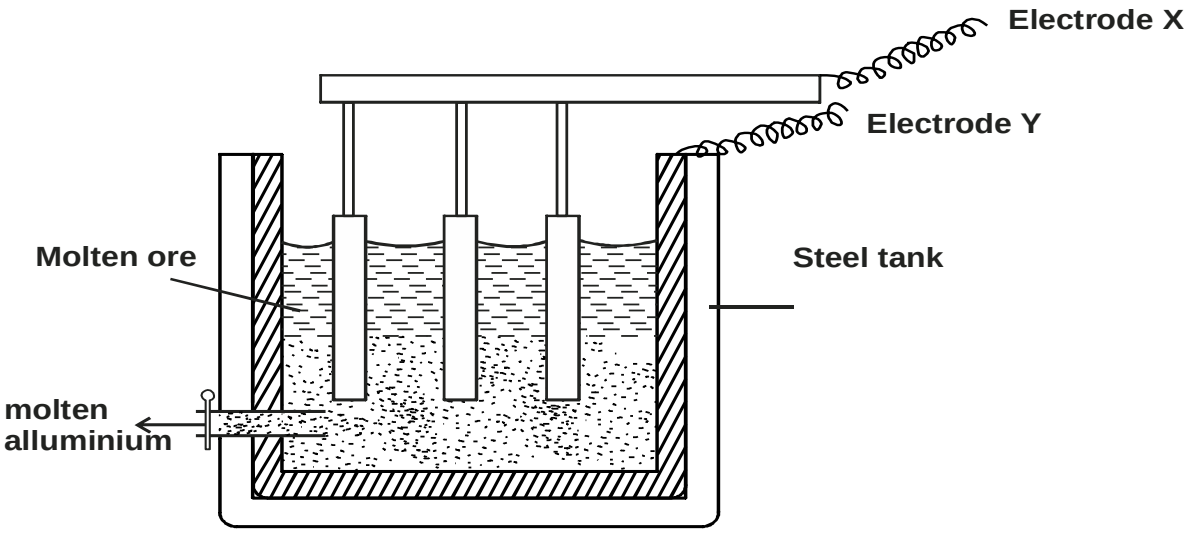
ii) Determine the change in mass of the anode which occurred as a result of the electrolysis process (Cu= 63.5 1 Faraday= 96500 coulombs) (3marks)

3. Study the reactive scheme below and answer the questions that follow.



i) What is the distinguished physical property of substance P (1mark)
ii) Identify a suitable reagent that can be used in step I . (1mark)
iii) Describe how C_3H_7COOH can be distinguished from C_4H_9OH (2marks)
iv) Write an equation for the reaction that takes place in step III. (1 mark)
v) Name the type of reaction that occurs in steps II and VII. (2 marks)
vi) If 7.4g of butanol completely underwent step III, determine the volume of gas Z produced at STP (MGV = 22. 4L , C= 12.0, H=1.0 O=16.0) (3 marks)
vii) Write an equation for the reaction between R and one mole of fluorine. (1 mark)
viii) Describe a chemical test for liquid X. (2 marks)

4. Aluminium is extracted using the electrolytic cell represented by the diagram below



i) Why is aluminium extracted by electrolytic method? (1 mark)
ii) Name the electrodes labelled X and Y (2marks)
iii) The chief ore from which aluminium is extracted is bauxite.
a) Name **two** main impurities present in bauxite. (2 marks)
b) Aluminium oxide is the main component in bauxite with a melting point of 2015°C but electrolysis of molten aluminium oxide is carried out at 800°C. Explain how this is achieved. (2mks)
iv) Write the equations for the reaction taking place at the anode. (1 mark)
v) One of the electrodes is replaced periodically. Which one and why? (2 mark)
vi) Duralumin (an alloy of copper, aluminium and magnesium) is preferred to pure aluminium in the construction of aeroplane bodies. Give **one** property of duralumin that is considered. (1 mark)

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

C				F	G		I	
						H		K
D	E							
							J	

i) Identify the most reactive non-metal. Explain. (2 marks)
ii) What is the name given to the family of elements of which I and J belong? (1 mark)

iii) Using dots (•) and crosses (×) to represent electrons, show bonding in the compound formed between C and H. (2 marks)

iv) How does the atomic radius of F compare with that of I. Explain. (2 marks)

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

Substance	M	N	O	P	Q	R
M.P. °C	801	1356	-101	26	-39	113
B.P °C	1410	2850	-36	154	457	445
Electrical conductivity in solid state	Poor	Poor	Poor	Poor	Good	Poor
Electrical conductivity in molten state	Good	Poor	Poor	Poor	Good	Poor

i) Explain why substance M is a good conductor in molten state and not in solid state. (2marks)

ii) What is the most likely structure of substance N. Explain. (2 marks)

iii) Identify, with reasons, a substance that exists as a liquid at room temperature. (2 marks)

6. A piece of marble chip (calcium carbonate) is put in a beaker containing excess of dilute hydrochloric acid which is placed on a reading balance. The mass of the beaker and its contents is recorded every two minutes as shown in the table.

Time (min)	0	2	4	6	8	10	12
Mass (g)	126.4	126.3	126.2	126.1	126.0	126.0	126.0

i) Why is there a continuous loss of mass of the reaction mixture. (1 mark)

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

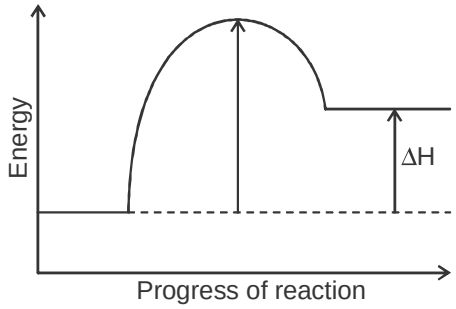
iii) State two different ways by which the reaction could have been made more rapid. (2 marks)

iv) Why does the mass remain constant after 8 minutes (1 mark)

v) State the observations that would be made if a few drops of lead II nitrate solution was added to $1cm^3$ of the resulting solution followed by excess ammonia solution. (2 marks)

vi) State one environmental effect that excess carbon (IV) oxide in the air causes. (1 mark)

vii) The energy profile for the forward direction of a reversible reaction is shown.



Sketch on the diagram the path for a catalysed reaction. (2 mark)

viii) What do you observe when you introduce the following substances in this equation

$$2CrO^{2-}_{4(aq)} + 2H^{+}_{(aq)} \rightleftharpoons Cr_2O^{2-}_{7(aq)} + H_2O_{(l)} \qquad \Delta H = -477Kj/Mol$$

Yellow Orange

i) Dilute hydrochloric acid solution (2 mark)

ii) Increase heat (2 mark)

KIGUMO
CHEMISTRY Paper 3
(PRACTICAL)

1. You are provided with:
   - 3.0g of dibasic acid H_2X, solid **W**
   - Aqueous Sodium hydroxide solution **K**
   - Aqueous hydrochloric acid containing 7.3g per litre, solution M

   You are required to:
   Determine the concentration of sodium hydroxide, solution **K** in moles per litre. Work out the concentration of solution **W**

   Procedure I
   Fill the burette with solution **M**. pipette 25cm^3 of solution **K** and pour into a conical flask. Add 2 drops of phenolphthalein indicator and titrate against solution M from burette. Repeat two more times and complete table 1
   Table 1

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

(4mks)

(a) (i) Work out the average volume of solution **M.** (1mk)
(ii) Calculate the concentration of solution **M** in mole per litre. (2mks)
(iii) Calculate the number of moles of solution **K** present in one litre of its solution. (2mks)

Procedure II
Using a 100ml measuring cylinder, measure 40cm^3 of distilled water and add the whole of solid **W** to the water in a measuring cylinder. Shake to dissolve solid **W** and add more distilled water to make a total volume of 50cm^3 of the solution. Transfer the solution into an empty beaker. Measure accurately 25.0cm^3 of the solution using a 100ml measuring cylinder and then add distilled water to make 100ml of the solution and label it solution **W.** Pipette 25.0cm^3 of solution **K** into a conical flask and add two drops of Methyl orange indicator. Titrate against solution W from burette. Repeat two more times and record your results in table II below

Table II

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

(4mks)

(a) What is the average volume of solution W used? (1mk)
(b) Calculate the:
(i) Mole of solution **W** that reacted with solution K(reaction ratio=2:1,2 mole of K react with 1 mole of **W**) (2mks)
(ii) Mole of solution W in 100cm^3 of solution (2mks)
(iii) Moles per litre of the original solution made when solid **W** was dissolved (2mks)

2. You are provided with solid **D** weighed exactly of 4.0g
You are required to determine the solubility of solid **D** at difference temperatures
Procedure
(i) Put all the solid D provided into boiling tube.
(ii) Using a clean burette, transfer 4cm^3 of distilled water to a boiling tube containing all the solid **D** provided
(iii) Heat the mixture while stirring with the thermometer to a temperature of about 80^oC
When the entire solid will have dissolved

(iv) Allow the solution to cool while stirring with thermometer. Note the temperature at Which crystals start to appear and record the temperature in the table below.

(v) To the same solution, add 2cm^3 of distilled water from the burette, heat the mixture While stirring with the thermometer to a temperature of about 80^{o}C when the entire Solid will have dissolved.

(vi) Allow the mixture to cool and record the temperature at which crystals first appear in the table below

(vii) Repeat procedure (v) and (vi) three more times and record the temperature in the table

(viii) Complete the table of solubility of solid **D** at different temperatures. (5mks)

Volume of water in boiling tube (cm3)	Temperature at which crystals first appear (^{o}C)	Solubility of solid D in g/100g of water
4		
6		
8		
10		
12		

(a) On the grid provided plot a graph of solubility of solid **D** against temperature (3mks)

(b) Hence determine the mass of solid deposited when solution is cooled from 55^{o}C to 50^{o}C (1mk)

(c) Use your graph to determine the temperature at which 80g of solid **D** would dissolve in 100g of water. (1mk)

3. (a) You are provided with solid **N**. Carry out the tests below. Write your observations and inferences in the spaces provided

(i) Heat about one third of solid **N** in a clean dry test-tube. Test the gases produced with both blue and red litmus papers.

(ii) Using a boiling tube, dissolve the rest of solid N in about 10cm^3 of distilled water and use the solution for the tests below.

i. To about 2cm^3 of the solution, add 5cm^3 of solution P (Aqueous sodium Hydroxide)

ii. To 2cm^3 of the solution, add about 4cm^3 of aqueous ammonia drop wise until in excess

iii. To 2cm^3 of the solution, add about 4cm^3 of aqueous barium nitrate

iv. To the mixture obtained in III above, add about 2cm^3 of dilute hydrochloric acid

CONFIDENTIAL TO ALL SCHOOLS FOR CHEMISTRY TEACHERS

The information contained in this paper is to enable the Head of the school and the teacher in charge of chemistry to make adequate preparations for this year's mock chemistry practical examination. **NO ONE ELSE** should have access to this paper or acquire knowledge of its contents. Great care should be taken to ensure that the information contained herein **DOES NOT** reach the candidates either directly or indirectly. The teacher in charge of chemistry should NOT perform any of the experiment in the same room as the candidates nor make the results of the experiment available to the candidates or give any other information related to the experiment to the candidates.

Requirements for candidates

In addition to the apparatus and fittings found in a chemistry laboratory, each candidate will require the following

1. About 100cm^3 of solution **M**
2. About 80cm^3 of solution **K**
3. One burette 0-50ml
4. One pipette 25ml
5. Two conical flasks 250ml
6. Solid **D** (exactly 4.0g)
7. One thermometer -10 to 110^{o}C)
8. One measuring cylinder 100ml
9. Two boiling tubes

10. About 0.5g of solid **N**
11. Empty beaker 100ml
12. Filter funnel
13. 3.0g of solid **W** in a stoppered container
14. Six test tubes
15. Test tube holder
16. One blue and one red litmus paper
17. One 10ml measuring cylinder
18. 500ml distilled water in wash bottle
19. Means of labeling
20. Pipette filler

ACCESS TO:

1. Phenolphthalein indicator with a dropper
2. Methyl orange with a dropper
3. Source of heat (Bunsen burner)
4. 2M ammonia solution with a dropper
5. 0.5M $Ba(NO_3)_2$ solution with a dropper
6. Solution P, sodium Hydroxide solution with a dropper
7. 2M hydrochloric acid supplied with a dropper

Note

1. Solid **N** is $ZnSO_4.\ 7H_2O$
2. Solids **D** and **W** are oxalic acid
3. Solution **K** is prepared by dissolving exactly 6.4g of sodium hydroxide in 400ml of distilled water and make up to one litre by adding more distilled water
4. Solution **M** is prepared by measuring 16.5ml of concentrated hydrochloric acid in 400ml distilled water and dilute it by adding more distilled water to a total volume of one litre

KIGUMO
CHEMISTRY PAPER 1(THEORY PAPER)
MARKING SCHEME-TERM II 2019

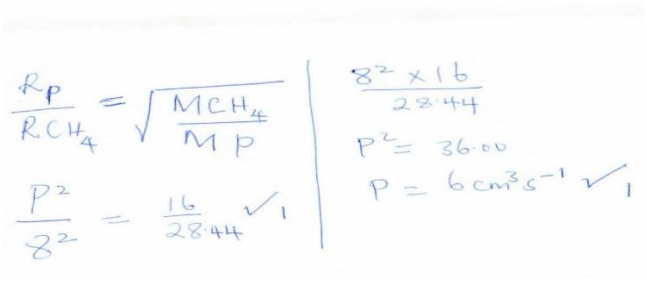
1. a) fractional distillation
   b) funnel separation
   c) chromatography
2. a) group II
   b) element S
   c) P_2O
3. $ZnO_{(s)} + H_2O_{(g)} \longrightarrow H_{2(g)} + Zn_{(s)}$
   b) A mixture of hydrogen and air explodes
   c) Magnesium,Iron,Lead or Cupper
4. The metal darts around the water surface
   Melts into a silvery ball
   Produces a hissing sound
5. mass of water= 27.8-20.6=7.2√1

Al2O3	H2O
Moles 20.6/102 =0.202	7.2/18 =0.4
Mole ratio 0.0202/0.202	0.4/0.202
1	2

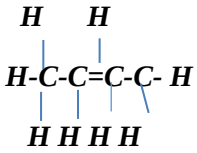
√1

X=2√1

6. Rate of a diffusion of a gas at constant pressure and temperature is inversely proportional to the square root of it's density.



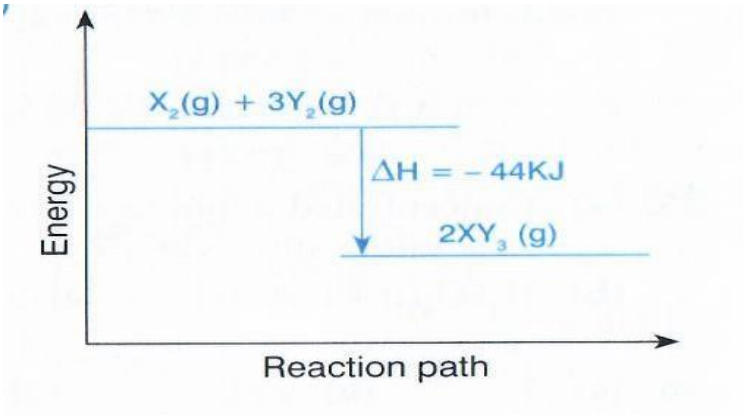
7. copper II Oxide (black) turns to brown (copper metal)
   b) $CO(g) + CuO(s) \longrightarrow Cu(s) + CO_2(g)$
   c) reducing nature
8. a) Oxygen
   b) Turns red then bleached;√1HOCl releases Oxygen atom into the dye decolourizing it√
9. a) atomic radii decreases;√across the period due to increase in nuclear charge/proton number which create more attration of electrons
   b) 13-14
10. a) $2NaOH(aq) + H_2SO_4(aq) \longrightarrow Na_2SO_4(aq) + 2H_2O(l)$
   b) 0.2 moles--------1000 $\frac{0.2x25}{1000}$ √½ =0.005moles√½
      ? --------- 25
   c) mol of acids $\frac{0.005}{2}$ √½ = 0.0025mol----------18 $=\frac{0.0025X1000}{18}$ =0.139M√½
      ? ---------- 1000
11. a) blue copper II sulphate faded√
   b) Cu^{2+}√ they gained electrons√
12. HCl gas in methylbenzene does not dissociate√ but in water it does√
13. a) fractional crystallization
   b) Nacl√½ ,Na_2CO_3 is more soluble at high temperature√½
   c) Na_2CO_3;when the temperature is low,they it is less soluble
14. a) But-2-ene √



b) 2,3-dichlorobutane

15

Axis-½ ×2=1
Exothermic expression √1
Eqn and ΔH√1



b). increasing the pressure√1 or
Lowering the temperature

17 a). $^{0}_{-1}e$- b) $^{4}_{2}He$

18. brown sugar turns to black mass
b) Blue copper II sulphate turns white
c) dehydrating agent

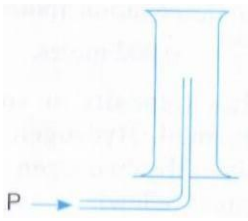
19. lemon juice 5.0√½
Sodium chloride 7.0√½
Potassium chloride 14.0√½
Hydrochloric acid 1.0√½

b) addition of calcium oxide or calcium hydroxide to soil to improve ph.

20. Ammonia/NH_3

b) $Ca(OH)_2(aq) + 2NH_4Cl(s) \longrightarrow CaCl_2(s) + 2H_2O(l) + 2NH_3(g)$

c)



21.a) Zinc blende
b) reacts with the acidic impurities to form slag
c) galvanization

22. It contains sulphates of magnesium and calcium√;these form scum with soap leading to soap wastage.√
23. the reaction started but eventually stoped√;due to formation of an insoluble layer of lead sulphate which prevents further reaction√
b). lead II nitrate
24. a). wearing out of Iron metal when it's exposed to air and moisture/water or corrosion of Iron metal√
Oxygen is used in both
Oxides are formed
There's increase in mass
25. dissolve the mixture in water
Filter off the residue
Heat the filtrate to evaporate excess water
Cool to form crystals
26. a) 32=16 +N
N=16 √½ P=16√½

b) Covalent
c) acidic

27.
White ash/solid is formed.√½
Black speck/solid/particles formed on the side of gas jar.√½

Magnesium burn to produce/release enough heat energy to decompose Carbon(IV) oxide gas to carbon√ and oxygen.Magnesium continues to burn in Oxygen forming white Magnesium Oxide solid/ash.√

28.When the air hole is open
b)It's hotter than luminous
non smoky/sooty

29.
a) $0.82 \times 5 \times 60 \times 60 = 14760$√½
$\frac{14760}{96500}$ =0.1529F√½

b)
2.65g---------0.1529f ⟶ $\frac{0.1529 \times 52}{2.65}$ √½ =3F√½
52g----------?

c) P P^{3+} +3e-

MURANGA SOUTH
233/1
CHEMISTRY
Paper 1
July/August 2019

1. State two reasons why we use the non-luminous flame for heating in the laboratory instead of using luminous flame. (2 marks)

2. Element K has a symbol $^{40}_{20}K$, fill in the blanks below about the element. (2 marks)

i) Group
ii) Period

3. Unknown substances had pH values as shown in the table below.

Substance	Ph Values
A	5.0
B	1.0
C	8.0

State which substance is likely to be ?
i) Citric acid..... (½ mark)
ii) Phosphoric (V) acid ..... (½ mark)
iii) Identify a substance that would be a better electrolyte. (1 mark)

4. Using dots (•) and crosses (×) show bonding in Ammonium ion (NH^+_4) (N=14, H=1) (1 mark)

5. Identify the particles responsible for conducting electric current in (2 marks)
a) Molten sodium chloride.....
b) Sodium metal.....

6. A hydrocarbon S contains 3.6g carbon by mass and 0.8g hydrogen. Given that 3dm³ of the compound at s.t.p has a mass of 5.89g
a) Calculate the molecular formula (Molar gas volume at s.t.p = 22.4dm³, C=12, H=1) (3 marks)
b) To which homologous series do hydrocarbon S belong. (1 mark)

7. Name the following processes.
a) When anhydrous calcium chloride is left in an open beaker overnight a solution was formed. (1 mark)
b) White sugar changes to black solid when mixed with excess concentrated sulphuric (VI) acid. (1 mark)

8. An oxide of element P has the formular as P_2O_3
a) State the valency of element 'P' (1 mark)
b) In which group of the periodic table is the element. (1 mark)

9. a) State Boyle's law. (1 mark)
b) A balloon used in a meteorological station contains 250dm³ of helium at 25°C and 100 Kpa pressure. Calculate the temperature when its volume reaches 400dm³ and 80kpa pressure. (2 marks)

10. a) Name the method used in separating coloured mixtures. (1 mark)
b) The coloured mixtures separated using the method named above is based on two properties. Name the properties. (1 mark)

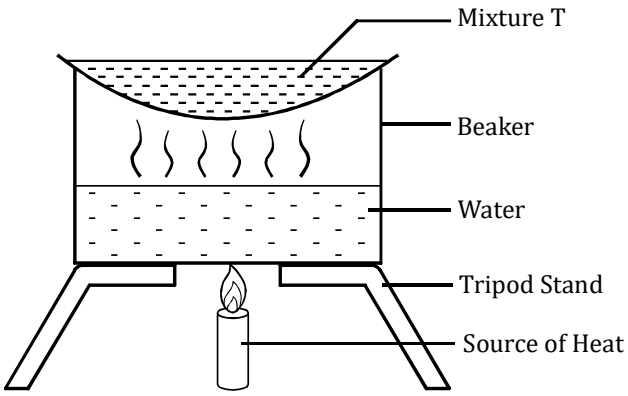
11. A small crystal of potassium Manganate (VII) was placed in a beaker containing water. The beaker was left standing for two days without shaking. State and explain the observation that were made. (2 marks)

12. Describe how a sample of Zinc carbonate can be prepared from the following reagents; Zinc (II) oxide, dilute nitric (V) acid, water and potassium carbonate solid. (3 marks)

13. Chlorine has two isotopes with mass number 35 and 37. If the relative atomic mass of chlorine is 35.5. Determine the percentage abundance of each isotope of chlorine. (2 marks)

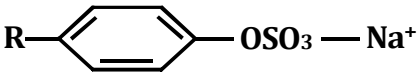
14. Below is a list of oxides.
CaO, CO_2, K_2O and ZnO
select
a) an acidic oxide. (1 mark)
b) an oxide which react with both sodium hydroxide solution and dilute hydrochloric acid. (1 mark)

15. The set-up shown below was used to prepare a mixture.



a) Name the apparatus missing in the set-up. (1 mark)
b) Give one example of mixture T (1 mark)
c) What is the name of this method of separation? (1 mark)

16. a) The structures below represents two cleansing agents X and Y

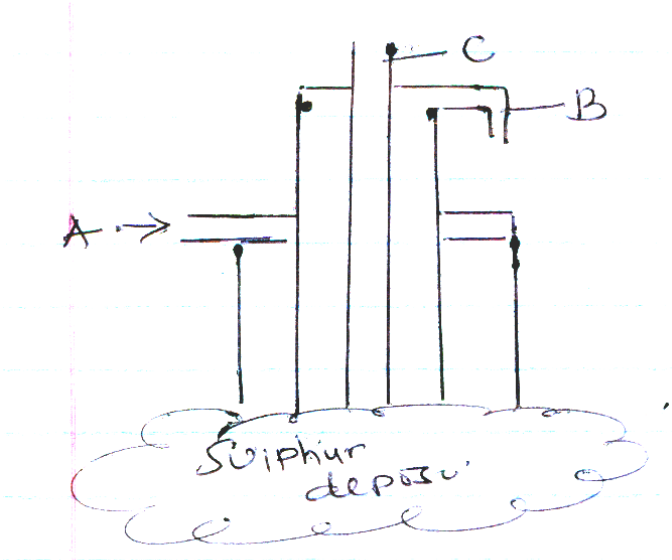


State a cleansing agent that would be suitable for washing in water containing calcium chloride. Give a reason. (2 marks)
b) Name two ions responsible for hardness of water. (1 mark)
c) Give one advantage of using hard water for domestic purpose. (1 mark)

17. During electrolysis of silver nitrate solution, a current of 5.0A was passed though the electrolyte for 3 hours using inert electrode.
a) Write the ionic equation for the reaction which took place at the anode. (1 mark)
b) Calculate the mass of the silver deposited (Ag = 108, IF = 96500c) (2 marks)

18. a) Define the term isomerism.....
b) The molecular formula of compound T is $C_2H_2Br_4$. Draw two structural formula of compound T(2 marks)

19. The diagram below shows the method used during extraction of sulphur.



a) Name the process. (1 mark)
b) Name the substances that pass through tubes. (2 marks)
A , B ..

20. After 7.5 hrs the percentage of a certain nuclide in a sample of ore was found to be 12.5%
a) What is meant by the term half-life. (1 mark)
b) Determine the half-life of the nuclide. (1 mark)

21. a) Distinguish between weak acid and dilute acid. (1 mark)
b) A solution of ammonia in Methylbenzene has no effect on red litmus paper while a solution of ammonia in water turns red litmus paper blue. Explain (1 mark)

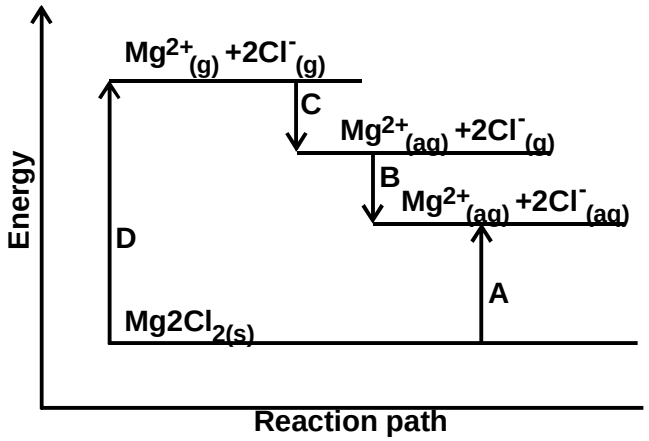
22. a) Work out of the oxidation number of sulphur in H_2SO_3 (H=1, S=32, O=16)
b) Study the equation below.

$$Mg_{(S)} + H_2SO_{3(aq)} \rightarrow MgSO_{s(aq)} + H_{2(g)}$$

Which species undergo oxidation? Explain using oxidation number (3 marks)

23. State and explain the observation seen when carbon (IV) oxide is bubbled through time water for a
i) Short period (1 mark)
ii) Longer period (1 mark)

24. Study the energy level diagram below and answer the questions.

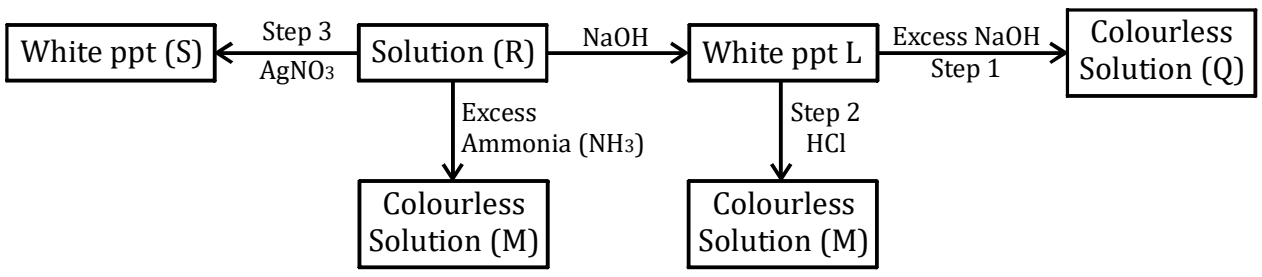


i) Which letters A, B, C and D represents. (2 marks)
I. Hydration Energy for magnesium
II. Lattice energy for magnesium chloride.
ii) According to the diagram, is heat of solution for magnesium chloride exothermic or endothermic? (1 mark)
iii) Suppose the lattice energy for magnesium chloride is -2493kj/mol, hydration energy of Mg^{2+} and Cl^- ions are -1891 and -840 kJ/mol respectively, calculate heat of a solution of magnesium chloride (2 marks)

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

26. Liquid X is suspected to be water, describe two chemical test that can be used to confirm that it is water. (2 marks)

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



a) Identify the cation and anion in solution (R) (2 marks)
Cation.....
Anion .....

b) Name the white precipitate L (1 mark)

c) Write the formula for complex ion in solution Q. (1 mark)

28. Explain why copper metal reacts with nitric (V) acid and does not react with hydrochloric acid. (2 marks)

29. The table below shows the solubilities of salt L and K at 10°C and 40°C.

	Solubility in g/100g of water	
	at 10°C	At 40°C
L	60	75
K	20	32

A mixture containing 80g of L and 10g of K in 100g of water at 50°C was cooled to 10°C.

i) Which salt crystallized out? Give a reason. (2 marks)

ii) Calculate the mass of the salt that crystallized out. (1 mark)

iii) Suggest the industrial application of the method. (1 mark)

30. a) State Le-chateliers principle. (1 mark)

b) A solution of bromine gas in water is an example of a dynamic equilibrium as shown by the equation below.

$$Br_{2(g)} + H_2O_{(l)} \qquad HOBr_{(aq)} + HBr_{(aq)}$$

orange Red brown

State and explain the observation made when sodium hydroxide pellets are dropped in the beaker containing bromine water in the equilibrium (2 marks)

MURANGA SOUTH
233/2
CHEMISTRY
Paper 2
July/August 2019

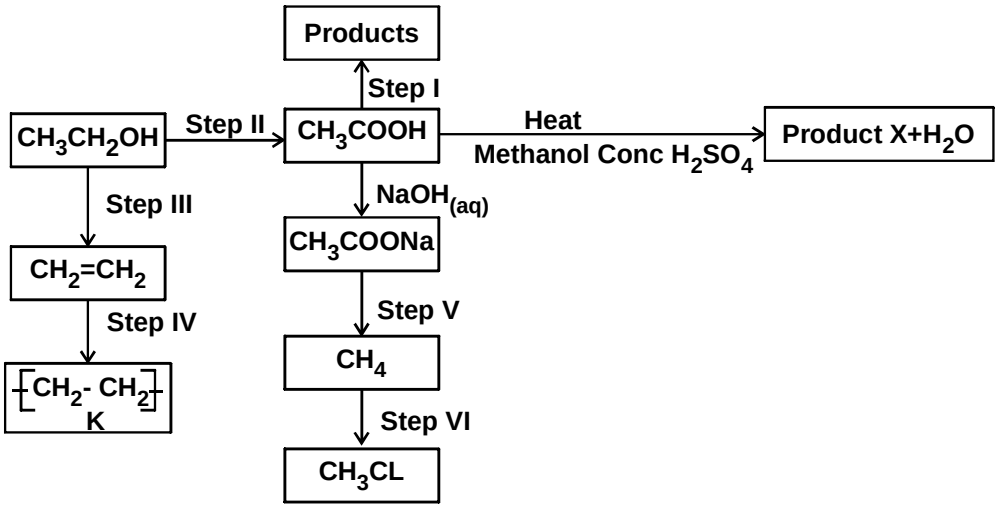
1. a) Given the IUPAC names of the following compounds.

i) $CH_3 - CH(CH_3) - CH = CH_2$

ii) $CH_3 - CH(CH_3) - CH = CH_2$

b) Describe **one** chemical tests that can be used to distinguish between two compounds represented by the formulae C_2H_6O and $C_2H_5O_2$ (2 marks)

c) The scheme below shows a series of reactions starting with ethanol. Study it and answer the questions that follow.



i) Identify the processes in
Step II..... (½ mark)
Step VI..... (½ mark)

ii) State the reagent and conditions required in: (2 marks)
Step III

Reagent : .....
Condition: .....
Step VI
Reagent : .....
Condition: .....

iii) Write an equation for the reaction in step I.

iv) Draw the structural formula of produce X. (1 mark)

v) Name compound K and state one of it's uses.
Name.....
Use : .....

vi) 17.25g of ethanol was completely burnt in air at room temperature and pressure. Calculate the volume of the gas formed after cooling.
[C = 12.0, O=16.0, H=1.0; Molar gas volume = 24.0dm^3) (3 marks)

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

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

a) Write the electron arrangement for the
   i) Atom of D..... (½ mark)
   ii) Ion of F ..... (½ mark)
b) Select an element which is
   i) The most reactive non-metal. (½ mark)
   ii) Poor conductor of electricity. (½ mark)
c) To which group of the periodic table does element G belong. (1 mark)
d) How do the reactivity of element C and G compared? Explain (2 marks)
e) Using dots [•] and crosses [×] to represent outermost electrons, show the bonding in the compound formed between elements B and D. (1 mark)
f) Explain why the melting point of element D is higher than that of element C. (2 marks)
g) Write a chemical equation for the reaction that will occur between C and A. (1 mark)
h) Compare the atomic and ionic radius of element F. (2 marks)

3. **a)** Define the term 'Enthalpy of formation'. (1 mark)
b) Use the information below to answer the questions that follow

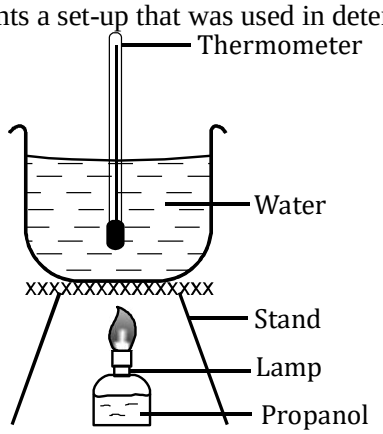
$C_{(S)} + O_{2(g)} \rightarrow CO_{2(g)}$ ΔH = -394 kj/mol

$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}$ ΔH=-286kj/mol

$C_2H_{2(g)} + 5_2O_{2(g)} \rightarrow 2CO_{2(g)} + H_2O_{(l)}$ ΔH = -1300kj/mol

i) Write the equation for the formation of ethyne. (1 mark)
ii) Draw an energy cycle diagram that links the heat of formation of ethyne with it's heat of combustion and the heats of combustion of carbon and hydrogen. (3 marks)
iii) Calculate the standard 'enthalpy of formation of ethyne'. (2 marks)

c) The diagram below represents a set-up that was used in determining the molar heat of combustion of propanol (C_3H_7OH)

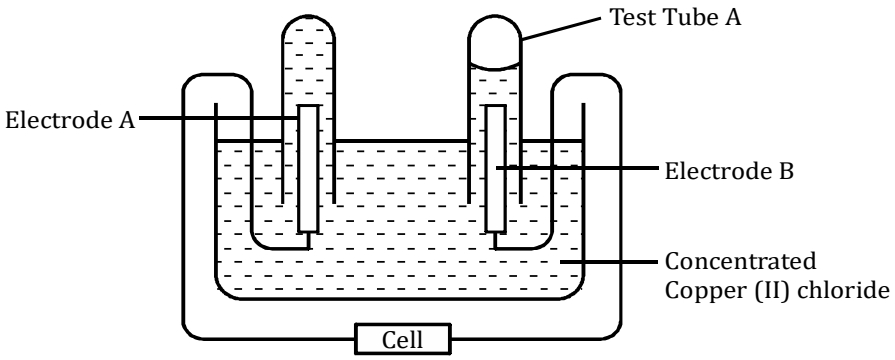


During the experiment the data given below was recorded.
Volume of water = 100cm³
Final temperature of water = 43.5°C
Initial temperatures of water = 20.5°C
Mass of propanol + lamp before burning = 126.5g
Mass of propanol + lamp after burning = 124.7g

Calculate

i) Mass of propanol used. (1 mark)
ii) Heat evolved during the experiment [Density of water = 1g/cm³, specific heat capacity of water = 4.2kJ/kg / k (2 marks)
iii) The molar heat of combustion of propanol [C=12, O=16, H=1] (3 marks)
iv) The heating value of propanol (1 mark)
v) Give two disadvantages of using hydrogen as a source of fuel. (1 mark)

4. **a)** An electric current was passed through concentrated copper (II) chloride as shown in the diagram below using inert electrode.



i) Identify the cations.....(1 mark)
ii) Which of the electrode is the cathode? Explain. (2 marks)
ii) After sometime test tube A was found to contain a mixture of two gases.

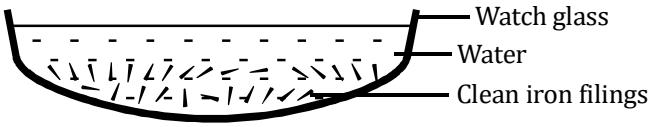
I. Identify the two gases. (1 mark)
II. Explain how the two gases were formed. (2 marks)

b) Use the standard reduction potential for elements A, B, C, D and E given below to answer the questions that follows. Letters used are not the actual symbol of the elements.

		Eθ volts
$A^{+}_{(aq)} + e^{-}$	$A_{(s)}$	-2.71
$B^{2+}_{(aq)} + 2e^{-}$	$B_{(S)}$	-237
$2C^{+}_{(aq)} + 2e^{-}$	$C_{2(g)}$	0.00
$D^{2+}_{(aq)} + 2e$	$D_{(s)}$	+0.34
$½E^{-}_{(aq)} + e^{-}$	$E_{(s)}$	+2.87

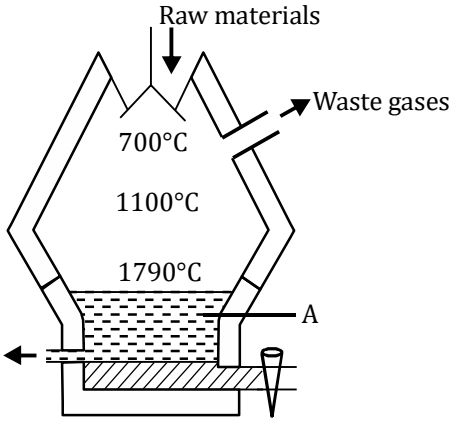
i) Which element is likely to be hydrogen ? Given a reason to your answer. (2 marks)
ii) What is the E□ value of the strongest reducing agent. (1 mark)
iii) Draw an electrochemical cell that will produce the lowest emf. (3 marks)
iv) Calculating the emf of the cell constructed in 4b(iii) above. (1 mark)

5. **a)** Clean iron fillings were weighed and then place on a watch glass containing water as shown.



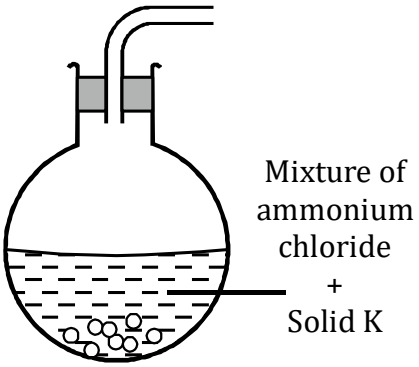
i) State the observation made on the iron fillings after three days. (1 mark)
ii) With a reason compare the mass of iron fillings at the start of the experiment with that of the product after three days. (2 marks)
iii) Give general chemical formula of the product formed in this experiment. (1mark)
iv) An ore is suspected to contain iron metal, describe how the presence of iron in the ore could be confirmed. (3 marks)

b) i) Name **one** ore from which iron is extracted. (1 mark)
ii) What is the name of the process used in the extraction of iron metal in the blast furnace. (1 mark)
iii) The following diagram represents the blast furnace in which extraction of iron is carried out. (3 marks)



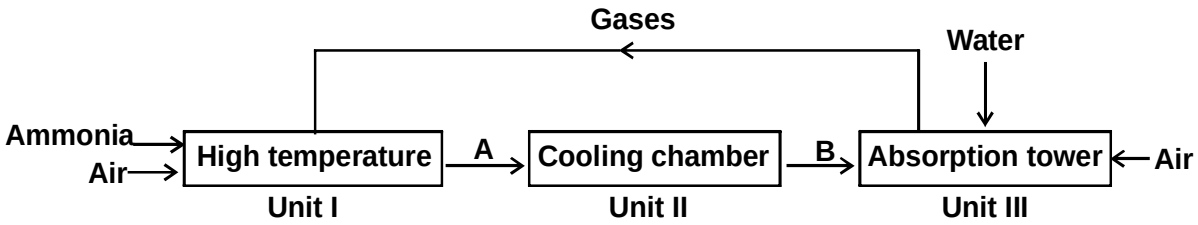
I. Identify one other raw material used apart from iron ore. (½ mark)
II. Write the equations that lead to formation of substance A in the blast furnace. (1 mark)
III. State one property of the iron produced on the blast furnace. (½ mark)

6. **a)** The diagram below shows an incomplete set-up used to prepare and collect dry ammonia gas.



i) Complete the diagram to show how a dry sample of ammonia gas can be collected. (3 marks)
ii) Name solid K. (1 mark)
iii) With an equation for the reaction that occurred when a mixture of ammonium chloride and solid K was reacted. (1 mark)

b) Ammonia gas is used in the manufacturer of nitric (V) acid as shown below.

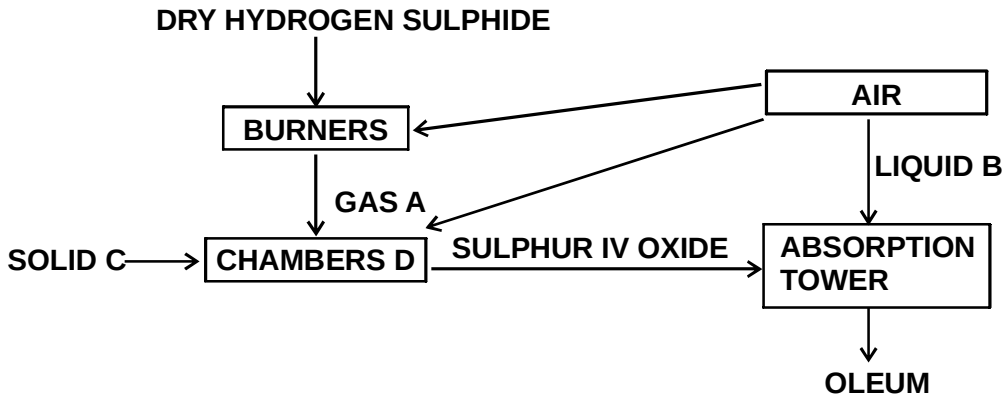


i) The process requires the use of a catalyst. What is the name of the catalysts used and in which unit is the catalyst used?
Catalyst ..... (1 mark)
Unit

ii) Identify compounds A and B. (1 mark)

iii) Ammonia and nitric acid are used in the manufacture of ammonium nitrate fertilizer. Calculate the amount of nitric (V) acid required to manufacture 1000kg of ammonium nitrate using excess ammonia [N=14, H=1, O=16] (3 marks)

7. Sulphuric (IV), acid can be prepared using hydrogen sulphide as shown in flow chart below. Study it and answer the questions that follow.



a) Identify
i) Gas A..... (1 mark)
ii) Liquid B ..... (1 mark)

b) i) What is the function of solid C in chamber D. (1 mark)
ii) Write an equation for the reaction in chamber D. (1 mark)

c) Explain the observations made if hydrogen sulphide gas is bubbled through copper (II) nitrate solution? (1 mark)

d) Write an ionic equation for the confirmatory test for hydrogen sulphide gas. (1 mark)

e) Write a chemical equation to snow the formation of concentrated sulphuric (VI) acid from the oleum.(1 mark)

f) Explain why in contact process sulphur (VI) oxide gas is not directly dissolved in water to form concentrated sulphuric (VI) acid. (1 mark)

g) State **one** use of sulphuric (VI) acid. (1 mark)

MURANGA SOUTH
233/3
CHEMISTRY
Paper 3
July/August 2019

1. **(21 marks)** You are provided with:
- 0.02M solution A, acidified potassium manganete VII
- Solution B prepared by dissolving 5.88g of solid B in distilled water to make 250cm³ of solution.
- 0.21M solution C, glucose solution
- 1.0M, sulphuric (VI) acid.

You are required to:
•Determine the number of moles of B that react with one mole of potassium manganete VII
•Determine the rate of reaction between solution C and A at different temperatures.

PROCEDURE 1
Fill a burette with solution A. Using a clean pipette and a pipette filler place 25.0cm³ of solution B into a 250ml conical flask and titrate with solution A until a permanent pink JUST APPEARS. Record your results in table 1 below. Repeat the procedure two more times.

a) Table 1

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

(4 marks)

b) Calculate the
I. Average volume of solution A used. (1 mark)
II. Number of moles of solution A used. (2 marks)
III. Concentration of solution B in moles per litre [The RFM of B is 392] (1 mark)

c) Calculate the number of moles of B:
I. In 25.0cm³ of the solution. (2 marks)
II. Which react with one mole of solution A [Acidified potassium manganete (VII)] (1 mark)

PROCEDURE 2

Place 2cm³ of solution A into a 250ml beaker. Using 100ml measuring cylinder add 30cm³ of 1.0M sulphuric (VI) acid to the beaker containing solution A. Warm the mixture to about 47°C. Stop warming and allow the mixture to cool. When the temperature is exactly 45°C add 15cm³ of solution C and start the stopwatch / stop clock **immediately**. Stir the mixture using the thermometer and record the time taken for the colour of the mixture to change from purple to colourless in table 2 below. Clean the beaker and repeat the procedure at temperature 50°C, 55°C, 60°C, 65°C and 70°C instead of 45°C. Record the time taken in each case in table 2 below.

Table 2

Temperature m°C	45	50	55	60	65	70
Time taken in seconds						
sec^{-1}						

d) Complete the table by computing sec^{-1} (4 marks)
e) Plot a graph of sec^{-1} (y-axis) against temperature °C (y - axis) (3 marks)

f) From the graph, determine the time that would be taken if the temperature was 52°C. (2 marks)

g) How does the rate of reaction of acidified potassium manganete (VII) with glucose solution vary with temperature. (1 mark)

2. You are provided with Solid D. Carry out the tests below. Write your observations and inferences in the spaces provided.

a) Place one half of solid D in a clean dry test tube and heat it strongly. Test any gases produced with blue and red litmus papers.

b) Place the other half of solid D in a boiling tube. Add about $10cm^3$ of distillate water and shake until all the solid dissolves (Use the solution for test (i), (ii), (iii) and (iv) and (v) Label the solution as solution D.
   i) Using about $2cm^3$ of solution D. Determine the P^H of the mixture using universal indicator paper and P^H chart.
   ii) To about $2cm^3$ of solution D in the test tube, add $2cm^3$ of 2M hydrochloric acid.
   iii) To about $1cm^3$ of solution D in the test tube, add 2M ammonium hydroxide dropwise until in excess.
   iv) To about $1cm^3$ of solution D in the test tube, add 2M sodium hydroxide dropwise until in excess.
   v) To about $2cm^3$ of solution D, add four or five drops of barium nitrate.

3. You are provided with liquid F. Carry out the tests below. Record your observations and inferences in the spaces provided.

a) Place three or four drops of liquid F on a watch glass. Ignite the liquid using a Bunsen burner.

b) To about $1cm^3$ of liquid E in a test-tubes, add about $1cm^3$ of distilled water and shake thoroughly.

c) To about $1cm^3$ of liquid E in a test tube, add solid hydrogen carbonate provided.

d) To about $2cm^3$ of liquid E in a test-tube add about $1cm^3$ of acidified potassium dichromate (VI). Warm the mixture gently and allow it to stand for about one minute.

e) To $10cm^3$ of liquid E in a boiling tube add about $5cm^3$ of 2M sulphuric acid and then about $5cm^3$ of ethanoic acid. Warm the mixture.

MURANGA SOUTH
233/3
CHEMISTRY

CONFIDENTIAL INSTRUCTIONS

Each student should be provided with :

1. About 120cm^3 of solution A
2. About 100cm^3 of solution B
3. About 80cm^3 of solution C
4. About 200cm^3 of 1.0M sulphuric acid
5. 0.5g of solid D
6. 20cm^3 of liquid in stoppered test tube
7. About 0.5g of sodium hydrogen carbonate
8. One burette 0-50ml
9. One pipette 25ml
10. One thermometer
11. Bunsen burner
12. One stopwatch
13. Spatula
14. Test tube holder
15. Distilled water in a wash bottle
16. 2 boiling tubes
17. 6 test tubes
18. Tripod stand
19. Universal indicator paper with a chart
20. Empty glass beaker
21. 2 conical flask
22. About 20cm^3 ethanoic acid 2M
23. Filter funnel
24. Bunsen burner
25. Tripod stand
26. Wire gauze

Access to:

1. Bunsen burner (each student)
2. 2M HCl
3. 2M ammonia solution
4. 2M sodium hydroxide solution
5. 2M Barium nitrate solution
6. Potassium dichromate solution
7. 2M sulphuric (VI) acid

Note

1. Solution A is prepared by dissolving 3.2g of $KMnO_4$ in 400cm^3 of 1M sulphuric acid and diluting to one litre of solution using distilled water (0.02M $KMnO_4$)
2. Solution B is prepared by dissolving 23.52g of hexalydrous ammonium iron (II) sulphate $(NH_4)Fe(SO_4)_26H_2O$ (RFM = 392) in 400cm^3 of 1M H_2SO_4 and diluting to one litre of solution using distilled water
   NB: This solution should be prepared ni not more than o ne our to the practical time and the container be sealed with aluminium foil. (The solid should be dissolved in the sulphuric acid immediately after weighing)
3. Solution C is 0.21M glucose