CEKENAS MOCK EXAMINATION, 2023

Kenya Certificate of Secondary Education

233/1

CHEMISTRY

Paper 1

(Theory)

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES

1. *All working must be clearly shown where necessary.*
2. *Mathematical tables and silent electronic calculations may be used*

1. Give two difference between a thistle funnel and a dropping funnel (2marks)
2. Give names of the following processes used to
a) Separate calcium carbonate from water (1mark)
b) Separate a mixture of nitrogen and Helium (1mark)
3. The table below shows some solutions and their pH value

Solution	pH values
P	1.5
Q	6.0
R	14.0
S	8.0

Which of the above solutions is likely to be of
a) Sodium carbonate (1mark)
b) Solution with high concentration of Hydrogen ions (1mark)
4. In the laboratory preparation of oxygen gas, Hydrogen peroxide is used.
a) Name the catalyst used (1mark)
b) Write a balanced chemical equation for the reaction (1mark)
5. State three observation made when a piece of potassium metal is dropped into cold water giving a reason for each. (3marks)
6. In the extraction of iron, the iron ore is reduced to iron in a blast furnace
a) Name the main ore used in extraction of iron (1mark)
b) What is the main reducing agent in the blast furnace (1mark)
c) Write the equation for the reaction through which the iron ore is reduced to iron in the blast furnace . (1mark)
7. Draw the structure of the following
a) Mg^{+} (1mark)
b) Hydroxonium ion (1mark)
8. When 27.8g of hydrated aluminium oxide $(Al_2O_3 \bullet XH_2O)$ was heated to a constant mass 20.6 g of aluminium oxide was obtained. Determine the value of X (Al=27, O=16, H=1) (3marks)
9. In the Haber process, the industrial manufacture of ammonia is given by the following equation $N_{2(g)} + H_{2(g)} \rightleftharpoons 2NH_{3(g)}\ \Delta H = -97kJ/mol$
a) Name one source of nitrogen gas used in this process (1mark)
b) Name the catalyst used in the above reaction (1mark)
c) What is the effect of increasing temperature on the yield of ammonia? Explain (2marks)
10. Describe the correct process of heating a liquid in a test-tube using a bunsen burner. (3marks)
11. Draw a labelled diagram of a set up that can be used to prepare dry sample of carbon (IV) oxide using calcium carbonate (3marks)
12. a) Draw structural formulae of two positional isomers with molecular formula C_4H_8 (2marks)
b) Study the equation below and answer the questions that follow
$C_6H_{14} + Cl_2 - C_6H_{13}Cl + HCl$
i) State the condition under which this reaction occurs (1mark)

ii) Give the general name of this type of reaction (1mark)

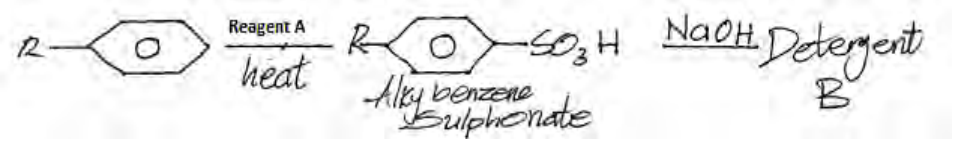
13. a) Define hydration energy (1mark)

b) Given that the lattice energy of NaCl is +781kJ/mol and hydrated energy of Na^+ and Cl^- are -390kJ/mol and -384kJ/mol respectively. Calculate the heat of solution of one mole of $NaCl_{(s)}$ using energy cycle. (3marks)

14. $240cm^3$ of nitrogen (I) oxide gas takes 16 seconds to diffuse through a certain porous pot. $300cm^3$ of x takes 12 seconds to diffuse through the same pot calculate the relative molecular mass of gas x. (N=14, O=16) (3marks)

15. Draw a well labelled diagram that can be used during electrolysis of molten sodium chloride in the laboratory (3marks)

16. The figure below describes the manufacture of detergent B

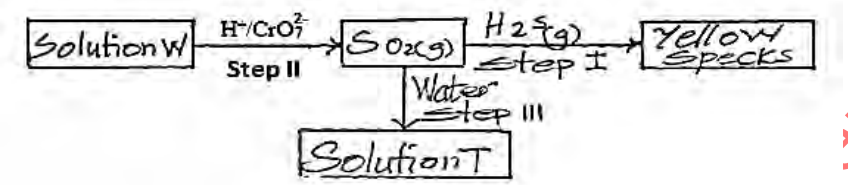


a) What type of detergent is B (1mark)

b) Draw the structure of detergent B (1marks)

c) State two disadvantage of using detergent B (2marks)

17. Use the flow chart below to answer the question below

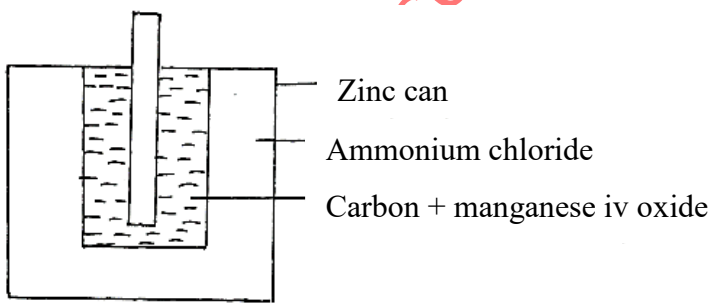


a) Explain the observation in step II (1mark)

b) Name the process that takes place when flower petals are put into solution T (1mark)

c) Reaction in step I takes place only in presence of moisture. Give a reason for this (1mark)

18. The diagram below represent a dry cell with Zinc can and graphite as the electrodes and ammonium chloride paste as an electrolyte



a) Write an ionic equation for the reaction taking place at

i) Anode (1mark)

ii) Cathode (1mark)

b) State the property of carbon powder that make it suitable for use in the cell (1mark)

c) State one other substance that could be used in place of manganese (IV) oxide (1mark)

19. The diagram bellow represents part of periodic table. Use it to answer the question that follow.

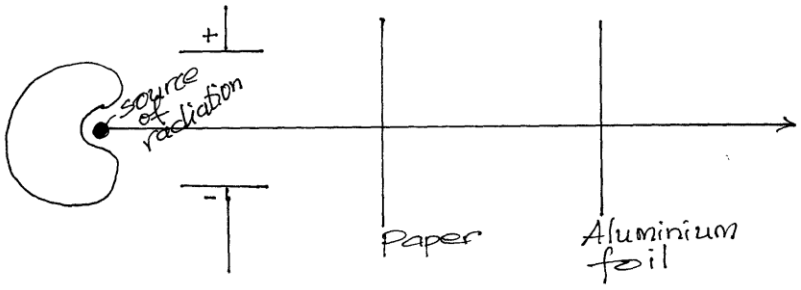
A					Q			
Z	W		X					

a) Write the electronic arrangement for the stable ion formed by X (1mark)

b) Write an equation for the reaction between W and Q (1mark)

c) Compare the ionization energy of element A and Z. Explain. (2marks)

20. Write equations to show the effect of heat on each of the following
a) Ammonium nitrate (1mark)
b) Potassium nitrate (1mark)
c) Anhydrous iron (II) sulphate (1mark)
21. When excess chlorine gas is bubbled through diluted sodium hydroxide solution; the resulting solution act as a bleaching agent
a) Write an equation for the reaction between chlorine gas and sodium hydroxide solution (1mark)
b) Name the bleaching agent (1mark)
c) Write an equation to show the bleaching and explain how it occurs (2marks)
22 Alpha (α)and beta (ß) particles can be distinguished using papers, aluminium foil and an electric field complete the diagram below to show how this is done (3marks)



23. During electrolysis of magnesium sulphate, a current of 0.3A was passed for 30 minutes calculate the volume of gas produced at the anode (molar gas volume =24dm^3, IF = 96500C) (3marks)
24. Starting with sodium metal, describe how a sample of crystal of sodium hydrogen carbonate may be prepared (3marks)
25. When 20cm^3 of 0.5M sulphuric (VI) acid was mixed with 20cm^3 of 1M NaOH, the temperature of the solution rose from 24.0°C to 32.0°C calculate the molar heat of neutralisation.
(Specific heat capacity of the solution is 4.2Jg^{-1}density is 1g/cm^3) (3marks)
26. The table below shows the test carried out on a sample of water and results obtained

Sample	Test	Observation
A	Addition of NaOH solution drop wise until in excess	White precipitate soluble in exess
B	Adding of $NH_{3(aq)}$ solution	White precipitate
C	Addition of dilute HNO_3 followed by $Ba(NO_3)_2$	White precipitate

a) Identify the anion present in the water (1mark)
b) Write the ionic equation for the reaction in C (1mark)
c) Write the formula of the complex ion in A (1mark)

CEKENAS MOCK EXAMINATION, 2023
Kenya Certificate of Secondary Education
233/2
Chemistry
PAPER 2
(Theory)
TIME: 2 HOURS

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

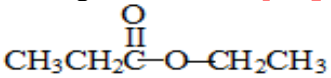
G							
					I		V
K							
J	L		M				

a) i) Select elements which belong to the same chemical family (1mark)
ii) Write the formulae of ions for two elements in the same period (1mark)
b) The first ionization energies of two elements K and M at random are 577kJ/mol and 494kJ/mol.
i) Write equations for the 1st ionisation energies for elements K and M and indicate their energies (2marks)
ii) Explain the answer in b (i) (1mark)
iii) Write the formula of the compound formed when I and L react (1mark)
iv) Give one use of element L (1mark)
c) I) How do the reactivity of elements K and L compare? Explain (2marks)
II) Element L and M form chlorides. Complete the table by writing the formulae of each chloride and state the nature of the solutions (2marks)

Element	Formula of chloride	Nature of chloride solution
L		
M		

III) The chloride of element M vaporizes easily while its oxide has a high melting point. Explain (2marks)
IV) Which elements forms a trivalent:
a) Cation (½mark)
b) Anion (½mark)

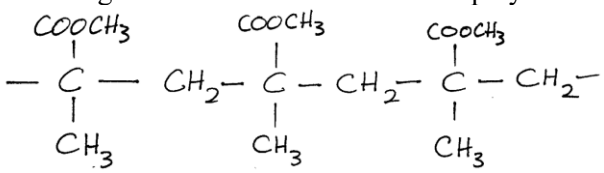
2. i) The following is a structure of an organic compound.



a) Which organic series does the compound belong? (1mark)
b) Give the structures and names of the reactants that form the above compound (2marks)
ii) The table shows structural formula of some organic compounds

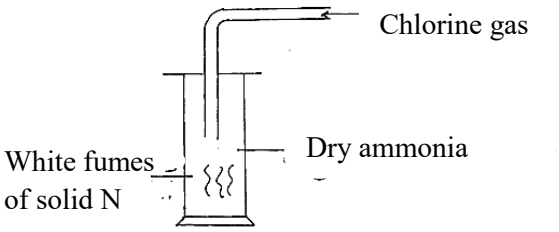
Compound	Structural formula
A	$CH_3CH_2CH_2CH_3$
B	CH_3CH_2COOH
C	CH_3CHCH_2
D	$CHCCH_3$
E	$CH_3CH_2CH_2CH_2OH$

a) Give the chemical test that can be used to identify compound C. (1mark)
b) Compare the boiling points of compound E and A (2marks)
c) State and explain the observation made when Sodium carbonate is added to compound G. (2marks)
d) Write an equation to show the reaction between compound E and magnesium metal and give the name of the product formed. (2marks)
e) The following is a structure of a section of a polymer



i) Draw the structure of the monomer (1mark)
ii) Give the name of the polymer (1mark)
iii) State one use of the polymer. (1mark)

3. a) Dry chlorine gas was passed over heated iron resulting in P. P was dissolved in water resulting in the formation of a solution of P. To a little of the solution P a few drops of Sodium hydroxide were added and solid Q was obtained.
I) Name substance P and Q (2marks)
II Write equations to show how substances P and Q were formed. (2marks)
III) Name a suitable drying agent for chlorine gas (1mark)
b) Chlorine burns in dry ammonia gas as shown in the diagram below.



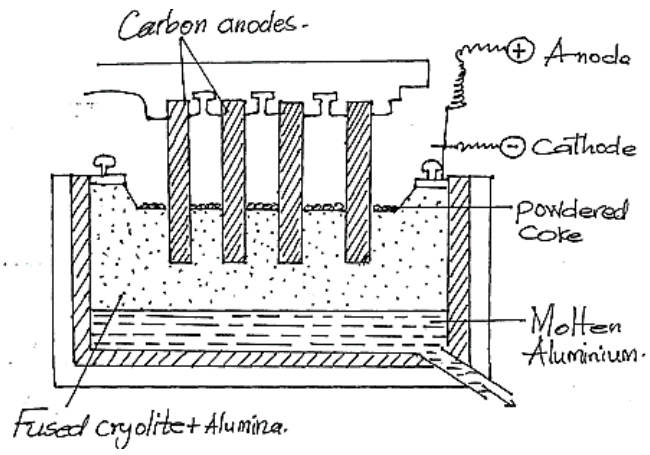
i) Identify solid N (1mark)
ii) A colourless and odourless gas is produced. Identify the gas (1mark)
iii) Write the equation for the burning of chlorine in dry ammonia gas (1mark)
iv) 3g of divalent metal X (atomic mass=24) react with dilute hydrochloric acid.
Calculate the volume of hydrogen gas produced at STP. (X=12, H=1 molar gas volume at STP=22.4dm^3 (3marks)
v) When excess chlorine was bubbled into hot concentrated sodium hydroxide, the following reaction occurred.
$3Cl_{2(g)} + 6NaOH_{(aq)} \rightarrow NaClO_{3(aq)} + 5NaCl_{(aq)} + 3H_2O_{(l)}$. In which product did chlorine under oxidation.
Explain (2marks)

4. a) Aqueous potassium sulphate was electrolysed using platinum electrodes in a cell.
i) Shows the product formed at the anode and cathode with the help of an equation (2marks)
Anode
Cathode
ii) Why would it not be advisable to electrolyse aqueous potassium sulphate using potassium metal electrodes? (1mark)
b) Use the standard electrode potential for elements A, B, C, D and F given below to answer that follow;

	E^0 (volts)
$A^{2+}_{(aq)} + 2e^-$ ⇌	-2.90
$B^{(2+)}_{(aq)} + 2e^-$ ⇌ $_{(l)}$	-2.38
$C^{+}_{(aq)} + e^-$ ⇌ $_{(g)}$	0.00
$D^{2+}_{(aq)} + 2e^-$ ⇌ $_{(g)}$	-0.34
$\frac{1}{2}F_{2(g)} + e^-$ ⇌ $_{(l)}$	$+2.87$

I) Which element is likely to be hydrogen? Explain (1mark)
II) What is the E^o value of the strongest reducing agent? (1mark)
III) In the space provided draw a labelled diagram of the electrochemical cell that would be formed when the half cells of elements B and D are combined. (3marks)
IV) Calculate the E^o value of the electrochemical cell constructed in (III) above (1mark)
c) During electrolysis of aqueous copper (ii) sulphate using copper electrodes, a current of 0.2 amperes was passed through the cell for 5 hours.
i) Write an ionic equation for the reaction that took place at the anode (1mark)
ii) Determine the change in mass of the anode which occurred as a result of electrolysis
$[Cu = 63.5, I\ Faraday = 96500C]$ (1mark)

5. a) The diagram below represents the electrolytic cell used for extraction of aluminium.



i) Write the formula of the main ore in which aluminium is extracted (1mark)
ii) Explain why the ore is first dissolved in hot concentrated sodium hydroxide. (2maks)
iii) Write equations for the reactions that takes place at
I) The anode (1mark)
II) The cathode (1mark)
iv) State why the graphite lining is used as the cathode (1mark)
v) Give two reasons for mixing aluminium oxide with cryolite in the electrolyte cell (2marks)
b) Aluminium is resistant to corrosion while iron corrodes very fast.
I) Why is aluminium not used to make window frames? (1mark)
II) State one reason why galvanised iron is resistant to corrosion even when the protective surface of zinc is broken? (1mark)
III) Write an equation to show the reaction between aluminium and concentrated sodium hydroxide solution (1mark)
IV) Explain how one word obtain aluminium oxide given the following; aluminium chloride solid, sodium hydroxide solid and distilled water. (3marks)

6. a) What are isotopes (1mark)
b) The table below shows the isotopic composition of naturally occurring neon

particle	$^{22}_{10}Ne$	$^{21}_{10}Ne$	$^{20}_{10}Ne$
% Abundance	9.2	0.3	90.5

i) Which is the most stable isotope of Neon? Explain (2marks)
ii) Calculate the relative mass of Neon (2marks)
iii) Balance the nuclear equation below
$^{14}_{6}C \rightarrow ^{14}_{7}N +$ _____ (1mark)
iv) Distinguish between nuclear fission and nuclear fusion. (1mark)
c) Bismuth undergoes radioactive decay. The table below shows the mass of Bismuth remaining at different times.

Time (min)	0	6	12	22	38	62	100
mass of Bismuth remaining (g)	50	41.5	32.5	23	14.5	6	1.5

i) Plot a graph of mass of bismuth remaining (vertical axis) against time. (3marks)
ii) From the graph determine
I) Mass of Bismuth remaining after 30 minutes (1mark)
II) The half-life of bismuth. (1mark)
III) What would happen to the rate of disintegration of bismuth if the temperature is increased? Explain (2marks)
d) State one application of radio isotopes in agriculture (1mark)

CEKENAS MOCK EXAMINATION, 2023

Kenya Certificate of Secondary Education

233/3

CHEMISTRY

Paper 3

CONFIDENTIAL / REQUIREMENTS

1. Solid E
2. $50cm^3$of solution F
3. $80cm^3$of solution H
4. 0.5g of solid K
5. 0.5g of solid L
6. Distilled water
7. Burette
8. Pipette
9. Pipette filter
10. Label
11. 250ml volumetric flask
12. Two 250ml conical flasks
13. Test tube holder
14. 2 boiling tube
15. 6 test tubes
16. Stopwatch
17. 10ml measuring cylinder
18. Spatula
19. 0.5g sodium hydrogen carbonate
20. $5cm^3$of ethanol
21. Filter paper – 3 pieces
22. Filter funnel
23. Blue and red litmus paper

Access to

1. 0.1M $BaCl_2$
2. 2M HCl
3. 2M Ammonia solution
4. 2M NaOH
5. 2M H_2SO_4 acid
6. Source of heat
7. Phenolphthalein indicator

Preparations

1. Solid E – 5cm magnesium ribbon
2. Solution F – 2M HCl
3. Solution H – 0.375M NaOH
4. Solid K – sodium benzoate
5. Solid L – Ammonium aluminium sulphate

CEKENAS MOCK EXAMINATION, 2023

Kenya Certificate of Secondary Education

233/3
Chemistry
(PRACTICAL)
Paper 3
TIME: 2¼ HOURS

INSTRUCTIONS TO CANDIDATES

1. *Answer all the questions in the spaces provided*
2. *All working must be clearly shown where necessary.*
3. *You are not allowed to start working with the apparatus for the first 15 minutes. This time is to enable you read the question paper and make sure you have all the requirements.*

1. You are provided with:
   - Magnesium ribbon solid E
   - 2M hydrochloric acid, solution F
   - 0.375M sodium hydroxide, solution H

   You are required to determine

i) The rate of reaction between magnesium and hydrochloric acid
ii) The mass of 1cm length of magnesium ribbon

PROCEDURE 1

Step 1: Cut out five pieces of exactly 1cm length of magnesium ribbon solid E. Carefully fill the burette with solution F.

Step 2: Drain from the burette 10cm^3 solution F into a test tube. Put one piece of magnesium ribbon into the tube and immediately start a stopwatch. Record the time taken for the magnesium ribbon to completely react.

Step 3: Transfer all the contents of the test tube into a 250ml volumetric flask. Rinse the test tube with distilled water and put in into the volumetric flask.

Step 4: Repeat step 2 and 3 by placing 9cm^3 of solution F and 1cm^3 of distilled water shake the contents before use. After each experiment transfer the mixture into the volumetric flask.
Repeat the procedure using contents in test tube 3, 4 and 5 as shown in the table below.
RETAIN THE SOLUTION IN THE VOLUMETRIC FLASK FOR USE IN PROCEDURE II

Table I

Test tube number	1	2	3	4	5
Volume of solution F(cm^3)	10	9	8	7	6
Volume of water added (cm^3)	0	1	2	3	4
Time taken (seconds)					
$\frac{1}{t}$ (sec^{-1})					

(5mks)

a) i) Plot a graph of rate $\left(\frac{1}{t}\right)$, against volume of solution F. (3mks)

ii) Use the graph to determine the time taken for 1cm length of magnesium to dissolve if volume of water added is 1.5cm^3 . (2mks)

iii) a) In terms of rate of reaction, explain the shape of the graph (2mks)

PROCEDURE II

Add distilled water into the solution in the 250ml volumetric flask up to the mark. Label it as solution G.
Clean the burette and fill it with Sodium hydroxide, solution H.
Pipette 25cm^3 of solution G into 250ml conical flask. Add 2 drop of phenolphthalein indicator and titrate it with solution H from the burette.

Record your results in table below

Table II (4mks)

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

b) Determine the

i) Average volume of solution H used. (1mk)

ii) Number of moles of hydrochloric acid in 250cm^3 of solution G. (2mks)

iii) Number of moles of hydrochloric acid solution F that reacted with solid E. (2mks)

iv) The mass of magnesium ribbon that reacted. (Mg=24). (2mks)

v) Mass of 1cm length magnesium ribbon. (1mk)

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

a) Place all solid K into a boiling tube. Add about 5cm^3 of distilled water and shake the mixture.

Observation	Inferences
(1mk)	(1mk)

b) To about 2cm^3 of the solution K , add half a spatula of sodium hydrogen carbonate.

Observation	Inferences
(½mk)	(½mk)

c) To the remaining solution K, add about 10$cm^3$of dilute hydrochloric acid. Shake thoroughly. Filter the mixture then wash the residue with distilled water. Dry the residue with filter paper.

i) Place one third of the residue into a test tube. Add about 10cm^3 of distilled water and shake the mixture. Add half a spatula sodium hydrogen carbonate.

Observation	Inferences
(½mk)	(½mk)

ii) To the remaining residue add 5cm^3 of distilled water then 5cm^3 of sulphuric (VI) acid, followed by 5cm^3 of ethanol and warm the mixture.

Observation	Inferences
(1mk)	(1mk)

3. You are provided with solid L carry out the following test and record your observations and inferences in the space provided.

a) Place one third of the solid L in a dry test tube. Heat it and test any gas produced with blue and red litmus paper.

Observation	Inferences
(2mks)	(1mk)

b) Place the remaining solid L in a boiling tube. Add about 10cm^3 of distilled water and shake. Divide the solution in to four portions.

i) To about 2cm^3 of solution L add 2 drops of barium chloride solution

Observation	Inferences
(1mk)	(1mk)

ii) To about 2$cm^3$of solution L add 5 drops of dilute hydrochloric acid

Observation	Inferences
(1mk)	(½mk)

iii) To 2cm^3 of solution L add ammonia solution drop wise until in excess

Observation	Inferences
(1mk)	(1mk)

iv) To 2cm^3 of solution L add sodium hydroxide drop wise until in excess

Observation	Inferences
(1mk)	(½mk)

EASTERN CLUSTER EVALUATION - 2023
Kenya Certificate of Secondary Education (K.C.S.E)
233/1
CHEMISTRY THEORY
Paper 1
Time: 2 Hours

INSTRUCTIONS TO CANDIDATES

- *Answer all the questions*
- *Mathematical tables and Electronic calculators may be used.*
- *All working must be clearly shown where necessary*

1. Distinguish between a thistle funnel and a dropping funnel (1mark)
2. a) What is an acid. (1mark)
   b) An ammeter was used to test electrical conductivity of sodium hydroxide and ammonia solution. State and explain the observations made. (2marks)
3. An unknown rock X was discovered in Ukambani. Test with dilute sulphuric (VI) acid shows rapid effervescence with production of a colourless gas A that forms a white precipitate with lime water (calcium hydroxide) and colourless solution B. On adding $3cm^3$ of 2M sodium hydroxide to a simple of solution B, a white precipitate C is formed that dissolves to form a colourless solution D on adding more sodium hydroxide. On adding 2M aqueous ammonia, a white precipitate E is formed which dissolves in excess aqueous ammonia. On adding $5cm^3$ of 1M lead (II) nitrate to a sample of solution B a white precipitate G is formed which remains on heating.
   Identify: (3marks)

a) Gas A
b) Solution B
c) Precipitate C
d) Solution D
e) Precipitate E
f) Precipitate G

4. Potassium sulphite solution was prepared and divided into two portions. The first portion gave a white precipitate when reacted with lead (II) nitrate. On addition of dilute nitric (V) acid the white precipitate disappeared.

a) Give the identity of the compound which formed as the white precipitate. (1mark)
b) Write the equation for the reaction between dilute nitric (V) acid and the compound whose formula is written in (a) above. (1mark)
c) What observation would be made if one drop of potassium dichromate solution was added to the second portion followed by dilute sulphuric (VI) acid? (1mark)

5. a) What name is given to the process by which an alkanol is formed from a carbohydrate? (1 mark)
   b) Explain why the solubility of ethane in water is lower than that of ethanol. (1 mark)
6. Study the standard reduction potential given and answer the questions that follow.
   (The letters are not the actual symbols of the elements).

			E^{θ} (volts)
$M^{2+}_{(aq)} + 2e$	→	$M_{(s)}$	-0.76
$N^{2+}_{(aq)} + 2e$	→	$N_{(s)}$	-2.37
$P^{+}_{(aq)} + e$	→	$P_{(s)}$	+0.80
$Q^{2+}_{(aq)} + 2e$	→	$Q_{(s)}$:	-0.14

a) The standard reduction potential for $Fe^{2+}(aq)$ is -0.44 volts. Explain why M would be more effective in protecting iron from rusting than P. (2 marks)
b) Calculate the E^{θ} value for the cell represented as $M_{(s)} / M^{2+}_{(aq)} // P^{+}_{(aq)} / P(s)$. (1 mark)

7. (a) State Charles's law. (1mark)
   b) A sealed glass tube containing air at s.t.p was immersed in water at 100^0c. Assuming that there was no increase in the volume of the glass tube due to the expansion of the glass, calculate the pressure of the inside tube. (Standard pressure = 760mmHg, standard temperature =273K) (2marks)
8. a) Methane reacts with oxygen as shown by the equations I and II below:
   I $CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$
   II $2CH_4(g) + 3O_2(g) \longrightarrow 2CO(g) + 4H_2O(l)$
   Which one of the two reactions represents the complete combustion of methane? Explain. (1½ marks)
   b) $80cm^3$ of methane was reacted with $150cm^3$ of oxygen forming carbon (IV) oxide and water.
   If the resultant mixture was allowed to cool to room temperature:
   Calculate the volume of:
   (i) Carbon (IV) oxide formed (1 mark)
   (ii) The unreacted gaseous mixture. (½ mark)

9. An isotope of Uranium; $\frac{234}{92}U$ decays by emission of an alpha particle to form thorium (Th)

a) Write the equation for the nuclear reaction undergone by the isotope. (1 mark)

b) Explain why it is not safe to store radioactive substances in containers made from aluminum sheets. (1 mark)

c) Give one use of radioactive isotopes in agriculture (1mark)

10. Consider the following reaction at equilibrium.

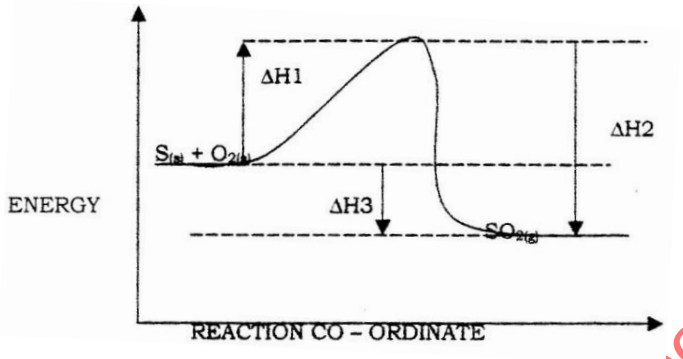
$PCl_{5\,(g)} \rightleftharpoons PCl_3\,(g) + Cl_{2\,(g)}$

Complete the table below to show the effect of different factors on the position of equilibrium.

Factor	Effect on the equilibrium position
(i) Decrease pressure	
(ii) Removing chlorine	
(iii) Adding Helium gas to mixture	

(3marks)

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



a) What do $\triangle H_1$ and $\triangle H_3$ represent? (2 marks)

$\triangle H_1$.....

$\triangle H_3$.....

b) Write an expression, for $\triangle H_3$ in terms of $\triangle H_1$ and $\triangle H_2$ (1mark)

12. (a) A sample of water in a beaker was found to boil at 102°C at 1 atmospheric pressure. Assuming that the thermometer was not faulty explain this observation (1mark)

(b) A colourless solution was suspected to be water. Give one chemical and one physical best that can be used to show that the colourless solution is water.

i) Chemical test: - (1mark)

ii) Physical test: - (1mark)

13. David mixed wax and ammonium chloride accidentally. Briefly describe how he could have separated them. (2marks)

14. A compound whose formula is $Z(OH)_2$ reacts as shown below;

$Z(OH)_{2(s)} + 2H^+_{(aq)} \rightarrow Z^{2+}_{(aq)} + 2H_2O_{(L)}$

$Z(OH)_{2(s)} + 2OH^-_{(aq)} \rightarrow Z(OH)^{2-}_{4(aq)}$

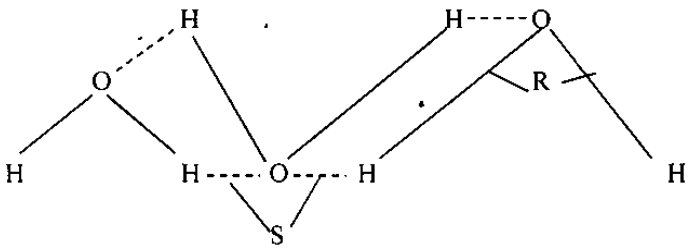
a) What is an acid salt? (1mark)

b) i) State the property exhibited by $Z(OH)_2$ (1mark)

ii) Name two hydroxide that behave like $Z(OH)_2$ (1mark)

15. Describe you would prepare a pure sample of zinc carbonate starting with zinc oxide. (3marks)

16. a) The diagram below shows a structure of water molecules.



Name the bonds labeled

R - (½mark)

S - (½mark)

b) Using dot (• and cross (x) diagram show bonding in;

i) Potassium chloride (K = 19 Cl = 17) (1mark)

ii) Carbon tetrachloride (C=6, Cl=17) (1mark)

17. i) In an experiment to determine solubility of solid P in water at 25^0C, the following results were obtained.
Mass of empty evaporating dish = 24.2g
Mass of evaporating dish + saturated solution = 40.4g
Mass of evaporating dish + dry solid P = 28.4g
Using the information above calculate the solubility of solid P at 25^0C in g/100g of water. (2marks)

ii) State one precaution observed when carrying out the experiment in (i) above 1 (1mark)

18. i) On complete combustion of a hydrocarbon 0.88g of carbon (iv) oxide and 0.36g of water were formed calculate the molecular formula of the hydrocarbon given that relative molecular mass of the hydrocarbon is 70. (C = 12, H = 1, O = 16) (2marks)

ii) Draw the structural formula of the hydrocarbon in (i) above and give its name (1mark)

19. The table below shows solutions and their PH values.

Solution	PH value
L	2.0
M	7.0
N	14.0

i) Select two solutions that will react with calcium metal. Give a reason. (2marks)

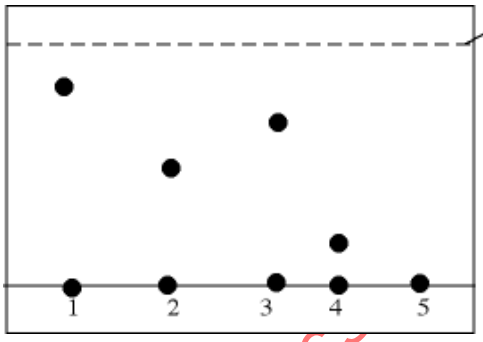
ii) Which solution is likely to be that of sodium chloride solution? (1mark)

20. During the extraction of aluminium, cryolite is added to molten aluminium oxide.

i) State the function of cryolite during the process (1mark)

ii) Give two reasons why aluminium is used in making overhead cables. (2marks)

21. The diagram below represents a paper chromatogram of pure inks marked 1, 2, 3 and 4.
Ink 5 is a mixture that contains inks 1 and 4 only.



a) Give a reason why ink 1 moves faster to the solvent front than ink 2. (1mark)

b) Show on the chromatogram diagram the;

(i) chromatography of ink 5. (1mark)

(ii) The baseline (1mark)

22. (a) What is the half life? (1mark)

(b) X g of a radioactive element was reduced to 12.5g in 15.6years.If the half life of the element is 5.2years.
Calculate the value of X. (2marks)

23. Study the table below and answer the question that follow. The letters do not represent the actual symbols of the element.

Formula of ion	Electron configuration
W^{2+}	2
V^{2-}	2.8
X^{3+}	2.8
U^{2+}	2.8
Y^{-}	2.8.8

a) Select letters representing elements found in;

i) The same group and name the group (1mark)
Letters……Group……..

ii) Period threeand name the period. (1mark)
Letters……..Period…….

b) What is the family name given the group members to which element Y belongs (1mark)

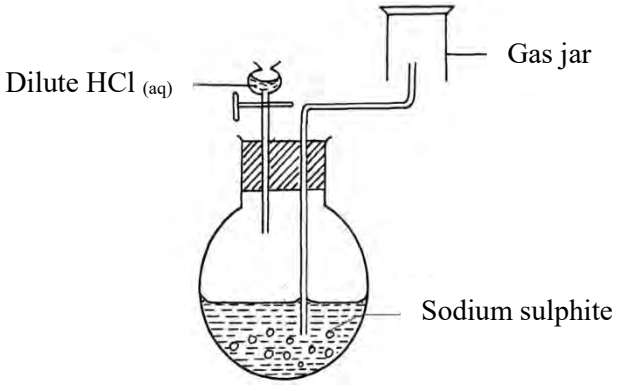
24. Both anhydrous calcium chloride and anhydrous copper (II) sulphate are put in separate petri dishes in the laboratory and left overnight.

a) What was the observable difference made in the morning? (2marks)

b) Name the process represented by each change. (1mark)
Anhydrous calcium chloride:
Anhydrous copper (II) sulphate:

25. Plastics are made from petroleum products.
a) Name two plastics derived from ethene and give their use. (2marks)
b) State **one** disadvantage of continuous use of plastics (1mark)

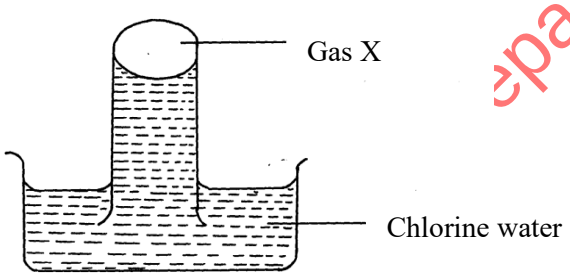
26. Dilute hydrochloric acid and Sodium sulphite were reacted as shown in the set-up below:



(a) Name the gas produced in the flask (1mark)
(b) Write a chemical equation for the reaction taking place (1mark)
(c) Give two reasons why no gas was collected in the gas jar. (1mark)

27. Temporary water hardness can be removed by boiling;
(a) What is hard water? (1mark)
(b) Write a chemical equation to show how temporary hardness can be removed by boiling. (1mark)
(c) State one advantage of hard water. (1mark)

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



(a) Name gas X ……. (1mark)
(b) State the condition which is not indicated on the diagram for gas X to be formed. (1mark)

29. Calculate the number of moles of ammonia in 8.9dm^3 of the gas at s.t.p
(Molar gas volume at s.t.p = 22.4dm^3, L = 6.0 x 10^{23} mol^{-1}) (1mark)

EASTERN CLUSTER EVALUATION - 2023
Kenya Certificate of Secondary Education (K.C.S.E)
233/2
CHEMISTRY
PAPER 2
TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES

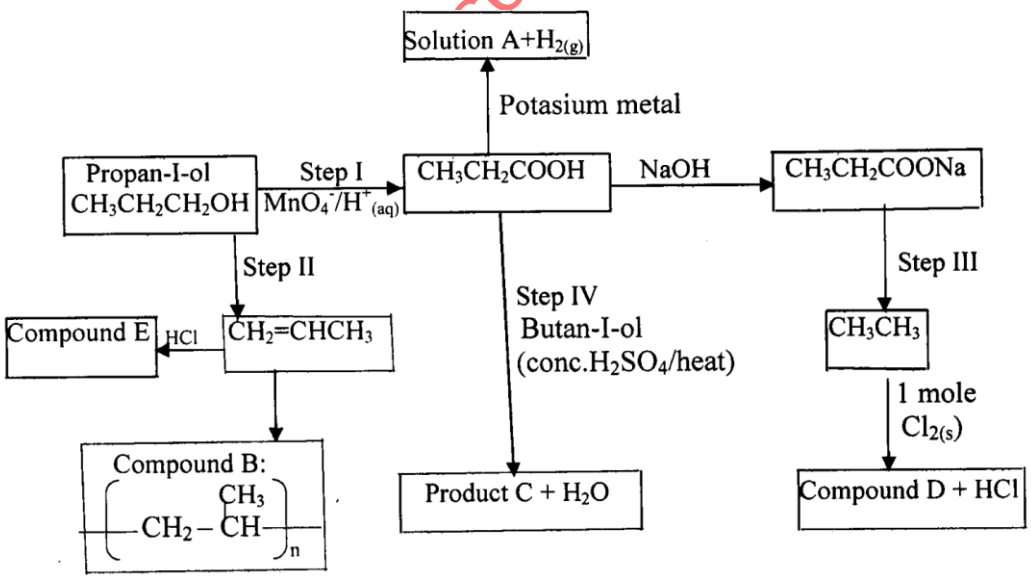
1. *Answer all the questions*
2. *KNEC or electronic calculators may be used in calculations.*
3. *All working MUST be shown clearly where necessary.*

1. The table below shows some elements in the periodic table. Use it to answer the questions that follow. The letters are not the actual symbols of the elements.

								F
A	G		E		B		D	
C								

i) Select the most reactive metal. Explain. (1mk)
ii) Write the formula of the compound formed between element G and D. (1mk)
iii) Compare the following with explanations:
I) The electric conductivity of A and E. (2mks)
II) The atomic radius of B and D. (2mks)
iv) Which element has the highest ionisation energy? Explain. (2mks)
v) Show on the periodic table above an element Z belonging to period 4 and group VI. (1mk)
vi) Element C has relative atomic mass of 40.2 and has two isotopes of mass 39 and 42. Calculate the relative abundance of each isotope. (3mks)

2. The scheme below shows a series of reactions starting with propan-I-ol. Study it answer the questions that follow.



a) Name the type of reaction that takes place in:
i) Step I (1mk) ii) Step II (1mk)
b) Write the equation for the reaction that takes place in step III. (1mk)
c) Name the substances labelled: A, C, D and E. (2 mks)
d) Draw the structural formula of the product C. (1mk)
e) Name the process in step IV (1mk)
f) Name compound B and state the type of reaction involved in its formation. (2mks)
g) If the relative molecular mass of B is 35700, determine the value of **n**. (2mks)

h) Below are structures of two cleaning agents X and Y.

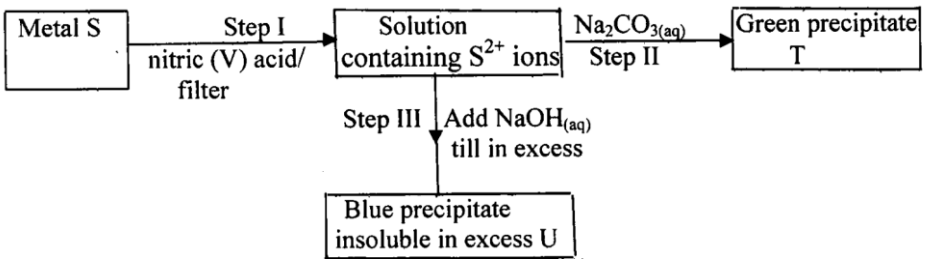
X: $R - COO^- Na^+$

Y: 

i) Identify the cleaning agent suitable to be used with water containing magnesium chloride. (1mk)

ii) State **one** advantage of using cleaning agent Y. (1mk)

3. Study the reaction scheme shown below and answer the questions that follow.



a) Identify the following:

i) Metal S (1mk)

ii) Green precipitate T: (1mk)

iii) Blue precipitate U: (1mk)

b) Write ionic equation for the reaction that takes place in step II. (1mk)

c) i) Distinguish between a strong acid and a weak acid. (1mk)

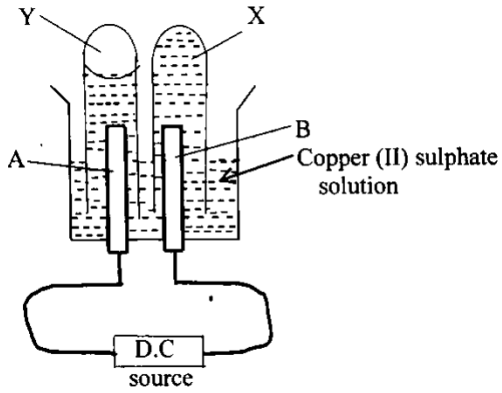
ii) A student tested pH – value of solutions using universal indicator and obtained the following results:

Solution	A	B	C	D	E
Colour	Blue	Violet	Red	Green	Yellow
PH	10	14	1	7	5
Classification				Neutral	

Complete the table by classifying the solutions as strongly acid, weakly acid, strongly basic, weakly basic. (2mks)

iii) Identify two solutions likely to react with aluminium oxide. Give a reason. (2mks)

4. a) Use the diagram below and answer the questions that follow:



The above experiment was performed using a carbon electrode and another electrode.

i) Identify electrode B. _____ (1mk)

ii) Name the colourless gas Y. _____ (1mk)

iii) Explain why no gas was observed in X. (1mk)

iv) Write chemical equation for the reaction which occur at electrode:

A: _____ (1mk)

B: _____ (1mk)

b) Study the reduction potentials below and answer the questions that follow.

Half cell			E^{Θ} (Volts)
$A^{2+}_{(aq)} + 2e^-$	$\rightleftharpoons$	$A_{(s)}$	+0.34
$B^+_{(aq)} + e^-$	$\rightleftharpoons$	$B_{(s)}$	-2.92
$\frac{1}{2} C_{2(g)} + e^-$	$\rightleftharpoons$	$C^-_{(aq)}$	+2.87

i) Identify the weakest oxidizing agent. _____ (1mk)

ii) Calculate the e.m.f of the cell that would produce highest output voltage. (2mks

iii) Write the cell representation for the cell formed in (ii) above. (1mk)

c) In electrolysis of dilute magnesium sulphate using inert electrodes, a current of 2.5A was passed through the electrolyte for 1 hour 20 minutes. Calculate the volume of the gas produced at the anode at standard temperature and pressure s.t.p. (IF = 96500C, molar volume at s.t.p = 22.4 dm^3) (3mks)

5. a) Define standard enthalpy of combustion of a substance. (1mk)

b) Study the heats of combustion shown below:

$H_{2(g)} + ½ O_{2(g)} \longrightarrow H_2O_{(l)}$ $\Delta H = -393KJmol^{-1}$

$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ $\Delta H = -286KJmol^{-1}$

$C_3H_8 + 5O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(l)}$ $\Delta H = -2218KJmol^{-1}$

i) Draw an energy level diagram linking heat of formation of propane (C_3H_8) with its heat of combustion of its constituent elements. (2mks)

ii) Use the information above to calculate heat of formation of propane. (2mks)

c) A given mass of propane was used to heat one litre of water. The temperature of water rose from 25°C to 50.5°C (Specific heat capacity of water = $4.2Jg^{-1}K^{-1}$)

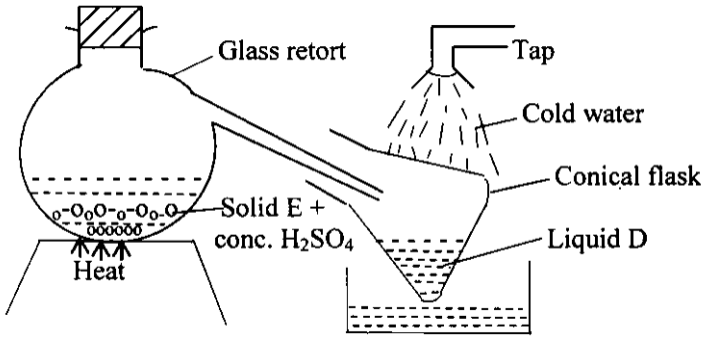
i) Calculate the heat change for the reaction. (2mks)

ii) Find the mass of propane burnt (C=12; H=1) (2mks)

d) Calculate the calorific value of propane. (2mks)

e) Apart from heating value, state two other factors to consider when choosing a fuel. (2mks)

6. a) The diagram below shows preparation of nitric (V) acid in the laboratory.



i) Name solid E. (1mk)

ii) Give the reason why apparatus used is all made of glass. (1mk)

iii) Write the equation for the reaction between solid E and concentrated sulphuric (VI) acid. (1mk)

iv) State and explain two observations made during the experiment. (2mks)

b) During the industrial manufacture of nitric (V) acid, a mixture of purified dry ammonia and air is passed through a catalyst at 900°C. A series of reactions take place leading to production of concentrated nitric (V) acid.

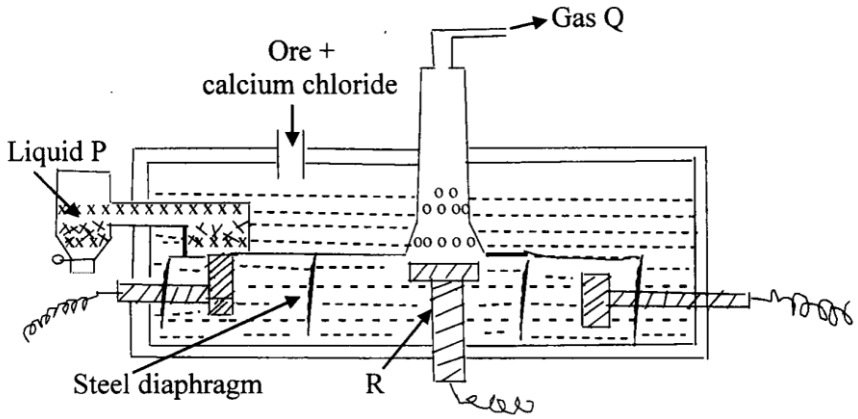
i) Name the catalyst used. _____ (1mk)

ii) Give three reactions in order in which they occur leading to production of nitric (V) acid. (3mks)

iii) Give one use of nitric (V) acid in agriculture. (1mk)

7. a) Name the main ore from which sodium metal is extracted. (1mk)

b) The diagram below shows Down's cell for extraction of sodium. Study it and answer the questions that follow.



i) Identify the following:
   I) Gas Q _____ (1mk)
   II) Electrode R _____ (1mk)
   III) Liquid P _____ (1mk)
ii) Write equation for the reaction which takes place at the cathode. (1mk)
iii) State the role of the following in the cell.
   I) Calcium chloride (1mk)
   II) Steel diaphragm (1mk)
iv) State **one** use of sodium metal. (1mk)
c) i) Give the name and formula of the major ore from which copper is extracted. (1mk)
   ii) Draw a diagram of a set up used in the electrolytic purification of blister copper. (2mks)

EASTERN CLUSTER EVALUATION - 2023
Kenya Certificate of Secondary Education (K.C.S.E)
233/3
CHEMISTRY
PRACTICAL
Paper 3

CONFIDENTIAL INSTRUCTIONS TO SCHOOLS

In addition to the normal fittings and apparatus in the laboratory, each candidate would need the following:

- Solid P in a boiling tube
- 100 cm^3 of solution Q
- 1 Burette
- 1 Pipette
- 1 Filter funnel
- 1 Label
- 1 Pipette filler
- 1 Thermometer
- 250 cm^3 volumetric flask
- 1 Conical flask
- 1 Test tube holder
- Water bath
- 1g Solid E
- 4cm^3 liquid G supplied in a test tube
- 1 Boiling tube
- 6 test tubes in a test tube rack
- Distilled water in a water bottle
- 2 Filter papers
- 10cm^3 measuring cylinder
- 1 blue and 1 red litmus papers
- 1 wooden splint
- 1 Watch glass

ACCESS TO

- Source of heat
- Phenolphthalein indicator supplied with a dropper
- 2M sodium hydroxide solution supplied with a dropper
- 2M ammonia solution supplied with a dropper
- Sodium chloride solution supplied with a dropper
- Barium nitrate solution supplied with a dropper
- Nitric(v)acid supplied with a dropper
- Acidified potassium manganate (vii) supplied with dropper
- Universal indicator supplied with a dropper
- pH chart

PREPARATION

- Solution Q is 0.2M sodium hydroxide
- Solid P is 4.5 g oxalic acid supplied in a boiling tube
- Solid E is a mixture of 0.5g aluminium sulphate and 0.5 g zinc carbonate.
- Liquid G is 4 cm^3 of ethanol supplied in a stoppered test tube

EASTERN CLUSTER EVALUATION - 2023
Kenya Certificate of Secondary Education (K.C.S.E)
233/3
CHEMISTRY
Paper 3
(PRACTICAL)
TIME: 2¼ HOURS

INSTRUCTIONS TO CANDIDATES

- *Answer **all** questions.*
- *You are not allowed to start working with the apparatus for the first **15 minutes** of the 2 ¼ hours allowed for this paper. This time is to enable you to **read** the questions paper and **make sure** you have all the chemicals and apparatus that you may need.*
- *All working **must** be clearly shown where necessary.*

1. You are provided with:-

- 4.5g of solid P in a boiling tube.
- Solution Q, 0.2M sodium hydroxide.
- Phenolphthalein indicator.

You are required to determine:

(i) Solubility of solid **P** at different temperatures.
(ii) The value of **n** in the formula $(HX)_n \cdot 2H_2O$ of solid P.

Procedure I

(a) Fill the burette with distilled water. Using the burette, add 4.0cm^3 of distilled water to solid P in a boiling tube. Heat the mixture in a water bath while stirring with a thermometer to about 70^{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 P start to appear. Record this temperature in table I.
(c) Using the burette, add 2.0cm^3 of distilled water to the contents of the boiling tube. Heat the mixture in a 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 P start to appear.
(e) Repeat the procedure (c) and (d) three more times, heating the solution in a water bath and record the temperature in the table I. ***Retain the contents of the boiling tube for use in procedure II.***
(f) Complete the table by calculating the solubility of solid P at the different temperatures. (The solubility of a substance is the mass of that substance that dissolves in 100cm^3 (100gm) of water at a particular temperature.)

TABLE I

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

(5mks)

(i) On the grid provided, plot a graph of solubility P against temperature. (3mks)
(ii) Using your graph, determine the temperature at which 100g of solid P would dissolve in 100cm^3 of water. (1mk)
(iii) Determine the solubility of solid P at 55^{0}C. (1mk)

Procedure II

- Transfer the contents of the boiling tube from Procedure I into 250ml volumetric flask. Rinse the boiling tube and the thermometer with distilled water and add to the volumetric flask.
- Add more distilled water to make up the mark. Label this solution P.
- Fill the burette with solution P. Using a pipette and pipette filler place 25.0cm^3 of solution Q into a conical flask.
- Titrate solution Q with solution P using phenolphthalein indicator.

Table II

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

(4mks)

Calculate the:

i) Average volume of solution P used in the experiment. (1mk)

ii) Number of moles of sodium hydroxide used in solution Q. (1mk)

iii) Concentration of solution P in moles per dm^3 given that the relative formula mass of P, $(HX)_n \cdot 2H_2O$ is 126. (2mks)

iv) Number of moles of $(HX)_n \cdot 2H_2O$ used in solution P. (1mk)

v) The number of moles of sodium hydroxide required to react with one mole of P. Hence find the value of in the formula $(HX)_n \cdot 2H_2O$. (1mk)

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

a) i) Place all of solid E in a boiling tube. Add about $10cm^3$ of distilled water and shake thoroughly. Filter the mixture into another boiling tube. Retain the filtrate for use in test 2(b) below.

Observations	Inference
1mk	1mk

ii) Dry the residue obtained using pieces of filter papers. Transfer dry residue into a clean dry boiling tube. Heat the residue strongly and test any gas produced using a blue and red litmus papers and a burning splint.

Observations	Inference
1mk	1mk

b) i) Divide the filtrate obtained in a(i) above into four portions. To the first portion add sodium hydroxide solution drop wise until excess.

Observations	Inference
1mk	1mk

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

Observations	Inference
1mk	1mk

iii) To the third portions add sodium chloride solution.

Observations	Inference
1mk	1mk

iv) To the fourth portion add barium nitrate solution, then add nitric (v) acid.

Observations	Inference
1mk	1mk

3. You are provided with liquid G in a test tube. Carry out the tests in (a) and (b) and write the observations and inferences in the spaces provided. Describe the method used in part (c).

a) Place about $2cm^3$ of liquid G in on a check glass and ignite it.

Observations	Inference
1mk	1mk

b) i) To the remaining liquid G in a test tube, add 3 cm^3 of water and shake well. Use the mixture obtained to carry out tests b(ii) and c

Observations	Inference
1mk	1mk

ii) To $2cm^3$ of the mixture add 2 drops of potassium manganate (vii). Warm the mixture.

Observations	Inference
1mk	1mk

c) To $2cm^3$ of the mixture determine the pH value.

Method used	Inference
1 mk	1mk

LUGARI JOINT EVALUATION EXAMINATION, 2023
233/1
Chemistry
Paper 1
2 hours

Instructions to candidates

c) Answer all the questions.
d) *All working **MUST** be clearly shown.*
e) KNEC mathematical tables and silent non-programmable electronic calculators may be used.

1. a) Draw a labelled diagram showing atomic structure of $(^{23}_{11}Na.)$ 2mks
   b) The atomic number of phosphorus is 15.Draw a dot (•) and cross(x) diagram for the compound formed when phosphorus reacts with hydrogen atomic number 1 (1mk)
2. Study the following heat changes and answer questions that follow

   $NaCl(s) \longrightarrow Na^+_{(g)} + Cl^-_{(g)}$ ΔH_1 +781kJmol$^-$
   $Na^+(g) \longrightarrow Na(aq)$ ΔH_2 -390kJmol$^-$
   $Cl^-(g) \longrightarrow Cl^-(aq)$ ΔH_3 -384kJmol$^-$

a) Identify the heat changes H1, H2 (1mk)
b) Calculate the heat of solution of sodium chloride using the above heat changes (2mks)

3. Dry carbon (II) oxide gas reacts with heated lead (II) oxide as shown in the equation below.

   $PbO_{(s)} + CO_{(g)} \longrightarrow Pb_{(s)} + CO_{2(g)}$

(a) Name the process undergone by the lead (II) oxide. (1mk)
(b) Give a reason for your answer in (a) above. (1mk)
(c) Name another gas that can be used to perform the same function as carbon (II)oxide gas in the above reaction. (1mk)

4. The following reaction is in equilibrium in a closed container

   $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2\ SO_{3\ (g)}$ ΔH= -Ve

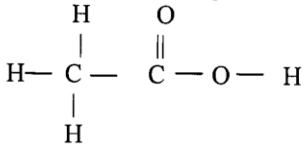
   State giving reasons how an increase in temperature would affect the amount of sulphur (VI) oxide gas. (2mks)

5. The standard electrode potential for elements **P, Q, R** and **S** are given below.

	E^θ (volts)
$P^{2+}(aq) + 2e^- \longrightarrow P_{(s)}$	–2.40
$Q^{2+}(aq) + 2e^- \longrightarrow Q(s)$	–0.80
$2R^+(aq) + 2e^- \longrightarrow R_2(g)$	0.00
$S^{2+}(aq) + 2e^- \longrightarrow S(s)$	+0.35
$½\ T_2(aq) + e^- \longrightarrow T^-(aq)$	+1.40

(a) What is the E^θ value for the strongest oxidizing agent? (1mk)
(b) Which two of the above elements in an electrochemical cell produce the largest e.m.f . (1mk)
(c) Calculate the electromotive force of the cell in (b) above. (1mk)

6. a) What is meant by the term:
   Half-life:- (1mk)
   b) State one application of radioactivity in medical
   c) 50g of a radioactive substance was reduced to 6.25g in 36.3years.
   Calculate the half-life of the substance. (2mks)
7. The structure below belongs to a member of alkanoic acid.



a) Give the name of the Structure. (1mk)
b) What is the total number of electrons used for bonding in a molecule of the structured *Named in (a)* *(2mks)*

8. The purple color of a solution containing manganese (vii) ions disappears when iron (ii) ions are added.
   The ionic equation for the reaction which occurs is;

   $MnO^-_{4(aq)} + 5Fe^{2+}_{(aq)} + 8H^+_{(aq)} \longrightarrow Mn^{2+}_{(aq)} + 5Fe^{3+}_{(aq)} + 4H_2O_{(l)}$

   With reasons state which substance is acting as a; (2 mks)

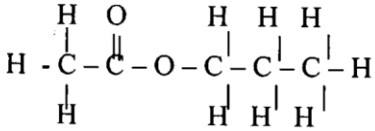
i) Reducing agent.
ii) Oxidizing agent.

9. 3.1g of an organic compound containing carbon, hydrogen and oxygen only produced 4.4g of carbon(iv) and 2.0 of water on combustion

a) Calculate its empirical formulae (2mk)

b) Calculate its molecular formula if its mass 90. (1mk)

10. Esters, fats and polyesters all contain the ester linkage. The structural formula of the ester is given below.



Name **two** chemicals that could be used to make this ester and draw their structural formulae.
Show all bonds. (2mks)

11. An iron sculpture was produced to commemorate the anniversary of founder of a certain village. To prevent it from rusting, the village elder attached it by a wire to a block of zinc which was stored underground out of sight.

i) Explain how the village elder's action would prevent the rusting of the sculpture. (1mk)

ii) What name is given to this method of preventing rusting? (1mk)

iii) List down **two** other ways in which rusting of the statue could be prevented. (1mk)

12. $50cm^3$ ammonia gas diffuses through a small orifice in 20 seconds. How long will it take a similar volume of propane (C_3H_8) to diffuse through the same orifice under the same conditions of temperature and pressure? (C=12.0, H =1.0, N=14.0) (3mks)

13. a) what observations would be made if hydrogen sulphide gas was bubbled through a solution of Copper (II) sulphate. (1mk)

b) Write an equation for the reaction that takes place in (a) above. (1mk)

c). Chlorine reacts with methane as shown below.

$CH_{4(g)} + Cl_{2(g)} \longrightarrow CH_3Cl_{(g)} + HCl_{(g)}$

What condition is necessary for this reaction to take place? (1mk)

14. The table below gives some properties of three metals: Aluminium, iron and copper. Use it to answer the questions that follow.

Metal	Density	Tensile Strength 10^{10}pa	Electrical conductivity
Aluminium	2.70	7.0	0.38
Iron	7.86	21.1	0.10
Copper	8.92	13.0	0.59

Assuming that steel and stainless steel have similar properties to iron.

a) Why do some stainless steel sauce pans have a copper base? (1mk)

b) Aluminum with a steel core is used for overhead power cables in preference to copper.
Why is aluminium preferred? (1mk)

c) Apart from overhead power cables copper is chosen for almost all other electrical uses.
Suggest **two** reasons for the choice of copper. (2mks)

15. A form four student wanted to determine the solubility of potassium nitrate. He obtained the following results.

Mass of evaporating dish = 15.13g
Mass of evaporating dish and solution. = 36.51g
Mass of evaporating dish and salt = 19.41g
Use the information above to calculate the solubility of potassium nitrate. (3mks)

16. The grid below is part of the periodic table. Use it to answer the questions that follow. (The letters do not represent the actual symbols of elements.)

							R	**S**	
N	**Q**							**T**	**U**
P									

a) Indicate in the grid the position of an element represented by letter V, whose atomic number is 14. (1mk)

b) Select a letter which represents a monoatomic gas. (1mk)

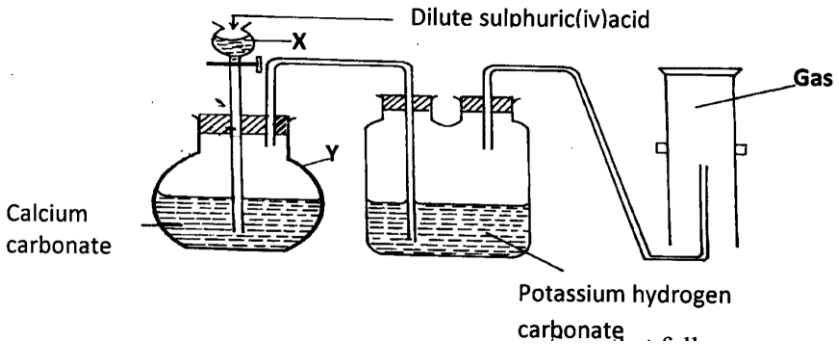
c) Write an equation for the reaction between Q and T (1mk)

17. The table below shows ammeter readings recorded when two equimolar solutions were tested separately.

Electrolyte	Current (A)
Dilute Sulphuric (VI) Acid	7.2
Ethanoic Acid	4.0

Explain the difference in the ammeter readings. (1mk)

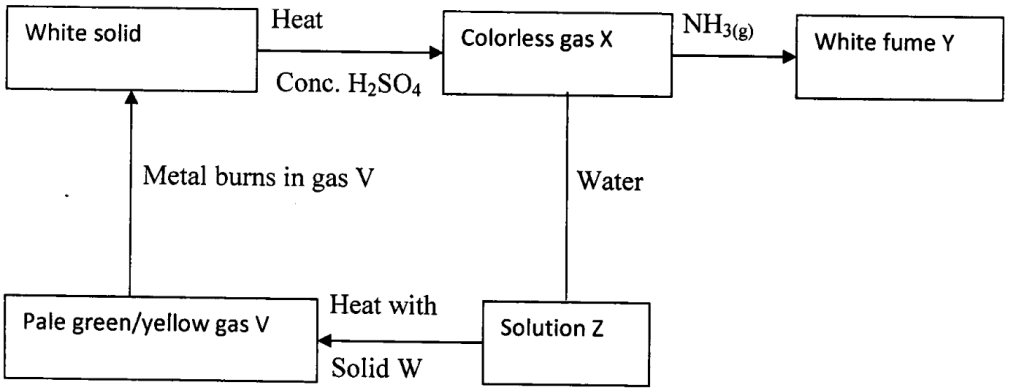
18. A student set up the apparatus for the preparation of carbon (IV) oxide gas as shown below.
Study the set up and answer the questions that follow.



(a) Explain using an equation why the reaction in apparatus Y occurs for a very short time then stops. (1mk)
(b) What is the purpose of passing the gas through potassium hydrogen carbonate? (1mk)
(c) **State** and **explain** why there is no sample of carbon (IV) oxide gas collected. (1mk)

19. Describe how a solid of ammonium sulphate can be prepared starting with $100cm^3$ of 2M ammonium hydroxide

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



a) Write an equation for the formation of white fumes Y. (1 mk)
b) What is the function of solid W in the reaction? (1 mk)
c) Identify gas V. (1 mk)

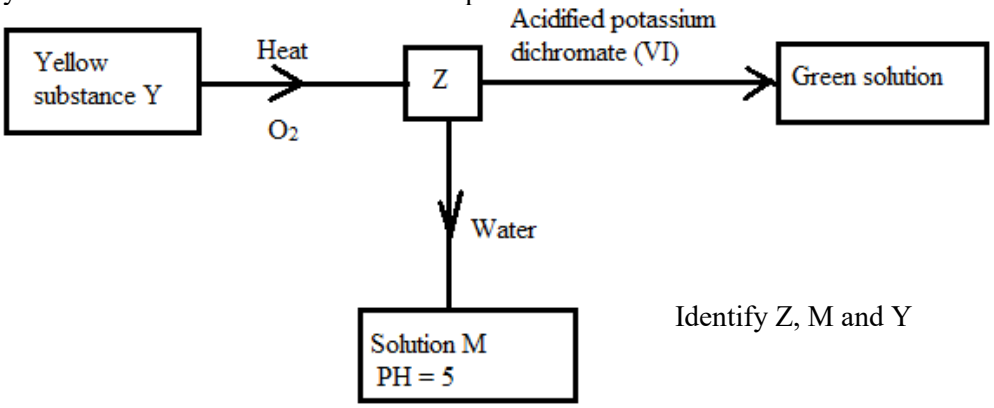
21. Explain the effect of the following on the rate of reaction in terms of the collisions theory; (3mks)
a) Increase in concentration
b) Change in pressure
c) Use of catalyst

22. Explain each of the following observations.
(a) Soft drinks fizz when the cap is removed from the bottle. (1mk)
(b) Diamond does not conduct electricity while graphite does. (1mk)
(c) Pure nitric (V) acid is colourless but during its laboratory preparation, it appears yellow. (1mk)

23. Polyvinyl/ chloride (PVC) is an example of an addition polymer whose monomer is Chloroethene.
(a) What is a polymer? (1mk)
(b) What is meant by addition polymerization? (1mk)
(c) Using 2n molecules draw the structure of PVC. (1mk)

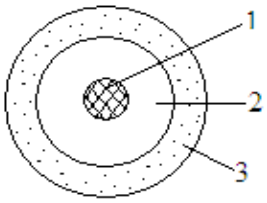
24. (a) State Boyle's law (1mk)
(b) A gas occupies $500cm^3$ at 27° and 100,000pa. What will be its volume at 0° and 101325pa (2mks)

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



Identify Z, M and Y (3mks)

26. The diagram below represents pipes used in Frasch pump for the extraction of sulpur



Which substance passes through tube 1, 2 and 3? (3mks)

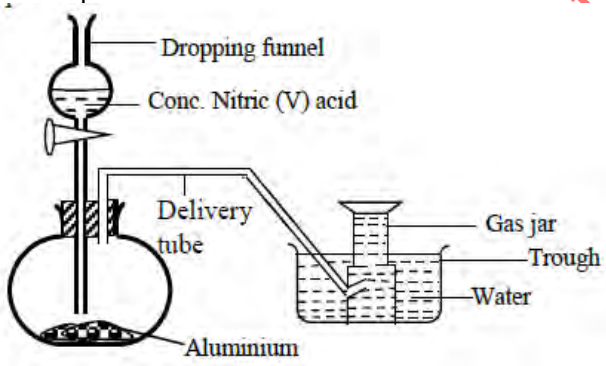
27. In the last stage of the solvay process, a mixture of sodium hydrogen carbonate and ammonium chloride is formed.

(i) State the method of separation used. (1mk)

(ii) Write an equation showing how lime is slaked (1mk)

(iii) Name the by- product recycled in the above process. (1mk)

28. In order to prepare hydrogen gas in the laboratory a student set-up the apparatus shown in the diagram below. Study it and answer the questions that follow.



(a) Suggest why the student did not collect hydrogen gas. (1mk)

(b) In a separate experiment the student reacted iron and hydrochloric acid to prepare hydrogen gas.

(i) Write an ionic equation for the reaction. (1mk)

(ii) The hydrogen gas produced was found to have a foul smell. Suggest an explanation for this. (1mk

LUGARI JOINT EVALUATION EXAMINATION, 2023
233/2
Chemistry
Paper 2
2 hours

INSTRUCTIONS TO CANDIDATES.

(a) Answer all the questions.
(b) All workings must be clearly shown where necessary.
(c) KNEC mathematical tables and non-programmable electronic calculators may be used.

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

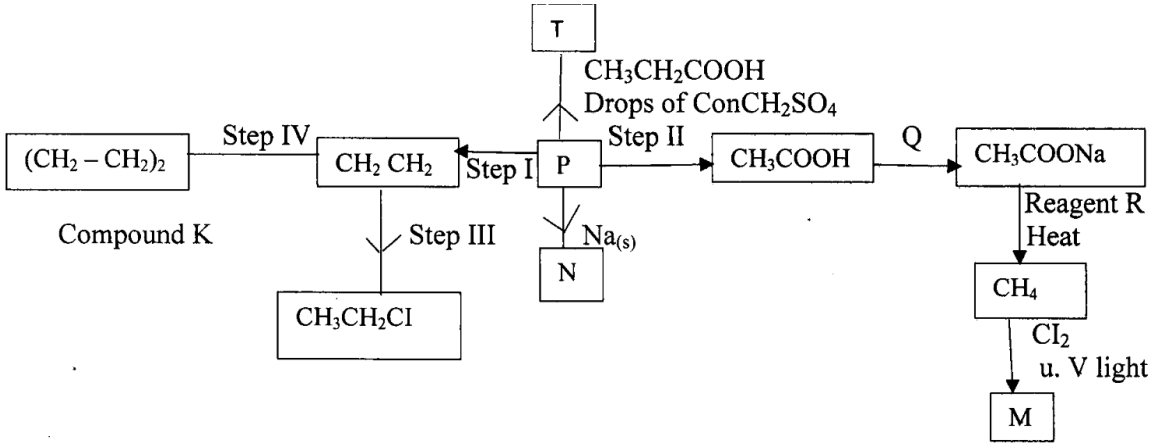
I	II		III	IV	V	VI	VII	VIII
						A		
K	B		C		D		E	
F	G							
							H	

(a)
(b) Which element forms ions with charge of -2? Explain your answer. (2mks)
(c) Which element is the most reactive metal? (1mk)
(d) Name the chemical family to which element B and G belong. (1mk)
(e) What is the nature of the oxide formed by C? (1mk)
(f) How does the reactivity of H compare with that of E? Explain. (2mks)
(g) Write a balanced equation between B and Chlorine. (1mk)
(h) Explain how the atomic radii of F and G compare. (2mks)
(i) If the oxides of B and D are separately dissolved in water, what effects will their aqueous solutions have on litmus paper? (2mks)

2. (a) (i) State what is meant by "dynamic equilibrium". (1mk)
(ii) Dichromate (VI) ions are orange in colour while chromate (VI) ions are yellow.
Consider the following equilibrium.
$Cr_2O_{7(aq)}^{2-} + 2OH^-_{(aq)} \rightleftharpoons 2CrO_{4(aq)}^{2-} + 2H_2O_{(l)}$
State and explain the observations that will be made if sulphuric (VI) acid is added to the mixture. (2mks)

(b) One of the reactions in the manufacture of Nitric(V) acid involves catalytic oxidation of ammonia as shown in the equation.
$4NH_{3(g)} + 5O_{2(g)} \rightleftharpoons 4NO_{(g)} + 6H_2O_{(g)}$; $\Delta H = -90kjmol^{-1}$
The reaction is carried out at a pressure of 10 atmospheres and a temperature of 900^0C.
i) Other than Nitric(V) acid, name another product that is formed. (1mk)
ii) State and explain the effect on the position of equilibrium if the reaction is carried out;
(I) at 10 atmospheres pressure and 450^0C. (2mks)
(II) at 900^0C and 20 atmospheres pressure. (2mks)
(III) In the absence of a catalyst. (1mk)
(c) State and explain the effect on the rate of the reaction if the reaction is carried out at 10 atmospheres and 450^0C. (2mks)
(d) A factory uses 100kg of ammonia each day to produce 160kg of nitrogen (II) oxide.
Calculate the percentage yield of nitrogen (II) oxide. (3mks)

3. The scheme below shows reactions of some organic compounds. Study it and answer the following questions.



(a) Give the name and draw the structural formula of compound P. (2mks)
(b) Give the reagents and conditions necessary for carrying out:-
(i) Step (I) (1mk)
(ii) Step (II) (2mks)
(c) Give the name of the type of reaction that takes place in:-
(i) Step (1) (½) (ii) Step (II) (½)
(iii) Step (IV) (½)
(d) Name reagent Q. (½)
(e) Write an equation forming compound T (1Mk)
(f) Draw the structural formula of M and give its name (1Mk)
(g)
(I) Name compound K (1Mk)
(II) If the relative molecular mass of K is 84,000, determine the value of n (C=12, H=1) (2Mks)

4. The following data was obtained during an experiment to determine the molar heat of combustion of methanol.

Volume of water used	=	$100cm^3$
Initial temperature of water	=	22^0C
Final temperature of water	=	38^0C
Mass of methanol + Lamp before burning	=	88.10g
Mass of methanol + Lamp after burning	=	87.78g

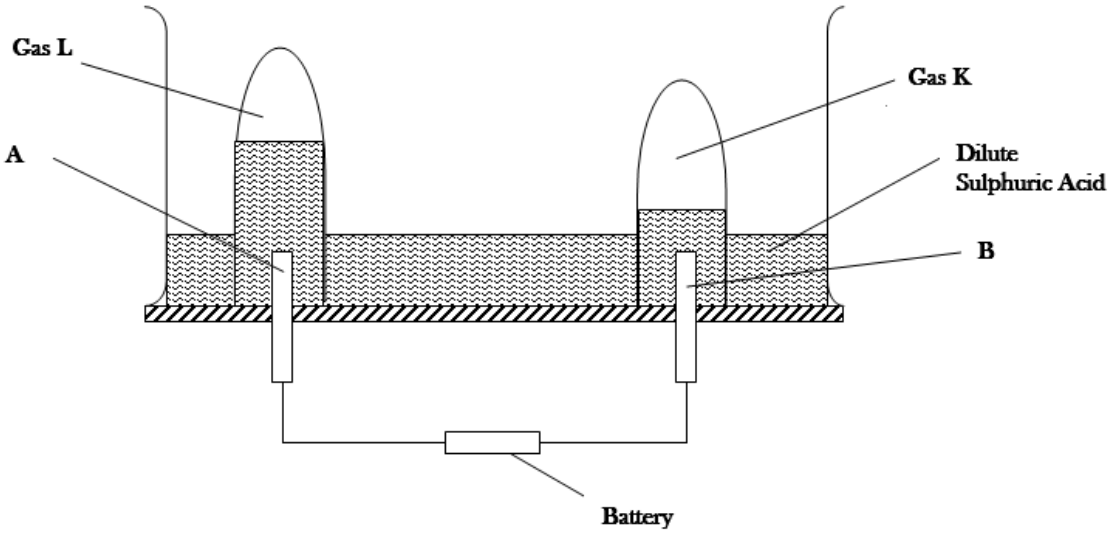
(a) Calculate:-
(i) The highest temperature change. (1mk)
(ii) The mass of methanol burnt (1mk)
(iii) The number of moles of methanol used in the experiment (C=12, O = 16, H = 1). (1mk)
(iv) The heat change in the experiment. (2mks)
(Density of water $1g/cm^3$, specific heat capacity of water = $4.2\ Jg^{-1}K^{-1}$)
(v) The molar heat of combustion of methanol. (2mks)
(vi) Write the thermochemical equation for the combustion of methanol. (1mk)
(vii) In the space provided, sketch a simple energy level diagram for the above change, showing activation energy. (2mks)

5. (a) Study the standard electrode potentials for the half cells given below and answer the questions that follow. (The letters do not represent the actual symbols of the elements).

Half cells	**E^0 Volts**
$N^+_{(aq)}\ e \longrightarrow N_{(s)}$	-2.92
$J^+_{(aq)} + e \longrightarrow J_{(s)}$	+0.52
$K^+_{(aq)} + e \longrightarrow ½\ K_{2(g)}$	0.00
$½\ G_{2(g)} + e \longrightarrow G^-_{(aq)}$	+1.36
$M^{2+}_{(aq)} + 2e \longrightarrow M(s)$	-0.44

(i) Identify the strongest reducing agent. Give a reason for your answer. (1mk)
(ii) Which two half cells would produce the highest potential difference when combined. (1mk)
(iii) Explain whether the reaction represented below can take place. (2mks)
$2N^+_{(aq)} + M_{(s)} \longrightarrow 2N_{(s)} + M^{2+}_{(aq)}$

(b) 100cm^3 of 2M Sulphuric (VI) acid was electrolyzed using the set-up represented by the diagram below.



(i) Name electrode A and B (1mk)
(ii) Write an equation for the reaction that produces gas L. (1mk)
(iii) Describe how gas K can be identified. (1mk)
(iv) Explain the difference in.
(I) The volume of the gases produced at the electrodes. (1mk)
(II) Brightness of the bulb if 100cm^3 of 2M ethanoic acid was used in place of sulphuric (VI) acid. (1mk)

6. (a) The diagram below was used to prepare hydrogen chloride gas which was passed over heated iron powder.

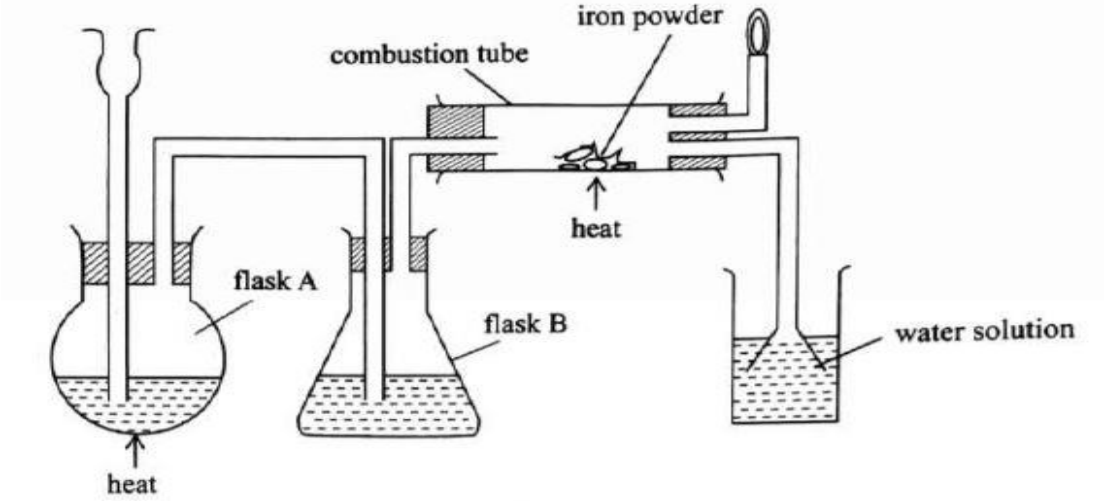
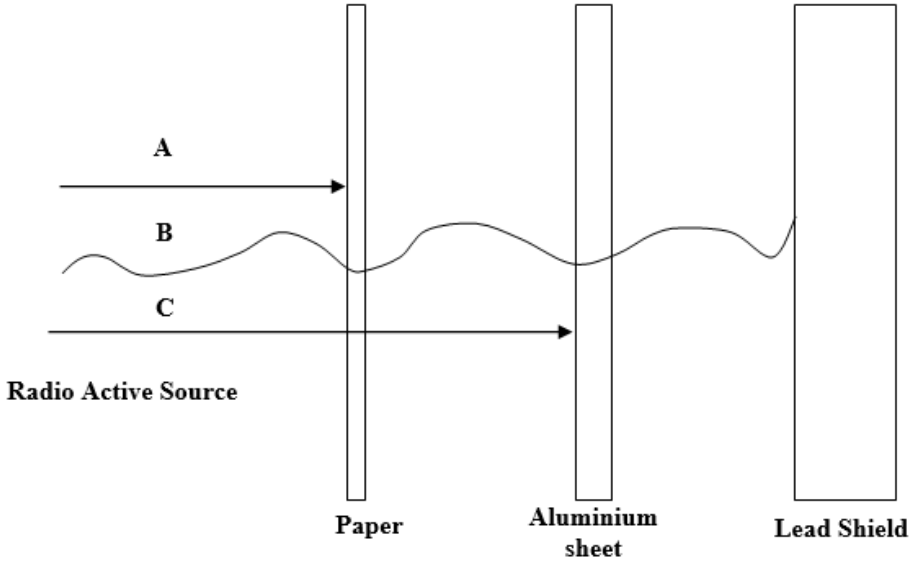


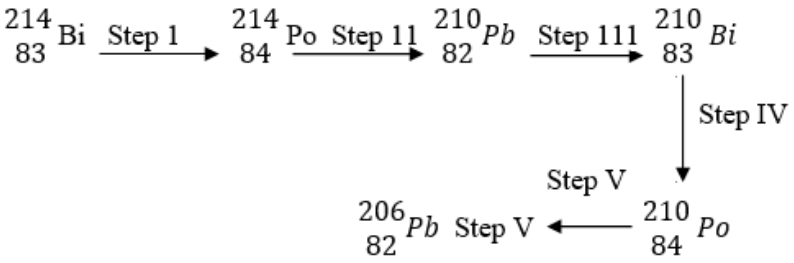
Figure 4

(i) Give a pair of reagents that will produce hydrogen chloride gas in flask A. (1mk)
(ii) Name the substance in flask B. (1mk)
(iii) State the observation made in the combustion tube. (1mk)
(iv) Write an equation for the reaction in the combustion tube. (1mk)
(b) (i) Identify the gas that burns at the jet. (1mk)
(ii) Explain why the gas in b (i) is burned. (1mk)
(c) Give reasons why excess hydrogen chloride gas is dissolved using the funnel arrangement. (1mk)
(d) State what will be observed when the reaction in the combustion tube is complete. (1mk)

7. (a) Define radioactivity. (1mk)
(b) Give two differences between chemical and nuclear reactions. (2mks)
(c) Study the diagram below and answer the questions that follow.



(i) What property of radiations is being investigated by the illustration above. (1mk)
(ii) Give the name of the radiation B and give a reason. (1mk)
(e) Below is the radioactive decay starting with $^{214}_{83}Bi$, study it and answer the questions that follow.



(i) Identify the radiations emitted at: - (1mk)
Step 1
Step V
(ii) Write a nuclear equation for step II. (1mk)
(e) State one application of radioactivity in: -
(i) Medicine (1mk)
(ii) Agriculture (1mk)
(f) State two dangers associated with radioactivity. (1mk)
(g) The decay rates of a sample of radioisotope of Bismuth at different time. Intervals as indicated in the following table.

Time (Hours)	0	5	10	15	20	25
Rate of disintegration in counts 5^{-1}	730	570	455	365	292	232

(i) Draw a graph of disintegration rate against time. (3mks)
(ii) Determine the half-life of Bismuth. (1mk)

LUGARI JOINT EVALUATION EXAMINATION, 2023
233/3
Chemistry
Paper 3
PRACTICAL

CONFIDENTIAL

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

1. About 100cm^3 of 0.2m hydrochloric acid labelled solution S
2. Accurately weighed 2.4g of anhydrous sodium carbonate.
3. 250ml volumetric flask
4. 50ml measuring cylinder
5. Distilled water
6. 250ml empty beaker
7. Glass rod
8. About 50cm3 of 0.5m sulphuric (VI) acid labelled solution G
9. About 70cm3 of 1m sodium hydroxide solution labelled solution F
10. 10ml measuring cylinder
11. 100ml empty beaker
12. 0-110°C thermometer
13. One burette 0-50ml
14. one 25.0ml pipette
15. one pipette filler
16. retort stand
17. 2 labels
18. two conical flasks (250ml)
19. one boiling tube
20. six dry test tubes in a test tube rack
21. Methyl orange indicator
22. One filter funnel
23. a white tile
24. Metallic spatula
25. 1.5 g of solid C
26. 1g of solid P
27. About 0.5g anhydrous sodium carbonate.

Access to
i) Means of heating
ii) 2m NaoH solution with a dropper
iii) 2m ammonia solution with a dropper
iv) 0.5m sodium chloride solution with a dropper
v) 1m sulphuric (VI) acid with a dropper

NOTE
1. Solid C is lead (ii) nitrate
2. Solid P is oxalic acid
3. solution F is sodium hydroxide solution prepared by dissolving 40g of it in 1 litre of solution
4. Solution S is 0.2m Hydrochloric acid prepared by dissolving 17.2cm^3 of concentrated hydrochloric acid in 1 litre.
5. Solution G is 0.5m sulphuric (vi) acid prepared by dissolving 27.5cm^3 of concentrated sulphuric (vi) acid in 1 litre of solution (Density 1.84g/cm^3)
6. 0.5m sodium chloride solution is prepared by dissolving 29.25g of solid sodium chloride in 1 litre of solution

LUGARI JOINT EVALUATION EXAMINATION, 2023
233/3
Chemistry
Paper 3
(Practical)
2¼ HRS

INSTRUCTIONS TO CANDITATES

a) Answer all the questions
b) You are NOT allowed to start working with the apparatus for the first 15 minutes of the 2 ¼ hrs allowed for this paper. This time is to enable you to read the question paper and make sure you have all the chemicals and apparatus that you may need.
c) *All working must be clearly shown where necessary.*

1. You are provided with
   - Solution S 0.2m Hydrochloric acid solution
   - N grams of anhydrous sodium carbonate
   - Methyl orange indicator

   You are required to prepare a solution of sodium carbonate and then standardize it with hydrochloric acid solution.

   Procedure

   Transfer all the N grams of sodium Carbonate into a 250ml volumetric flask Add 100cm^3 of distilled water and shake till all the solid dissolves. Add more distilled water up to the 250ml mark and label it solution P using a measuring cylinder, transfer 50cm^3 of solution P into a clean 250ml beaker and add 50cm^3 of distilled water. Stir well with a glass rod and label it solution T. Pipette 25.0cm^3 of solution T and place it into a conical flask, add 3 drops of methyl orange indicator and titrate with solution S from the burette. Record your results in the table I below. Repeat the titration two more times and complete the table below. (3mks)

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

a) Calculate the average volume of solution S used (1mk)
b) i) Calculate the number of moles of solution S used. (2mks)
   ii) Write a balanced chemical equation for the reaction between solution T and S (1mk)
   iii) Calculate the number of moles of sodium carbonate solution in 25cm^3 of solution T. (2mks)
   iv) Calculate the number of moles of sodium carbonate in 100cm^3 of solution T (2mks)
   v) Calculate the number of moles of sodium carbonate in 50cm^3 of the original solution P (1mk)
c) Given that Na =23.0, C= 12.0, O = 16.0 Calculate
i. The mass of sodium carbonate N grams that were dissolved to make solution P (2mks)
ii. The concentration of sodium carbonate solution P in moles per litre (2mks)

2. You are provided with 1M sodium hydroxide solution F. 0.5m Solution of an acid solution G.
   You are required to determine the molar heat of neutralization of sodium hydroxide with acid G.

   Procedure

   Place six test tubes on the test tube rack. Using 10cm^3 measuring cylinder measure 5cm^3 portions of solution G and place them into each of the six test tubes. Measure 25cm^3 of solution F using a 50cm$_3$ measuring cylinder and place it into a 100cm^3 beaker. Measure the temperature of this solution F and record it in table II below. Pour the first portion of the 5cm^3 of solution G from the test-tube into the beaker containing 25cm^3 of solution F. Stir with the thermometer and record the highest temperature of the mixture pour the second portion of solution G, stir carefully and record the highest temperature of this mixture. Continue with this procedure using the remaining portions of solution G to complete table II below

TABLE II

a) (3mks)

Total volume of G added (cm^3)	0	5	10	15	20	25	30
Volume of F (cm^3)	25	25	25	25	25	25	25
Highest temperature (0°c)							

b) On the grid provided, plot a graph of temperature (vertical axis) against volume of solution G added (3mks)

c) From the graph determine

i. The volume of solution G required to neutralize the $25cm^3$ of sodium hydroxide solution F (1mk)

ii. The highest temperature change, ΔT. (1mk)

d) Calculate the number of moles of sodium hydroxide solution F used (1mks)

e) Calculate the molar heat of neutralization of the sodium hydroxide solution F.
(specific heat capacity of water = $4.2Jg^{-1}k^{-1}$, density of water = $1g/cm^3$) (2mks)

(I) you are provided with solid C carry out the tests below to identify the ions present in substance C.

TEST	**OBSERVATIONS**	**INFERENCES**
a) dissolve one spatula end full of solid C in about $10cm^3$ of distilled water divide the solution into 4 portions		
i) To the first portion add 3 drops of aqueous NaoH and then to excess	(1mk)	(1mk)
ii) To the second portion add 3 drops of ammonia solution and then to excess	(1mk)	(1mk)
iii) To the third portion add 4 drops of sodium chloride solution and warm	(2mk)	(1mk)
iv) To the fourth portion add 3 drops of sulphuric (VI) acid	(1mk)	(1mk)

(II) You are provided with solid p carry out the tests below to identify the solid

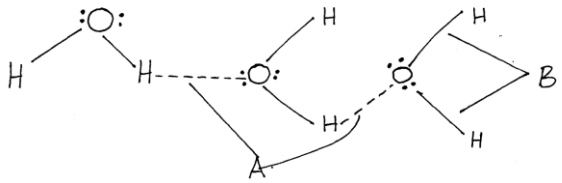
TEST	**OBSERVATIONS**	**INFERENCES**
a) Scoop a little of solid P using a clean metallic spatula and ignite it with a flame	(1mk)	(1mk)
b) Place the remaining solid P in a test –tube. Add $2cm^3$ of distilled water. Add all the solid sodium carbonate provided	(1mk)	(1mk)

BUURI FORM 4 JOINT EXAMINATION, 2023
233/1
Chemistry
PAPER 1
(Theory)
TIME: 2 HOURS

Instruction to candidates

1. *Answer all the questions*
2. *All working must be clearly shown where necessary.*

1. a) State Graham's law of diffusion. (1mk)
   b) 50cm³ of nitrogen (ii) oxide was allowed to diffuse through a porous membrane in 20 seconds. Calculate the time taken by equal volume of carbon (ii) oxide to diffuse through the same membrane. (C=12, N=14, O=16). (2mks)
2. State two functions of a fume chamber in a laboratory. (2mks)
3. The diagram below shows a structure of water molecule.



Name the bonds labelled. (2mks)
i) A
ii) B

4. Two samples of water were put in separate beakers. They were boiled for some time and allowed to cool. Equal volumes of soap were added to each sample and stirred. Water in beaker C readily formed lather with soap while water in beaker D required more soap to lather.

i) Write the formula of one salt likely to be in water in beaker. (2mks)
a) C
b) D
ii) Name one method that can be used to soften water in beaker D. (1mk)

5. Describe how you would prepare lead (ii) sulphate given the following reagents: dilute nitric (v) acid, distilled water, sodium sulphate solid and lead metal. (3mks)
6. During manufacture of sulphuric (vi) acid, sulphur (iv) oxide is oxidised to sulphur (vi) oxide in the presence of vanadium oxide catalyst as shown below:

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)} \quad \triangle H = -197kJ/mol$$

The reaction is carried out at a pressure of 3 atmospheres and a temperature of 450^{0}C. State and explain the effect on the yield of sulphur (vi) oxide if the reaction is:

a) Carried out at 3 atmospheres and 600^{0}C. (2mks)
b) In absence of a catalyst. (2mks)

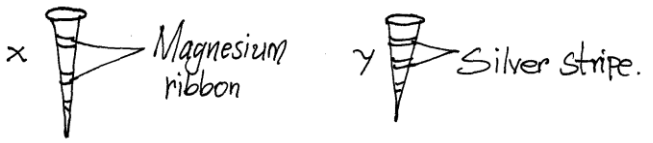
7. a) Hydrogen gas was passed over 4.64g of an oxide of iron in a combustion tube until there was no further change. The mass of the final substance was found to be 3.36g. Determine the empirical formula of the oxide. (Fe=56, O= 16). (3mks)
   b) State the property of hydrogen demonstrated in the experiment above. (1mk)
8. Atoms of element X exist as $^{14}_{6}X$ and $^{12}_{6}X$.

a) What name is given to the two types of atoms? (1mk)
b) Use dot (•) and (x) diagram to represent electrons draw the atomic structure of x. (2mks)

9. Hydrogen sulphide gas was passed through a solution of iron (ii) chloride.

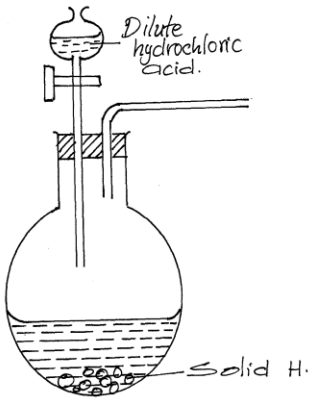
i) State two observations made. (2mks)
ii) Write an equation for the reaction taking place in (i) above. (1mk)

10. Two clean iron nails of the same size were connected with wire to magnesium and silver stripes as shown.



State and explain the observation made on nail x and y if they were left in the open for 2 weeks. (2mks)

11. The diagram below shows an incomplete setup used to prepare sulphur (iv) oxide in the laboratory.



a) Identify solid H. (1mk)
b) Complete the set up above to show how dry sulphur (iv) oxide may be collected. (2mks)

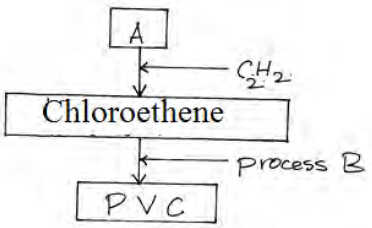
12. Some average bond energies are given below.

Bond	Energy in kJ/MOL
C-C	348
C-H	414
Cl- Cl	243
H-Cl	340
C – Cl	432

Determine whether the reaction below is exothermic or endothermic. (3mks)

$C_2H_{6(g)} + Cl_{2(g)} \longrightarrow C_2H_5Cl_{(g)} + HCl_{(g)}$

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

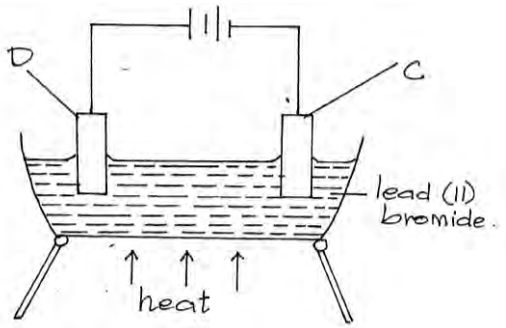


a) Identify reagent A. (1mk)
b) Name process B (1mk)
c) What does PVC stand for? (1mk)

14. Ethanedioic acid ($H_2C_2O_4$) is used instead of methanoic acid (HCOOH) to prepare carbon (ii) oxide in the laboratory. It gives equal volume of carbon (ii) oxide and carbon (iv) oxide.

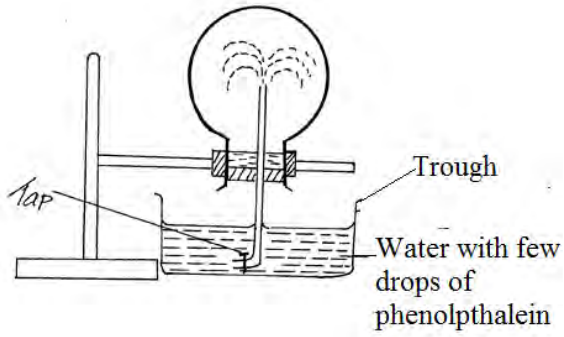
a) Write an equation for the dehydration of ethanedioic acid. (1mk)
b) Explain how pure carbon (II) oxide can be obtained from the mixture. (2mks)

15. The diagram below represents a set-up of apparatus used to investigate the effect of an electric current on lead (ii) bromide.



a) Describe the observation made at electrode C. (2mks)
b) State two applications of electrolysis. (1mk)

16. The set up below was used to investigate a property of ammonia gas.



i) What property of ammonia gas is being investigated? (1mk)

ii) The experiment above is commonly known as 'the fountain experiment'; explain. (2mks)

iii) Identify another gas that may be used instead at ammonia gas. (1mk)

17. Draw a well labelled diagram to show how crystals of sodium chloride can be obtained from sodium chloride solution. (3mks)

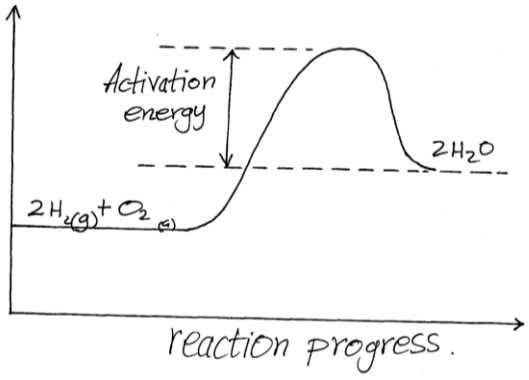
18. a) Define the term solubility. (1mk)

b) 40g of a saturated solution yields 15g of salt when evaporated to dryness.
Calculate the solubility of the salt. (2mks)

19. Increased levels of carbon (ii) oxide leads to global warming. Give two reasons why the amount of carbon (iv) oxide in the atmosphere is increasing gradually. (2mks)

20. Explain the observation made when a blue litmus paper is dipped in methylbenzene in which hydrogen chloride gas is bubbled through. (2mks)

21. The reaction between hydrogen gas and oxygen releases energy. A student drew the reaction profile for the reaction between hydrogen gas and oxygen gas.



State two errors made when drawing the reaction profile. (2mks)

22. Both water (18) and hydrogen sulphide (34) are molecular substances. However water has a higher boiling point than hydrogen sulphide. Explain. (2mks)

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

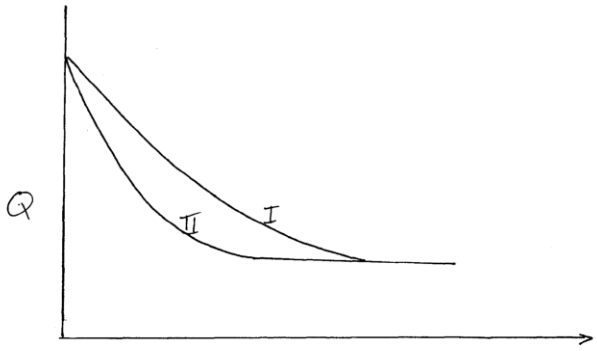
	E				A		X	
R			G			C		
				Q				

a) How do the atomic radii of R and G compare. (1mk)

b) How do the pH of the oxides of A and E compare. (1mk)

c) On the grid, indicate with a tick (✓) the position of K which is found on the third period and forms K^{3-} ions. (1mk)

24. The curves below were obtained when equal volumes of nitric (v) acid of same concentration were reacted with 25.0g of calcium carbonate, labelled Y. In one case, the acid was first warmed before the reaction.



a) Which curve represents the reaction involving warm nitric (v) acid? (1mk)

b) Sketch the curves obtained if the graph of the volume of CO_2 produced against time were plotted. (NB: on the same axis). (2mks)

25. i) State two observations made when a small piece of potassium metal is put in a beaker full of water. (2mks)

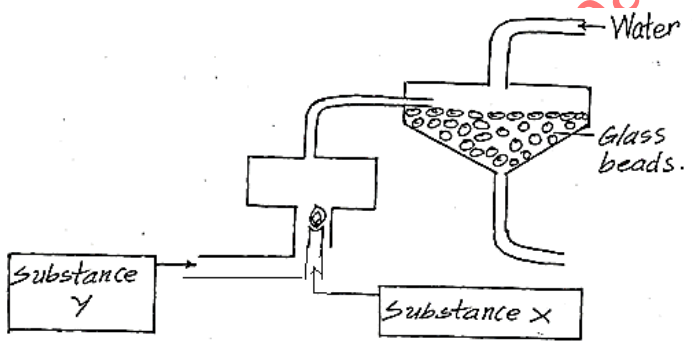
ii) Name the group of the periodic table to which potassium belongs. (1mk)

26. When a hydrocarbon with formula C_xH_y burns in chlorine gas, black specks and a colourless gas are obtained.

a) To which homologous series does the hydrocarbon belong? (1mk)

b) Write the general equation for the reaction between the hydrocarbon and chlorine gas. (1mk)

27. The diagram below represents a set up for large scale manufacture of hydrochloric acid. Study it and answer the questions that follow.



i) Name the substance X. (1mk)

ii) What is the purpose of glass beads? (1mk)

iii) Give one use of hydrochloric acid. (1mk)

28. When 25cm³ of 0.5M HCl is added to 25cm³ of 0.5M NaOH, the temperature of the solution rose from 23^0C to 26^0C. Given that the density of the solution is 1g/cm³ and its specific heat capacity is $4.2Jg^{-1}k^{-1}$.

a) Determine the amount of heat evolved that caused the temperature to rise. (1mk)

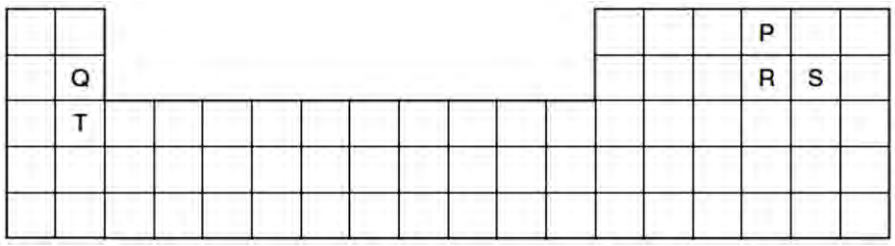
b) Work out the molar enthalpy of neutralization for this reaction. (2mks)

BUURI FORM 4 JOINT EXAMINATION, 2023
233/2
Chemistry
PAPER 2
TIME: 2 HOURS

Instructions to candidates

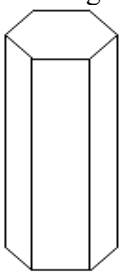
1. *Answer all the questions.*
2. *Mathematical tables and scientific calculators may be used.*
3. *All working must be clearly shown where necessary.*

1. The diagram shows part of the Periodic Table. The letters are not the actual symbols of the elements.



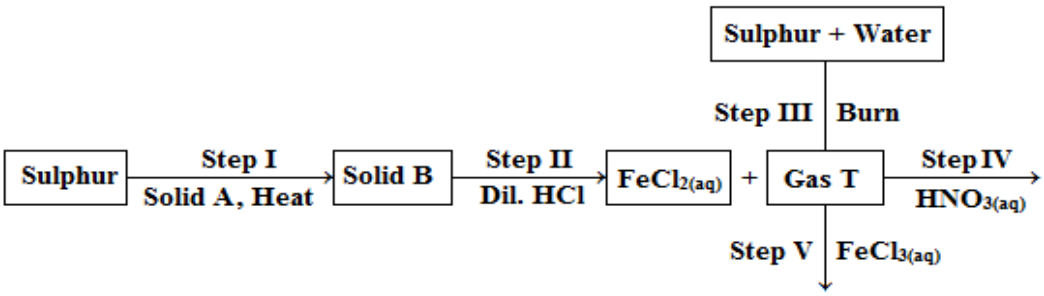
(a) Compare the reactivity between elements Q and T. (2mks)
(b) Explain the electrical conductivity of the chloride of element T. (2mks)
(c) Compare the melting and boiling points of elements R and S. (2mks)
(d) Write an equation for the second ionization energy of element Q. (1mk)
(e) How does the atomic and ionic radius of each of the following elements compare?
(i) Element T. (1½mks)
(ii) Element P (1½mks)
(f) Compare atomic radius of elements R and Q. (1½mks)
(g) Explain the difference in the melting points of the oxides of element Q and the oxide of element R. (1½mks)

2. (a) The diagram below shows the structure of an allotrope of sulphur



(i) What are allotropes? (1mk)
(ii) Identify the allotrope shown in the diagram above. (1mk)
(iii) State **two** properties of the allotrope above. (2mks)

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



(i) Write the equation for the reactions in:
I. Step I. (1mk)
II. Step II. (1mk)
(ii) State **two** observations made in step II. (2mks)
(iii) Explain the observations made in:
I. Step IV. (1½mks)
II. Step V. (1½mks)
(iv) State **one** use of gas T. (1mk)

3. Next to each letter, **A** to **F**, in the table below is the molecular formula of an organic compound.

A	C_2H_5Br	**B**	C_2H_4
C	C_4H_{10}	**D**	C_2H_6O
E	C_3H_6O	**F**	$C_3H_6O_2$

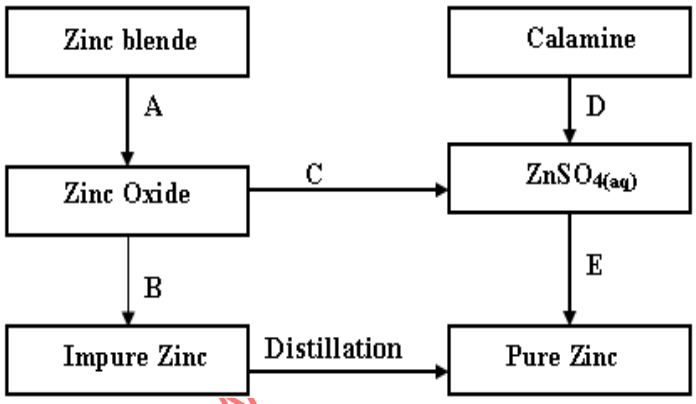
(a) Choose a molecular formula above that represents an organic compound below.
Write down only the letter (A to F) next to the question numbers
(i) A haloalkane (½mk)
(ii) An alcohol (½ mark)
(iii) An unsaturated hydrocarbon (½ mark)
(iv) A product of thermal cracking of compound C. (½ mark)

(b) If compound F is a carboxylic acid, write down the following:
(i) The structural formula of a functional isomer (an isomer with a different functional group) of F. (1mk)
(ii) The IUPAC name of a functional isomer of F. (1mk)

(c) Compound B is a monomer used to make a polymer. Write down the:
(i) Definition of a polymer. (1mk)
(ii) IUPAC name of the polymer. (1mk)
(iii) Balanced equation for the polymerisation reaction (1mk)

(d) Compound A is used as a reactant in the production of compound D.
(i) Name the type of reaction that takes place. (1mk)
(ii) State two changes that can be made to the reaction conditions in (d) (i) to obtain compound B, instead of D, as product. (2mks)

4. The flow chart below summarizes the extraction of Zinc, study it and answer the questions that follow.



(a) Name the process represented by A and B (2mks)
(b) Identify the reagents required for process B, C and D (3mks)
(c) Write a chemical equation of the reaction that occurs in process B (1mk)
(d) With an aid of a diagram, explain how you would obtain a pure sample of Zinc by process E. (2mks)
(e) State two uses of Zinc metal (2mks)

5. (a) The table below gives some values of standard enthalpies of formation ($\Delta H_f^{\ominus}$).

Substance	$F_{2(g)}$	$CF_{4(g)}$	$HF_{(g)}$
$\Delta H_f^{\ominus}$ ($kJmole^{-1}$)	0	– 680	– 269

The enthalpy changes for the reaction $\mathbf{C_2H_{6(g)} + 7F_{2(g)} \rightarrow 2CF_{4(g)} + 6HF_{(g)}}$ is –2889 kJ mol^{-1}.
Use this value and the standard enthalpies of formation in **Table 2** to calculate the standard enthalpy of formation of $C_2H_{6(g)}$. (3mks)

(b) In an experiment to determine the enthalpy of solution of concentrated sulphuric (VI) acid (Specific gravity = 1.84gcm^{-3}) the following procedure was used:
- A clean 250.0 cm^3 glass or plastic beaker is wrapped with a newspaper leaf.
- About 50.0 cm^3 of tap water is measured into the beaker and the steady temperature noted.
- The beaker is held in a tilted position and 2.0 cm^3 of and sulphuric acid added into the water

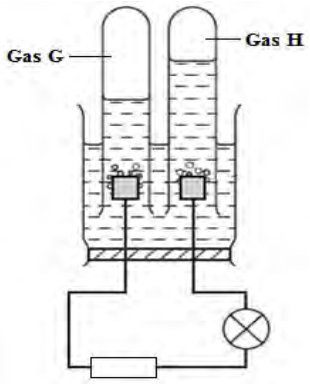
(i) Why was the beaker wrapped with newspaper leaf? (1mk)
(ii) Why was the acid added into water and not vice versa? (1mk)
(iii) Explain the reason for tilting the beaker during addition of the acid into water. (2mks)
(iv) Calculate the molar enthalpy of solution of concentrated sulphuric (VI) acid given that ΔT for the reaction ΔT = 1°C. (Density of water = 1gcm^{-3}; specific heat capacity of water = 4.2kJkg^{-1}K^{-1}). (4mks)

6. (a) Consider the electrochemical cell represented by the cell notation below, where X is an unknown metal:
$Pt_{(s)}$ | $Fe^{2+}_{(aq)}$, $Fe^{3+}_{(aq)}$ || $X^{+}_{(aq)}$ | $X_{(s)}$
(The cell potential of this cell was found to be 0.03 V.
(i) Write down the type of electrochemical cell illustrated above. (1mk)
(ii) What does the single line (|) in the above cell notation represent? (1mk)
(iii) Write down the half-reaction that takes place at the anode in the above cell. (1mk)
(iv) Given that:

Half reaction	**E^{Θ} (volts)**
$Fe^{3+}_{(aq)} + e \rightarrow Fe^{2+}_{(aq)}$	+ 0.77
$Ag^{+}_{(aq)} + e \rightarrow Ag_{(s)}$	+ 0.80
$Na^{+}_{(aq)} + e \rightarrow Na_{(s)}$	– 2.87
$K^{+}_{(aq)} + e \rightarrow K_{(s)}$	– 2.92

Identify X with the aid of a calculation. (2mks)

(b) The diagram below shows the apparatus that can be used to electrolyse dilute Sulphuric acid. Study it to answer the questions that follow.



(i) Identify the gases H and G
I. H (1mk)
II. G (1mk)
(ii) What happens to the concentration of the Sulphuric acid during the process with time? Explain (2mks)
(iii) During the electrolysis a current of 0.72A was passed through the electrolyte for 15 minutes. Calculate the volume of gas H produced. (1 Faraday = 96,500C, molar gas volume = 24 dm^3 at r.t.p). (3mks)

7. (a) (i) What is a salt? (1mk)
(ii) Write the formula of any **two** double salts. (1mk)
(b) A student has found that her sample of potassium nitrate is contaminated with small amounts of a green solid. She picks out a small piece of the green solid and finds that it is insoluble in water.
(i) Describe how you would make a pure sample of potassium nitrate from the impure mixture. (3mks)
(ii) The student believes that the green solid is copper (II) carbonate. Describe a series of 3 tests that the student could use to confirm this. (6 marks)

Test	**Procedure**	**Observations**	**Conclusion**
1			
2			
3			

(c) In an experiment 50g of a saturated solution of a salt X was heated to dryness in an evaporating dish. The mass of crystals when weighed gave a reading of 2.7g. Determine the solubility of the salt. (2mks)

BUURI FORM 4 JOINT EXAMINATION, 2023
233/3
Chemistry
PAPER 3
Practical

CONFIDENTIAL

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 F
2. about 50cm^3 of solution G
3. 30cm^3 of solution M
4. 30cm^3 of solution N
5. one burette 0 – 50ml
6. one pipette 25ml
7. two conical flasks
8. 100ml measuring cylinder
9. 200ml or 250ml beaker
10. About 500ml distilled water
11. Phenolphthalein indicator
12. thermometer (0 – 110^{0}C)
13. Source of strong heat (preferably Bunsen burner)
14. clock or stop watch
15. 2 boiling tubes
16. one CLEAN METALLIC spatula
17. 6 clean dry test-tubes
18. one test-tube holder
19. at least 6cm length of universal indicator paper
20. 0.5g of sodium hydrogen carbonate
21. pH chart pH 1 – 14
22. Bromine water supplied with a dropper
23. 0.5g of solid K – oxalic acid.
24. 0.5g of solid P – Sodium sulphite

The students should have access to the following

a. 2.0M NaOH solution with a dropper
b. 1.0M barium nitrate solution with a dropper
c. Bromine water with a dropper
d. Acidified potassium manganate (vii) with a dropper
e. 2.0M HCl with a dropper

1. Bromine water is prepared by adding 1ml of liquid bromine to 100cm^3 of distilled water and shaking thoroughly in a fume cupboard.
2. Acidified potassium permanganate is prepared by adding 3.16g of solid potassium permanganate to 400cm^3 of 2M sulphuric acid and diluting to one litre of solution using distilled water.
3. Solution M is made by dissolving 12.6g of oxalic acid in 400cm^3 distilled water and making it to 1 litre.
4. Solution N is prepared by dissolving 3.16g of potassium manganate (VII) in 200cm^3 of 2M sulphuric acid and adding more water to make 1 litre
5. Solution F is prepared by dissolving 4g of sodium hydroxide pellets in about 800cm^3 of distilled water and diluting it to one litre solution.
6. Solution G is prepared by dissolving 9.0g of oxalic acid (ethan-1,2-dioic acid) in 200cm^3 of distilled water and diluting it to 250cm^3 solution.

BUURI FORM 4 JOINT EXAMINATION, 2023
233/3
Chemistry
Paper 3
TIME: 2HRS 15MINS

INSTRUCTIONS TO CANDIDATES

1. *Answer all the questions.*
2. *All working must be clearly shown where necessary.*
3. *You are not allowed to start working with the apparatus for the first 15 minutes. This time is to enable you read the question paper and make sure you have all the requirements.*

1. You are provided with:
   - 0.1M sodium hydroxide solution F
   - Solution G made by dissolving 9.0g of dibasic acid H_2MO_4 in 250cm^3 of distilled water

   You are required to:

(i) Standardize the diluted solution H using the sodium hydroxide solution F
(ii) Determine the mass of M in the formula H_2MO_4

Procedure 1

Using a measuring cylinder measure 20cm^3 of solution G and transfer it into a beaker.
Measure 80cm^3 of distilled water and add it to the 20cm^3 of solution G in the beaker. Label this as solution H. Place solution H in a burette. Pipette 25cm^3 of solution F into 250cm^3 conical flask. Add 2 – 3 drops of phenolphthalein indicator and Titrate with solution H. Record your results in table 1. Repeat the titration two more times and complete the table.

a) Table 1

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

(4mks)

b) Calculate the average volume of solution H used. (1mk)
c) Determine the number of moles of:-
   i) Sodium hydroxide in Solution F in 25cm^3 (1mk)
   ii) Acid in solution H in the average volume used. (1mk)
   iii) Acid in 100cm^3 of solution H. (1mk)
   iv) Acid in 20cm^3 of solution G. (1mk)
   v) Acid in 250cm^3 of solution G. (2mks)
d) Calculate the:
   i) Molar mass of acid H_2MO_4. (2mks)
   ii) Mass of M in the formula H_2MO_4 given that H = 1, O=16. (1mk)

2. You are provided with:
   - 0.15M ethan-1,2-dioc acid (oxalic), solution M
   - 0.02M acidified potassium manganate (VII) solution N

   You are required to:

❖ Determine the rate of reaction between acidified potassium manganate (VII) and ethan – 1,2 – dioc (oxalic) acid at different temperatures.

Procedure

Place 5cm^3 of solution N in a boiling tube. Place another 5cm^3 of solution M in another boiling tube.
Heat solution N on a Bunsen burner flame to 80^{0}C. Allow it to cool to 70^{0}C. Add all solution M into solution N and at the same time start the stop watch. Stir the mixture and record in table II the time taken for purple colour to disappear. At the same time record the temperature. Using clean boiling tubes repeat the procedure while allowing solution N to cool to 60^0, 50^{0}C and 45^{0}C in each case to complete table II below

a) Table II

Temperature before mixing ^{0}C	**70**	**60**	**50**	**45**
Temperature at which purple colour disappear ^{0}C				
Time taken for purple colour to disappear				
$^1/_{time}$ sec^{-1}				

(4mks)

b) On the grid of graph paper provided plot $^{1}/_{time}$ (y-axis) against temperature at which the purple colour disappears. (3mks)

c) From your graph;

i) Determine the time taken for purple colour to disappear at $47.5^{0}C$. (1mk)

ii) State the relationship between rate of reaction and the temperature at which purple colour disappears. (1mk)

3. a) You are provided with substance ***P*** for this question. ***Transfer*** the substance into a clean boiling tube. ***Add*** about $10cm^3$ of distilled water and ***stir***. ***Pour*** the mixture into ***four*** clean test tubes of about $2cm^3$ each.

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

i) To the ***first*** portion of the solution, ***add*** sodium hydroxide solution dropwise ***until*** in excess.

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

ii) ***Dip*** a clean stirring rod/glass rod/nichrome wire into the second portion and then ***place*** into the side of a blue bunsen flame.

Observations	***Inferences***
(½mk)	(1mk)

iii) To the ***third*** portion, ***add*** 2-3 drops of barium nitrate solution ***followed by excess*** hydrochloric acid.

Observations	***Inferences***
(1mk)	(½mk)

iv) To the ***fourth*** portion, ***add*** 2-3 drops of acidified potassium manganate (VII)

Observations	***Inferences***
(½mk)	(½mk)

b) You are provided with solid K. Carry out the tests below. Write your observations and inferences in the spaces provided.

i) Using a clean metallic spatula, heat about one third of solid K in a Bunsen burner flame.

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

ii) Dissolve the remaining portion of solid K into about $10cm^3$ of distilled water and divide the solution into 4 portions.

To the first portion, add two drops of acidified potassium permanganate solution.

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

iii) To the second portion, add two drops of bromine water.

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

iv) Determine the pH of the third portion using universal indicator paper.

Observations	***Inferences***
(½mk)	(½mk)

v) To the fourth portion, add a small amount of solid sodium hydrogen carbonate.

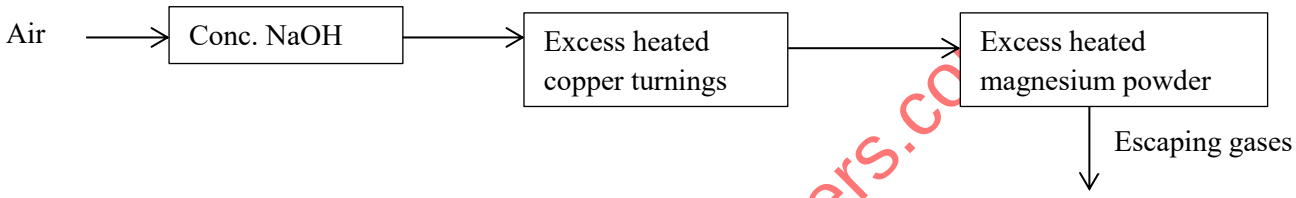
Observations	***Inferences***
(1mk)	(1mk)

IMENTI SOUTH EXAMINATIONS, 2023
Kenya Certificate of Secondary Education
233 /1
CHEMISTRY
PAPER 1
TIME: 2HRS

1. Describe the observable characteristics of a luminous flame. (2 marks)
2. Study the table below to answer the questions that follow.

Solution	A	B	C	D
pH value	13.5	2.2	7.2	6.5

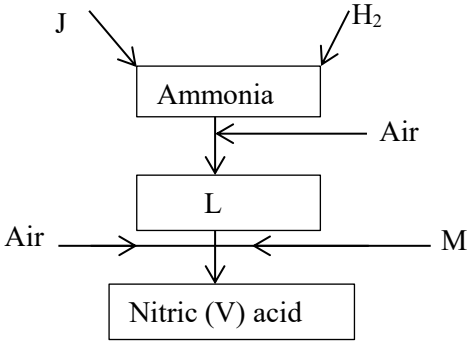
i) Which solution is likely to be?
a) Potassium hydroxide (1 mark)
b) Acid rain (1 mark)
ii) Substance E reacted with both solution A and B. What is the nature of substance E? (1 mark)
3. Air was passed through several reagents as shown below.



i) Name **one** gas which escapes from the chamber containing magnesium powder.
Give a reason for your answer. (2 marks)
ii) Write an equation for the reaction which takes place in the chamber containing magnesium powder. (1 mark)
4. a) A fixed mass of a gas occupies 200cm^3 at a temperature of 23°C and pressure of 780mmHg.
Calculate volume of the gas at -25°C and 740mmHg. (2 marks)
b) What is the relationship between the rate of diffusion of a gas and its molecular mass? (1 mark)
5. An atom of element Q has a mass number 39 and 19 protons.
a) Write the electronic arrangement of its ion. (1 mark)
b) State whether the element is a metal or non-metal. (1 mark)
c) State the period and group to which element Q belongs. (1 mark)
6. The table below shows properties of metal chloride X and Y.

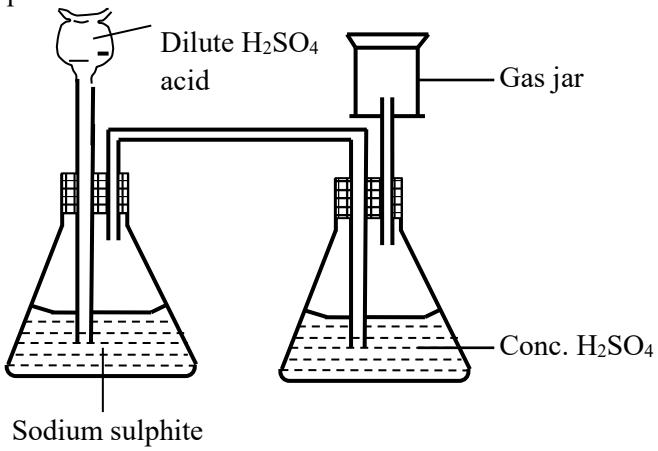
Chloride	Melting points (°C)	Electrical conductivity
X	203	Poor
Y	1070	Good

a) State the type of bond present in:
i) X _____ (1 mark)
ii) Y _____ (1 mark)
b) In terms of structure and bonding, explain why Y conducts electricity while X does not. (1 mark)
7. 15g of zinc carbonate were strongly heated to a constant mass. Calculate mass of the solid residue formed.
(Zn = 65, C = 12, O = 16) (3 marks)
8. Starting with copper metal describe how a sample of copper (II) sulphate can be prepared. (3 marks)
9. The flow chart shows the process that occurs in the manufacture of nitric (V) acid.



Name substances
i) J _____ (1 mark)
ii) M _____ (1 mark)
iii) L _____ (1 mark)

10. The set-up below is used to prepare dry sulphur (IV) oxide in laboratory.
Answer the questions that follows.



a) Identify the mistakes in the set up. (1 mark)
b) State how the pollution effects of the gas on the environment can be controlled in the contact. (1 mark)
c) Write an equation for the reaction in the set-up. (1 mark)

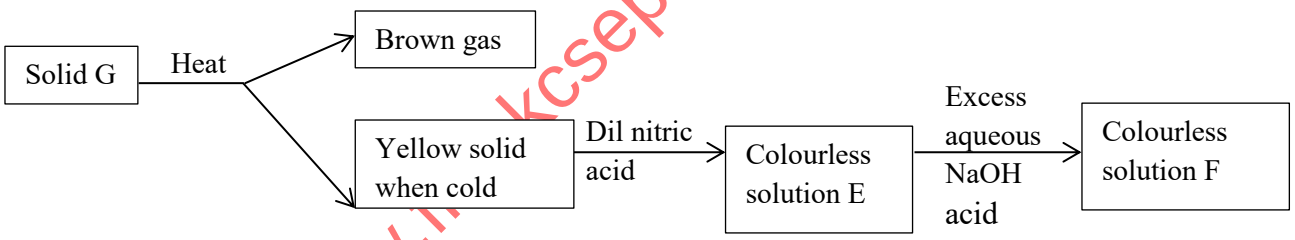
11. 8g of sodium carbonate were allowed to react with 25cm^3 of 0.4M sulphuric (VI) acid until there was no further reaction. Calculate the mass of unreacted sodium carbonate. (3 marks)

12. A crystal of iodine was heated in a boiling to give off a purple vapour.
a) What type of bond is broken when the iodine crystal is heated gently? (1 mark)
b) Write the formulae of the substance responsible for the purple colour. (1 mark)
c) State **one** use of iodine. (1 mark)

13. Name the following compound of organic compounds.
a) $CH_3\ C(CH_3)\ C(CH_3)\ CH_3$ (1 mark)
b) $CH_3\ CH\ (CH_3)\ CH_2\ CH(CH_3)\ CH_3$ (1 mark)

14. In an attempt to prepare carbon (IV) oxide, sulphuric (IV) acid was reacted with barium carbonate. The yield of carbon (IV) oxide was found to be negligible. Explain. (2 marks)

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



a) Identify solid G. (1 mark)
b) Write a balanced chemical equation between yellow solid and dilute nitric (V) acid. (1 mark)
c) Write the formula of the complex ion in solution F. (1 mark)

16. When hydrogen chloride gas is dissolved in water, the solution conducts electricity while a solution of hydrogen chloride gas in methyl benzene does not conduct electricity. Explain. (2 marks)

17. a) What is meant by allotropy? (1 mark)
b) Name **two** allotropes of carbon. (1 mark)
c) Give **one** use of charcoal in sugar refinery industry. (1 mark)

18. a) Define the term solubility. (1 mark)
b) State **one** application of solubility. (1 mark)
c) The table below gives the solubilities of substance T and U at 10°C and 40°C.

Substance	Solubility g/100g of water	
Temperature	10 °C	40°C
T	40	65
U	15	17

When an aqueous mixture containing 55g of T and 11g of U at 80°C was cooled to 10°C, crystal formed.
a) Identify the crystals formed. (1 mark)
b) Determine the mass of the crystals formed. (1 mark)
c) Name the method used to obtain the crystal. (1 mark)

19. a) Distinguish between endothermic and exothermic reaction. (2 marks)
    b) Use the information below to answer the questions that follows.

Bond	Bond energy ($kJmol^{-}$)
C – H	412
Cl – Cl	242
C – Cl	338
H – Cl	431

    i) State what is meant by heat of reaction. (1 mark)
    ii) Calculate the heat change when one mole of methane reacts completely with excess chlorine in the presence of UV light. (2 marks)

20. a) State grahams law. (1 mark)
    b) $50cm^3$ of carbon (IV) oxide diffuses through a porous plate in 15 seconds. Calculate the time taken by $75cm^3$ o nitrogen (IV) oxide to diffuse through the same plate under similar conditions.
    (C = 12, O = 16, N = 14) (3 marks)

21. a) Give equations to show the reactions that take place when:
    i) Magnesium reacts with dilute hydrochloric acid. (1 mark)
    ii) Iron reacts with steam. (1 mark)
    b) Give **one** industrial use of the gas produced in the reactions in a(i) and a(ii) above. (1 mark)

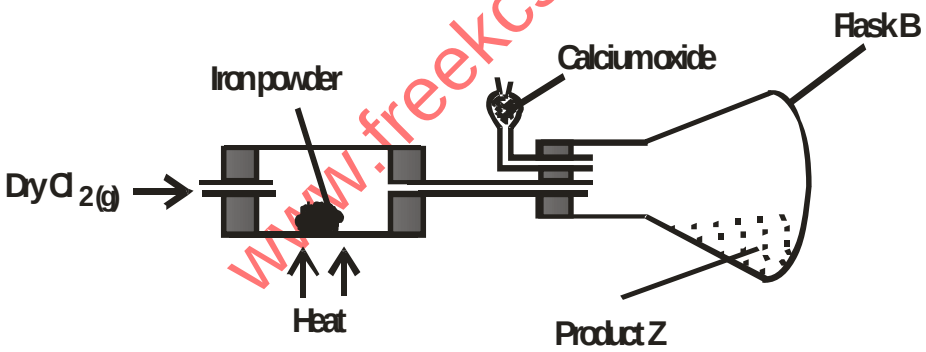
22. The grid below is a section of the periodic table. The letters do not represent the actual symbol of the elements. Use it to answer the questions that follow.

								K
C				F			H	
D	E				G		I	
							J	

a) How does the electronegativity vary from H to J. (1 mark)
b) Give the formula of the compound between E and J. (1 mark)
c) State the nature of the oxide formed by E. (1 mark)

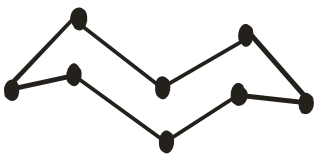
23. Potassium consists of three isotopes with mass numbers Y, 40 and 41 having relative abundances 93.1%, 0.01% and 6.89% respectively. Determine the value of Y given the atomic number of potassium is 19 and its relative atomic mass is 39.1379 (3 marks)

24. The set up below was used to react dry chlorine gas with iron powder. The product Z was collected in flask B.



a) Identify product Z. (1 mark)
b) i) What property of product Z makes it possible to be collected as shown in the diagram. (1 mark)
    ii) Explain why calcium oxide is preferred to calcium chloride. (1 mark)

25. A molecule of one of the elements is shown below.



i) Identify the element. (1 mark)
ii) Explain why this element has a higher boiling point compared to that oxygen. (2 marks)
iii) Write an equation to show the reaction between this element with oxygen. (1 mark)

26. Boilers used for boiling hard water are normally covered with scales after some time.
a) What is the chemical name for boilers scales? (1 mark)
b) How is the boiler scale removed? (1 mark)

27. State Charle's law. (1 mark)

IMENTI SOUTH EXAMINATIONS, 2023
Kenya Certificate of Secondary Education
233/2
CHEMISTRY
Paper 2
(Theory)
TIME: 2 HOURS

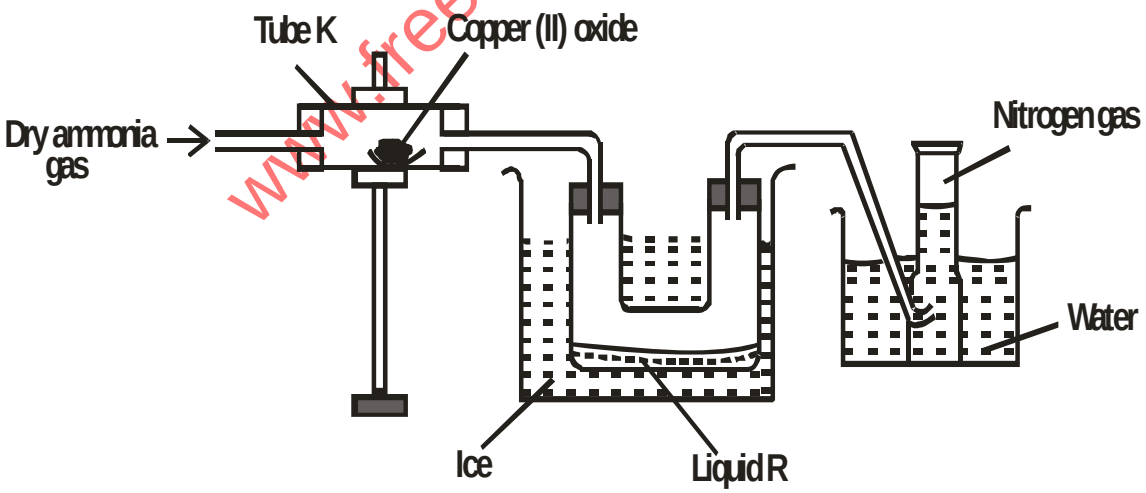
INSTRUCTIONS:
- *Answer **ALL** the questions.*
- *Electronic calculators may be used.*
- *All working must be clearly shown where necessary.*

1. The grid below shows part of the periodic table. Study it and answer the questions that follow.
(The letters does not represent the actual symbol of the elements)

					P	R		
Q					V	S		
T	U							

a) i) Select an element that can form an ion with a charge of -2. (1 mark)
ii) What type of structure will the chloride of Q have? (1 mark)
iii) Explain how the reactivity of R and S can be compared. (2 marks)
b) 2.5g of Q react completely with 1.2dm^3 of gas R at s.t.p
i) Write a balanced equation for the reaction between Q and R. (1 mark)
ii) Determine R.A.M of Q. (Molar gas volume at s.t.p = 22.4 dm^3) (3 marks)
c) T and V reacts with oxygen to form an oxide.
i) State the nature of oxide of T and V (2 marks)
ii) Write down the formula of the oxides formed between T and oxygen and V and oxygen. (2 marks)

2. a) The diagram below shows a set up used to obtain nitrogen gas in an experiment.



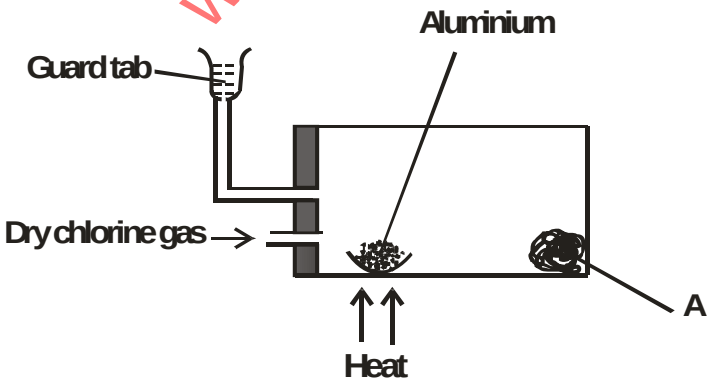
i) Name liquid R. (1 mark)
ii) What observation would be made in the tube K after heating for same time? (1 mark)
iii) Write an equation for the reaction that took place in tube K. (1 mark)
b) i) If 320cm^3 of ammonia gas reacted with copper (II) oxide, calculate the volume of nitrogen gas produced. (1 mark)
ii) The mass of copper (II) oxide that reacted.
(Cu = 63.5, O = 16.0, 1 mole of a gas occupies 24 litres at r.t.p) (2 marks)
iii) At the end of the experiment the pH of the liquid R in the U-tube was found to be about 10.0. Explain. (1 mark)
c) Why is it advisable to obtain nitrogen from air instead of ammonia? (1 mark)

d) A beaker containing concentrated hydrochloric acid was brought near a gas jar containing concentrated ammonia solution.
i) What observation was made? (1 mark)
ii) Write the equation for the reaction. (1 mark)
e) State **two** uses of ammonia gas. (2 marks)

3. The following is the procedure that was used to obtain the solubility of salt R in water at 25°C. Study it and answer the questions that follows.
Salt R was dissolved in water until no more could dissolve. The mixture was then cooled to 25°C and allowed to settle. A dry evaporating dish and dry watch glass were weighed. Some of the solution was decanted into the dish, covered with the watch glass and then weighed.
The solution was evaporated to dryness over a small flame. The residue, the dish and the watch glass were weighed. The residue was heated repeatedly until a constant mass was obtained.
The below results were obtained:
Mass of dish + watch glass = 50.60g
Mass of solution + dish + watch glass = 80.60g
Mass of residue + dish + watch glass = 62.60g

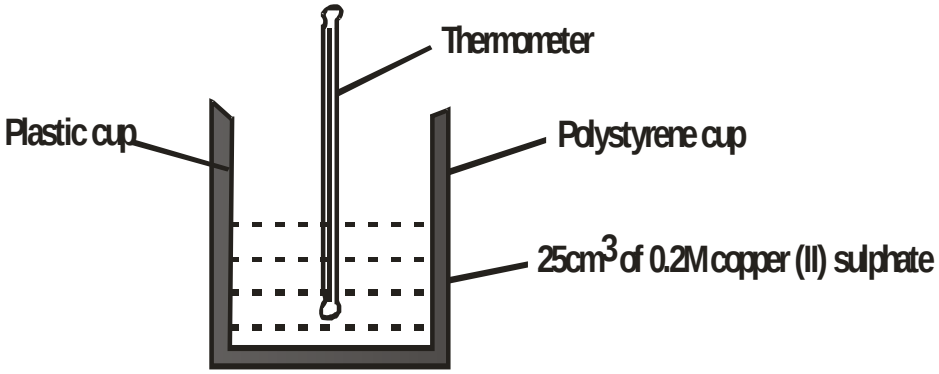
a) Use the data to answer the questions that follows.
i) What is the purpose of the watch glass in such an experiment? (1 mark)
ii) Why would the heating be continued until a constant mass was obtained? (1 mark)
iii) Calculate the mass of the solution. (1 mark)
iv) Calculate the mass of the residue. (1 mark)
v) Calculate the mass of water. (1 mark)
vi) Calculate the solubility of salt R in g per 100g of water at 25°C. (2 marks)
b) Hard water has both advantages and disadvantages. Give **one** advantage and **one** disadvantage.
i) Advantage (1 mark)
ii) Disadvantage (1 mark)
c) Using an equation, explain how addition of sodium carbonate is used to remove water hardness. (2 marks)

4. a) Two reagents that can be used to prepare chlorine gas are manganese (IV) oxide and concentrated hydrochloric acid.
i) Write an equation for the reaction. (1 mark)
ii) Give the formula of another reagent that can be reacted with concentrated hydrochloric acid to give chlorine gas. (1 mark)
iii) Describe how chlorine could be dried in the laboratory. (1 mark)
c) In another experiments dry chlorine gas was reacted with aluminium as shown.



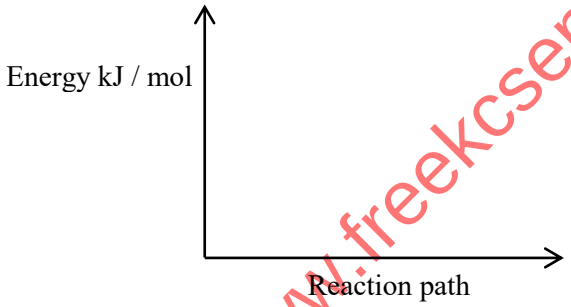
i) Name substance A. (1 mark)
ii) Write an equation for the reaction that took place in the combustion tube. (1 mark)
iii) 0.84g of aluminium reacted completely with chlorine gas. Calculate the volume of chlorine gas used. (Al = 27.0, Cl 35.5) (3 marks)
iv) Name **one** substance that can be put in the guard tube. (1 mark)

5. A student set up apparatus as shown below to determine the molar enthalpy of displacement for the reaction between zinc and copper (II) sulphate solution.



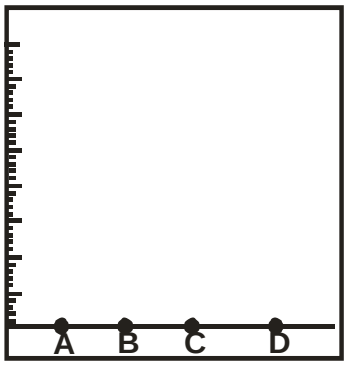
An excess of powdered zinc was added to $25cm^3$ of 0.2M copper (II) sulphate solution and stirred. The temperature of the solution was noted to have risen from 24°C to 32°C.

a) Define the term "Molar heat of displacement." (1 mark)
b) Explain why polystyrene cup was used instead of glass beaker. (1 mark)
c) Write an ionic equation for the reaction that took place. (1 mark)
d) Calculate:
i) The number of moles of copper (II) sulphate solution used. (1 mark)
ii) The heat of displacement for the above reaction. (2 marks)
iii) The molar heat of displacement of copper by zinc.
(Specific heat capacity of solution = 4.2kJ / kg / k, density of solution = $1g/cm^3$) (1 mark)
e) The theoretical value of the enthalpy of displacement of copper by zinc is -217kJ/mol. How does this value compared with the value calculated in d(iii) above? Explain your answer. (1 mark)
f) On the same axes provided, Draw an energy level diagram to represent the displacement reaction between zinc and copper (ii) sulphate solution. (2 marks)



g) If magnesium had been used instead of zinc in the experiment, how would the value obtained compared with value obtained in d(iii) above? (1 mark)

6. a) The diagram below shows spot of pure substance A, B and C on a chromatography paper spot D is that of a mixture.



After development A, B and C were found to have more 8cm, 3cm and 6cm respectively. D has separated into two spots which moved 6cm and $8cm^3$.

i) On the diagram
I. Label baseline. (1 mark)

II. Show the position of all sport after development. (2 marks)

ii) Identify the substances present in mixture D. (1 mark)

b) A mixture contains Lead (II) nitrate, Lead (II) sulphate and Lead (II) chloride.
Describe how the mixture can be separate. (3 marks)

c) The table shows liquid that are miscible and those that are not immiscible.

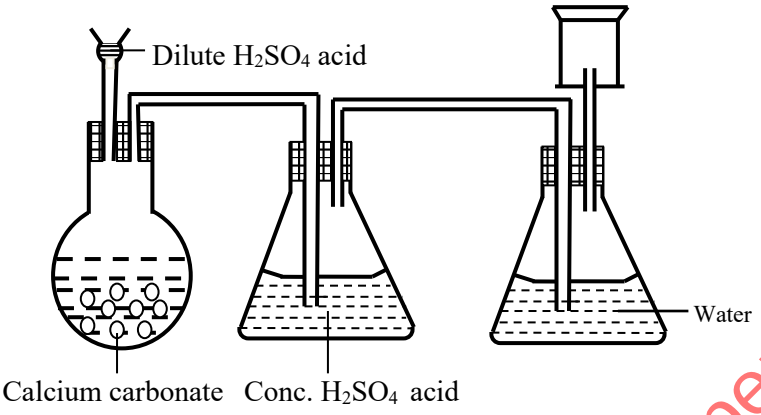
Liquid	L_3	L_4
L_1	Miscible	Miscible
L_2	Miscible	immiscible

Use the above information to answer questions that follows.

i) Name the method that can separate L_1 and L_3 of a mixture of the two. (1 mark)

ii) What property is used to separate the mixture? (1 mark)

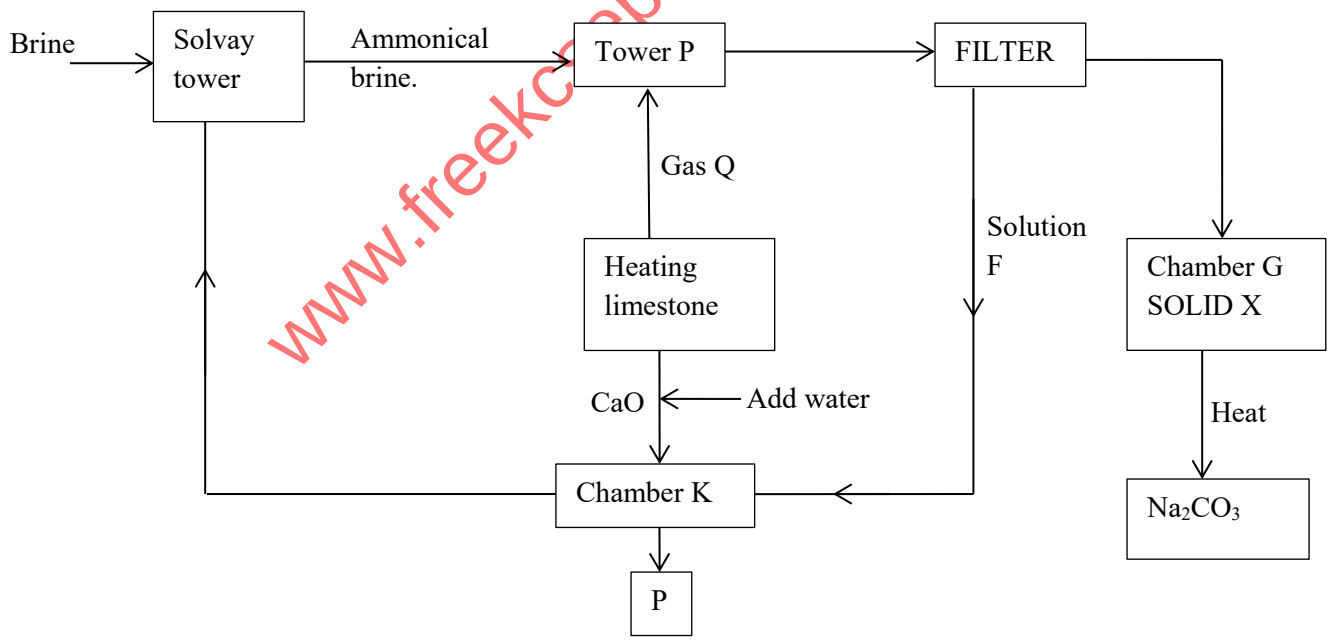
7. A student set up the apparatus shown below to prepare and collect dry carbon (IV) oxide.



a) State a correction for the three mistakes in the set-up above. (3 marks)

b) Give **two** reasons why carbon (iv) oxide is used as a fire extinguisher Miscible. (1 mark)

c) The flow chart below is for the manufacture of sodium carbonate by solvary process. Use it to answer the questions that follows.



Name:

i) Gas M (½ mark)

ii) Gas Q (½ mark)

iii) Solution F (½ mark)

iv) Solid X (½ mark)

d) Name the product P formed and give **one** use.

i) Name (½ mark)

ii) Use (½ mark)

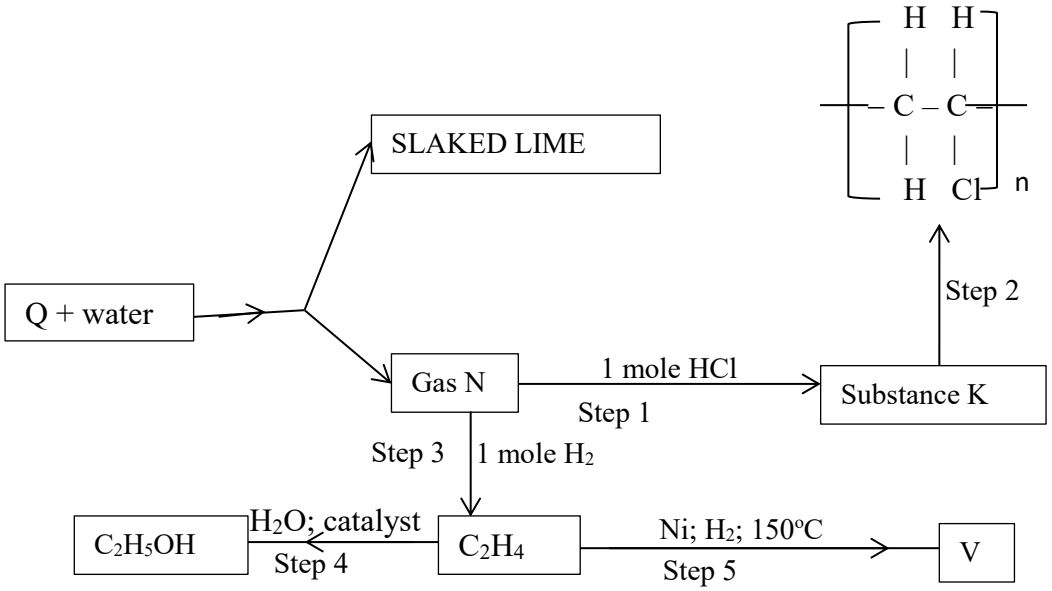
e) Write the equation of the reaction in

i) Tower P (1 mark)

ii) Chamber K (1 mark)

f) Name the **two** raw materials required in the manufacture of sodium carbonate. (1 mark)

8. Study the flow chart given below and then answer the question that follows.



a) i) Identify reagent Q. (½ mark)
ii) Name the catalyst used in step 4. (½ mark)
iii) Draw the structural formula of gas N. (½ mark)
iv) What name is given to process that takes place in step 2. (½ mark)
v) Using chemical equations show how substance K formed from gas N. (1 mark)
vi) Give the commercial application of the process that takes place in step 5. (½ mark)
vii) Name gas V. (½ mark)

b) i) An Hydrocarbon contains 1.44g of carbon and 0.24g of hydrogen.
Determine the empirical formula. (1 mark)
ii) If the molecular mass of hydrocarbon is 84, determine the molecular mass. (½ mark)
iii) State the reagents that can be used to test hydrocarbon. (½ mark)

IMENTI SOUTH EXAMINATIONS, 2023
Kenya Certificate of Secondary Education
233/3
CHEMISTRY
PAPER 3
(PRACTICAL)

CONFIDENTIAL

INSTRUCTION TO SCHOOLS

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

- 4.0g of solid A accurately measured and put in a stoppered boiling tube
- About 80cm^3 of solution B
- 10cm^3 of solution C
- Solid D about 0.5g
- 1 thermometer
- One burette
- One pipette
- 250ml volumetric flask
-
- A complete retort stand
- 2 conical flask
- A test tube holder
- One boiling tube
- Six clean test tubes
- 10ml measuring cylinder
- 0.5g sodium hydrogen carbonate
- 500ml of distilled water in a wash bottle

ACCESS TO:

- Phenolphthalein indicator
- Potassium iodide solution
- 2.0M ammonium solution
- 2.0M sodium hydroxide solution
- 0.1M Lead (II) nitrate solution
- 0.1M barium nitrate solution
- 2.0M Nitric (V) acid
- Acidified potassium manganese (VII) solution ($KMnO_4$)
- Bromine water

PREPARATION

1. Solid A is 4.0g oxalic acid $(COOH)_2\ 2H_2O$ accurately measured and placed in a stoppered boiling tube
2. Solution B is 0.25M NaOH prepared by dissolving 10g NaOH pellets in 600cm^3 of water and topping up to 100cm^3 solution with distilled water
3. Solution C is prepared by dissolving a mixture of aluminium nitrate and sodium sulphite ($NaSO_3$) i.e 10g aluminum nitrate and 10g sodium sulphate in 600cm^3 of distilled water and topping up to 1000cm^3 solution with distilled water
4. Solid D is maleic acid
5. Potassium iodide is prepared by dissolving 21.4g of solid K in 1000cm^3 of solution (Prepare the quantity you require)
6. 2M ammonia solution is prepared by dissolving 123cm^3 of ammonia in 1000cm^3 of ammonium hydroxide solution
7. 2M NaOH is prepared by dissolving 80g of HaOH pellets in 1000cm^3 of solution
8. Lead (II) nitrate solution is prepared by dissolving 33.1g of Lead (II) nitrate in 1000cm^3 of solution (Prepare the quantity you require)
9. Barium nitrate solution is prepared by dissolving 26.1g of solid barium nitrate in 1000cm^3 of solution (prepare the quantity you require)
10. Nitric (V) acid is prepared by dissolving 145cm^3 of concentrated nitric (V) acid in 1000cm^3 of solution (prepare the quantity you require)
11. $KMnO_4$ is prepared by dissolving 3.2g $KMnO_4$ in 400cm^3 of 2.0M sulphuric (VI) acid and topping up to 1000cm^3 of solution using distilled water
12. Bromine water of prepared by dissolving 1cm^3 of bromine water is a fumed chamber.

IMENTI SOUTH EXAMINATIONS, 2023
Kenya Certificate of Secondary Education
233/3
CHEMISTRY
PAPER 3
(PRACTICAL)
TIME: $2\frac{1}{4}$ HOURS

INSTRUCTIONS

- Read the procedure carefully, perform the experiments and answer the questions.
- The first 15minutes of the $2\frac{1}{4}$ hours allowed for this paper are meant for reading through the paper to confirm that all the apparatus and reagents are provided.
- Mathematical tables and electronic calculators may be used.
- All working **must be** clearly shown where necessary.

Question 1

You are provided with,

– Solid A 4.0g $(COOH)_2$ XH_2O
– Solution B 0.25M NaoH

You are supposed to

i) Determine the solubility of A at different temperatures.
ii) Determine the amount of water of crystallization X in solid A.

Procedure A

– Into the boiling tube containing solid A, add $4cm^3$ of distilled water. Using a 10ml measuring cylinder.
– Stir with the thermometer while heating the mixture until all the solid dissolves.
– Withdraw from heat and allow the mixture to cool while stirring (you may use a water bath).
– Record the temperature at which crystals 1st appear in the table I below.
– Add $2cm^3$ more of distilled water to make a total of $6cm^3$ and repeat the above procedure.
– Repeat the above procedure two (2) more times and complete table I below. RETAIN the content of boiling tube for procedure B.

Table 1

Volume of water added	4	6	8	10
Solubility (g / 100g of water)				
Temperature at which crystals appear				

(6 marks)

i) Plot a graph of solubility of A against temperature. (3 marks)
ii) From your graph determine the solubility of A at 60°C. (1 mark)

Procedure B

Transfer the content of the boiling tube into a 250ml volumetric flask.
Add distilled water upto the mark.
Label the resulting solution, solution A.
Fill a burette with solution A.
Transfer 25ml of solution B into a 250ml conical flask using a pipette.
Add phenolphthalein indicator.
Titrate A against B until the pink colour disappears.
Record your results in the table two (2) below.
Repeat the procedure two (2) more times and complete table two (2).

Table 2

	I	II	III
Final burette reading			
Initial burette reading			
Volume of solution A used			

(4 marks)

i) Determine the average volume of solution A used. (1 mark)

ii) How many moles of NaOH solution B were used? (1 mark)
iii) If two moles of NaOH react with 1 mole of A, How many moles of A were used? (1 mark)
iv) Determine the molarity of solution A. (2 marks)
v) Calculate the molar mass of A. (1 mark)
vi) Determine the value of x in $(COOH)_2 XH_2O$ (C = 12, O = 16, H = 1). (1 mark)

Question 2

You are provided with solution C. Use it to carry the tests outlined below. Write your observations and inferences in the spaces provided.

Divide the solution into five (5) portion each $2cm^3$.

a) To the 1st portion add potassium iodide solution.

Observations	Inferences
(1 mark)	(1 mark)

b) To the 2nd portion add ammonia solution dropwise until in excess.

Observations	Inferences
(1 mark)	(1 mark)

c) To the 3rd portion add Sodium hydroxide solution dropwise until in excess.

Observations	Inferences
(1 mark)	(1 mark)

d) To the 4th portion add Lead nitrate solution.

Observations	Inferences
(1 mark)	(2marks)

e) To the last portion add Barium nitrate solution followed by dilute nitric nitric (V) acid.

Observations	Inferences
(2 marks)	(1 mark)

Question 3

You are provided with solid D, use it to carry the tests outlined below.

a) Add $6cm^3$ of distilled water to solid D in a test tube, shake well and record your observations.

Observations	Inferences
(½ mark)	(½ mark)

b) Divide the resulting solution into 3 portions.
To the 1st portion add solid sodium hydrogen carbonate.

Observations	Inferences
(1 mark)	(1 mark)

c) To the 2nd portion add acidified potassium manganite (vii) solution ($KMno_4$) and warm.

Observations	Inferences
(1 mark)	(1 mark)

d) To the last portion add bromine water.

Observations	Inferences
(1 mark)	(1 mark)

CEKENAS PREMOCK EXAMINATION, 2023

Kenya Certificate of Secondary Education

233/1

CHEMISTRY

Paper 1

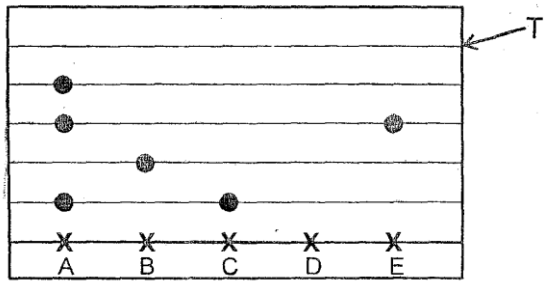
(Theory)

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES

1. *All working must be clearly shown where necessary.*
2. *Mathematical tables and silent electronic calculations may be used*

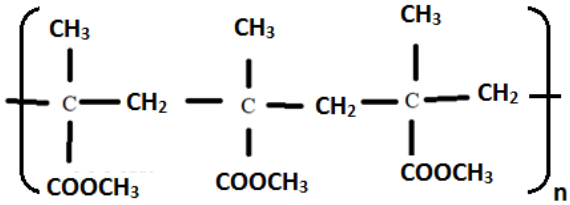
1. The following is chromatography of certain food coloring's A, B, C, D and E. Study and answer the questions that follow.



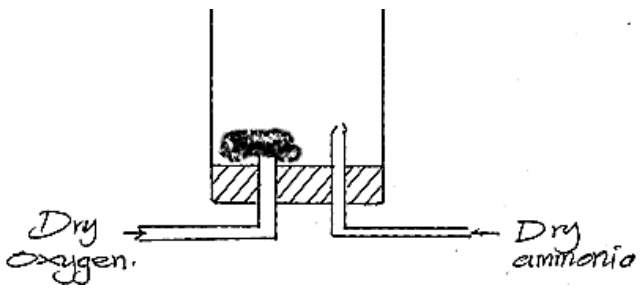
a. (i) What does line T represent? (1mark)
(ii) Mark with a tick the least soluble food coloring (1mark)
b) What does the chromatogram indicate about food coloring C and E? (1mark)
2. a) What is a flame (1mark)
b) Under what condition is non- luminous flame produced. (1mark)
c) State one functional difference between a non –luminous flame and luminous flame (1mark)
3. Complete the table below by selecting the appropriate pH for each substance from pH values 1.0, 4.0, 7.0 and 11. (3mks)

Substance	pH
Sodium carbonate	
Lemon juice	
Sodium chloride	

4. The structure below represents a portion of an additional polymer.



a) Draw the structure of monomer. (1mk)
b) If the portion of the polymer has a relative molecular mass of 1000, calculate the number of monomer in the portion. (2mks)
5. You are provided with the following: copper turnings, dilute sulphuric (VI) acid and source of heat.
Describe fully how you would prepare copper (II) sulphate crystals (3mks)
6. The set up below was used to study the reaction between ammonia and air in the absence of a catalyst.



a) State the observation in the above set up. (1mk)

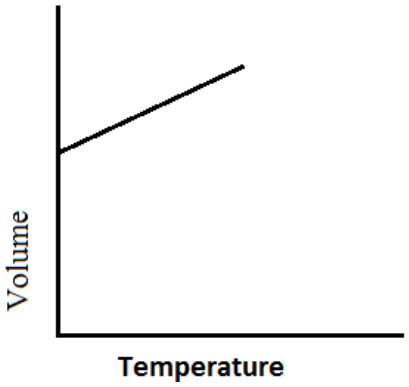
b) What condition is necessary for ammonia to burn as shown above? (1mk).
c) Write an equation for the burning of ammonia (1mk)

7. The table below shows properties of chloride of period 3 elements. Study and answer the questions that follow.

Chloride	Mpt (^{0}c)	Bpt (^{0}c)	Physical state at room temperature.
Sodium chloride	801	1467	Solid
Magnesium chloride	714	1437	Solid
Aluminium chloride	180	Sublimes	Solid
Phosphorus (v) chloride	32	-75	Liquid

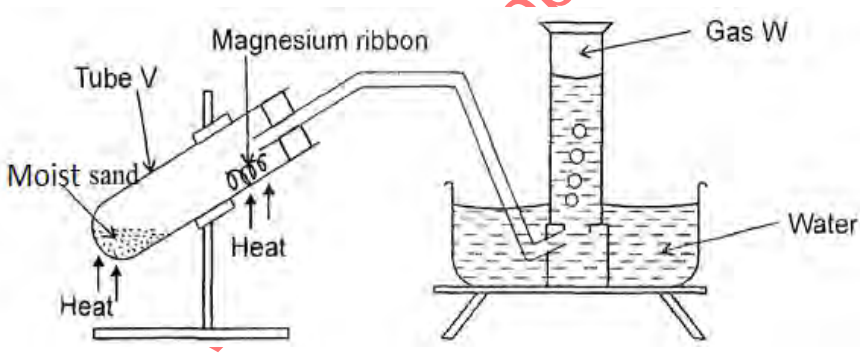
a) Explain why sodium chloride has a high melting point and boiling point while aluminium chloride sublimes (2mks)
b) Compare the nature of the solution formed when both magnesium chloride and aluminium chloride are dissolved in water. Explain. (2mks)

8. When gas A is heated at constant pressure its volume changes as shown in the sketch below.



a) Name the law that gas A obeys. (1mk)
b) A certain mass of a gas has volume of 271cm^3 at 310k and 750mmHg pressure. Calculate the temperature in 0^0c that the same gas would occupy 283cm^3 at 750mmHg pressure. (2mks)

9. Study the set-up of apparatus below and answer the questions that follow.



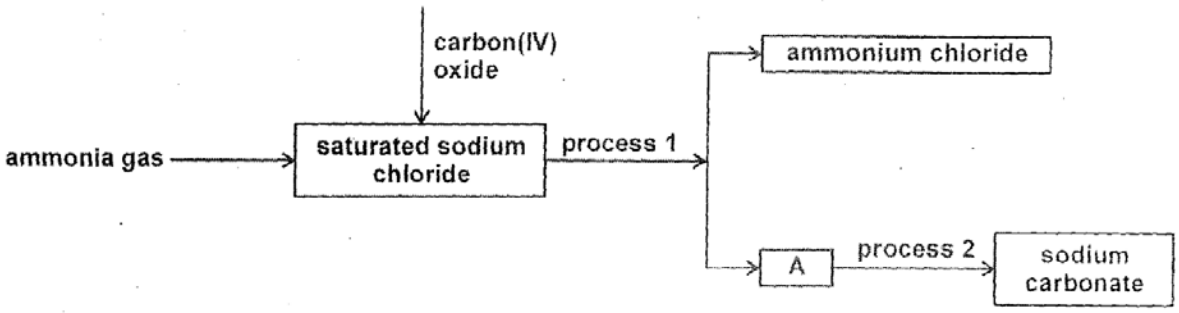
a) Write the equation for the reaction that occur in tube V (1mk)
b) State one industrial use of gas W (1mk)
c) Name another metal that can be used in tube V instead of magnesium. (1mk)

10. The following chemical tests were carried out on separate sample of solution labelled A. The observations made were recorded as shown below.

	Test	**Observation**
(i)	Addition of sodium hydroxide	White precipitate soluble in excess
(ii)	Addition of ammonium hydroxide	White precipitate insoluble in excess
(iii)	Addition of hydrochloric acid	Effervescence
(iv)	Addition of acidified potassium manganite (VII)	Its color remains purple

a) Identify the possible ions present in solution A. (1mk)
b) Write the formula of the compound formed in chemical test (i) (1mk)
c) State one application of a complex ion. (1mk)

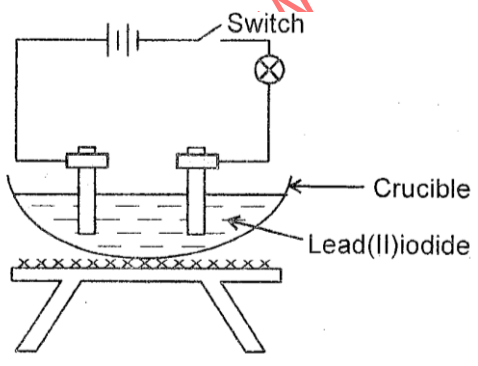
11. Iron objects can corrode when exposed to the atmosphere.
(i) Corrosion involves the oxidation of iron .State what is meant by oxidation. (1mk)
(ii) Painting iron objects prevents corrosion. Explain how painting prevents iron from corrosion. (1mk)
(iii) Corrosion of iron objects can be prevented by painting or electroplating. State another way that can prevent corrosion. (1 mk)
12. Dry ammonia gas was passed through heated oxide of lead of mass 4.78g until there was no further change. The mass of the residue was found to be 4.14g. Determine the formula of the oxide if its molecular mass is 239g. (Pb=207, O=16) (3mk)
13. The schematic diagram for the manufacture of sodium carbonate is shown below.



a) Write an equation for the reaction of formation of ammonium chloride and substance A. (1mk)
b) State how the following are carried out
(i) Process 1 (1mk)
(ii) Process 2 (1mk)
14. The table below shows the solubility of salt X at various temperatures.

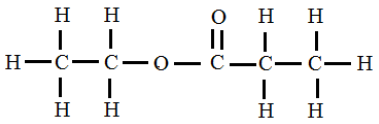
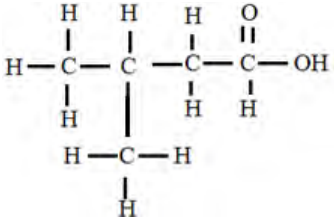
Temperature (^{0}c)	Solubility(g/ 100g of H_2O)
0	36
40	30
80	25
100	22
120	20

(i) A saturated solution of the salt at 40^{0}c was heated at 100^{0}c. State and explain the observation made. (1mk)
(ii) Calculate the mass of salt formed when a saturated solution of the salt at 0^{0}c is heated to 100^{0}c. (1mk)
15. The figure below shows the apparatus used by students to study the electrolysis of molten lead (II) iodide.



a) In the diagram label the anode. (1mk)
b) When the switch was on, the bulb did not light. Explain. (1mk)
c) State and explain the observation made at the anode. (1mk)

16. The table below shows information about some hydrocarbons complete the table to show the names and structures of these hydrocarbons (3mks)

	Name	Structure
i)	_____	
ii)	_____	

iii) 3- Methylpentane _____

17. a) Hydrogen sulphide gas was bubbled into an aqueous solution of iron (ii) chloride. State and explain the observations made. (2mks)
    b) Write the equation for the reaction that took place (1mk)

18. Excess magnesium powder was added to 25cm^3 of 1M copper (ii) chloride solution. The temperature of solution increased by 43^{0}c. (Density of solution =1g/cm^3, specific heat capacity=4.2 J/g/K)
    Determine;
a) The heat of reaction (1mk)
b) The molar heat of displacement of copper (2mk)

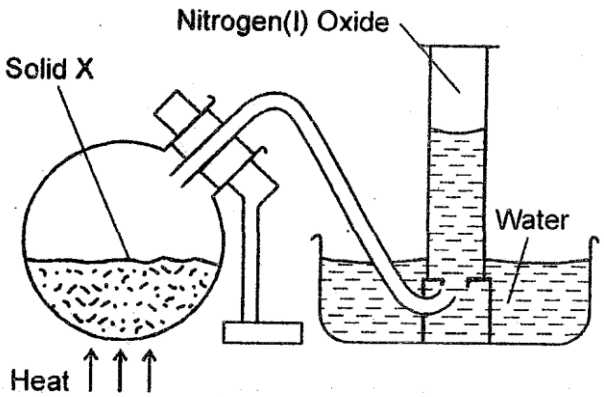
19. The grid below is part of the periodic to table. Use it to answer the question that follow.
    (The letters are not the actual symbol of the elements)

P			S	T			W	X
					M			Y
R								Z

a) Draw a dot (•) and cross (x) diagram to show the structure of elements T, (1mk)
b) Write an equation for the reaction that occurs when element R in solid form react with an aqueous solution containing ions of element P (1mk)
c) J is an element that belongs to the 4th period of the periodic table and reacts by gaining one electron. Show the position of J in the grid. (1mk)

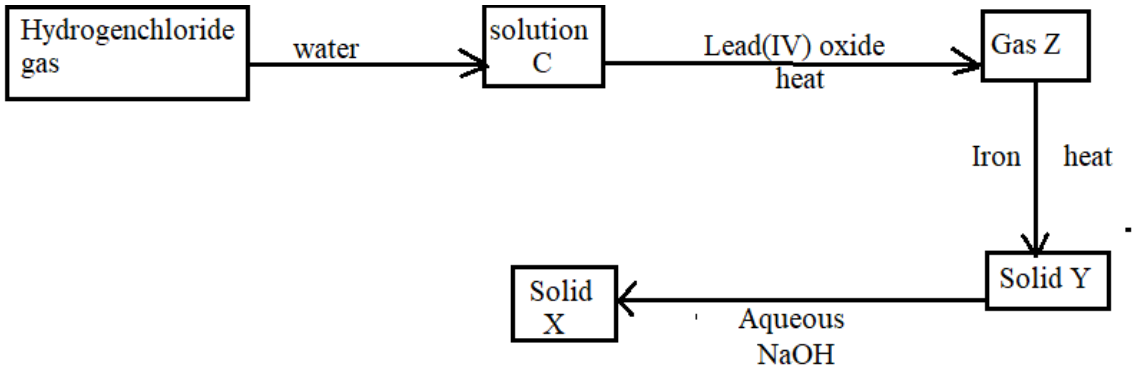
20. 15.7 g of an organic acid RCOOH was dissolved in 600cm^3 of water and more water added to make one litre of solution. 25.0cm^3 of this solution was found to require 21.5cm^3 of 0.207 M potassium hydroxide solution for complete neutralization. (C=12, O=16, H=1)
(i) Determine the formula mass of the acid (3mks)
(ii) Calculate the mass of R (1mk)

21. The set up below shows the apparatus for preparation of nitrogen (i) oxide.



(i) Name solid X (1mk)
(ii) What precaution is taken when heating solid X (1mk)
b) Nitrogen (i) oxide doesn't burn but a burning magnesium ribbon continues burning in the gas. Explain (1mk)

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



a) Name substance Y and Z (1mk)
b) Write an equation for the formation of solid X (1mk)
c) State one use of solution C (1mk)

23. a) Phosphorous has a melting point of 44^0C or 590^0C . Explain (1mk)
b) Why is phosphorous stored under water (1mk)
c) Using dot (•) and cross diagrams, draw the structure of aluminium oxide (1mk)

24. A gold rings contain 3.94g of gold. Calculate the number of gold atoms in the ring.
(Avogadro's constant = 6.02×10^{23}, Au = 197) (2mks)

25. A student accidentally placed a small amount of charcoal in a solution labelled concentrated nitric (v) acid.
a) State and explain the observation made (2mk)
b) Write the equation for the reaction (1mk)

26. (a) Name two reagents that are used to prepare ethyne (1mk)
(b) Propanol and butanol are third and fourth members respectively of the same homologous series.
State and explain how their boiling points compare. (2mks)

27 Using a well labelled diagram show how to prepare and collect dry sulphur (iv) oxide starting with copper turnings. (2mks)

CEKENAS PREMOCK EXAMINATION, 2023

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CHEMISTRY

PAPER 2

TIME: 2 HOURS

INSTRUCTION TO THE CANDIDATES

1. *All working must be clearly shown where necessary.*
2. *Mathematical tables and silent electronic calculations may be used*

1. a) The grid below shows part of the periodic table. Study it and answer the questions that follow. (Letters do not represent the actual symbols)

E								
						S		
	P			U	V		M	
X	Y							
							N	

i) Select an element which forms an ion with a charge of -3 (1mark)

ii) Name the type of structure that the chloride of Y would have. Explain (2marks

iii) How does the reactivity of M compare with that of N. Explain (2marks)

iv) 1.3g of P completely burns in chlorine and consumes 1.2 litres of the gas.

I) Write an equation for the reaction between element P and chlorine (1mark)

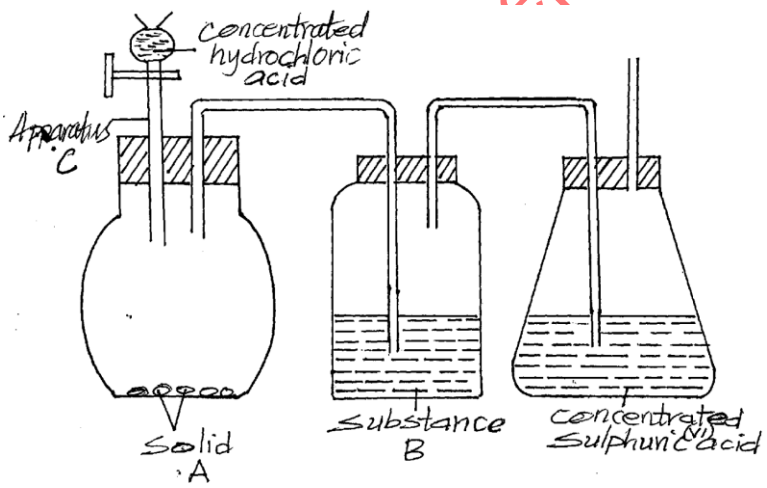
II) Determine the relative atomic mass of P (molar gas volume= 24litres) (2marks)

b) State and explain how you would expect the following to compare

i) Atomic radii of E and X (2marks)

ii) pH values of aqueous oxides of Y and V (2marks)

2. The setup below is used to prepare chlorine gas. Study it and answer the questions that follow: NB No heating is applied to produce the gas.



i) Identify: Solid A..... (1mark)

Substance B..... (1mark)

Apparatus C..... (1mark)

ii) Complete the setup above to show how chlorine gas is collected ..... (1mark)

iii) Name another substance that can be used to serve the same purpose as concentrated sulphuric (VI) acid. (1mark)

iv) State the observations made when the following are put in a gas jar full of dry chlorine gas.

a) Dry blue litmus papers (1mark)

b) Red hot iron fillings (1mark)

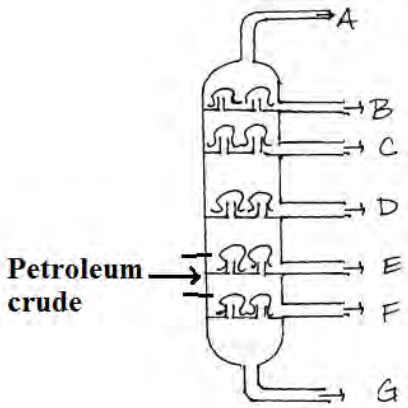
v) Write the equation for the reaction that occurs in (b) above (1mark)

vi) Explain the following observations.

a) A white precipitate is formed when hydrogen chloride gas is passed through aqueous silver nitrate (1mark)

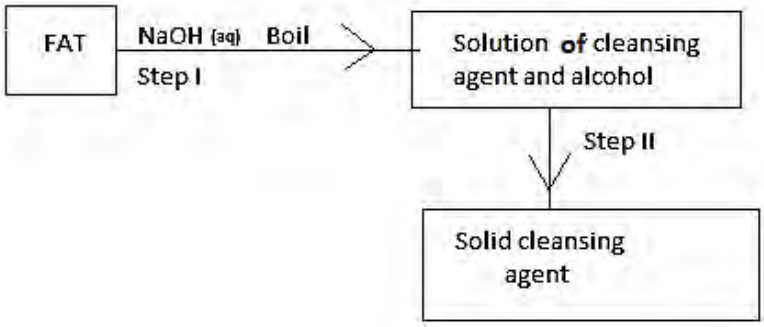
b) Potassium bromide changes to yellow when chlorine gas is bubbled through the solution. (1mark)

3. a) Crude oil is a mixture of several compounds which are separated in a refinery as shown below.



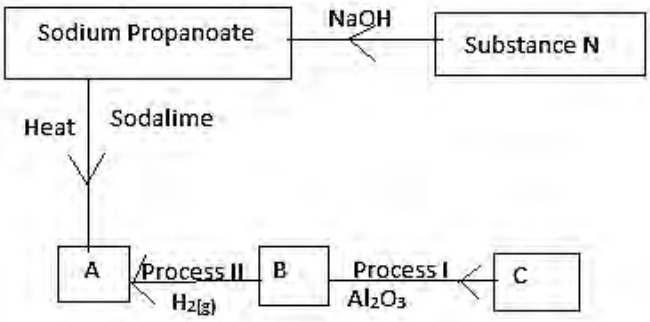
i) What is the name of the apparatus above (1mark)
ii) What is the name of the process which is used in separation of crude oil (1mark)
iii) What physical property of the compounds in the mixture does the separation depend on. (1mark)
iv) Use the letter A to G to describe where the following could be formed: (1mark)
I) The fraction that represent gases
(II) The fraction that represents the largest molecules (1mark)

b) The scheme below was used to prepare a cleansing agent. Study it and answer the questions that follow.



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

c)



i) Identify the following substances (1mark)
A……
C……
ii) Name process I and II (1mark)
iii) Draw the structure of the organic product formed when compound N reacts with methanol (1mark)
iv) Explain how you would distinguish compound N and C (1mark)

4. a) i) Sea water contains approximately 3% sodium chloride. Describe how sodium chloride is obtained from sea water (3marks)
ii) The solubility of sodium chloride is 36.2g in 100g of water at 30^0c. Determine the concentration in moles per litre of a saturated aqueous sodium chloride at 30^0c. (Na = 23, Cl =35.5 density of water 1g/cm^3) (2marks)

b) Water containing hydrogen carbonate, HCO_3^- and calcium ions, Ca^{2+} is said to be hard. Explain how these ions get into sources of water. (2marks)

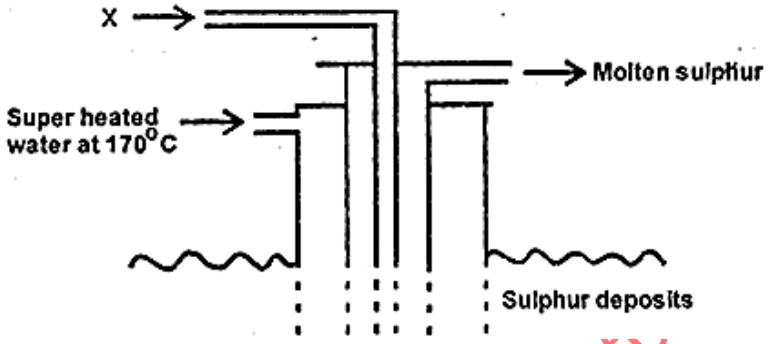
c) Analysis of river water sample showed the presence of the following ions:
Mg^{2+}, Na^{+}, Cl^{-}, SO_4^{2-}

i) Name the type of water hardness present in the sample (1mark)
ii) Identify two methods used to remove this type of hardness. (2marks)
d) Study the information in the table below and answer the questions that follow.

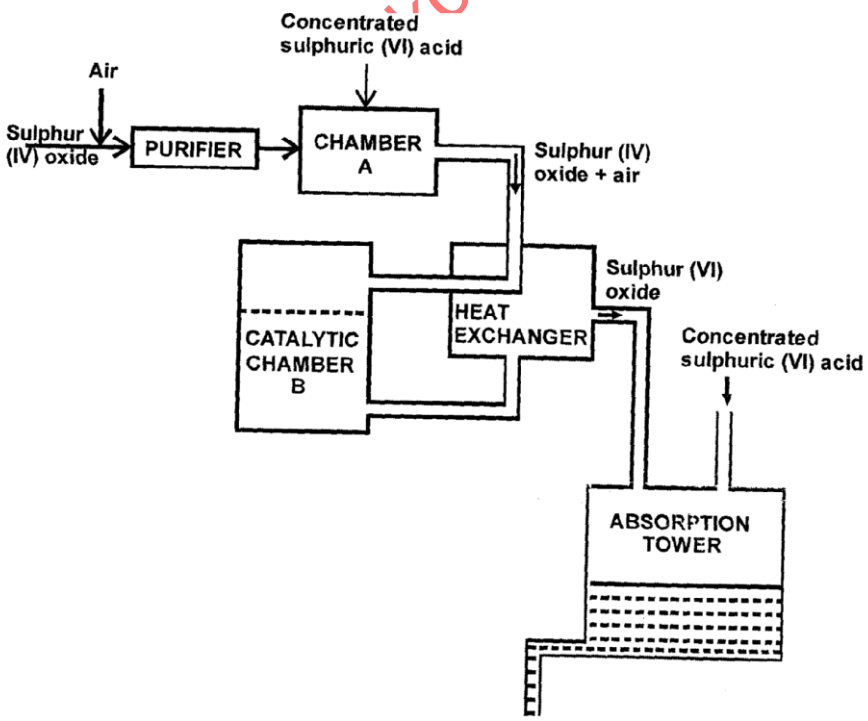
Salt	Solubility in g/ 100g water	
	At 40^0C	At 60^0C
Na NO_3	38	24
Na Cl	101	52

A mixture containing 31g $NaNO_3$ and 47g NaCl in 100g of water at 60^0c was cooled to 40^0c.
a) Which salt crystallizes out and by what mass (1mark)
b) Identify the method used to obtain crystals (1mark)

5. a) The diagram below shows 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 in this process? (1mark)
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 the questions that follow.



i Write an equation for the reaction in the absorption chamber (1mark)
ii) Explain how the acid is obtained after the reaction in the absorption chamber (1mark)
iii) State two roles of the heat exchanger (2marks)
iv) How is pollution controlled in the above process (1mark)

c) Complete the table below to show the observation made and property when sulphur (IV) oxide is bubbled through the following. (3marks)

Substance	Observation	Property
Acidified potassium Dichromate (VI) solution	(1mark)	(½mark)
Moist hydrogen sulphide	(1mark)	(½mark)

6. a) Use the following data to calculate the enthalpy change for the decomposition of calcium carbonate

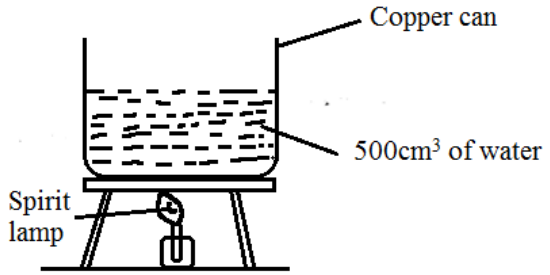
$Ca_{(s)} + \frac{1}{2}O_{2(g)} \rightarrow Ca\,O_{(s)}$ $\Delta H = -635kJmol^{-1}$

$Ca_{(s)} + C_{(s)} + {}^{3}/_{2}O_{2(g)} \rightarrow Ca\,CO_{3(s)}$ $\Delta H = -1207kJ/mol$

$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ $\Delta H = -394kJ/Mol$ (2marks)

b) State **two** factors to consider when choosing a fuel (1mark)

c) The diagram below represents a set up used to determine the molar heat of combustion of ethanol.



Results:
Initial water temperature $=22.0^0C$
Final water temperature$=44.5^0C$
Mass of lamp before burning=126.5g
Mass of lamp after burning =125.0g

Calculate:

i) Heat given out during the experiment (density of water= $1g/cm^3$, C= 4.2kJ/kg/k) (2marks)

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

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

d) i) State Hess's law (1mark)

ii) Study the information below and answer the questions that follow.

$MgCl_{2(s)} \rightarrow Mg^{2+}{}_{(g)} + 2\,Cl^{-}{}_{(g)}$ $\Delta H = +2487kJ/mol$

$MgCl_{2(s)} + aq \rightarrow Mg\,Cl_{2\,(aq)}$ $\Delta H_2 = -170\ kJ/mol$

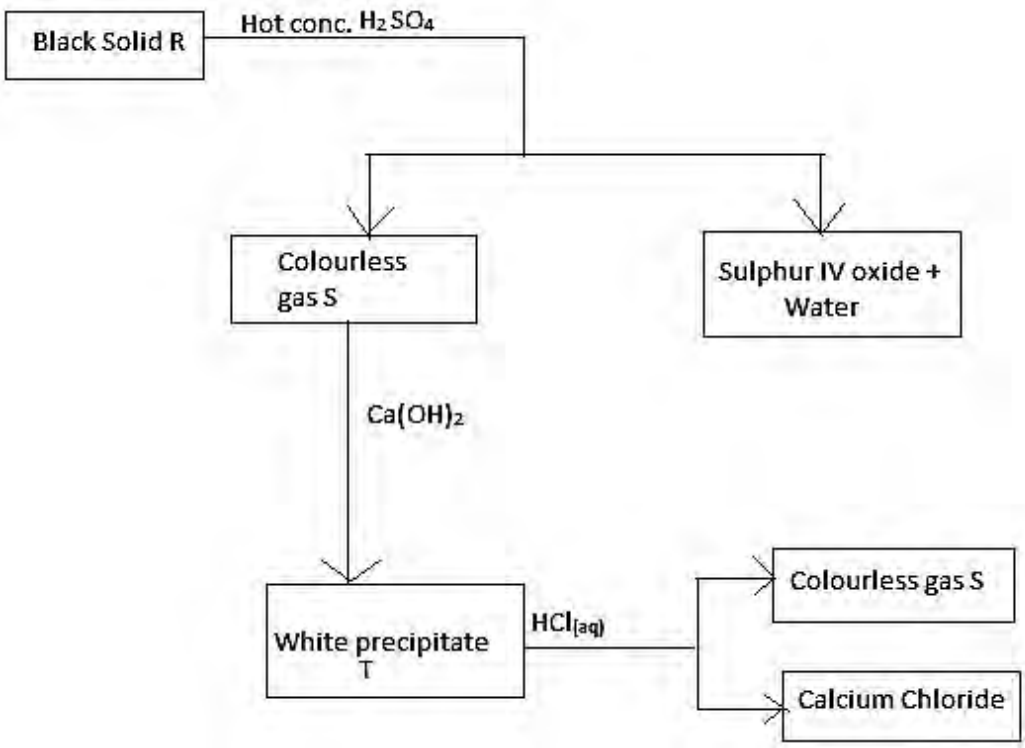
$2Cl^{-}{}_{(g)} + (aq) \rightarrow 2Cl^{-}{}_{(aq)}$ $\Delta H_3 = -762kJ/mol$

a) Name the enthalpies H_1 and H_2 (1mark)

b) Determine the enthalpy for the reaction (2marks)

$Mg^{2+}{}_{(g)} + (aq) \rightarrow Mg^{2+}(aq)$

7. a) Study the flow chart below and use it to answer the questions that follow.



I) Name: R, S and T (3marks)

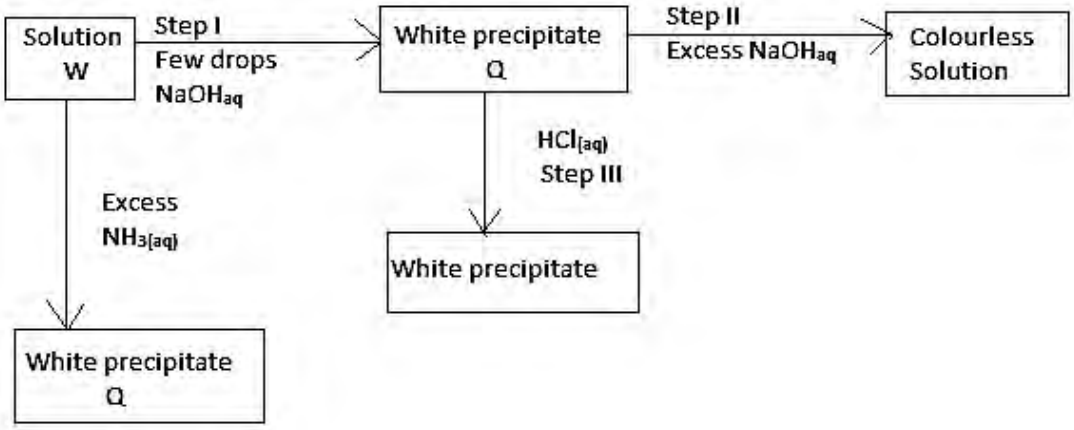
II) Write the chemical equation for the reaction between

i) R and concentrated sulphuric (VI) acid (1mark)

ii) T and hydrochloric acid (1mark)

III) What is the role played by R in the reaction in II (i) above (1mark)

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



i) Write the formula of the metal ion in solution W (1mark)

ii) Name the white precipitate Q (1 mark)

iii) What property of the white precipitate is illustrated in step II and III (1mark)

iv) Write the equation for the reaction taking place in step II (1mark)

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CHEMISTRY

PAPER 3

CONFIDENTIAL INSTRUCTIONS

In addition to the laboratory facilities each student requires the following:

- About $50cm^3$ of solution P
- About $80cm^3$ of solution Q
- Two pieces of solid M
- A burette
- A pipette and pipette filler
- $50cm^3$ measuring cylinder
- Thermometer
- A stop watch
- A 250ml volumetric flask
- A 250ml empty beaker
- A 100ml plastic beaker
- One label
- 2 conical flasks
- Complete stand
- About $10cm^3$of liquid L in a stopped boiling tube.
- Six test tubes and a test tubes rack
- About $10cm^3$of solutions R in boiling tube
- Wooden splint
- Spatula
- Filter paper and filter funnel

Access to

- Source of heat.
- Distilled water
- Phenolphthalein indicator
- Acidified potassium dichromate(vi)
- Acidified potassium manganate(vii)
- 2M ammonia solution
- 2M sodium hydroxide solution
- 2M HNO_3 acid
- 2M H_2SO_4
- Barium chloride solution

PREPARATIONS

- Solution P is 2M dilute HCL
- Solution Q is 0.5M sodium hydroxide solution
- Solid M is 2 pieces of magnesium ribbon each exactly 2cm long
- Liquid L is 2M ethanoic acid solution
- Solution R is a mixture of copper (II) sulphate and magnesium sulphate solution.

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CHEMISTRY

PAPER 3

TIME: 2¼ HOURS

INSTRUCTIONS TO THE CANDIDATES

*a) Answer **ALL** the questions in the spaces provided in this question paper.*
*b) **ALL** working **MUST** be clearly shown where necessary.*
c) Mathematical table and silent electronic calculators may be used.

1. You are provided with:

i) Solution P which is a monobasic acid solution.
ii) 2cm long magnesium ribbon labelled metal M.
iii) 0.5M sodium hydroxide solution Q

You are required to:

a) Calculate the mass of the 2cm long metal M.
b) Determine the molarity of the dibasic acid solution P.

PROCEDURE 1

- Measure exactly 40cm^3 of solution P using 50ml measuring cylinder and transfer it into a 100ml plastic beaker.
- Measure the temperature of the solution after every thirty seconds for the first sixty and record in table I below.
- At exactly 90 seconds add the 2cm long solid M and record the temperature of the solution after every thirty seconds up to 300 seconds

(RETAIN THIS SOLUTION FOR PROCEDURE II BELOW)

Table I

Time(sec)	0	30	60	90	120	150	180	210	240	270	300
Temperature				X							

(4marks)

a) Draw a graph of temperature against time in the grid provided below. (3marks)
b) From the graph determine the highest temperature change, ΔT (1mark)
c) Calculate the heat change for the reaction above in kJ (1mark)
(Density of solution = 1g/cm^3 specific Heat capacity of solution =4.2Jg^{-}K^{-}mol^{-})
d) i) Given that the molar enthalpy reaction between metal M and acid P is −1590kJmol^{-}, determine the number of moles of metals M in the 2cm long pieces. (1mark)
e) Given that R.A.M of Magnesium is 24.1. Calculate the mass of the 2cm long ribbon (1mark)

PROCEDURE II

- Transfer all the solution formed from procedure I into a 250ml volumetric flask.
- Add distilled water to the mark, transfer the solution into a 250ml beaker and this solution as P_1.
- Fill the burette with solution Q
- Pipette 25cm ^{3} of solutions P_1 into a 250 ml conical flask.
- Titrate solution Q against P_1 using phenolphthalein indicator and record your results in table II below.
- Repeat the titration two more times to get consider values.

Table II

	I	II	III
Final Burette Reading (cm^3)			
Initial Burette Reading (cm^3)			
Volume of solution Q used (cm^3)			

(4mks)

i) Calculate the average volume of solution Q used. (1mark)
ii) Calculate the number of moles of solution P_1 in the 25cm^3 of solution used. (2marks)
iii) Find the number of moles of acid P in the 250cm^3 of P_1 prepared. (1mark)
iv) How many moles of the acid were present in the original 40cm^3 of acid P. (1mark)
v) Calculate the molarity of the original acid P. (1mark)

2. You are provided with a solution labeled R. Carry out the tests below and record your observations and inferences in the spaces provided.

a) Add above 2cm^3 of sodium hydroxide solution to all the solution R in a boiling tube and shake well
Filter the mixture and retain both residue and the filtrate for the tests below:

Observations	Inferences
(1mark)	(1mark)

Divide the filtrate into 5 portions of 2cm^{3}each

i) To the first portion add about 2cm^3 of 2M nitric (v) acid.

Observations	Inferences
(½mark)	(1mark)

ii) To the second portion add sodium hydroxide dropwise until in excess

Observations	Inferences
(1mark)	(1mark)

iii) To the third portion add ammonia solution dropwise until in excess.

Observations	Inferences
(1mark)	(1mark)

iv) To the fourth portion add 3 drops of 2M sulphuric (VI) acid.

Observations	Inferences
(½mark)	(½mark)

v) To the fifth portion add three drops barium chloride solution.

Observations	Inferences
(½mark)	(1mark)

c) Place one spatula of the residue obtained above into a test tube. Add about 2cm^3 of dilute nitric (v) acid and shake. To the solution formed add ammonia solution dropwise until in excess.

Observations	Inferences
(1mark)	(½mark)

3. You are provide with liquid L. Perform the following tests using 2cm^3 portions of liquid L writing your observations and inferences in the spaces provided.

a) To the first portion add an equal amount of distilled water.

Observations	Inferences
(1mark)	(½mark)

b) To the second portion add two drops of acidified potassium dichromate (VI) solution.

Observations	Inferences
(1mark)	(½mark)

c) To the third portion add acidified potassium manganate (vii) solution

Observations	Inferences
(1mark)	(½mark)

d) To the fourth portion add the 2cm long solid M (Magnesium ribbon), test the gas produced with a burning wooden splint.

Observations	Inferences
(1mark)	(1mark)

KIRINYAGA CENTRAL EFFECTIVE 40 JOINT EXAMINATION, 2023
233/1
CHEMISTRY
PAPER 1
THEORY
TIME: 2 HOURS

Instructions to candidates

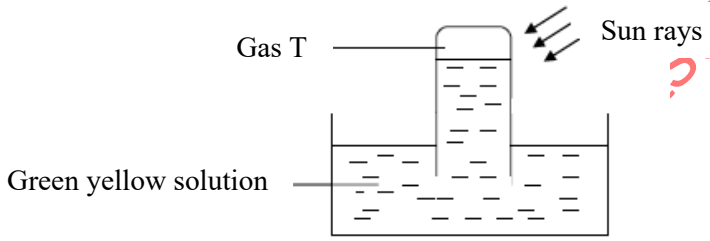
a. *Answer **ALL** the questions.*
b. *Mathematical tables and electronic calculators may be used.*
c. *All working **MUST** be clearly shown where necessary.*

1. a) State the most suitable method that can be used to acquire the first substance in the following mixtures.
i. Iodine from iodine and sand. (1mk)
ii. Water from salt solution. (1mk)
b) Explain why a luminous flame of a Bunsen burner produces more light. (1mk)

2. In very cold countries salts are sprinkled on the roads during winter.
a) Explain why this is important. (1mk)
b) Give one negative effect of this. (1mk)

3. Sodium metal burns with a yellow flame in excess oxygen forming a yellow solid. The yellow solid reacts with water to form gas F.
a) Name the yellow solid. (1mk)
b) Identify gas F. (1mk)
c) Write an equation for the reaction of the yellow solid with water. (1mk)

4. 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.

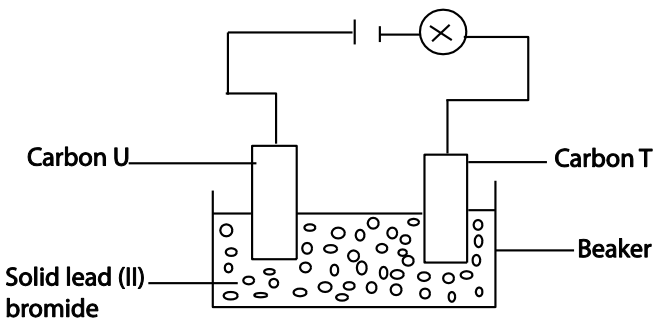


a) What compounds are in the green yellow solution? (1 mk)
b) Write an equation to show how gas **T** is formed. (1mk)
c) Give one use of chlorine. (1mk)

5. 0.21g of a gaseous hydrocarbon occupies a volume of 120 cm^3.
a) Determine the molecular mass of the hydrocarbon. (Molar gas volume = 24dm^3) (2mks)
b) The hydrocarbon decolourises bromine water. Write the structural formula of the hydrocarbon. ($^1/_2$ mk)
c) Give the name of the hydrocarbon. ($^1/_2$ mk)

6. Element T whose atomic number is 16 and mass number 32. Combine 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 the compound formed between T and oxygen. (1mk)

7. The set up below was used to carry out electrolysis of lead bromide. Study and answer the questions that follow.



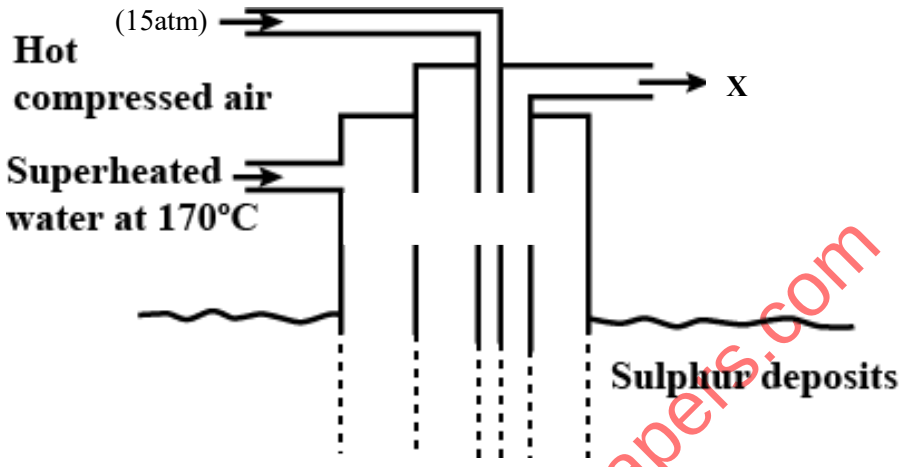
a) Identify electrode U and T. (1mk)
b) Identify with reasons on the missing condition in the above set up. (2mks)

8. Bond energies for some bonds are tabulated below.

Bond	Bond energies
H-H	436
C= C	610
C-H	410
C-C	345

Use the bond energies to estimate the enthalpy of the reaction represented below.
$C_2H_4 + H_2 \longrightarrow C_2H_6$ (3mks)

9. The diagram below shows part of the Frasch process used for extraction of sulphur.
Use it to answer the questions that follow.

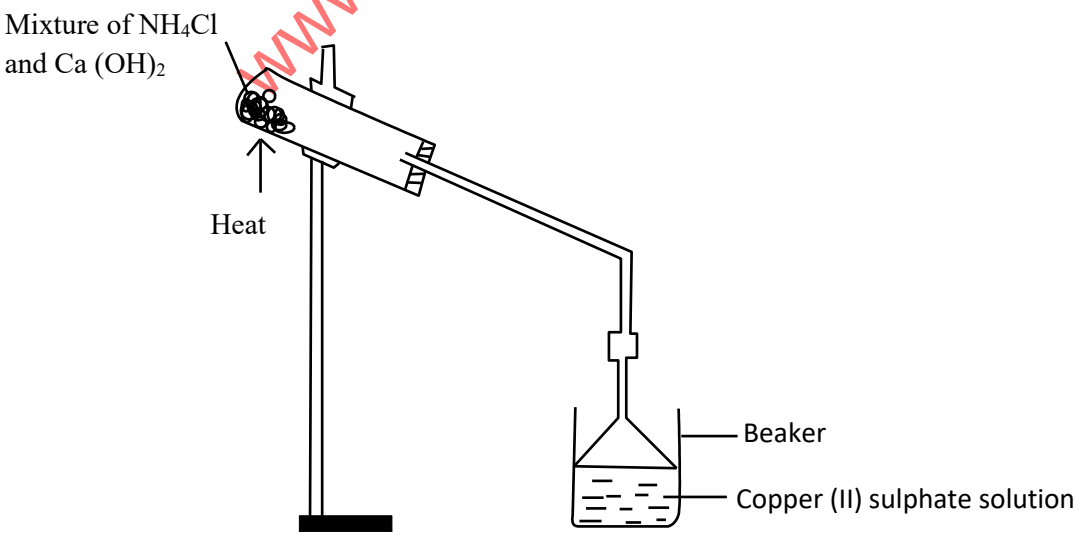


a) Identify X (1mk)
b) Why is it necessary to use superheated water and hot compressed air in this process? (1mk)
c) State two physical properties of sulphur that makes it possible for it to be extracted by this method. (1mk)

10. Hydrogen sulphide gas was bubbled through a solution of zinc nitrate for some time.
i. State observation made. (1mk)
ii. Where should the experiment be carried out and why? (1mk)
iii. Write the equation of the reaction that occurs. (1mk)

11. Calcium carbonate reacts with dilute sulphuric (VI) acid to form a gas and a salt.
i. Write an equation for the above reaction. (1mk)
ii. Why would the above reactants not be suitable for preparation of the above gas in the laboratory? (2mks)

12. A student prepared ammonia gas and bubbled it in a solution of copper (II) sulphite as shown below.



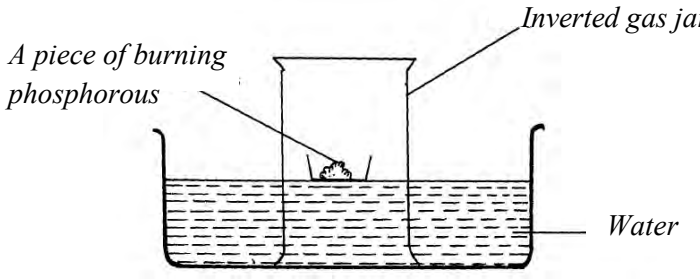
a) State the observation made in the beaker after;
i. A short while (1 mk)
ii. A long while (1 mk)
b) Write the formula of the ion formed in the beaker in a (ii) above.

13. Study the table below and answer the question that follow.

Solution	pH
A	3.0
B	14.0
C	8.0

i. In which solution will phenolphthalein indicator be colourless? Explain (1mk)
ii. Which of the solutions can be used to relieve a heartburn. Explain (1mk)
iii. Which two solutions can react with zinc oxide. (1 mk)

14. The diagram below shows a set up that was used to show the part of air used in burning.



a) Given that phosphorous was in excess, draw a diagram of the set up at the end of the experiment when there was no further observable change. (1 mk)
b) Suggest of one modification that can be made to the apparatus if the percentage of air used is to be determined. (1mk)
c) Write an expression to show how the percentage of air is used is calculated at the end of the experiment. (1mk)

15. a) State the Graham's law of diffusion. (1mk)
b) $100cm^3$ of methane gas diffused through a porous partition in 40 seconds. How long would $90cm^3$ of ozone gas (O_3) diffuse through the same partition. (3mks)
(C = 12, H = 1, O = 16)

16. Describe how a sample of zinc carbonate can be prepared from the following reagents zinc (II) oxide, dilute nitric (V) acid, water and solid potassium carbonate. (3mks)

17. a) The melting point of phosphorous (III) chloride is $-918^{O}C$ and that of sodium chloride is $801^{0}C$. Explain the huge difference in their melting points. (2 mks)
b) State the property which makes it possible for phosphorous to be stored under water. (1 mk)

18. When 16g of ammonium nitrate was dissolved in $100cm^3$ of water at $25^{0}C$, the temperature of the solution formed dropped to $19^{0}C$. Calculate the molar enthalpy of solution of ammonium nitrate.
(N = 14, H = 1 , O = 16) (3mks)

19. Ammonia burns in air in the presence of a catalyst as shown in the equation below.

$$4NH_{3\,(g)} + 5O_{2(g)} \rightleftharpoons 4NO_{(g)} + 6H_2O_{(g)}$$

i. Given that an increase in temperature reduces the amount of ammonia gas. State and explain whether the forward reaction is exothermic or endothermic. (2 mks)
ii. How will increase in pressure affect the yield of nitrogen (II) oxide? (1mk)

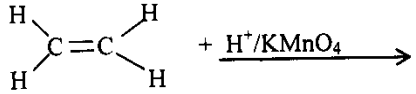
20. After 7.5 hrs the percentage of a certain nuclide in a sample of ore was found to be 12.5%.
a) What is meant by the term half-life? (1mk)
b) Determine the half-life of the nuclide. (2mks)

21. Name the following compound.

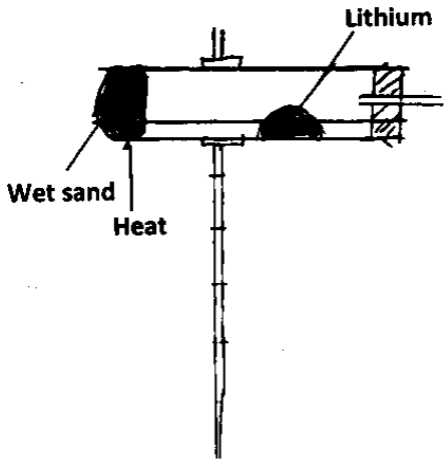
i. $CH_3CH_2CH_2C(=O)OH$

ii. $CH_3\,COOCH_2CH_2CH_3$ (1 mk)

b) Complete the equation below. (1mk)



22. The diagram below represented a set up that was used to react Lithium with water.
Study it and answer the question that follow.

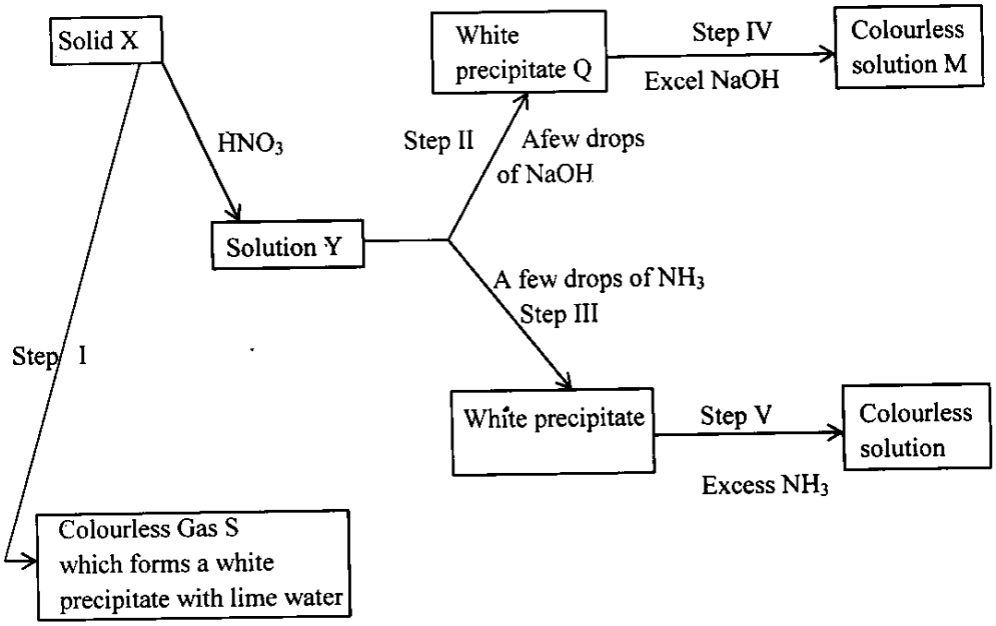


a) Complete the diagram to show how the gas formed can be collected. (1mk)
b) Write an equation for the reaction that takes place. (1mk)
c) Why would it not be advisable to use potassium in place of lithium in the above set up. (1mk)

23. During extraction of aluminium. Aluminium oxide with melting point of 2054^0C is electrolysed but the temperature is maintained between 800^0C and 900^0C.

a) Explain why electrolysis is not carried at 2054^0C (1mk)
b) How can the temperature be lowered from 2054^0C to about 800^0C (1mk)
c) State one use of aluminium. (1 mk)

24. The scheme below represents reactions starting with solid X.



i. Identify solid X. (1mk)
ii. Write an ionic equation to show formation of white precipitate. (1 mk)
iii. Why would gas S not form a white precipitate with solution of sodium hydroxide.

25. The electrode potentials for elements C and D are given below.

$C^{2+}_{(aq)} + 2\,e^- \rightleftharpoons C\,(s)$ $\quad E^\theta = -0.38V$
$D^{2+}_{(aq)} + 2\,e^- \rightleftharpoons D\,(s)$ $\quad E^\theta = -0.67V$

Is it advisable to store a nitrate solution of C in a container made of element D?
Explain showing your working. (3 mks)

26. a) Water is polar. What is meant by the term polar? (1 mk)
b) A solution of hydrogen chloride gas is in water conducts an electric current while that of hydrogen chloride is methylbenzene dopes not conduct. Explain. (2 mks)

27. Under certain conditions chlorine gas reacts with sodium hydroxide to form sodium chlorate(V).

a) Name the conditions under which sodium hydroxide reacts with chlorine to form sodium chlorate(V). (1mk)
b) Write a chemical equation for the reaction in (a) above. (1mk)
c) State one use of sodium chlorate(V). (1mk)

KIRINYAGA CENTRAL EFFECTIVE 40 JOINT EXAMINATION, 2023
233/2
CHEMISTRY
PAPER 2
THEORY
TIME: 2HOURS

INSTRUCTIONS TO CANDIDATES

1. *Answer all questions*
2. *Mathematical tables and electronic calculators may be used.*
3. *All working must be clearly shown where necessary.*

1. 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 equation that follow.
(Letters are not the actual symbols of the element)

Element	Electronic arrangement Of stable ion	Atomic radius (nm)	Ionic radius (mm)
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 number 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)

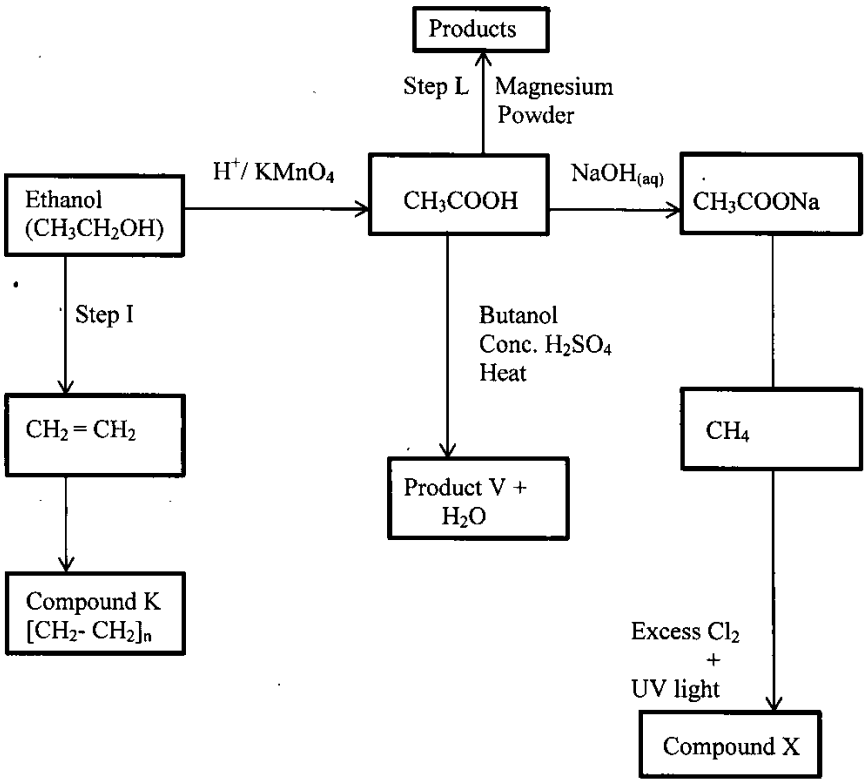
c) The table below gives properties of substances I, II, III and IV.
Study it and answer the questions that follow.

Substances	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? (2mks)

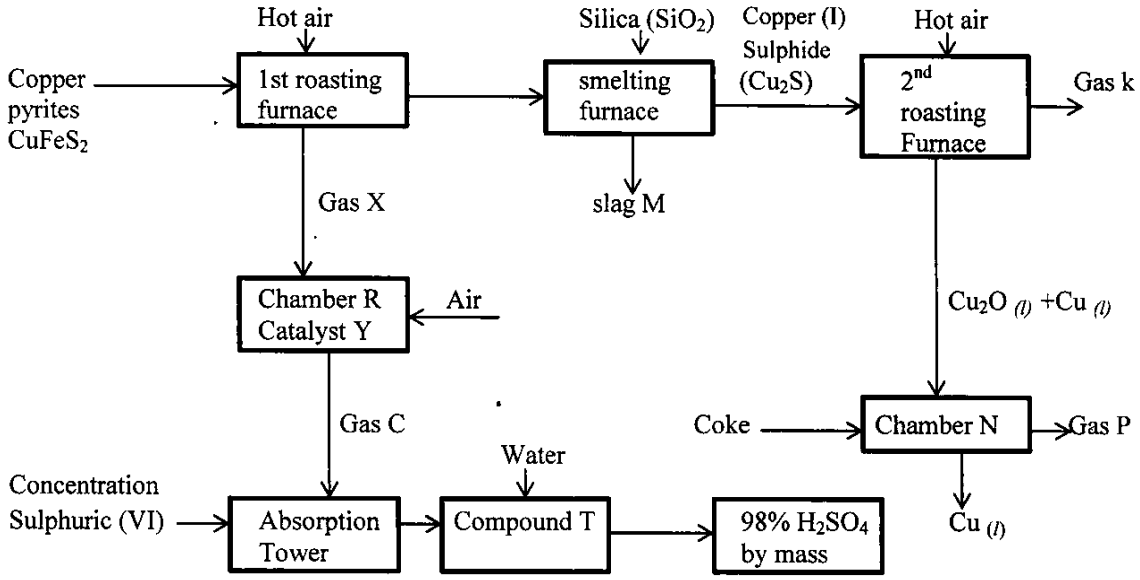
ii. Which substances is likely to be sulphur? Explain. (2mks)

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



a) i. Name the type of reaction in step I. (1mk)
ii. Give the reagent and conditions necessary for step I to take place. (2mks)
b) Write the equation for the reaction that takes place in step L. (1mk)
c) Name product V and write an equation for the reaction in which it is formed. (2mks)
d) Give the IUPAC name and structural formula of compound X. (2mks)
e) State the type of reaction involved in the formation of compound K. (1mk)
f) Identify the reagents necessary for the step w to take place. (1mk)
g) The relative molecular mass of compound k is 44, 800. Determine the value of n. (C = 12, H = 1) (2mks)

3. The flow chart below shows the outlines of the process below in the extraction of copper from copper pyrites. Study it and answer the questions that follow.



a) Write the equation for the reaction that takes place in the;
i. 1st roasting furnace (1mk)
ii. Chamber N (1mk)

b) Write the formula of the cation present to the slag M. (1mk)

c) What name is given to the reaction that takes place in chamber N?
Give a reason for your answer. (2mks)

d) I. Name the catalyst Y. (1mk)

II. State one commercial use of sulphuric (VI) acid. (1mk)

d) i. The copper obtained from the chamber N is not pure. Draw a labelled diagram to show the set up you would use to refine the copper by electrolysis. (2mks)

ii. Given that the mass of copper obtained from the above extraction was 210kg.
Determine the percentage purity of the ore (copper pyrites) if 810kg of it was fed to the 1st roasting furnace. (Cu= 63.5, Fe = 56, D = 32) (3mks)

4. Use the standard electrode potentials given below to answer the questions that follow.

Half cell	Eθ(Volts)
$Ag^{+}_{(aq)} + e^- \longrightarrow Ag_{(s)}$	+0.80
$Cu^{2+}_{(aq)} + 2e \longrightarrow Cu_{(s)}$	+0.34
$Pb^{2+}_{(aq)} + 2e^- \longrightarrow Pb_{(s)}$	-0.13
$Zn^{2+}_{(aq)} + 2e^- \longrightarrow Zn_{(s)}$	-0.76

a) Select two half cells which when connected give the lowest electromotive force(e.m.f) (1mk)

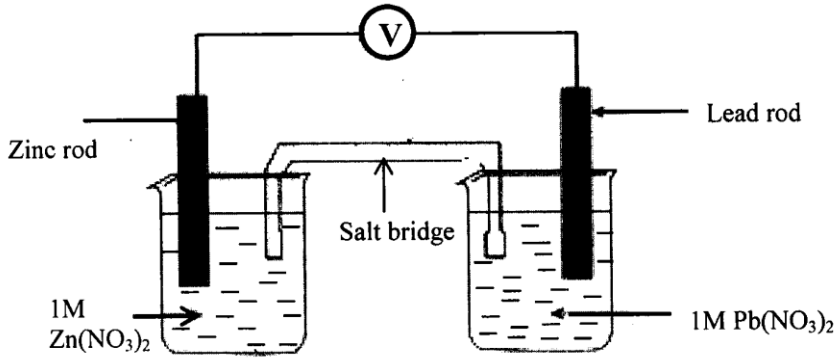
b) Calculate the e.m.f of the cell formed by combining the half cells in (a) above. (1mk)

c) Select the;

i. Strongest oxidizing agent. ($^1/_2$ mk)

ii. Strongest reducing agent ($^1/_2$ mk)

d) A cell was set up using lead and zinc electrodes as shown below.



i. Write the half cell equation for the half cell in which oxidation takes place. (1 mk)

ii. Write the overall cell equation. (1mk)

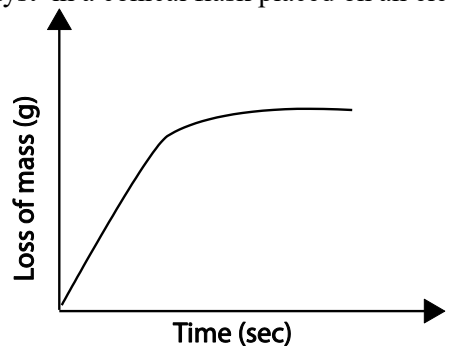
iii. What is the role of the salt bridge? (2mks)

e) An iron knife was electroplated using chromium. The knife was thoroughly cleaned and weighed before being dipped in the electrolyte used.

i. Why is it necessary to clean the knife before electrolysis is carried out. (1mk)

ii. A current of 0.75A was passed through the electrolyte for one hour and 4 minutes.
The mass of chromium deposited on the knife was 0.52g. Determine the valency of chromium.
(1F = 96500C, Cr =52) (2mks)

5. 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.



a) i) Write an equation for the reaction that took place. (1mk)
ii. Explain why there is loss in mass. (1mk)
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. (1mk)
II: No catalyst was used. Label it N. (1 mk)
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.

$$2\,SO_{2(aq)} + O_{2(g)} \rightleftharpoons 2SO_{2(g)} \quad \Delta H = -97kJ/Mol$$

i. What is meant by dynamic equilibrium? (2mks)
ii. State and explain how each of the following would affect the position of the equilibrium.
I. Decrease in pressure. (2mks)
II. Decrease in temperature. (2mks)
d) An equilibrium exists between chromate and dichromate ions as shown below.

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

(yellow) (aq) (Orange)
State and explain the observation made when aqueous sodium hydroxide is added to the above mixture. (2mks)

6. 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	I_2	iii……..	Slightly soluble

Complete the table by giving the missing information in (i), (ii) and (iii) (3mks)
b) Chlorine gas is prepared by reacting concentrated hydrochloric acid 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)

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

Volume of HCl (cm^3)	5	10	15	20	25	30	35	40	45	50
Temperature (^{0}C)	21.5	22.5	24.0	25.0	26.0	27.0	27.5	27.5	27.0	26.5

a) Plot a graph of temperature against volume of the acid added. (3mks)
b) i. From the graph determine volume of HCl used to neutralize 50cm^3 of 1M NaOH. (1mk)
ii. Hence determine concentration of the HCl in moles per litre. (3mks)
c) 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 mks)
ii. Hence calculate the molar enthalpy of neutralization of sodium hydroxide. (1mk)

KIRINYAGA CENTRAL EFFECTIVE 40 JOINT EXAMINATION, 2023
233/3
CHEMISTRY
PAPER 3

CONFIDENTIAL

Each candidate should have the following :-
1. $90cm^3$ of solution X.
2. $100cm^3$ of solution Y.
3. $120cm^3$ of solution Z.
4. 6 test tubes in a rack and 1 boiling tube.
5. 50ml measuring cylinder.
6. A conical flask.
7. A burette.
8. A 25ml pipette.
9. A thermometer (-10^0C – 110^0C)
10. Stopwatch.
11. About $15cm^3$ of liquid Q.
12. Watch glass.
13. Test – tube holder.
14. 0.1g $NaHCO_3$.
15. A dropper.
16. 1g ammonium iron (II) sulphate hexahydrate. (labelled solid T)
    $(NH_4)_2\ SO_4FeSO_4.6H_2O$)
17. $500cm^3$ distilled water in a wash bottle.
18. Metallic spatula.
19. One blue litmus paper and one red litmus paper.

Access to:-
1. 2M NaOH with own dropper.
2. 0.1M acidified potassium dichromate (VI) with a dropper.
3. 0.2Macidified barium nitrate with own dropper.
4. 20% hydrogen peroxide with own dropper.
5. 2M NH_4OH with own dropper.
6. 0.02M acidified potassium manganate (VII) with a dropper.
7. Bunsen burner flame.

Solution preparation confidential.
1. Solution X- Ferrous Ammonium sulphate.
   Prepared by dissolving 34g of Ferrous Ammonium Sulphate in $1000cm^3$ of distilled water.
   Note that this solution should be prepared the morning of the exam and also per shift to prevent oxidation.

2. Solution Y – Acidified potassium manganate (VII).
   Prepared by dissolving 3g of potassium Manganate (vii) crystals in $800cm^3$ of distilled water then adding $200cm^3$ of 2M sulphuric (VI) acid.

3. Solution Z – Oxalic acid.
   Prepared by dissolving 6.3g of oxalic acid in $1000cm^3$ of water.

4. Acidified potassium dichromate (VI) is prepared by dissolving 29.4g in $200cm^3$ 2M sulphuric (VI) acid and top – up to 1litre using distilled water.

5. Acidified barium nitrate is prepared by dissolving 52.3g of barium nitrate in $200cm^3$ of HNO_3 and top – up the solution with distilled water to 1l ($1000cm^3$)

6. Liquid Q is ethanol.

KIRINYAGA CENTRAL EFFECTIVE 40 JOINT EXAMINATION, 2023
233/3
CHEMISTRY
PAPER 3
Practical
TIME: 2 HOURS 15 MINUTES

Instructions to candidates

a. Answer ALL the questions
b. All working MUST be clearly shown where necessary.

1. You are provided with :

(i) Solution X; ferrous ammonium sulphate ($FeSO_4 \cdot (NH_4)_2SO_4.nH_2O$) 8.5g in 250$cm^3$ of solution.
(ii) Solution Y; 0.02M acidified potassium manganate (VII).
(iii) Solution Z; An organic substance.

You are required to:

(i) Determine the value of n in $FeSO_4.(NH_4)_2SO_4.nH_2O$.
(ii) Determine how the rate of reaction between acidified potassium manganate (VII) and the organic substance varies with temperature.

Procedure 1

Fill the burette with solution Y, pipette 25cm^3 of solution X into a conical flask and titrate until the solution turns to pink colour.
Record your results in the table 1 below, repeat the procedure 2 more times to complete table 1 below.
Retain the remaining solution Y for procedure 2.

Table 1

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

(4mks)

i. Calculate the average volume of solution Y used. (1 mk)
ii. Calculate the number of moles of solution Y used. (1 mk)

b) Given that the equation for the reaction between solution Y and X is:

$$MnO^-_{4\,(aq)} + 8H^+_{(aq)} + 5Fe^{2+}_{(aq)} \longrightarrow Mn^{2+}_{(aq)} + 5Fe^{3+}_{(aq)} + 4H_2O_{(l)}$$

Determine

i. The number of moles of iron (II) salt, solution X in 25cm^3 of the solution used. (1 mk)
ii. The concentration of solution X in moles per litre. (1 mk)
iii. The relative formula mass of the iron (II) salt. (1mk)
iv. The value of n in the formula $FeSO_4 \cdot (NH_4)_2SO_4.nH_2O$. (1mk)

(Fe =56, N=14, S = 32, O =16, H = 1)

Procedure 2

Using a burette place 1 cm^3 of solution Y in each of the 5 test tubes on the rack.
Measure 20cm^3 of solution Z into a boiling tube using a measuring cylinder.
Put a thermometer into solution Z in the boiling tube and warm it until it attains a temperature of 40^{0}C. Place the boiling tube in the rack and add the first portion of solution Y in the test tube and immediately start the start watch.
Record the time taken for the purple colour to be decolourised in the table 2 below.
Repeat the procedure above with 20cm^3 solution Z at 50^{0}C, 60^{0}C, 70^{0}C and 80^{0}C to fill table 2.
Clean the test tubes and the burette immediately you finish the experiment.

Table 2 (4 mks)

Temperature of solution Z (^{0}C)	40	50	60	70	80
Time taken for colour to decolourise (sec)(t)					
Rate $^1/_t$ (sec^{-1})					

a) On the grid below, plot a graph of rate ($^1/_t$) against temperature (^{0}C). (3mks)
b) From the graph, determine the time for decolourisation of the mixture if temperature of solution was 58^{0}C. (1mk)
c) Explain how the rate of reaction between solution Y and solution Z varies with change in temperature. (2mks)

2. You are provided with organic liquid Q. Carry out the tests below and write the observations and inferences in the spaces provided.

a) Using an dropper, place 5 drops of liquid Q on a watch glass and ignite with non – luminous flame.

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

b) i. Divide the remaining liquid Q into 4 portions. To the 1st portion, add about 3cm^3 distilled water and shake vigorously for about 30 seconds and allow to settle.

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

ii. To the 2nd portion add the $NaHCO_3$ provide.

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

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

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

iv. You are provided with acidified potassium dichromate(VII), source of heat, test tube and test tube holder.

a) Assuming liquid Q is an alkanol, describe a test using the reagents provided and the expected observations confirming the homologous series.

Test	**Expected observations**
(1mk)	(1mk)

b) Carry out the test(s) in iv(a) above and write the observations and inferences.

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

3. You are provided with solid T. Carry out the tests below and write the observations and inferences in the spaces provided to identify the ions in T.

a) Scoop a third of the solid using a clean spatula and heat it in a dry test-tube.
Test for the gases produced using moist blue and red litmus papers.

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

b) Transfer the remaining solid into a clean boiling tube and add about 10 cm^3 distilled water and shake.
Divide the resulting solution into 4 portions.

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

c) To the 1st portion add 3 drops of acidified potassium dichromate(VI).

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

d) To the second portion add 3 drops of acidified barium nitrate provided.

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

e) To the 3rd portion, add three drops of ammonium hydroxide.

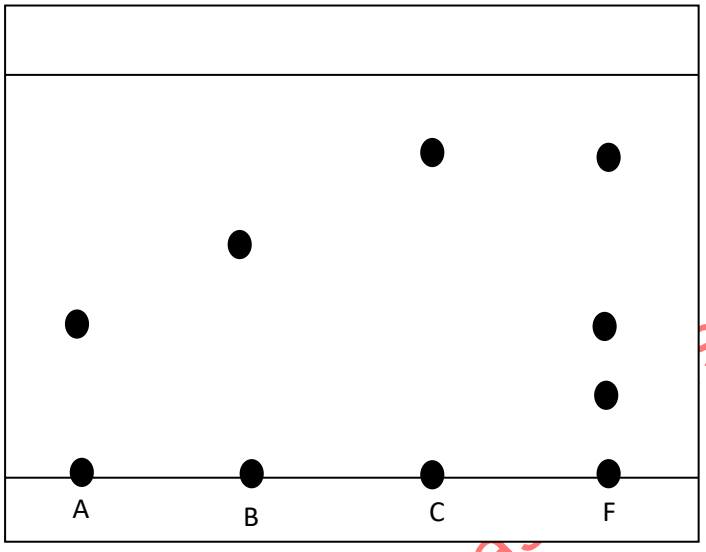
Observation	**Inferences**
($^1/_2$mk)	($^1/_2$mk)

f) To the 4th portion, add 4cm^3 of H_2O_2 followed by 3 drops of 2M sodium hydroxide.

Observations	Inferences
(1mk)	(1 mk)

WEITHAGA JOINT MOCK EXAMINATIONS, 2023
Kenya Certificate of Secondary Education
233/1
CHEMISTRY
Paper 1
(Theory)
TIME: 2 HOURS

1. Three pure pigments were prepared and their spots placed on a filter paper as shown below. The pure pigments are A, B, and C. A mixture F was also placed on the filter paper at the same time with the pure pigments. The filter paper was then dipped in ethanol solvent and left for some half an hour. The results obtained were as follows:



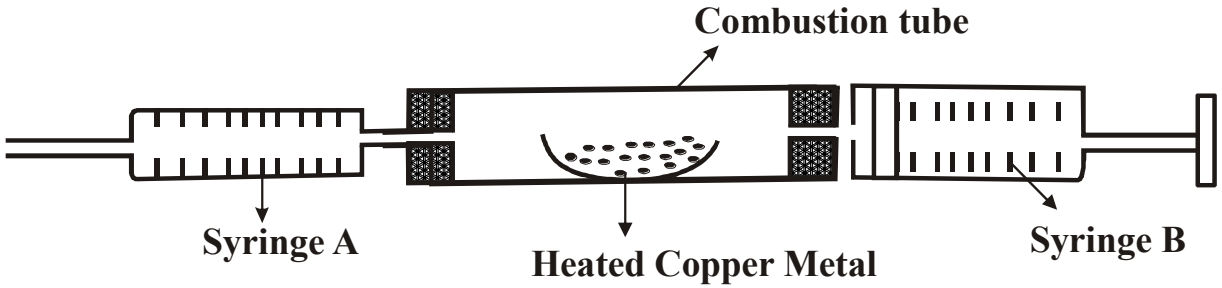
(i) Which of the three pure pigments is most sticky? Give a reason for your answer. 1 mark
(ii) Which pure pigment is not present in the mixture F? 1 mark
(iii) Show on the diagram the base line 1 mark

2. (i) Using a dot (●) and cross (X) show how NH_4^+ ion is formed from NH_3 molecule and H^+ ion. 2 marks
(ii) State the type of bond that exists between the NH_3 and the H^+ ion ½ mark
(iii) Molecular substances have low melting points. Give one reason why they have low melting points. 1 mark

3. A heavy metal P was dissolved in dilute nitric acid to form a solution of compound $P(NO_3)_2$. Portions of the resulting solution were treated as follows:
i) To the first portion a solution of dilute hydrochloric acid is added, where a white precipitate (S) is formed, which dissolves on warming.
ii) The second portion is treated with two drops of 2M Sodium hydroxide solution where a white precipitate T is formed. The white precipitate dissolved in excess sodium hydroxide to form a colourless solution.
iii) A solution of potassium iodide is added to the third portion where a yellow precipitate (U) is formed.
iv) When the resulting solution is evaporated to dryness and heated strongly a yellow solid (V) is formed and a brown gas (W) and a colourless gas (X) are formed.

a. Identify the substances P, S, T, U, V, W 3 marks
b. Write an ionic equation of the reaction that occurs in part (iii) 1 mark

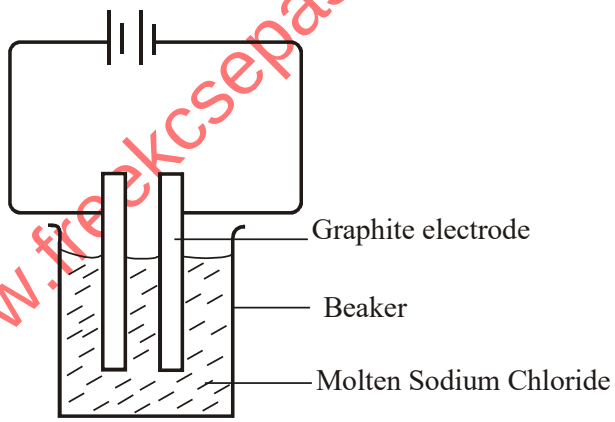
4. $100cm^3$ of air is continuously passed through a combustion tube connected to two syringes as shown below. The combustion tube contains some clean granules of copper metal which are heated. The process is repeated until there is no further change in the volume of air. The volume of air remaining is $80cm^3$



i) State one observation made in the combustion tube 1mark
ii) Work out the percentage of air used after the reaction 1mark
iii) List two gases remaining after the reaction 1 mark
iv) Would the reaction take place if it is repeated with magnesium in place of copper metal explain 1mk

5. The electronic configuration of the ions of X^{3+} and Y^{-} are 2, 8 and 2, 8 respectively.
i). Write the electronic configuration of the neutral atoms of X and Y 1 mark
ii). Write the formula of the compound formed between element X and O 1 mark
iii). Compare the atomic radius of element X and Y 2 marks

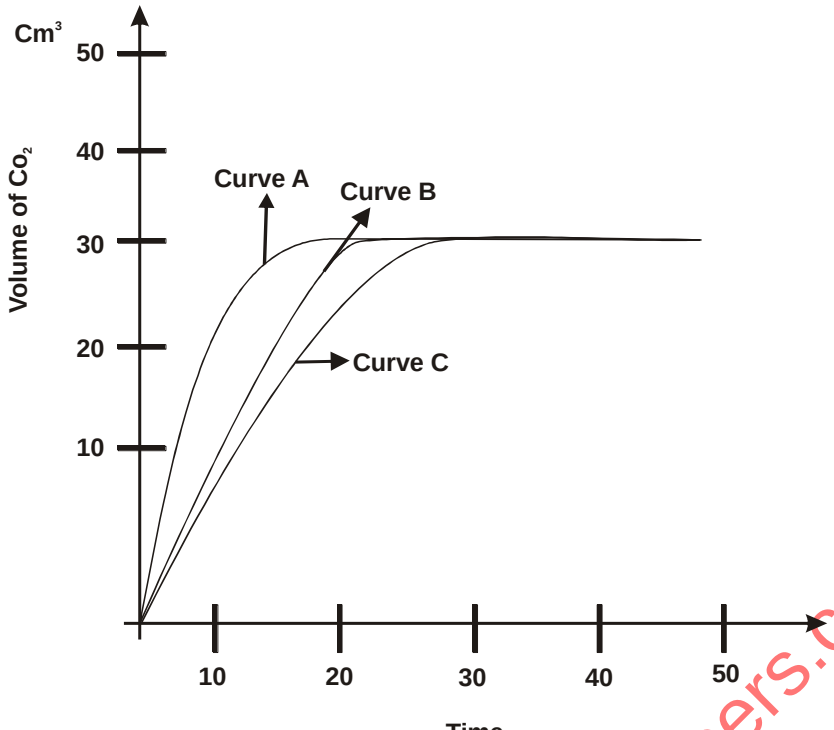
6. The diagram below represents an experiment which was carried out by a student, to investigate the effect of passing an electric current on molten sodium chloride.



i). Molten sodium chloride is a **binary** electrolyte. State the meaning of the term binary electrolyte. 1 mark
ii). State two observations made at the anode 1 mark
iii). Write an equation to show what happens at the cathode. 1 mark
iv) Show the direction of flow of electrons on the set up ½ mark

7. $100cm^3$ of propane gas diffuses through a porous plug in 20 seconds. How long would it take for $80cm^3$ of methane gas to diffuse through the same plug? (C =12, H =1) 3marks

8. The graphs below were drawn when 15g of marble chips in different physical states were reacted with 50cm^3 of 2M Hydrochloric acid. They are drawn by measuring the volume of carbon (iv) oxide produced with time.



a) Which curves corresponds to the reactions involving powdered calcium carbonate and large sized marble chips with the dilute acid.
   i) Powdered calcium carbonate 1 mark
   ii) Large sized calcium carbonate 1 mark

b) All the graphs eventually flatten out at the same level but at different time. Why do the graphs flatten out at the same level? 1 mark

c) Why is curve A very steep at any given point compared to the other curves 1 mark

9. One mole of ethane gas was mixed with excess chlorine gas in a gas jar at room temperature and kept in dark conditions. On observation, no reaction occurred in the dark conditions. On exposure to light the chlorine gas was decolourised.
   (a) State the importance of light in the above reaction. 1 mark
   (b) Write an equation for the reaction that occurs once the mixture is exposed to light. 1mark
   (c) Name the organic product formed in the above reaction 1mark

10. Below is an equation showing an equilibrium

$$Br_{2(aq)} + H_2O_{(l)} \longrightarrow Br^-_{(aq)} + 2H^+_{(aq)} + OBr^-_{(aq)}$$

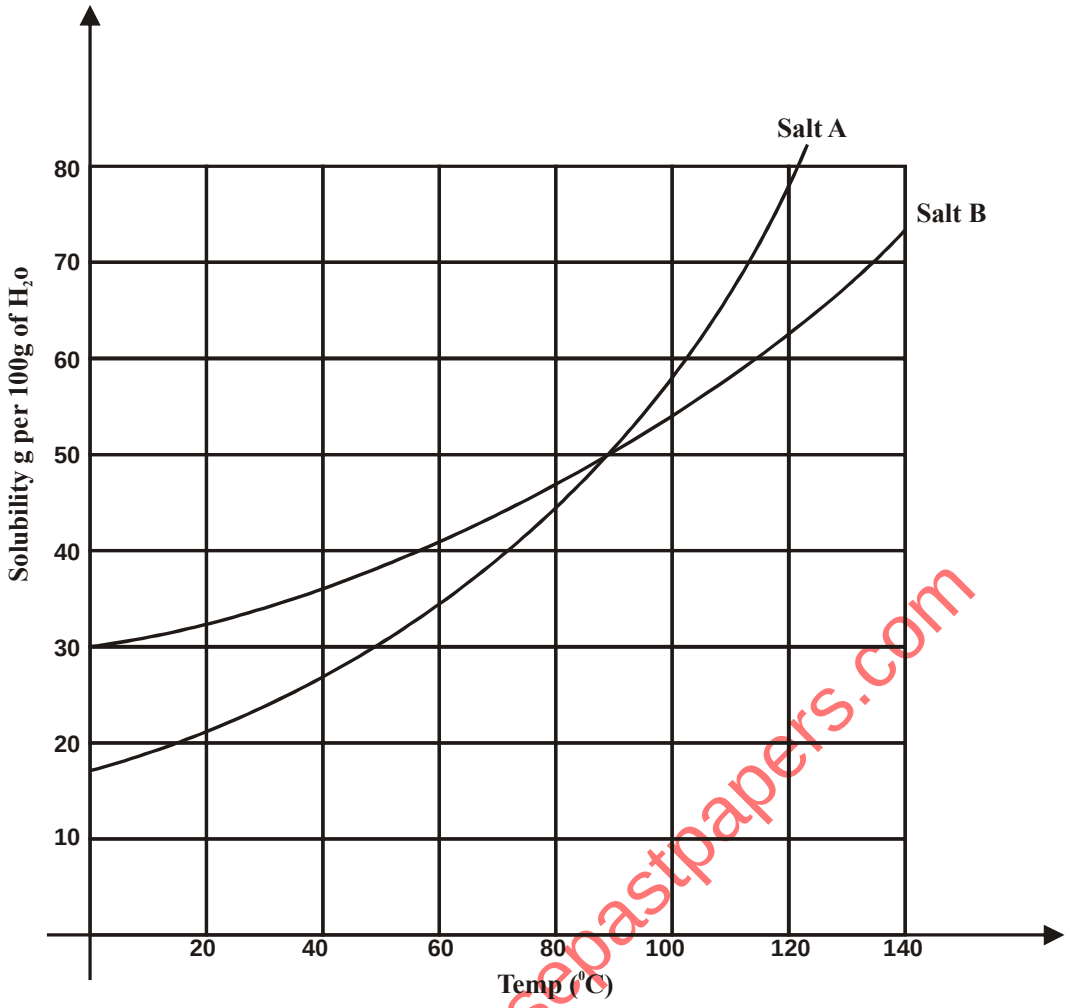
State and explain the observation that would be made if some drops of concentrated sodium hydroxide solution were introduced to the equilibrium mixture 3 marks

11. A mixture of dilute nitric acid (50% water + 50% acid) was reacted with copper turnings in a round bottomed flask.
   i) Name the gas that is produced in the above case. 1 mark
   ii) Write a balanced equation to show the reaction 1 mark
   iii) State two physical properties of the gas evolved above. 1 mark

12. The molar enthalpy of combustion of propanol is 1560Kjmol^{-1}
   i) Write an equation to show the combustion of ethanol completely in oxygen 1 mark
   ii) Calculate the amount of energy in joules released when10g of propanol is burnt in excess oxygen 2 marks
   iii) The practically obtained value of enthalpy of combustion of propanol is less than the value obtained from books. Give two reasons for the above variation. 1 mark

13. Given a solid sample of calcium carbonate and sodium chloride, explain how you can obtain some pure crystals of sodium chloride. 3 marks

14 The solubility curves below shows the solubility of two salts A and B in water. Study it and answer the questions that follow:



i) Which salt is more soluble in water at 70°c 1mark

ii) Work out the amount of salt that would saturate 50gm of water at 120°c (2mark)

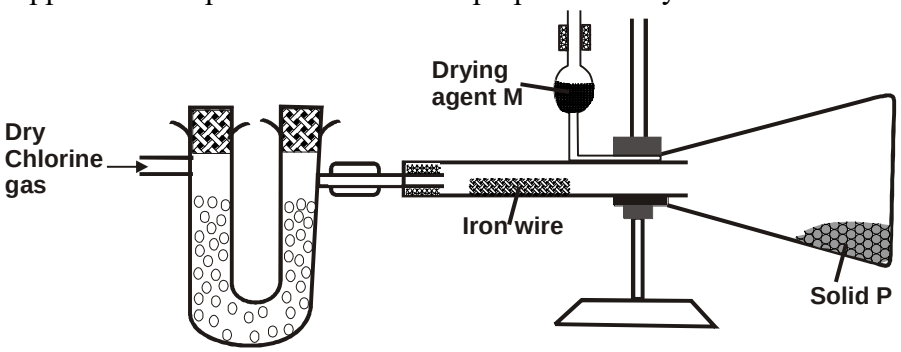
15. 3.78g of a hydrated salt of iron (II) sulphate, $FeSO_4$, in H_2O were heated until all the water of crystallization was driven off. The anhydrous salt left had a mass of 1.52g.
Determine the formula of the hydrated salt.
(Fe = 56, S = 32, H = 1, O = 16) 3 marks

16. A steady current of 0.2 Amperes was passed through molten silver bromide for 80 minutes.

i). Calculate the quantity of electricity that passed through the set up. 1 mark

ii). Calculate the mass of product deposited at the cathode.
(1F = 96500C; Ag = 108, Br = 80) 2 marks

17. The apparatus set up below was used to prepare an anhydrous solid P



(i) Identify solid P 1 mark

(ii) Write an equation for formation of solid P 1 mark

(iii) Suppose the gas used in the set up was dry hydrogen chloride gas; what would be the product obtained after the reaction? Give a reason for your answer 1 mark

18. A radioactive cobalt ($^{61}_{28}Co$) undergoes decay by emitting a beta particle and forming Nickel atom,
    (a) Write a balanced decay equation for the above change 1 mark
    (b) If a sample of the cobalt has an activity of 1000 counts per minute, determine the time it would take for its activity to decrease to 62.50 if the half-life of the element is 30years 2 marks
    (c) Define the term half-life. 1 mark

19. The table below gives the solubility of potassium bromide and potassium sulphate at 0°c and 40°C

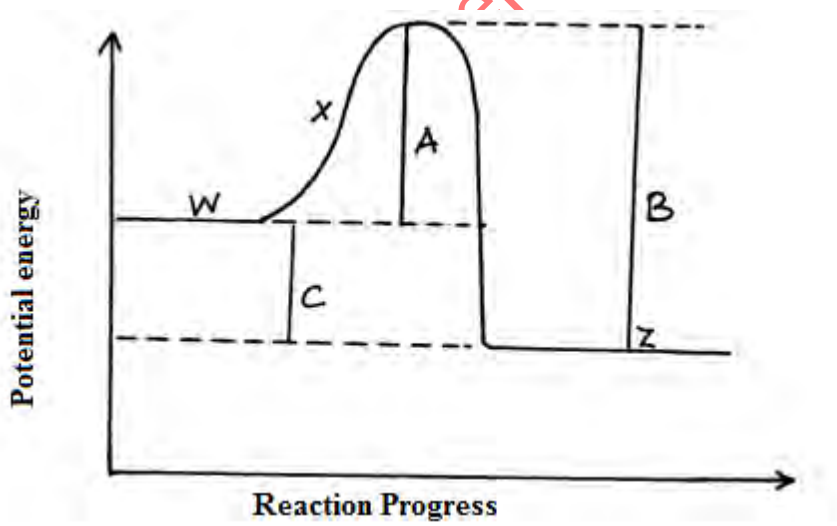
Substance	Solubility g/100g H2O at 0°c	40°C
Potassium bromide	55	75
Potassium sulphate	10	12

When an aqueous mixture containing 60g of potassium bromide and 7g potassium sulphate in 100g of water at 80°c was cooled to 0°C, some crystals were formed
(a) Identify the crystals (1mark)
(b) Determine the mass of the crystals (1mark)
(c) Name the method used to obtain the crystals (1mark)

20. The table below gives some information about the melting and the likely structures in substances V, W, and X. Complete the table by filling the missing Information in the spaces numbered. I, II and III (3marks)

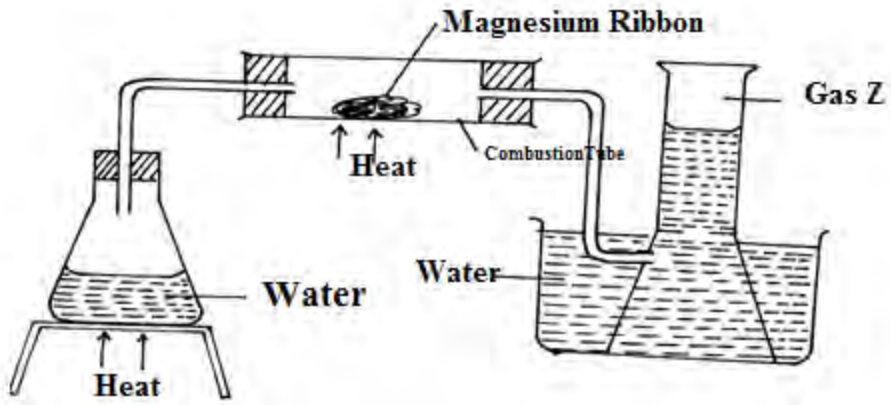
Element	Structure	Example	Melting point
V	Grant Metallic	(i)	High
W	(ii)	F2	Low
X	(iii)	Si	Very high

21. Use for diagram below to answer the questions that follows:-



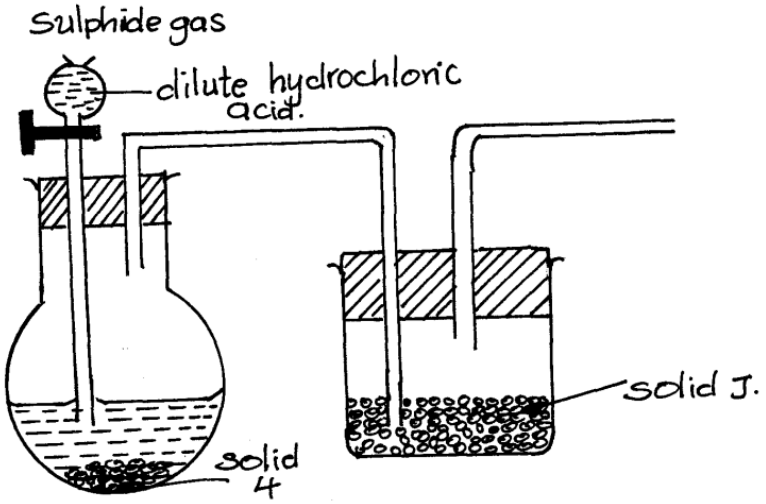
a) Name the letter that corresponds to:_
    i) Activation energy of the reaction (1mark)
    ii) Change in energy for the overall reaction. (1mark)
b) The reaction exothermic or endothermic. Explain. (2mark)

22. Study the set up below and answer the question that follows



a) Write an equation for the reaction which takes place in the combustion tube. (1mark)
b) What property of gas Z to allows it to be collected as shown in the diagram . (1mark)
c) Identify gas Z (1mark)

23. The setup below was used to prepare dry sample or hydrogen sulphide gas.



a) Complete the diagram to show how the gas was collected. (1mark)
b) Identify the following solids; H & J (2marks)

24. The table below shows the atomic and ionic radius of some elements.

Element	Atomic Radius (nm)	Ionic radius (nm)
U	0.174	0.099
V	0.203	0.133
W	0.099	0.181
X	0.136	0.065

a) Classify X as a metal or non-metal. Explain (1mark)
b) Identify the element which is the strongest reducing agent. (1mark)
c) Which element forms an anion? (1mark)

WEITHAGA JOINT MOCK EXAMINATIONS, 2023
Kenya Certificate of Secondary Education
233/2
Chemistry
PAPER 2
(Theory)
TIME: 2 HOURS

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

Element	No. Of protons	Atomic radius(nm)	Boiling point ^{0}C
W	2	0.93	-269
X	10	1.31	-246
Y	18	1.54	-186
Z	36	1.89	-152

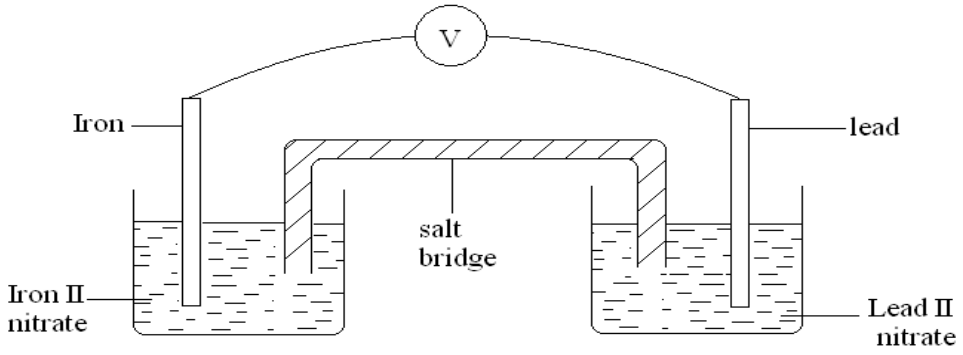
a) Write down the electron arrangement for elements W and X (1mk)
b) In which group of the periodic table are the elements in the table above? Give the name of the group (2mks)
c) Explain why the atomic radius of W is smaller than that of X (1mk)
d) state one use of element X (1mk)

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

				Q				
X			B	H		M	T	
Y		A					V	
Z							S	

a) Select the least reactive non-metal. (1mk)
b) Which of the elements has the greatest tendency of forming covalent compounds in nature? **Explain** your choice. (1mk
c) **Explain** why the atomic radius of **T** is smaller than that of **M**. (2mks)
d) Compare the electrical conductivity of element X and B. (2mks)

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



$Pb^{2+}_{(aq)} + 2e \longrightarrow Pb_{(s)}$ $E^{\Theta} = -0.13V$
$Fe^{2+}_{(aq)} + 2e \longrightarrow Fe_{(s)}$ $E^{\Theta} = -0.44V$

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

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

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

Anode. (1mk)

Cathode. (1mks)

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

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

$$C_6H_{12}O_{6(aq)} \longrightarrow 2C_2H_5OH_{(aq)} + 2CO_{2(g)}$$

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

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

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

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

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

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

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

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

Compound	Formulae
A	$C_2H_4O_2$
B	C_2H_6O
C	C_2H_6

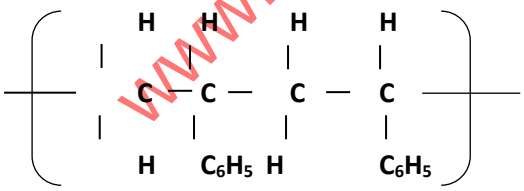
Giving a reason in each case, select the letter(s) which represent a compound that

i). Decolorizes acidified potassium manganate (VII). (1mk)

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

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

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



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

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

4. An experiment was carried out using magnesium ribbon and dilute hydrochloric acid of different concentrations. The time needed to produce 50cm^3 of the gas for every experiment was recorded in a table.

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

a) Complete the table above for $^1/_{time}$. (4mks)

b) Plot a graph of rate i.e $^1/_{time}$ against concentration. (3mks)

c) From your graph determine the concentration needed to produce $50cm^3$ of hydrogen gas when time is 15.0 seconds (1mk)

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

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

$Cr_2O_7^{2-}{}_{(aq)} + 2OH^-{}_{(aq)} \rightleftharpoons 2CrO_4^{2-}{}_{(aq)} + H_2O_{(l)}$

Orange **(Yellow)**

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

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

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

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

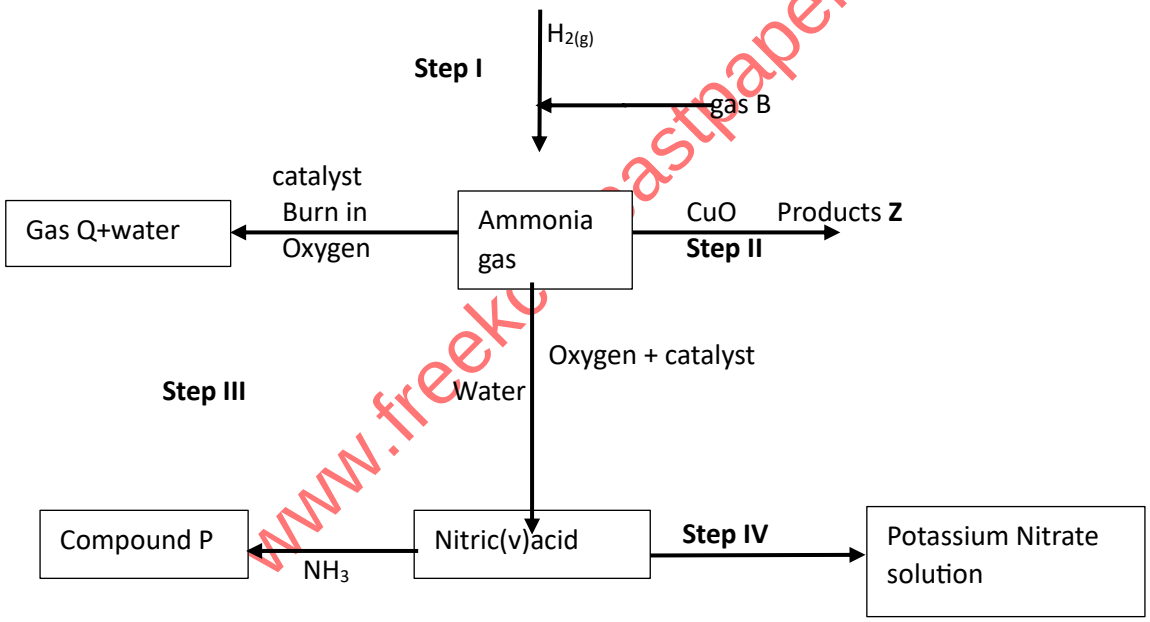
i) Identify gas L (1mk)

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

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

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

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



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

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

a) Step I

b) Step III

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

a) Step I

b) Step II

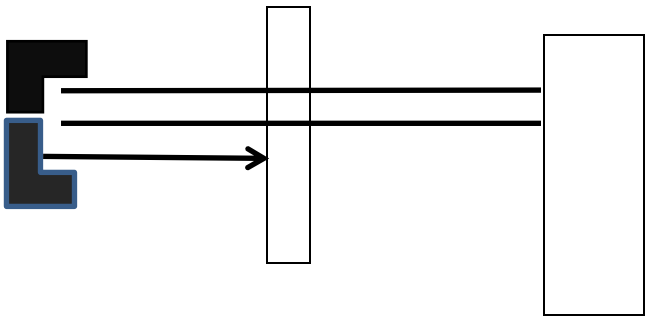
c) Step V

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

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

6 a) Define radioactivity (1mk)

b) Study the diagram below and answer the questions that follow



i) What property of radiations is being investigated by the illustration above (1mk)

ii) Give the name of the radiation B and give a reason. (2mks)

7 a). A metal F is very reactive and therefore it is extracted by electrolysis of its fused chloride. The electrolytic cell used in its extraction is made of anode surrounded by a ring-shaped iron cathode enclosed in a wire gauze shell that acts as a partition separating the two electrodes. When exposed to air it loses its lustre. At 620°C, it reacts with liquid ammonia liberating hydrogen gas. It is used as a deoxidizing agent in the preparation of light alloys and some rare earth metals from their oxides.

i) Name the process by which metal F is extracted. (1mk)

ii) What is the identity of metal F. (1mk)

iii) State the name of the ore from which metal F is extracted. (1mk)

iv) Explain why the metal loses its lustre when exposed to air. (1mk)

v) What is the function of wire gauze shell that separates the anode from the cathode? (1mk)

vi) Write a chemical equation for the reaction between metal F and ammonia (1mk)

vii) Apart from being a deoxidizing agent, state two other uses of metal F. (1mks)

b) During extraction of aluminium by electrolysis, molten cryolite is used instead of water and the anode must be replaced from time to time.

i) State the main ore from which aluminium is extracted (1mk)

ii) Explain why cryolite is preferred over water (1mk)

iii) Give a reason why the anode is replaced from time to time. (1mk)

iv) Extraction of aluminium is very expensive compared to other metals like Iron, explain (1mk)

8. a) Consider the following reaction:

$A_2(g) + B_2(g) \longrightarrow 2AB(g), \quad \Delta H = +75$ kJ

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

(b) The following data was obtained during an experiment

Mass of ethanol burnt	=	0.2g
Mass of water in the calorimeter	=	200g
Specific heat capacity of water	=	4.2 jg-1k-1
Initial temperature of water	=	23.5 0C
Final temperature of water	=	28.0 0C

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

ii) How much heat was required to raise the temperature of water from 23.5 0^C to 28.00^C? (2mks)

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

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

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

WEITHAGA JOINT MOCK EXAMINATIONS, 2023
Kenya Certificate of Secondary Education
233/3
Chemistry
(PRACTICAL)
Paper 3
TIME: 2¼ HOURS

1. You are provided with:-
   - Solid T, hydrated ethanedioic acid $H_2C_2O_4.nH_2O$.
   - Solution Q, 0.2M solution of sodium hydroxide.

   You are required to determine:
   (i) Solubility of solid T.
   (ii) The value of n is the formula $H_2C_2O_4.nH_2O$.

Procedure I

(i) Fill the burette with distilled water.
(ii) Place solid T in the boiling tube.
(iii) Transfer 4cm^3 of distilled water from the burette into the boiling tube containing solid T. Heat the mixture while stirring with the thermometer to a temperature of 80^0.
(iv) Allow the solution to cool while stirring with the thermometer. Record the temperature at which crystals start to form in the table 1 below.
(v) Add a further 2cm^3 of distilled water from the burette to the mixture. Repeat the procedure (iii) and (iv) above and record the crystallization temperature. Complete the table I below by adding the volumes of distilled water as indicated.

(Preserve the contents of the boiling tube for procedure II)

TABLE I

Volume of distilled water in boiling tube	Crystallization temperature	Stability of solid T in 100g / water
4		
6		
8		
12		

(6mks)

(a) On the grid provided, plot a graph of solubility of solid T (y-axis) against crystallization temperature. (3mks)

From the graph determine:
(i) Solubility of T at 55^{0}C (1mk)
(ii) The temperature at which 80g of T dissolve in 100g of water. (2mks)

Procedure II

- Transfer the contents of the boiling tube in procedure I to a clean 250ml volumetric flask. Add distilled water to the mark. Label the resulting solution T.
- Fill the burette with solution T. Pipette 25cm^3 of Q into a clean 250ml conical flask. Add 3 drops of phenolphthalein indicator.
- Titrate T against Q to an accurate end point. Record your results in the table II below.
- Repeat the experiment two more times and complete the table II below.

Table II

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

(4mks)

Calculate:

(a) Average volume of T used. (1mk)

(b) (i) Moles of Q used. (1mk)

(ii) Moles of T used. (1mk)

(iii) Concentration of T in molar per dm^3. (1mk)

(c) Determine the value of n in the formula $H_2C_2O_4.nH_2O$. (2mks)

2. You are provided with solution D. You are required to carry out the tests on solution and record your observations and inferences in the space provided.

(i) To about $2cm^3$ of solution D, add 3 drops of potassium iodide solution.

Observations	Inference
(1mk)	(1mk)

(ii) To the remaining portion in the boiling tube add $5cm^3$ of dilute hydrochloric acid and warm. Leave it to cool and filter.

Observation	Inference
(1mk)	(1mk)

Divide the filtrate into two portions.

(iii) To one portion, add sodium hydroxide drop-wise until in excess.

Observation	Inference
(1mk)	(1mk)

(iv) To 2nd portion, add aqueous ammonia drop-wise till in excess.

Observation	Inferences
(1mk)	(1mk)

(v) To 3rd portion, add all zinc granules provided and warm.

Observation	Inferences
(1mk)	(1mk)

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

(i) Place one third of solid R on a metallic spatula. Burn it in a non-luminous flame of the Bunsen Burner.

Observation	Inference
(1mk)	(1mk)

(ii) Place the remaining solid in a test-tube. Add about $6cm^3$ of distilled water and shake the mixture well.

Observation	Inference
(1mk)	(1mk)

Divide the solution into 3 portions.

(I) To about $2cm^3$ of the solution, add 0.5sg of solid A; sodium hydrogen carbonate.

Observation	Inference
(1/2mk)	(1/2mk)

(II) To about $1cm^3$, add 3 drops of acidified chromate (vi) and warm.

Observation	Inferences
(1mk)	(1mk)

(III) In another $2cm^3$, add 2 drops of acidified potassium manganate (vii).

Observation	Inferences
(½mk)	(½mk)

WEITHAGA JOINT MOCK EXAMINATIONS, 2023

Kenya Certificate of Secondary Education

233/3

Chemistry

(PRACTICAL)

Paper 3

CONFIDENTIAL INSTRUCTIONS TO SCHOOLS

Each candidate will require the following in addition to the apparatus and fittings in a Chemistry Laboratory:-

1. $100cm^2$ of solution Q.
2. Accurately weighed 4.0g of hydrated ethanedioic acid – Solid T.
3. One burette – 50ml.
4. One pipette – 25ml.
5. One pipette filler.
6. One 250ml volumetric flask.
7. One thermometer – 10^0C – 110^0C.
8. One boiling tube.
9. Six test-tubes in a rack.
10. One metallic spatula.
11. $400cm^2$ of distilled water.
12. Means of labeling.
13. About 0.5g of $NaHCO_3$ – Solid A.
14. $5cm^3$ of solution D.
15. About 1g of solid R.
16. Bunsen burner.

Access to:

- 2M aqueous ammonia solution supplied with a dropper.
- Phenolphthalein indicator supplied with a dropper.
- 0.5M KI solution.
- 2M HCL
- 2M NaOH
- Zinc granules. (0.5 g)
- Acidified $KMnO_4$ supplied with a dropper.
- Acidified $K_2Cr_2O_7$ supplied with a dropper.
- Solution D is a mixture of Pb $(NO_3)_2$ and Cu $(NO_3)_2$ (ratio 1:1)
- Solid R is a maleic acid.

MURANG'A EXTRA COUNTY SCHOOLS EXAMINATION.
Kenya Certificate of Secondary Education
233/1
Chemistry
Paper 1
(Theory)
TIME: 2 HOURS

1 a) Bauxite is the chief ore found in the extraction of Aluminium. **Name** two impurities found in bauxite (2mks)
b) **Name** the chief ores of both zinc and copper (1mk)
i) zinc ……
ii) copper ……

2. a) **Identify** the products formed when dinitrogen tetra oxide is dissolved in water (2mks)
b) Write the balanced **equation** for the reaction above (1mk)

3. **State** one use of the following substances (3mks)
i) AgBr……
ii) $CaSO_4.XH_2O$……
iii) Tincture of iodine……

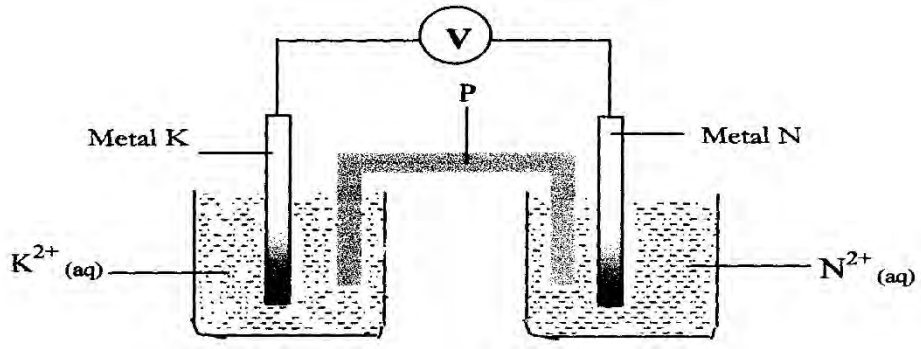
4. The grid below represents part of the periodic table. Study **it** and answer the questions that follow .The letters given do not represent the actual symbols of the elements.

					A		
	B		C		D		E
F	G						
						H	

i) **Select** the element that can form a divalent anion (½mk).
ii) **Name** type of **structure** would the oxide of C have? (½mk).
iii) How does the **melting point** of A compare with that of E? (½mk).
iv) **2.6 g** of B reacts completely when heated with 2.42 litres of chlorine gas (Cl_2) at s.t.p, **calculate** the relative atomic mass of B.(1 mole of gas occupies 22.4 litres at s.t.p.) ($1\frac{1}{2}$mk).

5. **Explain** the differences in bleaching properties of chlorine and sulphur (use equations where necessary) (3mks)

6. Metals **K** and **N** were connected to form a cell as shown in the diagram below. Their reduction potentials are as shown below:
$K^+_{(aq)} / K_{(s)} \equiv - 0.17V$
$N^+_{(aq)} / N_{(s)} = + 1.1\ 6V$



i) **P** is made by dipping a filter paper in a solution of sodium nitrate, on the salt bridge **show** the direction of flow of ions (1mk)

ii) On the diagram, **show** the flow of electrons (1mk)

iii) **Write** the equation for the half-cell reaction that occurs at (1mk)

Metal **K** electrode.....

Metal **N** electrode.....

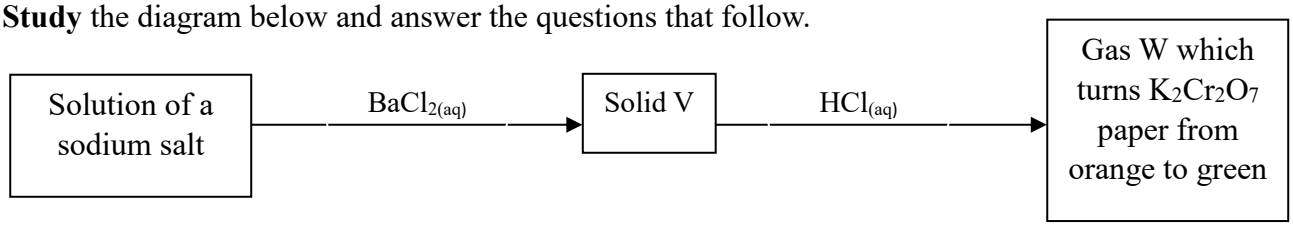
7. **Write equations** for the reactions between the following metals and steam. (3mks)

Iron……

Zinc……

Copper……

8. **Study** the diagram below and answer the questions that follow.



a. **Name** (1mk)

i) Solid V ……

ii) Gas W ……

b. **Describe** a chemical test for chloride ions (2mks)

9. Starting with ethanol, describe how a sample of tetrachloroethane can be prepared (3mks)

10. A solution of bromine in water is a chemical reaction in equilibrium. The reaction involved is represented by the equation below;

$Br_{2(aq)} + H_2O_{(l)} \longleftrightarrow 2H^{+(aq)} + Br^{-}_{(aq)} + OBr^{-}_{(aq)}$

Yellow Colourless

i) **State** and explain the observation made when dilute sulphuric (VI) acid is added to the mixture at equilibrium. (2mks)

ii) **Define** the term dynamic equilibrium (1mk)

11. Apart from downward delivery **name** another method that can be used to collect the following gases (2mks)

i) Nitrogen (IV) oxide ……

Sulphur(VI) oxide ……

ii) **Name one** gas that can be dried using anhydrous calcium oxide (1mk)

12. Starting with magnesium metal **describe** how a sample of magnesium carbonate can be prepared. (3mks)

13. With aid of **well labelled diagrams** show how a sample of sodium chloride, iodine and sand can be separated (3mks)

14. **Explain** the following (3mks)

i) Why number of protons and electrons are equal in an atom

ii) The role of neutrons in the nucleus of an atom

iii) Cations are positively charged

15. (a) In an experiment 10.6g of a mixture of a anhydrous Sodium Carbonate and Sodium chloride were dissolved in water to make $100cm^3$ of solution $.25cm^3$ of this solution required $20cm^3$ of 1M Hydrochloric acid solution for complete neutralization.

i) **Calculate** the number of moles of Hydrochloric acid used (1mk)

ii) **Write** a balanced equation for the above reaction. (1mk)

iii) **Calculate** the mass of Sodium Carbonate in 25 cm^3 of this mixture. (1mk)

16. Briefly **describe** how caffeine can be extracted from tea leaves. (3mks)

17. **State** the two roles of platinized-platinum in a standard hydrogen electrode (2mks)

18. **Explain** the following (3mks)

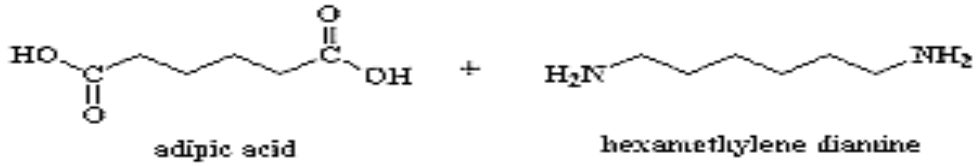
i) Yellow phosphorus is stored under water

ii) Sodium is stored under paraffin oil

iii) Lime water and not potassium hydroxide is used to test for carbon(iv) oxide

18. Study the information below and use it to answer the questions that follow
ΔH^{θ} lattice $=MgCl_2$ $-2477 kjmol^{-1}$
ΔH^{θ} hydration Cl^{-1} (aq) $-363 kjmol^{-1}$
ΔH^{θ} hydration Mg^{+2} (aq) $-1891 jmol^{-1}$
i) **Differentiate** between hydration energy and lattice energy? (1mks)
ii) **Calculate** the heat of solution of Magnesium Chloride (2mks)

19. Nylon 6,6 is formed from two monomers, hexan-1,6-dioic acid (adipic acid) and hexan-1,6-diamine (hexamethylene diamine) through condensation polymerisation as shown in the diagrams below.



adipic acid hexamethylene diamine

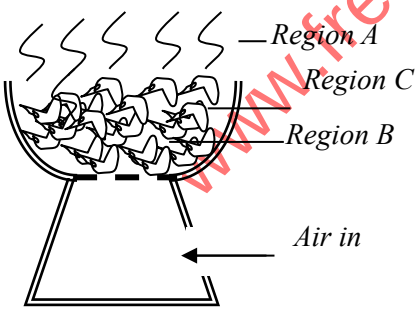
a. **Define** condensation polymerisation (1mk)
b. **Write** the equation for the formation of Nylon 6,6 (2mks)

20. According to Bronsted-Lowry theory**, define** an acid (1mk)
$NH_{3(aq)} + H_2O_{(l)} \longrightarrow NH_4^+{}_{(aq)} + OH^-{}_{(aq)}$
Identify the species that acts as;
i) A base.....
Explain ..... (1mks)
ii) An acid. .....
Explain..... (1mk)

21. a) **Explain** how painting prevents iron from rusting (1mk)
b. Apart from protection from rusting **state** another reason for electroplating (1mk)
c. **What** is sacrificial protection, use an example to **explain** your answer. (2mks)

22. The structure of $RCOO^-Na^+$ below represents a type of cleansing agent. **Describe** how the cleansing agent removes grease from a piece of cloth. (3mks)

23. The diagram below represents a 'jiko' when in use. Study it and answer the questions that follow.



(i) **Write** equations for the reactions that occur in region
I: B (1 mk)
II: C (1 mk)
(ii) **Explain** what happens in region A. (1 mks)

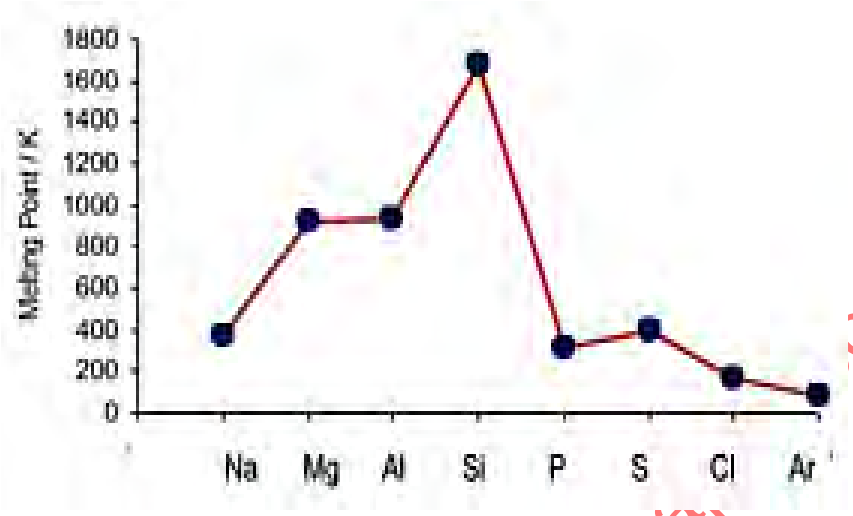
24. A compound contains 82.75% carbon and the rest is Hydrogen. (C=12, H=1)
(a) **Determine** its empirical formula. (2 Mrks)
(b) **Determine** the molecular formula if its molecular mass is 58. (1 Mks)

25. **Determine** the oxidation state of ***manganese*** in the following; (3mks)
$KMnO_4$
Mn_2O_3

26. **Explain** why the melting point of magnesium oxide is 3080°C while that of carbon IV oxide is -79°C. (2mks)

MURANG'A EXTRA COUNTY SCHOOLS EXAMINATION.
Kenya Certificate of Secondary Education
233/2
Chemistry
PAPER 2
(Theory)
TIME: 2 HOURS

1. a) The graph below represents the trend in melting points of elements in period 3. **Study it** and use it to answer the questions that follow



i) **Explain** the trend in melting point between Aluminum and Phosphorous. (2 marks)
ii) Give a reason why Argon has the lowest melting point (1 mark)

b) The table below shows the properties of several elements. **Study it** and use it to answer the questions that follow.

Element	Atomic radius (nm)	Ionic radius (nm)
P	0.136	0.065
Q	0.174	0.099
R	0.099	0.181
S	0.203	0.133

i) Giving a reason, identify the nonmetal (2 marks)
ii) Given that, element P and S belong to the same period of the periodic table, identify the element with a lower ionization energy. **Explain.** (2 marks)

c) An element X forms an ion with the formula X^{2+}. The electronic configuration of the ion is 2.8
i) State the group and period to which element X belongs. (1mark)
Group ……..…….
Period ……
ii) Draw dot and cross diagram showing bonding when X combines with chlorine (1 mark)

d) **Explain** the following observations;
i) Carbon has more than one melting point (1 mark)
ii) Silicon and phosphorous are in the same period but at room temperature, the oxide of silicon is a solid, while the oxide of sulphur is gaseous (1 mark)

2. a) Determine the oxidation state of the element indicated in brackets (3 marks)
i. MnO_4^- (Mn)
ii. $K_2Cr_2O_7$ (Cr)
iii. H_3PO_4 (P)

b) Below is a list of standard reduction potentials of some elements. Use it to answer the questions that follow.

$A^{2+}(aq) + 2e^- \rightarrow A(s)$	+ 0.34 V
$N^{2+}(aq) + 2e^- \rightarrow N(s)$	– 0.76 V
$G^{+}(aq) + 2e^- \rightarrow \frac{1}{2} G(s)$	0.00 V
$Y^{2+}(aq) + 2e^- \rightarrow Y(s)$	+ 0.88 V
$L^{2+}(aq) + 2e^- \rightarrow L(s)$	– 2.16 V

i) Identify the strongest reducing agent (1 mark)

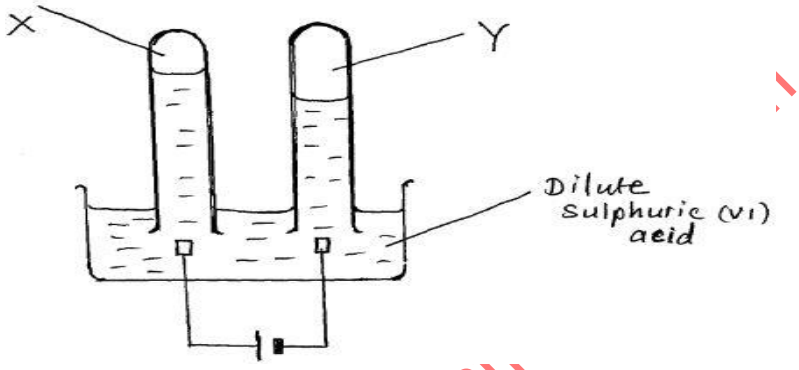
ii) Explain why a solution containing A^{2+} ions cannot be stored in a container made of metal N (1 mark)

iii) The half cells of Y and L were combined to form an electrochemical cell.

I Draw a well labelled diagram of the cell formed (3 marks)

II Calculate the e.m.f of the cell formed above (1 mark)

c) The diagram below shows the set up used to investigate electrolysis of dilute sulphuric (VI) acid solution

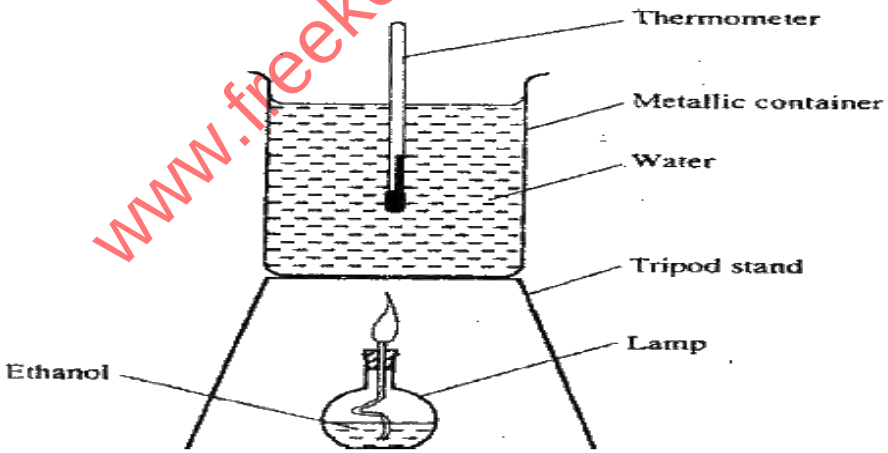


i) Identify product X and Y (1 mark)

ii) Write an equation for the reaction at the anode (1 mark)

iii) Explain what happens to the solution after 2 hrs sometime (1 mark)

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



a. During the experiment, the following data was collected

Volume of water	=	400 cm^3
Initial temperature of water	=	23.0^0 C
Final temperature of water	=	35.0^0 C
Initial mass of lamp and ethanol	=	99.07 g
Final mass of lamp and ethanol	=	98.23 g
Specific heat capacity	=	4.2 kJ Kg^{-1} K^-

Calculate the;

i) Temperature change (1 mark)

ii) Heat change for the reaction (2 marks)

iii) Mass of ethanol that reacted (1 mark)

iv) Molar enthalpy of combustion of ethanol (C=12, H=1.0, O=16.0) (2 marks)

b. Use the information in the table below to answer the questions that follow

$Na^+(g) + Cl^-(g) \rightarrow NaCl(s)$ $\Delta H_1 = -776$ kJ/ Mol

$Na^+(g) + aq \rightarrow Na^+(aq)$ $\Delta H_2 = -390$ kJ/ Mol

$Cl^-(g) + aq \rightarrow Cl^-(aq)$ $\Delta H_3 = -384$ kJ/ Mol

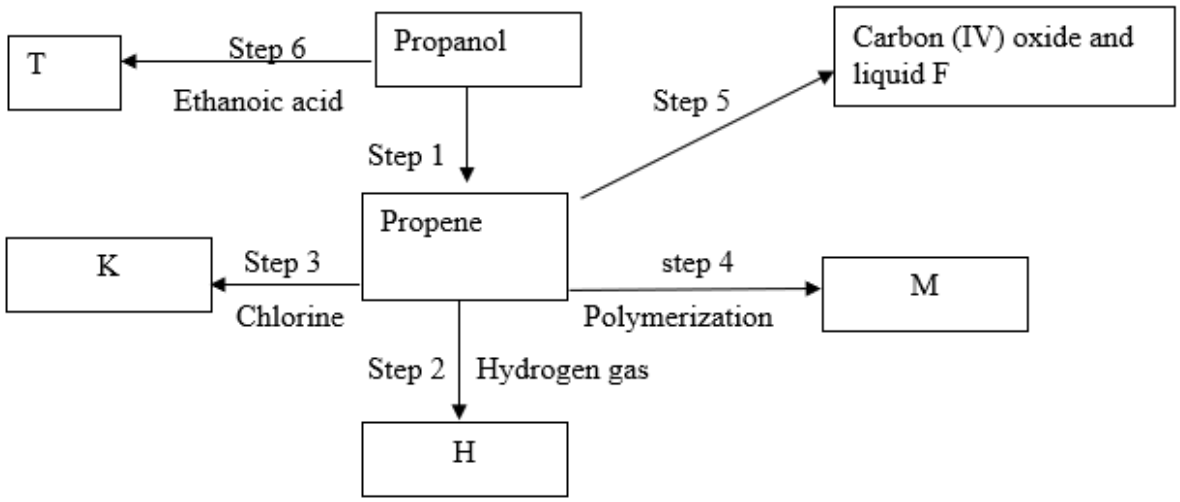
i) Give the name of (2 marks)

ΔH_1 ……..

ΔH_3 ……..

ii) Using an energy cycle diagram, calculate the molar enthalpy of solution of sodium chloride (3 marks)

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



a. Name substance; H , T & F (3 marks)

b. State the conditions for (2 marks)

i. Step 1

ii. Step 2

c. Write an equation for the reaction in (2 marks)

i. Step 6

ii. Step 5

d. Draw the structural formula of substance M (1 mark)

e. A sample of substance M was found to have a molar mass of 47,208. Calculate the number of monomers in the sample. (2 marks)

f. Name the process taking place in step 1 (1 mark)

g. Identify the reagent used in step 5 (1 mark)

5. a) Define the following terms

i) radioactivity (1 mark)

ii) Define half-life (1 mark)

b) In an experiment to determine the half-life of Radon – 220, the following results were obtained.

Time (seconds)	0	10	20	30	40	50	60	70
Count rate per second	30	26	23	21	18	16	14	12

i) On the grid provided, draw a graph of count rate against time (3 marks)

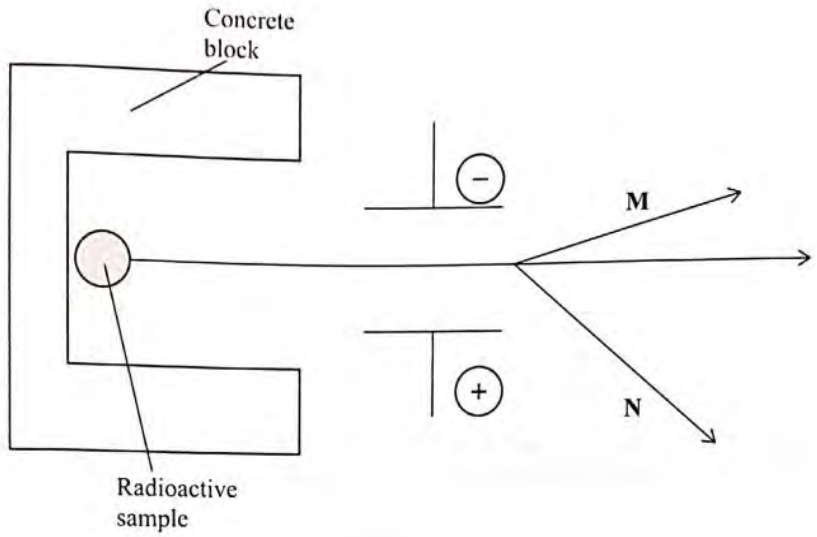
ii) from the graph, determine the half-life of radon – 220 (1 mark)

iii) State one application of radioactivity in; (2 marks)

Agriculture

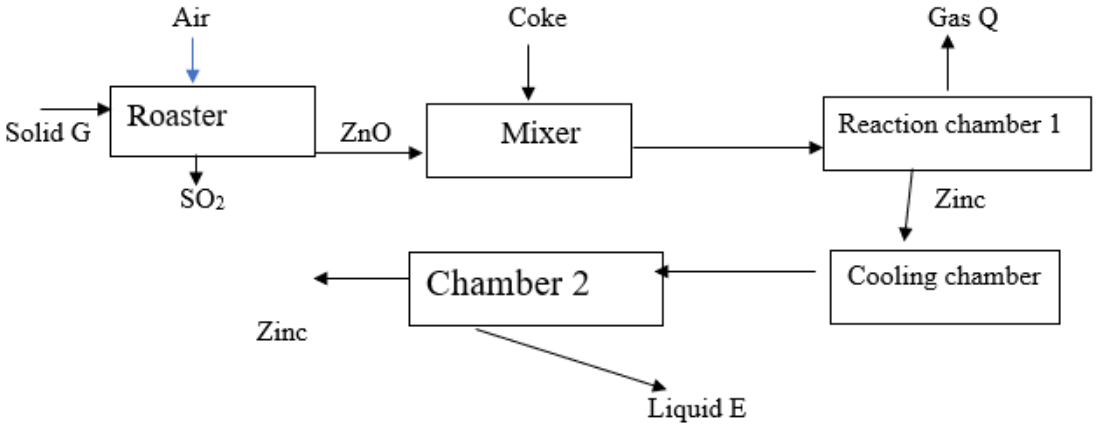
Medicine

c) The diagram below shows the radiations emitted by a radioactive sample.



i) Identify radiation M & N (2 marks)
ii) Explain the difference in the deflection of M and N (1 mark)

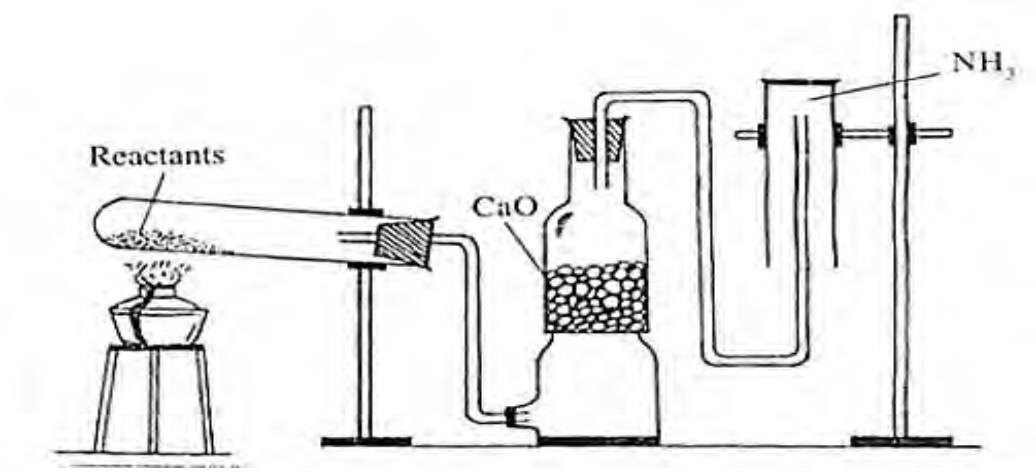
6. The flow chart below shows the process of extraction of zinc. Study it and answer the questions that follow.



a. Identify (1 mark)
i) Solid G .....
ii) Gas Q .....
b. Name the other substance introduced into the mixer and state its role (2 marks)
c. Write an equation for the reaction in; (2 marks)
i) Roaster
ii) Reaction chamber 1
d. Describe the process that takes place in the cooling chamber (2 marks)
e. Name the main impurity found in the zinc ore (1 mark)
f. Explain one danger caused by this process (1 mark)
g. A student found a piece of metal that he suspected could be zinc (II) ions. Describe **three successive tests** he would carry out to confirm the solid is zinc and give the observations expected in each test. **(3marks)**

Test	Procedure	Expected observation
1		
2		
3		

7. The diagram below shows the laboratory preparation of ammonia gas. Study it and use it to answer the questions that follow.



a. Name the reactants used (1 mark)
b. Give the role of calcium oxide (1 mark)
c. State 2 physical properties of ammonia gas (1 mark)
d. Write an equation for the reaction (1 mark)
e. Ammonia reacts with oxygen in the presence of a catalyst to produce nitric (V) acid industrially.
   i) Name the catalyst used (1 mark)
   ii) Describe how the product in e above is converted to nitric (V) acid (2 marks)
f. Ammonia and sulphuric (VI) acid are reacted to form a fertilizer.
   i) Write an equation for the reaction. (1 mark)
   ii) Calculate the volume of ammonia required at STP to manufacture 1500kg of the fertilizer at STP (N= 14.0, H= 1.0, S= 32, O= 16.0, MGV at STP = 22.4L) (3 marks)

MURANG'A EXTRA COUNTY SCHOOLS EXAMINATION.
Kenya Certificate of Secondary Education
233/3
Chemistry
PAPER 3
(PRACTICAL)

1. You are provided with;
- solution P, potassium manganate (VII)
- solution Q, containing 6.3 g/litre of dibasic acid $H_2X.nH_2O$
- Solution R, containing 4.0 g/litre of Sodium hydroxide solution.

You are required to determine:
a) The value of n in $H_2X.nH_2O$
b) How the rate of reaction of solution P with solution Q varies with change in temperature.

Procedure 1
– Fill the burette with solution Q.
– Pipette 25cm^3 of solution R into a conical flask and titrate solution Q with solution R using phenolphthalein indicator.
– Record your results in table I below and repeat the titration two more times and complete the table: Table I. (4mks)

	I	II	II
Final burette readings (cm^3)			
Initial burette readings ($cm^{3)}$)			
Volume of solution Q used (cm^3)			

a) Determine the average volume of solution Q used. (1mk)
b) Calculate the concentration of solution R in moles per litre (Na = 23.0, 16.0, H= 1.0) (1mk)
c) Given that the equation of the reaction taking place and R.F.M of X = 88

$$H_2X_{(aq)} + 2NaOH_{(aq)} \longrightarrow Na_2X_{(aq)} + H_2O_{(l)}$$

Calculate:
i) The number of moles of the dibasic acid solution Q that reacted (1½mks)
ii) The number of moles of the dibasic acid solution Q in 1000cm^3 of solution. (1mk)
iii) The R.F.M of the dibasic acid, hydrated. (1mk)
iv) The value of n in the formula of the hydrated acid given that the RFM of X= 88. (O =16.0, H = 1.0) (1½mks)

Procedure II
i) Using a measuring cylinder, place 10cm^3 portion of solution P into 5' test tubes placed in a test tube rack.
ii) Clean the measuring cylinder and use it to place 10.0 cm^3 of solution Q into a boiling tube.
iii) Insert a thermometer in the solution Q in the boiling tube and place the boiling tube in the water bath to attain a temperature of 50° C.
iv) Remove the boiling tube from the water bath and place it in a test- tube rack and add the first portion of solution P. and at the same time start the stopwatch.
v) Record the time taken for the purple colour and the mixture to decolourise in table II
vi) Repeat the experiment using 10cm^3 of solution Q at 50°C , 60°C, 70° C and 80°C.
vii) Record the time in table II below. Complete the table by computing $\frac{1}{t}$ sec^{-1}.

Table II (5marks)

Temperature of solution Q (°C)	40	50	60	70	80
Time of colour to decolourise (sec)					
1/t (sec^{-1})					

a) Plot a graph of $\frac{1}{t}$ (sec^{-1}) against temperature. (3mks)

b) From the graph , determine the time taken for decolourisation of the mixture, if the temperature of solution B was $65^{O}C$ (1mk)

c) How does the rate of reaction of potassium manganate (VII) with oxalic acid vary with temperature? Explain (2mks)

2. You are provided with solid V. Carry out the tests below and record your observations and inference in the spaces provided.

a) Strongly heat a spatula – end full of solid V in a dry test–tube test any gases produced using both blue and red litmus papers.

Observations	Inferences
(1mk)	(1mk)

b) i) Place the remaining solid V in a boiling tube. Add $10cm^3$ of distilled water. Divide the solution into four portions. To the first portion, add 2-3 drops of aqueous lead (II) nitrate solution and warm.

Observations	Inferences
(1mk)	(1mk)

ii) To the second portion add 2-3 drops of barium nitrate solution followed by about 2cm3 dilute nitric (V) acid.

Observations	Inferences
(1mk)	……..1mk)

ii) To the third portion add a few drops of sodium hydroxide until in excess.

Observations	Inferences
(1mk)	(1mk)

iv) To the fourth portion add few drops of aqueous ammonia until in excess'

Observations	Inferences
(1mk)	(1mk)

v) To the five portion add few drops of hydrochloric acid and warm.

Observations	Inferences
(½mk)	(½mk)

3. You are provided with solid T. Carry out the tests and your observations and inferences.

a) Place about a half of solid T on a metallic spatula and burn it using Bunsen burner.

Observations	Inferences
(1mk)	(1mk)

b) Place the remaining solid T in a test tube. Add about $6cm^3$ of distilled water and shake well. Divide the solution into three portions.

Observations	Inferences
(1mk)	(1mk)

i) To about $2cm^3$ of the mixture add a small amount of sodium hydrogen carbonate.

Observations	Inferences
(½mk)	(½mk)

ii) To about $2cm^3$ of the mixture add two drops acidified potassium manganate (VII)

Observations	Inferences
(1mk)	(1mk)

MURANG'A EXTRA COUNTY SCHOOLS EXAMINATION.
Kenya Certificate of Secondary Education
233/3
Chemistry
PAPER 3

Confidential
Instructions to schools

In addition to the fittings and apparatus found in a chemistry laboratory each candidate should have:
1. About 150 cm^3 of Solution **Q**
2. About 150 $cm^3$of solution **P.**
3. About 80$cm^3$of solution **R.**
4. Burette 50ml
5. Filter funnel
6. 25 cm^3 pipette
7. Clamp and stand
8. White tile
9. 2 conical flasks
10. 10ml Measuring cylinder
11. 6 test tubes
12. Boiling tube
13. Distilled water
14. Thermometer -10-110^{0}c
15. A stop watch
16. About 1g solid **V**
17. About 1.5g of solid **T**
18. Metallic spatula
19. About 1g of sodium hydrogen carbonate
20. Water bath
21. Pipette filter

Access to
1. Phenolphthalein indicator
2. Source of heat
3. 2M $Pb(NO_3)_{2(aq)}$
4. 2M $HNO_{3\,(aq)}$
5. 0.5M $Ba(NO_3)_{2\,(aq)}$
6. 2M Ammonia solution
7. 2M NaOH
8. Acidified $KMnO_4$ solution
9. 2M $HCl_{\,(aq)}$

NOTES
1. Solution Q is 0.05M oxalic acid
2. Solution P is 0.01M potassium manganate (vii) solution.
3. Solution R is 0.1M sodium hydroxide solution.
4. A hot Water bath prepared by placing about 200 $cm^3$of water in a 250ml beaker.
5. Solid **V** mixture $(NH_4)_2SO_4$ and $Al_2(SO_4)_3$ in the ratio 1: 1
6. Solid **T** is maleic acid crystals.
7. Acidified $KMnO_4$ is made by dissolving 3.169 of the solid $KMnO_4$ in about 500 $cm^3$of 2M H_2S0_4 acid and diluting to one litre of solution.

MUMIAS WEST JOINT EVALUATION TEST, 2023

Kenya Certificate of Secondary Education

233/1

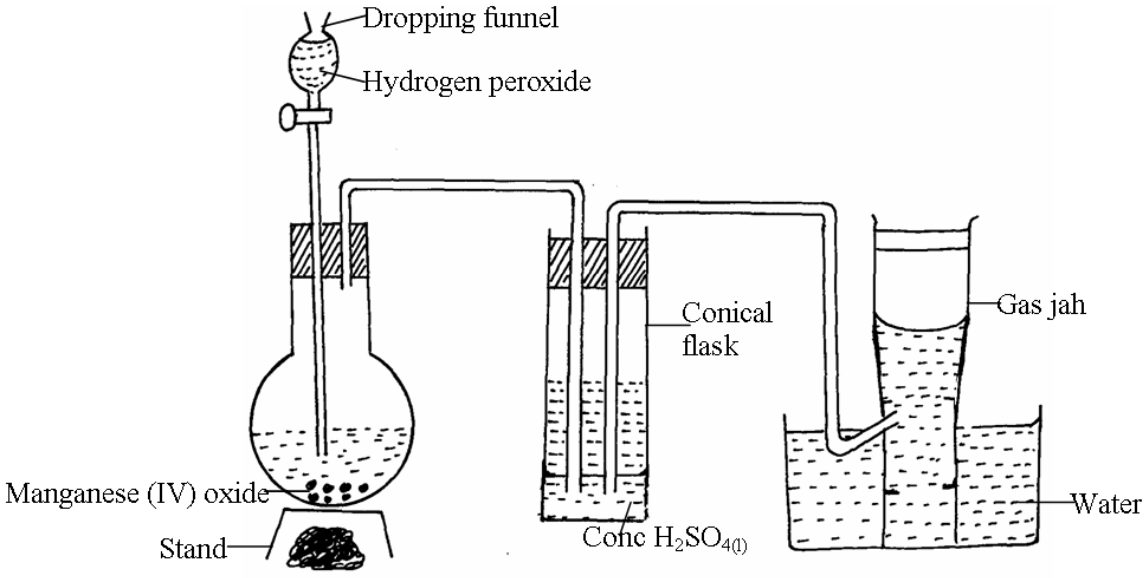
CHEMISTRY

Paper 1

(Theory)

TIME: 2 HOURS

1. A mixture of magnesium powder and copper powder was reacted with dilute hydrochloric acid. The solution was then filtered.
   Name:
   (a) (i) The residue (1mk)
   (ii) The filtrate (1mk)
   (b) Write an ionic equation for the reaction that takes place (1mk)
2. Aluminium chloride solution changes the blue litmus paper red. Explain this observation (2mks)
3. The diagram below shows the set-up that can be used to prepare and collect oxygen gas. Study it and answer the questions that follow.



   (a) Identify **two** mistakes from the diagram which must be corrected for one to collect **dry** oxygen gas (2mks)
   (b) What property of oxygen gas makes it possible to be collected over water? (1mk)
4. The table below gives information on four elements by letters K, L, M and N. Study it and answer the questions that follow. The letters do not represent the actual symbol of the elements.

Element	Electron arrangement	Atomic radius (nm)	Ionic radius (nm)
Q	2.8.2	0.136	0.065
R	2.8.7	0.099	0.181
S	2.8.8.1	0.203	0.133
T	2.8.8.2	0.174	0.099

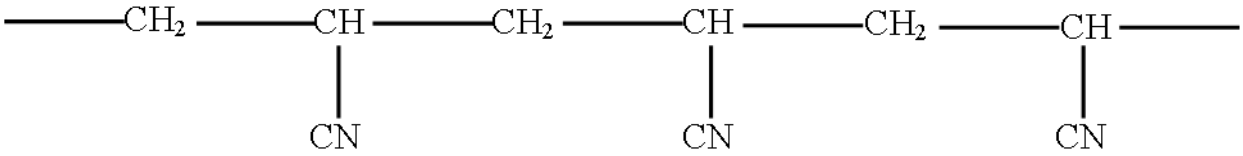
   (a) Which **two** elements have similar chemical properties? Explain (2mks)
   (b) What is the most likely formula of the oxide of R? (1mk)
   (c) Which element is a non-metal. Explain (1mk)
5. A fixed mass of a gas has a volume of $250cm^3$ at a temperature of 27^0C and 750mmHg pressure. Calculate the volume the gas would occupy at 42^0C and 750mmHg pressure. (3mks)
6. Zinc metal and Hydrochloric acid react according to the following equation

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

   1.96g of zinc were reacted with $100cm^3$ of 0.2M Hydrochloric acid,
   (a) Determine the reagent that was not enough (2mks)

(b) Calculate the total volume of hydrogen gas that was liberated at S.T.P conditions (Zn = 65.4, molar gas volume = 22.4 litres at S.T.P) (1mks)

7. (a) Explain how a sample of CH_3CH_2OH could be distinguished from a sample of CH_3COOH by a chemical test (2mks)
   (b) Give the name of the type of compound formed when the (a) above are reacted . (1mk)
8. A polymer has the following structure

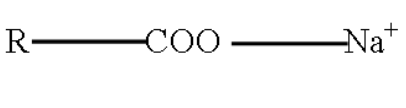


   (a) Draw the repeating unit of the polymer…… (1mk)
   (b) A sample of this polymer is found to have a molecular mass of 5194. Determine the number of monomers on the polymer (H = 1.0, C = 12.0, N = 14.0) (2mks)
9. Describe how the following reagents can be used to prepare lead (II) sulphate:
   Solid potassium sulphate, solid lead (II) carbonate, dilute nitric acid and distilled water. (3mks)
10. Explain why the enthalpy of neutralization of ethanoic acid with sodium hydroxide is different from that of Hydrochloric acid with sodium hydroxide. (3mks)
11. Use the information below to answer the questions that follow:

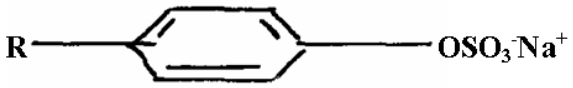
	Equation:	**Enthalpy of formation.**
(i)	$H_{2(g)} + \frac{1}{2} O_{2(g)} \longrightarrow H_2O_{(l)}$	$\Delta H_1 = -286 kJmol^{-1}$
(ii)	$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$	$\Delta H_2 = -394 kJmol^{-1}$
(iii)	$2C_{(s)} + 3H_{2(g)} + \frac{1}{2} O_{2(g)} \longrightarrow C_2H_5OH_{(l)}$	$\Delta H_3 = -277 kJmol^{-1}$

   Calculate the molar enthalpy of combustion of ethanol, given that:
   $C_2H_5OH_{(l)} + 3O_{2(g)} \longrightarrow 2CO_{2(g)} + 3H_2O_{(l)}$ (3mks)

12. The structure shown below represent two cleansing agents A and B.

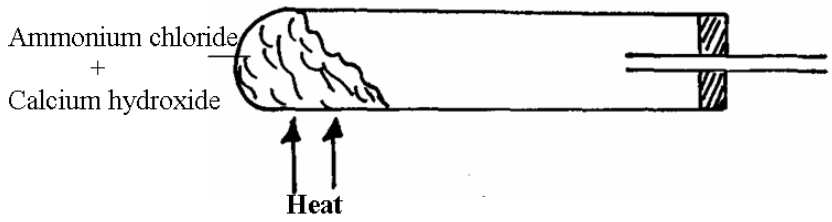


A



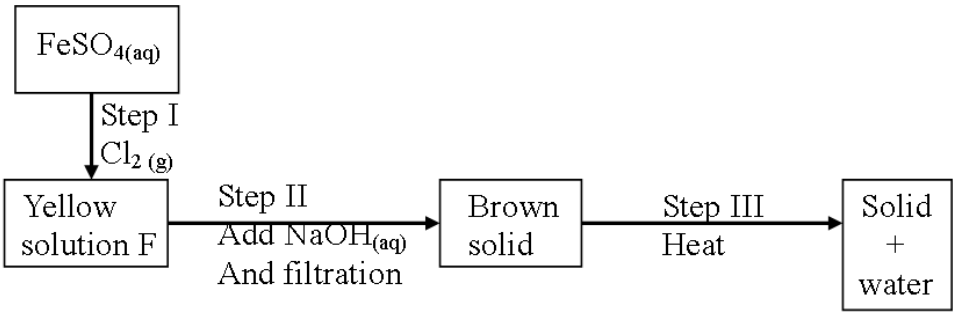
B

   Which cleansing agent would be more suitable for washing in water containing magnesium sulphate? Explain (2mks)
   (b) Identify the Soapy detergent…… (1mk)
13. M grammes of a radioactive isotope decayed to 5 grammes in 100 days. The half – life of the isotopes is 25 days.
   (a) What is meant by half – life? (1mks)
   (b) Calculate the initial mass M of the radioactive isotope (2mks)
14. Complete the diagram to show how a sample of dry ammonia gas can be prepared in the laboratory. (3mks)



15. $30cm^3$ of hydrogen gas was exploded with $10cm^3$ of oxygen gas at room temperature and pressure. Calculate the total volume of the mixture at;
   (a) 100^0C (2mks)
   (b) 70^0C (1mk)

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

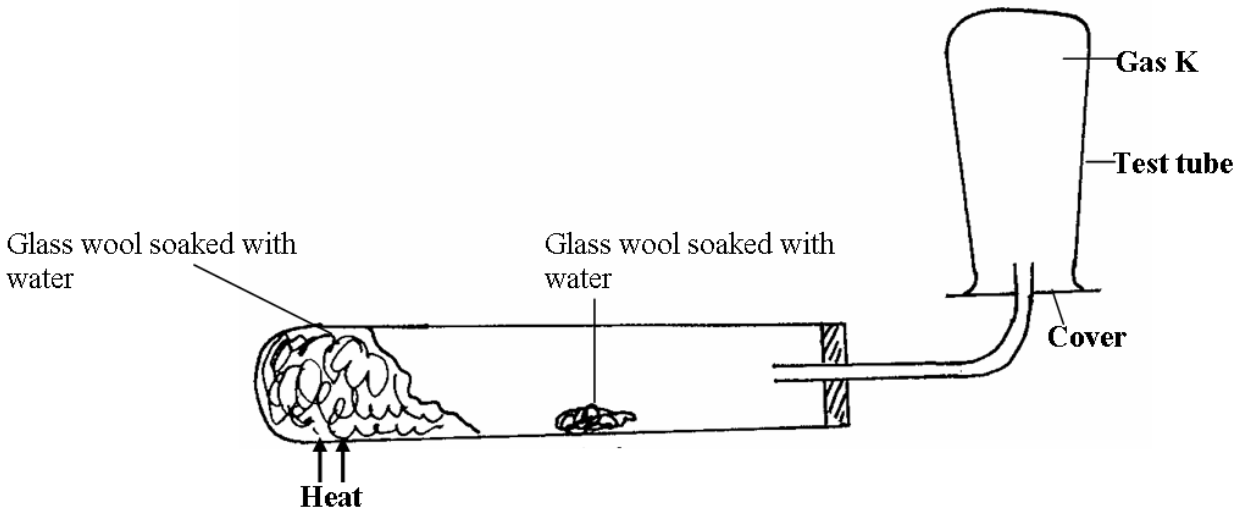


(a) Write the formula of the cation present in the yellow solution F (1mk)

(b) What property of chlorine is shown in step I (1mk)

(c) Write an equation for the reaction in step (III) (1mk)

17. A student set up the experiment below to collect gas K. The glass wool was heated before heating the zinc powder.



(a) Why was it necessary to heat the moist glass wool before heating the zinc powder(2mk)

(b) What observations were made in the test tube (1mk)

18. Using dots (•) and crosses (×) to represent the outermost electrons, draw the structure to show the bonding in CO_2. (C=6, O = 8). (3mks)

19. Calculate the mass of nitrogen (IV)oxide gas that would occupy the same volume as 10g of hydrogen gas at the same temperature and pressure. (H = 1.0, N = 14.0, O = 16.0) (3mks)

20. Below is a table of reduction potentials and voltage of some half cells. The letters are not actual symbols but use them to answer the questions which follow

Reaction	**volts**
$A^{2+}_{(aq)} + 2e \longrightarrow A_{(s)}$	-2.80
$B^{+}_{(aq)} + e \longrightarrow B_{(s)}$	-1.50
$2C^{+}_{(aq)} + 2e \longrightarrow C_{2(g)}$	0.00
$D_{2(g)} + 2e \longrightarrow 2D^{-}_{(aq)}$	+3.20
$G^{+}_{(aq)} + e \longrightarrow G_{(s)}$	+1.80

(a) Select the species with the largest

(i) Oxidizing power (1mk)

(ii) Reducing power (1mk)

(b) Calculate the electrode potential (e.m.f) for a cell constructed using half-cells of A and B (1mk)

21. The following table gives the melting points oxides of elements in period 3.
Study it and answer the questions that follow:

Formula of oxide	Na_2O	MgO	Al_2O_3	SiO_2	P_4O_{10}	SO_3
Melting point (^{0}C)	1190	3080	2050	1730	560	-73

(i) Explain the difference in the melting point of MgO and P_4O_{10} (2mks)

(ii) Name the compound in the above table that will dissolve both in dilute hydrochloric acid and dilute sodium hydroxide (1mk)

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

Bond	**Bond energy (KJmol^{-1})**
C – H	414
Cl – Cl	244
C – Cl	326
H - Cl	431

Calculate the enthalpy change of the reaction

$CH_{4(g)} + 2Cl_{2(g)} \longrightarrow CH_2Cl_{2(g)} + 2HCl_{(g)}$ (3mks)

23. (a) Urea, $(NH_2)_2CO$ is prepared by the reaction between ammonia and carbon(IV)oxide

$2NH_{3(g)} + CO_{2(g)} \longrightarrow (NH_2)_2CO_{(aq)} + H_2O_{(l)}$

In one process, 340kg of ammonia were reacted with excess carbon (IV) oxide.
Calculate the moles of urea that were formed. (H = 1.0, C = 12. 0, N = 14.0, O = 16.0)
(2mks)

(b) What is the oxidation number of Chromium in $Cr_2O_7^{2-}$ (1mk)

24. An element P has a relative atomic mass of 88. When a current of 0.5 amperes was passed through the fused chloride of P for 32 minutes and 10 seconds, 0.44g of P were deposited at the cathode. Determine the charge on an ion of P. (1 faraday = 96500 coulombs) (3mks)

25. In a neutralization experiment 25cm^3 of solution of sodium hydroxide containing 8g per litre was required for complete neutralization of 0.245g of a dibasic acid.
Calculate the relative molecular mass of the acid. (Na = 23.0, O = 16, H = 1) (3mks)

26. (i) Name one drying agent for hydrogen chloride (1mk)

(ii) State and explain the observation that would be made when hydrogen chloride gas is bubbled into a solution of silver nitrate. (2mks)

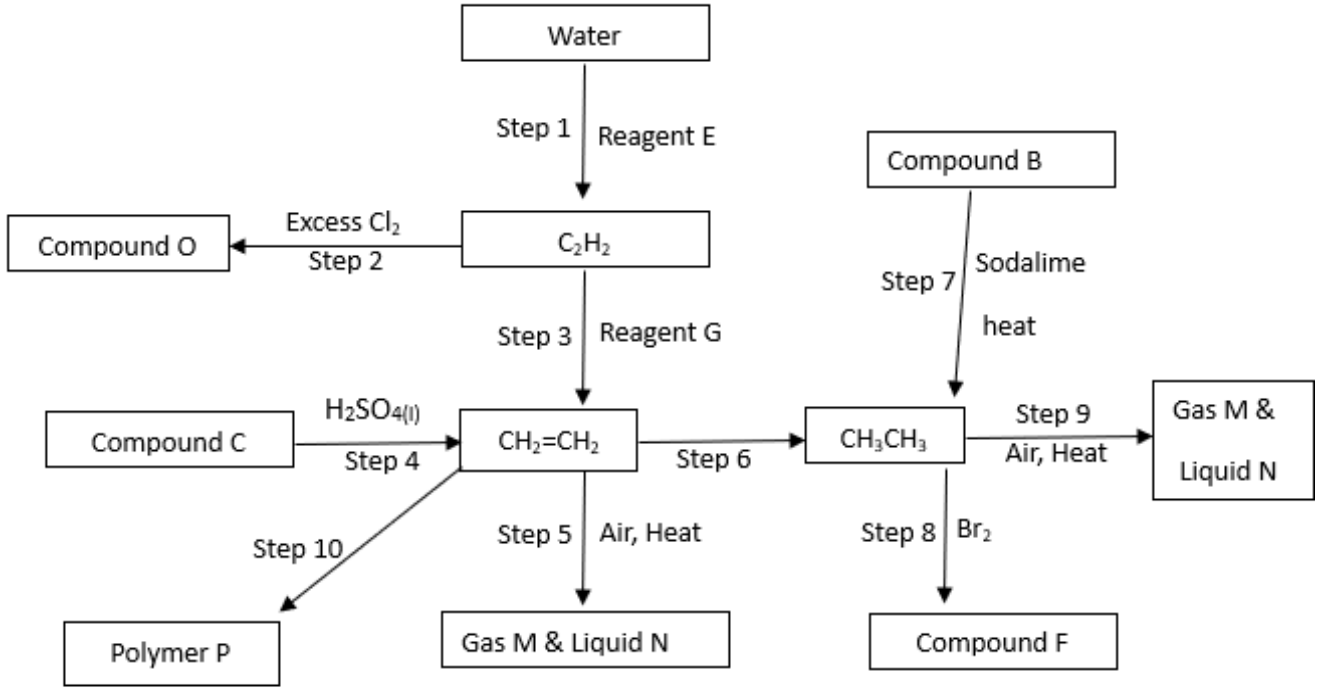
27. In an experiment to study the properties of concentrated nitric acid, a mixture of the acid and wood charcoal was heated in a boiling tube.

(a) What observations were made? Explain your answer (2mks)

(b) Write an equation for the reaction that took place in the boiling tube (1mk)

MUMIAS WEST JOINT EVALUATION TEST, 2023
Kenya Certificate of Secondary Education
233/2
Chemistry
PAPER 2
(Theory)
TIME: 2 HOURS

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



a) Name the following 3mrks
   i) Reagent E and Reagent S
   ii) Compound F
   iii) Reagent G
   iv) Compound B
   v) Compound C
   vi) Compound O
b) Name the type of reaction in steps 2, 4. 8 and 9. 2mrks
c) State any one condition necessary for steps 3, 4, 8 and 10 to take place 2mrks
d) Draw the structure of compounds P, F and O 3mrks
e) Steps 5 and 9 are similar and lead to the same products. State and explain one difference in the observations made when steps 5 and 9 are separately carried out. 2mrks
f) Write chemical equations for the reactions that take place in steps 2 and 8. 2mrks

2. a) Distinguish between an element and a molecule. (2mks)
   b) The diagram below represents part of the periodic table. Use it to answer the questions that follow. (the letters do not represent the actual symbols of the elements)

											F
C						**G**		**H**			
D	**E**			**J**				**K**			

   (i) Which metallic element shown on the table has the highest electrical conductance? Explain (2mks)

ii) Write the formula of the compound formed between E and G (1mk)

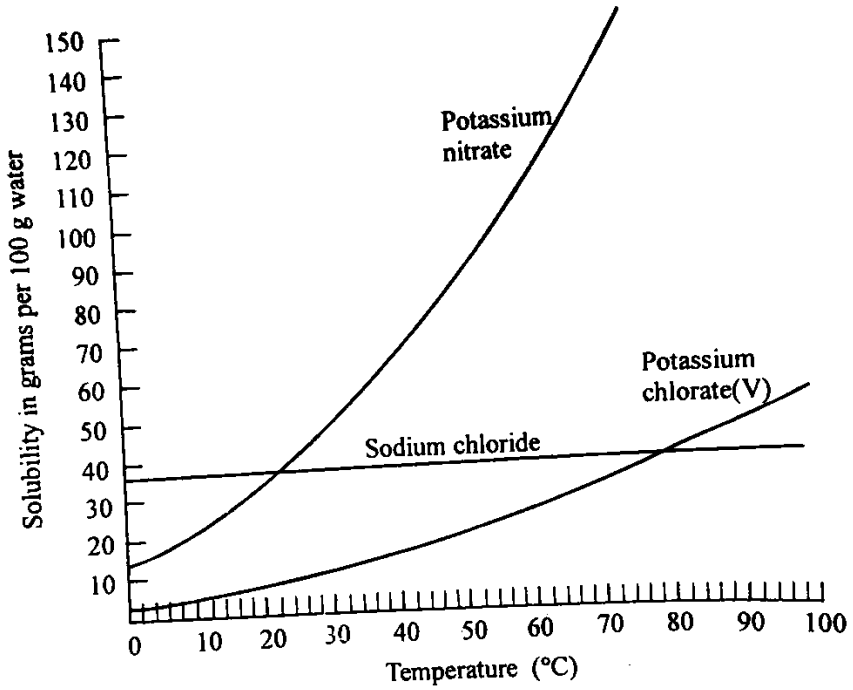
iii) How do the first ionization energies of elements C and D compare? Explain. (2mks)

(iv) The melting point of E and K are 1120°C and -34°C respectively. In terms of structure and bonding, explain why there is a large difference in the melting point of E and K. (2mks)

(v) Indicate on the grid the position of element L which forms L^{3-} ions with electronic configuration 2.8.8. (1mk)

(vi) Element J reacts with dilute sulphuric(VI)acid at room temperature to produce $0.4dm^3$ of gas. Determine the mass of J which was reacted with dilute sulphuric(VI)acid. (molar gas volume at rtp is $24dm^3$, relative atomic mass of J=27) (3mks)

3. The graph that follows shows the solubility curves for some three common salts. Study it and answer the questions that follow.



a) Which of the three salts has the highest solubility at 20^0C? 1mrk

b) Which of the three salts has the lowest solubility at 30^0C? 1mrk

c) State the temperature at which the solubility of sodium chloride is the same as that of potassium nitrate and state the solubility of these salts at this temperature. 2mrks

d) The solubility of potassium nitrate is 137g/100g of water at 70^0C and 110g/100g of water at 60^0C. The solubility of potassium chlorate is 32g/100g of water at 70^0C and 25g/100g of water at 60^0C. Predict what will happen when 100g of water containing 130g of potassium nitrate and 20g of potassium chlorate is cooled from 70^0C to 60^0C. 2mrks

e) 100g of water at 60^0C containing 100g of potassium nitrate and 22g of potassium chlorate (v) was cooled to 20^0C. All the crystals formed were filtered.

i) Calculate the mass of each salt filtered out. 2mrks

ii) Determine the composition of the solution at 20^0C after filtration. 2mrks

iii) Determine the total mass of the solution at 20^0C after filtration. 2mrks

4 a) Define the following terms. 3mrks

i. Enthalpy of formation.

ii. Enthalpy of combustion.

iii) Enthalpy of neutralization

b) Study the thermochemical equations below and use them to answer the questions that follow.

i) $H_{2(aq)} + \frac{1}{2} O_{2(g)} \longrightarrow H_2O_{(l)}$ $\Delta H = -286kJ/mol$

ii) $H^+_{(aq)} + OH^-_{(aq)} \longrightarrow H_2O_{(l)}$ $\Delta H = -57.8\ kJ/mol$

I) Give two possible names of the ΔH in b) i) above 2mrks

II) Explain why the enthalpy changes above are different yet the equations give the same product.

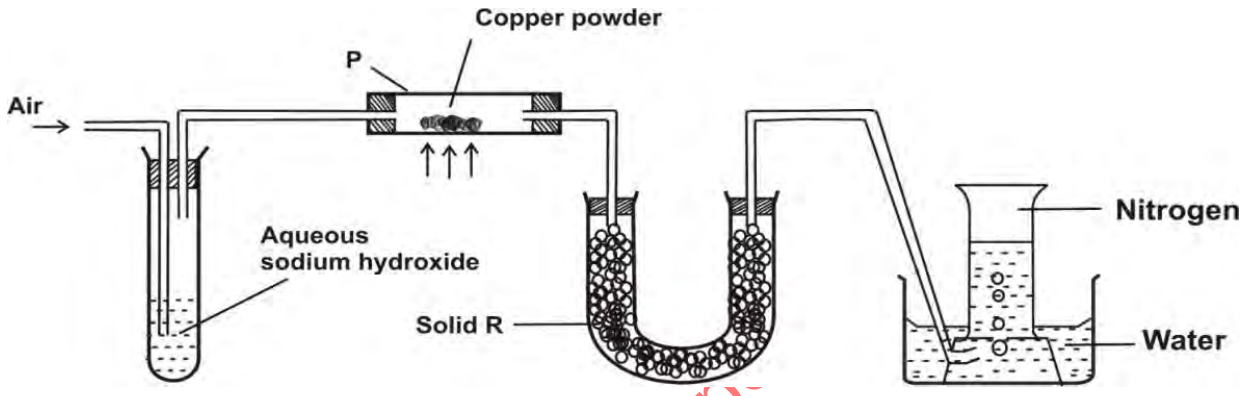
2mrks

c) Use the bond energies that follow to work out the enthalpy changes for the reaction that follows.

Bond	Bond energy (kJ/mol)
C-H	413
Cl-Cl	242
C-Cl	346
H-Cl	431

$CH_{4(g)} + 4Cl_{2(g)} \longrightarrow CCl_{4(l)} + 4HCl_{(g)}$ 4mrks

5. a) The diagram that follows represents a set-up that was used to obtain dry nitrogen from the air. Study it and answer the questions that follow.



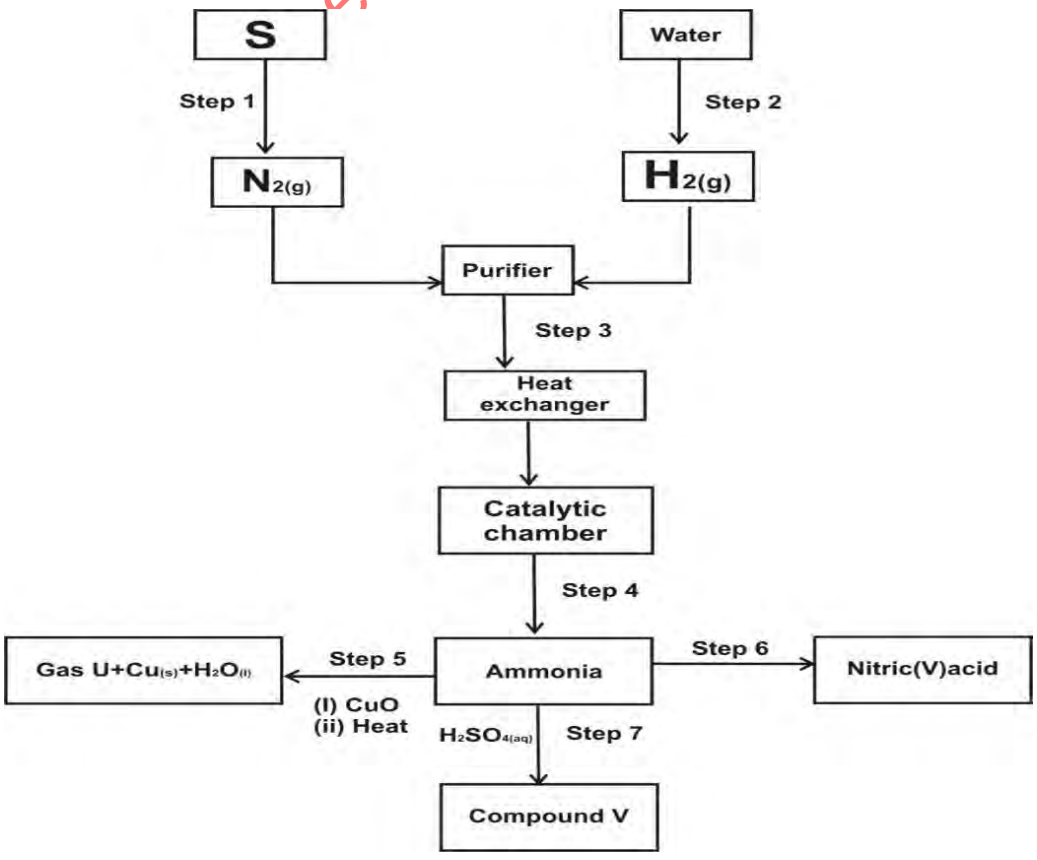
i) Name solid R (1mk)

ii) What is the purpose of sodium hydroxide in the setup? (1mk)

iii) State and explain the change in mass in tube P at the end of the experiment. (2mks)

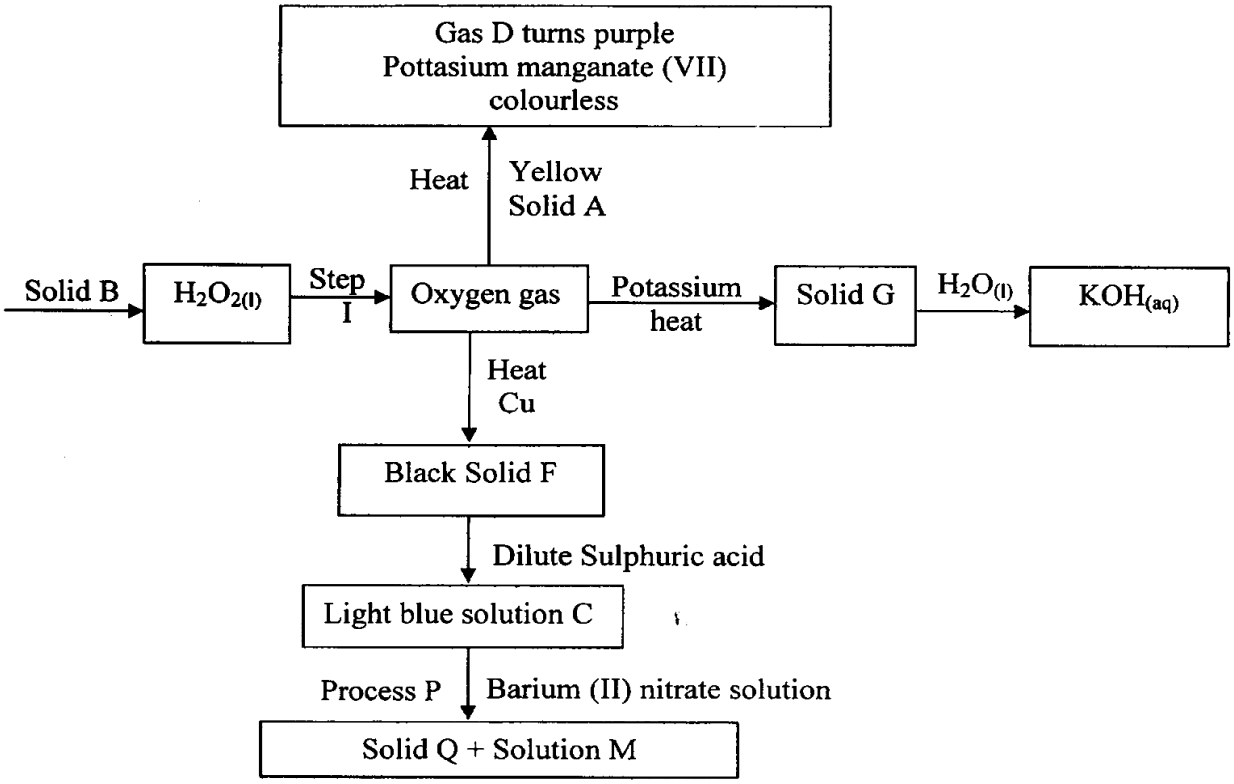
iv) State and explain what would happen to the volume of nitrogen gas collected in the gas jar if magnesium powder was used in place of copper powder (2mks)

b) The flow chart below shows the industrial preparation of ammonia and the process used in the manufacture of some ammonium compounds. Study it and answer the question that follows.



(i) Identify substances S, and V (2mks)
(ii) Name the catalyst and the reagents used in step 6 (2mks)
(iii) State and explain an observation made when conc. Nitric(V)acid is heated with a sample of sulphur. (1mks)

6. The flow chart below represents preparation and properties of oxygen gas. Study it and answer the questions that follow.



a) Identify the following substances (2mks)
i) Solid A
ii) Gas D.
iii) Solid Q.
iv) Solution M.
b) Write a chemical equation for the reaction in step I. (1mk)
c) Write chemical equation for the formation of the following compounds. (3mks)
i) Solid G.
ii) Gas D.
iii) Light blue solution C.
iv) State the confirmatory test for oxygen gas. (1mk)
v) Write the ionic equation for reaction taking place in process P. (1mk)
vi) State two uses of oxygen. (2mks)

7. a) State Charles' law 1mk
b) Complete the following table by interconverting the following temperatures and filling in the missing volumes assuming that the volumes apply to the same mass of gas at constant pressure. 5mrks

Temperature in ^0C	Temperature in K	Volume in litres
195		
	156	8
	312	
-234		

c) A certain gas occupies $700cm^3$ at -70^0C. If pressure remains constant, at what temperature in ^0C will its volume increase by a factor of 3? 4mrks

MUMIAS WEST JOINT EVALUATION TEST, 2023

Kenya Certificate of Secondary Education

233/3

Chemistry

(PRACTICAL)

Paper 3

TIME: 2¼ HOURS

---

1. You are provided with:

Sodium hydroxide labeled solution A

0.128M hydrochloric acid labeled solution B

Carboxylic acid labeled solution C

Solution D prepared by diluting $25cm^3$ of solution A with distilled water to $150cm^3$ of solution

You are required to:

i) Standardize solution D with solution B

ii) Determine the ratio between sodium hydroxide, solution A and the carboxylic acid, solution C

iii) Determine the concentration of C in moles per litre.

Procedure 1

Fill the burette with solution B. Pipette $25cm^3$ of solution D into $250cm^3$ conical flask. Add 2 drops of phenolphthalein indicator and titrate with solution B. Record your results in table 1 below. Repeat the titration two more times and complete the table.

Table 1 **(4marks)**

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

a) Determine the average volume of solution B used. (1mark)

b) Calculate the concentration in moles per litre of sodium hydroxide in :

i) Solution D (2marks)

ii) Solution A (2marks)

PROCEDURE 2

Using a clean burette, place $16cm^3$ of solution C into a boiling tube. Take the initial temperature of the solution in the boiling tube and record it in the table 2. Using a clean measuring cylinder, measure $4cm^3$ of solution A into $100cm^3$ beaker and add it to solution C in the boiling tube. Stir the mixture immediately with the thermometer and record in Table 2 the maximum (final) temperature reached. Repeat the experiment with the other set volumes of solution C and A in Table 2 and complete it. ***Rinse the thermometer and the boiling tube with distilled water after each experiment.***

Table 2 ***(6Marks)***

Volume of solution C, cm^3	16	12	8	6	4	2
Volume of solution A, cm^3	4	8	12	14	16	18
Final temperature (^OC)						
Initial temperature (^OC)						
Change in temperature,						

c) On the grid provided, plot a graph of change in temperature (vertical axes) against the volume of sodium hydroxide, solution A

d) From the graph, determine the volume of sodium hydroxide solution A required to neutralize the carboxylic acid (1mark)

e) Calculate the volume of carboxylic acid, solution C used for neutralization (1mark)

f) Calculate the:

i) Ratio between the volumes of solution A and C (2marks)

ii) Concentration in moles per litre of carboxylic acid, solution C (Assume the volume ratio is the same as the mole ratio) (2marks)

2. You are provided with solid E. Carry out the tests below and record your observations and inferences in the spaces provided.

a) Divide E into halves. Place one half of solid E in a clean dry test-tube. Heat it gently then strongly.

Observations	Inferences
(1mark)	(1mark)

b) Place the other half of soli E in a boiling tube. Add about $10cm^3$ of distilled water and shake well until all the solid dissolves.

i) To about $1cm^3$ of solution, add 2M sodium hydroxide drop wise until in excess.

Observations	Inferences
(1mark)	(1mark)

ii) Place $1cm^3$ of solution in a test – tube and add 2 to 3 drops of 2M sulphuric (VI) acid.

Observations	Inferences
(1mark)	(1mark)

iii) To about $1cm^3$ of solution, add 4-5 drops of lead (II) nitrate solution and heat to boiling.

Observations	Inferences
(1mark)	(1mark)

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

Place all of solid F into a boiling tube. Add about $10cm^3$ of distilled water and shake well. Use $2cm^3$ portion of the mixture for the following tests.

a) Test the first portion with both blue and red litmus papers

Observations	Inferences
(1mark)	(1mark)

b) To the second portion, add three drops of bromine water

Observations	Inferences
(1mark)	(1mark)

c) To the third portion, add 2 drops of acidified potassium manganate (VII) and shake well.

Observations	Inferences
(1mark)	(1mark)

d) Warm the fourth portion slightly and add a little solid G, sodium hydrogen carbonate.

Observations	Inferences
(1mark)	(1mark)

MUMIAS WEST JOINT EVALUATION TEST, 2023

Kenya Certificate of Secondary Education

233/3

Chemistry

(PRACTICAL)

Paper 3

CONFIDENTIAL

In addition to the fittings and chemicals found in the Chemistry laboratory, each candidate will require the following:

1. Burette (0-50 cm^3)
2. Filter funnel
3. Pipette 25cm^3
4. One pipette filler
5. 0.3g of solid **G**
6. Two 250ml conical flasks
7. About 120ml of solution **A**
8. About 100ml of solution **B**
9. About 60ml of solution **C**
10. About 100ml of solution **D**
11. One 10ml measuring cylinder
12. Thermometer (-10 – 110^OC)
13. 100ml plastic beaker
14. Two boiling tubes
15. One test – tube holder
16. 2 red and 2 blue litmus papers
17. 1g of solid **E**
18. 0.5g of solid **F**
19. 6 clean dry test – tubes
20. About 500ml distilled water

Access to the following:

1. 2.0M sodium hydroxide supplied with a dropper
2. 0.5M Lead (II) nitrate supplied with a dropper
3. Bunsen burner
4. Phenolphthalein indicator supplied with a dropper
5. 2M sulphuric (VI) acid
6. Bromine water supplied with a dropper
7. Acidified potassium manganate (VII) supplied with a dropper

NOTES AND PREPARATION

1. Solution **A** is made by dissolving 48g of **sodium hydroxide** in 500cm^3 of distilled water and diluting to make one litre.
2. Solution **B** is made by dissolving 12cm^3 of **concentrated hydrochloric** acid in about 600cm^3 of distilled water and diluting it to one litre.
3. Solution **C** is prepared by dissolving 76g of **oxalic acid** in 600cm^3 of distilled water and diluting to one litre
4. Solution **D** is prepared by dissolving 4g of **sodium hydroxide** in 600cm^3 of distilled water and diluting to one litre.
5. Solid **G** is **$NaHCO_3$**
6. Solid **E** is **calcium chloride**
7. Solid **F** is **benzoic acid**

KIRINYAGA WEST SCHOOL BASED EXAMINATION, 2023
233/1
CHEMISTRY
PAPER 1
Theory
TIME: 2 HOURS

Instructions to candidates

a. *Answer ALL the questions.*
b. *Mathematical tables and electronic calculators may be used.*

1. The number of protons, neutrons and electrons in particles A, B and C are given in the table below. The letters are not actual symbols of the elements.

Particle	Proteins	Neutrons	Electrons	
A	9	10	10	
B	17	18	17	
C	3	4	2	

a) Select a letter that represents;
   i. a cation (½ mks)
   ii. an anion (½ mks)
   iii. Neutral atom (½ mks)
b) Give the formula of compound formed when A and C combine. (½ mks)

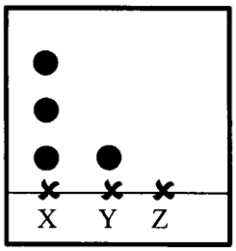
2. Nitrogen (IV) oxide (NO_2) was collected in a transparent gas jar at room temperature. The gas jar was then sealed. An equilibrium was established in the gas jar as represented by the equation below.

$2NO_{2(g)} \longrightarrow N_2O_{4(g)}$ $\Delta H = +9.7kJ/ml$
(brown) (yellow)

State and explain the observation made when the gas jar is lowered in ice cold water. (3mks)

3. i. When magnesium is heated strongly in a crucible its mass increases. Explain. (1mk)
   ii. Explain how magnesium is used to prevent rusting of iron by sacrificial protection. 1mk)
   iii. State two differences between rusting and burning. (1mk)

4. A student carried out chromatography experiment for three substances X, Y and Z. The chromatograms obtained are as follows.



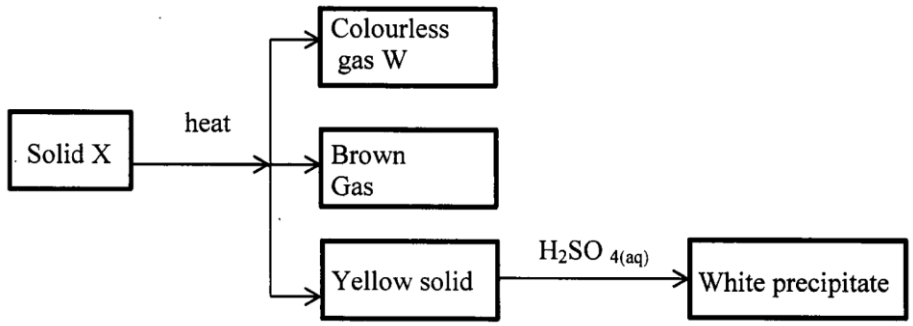
He then measured the boiling points of the three substances and got the following results. One boiled at 68^0C, the other boiled at $70^0C - 72^0C$ and the third one boiled at $78^0C - 85^0C$. With explanation give the substances which is likely to have boiled at :-

i. 68^0C (1mk)
ii. $78^0C - 85^0C$ (1mk)
iii. What does chromatogram of Z indicate? (1mk)

5. $100cm^3$ of oxygen diffuse through an opening in 10 seconds while $150cm^3$ of unknown gas takes 12 seconds. Calculate the molecular mass of gas x. (O = 16.0) (3mks)

6. In a titration experiment $25cm^3$ of sodium hydroxide solution containing 8.0g per litre was required for complete neutralization of 0.245g of diabasic acid. Calculate the relative molecular mass of the acid. (Na = 23, O = 16, H = 1.0) (3mks)

7. Use the information below and answer the questions that follow.



a) Identify solid x. (1mk)
b) Name gas w. (1mk)
c) Write an equation between yellow solid and sulphuric (VI) acid. (1mk)

8. Oxide of M was found to react with dilute hydrochloric acid and potassium hydroxide.
What type of oxide is M oxide? (1mk)

9. a) 100g of radioactive substance was reduced to 6.25g within 15.6 years. Calculate the half life of the substance. (2mks)

b) Study the nuclear reaction given in the scheme below and answer the question that follow.

$$^{12}_{6}C \xrightarrow{\text{Step 1}} {}^{14}_{6}C \xrightarrow{\text{Step 2}} {}^{14}_{7}C$$

Write an equation for the nuclear reaction in step II. (1mk)

10. The information below relates to elements D E F and H. The letters do not represent the actual symbols of the elements.
i. E displaces H from an aqueous solution containing ions H.
ii. Hydrogen gas reduces heated oxide of D but doesn't reduce heated oxide of H.
iii. F liberates hydrogen gas from cold water but E doesn't.

a) Write an equation for the reaction between E and ions of H.
(Both B and D are in group II of the periodic table. (1 mk)
b) Arrange the elements in order of their increasing reactivity. (1mk)

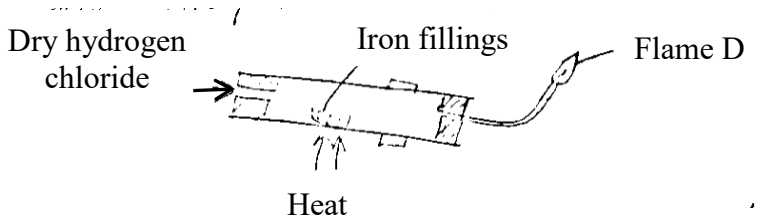
11. The table below shows some information about elements A_1, A_2, A_3 and A_4 which are in the same group of the periodic table. Use the information to answer the questions that follow.

Element	1st ionization energy kJ/Mol
A_1	500
A_2	420
A_3	400
A_4	520

i. What is meant by the term ionization energy? (1mk)
ii. Select the most reactive element. Give a reason for your answer. (1mk)
iii. Arrange the element according to increase in atomic radii. (1mk)

12. A factory uses 200kg of ammonia each day to produce 120kg of nitrogen (II) oxide.
Calculate the percentage yield of nitrogen (II) oxide. (3mks)

13. Dry hydrogen chloride gas was passed over heated iron turnings as shown in the diagram below.

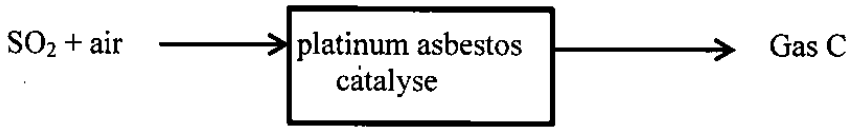


a) What was observed in the combustion tube during the experiment? (1mk)
b) Write down the equation for the reaction taking place in the combustion tube. (1 mk)
c) Identify the colour of the flame D. (1mk)

14. A gaseous hydrocarbon contains 80% carbon by mass. Given that $2dm^3$ of the compound at r.t.p has a mass of 2.5g. Calculate the molecular formula of the compound.
(C= 12, H=1, Molar gas volume at r.t.p = $24dm^3$) (3mks)

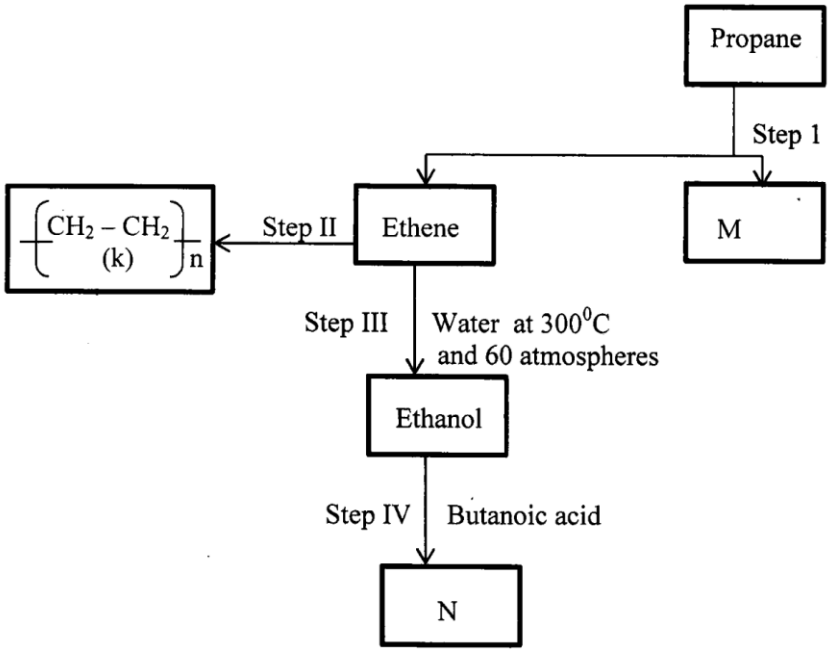
15. a) When potassium nitrate is heated it decomposes. Write a balanced equation for the thermal decomposition of potassium nitrate. (1mk)
b) How would you test for the gas produced in the process? (1 mk)
c) State one use of the gas formed on decomposition. (1mk)

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



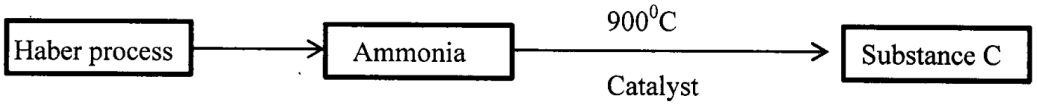
a) Identify gas C. (1 mk)
b) State one disadvantage of using platinum asbestos catalyst. (1 mk)
c) Give the most appropriate catalyst. (1 mk)

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



i. Give;
I. The name of process that takes place in step I and II. (1 mk)
Step I
Step II (1 mk)
II. The name and formula of substance N. (1 mk)
ii. The relative molecular mass of K is 15680. Calculate the number of monomers that make up K. (1mk)

18. Below is a flow chart that shows the process of obtaining substance C from ammonia gas at an optimum temperature of 900^{0}C and in presence of a catalyst.



a) Name raw materials used in Haber process. (1mk)
b) Identify catalyst used to convert ammonia into substance c. (1mk)
c) Write an equation leading to formation of substance C. (1mk)

19. When hydrogen peroxide is mixed with little manganese (IV) oxide, a colourless gas is evolved.
a) Identify the gas. (1mk)
b) What is the purpose of manganese (IV) oxide? (1 mk)
c) How is the gas (a) above prepared in large scale? (1mk)

20. Hydrogen sulphide gas was bubbled in a test tube containing a solution of Nitric (V) acid.
a) State and explain the observation that was made. (2mks)
b) Write an equation for the reaction that took place. (1mk)

21. a) Name two gaseous pollutants emitted from a car exhaust. (1mk)
b) What is a pollutant? (1 mk)

22. a) In the space provided below draw a diagram to represent the apparatus that can be used to prepare hydrogen gas from a reaction of steam and metal x that is divalent. (2 mks)
b) Write a balanced chemical equation for a (above). (1 mk)

23. The table below shows the relative molecular masses and the boiling points of;

	Relative Molecular mass	Boiling point(^{0}C)
Butane	58	-1
Butan – 1 – ol	74	117

Explain why the boiling point of butan – 1 – ol is higher than that of butane. (2mks)

24. Study the thermochemical equations below and answer the questions that follow.

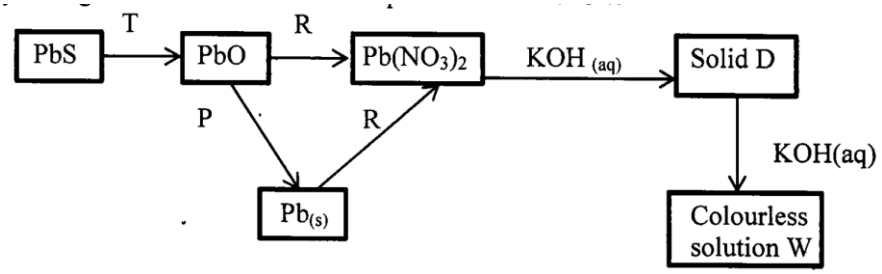
$C_{(s)} + O_{2(g)} \text{-----} \rightarrow CO_{2(g)}\ \Delta H^{\theta}_C = -39.3kJ/Mol$

$H_{2(g)} + \frac{1}{2} O_{2(g)} \text{------} \rightarrow H_2O_{(g)}\ \Delta H^{\theta}_C = -286kJ/Mol$

$3C_{(s)} + 4H_{2(g)} \text{-------} \rightarrow C_3H_{8(g)}\ \Delta H_f = 103.6kJ/Mol$

Calculate the heat of combustion of propane (C_3H_8) (3mks)

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



i. Name process T. ($^1/_2$ mk)
ii. Name the substance represented by R. ($^1/_2$ mk)
iii. Write the formula of complex ion present in solution W. (1 mk)
iv. Write the equation for the reaction taking place in step P. (1 mk)

26. The following equations show the dissociation of two acids.

I. $rH_{(aq)} \longrightarrow r^-_{(aq)} + H^+(aq)$

II. $PH_{(aq)} \rightleftharpoons P^-_{(aq)} + H^+_{(aq)}$

a) Which of the two acids is a weak acid?
Give a reason for your answer. (2 mks)

b) Give a difference between a dilute acid and weak acid. (1mk)

27. Element Z has three isotopes ^{36}Z, ^{38}Z ^{40}Z and the abundance of the element is 0.34%, 0.06% and 99.6% respectively. Calculate the relative atomic mass of Z. (2mks)

28. Describe the chemical tests that would distinguish between C_3H_8O and $C_2H_4O_2$. (2 mks)

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

Half reactions		**Electrode potential EθV**
$P^{2+}_{(aq)} + 2e^-$	$\longrightarrow P_{(s)}$	+0.34
$Q^{+}_{(aq)} + e^-$	$\longrightarrow Q_{(s)}$	+0.80
$R^{2+}_{(aq)} + 2e^-$	$\longrightarrow R_{(s)}$	-2.87
$V^{2+}_{(aq)} + 2e^-$	$\longrightarrow V_{(s)}$	-0.13
$W^{2+}_{(aq)} + 2e^-$	$\longrightarrow W_{(s)}$	-2.71
$U^{3+}_{(aq)} + e^-$	$\longrightarrow U^{2+}_{(s)}$	+0.68

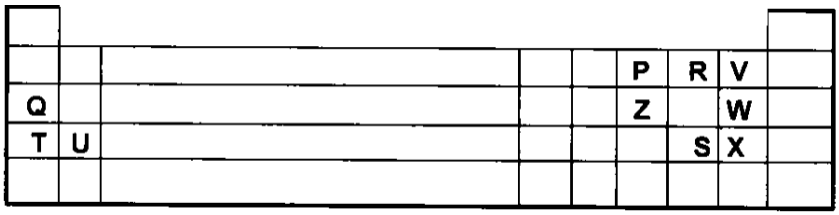
Construct an electrochemical cell that will produce the largest e.m.f. (3mks)

KIRINYAGA WEST SCHOOL BASED EXAMINATION, 2023
233/2
CHEMISTRY
PAPER 2
Theory
TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES

1. **Answer all questions in the English.**
2. **Mathematical tables and electronic calculators may be used.**
3. **All working must be clearly shown where necessary.**

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



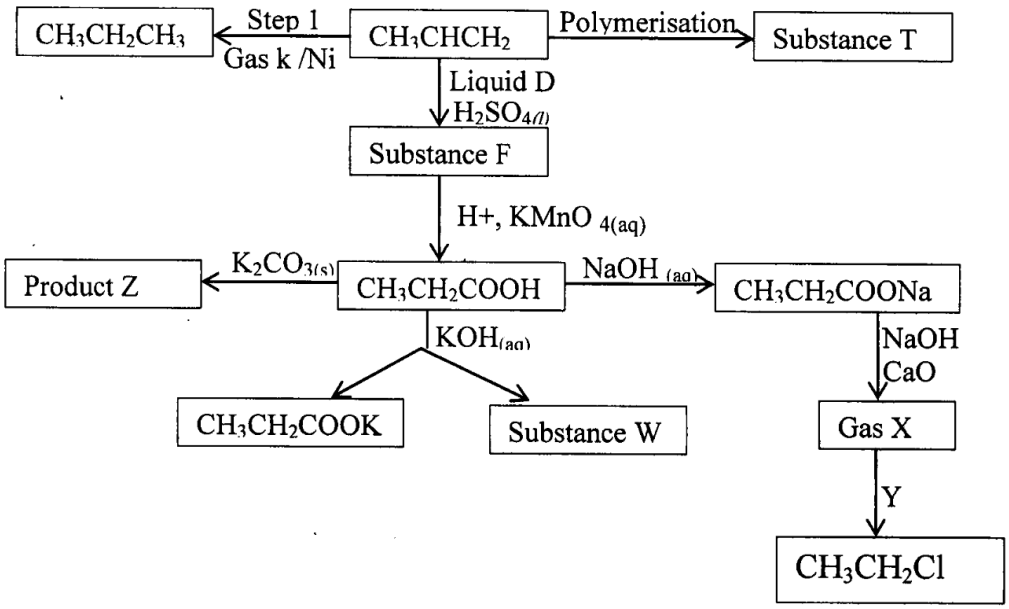
i) State an element that can form an ion with a charge of -2. (½mk)
ii) What type of structure will a chloride of Q have? (½mk)
iii) Explain how the reactivities of V and W compare. (2mks)
iv) Compare the atomic radius of T and S. Explain. (2mks)
v) 2.5g of a Q react completely with 1.2dm3 of gas R at s.t.p
I. Write a balanced equation for the reaction between Q and R. (1mk)
II. Determine the R.A.M of Q (Molar Volume of a gas at s.t.p = 22.4dm^3) (2mks)

b) Study the information given below and answer the questions that follow.

Formula of compound	Nacl	$MgCl_2$	Al_2Cl_6	$SiCl_4$	PCl_5
Boiling point (^{0}C)	1470	1420	Sublimes	60	75
Melting point (^{0}C)	800	710	800	-70	90

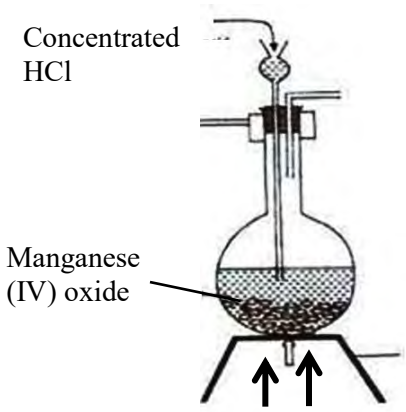
i) Why is the fomula of aluminium chloride given as Al_2Cl_6 and not $AlCl_3$. (1mk)
ii) Give a chloride that is a liquid at room temperature. Explain (1mk)
iii) Explain the difference in melting point of NaCl and PCl_5. (2mks)

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



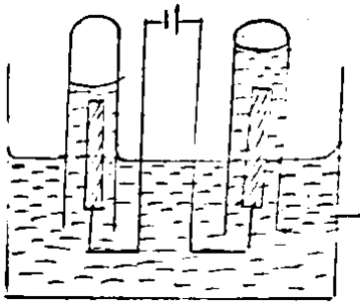
a) Identify
i) Substance F ($^1/_2$mk)
ii) Liquid D ($^1/_2$mk)
iii) Gas Y ($^1/_2$mk)
iv) Gas X ($^1/_2$mk)
b) Name and draw the structure of compounds;
b) T (2mks)
c) X (2mks)
c) Identify the type of reaction and condition for changing X to CH_3CH_2Cl. (1mk)
d) Name the type of reaction that
i) Leads to the formation of CH_3CH_2COOH. (1mk)
ii) Leads to the formation of substance W. (1mk)
d) Write an equation that results in formation of product Z. (1mk)
e) What is the effect on the continued use of substance T to the environment? Explain. (2mks)

3. a) The diagram below is part of a set up used to prepare and collect dry chlorine gas.



i) Complete the diagram to show how dry chlorine gas can be collected. (2mks)
ii) Name another substance that can be used instead of Manganese (IV) oxide. (1mk)
ii) Write an equation for the following
I. Chlorine reacting with Iron. (1mk)
II. Chlorine reacting with hot concentrated sodium hydroxide solution. (1mk)
iv) An oxide of chlorine of mass 1.83g was found to contain 1.12g of oxygen.
Determine the empirical formula of the oxide. (O =16, Cl = 35.5) (3mks)
v) Other than manufacture of hydrochloric acid name two other uses of chlorine. (1mk)
b) Two solutions containing cations P and Q were separately added to solutions containing chloride ions. In both cases a white precipitate was formed. To each a few drops of nitric (V) acid were added. The chloride compound of P and Q warmed. The chloride compound of Q dissolved while that of P did not.
i) Identify the metal ions of P and Q. (1mk)
ii) Write ionic equations for the reaction that occurred when cations of P and Q reacted with chloride ions. (2mks)

4. a) The set up below was used during electrolysis of aqueous iron (II) sulphate using inert electrodes. Study it and answer the questions that follow.



i) Name a suitable material for the electrodes. (1mk)
ii) Identify the cations present in the solution. (1mk)
iii) On the diagram label the cathode. (1mk)
iv) Write an ionic equation for the reaction that took place at the anode. (1mks)
v) Explain the changes that occurred in the concentration of iron (II) sulphate solution during the experiment. (2mks)

b) The information below is about the standard reduction potentials of four half cells. Study it and answer the questions that follow. Letters do not represent the actual symbols of the elements.

Half cell	E^{θ} value (V)
$F_{2(aq)} + 2e^- \longrightarrow 2F\text{-}(aq)$	+0.54
$G^{2+}_{(aq)} + 2e^- \longrightarrow G(s)$	-0.44
$H^{2+}_{(aq)} + 2e^- \longrightarrow H(s)$	+0.34
$2J^{+}_{(aq)} + 2e^- \longrightarrow J2(g)$	0.00

i) Identify the strongest reducing agent. Explain. (1mk)
ii) Write the equation for reaction which takes place when solid G is added to a solution containing $H^{2+}_{(aq)}$ ions (1mk)
iii) Calculate the E^{θ} value of the reaction in (ii) above. (1mk)
iv) If element G becomes the reference electrode calculate the new standard electrode potential for element H. (1mk)

c) Calculate the mass of chlorine liberated during the electrolysis of molten sodium chloride when a current of 2A is passed for 4 minutes. (Cl = 35.5) (2mks)

5. a) Define the following terms.
i) Half-life (1mk)
ii) Nuclear fission (1mk)

b) The table below gives percentage of a radioactive isotope of Bismuth that remains after decaying at different times.

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

i) On a graph paper plot the percentage of Bismuth remaining against time. (3mks)
ii) Using the graph determine the original mass of the Bismuth Isotope given that the mass that remained after 70 minutes was 0.16g. (2mks)

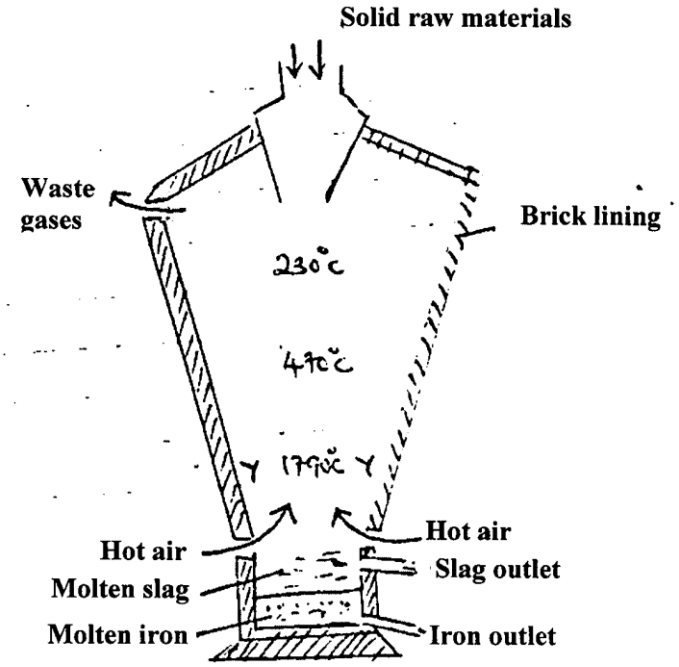
c) Radioactive Carbon – 14 decays by emitting beta particle to form N-14, write a nuclear equation for the reaction. (1mk)

d) State one use of radioactive Isotope in:
i) Medicine (1mk) ii) Industry (1mk)

6. An excess Zinc powder was added to 200cm^3 of Copper (II) sulphate solution. The mixture was stirred with a thermometer and the temperature noted. The temperature rose from 22^{0}C to 28.2^{0}C and 1.58g of Copper was deposited.

a) Write ionic equation for the reaction that took place. (1mk)
b) Why was excess Zinc powder used? (1mk)
c) Besides the temperature rise state two other observations made as the mixture was stirred. (2mks)
d) Using the information above calculate the molar enthalpy of deposition of copper by zinc. (R.A.M of copper = 63.5, Specific heat capacity 4.18$KjKg^{-1}$ k^{-1}) (4mks)
e) Using the result of (d) above draw an energy level diagram of deposition of copper by zinc. (2mks)
f) If this experiment was repeated using Iron fillings instead of zinc powder how would you expect the molar enthalpy of displacement to compare with one obtained in (d) above. Explain. (2mks)

4. Iron is obtained from haematite using a blast furnace shown in the figure below.



a) State two raw materials required for the production of iron other than iron oxide. (1mk)
b) Write an equation for the reaction in which carbon (IV) oxide is converted to carbon (II) oxide. (1mk)
c) Explain why the temperature in the region marked Y is higher than that of the incoming hot air. (2mks)
d) State one physical property of molten slag other than density that allows it to be separated from molten iron as shown. (1mk)
e) One of the components of the waste gases is nitrogen (IV) oxide. Describe the adverse effects it has on the environment. (2mks)
f) Iron from the blast furnace contains 5% carbon.
i) Describe how the car bon content is reduced. (2mks)
ii) Why is it necessary to reduce the carbon content? (1mk)

KIRINYAGA WEST SCHOOL BASED EXAMINATION, 2023
233/3
CHEMISTRY
PAPER 3

CONFIDENTIAL

In addition to the sittings and apparatus found in a chemistry laboratory, each candidate will require the following;
- 120 cm^3 of solution T.
- 100 cm^3 of solution E
- 100cm^3 of solution F
- 3 cm of polished magnesium ribbon (labelled solid M)
- 1 label
- 50 ml burette
- 25 ml pipette
- 2 conical flasks
- Thermometer
- White file
- Complete stand
- 250ml volumetric flask
- White plain piece of paper.
- Distilled water.
- 50ml measuring cylinder.
- 10ml measuring cylinder.
- 100ml plastic beaker
- Stop watch
- Filter funnel.
- 1 boiling tube.
- 5 test tubes in a rack.
- 0.2g of solid sodium hydrogen carbonate (approximate).
- Solid K
- Solid Q
- Filter funnel
- Test tube holder
- 1 filter paper.
- Metallic spatula.
- Source of heat

Access to:
- Bunsen burner.
- 2M sodium hydroxide solution with a dropper.
- 0.5 M sodium sulphate solution with a dropper.
- 0.5M barium nitrate solution with a dropper.
- 0.5M lead (ii) nitrate solution with a dropper.
- Acidified potassium manganate (VII) solution with a dropper.
- Acidified potassium dichromate (VI) solution with a dropper.
- Phenolphthalein indicator with a dropper.

NOTES
1. Solid Q , 1 g zinc chloride
2. Solid K, crushed paracetamol (panadol) (0.5g)
3. Solution E is 2M hydrochloric acid.
4. Solution F is 0.2M sodium hydroxide solution.
5. Solution T is 0.15M sodium thiosulphate.
6. Solid M is 3 cm polished magnesium ribbon.

KIRINYAGA WEST SCHOOL BASED EXAMINATION, 2023
233/3
CHEMISTRY
PAPER 3
Practical
TIME: 2 HOURS 15 MINUTES

Instructions to candidates
a. Answer ALL the questions.
b. Mathematical tables and electronic calculators may be used.
c. All working MUST be clearly shown where necessary.

1. You are provided with;
- Solution E, containing 2M hydrochloric acid.
- Solution F, containing 0.2M sodium hydroxide.
- Solid M, Magnesium ribbon.
- Solution T, containing 0.15M sodium thiosulphate.

You are required to;
i. Determine molar heat of reaction between magnesium and hydrochloric acid.
ii. Determine rate of reaction between hydrochloric and sodium thiosulphate.

Procedure 1
i) Place 20cm^3 of solution E into 100ml plastic beaker and measure the intial temperature of solution E.
Initial temperature of solution E _____^{0}C ($^1/_2$ mk)
ii) Add all the solid M provided to solution E and stir the mixture with a thermometer. Measure the maximum temperature of the solution.
Maximum temperature of the solution _____^{0}C. ($^1/_2$ mk)
iii) Transfer the resulting solution formed into a 250ml volumetric flask, add distilled water upto the mark. Shake the mixture well and label it as solution G.
iv) Fill the burette with solution G upto 0.0cm^3 mark. Pipette 25cm^3 of solution F into a clean conical flask and add 2-3 drops of phenolphthalein indicator.
v) Titrate solution G against solution F until the pink colour turns colourless. Repeat the titration two more times and record the values in table 1 below.

a) **Table 1** (4 mks)

Experiment	i	ii	iii
Final burette reading			
Initial burette reading			
Volume of solution G used(cm^3)			

b) Calculate the average volume of solution G used. (1 mk)
c) Calculate the number of moles of sodium hydroxide solution F used. (1 mk)
d) Calculate the number of moles of hydrochloric acid;
   i. In the average volume of solution G used. (1 mk)
   ii. In 250 cm^3 of solution G. (1 mk)
   iii. In the original 20cm^3 of solution E. (1 mk)
   iv. That reacted with solid M, magnesium. (1 mk)
e) Determine the number of moles of magnesium that reacted with hydrochloric acid, solution E. (1 mk)
f) Determine the molar heat of reaction between hydrochloric acid, solution E and solid M, magnesium. (Specific heat capacity = 4.2J/g/k. density of solution = 1g/ cm^3). (2 mks)

Procedure II
Draw a cross (X) on a piece of white paper using a blue or black pen. Measure 30cm^3 of solution T using a 50 ml measuring cylinder and put it into a 250ml conical flask placed over a white piece of paper drawn above. Measure 10cm^3 of hydrochloric acid, solution E using a 10 ml measuring cylinder. Add it to the contents of conical flask, start the stop watch immediately and swirl the mixture. View the cross from the above the mixture in the conical flask. Stop the stop watch when the cross becomes invisible and record the time in the table 2 below. Repeat the above procedure using volumes of solution T, water and solution E as indicated in table 2 below.

a) **Table 2**

Experiment	Volume of Solution T (cm^3)	Volume of water (cm^3)	Volume of solution E (cm^3)	Time (secs)	Rate = $\frac{1}{time(s^{-1})}$
1 30	0	10			
2 25	5	10			
3 20	10	10			
4 15	15	10			
5 10	20	10			
6 5	25	10			

(6mks)

NB: Calculate the values of rate = $^1/_{time}$ to 3 decimal places and record in table 2 above.

h) Plot a graph of rate $^1/_{time\ (s\text{-}1)}$ (vertical axis) against volume of solution T. (3mks)

i) From the graph determine;

I. The rate of reaction when $18cm^3$ of solution T was used. (1 mk)

II. The time taken for x to be invisible when $12cm^3$ of solution T was used. (1 mk)

III. The time taken for x to be invisible when $3cm^3$ of water was used. (1 mk)

2. You are provided with solid Q. Carry out the tests below. Record your observations and inferences in the spaces provided. Place the entire solid in a boiling tube. Add about $10cm^3$ of distilled water. Shake until all the solid dissolves.

i. To about $2cm^3$ of the solution, add sodium hydroxide solution drop wise until in excess.

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

ii. To about $2cm^3$ of the solution, add 3 drops of sodium sulphate solution.

Observation	Inferences
(1mk)	(1mk)

iii. To about $2cm^3$ of the solution, add 3 drops of barium nitrate solution.

Observation	Inferences
(½ mk)	(1 ½ mks)

iv. To about $2cm^3$ of solution, add 3 drops of lead (II) nitrate solution and warm the mixture.

Observation	Inferences
(1mk)	(1 mk)

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

a) Place half of solid K in a clean metallic spatula and heat it directly on the Bunsen burner flame.

Observation	Inferences
(1mk)	(½ mk)

b) Place the remaining portion of solid K in a boiling tube. Add about 6 cm^3 of distilled water and shake it well. Filter the mixture.

i) To about 2 cm^3 of the filtrate in a test tube add solid sodium hydrogen carbonate provided.

Observation	Inferences
(½ mk)	(½ mk)

ii) To about 2 cm^3 of the filtrate in a test tube add two drops of acidified potassium manganate (VII) solution.

Observation	Inferences
(1 mk)	(1 mk)

iii) To about 2 cm^3 of the filtrate in a test tube, add 3 drops of acidified potassium dichromate (VI) solution.

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

FORM IV TRIAL 2 EXAMINATIONS, 2023
Kenya Certificate of Secondary Education (K.C.S.E)
233/1
CHEMISTRY
Paper 1
THEORY
Time: 2 Hours

INSTRUCTIONS TO CANDIDATES

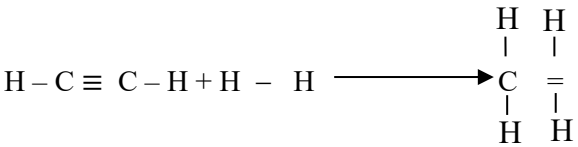
- *Answer **ALL** the questions.*
- ***Mathematical tables and electronic calculators may be used.***
- *All working **MUST** be clearly shown where necessary.*

1. a) A hydrocarbon consists of 92.3% carbon. Its molecular mass is 26. Calculate it's Molecular formula. (2 marks)
   b) Draw the structure of the hydrocarbon. (1 mark)
2. a) Explain why melting point of chlorine gas is greater than that of Argon. (l mark)
   b) Using dot(•) and cross (×) to represent electrons draw a diagram to show bonding in carbon (iv) oxide. (1 mark)
   c) In terms of structure and bonding. Explain why Graphite is used as a lubricant. (1 mark)
3. a) What is observed when a few drops of phenolphthalein indicator is added to a solution whose pH value is 3.0? (1 mark)
   b) Write an equation for the reaction between Lead (ii) oxide and dilute Nitric acid. (1 mark)
4. State and explain the observation that would be made when zinc powder is heated with copper (II) oxide. (2 marks)
5. Why is it dangerous to run a motor car engine in a closed garage? (2 marks)
6. 2 grams of sodium hydroxide is added to 30 cm3 of IM sulphuric (VI) acid. What volume of 0. 1M potassium hydroxide solution will be needed to neutralize the excess acid. (Na23, 016, H1) (3 marks)
7. An aqueous solution of hydrogen chloride gas reacts with manganese (IV) oxide to form chlorine gas while a solution of hydrogen chloride gas in methylbenzene does not react with manganese (iv) oxide.
   Explain (2 marks)
8. A small piece of potassium Manganate (VII) was placed in a glass of water and was left standing for 6 hrs without shaking. State and explain the observations made. (2 marks)
9. Magnesium reacts with both dilute and concentrated sulphuric (VI) acid. Write a balanced equation for the two reactions. (2 marks)
10. The table below gives the atomic numbers of elements **W, X, Y** and **Z**.

Element	W	X	y	Z
Atomic number	14	17	16	19

a) Name the type of bonding that exists in the compound formed when **X** and **Z** reacts. (1 mark)
b) Select the letter representing the strongest reducing agent. Give a reason for your answer. (2 marks)

11. Ethyne reacts with hydrogen as shown below



Use the bond energies below to calculate the enthalpy changes for the above reaction. (3 marks)

BOND	**ENERGY**
H-H	435
C-H	413
C ≡ C	835
C=C	611

12. a) Explain the role of common salt in defrosting ice on roads in ice cold countries. (1 mark)
    b) Explain why the long-term effects of use of common salt is costly to motorists. (1 mark)
13. Given the equation below
    $NH_{3(aq)} + H_2O_{(l)} \longrightarrow NH_4^+{}_{(aq)} + OH^-{}_{(aq)}$
    Identify the species that acts as;

i) A base. Explain (1 mark)
ii) An acid. (½ mark)

14. a) State Grahams law of diffusion. (1mark)
b) The rate of diffusion of Sulphur (IV) oxide gas through a porous material is $40cm^3s^{-1}$.
Calculate the rate of diffusion of carbon (IV)oxide gas through the same porous material
(S=32,O=16,C=12) (2 marks)

15. Describe how a solid sample of lead (II) chloride can be prepared using the following reagents: dilute nitric acid, dilute hydrochloric acid and lead carbonate (3 marks)

16. The production of ammonia is given by the equation

$$3H2\,(g) + N_2(g) \rightleftharpoons 2NH_3\,(g);\ \Delta H\text{=-ve}$$

(i) State and explain the effect of addition of dilute hydrochloride acid on equilibrium. (2 marks)
(ii) Explain the effect of increase in temperature on the yield of ammonia. (2 marks)

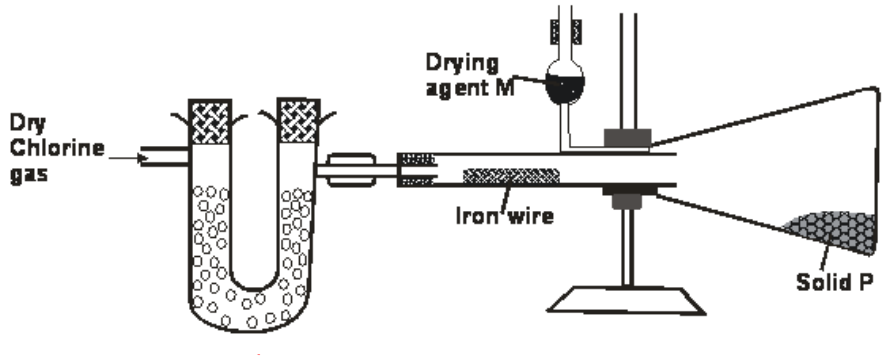
17. $Cr_2O_7^{2-} + 14\ H^+\ (aq) + 6Fe^{2+} \longrightarrow Cr_2^{3+} + 7H_2O(l) + 6Fe^{3+}$.
The above equation show a redox reaction
(a) Calculate the oxidation state of chromium in $Cr_2O_7^{2-}$ (2 marks)
(b) What is the role of H^+ in the above reaction. (1 mark)

18. a) Define the standard heat of formation. (1 mark)
b) Draw energy cycle diagram to show how the standard heat of formation of ethanol (C_2H_5OH) can be determined from standard heats of combustion of its elements. (2 marks)
c) Given that $\Delta H_C(C) = -393kJmole^{-1}$, $\Delta H_C(H_2) = -286kJmole^{-1}$ and $\Delta H_C(C_2H_5OH) = -1368kJmole^{-1}$.
Calculate the enthalpy of formation of C_2H_5OH. (2 marks)

19. 3.78g of a hydrated salt of iron (II) sulphate, $FeSO_4$, in H_2O were heated until all the water of crystallization was driven off. The anhydrous salt left had a mass of 1.52g. Determine the formula of the hydrated salt.
(Fe = 56, S = 32, H = 1, O = 16) (3 marks)

20. A steady current of 0.2 Amperes was passed through molten silver bromide for 80 minutes.
a) Calculate the quantity of electricity that passed through the set up. (1 mark)
b) Calculate the mass of product deposited at the cathode. (1F = 96500C; Ag = 108, Br = 80) (2 marks)
c) If a sample of cobalt has an activity of 1000 counts per minute, determine the time it would take for its activity to decrease to 62.50 if the half-life of the element is 30 minutes. (2 marks)

21. The apparatus set up below was used to prepare an anhydrous solid P



a) Write an equation for formation of solid P (1 mark)
b) Suppose the gas used in the set up was dry hydrogen chloride gas; what would be the product obtained after the reaction? Give a reason for your answer. (1 mark)

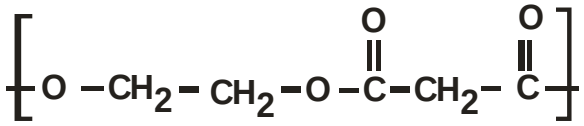
22. Aluminium is obtained from the ore with the formula $Al_2O_3.2H_2O$. The ore is first heated and refined to obtain pure aluminium oxide (Al_2O_3). The oxide is then electrolysed to get Aluminium and oxygen gas using carbon anodes and carbon as cathode.
a) Give the common name of the ore from where aluminium is extracted from. (½ mark)
b) What would be the importance of heating the ore first before refining it? (1 mark)
c) The refined ore has to be dissolved in cryolite first before electrolysis. Why is this necessary? (1 mark)
d) Why are the carbon anodes replaced every now and then in the cell for electrolysing aluminium oxide? (1 mark)

23. Use the cell representation below to answer the questions that follow
$V(s) / V^{3+}\ (aq)\ //Fe^{2+}\ (aq)\ /Fe(s)$
i) Write the equation for the cell reaction (1 mark)
ii) If the E.M.F of the cell is 0.30 volts and the E^θ value for $V^{3+}aq\ /\ V\ (s)$ is -0.74V, calculate the E^θ of $Fe^{2+}(aq)/Fe(s)$ (2 marks)

24. When $50cm^3$ 1M potassium hydroxide was reacted with $50cm^3$ of 1M hydrochloric acid, the temperature rose by 8^0C. When the same volume of Potassium hydroxide was reacted with $50cm^3$ of 1M Pentanoic acid, the temperature rose by 3^0C.

i) Give reasons for the above difference in temperature. (2 marks)
ii) Write an equation to show dissociation of pentanoic acid? (1 mark)

25. The following is structural formula of polyester.

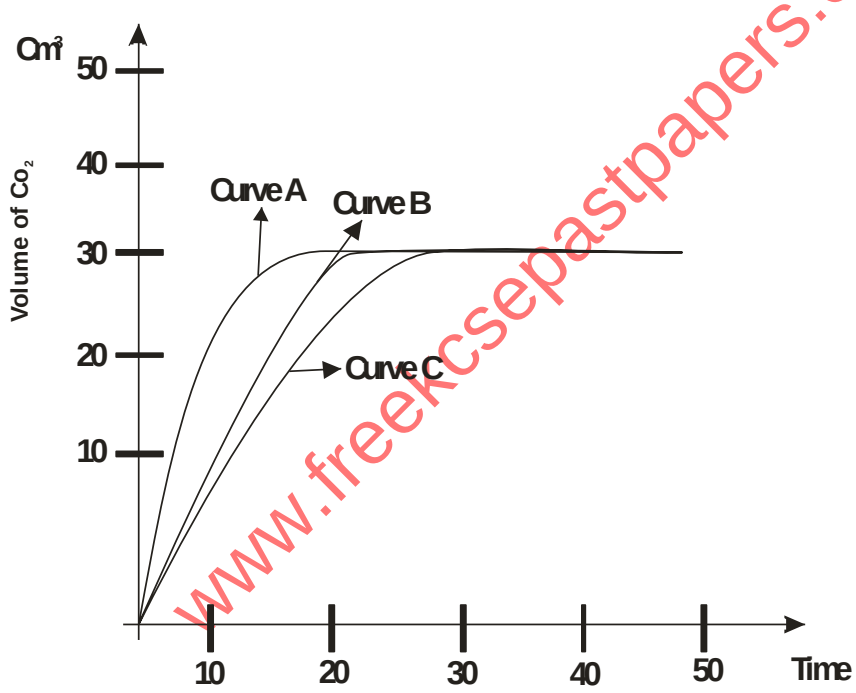


a) Draw the structural formula and name the alkanoic acid and alkanol that react to form the polymer. (2 marks)
b) Give **one** use of polyester. (1 mark)

26. A heavy metal P was dissolved in dilute nitric acid to form a solution of compound $P(NO_3)_2$. Portions of the resulting solution were treated as follows:

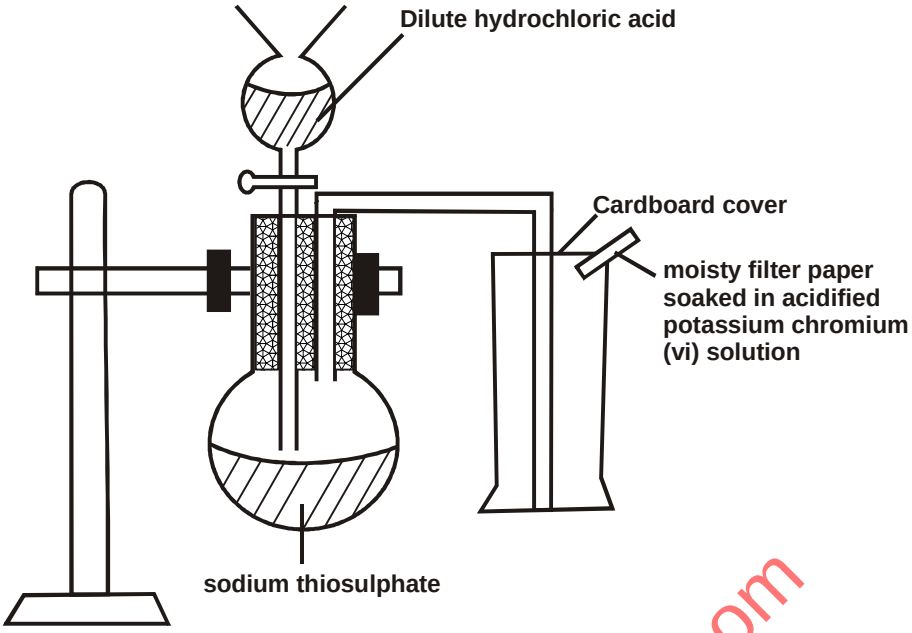
a) To the first portion a solution of dilute hydrochloric acid is added, where a white precipitate (S) is formed, which dissolves on warming.
b) The second portion is treated with two drops of 2M Sodium hydroxide solution where a white precipitate T is formed. The white precipitate dissolved in excess sodium hydroxide to form a colourless solution.
c) A solution of potassium iodide is added to the third portion where a yellow precipitate (U) is formed.
d) When the resulting solution is evaporated to dryness and heated strongly a yellow solid (V) is formed and a brown gas (W) and a colourless gas (X) are formed.
Identify the substances P, S, T, U, V, W. (3 marks)

27. The graphs below were drawn when 15g of marble chips in different physical states were reacted with $50cm^3$ of 2M Hydrochloric acid. They are drawn by measuring the volume of carbon (iv) oxide produced with time.



a) Which curves corresponds to the reactions involving powdered calcium carbonate and large sized marble chips with the dilute acid?
(i) Powdered calcium carbonate (½ mark)
(ii) Large sized calcium carbonate (½ mark)
b) All the graphs eventually flatten out at the same level but at different time. Why do the graphs flatten out at the same level? (1 mark)
c) Why is curve A very steep at any given point compared to the other curves? (1 mark)

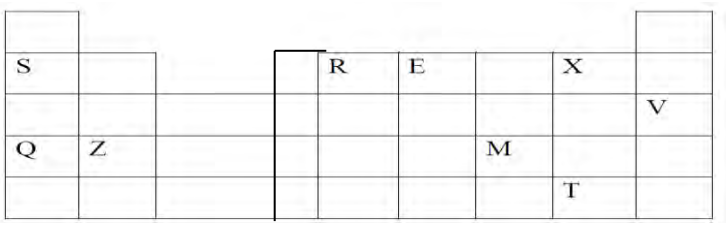
28. Sodium thiosulphate was reacted with dilute hydrochloric acid in a round bottomed flask as shown below. The gas evolved was collected by downward delivery in a gas jar.



a) Write an equation to show the reaction going on in the reaction in vessel. (1 mark)
b) State the observation noted on the filter paper. Give a reason for your answer. (1 mark)
c) Give a reason why the filter paper soaked in the acidified potassium chromium (VI) is used at the top of the flask (1 mark)

FORM IV TRIAL 2 EXAMINATIONS, 2023
Kenya Certificate of Secondary Education (K.C.S.E)
233/2
CHEMISTRY
Paper 2
THEORY
Time: 2 Hours

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

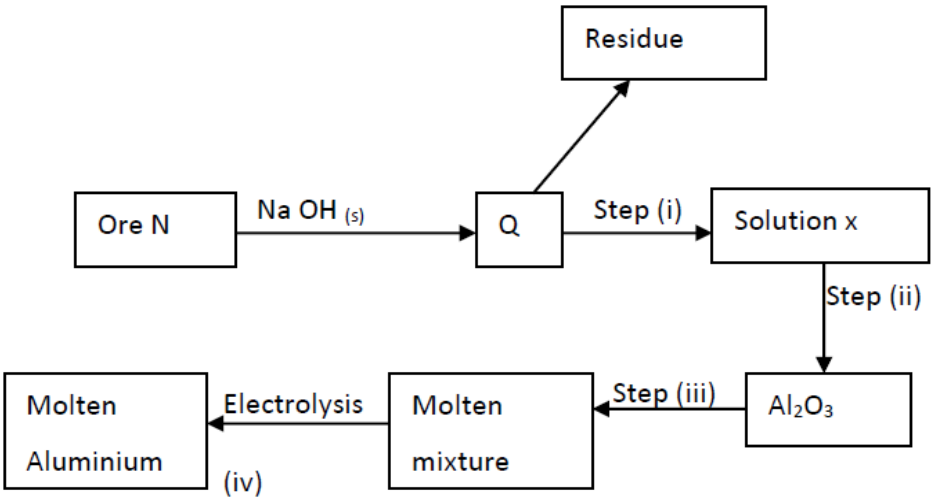


i) Identify the most reactive non-metal (1mark)
ii) Which of the metal is the most reactive? Explain. (1mark)
iii) What name is given to the family of elements to which X and T belong? (1mark)
iv) Give reasons for the following
Ionic radius of Q is smaller than that of M 1mark
Atomic radius of Q is greater than that of S (1mark)
v) Give an element that does not form compounds under ideal conditions.
Explain. (2marks)
vi) Give formula of compound formed between E and Z (1mark)
b) Study the table below and answer the questions that follow.

Substance	**A**	**B**	**C**	**D**	**E**	**F**
Melting point (°C)	801	113 119	-39	5	-101	1356
Boiling point(°C)	1410	445	457	54	-36	2860
Electrical Conductivity (Solid)	Poor	Poor	Good	Poor	Poor	poor
Electrical Conductivity (Liquid)	Good	Poor	Good	Poor	Poor	Poor

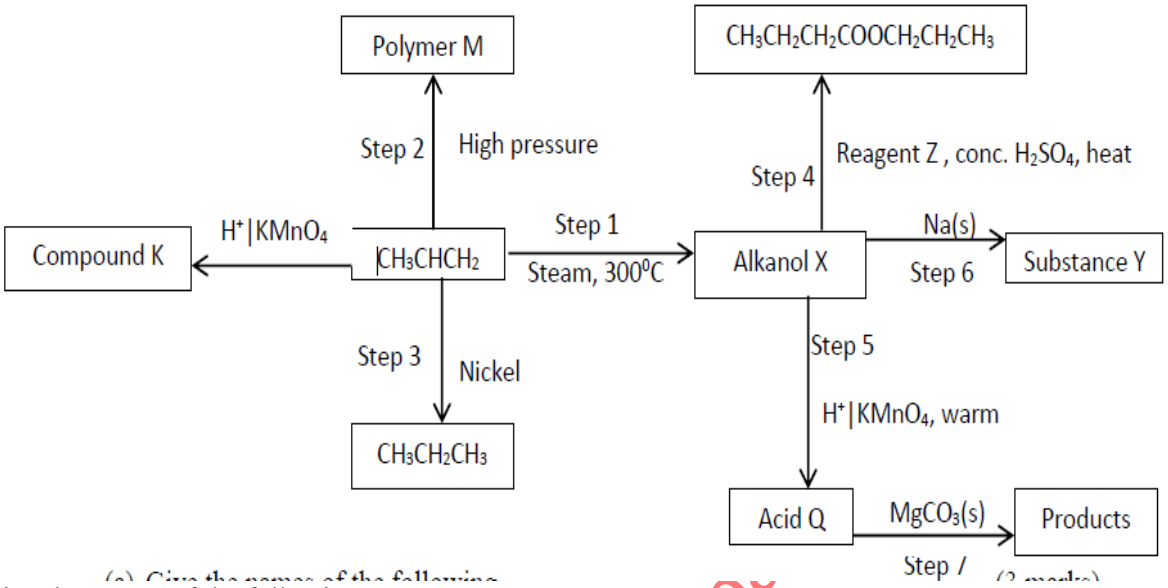
i) Identify a substance with:
a) Giant metallic structure (1mark)
b) Has a molecular structure and exists in gaseous state at room temperature and pressure? (1mark)
ii) Suggest a reason why substance B has two melting points. (1mark)
iii) Substances A and C conduct electric current in the liquid state. State how the two substances differ as conductors of electric current. (2marks)

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

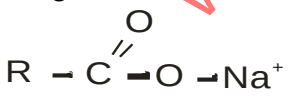


a) Name ore N (1mark)
b) Explain why the ore is first dissolved in excess sodium hydroxide solution. (1mark)
c) Name the major compound present in the residue. (1mark)
d) Give the formula of the aluminium compound present in solution (1mark)
e) i) Explain how to obtain aluminium hydroxide from solution X (1mark)
ii) Write equation for reaction that takes place in (e) above (1mark)
iii) What is the role of cryolite in the extraction of aluminium. (1mark)
f) Aluminium is a good conductor of electricity. State two uses of aluminium based on this property. (2marks)
g) If sodium carbonate is added to aluminium nitrate solution, effervescence occurs. Explain. (2marks)

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



a) Give the names of the following
i) Compound K (1mark)
ii) Substance Y (1mark)
iii) Product obtained in step 4 (1mark)
b) Identify the **type of reaction** that takes place in step 1 and give one other condition necessary for the reaction other than the temperature indicated.
Type of reaction…… (1mark)
Condition…… (1mark)
c) Draw the structural formula of the following
i) Polymer M (1mark)
ii) Acid Q (1mark)
d) Give the **industrial application** for the reaction in step 3 (1mark)
e) Write chemical equations for the reactions in step 6 and step 7. (2marks)
f) The following are structures of two cleansing agents.



In the table below, give one advantage and one disadvantage of each of them. (2marks)

Cleansing Agent	Advantage	Disadvantage
R-COO-Na^+		
R-OSO3-Na^+		

4. The standard reduction potentials for five half cells are shown in the table **below**. Study it and answer the questions that follow. (The letters do not represent the actual symbol of elements).

Elements					E^θ (Volts)
(i)	$A_{2(aq)}$	+ $2e^-$	→	$2A^-_{(aq)}$	+1.09
(ii)	$Q^{2+}_{(aq)}$	+ $2e^-$	→	$Q_{(S)}$	−0.13
(iii)	$R^{2+}_{(aq)}$	+ $2e^-$	→	$R_{(S)}$	−2.37

(iv) $Y^{2+}_{(aq)} + 2e^- \rightarrow Y_{(S)}$ $+0.34$

(v) $2S^{+}_{(aq)} + 2e^- \rightarrow S_{2(S)}$ 0.00

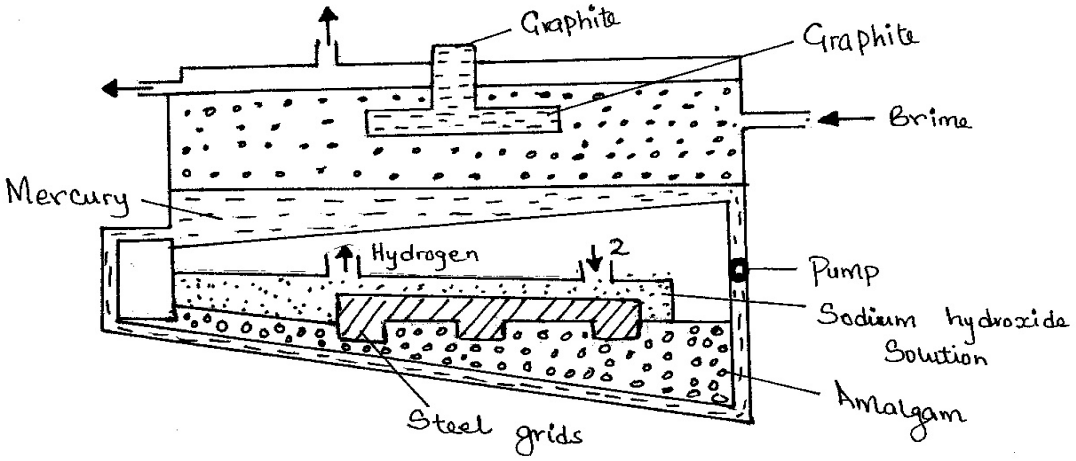
I (a) With a reason, identify the strongest reducing agent. (1mark)

(b) Which half-cell is likely to be hydrogen? (1mark)

(c) Write an equation for the reaction between two half cells in (ii) and (IV). (1mark)

(d) Calculate the e.m.f of the cell in (c) above. (2mark)

II. 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) Name:

i) Raw material introduced at **2**. (½ mark)

ii) Another substance that can be used in the cell instead of graphite. (½ mark)

(b) Identify the by-product that comes out at **I**. (1 mark)

(c) Write an equation for the reaction: -

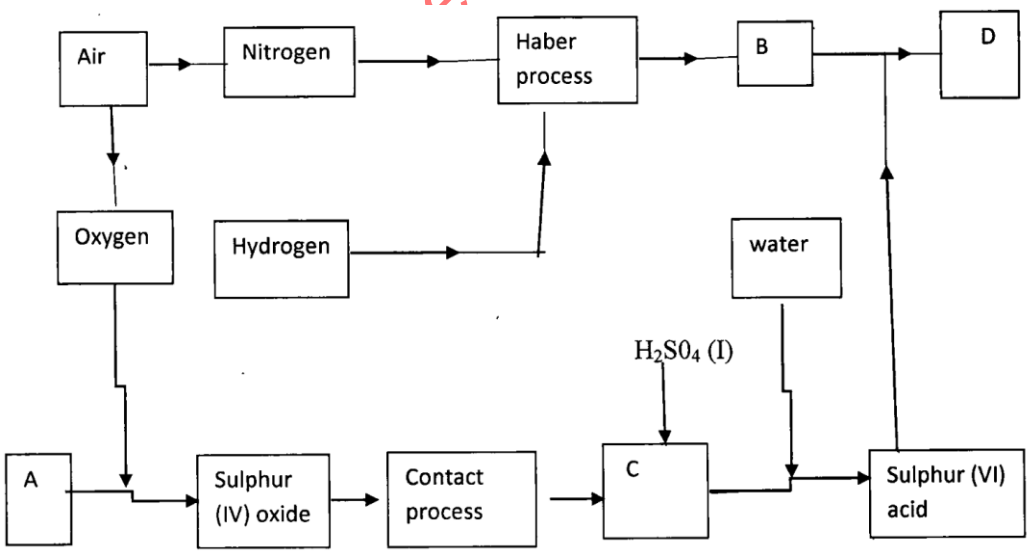
(i) That occurred at the anode. (1 mark)

(ii) In which sodium hydroxide was produced. (1 mark)

(d) Give **two** reasons why mercury is recycled. (2 marks)

(e) State one use of sodium hydroxide (1mark)

5. The flow chart below illustrates two industrial processes. Haber process and the contact process.



(a) Name the process of obtaining nitrogen from atmospheric air. (1mark)

(b) List TWO sources of obtaining large volumes of hydrogen for industrial use. (2 marks)

(c) Write equation for Haber process. (1mark)

(d) Name the catalysts for: (1mark)

(i) Haber process

(ii) Contact process

(e) Identify substances: (1mark)

(i) D……

(ii) C …….

(f) Give ONE major use of compound D (1mark)

(g) Write an equation for dilution of C with water. (1mark)

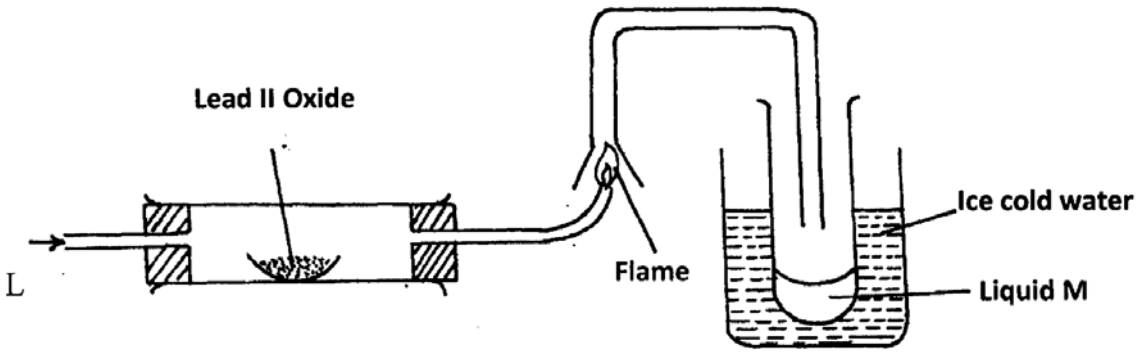
h) A farmer has three plots each measuring 0.25 acres. He applied nitrogenous fertilizers as follows.

- plot A 250 kg of ammonium phosphate
- plot B 250 kg of urea $CO(NH_2)_2$
- Plot C 250kg of ammonium nitrate

Which plot received the highest nitrogen content? (3marks)

H = 1, N = 14, 0 = 16. P = 31, C = 12.

6. Study the diagram below and answer the questions which follow.



(i) State **two** observations made when hydrogen gas pass over hot Lead (II) oxide. (2marks)

(ii) Write the equation for the reaction which occurs in the combustion tube. (1mark)

(iii) What property of hydrogen is shown in the experiment above. (1mark)

(iv) Identify liquid M and describe the test for its purity (2marks)

(v) What would be observed if MgO was used instead of Lead II Oxide: Explain (2marks)

(vi) What is the colour of the flame (1mark)

(vii) Write a chemical equation of the reaction producing the flame. (1mark)

(vii) Apart from hydrogen peroxide, state **two** other reagents that can be used to prepare oxygen gas. (1mark)

(viii) Write an equation to show how hydrogen gas is formed from the reagents chosen in (vii) above. (1mark)

7. I. Use the data below to calculate the enthalpy change for the reaction below

$CH_{4(g)} + 2O_{2(g)} \longrightarrow CO_{2(g)} + 2H_20_{(l)}$ (3marks)

Bond	**Energy (KJ)**
C – H	314
O = O	296
C = O	149
H – O	283

II. Given the following Standard Molar enthalpies of combustion. Calculate the standard heat of formation of butane (C_4H_8). (3marks)

ΔH_c^{θ} Carbon (Graphite) = -393.5KJ/mol

ΔH_c^{θ} Hydrogen = 285.8KJ/mol

ΔH_c^{θ} butene = -2877KJ/mol

III. Use the following information to answer the questions that follow

$\Delta H_{lattice}$ $Mgcl_2$ = -2489 kJ/ mol^{-1}

$\Delta H_{hydration}$ Mg^{2+} = - 1891 kJ/ mol

$\Delta H_{hydration}$ Cl^- = -384 kJ/ mol

Using energy level diagram calculate the molar heat of solution of magnesium chloride. (4marks)

FORM IV TRIAL 2 EXAMINATIONS, 2023
Kenya Certificate of Secondary Education (K.C.S.E)
233/3
CHEMISTRY
Paper 3

CONFIDENTIAL

Each candidate requires:
1. About 100 ml of solution L- 0.2 M NaOH
2. Distilled water in a wash bottle
3. Burette
4. Pipette and pipette filler
5. 2 conical flasks
6. 10 ml measuring cylinder
7. 250 ml volumetric flask
8. Exactly 3.6g of solid P- oxalic acid
9. Means of labelling- 1 piece
10. Test-tube holder
11. Thermometer(-10 to 110°C)
12. Boiling tube
13. 5 Test tubes
14. Glass rod
15. Aluminium Foil
16. Red and Blue litmus papers
17. Ethanol labelled Liquid Q
18. Universal indicator and universal chart paper
19. Watch glass
20. Wooden splint
21. Solid Barium Nitrate labelled solid E

ACCESS TO:
Source of heat.
Phenolphthalein indicator.
NaOH.
Dilute H_2SO_4.
$Pb(NO_3)_2$ Solution.
Acidified $K_2Cr_2O_7$.

FORM IV TRIAL 2 EXAMINATIONS, 2023
Kenya Certificate of Secondary Education (K.C.S.E)
233/3
CHEMISTRY
Paper 3

Instructions to Candidates:
1. Answer **ALL** questions.
2. You are required to spend the first 15 minutes of the 2 $^1/_4$ hours allowed for this Paper reading the whole paper carefully before commencing your work.
3. Additional pages must not be inserted.

1. You are provided with;
- 3.6 g of solid P in a boiling tube. Solid P is a hydrated dibasic acid with the formula $H_2C_2O_4.nH_2O$
- Solution L which is a 0.2 M sodium hydroxide solution. You are required to determine;

(i) Solubility of solid P
(ii) The value of n in the formula $H_2C_2O_4.nH2O$

Procedure I

I. Using a burette, add 4cm^3 of distilled water to solid P in the boiling tube. Heat the mixture while stirring with the thermometer to about 70 ºC. When all of solid has dissolved, allowthe solution to cool while stirring with the thermometer. Note the temperature at which crystals of solid P first appear. Record the temperature in **table 1** below.

II. Using the burette, add 2 cm^3 of distilled water to the contents of the boiling tube. Warm the mixture while stirring with the thermometer until all the solid dissolves again. Allow the mixture to cool while stirring. Note the temperature at which crystals of solid P appears.

III. Repeat procedure (II) three more times and record the temperatures in **table 1**. **RETAIN the contents of the boiling tube for use in PROCEDURE II.**

TABLE 1

Volume of water in the boiling tube (cm^3)	Crystallization temperature (ºC)	Solubility of solid P in g/100 g of water
4		
6		
8		
10		
12		

(4marks)

(a) Complete **table 1** above by working out the solubility. (1 mark)
(b) On the graph provided, plot a graph of solubility of solid P against crystallization temperature. (3marks)
(c) From the graph, determine;
(i) The solubility of solid P at 50 ˚C (1 mark)
(ii) The temperature at which 65 g of solid P would dissolve in 100 g of water (1 mark)

Procedure II

(i) Transfer the contents of the boiling tube from **PROCEDURE I** into a clean 250 mlvolumetric flask.
(ii) Add distilled water up to the mark
(iii) Label the resulting solution as solution P
(iv) Fill the burette with solution P
(v) Pipette 25cm^3 of solution L into a conical flask. Add three drops ofphenolphthalein indicator
(vi) Titrate solution P against solution L to an accurate end point.Record your results in **table 2** below.

(4 marks)

TABLE 2	1	2	3
Final burette reading			
Initial burette reading			
Volume of solution P used (cm^3)			

a) Calculate Average volume of solution P used. (1mark)
b) (i) Moles of solution L used. (1 mark)
(ii) Moles of solution P used. (1 mark)
(iii) Moles of solution P in 250 cm^3 of solution P (1 mark)
(iv) The relative formula mass of P. (1 mark)
c) Determine the value of n in the formula; $H_2C_2O_4.nH2O$ (H = 1, C = 12, O = 16) (2marks)

2. You are provided with solid E. Carry out the experiments below. Write your observations and inferences in the spaces provided.
Place all solid E into a boiling tube. Add about 20cm^3 of distilled water and shake. Retain the contents of the boiling tube.

Observations	inferences
1 mark	1 mark

Use 2cm^3 of solution E, in a test tube in each experiment i, ii, iii, iv and v

i. To experiment i, Add two drops of aqueous Sulphuric vi acid

Observations	inferences
1 mark	1 mark

ii. To experiment ii, add NaOH solution drop wise till in excess.

Observations	inferences
1 mark	1 mark

iii. To experiment iii, dip a stirring rod into the solution, place the rod in a non-luminous flame.

Observations	inferences
1 mark	1 mark

iv. To experiment iv, add two drops of lead (ii) nitrate solution.

Observations	inferences
1 mark	1 mark

v. To experiment v, add a piece of aluminium foil followed by sodium hydroxide solution and warm. Test the gas given out with litmus papers.

Observations	inferences
2 marks	1 mark

3. You are provided with liquid Q. carry out the tests below. Write your observations and inferences in the spaces provided.
i). To 2 cm^3 of liquid Q in a test tube, add universal indicator

Observations	inferences
1 mark	1 mark

ii). Place 3 drops of liquid Q on a watch glass and ignite.

Observations	inferences
1 mark	1 mark

iii). To 2 cm^3 of liquid Q in a test tube , add two or three drops of acidified potassium dichromate VI and warm

Observations	inferences
1 mark	1 mark

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CHEMISTRY
PAPER 1
(THEORY)
2 HOURS

Answer all the questions.

1. Describe the non – luminous flame of a Bunsen burner and give a reason why it's preferred when heating substances in the laboratory. (3mks)
2. The table below gives some properties of gases M and N

GASES	Density	Effect of $KOH_{(aq)}$
M	Lighter than air	dissolves without reacting
N	Heavier than air	Not affected

Describe how one would obtain a sample of gas N from a mixture of gases **M** and **N** (2mks)

3. The following results were obtained trying to determine the solubility of copper (II) sulphate in water at 400ºC.
Mass of empty dish16.8g,
Mass of dish + saturated solution at 400ºC =26.9g,
Mass of dish + solid CuSO4 after evaporation to dryness = 17.8g.
Calculate the mass of saturated solution containing 70g of water at 400ºC. (3mks)
4. Using dots (•) and crosses (×) to represent electrons, draw diagrams to show bonding in;

(a) C_2H_4 (C=12, H=1) (1 ½ mks)

(b) Hydroxonium ion H_3O^+ (H=1 , O=8) (1 ½ mks)

5. Given sodium carbonate solid, lead (II) nitrate solid and water, explain how you can obtain a solid sample of Lead (II) carbonate. 3mks
6. Excess magnesium ribbon sample was heated in equal volumes of:-
   i) Pure oxygen gas
   ii) Air

a) Why was the mass of the resulting product in (ii) more than in (i)? (1mark)

b) Write the equations for the reactions in part (ii) (2marks)

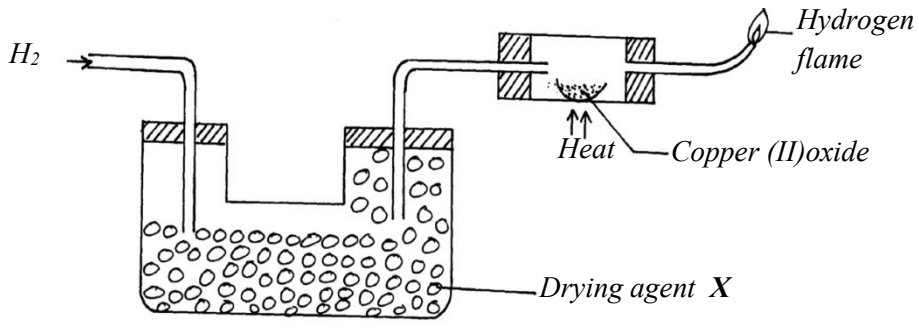
7. Aluminium is obtained from its ore, with formula $Al_2O_3.2H_2O$. The ore is first heated and refined to obtain pure aluminium oxide (Al_2O_3). The oxide is then electrolysed to get Aluminium and Oxygen gas using carbon electrodes

a) Write the equation that takes place at the anode (1mk)

b) What would be the importance of heating the ore before electrolysed (1 mk)

c) Explain why Aluminium is used for making cooking pans yet it is a reactive metal (1 mk)

8. Calculate the volume of oxygen produced when 10g of silver nitrate was completely decomposed by heating at s.t.p (Ag =108, N=14, O = 16, Molar gas volume at s.t.p= 22.4dm3) (3marks)
9. The set-up below was used to investigate the properties of hydrogen gas.

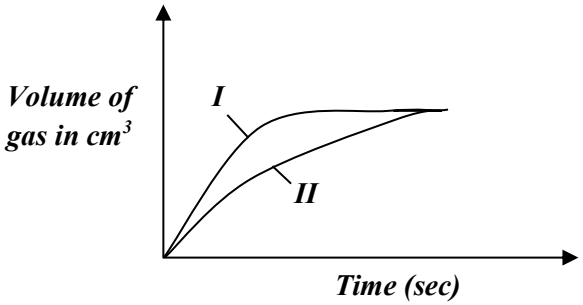


i) Write an equation for the reaction that takes place in the combustion tube. (1mk)

ii) Suggest a possible drying agent **X**. 1mk

iii) Which property of Hydrogen is under investigation in the set up above? (1mk)

10. The curves below were obtained when equal volumes of 1.5M HCl were reacted with 2.0g of marble chips ($CaCO_3$). In one of the reactions, the acid was warmed before adding the marble chips.

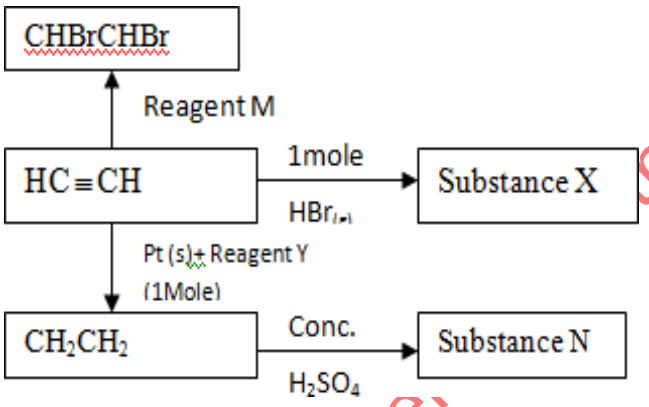


a) Write the equation for the reaction (1mk)

b) Identify the curve representing the reaction where the acid was warmed. (1mk)

c) The volume of the gas produced in the two experiments is the same. Explain. (1mk)

11. The scheme below shows some reactions starting with ethene. Study it and answer the questions that follow.



a) Name substance

(i) X…….. (1/2mark)

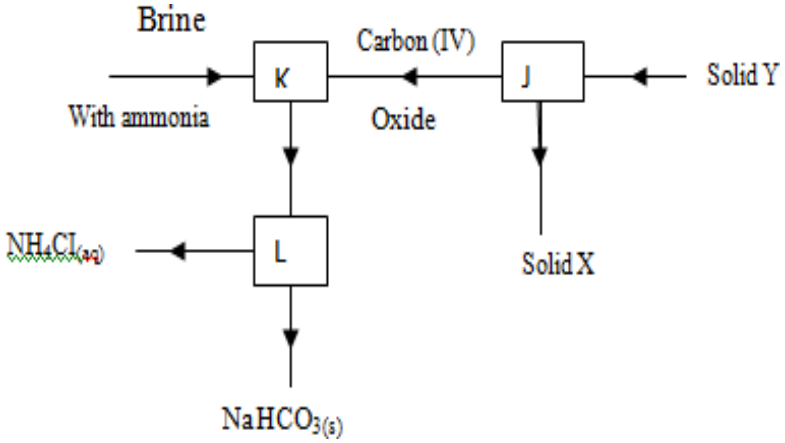
(ii) N……. (1/2mark)

b) Name reagent M……..…….. (1/2 mark)

c) A sample of the polymer formed from the monomer $CH_3CH=CH_2$ has a molecular mass of 4116. Determine the number of monomers that formed the polymer. (C = 12, H = 1) (1 ½ marks)

12. $400cm^3$ of Nitrogen gas diffuses through a porous plug in 70seconds. How long would it take $200cm^3$ of Carbon (IV) oxide to diffuse through the same porous pot? (C=12,O=16, N=14) (3mks)

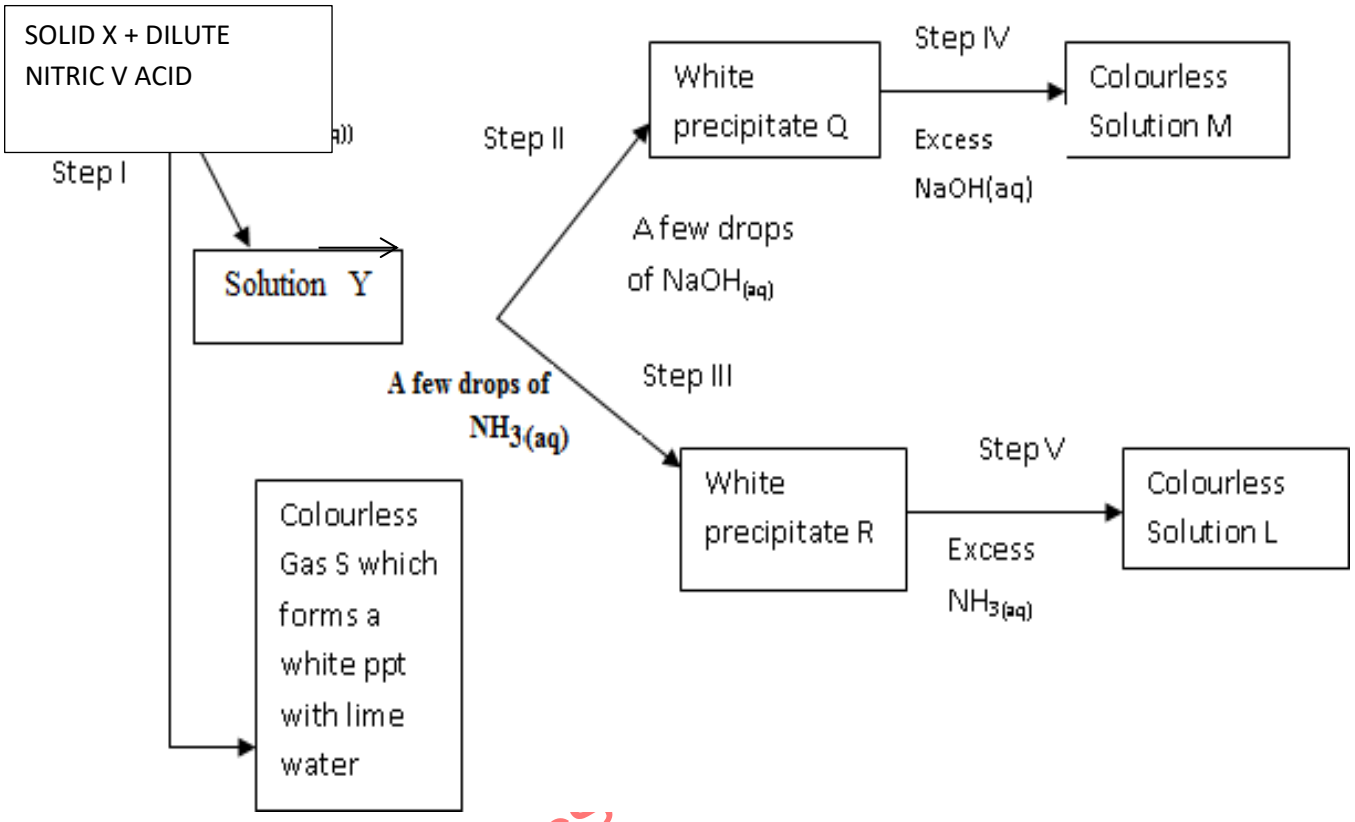
13. The diagram below shows part of Solvay process.



a) Name solid X (1mark)
b) State the process taking place in chamber L (1mark)
c) State two uses of sodium carbonate (1mark)

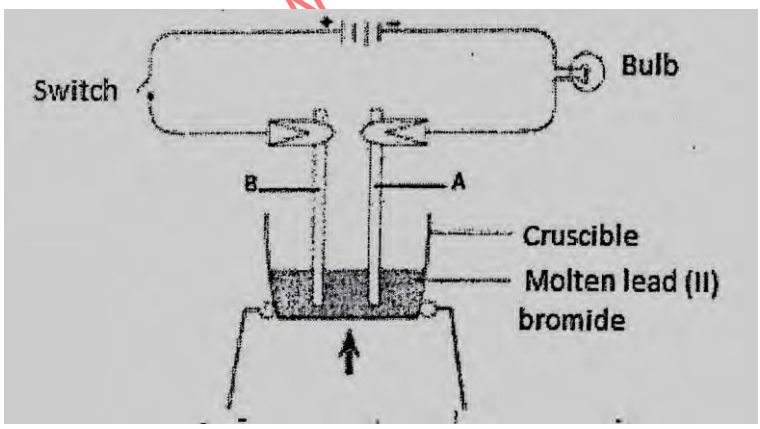
14. A radioactive isotope U decays by emitting one alpha particle and two gamma rays to form $^{218}_{84}Po$
a) What is the atomic number of U. (1mk)
b) After 213 days $^{1}/_{8}$ of the original mass of U remained. Determine the half-life of U. (2mks)

15. The scheme below represents reactions starting with X solid



i) Identify solid X (1mark)
ii) Write an ionic equation to show formation of white precipitate. (1mark)
iii) Why would gas S not form a white precipitate with solution of sodium hydroxide (1mark)

16. Below is a diagram of set up of apparatus that is used to investigate the effect of electric current on a binary electrolyte, lead (II) bromide.



i) Explain what is meant by a binary electrolyte? (1mk)
ii) During the experiment, brown vapor was seen around electrode B. Explain this observation. 1mk
iii) State the function of heat in the above experiment. (1mk)

17. The table below shows pH values of solutions A to E

Solution	E	B	D	A	C
pH	3	14	7	6	9

Identify;

a) A solution which contains the largest concentration of hydroxyl ions……..…..... (1mk)

b) A solution which contains the largest concentration of hydrogen ions…… (1mk)

c) Two solutions that can react with Zinc (II) oxide. (1mk)

18. a) State and explain the observations made when chlorine gas is bubbled through a solution of potassium bromide. (2marks)

b) Write the ionic equation for the reaction that took place in the above reaction. (1mark)

19. Study the information tabulated below to answer the questions that follow

Melting point	**Element**	**Atomic number**
97.8	**P**	**11**
1441	**Q**	**14**
-42	**X**	**17**
64	**Y**	**19**

a) Write the electron arrangement of the

(i) Atom of Y (½ mark)

(ii) Ion of X (½ mark)

b) Compare the ionic radius of Y with its atomic radius. Explain. (2marks)

20. a) Which of the following cleaning agent below is best in cleaning in water containing magnesium sulphate? explain

A: $CH^3(CH^2)16COO^-Na^+$

B: $CH^3(CH^2)15OSO_3^-Na^+$ (2mks)

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

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

Bond	Bond energy ($kJmol1^{-1}$)
C-H	414
Cl – Cl	244
C – Cl	326
H – Cl	431

Calculate the enthalpy change of the reaction (3mks)

$CH_{4(g)} + Cl_{2(g)} \longrightarrow CH_3Cl_{(g)} + HCl_{(g)}$

22. In an experiment the quantity of electricity passed through a solution deposited 2.4g of metal W was 3860 coulombs. Calculate the charge of metal W given that it's relative atomic mass is 120. (IF = 96500C) (3mks)

23. Explain why the boiling point of ethanol is higher than that of hexane.
(Relative molecular mass of ethanol is 46 while that of hexane is 86) (2mks)

24. Hydrogen sulphide gas was bubbled through a solution of zinc nitrate for some time.

i) State the observation made. (1mark)

ii) Where should the experiment be carried out and why? (1mark)

iii) Write the equation of the reaction that occurs (1mark)

25. $25cm^3$ of 0.12M Potassium Hydroxide solution required $30cm^3$ of a solution of a dibasic acid (H_2X) for complete neutralization. The acid contained 3.15g per $500cm^3$ solution. Calculate

(i) The molarity of the acid solution. (2marks)

(ii) The relative molecular mass of the acid. (1mark)

26. In the Haber process, the industrial manufacture of ammonia is given by the following equation;

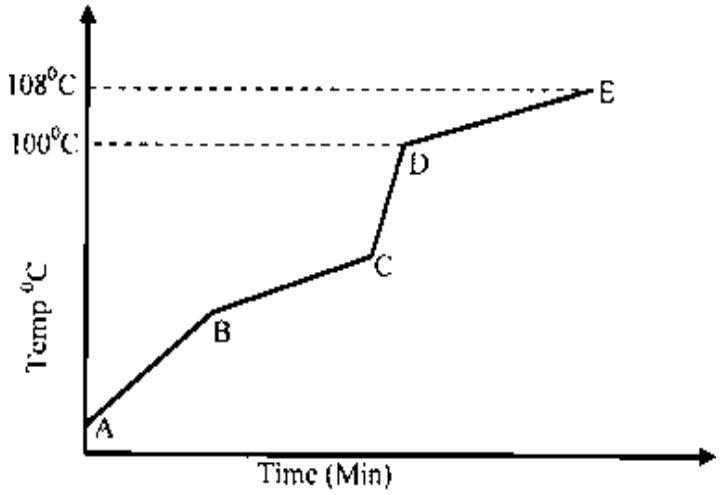
$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)} \quad \Delta H = -97\,KJmol^{-1}$$

(i) Give one source of the Hydrogen that is used in the process 1 mk

(ii) Name the catalyst used in the above reaction

(iii) What is the effect of increasing temperature on yield of ammonia? Explain. 1 mk

27. Study the diagram shown below to answer the questions that follow. The curve shows heating curve of water in the laboratory.



i) At what temperature does the water boil? (1mark)

ii) Is the curve for a pure water or impure water? Give a reason for your answer. (2marks)

iii) Give the effect of impurities on the boiling point of water. (1mark)

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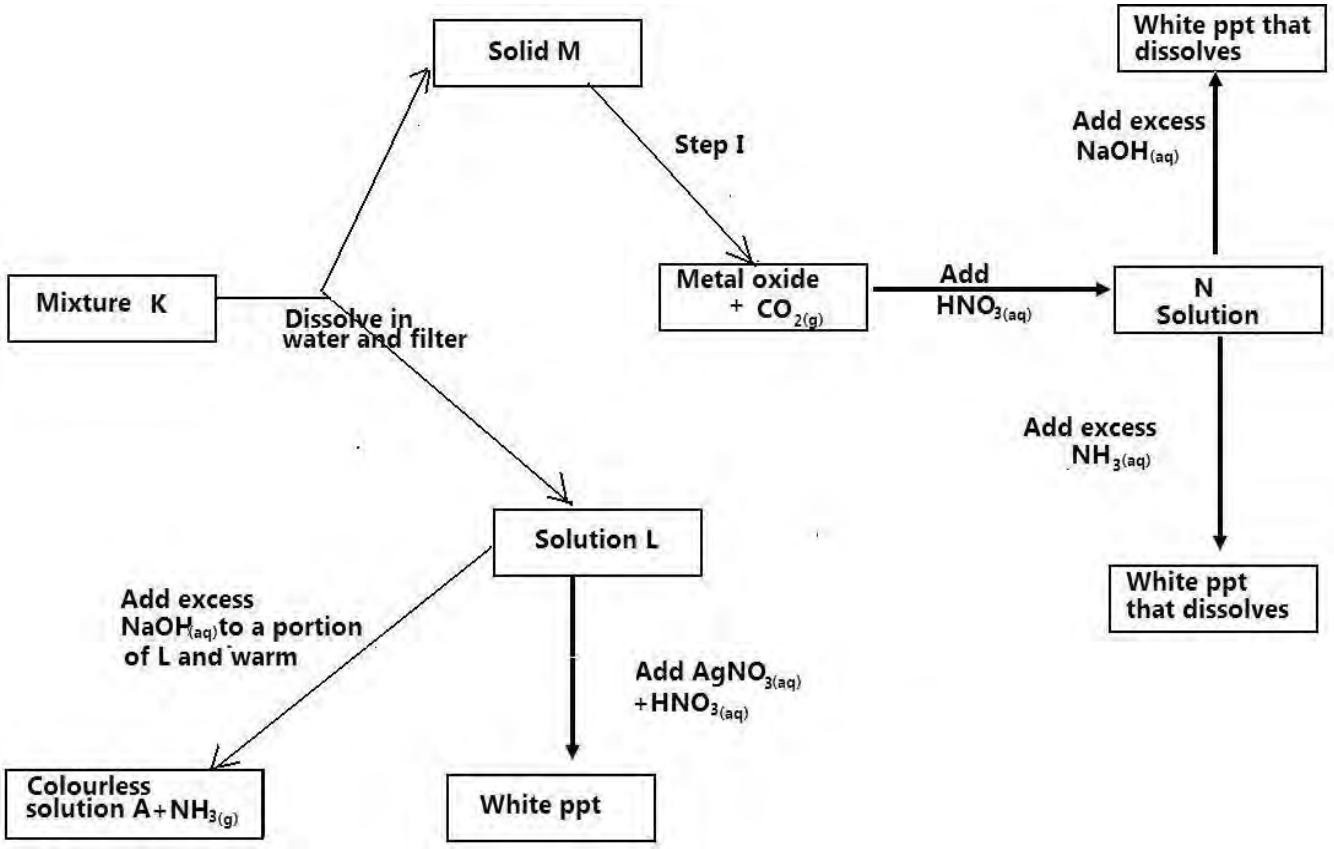
CHEMISTRY
PAPER 2
THEORY
2 HOURS

INSTRUCTIONS TO CANDIDATES

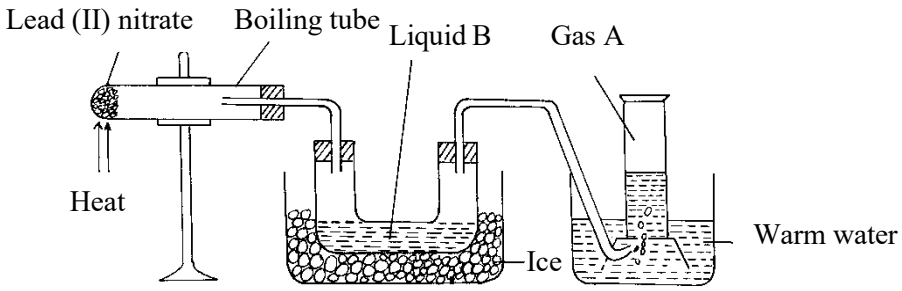
- *Answer **ALL** questions.*
- *Mathematical tables and electronic calculators **may** be used.*
- *All workings **must** be clearly shown where necessary.*

1. The flow chart given shows an analysis of mixture K that contains two salts. **Study** it and answerthe question that follows.



(a) Name substances L, M and N (1½marks)
(b) **What** condition is necessary for step 1 to take place? (1mark)
(c) **State** the colour changes that the metal oxide undergoes when hot and cold (1mark)
(d) **Write down** an equation to show how
  (i) Solution N is formed (1mark)
  (ii) Colourless solution A and $NH_{3(aq)}$ are formed. (1mark)
(e) When excess $NaOH_{(aq)}$ is added to a solution N a white precipitate is formed which subsequentlydissolves.
  Give the name and formula of the complex ion formed (1mark)
(f) Ammonia gas bubbled into water forms a solution which conducts electricity whereas the solutionformed when it is bubbled through methylbenzene does not. **Explain**. (2 marks)
(g) Boilers used for boiling hard water are normally covered with boiler scales after sometime.
  (i) **What** is the chemical name for boiler scales? (1 mark)
  (ii) **Describe** how the boiler scales can be removed? (1½ marks)

2. a) The diagram below shows a set-up of apparatus that can be used to prepare nitrogen (IV)oxide. **Study** it and use it to answer the questions that follow



i) **Write** the equation for the reaction that takes place in the boiling tube. (1mark)

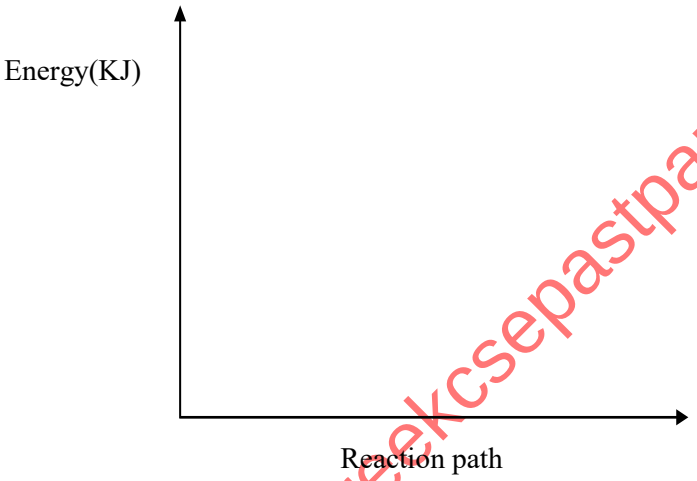
ii) **Explain** why lead (II) nitrate is preferred over other metal nitrates in this experiment. (2marks)

iii) **Describe** how gas A can be identified. (1mark)

iv) **Name** liquid B (1mark)

(b) Consider the following reaction: $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ $\Delta H = 75KJ$

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



c) Given that the lattice energy of calcium chloride is +2237kJmol^{-1} and the hydration energy of $Ca^{2+}_{(aq)}$ = -1650kJmol^{-1} and $Cl^{-}_{(aq)}$ = -364kJmol^{-1}. Calculate the enthalpy of solution of calcium chloride. (2 marks)

d) i) **Define** the term **Heat of atomization** of a compound. (1mark)

ii) **Use** the following information to answer the questions that follow.

$C(s) + O_2(g) \longrightarrow CO_2(g)$ $\Delta H = -393kJmol^{-1}$

$H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(g)$ $\Delta H = -285kJmol^{-1}$

$C_2H_5OH(l) + 3O_2(g) \longrightarrow 2CO_2(g) + 3H_2O(g)$ $\Delta H = -1370kJmol^{-1}$

Calculate the heat of formation of ethanol. (2marks)

3. **Study** the table below and answer the questions that follow. (the letter do not represent the actualsymbols of the elements)

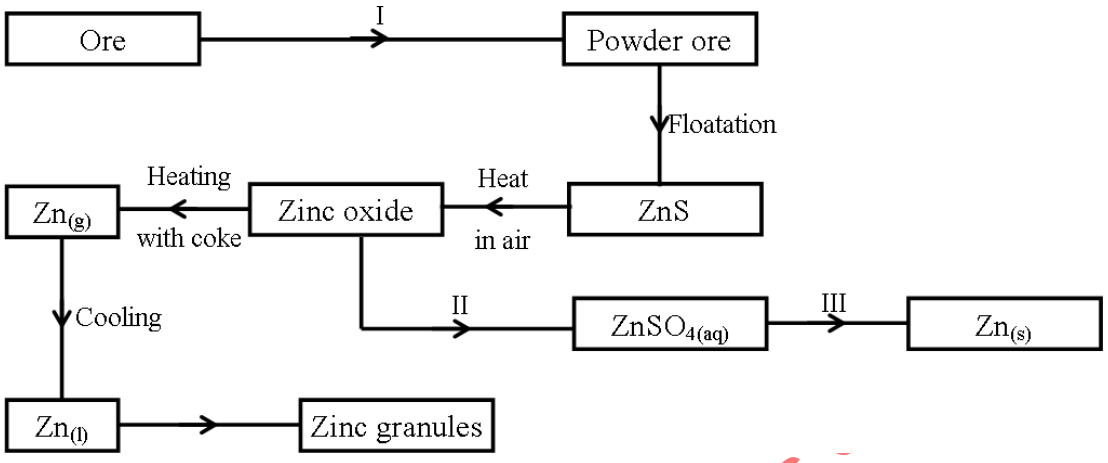
Element	A	B	C	D	E	F	G	H
Atomic number	11	12	13	14	15	16	17	18
Boiling point (^{0}c)	890	1110	2470	2360	280	445	-34.2	-186
Formula of Oxide		BO			E_2O_5		G_2O	
Boiling point of oxideof (^{0}c)	1193	3075	2045	1728	563	-72	-91	

(a) **Complete** the table to show the formulae of the oxides of A, C, D, and F. (2marks)

(b) **State** the period to which the element above belong to. (1mark)

(c) **Select** an oxide that reacts with both dilute hydrochloric acid and potassium hydroxide solution. (1mark)
(d) **Write** an equation for the reaction between the oxide of **A** and water. (1mark)
(e) **Explain** the difference in boiling point of the chlorides of **B** and **C**. (2marks)
(f) **Write** the formula of the compound formed between **E** and **G**. (1mark)
(g) **Explain** the difference in the atomic radii of elements **D** and **H**. (2marks)

4. The flow diagram below is for the extraction of zinc.



a) **Name** the chief ore from which zinc is extracted. (1mark)
b) **Describe** how froth floatation is carried out (2marks)
c) **Name** the process taking place at I and II (2marks)
d) **Explain** how zinc liquid is changes to zinc granules. (1mk)
e) **Identify** the reagent used at stage II. (1 mark)
f) **Name** two major environmental pollutants likely to be released into the atmosphere (1 mark)
(g) Zinc sulphide and sulphuric acid react according to the following equation:
$ZnS_{(S)} + H_2SO_{4(aq)} \rightarrow ZnSO_{4(aq)} + H_2S_{(g)}$
2.91g of zinc sulphide reacted with 100cm³ of 0.2M sulphuric acid. **Determine** the limitingreagent in this reaction. (Zn = 65.0, S = 32.0). (2 marks)

5. a) In an experiment to determine how the rate of reaction of hydrogen peroxide with potassium iodide varies with the concentration of hydrogen peroxide. The data in the tablebelow was recorded.

Experiment		1	2	3	4	5
Beaker X	Hydrogen peroxide	30	25	20	15	10
	Water (cm^3)	0	5	10	15	20
Beaker Y	Potassium iodide (cm^3)	5	5	5	5	5
	Detergent (cm^3)	5	5	5	5	5
	Food colour (g)	1	1	1	1	1
	Time (T) (seconds)	54	63	82	103	164
	$\frac{I}{Time}$ (sec^{-1})					

(i) Plot a graph of $\frac{I}{Time}$ (sec^{-1}) (vertical axis) against volume of hydrogen peroxide used. (3 marks)
(ii) From the graph, determine the time the reaction would take if the volume of hydrogen peroxide is28.5cm³. (1 mark)
(iii)How does the concentration of hydrogen peroxide affect its rate of reaction with potassium iodide. (1 mk)
(iv)Other than concentration, state two factors that would affect the rate of this reaction. (1 mk)

b) Given the equation below

$Br_{2\,(aq)} + H_2O_{(l)} \rightleftharpoons OBr^-_{(aq)} + 2H^+_{(aq)}$

Yellow Colourless

What is the effect of adding ethanoic acid to the above system in a chemical equilibrium (1 ½ marks)

c) Below is a radioactive decay series starting from $^{214}_{83}Bi$ and ending at $^{206}_{82}Pb$. Study it and answer the questions that follow;

$^{214}_{83}Bi \xrightarrow{\text{Step I}} {}^{210}_{81}Ti \xrightarrow{\text{Step II}} {}^{206}_{82}Pb$

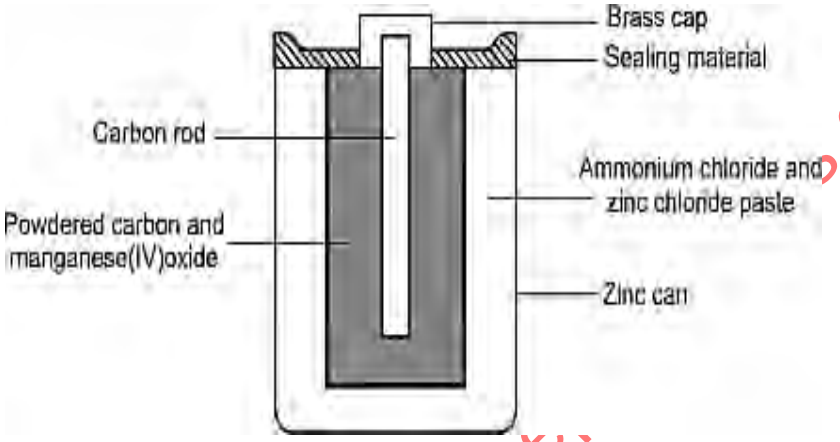
$\downarrow$ Step III

$^{206}_{82}Pb \xleftarrow{\text{Step V}} {}^{210}_{84}Po \xleftarrow{\text{Step IV}} {}^{210}_{83}Bi$

(i) **Identify** the particles emitted in steps III and V (2mks)

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

6. a) Below is a diagram of a Le'Clanche cell (dry cell).



i) State the use of manganese (iv) oxide. (1 mark)

iii) Why is ammonium chloride used as a paste rather than a dry solid? (1 mark)

iv) The following reaction occurs when the cell in in use.

$Zn_{(s)} + 2NH_4^+{}_{(aq)} \xrightarrow{MnO_2} Zn^{2+}{}_{(aq)} + 2NH_{3\,(aq)} + H_2O_{(l)}$

Given that:

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

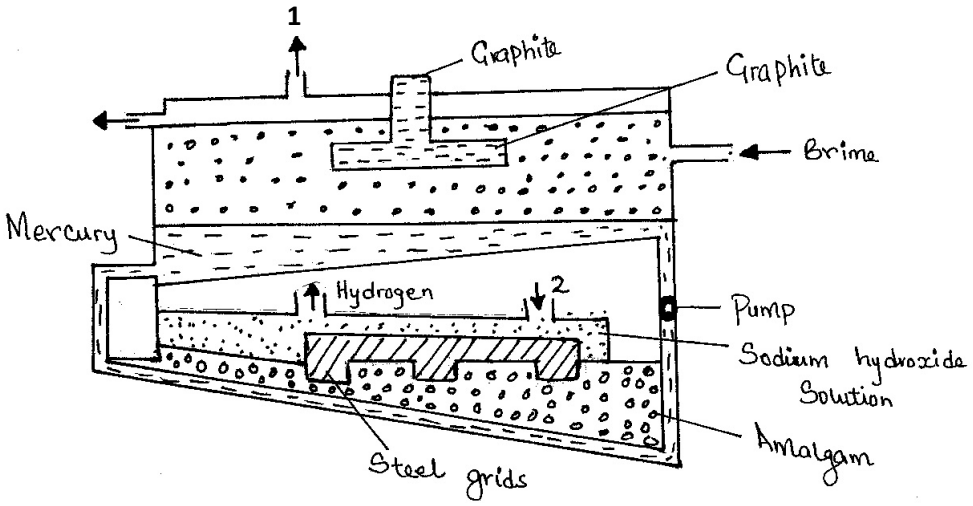
$2NH_4^+{}_{(aq)} + 2e^- \longrightarrow 2NH_{3\,(q)} + H_2O_{(l)}$ $\quad E^\theta = +-0.74V$

Calculate the e.m.f. of the cell. (1mk)

b) (i) **Draw** a diagram to show how an aluminium spoon can be electroplated with copper. (2 marks)

(ii) In the experiment to electroplate aluminium spoon, 0.2 amperes were passed through thesolution for 1,930 seconds. The mass of the aluminium spoon increased from 6.35 to 6.478 g.**Find** the charge on a copper ion. (1 Faraday = 96,500 coulombs, Cu = 64). (3 marks)

c) The diagram **below** represents a mercury cell that can be used in the industrial manufactureof sodium hydroxide. Study it and answer the questions that follow:



I Name:

(i) Raw material introduced at **2**. (½ mark)

(ii) Another substance that can be used in the cell instead of graphite. (½ mark)

II Identify the by-product that comes out at **I**. (1 mark)

III Write an equation for the reaction:-

(i) That occurred at the anode. (1 mark)

(ii) In which sodium hydroxide was produced. (1 mark)

IV Give **two** reasons why mercury is recycled. (1 mark)

7. a) Petrol is a mixture of hydrocarbons used as a fuel and is obtained from crude oil by fractionaldistillation.

i) **Define** the term fractional distillation (1mk)

ii) **Name** two gases that pollute the atmosphere as a result of burning in internal combustionengines. (1mk)

iii) Tetraethyl lead is an anti-knock additive that is added to petrol. This petrol additive ishowever being phased out. **Give** a reason to this. (1mk)

iv) CF_2Cl_2 is present in aerosols. **Explain** how it is a hazard to the atmosphere and **give** itssystematic name. (1 mark)

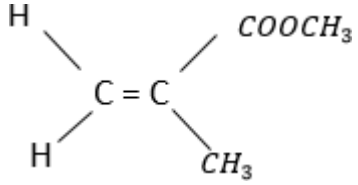
v) One of the hydrocarbons present in petrol is 3,3-dimethylpentane.

$C_7H_{16} + 11O_2 \longrightarrow 7CO_2 + 8H_2O, \quad \Delta H = -4800Kj$

I. What mass of carbon (IV) oxide would be produced when 5g of C_7H_{16} were burned?[C = 12, H = 1, O =16] (2mks)

II. Draw the structural formula of 3,3-dimethylpentane. (1mk)

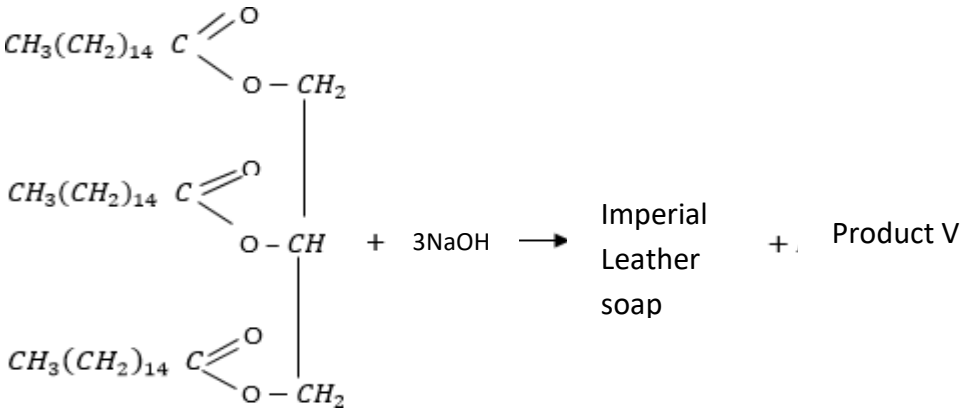
(b) Perspex is a synthetic polymer formed from the monomer below.



(i) Draw a polymer with three repeat units. (1 mark)

(ii) A sample of Perspex has a mass of 100,000g. **Calculate** the number of monomers in thePerspex. (1 mark)

c) Sodium hexandecanoate (sodium palmate) commonly known as Imperial Leather soap ismanufactured by hydrolysis of palmitic acid using sodium hydroxide as shown.



Write the formula of the Imperial Leather soap and the product **V**. **(2 marks)**

Imperial Leather soap	Product **V**

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CHEMISTRY
PAPER 3

CONFIDENTIAL

Requirements for each candidate

1. 150 cm^3 of solution A
2. 200 cm^3 of solution B
3. 60 cm^3 of solution X
4. 150 cm^3 of solution Z
5. Pipette
6. Burette
7. Thermometer
8. Stop watch
9. 2 conical flasks
10. 1 boiling tube
11. 7 test tubes
12. 2 filter paper and a filter funnel
13. Clean spatula
14. 10 ml measuring cylinder
15. 50 ml /100 ml measuring cylinder
16. Solid Q 1g $Na_2 CO_3$: $PbCO_3$ (1:2)
17. Solid M. Crushed paracetamol.1 tablet per candidate

ACCESS

i) 2M HNO_3
ii) 2M HCl
iii) 2M NH_3
iv) Acidified $KMnO_4$
v) Acidified $K_2Cr_2O_7$
vi) Bromine
vii) Source of heat
viii) Tripod stand
ix) Wire gauze

NOTES

a. Solution B 0.04 M acidified $KMNO_4$
b. Solution A Ferrous ammonium sulphate ($Fe SO_4(NH_4)_2 SO_4 X H_2O$ made by dissolving 8.5 g in 50 cm^3 of 2M H_2SO_4 making it to 250 cm^3
c. Solution X which is prepared by dissolving 75.6 g of glucose in about 500 cm^3 of distilled water, then making it up to the liter.
d. Solution Z, 2 M Sulphuric (vi) acid.

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CHEMISTRY
Paper 3
PRACTICAL
Time: 2 ¼ Hours

Instructions to candidates

- *Answer **all** the questions*
- *You are **NOT** allowed to start working with the apparatus for the first 15 minutes of the 2 ¼ Hours allowed for this paper. This time is to enable you to read the question paper and make sure you have all the chemicals and apparatus that you may need.*
- *Mathematical tables and silent electronic calculators may be used.*
- *All working must clearly be shown where necessary.*

1. (a) You are provided with;

(i) Solution A – Ferrous ammonium sulphate ($FeSO_4.(NH_4)_2SO_4.XH_2O$) containing 8.5g in $250cm^3$ of solution

(ii) Solution B 0.04 M acidified potassium manganite (VII)

You are required to determine the value of X in $FeSO_4.(NH_4)_2SO_4.XH_2O$

Procedure I

Fill the burette with solution B. Pipette $25.0cm^3$ of solution A into a clean conical flask and titrate until the solution turns pink. Record your results in table I below. Repeat the procedure and fill table I

a)

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

(4 marks)

b) i) Calculate the average volume of solution B used (1 mark)

ii) The number of moles of solution B in volume in (i) above (1 mark)

c) Given that the reaction is represented by the ionic equation

$MnO^-_{4(aq)} + 8H^+_{(aq)} + 5Fe^{2+}_{(aq)} \longrightarrow Mn^{2+}_{(aq)} + 4H_2O_{(l)}$

Determine;

(i) The number of moles of iron (II) salt solution A in $25.0cm^3$ of the solution used. (1 mark)

(ii) The concentration of solution A in moles per litre (1 marks)

(iii) The concentration of solution A in grams per litre (1 marks)

(iv) The relative formula mass of iron (II) salt (1 marks)

(v) The value of X in the formula $FeSO_4.(NH_4)_2SO_4.XH_2O$ Fe=56, N=14, S=32, O=16 (1 mark)

b) You are provided with

- 2.0 M sulphuric (vi) acid labeled as solution Z
- 0.42 M glucose solution labeled as solution X
- 0.04 M potassium manganate (vii) labeled as solution B

You are required to determine the rate of reaction between aqueous glucose solution and acidified potassium manganate (vii) at different temperatures.

Procedure

i) Using the 10 cm^3 measuring cylinder, place 10 cm^3 of solution B into the conical flask

ii) Rinse the 10 cm^3 measuring cylinder and use it to measure 10 cm^3 of solution of solution X. Keep it for step below

iii) Using the 100cm^3 or the 50 cm^3 measuring cylinder, measure 25 cm^3 of solution Z and add it into the conical flask, containing solution B, Heat the mixture to slightly above 65 ^{0}c and then remove it from the heat source.

iv) Allow the mixture in step 3 to cool to 65^{0}c, then add the 10 cm^3 of solution X and immediately start the stop watch.

v) Stir the mixture and note the time taken for the colour of the mixture to change from purple to colourless. Record the time taken in the table below.

vi) Rinse the conical flask and the 10 cm^3 measuring cylinder and repeat the procedure at temperatures of 60^0 c, 55^{0}c , 50^{0}c,and 45^{0}c respectively. Record the time taken in the table below in each case.

vii) Complete the table by calculating the reciprocal of time $^1/t$

Temperature of the solutions ^{0}c	65	60	55	50	45
Time taken for the purple colour to disappear (s)					
$^1/_t$ sec$^-$					

(5mks)

I. Plot a graph of $^1/_t$ (y axis) against the temperature at the point when the solution becomes colourless (3mks)

II . From the graph

a) Determine the time that the reaction would take if the temperature at which the solution becomes colourless is 52.5^{0}c (2mks)

b) Determine the rate of reaction if the temperature at which the solution becomes colourless is 47^{0}c (1mk)

c) Explain the shape of the graph (1mk)

2. You are provided with solid Q

Carry out the following tests and record your observations and inferences in the spaces provided,

a) Add about 15 cm^3 of distilled water to solid Q and shake. Filter and retain both the filtrate and the residue.

i) To about 2 cm^3 of the filtrate add ammonia solution drop wise until in excess

Observations	Inferences
(1 mark)	(1 mark)

ii) To about 2 cm^3 of the filtrate add a few drops of dilute hydrochloric acid.

Observations	Inferences
(1 mark)	(1 mark)

b) (i) Put the residue in a test tube and add about 10cm^3 of dilute nitric(v) acid and wait for about five minutes To 2 cm^3 of the solution add 2 to 3 drops of barium nitrate

Observations	Inferences
(1 mark)	(1 mark)

(ii) To 2 cm^3 of the solution add ammonia solution drop wise until in excess

Observations	Inferences
(1 mark)	(1) mark)

(iii).To 2 cm^3 of the solution add 2 to 3 drops of potassium iodide solution

Observations	Inferences
(1 mark)	(1 mark)

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

a) Place half of solid M in a clean metallic spatula and ignite using a non-luminous flame

Observations	Inferences
($^1/_2$ mark)	½ mark)

b) Place the remaining portions of solid M in a boiling tube add 10 cm^3 of distilled water, filter, divide the filtrate into three portions.

i) To the first portion add 2 to 3 drops of acidified potassium manganate (vii)

Observations	Inferences
(1 mark)	(1 mark)

ii) To the second portion add 2 to 3 drops of bromine water

Observations	Inferences
(1 mark)	(1 mark)

iii) To the third portion add 2 to 3 drops of acidified potassium dichromate (vi)

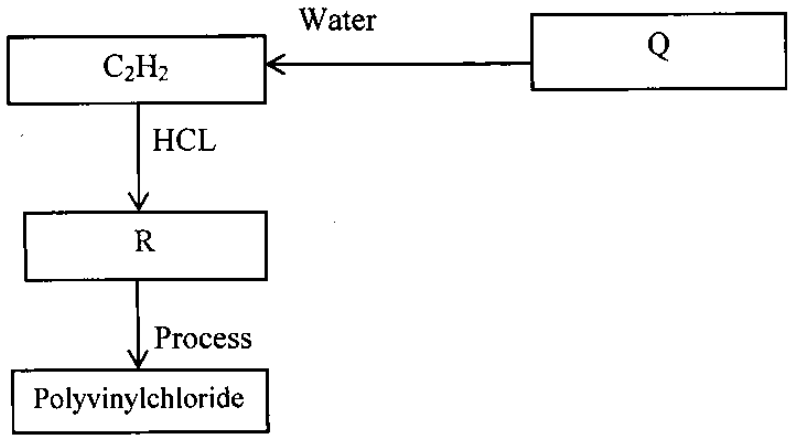
Observations	Inferences
(1 mark)	(1 mark)

KIGUMO CLUSTER EXAMINATION, 2023
Kenya Certificate of Secondary Education (KCSE)
233/1
CHEMISTRY (THEORY)
PAPER 1
2 HOURS

INSTRUCTIONS TO CANDIDATES

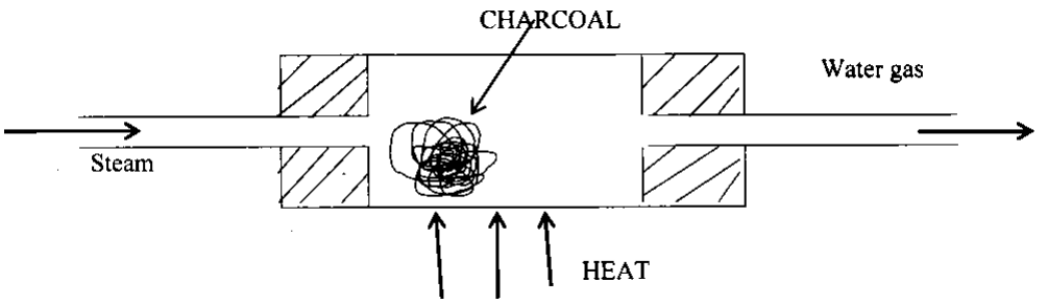
1. *Answer **ALL** the questions.*
2. *KNEC Mathematical tables and silent non-programmable electronic calculators may be used.*
3. *All working **MUST** be clearly shown where necessary*

1. (a) Explain the condensation process using the kinetic theory of matter. (1mk)
   (b) Name one chemistry laboratory apparatus that can be used to measure accurate volume of a solution (1mk)
2. Study the flow chart below and answer the questions that follow:



a) Identify
i) Q (1/2 mk)
ii) R (1/2 mk)
b) State two uses of Polyvinylchloride (1mk)

3. Naphthalene is soluble in ether but not in water and has a melting point of 80^0C.You are provided with a mixture of powdered naphthalene, Sodium Chloride and Zinc Carbonate. Describe briefly how Naphthalene can be obtained from the mixture. (3mk)
4. a) Name a suitable solvent for extracting an indicator from flowers. (1mk)
   b) Give a reason why the solvent named in (a) above is used (1mk)
5. Using the elements Chlorine, Calcium and Phosphorus,
(a) Select Elements that will form an Oxide whose aqueous solution has a PH of Less than 7. (1mk)
(b) Write an Equation for the reaction between Calcium Oxide and dilute Hydrochloric Acid. (1mk)
(c) Give **one** use of Calcium oxide. (1mk)
6. When steam was passed over heated charcoal as shown below, Hydrogen and carbon (II) Oxide were formed.



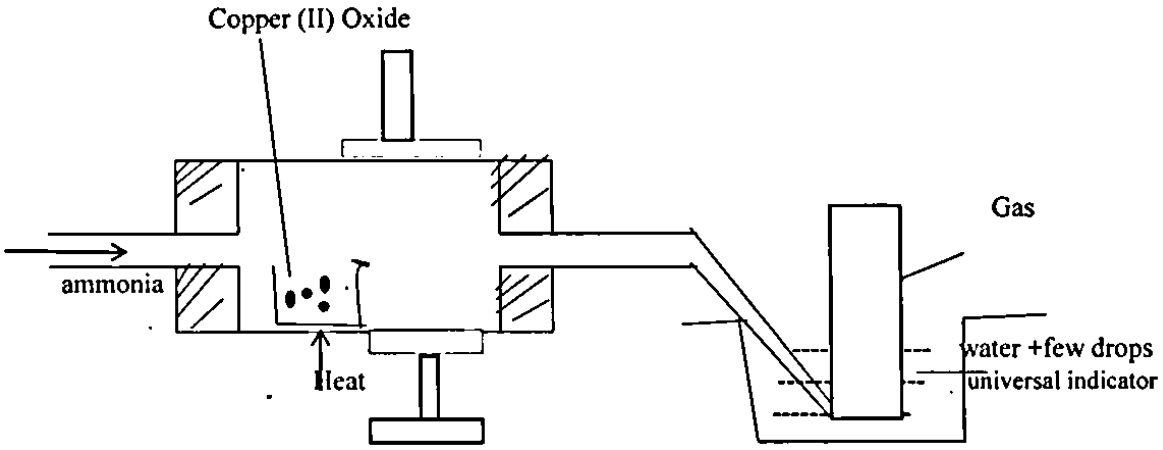
a) Write the equation for the reaction that takes place (1mk)
b) Name one common use of carbon (II) Oxide and Hydrogen gas. (1mk)

7. a) State Grahams Law of Diffusion. (1mks)
   b) Determine how long it would take for a given volume of ammonia gas to diffuse through a porous plug , If the same volume of hydrogen chloride takes 48 seconds to diffuse under the same conditions. (3mks)
8. In an experiment it was found out that 0.28g of iron powder reacted with 0.53g of chlorine. Use this information to write a balanced equation to represent the reaction. (Fe=56, Cl= 35.5). (3mks)
9. (a) What is meant by atomic number? (1mk)
   (b) An element P has a mass number of 35 and atomic number 17.Draw a diagram showing the Composition of electrons and the composition of the nucleus of its atom. (2mks)
10. The table below shows properties of some elements P, Q, R and S which belong to the same period of the periodic table. The letters are not the actual symbols of the elements.

Element	**P**	**Q**	**R**	**S**
M.P (^{0}C)	**1410**	**98**	**-101**	**660**
Atomic Radius	**0.117**	**0.186**	**0.099**	**0.143**
Electrical conductivity	**P00v**	**Good**	**Non conductor**	**Good**

a) Arrange the elements in the order they would appear in the period. Give reasons. (2mks)
b) Select the metallic element which is the better conductor of electricity. Give a reason. (2mks)

11. Distinguish between polar substances and non-polar substances (1mk)
12. Starting with copper describe how a pure sample of copper (II) carbonate can be prepared. (3mks)
13. Study the setup below and answer the questions that follow:



a) Write an equation for the reaction between ammonia and copper (II) Oxide (1mk)
b) During the experiment the colour of the contents in the water trough changed .State the colour observed and give an explanation. (2mks)

14. a) Define the molar heat of displacement (1mk)
    b) The following ionic equation represents the reaction between metal Z and aqueous Y^{2+}

$$Z_{(s)} + Y^{2+}_{(aq)} \longrightarrow Z^{2+}_{(aq)} + Y_{(s)} \qquad \Delta H = -VE$$

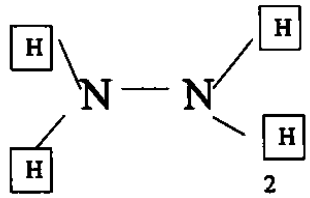
    Draw an energy level diagram to represent the reaction (2mks)

15. a) Why is graphite preferred for use as a non-greasy lubricant (2mk)
    b) Brine is electrolysed using graphite as electrodes .State the products formed at
    i) Anode (1mk)
    ii) Cathode (1mk)

16. a) Sulphur (IV) Oxide is bubbled through acidified Potassium Manganate (VII). State and Explain the observation made. (2mks)
    b) What is meant by vulcanisation? (1mk)

17. a) Other than the manufacture of weed killers, Name **two** other uses of chlorine (1mk)
    b) State and explain what would happen if a dry red litmus paper was dropped in a gas jar of dry chlorine. (2mks)

18. A gas whose structure is shown burns in oxygen to form nitrogen gas and steam



2

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

b) Using the bond energies given below, Calculate the enthalpy change for the reaction in (a) above (2 mks)

Bond	Bond Energy (KJ per mole)
N ≡ N	944
N-N	163
N-H	388
O= O	496
H-O	483

19 a) Aqueous hydrogen chloride reacts with potassium Manganate (VII) to produce Chlorine gas, while a solution of hydrogen chloride in methylbenzene has no effect on potassium Manganate(VII). Explain this observation (2mks)

b) From the equation below, identify the species that reacts as the acid and the one that reacts as the base. (1mk)

$NH_{3\,(g)} + H_2O_{(l)} \longrightarrow NH^+_{4(aq)} + OH^-_{(aq)}$

Acid……

Base……

20. a) Barium carbonate and dilute sulphuric (VI) acid are not used to prepare a sample of carbon (IV) oxide in the laboratory. Explain. (2mks)

b) Name a method that can be used to collect dry carbon (IV) oxide and give a reason. (1mk)

21. a) State the Le Chatelier's principle (1mk)

b) Carbon (II) oxide gas reacts with steam according to the equation.

$CO_{(g)} + H_20_{(g)} \rightleftharpoons H_2(g) + CO_2(g)$

What would be the effect of increasing pressure of the system at equilibrium .Explain (2mks)

22. Given the following half – cell equations;

$P^{2+}_{(aq)} + 2e^- \longrightarrow P(S)$ $E^\sigma = -2.37V$

$Q^{2+}_{(aq)} + 2e^- \longrightarrow (S)$ $E^\sigma = -0.76V$

a) Write an equation for the cell reaction. (1mk)

b) Calculate the E^σ value for the cell (1mk)

c) Write the cell representation for the electrochemical cell formed. (1mk)

23. A hydrated salt has the following composition by mass.

Iron – 20.2 % , oxygen – 23.0% , Sulphur -11.5% and water 45.3%. Determine the empirical formula of the salt.(Fe+ 56, S =32, O=16, H = 1) (3 mks)

24. Give the systematic names of the following compounds (3mks)

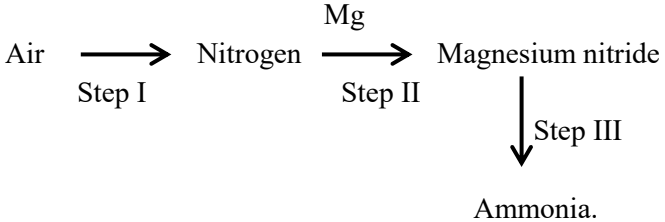
a) $CH_3\,CH\,(CH_3)\,CH_2\,CH_3$

b) $CH_3\,CH_2CH_2\,CH\,Br\,CH_2\,OH$

c) $HOCH_2\,CH_2\,CH_2OH$

25. Using a well labelled diagram, illustrate how an iron bungle can be electroplated using silver (3mks)

26. Study the sequence of reactions below and answer the questions that follow;



a) Name the process in step I (1mk)

b) Name the reagent that can be used in step III. (1mk)

c) Write a balancing Equation for step II (1mk)

27. When an aqueous solution of compound W was mixed with a few drops of Bromine water, the colour of the mixture remained yellow. When another portion of W was reacted with acidified potassium dichromate (VI) , the colour of the mixture changed from orange to green.

a) What conclusion can be made from the use of

i) Bromine water? (1mk)

ii) Acidified potassium dichromate (VI) (1mk)

d) Solution W was reacted with a piece of a metal and a colourless gas was produced. Describe a simple experiment to identify the gas. (1mk)

28. An element P contains two isotopes ${}^{16}_{8}Pand{}^{18}_{8}P$ whose relative abundance is in the ratio 9:1.

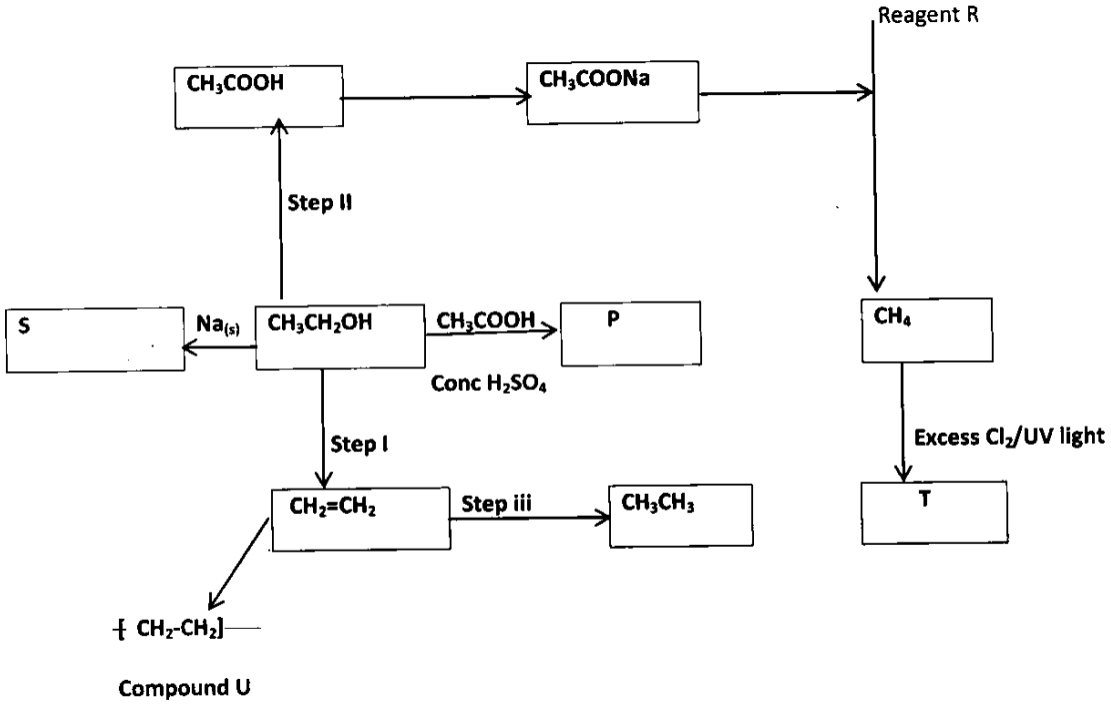
Find the relative atomic mass of P. (2 marks)

KIGUMO CLUSTER EXAMINATION, 2023
Kenya Certificate of Secondary Education (KCSE)
233/2
CHEMISTRY (THEORY)
PAPER 2
2 HOURS

INSTRUCTIONS TO CANDIDATES

*1. Answer **ALL** the questions.*
2. KNEC Mathematical tables and silent non-programmable electronic calculators may be used.
*3. All working **MUST** be clearly shown where necessary*

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



a) Write the formula of the organic compounds **P** and **S** (2mks)
b) Name the types of reaction, the reagents and conditions for the reactions in the following steps (4mrks)

	Reaction	Reagent	condition
Step I			
Step II			

c) Name the reagent **R** (1mrk)
d) Draw the structural formula of **T** and give its name
i) Structural Formula (1Mk)
ii) Name (1mk)
e) If the relative molecular mass of **U** is 42000, determine the value of n **(C=12, H=1)** (2mrks)
f) State the reasons why C_2H_4 burns with more smoky flame than C_2H_6 (1mrk)

2. The heat of solution of magnesium chloride is +1278 kJ/Mol. Given that the lattice energy of magnesium chloride is -3933kJ/Mole and hydration energy of magnesium is -1891kJ/Mol
a) Draw an energy level diagram to show this information (2mrks)
b) Calculate the hydration energy of chloride ions (2mrks)
c) The enthalpies of combustions of methane, carbon and hydrogen are -886.7, -393.5 and -285.7 kJ/Mol respectively. Use the information given to calculate molar heat of formation of methane (2mrks)
d) State two measures taken to reduce pollution by vehicles (2mrks)

3) In an experiment to study the reactions between German silver (an alloy of Nickel, Zinc and Copper) and excess sulphuric (VI) acid, the data below was recorded. It showed the volume of gas collected after every one minute. Use it to answer the questions that follow.

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

a) Plot a graph of total volume of gas produced against time on the grid below (3mrks)

b) Use the graph to determine the volume of gas produced at the end of $3\frac{1}{2}$ minutes (1mrk)

c) Explain why some solid remained at the end of the experiment (2mrks)

d) Determine the rate of reaction between the 3rd and the 4th minute (2mrks)

e) Study the equation below and answer the questions that follow

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

i) After decreasing the temperature, the yield of sulphur (VI) oxide increased. Is the reaction above exothermic or endothermic? Explain. (2mrks)

ii) State the effect of decreasing pressure on the position of equilibrium to the yield of sulphur (vi) oxide (2mrks)

f) i) List one factor that does not affect the position of equilibrium when altered but would increase rate of reaction (1mrk)

ii) Define a dynamic equilibrium (1mrk)

4. The following is information for the preparation of copper (ll) sulphate crystals. An excess of copper carbonate is added to 50.0cm3 of 2M sulphuric (VI) acid in a beaker and the mixture warmed until no further reaction takes place. The warm mixture is then filtered and the filtrate evaporated until the volume reduced to 20.0cm3. The mixture is allowed to cool and the crystals formed dried and weighed.

a) Write the ionic equation for the reaction (1mrk)

b) Give reason for adding excess copper carbonate (1mrk)

c) Give reasons for warming the mixture (1mark)

d) How does one determine the end of the reaction (1mrk)

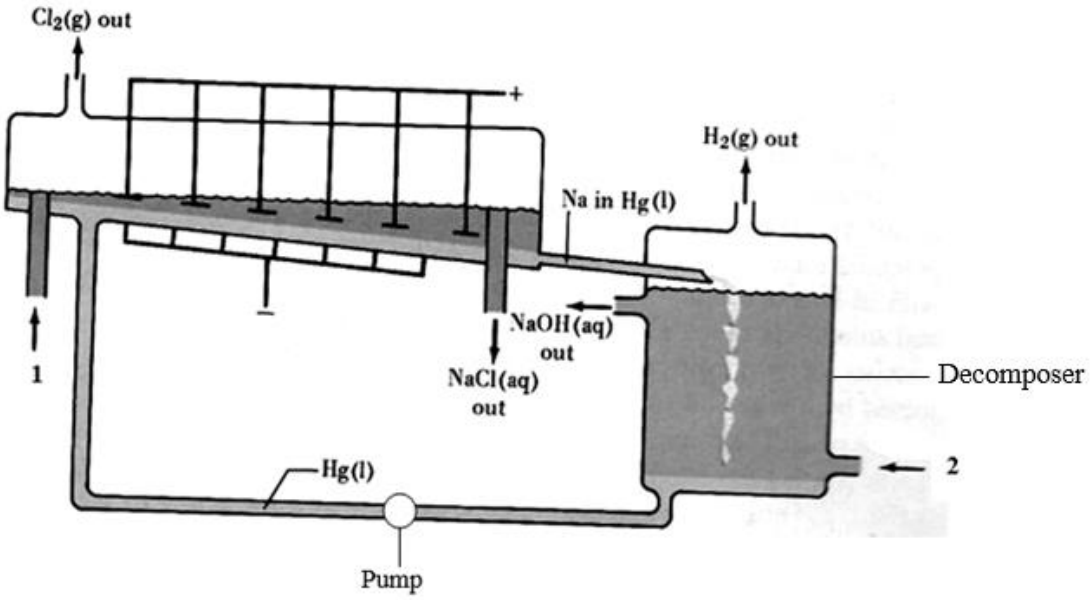
e) Why is it necessary to filter the reaction mixture after the end of reaction (1mrk)

f) It is advisable not to evaporate the filtrate to dryness. Give two reasons (2mrks)

g) Determine the mass of anhydrous copper (ii) sulphate formed (3mrks)
(CU=64, S=32, O=16, H=1)

h) Give reasons as to why crystals of Lead(II) sulphate are not prepared using lead carbonate and Sulphuric (VI) acid as outlined in the experiment above (2mrks)

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



(a) (i) Name the raw materials introduced at 1 and 2. (2 marks)

(ii) Identify a substance that can be used as anode. (1 mark)

(iii) Write equations for the reactions taking place at:

Cathode (2 marks)

Decomposer (1 mark)

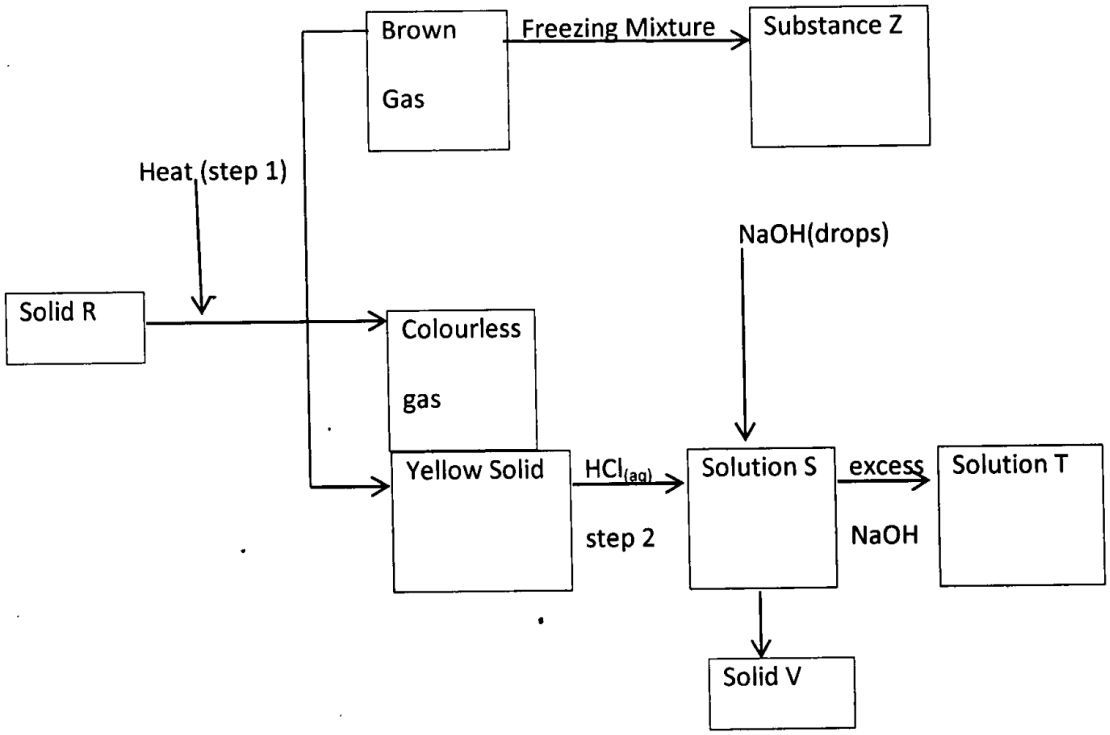
(iv) Give **two** reasons why mercury is recycled. (2 marks)

(v) How is the aqueous sodium hydroxide purified? (1 mark)

(vi) State **one** use of sodium hydroxide. (1 mark)

(b) If a factory produces 1000 kg of sodium hydroxide in every 24 hours, calculate the required current per day. (H= 1.0, Na = 23.0, O = 16.0) (2 marks)

6. Study the following diagram below and use it to answer the questions that follow:-



a) Identify ions present in solid **R** (1mrk)

b) Identify

Solid –V (1mk)

Solution S- (1 mk)

Solution T- (1mk)

c) Write an equation leading to the formation of substance **Z** (1mrk)

d) What is the identity of?

Brown gas- (1mk)

Colorless gas- (1mk)

Yellow solid – (1mk)

e) What name is given to the reaction in step 2? (1mrk)

f) State and explain the observation that would be made if sodium carbonate solution was added to solution S (1mk)

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

S								**P**
	Z		**T**			**D**		**Q**
	C							
X	**J**							**R**

a) To which family do element **P, Q** and **R** belong? (1mrk)
b) Write the electronic arrangements of stable **ions** of **D** and **C** (2mrks)
c) Compare melting point of chlorides of **Z** and **T** (2mrks)
d) Select the most reactive metallic element (1mrk)
e) Give one use of element **Q** (1mrk)
f) Compare the atomic radius of element **Z** and **J** (2mrks)
g) Element **B** forms an ion $\mathbf{B^{3-}}$ with electron arrangement of 2.8.8. Place it on the periodic grid above (1mrks)
h) Write the formula of the compound formed when elements X and D react (1mk)
i) Explain the trend of reactivity of element Z, C and J (1mk)

KIGUMO CLUSTER EXAMINATION, 2023
Kenya Certificate of Secondary Education (KCSE)
233/3
CHEMISTRY
PAPER 3

CONFIDENTIAL

Requirements to Candidates

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

1. **Solid A** (4.8 g of **oxalic acid** in a boiling tube)
2. $100cm^3$ **solution B (0.2M NaOH)**
3. Thermometer (-10ºC – 110ºC)
4. One 50ml burette
5. Filter funnel
6. Pipette and pipette filler
7. One label
8. 250ml volumetric flask
9. Two 250ml conical flasks
10. About $300cm^3$ of distilled water
11. Bunsen burner
12. 0.5g of solid F(maleic acid)
13. 0.5g of **solid V** iron iii sulphate
14. 6 test-tubes in a rack
15. Boiling tubes – 2
16. Test – tube holder

Access to the following;

1. Phenolphthalein indicator supplied with a dropper
2. 2M NaOH supplied with a dropper
3. Dilute nitric (V) acid supplied with a dropper
4. 0.5M $Pb(NO_3)_2$ supplied with a dropper
5. 0.5g $NaHCO_3$ supplied with a dropper
6. Acidified $K_2Cr_2O_7$ supplied with a dropper
7. Acidified $KMnO_4$ supplied with a dropper
8. Bromine water

NB/ Each of the solutions in Bottle should be supplied with a dropper.

Preparations

- Solution B is prepared by dissolving 8.0g of NaOH pellets in $600cm^3$ of distilled H_2O then making it to one litre of solution
- Acidified potassium permanganate is prepared by dissolving 3.16g of solid $KMnO_4$ in $400cm^3$ of 1M H_2SO_4 acid and making it to one litre of solution.

KIGUMO CLUSTER EXAMINATION, 2023
Kenya Certificate of Secondary Education (KCSE)
233/3
CHEMISTRY
Practical
Paper 3
Time: 2 ¼ Hours

Kenya Certificate of Secondary Education

a) Answer **ALL** the questions
b) KNEC Mathematical tables and electronic calculators may be used for calculations
c) All working **MUST** be clearly shown where necessary

1. **You are provided with;**

- 4.8g of solid A which is a hydrated acid with formula $H_2C_2O_4.nH_2O$
- Solution B, a 0.2M sodium hydroxide solution.

You are required to determine:
Solubility of solid A

Procedure 1

Fill the burette with distilled water
Place solid A in the boiling tube.
Transfer 4cm^3 of distilled water from the burette into the boiling tube containing solid A.
Heat the mixture while stirring with the thermometer to a temperature of 75˚C.
Allow the solution to cool while stirring with a thermometer.
Record the temperature at which the crystals start to form in the table below
Add a further 2cm^3 of distilled water from the burette to the mixture
Repeat procedure (iv) and (v) above and record the crystallization temperature. Complete the table below by adding the volumes of distilled water as indicated. (**PRESERVE THE CONTENTS**)

Volume of distilled water (cm^3)	Crystallization temperature	Solubility of solid A in g/100g of water
4.0		
6.0		
8.0		
10.0		
12.0		
14.0		

(6marks

a) On the grid provided, plot a graph of solubility of solid A (y – axis) against crystallization temperature. (3 marks
b) From the graph determine;
i) The solubility of solid A at 80˚C (1 mark)
ii) The temperature at which 34g of A dissolves in 50g of water (1 mark)
iii) Describe the trend of the graph (1 Mk)

Procedure II

- Transfer the contents of the boiling tube in procedure I to a clean 250ml volumetric flask.
- Add distilled water to the mark
- Label the resulting solution as C
- Fill the burette with solution C
- Pipette 25cm^3 of solution B into a clean conical flask. Add three drops of phenolphthalein indicator
- Titrate C against B to an accurate end point.

Record your results in table II below

Table II (4 mks)

	I	II	III
Final burette reading in cm^3			
Initial burette reading in cm^3			
Volume of solution C used in cm^3			

Calculate;

a) Average volume of C used (1mark)

b) Moles of solution B used (1mark)

c) Moles of solution C given that 2 moles of B react with 1 mole of C. (1 mark)

d) Concentration of solution C in moles per litre (1 mark)

2. (a) You are provided with:
   - Solid V, which could be iron (III) sulphate
   - 1 M nitric acid
   - 1 M sodium hydroxide
   - Source of heat
   - Distilled water
   - 0.1 M Lead (II) nitrate solution

(i) From the reagents provided, describe **three** tests that may be carried out **consecutively** to confirm if **solid V** is **iron (III) sulphate**. Write the tests and expected observations in the spaces provided.

Test 1	**Expected Observations**
(1 mark)	(1 mark)

Test 2	**Expected Observations**
(1 mark)	(1 mark)

Test 3	**Expected Observations**
(1 mark)	(1 mark)

(ii) Carry out the tests described in (a) above using **solid V** and record the observations and inferences in the spaces provided.

Test 1

Observations	**Inferences**
(1 mark)	(1 mark)

Test 2

Observations	**Inferences**
(1 mark)	(1 mark)

Test 3

Observations	**Inferences**
(1 mark)	(1 mark)

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

a. Place the half of solid F in a boiling tube and add 12cm^3 of distilled water divide the resulting solution into five portions

b. To the first portion add acidified potassium manganate (VII) and warm

Observations	Inference
(1 marks)	(1 marks)

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

Observations	Inference
(1 marks)	(1 marks)

d. To the third portion add $NaHCO_3$

Observations	Inference
(1 marks)	(1 marks)

e. Test the forth portion add bromine water

Observations	Inference
(1 marks)	(1 marks)

BOKAKE JOINT EXAMINATIONS, 2023

Kenya Certificate of Secondary Education

233/1

CHEMISTRY

Paper 1

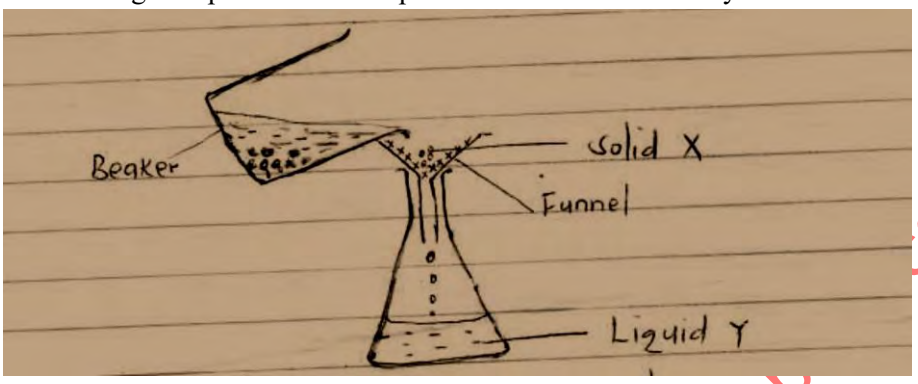
(Theory)

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES

1. *All working must be clearly shown where necessary.*
2. *Mathematical tables and silent electronic calculations may be used*

1. The following set up was used to separate sand and water. Study it and answer the questions that follows.



i. Identify the method of separation. 1mk

ii. Give a special name given to solid X and liquid Y. 2mks

2. The table below gives the number of electrons, protons and neutrons in substance X, Y and Z. Study it and answer the questions that follow.

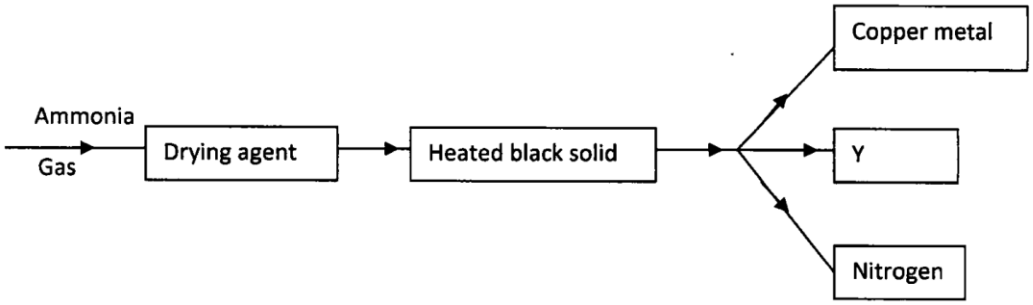
Substance	Electrons	Protons	Neutrons
X	10	10	10
Y	10	8	10
Z	8	8	8

a. Which letters represent an ion? (½ mk)

b. Which of the substances are isotopes? Explain. (1 1/2mks)

c. Calculate the mass number of substance Y. (1mk)

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



a. Name the suitable drying agent for ammonia. (1mk)

b. Describe one chemical test for ammonia. (1mk)

c. Name Y. (1mk)

4. Given that the atomic number of element Y is 12 and that of Z is 9.

a. Write the electronic arrangement of Y and Z. (1mk)

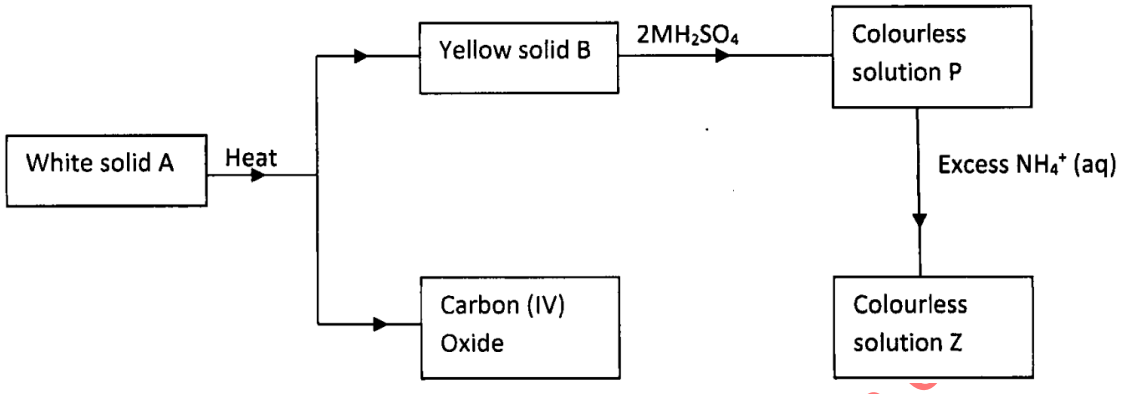
b. Draw the dot (•) and cross (x) diagram for the compound formed by Y and Z. (1mk)

c. Which type of structure is formed in the compound formed above? (1mk)

5. $20.0cm^3$ of a solution containing 4g per litre of sodium hydroxide was neutralized by $8.0cm^3$ of dilute sulphuric (VI) acid. Calculate the concentration of sulphuric (VI) acid in moles per litre. (Na=23, O=16, H=1, S=32) (3mks)
6. Describe how you can extract oil from ground nuts? (3marks)
7. Passing a small quantity of carbon (iv) oxide through calcium hydroxide, forms a white precipitate which dissolves when excess carbon (IV) oxide is bubbled through.

a) Name the white precipitate. (½ mk)
b) Explain using a chemical equation why the white precipitate dissolves in excess carbon (IV) oxide. (1 ½ mks)
c) What will happen when solution in (b) above is boiled? (1mk)

8. The scheme below represents some reactions starting with a white solid A.



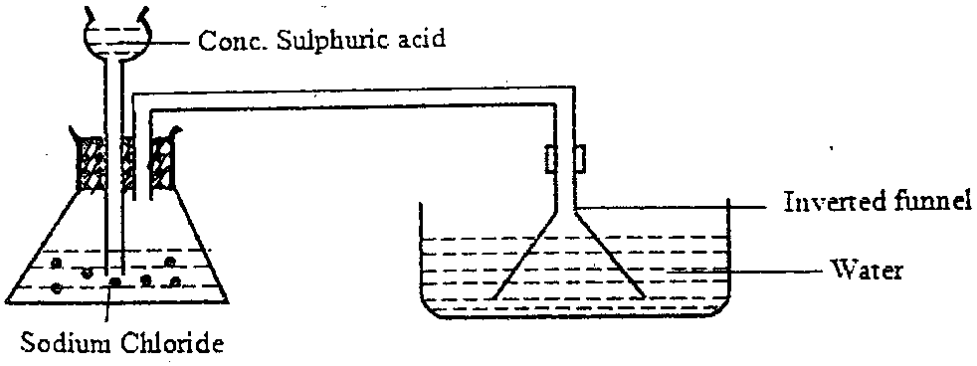
a) Identify solid A (1mk)
b) Write an equation for the reaction between solid B and 2M sulphuric (VI) acid. (1mk)
c) Write ionic equation for the formation of colourless solution Z. (1mk)

9. Some reaction of metals P, Q, R and S are given below.

Metal	Reaction with water	Reaction with dilute hydrochloric acid
P	A few bubbles form slowly in water	Vigorous reaction. Gas is given off
Q	Vigorous reaction , metal melts gas given off	Explosive reaction (Should not be attempted)
R	No reaction	No reaction
S	Does not react with cold water. Hot metal reacts with steam	Steady fizzing

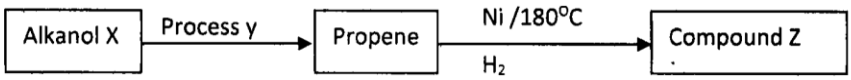
a) Arrange the metals in order of the reactivity starting with the least reactive. (1mk)
b) Write a chemical equation for the reaction between metal Q and water 1mk
c) Which of the metals could be copper? Explain. (1mk)

10. The diagram below shows the laboratory preparation of hydrochloric acid.



a) State the condition necessary for the reaction to occur. (1mk)
b) Write a chemical equation for the reaction between sodium chloride and concentrated sulphuric (VI) acid. (1mk)
c) Give one reason why an inverted funnel is used instead of delivery tube. (1mk)

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



a) Draw the structure of alkanol X. (1mk)
b) Name process Y. (1mk)

c) Write the molecular formula of the 5th member in which propene belong. (1mk)

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

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

(a) Define the term acid 1mk

(b) Identify an acid in the above reaction 1mk

(c) Explain your answers in (b) above 1mk

13. Define;

a) Solubility 1mk

b) The solubility of Iron (II) Sulphate crystals is 22oC is 15.65g per 100g of water. Calculate the mass of iron (II) sulphate crystals in 45g of saturated solution at the same temperature. 2mks

14. In an attempt to prepare a gas, Njeri added concentrated hydrochloric acid to Potassium manganate. The products were then passed through two wash bottles containing water and concentrated sulphuric acid

(a) Name the gas prepared 1mk

(b) Name the purpose of wash bottle:

(i) Containing water? 1mk

(ii) Containing concentrated sulphuric acid? 1mk

15. A fixed mass of gas occupies 200 cm3 at a temperature of 230c and a pressure of 740 mm Hg. Calculate the volume of the gas at -250c and 790 mm Hg pressure. 2mks

16. Study the table below and answer the questions that follow

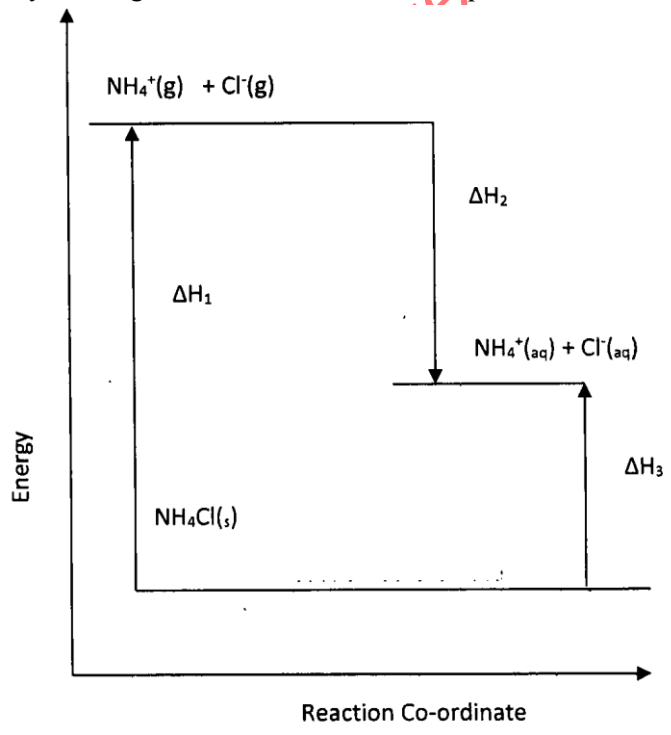
Bond type	bond energy kJmol^{-1}
C-C	346
C = C	610
C-H	413
C-Br	280
Br-Br	193

a) Calculate the enthalpy change for the following reaction 2mks

$C_2H_{4(g)} + Br_{2(g)} \longrightarrow C_2H_4Br_{2(g)}$

b) Name the type of reaction that took place in **(a)** above ***1 mark***

17. Study the diagram below and answer the questions that follow:



a) What do ΔH1 and ΔH2 represent?

ΔH1 1mk

ΔH2 1mk

b) Write an expression to show the relationship between ΔH1, ΔH2 and ΔH3. 1mk

18. Nitrogen and hydrogen react reversibly according to the equation:-

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$; $\Delta H = -92kjmol^{-1}$

How would the yield of ammonia be affected by:

(i) A increase in temperature. 2mks

(ii) An increase in pressure. 1mk

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

Element	Atomic radius (nm)	Ionic radius (nm)
W	0.114	0.195
X	0.072	0.136
Y	0.133	0.216
Z	0.099	0.181

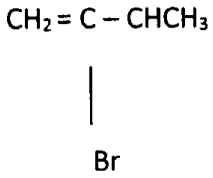
(a) Would these form part of a metallic or a non-metallic group? Explain 1 ½ mks

(b) Suggest an element in the table above likely to be the most reactive. Explain 1 ½ mks

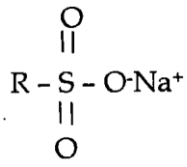
20. Give the IUPAC names of the following compounds: 3mks

i) $CH_3COOCH_2CH_3$ ii) CH_3CH_2COOH

iii)



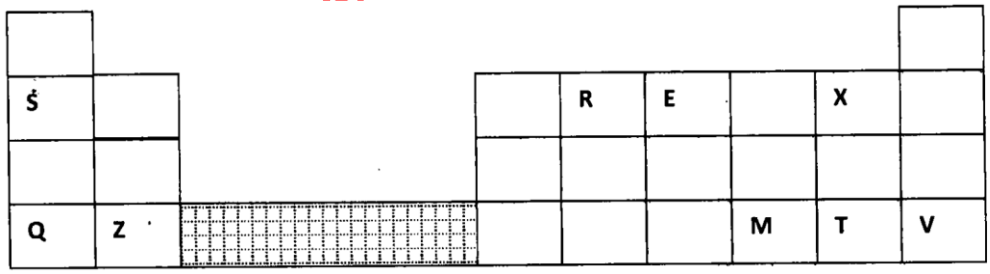
21. The structure below represents a cleansing agent.



a) State the type of cleansing agent represented above 1mk

b) State **one** advantage and one disadvantage of using the above cleansing agent. 2mks

22. The grid below represents part of the periodic table. Study it and answer the questions that follow:



(i) Identify the element that gains electrons most readily 1mk

(ii) Which of the metal is most reactive? Explain 1mk

(iii) What name is given to the family of elements to which elements **X** and **T** belong? 1mk

23. 3.52g of Carbon (IV) Oxide and 1.40g of water are produced when a mass of a hydrocarbon is completely burnt in oxygen. Determine the empirical formula of the hydrocarbon;(H = 1 , C= 12, O = 16) 3mks

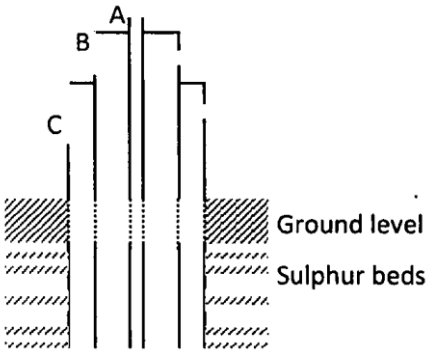
24. (a) Hydrogen can reduce coppers Oxide but not aluminium oxide. Explain 1mk

(b) When water reacts with potassium metal the hydrogen produced ignites explosively on the surface of water.

(i) What causes this ignition? 1mk

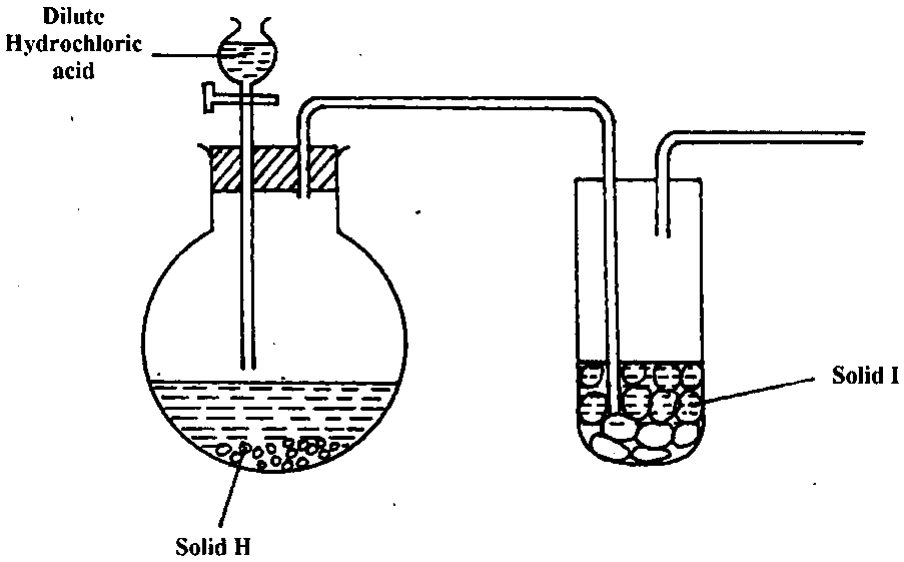
(ii) Write an equation to show how this ignition occurs 1mk

25. The diagram below shows the extraction of sulphur by Frasch process.



State the uses of pipes A, B and C. 3mks

26. The set-up below was used to prepare dry sample of hydrogen sulphide gas



(a) (i) Complete the diagram to show how the gas was collected 2mks

(ii) Identify the following:-

I. Solid H ½ mk II. Solid I ½ mk

27. Define the following terms:

a) Malleability. 1mk

b) Ductility. 1mk

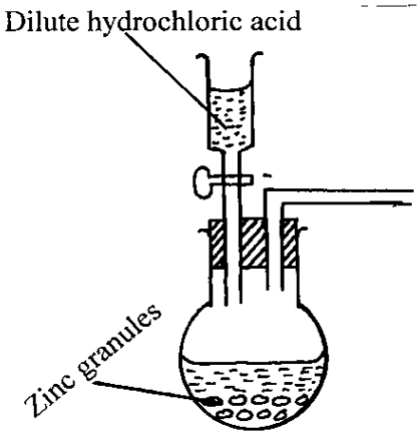
c) Give an example of element with the above properties. 1mk

BOKAKE JOINT EXAMINATIONS, 2023
233/2
CHEMISTRY
PAPER 2
(THEORY)
2 HOURS

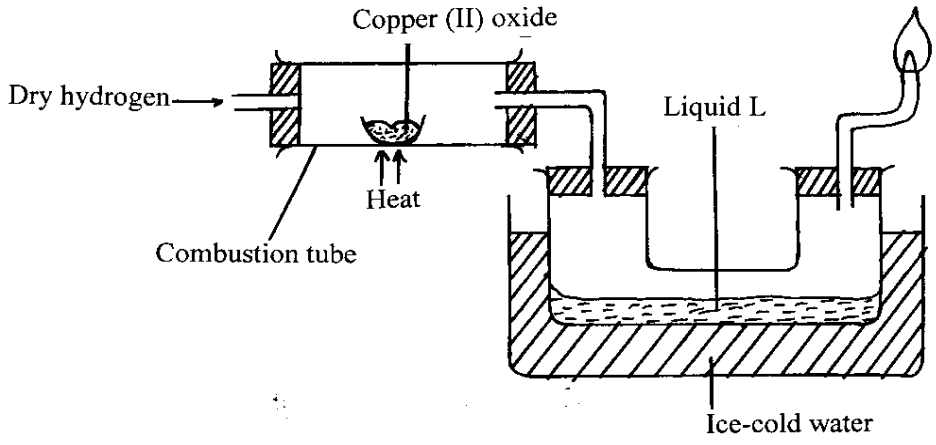
Instructions to candidates
(a) *Answer **all** the questions.*
(b) *Non-programmable silent electronic calculators and KNEC mathematical tables may be used.*
(c) *All working **must** be clearly shown where necessary.*

1. The set up below shows the reagents that can form hydrogen gas in a laboratory.

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

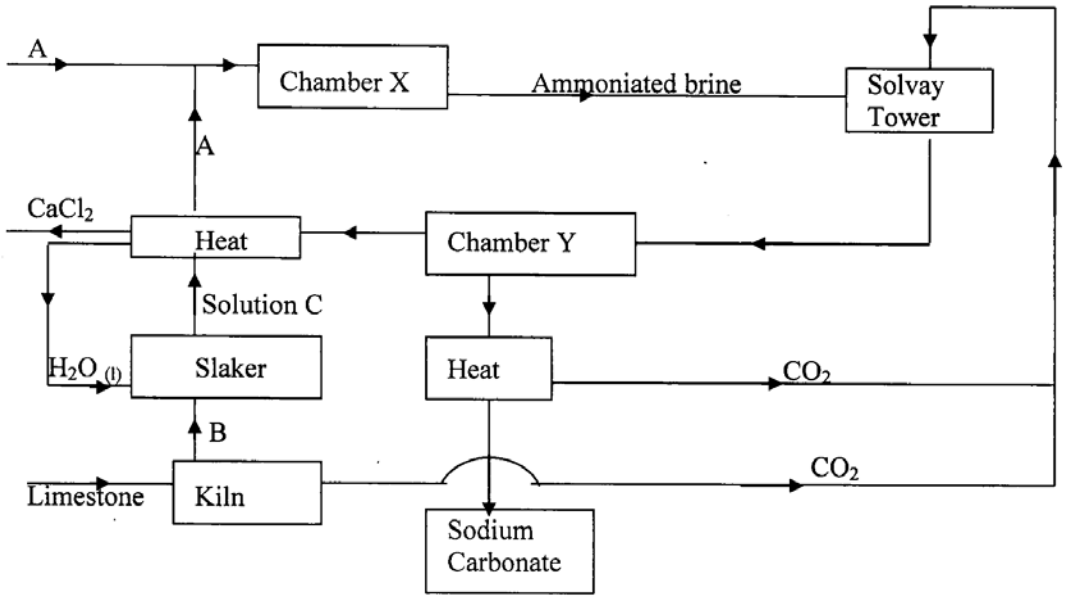


(b) Write the chemical equation for above reaction. (1 mark)
(c) Why is it not advisable to use calcium in this method to prepare hydrogen? (1 mark)
(d) Why is it advisable to discard the first jar of the gas collected? (1 mark)
(e) The set-up below was used to investigate some of the properties of hydrogen gas.



i) State the observation made in the combustion tube. (1 mark)
ii) Write down the equation leading to formation of liquid L. (1 mark)
iii) What property of hydrogen is being investigated? (1 mark)
iv) Why is potassium oxide not used to investigate this property of hydrogen gas? (1 mark
v) Hydrogen gas is used in hydrogenation of oils.
What do you understand by the term? hydrogenation? (1 mark)
vi) Give any two other industrial uses of hydrogen gas. (2 marks)

2. The chart below represents the main steps in the large-scale manufacture of sodium carbonate.



(a) Name substances A and B. (2 marks)

(b) Write down the chemical equation leading to formation of C. (1 mark)

(c) A stream of cold water is made to circulate around chamber X. What does this suggest about the reaction taking place. (1 mark)

(d) Name the process that takes place in chamber Y. (1 mark)

(e) State any two by-products recycled in the process. (2 marks)

(f) Give any two uses of sodium carbonate. (1 mark)

(g) In an experiment, wood charcoal was mixed with concentrated sulphuric (VI) acid in a test-tube. The mixture was then placed over a Bunsen-burner flame for some time.

(i) Write down the chemical equation of the reaction that takes place. (1 mark)

(ii) State the property of concentrated sulphuric (VI) acid investigated in (i) above. (1 mark)

3. a) Ethyne gas can be prepared in the laboratory by action of water on a certain compound M

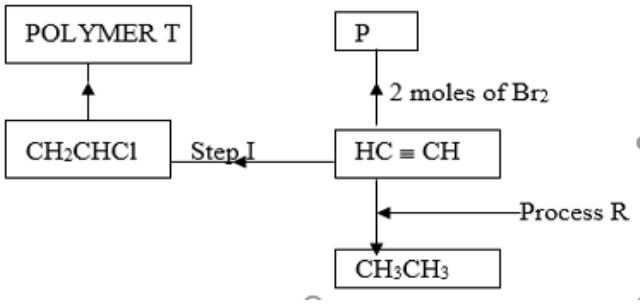
(i) Name compound M …… (1 mark)

(ii) Write an equation for the reaction taking place between compound M and water. (1mark)

(iii) Name the homologous series in which ethyne belongs. (1mark)

(iv) State one commercial use of ethyne. (1 mark)

(b) The scheme below represents some reactions of ethyne. Study it and answer the questions that follow.



i) Name compound P and draw its structural formula. (2 marks)

ii) Identify the reagents used in:

I) Process R (1 mark)

II) Step I (1 mark)

iii) Draw the repeating unit in polymer T. (1 mark)

iv) Name polymer T …….... (1 mark)

v) Give one use of polymer T (1 mark)

4. In the preparation of Copper carbonate, copper was burnt in air and the product collected. Dilute sulphuric acid was added and the mixture filtered and cooled. Sodium carbonate solution was added to the filtrate and the content filtered. The residue was washed and dried to give a green powder.

a) Give the chemical name of the product formed when Copper burns in air (1mk)

b) Write a chemical equation that leads to the formation of the green powder. (1mk)

c) i) Name filtrate collected after sodium carbonate was added (1mk)

ii) Name the green powder. (1mk)

d) Write chemical equation for the reaction between product in (a) and acid. (1mk)

e) Write an ionic equation to show the formation of the green powder (1mk)

f) Write an equation to show what happened when green powder is strongly heated. (1mk)

g) Using a diagram, describe how a salt can be obtained from the filtrate in c(i) above (3mks)

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

K	**L**				**M**		**N**	**P**
	Q		**R**	**S**		**T**	**V**	
W								

a) Name the family to which element P belongs. (1mark)

b) Which two elements will form carbonates that do not decompose on heating. (1 mark)

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

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

e) State two uses of element **R** and for each use, state property of element **R** that makes it possible for the use

(i) Use (1mark)

Property (½ mark)

(ii) Use (1 mark)

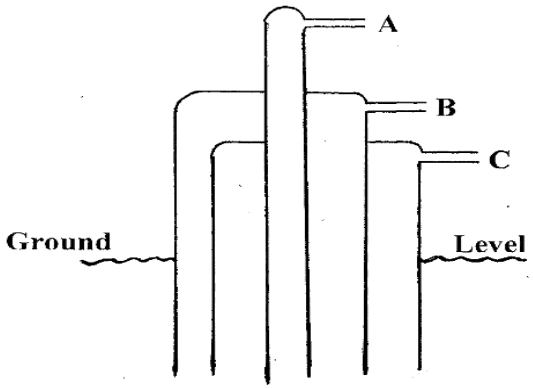
Property (½ mark)

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

g) In terms of structure and bonding, explain why the boiling point of the oxide of L is higher than that of N. (2 marks)

h) Calculate the volume of the gas produced when 1.95g of element W reacts with water (W= 39, Molar gas volume at S.T.P= 24,000cm^3) (2 marks)

6. (a) The diagram below represents the extraction of Sulphur by the Frasch process.



i) Identify and state the use of the substances that pass through tubes A and C. (2 marks)

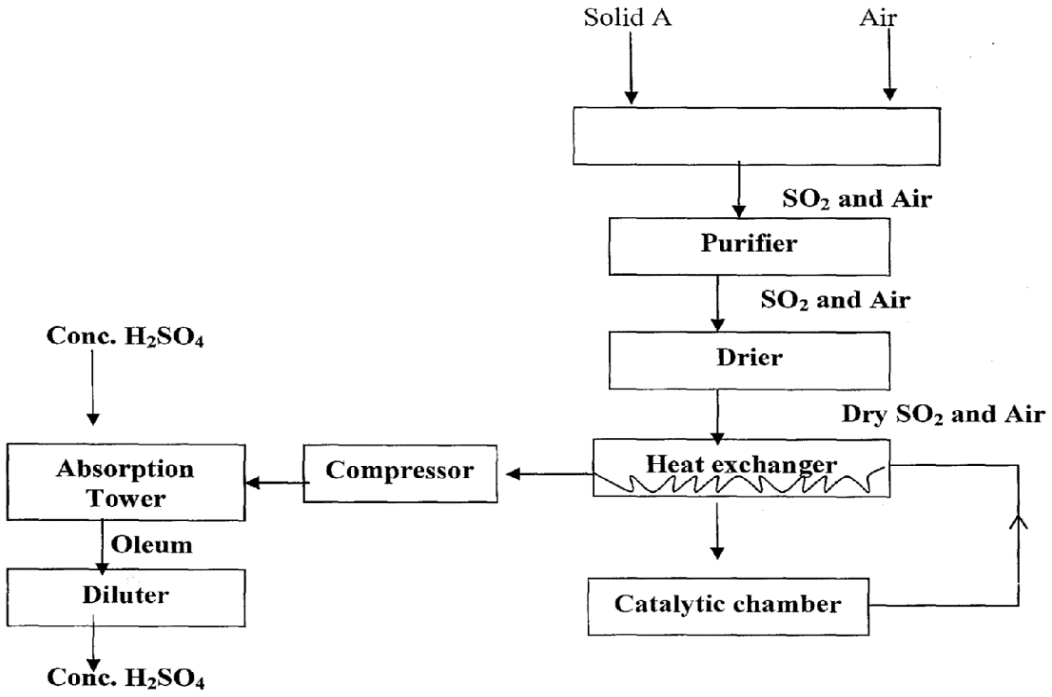
ii) Rhombic and monoclinic are allotropes of Sulphur. They are inter convertible as shown below

$$\text{Rhombic} \underset{}{\overset{\text{Rhombic}}{\rightleftharpoons}} \text{Monoclinic}$$

I. What does the temperature 96°C represent? (1 mark)

II. State the difference in crystalline appearances between rhombic and monoclinic crystals. (1 mark)

(b) The following scheme represents the steps followed in the contact process, study it and answer the questions which follow.



i) Name solid **A**. (1 mark)
ii) Name **two** impurities removed by the purifier. (1 mark)
iii) Why is it necessary to remove impurities? (1 mark)
iv) Write chemical equations for the reactions which occur in the;
Catalytic chamber (1 mark)
Diluter (1 mark)
v) State the optimum temperature used in the catalytic chamber. (1 mark)
vi) Why is sulphur (VI) oxide gas not dissolved in water directly. (1mark)

7. Equal masses (0.65g) of zinc granules and zinc powder were reacted in separate experiments with 2.0M hydrochloric acid. The volume of hydrogen liberated was measured at half-minute intervals and these volumes were measured at s.t.p. The results obtained are given in the table below.

Time (minutes)	**Volume of Hydrogen produced using zinc granules**	**Volume of Hydrogen produced using zinc powder.**
0.5	17	88
1.0	34	144
1.5	76	207
2.0	134	222
2.5	184	224
3.0	216	224
3.5	222	224
4.0	224	224

a) Plot the graphs of the volume of hydrogen produced against time using zinc granules and zinc powder respectively on the axis. (4 marks)
b) Which reaction has a greater initial rate? Explain your answer. (2 marks)
c) At what time is the rate of the two reactions the same? Explain. (2 marks)
d) What mass of zinc will be left after one minute in the reaction between zinc powder and hydrochloric acid. (molar volume at s.t.p = 22.4dm3, zn = 65) (2 marks)
e) On the same axis, draw a sketch of the graph that would be obtained if the zinc granules are reacted with 1.0M hydrochloric acid. (1 mark)

BOKAKE JOINT EXAMINATIONS, 2023

Kenya Certificate of Secondary Education

233/3

CHEMISTRY

Practical 3

Time 2 ¼ hours

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1. You are provided with the following
   - 4cm of magnesium ribbon
   - 2M hydrochloric acid solution A

   You are require to determine the rate of reaction of magnesium with hydrochloric acid

   PROCEDURE
   - Take four 100cm^3 plastic beaker and label them 1,2,3,4
   - To the first beaker, place 10cm^3 of 2M hydrochloric acid.
   - To the second beaker place 8cm^3 of acid and 2cm^3 of distilled water.
   - To the third beaker place 6cm^3 of acid and 2cm^3 of distilled water.
   - To the forth beaker place 4cm^3 of acid and 6cm^3 of distilled water.
   - Cut the magnesium ribbon into 4 parts of 1cm each
   - Place a piece of 1cm magnesium ribbon into the first beaker and start the stop watch

     Record the time taken for the magnesium ribbon to disappear completely. Record it in the table below. Repeat this procedure with beaker 2, 3 and 4 to complete the table. (4mks)

Beaker	**1**	**2**	**3**	**4**
Volume of acid (cm^3)	10	8	6	4
Volume of water (cm^3)	0	2	4	6
Time (second)				

a) Plot a graph of volume of acid (cm^3) against time (sec) in the graph provided. (3mks)

b) From the graph determine;
   i) Time taken for magnesium to disappear completely at 5cm^3 (1mk)
   ii) Volume of the acid in which magnesium takes 100 seconds to disappear completely (1mk)

c) The rate of reaction for the reaction at 100secs (2mks)

d) Name one factor been investigated above that can affect the rate of reaction (1mk)

B. You are provided with
- Solution B containing 4. 26g of potassium dichromate (VI) per litre ($K_2Cr_2O_7$)
- Solution C containing 39.2g of ammonium ferrous sulphate per litre $(NH_4)_2SO_4).FeSO_4.nH_2O$

You are required to:

1. Determine the concentration of solution B in moles per litre
2. Determine the value of n in the formula of compound C

PROCEDURE

Fill the burette with solution B. Pipette 25cm^3 of it and transfer into a conical flask. Titrate against C until the colour turns green. Record your results in the table below. Repeat this procedure to complete the table (4mks)

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

a) Determine the average volume of B used (1mk)

b) Calculate the concentration of solution B in moles per litre (K=39, Cr=52, O=16) (1mk)

c) Calculate the number of moles of B that reacted (1mk)

d) Given the equation

$Cr_2O_7^{2-} + 6Fe^{2+} + 14\ H^+ \longrightarrow Cr^{3+}_{(aq)} + 5\ Fe^{3+}_{(aq)} + 7H_2O_{(l)}$

(i) Calculate the concentration of C in moles per litre (1mk)

(ii) Calculate the RFM of C (1mk)

(iii) Determine the value of n in the formula of compound C (1mk)

2. You are provided with solid F

a) Put a spatula full of F in a test tube and heat strongly. Test any gas produced

Observation	inference
(2 marks)	(2 marks)

b) Place the remaining of F in a test tube and add $8cm^3$ of distilled water and shake. Divide into three portions

Observation	inference
(½ marks)	(½ marks)

c) To the first portion add 2 drops of NaOH Solution dropwise until in excess

Observation	inference
(1 mark)	(1 mark)

d) To the second portion, add two drops of Ammonium solution dropwise until in excess

Observation	inference
(1 mark)	(1 mark)

e) To the third portion, add 4 drops of dilute HCl and warm.

Observation	inference
(1 mark)	(1 mark)

3. You are provided with solid T

a) Put whole of solid T into a boiling tube and add $8cm^3$ of distilled water and shake well.

Observation	inference
(½ mark)	(½ mark)

Divide the solution into 3 equal portions

b) To the first portion add 3 drops of universal indicator paper, note the PH

Observation	inference
(1 mark)	(1 mark)

c) To the second portion add 3 drops of acidified, potassium manganate (VII) solution and warm

Observation	inference
(1 mark)	(1 mark)

d) To the third portion add $2cm^3$ of sodium carbonate solution

Observation	inference
(1 mark)	(1 mark)