FORM 4 END TERM 1 EXAMS CHEMISTRY

Class of KCSE March 2022.

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Name ……. **Index No……/……**

School……. **Candidate's sign……**

Date……

233/1

CHEMISTRY THEORY

PAPER 1

END TERM 1

2 Hours

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

INSTRUCTIONS TO CANDIDATES

1. **Answer ALL questions in the spaces provided**
2. **Mathematical tables and electronic calculators may be used.**
3. **All working MUST be shown clearly where necessary.**

FOR EXAMINERS USE ONLY

Maximum score	Candidate's score
80	

This paper consists of 13 printed pages. Candidates should check the questions to ensure that all pages are printed as indicated and no question(s) are missing

1. Study the information given below and use it to answer the questions that follow;

Red dye is more soluble than green dye, green is more soluble than yellow whereas blue dye is the least soluble.

i) Represent the three dyes on a round paper chromatography. **(2marks)**

ii) Name one industrial application of chromatography. **(1mark)**

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2. a) What is a fuel? **(1mark)**

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b) Calculate the heat value of ethanol if its molar enthalpy of combustion is-1360kjmol^{-1}
(C=12.0, O=16.0, H=1.0) **(2marks)**

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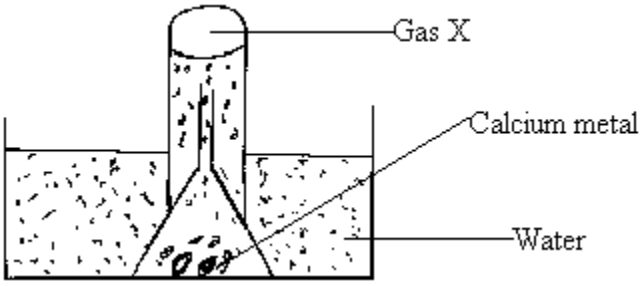
3. Study the set up below and use it to answer the questions that follow.



a) What physical property of calcium metal is demonstrated in the diagram above? **(1mark)**

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b) What would be observed if water was replaced with dilute Sulphuric (VI) acid? **(2marks)**

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4. A hydrocarbon decolorizes chlorine gas in presence of ultra violet light but does not decolorize acidified potassium manganate (VII) solution.

i) Name the homologous series to which the hydrocarbon belongs. **(1mark)**

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ii) Draw the structural formula and name the fourth member of the homologous series to which the hydrocarbon belongs? **(2marks)**

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5. Explain why a solution of hydrogen chloride in water turns blue litmus paper red but a solution of hydrogen chloride in methylbenzene has no effect on litmus papers. **(2marks)**

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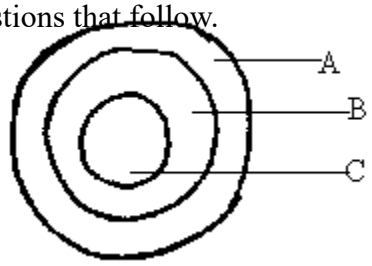
6. The diagram below represents a cross section of the apparatus used to extract sulphur from its deposits. Study it and answer the questions that follow.



a) State the role of the substance that is passed through;

i) A …….. **(1mark)**

ii) C…… **(1mark)**

b)Give one reason why the method shown in the diagram is suitable for extraction of sulphur. **(1mark)**

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7. Explain how you would obtain magnesium carbonate from a mixture of magnesium carbonate and sodium carbonate. **(2mark**

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8. 20g of potassium carbonate were dissolved in 50cm^3 of water in a conical flask. Lemon juice was then

added drop wise while shaking until there was no further observable change.

a) Explain the observation that was made in the conical flask when the reaction was in progress**. (1mark)**

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b) What observation would be made if lemon juice had been added to copper turnings in a conical flask? Give a reason. **(2marks)**

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9. Explain why a burning magnesium continues to burn in a gas jar full of carbon (IV) oxide while a burning candle would be extinguished. **(2marks)**

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10. 8.4g of carbon (IV) oxide and 3.42g of water are formed when a hydrocarbon is burnt completely in oxygen.

Determine the empirical formula of the hydrocarbon.

(H=1.0; C=12.0; O=16.0) **(3marks)**

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11. The melting point of nitrogen is -196^0C while that of sodium is 98^0C, in terms of structure and bonding explain the differences in the melting points of nitrogen and sodium. **(2marks)**

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12. a) What is an amphoteric substance? **(1mark)**

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b) Identify the reagent that acts as a base in the equation below. Give a reason for your answer.

$H_2O_{2(aq)} + H_2O_{(I)} \longrightarrow H_3^+O_{(aq)} + HO_{2(aq)}$ **(2marks)**

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13. In the industrial manufacture of ammonia gas by Harber process, Nitrogen and hydrogen gases are reacted together.

a) State any two conditions necessary for ammonia to be formed in the Harber process. **(1mark)**

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b) Nitrogen and hydrogen must be purified before they are reacted. Give a reason. **(1mark)**

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c) Other than manufacture of fertilizers state one use of ammonia. **(1mark)**

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14. Describe how you would prepare crystals of potassium sulphate starting with $100cm^3$ of 0.5M potassium hydroxide. **(3marks)**

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15. Distinguish between atomic mass and relative atomic mass. **(2marks)**

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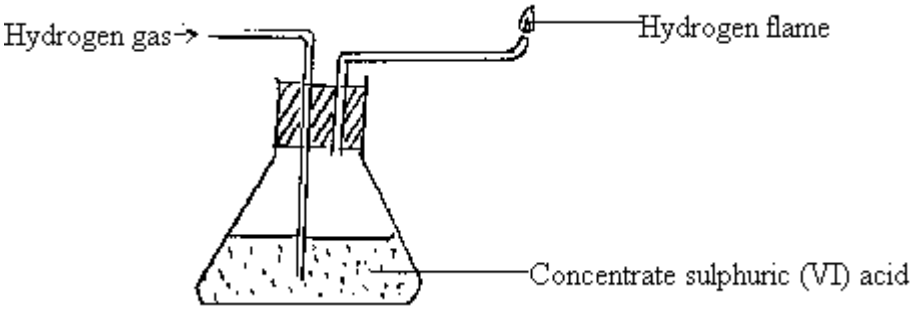
16. Study the diagram below and answer the questions that follow:



a) Name one chemical and one physical property of hydrogen being demonstrated in the set-up above.

i) Chemical property. **(1mark)**

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ii) Write a chemical equation for the reaction taking place. **(1mark)**

b) Name any other substance that can be used in place of concentrated sulphuric (VI) acid. **(1mark)**

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c) Give a reason why it is necessary to burn the hydrogen gas as shown in the set-up. **(1mark)**

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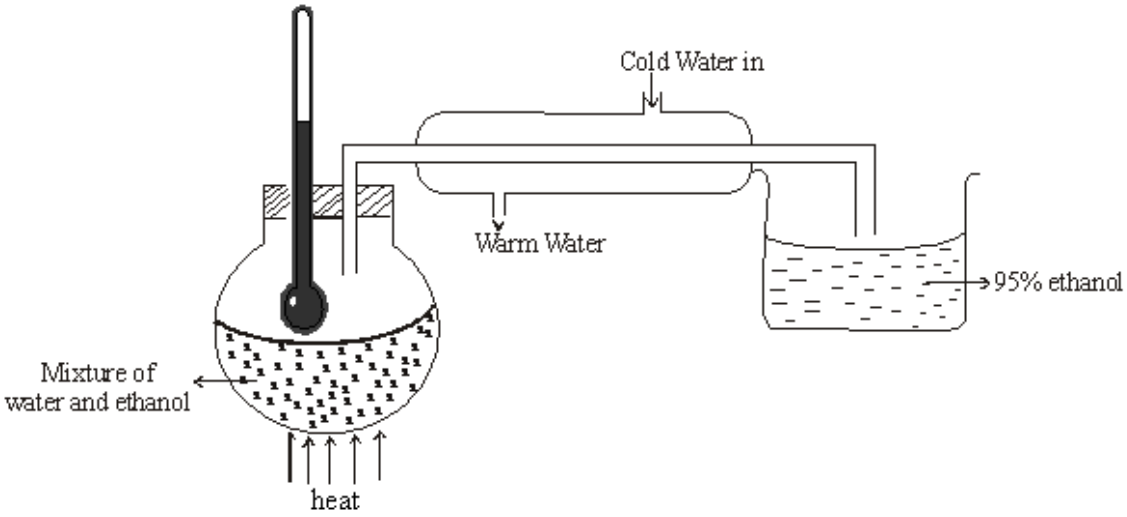
17. The diagram below shows a simple distillation to separate water and ethanol.



a) State one of the conditions for the above process to take place. **(1mark).**

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b) Ethanol collected is 95% pure. Secondary distillation is carried out in which calcium metal is placed in ethanol to react with water. Give a reason why the following cannot be used. **(2marks)**

i. Sodium

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ii. Copper……

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18. A solution of potassium chloride was added to a solution containing a lot of lead (II) nitrate. A precipitate that weighed 5.56g was formed. Find the amount of potassium chloride in the solution **(3marks)**

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19. 1.9g of Magnesium chloride was dissolved in water. Silver nitrate solution was added till excess. Calculate the mass of silver nitrate that was added for complete reaction. **(3marks)**
($MgCl_2$= 95, N=14, O=16, Ag = 108)

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20. In an experiment 40cm^3 of 0.5M nitric acid was reacted with excess Sodium Carbonate and the volume of Carbon (IV) Oxide produced recorded with time. In another experiment, the same volume and concentration of ethanoic acid was reacted with excess Sodium Carbonate and the volume of Carbon (IV) Oxide produced recorded with time.

a) Why was Sodium Carbonate used in excess? **(1marks)**

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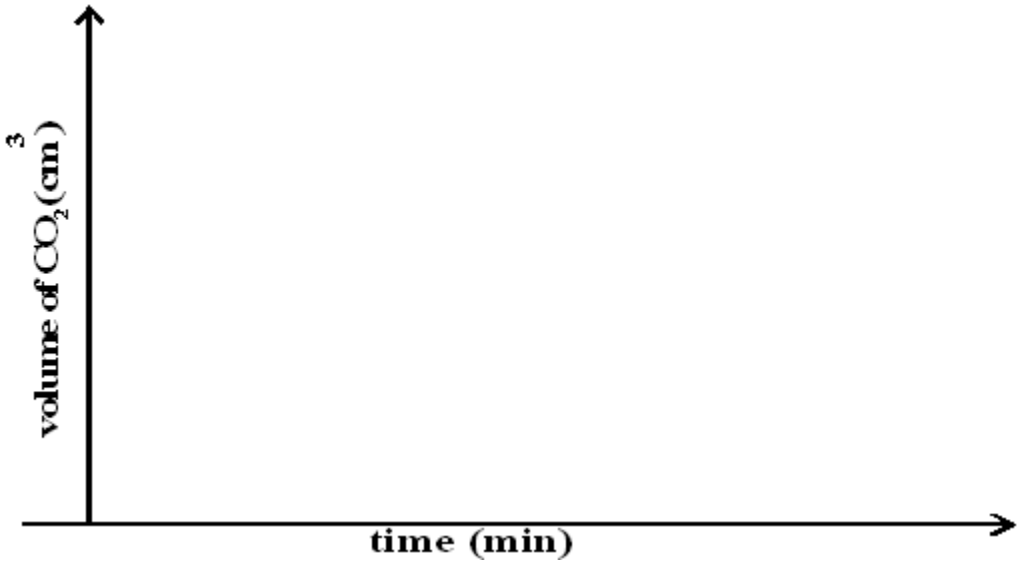
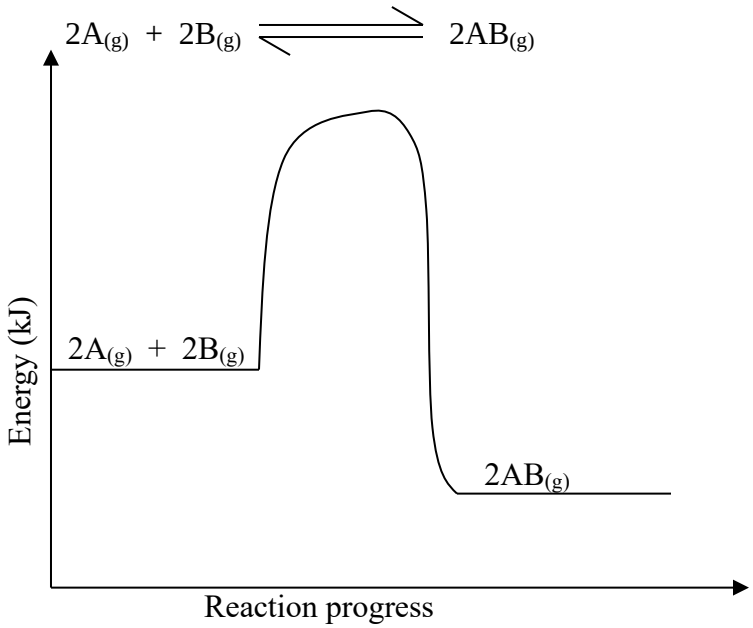
b) On the graph below sketch and label the curves of the volumes of Carbon (IV) Oxide produced against time. **(2marks)**



21. The figure below is an energy level diagram for the reaction.



Explain how the following conditions would affect the yield of AB.

(i) Increase in pressure. **(2marks)**

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(ii) Decrease in temperature. **(2marks)**

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22. A white solid K was heated. It produced a brown gas **A** and another gas **B** which relights a glowing splint. The residue left was yellow even after cooling.

a) Identify gases **A** and **B**. **(2marks)**

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b) Write a balanced chemical equation for the decomposition of solid K. **(1mark)**

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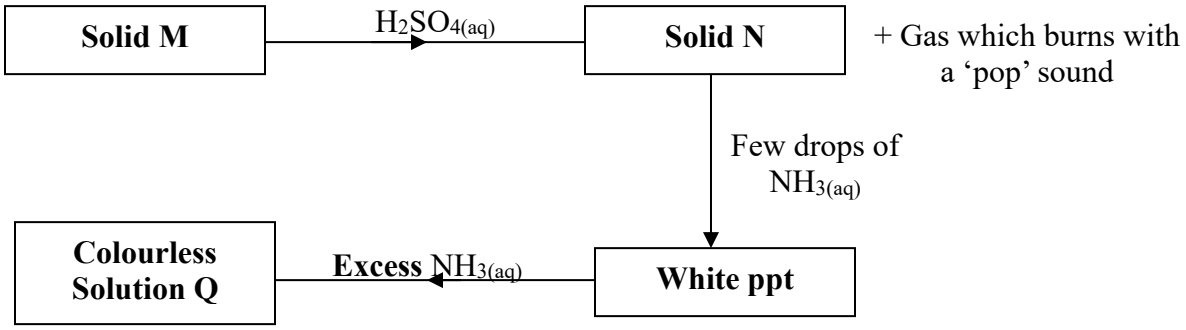
23. The scheme below shows some reaction sequence starting with solid M.



a) Name solid **M**. **(1mark)**

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b) Write the formula of a complex ion present in solution **Q**. **(1mark)**

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Write an ionic equation of the reaction between barium nitrate and solution **N**. **(1mark)**

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24. (a) What is meant by a saturated solution? **(1mark)**

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(b) In an experiment to determine the solubility of solid Y in water at 30^0C the following results were obtained.

Mass of evaporating dish	=	26.2g
Mass of evaporating + saturated solution	=	42.4g
Mass of evaporating dish + dry solid Y	=	30.4g

Using the information, determine the solubility of solid Y at 30^0C. **(2marks)**

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25. Compare the electrical conductivity of dilute Sulphuric (VI) acid and concentrated Sulphuric (VI) acid. Explain your answer. **(2marks)**

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26. Draw a well labelled diagram of a setup used to prepare and collect dry Sulphur IV oxide. **(3marks)**

27. The molar heat of formation of carbon (II) oxide is -105kJmol^{-1}, molar heat of combustion of carbon

is -393kJmol^{-1}.

By using an energy cycle diagram, determine the molar heat of combustion of carbon (II) oxide.

(3marks)

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28. In an experiment, a small amount of charcoal was added into a test tube and 5cm^3 of concentrated nitric (V) acid added, then warmed.

(i) State the observation that was made. **(1mark)**

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(ii) Explain the observation made in (i) above. **(1mark)**

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

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Name…… ……..…**Adm No**:……..

233/2
CHEMISTRY
PAPER2
THEORY
END TERM 1
TIME: 2 HOURS

Candidate's Signature ……..……
Date: ……..

Kenya Certificate of Secondary Education (K.C.S.E.)
233/2
Chemistry
Paper 2
2 Hours

INSTRUCTIONS TO CANDIDATES

- Write your name and Index number in spaces provided above.
- Sign and write the date of examination in the spaces provided above
- Answer all the questions in the spaces provided above.
- KNEC Mathematical tables and silent electronic calculators may be used.
- All working must be clearly shown where necessary.
- Candidates should answer the questions in English.

For Examiners Use Only

Question	**Maximum score**	**Candidate's score**
1	12	
2	13	
3	12	
4	12	
5	10	
6	13	
7	08	
Total score	**80**	

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

1. (a) Define the following terms:

i) Strong bases (1mk)

ii) Amphoterism (1mk)

iii) Solubility (1mk)

b) Using the equation below, identify the species that acts as the base in the forward reaction. Give a reason. (2mks)

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

c) A solution of ammonia gas in water causes a greater deflection of the ammeter while a solution of ammonia gas in methylbenzene does not cause deflection. Explain this observation. (1mk)

d) Write a well-balanced chemical equation for the reaction between sodium hydroxide solution and zinc oxide. (1mk)

e) Explain how hard water is softened by ion exchange method. (2mks)

f) The table below gives the solubilities of sodium chloride and sodium sulphate at 0°C and 40 °C.

Substance	Solubility in g/100g of water	
	0 °C	40 °C
Sodium chloride	55	75
Sodium sulphate	10	12

When an aqueous mixture containing 60g of sodium chloride and 7g of sodium sulphate in 100g of water at 80 °C was cooled to 0 °C, some crystals were observed.

i) Identify the crystals and determine the mass of the crystals formed. (2mks)

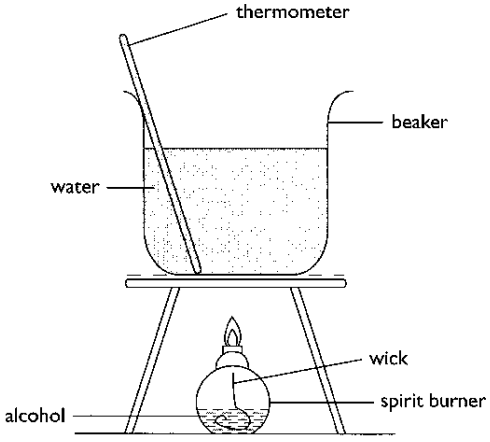
ii) Name the method used to obtain the crystals. (1mk)

2. a) Define

i) Molar heat of combustion. (1mk)

ii) Heating value of a fuel. (1mk)

b) In an experiment to determine the heat of combustion of ethanol. CH_3CH_2OH, a student set up apparatus as shown in the diagram below. Study the set up and the data and answer the questions that follow.



Volume of water	=	$100cm^3$
Final temperature of water	=	36.0^0c
Initial temperature of water	=	22.0^0c
Final mass of lamp an ethanol	=	84.75g
Initial mass of lamp and ethanol	=	85.10g
Density of water	=	1 g/cm^3

(Specific heat capacity of water = $4.2kJKg^{-1}K^{-1}$)

i) Calculate:

I) Number of moles of ethanol used in this experiment. (C=12, O=16, H=1)(1 mk)

II) The amount of heat given outin this experiment. (2mks)

III) The heat of combustion per mole of ethanol. (1 mk)

ii) Write a thermochemical equation for the combustion of ethanol. (1 mk)

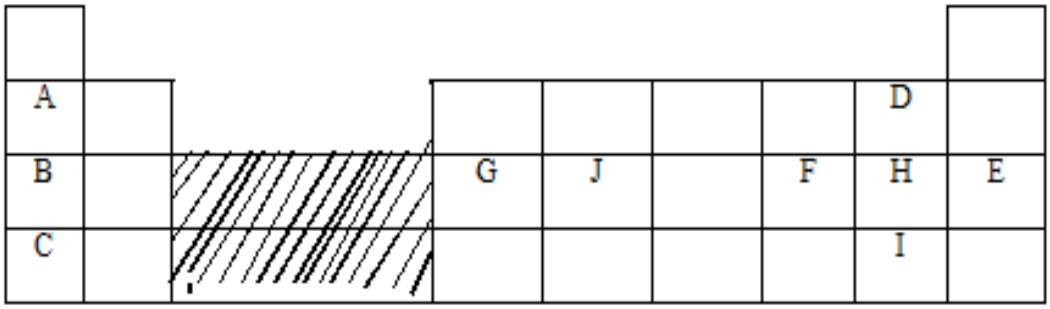
iii) Explain how the molar heat of combustion for ethanol obtained above differs with the theoretical value. (2mks)

iv) State one precaution that should be adhered to when carrying out this experiment. (1mk)

v) In this experiment an assumption that links ethanol and water is made. State the assumption. (1 mk)

vi) Draw an energy level diagram for the combustion of ethanol. (2mks)

3. The figure below represents a section of the periodic table. Study it and answer the questions that follow. Note that the letters do not represent the actual symbols of the elements.



(a) Consider elements H and I.

(i) Explain why theatomic radius of element H is smaller than its ionic (1mk)

(ii) When element H was dissolved in water and blue litmus papers dipped, the colour of the litmus paper changed from blue to red to white. Explain. (2mks)

(iii) Explain what is likely to be observed when element H is bubbled through a solution containing the ions of element I. (2mks)

(b) Compare the atomic radius of elements G and J. Explain the difference. (2mks)

(c) Use dot and cross diagram to show bonding in a compound of B and H. (1mk)

(d) G chloride has an unexpected bond type and structure.State the type of bond and the structure.

Bond type (lmk)

Structure (lmk)

(e) A piece of blue litmus paper is placed in a solution of B chloride and a solution of G chloride. Explain what would be observed in each case.

(i) B chloride solution (lmk)

(ii) G chloride solution (1mk)

4. In an experiment to study the rate of reaction, 2.5g of copper (II) sulphate crystals were added to a given mass of zinc granules and 100cm^3 dilute hydrochloric acid at 27^{o}C. The volume of hydrogen released was measured at 10 second intervals. The results obtained are tabulated below.

Time (seconds)	0	10	20	30	40	50	60	70	80	90
Volume (cm^3)	0	60	85	105	114	116	118	122	122	122

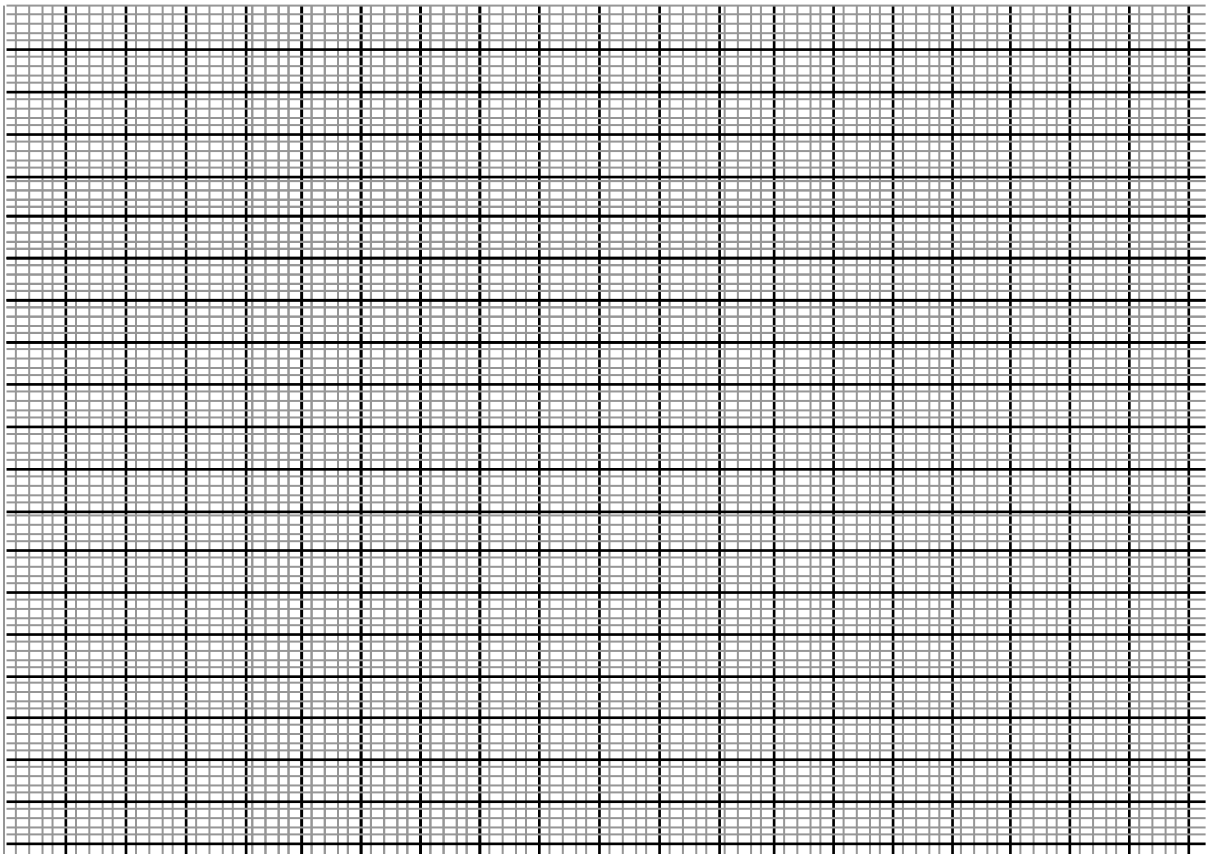
a) Why were the following not used in the reaction?

i) Nitric (V) acid (1mk)

ii) Iron powder (1mk)

iii)

b) On the grid below plot a graph of volume of gas against time and label it X (3mks)



i) Use the graph to calculate the rate of reaction at t=25seconds (2mks)

ii) Explain why the volume of gas produced does not exceed $122cm^3$ (1mk)

iii) Sketch graph Y on the same grid to show the results if the experiment is repeated at 20^oC. (1mk)

iv) How does the catalyst used (copper (II) sulphate) speed up the reaction? (1mk)

c) i) State Le'Chatelier's principle. (1mk)

ii) What is the effect on the position of equilibrium when dilute hydrochloric acid is added to the closed system of the reaction below (1mk)

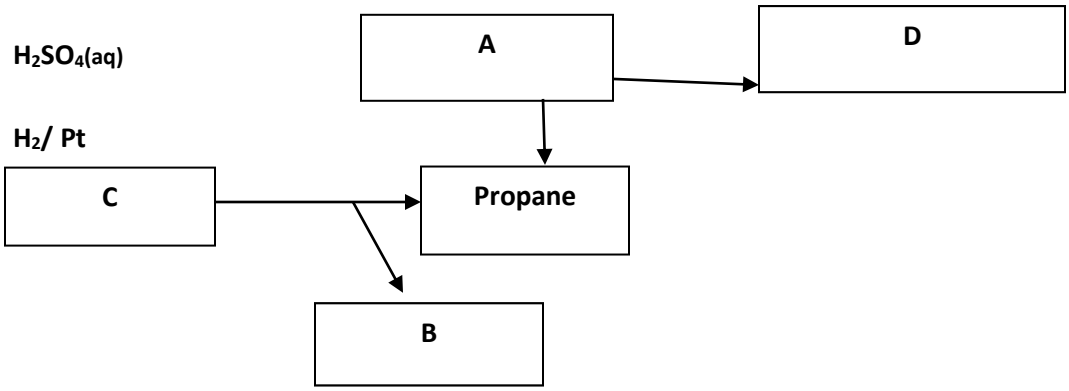
$$NH_{3\,(g)} + H_2O_{\,(l)} \rightleftharpoons NH_4^+{}_{(aq)} + OH^-{}_{(aq)}$$

5. (a) Give the IUPAC names of the following organic compounds. (2 mks)

(i)
$$CH_3 - CH_2 - \underset{\displaystyle CH - CH_3}{\underset{|}{CH}} - \underset{\displaystyle CH_3}{\underset{|}{CH_3}}$$

(ii) $CH_3 - C \equiv C - CH_3$

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



(i) Identify substances (2mks)

A

B

C

D

(ii) State how substance A and propanecould be distinguished chemically. (1 mk)

(iii) Give the components of soda lime in step I (2mks)

(iv) What is the industrial application of the process that converts substance A to propane? (1mk)

(c) In the laboratory propene can be prepared using propanol, broken porcelain and sodium hydroxide. State the use of broken porcelain and sodium hydroxide solution

Broken porcelain (1mk)

Sodium hydroxide solution (1mk)

6. a) Draw a fully labeled diagram of the apparatus you would use to electrolyse an electrolyte in the aqueous state. (3mks)

b) Explain why crystals of sodium chloride are non-conductorsof electricity butwhen melted they conducts electric current more readily. (2mk)

c) Answer the following questions in relation to the electrolysis of molten lead (II) iodide.

i) State what happens to molten lead (II) iodide when an electric current is passed through it. (1mk)

ii) At what electrode is a metal formed? Write an equation to show how the metal is formed. (2mks)

iii) Why is it necessary to carry out this experiment in a fume chamber? (1mk)

iv) What is a binary electrolyte? (1mk)

c) Give the application of electrolysis in

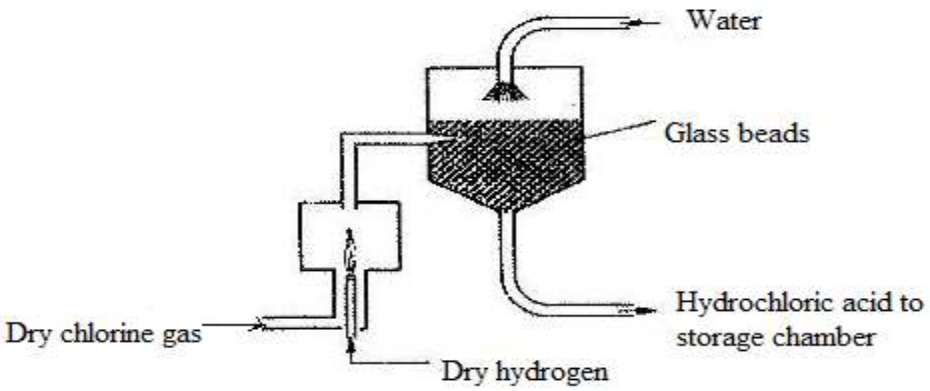
i) Chemical manufacturing industry (1mk)

ii) Metal extraction industries (1mk)

iii) Jewellery e.g. necklaces manufacturing industries (1mk)

7. The diagram below represents the industrial manufacture of hydrochloric acid. Study it and answer the

questions that follow.



a) Name the main source of hydrogen in this process. (1mk)

b) The reaction between chlorine and hydrogen can be very explosive. How can this be avoided? (1mk)

c) What is the role of glass beads in the absorption chamber? (1mk)

d) Explain why the storage chamber for hydrochloric acid is made up of steel lined with rubber. (1mk)

e) The acid obtained is 35% pure. Calculate its molarity, given that at 25^{o}C, the density of the acid is 1.08g/cm^{3} (H=1, Cl=35.5) (3mks)

f) Explain why hydrochloric acid is not used to acidify potassium manganate (VII) solution.(1mk)

233/3

CHEMISTY PAPER 3

CONFIDENTIAL

END TERM 1

KENYA CERTIFICATE OF SECONDARY EDUCATION (KCSE)

CONFIDENTIAL

Each candidate requires

1. Solution A, 60cm^3 of 2mHCl.
2. Solution B, 100cm^3 of 0.05MNaOH
3. Solid C, 10cm magnesium ribbon.
4. 10ml measuring cylinder
5. 25ml pipette
6. 50ml Burette
7. Complete stand
8. Stopwatch
9. 2 labels
10. Distilled water
11. 6 test tubes.
12. 0.5g sodium hydrogen carbonate.
13. 5cm3 ethanol.
14. 1 – 14 PH chart.
15. Solid R, 1g Oxalic acid.
16. Solid Q, Mixture of $(NH_4)_2SO_4$ and $Al_2(SO_4)_3$ (ration 1:1)
17. Pipette filler
18. Phenolphthalein indicator
19. 250ml conical flask (2)
20. 250ml volumetric flask
21. 1 boiling tube
22. 1 spatula

ACCESS TO:

23. Universal indicator solution
24. Acidified potassium manganite (VII) solution
25. Bromine water
26. Conc. Sulphuric (VII) acid with a dropper.
27. Means of heating.
28. 2M Lead (II) nitrate solution.
29. 2M dilute nitric (V) acid solution
30. 0.5m Barium nitrate solution
31. 2M sodium hydroxide solution.
32. 2M Aqueous ammonia.
33. 2M Hydrochloric acid.

NAME: …….. INDEX.NO: ……..……

SCHOOL: ……CANDIDATES SIGN: ……..…..…

DATE: ……

233/3

CHEMISTY PAPER 3
PRACTICAL
END TERM 1

KENYA CERTIFICATE OF SECONDARY EDUCATION (KCSE)

Instructions to candidates

1. *Write your name, index number and school in the spaces provided above.*
2. *Sign and write the date of examination in the spaces provided above.*
3. *Answer **ALL** the questions in section in the spaces provided.*
4. ***ALL** working **MUST** be clearly shown.*

FOR EXAMINERS USE ONLY

QUESTION	**MAXIMUM SCORE**	**CANDIDATE SCORE**
1 2 3	18 12 ½ 9 ½	
TOTAL	**40**	

1. You are provided with:
    - Solution A, Dilute hydrochloric acid
    - Solution B, made by dissolving 0.5g of sodium hydroxide in water and made to 250cm^3 of solution
    - Solid C, Magnesium ribbon
    - Phenolphthalein in indicator

You are required to:

(i) Standardize solution A
(ii) Determine the rate of reaction between solution A and magnesium

PROCEDURE

(i) Measure exactly $10cm^3$ of solution A using a burette and transfer into a 250ml volumetric flask. Top up to the mark using distilled water. Label this solution D.
(ii) Drain the remaining solution A in the burette, rinse the burette thoroughly and fill the burette with solution D.
(iii) Pipette $25cm^3$ of solution B into a conical flask. Add three drops of phenolphthalein indicator
(iv) Titrate solution D with solution B. Record your results in the table below. Repeat procedure (i) to (iv) to complete the table. (3 marks)

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

(a) Calculate the average volume of solution D used (1 mark)

(b) Calculate:
(i) Number of moles of solution B used (1½ marks)

(ii) Number of moles of solution D in 250cm3 of solution (1½ marks)

(iii) Morality of solution A (1 mark)

PROCEDURE II

(i) Cut solid C into equal pieces, each 2cm long.

(ii) Using a burette, measure $12cm^3$ of solution A, into a clean boiling tube.

(iii) Drop one piece of solid C into the boiling tube containing solution A and start stopwatch immediately. Stop the stopwatch when all solid C has just reacted. Record your results in the table below.

(iv) Repeat steps (ii) and (iii) above using 10cm3, 8cm3, 6cm3 and 4cm3 of solution A. Top up each with distilled water to make 12cm3 of solution and complete the table below. (4 marks)

Volume of solution A (cm^3)	Volume of distilled water (cm^3)	Concentration of solution a (moles/l	Time(s)	$\frac{I}{t}(s^{-1})$
12	0			
10	2			
8	4			
6	6			
4	8			

(a) Plot a graph of $\frac{I}{t}(y-axis)$ against the concentration of solution A (3 marks)

(b) From the graph, determine the time taken for the reaction to reach completion when 1.5 moles of solution A are used (2 marks)

(c) Comment on the shape of the graph (1 mark)

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

(a) Strongly heat a spatula-end full of solid Q in a dry test tube (1 mark)

Observation	Inference

(b) (i) Place the remaining solid Q in a boiling tube. Add 10cm3 of distilled water. Divide the solution into five portions. (2 marks)

Observation	Inference

(ii) To the first portion, add aqueous lead (II) nitrate solution (1 mark)

Observation	Inference

(iii) To the second portion add dilute nitric (V) acid, followed by barium nitrate solution (2marks)

Observation	inference

(iv) To the third portion add a few drops of sodium hydroxide until excess observation (2marks)

Observation	Inference

(v) To the fourth portion, add a few drops of aqueous ammonia until is excess. (2 marks)

Observation	Inference

(vi) To the fifth portion, add a few drops of hydrochloric acid (1½ marks)
Warm the contents.

Observation	Inference

3. You are provided with solid R. carry out the tests below and record your observations and inferences.
   (a) Place a spatula-end full of solid R in a dry boiling tube and add about $10cm^3$ of distilled water. Shake thoroughly and heat to boil. Divide the solution into five portions.
   (1½ marks)

Observation	inference

(b) (i) Test the first portion with the universal indicator solution provided. (1½ marks)

Observation	Inference

(ii) To the second portion, add a few drops of acidified potassium manganite (VII) solution (2 marks)

Observation	Inference

(iii) To the third portion, add a few drops of bromine water (2 marks)

Observation	Inference

(iv) To the fourth portion, add half spatula of sodium hydrogen carbonate (1 mark)

Observation	Inference

(v) To the fifth portion in a boiling tube, add 5cm3 of ethanol followed by a few drops of concentrated sulphuric (VI) acid. Warm the mixture. (1 ½ Marks)

Observation	Inference