NAME…….. INDEX NO…….....

233/1 **CANDIDATE'S SIGN……..……..**
CHEMISTRY
PAPER 1 **DATE……..……**
(THEORY)
JULY/AUGUST, 2015
TIME: 2 HOURS

KIRINYAGA CENTRAL SUB-COUNTY JOINT EXAMINATION - 2015

Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 1
(THEORY)
TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

(i) Write your **name** and **index number** in the spaces provided **above**.
(ii) **Sign** and write the **date** of examination in the spaces provided **above**.
(iii) Answer **ALL** the questions in the spaces provided.
(iv) Mathematical tables and silent electronic calculators **may be** used.
(v) All working **must be** clearly shown where necessary.
(vi) Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing

For Examiner's Use Only

Questions	Maximum Score	Candidate's Score
1 – 30	80	

This paper consists of **12** printed pages. Candidates should check to ascertain that all the pages are printed as indicated and that no questions are missing.

1. Element A and B with atomic numbers 12 and 17 respectively react together.
   (a) Write the electronic configurations of each.

   A _____ (1 mark)

   B _____ (1 mark)

   (b) Write the formula of the compound formed between A and B.

   _____

2. When a compound X was heated, a brown gas and a black residue were produced. Give the formula of:
   (i) the brown gas. _____ (1 mark)

   (ii) the black residue. _____ (1 mark)

3. $20cm^3$ of a dibasic acid required $25cm^3$ of 0.1M NaOH for complete neutralization.
   (a) How many moles of sodium hydroxide reacted with the dibasic acid? (1 mark)

   _____

   _____

   (b) Calculate the concentration of the dibasic acid in moles per litre. (2 marks)

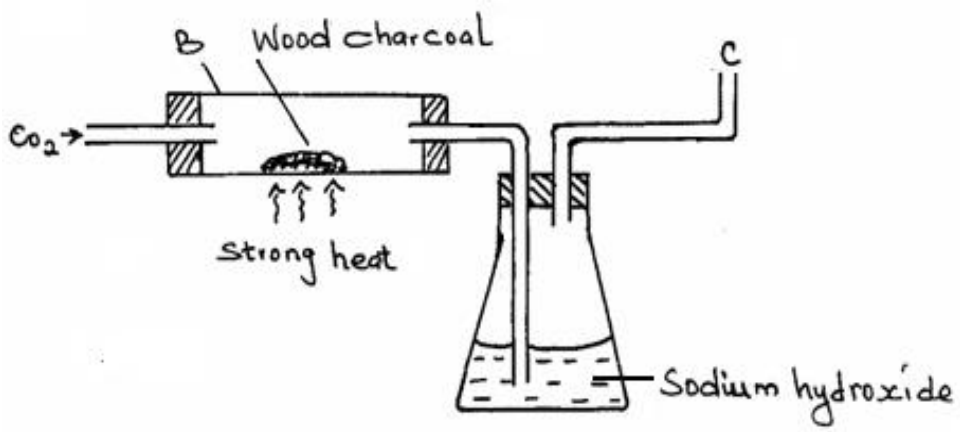
   _____

   _____

   _____

   _____

4. The set-up was used to prepare carbon (IV) oxide and investigate its properties.



   (a) Write an equation for the reaction in vessel B. (1 mark)

   _____

(b) What is the role of sodium hydroxide solution in the set-up? (1 mark)

_____

(c) What would be observed if a burning splint is introduced at jet C? (1 mark)

_____

5. Write down the property of concentrated sulphuric (VI) acid shown in the following reactions.

(a) $H_2C_2CO_4.2H_2O_{(S)} \xrightarrow{H_2SO_{4(l)}} 2H_2O_{(l)} + CO_{2(g)} + CO_{(g)}$

Property _____ (1 mark)

(b) $C_{(S)} + 2H_2SO_{4(S)} \rightarrow CO_{2(g)} + 2H_2O_{(l)} + 2SO_{2(g)}$

Property _____ (1 mark)

6. When $25cm^3$ of 0.5M HCl is added to $25cm^3$ of 0.5M NaOH the temperature of the solution rose from 23°C to 26°C. Given that the density of the solution is $1gcm^{-3}$ and its specific heat capacity is $4.2Jg^{-1}K^{-1}$.

(a) Determine the amount f heat evolved that caused the temperature rise. (1 mark)

_____

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

_____

_____

_____

_____

7. The empirical formula of a compound is CH_2 and its molecular mass is 42.

(a) What is the molecular formular of this compound? (1 mark)

_____

_____

_____

_____

(b) To which group of hydrocarbons does the compound above belong? (1 mark)

_____

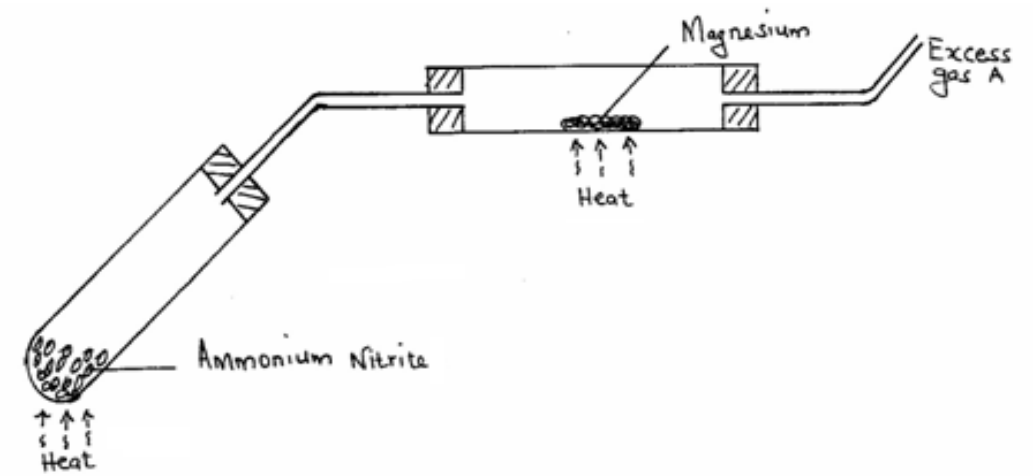
(c) Draw the structural formula of the fourth member of this series and give its IUPAC name. (1 mark)

_____

_____

_____

8. The set-up below shows how gas A was prepared and reacted with heated magnesium.



(a) Give a reason why it is not advisable to heat magnesium before heating ammonium nitrite. (1 mark)

_____

_____

_____

(b) (i) Identify gas A. (1 mark)

_____

(ii) Write a chemical equation for the reaction between gas A and magnesium. (1 mark)

_____

_____

9. In the down's process (used for extraction of sodium) a certain salt is added to lower the melting point of sodium chloride from 800°C to about 600°C.

(i) Identify the salt added. (1 mark)

_____

(ii) Why is it necessary to lower the temperature? (1 mark)

_____

_____

_____

(iii) Give **one** use of sodium. (1 mark)

_____

_____

_____

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. (3 marks)

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

11. (a) State Graham's Law of diffusion. (1 mark)

_____

_____

_____

(b) 100cm³ of sulphur (IV) oxide takes 20 seconds to diffuse through a porous plate. What volume of oxygen gas would diffuse through the same plate in 30 seconds under similar conditions. (S = 32, O = 16). (2 marks)

_____

_____

_____

_____

_____

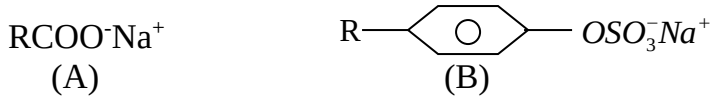
_____

12. Element X contains isotopes with mass number 16 and 18 respectively existing in the ratio 1:3 calculate the relative atomic mass of X. (2 marks)

_____

_____

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



(A) (B)

(a) Identify the cleansing agent B. (1 mark)

_____

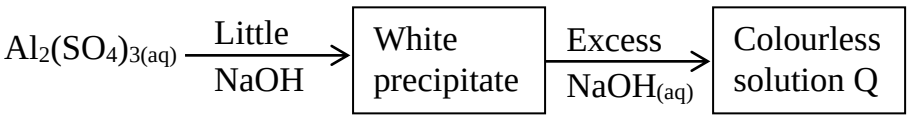
(b) Which cleansing agent would be more suitable for washing in water containing magnesium sulphate? Explain. (2 marks)

_____

_____

_____

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



(a) Write an ionic equation for the formation of the white precipitate. (1 mark)

_____

_____

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

_____

15. Study the table below and use it to answer the questions that follow.

Solution	PH
A	3.5

B	14
C	8.5

(i) In which of the solution will phenolphthalein indicator be colourless. (1 mark)

_____

(ii) Which of the solutions could be used to relieve heartburn? Explain. (2 marks)

_____

_____

_____

16. Starting with dilute sulphuric (VI) acid, dilute nitric (V) acid and lead (II) carbonate powder, describe how you can prepare a dry sample of lead (II) sulphate. (3 marks)

_____

_____

_____

_____

_____

17. (a) 384g of radioactive element was reduced to 48g in 540 days. Determine the half-life of X. (2 marks)

_____

_____

_____

_____

(b) Give **one** use of radioactive isotopes in industries. (1 mark)

_____

_____

_____

18. The diagram below is a set-up of apparatus used to react ammonia gas with iron (IV) chloride solution.

(a) State the observation made in the beaker after a few minutes. (1 mark)

_____

(b) Explain why the funnel is used to deliver the ammonia into the solution. (1 mark)

_____

_____

_____

19. (a) A mass of 40g of a saturated solution of potassium chlorate at 25°C yields 14g of potassium chlorate when evaporated to dryness. Calculate the solubility of potassium chlorate at 25°C. (2 marks)

_____

_____

_____

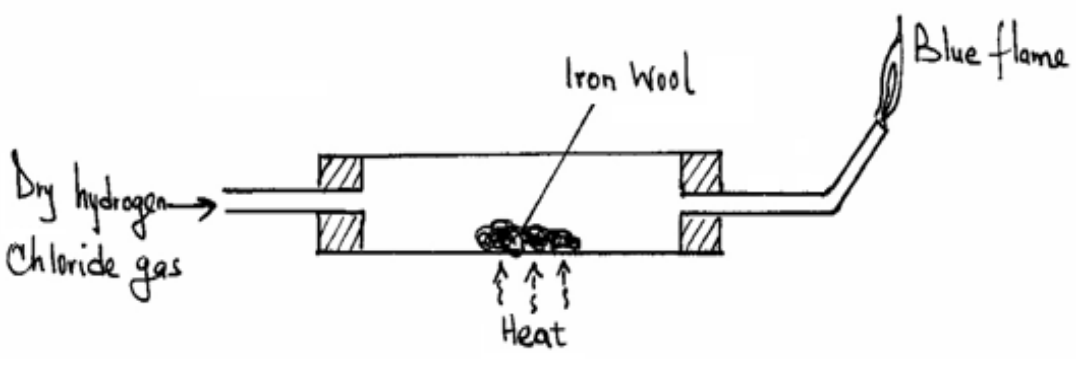
_____

(b) State **one** advantage of hard water. (1 mark)

_____

_____

20. Dry hydrogen chloride gas was passed over heated iron wool as shown below.



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

_____

(b) Write the equation for the reaction taking place:-

(i) In the combustion tube. (1 mark)

_____

_____

(ii) Leading to production of the blue flame. (1 mark)

_____

_____

21. A dry cell is constructed using the following substances. Zinc metal, graphite rod, ammonium chloride paste and manganese (IV) oxide mixed with carbon powder.

(a) State the roles of:

(i) ammonium chloride paste. (1 mark)

_____

_____

_____

(ii) Manganese (IV) oxide mixed with carbon powder. (1 mark)

_____

_____

_____

(b) Given that: $2NH_{4(aq)}^{+} + 2e^{-} \rightarrow 2NH_{3(g)} + H_{2(g)} \quad E^{\theta} = 0.74V$

and $Zn_{(aq)}^{2+} + 2e^{-} \rightarrow Zn_{(S)} \quad E^{\theta} = -0.76V$

Calculate the e m f of the cell given zinc forms the negative electrode. (1 mark)

_____

22. 1.26g of lead powder were dissolved in excess nitric (VI) acid to form lead nitrate solution. All the lead nitrate solution was reacted with sodium sulphate solution.

(a) Write an ionic equation for the reaction between lead nitrate and sodium sulphate solutions. (1 mark)

_____

_____

(b) Determine the mass of lead salt formed in
(a) above (Pb = 207, S = 32, O = 16). (2 marks)

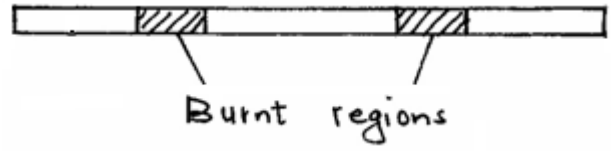
_____

_____

_____

_____

23. The figure below shows a burning splint that was put across the middle of a non-luminous flame. Explain the results. (2 marks)



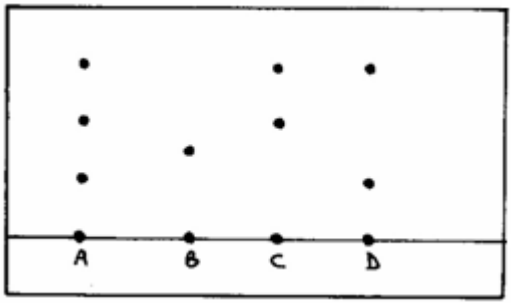
_____

_____

_____

_____

24. The following chromatogram was obtained in an experiment to investigate the components present in certain dyes.



(a) Which two dyes when mixed would produce A? (1 mark)

_____

(b) Which dye is pure? _____ (1 mark)

(c) Indicate on the diagram the solvent front. (1 mark

25. (a) Draw a dot (.)/cross (X) diagram to show bonding in Cl_2O. (Cl = 17, O = 8). (1 mark)

(b) In terms of structure and bonding explain why the component Cl_2O has a very low melting and boiling point. (2 marks)

_____

_____

_____

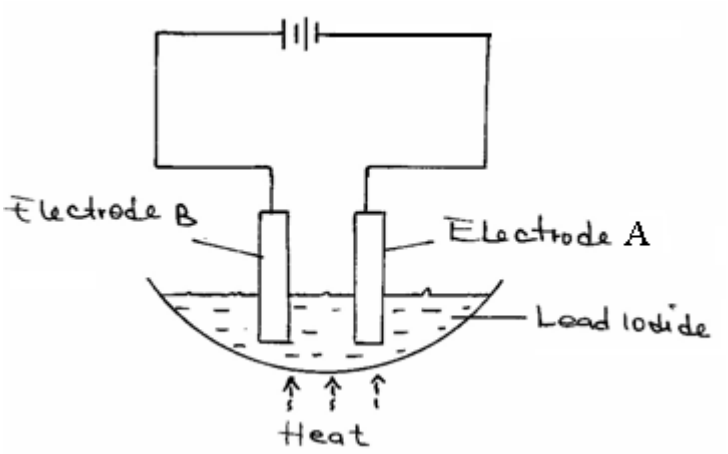
_____

26. Solid J reacts with cold water but solid K does not. L reduces the oxide of M but does not reduce the oxide of K. Arrange the elements in order of reactivity starting with the most reactive. (2 marks)

_____

_____

27. The figure below shows a set-up used in electrolysis of lead iodide.



(a) Why is heating necessary? (1 mark)

_____

_____

(b) Write the equation of the reaction that occurs at the cathode. (1 mark)

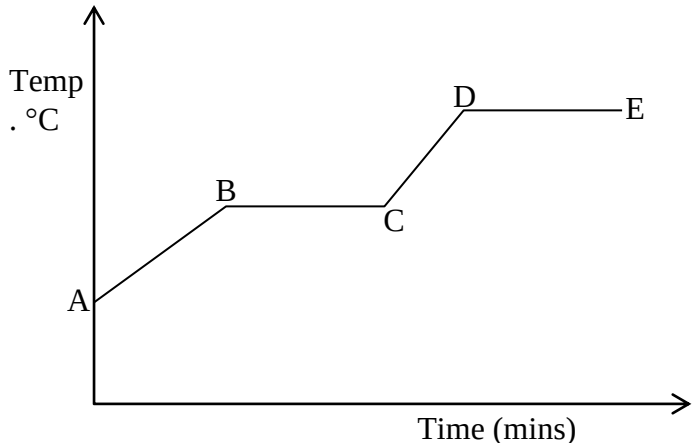
_____

_____

(c) At which electrode does reduction occurs. (1 mark)

28. 3.22g of hydrated sodium sulphate, $Na_2SO_4.XH_2O$ were heated to a constant mass of 1.42g. Determine the value of X in the formula. (Na = 23.0, S = 32.0, O = 16.0, H = 1). (3 marks)

29. The curve shown below was obtained when solid naphthalene was heated to boiling.



(a) Explain in molecular terms the changes occurring in portions.

(i) AB. (1 mark)

(ii) DE. (1 mark)

(b) What is the significance of portion BC? (1 mark)

30. Use the equation below to answer the questions that follow.

$$Cr_2O_{7(aq)}^{2-} + OH_{(aq)}^{-} \rightarrow 2CrO_{4(aq)}^{2-} + 2H_2O_{(l)}$$

Using oxidation numbers show where reduction has taken place. (2 marks)

_____

_____

_____

_____

NAME…….. INDEX NO…….....

233/2 **CANDIDATE'S SIGN……..……..**
CHEMISTRY
PAPER 2 **DATE……..……**
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TIME: 2 HOURS

KIRINYAGA CENTRAL SUB-COUNTY JOINT EXAMINATION - 2015

Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 2
(THEORY)
TIME: 2 HOURS

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FOR EXAMINER'S USE ONLY:

Question	Maximum Score	Candidate's Score
1	11	
2	9	
3	13	
4	11	
5	12	
6	13	
7	11	
Total Score	80	

This paper consists of **12** printed pages. Candidates should check to ascertain that all the pages are printed as indicated and that no questions are missing.

Chemistry Paper 2 *Turnover*

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

Element	Atomic radius (nm)	Ionic radius (nm)	Formula of oxide	Melting point of oxide (°C)
A	0.364	0.421	A_2O	-119
B	0.830	0.711	BO_2	837
E	0.592	0.485	E_2O_3	1466
G	0.381	0.446	G_2O_5	242
J	0.762	0.676	JO	1054

(i) Which elements are non-metals? Give a reason. (3 marks)

_____

_____

_____

(ii) Explain why the melting point of the oxide of **E** is higher than that of the oxide of **G**. (2 marks)

_____

_____

_____

_____

(iii) Give **two** elements that would react vigorously with each other. Explain your answer. (2 marks)

_____

_____

_____

_____

(b) Study the information below and answer the questions that follow. The letters do not represent the actual symbols of the elements.

Element	Electronic Configuration	Ionization energy KJ/mol	
		1^{st} I.E	2^{nd} I.E.
X	2.2	900	1800
Y	2.8.2	736	1450
Z	2.8.8.2	590	1150

(i) What chemical family does the elements **X**, **Y** and **Z** belongs? (1 mark)

_____

(ii) What is ionization energy? (1 mark)

_____

_____

_____

(iii) The 2nd ionization energy is higher than the 1st ionization energy of each element. Explain. (1 mark)

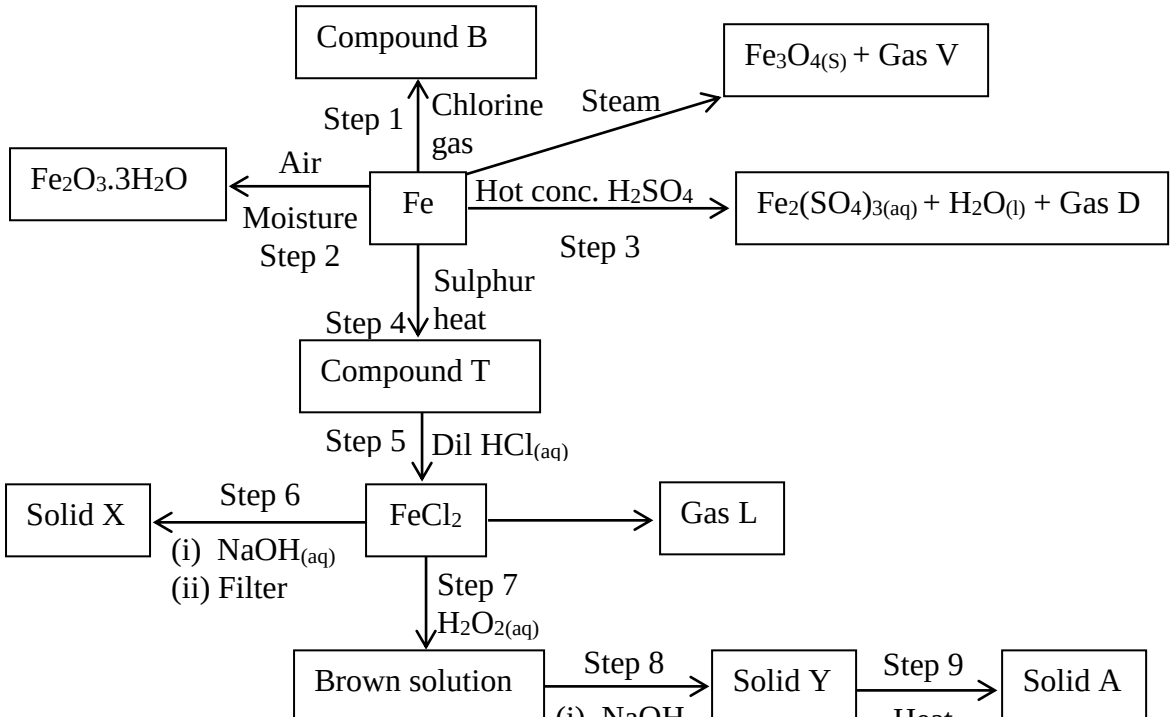
_____

_____

_____

(iv) When a piece of element Z is placed in cold water, it sinks to the bottom and effervescence of a colourless gas that burns explosively is produced. Use a simple diagram to illustrate how this gas can be collected during this experiment. (2 marks)

2. Study the flow chart below starting from iron metal and answer the questions that follow.



(a) Identify gases. (1½ marks)

D _____

L _____

V _____

(b) Identify the following substances. (2½ marks)

(i) Compound **B** _____

(ii) Compound **T** _____

(iii) Solid **A** _____

(iv) Solid **Y** _____

(v) Solid **X** _____

(c) What name is given to the reaction in Step **2**? _____ (1 mark)

(d) State the colour of solid **X**. _____ (1 mark)

(c) Write balanced equations for the reactions that occurred in
Step 1. (1 mark)

_____

Step 5. (1 mark)

_____

(f) What property of hydrogen peroxide (H_2O_2) is indicated in Step 7? (1 mark)

_____

3. (a) One mole of heptane was thermally cracked, two hydrocarbons Q and P were formed. Q was an alkene molecule with three carbon atoms.

(i) Give the molecular formula of.

I Q (1 mark)

_____

II P (1 mark)

_____

(ii) Write the structural formula of Q. (1 mark)

(iii) Name the compound formed when Q undergoes self addition reaction. (1 mark)

(iv) State **one** disadvantage of using the product named in a(iii) above. (1 mark)

(v) Cracking can also be achieved using less amount of heat in the presence of a catalyst. Name one catalyst that is often used. (1 mark)

(b) An organic compound J has the following percentage by mass, carbon 64.86%, hydrogen 13.51% and the rest is oxygen. The relative molecular mass of the compound is 74. C = 12, O = 16, H = 1)

(i) Work out the molecular formula of compound J. (3 marks)

(ii) To which homologous series does compound J belong? (1 mark)

(iii) Write a balanced chemical equation for the reaction that occurs when compound J reacts with sodium metal. (1 mark)

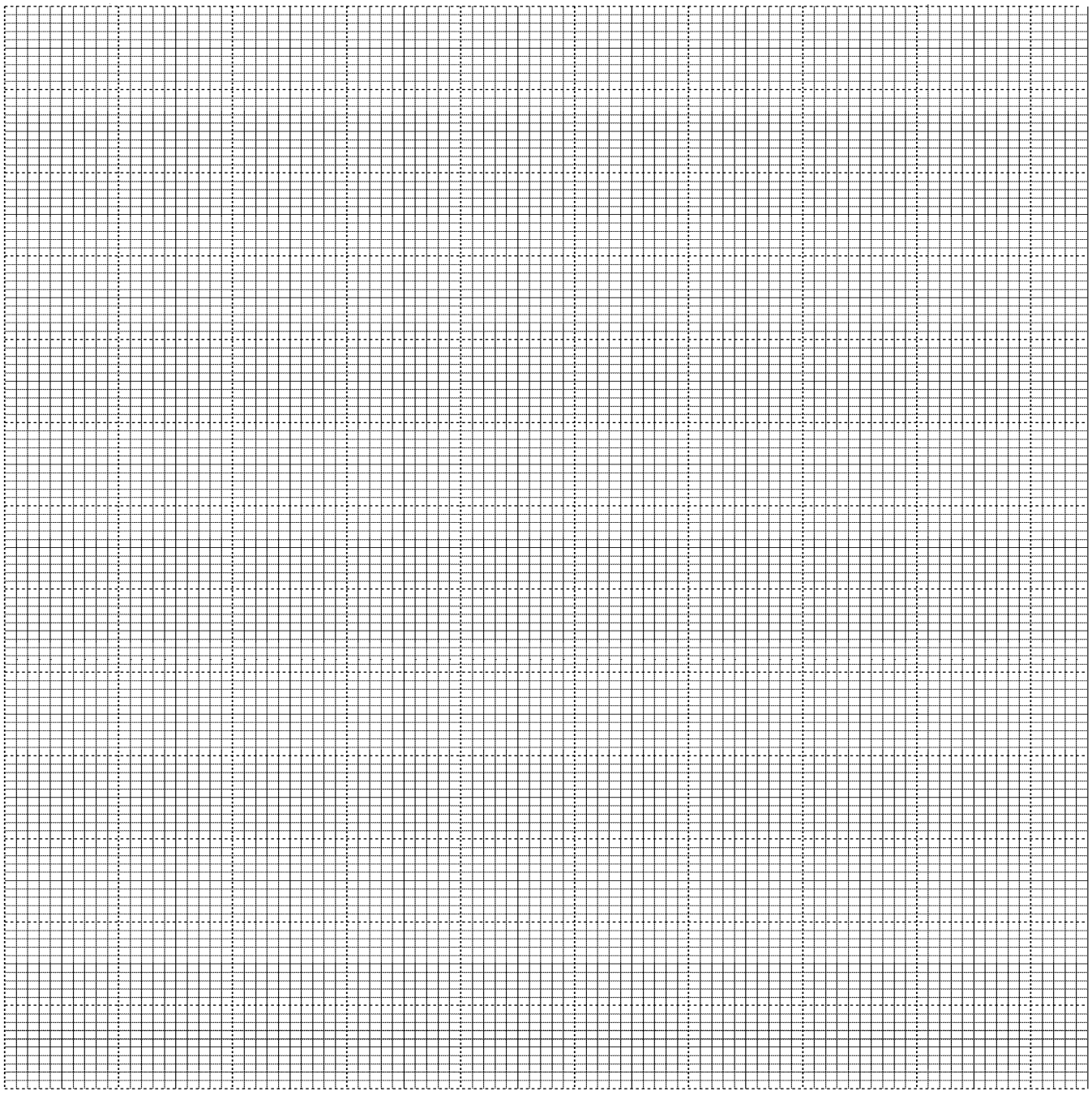
(iv) Name the type of reaction indicated in b(iii) above. (1 mark)

(v) Name the organic compound formed when J reacts with excess acidified potassium managanate (VII). (1 mark)

4. 2.5g of a pure metal carbonate MCO_3 was reacted with excess 2M nitric (V) acid. The volume of carbon (IV) oxide evolved was measured and recorded at 10 second intervals. The results were recorded as shown in the table below.

Volume of gas (cm^3)	0	90	150	210	280	340	390	450	480	480	480
Time (seconds)	0	10	20	30	40	50	60	70	80	90	100

(a) (i) On the grid provided, plot a graph of volume (vertical axis) against time – Label it curve A. (3 marks)



(ii) From your graph determine the rate of reaction between 25 seconds and 40 seconds. (2 marks)

_____

_____

_____

_____

(iii) On the same axes, sketch a curve that would be obtained if the same experiment was repeated using excess 1M nitric (V) acid. Label it curve B. (1 mark)

(iv) Give that carbon (IV) oxide was measured at room temperature and pressure, work out the relative atomic mass of metal M. (Molar gas volume at r.t.p = 24dm³, C = 12, O = 16). (3 marks)

_____

_____

_____

_____

_____

_____

(b) When bromine is dissolved in water the equilibrium shown below is established.

$$Br_{2(aq)} + H_2O_{(l)} \rightleftharpoons \underbrace{Br^-_{(aq)} + OB^-_{(aq)}}_{\text{(Colourless)}} + 2H^+_{(aq)}$$

(Yellow)

State and explain the observation that would be made if aqueous sodium hydroxide was added to the equilibrium mixture. (2 marks)

_____

_____

_____

_____

5. (a) Use the standard electrode potentials for elements A, B, C, D and F given below to answer the questions that follow.

	E^θ (Volts)
$A^{2+}_{(aq)} + 2e^- \rightleftharpoons A_{(S)}$	-2.90

$B^{2+}_{(aq)} + 2e^-$	$\rightleftharpoons$ $B_{(S)}$	-2.38
$C^+_{(aq)} + e^-$	$\rightleftharpoons$ $\frac{1}{2}C_{2(g)}$	0.00
$D^{2+}_{(aq)} + 2e^-$	$\rightleftharpoons$ $D_{(S)}$	+0.34
$\frac{1}{2}F_{2(g)} + e^-$	$\rightleftharpoons$ $F_{(aq)}$	+2.87

(i) Which element is likely to be hydrogen? Give a reason for your answer. (2 marks)

_____

_____

_____

_____

(ii) What is E^θ of the strongest reducing agent? (1 mark)

_____

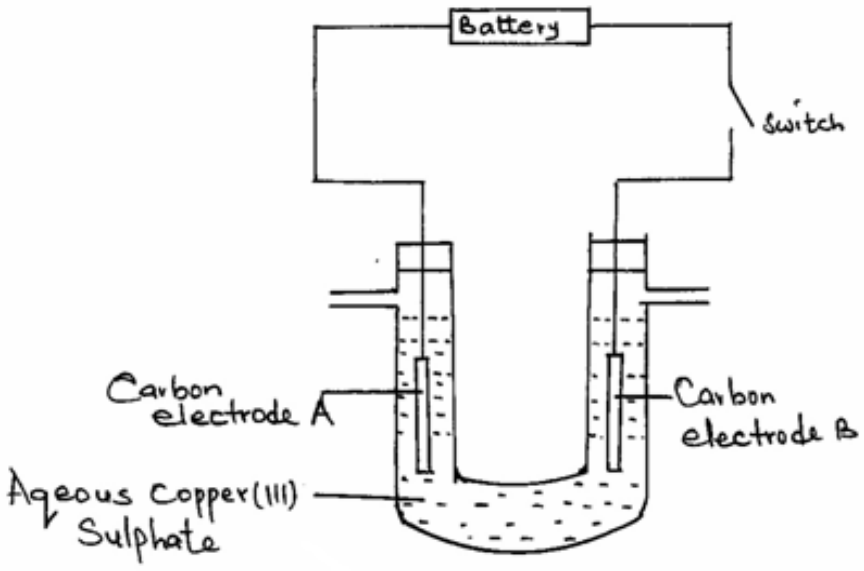
(iii) Calculate the e.m.f of the cell that would be formed when half cells of B and D are combined. (1 mark)

_____

_____

_____

(b) Aqueous copper (II) sulphate was electrolysed using the set up below.



(i) When the switch was closed a gas was produced only at electrode B. Which electrode is the anode? (1 mark)

_____

(ii) Write the half equation for the reaction occurring at electrode B. (1 mark)

_____

_____

(iii) What happens to the PH of the electrolyte during electrolysis? Explain. (2marks)

_____

_____

_____

_____

(iv) If carbon electrodes were replaced with copper electrodes in the cell above, write the equation of the reaction that would occur at the anode. (1 mark)

_____

(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. Determine the change in mass of the cathode that occurred as a result of the electrolysis process.
(Cu = 64, IF = 96500 coulombs). (3 marks)

_____

_____

_____

_____

_____

_____

6. (a) State Hess's law. (1 mark)

_____

_____

(b) Use the following information to answer the questions that follow:

$C_{(S)} + O_{2(g)} \rightarrow CO_{2(g)}$ $\Delta H = -393KJ/mol$

$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(g)}$ $\Delta H = -296KJ/mol$

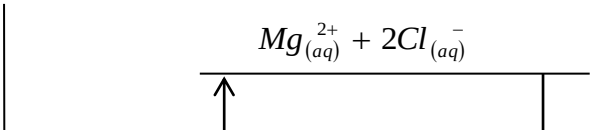
$C_4H_{10} + \frac{13}{2}O_{2(g)} \rightarrow 4CO_{2(g)} + 5H_2O$ $\Delta H = -2877KJ/mol$

(i) Draw an energy cycle diagram relating heat of formation and combustion of butane. (2 marks)

(ii) Calculate the heat of formation of butane. (3 marks)

(c) Distinguish between hydration energy and lattice energy. (2 marks)

(d) The diagram below shows an energy level diagram for the formation of magnesium chloride. Study it and answer the questions that follow.



(i) State the enthalpy changes represented by

A _____ (½ mark)

B _____ (½ mark)

C _____ (½ mark)

(ii) What is the relationship between ΔH_A, ΔH_{BA} and ΔH_C. (½ mark)

_____

(e) Define heat value of a fuel. (1 mark)

_____

_____

_____

(ii) Give **two** reasons why wood and charcoal are chosen for domestic heating. (2 marks)

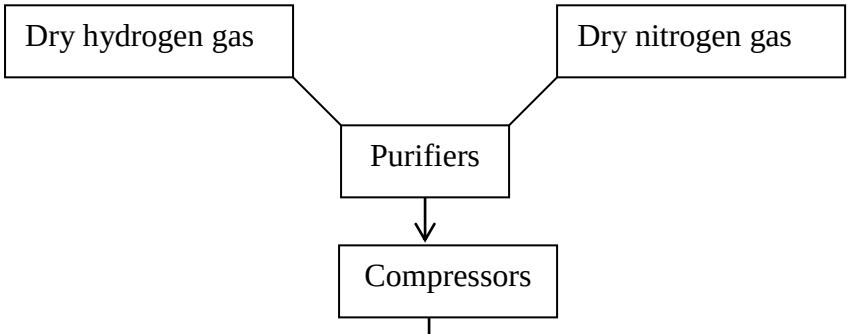
_____

_____

_____

_____

7. The flow chart below shows the large scale manufacture of ammonia gas and some ammonium compounds. Study it and answer the questions that follow.



(a) What are the sources of the following raw materials?

(i) Hydrogen gas. (1 mark)

_____

(ii) Nitrogen gas. (1 mark)

_____

(b) What optimum conditions are needed during the manufacture of ammonia in the

(i) Compressor. (1 mark)

_____

(ii) Catalytic chamber. (1 mark)

_____

(c) Why should the gas be passed through the compressor. (1 mark)

_____

_____

(d) Write an equation for the reaction that occurs in Step **1**. (1 mark)

_____

_____

(e) Write the formula of the compound **B**. (1 mark)

_____

(f) Calculate the percentage of nitrogen in compound **A**. (2 marks)

_____

_____

_____

_____

(g) What observation would be made if compound C was added to a sample suspected to contain copper (II) ions dropwise then in excess? (2 marks)

_____

_____

_____

_____

KIRINYAGA CENTRAL SUB-COUNTY

CHEMISTRY
PAPER 3
(PRACTICAL)
TIME: 2¼ HOURS

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 250cm³ of solution.
   - Solid C, Magnesium ribbon.
   - Phenolphthalein indicator.

   You are required to:
   (i) Standardize solution A.
   (ii) Determine the rate of reaction between solution A and maganesium.

   PROCEDURE I:
   (i) Measure exactly 10cm³ 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 25cm³ 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 procedures (i) to (iv) to complete the table.

	1	2	3
Final burette reading (cm³)			
Initial burette reading (cm³)			
Volume of base, solution A used (cm³)			

(3 marks)

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

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

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

   (iii) Molarity of solution A. (1 mark)

PROCEDURE II:

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

(ii) Using a burette, measure 12cm³ of solution A, into a clean boiling tube.

(iii) Drop one piece of solid C into the boiling tube containing solution A and start the 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 make12cm³ of solution and complete the table below.

Volume of Solution A (cm³)	Volume of distilled water (cm³)	Concentration of solution A (moles/l)	Time(s)	$\frac{I}{t}\left(S^{-1}\right)$
12	0			
10	2			
8	4			
6	6			
4	8			

(4 marks)

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

(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.

Observation	Inference
(1mk)	(1mk)

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

Observation	Inference
(½mk)	(½mk)

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

Observation	Inference
(½mk)	(½mk)

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

Observation	Inference
(½mk)	(½mk)

(iv) To the third portion add a few drops of sodium hydroxide until in excess.

Observation	Inference
(1mk)	(1mk)

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

Observation	Inference
(1mk)	(½mk)

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

Observation	Inference
(1mk)	(½mk)

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.

Observation	Inference
(1mk)	(½mk)

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

Observation	Inference
(½mk)	(1mk)

(ii) To the second portion, add a few drops of acidified potassium manganate (VII) solution.

Observation	Inference
(1mk)	(1mk)

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

Observation	Inference
(1mk)	(1mk)

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

Observation	Inference
(½mk)	(½mk)

(v) To the fifth portion in a boiling tube, add 5cm^3 of ethanol followed by a few drops of concentrated sulphuric (VI) acid. Warm the mixture.

Observation	Inference
(1mk)	(½mk)