MACHAKOS COUNTY KCSE TRIAL AND PRACTICE EXAM 2015

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

233/1

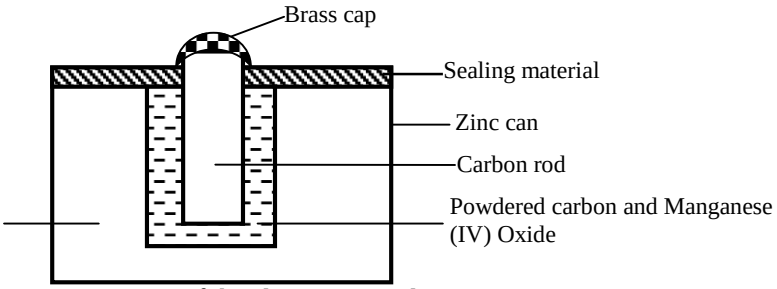
CHEMISTRY

PAPER 1 (THEORY)

JUNE / JULY 2015

Time: 2 Hours

1. The electron arrangement of ions Q^{2-} and R^{3+} are as 2, 8, 8, and 2,8respectively.



(a) Write the electron arrangement of the elements Q and R (2marks)

(b) Write the formula of the compound that would be formed between Q and R (1mark)

2. Explain why a high temperature is required for Nitrogen to react with oxygen (1mark)

3. Give one advantage and one disadvantage of using petrol containing tetraethyl lead in motor vehicles 4. (2marks)

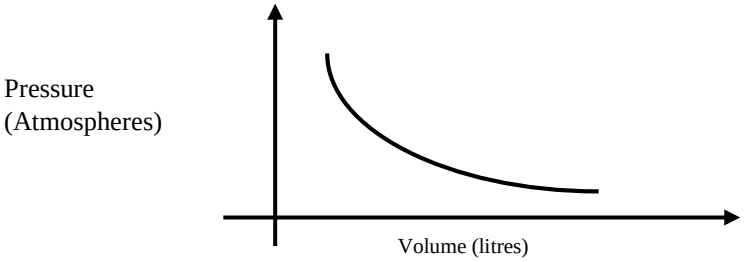
The diagram below is a cross section of a dry cell. Study it and answer the questions that follow.

Ammonium Chloride and Zinc Chloride paste

(i) Write the equation for the reaction in which electrons are produced. (1mark)

(ii) The Zinc can is lined with Ammonium Chloride and Zinc Chloride paste. What would happen if the mixture was to become dry? Give reason. (2marks)

5. The graph below shows the behavior of a fixed mass of a gas at constant temperature.



(a) What is the relationship between the volume and the pressure of the gas? (1mark)

(b) $1500cm^3$ of nitrogen gas at one atmosphere were compressed to two atmospheres atconstant temperature. Calculate the volume occupied by the nitrogen gas.
(2marks)

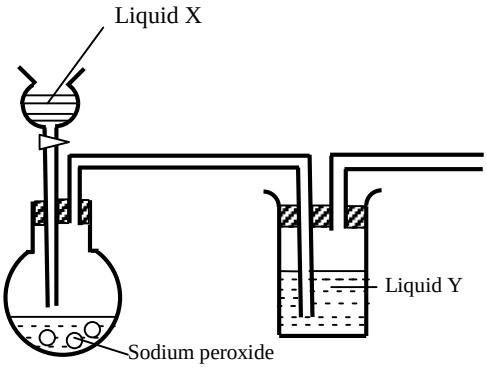
6. The table below gives some properties of three elements X,Yand Z.

ELEMENT	Atomic No.	Meeting point(^{0}C)	Boiling Point (^{0}C)
X	53	114	184
Y	35	-7	58.8
Z	17	-101	-34.7

(a) Which element is in liquid form at room temperature? Give reason. (1mark)

(b) Explain why the boiling point of element X is higher than that of element Z. (2marks)

7. The diagram below is a set up for the laboratory preparation of dry oxygen gas.



(a) Name:
I. Liquid Y (1 Mark)
II. Liquid X
(b) Write an equation for the reaction that took place in the flask. (1mark)
(c) Complete the diagram to show how dry oxygen can be collected. (1mark)

8. Use the information below and answer the questions that follow .The letters are not the actual symbols of the elements.

$E^{2+}_{(aq)}+$ $\rightleftharpoons$ $E_{(s)}$ 2e -0.76V

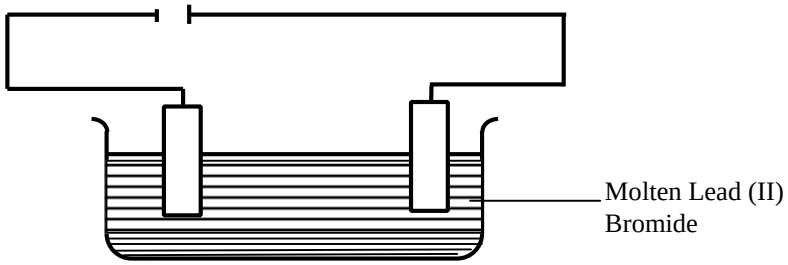
$F^{3+}_{(aq)}$ + 3 e -1.66V

$\rightleftharpoons$ $F_{(s)}$

$\rightleftharpoons$ G $G^{2+}_{(aq)}$+ 2e (s) -0.44V

| || | $F_{(s)}$

(a) Calculate the E^{θ} value for the electrochemical cell represented below. (1mark)
(b) Arrange the elements in order of reactivity starting with the least reactive. (1mark) (c) Explain if it would be advisable to store element G in a solution containing E^{2+} Ions. (1mark) 9. The set up below was used to electrolyze molten lead (II) bromide.



(a) State the observation that was made at the anode during electrolysis. (1mark)
(b) A current of 2.5A was passed for 30 minutes. Calculate the mass of lead that was deposited (2marks)

10. When wood is burnt a grey powder called ash remains. The ash is stirred with water and filtered to form a colourless solution.
(a) What is the main component of the colorless solution? Give a reason. (2marks)
(b) State the observation that would be made if methyl orange indicator was passed through the solution of ash. (1mark)

11. The elements A and B have the following properties

Element	Mass No.	Atomic No.
A	37	17
B	37	18
C		

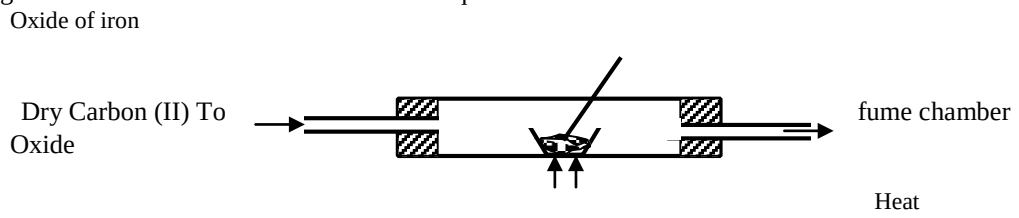
(a) When the isotope A was bombarded with a neutron, an isotope C was formed .Fill in the table to show the properties of element C (1mark)
(b)Write an equation for the reaction between isotope B and Beta particles (1mark)
(c) State one use of radioisotopes in medicine.
(1mark)

12. When Carbon (IV) oxide gas was passed through aqueous calcium hydroxide a white suspension was formed.

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

(b) State and explain the changes that took place when excess Carbon (IV) Oxide was bubbled through the white suspension (2marks)

13. Excess Carbon (II) Oxide was passed over a heated sample of an oxide of iron as shown in the diagram below. Study the diagram and the data and use it to answer the questions that follow.

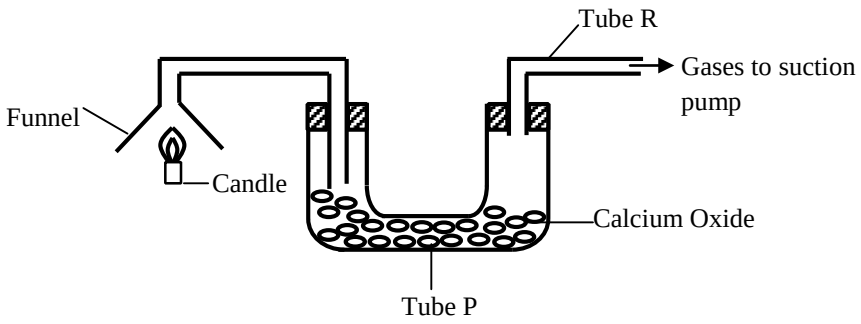


Mass of empty dish =6.72g
Mass of empty dish + oxide of iron =9.04g
Mass of empty dish + residue=8.40g

(a) Determine the formula of the oxide of iron given that the relative formula mass of oxide of Iron = 232, Fe = 56.0, O=16.0 (2marks)

(b) Write an equation for the reaction which took place in the dish (1mark)

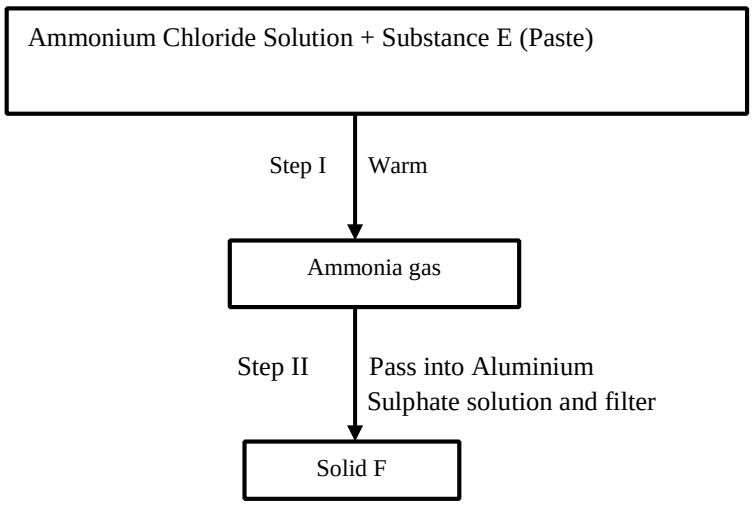
14. The products of a burning candle were passed through a tube containing calcium oxide as shown in the diagram below.



(a) Write two chemical equations for the reactions that took place in tube P. (2marks)

(b) Name two gases that came out through tube R. (1mark)

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

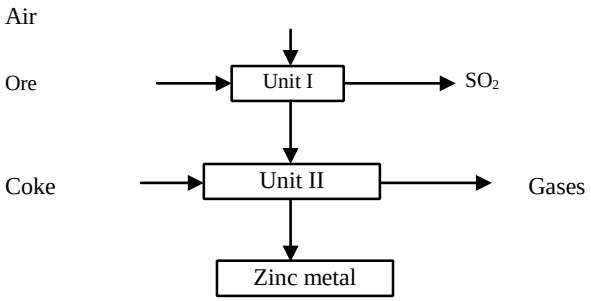


(a) Identify substance E (1mark)

(b) Write an equation for the reaction in Step (II) that produces solid F (1mark)

16. The elements nitrogen, phosphorus and potassium are essential for plant growth. Phosphorus in the fertilizer may be in the form of ammonium phosphate. Calculate the mass of nitrogen present if a 25kg bag contained pure ammonium phosphate. $(NH_4)_2HPO_4$ (N=14.0, H=1.0, P=31.0, O=16.0) (2 Marks)

17. The flow chart below shows the processes involved in the industrial extraction of zinc metal.



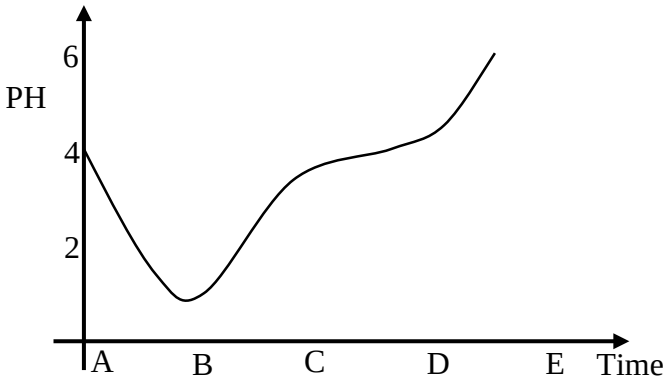
(a) Name the ore from which zinc is extracted on the above diagram. (1mark)
(b) Write the equation of the reaction taking place in Unit I (1mark)
(c) Name two uses of zinc metal. (1mark)

18. A weighed sample of crystalline sodium carbonate ($Na_2CO_3 .nH_2O$) was heated in a crucible until there was no further change in mass .The mass of the sample reduced by 14.5%. Calculate the number of moles (n) of the water of crystallization. (2marks)

19. (a) Describe how you would prepare crystals of sodium nitrate starting with $200cm^3$ of 2M sodium hydroxide (2marks)
(b) Write an equation for the reaction that takes place when a solid sample of sodium nitrate is heated. (1mark) 20. The structure below represents a sweet smelling compound.

Give the names of the two organic compounds that can be used to prepare this compound in the laboratory. (2marks) 21. Magnesium reacts with both concentrated and dilute acid. Write the equations for the two reactions. (2marks)

22. The graph below shows how the PH value of soil in a farm changed over a period of time.



(a) Describe how the PH of the soil can be determined. (2marks)
(b) State one factor that may have been responsible for the change in the soil PH in the time interval AB. (1mark)

23. A student put calcium carbonate and calcium hydrogen carbonate in separate test tubes and performed the tests as shown in the table below. Complete the table by giving the expected observations.

Salt	Adding water	Heating
Calcium Carbonate		
Calcium hydrogen carbonate		

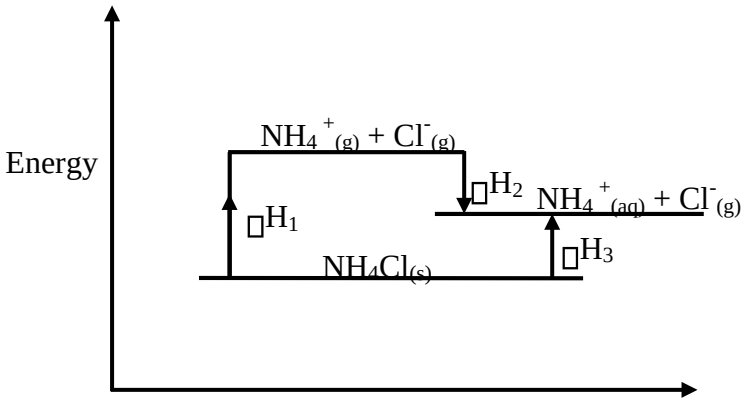
(2marks)

24. A mixture contains Iron (III) Chloride, calcium chloride and iron filings. Describe how one can separate and recover the substances in the mixture. (3marks)

25. The structure below represents two cleansing agents A and B. Which cleansing agent would be suitable for washing in water containing calcium chloride? Give a reason. (2marks)

A B

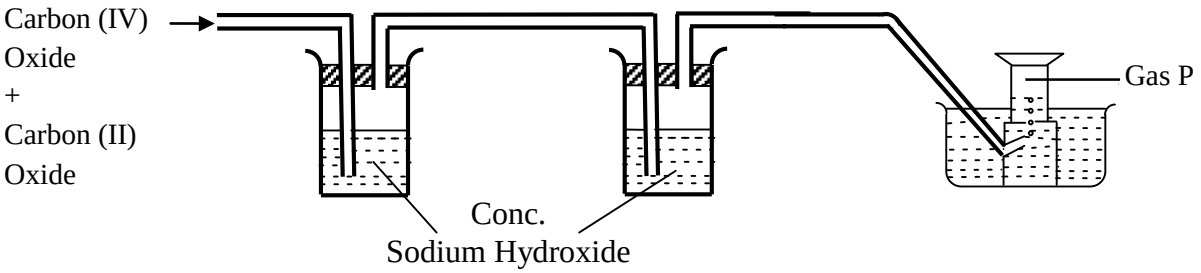
26. Study the diagram below and answer the questions that follow.



(a) What do ΔH_1 and ΔH_2 represent.

(b) Write an expression to show the relationship between ΔH_1, ΔH_2 and ΔH_3. (2marks)

27. Study the diagram below and use it to answer the questions that follow. (1mark)



(a) Name two reagents that are reacted to produce both Carbon (IV) Oxide and Carbon (II) Oxide. (1mark)

(b) Write the equation for the reactions that took place in the wash bottle. (1mark)

(c) Give a reason why Carbon (II) Oxide is not easily detected. (1mark)

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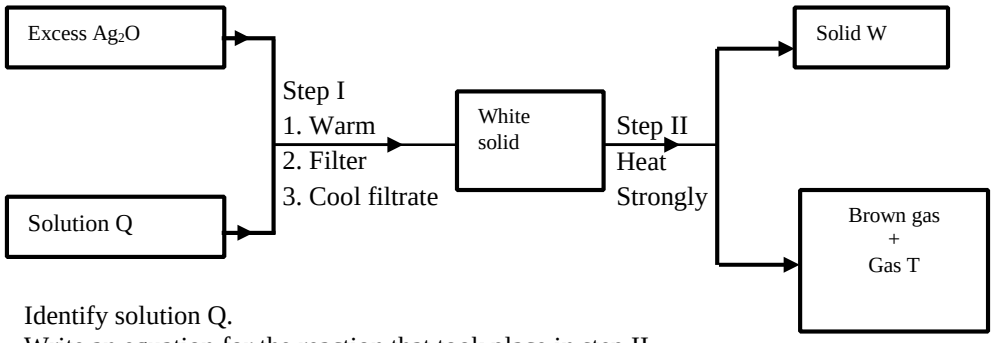
28. When a few drops of ammonia solution were added to Copper (II) Nitrate solution, a light blue precipitate was formed. On addition of more aqueous ammonia a deep blue solution was formed. Identify the substances responsible for the:

(a) Light blue precipitate. (1mark)

(b) Deep blue solution. (1mark)

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



a) Identify solution Q. (1mark)

b) Write an equation for the reaction that took place in step II. (1mark)

(c) State one commercial use of gas T. (1mark)

30. How does pH value of 0.1M potassium hydroxide solution compare with that of 0.1M aqueous Ammonia? Explain (2marks)

31. During the manufacture of rubber raw rubber is heated with sulphur, carbon, phosphorus and manganese

i) What name is given to this process. (1mark)

ii) Explain why the process is necessary. (2marks)

MACHAKOS COUNTY KCSE TRIAL AND PRACTICE EXAM 2015

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

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CHEMISTRY

Paper 2

(THEORY)

TIME: 2 HOURS

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

Element	Atomic	Relative Atomic mass	Melting point (^{O}c)
Sodium	11	23.0 27.0	97.8
Aluminium	13	31.0	____
Phosphorus	___	____	44.2(white)590(Red)
Neon	10	40.0	-249
Calcium	20	1.0	850
Hydrogen	___	____	-259
Carbon	6		3730

a) Complete the table by filling in the missing atomic numbers and atomic mass. (2 marks)

b) i) Three isotopes of magnesium have mass numbers 24, 25 and 26. What is the mass number of the most abundant isotope of magnesium? Explain. (2 marks)

ii) Define the term isotopes (1 mark)

c) Phosphorous exists in two allotropic forms, white phosphorous and red phosphorous.

i) What are allotropes? (1 mark)

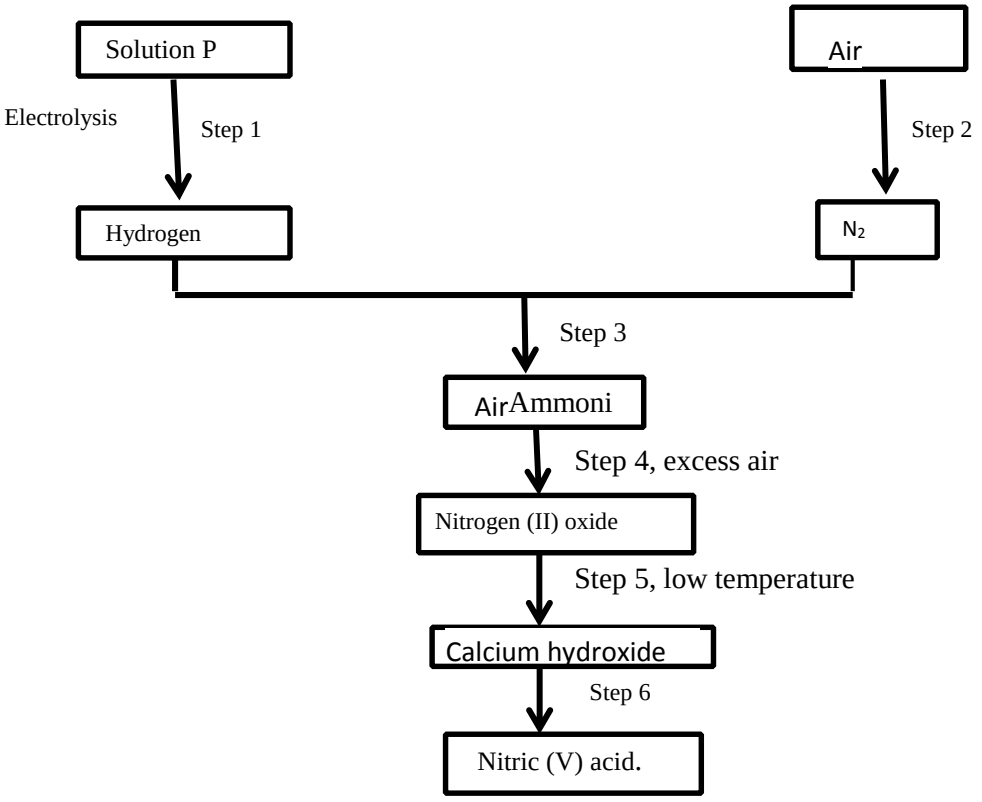
ii) Name another element that exhibits allotropy. (1 mark)

iii) Which of the allotropes of phosphorous has a higher density? Explain (1 mark)

d) Explain the difference in the melting points of sodium and aluminium.

e) Give the formula of the compound formed between aluminium and carbon.

2. a) The flow chart below shows the industrial preparation of ammonia and the process used in the manufacture of Nitric (V) acid



i) Identify solution P (1 mark) ii) Excess air is used in step 4. What other conditions are necessary in step 4 in order to produce Nitrogen (II) Oxide.

(1 mark) iii) The equation for the reaction in step 5 is:

$2NO_{(g)} + O_{2(g)} \rightleftharpoons 2NO_{2(g)} \quad \Delta H = -114\ KJmol^{-1}$

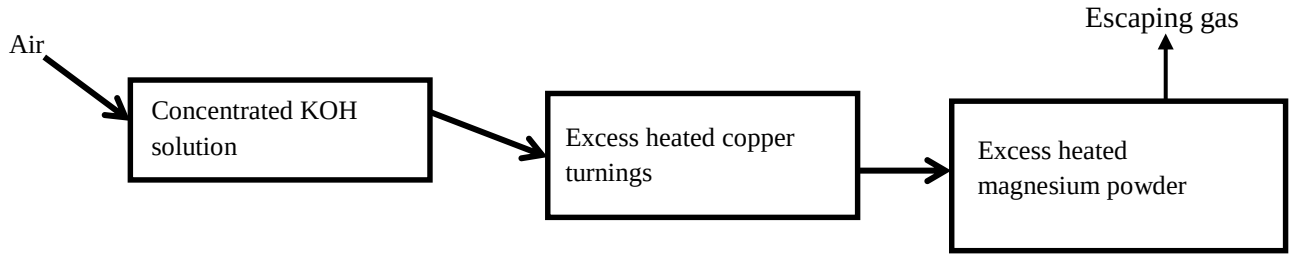
Explain why low temperatures are used in this step. (1 mark)

iv) Draw a diagram to show how Nitrogen (IV) Oxide can be dissolved in water to form an acid. (1 mark)

v) The Nitric (V) acid produced is only 50% concentrated. Explain how you can increase the concentration of the acid. (1 mark) vi) State and explain the observations that would be made if a sample of red hot charcoal is heated with Nitric (V) acid. (1 mark)

vii) Describe the process that takes place in step 2 (1 mark) viii) Write a chemical equation showing how ammonium nitrate would be produced in the above set up (1 mark) ix) State the name of the gas produced when ammonium nitrate is heated. (1 mark)

b) Air was passed through several reagents as shown in the flow chart below.

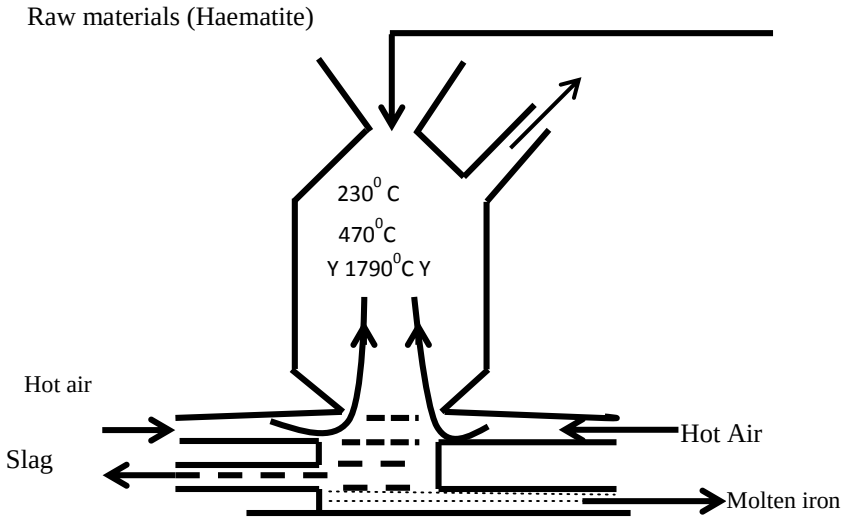


i) Write an equation for the reaction that takes place in the chamber with magnesium powder. (1 mark)
ii) Name one gas which escapes from the chamber containing magnesium powder. Give a reason. (1 mark) c) In the Haber process, Nitrogen and Hydrogen react according to the following equation at a temperature of 450^0c and a pressure of 200 atmospheres.

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

i) Explain how the yield of ammonia would be affected if the pressure was decreased. (1 mark) ii) Give one use of ammonia (1 mark)

3. a) Iron is obtained from haematite using a blast furnace shown below. Study it and answer the questions that follow.



i) Four raw materials are required for the production of iron. Three of these are haematite, hot air and coke. Give the name of the fourth raw material and its use. (1 mark)

I Name II Use ii) Name another Iron ore other than the one shown in the blast furnace. (1 mark) iii) State one physical property of slag other than density that allows it to be separated from molten Iron as shown in the figure. (1 mark) iv) Iron from the blast furnace contains about 5% carbon.

I. Describe how the carbon content is reduced. (1 mark)
II. Why is it necessary to reduce the carbon content? (1 mark)

v) Explain why temperature in the region marked Y is higher than that of the incoming hot air (1 mark) vi) Describe the process which led to the formation of iron in the blast furnace (3 mark)

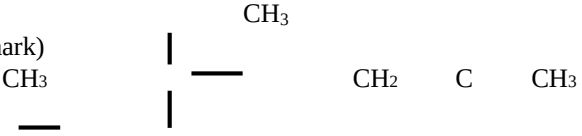
vii) Give a reason why the melting point of the Iron obtained from the blast furnace is 1200^0C while that of pure iron is 1535^0C (1 mark) viii) One of the components of the waste gases is Nitrogen (IV) oxide. Describe the adverse effects it has on the environment.

(2 marks)

4. a) What name is given to a compound that contains carbon and hydrogen only? (1 mark)

b) Give the names of the following compounds.

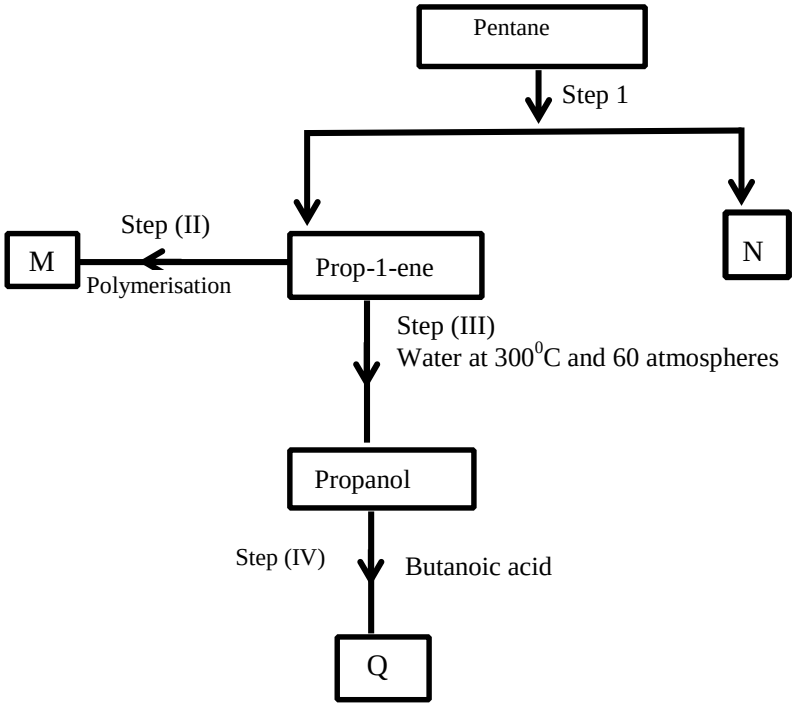
i) (1 mark)



ii) $CH_3 \equiv CCH_2CH_3$ (1 mark)

c) Describe a chemical test that can be carried out in order to distinguish between substances represented by structures (i) and (ii) above. (2 marks)

d) Ethyne, C_2H_2 is a compound found in crude oil. One mole of ethyne was reacted with one mole of hydrogen chloride gas and a product P1 was formed. P1 was then reacted with excess hydrogen gas to form P2. Draw the structures P1 and P2 e) Study the flow chart below and answer the questions that follow.



i) Name the process in step I and the conditions for the reaction in step I

Name of process (1 mark)

Conditions (1 mark) ii) Identify substance N (1 mark) iii) Give

I. One disadvantage of the continued use of substance such as M (1 mark) II. The name of the process that takes place in step III (1 mark)

III. The name and structural formula of the substance Q (1 mark)

Name

Structural formula

5. The flow chart below shows the various stages of water treatment. Study it and answer the questions that follow.

ii) What is the name of process X (1 mark)

What is the purpose of

I. Process X (1 mark)

II. Addition of sodium hypochlorite (1 mark)

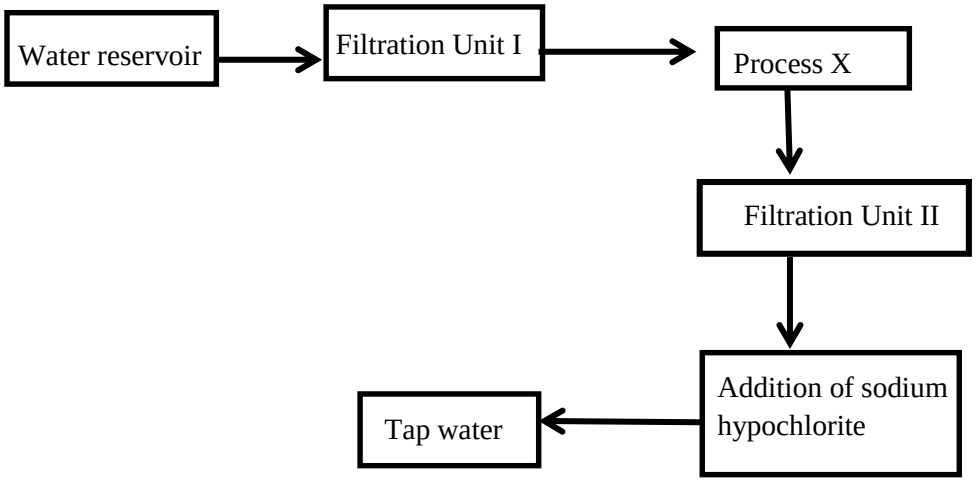
b) A sample of tap water was found to contain magnesium sulphate.

i) What type of hardness was present in the water? (1 mark)

ii) Explain how the hardness can be removed. c) (1 mark)

i) Describe how a solid sample of calcium carbonate can be prepared starting with magnesium oxide. (3 marks)

ii) State one use of calcium carbonate. (1 mark)



i) What is the purpose of filtration unit I (1 mark)

6. a) The reaction between bromine and methanoic acid at 30^0C proceeds according to the information given below.

$Br_{2(aq)} + HCOOH_{(aq)} \longrightarrow 2H^+_{(aq)} + 2Br^-_{(aq)} + CO_{2(g)}$

Concentration of $Br_{2\,(aq)}$ Mol dm^{-3}	Time (minutes)
10.0×10^{-3}	0
8.1×10^{-3}	1
6.6×10^{-3}	2
4.4×10^{-3}	4
3.0×10^{-3}	6
2.0×10^{-3}	8
1.3×10^{-3}	10

i) On the grid below, plot a graph of concentration of bromine (vertical axis) against time. (2 marks) ii) From the graph determine:

I) The concentration of bromine at the end of 3 minutes. (1mark)

II) The rate of the reaction at the time "t" while t=11/2 minutes. (1 mark) iii) Explain how the concentration of bromine affects the rate of reaction. (1 marks)

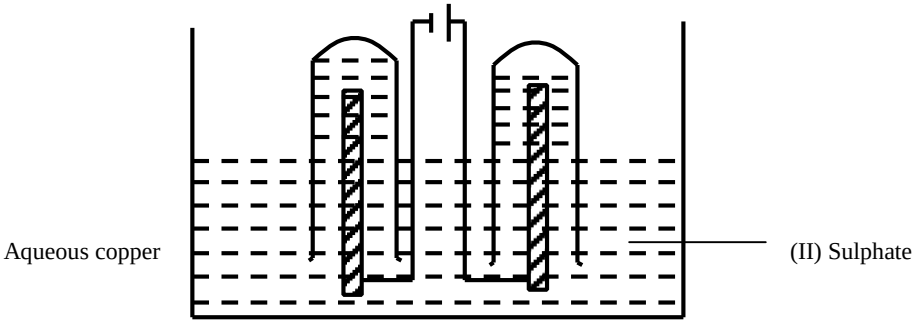
iv) On the the same axes, plot the curve that would be obtained if the reaction was carried out at 20^0C and label the curve as curve (II). Give a reason for your answer (2 marks)

b) Copper (II) sulphate reacts with barium chloride according to the equation.

$CuSO_{4(aq)} + BaCl_2 \longrightarrow CuCl_{2(aq)} + BaSO_{4(s)} \quad \Delta H = -17.7kJ\ mol^{-1}$

Calculate temperature change when 450cm^3 of 2M Copper (II) Sulphate were added to 300cm3 of 2M Barium (II) chloride. Assume the heat capacity of solution is $4.2Jg^{-1}k^{-1}$ and density is$1gcm^{-3}$ (3 marks)

7. a) The set up below was used during electrolysis of aqueous copper (II) sulphate using inert electrodes.



i) Name a suitable pair of electrodes for this experiment. (1 mark) ii) Identify the ions and cations in the solution. (1 mark) iii) On the diagram label the cathode. (1mark) iv) Write ionic equations for the reactions that took place at the anode (1 mark)

v) Explain the change that occurred to the Copper (II) Sulphate solution during the experiment. (2 marks) vi) During the electrolysis a current of 2 amperes was passed through the solution for 4 hours. Calculate the volume of the gas produced at the anode. (1 Faraday = 96500 coulombs and volume of gas at room temperature is 24000cm^3) (3 marks) b)

i) Draw a diagram to show how an impure copper lump can be refined through electrolysis. (3 marks)

ii) State one other use of electrolysis other than the one shown in b (ii) above. (1 mark)

MACHAKOS COUNTY KCSE TRIAL AND PRACTICE EXAM 2015

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

Chemistry 3

Practical

Time: 2 ¼ Hours

CONFIDENTIAL INSTRUCTIONS TO SCHOOLS

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

1. 6.0g of solid P accurately weighed and supplied in a clean boiling tube.
2. About 60$cm^3$of 2M sodium hydroxide solution Q.
3. About 40$cm^3$of 2M solution W.
4. One pipette, 25.0ml.
5. One pipette filler.
6. One volumetric flask, 250ml.
7. Four labels.
8. About 500cm^3 of distilled water.
9. One burette 50.0ml.
10. Three conical flasks.
11. One 10ml measuring cylinder.
12. One 100ml measuring cylinder.
13. Two boiling tubes.
14. One thermometer -10^{0}c to 110^{o}c.
15. About 0.5g solid E supplied in a stoppered container.
16. Six dry clean test tubes.
17. About 0.5g of Solid F supplied in a stoppered container.
18. One blue and one red litmus paper.
19. One metallic spatula.
20. Two 100ml beaker.
21. About 1g of solid sodium hydrogen carbonate.
22. About 500cm^3 of distilled water.
23. One spatula.

ACCESS TO

1. Source of heat.
2. 2M aqueous Ammonia supplied with a dropper.
3. 0.5M Lead (II) Nitrate solution supplied with a dropper. 4. 0.5M Barium Chloride solution supplied into a dropper 5. Bromine water supplied into a dropper.
6. Acidified Potassium Manganite (VII) supplied into a dropper.
7. Phenophythelin indicator supplied with a dropper.

NOTES

1. 2M Sodium Hydroxide solution Q is prepared by dissolving 80g of Sodium Hydroxide pellets in about 600cm^3 of distilled water and diluting to 1 litre solution.
2. Acidified Potassium Manganate (VII) is prepared by dissolving 3.16g of solid Potassium Manganate (VII) in about 600cm^3 of 2M Sulphuric (VI) acid and adding distilled water to make a litre of solution.
3. Bromine water is prepared by taking 10cm^3 of liquid Bromine and dissolving it in 100cm^3 of distilled water in a fume cupboard or open air. This must be freshly prepared and stored in a dark bottle.
4. 2M HCl is prepared by dissolving 172cm^3 of concentrated Hydrochloric acid in distilled water and diluting to make one liter solution.
5. 2M aqueous Ammonia is prepared by dissolving 298cm^3 of concentrated Ammonia in distilled water and diluting to one litre of solution.

6. 2M H_2S0_4 acid is prepared by dissolving $55cm^3$ of concentrated Sulphuric (VI) acid in distilled water and diluting to make one litre solution.
7. Solid E is pure Aluminum (III) Chloride.
8. Solid F is pure Oxalic acid.

MACHAKOS COUNTY KCSE TRIAL AND PRACTICE EXAM 2015

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

233/3

CHEMISTRY

Paper 3

Time: 2 ¼ Hours

1. You are provided with:

- 6.0g of an alkanoic acid labeled solid p in a boiling tube
- 2M hydrochloric acid solution W
- 2M sodium hydroxide solution labeled solution Q You are required to:

a) Determine the solubility of solid P at different temperatures.
b) Determine the number of moles of water of crystallization in solid P.
c) Find the molar mass of the alkanoic acid.

PROCEDURE I

i) Using a burette add $10cm^3$ of distilled water to solid P in the boiling tube. Heat the mixture while stirring with the thermometer to about 70^0 c. When the entire solid has dissolved, allow the solution to cool while stirring with the thermometer. Note the temperature at which crystals of solid p first appear. Record this temperature in table I.
ii) Using the burette, add $2cm^3$ of distilled water to the contents of the boiling tube. Warm the mixture while stirring with the thermometer until all the solid dissolves. Allow the mixture to cool while stirring. Note and record the temperature at which crystals of solid P first appear.
iii) Repeat the procedure (ii) two more times and record the temperatures in table I. Retain the contents of the boiling tube for use in procedure II.

Complete table I 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 $100cm^3$ (100g) of water at a particular temperature)

TABLE I

Volume of water in the boiling tube	Temperature at which crystals of solid P first appear.	Solubility of solid p (g/100g water)
10		
12		
14		
16		

(ii) On the grid provided, plot a graph of the solubility of solid p (Vertical axis) against temperature. (3marks)
(iii) Using your graph, determine the temperature at which 100g of solid P would dissolve in $100cm^3$ of Water. (1mark)

PROCEDURE (II)

i) Transfer the contents of the boiling tube in procedure I into a 250ml volumetric flask. Rinse both the boiling tube and the thermometer with distilled water and add to the volumetric flask. Add more distilled water to make up to the mark. Label this solution R.
ii) Using a measuring cylinder place $25.0cm^3$ of solution Q into a 250ml volumetric flask. Add about $200cm^3$ of distilled water. Shake well. Add more distilled water to make up to the mark. Label this as solution T. Retain the remaining solution Q for use in procedure (iii) and question 2.
iii) Fill a burette with solution R. Using a clean pipette and a pipette filler place $25.0cm^3$ of solution T into a 250ml conical flask. Add two drops of phenolphthalein indicator and titrate with solution R. Record your results in table II. Repeat the titration two more times and complete the table.

Table II	I	II	III
Final burette reading			
Initial burette reading			
Volume of solution R (cm^3) added			

(4 marks)

Determine the:

i) Average volume of solution R used (1 mark) ii) Concentration of solution T in moles per litre (1 mark)

iii) Concentration of the alkanoic acid solution R in moles per litre.(1 mole of acid reacts with 2 moles of the base) (1 mark) iv) The relative formula mass of the alkanoic acid, solid P (1 mark)

v) The formula of P has the form $M.XH_2O$. Determine the value of x in the formula given that the relative formula mass of M is 90.0 and atomic masses of oxygen and hydrogen are 16.0 and 1.0 respectively (1 mark)

PROCEDURE III

Pipette 25.0cm^3 of solution W into a 100ml beaker. Measure the temperature T_1 of solution W and record it in table III. Pipette 25.0cm^3 of solution Q into another 100ml beaker and measure the temperature T_2 of solution T and record it in table III. Add all solution W at once to solution T. Stir carefully with the thermometer and measure the highest temperature T_3 of the mixture and record it in table III. Repeat the procedure and complete table III.

	I	II
Initial temperature of solution W, T_1 (^OC)		
Initial temperature of solution T,T_2 (^OC)		
Highest temperature of mixture T_3 (^OC)		
Change in temperature $T\triangle$ (^OC)		

Calculate

a) Average □□T value (1 mark)

b) Heat change for the reaction (Assume density of the solution is 1g/cm^3 and the specific heat capacity is 4.2Jg^{-1} K^{-1})

(1 mark)□□

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

a) Place about one-half of solid E in a dry test tube. Heat it gently then strongly and test any gas produced with red and blue litmus papers.

Observation	Inferences
(1 mark)	(1 mark)

b) Place the rest of solid E in a boiling tube. Add about 10cm^3 of distilled water. Shake well and use 2cm^3 portions for each of the tests below.

i) To one portion add solution Q (that remained in question 1) drop wise until in excess

Observation	Inferences
(1 mark)	(1 mark)

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

Observation	Inferences
(1 mark)	(1 mark) iii) To the third portion, add 1cm^3 of Barium chloride solution.

Observation	Inferences
(1 mark)	(1 mark) iv) To

the fourth portion add two drops of aqueous lead(II)nitrate and heat the mixture to boiling

Observation	Inferences
(1 mark)	(1 mark)

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

a) Describe the appearance of solid F (1mark)

b) Place about one-third of solid F on a metallic spatula and burn it in a Bunsen burner flame

Observation	Inferences
(1 mark)	(1 mark)

c) Dissolve the remaining amount of solid F in about $10cm^3$ of distilled water in a boiling tube and shake well. Boil the mixture and divide it into three portions.

i) To the first portion, add five drops of bromine water

Observation	Inferences
(1 mark)	(1 mark)

ii) To the second portion add three drops of acidified potassium manganate (VII) solution and warm.

Observation	Inferences
(1 mark)	(1 mark)

iii) To the third portion add all the solid sodium hydrogen carbonate provided.

Observation	Inferences
(1 mark)	(1 mark)

d) Describe how you can find the P^H of solid F above (1 mark)

MACHAKOS COUNTY KCSE TRIAL AND PRACTICE EXAM 2015

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

CHEMISTRY

Paper 1

Time: 2 Hours

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1. a) Q 2, 3, 6 ✓1

R 2, 8, 3✓1

b) R_2Q_3 ✓1

2. It is required to break the strong N=N ✓ 1triple covalent bond.

3.

- Prevents knocking of engines
- Prevents premature ignition
- Increase the octane rating number (any ✓1)

4. $Zn_{(s)} + Zn^{2+} + 2e-$ ✓ 1

 The cell does not produce any current/stops working (any ✓

1) Because the ions are not mobile, the solid is a non-electrolyte ✓1

5. a) At a constant temperature the volume is inversely proportional to pressure.✓

 OR $v\alpha \frac{I}{P} = V = \frac{K}{P}$

a) $V = \frac{K}{P}$

$V_1P_1=V_2P_2$

$1500x1=V_2x2$✓1

$V_2 = \frac{1500x1}{2} = 750cm^3$ ✓1

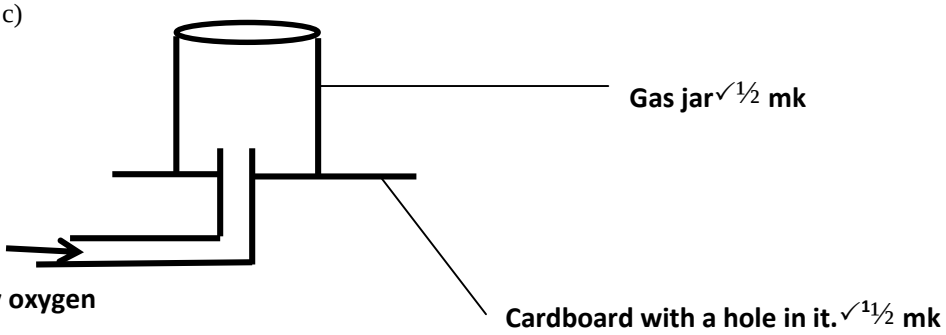
6. a) Y-At room temperature (25^0c) Y is a liquid since its M.P and B.P lie between -7°c and 58.8^0c OR (room temperature is between M.P and B.P.)

b) The molecular mass of x is higher✓1 than that of Z; the Vander Waals forces are stronger ✓in X molecules than in Z molecules hence X has a higher boiling point than Z. 7. a) I water ✓ ½ mk

II concentrated sulphuric acid✓ ½ mk

b) $2Na_2O_{2(s)} + 2H_2O(l) \longrightarrow 4NaOH_{(aq)} + O_{2(g)}$ ✓ 1

c)



8. a) $E = E_{red} - E_{ox}$

$= -0.44 + +1.66$

= +1.22v✓ 1

b) G, E, F✓ 1

c) Yes✓$^1/_2$mk- G cannot be displaced the E^{2+} ions because it is less reactive than E.✓

½ mk 9. a) Brown red vapour of bromine gas produced.

b) Q =It

$= 2.5x30x60$

$No.of\ feradays = (\frac{2.5x30x60}{96500})$ F

$1\ mole\ Pb \rightarrow 2F$

$\rightarrow \left(\frac{2.5x30x60}{96500}\right) F$

$\frac{1}{2} x \frac{2.5x30x60}{96500} x207$ ✓1 $= 4.82g$ ✓1

10. a) KOH✓1

b) Plants need potassium ✓$^1/_2$on large scale; potassium is a macro nutrient therefore the ash contains K_2O✓$^1/_2$ Would turn yellow✓1

11. a) Mass No of C=38✓½

Atomic No =17✓½

b) $^{37}_{18}B + {}^{0}_{-1}e \rightarrow {}^{37}_{17}A$ ✓1

c)

- C_0-60 is used to destroy cancerous tissue in patients without serious damage to other tissues.
- Sterilization of surgical instruments using gamma radiation.
- Radioactive iodine-131 is used in the treatment of goiter
- To monitor growth in bones and healing of fractures
- Detecting leakages in underground water or oil pipes without digging them out. (any ✓1)

12. a) $Ca(OH)_{2\ (aq)} + CO_2$ [redacted] $CaCO_{3(s)} + H_2O_{(l)}$ ✓1

b) White precipitate dissolves✓1 because the insoluble $CaCO_3$ ✓½ is changed into soluble calcium hydrogen carbonate.✓ ½

13. a) $mass\ oxygen = 9.04 - 8.40 of$

$= 0.64g$

of

$mass\ iron = 8.40 - .72 = .\ g6\ 1\ 68$

$Fe \frac{1.68}{56} = 0.03$✓

$O\ \frac{0.64}{16} = 0.04$✓

Mole ratio 3:4

Hence molecular formula F_3O_4✓1

b) $Fe_3O_{4(s)} + 4CO_{(g)} \rightarrow 3Fe_{(s)} + 4\ CO_{2(g)}$

14. a) I $CaO_{(s)} + H_2O_{(l)} \rightarrow Ca\ (OH)_{2\ (aq)}$

II $Ca\ (OH)_2 + CO_2 \rightarrow CaCO3_{\ (s)} + H_2O_{\ (l)}$

b) Excess oxygen✓1 and nitrogen✓1/helium✓1/neon/argon (accept a name of inert gas)

15. a) $Ca(OH)_2$ paste ✓1

b) $Al^{3+}{}_{(aq)} + 3OH^-{}_{(aq)} \rightarrow Al\ (OH)_{3\ (s)}$✓1

16. $\frac{25x1000x28}{132x1000} = 5.3kg$ ✓1

17. a) Zinc blend/ZnS

a) $2ZnS_{(s)} + 3O_{2(g)} \rightarrow 2ZnO_{(s)} + 2SO_{2(g)}$

b)

- Manufacture of dry cells
- Galvanizing iron sheets
- Making of allows e.g. brass (any ✓1)

18. R.M.M of H_2O=18

R.M.M of Na_2CO_3=106

$moles\ of\ H2O = \frac{14.5}{18} = 0.805$✓½

$moles\ of\ Na2CO3\ \frac{85.5}{106} = 0.806$✓½

$Mole\ ratio\ 1:1$✓1

$hence\ n = 1$✓1

19. a) Add 200cm^3 of 2M HNO_3 to 200cm^3 of 2M NaOH
Filtrate with a suitable indicator get end point✓$^1/_2$-repeat without indicator✓$^1/_2$
Crystallize the filtrate✓½

$2NaNO_{3(s)} \longrightarrow 2NaNO_{2(s)} + O_{2(g)}$

20. Propanoic✓ acid and ethanol.✓

21. $2HNO_{3(l)} + Mg_{(s)} \longrightarrow Mg(NO_3)_{2(aq)} + NO_{2(g)} + H_2O_{(l)}$
$Mg_{(s)} + 2HNO_{3(aq)} \longrightarrow Mg(NO3)_{2(aq)} + H_{2(g)}$

22. a) Add distilled✓$^1/_2$ water to the soil sample and stir. Add 2 drops of universal indicator✓$^1/_2$ to the mixture and compare with the PH chart✓½.
b)

- Extensive use of acidic fertilizers
- Pollution by acid rain. (any ✓1) 23.

24.

Salt	Adding water	Heating
Calcium carbonate	Does not dissolve	Forms a white solid
Calcium hydrogen carbonate	Dissolves to form a colorless solution	Forms a white solid and a colourless liquid form on the upper cooler parts of the apparatus

- Place the mixture on a piece of paper and put a magnet ✓1above the mixture to attract iron filings
- Heat the remaining part of the mixture for Al_2Cl_3 ✓1to sublime and collect sublimate.
Calcium chloride will remain at the bottom of the tube.✓1

25. A✓1-does not form scum with hard water.✓1

26. a) ΔH_1-lattice energy✓1
ΔH_2-Hydration energy✓1
b) $\Delta H_3 = \Delta H_1 + \Delta H_2$✓1

27. a) Oxalic acid✓$^1/_2$ and concentrated sulphuric acid✓½
b) $NaOH_{(aq)} + CO_{2(g)} \longrightarrow Na_2CO_{3(aq)} + H_2O_{(l)}$
c) CO: Colourless✓½ and odourless✓$^1/_2$

28. a) Copper II ions✓1
b) Tetra amine copper ions✓1

29. a) Dilute nitric (v) acid✓
b) $AgNO_{3(s)} \longrightarrow Ag_{(s)} + NO_{2(g)} + O_{2(g)}$✓1
c)

- Aiding patients with breathing problems
- Welding metals
- Used during climbing of high mountains and deep sea diving (any ✓1)

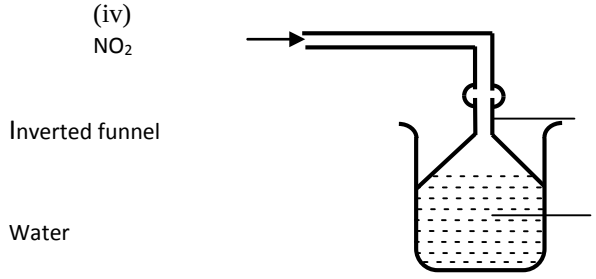
30. The PH of 0.1M KOH is higher✓½ than that 0.1M aqueous ammonia. KOH is strongly/completely dissociated✓½ in solution while aqueous ammonia is partially ✓½ dissociated in solution.

31. i. Vulcanisation ✓1 ii. To harden rubber ✓1-the sulphur atoms form link between chains or rubber molecules reducing the number of double bonds in the polymer.✓1

MACHAKOS COUNTY KCSE TRIAL AND PRACTICE EXAM 2015
233/2 CHEMISTRY
PAPER 2 MARKING SCHEME

1. (a) P = 15
Ne = 20.0
H = 1
C = 12.0
Each ✓ ½ Mark
(b) (i) The one of atomic number 24 ✓ 1 because it is closer to R.A.M (24.3) that means it contributes to R.A.M more than the other two ✓ 1.
(ii) Isotopes are atoms of the same element with the same number of protons but different number of neutrons. ✓ 1
(c) (i) Isotopes are crystalline forms of the same element in the same physical state.
(ii) Sulphur and carbon Any ✓ 1
(iii) Red phosphorous ✓ ½ because it has a higher melting point. ✓ ½
(d) The melting point of aluminium is higher than that of sodium ✓ 1 because its effective nuclear charge ✓ 1 OR
Aluminium contributes more ✓ 1 electrons to the metallic bonding as compared to sodium which contributes less ✓ 1
(e) Al_4C_3 ✓ 1

2. (a) (i) Dilute Sulphuric acid ✓ 1/Acidified water
(ii) Red – hot platinum ✓ 1
(iii) A temperature of 30^0C or 303K
Forward reaction is exothermic ✓ ½ and is favoured by reduction in temperature inorder to produce the maximum ✓ ½ yield of Nitrogen (IV) oxide
(iv)



(v) Fractional distillation ✓ 1 of the dilute acid.
(vi) It continues ✓ ½ to burn fuming reddish-brown fumes of Nitrogen (IV) oxide ✓ ½
(vii) Fractional distillation ✓ ½ of liquid air to obtain nitrogen at -196^0C ✓ ½
(viii) $NH_{3(g)} + HNO_3 \rightarrow NH_4NO_{3(aq)}$ ✓ 1
(ix) Nitrogen (I) Oxide ✓ ½
(b) (i) $3Mg_{(s)} + N_{(g)} \rightarrow Mg_3N_{2(s)}$
(ii) Argon/Neon/Helium/ name of a noble gas ✓ ½ - Is inert ✓ ½ and hence did not react with air.
(c) (i) Decrease in presence shifts the equilibrium to the left ✓ ½, lowering ✓ ½ the yield of ammonia.
(ii) - Manufacture of Nitric (V) acid any ✓1
- Raw material in the Solvay Process for manufacture of soda ash
- Removal of stains
- Manufacture of nitrogenous fertilizers

3. (a) (i) I Name – Limestone ✓ 1
II Use – To produce Calcium Oxide which reacts with Silica to form slag ✓ 1
(ii) - Magnetite, Fe_3O_4 Any ✓ 1
- Siderite, $FeCO_3$
- Iron pyrites
Accept both the name and/ or a correct formula
(iii) Slag is immiscible with molten iron ✓ 1
(iv) I. Blowing/passing oxygen into molten iron which converts carbon to carbon (IV) oxide.
II. To make iron less brittle/to increase tensile strength/to make it more malleable
(v) The reaction between coke and hot air is highly exothermic ✓ 1
(vi) Air reacts with coke to form Carbon (IV) Oxide ✓ 1. The reaction Carbon (IV) oxide reacts with coke to form Carbon (II) Oxide✓ 1, which reduces ✓ 1 Iron (II) Oxide to form iron.
(vii) Cast iron is impure ✓ 1

(viii) Nitrogen (IV) oxide forms acid rain ✓ 1 which corrodes metallic materials ✓ 1/destroys vegetation in the environment/destroys stone buildings.

4. (a) Hydrocarbon ✓ 1

(b) (i) 2,2 – dimethylbutane ✓ 1

(ii) Pent-2-yne ✓ 1

(c) When acidified $KMnO_4$ or bromine water is added separately into each of the compounds, compound (ii) decolourises the reagents ✓ 1 while compound (i) does not.

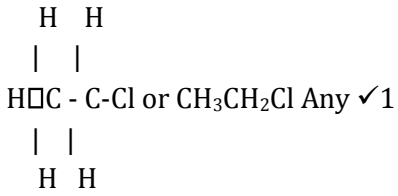
OR

Burn each of the compounds; Compound (ii) burns with a yellow flame (luminous flame) while compound (i) burns with a blue flame (non-luminous flame)

(d) P_1

$H\square C{=}C\text{-}Cl$ or CH_2CHCl Any✓1

P_2



$H\square C\text{ - }C\text{-}Cl$ or CH_3CH_2Cl Any ✓1

(e) (i) Name of process – Thermocracking ✓ ½

Conditions – Heat, temperature □ 400K ✓ ½

Catalyst temperature □ 700K

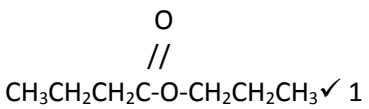
(ii) Ethane | CH_3CH_3|C_2H_6 any ✓1

(iii) I. Pollutes the environment /Produces poisonous gases when burnt✓1

II. Hydrolysis

III. Name:- Propylbutanoate ✓ 1

Structural formula:



$CH_3CH_2CH_2C\text{-}O\text{-}CH_2CH_2CH_3$✓ 1

5. (a) (i) To remove the large solid particles from water ✓ 1

(ii) Sedimentation ✓ 1

(iii) I. Cause the small suspended particles to settle down. ✓ 1

II. To kill germs/microorganisms/microbes Any ✓1

(b) (i) Permanent

(ii) Addition of Na_2CO_3 which precipitates Mg^{2+} as $MgCO_3$

OR

Use of ion exchange resin which will remove Mg^{2+} or distillation where $MgSO_4$ is left behind as residue. Any ✓ 1

(c) (i) Add excess ✓ ½ calcium oxide to dilute HCl/HNO_3 ✓ ½ filter to obtain the filtrate and add aqueous Na_2CO_3/K_2CO_3 ✓ ½ to the filtrate to precipitate $CaCO_3$ ✓ ½; wash the precipitate with distilled ✓ ½ water and dry it between filter papers ✓ ½

(ii) Used as chalk

- Used in the extraction of iron ✓ 1

6. (a) (i) P1 – All points plotted ✓ 1

C1 – Smooth curve ✓ 1

(ii) I. 5.4×10^{-3} mol dm^{-3}

II. Draw a tangent at t = $1\frac{1}{2}$ minutes

Hence rate = $\frac{9.4}{6.8}$

= 1.38×10^{-3} ✓1

(iii) Rate increases with increase in concentration ✓ ½ because the more the particles in solution the higher the frequency of collision between the particles. ✓ ½

(iv) See graph ✓ 1

Reason: At lower temperature, the particles have less K.E ✓ ½ hence frequency of collisions is reduced. ✓ ½

(b) No. of moles of $BaCl_2$ $= \frac{300\ x\ 2}{1000}$

= 0.6 moles ✓ ½

1 Mole $BaCl_{2(aq)}$ □ 17.7kJ $mol^{-1}$of Heat Energy evolved.

0.6 moles $BaCl_{2(aq)}$ □ ?

$\frac{17.7}{1}$ x 0.6 = 10.62 Kj ✓ ½

$\frac{750\ x\ 4.2\ x\ \Delta T}{1000}$ = 10.62kJ ✓ ½

□T $= \frac{10.62\ x\ 1000}{750\ x\ 4.2}$

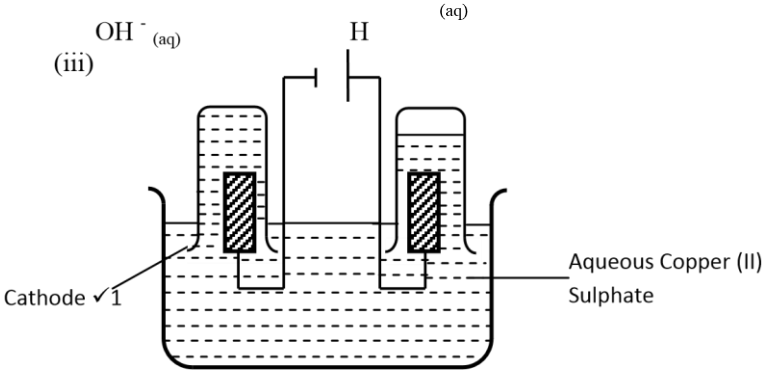
= 3.371 minutes

□ 3.4 minutes (1 d.p) ✓ 1

7. (a) (i) Platinum/Graphite (Carbon) Any ✓ 1

(ii) $SO_4^{-2}{}_{(aq)}$ $Cu^{2+}{}_{(aq)}$ $H^+{}_{(aq)}$ $OH^-{}_{(aq)}$ All ✓ 1

(iii)



(iv) $4OH^-_{(aq)} \rightarrow 2H_2O_{(l)} + O_{2(g)} + 4e^-_{(g)}$ ✓ 1

(v) The concentration of copper (II) ions in solution decreases ✓ ½ and the blue colour of the Copper (II) Sulphate solution becomes pale and finally colourless ✓ ½

(vi) Q = It

= 2 x 4 x 60 x 60 ✓ ½

= 28000C ✓ ½

1 mole of gas □ 4F

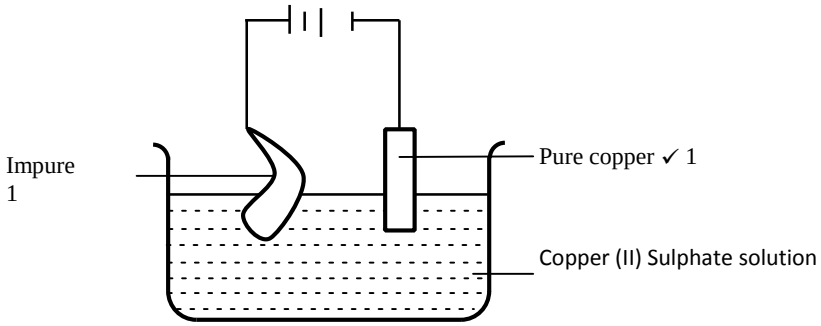
? □$\left(\frac{2\ x\ 4\ x\ 3600}{96500}\right)$F

$\frac{\frac{1}{4}x2x4x3600}{96500}$ moles ✓ 1

Volume of gas = $\frac{1}{4}$ x $\frac{2\ x\ 4\ x\ 3600\ x\ 24000}{96500}$ ✓1

= 1790.67cm^3 (2 d.p) ✓1

(b) (i)



(ii) – Electroplating

- Extraction of reactive metals
- Cathodic protection Any ✓ 1

MACHAKOS COUNTY KCSE TRIAL AND PRACTICE EXAM 2015
Kenya Certificate of Secondary Education (K.C.S.E.)
Chemistry 3
Practical
Time: 2 ¼ Hours
MARKING SCHEME

TABLE 1

Volume of water in the boiling tube	Temperature which crystals of solid P first appear (0C)	Solubility of solid P (g/100g water)
10	56.0✓1	60✓$^1/_2$
12	48.0✓1	50✓$^1/_2$
14	47.0✓1	42.85✓$^1/_2$
16	44.5✓1	37.5✓$^1/_2$

ii) Graph is a curve
Smooth curve-1 mark✓C1
Plotting all your points correctly✓P1-1 mark Scale-
graph must occupy ¾ S1of grid.

iii) Interpretation from the graph- (1 mark)✓1

PROCEDURE (II)

TABLE II	I	II	II
Final burette reading			
Initial burette reading			
Volume of solution R (cm^3) added			

1-complete table
1-decimals
1-accuracy
3 marks

Required value=12.5cm^3

i) Average volume of solution R used
$\frac{Add\ 3\ titre\ values}{3}$✓ $^1/_2$mk Give answer to 2 decimal places ✓$^1/_2$

ii) Using the given information
$concentration = \frac{25x2}{250}$✓0.2mol dm^{-3}✓1

iii) $No\ of\ moles\ base\ used = \frac{0.2x25}{1000}$

$$No\ of\ moles\ of\ acid = \frac{0.2x25}{100} x \frac{1}{2} = (mole\ ratio 1:2\ mol)$$

$$= 0.0025 moles$$

$$concentration\ of\ acid = \frac{0.0025x1000}{Average\ titre\ value\ in\ (i)}$$

$$MM = \frac{gl^{-1}}{molarity}$$

iv)
250cm3 ⟶ 6g
1000cm^3 ⟶ ?

——✓1

v)

$$x = \frac{Answer\ in\ (iv) - 90}{18} \checkmark\ 1$$

Approximately 2

PROCEDURE III

		I	II	
$T_1{}^OC$	1decimal 0.5 or 0.0	1	decimal place 0.0 or 0.5	
$T_2{}^OC$	1 decimal place 0.0 or 0.5	1	decimal place 0.0 or 0.5	
$T_3{}^OC$	1 decimal place 0.0 or 0.5	1	decimal place 0.0 or 0.5	

a) $\Delta T\ (^oC) = T_3 - \frac{T1+T2}{2}$

b) $\Delta H = \left(\frac{m\Delta TC}{1000}\right) kJ$

Where $m = 25 + 25 = 50cm^3$

$\Delta T = value\ in\ answer\ \ a()$

E-$AlCl_3$

2. You are provided with solid E. (carry out the tests below and record your observations and inferences in the space provided.

a) Place about one-half of the solid E in any test tube. Heat gently then strongly and test any gas produced with red and blue litmus papers.

Observation	Inferences	
-White fumes which turns blue litmus red and red litmus remains red.		-Acidic gas produced.
-Colourless liquid formed on the cooler par of test tube. (2 marks)		-Is a hydrated salt. (1mark)

b) Place the rest of solid E in a boiling tube. Add about 10cm^3 of distilled water. Shake well and use 2cm^3 portions for each of the tests below.

i) To one portion add solution Q (sodium hydroxide) drop wise until in excess.

Observations	Inference White precipitate that dissolves in excess (1 mark) Al^{3+}, Pb^{2+}, Zn^{2+} present (1 mark)	

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

Observation	Inferences	
White precipitate Insoluble in excess (1 mark)	Al^{3+}, Pb^{2+} present	

iii) To the third portion, add 1cm^3 of $BaCl_2$ solution.

Observation	Inferences	
No white precipitate formed (1 mark)	$SO^{2-}{}_4$,$SO^{2-}{}_3$,$CO^{2-}{}_3$ absent (1 mark)	

iv) To the fourth portion add two drops of aqueous lead (II) nitrate and heat the mixture to boiling.

Observation	Inferences	
White precipitate is formed and dissolves on warming. mark)	Cl^- present (1 mark) (1	

F-oxalic acid

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

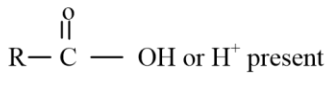
a) Describe the appearance of solid F white crystalline solid

b) Place about one-third of solid F on a metallic spatula and burn it in a Bunsen burner flame.

Observation	Inferences
Solid melts and burns with smoky flame (1 mark)	C C - C C - Present (1 mark)

c) Dissolve the remaining amount of solid F in about 10 cm3 of distilled water in a boiling tube and shake well. Divide the solution into three portions.

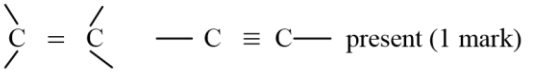
i) To the first portion add all of the solid sodium hydrogen carbonate provided.

Observation	Inferences
Effervescence occurs with production of a colourless gas. (1 mark)	 R— C — OH or H^+ present

ii)To the second portion, add three drops of acidified potassium (VI) solution and warm.

Observation	Inferences
Purple potassium Magnate (VII) is decolourised(1mark)	 R-OH present. (1 mark)

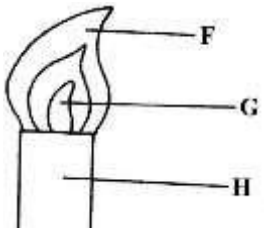
iii) To the third portion, add five drops of bromine water.

Observation	Inferences
Bromine water decolourised (1 mark)	 present (1 mark)

iv) Describe how you can find the PH of solid F above. (1 mark)
Dissolve the solid in distilled water to form a solution.
To the solution, add a few drops of universal indicator and match the colour produced with PH chart and record its PH.

NANDI NORTH SUB-COUNTY JOINT PRE-MOCK EXAMINATIONS 2015
Kenya Certificate of Secondary Education (K.C.S.E.)
233/1
CHEMISTRY
PAPER 1
THEORY

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



Name the parts labelled **F** and **G**. (1mk)

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

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

3. Describe how a solid sample of Lead (II) Chloride can be prepared using the following reagents:
Dilute Nitric Acid, Dilute Hydrochloric Acid and Lead Carbonate. (3mks)

$^{--1}$

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

4. $Na^+_{(g)} + Cl_{(g)} \longrightarrow NaCl_{(s)}$ ΔH_1 = -781KJmol

$NaCl_{(s)} \xrightarrow{H_2O_{(l)}} Na^+_{(aq)} + Cl^-_{(aq)}$ ΔH_2 = +7KJmol^{-1}

$Na^+_{(aq)} + Cl^-_{(aq)} \longrightarrow Na^+_{(aq)} + Cl^-_{(aq)}$

(a) What is the name of ΔH_1? (1mk)

(b) Calculate the heat change for the process: (2mks)

$H_2O_{(l)}$

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

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

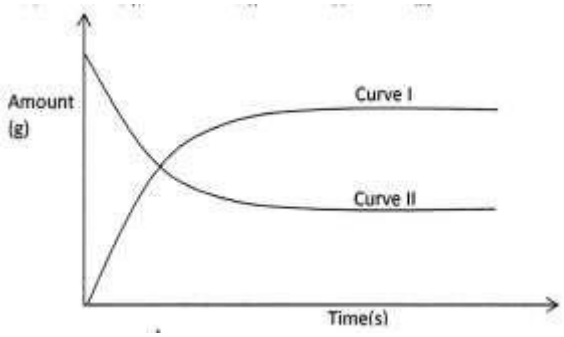
When an aqueous mixture containing 60g of potassium bromide and 7g potassium sulphate in 100g of water at 80^0C was cooled to 0^0C, some crystals were formed.

(a) Identify the crystals. (1mk)

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

6. The graph below shows the amount of calcium carbonate and calcium chloride varying with time in the reaction.

$CaCO_{3(s)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + H_2O + CO_{2(g)}$



(a) Which curve shows the amount of calcium chloride varying with time? (1mk)

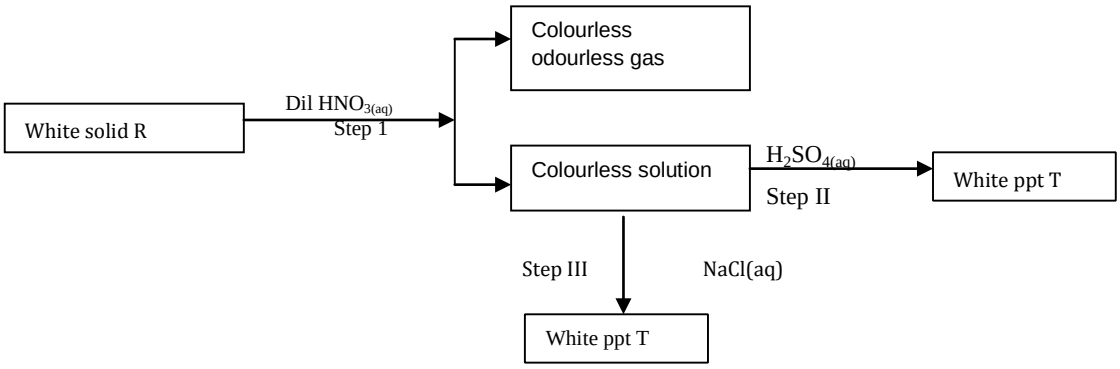
(b) Explain why the two curves become horizontal after a given period of time. (1mk)

(c) Sketch on the graph, how curve II would appear if the experiment was repeated using a more dilute hydrochloric acid solution. (1mk)

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

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

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



(a) Identify solid R. (1mk)

(b) Write a balanced equation for step II and ionic equation for step III.

Step II (1mk)

Step III (1mk)

10. In an experiment to study properties of carbon, a small amount of charcoal is placed in a boiling tube. $5.0cm^3$ of concentrated nitric acid is added. The mixture is then heated.

(a) What observations are made? (1mk)

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

(c) What property of carbon is shown in this reaction? (1mk)

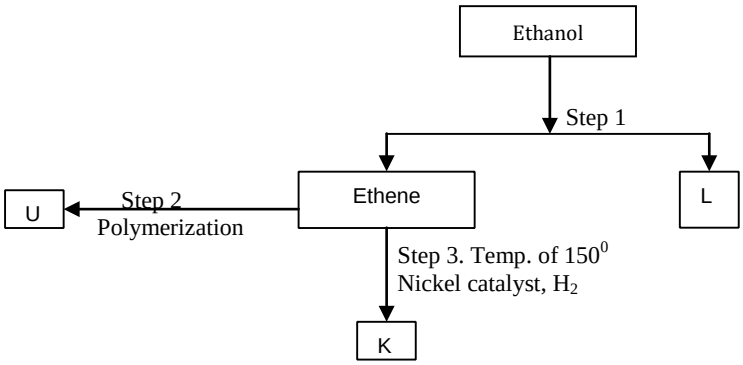
11. Both diamond and graphite have giant atomic structures. Explain why diamond is hard while graphite is soft. (2mks)

12. (a) Define the term oxidation state. (1mk)
    (b) Calculate the oxidation states of chromium and manganese in the following ions. (2mks)

(i) Chromium in $Cr_2O_7^{2-}$

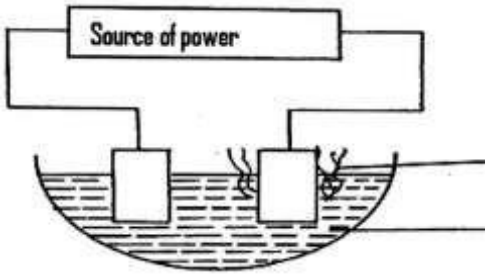
(ii) Manganese in MnO_4^-

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



    (a) Identify substances: K, U L (1½ marks)
    (b) State the conditions for the reaction in step 1 to occur. (2mks)
    (c) Give **one** disadvantage of continued use of substances such as U. (½mk)

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



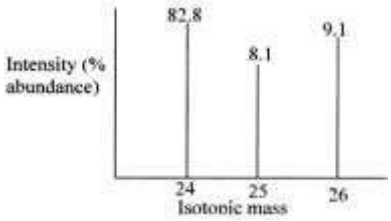
    (a) On the diagram, label the cathode. (1mk)
    (b) Write the equation for the reaction on the cathode. (1mk)

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

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

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

16. The peaks below show the mass spectrum of element X.

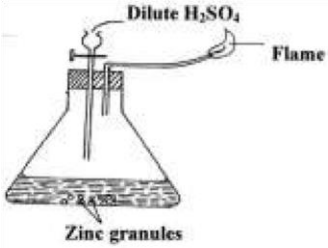


    Calculate the relative atomic mass of X. (2mks)

17. In an experiment, concentrated sulphuric (VI) acid was put in a beaker and exposed to air for one week as shown below.

(i) What observation was made after one week? Explain. (2mks)
(ii) What property of sulphuric (VI) acid was being investigated in the experiment? (1mk)

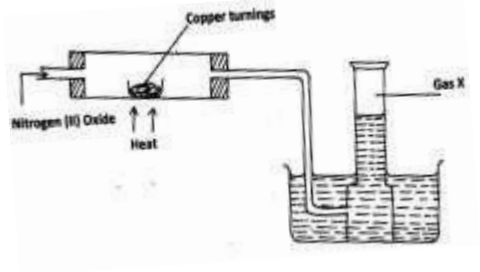
18. Below is a set-up of apparatus used to prepare hydrogen gas in the laboratory. Study it and answer the questions that follow.



(a) Write a chemical equation for the two reactions taking place in he above set-up. (2mks)
(b) State the chemical test for hydrogen gas. (1mk)

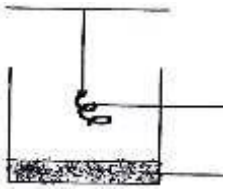
19. State **three** reasons why air is considered to be a mixture but not a compound. (3mks)

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



(a) Identify gas X. (1mk)
(b) State the observation made in the combustion tube. (1mk)
(c) Write equation for the reaction in combustion tube. (1mk)

21. The set-up below shows the catalytic oxidation of ammonia in the laboratory.



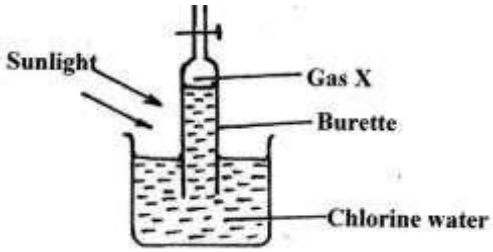
Red hot platinum

Ammonia

(a) State and explain the observation made. (2mks)
(b) Write a chemical equation for the first reaction taking place in the beaker. (1mk)

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

23. An experiment was set up using chlorine water as shown below.



(i) Identify gas X. (1mk)
(ii) Write an equation for the production of gas X. (2mks)

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

Element	**1st I.E**	**2nd I.E**	**3rd I.E**
G	520	7,300	9,500

R	420	3,100	4,800

(i) Define the term 1st ionization energy. (1mk)

(ii) Apart from the decrease in energy levels, explain the big difference between the 1st and 2nd ionization energies. (1mk)

(iii) Calculate the amount of energy for the process: (1mk)

$R_{(g)} \longrightarrow R^{3+}_{(g)} + 3e^-$

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

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

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

(a) Which solution is likely to be:

(i) Potassium hydroxide (1mk)

(ii) Lemon juice (1mk)

(b) Explain why a solution of hydrogen chloride gas in methyl benzene was identified as N. (1mk)

27. Using dots (•) and crosses (x) to represent electrons, show bonding in the compound formed when the following elements reacts. (N = 14, H = 1).

Nitrogen and Hydrogen. (1mk)

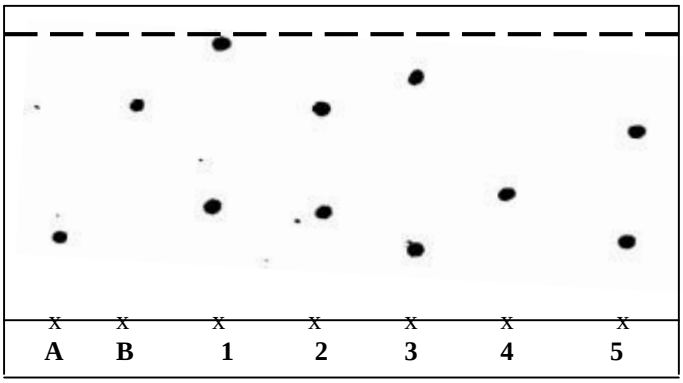
28. Some salts may be classified as double salts or basic salts. Trona with the formula $Na_2CO_3.NaHCO_3$ is an example of a double salt. An example of a basic salt is basic magnesium carbonate with formula $MgCO_3.Mg(OH)_2$.

(a) What is meant by a double salt? (1mk)

(b) Write equations of reactions that occur when dilute hydrochloric acid is reacted with: (2mks) (i) Trona

(ii) Basic magnesium carbonate.

29. During Olympics, urine sample of five short distance runners were taken and tested for the presence of two illegal steroids by paper chromatography. Methanol was used as the solvent. A chromatogram from the test appeared as shown below. Study the chromatogram and answer the questions that follow.



KEY

SPOT A – STEROID A
SPOT B – STEROID B
SPOT 1 – ATHLETE 1
SPOT 2 – ATHLETE 2
SPOT 3 – ATHLETE 3
SPOT 4 – ATHLETE 4

(a) Which of the two steroids is most likely to be more soluble in methanol? Give a reason. (1mk)

(b) Identify the athletes that tested positive for the illegal steroids. (2mks)

NANDI NORTH SUB-COUNTY JOINT PRE-MOCK EXAMINATIONS 2015

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

233/2

CHEMISTRY

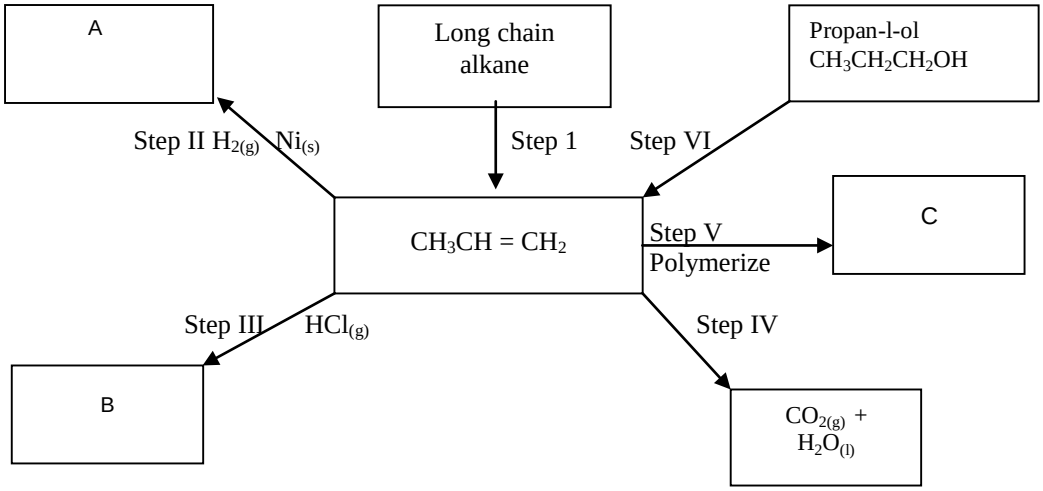
PAPER 2

THEORY

MARCH / APRIL 2015

TIME: 2 HOURS

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



(i) Name the process taking place in step (I). (1mk)

(ii) Describe chemical test that can be carried out to show the identity of organic compound A. (2mks)

(iii) Give the name of the following: (2mks)

I. A: II. B:

(iv) Give the structural formulae of substance C. (1mk)

(v) Name the type of reaction that occurs in:

I. Step IV (1mk)

II. Step VI:

(vi) Give the reagent and the condition necessary for step VI. (1mk) Reagent:

Condition:

(b) Give the systematic names of the following compounds:

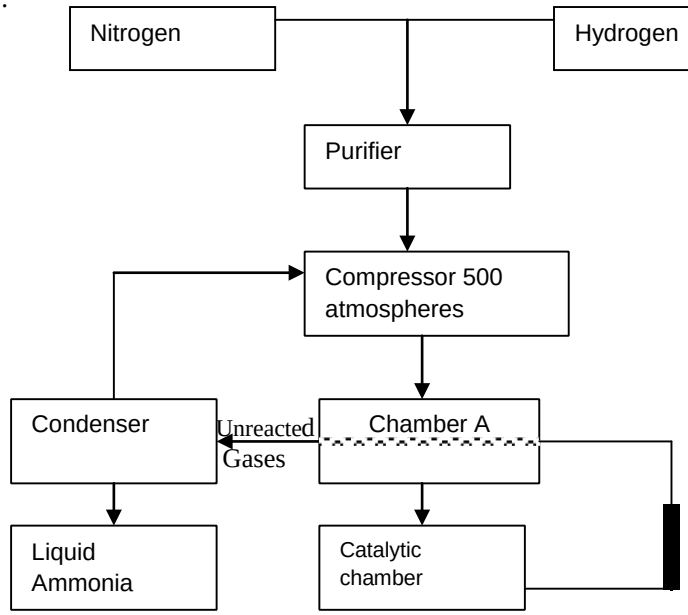
I. $CH_2CHCHCH_2CH_3$

(1mk)

II. CH C C H_3

(1mk) 2. The flow chart below shows the Haber process in the large scale manufacture of Ammonia gas. Use it to answer the

questions that follow.



Describe how nitrogen is obtained from air on a large scale. (3mks)

(a) (i) Name **one** source of hydrogen gas used as a raw material in the above process. (1mk)

(ii) Name chamber A. (1mk)

(iii) Write an equation for the reaction taking place in the catalytic chamber. (1mk)

(iv) In the Haber process optimum temperature of 500^0C and 200 atmospheres of pressure are used to get optimum yield of Ammonia. Why can"t lower temperatures and higher pressure be used? (2mks)

(b) Give **two** reasons why finely divided iron is the commonly used catalyst. (1mk)

(c) State and explain the observation made when dry ammonia gas is passed over heated copper (II) Oxide in a combustion tube. (2mks)

(d) Give **two** uses of ammonia gas. (1mk)

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

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

(i) Plot the graph of time in minutes on the horizontal axis against volume of hydrogen gas on the vertical axis. (3mks)

(ii) Name the factor that was investigated in this experiment. (1mk)

(iii) Use the graph to determine the volume of hydrogen gas that was produced between 2¾ minute and 5.0 minutes. (2mks)

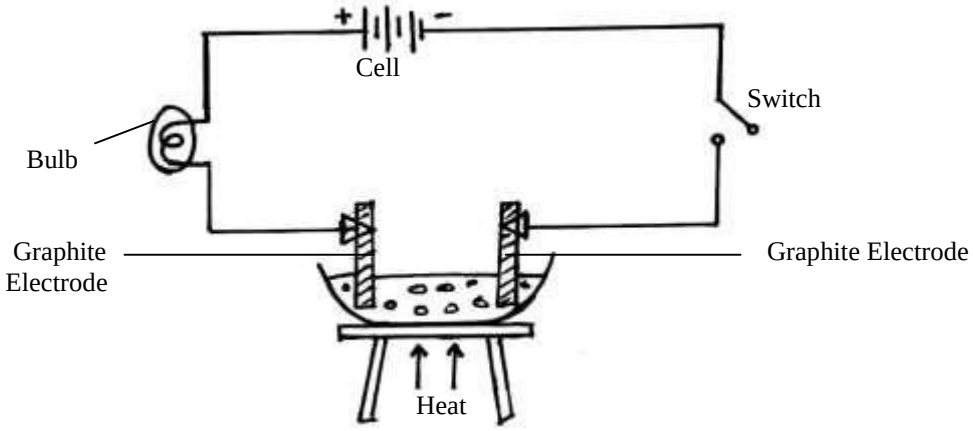
(iv) Explain the shape of the graph between minutes 7.0 and 8.0. (2mks)

(b) Hydrogen gas reacts with chlorine gas to form hydrogen chloride gas as shown in the equation below. $H_{2(g)} + Cl_{(g)} \rightleftharpoons 2HCl_{(g)}$

(i) Explain the effect on the yield of $HCl_{(g)}$ by lowering the pressure for this reaction. (2mks)

(ii) Using a well labeled diagram, describe how a solution of hydrogen chloride can be prepared in the laboratory. (2mks)

4. The diagram below shows a set up which was used by student to investigate effect of electricity on solid Molten Lead (II) Bromide. Study it and answer the questions that follow.



(a) (i) State and explain the observation at the anode when the switch is switched on. (2mks)

(ii) What precaution should be taken when carrying out this experiment? (1mk)

(iii) Write the equation of the reaction taking place at the Anode. (1mk) (iv) Why are graphite electrodes used in the experiment? (1mk)

(v) On the diagram, indicate the direction of flow of electrons.

(vi) The students noted that the bulb only produced light after the Lead (II) Bromide had melted. Explain this observation. (2mks)

(b) State the difference in conduction of electric current between Molten Lead (II) Bromide and Lead Metal. (1mk)

(c) Explain why it is not advisable to store Copper (II) Sulphate solution in a can made of Zinc metal. (2mks)

(d) State **two** applications of electrolysis. (1mk)

5. (a) What is meant by molar heat of solution? (1mk)

(b) The enthalpies of combustion of carbon, and carbon (II) oxide are indicated below.

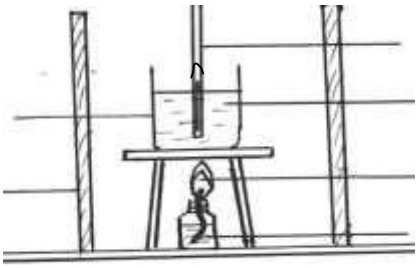
$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$: DH = 393 KJ mol^{-1}

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

(i) Draw an energy level diagram that links the enthalpy of formation of Carbon (II) Oxide to enthalpies of combustion of carbon and Carbon (II) Oxide. (2mks)

(ii) Determine the enthalpy of formation of Carbon (II) Oxide. (2mks)

(c) The set up below was used by a student to determine the enthalpy of combustion of ethanol (CH_3CH_2OH). Study it and answer the questions that follow.



The following data was collected from the experiment:

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

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

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

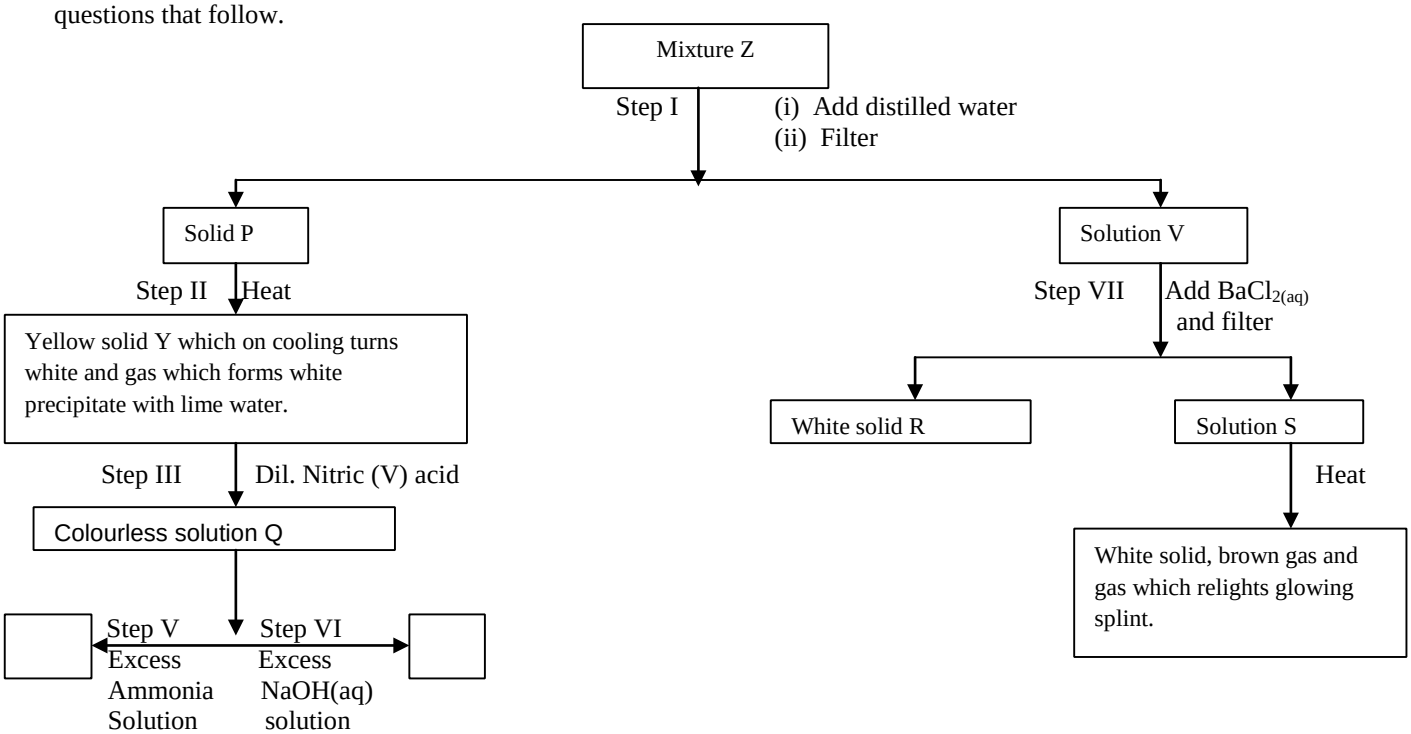
(iii) Calculate the molar heat of combustion of Ethanol (C = 12, O = 16, H = 1) (2mks)

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

(d) Give **<u>two</u>** precautions necessary when using fuels. (1mk)

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

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



Write the formulae of the two salts present in mixture Z. (2mks)

(c) Write an ionic equation for the reaction in step VII. (1mk) (d) State and explain the observation in Step (V) and (VI). (3mks)

(i) Step (V):

(ii) Step (VI):

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

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

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

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

(b) Explain why sodium chloride has melting point of 1074^{0}C whereas silicon tetrachloride has a melting point of 203^{0}C under the same conditions. (2mks)

NANDI NORTH DISTRICT MOCK 2015
233/3 – CHEMISTRY PRACTICALS
CONFIDENTIAL INSTRUCTIONS TO SCHOOLS

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

Access to:-

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

NANDI NORTH SUB-COUNTY JOINT PRE-MOCK EXAMINATIONS 2015
Kenya Certificate of Secondary Education (K.C.S.E.)
233/3
CHEMISTRY
PAPER 3
PRACTICAL
MARCH / APRIL 2015
TIME: 2 ¼ HOURS

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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 $(HX)_n \bullet 2H_2O$ of solid P.

Procedure I

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

TABLE I

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

(6mks)

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

Procedure II

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

Table II

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

(4mks)

Calculate the:

(i) Average volume of solution P used in the experiment. (1mk)
(ii) Number of moles of sodium hydroxide used in solution Q. (2mks)
(iii) Number of moles of solution P given that the relative formula mass of P, $(HX)_n \bullet 2H_2O$ is 126. (2mks)
(iv) The number of moles of sodium hydroxide required to react with one mole of P. Hence find the value of n in the formula $(HX)_n \bullet 2H_2O$. (2mks)

2. You are provided with solid **W** and solution **K**. You are required to carry out the tests prescribed in solid **W** and solution **K**. Write your observation and inferences accordingly.

(a) Place all solid **W** in a boiling tube.
   (i) Add about 10cm^3 of distilled water to solid W, and shake.

Observations (1mk)	Inference (1mk)

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

Observation (1mk)	Inference (1mk)

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

Observation (1mk)	Inference (1mk)

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

Observation (1mk)	Inferences (1mk)

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

Observation (1mk)	Inferences (1mk)

(b)

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

Observation (1mk)	Inference (1mk)

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

Observation (1mk)	Inference (1mk)

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

Observation (1mk)	Inference (1mk)

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

Observation (1mk)	Inferences (1mk)

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1. F – Thin outer region.
   G – Colourless region.
   (b) A_2B_3
2. K and N (must state two otherwise penalize). They have the same number of electrons in he outermost energy level. - Both react by losing two electrons.
3. - Add lead (II) carbonate to nitric acid and filter.
   - Add sulphur (VI) acid to the filtrate.
   - Filter and dry the residue which is $PbSO_4$ between two filter papers.
4. (a) Lattice energy
   (b) ΔH
   = - 781 + 7
   - 774KJ
5. (a) Potassium Bromide KBr
   (b) 65 – 55 = g
6. (a) Curve 1

(b) The reaction will have reached completion and the amount of reactants and products do not change further.

7. $\frac{TN_2O}{MMN_2O} = \frac{TSO_2}{MMSO_2}$

$\frac{135}{44} = \sqrt{\frac{TSO_2}{64}}$

$\frac{135}{TSO_2} = \sqrt{0.6875}$

$\frac{135}{TSO_2} = 0.82916$

$TSO_2 = \frac{135}{0.82916} = 162.825$

8. $C_xH_y + O_2 \longrightarrow CO_2 + H_2O$

Mass of C in CO_2 $\frac{12 \times 9.6}{44} = 2.618g$

Mass of H in H_2O $= \frac{2}{18} \times 4.9 = 0.544kg$

	Element C	Element H
Mass	2.618	0.54444
RAM	12	1
Moles	$\frac{2.618}{12}$	$\frac{0.54444}{1}$
	$\frac{0.21816}{12}$	$\frac{0.54444}{1}$
Mole ratio	1	2.5
	2	5

E.F C_2H_5

MF $(C_2H_5)_n = 58$

$29n = 58n$

$n = 2$

MF = C_4H_{10}

9. (a) R – Lead carbonate

(b) Step II - $PbNO_{3(aq)} + {}_{4(aq)} \longrightarrow$

$H_2SOPbSO4(s)$ Step III – $\longrightarrow Pb_{2+(aq)} +$

$2Cl_{-(aq)}\ PbCl_{2(s)}$

10. (a) Black colour of carbon (charcoal fades) - A brown gas was formed at the boiling tube. (b) $C_{(s)} + HNO_{3(aq)} \longrightarrow NO_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$ (c) Reducing property.

11. Diamond is hard due to strong covalent bonding by all the four valency electrons while graphic is soft because of layers which slide over each other occation by strong covalent bond and weak van der waal forces.

12. (a) Oxidation sate is the charge carried by an ion of an element or a radical.

(b) $Cr_2O_7^{2-}$

$2x + 7x - 2 = -2$

$2x - 14 = -2$

$2x = -2 + 14$

$2x = -10$

$= -5$

$cr = -5$

(ii) MnO_4^-

$x + 4 - 2 = -1$

$x - 8 = -1$

$x = -1 + 8$

$x = +7$ x

Mn = +7

13. (a) K – Ethane

U – Polyethene

L – Water

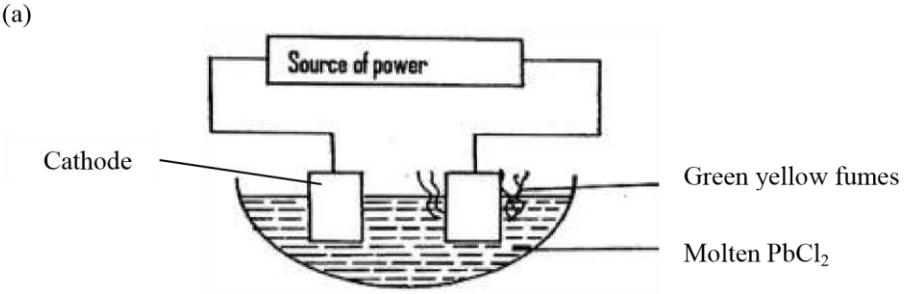
(b) - Heat

- Conc. H_2SO_4

(c) - Non biodegradable

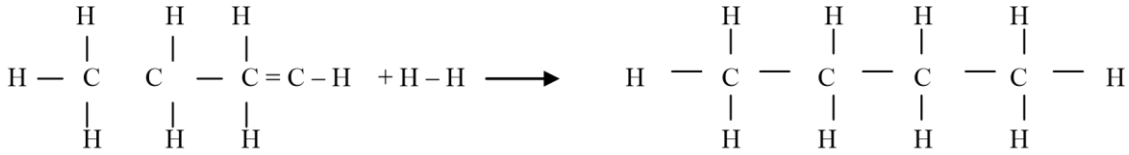
- Blockage of water sources.

14. (a)



(b) $Pb^{2+}_{(l)} + 2e \longrightarrow Pb_{(s)}$

15. $C_4H_8 + H_2 \longrightarrow C_4H_{10}$



8 C – H, C = C 2C –C H – H → 10C – H, 3C – C

Heat absorbed → Heat evolved

8 x 413 + 610 + + 432 → 10 x 13 + 3 x 346

2 x 610

Heat absorbed +5566 Heat evolved – 5168

5566 – 5168

+398KJ

16. $\frac{82.8 \times 24 + 8.1 \times 25 + 9.1 \times 26}{100}$

$\frac{2426.3}{100}$ RAM =24.26

17. (i) The level of sulphuric (VI) acid rises above $40cm^3$. (ii) Hygroscopic nature / Ability to absorb moisture.

18. $H_2SO_{4(aq)} + Zn_{(s)} \longrightarrow ZnSO_{4(aq)} + H_{2(g)}$ $2H_2O_{(g)} + O_{2(g)} \longrightarrow 2H_2O_{(l)}$

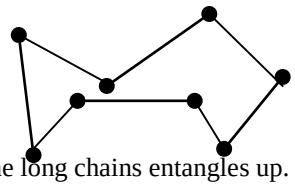
(b) Burns with a „pop" sound when ignited in presence of air.

19. - Components can be separated physically.
- Does not react as air but its components react independently.
- When subjected to condensation different components condenses at different temperatures.

20. (a) Nitrogen gas
(b) Brown copper turning turned black due to formation of copper (ii) oxide.
(c) $2CU_{(s)} + 2NO_{(g)} \longrightarrow 2CuO_{(s)} + N_{2(g)}$

21. (a) Red hot platinum continues to glow red hot oxidation of ammonia is exothermic therefore heat produced keeps platinum glowing.
(b) $2NH_{3(g)} + 2O_{2(g)} \longrightarrow N_2O_{(g)} + 3H_2O_{(l)}$

22. (a)



(b) The long chains entangles up.
(c) Flowers of sulphur / plastic sulphur.

23. (i) Oxygen gas
(ii) $2HOCl_{(aq)} \longrightarrow 2HCl_{(aq)} + O_{2(g)}$

24. (i) Energy required by an element to lose one electron in its outermost energy level in the gases state.
(ii) After losing the first electron the remaining electrons are firmly attracted by same number of protons hence require more energy for the second electron to be lost. (iii) 420 + 3100 + 4800
= 8320KJ

25. 1 mole 22.4
? $3.2dm^3$

$\frac{3.2 \times 1}{22.4}$ = 0.142857 moles

Molar mass = 6

0.142857 = 42

C	H
86	14
12	1
86	14
	1
12	
7.1661	14
1	2
EF	CH

MF = $(CH_2)n$ = 42

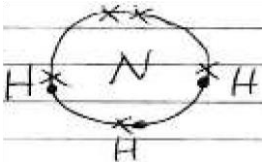
14n = 42

n = 3

MF = C_3H_6

26. (a) (i) K
    (ii) J
    (b) HCl does not dissociate fully in methyl benzene.

27. N – 2.5 x
    H – 1 •



28. (a) A salt that consists of two different salts in one crystal of the molecule.
    (b) (i) $2Na_2CO_3NaHCO_3 + 6HCl \longrightarrow 6NaCl + CO_2 + H_2O$
    (ii) $MgCO3.\ Mg(OH)2 + HCl \longrightarrow MgCl + CO_2 + H_2O$
29. (a) B moves the furthest distance compared to steroid A. (b) 3,2

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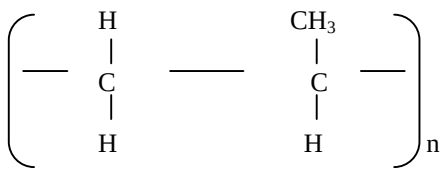
CHEMISTRY
PAPER 2

1. (a) (i) Cracking
    (ii) When the gas is burnt in air it burns with a pale blue flame.
    Does not decolourize purple acidified potassium manganate (II).
    (iii) I. A. Propane
    II. B 2- Chloro propane
    (iv)



    (v) (i) Combustion
    (ii) Dehydration
    (vi) Conc. H_2SO_4
    Temperature of 170^0C.
    (b) (i) Pent-2-ene
    (ii) Prop-1-yne.

2. (a) Purify to remove dust, bubble in NaOH / KOH to remove CO_2, reduce temperature to 25^0C to remove water as ice, compress to liquefy air and fractionally distillate to obtain nitrogen at -196^0C.

(b) (i) Cracking of long chain alkane. (ii)
Heat exchanger

(iii) $3H_{2(g)} + N_{2(g)} \longrightarrow 2NH_{3(g)}$ + Heat (Not balanced zero, missing state symbols penalize ½ mk) (iv) At low temperature the reaction is slow.

(v) At higher pressure the cost of production will be higher because maintaining higher pressure is expensive. (c)

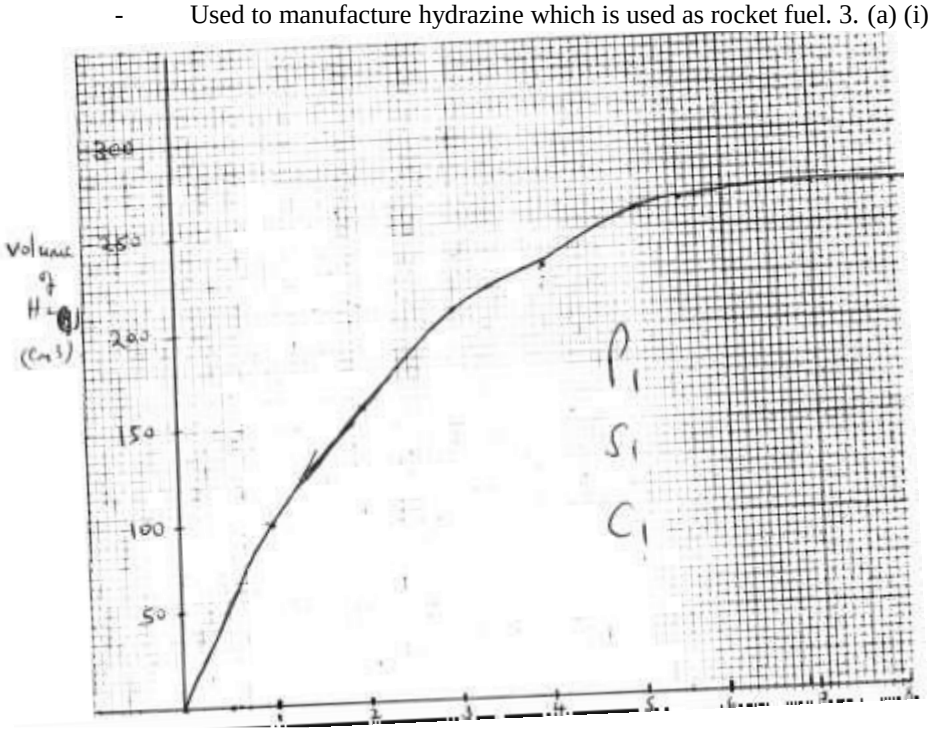
- Not easily poisoned.
- Less expensive, it is cheap.

(d) Black copper (II) oxide turns red brown, copper(II)oxide is reduced to copper metal.

- Colourless liquid condenses on the cooler parts of combustion tube. Ammonia gas is oxidized to water.

(e) - Manufacture of nitrogenous fertilizers.

- As a refrigerant.
- Use as water softener.
- Used to remove greasy stains.
- Used to manufacture hydrazine which is used as rocket fuel. 3. (a) (i) Graph



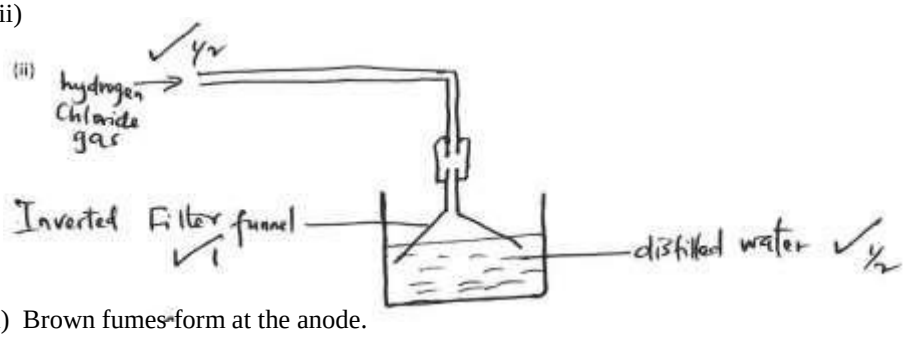
(ii) Effects of concentration on rate of reaction.

(iii) Value of minute 5 – value of 2 ¾ = Ans.

(iv) At minute 7.0 and 8.0 it flattens out. All reactants are used up and the reaction stops.

(b) (i) The yield of $HCl_{(g)}$ does not change. The number of moles are the same both on the reactant and product side.

(ii)



(a) (i) Brown fumes form at the anode.

4. - Bromide ions in the molten lead (II) bromide are oxidized to bromine gas which is brown.

(ii) Experiment should be carried out in a fume chamber or in the open because bromine gas is poisonous.

(iii) $2Br^- \longrightarrow Br_{2(g)} + 2e$ (If not balanced – zero)
(Penalize ½ mk for missing or wrong state symbols.

(iv) - They are good conductors of heat.

- They are inert.

(v) On the diagram arrow point from negative terminal of cell to cathode.

(vi) In solid state led (II) bromide is a poor conductor of electricity because it does not have mobile ions in molten state lead (II) bromide is a good conductor. It has no mobile ions.

(b) PbBr conducts because of mobile ions.
Pb metal conducts due to mobile electrons.

(c) The zinc container will be corroded because zinc is more reactive than copper. Zinc container will react with copper (II) sulphate solution to form zinc sulphate.

(d) - Extraction of meal of Na, Ma, Al.
- Purification of metal of copper.
- Electroplating metal to prevent corrosion or improve appearance.
- Manufacture of chemicals of Cl, NaOH and $H_{2(g)}$.

5. (a) It is the heat change that occurs when one mole of a substance dissolves in a solvent to give an infinitely dilute solution. (b) (i)

(ii) $DH_1 = DH_2 = -393 - 283$
$DH_2 = DH_1 - DH_3 = -393 + 283$
$= -110KJmol^{-1}$

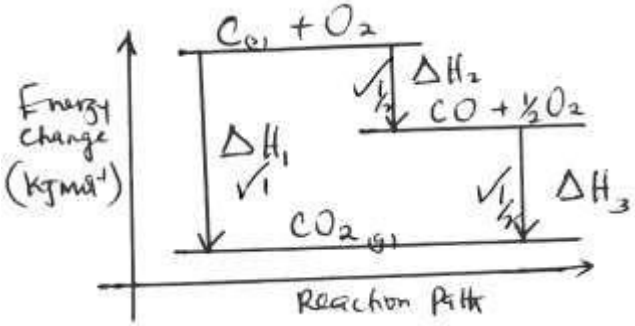
(c) (i) To prevent draughts.

(ii) $DH = MCDT$
$= 400g \times 4.20Jg^{-1}K^{-1} \times 10K$
$= 16800$ Joules or 16.8KJ

(iii) Molar mass of ethanol = 46g
Mass of ethanol burnt = 0.92g
0.92g => 16800J 45g
=> ?

$$\frac{46g \times 16800J}{0.92g} = 84000J/mol \text{ or } -840KJmol^{-1}$$

(iv) $\frac{840\ KJmol^{-1}}{46} = 18.26KJg^{-1}$



(d) Charcoal stoves should be used in well ventilated room. Car engine should not be left running in closed garages.

6. (a) - Place solid $CaCO_3$ in a beaker and add while stirring dil. HNO3 until effervescence stops.
- Filter to obtain calcium nitrate equations solution as filtrate and unreacted calcium carbonate as residue.
- To the filtrate add sodium sulphate as solution.
- Filter to obtain calcium sulphate as residue and sodium nitrate as filtrate. - Wash and dry between filter paper.

(b) $ZnCO_3$ and $Pb(NO_3)_2$

(c) $Pb^{2+}_{(g)} + Cl^{-}_{(g)} \longrightarrow PbCl_{2(g)}$

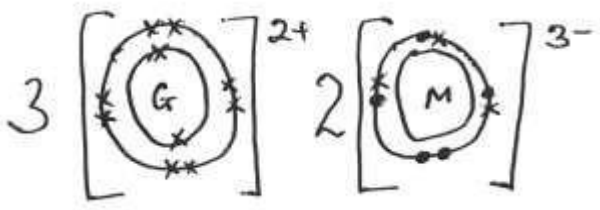
(d) (i) - White precipitate which dissolves in excess sodium hydroxide solution. - Excess equation ammonia solution.
- $ZnOH^{+2}_{(g)} + 4NH_{3(aq)} \longrightarrow [Zn(NH3)_4]^{2+}_{(aq)} + 2OH^{-}_{(aq)}$ (ii)
White precipitate dissolve in excess sodium hydroxide solution.

$Zn(OH)_{2(s)} + 2NaOH_{(aq)} \longrightarrow Na_2Pb(OH)_{4(aq)}$

(e) $CuSO_{4(s)} \longrightarrow CuO_{(s)} + SO_{2(g)}$

7. (a) (i) Alkaline earth metal. Reject group II.
(ii) E – has the smallest atomic radius.
(iii) When an atom of K forms an ion it gains one electron. This increases electron repulsion effect hence increasing its ionic radius.

(iv)



(v) $GCO_{3(s)} + H2SO_{4(aq)} \longrightarrow GSO_{4(aq)} + H_2O_{(s)} + CO_{2(g)}$

Moles of CO_2 = $\frac{0.4dm^3}{22.4dm} = 0.01786$

Moles of GCO_3 = 0.01786 moles

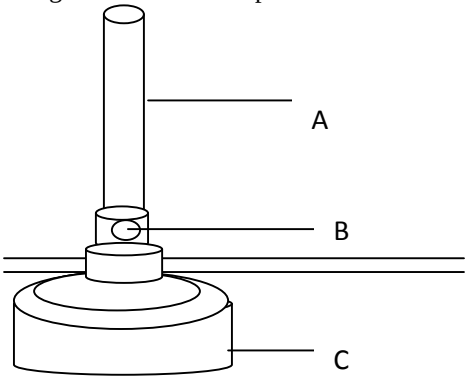
Moles of GCO_3 = 0.01786 moles x 84

= 1.49 or 1.5g

(b) - Sodium chloride has a giant ionic structure with strong ionic bond in its structure hence higher melting point.
- Silicon tetraoxide has simple molecular structure with weaker intermolecular forces hence lower melting point.

MOKASA JOINT EVALUATION EXAMINATION
Kenya Certificate of Secondary Education
233/1
CHEMISTRY
Paper 1
Mock Exams
2 hours

1. The diagram below shows parts of a Bunsen burner.



a) Name the parts labelled A , B (½ mark)

b) Give one use of the part labelled B (1 mark)

2. Hydrated copper (II) sulphate exists as blue crystals while anhydrous copper (II) sulphate is a white powder. Describe a laboratory experiment that can be used to show that the action of heat on hydrated copper (II) sulphate is a reversible reaction (2 marks)

3. A piece of burning magnesium ribbon was placed in a gaSs jar full of Nitrogen gas. The product Q formed was then reacted with water.
   a) Write the chemical formula for the product Q (1 mark)
   b) Write the equation for the reaction between product Q and water (1 mark)
   c) Using dot (•) and cross (x) diagrams to represent electrons, draw the structure to show bonding in nitrogen molecule (1 mark)

4. (i) What are isotopes (1 mark)
   (ii) Element Y (not the actual symbol of the element) has two isotopes with mass number 6 and 7. If the relative atomic mass of Y is 6.94, determine the percentage abundance of each isotope (2 marks)

5. Given zinc oxide, dilute nitric (V) acid and sodium carbonate solution. Briefly describe how you can prepare zinc carbonate (3 marks)

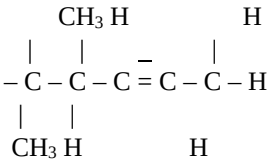
6. The elements shown in the table below (not actual symbols) belong to a certain family of metals in the periodic table. Study the information and answer the questions that follow.

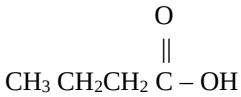
Element	Atomic size (nm)
S	0.160
T	0.180
V	0.930

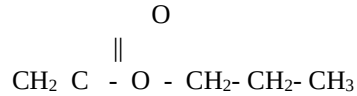
   (i) Define the term ionization energy (1 mark)
   (ii) Which element is likely to have the highest ionization energy. Explain (2 marks)

7. A certain mass of copper (II) carbonate was strongly heated.
   a) Write a balanced chemical equation for the reaction (1 mark)
   b) Given that 300cm^3 of carbon(IV) oxide gas was collected at s.t.p. and this represents 83% yield, determine the mass of copper (II) carbonate heated. (molar gas volume = 22.4dm^3, Cu=64, 0=16, C=12) (3 marks)

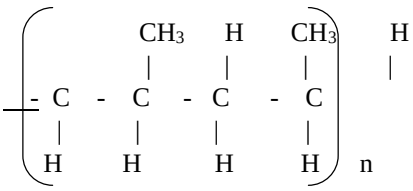
8. (i) Give the IUPAC names for the following organic compounds

   a)  (1 mark)

   b)  (1 mark)

   c)  (1 mark)

   (ii) A polymer has the following structure

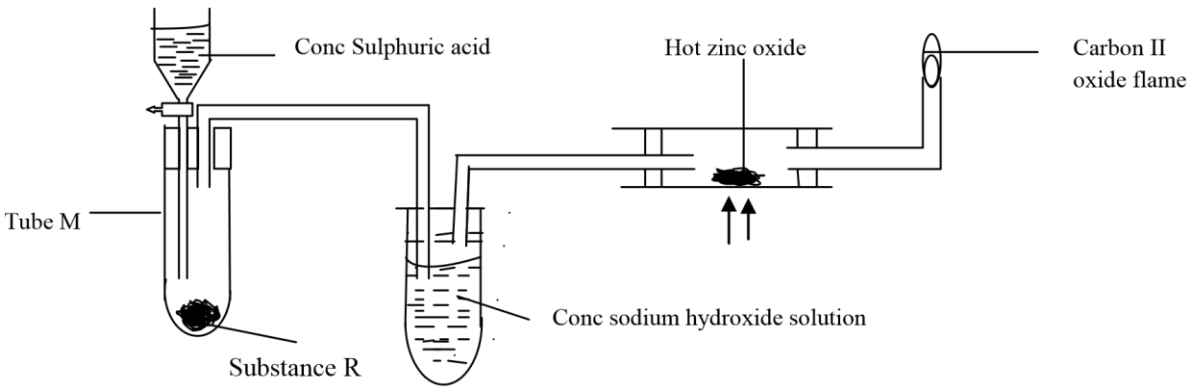


A sample of this polymer is found to have a molecular mass of 2184. Determine the number of monomers of the polymer. (C = 12, H = 1) (3 marks)

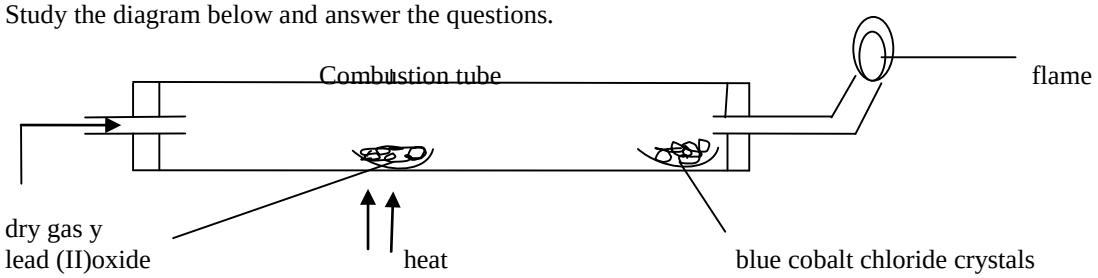
9. During an experiment, chlorine was bubbled into a solution of sodium bromide in a beaker
   a) State and explain one observation made (2 marks)
   b) Write an ionic equation for the reaction that took place in the beaker (1 mark)

10. Hardness of water may be removed by either boiling or addition of chemicals.
    a) Write down an equation to show how boiling removes hardness of water (1 mark)
    b) Name two chemicals that are used to remove hardness of water (2 marks)
11. i) Define solubility (1 mark)
    ii) 115g of a saturated solution at 65°C is found to contain 65g of potassium nitrate. Calculate the solubility of potassium nitrate at 65°C. (2 marks)
12. The equation for the reversible reaction of Bismuth (III) chloride in water is $BiCl_{3(s)} + H_2O_{(l)} \rightleftharpoons BiOCl_{(s)} + 2H^+_{(aq)} + 2Cl^-_{(aq)}$

    a) State Le chatelier"s principle (1 mark)
    b) What would be the effect of adding NaOH pellets to the equilibrium mixture. Explain. (2 marks)
13. In the equation, below identify the reagent that acts as an acid in the forward reaction. Give a reason.
    $NH^+_{4(aq)} + H_2O_{(l)} \rightleftharpoons NH_{3(aq)} + H_3O^+_{(aq)}$ (2 marks)
14. In preparation of oxygen gas, a student used hydrogen peroxide and added a black solid and collected the gas over water.
    a) What is the name of the black solid and what is its function (1 mark)
    b) During collection of the gas, why should the first bubbles be allowed to escape (1 mark)
    c) Give one main advantage of collecting a gas over water. (1 mark)
15. Explain the following observation, a one molar solution of nitric (III) acid (1M HNO_2) has a pH of 2 where as a one molar solution of chloric(I) acid (IM HOCl) pH of 4. (2 marks)
16. a) Study the set-up below and use it to answer the questions that follow.

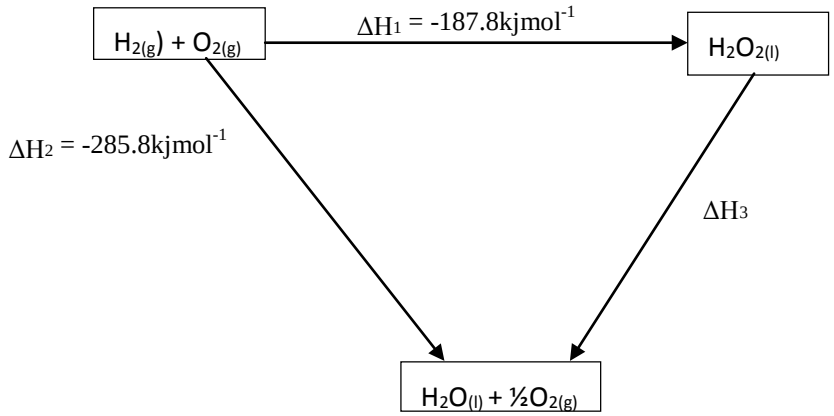


    a) Identify substance R (1 mark)
    b) State the function of concentrated sodium hydroxide solution (1 mark)
    c) State the property of carbon (II) oxide gas demonstrated in the above set-up (1 mark)
    d) Write a balanced chemical equation for the reaction occurring in tube M. (1 mark)
17. $200cm^3$ of oxygen diffused through a porous plug in 60 seconds. How long will it take $300cm^3$ of sulphur (IV) oxide to diffuse through the same plug? (S = 32, O = 16) (3 marks)
18. Study the diagram below and answer the questions.



    (i) Identify gas Y (1 mark)
    (ii) State and explain two observations made in the combustion tube. (2 mark)
    (iii) Write a chemical equation for the reaction between lead (II) oxide and gas Y (1 mark)
19. i) State Hess"s law. (1 mark)

ii) The figure below shows an energy cycle diagram.



a) Give the name of the enthalpy change ΔH_1 (1 mark)

b) Determine the value of ΔH_3 (1 mark)

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

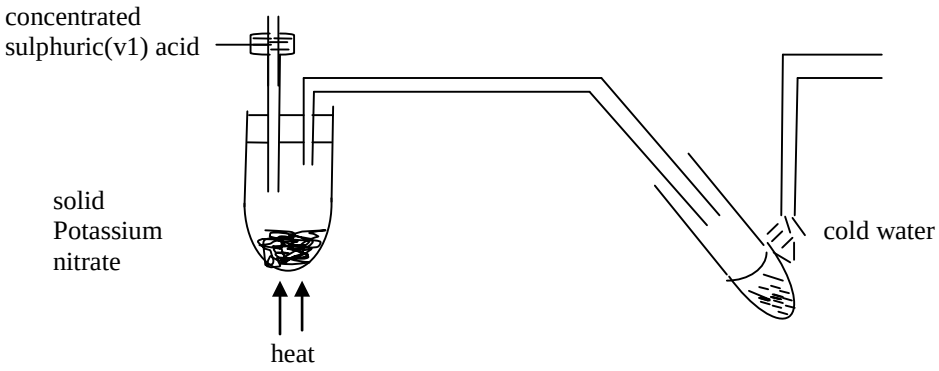
Solutions	A	B	C	D
pH values	13.0	7.0	2.0	6.5

a) Which solution reacts vigorously with magnesium metal? Explain. (1 mark)

b) Which solution is likely to be that of lemon juice? (1 mark)

c) Which solution is likely to produce green colour with the universal indicator. (1 mark)

21. The diagram below shows a set-up that was used to prepare and collect a sample of nitric (V) acid in the laboratory.

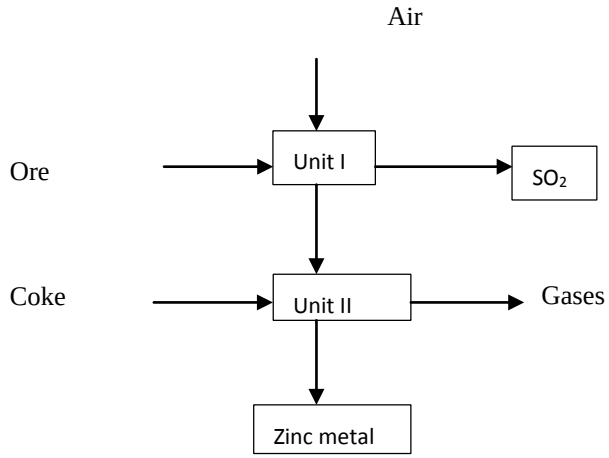


a) Give a reason why it is possible to separate nitric acid from the sulphuric (VI) acid in the set-up (1 mark)

b) Name another substance that can be used instead of potassium nitrate (1 mark)

c) Give one use of nitric (V) acid (1 mark)

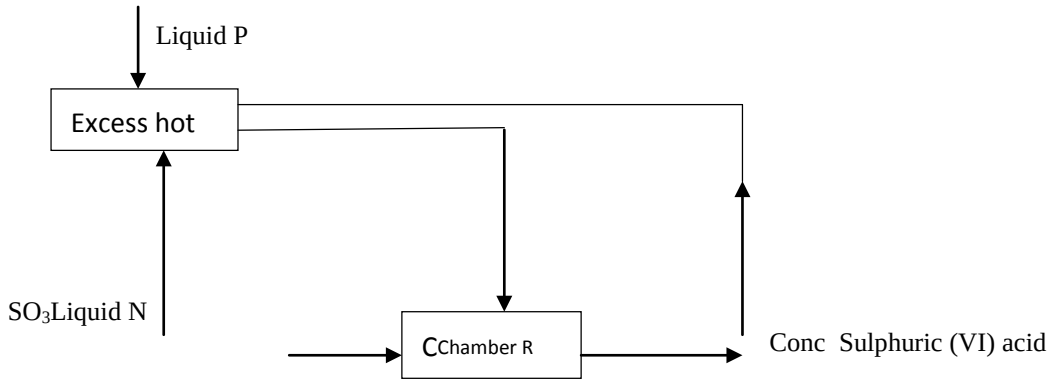
22. The flow chart below shows some processes involved in the industrial extraction of zinc metal.



a) Name one ore from which Zinc is extracted (1 mark)
b) Write the equation of the reaction taking place in unit II (1 mark)
c) Name two uses of Zinc metal (1 mark)

23. Thorium $^{232}_{90}Th$ undergoes two consecutive alpha decays followed by two consecutive beta decays to form the nuclide $^{x}_{y}R$. Identify the values of x and y. (2 marks)

24. Below is part of the flow diagram of the contact process



a) Identify
(i) Liquid P (1 mark)
(ii) Liquid N (1 mark) b) Write the equation for the reaction taking place in chamber R (1 mark)

25. a) Define the term oxidation state (1 mark)
b) Calculate the oxidation states of manganese and chromium in:
(i) MnO_2 (1 mark)
(ii) CrO^{-}_{4} (1 mark)

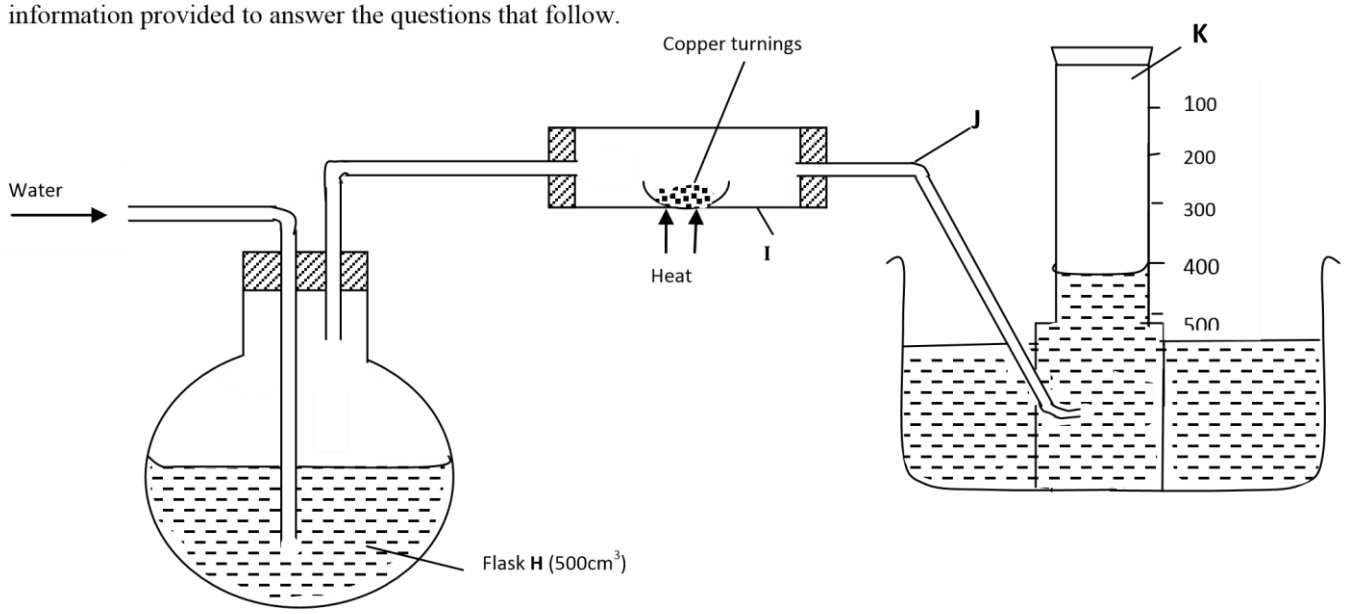
26. When hydrogen sulphide gas is bubbled through a solution of iron (III) chlorides, a green solution and a yellow solid are formed. Explain the observations (2 marks)

27. During purification of copper by Electrolysis, 1.48g of copper were deposited when a current was passed through copper (II) sulphate solution for 2½ hours. Calculate the amount of current that was passed (3 marks)
(Cu = 63.5, IF = 96500C)

M O K A S A J O I N T E X A M I N A T I O N - 2015
233/2
CHEMISTRY
Paper 2

1. A. In an experiment to determine the percentage of oxygen in air, the apparatus below were set up. Study the set up and the

information provided to answer the questions that follow.



A 500cm^3 measuring cylinder **K** was filled with water and assembled for gas collection. Copper turnings were heated red hot and water was slowly passed into 500cm^3 flask **H** until it reached the 500cm^3 mark. A colourless gas was collected in **K**.

(i) What was the purpose of passing water into flask **H**? (1 mark)

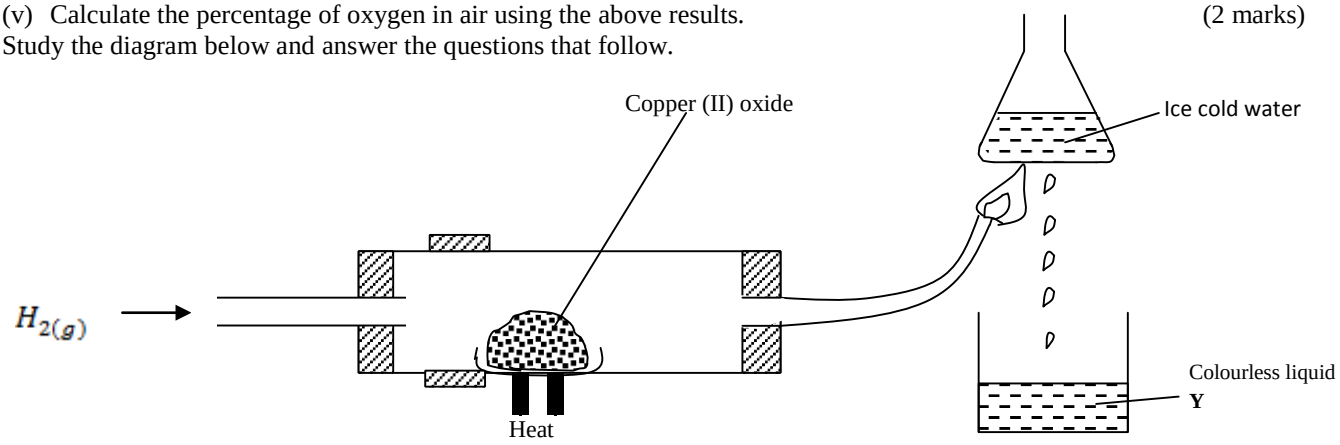
(ii) What observations were made in the tube **I**? (1 mark)

(iii) Name one of the gases that is likely to be found in **J**. (1 mark)

(iv) What was the volume of the gas collected in the measuring cylinder at the end of the experiment? (1 mark)

(v) Calculate the percentage of oxygen in air using the above results. (2 marks)

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



(a) Give ***one*** observation made in the combustion tube after some time. **(1 mark**

(b) Write an equation for the formation of the colourless liquid **Y**. **(1 mark)**

(c) What was the aim of the above experiment as demonstrated in the combustion tube? Explain. **(2 marks)**

2. Use the information below to answer the questions that follow. The letters are not the actual symbols of the elements.

Element	Atomic No.	M.P^{0}C	B.P^{0}C	Ionic radius (nm)
P	11	98	890	0.095
Q	12	650	1110	0.065
R	13	660	2470	0.050
S	14	1410	2360	0.041
T	15	44.2 & 590	280	0.034
U	16	113 & 119	445	0.184
V	17	-101	-35	0.181
W	18	-189	-186	-

(a) (i) Write the electronic configuration of the atoms represented by letters **T** and **W**. **(1 mark)**

(ii) State the nature of the oxides of the elements represented by **Q** and **U**. **(2 marks)**

(b) Why does the elements represented by the letters **T** and **U** have two values of melting points? **(1 mark)**

(c) Explain the following observations in terms of structure and bonding.

(i) There is an increase in boiling point from **P** to **R**. **(2 marks)**

(ii) Element **S** has a high boiling point. **(2 marks)**

(iii) There is a decrease in boiling points from **U** to **W**. **(2 marks)**

(d) (i) Compare the atomic radius of **U** and **V**. **(1 mark)**

(ii) Why is there no ionic radius for **W** reported in the table? **(1 mark)**

3. (a) The solubilities of potassium nitrate and potassium bromide at different temperatures was determined. The following data was obtained.

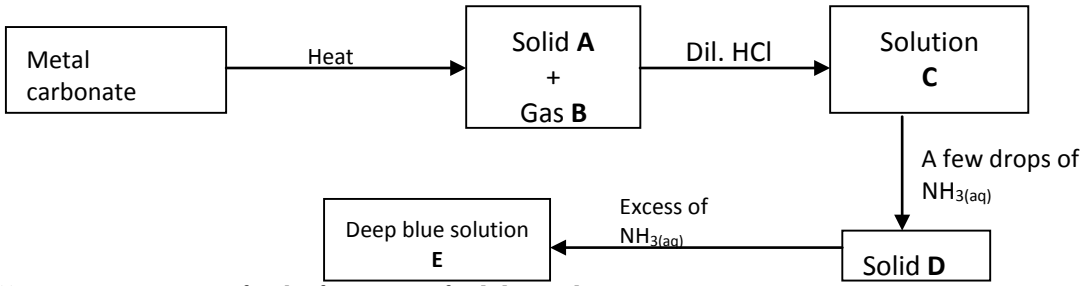
Temperature ^0C		0	10	20	30	40	50	60	70	80
Solubility	KNO_3	5	15	26	43	61	83	105	135	165
$g/100g\ H_2O$	KB_r	50	55	60	65	70	77	85	90	95

(i) Draw solubility curves for both salts on the same axis. **(3 marks)**

(ii) What was the solubility of each salt at 65^0C? **(1 mark)**

(iii) 100g of a saturated solution of potassium nitrate at 70^0C was cooled to 20^0C. What mass of the crystals will be crystallized? **(2 marks)**

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



(i) Write an equation for the formation of solid **A** and gas **B**. **(1 mark)**

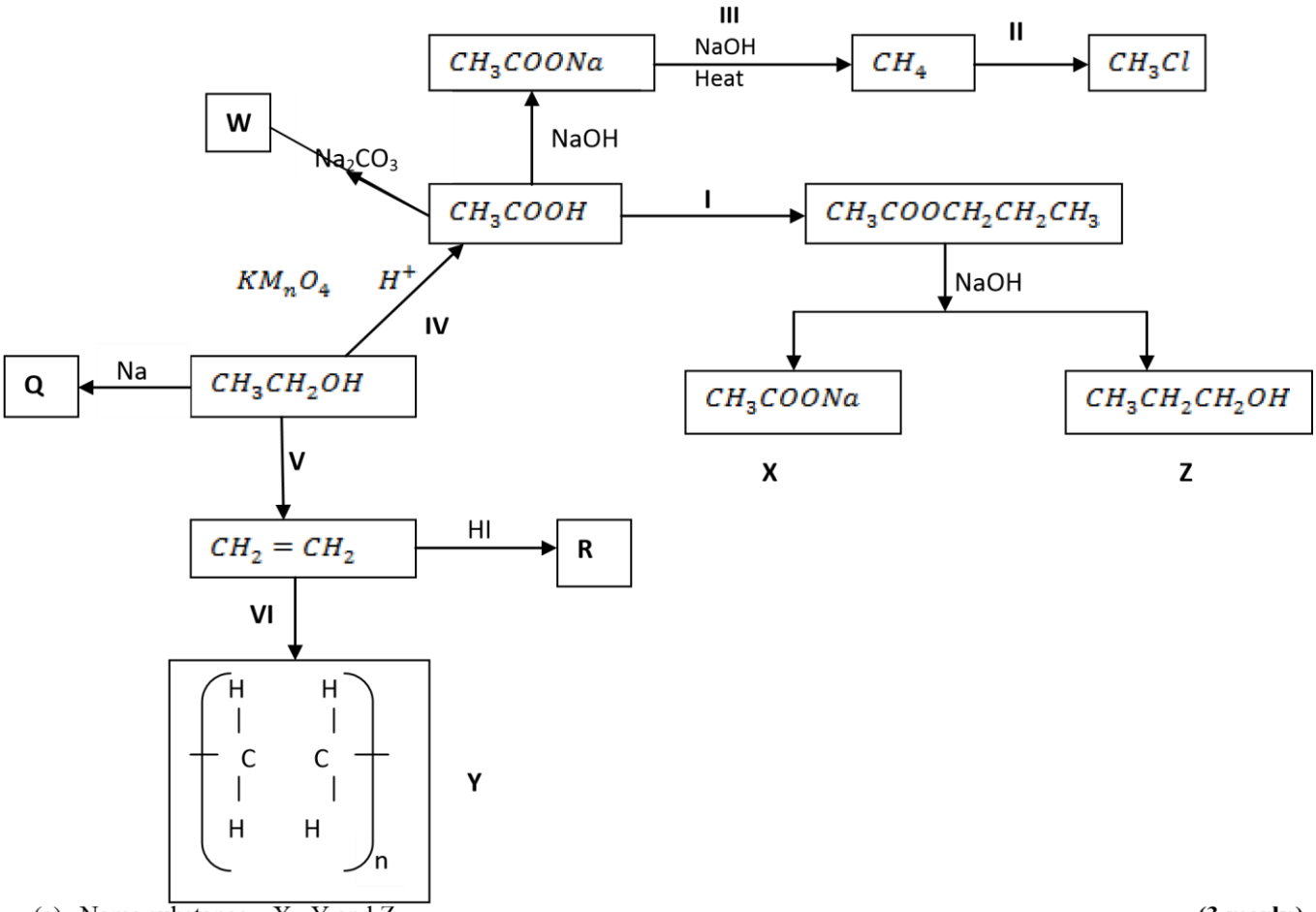
(ii) Name;

Solution **C** **(1 mark)**

Solid **D** **(1 mark)**

(c) Write the formula of the complex ion in solution **E**. **(1 mark)**

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



(a) Name substance. X , Y and Z **(3 marks)**

(b) Write down an equation for the reaction represented by step III. **(1 mark)** (c) What are the conditions and reagent required for steps?

(i) **I** **(2 marks)**

Reagent

Condition

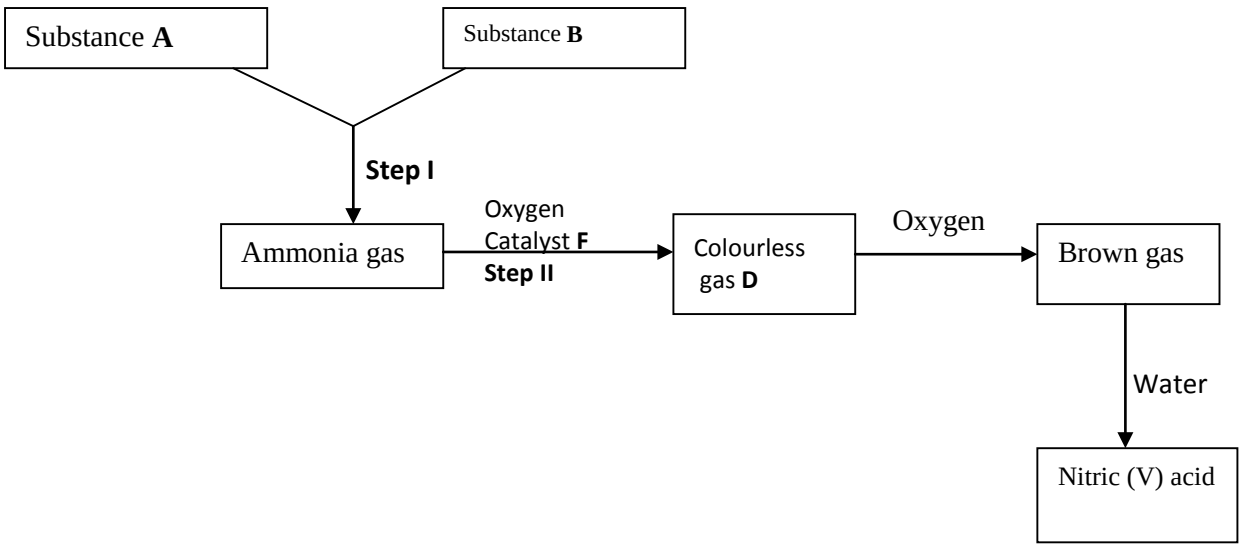
(ii) **IV** **(2 marks)**

Reagent

Condition

(b) Name the process represented by: I, II, III, IV, and V **(4 marks)**

5. **I.** Study the scheme below and answer the questions that follow.



(a) Identify substances. A, B, D **(3 marks)**

(b) State the catalyst necessary for; **(2 marks)**

Step **I**

Step **II**

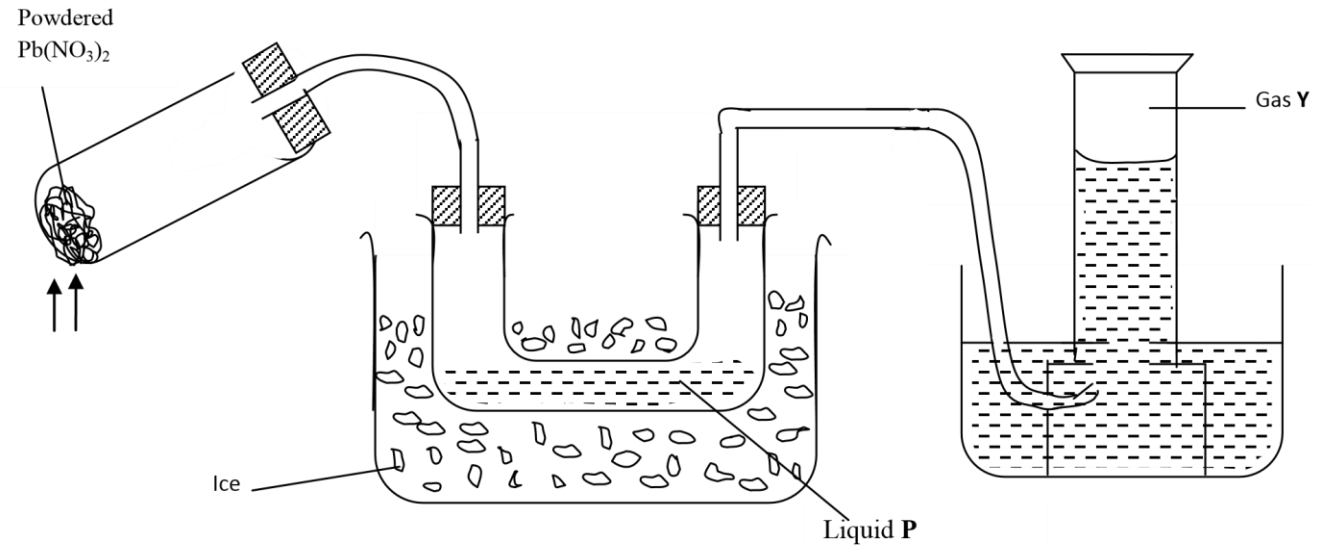
(c) Write an equation for the reaction taking place in step **II**. **(1 mark)**

(d) Write two balanced chemical equations for the reaction between chlorine gas and;

(i) Hot and concentrated sodium hydroxide. **(1 mark)**

(ii) Dilute and cold sodium hydroxide. **(1 mark)**

II. The diagram below shows an experiment in which the Lead (II) nitrate crystals are heated.



(a) Name; **(2 marks)**

(i) Liquid **P**

(ii) Gas **Y**

(b) Write a balanced chemical equation for the decomposition of Lead (II) nitrate. **(1 mark)**

(c) Explain how you can distinguish between nitrogen (II) oxide and nitrogen (I) oxide. **(2 marks)**

6. **I.** Study the standard electrode potentials given below and answer the questions that follow.

$$D^{2+}_{(aq)} + 2e^- \rightleftharpoons D_{(s)} \qquad E^\theta = -2.92V$$

$$G^{2+}_{(aq)} + 2e^- \rightleftharpoons G_{(s)} \qquad E^\theta = -2.36V$$

$$\frac{1}{2}J^{2+}_{(g)} + e^- \rightleftharpoons J_{(s)} \qquad E^\theta = 0.00V$$

$$M^{2+}_{(aq)} + 2e^- \rightleftharpoons M_{(s)} \qquad E^\theta = +0.34V$$

$$\frac{1}{2}R^{2+}_{(aq)} + e^- \rightleftharpoons R_{(s)} \qquad E^\theta = 2.87V$$

(a) Identify the strongest:

(i) Reducing agent **(1 mark)**

(ii) Oxidizing agent **(1 mark)**

(b) Calculate the e.m.f of a cell made of G and M. **(2 marks)**

(c) Write the cell representation for the above cell in (b). **(1 mark)**

(d) Draw a cell diagram for the cell in (b) above. **(2 marks)**

(e) Write the cell reaction for the drawn cell diagram in (d) above. **(1 mark)**

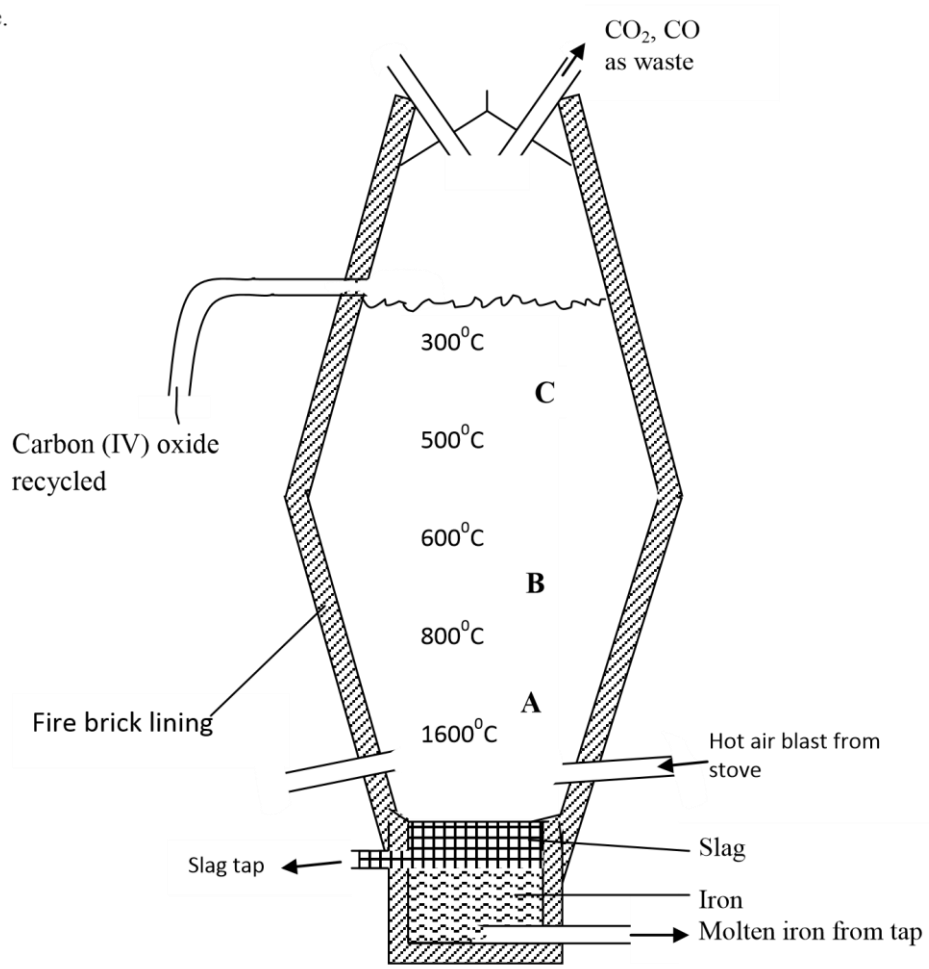
II. Electrolysis of aqueous solution of metal M resulted in the deposition of 1.07g of metal upon passage of a current of 1.32 Amperes for 75 minutes. (M = 52, 1F = 96500C)

(i) Calculate the quantity of electricity passed through the cell. **(1 mark)**

(ii) Calculate the charge on the metal ion. **(3 marks)**

7. Extraction of iron involves two main processes, smelting and refining. Below is the blast furnace which is used to smelt iron from

its ore.



(a) (i) What does the word smelt mean? **(1 mark)**

(ii) Name the reducing agent in the process. **(1 mark)**

(iii) What is the role of the hot air blast in the process? **(2 marks)**

(b) Write equations for the reactions that take place at the region marked A, B and C. **(3 marks)**

(c) What is the purpose of limestone in the extraction process? **(1 mark)**

(f) Write equations to show how impurities are removed from the ore. **(3 marks)**

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CHEMISTRY
PAPER 3
MOKASA 2015
(CONFIDENTIAL)
In addition to the apparatus found in the laboratory each candidate will require the following;

- About 0.5g of solid F
- About 1g of solid G
- 6 clean test-tubes
- Universal indicator solution and a pH chart
- Ethanol supplied with a dropper
- Clean dry metallic spatula
- 1 boiling tube
- Distilled water
- Solution J, about 130cm^3 ➢ Solution Q, about 160cm^3
- Solution R, about 30cm^3
- Screened methyl orange indicator
- Methyl orange indicator
- 100ml measuring cylinder
- Filter paper
- Means of labeling

- Solid P
- Thermometer
- 100ml beaker

Access to the following;

- Ethanol supplied with a dropper
- Concentrated sulphuric (VI) acid supplied with a dropper bottle ❖ Acidified Potassium dichromate (VI) solution ❖ Acidified Potassium Manganate (VII) solution.
- 2M $Ba(NO_3)_2$ solution.
- 2M NaOH solution.
- 2M HCl acid.
- Source of heat.

Preparation

- ✓ Solurion J is 0.12M HCL, prepared by adding about 800cm^3 of distilled water to 4.05$cm^3$of concentrated HCL of density 1.08gcm^{-3} and making it to one litre of solution.
- ✓ Solution Q is prepared by dissolving 5.3g of anhydrous sodium carbonate in enough distilled water and making up to one litre of solution.
- ✓ Solution R is prepared by dissolving 15.75g of hydrated barium hydroxide in enough distilled water and top up to one litre of solution.
- ✓ Solid P is 2.0g of oxalic acid weighed accurately and supplied in a stoppered container
- ✓ Solid F is maleic acid
- ✓ Solid G is sodium sulphite

MOKASA JOINT EXAMINATION-2015
Kenya Certificate of Secondary Education (K.C.S.E.)
233/3
CHEMISTRY

1. You are provided with:

- A monobasic acid HA, solution J.
- Sodium carbonate solution, solution Q, containing 1.325g in 250cm^3 of solution.
- Solution R, containing 15.75g of $M(OH).8H_2O$ per litre.
- Screened methyl orange indicator.

You are required to:

- Standardize solution J.
- Determine the relative atomic mass of element M in $M(OH)_2.8H_2O$.

Procedure 1

Fill the burette with solution J. Pipette 25cm^3 of solution Q into a clean 250ml conical flask and add 2 – 3 drops of screened methyl orange indicator. Titrate this solution with the solution in the burette and record your results in table 1 below. Repeat this procedure and complete the table. **Retain solution J in the burette for use in procedure II**.

Table 1

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

(4 marks)

a) Calculate the average volume of solution J used. (1 mark)
b) Determine the concentration of solution Q in moles per litre (Na=23, C=12, O=16 (1 mark)
c) (i) Determine the number of moles of the monobasic acid solution, HA, that are in the averaged value calculated in (b) above. (1 mark)
(ii) Determine the concentration of solution J in moles per litre. (1 mark)

Procedure 2

- Using a 25cm^3 measuring cylinder, transfer 25cm^3 of solution R into a clean 250ml conical flask. Using a 100ml measuring cylinder, transfer 75cm^3 of solution Q into the flask with solution R. Boil the mixture for about 5 minutes. After cooling filter into a conical flask and transfer the filtrate into a clean 100ml measuring cylinder and add distilled water to make exactly 100cm^3 of solution. Label this solution as solution S.

- Pipette 25cm^3 of solution S into a conical flask and titrate it with solution J using 2 drops of screened methyl orange indicator. Record your results in table 2 below. Repeat this to complete the table.

Table 2

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

(4 marks)

d) Calculate the average volume of solution J used. (1mark)

e) Determine the number of moles of:

(i) The monobasic acid, HA, in the average volume. (1 mark)

(ii) Sodium carbonate in 25cm^3 of solution S. (1 mark)

(iii) Sodium carbonate in 75cm^3 of solution S. (1 mark)

iv) Sodium carbonate in the original 75cm^3 of solution S. (1 mark)

v) Sodium carbonate that reacted with solution R. (1 mark)

vi) M $(OH)_2$. $8H_2O$ in 25cm^3 of solution R. (1 mark)

(1 mole of M $(OH)_2$. $8H_2O$ reacts with one mole of sodium carbonate)

f) Determine

(i) the concentration of solution R in moles per litre. (1mark)

(ii) the relative formula mass of $M(OH)_2.8H_2O$. (1 mark)

(iii) the relative atomic mass of M (O=16.0, H=1.0) (1mark)

2. You are provided with:

Solid P, 2.0 g of a dibasic acid H_2X.

You are required to determine the molar heat of solution of solid P.

PROCEDURE

Place 30cm^3 of distilled water into a 100ml beaker. Measure the initial temperature of the water and record it in the table below. Add all the solid P at once and stir the mixture carefully with the thermometer until all the solid dissolves. Measure the final temperature reached and record it in table.

Final temperature (^{o}C)	
Initial temperature (^{o}C)	

(3 marks)

a) Determine the change in temperature, ΔT. (1 mark) b)

Calculate the:

i) heat change when H_2X dissolves in water. (Assume the heat capacity of the solution is 4.2 $Jg^{-1o}C^{-1}$ and density is 1g/cm^3) (2 marks) ii)

Number of moles of the acid that were used. (Relative formula mass of H_2X is 126) (1mark) iii)

Molar heat of solution, ΔH, of the acid H_2X. (1mark)

3. You are provided with solid **G**.Place all solid **G** in a boiling tube.Add distilled water and shake.Divide the resulting solution into three portions.

i)

ii)

iii)

Inferences	0bservations
(½ mk)	(½ mk)

To the first portion add drops of 2M sodium hydroxide.

Inferences	0bservations
(½ mk)	(½ mk)

iv) To the fourth portion acidified (VI) add three drops of potassium dichromate solution.

To the second portion dip a metallic spatula in the solution and burn it directly on a non-luminous flame.

Inferences	0bservations
(½ mk)	(½ mk)

To the third portion add three drops of barium nitrate solution followed by 2cm^3 of 2M hydrochloric acid.

Inferences	0bservations
(½ mk)	(½ mk)

Inferences	0bservations
(½ mk)	(½ mk)

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

(i) Using a metallic spatula, heat half of solid F in a non-luminous bunsen burner flame .

Inferences	0bservations
(½ mk)	(½ mk)

Put a half spatula endful of solid **F** into a boiling tube. Add about 10cm^3 of distilled water and shake.

Inferences	0bservations
(½ mk)	(½ mk)

(ii)

Divide the resulting solution from a(ii) above into two portions

(i) To the first portion,2-3 drops of universal indicator and determine its pH.

Inferences	0bservations
(½ mk)	(½ mk)

To the second portion, add two drop of acidified pota ssium Manganate (VII) solution and shake.

Inferences	0bservations
(½ mk)	(½ mk)

(ii)

(c) Put half spatula endful of solid **F** into a boiling tube and add 5 drops of ethanol followed by 2 drops of concentrated sulphuric (VI) acid.warm the mixture.

Inferences	0bservations
(½ mk)	(½ mk)

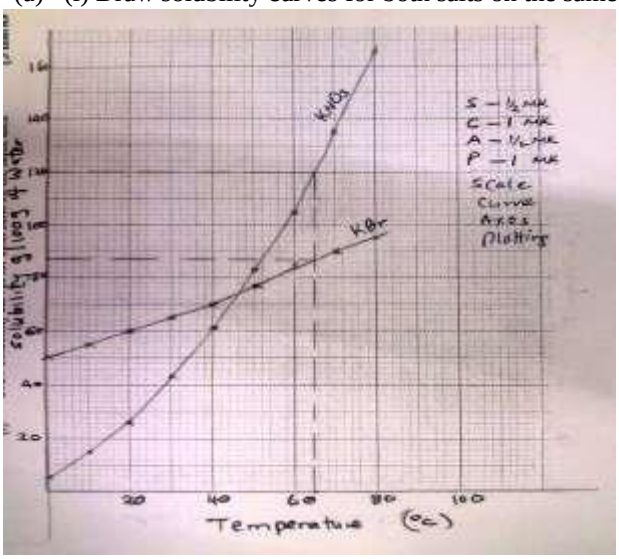
M O K A S A J O I N T E X A M I N A T I O N - 2015
233/2
CHEMISTRY
Paper 2

1. a. (i) To displace air in flask H over the hot copper turnings.
(ii) The brown solid changes to black
(iii) Nitrogen, carbon (IV) oxide, argon, (Xeron, neon) (Any one)
(iv) $410cm^3$
(v) $\frac{(500 \times 410)}{500} \times 100 = \frac{90 \times 100}{500} = 18\%$

b. (a) Black CuO turns to red-brown Cu.
(b) ⟶
(c)To determine the reducing property of hydrogen. ✓1 Hydrogen is above Cu ✓1 in the reactivity series, thus it reduces the oxygen from CuO.

2. (a) i) T - 2.8.5 ✓ ½
W - 2.8.8 ✓ ½
(ii) Q - Basic Oxide ✓1 U - Acidic oxide ✓1
(b) The two elements exhibit allotropy.
(c) (i) There is gradual increase in the strength of the metallic bonds ✓1 due to the increase in the number of delocalized (valence) electrons in the element ✓1
(ii) The atomic radius of V is smaller than that of U. ✓1 V has more protons therefore has a stronger nuclear attraction hence the smaller atomic radius. ✓1
(iii) Elements U, V and W have simple molecular structures ✓1 in which the molecules are held by weak Van der waals ✓1 forces. The Van der waals forces weaken from U to W.
(d) (i) The atomic radius of V is smaller than that of U. ✓1
(ii) It has a stable electron configuration hence does not ionize.

3. (a) (i) Draw solubility curves for both salts on the same axis. **(3 marks)**



(ii) $KNO_3 - 120g/100g$ of water ± 1 ✓ ½
KBr _ 87g/100g of water ± 1 ✓ ½

(iii) At 70^0C solubility = 135g/100g of water
If 235g contain 135g of salt
100g contain 135g

$\frac{100 \times 135}{235} = 57.4468g$ ✓ ½

At 20^0C solubility = 26g/100g of water
If 126g contain 26g of salt
100g contain ?

$\frac{100 \times 26}{126} = 20.6349g$ ✓ ½

Mass which will crystallized
57.4468 – 20.6349
= 36.8119g

(b) (i) ⟶
(ii) Name; Solution C - Copper (II) chloride (1 mark)

Solid D - Copper (II) hydroxide (1 mark)

(c) $\left[\quad\right]^{2+}$

4. (a) Name substance. (3 marks)

X - Sodium ethonoate

Q - Sodium ethoxide

R - Iodoethane

(b) $\longrightarrow$

(c) (i) I Reagent - Propan-l-ol

Condition - Conc. H_2SO_4

(ii) IV Reagent - Conc. H_2SO_4

Condition - Temp $160 - 180^0C$

(d) I - Esterification

II - Substitution

IV - Oxidation

V - Dehydration

5. I. (a) Identify substances. (3 marks)

A - Hydrogen

B - Nitrogen

D - NO

(b) Step I - Iron finely divided / iron

Step II - Platinum – rhodium catalyst

(c) $4NH_{(3)} + SO_2 \longrightarrow 2NO_{(g)} + 6H_2O$

(d) (i) $6NaOH_{(aq)} + 3Cl_{2(g)} \longrightarrow NaClO_{3(aq)} + 5NaCl_{(aq)} + H_2O_{(l)}$ (ii)

$2NaOH_{(aq)} + Cl_2 \longrightarrow NaOCl + NaCl + H_2O$

II.

(a) (i) Liquid P - dinitrogen tetra oxide

(ii) Gas Y - oxygen

(b) 2 $\longrightarrow$

(c) Nitrogen (V) oxide relights a glowing splint while nitrogen (II) oxide does not.

- N_2O has xtic sweet smell, while. NO_2 is odourless.

6. **I.** a) i) Reducing agent D **(1 mark)**

ii) Oxidizing agent R^{2+} (1 mark) b)

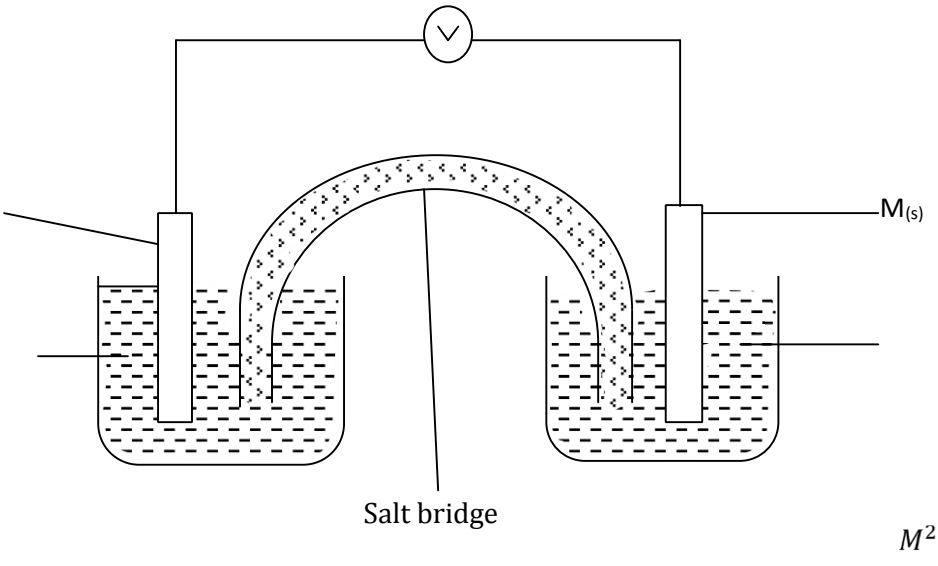
e.m.f = $E^{\theta}R - E^{\theta}O$

= $+0.34 - {}^{-}2.36$

= +2.70V

c) $G_{(s)} / G^{2+}{}_{(aq)} // M^{2+}{}_{(aq)} / M_{(s)}$; $E = +2.70V$ Penalize for lack of states and E value

d) Draw a cell diagram for the cell in (b) above. **(2 marks)**



e) $G_{(s)} + M^{2+}_{(aq)} \longrightarrow G^{2+}_{(aq)} + M_{(s)}$; E = +2.70V

II. i) $Q = 1t$

$= 1.32 \times 75 \times 60$

$= 5940C$

ii) If 1.07g is departed by 5940C

52g " "

$\frac{52 \times 5940}{1.07} = 288{,}672.8972C$ ✓1

If 1F is 96500C

? " 288672.8972C

$\frac{1 \times 288{,}672.8972}{96500}$ ✓1

$= 2.994$

-3

$+3$ ✓1

7. (a) (i) Extraction of a metal from its ore using a reducing agent and heat.

(ii) Carbon (in form of coke)

(iii) Hot air reacts with coke to form carbon (IV) oxide producing a lot of heat which melts the iron formed in the blast furnace.

(b) A $C_{(s)} + O_{(2)} \longrightarrow CO_{2(g)}$

B $CO_{2(g)} + C_{(s)} \rightarrow 2\,CO_{(g)}$

C $2Fe_2O_{3(s)} + 3C_{(s)} \longrightarrow 4Fe_{(s)} + 3CO_{2(g)}$

(c) To remove silica impurities in the ore.

(d) ⟶

⟶

⟶

MOKASA JOINT EXAMINATION-2015
233/3
CHEMISTRY
MARCH/APRIl
Kenya Certificate of Secondary Education (K.C.S.E.)

1. **Table 1**

a) Complete table …… 1mark

Conditions:

i) Complete table with 3 titrations done ……. 1 mark ii)
Incomplete table with two titrations done…. ½ mark iii)
Incomplete table with only one titration done …. 0 mark

Penalties:

i) Wrong arithmetic ii) Inverted table iii)
Unrealistic values i.e less than 1 cm^3,or in 100s iv)
Burette readings >50 cm^3,unless explained

Penalize ½ mark each to a maximum of ½ mark, i.e, penalize ½ mark ONCE.

Use of decimal places…… 1 mark (Tied to 1st and 2nd row only)

i) Accept 1 or 2 decimal places used consistently, otherwise penalize FULLY.
ii) If two decimal places are used, the 2nd must be a "0" or a "5", otherwise penalize FULLY.
iii) Accept the inconsistency in the use of zeros in the initial burette readings e.g 0.0,0.00, 00.0

Accuracy…….. 1 mark

Compare candidate"s correct titre value with school value (s.v) and tick (✓) if it earns a mark and award accordingly.

Coditions:

i) If at least one titre value is within ± 0.1 cm^3 of s.v award…… 1 mark
ii) If no value is within ± 0.1 cm^3 of s.v but there is at least one within ± 0.2 cm^3 award …… ½ mark
iii) If no titre value is within ± 0.2 cm^3 award…… 0 mark

Principles of averaging…… 1 mark

i) If three consistent values are averaged ……. 1 mark ii) If three titrations are done and only two are consistent and averaged…… (1 mark) iii) If two titrations are done, are inconsistent and averaged … (0 mark)

Final Accuacy (tied to correct average titre)…….. (1 mark)

Compare the candidate"s correct average titre with s.v;

i) If within ± 0.1 of s.v …….. 1 mark ii) If not within ± 0.1 but within ± 0.2 of s.v ……½ mark
iii) If beyond ± 0.2 of s.v ……. 0 mark

b) 250 cm^3 ~~1.325~~g of Na_2CO_3
→ 1.325 x 4g of $N_{a2}CO_3$
= 5.3/ RFM
= $\frac{5.3}{106}$ grams per litre
= 0.05M ✓

c) i) Moles of Na_2CO_3 reacted = $\frac{0.05 \times 25}{1000}$
= 0.00125 ✓
Reacting mole ratio of HA: Na_2CO_3 = 2:1

ii) 0.0025 moles of HA → average titre
? ← 1000cm^3
= $\frac{0.0025 \times 1000}{\text{Average titre}}$
= 0.12M ✓

Table II: mark as in table I

e) i) 1000cm^3 0.12 ~~mol.~~ →
Titre volume → $\frac{\text{average volume} \times 0.12}{1000}$ moles

= correct answer

ii) Reacting mole ratio of HA to Na_2CO_3 is 2 : 1

Moles of Na_2CO_3 = ½ * answer above

=Correct answer

2. **Table 1**

d) Complete table …… 1mark

Conditions:

iv) Complete table with 3 titrations done ……. 1 mark

v) Incomplete table with two titrations done…. ½ mark vi) Incomplete table with only one titration done … 0 mark

Penalties:

v) Wrong arithmetic vi) Inverted table vii) Unrealistic values i.e less than 1 cm^3,or in 100s viii) Burette readings >50 cm^3,unless explained

Penalize ½ mark each to a maximum of ½ mark, i.e, penalize ½ mark ONCE.

Use of decimal places…… 1 mark (Tied to 1st and 2nd row only)

iv) Accept 1 or 2 decimal places used consistenly, otherwise penalize FULLY.

v) If two decimal places are, the 2nd must be a "0" or a "5", otherwise penalize FULLY. vi) Accept the inconsistency in the use of zeros in the initial burette readings e.g 0.0,0.00, 00.0

Accuracy…….. 1 mark

Compare candidate"s correct titre value with school value (s.v) and tick (✓) if it earns a mark and award accordingly.

Coditions:

iv) If at least one titre value is within ± 0.1 cm^3 of s.v award…… 1 mark

v) If no value is within ± 0.1 cm^3 of s.v but there is at least one within ± 0.2 cm^3 award …… ½ mark

vi) If no titre value is within ± 0.2 cm^3 award…… 0 mark

Principles of averaging…… 1 mark iv) If three consistent values are averaged ……. 1 mark

v) If three titrations are done and only two are consistent and averaged…… (1 mark) vi) If two titrations are done, are inconsistent and averaged … (0 mark)

Final Accuacy (tied to correct average titre)…….. (1 mark)

Compare the candidate"s correct average titre with s.v; iv) If within ± 0.1 of s.v …….. 1 mark

v) If not within ± 0.1 but within ± 0.2 of s.v ……½ mark vi) If beyond ± 0.2 of s.v ……. 0 mark e)

250 cm^3 ⟶ 1.325g of Na_2CO_3

1.325 x 4g of $N_{a2}CO_3$ ⟶

= 5.3/ RFM

= $\frac{5.3}{106}$ grams per litre

= 0.05M ✓

f) i) Moles of Na_2CO_3 reacted = $\frac{0.05 \times 25}{1000}$

= 0.00125 ✓

Reacting mole ratio of HA: Na_2CO_3 = 2:1

ii) 0.0025 moles of HA ⟶ average titre

? ⟵ 1000cm^3

= $\frac{0.0025 \times 1000}{\text{Average titre}}$

= 0.12M ✓

Table II: mark as in table I

e) i) 1000cm^3 0.12 mol. ⟶

Titre volume ⟶ $\frac{\text{average volume} \times 0.12 \text{ moles}}{1000}$

= correct answer ii)

Reacting mole ratio of HA to Na_2CO_3 is 2 : 1

Moles of Na_2CO_3 = ½ * answer above
=Correct answer iii)
$25cm^3$ answer(ii)

⟶

$75\ cm^3$ answer (ii) x $\frac{75}{25}$ = correct answer

iv) Original solution c: 75 x answer (iii) = correct answer

v) 0.00375 – answer (iV) = correct answer

vi) Reacting mole ratio is 1 : 1 moles of $M(OH)_2.8H_2O$ = answer (v)

f) i) answer b(vi) are in 25 cm^3 of $M(OH)_2.8H_2O$ x $\frac{1000}{25}\ cm^3$

$x = \frac{\text{answer x } 1000}{25}$ ✓

= correct answer (moles per litre) ✓ ii)

15.75 g ⟶ answer (i)

?? ⟵ 1mol.

x = 18.3 x 1✓

answer (i)

= correct answer ✓ (accept rounded off to ma whole number)

iii) M + 178 = answer (ii)

M = Answer (ii) - 178✓

R.A.M of M = correct answer ✓

vii) answer(ii)

$75\ cm^3$ answer (ii) x $\frac{75}{25}$ = correct answer

viii) Original solution c: 75 x answer (iii) = correct answer ix)

0.00375 – answer (iV) = correct answer

x) Reacting mole ratio is 1 : 1 moles of $M(OH)_2.8H_2O$=

= answer (v)

f) i) answer b(vi) are in 25 cm^3 of $M(OH)_2.8H_2O$

x $\frac{1000}{25}\ cm^3$

$x = \frac{\text{answer x } 1000}{25}$ ✓

= correct answer (moles per litre) ✓

ii) 15.75 g ⟶ answer (i)

?? ⟵ 1mol.

x = 18.3 x 1✓

answer (i)

= correct answer ✓ (accept rounded off to a whole number)

iii) M + 178 = answer (ii)

M = Answer (ii) - 178✓

R.A.M of M = correct answer ✓

Question 2

Table

(i) Complete table…..2 readings recorded…. 1 mk

Penalty:

penalize fully for any space not filled.

(ii) Use of decimal…… 1 mk

Accept temperature readings for 1 mk if consistently given either as whole numbers of 1 d.p. of .0 or .5

(iii) Accuracy…… 1 mk

Compare candidate"s initial temperature reading to school value. Award 1 mk for value within ± 2°C of SV otherwise penalize fully.

Questions

(a) ΔT = Final-Initial = Correct ans 1 mk

Penalties

- Penalise ½ mark for wrong units or omission of unit on the answer.

(b) (i)Accept correct transfer of ΔT, even if rejected in (a) above.

Heat change= m.c. ΔT

= 30 x 4.2 x ΔT 1 mk

= correct ans 1 mk

ii) Number of moles $= \frac{2.0}{126}$ = 0.01587 1 mk

- Penalise ½ mk for wrong units used otherwise ignore if omitted.

iii) Molar heat of solution.

$\Delta H = \frac{\text{ans b(i)}}{\text{ans b(ii)}}$ ½ mk

= correct ans ½ mk

Penalties

- Penalise ½ mk for transfer of either b(i) or b(ii), otherwise penalize fully for strange values.

3 i)

Observation	Inference
No white precipitate formed ✓½	$Na^{\square}$, $K^{\square}$, $NH_4^{\square}$ ✓½

(ii)

Observation	Inference
Burns with a golden-yellow flame ✓1	Na^+ present ✓½

(iii)

Observation	Inference
White precipitate ✓½ dissolves on addition of HCl acid ✓½	$SO_3^{2\square}, CO_3^{2\square}$ *present* ✓

(iv)

Observation	Inference
Colour changes from orange to green ✓½	$SO_3^{2\square}$ *present* ✓½

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

(i) Using a metallic spatula, heat half of solid F in a non-luminous burnsen burner flame for some time then remove when it ignites

Observations	Inferences
Melts burns with a sooty/smoky/luminous yellow flame√½ (accept melts on its own for ½ mk)	C= C or -C = C- present √1 Organic compound with high C:H ratio long chain organic compound (½ mk)

ii) Put a half spatula endful of solid F into a boiling tube. Add about 10cm3 of distilled water and shake vigorously

Observations	Inferences
Dissolves into a colourless solution ½ mk	Soluble compound /salt/polar substance ½ mk

iii) Divide the resulting solution into two portions

a) To the first portion,add 2-3 drops of universal indicator and dertermine its PH

Observations	Inferences
pH 2.0√ ½	Strongly acidic H^+/-COOH √ ½ (½ mk

b) To the second portion, add two drops of acidified potassium manganate (VII) solution and shake vigorously

Observations	Inferences
$H^+/KMnO_4$ decoclourises √1 (½ mk)	C= C or –C= C- present √ ½ Or R-OH present √ ½

KURIA EAST DISTRICT JOINT EXAMINATION COUNCIL

***K*233/1**

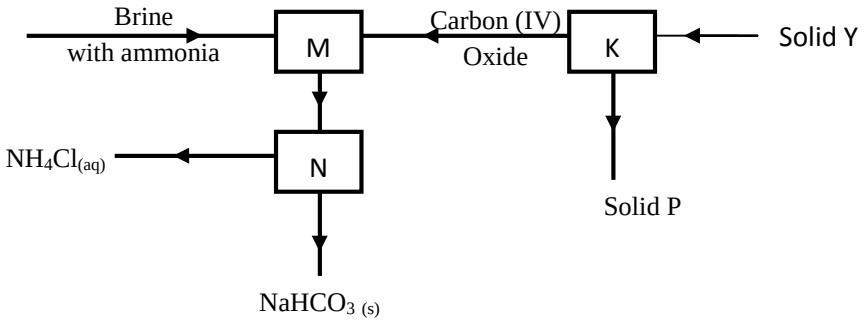
CHEMISTRY

PAPER 1

(THEORY)

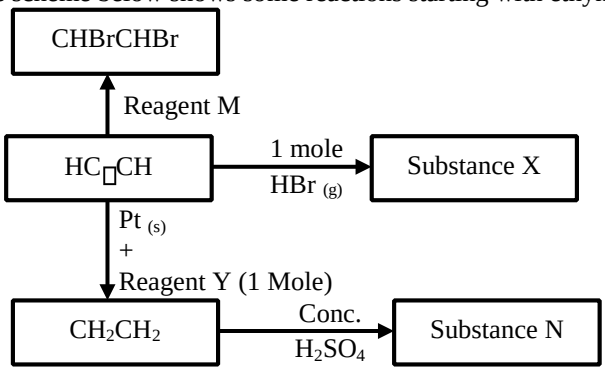
JULY/AUGUST 2015

1. The diagram below shows part of Solvay Process.



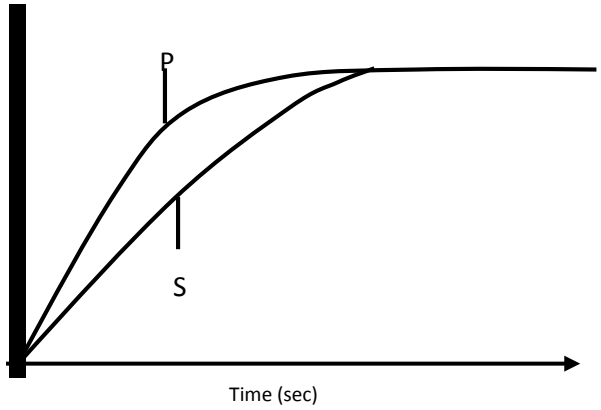
   (a) Name solid P (½ Mark)
   (b) State the process taking place in chamber N. (½ mark)
   (c) State two uses of calcium chloride which is a by-product in this process. (½ mark)

2. $100cm^3$ of methane gas diffused through a porous partition in 40 seconds. How long would it take $90cm^3$ of ozone gas to diffuse through the same partition? C = 12, H = 1, O = 16 (2marks)
3. 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 = $22.4dm^3$) (2 Marks)
4. The scheme below shows some reactions starting with ethyne. Study it and answer the questions that follow.



   (a) Name substance X and N (1mark)
   (b) Name reagent M (½ Mark)
   (c) Ethene undergoes polymerization to form a polymer. Give an equation for the reaction and name the product.
      (i) Equation; (1 mark)
      (ii) Name: (½ mark)

5. The curves below represent the volume of carbon (IV) oxide gas evolved once 2M(concentrated) hydrochloric acid was reacted with 100g of powdered calcium carbonate and also when 1M concentrated hydrochloric acid was reacted with the same quantity of carbonate.



(i) Which of the two curves represents the reaction of 2M concentrated HCl with powdered calcium carbonate. Give a reason. (2 marks)

(ii) Why do the two curves flatten at the same level of production of CO_2 (1 mark)

6. Study the following equilibrium equation.

$2X_2(g) + Y_{2(g)} \rightleftharpoons 2X_2Y_{(g)}$ $\Delta H = -197Kj/mol$

Suggest two ways of increasing the yield of X_2Y. (1 mark)

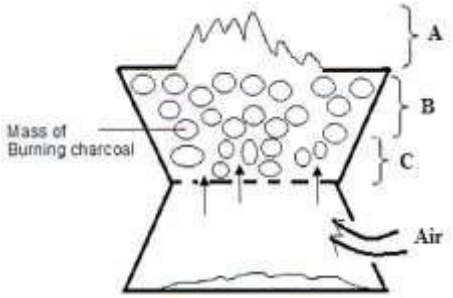
7. The table below gives some elements in the periodic table. Use it to answer the questions that follow. The letters do not represent the actual symbols of the elements.

Element	A	B	C	D	E
Atomic number	12	13	14	15	16

Which of the above letters represent:

(a) A metallic element which forms ions with the smallest ionic radius? Explain (1 mark) (b) A non metallic element with the largest atomic size? Explain. (1 mark)

8. The diagram below shows a burning jiko. Study it and answer the questions that follow.

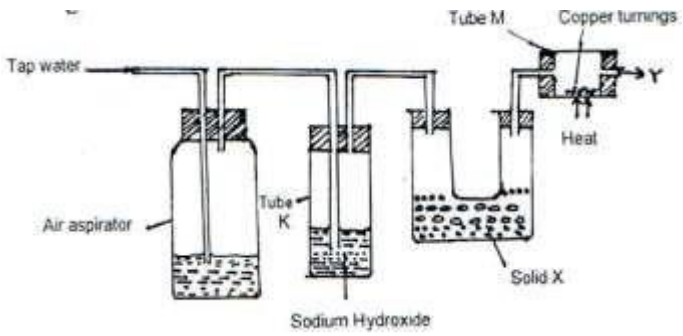


(a) Write the equation for the reaction taking place in region A. (1 Mark)

(b) Name the gas produced at region B. (1 Mark)

(c) State ONE use of the gas named in (b) above. (1 Mark)

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



(i) What is the purpose of passing tap water through the air aspirator? (1 Mark)

(ii) State and explain the observation that would be made in tube M after sometime. (1 Mark)

(iii) The sample of nitrogen collected at point Y had greater density than expected.What conclusion could be made about the gas? (1 Mark)

10. The table below gives the rate of decay of a radioactive element G.

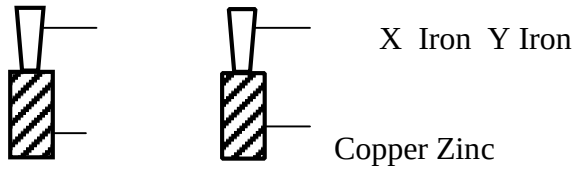
Number of days	Mass in g
0	48
270	1.5

Calculate the half-life of the radioactive element G. (2 Marks)

11. 15g of sodium chloride was dissolved in 120cm^3 of distilled water. Calculate the concentration of the resulting solution in moles per litre. (Na = 23, Cl = 35.5) (2 Marks)
12. (a) State Boyle"s Law. (1 Mark)
    (b) The volume of a gas at 30^{0}C and 780mmHg is 400cm^3. What will be its volume at 50^{0}C at 600mmHg.
13. Sulphur exhibits allotropy.
    (a) What is allotropy? (1 Mark) (b) Name the **two** allotropes of sulphur. (1 Mark)
    (c) Sulphur powder was placed in a deflagrating spoon and heated on a Bunsen Burner.
    (i) State the observation made. (1 Mark)
    (ii) The product obtained was dissolved in water. Comment on the PH of the solution formed. (1 Mark)
14. 0.318g of an oxide of metal M was completely reduced by hydrogen gas to 0.254g of metal. Calculate empirical formula of the metal oxide. (M = 63.5, O = 16) (3 Marks)
15. Given the following reagents: Solid sodium Carbonate, water, solid Lead (II) nitrate. Describe how a sample of Lead (II) Carbonate can be prepared in the laboratory. (3 Marks)
16. Volume of liquids can be measured using a pipette; measuring cylinder or burette. Explain which one would be best for measuring 29.1cm^3 of liquid. (1 Mark)
17. Study the information in the table and answer the questions below.

Substance	Solubility g/100g water
V	126
W	2

Describe how a solid sample of substance **V** could be obtained from a solid mixture of **V** and **W**. (2 Marks) 18.
A form two student in an attempt to prevent rusting put copper and zinc in contact with iron as shown below.



(i) State what would happen in set up X and Y after one week. (1 Mark)
(ii) Explain your answer in diagram Y. (1 Mark)

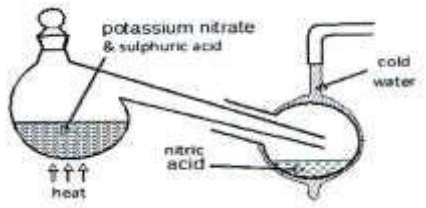
19. An element X has a relative atomic mass of 88. When a current of 0.5 ampere was passed through a fused chloride of X for 32 minutes 10 seconds, 0.44g of X was deposited.
(i) Determine the charge of element X [1 Faraday = 96500C] (2 Marks)
(ii) Write the formula of hydroxide of X
20. The PH of a soil sample was found to be 5.7. An agricultural officer recommended addition of lime.
    (a) State **two** functions of the lime. (1 Mark)
    (b) Give the name of the process applied in (a) above.
21. The electronic configuration of ions X^{2+} is 2.8 while that of ion Y^- is 2.8.8.
    (a) Write down the electron arrangement of the atoms of X and Y (1 Mark)
    (b) Compare the atomic radii of the two elements. (1 Mark)
    (c) Give the name of the chemical family to which element X belongs (1 Mark)
22. Use the information given below to calculate the enthalpy of formation of propane. (3 Marks)

$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ $\Delta H_c = -393KJ/Mol$

$H_{2(s)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}$ $\Delta H_c = -286KJ/Mol$

$C_3H_{8(g)} + 5O_{(2)} \rightarrow 3CO_{2(g)} + 4H_2O_{(l)}$ $\Delta H = -2220$ KJ/Mol

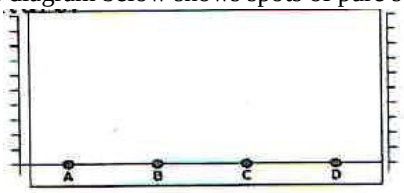
23. (a) (i) A student found a colourless liquid in the laboratory which he suspected to be water. Describe a chemical test he could have performed to confirm that the liquid is water. (2 Marks)
    (ii) What other test could he have done to prove that the liquid is pure water? (1 Mark)
24. The diagram below shows that the set-up that was used to prepare and collect a sample of nitric acid



(a) Give a reason why it is possible to separate nitric acid from sulphuric acid in the set-up. (1 Mark) (b) Name another substance that can be used instead of potassium nitrate. (1 Mark)

(c) Give one use of nitric acid.

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

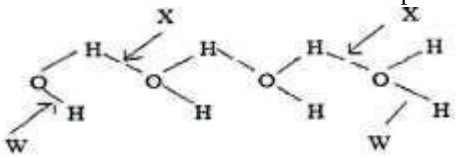


After development, A, B and C were found to have moved 8cm, 3cm and 6cm respectively. D had separated into two spots which had moved 6cm and 8cm. (i) On the diagram

I. Label baseline (1 Mark)

II. Show the positions of all the spots after development. (2 Marks) (ii) Identify the substances present in the mixture D. (1 Mark)

26. The structure of water molecules can be represented as shown below.



(i) Name the bond type represented by letter X and W. (1 Mark)

(ii) Relative molecular mass of methane and water are almost similar, however the boiling of water is 100^0C while that of methane is -161^0C. Explain. (1 Mark)

27. What is the oxidation number of:-

(i) Manganese in $MnO4^-$ (1 Mark)

(ii) Sulphur in SO_2 (1 Mark)

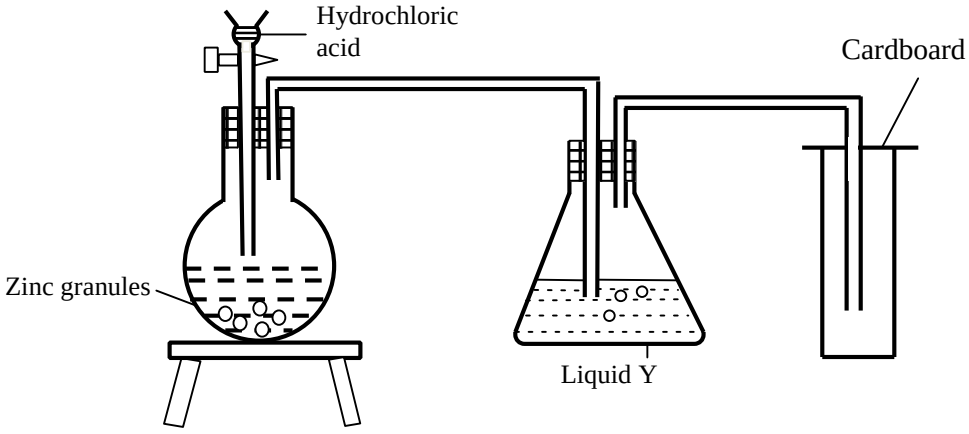
(iii) Chromium in $Cr_2O_7^{2-}$ (1 Mark)

28. Diamond and graphite are allotropes of carbon. In terms of structure and bonding, explain why?

(i) Diamond is used in drilling of hard rocks. (2 Marks)

(ii) Graphite is a lubricant. (2 Marks)

29. The set up was used to prepare dry hydrogen gas. Study it and answer the questions that follow.



(i) Is set-up used to prepare the gas correct? Give reason. (1 Mark)

(ii) What would be liquid Y?

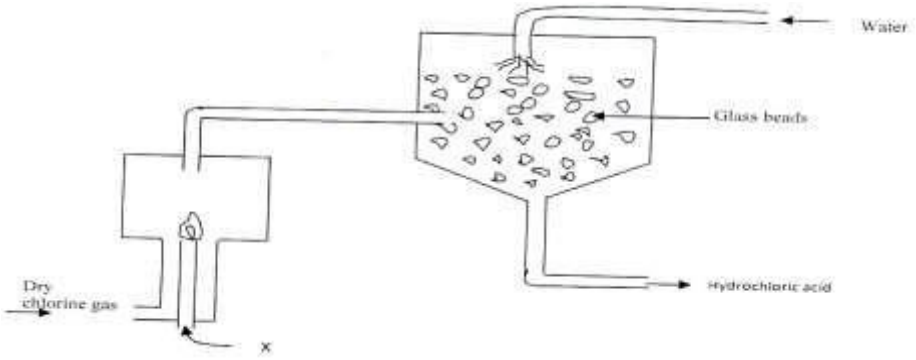
(iii) Give two physical properties of hydrogen gas (1 Mark)

30. Given element W has atomic number 14 and consists of isotopes as shown below.

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

Determine the relative atomic mass of W (2 Marks)

31. The diagram below represents a set up used for the large scale manufacture of hydrochloric acid.



(a) Name substance X (½ Mark)

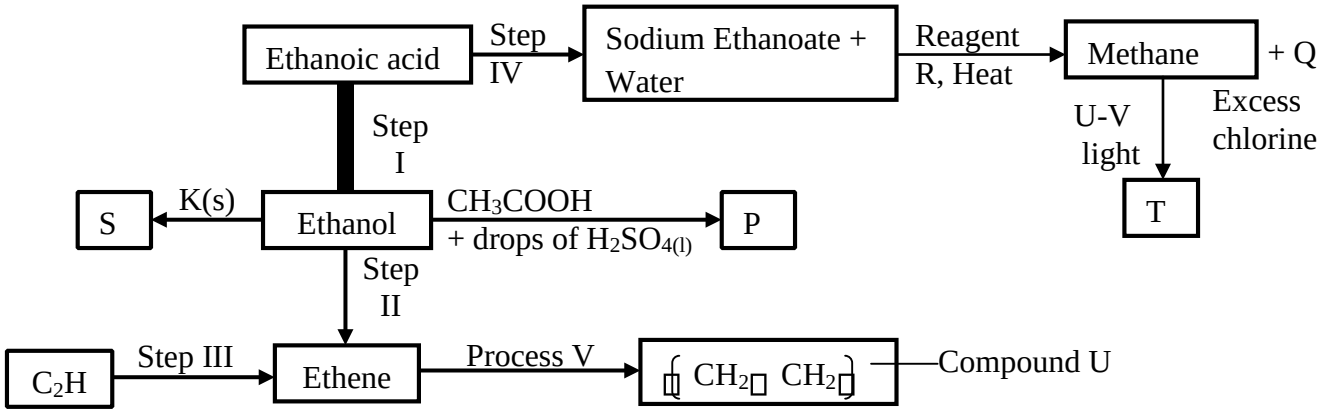
(b) What is the purpose of the glass beads? (½ Mark)

(c) Give one use of hydrochloric acid (½ Mark) **KURIA**

EAST DISTRICT JOINT EXAMINATION COUNCIL

(KEDJEC)
233/2
CHEMISTRY
PAPER 2
(THEORY)
JULY/AUGUST 2015

1. The scheme below shows reactions starting with ethanol. Study it and answer the questions that follow.



a. (i) Name the compounds: P and S (2 marks)

(ii) State the type of reaction, reagents and conditions for the reactions in the following steps: (5 Marks)

Step	Type of reaction	Reagents	Conditions
I.			
II.			
III.			

(iii) Name the reagent R. (1 Mark)

(iv) Write the equation for step IV. (1 Mark)

(v) Name compound T and draw its structural formula. (2 Marks)

(vi) Name compound U and state one use of U (2 Marks)

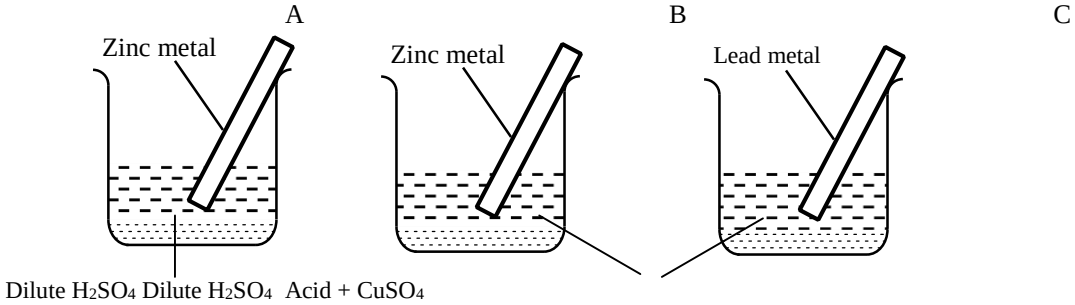
(vii) State one physical test to differentiate ethene from C_2H_2. (1 Mark)

2. The table below shows the positions of some elements in the periodic table. The letters are not actual symbols of the elements.

						A		
	B		C		D		E	
F	G							
							H	

(a) Select an element that can form an ion with a charge of +2. Give a reason. (1Mark)
(b) What type of structure would the oxide of C have. Explain your answer. (1½ Marks)
(c) How does the reactivity of H compare with that of E. Explain. (1½ Marks)
(d) Explain how you would expect the following to compare.
(i) Atomic radii of F and G (1½ mks)
(ii) The PH values of aqueous solutions of the oxides of B and D (1½ mks)
(e) Draw a diagram to represent an ion of element D (1 Mark)
(f) Calculate the volume of oxygen gas required to completely burn 1.95g of F to form its oxide. (F = 39, molar gas volume at s.t.p = 22,400cm^3) (3 Marks)

3. (a) A student set up an experiment as illustrated by the diagrams below to investigate the action of dilute Sulphuric (VI) acid on Zinc and Lead metals. Before introducing each metal into the acid it was cleaned.



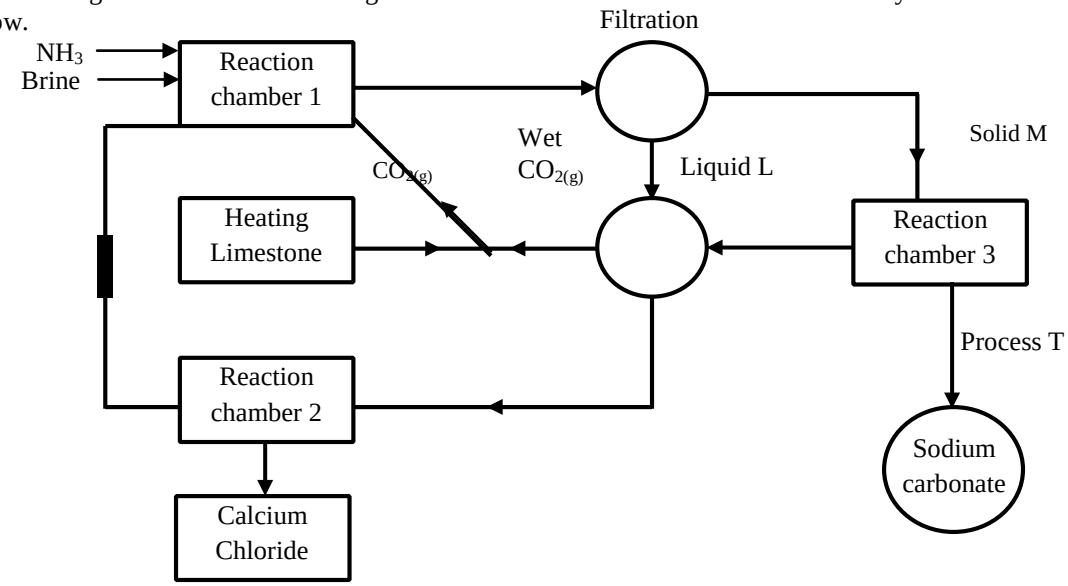
(i) Why was it necessary to clean the metal pieces before introducing them into their respective beakers. (1 Mark)
(ii) What observations were made immediately the pieces were introduced into the beakers A and C. (2 Marks)
(iii) Explain the observations made in beaker B (1 Mark)

(b) Compound X decomposes at 25^{0}C. The decomposition of compound X was monitored at 25^{0}C by measuring the concentration of the compound remaining at different time intervals. The following data was obtained.

Time (min)	0	1.0	2.0	3.0	4.0	5.0
Concentration	1.20	0.54	0.36	0.26	0.17	0.10

(i) Plot a graph of the concentration of compound X (Y – axis) against time. (3 Marks)
(ii) From the graph, determine the rate of decomposition of X at 2.5 minutes. (2 Marks)
(iii) One the same axis, sketch the curve that would be obtained if the decomposition was carried out at 10^{0}C. Label this curve II. Give a reason for your answer. (3 Marks)

4. The flow diagram below shows the stages in the manufacture of sodium carbonate. Study it and answer the questions that follow.



(a) Name the three raw materials for the manufacture of sodium carbonate. (3 Marks)
(b) (i) Name two substances that are recycled in this process and state the chambers in which each is regenerated. (2 Marks)

(ii) Give two advantages of industrial recycling of materials. (2 Marks)

(c) Identify liquid L and solid M (1 Mark)

(d) Write an equation for the reaction for the reaction which occurs in.

(i) Reaction chamber 1 (1 Mark)

(ii) Reaction chamber 2 (1 Mark)

5. The following results were obtained when the molar heat of neutralization between hydrochloric acid and sodium hydroxide was determined. $100cm^3$ of 1.0M HCl acid was reacted with $50cm^3$ of 2M NaOH solution. Initial temperature of the base was 25^0C and that of the acid was 27^0C. The final stable temperature when the acid and base were mixed was 34^0C.

(a) Write an ionic equation for the reaction. (1 Mark)

(b) Calculate the:

(i) Change in temperature T. (1 Mark)

(ii) Heat change for the reaction. (s.h.c = $4.2KJ/g^0K$) and density of solution is $1.0g/cm^3$. (2 Marks)

(iii) Molar heat of neutralization of HCl. (2 Marks)

(c) Draw an energy level diagram for the reaction. (2 Marks)

(d) Account for the heat loss (2 Marks)

(e) How can the heat loss be minimized. (1 Mark)

(f) Write the thermochemical equation for the reaction. (1 Mark)

6. I. An electric current was passed through concentrated solution of Copper (II) Chloride using inert pair of electrodes.

(a) Name a suitable pair of electrodes for this experiment. (1 Mark)

(b) Identify cations present in the solution. (1 Mark)

(c) Which ions are preferentially discharged at the anode (1 Mark)

(d) Write an ionic equation for the reaction that takes place at the cathode. (1 Mark) (e) Explain the observation that would be made on the electrolyte as the experiment progresses. (2 Marks) (II) Use the standard electrode potentials for elements V, W, X, Y and Z given below to answer the questions that follow.

		E Volts
$W_{2+\,(aq)} + 2e^- \rightarrow$	$W_{(s)}$	-2.87
$Z_{2+(aq)} + 2e^- \rightarrow$	$Z_{(s)}$	-2.37
$V_{+(aq)} + e^- \rightarrow$	$\frac{1}{2} V_{2(g)}$	0.00
$X_{2+(aq)} + 2e^- \rightarrow$	$X_{(s)}$	+0.34
$\frac{1}{2} Y_{(2)} + e^- \rightarrow$	$Y_{-(aq)}$	+1.99

(a) Identify the strongest reducing agent. (1 Mark)

(b) Which element is likely to be hydrogen? Give a reason for your answer. (1 Mark)

(c) Which elements would form a couple with the highest E.M.F. Calculate the E.M.F (2 Marks)

(d) Write the cell notation for the electrochemical cell formed by the cells in (c) above (1 Mark)

7. A mixture of iron fillings and sulphur was heated strongly. A red glow spread throughout the mixture and a black residue was formed. The cold residue reacts with dilute hydrochloric acid and a gas which gives a black precipitate with Lead (II) solution was given off.

(a) (i) What did the red glow indicate? (1 Mark)

(ii) Identify the gas evolved when black solid reacted with dilute hydrochloric acid. (1 Mark)

(iii) Write the formula of the black solid (1 Mark)

(iv) Write an ionic equation for the formation of the black precipitate. (1 Mark)

(b) (i) When chlorine gas is passed over heated iron wool, a chloride of iron is formed. Name the chloride. (1 Mark)

(ii) Calculate the mass of iron required to react completely with 0.12 litres of chlorine at room temperature and pressure (3 Marks)

(iii) Calculate the amount of chloride of iron formed in (ii) above (Fe = 56, Cl = 35.5, 1 mole of gas occupies 24 litres at room temperature (2 Marks)

KURIA EAST DISTRICT JOINT EXAMINATION COUNCIL

(KEDJEC)

233/3

CHEMISTRY

PAPER 3

1. You are provided with

- Solution P – $100cm^3$ of 0.4M HCl
- Solid M – 0.5g X CO_3
- Solution Q – 0.1M NaOH
- Phenolphthalein indicator

Procedure

i. Add all solid M into 100cm^3 of solution P ii. When effervescence has stopped transfer the mixture above into a clean 250m volumetric flask and top up to the mark using distilled water. Label this as solution E. iii. Fill the burette with solution E. iv. Pipette 25cm^3 of solution Q into a clean conical flask.
v. Add 3 drops of phenolphthalein indicator into conical flask. vi.

(a) Calculate the average volume of E used. (1 Mark)
(b) Determine the number of moles of solution Q that reacted with solution E (1 Mark)
(c) Calculate the number of moles of solution E in 250cm^3 of solution. (2 Marks)
(d) Determine the number of moles of the original solution P in 100cm^3 of solution. (1 Mark)
(e) Calculate number of moles of solution P that reacted with the carbonate (1 Mark)
Titrate the contents of the conical flask against solution E
vii. Repeat the procedure (iv and vi) two more times and complete the table. (4 Marks)

Final burette reading	I	II	II
Initial burette reading			
Volume of E used			

(f) Given ionic equation $2H^+_{(aq)} + CO^{2-}_{3\,(s)} \rightarrow CO_{2(g)} + H_2O_{(l)}$
Determine the number of moles of CO^{2-}_3 that reacted with solution P (1 Mark)
(g) Determine the mass of X (2 Marks)

2. You are provided with:
- Solution A 0.2M potassium iodide solution.
- Solution B 0.2M Sodium Thiosulphate solution.
- Solution C Hydrogen Peroxide solution.
- Starch indicator solution.

You are required to determine the effect of temperature on the rate of reaction.

Procedure

i. Transfer 10cm^3 of potassium iodide solution into test tube labelled A, 5cm^3 of sodium thiosulphate solution into test tube B and 5cm^3 hydrogen peroxide in test tube C.
ii. Transfer solution B into a conical flask followed by 5cm^3 of freshly prepared starch indicator solution.
iii. Simultaneously transfer solution A and C into the conical flask and immediately start the stop watch. Note the time taken for the mixture to turn to blue black and record the result. iv. Repeat the procedure at temperatures given hence fill the table.

Set	Vol of A(cm^3)	Vol of B(cm^3)	Vol of C(cm^3)	Vol of starch (cm3)	Temp ^{0}C	Time(sec)	($\frac{1}{t}$ sec $^{-1}$)
1	10	5	5	5	Room temp		
2	10	5	5	5	30		
3	10	5	5	5	40		
4	10	5	5	5	50		
5	10	5	5	5	60		

(6 Marks)

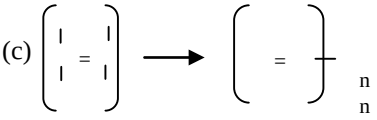
(a) Plot a graph of temperature against reciprocal of time ($\frac{1}{t}$ sec $^{-1}$). (4 Marks)
(b) From your graph determine time taken for the colour to turn to blue black if solution is warmed to 42.5^{0}C. (2 Marks)
(c) Explain the formation of blue black colour. (2 Marks)
(d) Explain the shape of the graph obtained. (1 Mark)
(e) Suggest the effect of raising temperature on this experiment. (1 Mark)
(f) Apart from temperature, state any other two factors that affect rate of reaction. (1 Mark)

3. You are provided with solid V. You are required to carry out the test indicated and record your observations in the table.

Test	Observations	Deductions
(a) Place all the solid V in a boiling tube and add 6cm^3 of distilled water and shake	(1 Mark)	(1 Mark)
(b) Test the PH of the solution using universal indicator paper	(1 Mark)	(1 Mark)

(c) Divide the resultant mixture into three portions and to the 1st portion add a spatula of sodium carbonate	(1 Mark)	(1 Mark)
(d) To the second portion add two drops of potassium permanganate solution	(1 Mark)	(1 Mark)
(e) To 3rd portion add three drops of concentrated sulphuric acid, shake and add 2cm^3 absolute ethanol	(1 Mark)	(1 Mark)

KURIA EAST DISTRICT JOINT EXAMINATION COUNCIL
CHEMISTRY PAPER 233/1
PAPER 1
MARKING SCHEME

1. (a) Calcium oxide//Quickline ✓ 1 Mark
   (b) Filtration//Fractional crystallization/crystallisation of $NaOH_3$✓ 1
   (c) - In the extraction of sodium metal
   - Pickling
   - As a drying agent
   - Anti microbial agent
   - Anti cracking agent
   (Any to correct answers award ½ mark each)
2. Rate of diffusion of methane gas = $\frac{100cm^3}{40\ sec}$= 2.5cmsec^{-1} ✓ ½ mark
   Let rate of diffusion of ozone be $\frac{90}{t}$= R
   Molar mass of CH_4 = 12 + 4 = 16 ½ mark
   Molar mass of O_3 = 16 x 3
   = 48
   $\frac{Rmethane}{ROzone}=\frac{\sqrt{MMO_3}}{\sqrt{MMCH_4}}$
   $\frac{2.5}{R}=\frac{\sqrt{48}}{\sqrt{16}}$ ✓ ½ mark
   R = $\frac{2.5\ x\ \sqrt{16}}{\sqrt{48}}$= 1.4434cm^3/sec ✓ ½ mark
   $\frac{90}{t}$ = 1.4434✓ ½ mark
   t = $\frac{90}{1.4434}$
   = 62.3528sec ✓ ½ mark
3. $2AgNO_{3\,(s)} \longrightarrow 2Ag_{(s)} + 2NO_{2(g)} + O_{2(g)}$
   MM
   2(108 + 14 + 16 x 3) Volume of O_2 22.4dm^3
   = 340 ✓ ½ mark
   340g of silver nitrate releases 22.4dm^3 of O_2 ✓ ½ mark
   10g of silver nitrate releases $\frac{22.4dm^3}{340g}$ x 10g ✓ ½ mark
   = 0.6588dm^3 ✓ ½ mark
4. (i) X – Bromo ethene ✓ ½ mark
   N – Ethyl hydrogen sulphate ✓ ½ mark
   (c) M – Bromine gas ✓ ½ mark
   (c)  ✓ 1 mark
   Polyethene ✓ ½ mark
5. (i) - P ✓1
   - It reacts with the carbonate faster ✓ ½ and the reaction ends earlier. ✓ ½
   (ii) The same quantities of reactants ✓ ½ have been used hence total volume of gas ✓ ½ evolved is the same.
6. (i) Lowering the temperature ✓ ½ (ii) Increasing pressure ✓ ½
7. (a) B ½ - It looses 3 electrons and the remaining electrons are strongly held than before due to less repulsion. (1 Mark)
   (b) C ½ - It has the weakest nuclear charge among the non-metals given (1 Mark)
8. (a) 2CO(g) + O2(g) 2CO2(g) ✓1
   (b) – Carbon (II) Oxide ✓1
   (c) - Extraction of metals ✓1
9. (i) To displace/drive out the air in the aspirator
   (ii) A black solid (✓1); copper (II) oxide is formed // copper is oxidized to copper (II) oxide
10. t ½ t ½ t ½ t ½ t ½

48 ⟶ 24 ⟶ 12 ⟶ 6 ⟶ 3 ⟶ 1.5

5 t ½ = 270 t ½ =

$\frac{270}{5}$ = 54 days or

N1 = No (½) T/ t ½ 5t ½ = 270

$\frac{1.5}{48}$ = 48 (½) 270/ t ½ t ½ = 270

$\frac{1}{32}$ = (½) 270/ t ½ t ½ = 54 days

$(1/2)^5 = (½)^{270}/ t ½$

11. No. of moles = $\frac{m}{R.f}$

$= \frac{15}{58.5}$

= 0.25641 moles

Molarity = $\frac{0.25641}{0.12}$

= 2.13675M

12. (a) Boyles law states that the volume V_1 of a fixed mass of a gas is inversely proportional to its pressure P_1 when temperature is kept constant.

(b) $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_{12}}$

$\frac{780 \times 400}{303} = \frac{600xV_2}{323}$

⇨ $V_2 = \frac{323 \times 780 \times 400}{303 \times 600}$

= 554.3234cm^3

13. (a) Allotropy – existence of an element in more than one structural form in the same physical state.

(b) Rhombic/ ✓ ½

Monoclini// ✓ ½

(c) (i) Blue flame ✓ (1 mk)// pungent smell

(ii) Acidic ✓ (1 mk)//low pH

14.

Ratio	M		O
			$\frac{0.64}{16}$
Moles	$\frac{0.254}{63.5}$ ✓ ½		
Ratio	0.04	:	0.04 ✓ ½
	1	:	1

E.F = MO✓ 1

15. - Add water to Lead (II) nitrate to obtain Lead (II) nitrate solution. ½
- Add water to sodium carbonate to obtain sodium carbonate solution. ½
- Mix the solutions to ppt Lead (II) carbonate. ✓ 1
- Filter to obtain Lead (II) carbonate as a residue. ½
- Was the residue and dry between filter paper ½ 16. Burette ✓ 1 has accuracy of 0.1 cm^3 ✓ 1

17. - Add water to the solid mixture. - V dissolves while W will not.
- Filter to obtain W as residue.
- Heat the filtrate to evaporate the water.

18. (i) X – Iron rusted

Y – No rusting on iron

(ii) Zinc is more reactive than iron hence zinc undergoes corrosion in place of iron.

i.e. Zinc reacts with oxygen and moisture

19. T = (32 x 60) + 10 = 1930s ✓ I = 0.5

Q = It = 0.5 x 1930 = 765C

0.44g – 965C 88g ? $\frac{88}{0.44}$ x

96,500 = 193,000C ✓

Charge of X = $\frac{193000}{96500C}$ = 2 □X(OH)$_2$

20. (i) - Adding calcium ions to soil ✓

- Raise PH of soil/Neutralize soil ✓ 1

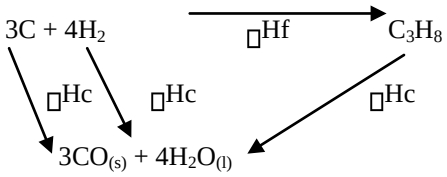
21. (a) X – 2.8.2

Y – 2.8.7

(b) Atomic radii of x is larger than that of y

(c) Alkaline earth metals

22.



23. (i) By putting a few drops of the liquid to anhydrous copper (II) sulphate, which would change from white to blue. Cobalt (II) chloride paper (anhydrous (II) chloride changes from blue to pink on adding the liquid. (2 mks)

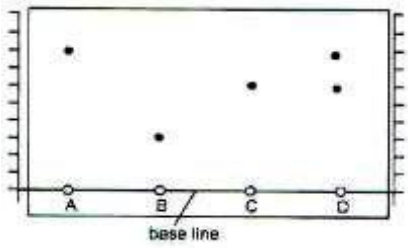
(ii) By determining its boiling point, has b.p of 100^0 at sea level/determining freezing point which is 0^0 at sea Level / determining its density which is $1g/cm^3$. (1 mk)

24. (a) It has a low boiling point (it is volatile)

(b) Sodium nitrate (1 mark)

(c) Manufacture of fertilizer

25. II Show the positions of all the spots after development.



(ii) A and C (2 mks)

26. (i) X – Hydrogen bond Y – Covalent bond

(ii) Water contain hydrogen bonds holding the molecules together which are stronger than van der waals forces whereas CH4 has only van der waals forces holding molecules together.

27. (i) MnO_4^- X + (-8) = 1
X = - 1 + 8 = +7

(ii) SO_2 ⟶ X + (-4) = 0
X = 0 + 4 = +4

(iii) $Cr_2O_7^{2-}$ ⟶ 2X + -14 = -2
2X = -2 + 14
2X = 12

28. (i) In diamond all carbon atoms are joined together by covalent bonds in three dimensional structure//or tetrahedral structure thus very hard.

(ii) The carbon atoms are bonded in layers/or hexagonal layers which are held by weak forces of attraction// or Van der waal"s forces these layers slide over one another easily.

29. CaCO3(s) + H2SO4(aq) CaSO4(s) + H2O(l) + CO2(g) ✓ 1

NB: - Equation must be balanced otherwise award 0
- State symbols a must if not less ½ mark

(i) NO ½ Mark

- The gas is <u>less dense</u> (✓ ½ Mark) hence can"t be collected by <u>downward</u> delivery.

(iii) Concentrated sulphuric (VI) acid (✓ ½ Mark) Reject if "concentrated" is missing

(iv) – It"s colourless ✓

- Odourless ✓

- Less dense than air ✓

Any two for (½ mark) each

30. (a) Isotopes are atoms of same element with same atomic number (no. of protons) but different mass no. ✓ 1

(b) $\frac{(92.2\ x\ 2.8)+(4.7\ x\ 29)+(3.2\ x\ 30)}{100}$ ✓ ½

$= \frac{2581.6+136.3+93.0}{100}$ ✓1

31. (a) Hydrogen ✓ 1

(b) They increase the surface area over which the gas dissolves in water.

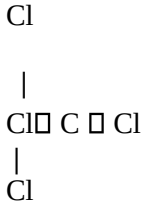
(c) Give one use of hydrochloric acid
- Treatment of water at the water works.
- Sewage treatment
- Manufacture of dyes, drugs etc
- To clean metal surfaces to remove rust

KURIA EAST DISTRICT JOINT EXAMINATION COUNCIL 2015
FORM 4
CHEMISTRY PAPER 233/2 MARKING SCHEME

1. (a) (i) P – Ethylethanoate
Q – Potassium ethoxide
(ii)

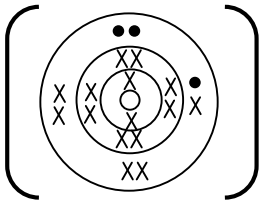
Step	Type of reaction	Reagents	Conditions
(I)	Oxidation	$KMNO_4/H^+$	
(II)	Dehydration	Conc. H_2SO_4	Temp. 180^0C
(III)	Addition	H_2 gas	- Nickel catalyst - Temperature 200^0C

(iii) Sodalime
(iv) $CH_3COOH_{(aq)} + NaOH_{(aq)} \rightarrow CH_3COONa_{(aq)} + H_2O_{(l)}$ (v)
Tetrachloromethane



(vi) U - Polyethene
- Making package materials
(vii) Ethene burns with smoky flame and ethyne burns with sooty flame.

2. (a) B or G
Reason: It losses its two outermost electrons during ion formation.
(b) Giant ionic → Two atoms of C will lose electrons to three oxygen atoms to form an ionic bond. This forms a strong giant ionic structure.
(c) It is less reactive than E or E is more reactive than H. They react by gaining electrons.
E is more electronegative OR E has a greater tendency to gain electrons than H due to its smaller atomic size or greater nuclear attractions.
(d) (i) G has a smaller atomic radius than F or F has a larger atomic radius than G. The added electron in G increases its nuclear attraction power, which tend to pull the outermost electrons closer to the nucleus OR G has higher nuclear charge.
(ii) Aqueous solution of the oxide of B has a pH above 7 while that of D is below 7. The oxide of B is basic while of D is acidic in nature.



(f) $4F_{(s)} + O_{2(g)} \rightarrow 2F_2O_{(s)}$
Moles of F = $\frac{1.95}{39} = 0.05$
Moles of O_2 used = $\frac{0.05}{4} = 0.0125$
Vol. of O_2 used = 0.0125 x 22400 = $280cm^3$

3. (a) (i) To remove film of oxide on the surface of the metal.
(ii) A – Brown deposit, blue colour of CUSO4 faded.
C – Slight effervescence, which then stops, and white ppt around rod.
(iii) Zn goes into solution displacing hydrogen ions, which form hydrogen gas since Zn is more reactive than hydrogen.
(b) (ii) Rate at 2.5min draw tangent to curve at 2.5 and determine slope.
e.g. $\frac{0.54\ x\ 0.3}{3.4-2} = \frac{0.24}{1.4}$= 0.17 moles per litre.
(iii) Curve II. Reaction rate is slower because at lower temps kinetic energy of molecules is reduced and number of collisions per unit time reduces. Reaction takes longer time.

4. (a) - Ammonia
- Sodium chloride

- Calcium carbonate

(b) (i) Carbon (IV) Oxide → Chamber 3

- Ammonia → Chamber 2

(ii) - Controls air and water pollution

- Saves on resources

(c) L - Ammonium Chloride

M - Sodium Hydrogen Carbonate

(d) (i) $NaCl_{(aq)} + NH_{3(g)} + CO_{(g)} + H_2O_{(l)} \rightarrow NH_4HCO_3 + NaCl_{(s)}$

(ii) $2NH_4Cl_{(s)} + Ca(OH)_{2(s)} \rightarrow 2NH_{3(g)} + CaCl_{2(aq)} + 2H_2O_{(l)}$

5. (a) $H^{+}_{(aq)} + OH^{-}_{(aq)} \rightarrow H_2O_{(l)}$

(b) (i) Initial temp. = $\frac{25+27}{2} = 26.0^0C$

Final temp = 34^0C

$\Delta T = 34^0C - 26^0C = 8.0^0C$

(ii) $H = MC\Delta$

$= 150 \times 4.2 \times 8 = 5040J = 5.040Kj$

(iii) Molar heat of neutralization

1 mole = 1000cm3

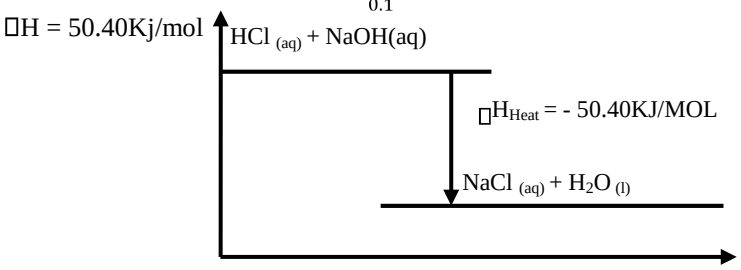
x = 100cm3

0.1 mole = 5.04kJ

1.0 mole = x

$x = \frac{1 \times 5.04}{0.1} = 50.40Kj$

(c)



(d) - Some heat was lost to the surroundings and to the apparatus.

- Error in measurement and taking of readings

(e) By ragging the apparatus

(f) $HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$ Δ Neut = -50.40 kJ = -50.40 kJ/mo

6. I (a) Graphite electrodes

(b) Cu2+, H+ ions

(c) Cl- ions (higher concentration)

(d) $Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$

(e) The green colour of $CuCl_2$ fades because Cu^{2+} ions are discharged.

II. (a) W

(b) V_2 – Used as the reference electrode.

(c) W and Y

1.09 – (-2.87) = 3.96v

(d) $W_{(s)}/W^{2+}_{(aq)}// Y_{2(g)} /Y^{-}_{(aq)}$; Pt

7. a (i) Reaction is exothermic

(ii) Hydrogen sulphide

(iii) FeS

(iv) $H_2S_{(g)} + Pb^{2+}_{(aq)} \rightarrow PbS_{(s)} + 2H^{+}_{(aq)}$

(b) (i) Iron (III) Chloride

(ii) $2Fe_{(s)} + 3Cl_{2(g)} \rightarrow 2FeCl_{3(s)}$

3 moles of Cl_2 reacts with 2 moles of Fe 3 x

24L Cl_2 react with 2 x 56g Fe

0.12L Cl2 react with $\frac{2 \times 56 \times 0.12}{3 \times 24} = 0.186g$

(iii) From equation: 2 moles of Fe gives 2 moles of FeCl3

56g Fe give 162.5

0.186 Fe gives $\frac{162.5 \times 0.186}{56}$ = 0.54g Fe

KURIA EAST DISTRICT JOINT EXAMINATION COUNCIL
CHEMISTRY PAPER 233/3
PRACTICAL
MARKING SCHEME

1. (a) ✓ Table I
   Complete table with 3 concordant readings — 2 Marks
   Incomplete table with 2 concordant readings — ½ Marks
   Incomplete less than 2 concordant readings — 0
   ✓ D.P tied to row 1 and 2 only — 1 Mark
   ✓ Principal of averaging — 1 Mark
   Within 0.2cm^3 otherwise award 0

   (b) $\frac{25\ x\ 0.1}{1000} = 0.0025$

   (c) Ratio 1:1

   (d) $\frac{\frac{250\ x\ b}{(a)}}{1000} = 0.04$

   (e) (d) - (c) = Ans

   (f) $\frac{e}{2}$ = Ans

   (g) $f_{1\ mole\ x} = 0.5g = \left|\frac{0.5}{f}\right.$ x + 12 + 48 = Ans

   x = Ans – 60

2. Table 2
   ✓ Complete table — $2\frac{1}{2}$ Marks
   Penalise ½ mk for unfilled space to max of 5 spaces
   ✓ Decimal — ½ Mark
   Accept whole No, 1 d.p or 2 dp used consistently otherwise penalise fully.
   ✓ Accuracy — 1 Mark
   Compare students 1st reading with S.V
    2 sec award 1 mk otherwise penalise fully
   ✓ Trend — 1 Mark
   Must be increasing downwards
   Total — 05 Marks
   (a) A straight line graph — ½ Mark
   ✓ Scale — ½ Mark
   At least ¾ of the space
   ✓ Labelling — ½ Mark
   Both axes tied
   ✓ Line — 1 Mark
   Straight line through origin and atleast two correctly plotted points
   Total — 04 Marks
   (b) Correct ans shown and read From correct graph
   Showing — ½ Mark
   Correct ans — ½ Mark
   (c) Iodide ions are oxidised to iodine which react with thiosulphate ions and unreacted molecular iodine react with starch to form blue black colour.
   (d) Increase in temperature increases kinetic energy leading to rapid movement hence more collision.
   (e) Rate is directly proportional to temperate. As temperature increase rate of collision increase.
   (f) Concentration, size of particles

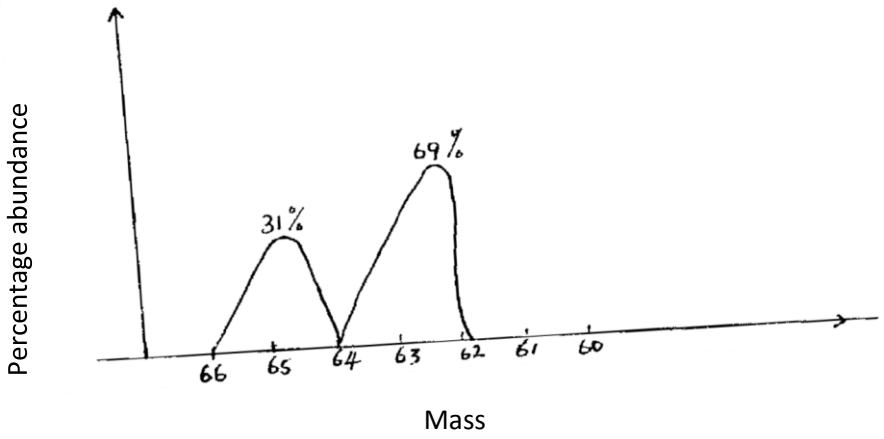
3.

Observations	Conclussion
(a) Colourless soln	Coloured ions absent

(b) PHF4	Acidic/H^+	
(c) Effervescence	H^+	
(d) Purple colour of potassium manganate is decolourised	C = C - | | R-	-C □ C- OH
(e) Sweet fruity smell	R-COOH	

KAMDARA JET
233/1
CHEMISTRY
PAPER 1
(THEORY)
JULY/AUGUST 2015

1. Give two reasons why luminous flame is not used for heating purposes in the laboratory. (2mks)
2. The diagram below shows the percentage abundance of the isotopes of copper.



(a) Calculate the relative atomic mass of copper from the information on the graph. (2marks)
(b) Write the isotope formula of the most abundant isotope of copper indicating the mass number and atomic number.(copper has
29 protons) (1mark)

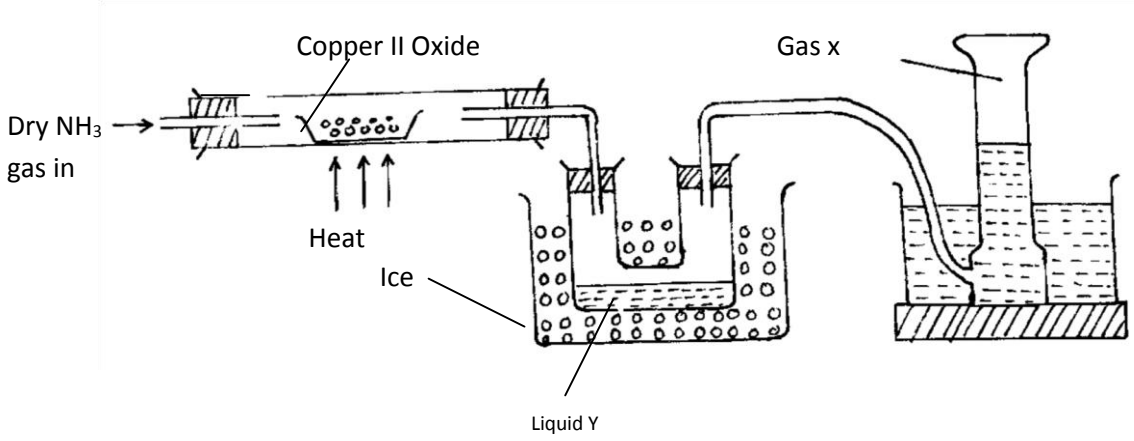
3. Three nitrates Q, R, and S were each heated and the products formed were tabulated as shown below.

Nitrate	**Products**
Q	Metal Nitrite + Oxygen
R	Metal + Nitrogen(IV) Oxide + Oxygen
S	Nitrogen(I)xide + water

(a) Identify S and R (2 marks)
(b) What is the name given to elements in the same group as Q? (1mark)

4. (a) Write an ionic equation for the reaction between copper II ions in solution and excess ammonia solution. (1mk)
(b) Name the complex ion formed in the reaction in (a) above. (1mk)

5. The diagram below shows some properties of ammonia gas. Use it to answer the questions that follow



(a) State the observation made in the combustion tube. (1mk)
(b) (i) Give the test that can be used to identify liquid Y. (1mk)
(ii) Name gas X (1mk)

6. a) A solution of $100cm^3$ of 0.1M ethanoic acid has a different p.H value from that of $100cm^3$ of 0.1M hydrochloric acid. Explain the difference. (2mks)

(b) Predict the p.H value of
(i) ethanoic acid. (½ mk)
(ii) hydrochloric acid (½ mk)

7. a) What is vulcanization of rubber? (1mk)

(b) State two properties that vulcanized rubber possesses as a result of vulcanization. (2mks) 8. Use the information below to answer the questions that follow.

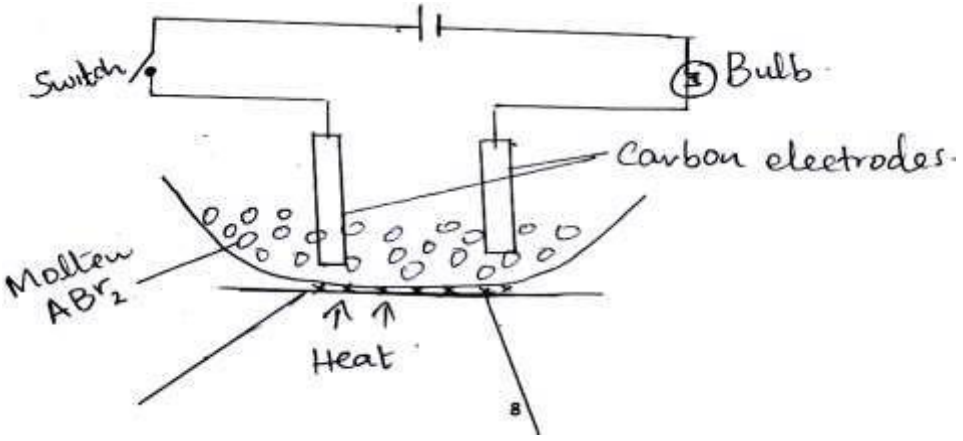
$C_{(s)} + O_{2(g)}$ ……> $CO_{2(g)}$ $\Delta H_1 = -393$ KJ/mol

$H_{2(g)} + ½ O_{2(g)}$……> $H_2O_{(l)}$ $\Delta H_2 = -286$ KJ/mol

$C_4H_{10} + 6 ½ O_{2(g)}$ ……> $4CO_{2(g)} + 5H_2O_{(l)}$ $\Delta H_3 = -2877$KJ/mol

(a) Calculate the molar enthalpy of formation of butane (C_4H_{10}) from its elements in their normal states. (3mks)

9. The set-up below was used to electrolyse a metal bromide ABr_2. Study it and answer the questions that follow.



(a) From the diagram label the Anode (1mk)
(b) Write an equation for the reaction that occurred at the Anode. (1mk)
(c) A current of 0.4A was passed through the molten salt for 10 minutes and 20 seconds. Calculate the amount of metal deposited at the Cathode. (R.A.M of A = 207, IF = 96500 C) (2mks)

10. What is
(a) an alloy? (1mk)
(b) Give an example of an alloy of Iron. (1mk)
(c) State one use of the alloy in (b) above. (1mk)

11. A piece of burning Magnesium was introduced into a jar of nitrogen.
(a) State what was observed. (1mk)
(b) Write an equation for the reaction that took place. (1mk)
(c) Describe how a solid sample of dry Lead (II) Carbonate can be prepared using the following reagents: dilute nitric acid,

Lead (II)Oxide and Sodium carbonate. (3mks)

12. Cyanogen is a gaseous compound of carbon and nitrogen only. On complete combustion is oxygen, 250cm^3 of cyanogen from 500cm^3 of Carbon (IV) Oxide and 250cm^3 of nitrogen. Determine the formula of cyanogen. (2mks)
13. Substance L, M, N and P have the following properties.

Substance	M.P.	Solubility in water	Electrical conductivity	
			Solid state	Liquid state
L	Low	Soluble	Does not	Does not
M	High	Soluble	Does not	Conducts
N	High	Soluble	Conducts	Conducts
P	High	Insoluble	Does not	Does not

(a) Select the letter which represents a substance which is suitable for making kettle handles (½mk)

(b) Which letter represents a substance which is likely to be sodium chloride? (½mk)

(c) Name the bond structure and bond type likely to be in L. (1mk)

(i) Bond structure

(ii) Bond type

14. (a) The atomic number of Sulphur hydrogen and oxygen are 16, 1 and 8 respectively. Write the electron arrangement of Sulphur in the following substances.

(i) H_2S…… (1mk)

(ii) SO_3^{2-}……. .(1mk)

(b) State the number of neutrons and electrons in the species of Aluminiumshown below:

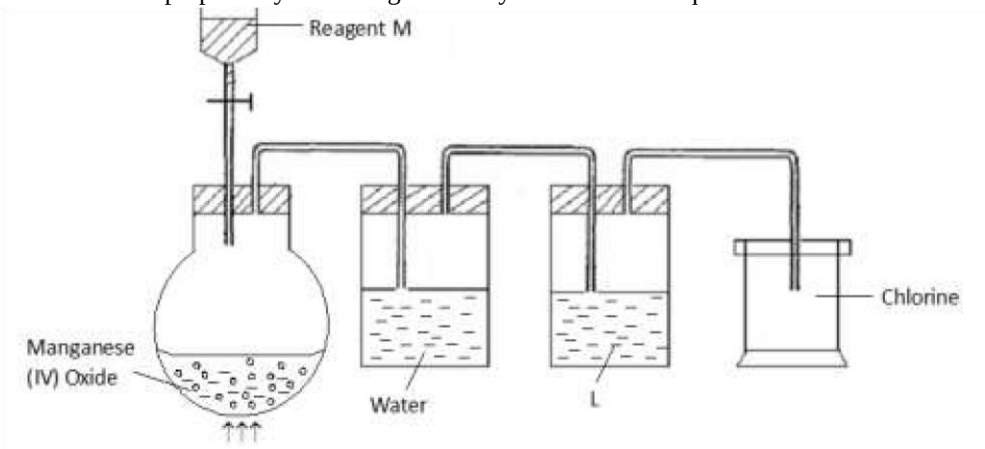
$^{27}_{13}Al^{3+}$

Neutrons …… (½mk) Electrons …… (½mk)

15. An organic compound with the formula $C_4H_{10}O$ reacts with sodium metal to give hydrogen gas and a white solid.
    (a) Give the formula of the white solid (1mk)
    (b) To which homologous series does the white solid belong (1mk)
    (c) Write the equation for the reaction between the organic compound $C_4H_{10}O$ and sodium metal. (1mk)

(d) Suppose 180cm^3 of a 2.0M solution is diluted to 1.0dm^3. What will be the concentration of the resulting solution? (2mks)

16. The set-up **below** was used to prepare dry chlorine gas. Study and answer the questions that follow



(a) Name reagents **M** and substance **L**.

(b) A warm red phosphorus was lowered into the gas jar of chlorine using a deflagrating spoon:

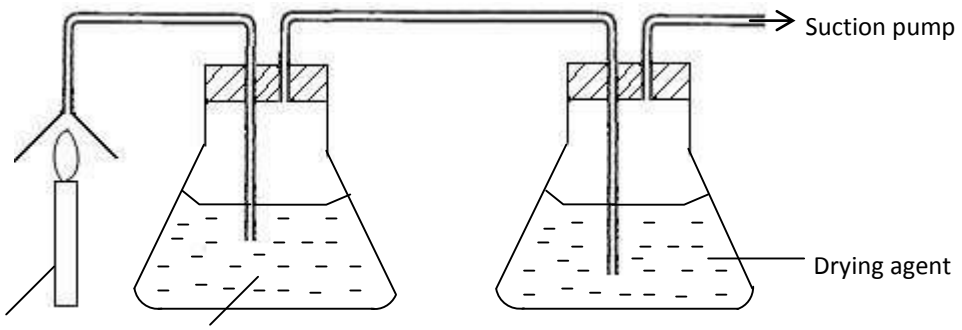
(i) State any **one** observation made in this experiment. (½ mark)

(ii) Identify the substance formed in the above reaction. (½ mark)

(c) Both substances in **(ii) above** undergo hydrolysis when exposed to air. Write an equation to show how anyone of them undergoes hydrolysis. (1 mark)

17. The set up of diagram shown **below** is used to prepare dry nitrogen gas from air. Study it and answer the questions that

follow.



(a) What is the purpose of using:

(i) A burning candle. (½ mark)

(ii) Sodium hydroxide solution. (½ mark)

(b) Name:

(i) **One** impurity present in nitrogen gas prepared. (½ mark)

(ii) A suitable drying agent used. (½ mark)

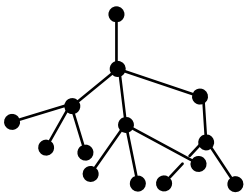
18. (i) Using a dot (**.**) and cross (x) show how NH_4^+ ion is formed from NH_3 molecule and H^+ ion.(2 marks)

(ii) State the type of bond that exists between the NH_3 and H^+ ion. (½ mark)

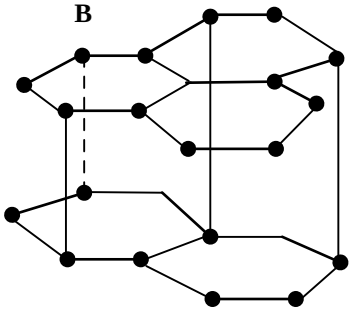
(iii) Molecular substances have low melting points. Give **one** reason why they have low melting points. (½ mark)

19. The following diagrams show the structure of two allotropes of carbon. Study them and answer the questions that follow.

A



B



(a) Name the allotropes. A and B (1 mark)

(b) Give **one** use of **A**. (½ mark)

(c) Which allotrope conducts electricity? Explain. (1½ marks)

20. Give **two** reasons why helium is used in weather balloons. (2 marks)

---

21. Ammonia is produced in large scale by Haber process.

(i) Write an equation for the formation of ammonia gas. (1 mark)

(ii) State **two** optimum conditions for obtaining a high yield of ammonia in the process. (2 marks

22. When a hydrated sample of calcium sulphate $CaSO_4.xh_2O$ was heated until all the water was lost, the following data was recorded:

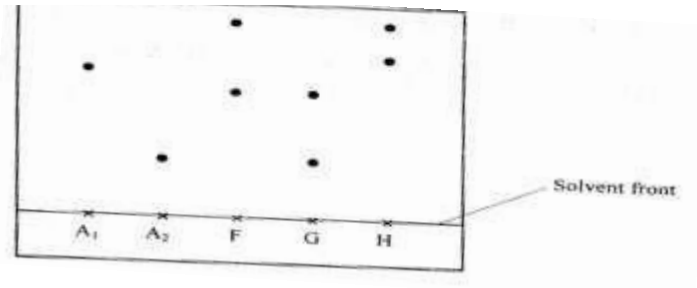
Mass of crucible	=	30.296 g
Mass of crucible + hydrated salt	=	33.111 g
Mass of crucible + anhydrous salt	=	32.781 g

Determine the empirical formula of the hydrated salt

(CA = 40, S = 32, O = 16 H = 1) (3mks)

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

24. Samples of urine from three participants F, G and H at an international sports meetings were spotted onto chromatography paper alongside two from illegal drugs A1 and A2. A chromatogram was run using methanol. The figure below shows the chromatogram.

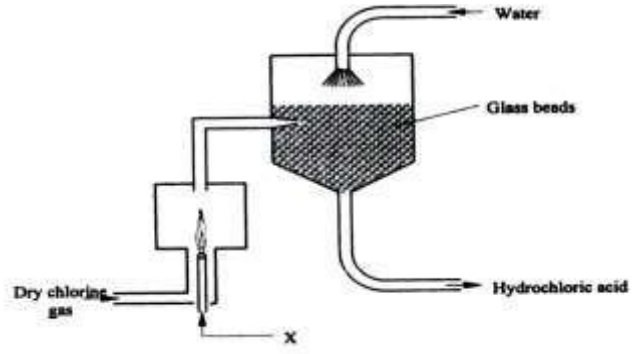


(a) Identify the athlete who had used an illegal drug. (1mk)
(b) Which drug is more soluble in methanol? (1mk)

25. Hardness of water may be removed by either boiling or addition of chemicals.
(a) Write an equation to show how boiling removes hardness of water. (1mk) (b) Name two chemicals that are used to remove hardness of water. (2mks)

26. Carbon (II) oxide is described as a "silent killer".
(a) State one physical property of carbon (II) oxide that makes it a "silent killer". (1mks)
(b) State and explain one chemical property that makes carbon (II) oxide poisonous to human beings. (2mks)

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



(a) Name substance X. (1mk)
(b) What is the purpose of the glass beads? (1mk)
(c) Give two uses of hydrochloric acid (1mk)

28. The half equations involved in a cell are:

$2H_{2(l)} + 2e \rightleftharpoons H_{2(g)} + 2OH^-_{(aq)} : E\theta = +0.40V$

$O_{2(g)} + 2H_2O_{(l)} + 4e \rightleftharpoons 4OH^-_{(aq)} : E^\theta = +0.40V$

(a) Write the overall equation for the electrochemical cell. (1mk) (b) Calculate the e.m.f generated by a battery consisting of ten cells. (1mk)

KAMDARA JET 2015
233/2
CHEMISTRY
PAPER 2
(THEORY)
JULY/AUGUST 2015

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

A					B			
C	D				E	F		
						G		

i) Select an element which forms a divalent cation. (1mk) ii) What type of structure will the chloride of A have? (1mk) iii) How do the reactivities of B and E compare? Explain. (2mks) iv) Compare the atomic radius of C with that of D. Give a reason for your answer. (2mks) v) C and E burn in oxygen to form oxides. Compare the pH values of the solutions of the oxides of C and E. (2mks)

b) Study the information in the table below and answer the questions that follow. (The letters are not the actual symbols of the substances)

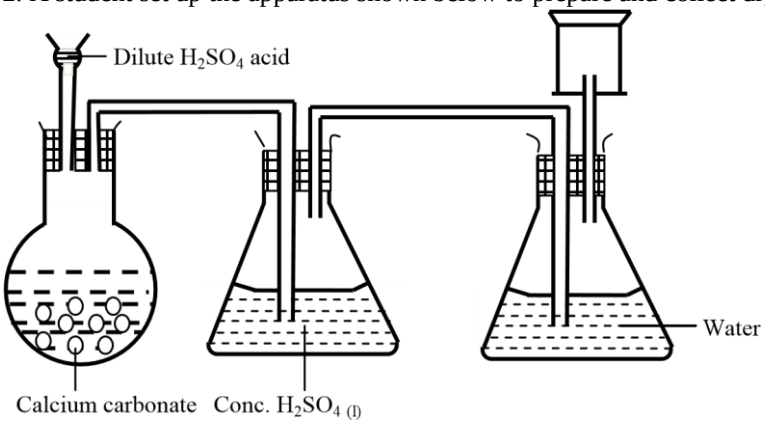
Substance	Melting point (°C)	Boiling point (°C)	Solubility in water
P	-117	78.5	Very soluble
Q	-78	-33	Very soluble
R	-23	77	Insoluble
S	-219	-18	Slightly soluble

i) Which substance would dissolve in water and could be separated from the solution by fractional distillation? Give a reason. (2mks)

ii) Which substance is a liquid at room temperature and when mixed with water two layers would be formed? (1mk)

iii) Which letter represents a substance that is a gas at room temperature and can be collected over water? Explain. (2mks)

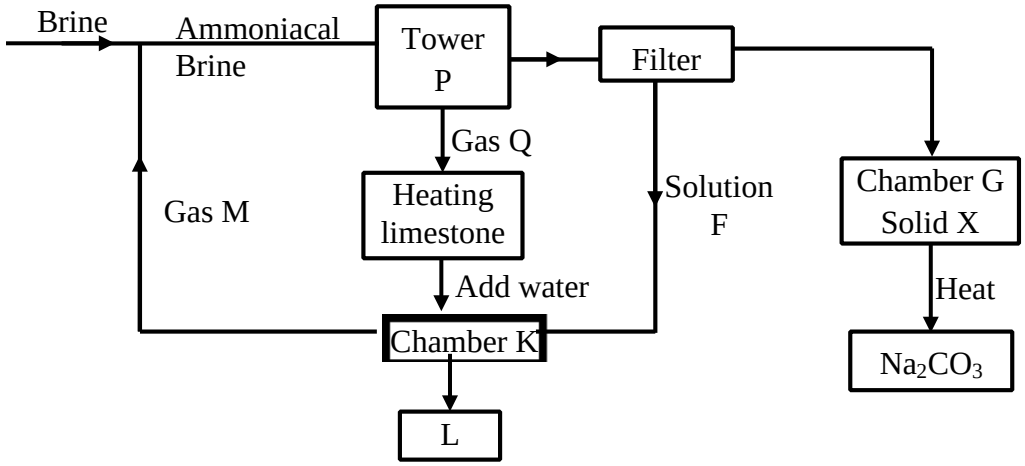
2. A student set up the apparatus shown below to prepare and collect dry carbon (IV) oxide gas.



(a) State a correction for three mistakes in the set up above (3 mks)

(b) Give two reasons why carbon (IV) oxide is used as a fire extinguisher (1 mk)

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



(i) Name gas M and Q (1Mark)

(ii) Name solution F and solid X (1 Mark)

(iii) Name the product L formed and give one of its uses (2 Marks)

(iv) Write equations of the reactions in (2 Marks)

Tower P

Chamber K

(v) Name the two raw materials required in the manufacture of sodium carbonate (1 Mark)

3. a) The list below gives the formulae of some organic compounds. Use it to answer the questions that follow.

K_1: CH_3CH_2OH

K_2: $CH_3CH_2CH_2CH_3$

K_3: $CH_3CH=CH_2$

K_4: $CH_3CH_2CH_2C(=O)OH$

K_5: $CH_3\,CH_3$

(i) Select two compounds which:

I. Are not hydrocarbons. (1mk)

II. Belong to the same homologous series (1mk) III

Identify the compound that is likely to undergo addition polymerization. Give a reason for your answer. (1mk) b) The structure below represent two cleansing agents

$R - COO^-Na^+$

$R- OSO_3^-Na^+$

In the table below,give one advantage and one disadvantage of using each one of them (2mks)

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

c) Under certain condition ethanoic acid ($C_2H_4O_2$) and ethanol (C_2H_5OH) react to form a sweet smelling compound.

(i) What is the general name of the compound to which the sweet smelling compound belongs? (1mk)

(ii) Write the structural formula of the sweet smelling compound (1mk)

(iii) Give the conditions for the formation of the sweet smelling compound (1mk)

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

v) Explain why the reaction between 1g of potassium carbonate and 2M HCl is faster than the reaction between 1g sodium carbonate and 2M ethanoic acid (2mks)

d) Fibres are either synthetic or natural. Give one:

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

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

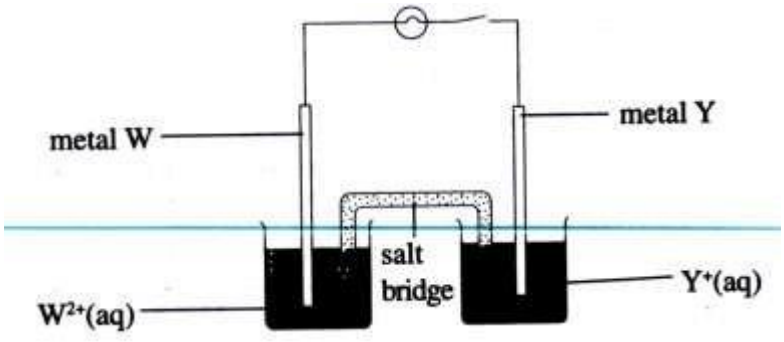
4. The table below gives reduction potentials obtained when the half – cells for each of the metals represented by letters, V,W,X, Y and Z were connected to a copper half – cell as the reference electrode.

Metal	**Electrode Potential (volts)**
V	-1.10
W	-0.47
X	0.00
Y	+0.45
Z	+1.16

(a) What is metal X likely to be? Give a reason. (1mk).

(b) Which of the metals cannot be displaced from the solution of its salt by any other metals in the Table? Give a reason. (2mks)

(c) Metals W and Y were connected to form a cell as shown in the diagram below.



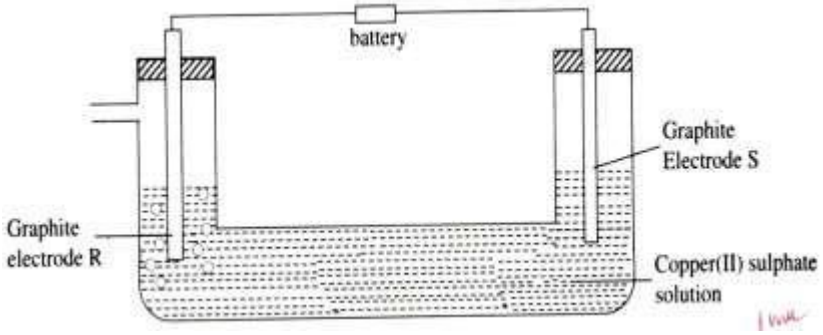
(i) Write the equations for the half – cell reactions that occur at :

I. Metal W electrode. (1mk)

II. Metal Y electrode. (1mk)

(ii) If the salt bridge is filled with saturated potassium nitrate solution, how does it help to complete the circuit? (2mks)

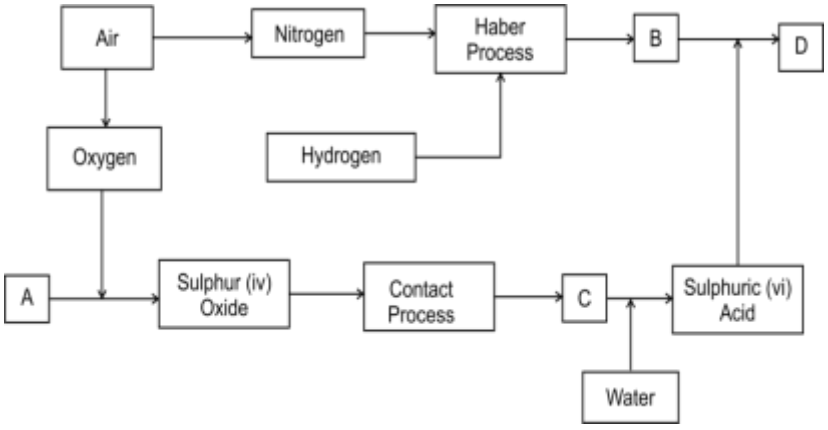
(d) When electric current is passed through Copper (II) sulphate solution for several hours as shown in the diagram below, a gas that relights a glowing splint is produced at electrode R.



(i) Which of the electrodes is the cathode? Give a reason. (1mk)

(ii) State and explain the observations that would be made at the electrodes. (2mks)

5. The flow chart below illustrates two industrial processes



a) (i) Give the name of the process by which air is separated into nitrogen and oxygen (1mk)

(ii) Apart from the gases given in (a) (i) above, name one other gas produced (1mk)

b) Name the substances represented by letters A and C (1 mark)

i) Write down the reversible reaction in contact process (1mk) ii) What is the effect of high pressure on the yield of the product in the reaction above? (1mk) iii) Name the catalyst used in Haber process and explain how it increases the rate of the reaction (1mk)

c) Calculate the percentage by mass of nitrogen in substance D (2mks)
(N=14, S=32, H=1, O=16)

d) 4g of N-13 decays by emitting a beta particle. The half life of N-13 is ten minutes

i) What is meant by half life? (1mk)

ii) How many grams of the isotope will remain after the fourth half life? (2mks)

(iii) State two differences between nuclear and chemical reaction (2mks)

Nuclear reaction	Chemical reaction

6. The table below shows the volume of nitrogen (IV) oxide produced when different volumes of 1M Nitric (V) acid- were each reacted with 4.14g of lead at room temperature.

Volume of 1M Nitric (V) acid (cm^3)	**Volume of Nitrogen (IV) oxide gas (cm^3)**
10	120
30	360
50	600
70	840
90	960
110	960

(a) Explain how the rate of the reaction between lead and nitric (V) acid would be affected if the temperature of the reaction mixture was lowered. (2mks)

(b) On the grid provided below plot a graph of the volume of the gas produced (vertical axis) against volume of acid.

(3mks)

(c) Using the graph, determine the volume of

(i) Nitrogen (iv) oxide produced when 60cm^3 of 1M Nitric (V)acid were reacted with 4.14g of lead.(1mk)

(ii) 1M Nitric (V) acid which would react completely with 4.14g of lead. (1mk)

(d) Using the answer in d (ii) above, determine

(i) the volume of 1M Nitric (V) acid that would react completely with one mole of lead. (Pb = 207)

(2mks) (ii) the volume of nitrogen (IV) oxide produced when one mole of lead reacts with excess 1M Nitric (V) and acid at room

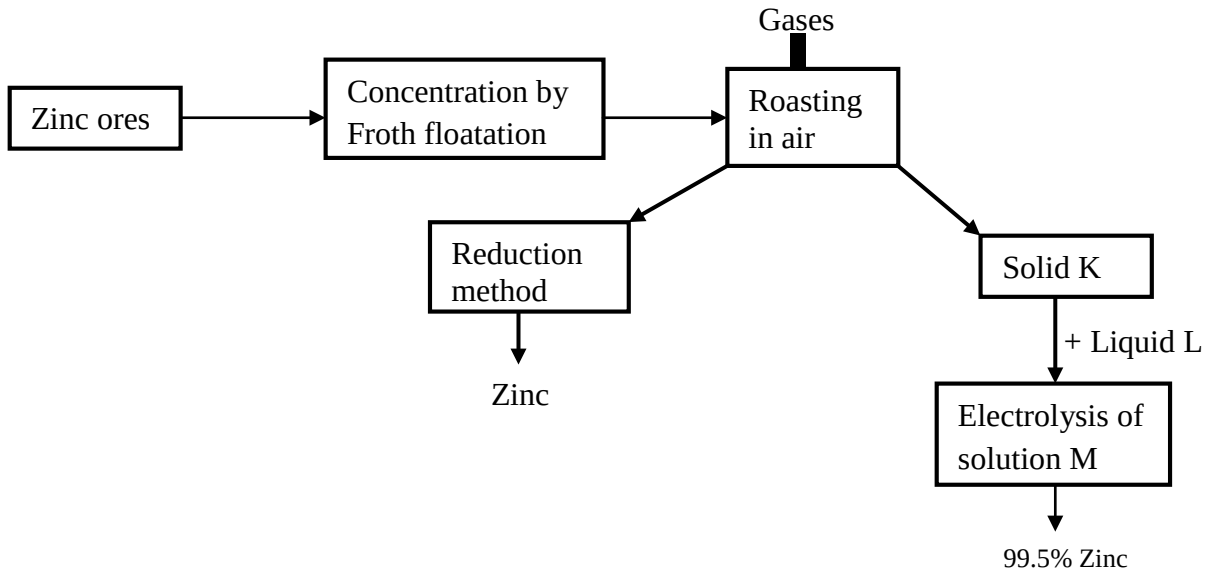
temperature. (1mk)

(e) Calculate the number of moles of

(i) 1M Nitric (IV) acid reacted with one mole of lead. (1mk)

(ii) Nitrogen (IV) oxide produced when one mole of lead were reacted with excess nitric acid. (Molar gas volume is 24,000cm^3) (1mk)

7. Study the following reaction scheme for the extraction of zinc metal and then answer the questions that follow.



(a) (i) Name two chief ores from which zinc can be extracted (1mk)

(ii) Write the equations for the reaction that take place at the roasting chamber. (2mk)

(b) (i) Name the reducing agents used in the reduction chamber. (1mk)

(ii) Write the equations for the reduction process to obtain zinc (2mk)

(c) Identify the following: (1mk)

Solid K

Liquid L

(d) State two uses of zinc metal (1mk)

233/3 Inst.
CHEMISTRY PRACTICAL(Confidential)
KAMDARA JET EXAMS 2015

In addition to the apparatus ordinarily present in the chemistry laboratory each student should have:

- 150cm^3 Solution P
- 150cm^3 solution Q 200cm^3 Solution T
- 50cm^3 of 2M hydrochloric acid
- Burette
- 2 conical flasks
- Pipette
- Pipette filler
- Stand
- White tile
- 6 test tubes in a rack
- 10cm^3 measuring cylinder
- 100cm^3 measuring cylinder
- Thermometer (-10 to 110 ºC)
- One 100cm^3 glass beaker
- Stop watch
- 1 g Solid U 1 g Solid V
- 2cm^3 ethanol
- 1 Boiling tube
- Distilled water in a wash bottle.
- White paper (10 by 10 cm)
- Universal indicator paper (What man) and its pH chart.
- Tripod stand and wire gauze
- Test tube holder
- Metallic spatula
- Thermometer (-10 -110ºC)
- 2 labels
- Volumetric flask 250ml
- ACCESS TO
- dilute sulphuric acid and dropper
- 2M sodium hydroxide and a dropper
- 2M Ammonia solution and a dropper
- 0.1M potassium iodide solution and a dropper
- Acidified potassium manganate (VII) and a dropper
- Bromine water and a dropper
- Concentrated sulphuric acid and a dropper Phenolphthalein indicator and a dropper.
- Source of heat NOTES

1. Solution Q is *ethane dioic acid (oxalic acid) solution containing 25.2 per litre of solution*.
2. Solution P is *sodium hydroxide solution containing 80g per litre of solution*.
3. Solution T is *sodium thiosulphate solution containing 49.6 g per litre of solution*
4. Solid U *is aluminium ammonium sulphate,* solid V *is maleic acid.*
5. Acidified potassium manganate (VII*) is made by dissolving 3.16g in about 200cm^3 of dilute sulphuricacid and add water up to 1000cm^3 of solution.*

KAMDARA JET 2015
Kenya Certificate of Secondary Education
CHEMISTRY
Paper 3
(PRACTICAL)
2¼ hours

1. You are provided with:
   -2M sodium hydroxide solution labeled **solution P**
   -solution Q containing 25.2g per litre of a **dibasic** alkanoic acid

You are required to;

(a) prepare solution **R** by diluting the sodium hydroxide solution **P** (b) determine the molar mass of the alkanoic acid.

Procedure

Place 25.0cm^3 of solution **P** into a 250cm^3 volumetric flask using pipette filler.

Add about 100cm^3 of distilled water and shake well. Add more distilled water to make up to the mark. Label this solution **R**. Fill the burette with solution **Q**. Pipette 25.0cm^3 of solution **R** into a 250cm^3 conical flask using a pipette filler. Add two drops of phenolphthalein indicator and titrate with solution **Q**. Record your results in table 1 below. Repeat the titration two or more times and complete the table.

Table 1

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

(4 marks)

Determine the;

(i) average volume of solution **Q** used. (1 mark)
(ii) concentration of solution **R** in moles per litre. (2 marks)
(iii) concentration of the alkanoic acid in solution **Q** in moles per litre (2 marks)
(iv) molar mass of the alkanoic acid. (1 mark)

2. You are provided with:

-2M hydrochloric acid -Solution T

You are required to determine the effect of temperature on the rate of reaction between solution **T** and hydrochloric acid.

Procedure

Using a 100cm^3 measuring cylinder, measure 30cm^3 of solution **T** and place it into a 100cm^3 beaker. Draw a thin cross(x) on the clean white paper provided. Place the beaker on the paper with a cross. Add 5cm^3 of dilute hydrochloric acid and at the same time start a stop watch. Record the time taken for the cross to become **invisible** when **viewed directly from above**. Repeat the procedure using the remaining solutions heated at temperatures of **30ºC, 40ºC, 50ºC** and **60ºC**. Record your results in the table 2 below.

Temperature of solution T (ºC)	**Time taken for the cross to be invisible *(t* seconds)**	**Rate ($\frac{1}{t}$ sec^{-1})**
Room temperature		
30		
40		
50		
60		

(5 marks)

(a) Plot a graph of the rate **($\frac{1}{t}$ sec^{-1})** against temperature **(ºC).** (3 marks)

(b) Identify the measurable change in this reaction.(1 mark)

(c) Explain why the graph shows a big deviation at higher temperatures from the expected linear relations. (2 marks)

(d) State one factor that was kept constant in the experiment.(1 mark).

3. You are provided with solids **U** and **V**. Carry out the tests below and write your observations and inferences in the spaces provided.

a) Place all of solid **U** in a boiling tube. Add about 15cm^3 of distilled water and shake it until all the solid dissolves. Label it as solution **U**.

i) To about 2cm^3 of solution **U** in a test tube add sodium hydroxide solution drop wise until in excess.

OBSERVATIONS	**INFERENCES**
(1 mk)	(1 mk)

ii) To about 2cm^3 of solution **U** in a test tube add aqueous ammonia drop wise until in excess.

OBSERVATIONS	**INFERENCES**
(1 mk)	(1 mk)

iii) To about 2cm^3 of solution **U** in a test tube add 3 drops of dilute sulphuric acid.

OBSERVATIONS	**INFERENCES**
(1 mk)	(1 mk)

iv) To about 2cm^3 of solution **U** in a test tube add 3 drops of aqueous potassium iodide.

OBSERVATIONS	**INFERENCES**
(1 mk)	(1 mk)

v) Place about 2cm^3 of solution **U** in a test tube and determine its pH.

OBSERVATIONS	**INFERENCES**
(½ mk)	(½ mk)

b) (i) Using a metallic spatula ignite about half of solid V in a Bunsen burner flame.

OBSERVATIONS	**INFERENCES**
(1 mk)	(1 mk)

c) Place the other half of solid V into a boiling tube, add 15cm^3 of distilled water and shake well. Label this solution **V**.

Use the solution for the following tests; iv) To about 2cm^3 of solution **V**, add 2cm^3 of ethanol and 3 drops of concentrated sulphuric acid. Warm the mixture.

i) Place 2cm^3 of solution **V** in a test tube and determine its pH.

OBSERVATIONS	**INFERENCES**
(½ mk)	(½ mk)

ii) To about 2cm^3 of the solution obtained in (c) above (solution **V**) add 3 drops of acidified potassium manganate (VII).

OBSERVATIONS	**INFERENCES**
(1 mk)	(1 mk)

iii) To about 2cm^3 of solution **V** add 2 drops of bromine water.

OBSERVATIONS	**INFERENCES**
(1 mk)	(1 mk)

OBSERVATIONS	**INFERENCES**
(1 mk)	(1 mk)

KAMDARA JET
CHEMISTRY PAPER 233/1
MARKING SCHEME

1. i) The soot it produces dirtifies the apparatus (1) ii)
The flame is not very hot (1)

2. a) R.A.M of Cu = $\frac{31}{100} \times 65 + \frac{69}{100} \times 63$ (1)

$= 63.62$ (1)

b) $_{29}^{69}Cu$

3. a) S is ammonium nitrate (1)
R is $Pb(NO_3)_2$ / $Cu(NO_3)_2$ / $Zn(NO_3)_2$ (1)

b) Alkali metals✓

4. $Cu^{2+}_{(aq)} + 4NH_{3(aq)} \longrightarrow Cu(NH_3)_{4\ (aq)}$ (1) b)

Tetrammine copper II ion (1)

5 **a)** Black (½) copper II oxide changes to brown (½) copper metal

b) i) Y changes white anhydrousCopper II Sulphate to a blue colour/OR changes blue cobalt chloride paper to pink colour ii) x is nitrogen gas (1)

6. a) The pH value of the hydrochloric acid is lower than that of ethanoic acid Hydrochloric acid is a strong acid whereas ethanoic acid is a weak acid

b) pH of ethanoic acid is 4 to 6 (½)
pH of hydrochloric acid is 1 to 3

7 a) Vulcanization of rubber is the process of adding sulphur to rubber then heating b)
It is harder ;

It is tougher ;

It is less flexible; ***Any two 2 mks***

8. .(a) (3mks)

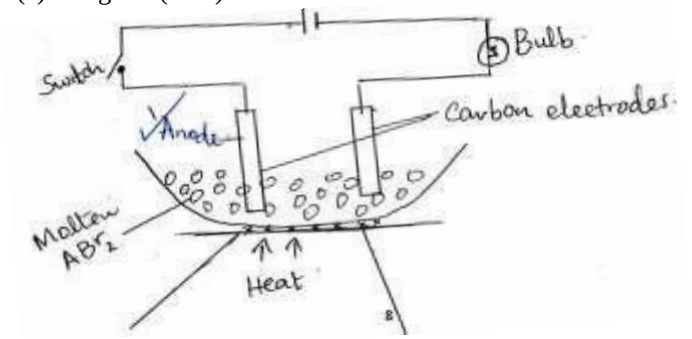
$4C(s) + 5H_2(g)$ ……$\Delta Hf(CH_4)$……..>$C_4H_{10}(g)$

$_2$ $4CO$ (g) + $5H_2O(l)$

$4(-393) + 5(-286) = \Delta Hf + (-2877)$ $\Delta Hf(CH_4) = 2877 - 1572 - 1430$

$= -125$ Kj/mol

9. (a) Diagram (1mk)



(b) Anode (1mk)

$2Br^-$ …….> $Br_2(g) + 2e^-$ (c)

(3mks)

Q = 1t

I = 0.4a

T = 620 sec

Q = It = 0.4 x 620 = 248C

Reaction for deposition of A

$A^{2+} + 2e$- ……..> A

2F are required to deposit 1 mole of A

207g …….> 2 x 96500C

? <……. 248C

$\frac{248 \times 207}{2 \times 96500} = 0.266g$

---

10. (a) An alloy is a uniform mixture of a metal with one or more other metals. (1mk)

(b) Stainless steel(or any other Wrought Iron – nails, Iron sheets e.t.c Cast Iron) – Iron boxes.

(c) Stainless steel – Construction steel cutlery any Wrought Iron – nails Iron sheets Agricultural use equipments Cast Iron Iron box e.t.c

11. (a) Magnesium continued to burn with a brilliant flame producing a white ash. (1mk)

(b) $3Mg(s) + N_2(g)$ ……> $Mg_3N_2(s)$

(c) Take 50cm3 of nitric acid and react it with excess Lead (II)Oxide

Filter to get the filtrate

To the filtrate add Sodium Carbonate and filter to obtain Lead (II)Carbonate as the residue. (3mks)

12. $27.C_x N_y(g) + {}_2O_2(g)$ …….> $2CO_2(g) + N_2(g)$

$250cm^3$: $500cm^3$ $500cm^3$: $250cm^3$

1 vol : 2 vol 2Vol : 1 Vol

XC = 2C X = 2 yN = 2N y= 2

Formula of Cyanogen C_2N

13. (i) P ✓$^1/_2$

(ii) M ✓$^1/_2$

(iii) a) Simple molecular ✓$^1/_2$

b) Covalent bonds ✓$^1/_2$

14. (a) (i) S_{16} = 2.8.6 ✓ 1

(ii) S_{12} = 2.8.2 ✓ 1

(b) (i) Neutron – 14 ✓$^1/_2$

(ii) Electron - 10 ✓$^1/_2$

1000cm^3 of solution contain ⟶ 2 moles of solute ½

∴ 180cm^3 of solution will contain ⟶ ? moles

= $\frac{180 \times 2}{1000}$ ½

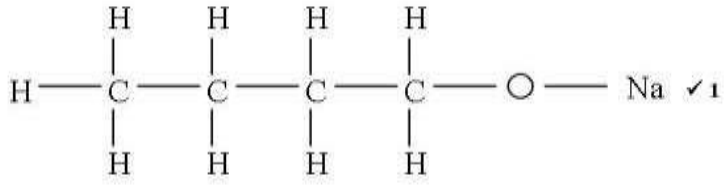
= 0.36 moles ½

1dm^3 = 1000cm^3 = 1 litre

∴ concentration of new solution = 0.36M ½

15.

(a)



✓1

Penalize for condemned structure / $CH_3CH_2CH_2CH_2ONa$ /$C_4H_{10}ONa$

(b) Alkoxide ✓ 1

(c) $2C_4H_{10}O_{(l)} + 2Na_{(s)} \longrightarrow 2C_4H_9ONa_{(l)} + H_{2(s)}$ ✓ 1

- *Balanced equation ½*
- *State symbols ½*

Penalize

- *Joining of letters*
- *Mixing small and capital letters.*
- *Wrong state symbols*
- *Penalize fully for unbalanced equations*

16. (a) M – Concentrated hydrochloric acid ✓½

L – Concentrated sulphuric (VI) acid

✓½

(b) (i) It catches fire, or presence of fumes. ✓½

(ii) PCl_3 or PCl_5 Phosphorus (III) chloride or phosphorus (V) chloride ✓½

(c) $PCl_{(s)} + 3H_2O_{(l)} \rightarrow H_3PO_{3(aq)} + 3HCl_{(g)}$ ✓1

Or $PCl_{5(s)} + 4H_2O_{(l)} \rightarrow H_3PO_{4(aq)} + 5HCl_{(g)}$

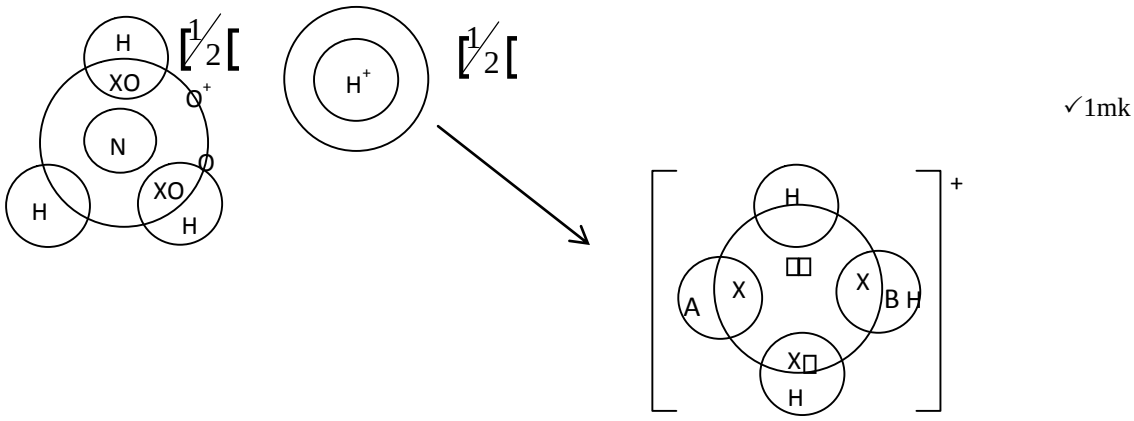
17. (a) (i) It is used to remove oxygen from air. ✓½

(ii) It removes CO_2 produced by the burning candle and also from air. ✓½

(b) (i) Argon/Neon/Krypton ✓½

(ii) Concentrated sulphuric (VI) acid // $H_2SO_{4(l)}$ ✓½

18. (i)



✓1mk

(ii) Dative bond/co-ordinate bond. ✓½

(iii) The molecules are held by weak van de waals forces. Weak intermolecular forces ✓½

19. A – Diamond ✓½

B – Graphite ✓½

(b) - Drilling metals. Any ✓½ - Jewelling.

(c) B ✓½ Existence of developed electrons ✓½ when transfer electricity. ✓½

20. Its light/less dense. ✓1 It"s inert/unreactive. ✓1

21. (a) $N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$

Pressures of 200 atms

Temperature of 450 °C to 500°C

Finely divided iron (any two)

22. Mass of $CaSO_4$ = 32.781 – 30.296
= 2.485 g

Mass of H_2O = 33.111 – 32.781
= 0.33 g

$CaSO_4$	H_2O
2.485	0.33
40+32+16x4	1x2+16
2.485 / 136 = 0.0183	0.33 / 18 = 0.0183
0.0183 / 0.0183 = 1	0.0183 / 0.0183 = 1

E.F = $CaSO_4.H_2O$

23. $Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$ (dilute)

$Zn(s) + 2H_2SO_4(l) \rightarrow ZnSO_4(aq) + 2H_2O(l) + SO_2(g$

24. (a) G

(b) A_1

25. (a) $Ca(HCO_3)_2(aq) \rightarrow CaCO_3(s) + H_2O(l) + CO_2(g)$

OR

$Mg(HCO_3)_2(aq) \rightarrow MgCO_3(s) + H_2O(l) + CO_2(g)$

(b) Sodium carbonate
Calcium hydroxide any two
Ammonium hydroxide

26. (a) It has no smell.

(b) It combines with haemoglogin to form stable carboxyhaemoglobin.This prevents the transportation of oxygen by the haemoglobin. The victim dies as a result of lack of oxygen.

27. (a) Hydrogen gas

(b) The glass beads increase the surface area over which absorption of hydrogen chloride gas in water takes place.

(c) To standardize pH of beers and wines. - In pickling of metals

- Manufacture of dyes and drugs
- Manufacture of photographic materials

(any one collect as above)

28. (a) $2OH^-_{(aq)} + H_{2(g)} \rightleftharpoons 2H_2O_{(l)} + 2e$ $E = {}^+0.83$ V

$O_{2(g)} + 2H_2O_{(l)} + 4e \rightleftharpoons 4OH^-_{(aq)}$ $E = {}^+0.40$ V

$H_{2(g)} + O_{2(g)} + 2e \rightleftharpoons 2OH^-_{(aq)}$ e.m.f. $= {}^+1.23$ V

(b) ${}^+1.23 \times 10 = {}^+12.3$ V

KAMDARA JET
CHEMISTRY PAPER 233/2
MARKING SCHEME

1. (a) i) D ii) Giant ionic structure iii) B is more reactive than E. It has a smaller atomic radius with greater nuclear attraction hence gains electrons more readily.
iv) C has a larger atomic radius than D. It has more protons with the same shielding effect as D hence stronger nuclear attraction.
v) Oxide of C has a higher pH value than a solution of oxide of E. C is a metal, forms a basic oxide. The oxide of E is acidic.

(b) i) P. It is soluble in water, its boiling point close to that of water.
ii) R iii) S. Boiling point below room temperature, slightly soluble in water.

2. a)
i. CO_2 is collected by downward delivery✓1mk ii. Exchange apparatus containing water and concentrated sulphuric (IV) acid.✓1 iii. Use dilute hydrochloric acid for dilute sulphuric acid✓1 b)
- It does not support combustion✓$^1/_2$
- It is denser than air✓$^1/_2$

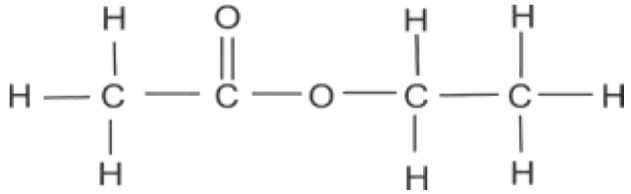
c) i)
- M-Ammonia gas
- Q-carbon (iv) oxide ii)
- F-Ammonium chloride
- X-Sodium hydrogen carbonate

iii)
- L-Calcium chloride
- Used as a drying agent iv) Tower P-$NH_{3(aq)}$+$CO_{2(g)}$+$Nacl_{(aq)}$+$H_2O_{(l)}$ ⟶ $Na_4HCO_{3(s)}$+$NH_4Cl_{(aq)}$ v) Sodium chloride, Ammonia, coke or limestone 3. a) (i) i k_1 and k_4 (1mk) ii K_2 and k_5(1mk) iii k_3 ($\frac{1}{2}$ mk) double covalent bond is broken setting electrons free that are used to bond with Neighbouring molecules .($\frac{1}{2}$ mk)

b)

	Advantage	Disadvantage
$RCOO^-Na^+$	Biodegradable ($\frac{1}{2}$mk)	Form scum hard water hence wasting soap ($\frac{1}{2}$ mk)
$ROSO_3^-Na^+$	More soluble, does not form scum with hard water ($\frac{1}{2}$ mk)	Nonbiodegradable ($\frac{1}{2}$ mk)

c) (i) Ester (1mk)
(ii)



(1mk)

(iii) conc. Sulphuric (vi) acid ($\frac{1}{2}$mk,) Heat ($\frac{1}{2}$ mk)

(iv) $Na_2CO_{3(s)}$ + 2C$H_3COOH_{(aq)}$→ $2CH_3COONa_{(aq)}$+ $H_2O_{(l)}$ + $CO_{2(g)}$ (1mk)

(V) HCI is a strong acid while ethanoic acid is a weak acid 1mk hence HCl has more H^+ Ions than ethanoic acid thus reacts fast with sodium carbonate (1mk) d) (i) silk , cotton (any 1-1mk)
(ii) can be made into complicated shapes easily
Not attacked by acids ,alkalis ,water or air
Less dense and strong (any 1- 1mk)

4. (a) Copper - It is assigned 0.00 electrode potential and is the reference electrode.

(b) V –L

Because it has the most negative electrode potential. So its tendency to donate electrons is the highest (or it is most easily oxidized) it is the most reactive

(c) (i) W(s) ……..>W^{2+} (aq) + $2e^-$

$2Y^+(aq) + 2e^-$…….> $Y_2(s)$

(ii)BY allowing ions to move into the two beakers K^+ ions pass into the beaker with Y electrode while NO_3^- ions pass into the beaker with Metal W, electrode.

(d) (i)S

Because oxygen gas is given out at electrode R thus electrode R is the anode since OH- ions which give oxygen migrate there.

(ii)$4OH^-(aq)$ ……>$2H_2O(l) + O_2(g) + 4e^-$

(iii)A brown solid is deposited on electrode S – this is because the CU^{2+} ions in solution gain electrons at S to form Copper metal as shown in the following equation.

$CU^{2+}(aq) + 2e^-$……>CU(s) brown

The Copper (II)Sulphate which is blue in colour will fade because Copper(II) ions that are responsible for the blue colour are being removed from the solution when they are discharged.

5. a) (i) fractional distillation (1mk)

(ii)argon (1mk)

b) A-Sulphur ($\frac{1}{2}$ mk) B-oleum ($\frac{1}{2}$ mk)

c) (i) $2SO_2 + O_{2(g)} \rightarrow 2SO_{3(g)}$ (1mk)

(ii)favors forward reaction increasing the yield of sulphur (iv) oxide (1mk)

(iii) Iron $\frac{1}{2}$mk,catalyses the reaction by lowering the activation energy ($\frac{1}{2} mk$)

d) $(NH_4)2SO_4$ $\frac{1}{2}$ mk, Formula mass =132 $\frac{1}{2}$ mk $^o/_o$ by mass of N = $\frac{28}{132}$ X $100^o/_o$ ($\frac{1}{2}$ mk)

=$21.2^o/_o$ ($\frac{1}{2}$ mk)

e) (i)Time taken for half of the amount of radioactive sample to decay (1mk)

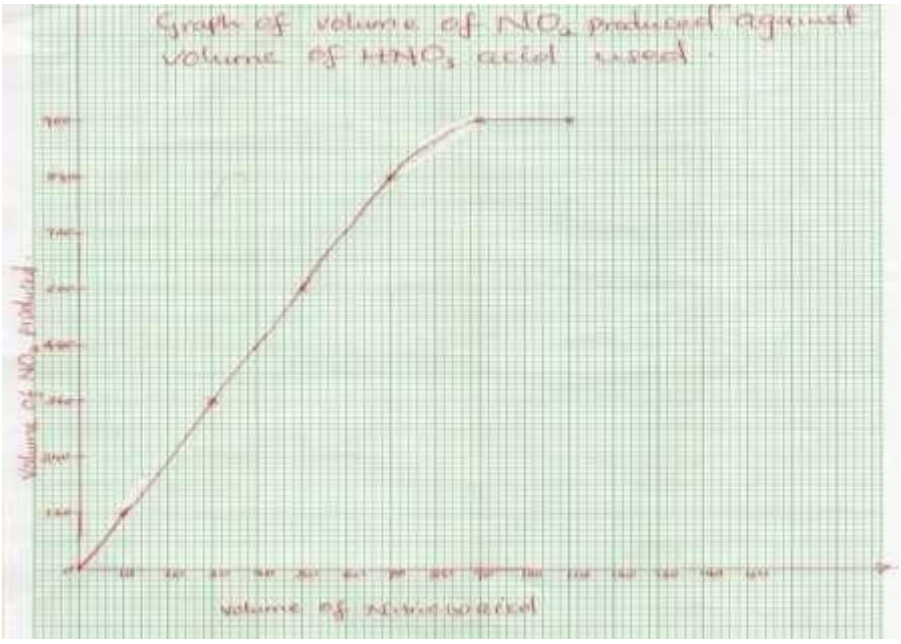
(ii) $4g \xrightarrow{t^1/_2} 2g \xrightarrow{t^1/_2} 1g \xrightarrow{t^1/_2} 0.5g \xrightarrow{t^1/_2} 0.25g$

Mass after fourth $\frac{1}{2}$ life is 0.25g

(iii) (any 2 -2mks)

Nuclear rxn	Chemical rxn
New elements are formed	No new elements are formed
irreversible	Some changes are reversible
Rxn not affected by external factors	Affected by external factors eg temperature
Involves protons and neutrons in the nucleus	Involve electrons in the outermost energy level
Huge amount of heat is produced	There is little amount of energy changes

6. (a) Decrease Kinetic energy of the molecules would decrease. The number of effective collision would decrease.



(b)Graph

(c) (i) 720cm^3 + ½ square of the graph
Value must be read from the graph
(ii) 80cm3 + ½ square of the graph
Value must be read from the graph

(d) (i) Moles of Pb = $\frac{4.14}{207}$ = 0.02

Volume of nitric acid that react with 1 mole of Pb is

$\frac{\text{Value in C(ii) above}}{0.02}$

i.e $\frac{80}{0.02}$ = 4000cm^3 (Penalize ½ mk for wrong or missing units.)

(ii) $\frac{960}{0.02}$ = 48000cm3

(e)(i) Value in d(i) ie $\frac{4000}{}$ = 4

1000

1000

(ii)Value in d(ii) ie $\frac{48000}{24000} = 2$

(f) $Pb(s) + 4HNO_3(aq)$ ……..>$Pb(NO_3)_2(aq) + 2NO_2 + 2H_2O(l)$

(g)Nitric (V) acid decomposes into Nitrogen (IV)Oxide when exposed to light

$4HNO_3(aq)$ …….> $4NO_2(g) + O_2(g) + 2H_2O(l)$

7 a) i) Calamine//Zinc carbonate//$ZnCO_{3(s)}$✓1mk
Zinc blende//Zinc sulphide//ZnS(s)✓1mk

b) i) Carbon (ii) oxide//$Co_{(g)}$✓$^1/_2$mk

Coke✓$^1/_2$mk ii) $ZnO_{(s)}+C_{(s)}$ ⟶ $ZnO_{(s)}+CO_{(g)}$

$Zn_{(g)}+CO_{(g)}$✓1mk ⟶

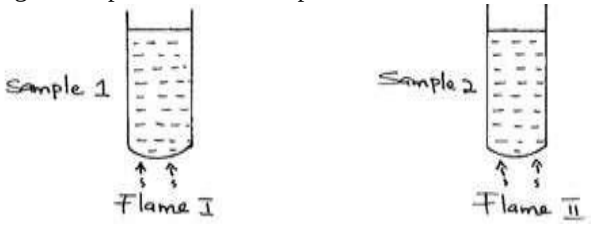
$Zn_{(g)}+CO2_{(g)}$✓1mk ⟶

c) Solid K $ZnO_{(s)}$✓1mk
Liquid L dilute $H_2SO_4(aq)$//dilute sulphuric (IV) acid
Solution M Zinc sulphate//$ZnSO_{4(aq)}$

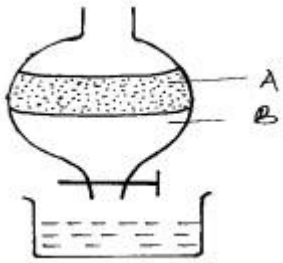
CENTRAL KENYA NATIONAL SCHOOLS JOINT MOCK - 2015
Kenya Certificate of Secondary Education
233/1
CHEMISTRY
PAPER 1
(THEORY)
JULY/AUGUST, 2015

1. (a) A patient was given tablets with prescription 2 x 3 on the envelope. Clearly outline how the patient should take the tablets. (1 mark)

(b) Two samples of equal volumes of water were put in 250cm³ beaker and heated for 10 minutes. Sample 1 registered a higher temperature than sample 2.



State the conditions under which flame I is produced in Bunsen burner. (1 mark) 2. The apparatus below was used to separate a mixture of liquid A and B.



(a) State two properties of the liquids that make it possible to separate them are using such apparatus. (2 marks)

3. Describe how solid samples of salts can be obtained from a mixture of lead (II) chloride, sodium chloride and ammonium chloride. (3 marks)

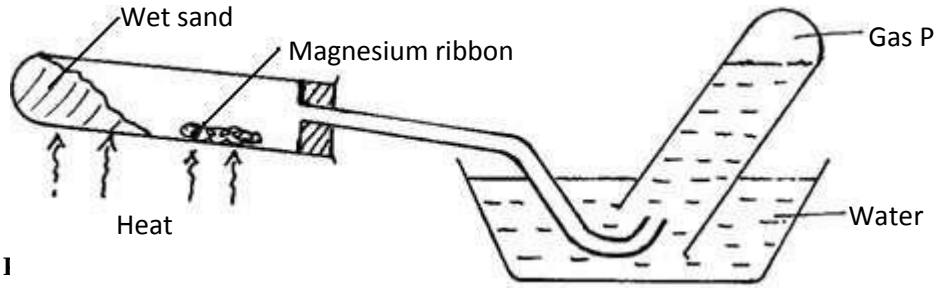
4. An ion of element is represented as:

$$^{24}_{12}X^{2+}$$

(i) Write electronic configuration of ion of . (1 mark)

(ii) To which group does element belong? (1 mark)

5. The set-up below can be used to study the reaction of magnesium and steam.



(a) Name gas **I** (1 mark)

(b) How would you expect copper to behave compared to magnesium in the combustion tube? (1 mark)

(c) Write the equation for the reaction between magnesium and steam. (1 mark)

6. An approximately molar solution of potassium managanate (VII) solution was standardized against precisely 0.1M iron (II) ammonium sulphate [$(NH_4)_3$ Fe $(SO_4)_2$. $6H_2O$] solution. 25.0cm³ of the solution of the iron (II) salt were oxidized by 24.15cm³ of the manganate (VII) solution. The equation of the reaction is:

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

What is the molarity of the potassium manganate (III) solution? (3 marks)

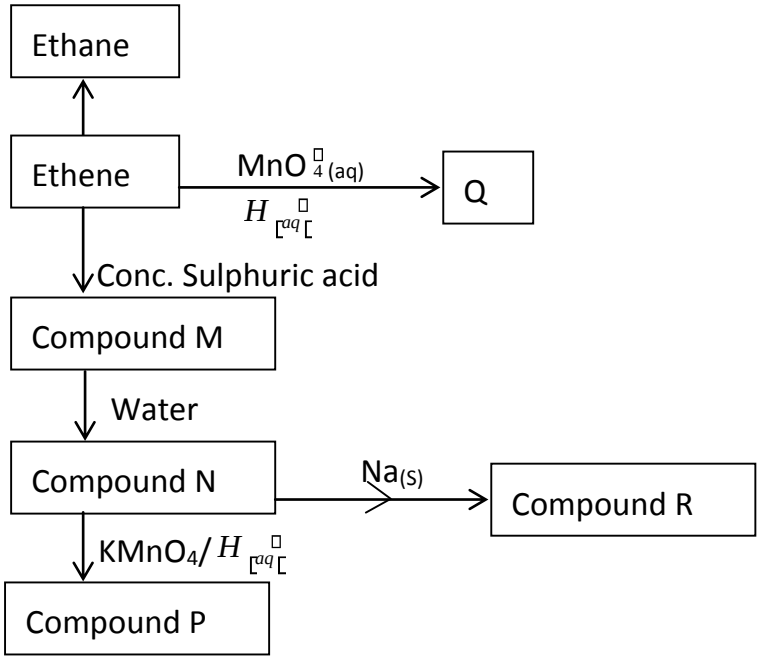
7. During extraction of iron in the blast furnace, state the uses of the following in the furnace.

(a) Molten slag. (1 mark)

(b) Waste gases leaving the furnace. (1 mark)

(c) Limestone. (1 mark)

8. The flow chart below gives some reactions starting with ethane. Study it and answer the questions that follow.



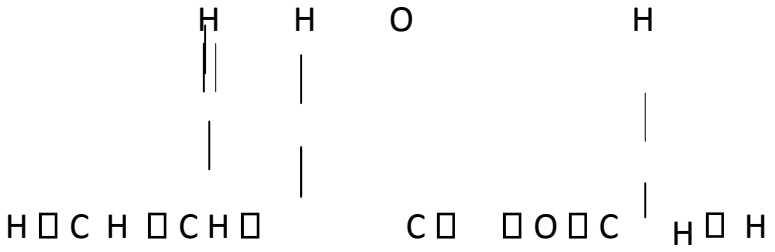
(a) Draw the structure of compounds:

P: (1 mark)

Q: (1 mark)

(b) Write the name of Compound R. (1 mark)

9. Study the organic compound below:



(a) In which homologous series does the compound belong to? (1 mark)

(b) Name and draw the structures of two compounds that can be used to prepare the above compound. (3 marks)

10. (a) State **one** factor that can determine the stability of an atom. (1 mark)

(b) Radioactive polonium – 216 decay as shown below.

$$^{216}_{90}Po \rightarrow ^{208}_{82}Pb + M + n$$

Find the value of M and n. (2 marks)

(c) If after 112 days $\frac{1}{16}$ of polonium remained, calculate the half-life of polonium. (1 mark)

11. A metal oxide has a formula M_2O_3.

(a) Write an equation to show how M form an ion. (1 mark)

(b) Write the formula of the chloride of M. (1 mark)

12. The thermodynamic equation for the formation of ammonia in the Haber process is:

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)} \quad \Delta H = -92kJ\ mol^{-1}$$

(a) State and explain one way in which the yield of ammonia can be increased. (2 marks)

13. A certain carbonate, JCO_3, reacts with dilute hydrochloric acid according to the equation below.

$$JCO_3 + 2HCl_{(aq)} \rightarrow GCl_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$$

If 1gof the carbonate reacts completely with 20cm³ of 1M hydrochloric acid, calculate the relative atomic mass of J. (C = 12, O = 16). (4 marks)

14. (a) What is meant by the term solubility? (1 mark)

(b) The mass of a solution A is 120g. This solution has 8g of salt A dissolved in it. The solubility of this salt is 25g/100g of water at 30°C. 55g of salt A are added to the solution at 30°C. How much of salt A will remain undissolved. (2 marks)

15. (a) Using electrons in the outermost energy level, draw the dot (•) and cross (X) diagrams to represent bonding in.

(i) C_2H_6 (C = 6, H = 1) (1 mark)

(ii) NH4Cl (N = 7, H = l, Cl = 17) (1 mark)

(b) The formula of a complex ion is $[Cu(NH_3)_4]^{2+}$ name the type of bond that is likely to exist between copper and ammonia in the complex. (1 mark)

16. (a) State Hess"s law. (1 mark)

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

$$MgCl_{2(S)} \rightarrow Mg_{(g)} + 2Cl_{(g)}, \quad \Delta H_1 = -2487kJ\ mol^{-1}$$

$$MgCl_{2(S)} + (aq) \rightarrow MgCl_{2(aq)}, \quad \Delta H_2 = -5142kJ\ mol^{-1}$$

$2Cl_{(g)}^{-} + (aq) \rightarrow 2Cl_{(aq)}^{-}$, $\Delta H_3 = -762kJ\ mol^{-1}$

(a) Name the enthalpies H_1 and H_2. (2 marks)

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

$Mg_{2g} + (aq) \rightarrow Mg_{2g}$

17. (a) Give two reasons why carbon (IV) oxide is used as a fire extinguisher. (1 mark)

(b) State the function of tartaric acid in baking powder. (2 marks)

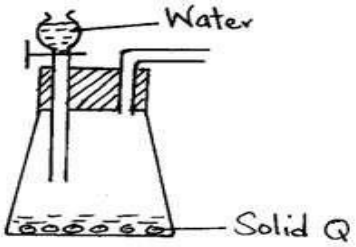
18. When an electric current of 0.5A was passed through a molten chloride of J for 32 minutes and 10 seconds, a mass of 0.44g of J was deposited at the cathode. (IF = 96500C).

(a) Calculate the quantity of electricity used. (1 mark)

(b) Determine the value of $\square$ if the ion of metal J is represented as $J^{\square+}$.
(R.A.M of J = 44). (1 mark)

19. (a) What is meant by the term basicity of an acid. (1 mark)

(b) Describe briefly how potassium sulphate can be prepared using $50cm^3$ of 1M potassium hydroxide. (3 marks) 20. The diagram below represents a set-up used to prepare oxygen gas.



(a) Name substance Q. (1 mark)

(b) Complete the set-up to show how oxygen gas is collected. (1 mark)

(c) Write the equation for the reaction that occur. (1 mark)

21. The table below shows some solutions and their PH values.

Solution	PH value
P	1.5
Q	6.0
R	14.0
S	8.0

Which of the above solution.

(a) Is strongly basic. (1 mark)

(b) Reacts with sodium carbonate more vigorously. (1 mark)

(c) Is ammonia solution. (1 mark)

22. In an experiment, a jar containing sulphur (IV) oxide was inverted over another jar containing hydrogen sulphide gas.

(a) State and explain the observation that was made. (2 marks)

(b) State two conditions necessary for the reaction to take place. (2 marks)

23. Two reagents that can be used to prepare chlorine gas are potassium manganate (VII) and hydrochloric acid.

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

(b) Give the formula of another reagent that can be used instead of potassium manganate (VII). (1 mark)

(c) Using an equation illustrate how chlorine bleach coloured substances. (1 mark)

24. (a) Distinguish between ionization energy and electron affinity. (2 marks)

(b) Explain why fluorine is more reactive than iodine. (2 marks)

25. $280cm^3$ of nitrogen gas diffuse through a porous plug in 70 seconds. How long will it take $400cm^3$ of carbon (IV) oxide gas to diffuse through the same porous plug. (C = 12, O = 16, N = 7). (3 marks)

26. An iron spoon was to be electroplated with silver. Sketch the set-up that could be used. (2 marks) 27. Write the equation for decomposition of:

(a) Sodium nitrate. (1 mark)

(b) Copper (II) nitrate. (1 mark)

CENTRAL KENYA NATIONAL SCHOOLS JOINT MOCK - 2015
Kenya Certificate of Secondary Education
233/2
CHEMISTRY
PAPER 2

(THEORY)

JULY/AUGUST, 2015

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

Element	A	B	C	D	E	F	G	H
Atomic no.	11	12	13	14	15	16	17	16
Boiling point (□C)	890	1110	2470	2360	280	445	-34.7	-186
Formulae of oxide		BO			E_2O_3	FO_2		xxxx
Boiling point of oxide (□C)	1193	3075	2045	1728	563	-72	-91	xxxx

(a) (i) Write the electronic arrangement for ion of element **C** and **F**. (1 mark)

(ii) To which period and group do element **B** belongs. (1 mark)

Period _____

Group _____

(b) Explain the difference in boiling points of element **B** and **F**. (2 marks)

(c) Write the formula of the compound formed between elements **B** and **G**. (1 mark)

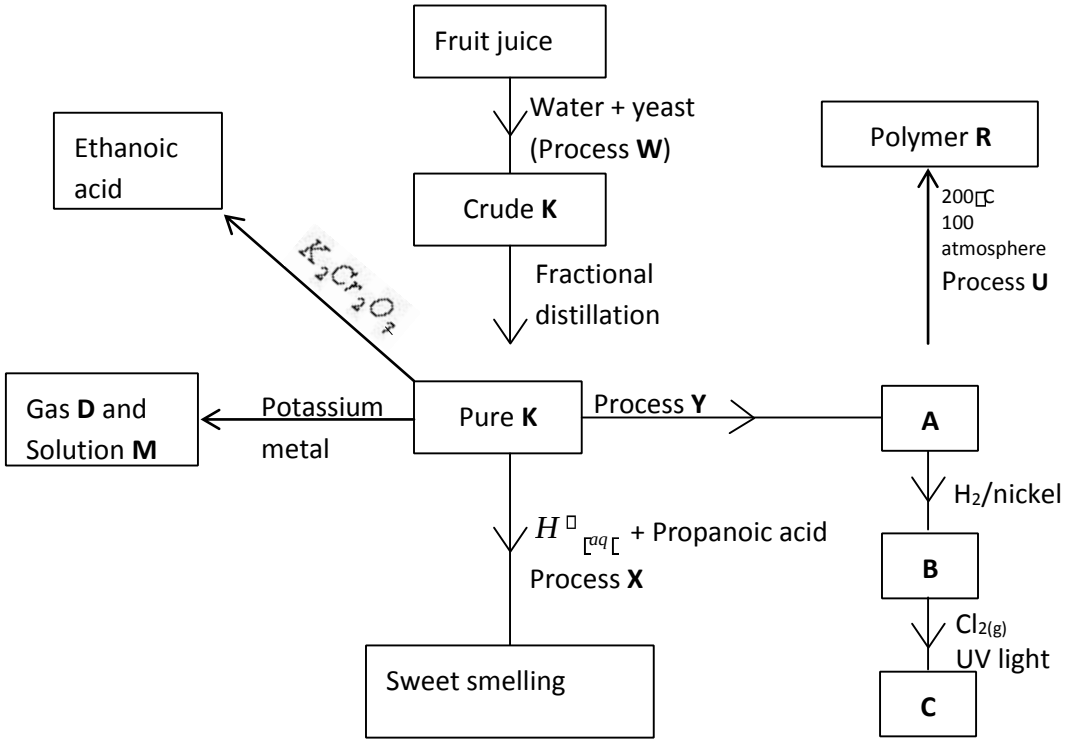
(d) The chloride of **A** has a higher boiling point than that of **C**. Explain. (2 marks)

(e) Complete the table to show the formulae of the oxides. (2 marks)

(f) Select an oxide that reacts with hydrochloric acid and potassium hydroxide. Explain. (1 mark)

(g) Determine the oxidation state of **F** in its oxide. (1 mark)

2. Study the reaction scheme below and answer the question that follows.

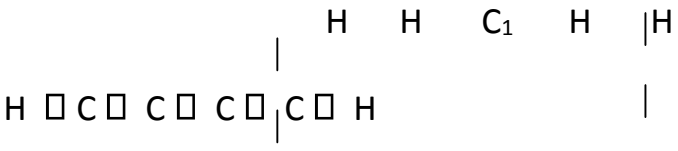


(a) (i) Give the names of the following substances A,B, C,D,K (2½ marks)

(ii) Give the structural formular of substance **M**. (1 mark)

(iii) Name the processes marked as: W, X and Y (3 marks)

(b) The compound below was formed when one mole of a hydrocarbon reacted with one mole of chlorine gas.



H C1 H H H

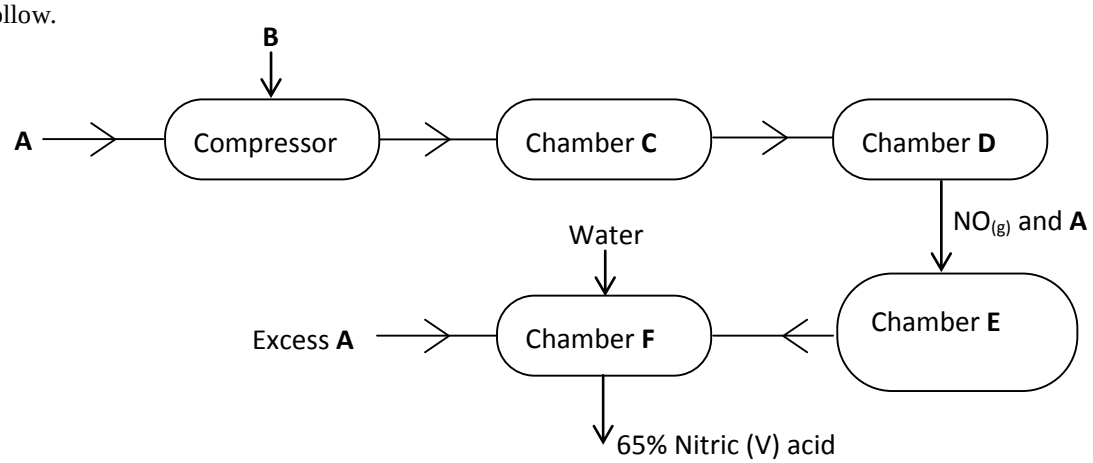
(i) Give the structure of the hydrocarbon. (1 mark)

(ii) Draw and name two isomers of the hydrocarbon. (2 marks)

(c) State **two** uses of ethane. (1 mark)

(d) Draw and name substance **Z**. (1 mark)

3. The flow chart below illustrates the major steps in the manufacture of nitric (V) acid. Study it and answer the questions that follow.



(a) Give reason for purifying the raw materials **A** and **B**. (1 mark)

(b) Name the substances: **A** ,**B** (1 mark)

(c) Name the parts labeled **D**, **E** and **F**. (3 marks)

(d) Write chemical equations for the reactions taking place in:

(i) Chamber **D**. (1 mark)

(ii) Chamber **F**. (1 mark)

(e) Name any other condition required in chamber **D** apart from maintaining temperature at 900□C. (1 mark)

(f) A mixture that comes out is 65% nitric (V) acid and 35% water. How could the concentration of nitric (V) acid be increased? (1 mark)

(g) Give **one** use of nitric (V) acid. (1 mark)

(h) When copper metal is reacted with dilute nitric (V) acid, a brown gas is evolved. Explain. (1 mark)

4. 150g of powdered brass (an alloy of zinc and copper) were added to excess 0.5M hydrochloric acid in a conical flask placed on top of a pan balance. The changes in mass of the flask and its contents with time were recorded in the following table. This experiment was carried out at room temperature.

Time (in seconds)	0	10	20	30	40	50	60
Mass in grams of flask and its contents	255.0	253.0	251.9	251.2	251.1	251.0	251.0

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

(b) State and explain the relationship between the mass of the flask and its contents with time. (2 marks)

(c) What observations was made in the flask at the end of the reaction? (1 mark)

(d) (i) Plot a graph of mass of the flask and its contents against time. (3 mark)

(ii) Using the graph determine rate of the reaction at the 20th second. (2 marks)

(iii) How would the rate in 4d(ii) above be affected if the reaction was carried out using 0.5M hydrochloric acid at 45□C?

Explain. (2 marks)

5. (a) Use the reduction potentials below to answer the questions that follow.

$E^{\square}$ (Volts)

$Q\square_{aq2\square}\square + 2e\square \rightarrow Q\square_{s\square}\square$ −2.38

$B_{(aq)}^{2+} + 2e^- \rightarrow B_{(s)} \quad -1.14$

$D_{(aq)}^{2+} + 2e^- \rightarrow D_{(s)} \quad -0.80$

$Fe_{(aq)}^{3+} + 3e^- \rightarrow Fe_{(s)} \quad -1.66$

$C^{+}_{(aq)} + e^- \rightarrow C_{(s)} \quad -0.76$

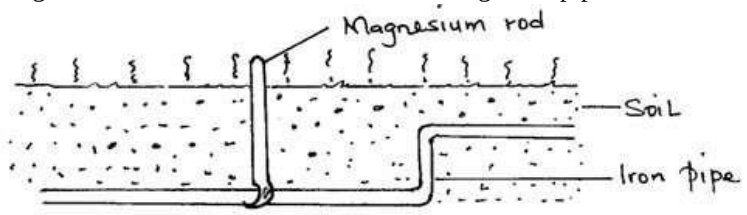
(i) Select the strongest reducing agent. Explain. (1 mark)
(ii) Calculate the e.m.f value of electrochemical cell obtained when elements **B** and **D** are paired together. (1 mark)

(iii) Write an ionic equation for the reaction that occurs when metal **Q** is immersed into a solution containing $C^{+}_{(aq)}$ ions. (1 mark)

(iv) State and explain whether the reaction given below occurs or not.

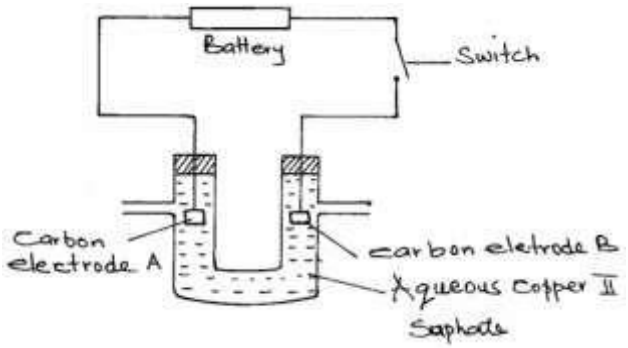
$3B_{(s)} + Fe_{(aq)}^{3+} \rightarrow Fe_{(s)} + 3B^{+}_{(aq)}$ (1 mark)

(b) Magnesium metal was connected to an underground pipe made of iron as shown below:



Explain why it is necessary to carry out the process shown above. (2 marks)

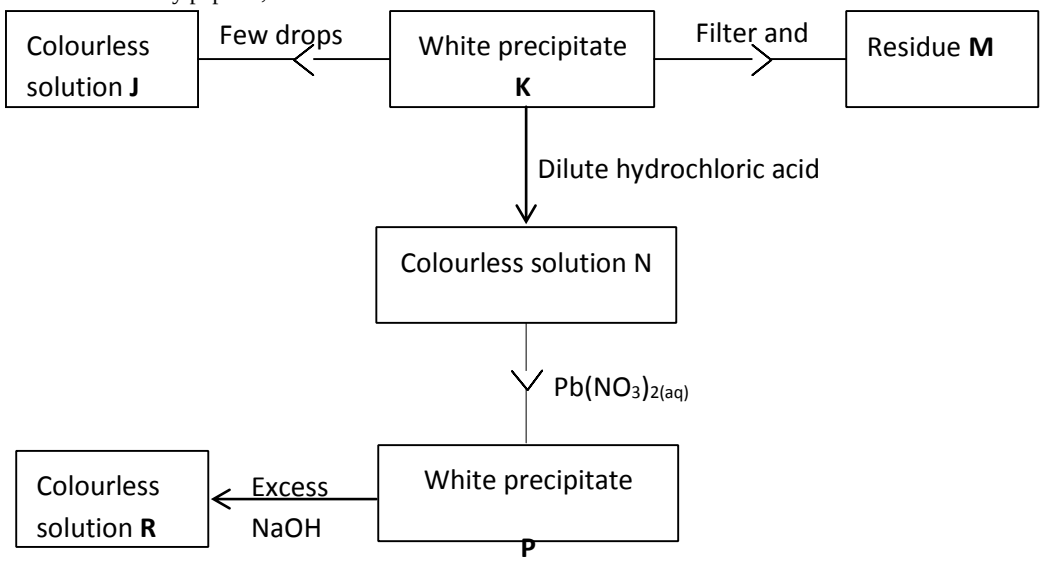
(c) Aqueous copper (II) sulphate was electrolysed using the set up shown below.



(i) When the switch was closed, a gas was produced at electrode **B**.
Which electrode is the anode?
(ii) Write the half equation for the reaction at electrode **B**. (1 mark)
(iii) State and explain the observation that will be made at electrode **A**. (1 mark)
(iv) What happens to the PH of the electrolyte above during electrolysis? Explain. (1 mark)

(d) If carbon electrodes were replaced with copper electrodes in the reaction in (a) above, write the equations of the reactions that would occur at the:
(i) Anode. (1 mark)
(ii) Cathode. (1 mark)
(iii) Name **one** industrial application of the above electrolysis. (1 mark)

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



Residue **M** was yellow when hot and white when cold.

(a) (i) Identify.

I White precipitate **K** _____ (1 mark)

II Solution **N** _____ (1 mark)

III Residue **M** _____ (1 mark)

(ii) Write an ionic equation for the reaction of solution N with $Pb(NO_3)_{2(aq)}$. (1 mark)

(iii) Write observations that would be made when ammonia solution is added drop wise till in excess to the colourless solution **N**. (1 mark)

(b) Ammonia gas bubbled into water forms a solution which conducts electricity whereas the solution formed when it is bubbled through methylbenzene does not. Explain. (2 marks)

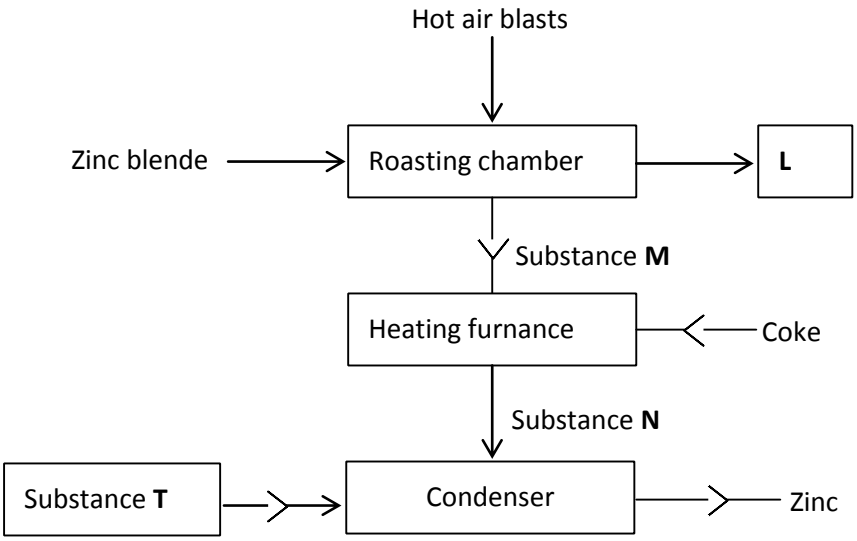
(c) Boilers used for boiling hard water are normally covered with boilers scale after sometime.

(i) What is the chemical name for boilers scales? (1 mark)

(ii) How is the boiler scale removed? (1 mark)

(d) Write the formula of the anion in solution **J**. (1 mark)

7. The flow chart below illustrates extraction of zinc from zinc blende. Study it and answer the questions that follow.



(a) Give an equation for the reaction in the roasting furnace. (1 mark)

(b) Name each of the substances marked **L**, **T**, **N** and **M**. (2 marks) (c)

Why is it necessary to condense substance **N**? (1 mark)

(d) Which other factory can be set up near the zinc extraction plant? Explain. (2 marks)

(e) Give **one** use of zinc metal. (1 mark)

(f) (i) 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 reagent that was in excess. (Zn = 65.0, S = 32.0). (2 marks)

(ii) Calculate the volume of hydrogen sulphide H_2S) gas produced in the reaction above at r.t.p. (Molar gas volume 24dm³). (2 marks)

CENTRAL KENYA NATIONAL SCHOOLS JOINT MOCK - 2015
Kenya Certificate of Secondary Education
233/3
CHEMISTRY
PAPER 3
(PRACTICAL)
JULY/AUGUST, 2015

1. (a) You are provided with solution X and Y solution X is acidified potassium manganate (VII) solution. Solution Y was prepared by dissolving 5.88g of an iron (II) salt $(NH_4)_2 Fe(SO_4)_2 . 6H_2O$ in 250cm³ of solution.You are required to standardize solution X using solution Y.

Procedure:

(i) Fill the burette with solution X.

(ii) Using a pipette and pipette filler, transfer 25.0cm³ of solution Y into a 250cm³ conical flask.

(iii) Titrate solution X against solution Y until a permanent pink colour just appears.

(iv) Record your results in the table below.

(v) Repeat the titration two more times to obtain two other titres and complete table I below

Table I

Titration	1	2	3
Final burette reading (cm³)			
Initial burette reading (cm³)			
Volume of solution X used (cm³)			

(3 marks)

(a) Calculate:

(i) Average volume of solution X used. (1 mark)

(ii) Molarity of solution Y. (2 marks)

(iii) Number of moles of solution Y in the average volume of solution X. (2 marks

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

$$MnO_4^- (aq) + 5Fe^{2+}(aq) + 8H^+(aq) \rightarrow Mn^{2+}(aq) + 5Fe^{3+}(aq) + 4H_2O(l)$$

Calculate:

(i) The number of mole of X in the average volume. (1 mark) (ii)

Concentration of solution Y in mole dm³. (2 marks)

(b) You are provided with:

(i) 0.21M glucose solution V.

(ii) 0.02M potassium manganate (VII) solution W.

(iii) 1.0M acqueous sulphuric (VI) acid.

You are required to determine the rate of reaction between solution W and V at different temperature.

Procedure:

- Place 2cm³ of solution W into a 250ml beakers using 100ml measuring cylinder add 50cm³ of 1.0M sulphuric (VI) acid to the beaker containing solution W.
- Warm the mixture to about 65°C. Stop warming and allow the mixture to cool.
- When the temperature is exactly 60°C add 15cm³ of solution V and start the stopwatch immediately.
- Stir the mixture and measure the time taken for the colour of the mixture to change from purple to colourless.
- Record the time in the table below also record the temperature at which the mixture becomes colourless. Clean the beaker and repeat the procedure at temperature 55°C, 50°C and 45°C instead of 60°C. *I*

(i) Calculate $\frac{1}{t}$ and complete the table below. (2 marks)

Temp. before mixing (°C)	60	55	50	45
Temp. when solution becomes colourless (°C)				
Time in (seconds)				
$\frac{1}{t}$				

(a) Plot a graph of $\frac{1}{t}$ (y-axis) against temperature at the point when the solution becomes colourless. (3 marks)

(b) From your graph:-

(i) Determine the time that the reaction would take if the temperature at which the solution becomes colourless is 42.5°C. (2 marks)

(ii) Describe the slope of your graphs. (1 mark)

2. (a) You are provided with solid B. Carry out the tests below and record your observations and inferences in the space below. Test for any gas produced using blue and red litmus paper.

(i) Place half spatula endful of solid B in a test tube and heat gently then strongly.

Observation	Inference
(3mks)	(1½mks)

(ii) Place a spatula end ful of solid B into a boiling tube, and add about 10cm³ of distilled water. Shake well and filter the residue retain the residue. Divide the filtrate into three portions.

Observation	Inference
(1mk)	(1mk)

(iii) To the 1st portion, add $NaOH_{(aq)}$ drop wise until in excess.

Observation	Inference
(1mk)	(½mk)

(iv) To the second portion add aqueous ammonia drop wise until in excess.

Observation	Inference
(1mk)	(½mk)

(v) To the 3rd portion add 3 drops of $HNO_{3(aq)}$ followed by 2-3, drops of lead (II) nitrate warm gently.

Observation	Inference
(½mk)	(½mk)

(vi) Place the residue obtained in (b) above into a boiling tube and add about 5cm³ of dilute hydrochloric acid and retain the resulting mixture.

Observation	Inference
(1mk)	(1mk)

(vii) To the resulting mixture in (vi) above, add aqueous ammonia dropwise until in excess.

Observation	Inference
(1mk)	(½mk)

You are provided with an organic solid Z. Use it to carry out the following tests.

(i) Heat a spatula end full of solid Z over a flame.

Observation	Inference
(1mk)	(1mk)

(ii) Put the remaining portion of Z in a boiling tube. Add 10cm³ of distilled water. Shake and divide into three portions 2cm³ each.

Observation	Inference
(½mk)	(½mk)

(iii) To portion one add four drops of potassium chromate (VI) warm.

Observation	Inference
(1mk)	(1mk)

(iv) To portion two add small quantity of sodium hydrogen carbonate.

Observation	Inference
(½mk)	(½mk)

(v) To portion three add few drops of universal indicator, determine PH of the solution.

Observation	Inference
(½mk)	(½mk)

3.

CENTRAL KENYA NATIONAL SCHOOLS JOINT MOCK - 2015

233/1 CHEMISTRY PAPER 1 MARKING SCHEME

1. (i) Take 2 tablets after every 8 hours. ✓1

(ii) Produced when the air hole is open. ✓1

2. (a)

- Difference in densities. ✓1
- They are immiscible. ✓1 3.
- Heat to sublime NH_4Cl. ✓½
- Add water ✓½ to dissolve NaCl. ✓½
- Filter ✓½ the residue is $PbCl_2$ ✓½
- Evaporate ✓½ the filtrate (NaCl solution) to obtain NaCl solid.

4. (i) 2.8 ✓1

(ii) Group II ✓1

5. (a) Hydrogen ✓1

(b) Copper would not react with steam. ✓1

Balanced equation ½

(c) $Mg_{(S)} + H_2O_{(g)} \rightarrow MgO_{(S)} + H_{2(g)}$ ✓1 *Correct state symbols* ½

6. M_m = M_{Fe} = 0.1M

V_m = 24.15cm³ V_{Fe} = 25cm³

Mole of Fe^{2+} = 0.1 mol → 1000cm³ ✓½

→ 25

Mole ratio 1: 5✓½ = 0.0025 moles ✓½

$$\frac{0025^{0.}}{5}$$

Moles of MnO_4 = → 0.0005 *moles*✓½

0.005 moles → 24.15cm³

$$\frac{005 \times 1000^{0.}}{24.15}$$

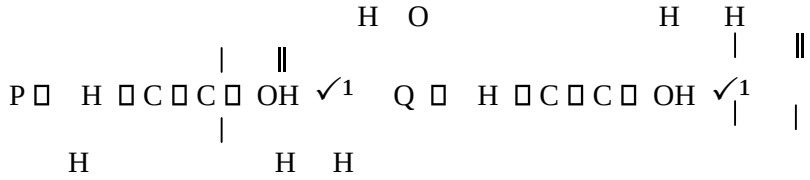
→ 1000cm³ ✓½ → 0.0207*moles*✓½

7. (a) Protect the hot iron from being re-oxidised. ✓1

(b) Used to preheat the air blown in at the base of the furnace. ✓1

(c) - Decomposes to calcium oxide which combines with unwanted silica forming slag. ✓1

8. (a)

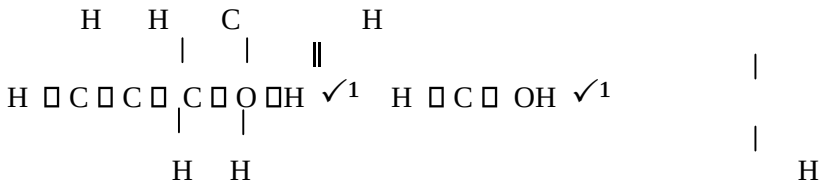


P → H → C → C → OH ✓1 Q → H → C → C → OH ✓1

(b) Sodium ethoxide. ✓1

9. (a) Esters ✓1

(b) Propanoic acid ✓½ Methanol ✓½



H → C → C → C → O → H ✓1 H → C → OH ✓1

10. (a) - Neutron – Proton ratio → ratio ✓1

- Amount of energy released when neutrons collide with protons in the nucleus (Any 1) (b) 216 = 208 + 4m + 0

4m = 216 – 208

4m = 8

$m \rightarrow 8/4 \rightarrow 2$✓1

90 = 82 + 2m + -n

4 = -n

n = 4 ✓1

(c) 1 ½ ¼ ⅛ 1/16

4 half-life"s = 112 days

1 half life = ??

$\frac{1 \times 112}{4}$ ✓½ = 28 days ✓½

11. (a) $M_{(g)} - 3e^- \rightarrow M^{3}_{(g)}$ ✓1

(b) MCl_3 ✓1

12.

- Withdraw of ammonia formed, ✓½ decrease in concentration of $NH_{3(g)}$ favours forward reaction. ✓½
  Use of low temperatures – Reaction is exothermic and decrease in temperature favours forward reaction.
- Addition of hydrogen/nitrogen; increase in concentration of reactants favours forward reaction.

(Any one)

13. Moles of HCl used $\frac{1 \times 20}{1000}$ ✓½

= 0.02 moles ✓½

$CaCO_3$: HCl

1: 2

Moles of $CaCO_3$ used = ½ x 0.02 moles

= 0.01 moles ✓½

0.01 moles → 1g

1 mole → ??

$\frac{1 \times 1}{0.01}$ → 100g ✓½

Ca + 12 + 16 x 3 =100

Ca = 100 – 40

Ca = 40 ✓1

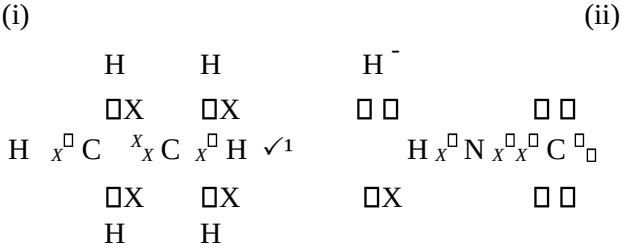
14. 100g of water → 25g

112g of water → $\frac{112 \times 25}{100}$ ✓½ = 28g ✓½

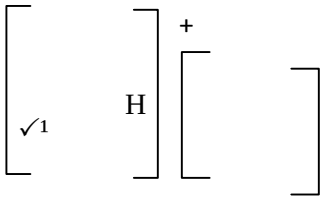
Undissolved salt = (8 + 55) – 28 ✓½

= 35g ✓½

15. (a) (i)



(ii)



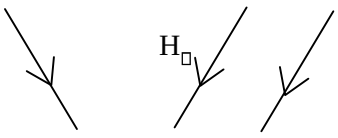
(b) Dative covalent. ✓1

16. (a) Enthalpy change of a reaction is the same regardless of the route followed as long as the reactants and products are the same. ✓1

(b) H_1 – Lattice energy ✓1

H_2 – Hydration energy of $MgCl_2$ ✓1

(c) $MgCl_{2(s)} \rightarrow Mg_{(g)} + 2Cl_{(g)}$



-762 ✓1

$MgCl_{2(aq)}$

$-5142 = -2489 + H_{□} + -762$

$-5142 + 2489 + 769 = H_{□}$

$H_{□} = -189/kJ/mol$ ✓1

17. (a)
- Denser than air ✓½
- Does not support combustion ✓1

(b)
- Reacts with $NaHCO_3$ to produce CO_2 which makes the dough to rise ✓1
- Reacts with Na_2CO_3 formed when $NaHCO_3$ is heated hence neutralizes Na_2CO_3in the dough. ✓1

18. (a) Q = 1t
= 0.5 x 1930 sec
= 965C ✓1

(b) *J*□□/□□ □□*C* □ *J* □s□

44g

965C □ 0.44g

□ 44g

□ $\frac{44 \times 965}{0.44}$ ✓½ = 96500C ✓½

□□ $\frac{96500}{96500}$ □ $\frac{965500}{96500}$ ✓½

□ = 1

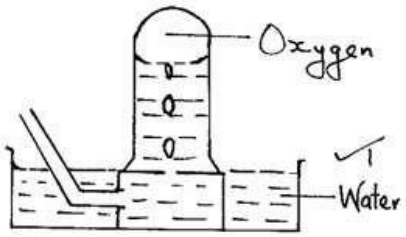
Charge = 1+ ✓½

19. (a) It is the number of replaceable hydrogen atoms in an acid. ✓1

(b)
- Mix/react 50cm³ of 0.5M H_2SO_4 or 25cm³ of 1M H_2SO_4 solution to obtain a neutral solution of K_2SO_4. ✓1
- Heat to evaporate some water. ✓1
- Cool slowly to crystallize the salt. ✓1

20. (a) Sodium peroxide ✓1

(b)



(c) $2Na_2O_{2(S)} + 2H_2O_{(l)} \rightarrow 4NaOH_{(aq)} + O_{2(g)}$

21. (a) R/14.0 ✓1 (b) P/1.5 ✓1
(c) S/8.0 ✓1

22. (a) Yellow solid is formed. ✓1
SO_2 gas is reduced by H_2S to sulphur. ✓1

(b)

(c)
- Jars should be moist. ✓1
- The jar with the denser gas should be placed on top of the jar with the light gas. ✓1

23. (a) $2KMnO_{4(S)} + 16HCl_{(aq)} \rightarrow 2KCl_{(aq)} + 2MnCl_{2(aq)} + 8H_2O_{(l)} + 5Cl_{2(g)}$ ✓1

(b) MnO_2 ✓1

(c) $Cl_{2(g)} + dye + H_2O_{(l)} \rightarrow 2HCl_{(aq)} + (dye - O)$ ✓1 24.
- Ionization energy is the energy required to remove an electron ✓½ (S) from a gaseous atom. ✓½
- Electron affinity is the energy required to add an electron ✓½ to a gaseous atom. ✓½

25. $RN_2 \propto \frac{280}{70}$ ✓½ 4cm³/sec; $RCO_2 \propto \frac{400}{t}$ ✓½

$\frac{4}{\frac{400}{t}} \propto \sqrt{\frac{44}{28}}$ ✓½

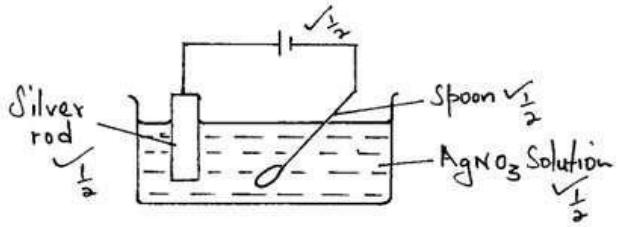
$4 \propto \frac{t}{400} \propto \sqrt{\frac{44}{28}}$

$\frac{t}{100} \propto \sqrt{\frac{44}{28}}$ ✓½

$t \propto \sqrt{\frac{44}{28}} \propto 100$ ✓½

= 125.36 sec ✓½

26.

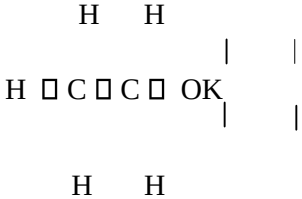


27. (a) $2NaNO_{3(S)} \rightarrow 2NaNO_{2(S)} + O_{2(g)}$ (b) $2Cu(NO_3)_{2(S)} \rightarrow 2CuO_{(S)} + 4NO_{2(g)} + O_{2(g)}$

CENTRAL KENYA NATIONAL SCHOOLS JOINT MOCK - 2015

233/2 CHEMISTRY PAPER 2 MARKING SCHEME

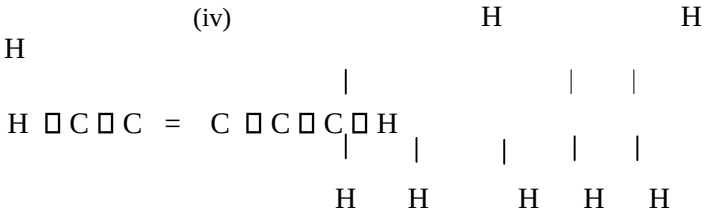
1. (a) (i) C = 2.8 ✓½
   F = 2.8.8 ✓½
   (ii) Period 3 ✓½
   Group II ✓½
   (b) B has a giant metallic structure ✓½ with strong metallic bonds ✓½ hence B.P very high compared to F which has molecular structure ✓½ with weak van der waal forces ✓½ between the molecules hence low B.P.
   (c) BG_2 ✓¹
   (d) Chloride of A is ionic has strong ionic ✓½ bonds hence high B.P.While C has molecular ✓½ structure with weak van der waal forces ✓½ hence low B.P.
   (e) A_2O ✓½ C_2O_3 ✓½ DO_2 ✓½ G_2O_7 ✓½/G_2O
   (f) C_2O_3 ✓½ its amphoteric ✓½
   (g) +4 ✓¹
2. (a) (i) A – Ethene
   B – Ethane
   C – 1, 2 – dichloroethane
   D – Hydrogen
   K – Ethanol
   (ii)

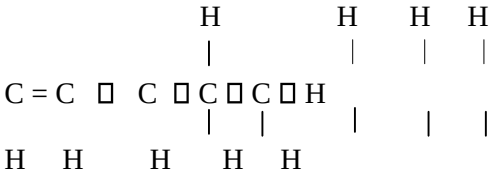


(iii) W – Fermentation

n X –
Esterification
Y – Dehydration

(iv)

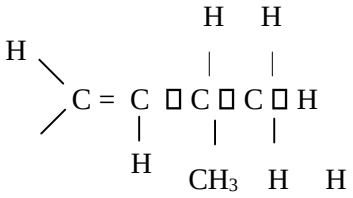




(c) Manufacture of polythene.
Manufacture of ethanol.

(d) $CH_3CH_2C(=O)OCH_2CH_3$ Ethyl propanoate

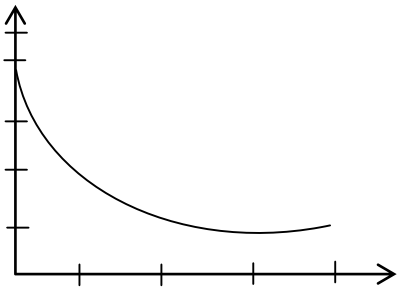
3. (a) To avoid poisoning the catalyst ✓1
(b) A: Air ✓½
B: Ammonia gas ✓½
(c) D: Catalytic chamber ✓1
E: Cooling chamber ✓1
F: Absorption tower ✓1
(d) (i) $4NH_3 + 5O_{2(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(g)}$ ✓1
(ii) $4NO_{2(g)} + O2_{(g)} + 2H_2O_{(l)} \rightarrow 4HNO_{3(aq)}$ ✓1
(e) Pressure: 9atm ✓1/Catalyst : Platinum-rhodium ✓1
(f) Fractional distillation. ✓1
(g) Manufacture of nitrogenous fertilizers ✓1/AOC.



(h) There is production of $NO_{(g)}$ which is oxidized by air to $NO_{2(g)}$ which is brown. ✓1

4. (a) $Zn_{(S)} + 2HCl_{(aq)} \rightarrow ZnCl_{2(aq)} + H_{2(g)}$

(b) It decreases with time until it becomes constant.
(c) Colourless solution/Brown solid.
(d) (i) Graph paper provided



Time

Plotting – (1mk)
Scale - (1mk)
Curve - (1mk)

$$\frac{\Delta y}{\Delta} \quad \frac{252.8 - 251}{0.09 - 0.01}$$

(ii) $\Delta\Delta$ $30 - 20$

(iii) Rate would increase.
Increase in temperature increases kinetic energy and lowers activation energy.

5. (a) (i) Q;✓½ Has the highest negative ✓½ $E^{\ominus}$ hence highest tendency to lose electrons.

(ii) $B_{(s)} \rightarrow B_{(aq)}^{2+} + 2e^{-}$ +1.14

$D^{2+} + 2e \rightarrow D_{(aq)}$ +0.80 ✓½

e.m.f = +1.94V ✓½

(or)

e.m.f = E_{Reduced} - E_{Oxidised} = +0.80 - -1.14 ✓½

= +1.94V ✓½

(iii) $Q_{(s)} \rightarrow 2C_{(aq)} \rightarrow Q_{(aq)} \rightarrow 2C_{(s)}$ ✓1

(iv) $3B \rightarrow 3B^{+} + 3e$ +1.14V

$Fe^{3+} + 3e^{-} \rightarrow Fe$ -1.66V

emf = -0.52V

→ Cannot occur because emf is negative.

(or) Fe is a stronger reducing agent hence B cannot reduce Fe^{3+}.

(b) To prevent rusting ✓1/corroding of iron pipe; magnesium is more reactive than iron, so it is attacked as a sacrificial metal. ✓1 (2 marks)

(c) (i) B ✓1

(ii) $4OH_{(aq)} \rightarrow 2H_2O_{(l)} \rightarrow O_{2(g)} \rightarrow 4e$ ✓1

(iii) A brown ✓1 deposit, Cu^{2+} migrate to cathode and are reduced to copper metal.

(iv) Becomes acidic/PH reduces because hydrogen ion concentration increases as OH^{-} ions are discharged.

(d) Anode dissolves: $Cu_{(s)} \rightarrow Cu_{(aq)}^{2+} \rightarrow 2e$ ✓1

Cathode: $Cu_{(aq)} \rightarrow 2e \rightarrow Cu_{(S)}$ ✓1

(v) Purification of copper. ✓1

6. (a) (i) I: $Zn(OH)_2$ ✓1

II: $ZnCl_2$ ✓1

III: ZnO ✓1

(ii) $Pb_{(aq)} \rightarrow 2Cl_{(aq)} \rightarrow PbCl_{2\,(S)}$ ✓1

(iii) White precipitate soluble in excess. ✓1

(b) Ammonia gas is polar and ionizes ✓1 in water which is polar. While it does not ionize in methylbenzene which is non polar.

(c) (i) Calcium carbonate/magnesium carbonate.

(ii) Passing a solution of dilute hydrochloric acid or nitric (V) acid in the boiler. (1mk) (d) $\rightarrow Zn(OH)_4^{2-}$

7. (a) $2ZnS_{(S)} + 3O_{2(g)} \rightarrow 2ZnO_{(S)} + 2SO_{2(g)}$ ✓1

(b) L: Sulphur (IV) oxide M: Zinc oxide

T: Lead Z: Zinc/Zinc vapour (Each ½mk)

(c) It produced in vapour state/form. ✓1

(d) Sulphuric (VI) acid manufacturing plant. ✓1

To utilize the sulphur (IV) oxide by product. ✓1

(e)

- Galvanization of iron sheets to prevent corrosion/rusting.
- Making brass, an alloy of copper and zinc.
- Making outer casing of dry batteries.
- Zinc cyanide is used for refining silver and gold. (any 1mk)

(f) (i) R.F.M ZnS = 97 Sulphuric acid H_2SO_4

$Moles \frac{2.91}{97} \rightarrow 0.03\ moles$ ✓½ 0.2 mole = 1000cm³

? = 100cm³

$\frac{100 \times 0.2}{1000} \rightarrow 0.02$ mole ✓½

Zinc sulphide ✓1 is excess by 0.01 mole.

(ii) 0.02 mole x 24000 ✓1 = 480cm³ ✓1

CENTRAL KENYA NATIONAL SCHOOLS JOINT MOCK - 2015

233/3 CHEMISTRY PAPER 3 MARKING SCHEME

Question 1

Table 1

1. (i) Complete table. (5mks)

Conditions

- 3 titrations (1mk)
- 2 titrations (½mk)
- 1 titration (0mk) Penalties
- Wrong arithmetic/subtraction
- Inverted table
- Burette reading beyond 50cm³ or below 1cm³.

Penalize ½mk for each penalty upto a max of. (½mk)

(ii) Decimals.

Conditions

- Accept 1 or 2d.p used consistently.
- Where 2d.p used 2nd d.p must be 0.5 or 5 Penalize fully if any conditions are not met (iii) Accuracy (1mk)

Compare candidates titre with school value. Conditions.

- If any is within ± 0.1cm³ SV (½mk)
- If none within ± 0.2cm³ SV (0mk)

(iv) Averaging

- Values averaged must be shown and be consistent within ± 0.2cm³ of each other.

Conditions

- If 3 consistent averaged. (1mk)
- If 3 titration done and two possible averaged (1mk)
- If only two titrations done, consistent and averaged (1mk)
- If only two titrations done, inconsistent yet averaged (1mk)
- If 3 titrations done, all are possible yet only two averaged (0mk)
- If 3 inconsistent values averaged. (0mk)

Final/answer

Compare final answer with SV (School value)

- If within ± 0.1cm³ of SV (1mk) If within ± 0.2cm³ of SV (1mk) If outside ± 0.2cm³ of SV (0mk) $\frac{88 \times 45.}{392}$

(a) (ii) ✓1 = 0.05M ✓1 (2mks)

(iii) $Moles = \frac{25}{1000} \times 0.06$ ✓1

= 0.0015 ✓1 (2mks)

(b) (i) Mole ratio = y: 1

= 5: 1

Moles of $A = \frac{1}{5} \times 0.0015$ ✓½

= 0.0003 ✓½ (1mk)

(ii) Concentration in mole dm^{-3}

$$\frac{1000 \times moles\ in\ b(i)}{Answer\ in\ a(i)} \times$$ ✓1

= Correct answer ✓1 (2mks)

Question 2

- Complete table (1mk)
- Trend in temperature (1mk)
- Trend in time (1mk)

Accuracy: Time (1mk)
Temperature (1mk)

1
Calculation of (2mks)
Time

———

Temp. before mixing (□C)	60.0	55.0	50.0	45.0
Temp. when solution become colourless (□C)	52.0	48.0	44.0	39.0
Time (sec)	25	35	48	70
1 (S $^{-1}$) *t*	4.000 x 10^{-2}	2.8571 x 10^{-2}	2.0853 x 10^{-2}	1.4285 x 10^{-2}

4 values – 2mks 3 values – 1mk 2 values – 0mk
Values of time should be whole number
Values of temperature with one decimals – The decimal should be 0 or 5
(Should decrease; if not) (0mk)
(Should increase; if not) (0mk)
(Must be within □ 5 sec of SV)
(Must be within □ 2□C of SV)
(Must have 4d.p 4 □ Correct values – (1mk) 3 values – (½mk) 2 values – (0mk)

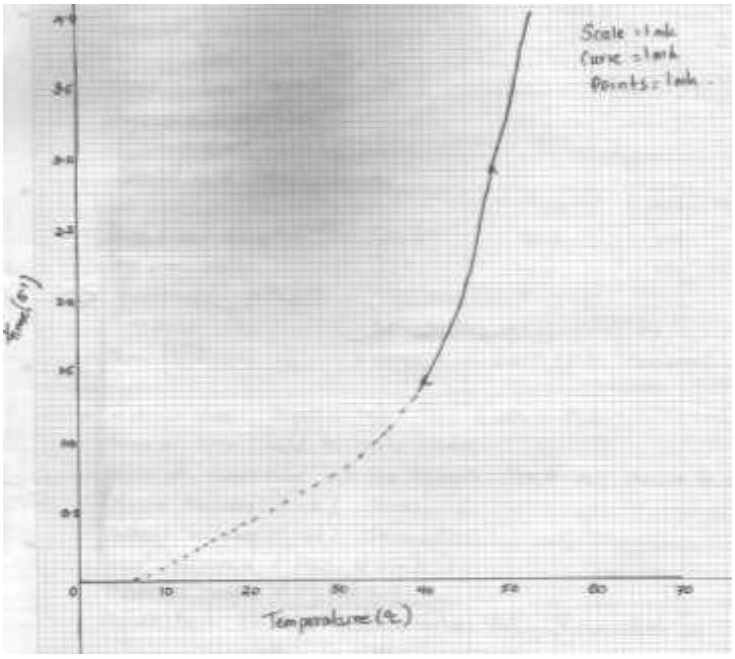
1 □^{2} *S*□^{1}

(b) □ 2.25 □10

$\overline{Time}$

$Time \square \frac{1}{25} \square 10^{2} Sec$

2.
Time = 44 secs. ✓^{1}
(Shown on the graph – (1mk) not shown (0mk) Total marks –
(2mks) (c) The rate of reaction increases with increase in temperature.



2.

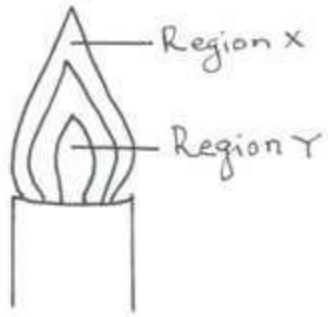
(a)	(i)	OBSERVATION	INFERENCES
		Blue turns red ✓½ Red remains red ✓½ Yellow residue when hot ✓½ White when cold ✓½ Colourless liquid on cooler ✓½ Parts of test tube ✓½	- Acidic gas ✓½ - ZnO ✓½ - Hydrated salt ✓½
	(ii)	- Colourless filtrate ✓½ - White residue ✓½	- Soluble✓½/Insoluble salt ✓½
	(iii)	White ppt soluble in excess ✓1	Al^{3+}, Pb^{2+}, Zn^{2+} present ✓1
	(iv)	White ppt soluble in excess ✓1	Zn^{2+} present ✓½
	(v)	White ppt formed ✓½ dissolves on warming ✓½	Cl^- present ✓½
	(vi)	Bubbles produced ✓½	CO^{2-}_3 present ✓½
	(vii)	White ppt soluble in excess ✓1	Zn^{2+} present ✓½

3.

(i)	OBSERVATION	INFERENCES
	Burns with aluminous sooty flame ✓1	- C □ C - ✓½ or – C = C - ✓½ Present Reject alkyne/alkenes in words
(ii)	Partially soluble ✓½	Organic substance with a high molecular mass ✓½
(iii)	$K_2Cr_2O_7$/H+ turns from orange to green ✓1	- C □ C - ✓½ , – C = C - ✓½ Present
(iv)	Effervescence occurs ✓½	RCOOH present Reject H^+/H_3O^+ ✓½
(v)	PH = 4.0 ✓½	Weakly acidic ✓½ RCOOH present Reject H^+/H_3O^+

KAHURO/KIHARU DISTRICT JOINT EXAMINATION - 2015
Kenya Certificate of Secondary Education
233/1
CHEMISTRY
PAPER 1
(THEORY)
JULY/AUGUST, 2015

1. (a) The diagram below shows a non-luminous flame. Use it to answer the questions that follow:



Two wooden splints were placed across regions **X** and **Y** respectively. Draw labelled diagrams to show the effects observed on the wooden splint placed across each region. (2 marks)

(i) Region **X**.

(ii) Region **Y**.

(b) It is advisable to leave your flame in the luminous state when not in use. Give a reason why. (1 mark) 2. Explain the change in mass expected when each of the following substances is heated in an open crucible.

(a) Copper metal. (1 mark) (b) Copper (II) nitrate. (2 marks)

3. The table below shows PH values of solutions **A**, **B**, **C** and **D**.

Solution	PH
A	3.0
B	13.0
C	8.5
D	7.0

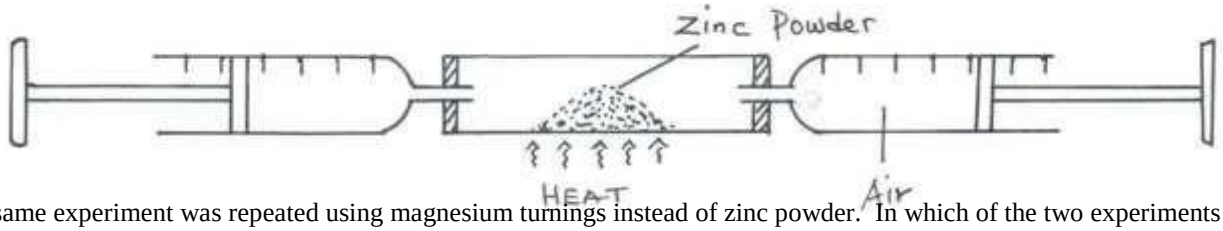
(a) Identify a solution which is

(i) Strongly acidic. _____ (½ mark)

(ii) Strongly basic _____ (½ mark)

(b) Which to solutions would react with lead (II) oxide? Explain. (2 marks)

4. In an experiment a certain volume of air was repeatedly passed between two syringes over heated zinc powder as shown below.



The same experiment was repeated using magnesium turnings instead of zinc powder. In which of the two experiments was the overall change in volume greater? Explain. (3 marks)

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

A			D	E			H	I
B	C		M		F	G		J

(a) What is the name given to the chemical family of element **C**? (1 mark)

(b) Would element **B** react with **J**? Explain. (1 mark)

(c) Compare the melting points of **B** and **M**. (1 mark)

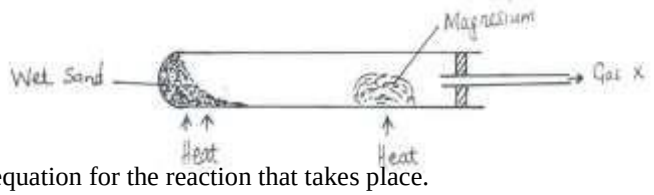
6. The atomic numbers of nitrogen, oxygen and sodium are 7, 8 and 11 respectively.

(a) Write the electron arrangements of their ions, N^{3-}, O^{2-} and Na^{+}. (1 mark)

(b) Arrange the 3 ions in increasing order of size. Give a reason for your answer. (2 marks)

7. The melting point of phosphorous (III) chloride is -91□C while that of magnesium chloride is +715□C. In terms of structure and bonding explain the difference. (3 marks)

8. The diagram below illustrates how lithium would react with steam. Study it then answer the questions that follow.

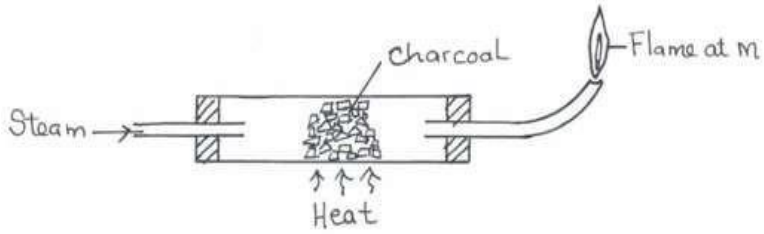


(a) Write the equation for the reaction that takes place.

(1 mark)

(b) Explain why this experiment cannot be carried out with potassium in the same way as shown. (1 mark)

9. Explain why this experiment cannot be carried out with potassium in the same way as shown. (2 marks)
10. Calculate the volume of carbon (IV) oxide that would be produced if 15g of calcium carbonate reacted with 100cm³ of 2.0M hydrochloric acid (C = 12.0, O = 16.0, Ca = 40.0) molar gas volume = 24000cm³. (3 marks)
11. (a) Study the diagram below hence answer the questions that follow.



(i) Explain why it is necessary to have the flame at **M**. (1 mark)

(ii) Write down the equation for the reaction inside the apparatus. (1 mark)

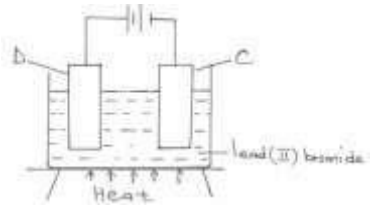
(b) Explain potassium hydroxide is not a suitable reagent for testing carbon (IV) oxide. (1 mark)

12. The table below contains information regarding a species of helium.

Species	Number of electrons	Number of neutrons
$_{2}^{3}He^{2}$		

Complete the table by indicating the numbers of electrons and neutrons. (2 marks)

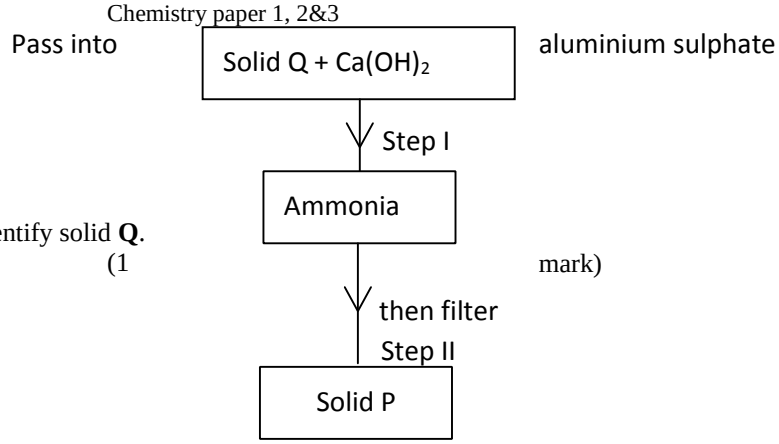
13. (a) The diagram below represents a set-up of apparatus used to investigate the effect of electric current on lead (II) bromide.



Describe what is observed at electrode C. (1 mark)

(b) A current of 2.5A was passed through a cell containing N^{2+} ions for 25 minutes. The mass of the cathode increased by 0.36g. Determine the R.A.M of N. ($F = 9.65 \times 10^{4} Cmol^{-1}$). (2 marks)

14. When aluminum chloride is dissolved in water, the resulting solution has a PH of 3. Explain. (3 marks)
15. Study the scheme below hence answer the questions that follow.



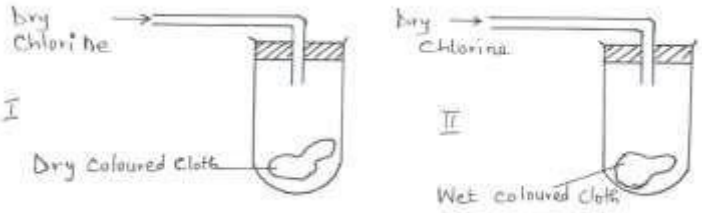
(a) Identify solid **Q**. (1 mark)

(b) Write an ionic equation for the reaction in Step **II**. (1 mark)

(c) State the condition necessary for Step **I**. (1 mark)

16. When sulphur is heated in a boiling tube in the absence of air, the yellow crystals melt into a golden yellow mobile liquid at 113□C. The liquid turns into a dark brown viscous mass at 180□C. At 400□C the brown liquid becomes less viscous and flows easily. Explain these observations. (3 marks)

17. Study the diagrams below.



(a) State the observations made at I and II (1 mark)

(b) Write the equation to show the reactions at II if dry sulphur (IV) oxide was used in place of dry chlorine. (2 marks)

18. In an experiment soap solution was used against 3 separate samples of water. Each sample was later boiled and soap added. Each water sample was 1000cm³. The results are tabulated below.

Volume of soap used to form lather	Sample		
	I	II	III
Before boiling (cm³)	27	3	10.6
After boiling (cm³)	27	3	3

(a) Which sample was likely to be soft water? Explain. (2 marks)

(b) State the cause of change in volume of soap used to form lather in sample (1 mark)

III.

19. Study the cycle below hence answer the questions that follow.

Fe(s) $\square Cl_2$ $\square H_1$ $FeCl_2$

Cl_2 $\square \frac{3}{2} Cl_2$ $\square \frac{1}{2}$

$\square H_3$

2

(a) What is $\square H_3$? $Fe\,Cl_3$ (1 mark)

(b) Show the relationship connecting $\square H_1$, $\square H_2$ and $\square H_3$ (1 mark)

□H

20. When bromine gas reacts with aqueous sodium hydroxide an equilibrium is established as shown below.

$$Br_{2(aq)} + 2OH^{-}_{(aq)} \rightleftharpoons Br^{-}_{(aq)} + OBr^{-}_{(aq)} + H_2O_{(l)}$$

(Brown) (Colourless)

What observation would be made if a few drops of dilute sulphuric (VI) were added to the equilibrium mixture? Explain. (2 marks)

21. (a) Aqueous sodium sulphate was electrolysed using platinum. Name the products at each electrode. (1 mark)

I Cathode

IIAnode

(b) Explain why it is not advisable to use potassium chloride as salt bridge in the cell shown below.

$$Pb_{(S)} / Pb^{2+}_{(aq)} \; // \; Cu^{2+}_{(aq)} / Cu_{(S)} \quad E = +0.47V$$ (1 mark)

22. A compound has empirical formula C_3H_6O and relative formula mass of 116. Determine it"s molecular formula. (C = 12, H = 1, O = 16). (2 marks)

23. (a) State the law of combining volumes of gases. (1 mark)

(b) What volume of methane would remain if a burner containing 40cm³ of methane burns in 40cm³ of enclosed air (assuming that oxygen is 20% of air)? (2 marks)

24. The molecular formula of compound T is C_3H_8O. T reacts with acidified potassium manganate (VII) to form another compound U whose formula $C_3H_6O_2$. T also reacts with sodium metal to produce hydrogen gas and T is neutral to litmus.

(a) Suggest the homologous series to which T belongs. (1 mark)

(b) Name the type of reaction leading to the formation of U in the reaction described above. (1 mark)

(c) Write the structural formula of U. (1 mark)

---

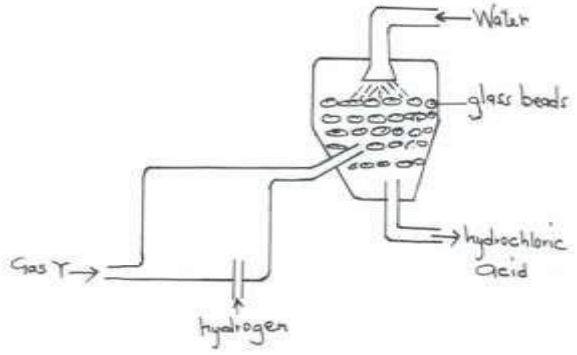
25. Potassium has two isotopes $^{39}_{19}K$ and radioactive $^{40}_{19}K$.

(a) State how the two isotopes differ. (1 mark)

(b) The half-life of $^{40}_{19}K$ is 1.3 x 10^9 years. Determine how long it would take for 4g of the isotope to decay to 1g. (1 mark)

(c) $^{39}_{19}K$ undergoes beta decay to form an isotope of calcium. Write the equation for this decay. (1 mark)

26. The diagram below represents a section of the hydrochloric acid manufacturing plant.



(a) Name **Y**. (1 mark)

(b) State the role played by glass beads. (1 mark)

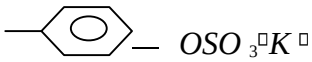
(c) Chlorine reacts with hydrogen sulphide gas according the equation shown below:

$$H_2S_{(g)} + Cl_{2(g)} \rightarrow 2HCl_{(g)} + S_{(S)}$$

From the equation identify the oxidizing agent. (1 mark)

27. The formulae below belong to 2 cleansing agents.

I $RCOO^- K^+$

II R  OSO_3K

(a) Which of the two cleaning agents would lather readily with hard water? (1 mark)

(b) State **one** disadvantage of the continued use of cleansing agent II. (1 mark)

(c) Write the formula of the compound formed when cleansing agent I is used with water containing Mg^{2+} ions. (1 mark)

28. Starting with solid lead (II) carbonate, briefly describe how a sample of lead (II) chloride can be prepared. (3 marks)

29. (a) State Boyle"s law. (1 mark)

(b) 60cm³ of oxygen gas diffused through a porous hole in 50 seconds. How long will it take 80cm³ of sulphur (IV) oxide to diffuse through the same hole under the same conditions (S = 32, O = 16). (2 marks)

KAHURO/KIHARU DISTRICT JOINT EXAMINATION - 2015
Kenya Certificate of Secondary Education
233/2
CHEMISTRY
PAPER 2
(THEORY)

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

Element	Atomic number	M.P(°C)
A	11	97.8
B	13	660
C	14	1410
D	17	-101
E	19	63.7

(a) Write the electronic arrangement for the ions formed by the elements **D** and **E**. (½ mark)

(b) Select and element which is:

(i) A poor conductor of electricity. (½ mark)

(ii) The most reactive non-metal. (½ mark)

(c) To which period of the periodic table does element **E** belongs? (½ mark)

(d) Element **E** losses its outermost electron more readily than **A**. Explain. (2 marks)

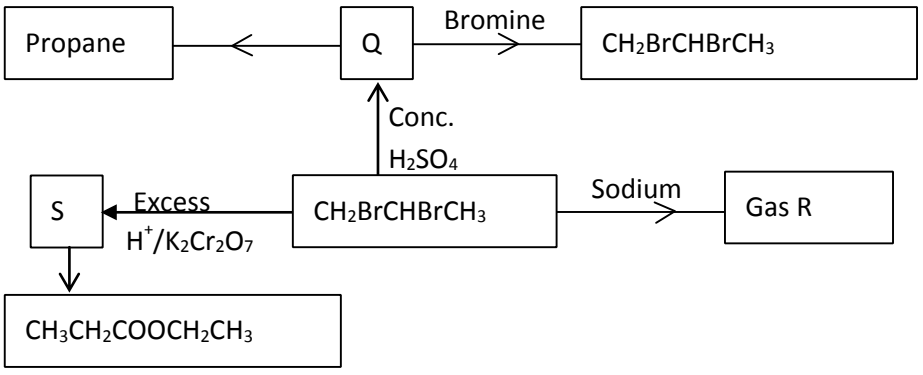
(e) Use dot (.) and crosses (X) to represent the valence electrons and show the bonding in the compound formed between element **C** and **D**. (2 marks)

(f) Explain why the melting point of element **B** is higher than that of element **A**. (2 marks)

(g) Write an equation for the reaction that takes place between element **A** and water. (1 mark)

(h) Describe how a solid mixture of the sulphate of element E and lead (II) sulphate can be separated into solid samples. (3 marks)

2. The scheme below shows several reactions starting with propanol. Study the scheme and answer the questions which follow.



(a) Name gas **R** (½ mark)

(b) Name and draw the structural formula of compound **Q**. (1 mark)

(c) What conditions and reagents are necessary to convert **S** to $CH_3CH_2COOCH_2CH_3$ (2 marks)

Reagents

Conditions

(d) Write an equation for the reaction that takes place when equal volumes of chlorine gas react with propane. (1 mark) (e) The table below shows some properties of organic compounds **U**, **V** and **W**. Use the information to answer the questions that follow.

	W	V	U
Reaction with liquid bromine	Decolourise bromine very fast	No reaction	Decolourises bromine liquid slowly
Combustion	Burns with yellow smoky flame	Burns with a blue flame leaving no residue	Burns with a yellow sooty flame
Reaction with conc. H_2SO_4	No reaction	It is dehydrated to form compound U	Reacts to form V

To which homologous series do the compounds belong? (3 marks)

U _____

V _____

W _____

(f) $CH_2 = CH - CH_3$ when heated under high temperatures and pressures forms a solid with large molecular mass.

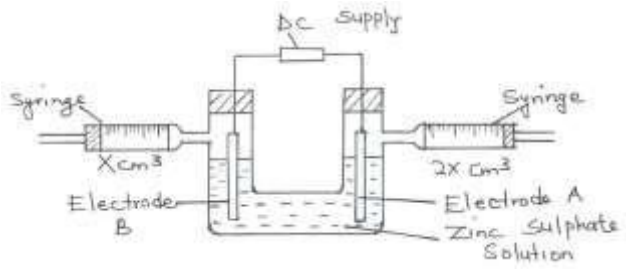
(i) Write the equation for the reaction which involves the formation of the solid. (1 mark)

(ii) Name the solid and give one use of the solid

Name _____ (½ mark)

Use _____ (1 mark) (g) State **two** uses of cracking. (2 marks)

3. (a) An aqueous solution of zinc sulphate is electrolysed using platinum electrodes as shown in the set up below.



(i) Write a half equation for the reaction taking place at electrode **A**. (1 mark)

(ii) Identify electrode **B**. (1 mark)

(iii) Explain observation at electrode **B** if copper plate was used instead of platinum electrode. (2 marks)

(b) 0.22g of metal Q is deposited by electrolysis when a current of 0.06A flows for 99 minutes (RAM of Q = 184, IF = 96500C)

(i) Find the number of moles of Q deposited. (1 mark)

(ii) Determine the value of n in the metallic ion Q^{n+}. (3 marks)

(c) An iron spoon is to be electroplated with silver. Draw a labelled diagram to represent the set-up that could be used to carry out this process. (2 marks)

(d) The following are half-cell equations for some elements. The letters do not represent actual symbols. Use the information to answer the questions that follow.

Half cell	$E^{\ominus}$, V
$M_{(aq)}^{2+} + 2e \rightleftharpoons M_{(s)}$	+0.34
$L_{(aq)}^{2+} + 2e \rightleftharpoons L_{(s)}$	+0.84
$K_{(aq)}^{2+} + 2e \rightleftharpoons K_{(s)}$	-0.13
$J_{(aq)}^{2+} + 2e \rightleftharpoons J_{(s)}$	-0.76

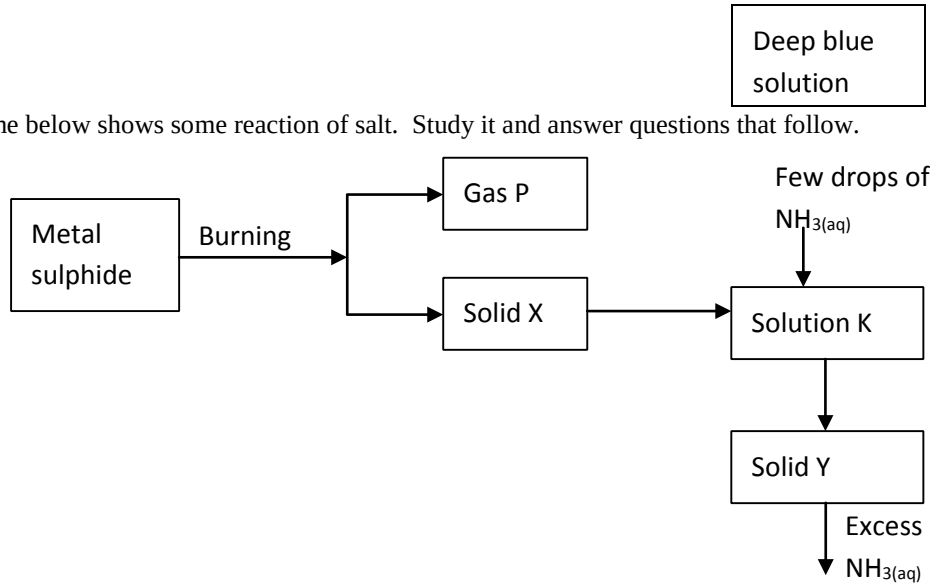
(i) Select the two half cells that would produce the highest emf of a cell. (1 mark)

(ii) Calculate the emf of the cell in d(i) above. (2 marks)

(iii) Give the cell diagram notation for the cell in d(ii) above. (1 mark)

4. (a) The results of an experiment to determine the solubility of solid Y in water at 40□C were as follows.
Mass of dish = 16.9g
Mass of dish + saturated salt at 40□C = 26.955g
Mass of dish + solid after evaporation to dryness = 17.96g Determine solubility of solid Y using the data above. (3 marks)

(b) The scheme below shows some reaction of salt. Study it and answer questions that follow.



(i) Write an equation for the reaction to show formation of gas **P** and solid **X**. (1 mark)

(ii) Give the name and formula of the complex ion responsible for the deep blue colour in the solution. (2 marks)

(c) Study the equation below and answer the questions that follow. $NH_{3(aq)} + H_2O_{(l)} \rightleftharpoons NH_{3(aq)} + H_3O^+_{(aq)}$

Identify the reactant that acts as an acid in the reverse process. Explain your answer. (2 marks)

(d) (i) What is meant by hard water? (1 mark)

(ii) Using an ionic equation, explain how sodium carbonate removes permanent hardness of water. (1 mark)

5. (a) In an experiment to determine the molar heat of displacement when magnesium displaces copper 0.36g of magnesium powder were added to 25cm³ of 1M copper (II) chloride solution, the temperature of solution increased by 43□C. (Cu = 63.5, Mg = 24.0 specific heat capacity 4.2J/g/K).

(i)Other than increase in temperature, state and explain the other observation made. (2 marks)

(ii) Determine the molar heat of displacement of copper. (3 marks)

(b) Given the following reactions

$2C_{(S)} + O_{2(g)} \rightarrow 2CO_{(g)} \quad \Delta H = -220kJ$

$2CO_{(g)} + O_{2(g)} \rightarrow 2CO_{(g)} \quad \Delta H = -566kJ$

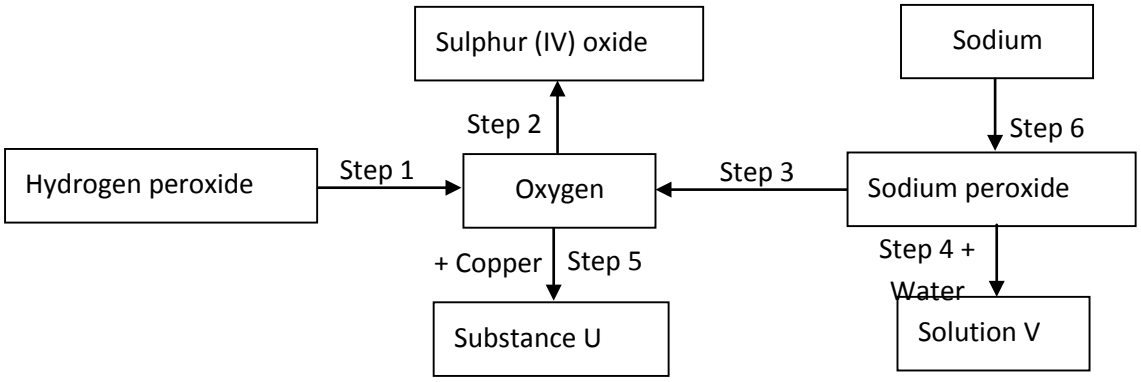
Using an energy cycle diagram, calculate the molar heat of formation of carbon (IV) oxide. (3 marks) (c) Study the table of bond energies below.

Use the information to calculate the enthalpy of the reaction shown below. (2 marks)

$H_{2(g)} + Br_{2(g)} \rightarrow Hbr_{(g)}$

Bond	Bond energy $kJmol^{-1}$
H – H	435
Br – Br	224
H - Br	336

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



(a) Identify the substances labeled **U** and **V**. (2 marks)

(b) Name the reagents necessary for the reactions in the following steps. (4 marks)

Step **1** _____

Step **2** _____

Step **3** _____

Step **6** _____

(c) Give the condition necessary for the reaction in Step **5** to take place. (1 mark)

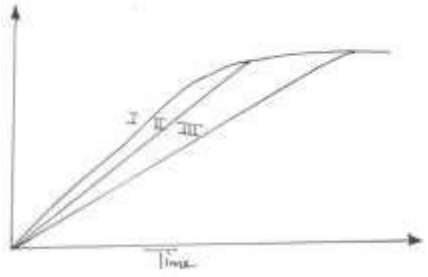
(d) Write equations for the reactions in the following steps. (2 marks)

Step **1** _____

Step **6**_____

(e) State and explain the observation made in Step 5. (2 marks)

7. (a) Below is a graph that was obtained when different concentrations of hydrochloric acid was reacted with equal amount of calcium carbonate.



The concentrations of hydrochloric acid were 0.8m, 0.5m and 0.1m. The calcium carbonate was in powder form. Match the graphs with concentrations.

Graph I _____ (1 mark)

Graph II _____ (1 mark)

(b) A state of equilibrium between dichromate (VI) and chromate ions is established as shown in the equation below.

$Cr_2O_{7(aq)} + 2OH^-_{(aq)} \rightleftharpoons 2CrO_{4^{2-}(aq)} + H_2O_{(l)}$

Orange Yellow

(i) What is meant by dynamic equilibrium? (1 mark)

(ii) State and explain observation made when a few pellets of potassium hydroxide are added to the equilibrium mixture. (2 marks)

(c) An experiment was done using magnesium ribbon and dilute hydrochloric acid of different concentrations. The time needed to produce 50cm³ of the gas for every experiment was recorded in the table below.

Conc. of HCl in mol/litre	2.0	1.75	1.50	1.25	1.00	0.75	0.50	0.25
Time in sec(s)	8.8	10.0	11.7	13.5	17.5	22.7	35.5	70.0
$\frac{1}{t}$ sec^{-1}								

(i) Complete the table above. (2 marks)

(ii) Plot a graph of rate $\left(\frac{1}{Time}\right)$ against concentration. (3 marks

(i) Determine from your graph the concentration needed to produce 50cm³ of hydrogen gas, when time is 15 seconds. (1 mark)

KAHURO/KIHARU DISTRICT JOINT EXAMINATION - 2015
Kenya Certificate of Secondary Education
233/3
CHEMISTRY
PAPER 3
(PRACTICAL)
JULY/AUGUST, 2015

1. You are provided with:-
(i) Solution M containing 1g of sodium hydroxide in 250cm³ of the solution.
(ii) 1.60g of a dibasic acid H_2Y labelled solid Z.
(iii) Phenolphthalein indicator You are required to:-
(a) Prepare 250cm³ of solution Z using solid Z.
(b) Determine the value of Y on the formular (H_2Y).

PROCEDURE I:

(i) Place all of solid Z in a 250cm³ beaker.
(ii) Add about 100cm³ of distilled water to the beaker and swirl until all the solid dissolves.
(iii) Transfer the solution into a 250cm³ volumetric flask.
(iv) Top up with distilled water to the mark and label it solution V.
Using a measuring cylinder transfer about 100cm³ of solution V into a 250cm³ beaker. Preserve the rest in the volumetric flask for procedure II.
(a) Pipette 25cm³ of solution M into a clean conical flask. Add 3 drops of phenolphthalein indicator to the 25cm³ solution in the conical flask.
(b) Fill the burette with solution V from the beaker.
(c) Titrate until the colour disappears.
(d) Repeat two more times and record your results in the table below.

Table I

Titre	1	2	3
Final burette reading (cm³)			
Initial burette reading (cm³)			
Volume of solution V used (cm³)			

(4 marks)

(a) Calculate the average volume of solution V used. (1 mark)
(b) Calculate the molarity of solution M. (Na = 23, O = 16, H = 1). (2 marks)
(c) How many moles sodium hydroxide were pipetted. (1 mark)
(d) How many moles of the acid, solution Z reacted with 25cm³ of solution M? (1 mark)
(e) How many moles of H_2Y were present in 1.60g of solid Z? (1 mark)
(f) Determine the value of Y in the formular H_2Y. (1 mark)

PROCEDURE II:

You are provided with:-

- A thermometer
- A stopwatch
- 0.02M acidified potassium manganate (III) solution H.
- Solution V diabasic acid (H_2Y)

You are required to determine how the rate of reaction of solution H potassium manganate (III) with the dibasic acid (solution v) varies with change in temperature.

(i) Using a 10ml measuring cylinder place 1cm³ portions of solution H into five separate test tubes.
(ii) Using a burette place 19cm³ of solution V into a boiling tube and insert a thermometer.
(iii) Warm the solution until the temperature reaches 40□C.
(iv) Place the boiling tube in a test tube rack, then add the first portions of solution H and at the same time start the stopwatch.
(v) Record the time taken for the purple colour of the mixture to decolourise and record the time in table II below.
(vi) Repeat the experiment by using 19cm³ of solution V at temperatures 50□C, 60□C, 70□C and 80□C and complete the table below.

Table II

Temperature of solution V(°C)	40°C	50°C	60°C	70°C	80°C
Time for colour to disappear (t) seconds					
$\frac{1}{t}$ sec^{-1}					

(4 marks)

(i) Using the grid provided plot a graph of $\frac{1}{t}$ sec^{-1} (y-axis) against temperature °C. (3 marks)

(ii) From the graph determine the time taken for decolouration of the mixture if the temperature of the solution V was 65°C. (1 mark)

(iii) How does the rate of reaction of potassium manganate (VII) with dibasic acid H_2Y vary with temperature? (1 mark)

2. You are provided with solid W. Carryout the test below and record your observations and inferences. Take half a portion of the solid W, put it into a boiling tube and add about 10cm³ of distilled water and shake. Divide the resulting solution into three portions.

Observation	Inference
(1mk)	(1mk)

(i) To the first portion add aqueous ammonia drop wise full in excess.

Observation	Inference
(1mk)	(1mk)

(ii) To the second portion, scoop the solution carefully using a clean metallic spatula and introduce it to a non-luminous flame.

Observation	Inference
(1mk)	(1mk)

(iii) To the third portion add 2 drops of barium nitrate and retain contents for test (iv) below.

Observation	Inference
(1mk)	(1mk)

(iv) To the contents in (iii) above add 4 drops of hydrochloric and followed by 2 drops of acidified potassium manganate (VII).

Observation	Inference
(1mk)	(1mk)

3. You are provided with solid B. Carryout the test below and record your observations and inferences.

(i) Describe the appearance of the solid. (1 mark)

(ii) Scoop a portion of the solid using a clean metallic spatula and introduce it to a non-luminous flame.

Observation	Inference
(1mk)	(1mk)

(iii) To the remaining portion of solid B, add about 10cm³ of distilled water. Shake and divide the solution into three portions.

Observation	Inference
(½mk)	(½mk)

(iv) To the first portion add about 1cm³ of acidified potassium manganate (VII) solution.

Observation	Inference
(1mk)	(1mk)

(v) To the second portion add about 1cm³ of acidified potassium dichromate (VI) solution.

Observation	Inference
(1mk)	(1mk)

(vi) To the third portion; determine the PH of the solution.

Observation	Inference
(1mk)	(1mk)

KAHURO/KIHARU DISTRICT JOINT EXAMINATION - 2015
233/1 - CHEMISTRY PAPER 1 MARKING SCHEME

1. (a) (i)

(ii)

(b) For easier visibility. ✓1 1

2. (a) Mass increases as oxygen combines with copper ✓1 1

(b) Mass decreases as ✓1 gases escape during decomposition ✓1 2

3. (a) (i) A ✓½

(ii) B ✓½ 1

(b) A and B✓1

Lead (II) oxide is amphoteric ✓1 2

4.

- Experiment with magnesium ✓1
- Zinc reacts with oxygen only while ✓1
- Magnesium reacts with both oxygen and nitrogen. ✓1 3

5. (a) Alkaline earth metals. ✓1

(b) J does not form compounds as it is chemically stable already. ✓1

(c) M has a higher melting point than B as it has a stronger metallic bond. ✓1 3

6. (a) 2.8 ✓1

(b) Na^+, O^{2-}, N^{3-} ✓1

No of protons decrease to the right hence reducing the effective nuclear charge. ✓1

7.

- PCl_3 has a simple molecular structure with ✓½
- Weak van der waals inter-molecular forces ✓1
- $MgCl_2$ has a giant ionic structure with ✓½
- Strong electrostatic forces between the oppositely-charged ions. ✓1 3

8. (a) $Mg_{(S)} + H_2O_{(g)} \rightarrow MgO_{(S)} + H_{2(g)}$ ✓1

(b) Potassium would react explosively with steam. ✓1 2

9. Graphite has a giant atomic structure hence. ✓1

High boiling point and is more stable than oil. ✓1 2 10.

$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$ ✓1

Moles of CaCO2 = $\frac{15}{100} = 0.15$ ✓½

Moles of HCl = $\frac{2}{1000} \times 100 = 0.2$ ✓½

- Moles of CO_2 produced $= \frac{0.2}{2} = 0.1$ ✓1 3
- Volume of CO_2 produced = 0.1 x 24000 ✓½= 2400cm³ ✓½

11. (a) (i) To burn off carbon (II) oxide which is highly poisonous. ✓1

(ii) $H_2O_{(g)} + C_{(S)} \rightarrow CO_{(g)} + H_{2(g)}$ ✓1

(b) Potassium hydroxide forms soluble carbonate and hydrogen carbonate. ✓1 (3marks)

12. Electrons neutrons

O ✓1 1 ✓1 (2marks)

13. (a) Grey solid ✓½, Pb2+ ions are discharged as $Pb_{(S)}$ ✓½

(b) Q = 2.5 x 25 x 60 = 3750C ✓1 $\frac{36 \times 193000}{3750}$.

$M = 18.5$ ✓1 (3marks)

14. Aluminium chloride is hydrolysed ✓1 by water to produce H^+ ions ✓1 to produce HCl, a strong acid ✓1 (3marks)

15. (a) Ammonium chloride. ✓1

(b) $Al_{(aq)}^{3+} + 3OH_{(aq)}^{-} \rightarrow Al(OH)_{3(S)}$ ✓1

(c) Heat ✓1 (3marks)

16.

- Mobile liquid comprises of S_8 molecules ✓1
- Dark viscous liquid as the S_8 chains entangle ✓1
- The S8 molecules fold into rings which flow independently. ✓1 (3marks) 17. (a) - No bleaching. ✓½

- Bleaching ✓½

(b) $SO_{2(g)} + H_2O_{(l)} \rightarrow 2H^{+}_{(aq)} + SO_{3(aq)}^{2-}$ ✓1 (3marks)

$SO_{3(aq)}^{2-} + Dye \rightarrow SO_{4(aq)}^{2-} + Bleach$ ✓1

18. (a) Sample II ✓1

- Requires little soap to lather ✓1

(b) Temporary hardness removed after boiling. ✓1 (3marks)

19. (a) Heat of formation of FeCl3 ✓1

(b) $\Delta H_3 = \Delta H_1 + \Delta H_2$ ✓1 (2marks)

20. Brown colour would intensify.✓1

OH^- Removed by addition hence ✓½ backward reaction triggered to replace OH^- ✓½ (2marks)

21. (a) I Hydrogen ✓½

II Oxygen ✓½

(b) Precipitation of $PbCl_2$ prevents flow ✓1 (2 marks)

22. 58n = 116 ✓½ n = 2 ✓½

$C_6H_{12}O_2$ ✓1 (2 marks)

23. (a) When gases react, they do so in simple ratios of volumes and those of their products if gaseous. ✓1

(b) $CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$ ✓½

$\frac{20}{100} \times 40 = 8cm^3 \text{ of } O_2$ ✓½

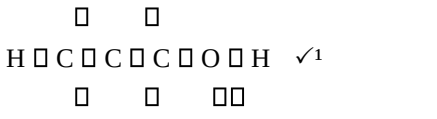
Volume of $CH_4 = \frac{8}{2} = 4cm^3$ ✓½ (3 marks)

Volume remaining = 40 – 4 = 36cm³ ✓½

24. (a) Alkanols ✓1

(b) Oxidation ✓1

(c)



✓1 (3 marks)

25. (a) $^{40}_{39}K$ has 21 neutrons while $^{40}_{19}K$ has 20 ✓1

(b) $4h\vec{2} \rightarrow h1 + 2h\vec{}$

2 x 1.3 x 10^9 = 2.6 x 10^9 ✓1 (3marks)

(c) $^{40}_{19}K + {}^{40}_{20}Ca + {}^{0}_{-1}\beta$

26. (a) Chlorine ✓1

(b) Increases surface area for dissolving process ✓1

(c) Cl_2 ✓1 (3 marks)

27. (a) II

(b) Non-biodegradable hence leads to water pollution. ✓1

(c) $(RCOO^-)_2Mg^{2+}$ ✓1 (3 marks)

28.

- To excess lead (II) carbonate, add nitric (V) acid ✓1
- Filter to obtain lead (II) nitrate filtrate. ✓½
- Add dil HCl acid. ✓1
- Filter to obtain lead (II) chloride residue. ✓½ (3 marks)

29. (a) The volume of a fixed mass of a gas is inversely proportional to its pressure at constant temperature. ✓1 (b)
$60cm^3$ - 50sec.

$80cm^3$? $\frac{80 \times 50}{60} = 66.67\,sec$ ✓1

$\frac{t_A}{t_B} = \sqrt{\frac{MA}{MB}}$

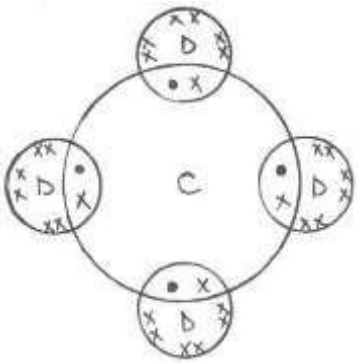
$t_B = \frac{66.67 \times \sqrt{64}}{\sqrt{32}}$ ✓1

= 94.28sec ✓1 (3 marks)

KAHURO/KIHARU DISTRICT JOINT EXAMINATION - 2015
233/2 - CHEMISTRY PAPER 2 MARKING SCHEME

1. (a) 2.8.8 ✓½ (½ marks)
(b) (i) D ✓½
(ii) D ✓½ (1 marks)
(c) 4 ✓½ (½ marks)
(d) E has a lower atomic size than A ✓1 hence less electrostatic attraction by the nucleus ✓1 (2 marks)

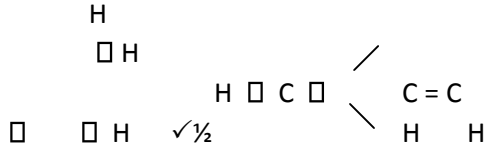
(e)



(f) B has a stronger metallic bond ✓1 as B has more valence electrons than A. ✓1 (2 marks)
(g) $2A_{(S)} + 2H_2O_{(l)} \rightarrow 2AOH_{(aq)} + H_{2(g)}$ ✓1 (1 marks)
(h) - Add water ✓
- Stir ✓
- Filter ✓

To obtain lead (II) ✓ sulphate as residue Heat the filtrate to obtain the sulphate of E thro" evaporation ✓ (3 marks)

2. (a) Hydrogen ✓1 (1 marks)
(b)

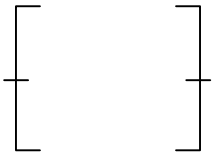


(1 marks)

Propene ✓½

(c) Ethanol ✓1
Warm and $H_2SO_{4(l)}$ ✓1 (tied) (2 marks)
(d) $CH_3CH_2CH_3 + Cl_2 \xrightarrow{UV} CH_3CH_2CH_2Cl + HCl$ ✓1 (1 marks)

(e) (i) Alkene ✓1
(ii) Alkanol ✓1
(iii) Alkynes ✓1 (3 marks)

(f) (i) $n\ CH_2CHCH_3$ →  ✓1 (3 marks)

(ii) Poly propene ✓½
(iii) Mfq of bottles, carpets, ropes, pipes, toys, textiles. (one ✓1) (1½ marks)

(g)
- Production of hydrogen ✓1
- Production of smaller and more useful molecules ✓1 (2 marks)

3. (a) (i) $2H_{(aq)} + 2e \rightarrow H_{2(g)}$ ✓1
(ii) Anode ✓1
(iii) B reduces in size as copper anode dissolves ✓1

$Cu_{(s)} \rightarrow Cu_{(aq)}^{2+} + 2e$ ✓1 (4 marks)

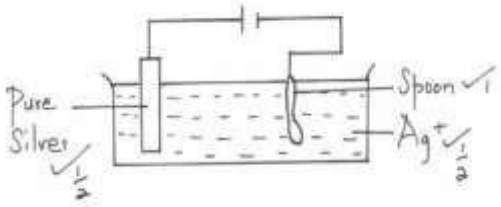
(b) (i) Moles of $Q = \frac{0.22}{184} = 0.0012\ mol$ ✓1

(ii) Q = It = 0.06 x 99 x 60 = 356.4C ✓1

$Q = \frac{356.4}{0.0012} = 297000\ Cmol^{-1}$ ✓1 (4 marks)

$n = \frac{297000}{96500} \simeq 3$ ✓1

(c)



(2 marks)

(d) (i) J and L ✓1
(ii) 0.84 - -0.76 ✓1
= +1.60V ✓1
(iii) $J/J^{2+}//L^{2+}/L$ E = +1.60V ✓1 (3 marks)

4. (a) Mass of Y = 17.96 – 16.9 = 1.06g ✓½
Mass of water = 26.955 – 17.96 = 8.095g ✓½
Solubility = $\frac{100}{8.095} \times 1.06$ ✓1
= 11.784g/100g water ✓1 (3 marks)

(b) (i) $2CuS + O_{2(g)} \rightarrow 2CuO_{(S)} + 2SO_{2(g)}$ ✓1 (ii) Tetra amine copper (II) ion ✓1

$Cu(NH_3)_4^{2+}$ ✓1 (3 marks)

(c) H_3O^+, donates proton to NH_3 ✓1 (1 marks)

(d) (i) Water that does not lather easily with soap.// water with Mg^{2+} or Ca^{2+} ✓1

(ii) $Ca_{(aq)}^{2+} + CO_{3(aq)}^{2-} \rightarrow CaCO_{3(s)}$

$Mg_{(aq)}^{2+} + CO_{3(aq)}^{2-} \rightarrow MgCO_{3(s)}$ ✓1 (2 marks)

5. (a) (i) Brown deposit
Blue solution fades/decolorized ✓½
Magnesium atoms displace Cu^{2+} from solution as copper is deposited. ✓1

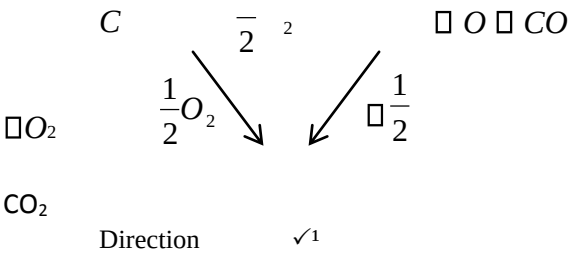
(ii) Moles of $Cu^{2+} = \frac{25}{1000} \times 1 = 0.025\ mol$ ✓½

Moles of $Mg = \frac{0.36}{24} = 0.015\ mol$ ✓½

E = 25 x 4.2 x 43 = 4515J ✓1 (5 marks)

$\Delta H = \frac{4515}{0.15 \times 1000} = -301kJ\ mol^{-1}$ ✓½

(b)



Direction ✓1

ΔH = -110 + -283 ✓1

= -393kJ ✓1

Calculations ✓1 (3 marks)

(c) 659 – 672 ✓1

= -13kJ ✓1 (2 marks)

6. (a) (i) Copper (II) oxide // CuO ✓1

(ii) Sodium hydroxide // NaOH ✓1 (2 marks)

(b) (i) Manganese (IV) oxide ✓1

(ii) Sulphur ✓1

(iii) Water ✓1

(iv) Excess oxygen ✓1 (4 marks)

(c) Heat ✓1 (1 marks)

(d) (i) $2H_2O_{2(aq)} \rightarrow 2H_2O_{(l)} + O_{2(g)}$ ✓1

(ii) $2Na_{(S)} + O_{2(g)} \rightarrow Na_2O_{2(S)}$ ✓1 (2 marks)

(e) Black solid ✓½ as copper (II) oxide is formed ✓½

7. (a) I 0.8M ✓1

II 0.1M ✓1 (2 marks)

(i) State of balance where forward reaction takes place at the same rate as backward reaction. ✓1 (2 marks) (ii) Solution turns yellow. ✓1

(b) Addition of NaOH favours ✓1 forward reaction.

(i) All ✓ 2

5 ✓ 1

5 ✓ 0

(ii) Graph scale ✓1, axes ✓1 and plotting ✓1

(iii) From the graph ✓1 (6 marks)

KAHURO/KIHARU DISTRICT JOINT EXAMINATION - 2015

233/3 - CHEMISTRY PAPER 3 (PRACTICAL) MARKING SCHEME PROCEDURE I

1.

Titre	1	2	3
Final burette reading cm³	23.2	21.5	21.5
Initial burette reading cm³	0.0	0.0	0.0
Volume of solution (V)cm³	23.2	21.5	21.5

(4 marks)

Table I (5 marks)
Complete table (1 mark)
Decimal place (1 mark)
Accuracy (1 mark)
Principal of averaging (1 mark) (Working must be shown as indicated below)
Final answer (1 mark)

(5 marks)

(a) Average volume

$\frac{21.5 + 21.5}{2}$ ✓½ = 21.5✓½

(b) Molarity of solution M. (2 marks)

1g – 250cm³

1000cm³ ✓½

$\frac{1 \times 1000}{250cm^3} = 4g/dm^3$ ✓½

$\frac{4g/cm^3}{40g}$ ✓½ = 0.1M ✓½ (2 marks)

(c) Moles of sodium hydroxide pipetted (1 mark) $\frac{1 \times 250.}{1000}$

✓½ = 0.0025 moles ✓½

(d) Moles of acid that reacted

$2NaOH_{(aq)} + H_2Y \rightarrow Na_2Y_{(aq)} + 2H_2O_{(l)}$

Mole ration acid: Base

1 2

Moles of acid = ½ moles of base = ½ x 0.0025 ✓½

= 0.00125 ✓½

(e) Moles of H_2Y in 1.6g (1 mark)

$\frac{250 \times 0.00125}{21.5}$ ✓½

= 0.014535 ✓½ (1 mark)

(f) Determining value of Y: 1.6g – 0.014535 moles

? 1 mole

$\frac{0.014535}{1.6}$

1 = 110.079✓½

2 + Y = 110.079

= 110.079 – 2 ✓½

= 108.079 (1 mark) **PROCEDURE II**

(a)

Temperature of solution V(ºC)	40ºC	50ºC	60ºC	70ºC	80ºC
Time for colour to disappear (+) sec^{-1}	200.76	60.62	43.26	18.37	8.35

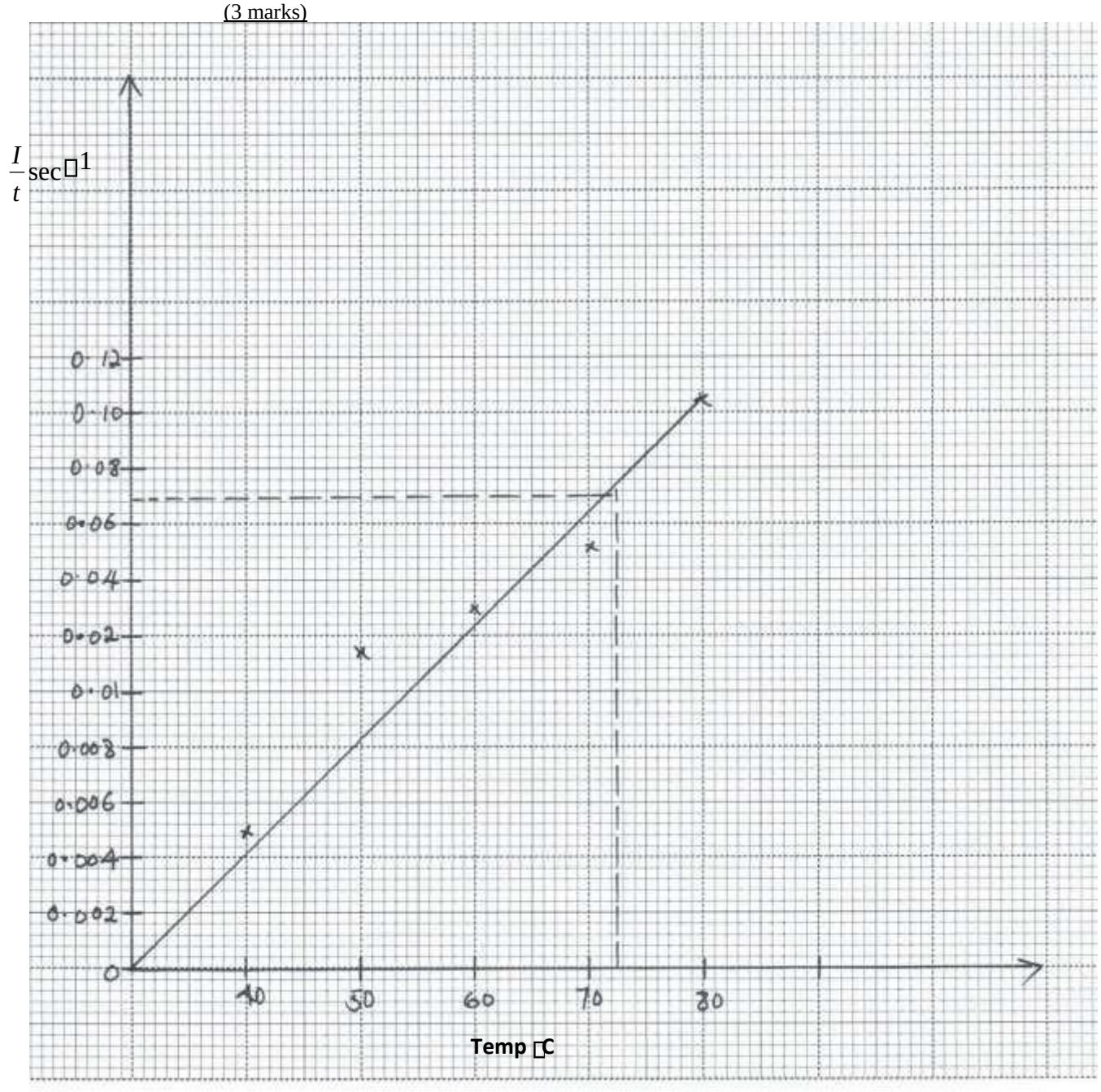
1 $\frac{1}{t}$ sec	0.00498	0.0165	0.0231	0.0544	0.1198

Complete table (1 mark)
Decimal place (1 mark)
Accuracy (1 mark)
Trend – Decreasing (1 mark)

(b) Graph

- Both correctly labelled axis with units of variables (½ mark)
- Scale ½ cover ¾ page ✓½
- Plots 1 mark (must be visible)
- Shape (line) (1 mark)

(3 marks)



(c) Time taken at 65ºC

1

$\square$ 0.045

$\bar{t}$

$t \square \frac{1}{0045} \square$ 22.22 se*conds*✓½

0.

Working out ✓½

Showing on graph ✓½

(d) Rate of reaction is directly proportional to increase in temperature or rate of reaction increases with increase in temperature.✓¹

2.

Observations	Inferences
Solid dissolves to ✓½ form colourless solution ✓½ (1mk)	- Coloured ions absent ✓½ i.e. Cu^{2+}, Fe^{2+}, Fe^{3+} - Solid is soluble ✓½ (1mk)

(i)

Observations	Inferences
No white precipitate formed ✓¹ (1mk)	Na^+, K^+, NH_4^+ present 3 - ions (1mk) 2 – ions (½mk) 1 – ion (no mark) (1mk)

(ii)

Observations	Inferences
Burns with a yellow flame ✓¹ (1mk)	Na^+ present ✓¹ (1mk)

(iii)

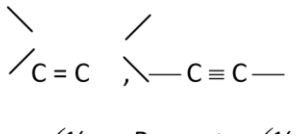
Observations	Inferences
White precipitate (1mk)	SO_3^{2-}, SO_4^{2-}, CO_3^{2-} present 3 - ions (1mk) 2 – ions (½mk) 1 – ion (0mk) (1mk)

(iv)

Observations	Inferences
- Colourless gas produced ✓½ - Purple acidified $KMnO_4$ changes to colourless ✓½ (1mk)	SO_3^{2-} present ½✓

3. (i) White crystals ✓¹

(ii)

Observations	Inferences
Solid ✓½ melts, burns with a yellow sooty flame. ✓½ Reject: Burns with yellow flame. (1mk)	

(iii)

Observations	Inferences
Solid dissolves to form colourless solution ✓½ (1mk)	Polar compound present ✓1 (1mk)

(iv)

Observations	Inferences
Solid ✓½ melts, burns with a yellow sooty flame. Reject: Burns with yellow flame. (1mk)	□ C□C□ ; C = C

(v)

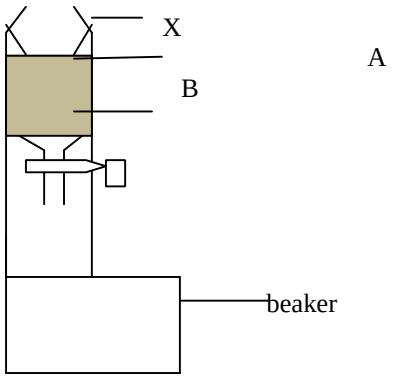
Observations	Inferences
Purple acidified $KMnO_4$ changes to colourless. (1mk)	□ C□C□ ; C = C ✓½

(vi)

Observations	Inferences
PH = 1 or PH = 2 ✓1	Strongly acidic ✓1

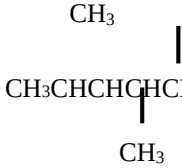
GATUNDU SOUTH SUB-COUNTY FORM FOUR 2015 EVALUATION EXAM
233/1
CHEMISTRY
PAPER 1
(THEORY)

1. The diagram below represents a method of separation used to separate two liquids A and B. use it to answer the questions that follow



a) Name two properties that makes it possible for the two liquids to be separated. (2mks)
b) Give one alternative method that may be used to separate the two liquids. (1mk)

2. Name the following organic compounds (2mks) a)



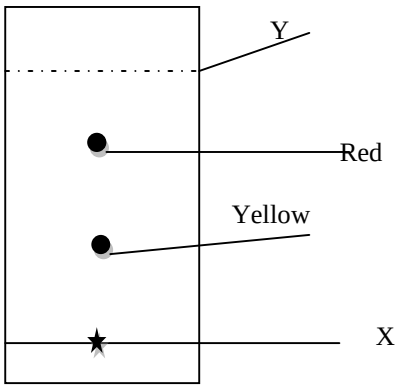
.....

b)

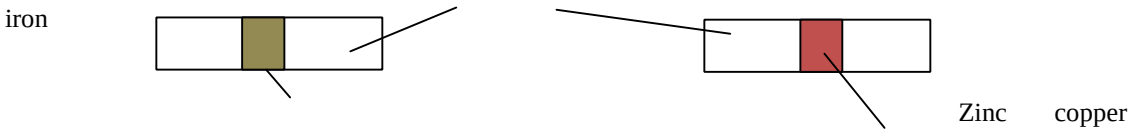
$CH_3COOCH_2CH_2CH_2CH_3$ .....

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

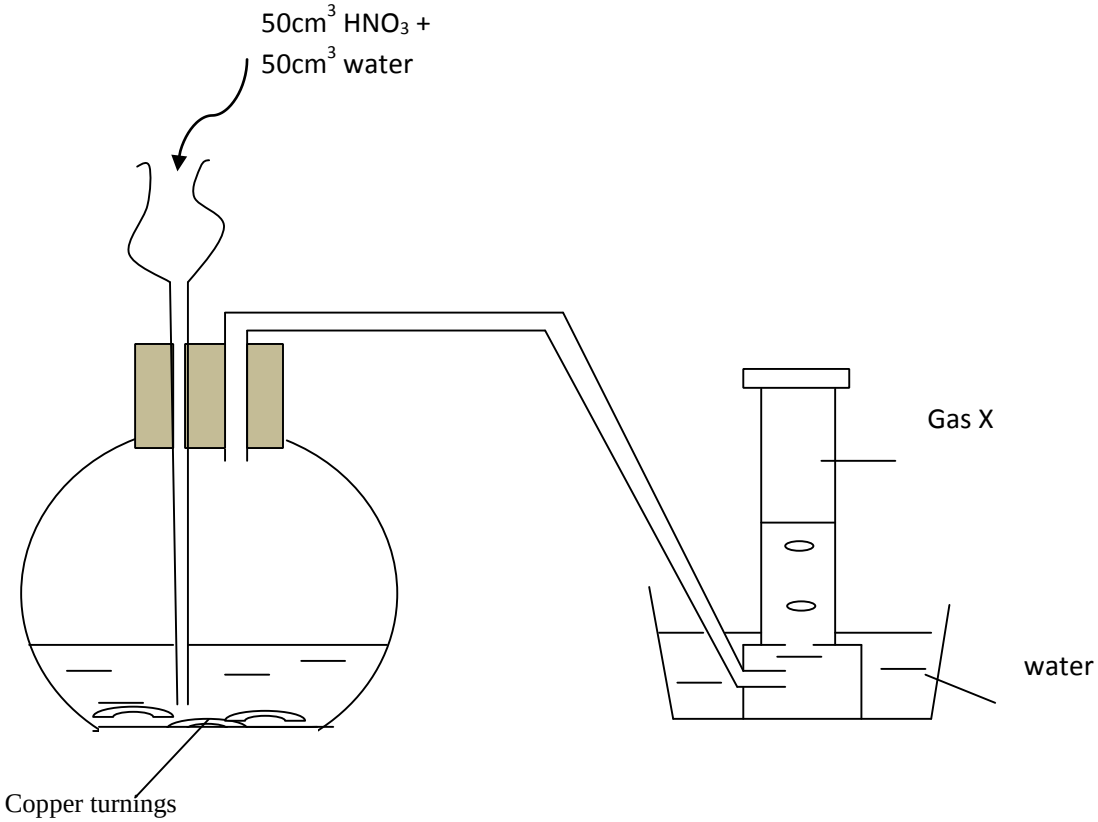
4. In 35 seconds, it was found that 140cm^3 of nitrogen (N_2) had diffused through a strip of porous porcelain. How long will it take 400cm^3 of carbon (IV) oxide to diffuse through the same strip of porous porcelain? (3mks)
5. The chromatogram below shows the constituents of a flower extract. Study it and answer the questions that follow



   a) Explain the different positions of red and yellow pigments. (2mks)
   b) What does lines X and Y represent (1mk)
6. Name the chief ore of iron and write its formula (2mks)
7. In an experiment, two pieces of iron sheets were wrapped in each case with zinc and copper metal sheets as shown below. They were left in the open for some months.

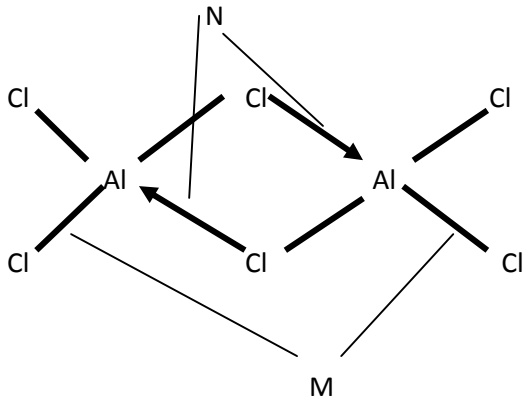


   State and explain the observations made in the experiments; (I), (II) (3mk)
8. Compare the atomic sizes of sodium and magnesium. Explain. (2mks)
9. The set up below was used to prepare gas X. study it and answer the questions that follow;



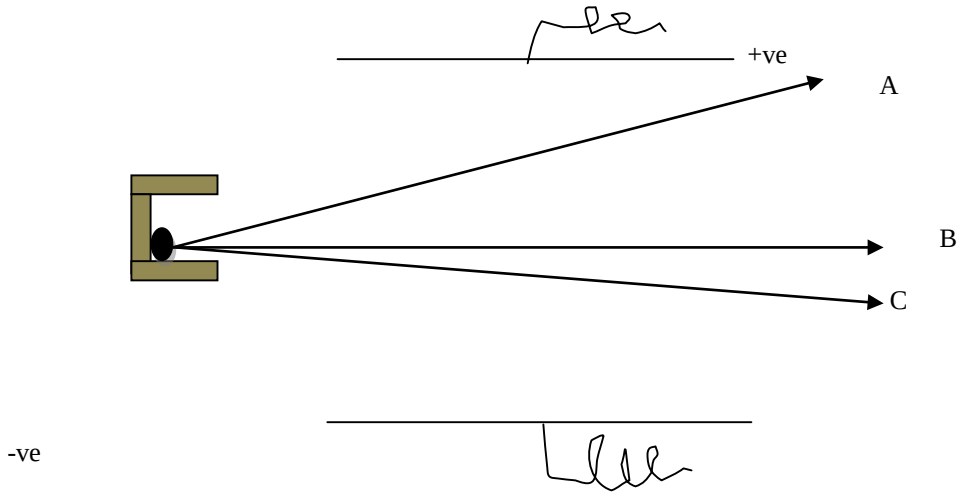
a) Name gas X (1mk)
b) Write an equation for production of gas X in the set up (1mk)
c) It"s hard to test whether gas X supports burning using a glowing splint. Explain. (1mk)

10. When solid M is dissolved in water, it dissolves and forms a blue solution. Addition of ammonia solution to this solution forms a blue precipitate which dissolves in excess to form a deep blue solution. Write the formula and name of the ion responsible for the deep blue solution. (2mks)
11. The diagram below represents the structure of aluminium chloride.



a) Identify the bonds labeled M and N. (2mk)
b) What Is the difference between bonds M and N (1mk)

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



a) Name particles A and B

b) What property of B makes it not to be deflected by magnetic/electric field

(1mk) 13. The table below shows the first ionization energies of elements Y and Z.

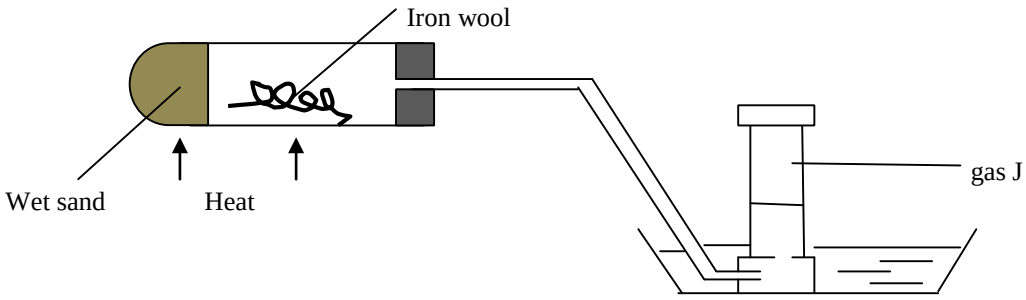
element	**Ionization energy kJ/mol**
Y	494
Z	418

a) What is ionization energy? (1mk)

b) Which of the two elements is the most reactive? Explain (2mks)

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

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



a) Name gas J (1mk)

b) Explain why its important to heat the wet sand before heating the iron wool. (1mk)

c) Name the product formed in the combustion tube. (1mk)

16. An element X has a relative atomic mass of 44. When a current of 0.5 A was passed through the molten chloride of X for 32 minutes and 10 seconds, 0.22g of X were deposited at the cathode

Determine the charge on an ion of X (1F=96,500c) (3mks)

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

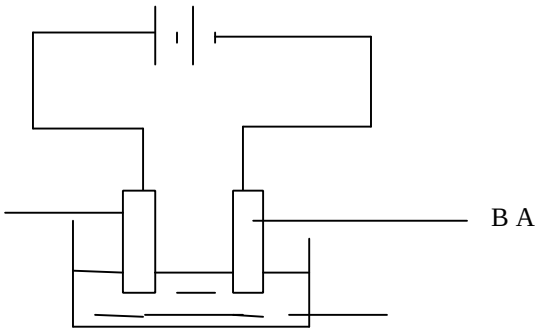
$2NO_{2\,(g)} \rightleftharpoons N_2O_{4\,(g)}$ ΔH = -ve

a) State and explain the observation made when a mixture at equilibrium is heated. (2mks)

b) If pressure is exerted at the mixture at equilibrium, what observation will be made? (1mk)

18. State and explain the trend in the boiling points of group (VII) elements down the group. (2mks)

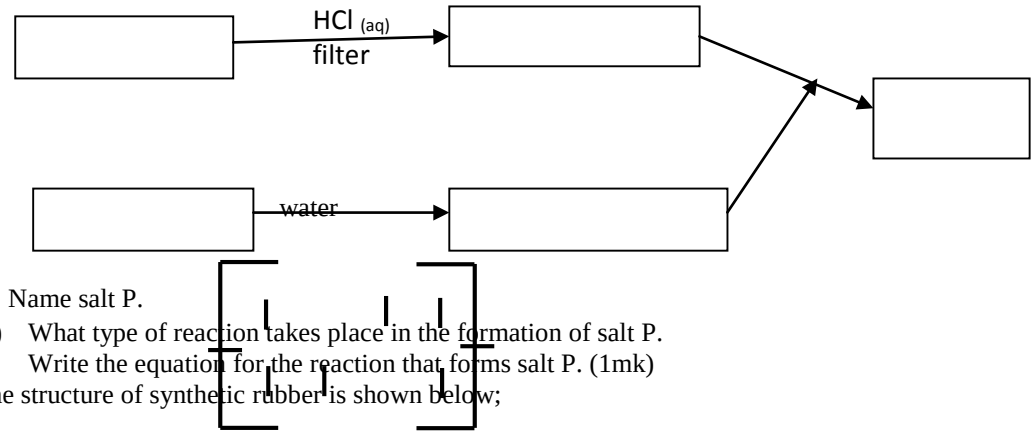
19. The diagram below shows electrolysis of dilute copper (II) sulphate solution using copper electrodes;



a) State the observations made at electrode A and B (2mks)

b) Write the equation of reaction at electrode A (1mk)

20. The flow chart shows a process of preparation of salt P.



a) Name salt P. (1mk)

b) What type of reaction takes place in the formation of salt P. (1mk)

c) Write the equation for the reaction that forms salt P. (1mk)

21. The structure of synthetic rubber is shown below;

H
H
H

C -

C = C - C

H Cl H n

a) Determine the relative molecular mass of a polymer made of 250 monomers (2mks)
(c=12,H=1 and Cl=35.5)

b) Give one advantage of natural polymers over synthetic ones. (1mk)

22. 0.92g of ethanol were found to burn in excess air producing a temperature rise of 32.5^{o}C in 200cm^{3} of water(C=12.0,H=1.0, O=16.0) Density of water is 1g/cm^{3}, specific heat capacity of water is 4.2KjKg^{-1}K^{-1}

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

(b) Determine the molar heat of combustion of ethanol
(2mks)

23.

a) The formula for cane sugar is ($C_{12}H_{22}O_{11}$). Use an equation to show what happens when sugar is added to conc. Sulphuric (VI) acid (1mk) b)

What name is given to the type of reaction above? (1mk)

c) Calculate the oxidation state of sulphur in sodium thiosulphate ($Na_2S_2O_3$) (1mk)

24. Iron (III) chloride can be prepared in the laboratory by passing dry chlorine gas over hot steel wool.

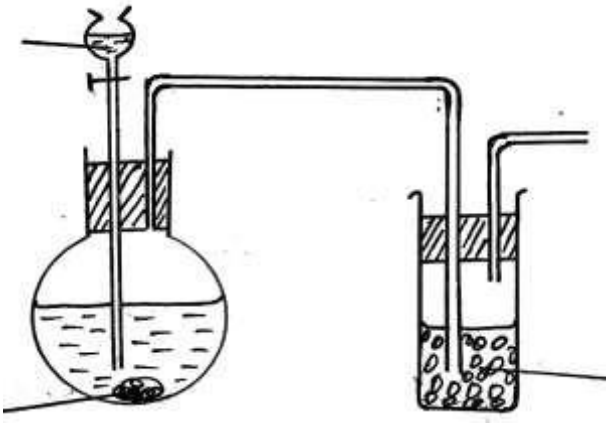
a) Name the above method of preparing salts (1mk)

b) Why should we prepare the salt in a dry environment? (1mk)

c) A solution of iron (III) chloride in water changes a blue litmus paper to red. Explain. (1mk)

25. The set-up below was used to prepare dry sample of hydrogen Sulphide gas

Dil. **Hydrochloric acid**



Solid J

Solid H

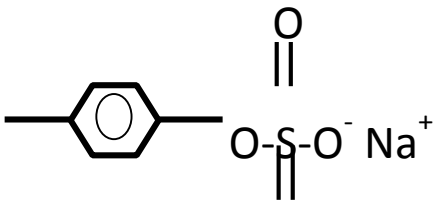
(a) (i) Complete the diagram to show how the gas was collected (2mks)

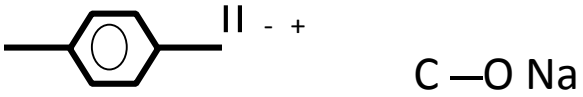
(ii) Identify the following

I: Solid H ($^1/_2$mk)

II.Solid J ($^1/_2$mk)

26. Study the structures below and answer the questions that follow.





a) Which structure represents a detergent suitable for washing in water containing calcium ions? (1mk)

b) Give one advantage of continued use of detergent B over A (1mk)

c) Name the process of manufacturing detergent B (1mk

27. Aluminium is used in making cooking vessels and overhead cables. State the property of aluminium that makes it suitable for the two uses separately.

Cooking vessels…… (½ mk)

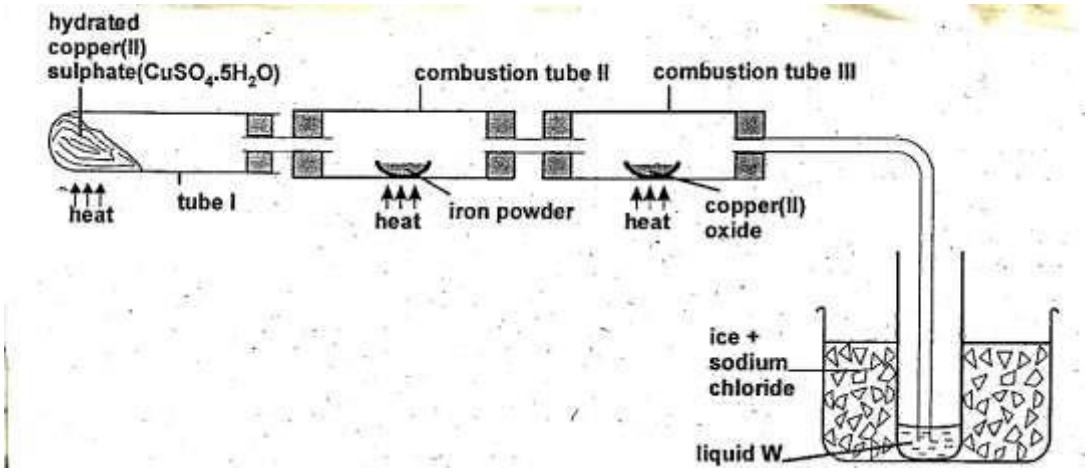
Overhead cables ……. (½ mk)

(b) Explain why it is not advisable to clean surfaces of cooking vessels made of aluminium using wood –ash solution (2mks)

28. 10g of an oxide of sodium contains 5.9g sodium. Its molar mass is 78. Determine its molecular formula. (3mks)
29. Differentiate between the terms atomic number and mass number (2mks)

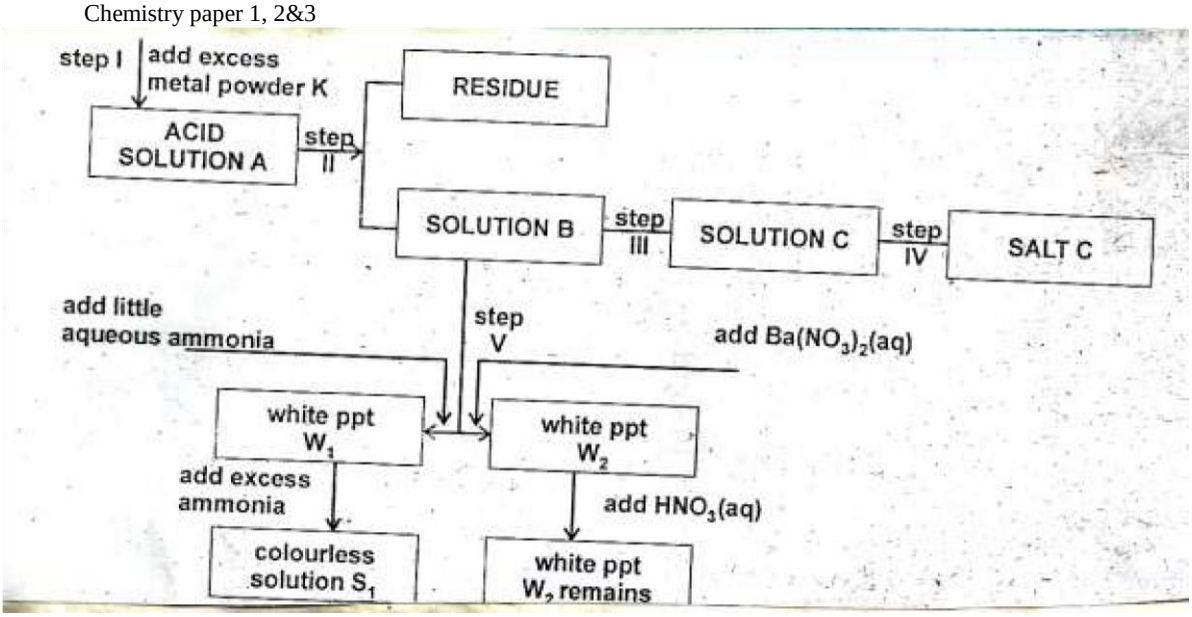
GATUNDU SOUTH FORM FOUR 2015 EVALUATION EXAM
233/2
CHEMISTRY
PAPER II (THEORY)
JULY/AUGUST 2015

1. The diagram below shows the apparatus for the preparation of gas A and investigate on its properties . Study it and answer the questions that follow.



a) (i) Name gas A. (1 mark)
(ii)Suggest the property of gas A under investigation. (1 mark) (iii) Write chemical equations for the reactions in the;
Boiling tube I (1 mark)
Combustion tube II (1 mark) b) (i) State and explain the observation made in
Tube I. (2 marks)
Combustion tube II (2 marks)
c) What is the use of hydrated copper (II) sulphate in the experiment? (1 mark)
(i) Name one other substance that comes out of tube III. (1 mark)
(ii) Name liquid W. (1 mark)
(iii) What is the role of sodium chloride in the ice (freezing mixture) (1 mark)
(iv) Explain why hydrogen gas has been replaced by helium in filling of aeroplane tyres. (1 mark)

2. The flow diagram below shows the reactions involved in the process for the preparation and reactions of salt C. Study it and answer the questions that follow.



a) Identify (3 marks) (i) Metal K
(ii) Acid A
(iii) Salt C

b) In step III the solution B is transferred into an evaporation dish and heated in a water bath until it is saturated.
(i) What is a saturated solution? (1 mark)
(ii) Why is heating done over a water bath? (1 mark)
(iii) How would one determine whether a solution is saturated? (1 mark) c) Explain why metal powder K is used in excess. (1 mark)

d) Name step (II) and state its importance. (1 mark)

e) Identify (3 marks)
(i) White precipitate W_1
(ii) White precipitate W_2
(iii) Colourless solution S_1

f) Write equations for step I and for the formation of S1
Equation step I (1 mark)
Formation of S_1 (1 mark)

3. a. (i) Sulphur is allotropic. What does this mean? (1 mark)

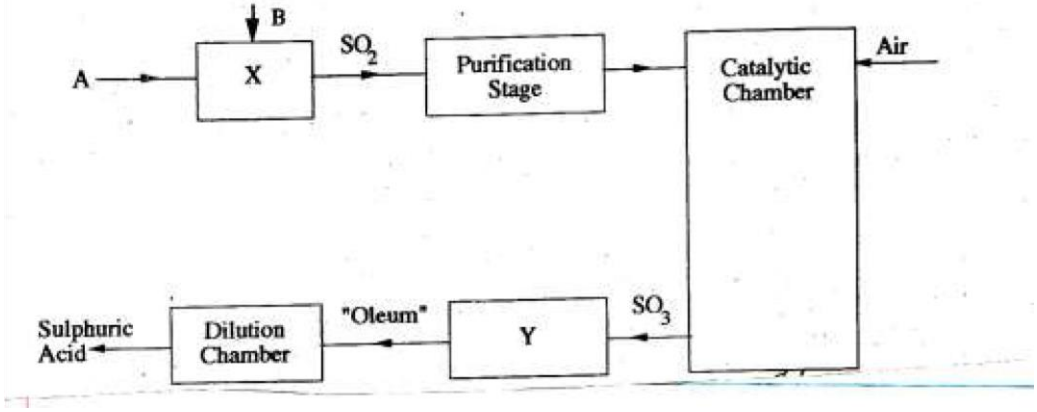
(ii) Give two differences between rhombic and monoclinic sulphur. (2 marks)

(iii) State and explain using an equation the observations made when sulphur reacts with hot concentrated nitric (v) acid. (3 marks)

Observations

Equation

The flow chart below shows how sulphuric acid is manufactured in a large scale. Study it and then answer the questions that follow.



I. (i) Name the raw materials A and B. (2 marks)

(ii) Name the chambers X and Y. (2 marks)

II. (i) Name two impurities that are removed during the purification stage. (2 marks)

(ii) Why must the impurities in (i) above be removed. (1 mark) III.

(i) Name the catalyst used in this process. (1 mark)

(ii) The equation below shows what happens in the catalytic chamber.

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_3 \qquad \Delta H = -197KJ/Mol$$

State the two conditions that are necessary for maximum production of SO_3 (1 mark)

4. a) Define the term standard heat of formation of a substance. (1 mark)

b) Butane cannot be prepared directly from its elements and so it"s standard heat of formation ($\Delta H^o f$) must be obtained indirectly. Write down an equation;

(i) For the formation of butane from it"s elements in their normal physical states at standard condition of temperature and pressure. (1 mark)

(ii) For the combustion of 1 mole of butane. (1 mark) c) (i) State the Hess"s law. (1 mark) If the following heats of combustion are given.

ΔH_c^o carbon(s) = -393Kj/Mol

ΔH_c^o $H_{2(g)}$ = 286Kj/Mol

ΔH_c C_4H_{10} = -2877 Kj/Mol

II. Draw an energy cycle diagram linking the heat of formation of butane with its heat of combustion and the heat of combustion of constituent elements. (2 marks)

III. Calculate the heat of formation of butane ΔH^{θ}_f (C_4H_{10}) (2 marks)

d) Use the equations below to answer the questions that follow.

$$MX_{(s)} \longrightarrow M^{n+}_{(g)} + X^{p-}_{(g)}$$

$$M^{n+}_{(g)} \xrightarrow{\text{water}} M^{n+}_{(aq)}$$

$$X^{p-}_{(g)} \xrightarrow{\text{water}} X^{p-}_{(aq)}$$

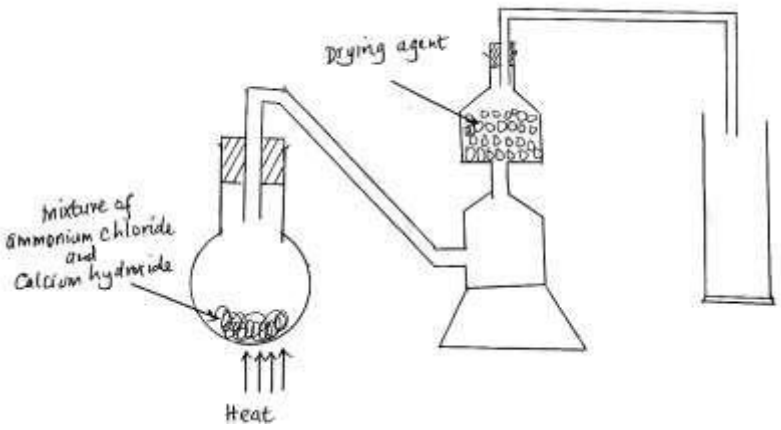
(i) Name the types of enthalpy changes represented by

ΔH_1 ..... (1 mark)

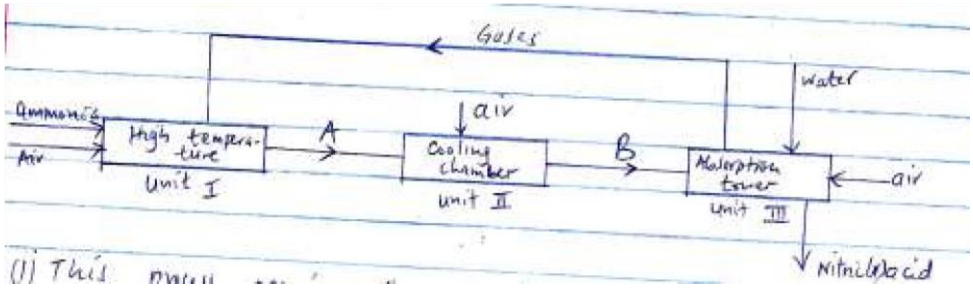
ΔH_2 ..... (1 mark)

(ii) Given that enthalpy change of ΔH_1 is +690Kj/Mol, and ΔH_2 and ΔH_3 are -322Kj and -364Kj respectively, Calculate the enthalpy change of solution of $MX_{(s)}$. (2 marks)

5. A student set up the apparatus as shown in the diagram below to prepare and collect dry ammonia gas.



a) Identify two mistakes in the set up and give a reason for each mistake. (2 marks)
b) Name a suitable drying agent for ammonia. (1 mark)
c) Write an equation for the reaction that occurred when a mixture of ammonium chloride and calcium hydroxide was heated. (2 marks)
d) Ammonia gas is used in the manufacture of nitric (v) acid as shown below;



(i) This process requires the use of a catalyst. What is the name of catalyst used and in which unit is the catalyst used? (2mks) -

Catalyst –
- Unit;-

(ii) Identify compounds A and B. (2 marks)
(iii) Ammonia and nitric (v) acid are used in the manufacture of ammonium nitrate fertilizer. Calculate the amount of nitric
(iv) (v) acid required to manufacture 1000kg of ammonium nitrate using excess ammonia (N = 14.0, H = 1, O=16) (3 marks)
(v) Nitric (v) acid is packed in dark containers. Explain. (1 mark)

6. During the extraction of copper from copper pyrites ($CuFeS_2$) some of the processes include
a) Crushing the ore
b) Mixing the crushed ore with water and oil and then bubbling air through it. c) Roasting the ore

---

A. (i) Name two other ores that can be used. (2 marks)
(ii)Name the process marked (b) above and give its use. (2mks)
Name -
Use -
(iii) Write an equation for the roasting of copper pyrites. (1 mark)
B. (i) Pure copper is obtained from impure copper by electrolysis. Name the; (3 marks)
Anode ……
Cathode…….
Electrolyte…….
(ii)Write equations for the reactions at (2 marks)
I Anode…….
II Cathode……..
(iv) Calculate the time taken for a current of 10 amps to deposit 32g of pure copper (Cu=64, IF = 96500c) (3 marks)
C. Give one use of copper metal (1 mark)

GATUNDU SOUTH FORM FOUR 2015 EVALUATION EXAM
233/3
CHEMISTRY
PAPER 3
JULY/AUGUST 2015
CONFIDENTIAL

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

1. About 80cm^3 of solution A
2. About 100cm^3 of solution B
3. About 70cm^3 of solution C
4. 1 pipette
5. 1 burette
6. 3 conical flasks (250ml)
7. A 250ml volumetric flask
8. 1 thermometer (-10^o C to 110^{o}C)
9. 8 test tubes
10. 2 boiling tubes
11. 10ml measuring cylinder
12. 7 labels
13. a test-tube holder
14. Solid G (about 0.3g)
15. Solid T (about 0.3g)
16. Glass rod
17. Metallic spatula
18. Solid sodium hydrogen carbonate (about 0.2g)
19. 500 ml distilled water Access To:

1. Bunsen burner
2. methyl orange indicator supplied with a dropper
3. Bromine water supplied with a dropper
4. 2M sodium hydroxide supplied with a dropper
5. Aqueous Barium nitrate supplied with a dropper
6. 2M Nitric (v) acid supplied with a dropper 7. universal indicator supplied with a dropper
8. PH scale chart.
9. Acidified potassium manganate (vii) supplied with a dropper.
10. Acidified potassium dichromate (vi) supplied with a dropper.

NB:

- Solution A is prepared by dissolving 55ml of concentrated sulphuric (vi) acid in one litre of solution.
- Solution B is prepared by dissolving 8g of anhydrous sodium carbonate in one litre of solution Sodium C is prepared by dissolving 80g of sodium hydroxide in one litre of solution.
- Bromine water is prepared by dissolving 1cm^3 of 20 volumes bromine water in 100cm^3 of solution.
- Acidified potassium manganate (vii) is prepared by dissolving 3.16g of $KMnO_4$ in 600cm^3 of $2MH_2SO_4$ and made to one litre solution.
- Acidified potassium Dichromate (vi) is prepare by dissolving 6g of $K_2Cr_2O_7$ in 600cm^3 of $2MH_2SO_4$ and made to one litre solution.
- 2M bench reagent of Sodium hydroxide is prepared by dissolving 80g of sodium hydroxide in one litre of solution.
- Nitric (v) acid (2) is prepared by dissolving 126Ml in one litre of solution.
- Barium nitrate solution is prepared by dissolving 0.05g in one litre of solution. Solid G = hydrated sodium carbonate
- Solid T = Maleic acid.

GATUNDU SOUTH FORM FOUR 2015EVALUATION EXAM
233/3

CHEMISTRY
PAPER 3
PRACTICAL
JULY /AUGUST 2015

- You are provided with Aqueous sulphuric (vi) acid ,solution **A**
- 4.0g in 500 cm^3 of sodium carbonate , solution **B**
- An aqueous solution of substance **C**,solution **C** You are required to determine the;
- Concentration of solution **A**
- Enthalpy of reaction between sulphuric (vi)acid and substance **C** **Procedure A**

Transfer 25.0$cm^3$of the solution A into 250 ml conical flask using a pipette .Add water to make 250cm^3 of solution .Label this as solution D .Place solution D in a burette.

Clean the pipette and use it to place 25.0cm^3 of solution B into conical flask .Add 3 drops of methyl orange indicator provided and titrate with solution D .Record your result in table I below .Repeat the titration two more times and complete the table I below. Table I

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

(4mrks)

Calculate the

(i) Average volume of solution **D** used (1mrk) ii) Concentration of sodium carbonate ,solution **B** in moles per Littre (Na=23,C=12,O=16) (1mrk)

i) Concentration of sulphuric (vi) acid in solution **D** in moles per litre (2mrks)

(iv) Concentration of Sulphuric (vi) acid in solution **A** in moles per litre (1mrk) **PROCEDURE B**

Label six test tubes as 1, 2,3,4,5, and 6.Using a measuring cylinder, measure 2cm^3 of solution **A** into test –tube number 1, 4cm^3 in test –tube number 2. Continue with this process for all the other test tubes as shown in **table II** below.

Clean the burette and fill it with solution **C**. From the burette, Place 14$cm^3$of solution **C** into a boiling tube .Measure the initial temperature of this solution and record it in the **table II** below to the nearest 0.5^{0}c. Add the content of test tube number 1 to the boiling tube containing solution **C** . Stir the mixture with thermometer and record the highest temperature reached in table II below .Repeat the process with the other sample of solution **C** given in the table II and complete the table.

Table II

Test tube number	1	2	3	4	5	6
Volume of solution **A**(cm^3)	2	4	6	8	10	12
Volume of solution **C** (cm^3)	14	12	10	8	6	4
Highest temperature of mixture (^{o}c)						
Initial temperature of solution C (^{o}c)						
Change in temperature ,ΔT (^{o}c)						

(4mrks)

(i) On the grid below ,draw a graph of ΔT(vertical axis)against volume of solution **A** (3mrk)

(ii) From the graph ,determine ;

(i) The maximum change in temperature

(ii)The volume of A required to give the maximum change in temperature (1mrk)

(II) Calculate the

(i)Number of moles of sulphuric (vi) required to give the maximum temperature change. (1mrk)

(II) Molar enthalpy of reaction between sulphuric (vi) acid and substance C in kilojoules per mole of sulphuric (vi) acid. (Specific heart capacity =4.2J/g/k, density of solution =1.0g/cm^3) (2mrks)

2 . You are provided with solid **G**.Carry out the tests below and write your observation and inferences in the spaces provided.

a)Place a third of solid **G** into a dry ,Clean test tube .Heat gently and then strongly .

Observation	inference
(1mk)	(1mk)

b) Place the remaining solid in a boiling tube and add about $10cm^3$ of distilled water and shake well.Divide the mixture into 4 portions

(i) To the 1st portion, add 5drops of sodium hydroxide solution

Observations	inference
(1mrk)	(1mrk)

(ii)Dip one end of a glass rod into the 2nd portion and burn it on a non-luminous flame

Observation	inference
(½ mk)	(½ mrk)

(iii)

a) To the 3rd portion ,add 5 drops of barium nitrate provided .(Retain for use in (iii)b)

Observations	inference
(1mrk)	(1mrk)

b) To the mixture in (iii) a) above, add about $2cm^3$ of dilute nitric (v) acid provided.

Observation	inference
(1mrk)	(1mrk)

(iv)To the 4th portion, add 5drops of acidified potassium dichromate (vi)

Observation	inference
(½ mark)	(½ mrk)

3 You are provided with solid T .Carry out the tests below and record your observations and inference In the spaces provided. a) Using a metallic spatula 1/3 of the solid T on a non-luminous Flame.

Observation	inference
(1mrk)	(1mrk)

b) Place the remaining solid in a boiling tube .Add about $10cm^3$ of distilled water and shake until the solid dissolves . Divide the mixture obtained into 5 portion ,

(i)To the 1st portion, add solid sodium hydrogen carbonate provided.

Observation	inference
(1/2mrk)	(1/2mrk)

(ii)To the2nd portion, add 3 drops of universal indicator.

Observation	inference
(½ mrk)	(½ mrk)

(iii)To the 3rd portion, add 3 drops of acidified potassium manganate (vii)

Observation	inference
(1mk)	(1mrk)

(iv) To the 4th portion ,add 4drops of acidified potassium dichromate (vi)

Observation	inference
(1mrk)	(1mrk)

(v)To the 5th portion, add 4 drops of bromine water.

Observation	inference
(½ mrk)	(½ mrk)

GATUNDU SOUTH SUB-COUNTY FORM FOUR 2015 EVALUATION MARKING SCHEME
233/1
CHEMISTRY MARKING SCHEME.
PAPER 1
(THEORY)

1.

a) Name two properties that makes it possible for the two liquids to be separated. (2mks)
- *Different densities*
- *Are immiscible*

b) Give one alternative method that may be used to separate the two liquids. (1mk)
- *Decantation/use of a dropper*

2. Name the following organic compounds (2mks)

a) *4,5-dimethylhept-2-ene*

b) *butylethanoate*

3. Name the following processes;

a) When anhydrous calcium chloride is left in an open beaker overnight a solution was formed. (1mk)
- *deliquescence*

b) When sodium carbonate decahydrate crystals are left in an open beaker for some days it turned into a powder. (1mk)
- *efflorescence*

4. In 35 seconds, it was found that 140cm^3 of nitrogen (N_2) had diffused through a strip of porous porcelain. How long will it take 400cm^3 of carbon (IV) oxide to diffuse through the same strip of porous porcelain (3mks)

35s ……140cm^3? X = 44
? 400cm^3 100 28

$\frac{35\times400}{140}$ =100sec X =125.4
sec

5.

a) Explain the different positions of red and yellow pigments. (2mks)

- *The red dye is highly soluble and less sticky*
- *The yellow dye is less soluble and highly sticky*

b) What does lines X and Y represent (1mk) *X – base line/origin Y –solvent front*

6. Name the chief ore of iron and write its formula (2mks) *Iron pyrites* *($Fe_2O_3.3H_2O$)*

7.

State and explain the observations made in the experiments; (3mk)

(I) No rusting. Zinc is above iron in the reactivity series
(II) Rusting occurs. Iron is more reactive than copper

8. Compare the atomic sizes of sodium and magnesium. Explain. (2mks)
- *Sodium is larger than magnesium. Magnesium has a higher nuclear charge than sodium and its outer energy level is more attracted towards the nucleus compared to sodium.*

9. The set up below was used to prepare gas X. study it and answer the questions that follow;

a) Name gas X - *nitrogen(II) oxide* (1mk)
b) Write an equation for production of gas X in the set up (1mk)

$HNO_{3\,(aq)} + Cu_{(s)} \longrightarrow Cu(NO_3)_{2\,(aq)} + H_2O_{(l)} + NO_{(g)}$

c) It"s hard to test whether gas X supports burning using a glowing splint. Explain. (1mk) *Readily combines with oxygen to form nitrogen (IV) oxide*

10. When solid M is dissolved in water, it dissolves and forms a blue solution. Addition of ammonia solution to this solution forms a blue precipitate which dissolves in excess to form a deep blue solution. Write the formula and name of the ion responsible for the deep blue solution. (2mks)

$[\quad]^{+2}$

$Cu(NH_3)_4$ tetra-amminecopper (II) ion

11.

a) Identify the bonds labeled M and N. (2mk)

- *M -covalent*
- *N –dative/coordinate*

b) What is the difference between bonds M and N (1mk)

- *Covalent bond involves sharing of electrons donated by both. In dative the shared pair is donated by one*

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

a) Name particles A and B

i) A -beta (1mk) ii) B-gamma (1mk)

b) What property of B makes it not to be deflected by magnetic/electric field (1mk)

- *Has no charge*

13. The table below shows the first ionization energies of elements Y and Z.

Element	Ionization energy kJ/mol
Y	494
Z	418

c) What is ionization energy? (1mk)

- *The minimum energy required to remove **one mole** of electrons from the outermost energy level of atoms in gaseous state.*

d) Which of the two elements is the most reactive? Explain (2mks)

- *Z. lower ionization energy*

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

Cycle/energy diagram ……..

2(-394) +(-286) +1300 =+226kJ/mol

15.

a) Name gas J (1mk)

- *hydrogen*

b) Explain why it"s important to heat the wet sand before heating the iron wool. (1mk)

- To drive out air in the tubes

c) Name the product formed in the combustion tube. (1mk)

- *Tri-iron tetraoxide*

16. An element X has a relative atomic mass of 44. When a current of 0.5 A was passed through the molten chloride of X for 32 minutes and 10 seconds, 0.22g of X were deposited at the cathode

Determine the charge on an ion of X (1F=96,500c) (3mks)

Q=it =0.5× (32×60+10)=965c

965c …… 0.22g

? ……. 44g

193000c

193000 = 2F charge = +2

96500

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

$2NO_{2\,(g)} \rightleftharpoons N_2O_{4\,(g)}$ ΔH = -ve

a) State and explain the observation made when a mixture at equilibrium is heated. (2mks)

- *Brown colour intensifies. The equilibrium shifts to the right to consume the excess heat.*

b)** If pressure is exerted at the mixture at equilibrium, what **observation will be made? (1mk)

- ***Yellow colour intensifies***

18. State and explain the trend in the boiling points of group (VII) elements down the group. (2mks)

- *Increases down the group. Molecular mass and size increases down the group. Intermolecular forces of attraction increases down the group.*

19. The diagram below shows electrolysis of dilute copper (II) sulphate solution using copper electrodes;

a) State the observations made at electrode A and B (2mks)

A- A brown solid is deposited/ mass increases

B- Becomes depleted/ goes into the solution

b) Write the equation of reaction at electrode A (1mk)

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

20. The flow chart shows a process of preparation of salt P.

a) Name salt P. *barium sulphate* (1mk)

b) What type of reaction takes place in the formation of salt P. (1mk)

- *Precipitation/double decomposition*

c) Write the equation for the reaction that forms salt P. (1mk)

$BaCl_{2(aq)} + Na_2SO_{4\ (aq)} \longrightarrow BaSO_{4\ (S)} + 2\ NaCl_{\ (aq)}$

21. The structure of synthetic rubber is shown below;

a) Determine the relative molecular mass of a polymer made of 250 monomers (2mks)
(c=12,H=1 and Cl=35.5)

RFM =88.5

88.5×250=22125

b) Give one advantage of natural polymers over synthetic ones. (1mk)

- *Are biodegradable*

22. 0.92g of ethanol were found to burn in excess air producing a temperature rise of 32.5°C in 200cm^3 of water(C=12.0,H=1.0, O=16.0) Density of water is 1g/cm^3, specific heat capacity of water is 4.2KjKg^{-1}K^{-1}

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

$C_2H_5OH_{\ (l)} + 3\ O_{2\ (g)} \quad 2CO_{2\ (g)} + 3\ H_2O_{\ (l)}$

(b) Determine the molar heat of combustion of ethanol (2mks)

$\frac{200\ kg \times 4.2\ kJ/kg/K \times 32.5K}{1000} = 27.3kJ$

$0.92 \ldots\ldots\ldots\ldots\ldots\ldots 27.3kJ \quad = 1365Kj/mol$

$46g \ldots\ldots\ldots\ldots\ldots\ldots\ldots ?$

23.

a) The formula for cane sugar is ($C_{12}H_{22}O_{11}$). Use an equation to show what happens when sugar is added to conc. Sulphuric (VI) acid (1mk)

$C_{12}H_{22}O_{11\ (s)} \quad H_2SO_{4\ (l)} \longrightarrow 12\ C_{(s)} + 11H_2O_{\ (l)}$

b) What name is given to the type of reaction above? (1mk)

- *dehydration*

c) Calculate the oxidation state of sulphur in sodium thiosulphate ($Na_2S_2O_3$) (1mk)

2+x-6=0 x=+4

24. Iron (III) chloride can be prepared in the laboratory by passing dry chlorine gas over hot steel wool.

a) Name the above method of preparing salts (1mk)

Direct synthesis

b) Why should we prepare the salt in a dry environment? (1mk)

- *Iron (III) chloride reacts with water vapour*

c) A solution of iron (III) chloride in water changes a blue litmus paper to red. Explain. (1mk)

- *Iron (III) chloride is hydrolysed by water to form HCl acid*

25. 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)

Drying agen *collection*

(ii) Identify the following

I: Solid H ($^1/_2$mk)

- *Iron (II) sulphide*

II.Solid J ($^1/_2$mk)

- *Anhydrous calcium chloride*

26. Study the structures below and answer the questions that follow.

a) Which structure represents a detergent suitable for washing in water containing calcium ions? (1mk)

- *A*

b) Give one advantage of continued use of detergent B over A (1mk)

- *biodegradable*

c) Name the process of manufacturing detergent B (1mk)

- *saponification*

27. Aluminium is used in making cooking vessels and overhead cables. State the property of aluminium that makes it suitable for the two uses separately.

Cooking vessels. (½ mk)

- *Malleable/ not easily corroded*

Overhead cables (½ mk)

- *ductile*

(b) Explain why it is not advisable to clean surfaces of cooking vessels made of aluminium using wood –ash solution (2mks)

- *Has a coat of aluminium oxide which is amphoteric which reacts with woodash (basic)*

28. 10g of an oxide of sodium contains 5.9g sodium. Its molar mass is 78. Determine its molecular formula.

Na	O
	NaO
5.9	4.1
	39n =78
0.2565	0.2565 n=2
1	1

29. Differentiate between the terms atomic number and mass number (2mks)

- Atomic number – number of protons
- Mass number- protons + neutrons

GATUNDU SOUTH FORM FOUR 2015 EVALUATION EXAM
233/2
CHEMISTRY
PAPER 2
THEORY
JULY/AUGUST 2015
MARKING SCHEME

1. a) (i) Hydrogen

(ii) Reducing agent

(iii) Tube I $CUSO_4 5H_2O \longrightarrow CUSO_{4(s)} + 5H_2O$

Tube II $3Fe_{(s)} + 4H_2O_{(g)} \longrightarrow Fe_3O_4 + 4H_{2(g)}$

b) (i) Blue solid turns white/colourless liquid; loss of water of crystallization.

Combustion III

Black solid turns brown. copper (ii) oxide reduced to copper metal.

c) (i) To produce steam

(ii) hydrogen

(iii) water

(iv) Decrease the freezing point of water

(v) Hydrogen is flammable

2. a) (i) Metal K - zinc

(ii) Acid A- dilute sulphuric (vi) acid

(iii) Salt C- zinc sulphate

b) (i) A solution that cannot dissolve any more of solute at given temperature.

(ii) Allow crystallization.

(iii) Dip a glass rod when heating. Allow solution on glass rod to cool. Formation of crystal. c) To ensure all the acid have reacted.

d) Filtration: To remove excess metal K.

e) W1 Zinc hydroxide W2 Barium sulphate

S1 Tetra ammine zinc (ii) hydroxide

f) Step I $Zn_{(s)} + H_2SO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + H_{2(g)}$

$Zn(OH)_{2\,(s)} + 4NH_{3(aq)} \longrightarrow (Zn(NH_3)_{4(aq)}^{2+} + 2OH^-_{(aq)}$

3. a (i) It can exist in several forms without change of state.

(ii)

Rhombic	Monoclinic
Octahedral	needle like
Melting point 114° C	melting point 119° C
Stable below 96° C	Stable above 96° C

Any 2 correct answers (iii)

Brown fumes, pale yellow liquid or colourless liquid.

Equation

$S_{(s)} + 6HNO_3 \longrightarrow H_2SO_{4(aq)} + 6NO_{2(g)} + 2H_2O_{(l)}$

b) I. (i) A Sulphur

B Oxygen

(ii) X burner/Roaster Y

Absorption tower

II. (i) Dust particles, carbon (iv) oxide/water vapour

(ii) To avoid poisoning of the catalyst.

(iii) Platinum/vanadium (v) oxide.

(ii) High pressure

Low temperature 400 – 500 °C

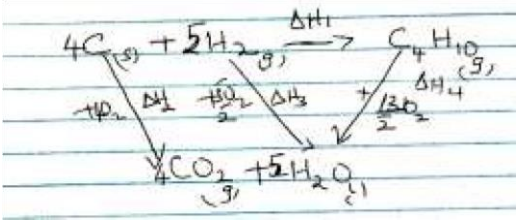
4. a) This is heat absorbed/evolved/heat change when one mole of any substance is formed from its constituent elements. b)

(i) $4C_{(s)} + 5H_{2(g)} \longrightarrow C_4H_{10(g)}$

(ii) $C_4H_{10(g)} + {}^{13}/_2O_{2(g)} \longrightarrow 4CO_{2(g)} + 5H_2O_{(l)}$

c) (i) Hess's law states that the enthalpy change is the same in converting reactant to product regardless of the route followed.

(ii)



(iii) $\Delta H_1 = \Delta H_2 + \Delta H_3 - \Delta H_4$

$4(-393) + 5(-286) – (-2877)$

$= -3002 + 2877$

-125Kj/Mol d) ΔH_1 lattice energy ΔH_2 hydration energy

(ii) $\Delta H_{sol} = \Delta H_{lattice} + \Delta H_{hydration}$

$= 690 + (-322 + -364)$

$= 690 – 686$

4Kj/Mol

5. a) The flask should have been in a sloppy position <u>reason</u> - to prevent water that condenses in the cooler parts from flowing back into the hot flask- method of collection of the dry gas.

<u>Reason</u>; ammonia is less dense than air hence escapes upwards. .

b) Calcium oxide

c) $2NH_4Cl_{(s)} + Ca(OH)_{2(s)} \longrightarrow CaCl_{2(s)} + 2H_2O_{(l)} + 2NH_{3(g)}$

d) (i) Finely divided iron (ii) A NO unit I B NO_2

(ii) $NH_{3(g)} + HNO_{3(aq} \rightarrow NH_4NO_3$

RFM NH_4NO_3 = 14 + 4+ 14 + 48 = 80g

Moles = $\frac{1000,000g}{80}$ = 12,500

Moles of HNO_3 = 12,500 RFM = 1 + 14 + 48 = 63g

12,500 = m/63 63 x 12,500 = 787,500g = 787.5kg

(iii) Easily decomposes in light hence the dark bottles prevent exposure.

6. (i) Cuprite/chalcocite/malachite any 2 correct

(ii) Froth flotation

Use: Concentrate the ores

(iii) $2CuFeS_{2(s)} + 4O_{2(g)} \longrightarrow 3SO_{2(g)} + 2FeO_{(s)} + CU_2S_{(s)}$

b) (i) Anode: Impure copper

Cathode: pure copper

Electrolyte: Copper (ii) Sulpahte

(ii) Anode: $Cu_{(s)} \longrightarrow Cu^{2+}_{(aq)} + 2e$

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

(iv) 64g – 2 moles of e-

1 mole – 96500c

32g 1 mole i.e.

96500 = 10 x t

9650 sec = t c)

- Making copper wires and contact in switches
- making soldering instruments
- Manufacture of alloys
- Making coins and ornaments Any 1 correct

GATUNDU SOUTH FORM FOUR 2015 EVALUATION EXAM

CHEMISTRY PAPER 3 PRACTICAL

MARKING SCHEME

TABLE 1

Complete table ----------1mrk

(i) Complete the table with 3 titrations done –(1mrk)

(ii) Incomplete table with 2 titrations done ---(1/2mrk)

(iii) Incomplete table with 1 titration done –(0mrk)

Penalties

I. Wrong table

II. Inverted table

III. Unrealistic value

Penalize ½ mark for each to a maximum of 1/2mrk

Decimals ----------1mrk

(Tied to the first and second row only)

Conditions

Accept either 1or 2 decimals points used consistently

If the 2 nd decimal point is used . can only be o or 5

Accuracy -------1mrk

Compare any titre value in the 3rd row with the school value (sv)

Conditions

I. If with or $\pm$0.1cm^3 of sv ---1mrk

II. If within $\pm$0.2$cm^3$of sv ---1/2 mark

III. Beyond $\pm$0.2cm^3 of sv -----omrk

NB/ if there is wrong arithmetic in the table compare the sv with the correct value and credit accordingly.

Principle of averaging ----1mrk

Value average must be shown and must be within $\pm$0.2 cm^3 of each other conditions. I.

3 values averaged and consistent -1mrk

II. 3 values done and only 2 possible averaged –1mrk

III. 2 titrations done and averaged -1mrk

IV. 2 titrations done and inconsistent -0mrk

V. 3 titrations done and impossible but only two averaged -0mrk
Final accuracy -1mrk

Compare with the (sv)

I. If within +_0.1 of sv-1mrk
II. If within +_0.2 of sv -1/2mrk
III. If beyond +_0.2 of sv -0mrk

NB// If the candidate has averaged wrong values pick the correct value if any ,average and credit accordingly

(i) 106 of Na_2CO_3 =1mole

8 g x $\frac{8x1}{106}$

=0.0755M Na_2CO_3

ii) In 1000cm^3 of Na_2CO_3=0.0755Moles

in 25 cm3 =$\frac{25x0.0755}{1000}$

=0.00189moles ½

$Na_2CO_{3(aq)} + Na_2CO_{3(aq)}$----------$Na_2SO_{4(aq)} + CO_{2(g)} + H_2O(l)$

Ratio $Na_2CO_3.H_2SO_4$

1 1

0.00189.0.00189 ½

17.0cm^3=0.00189

In 1000cm^3= $\frac{1000x0.00189}{17}$ ½

=0.1112M ½

iv) Concentration of sulphuric (vi) acid

in 1000cm^3 …… 0.1112

250cm^3 ……..?

0.1112 ×250 = 0.0278moles

1000 in 25cm

^{3}=0.0278moles in

1000cm^3= ?

$\frac{0.0278x1000}{25}$=1.112M ½

Conditions

I. If units given they should be correct however if not given ignore.
II. Molarity should be given to at least 3 decimals place otherwise penalize ½ marks for the answer.
III. Numbers of moles should be given to at least 4 decimal places, otherwise penalize ½ mark for answer.

TABLE II

a) Complete table -1mrk

5-6 experiments done -1

4 experiments done -1/2 mark

Less than 4 experiments done -0mrk

Penalties

I. Penalize ½ mark for inverted table
II. Penalize fully for unrealistic temperature readings i.e. Above50^0c or below 10^0c .

Decimals -1mark

The first digit after the decimal must be a zero or 5 otherwise penalize fully.

C) Accuracy -1mark

Accuracy is pegged on the candidate initial temperature reading

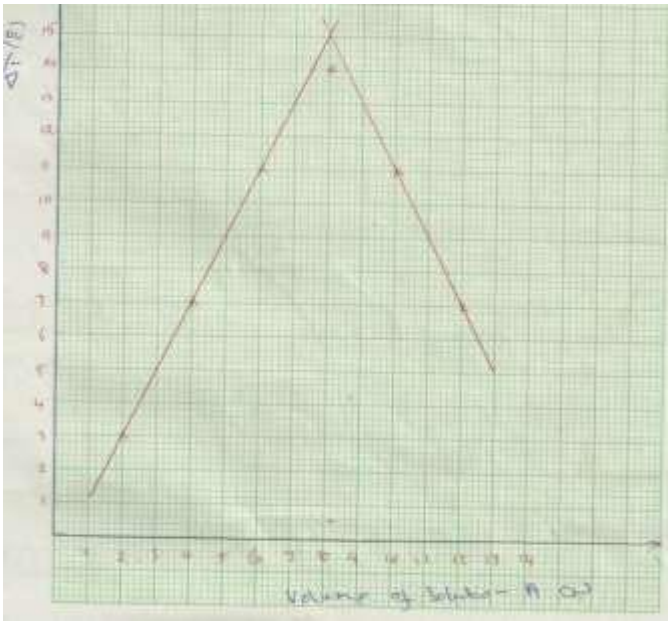
Conditions

I. Award 1 mark if the candidate value is within ±2units the school value.
II. The initial temperature reading should be the same for all the six experiments otherwise penalize fully.

D) Trend -1mrk (tied to ΔT)

I. Award1mark for a continuous rise followed by continuous drop.

II. Award 1mark for a continuous rise, a constant then followed by continuous drop GRAPH- 3mks



a) Labeling – ½ mrk
The vertical and horizontal axis must be correctly labeled with correct unit otherwise penalize fully Scale – ½ mark
The actual plot must cover at least seven big squares on the vertical axis and at least 8 big squares on the horizontal axis, otherwise penalize fully.

b) Plotting
5-6 correct plotted points -1mark
4 correctly plotted points- ½ mark
Less than 4 points plotted – 0mark
Line -1mrk
A straight line showing a continuous rise followed by a line showing a continuous drop.
Condition the two lines must be extrapolated above the last point. I i) The Δt must be read from a correctly drawn graph.
ii) ΔT is correctly shown on the graph but not, award accordingly.
The graph must be extrapolated above the last point.
II The volume of A must be read from a correctly drawn graph .
-The reading must be shown the graph
(iii) I $\frac{\text{Answer in (ii) above x answer (iv) in procedure A}}{100}$ ½
=correct answer 1 ½

II $\Delta H = mc\Delta T$
$= \frac{16}{1000} \times 4.2 \times \Delta T$ (answer (ii)I above)1 ½
=correct answer ½
$= \frac{1 \times \text{correct answer above}}{\text{Answer (iii)I above}}$ ½
=correct answer ½

QUESTION 2-SOLID G

Observations	inferences
a)Colorless droplet on the cooler parts of the test tube 1 mark	Hydrated compound G contain water of crystallization
c) I)No white precipitate 1 mark	Ca^{2+},Mg^{2+},Pb^{2+},Al^{3+}.Zn^{2+},absent 1mrk

II White precipitate.	CO_3^{2-} ,SO_4^{2-},SO_3^{2-} Present (3 ions -1mrk ,2 ions- ½ mark 1 ion –o mark)
I White precipitate dissolves 1mrk	CO_3^{2-},SO_3^{2-} Present 1mrk(2 ions -1mrk,1 ion-0mrk)
Iv) Orange colour of $K_2Cr_2O_7$ Persists ½ mark	CO_3^{2-} present ½ mark

NB// 1 Penalise ½ mark for every contradictory ions to a maximum of I mark .
2 For the inference to be correct ,the observation must be correct .

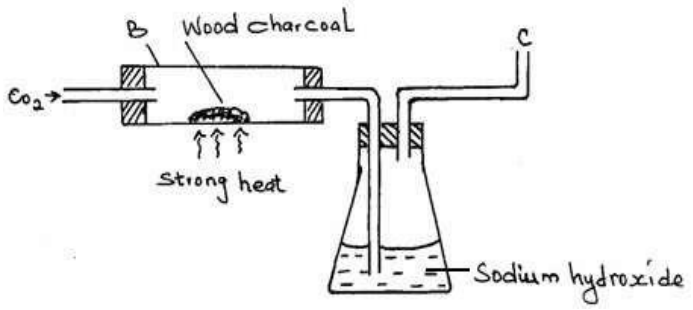
QUESTION 3-Solid T

a) Burns with a smoky /sooty flame ½ mark — C =C ´ present,-C≡C- ½
b) Effervescence /bubbles ½ — -$COOH^-$ present ½
i)PH=4 or 51mrk — Weakly acidic 1mrk
ii) Purple KM_nO_4turns colourless — - C=C- present,-
C≡C- iii) Orange colour of $K_2Cr_2O_7$ — ROH absent
1mrk

NB//1 Penalize fully for- C=C- and C= ~~or~~ H-C=C-C-H and H-C=~~C~~-H
2 The pH value should not be range of values.
3 Penalize fully for weak acid in the inference of b(ii)

KIRINYAGA CENTRAL SUB-COUNTY JOINT EXAMINATION - 2015
Kenya Certificate of Secondary Education
CHEMISTRY
233/1
PAPER 1
(THEORY)
JULY/AUGUST, 2015

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. 20cm³ of a dibasic acid required 25cm³ 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 25cm³ of 0.5M HCl is added to 25cm³ 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)

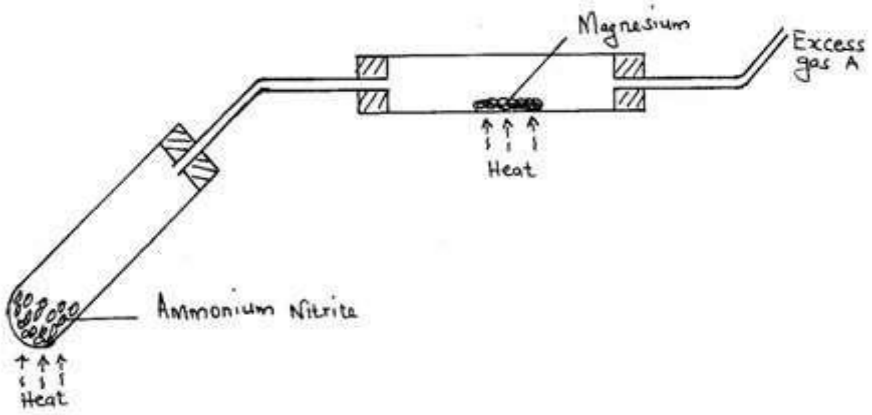
7. The empirical formula of a compound is CH_2 and its molecular mass is 42.

(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)

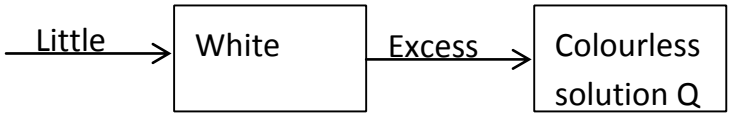
12. Element X contains isotopes with mass number 16 and 18 respectively existing in the ratio1:3 calculate the relative atomic mass of X. (2 marks)

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

RCOO (A) $^{-}Na^{+}$ (RB ) $OSO_3 \square Na \square$

(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.



$Al_2(SO_4)_{3(aq)}$

precipitat

(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.

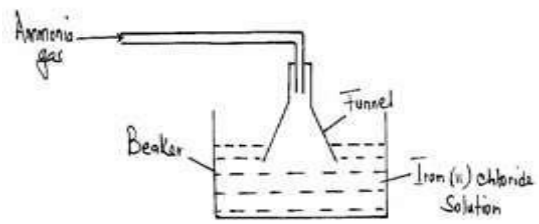
Solution	PH
A	3.5
B	14
C	8.5

(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)

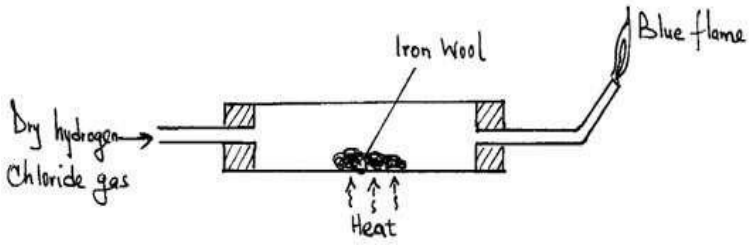
18. The diagram below is a set-up of apparatus used to react ammonia gas with iron (IV) chloride solution.



(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)

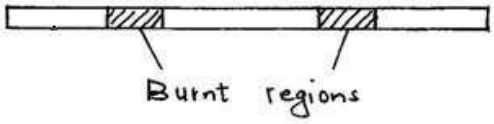
(b) Given that: $2NH_{4(aq)}^{+} + 2e^{-} \rightarrow 2NH_{3(g)} + H_{2(g)} \quad E^{\theta} = 0.74V$

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

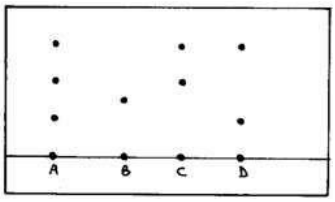
Calculate the e m f of the cell given zinc forms the negative electrode. (1 mark)

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.

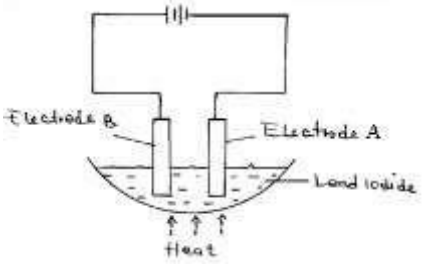


(a) Which two dyes when mixed would produce A? (1 mark)
(b) Which dye is pure? (1 mark)
(c) Indicate on the diagram the solvent front. (1 mark)

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)

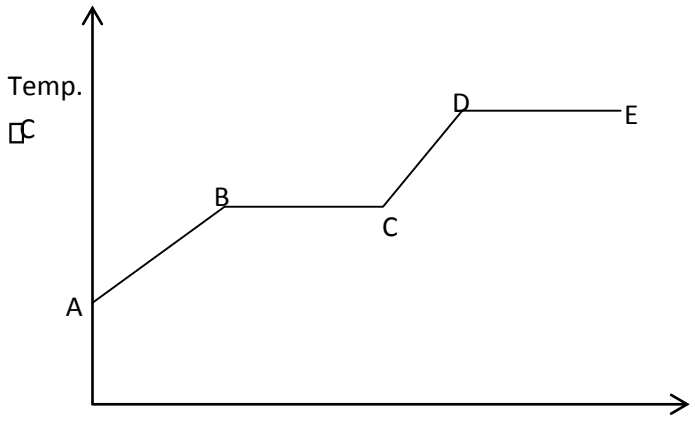
27. The figure below shows a set-up used in electrolysis of lead iodide.



(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.

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

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

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Kenya Certificate of Secondary Education
233/2
CHEMISTRY
PAPER 2
(THEORY)
JULY/AUGUST, 2015

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	
		1st I.E	2nd I.E.
X	2.2	900	1800
Y	2.8.2	736	1450
Z	2.8.8.2	590	1150

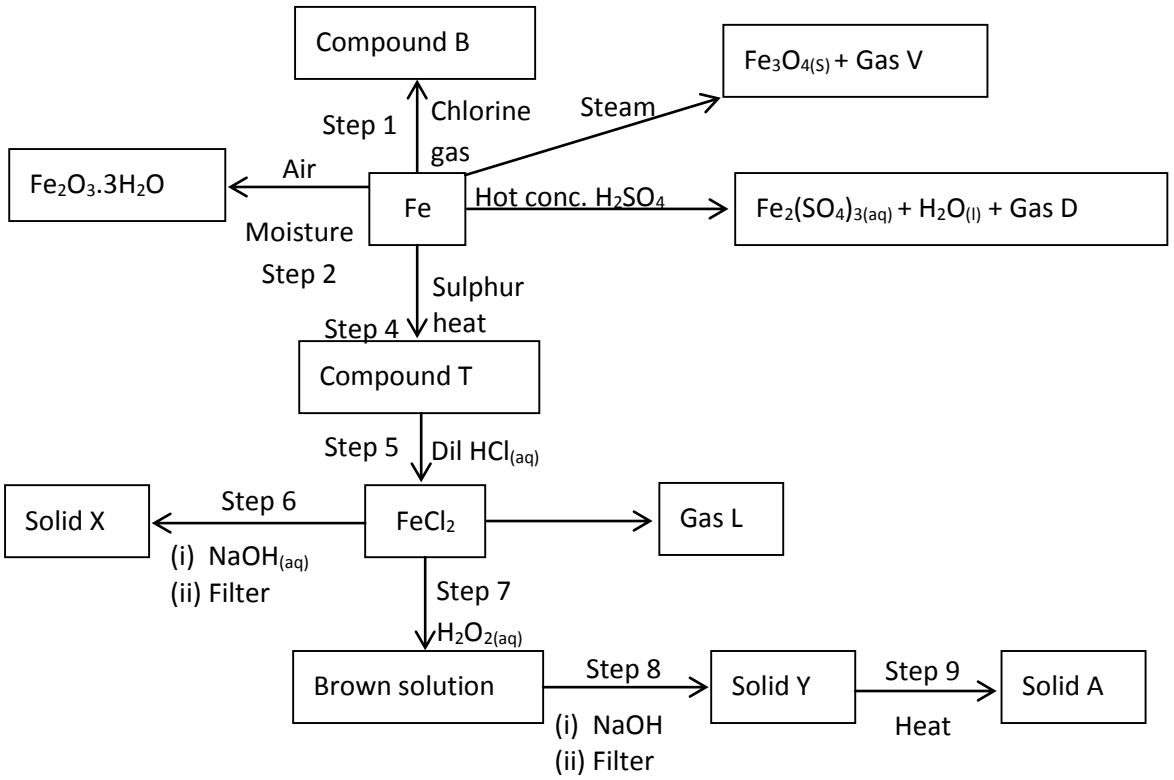
(i) What chemical family does the elements **X**, **Y** and **Z** belongs? (1 mark)

(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)

(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)

(vi) 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)

(iv) 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

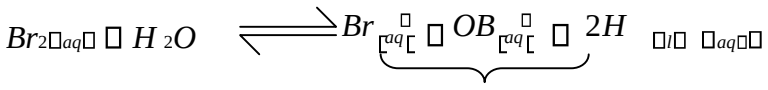
(a) (i) On the grid provided, plot a graph of volume (vertical axis) against time – Label it curve A. (3 marks)

(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 = $24dm^3$, C = 12, O = 16). (3 marks)

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



(Yellow) (Colourless)

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.

			$E^{\ominus}$ (Volts)
$A_{(aq)}^{2+}$	⇌	A $2e^{-}$ (S)	-2.90
$B_{(aq)}^{2+}$	⇌	B $2e^{-}$ (S)	-2.38
$C_{(aq)}^{+}$ e^{-}	⇌	D $2C_{(g)}$	0.00
$D_{(aq)}^{2+}$	⇌	F $2e^{-}$ (S)	+0.34

$1F$ e^{-} $_{(aq)}$ +2.87

2 $_{2(g)}$

—

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

(ii) What is $E^{\ominus}$ of the strongest reducing agent? (1 mark)

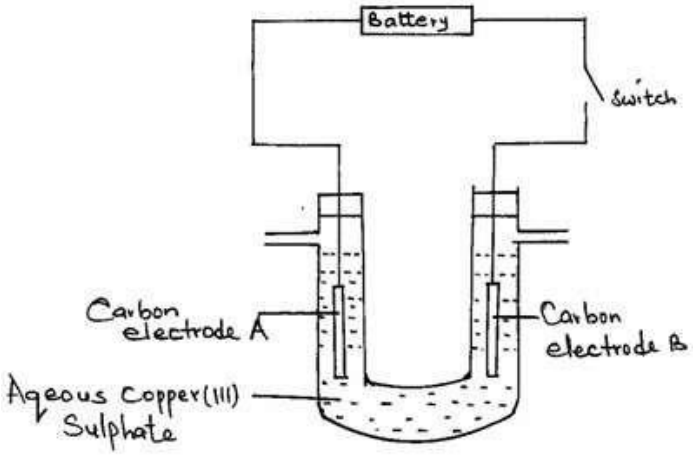
(iii) Calculate the e.m.f of the cell that would be formed when half cells of B and D are combined. (b) (1 mark)

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)



(vi) 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:

$C_{(S)} + O_{2(g)} \rightarrow CO_{2(g)} \quad \Delta H = -393KJ/mol$ 1

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

$\frac{}{2}$

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

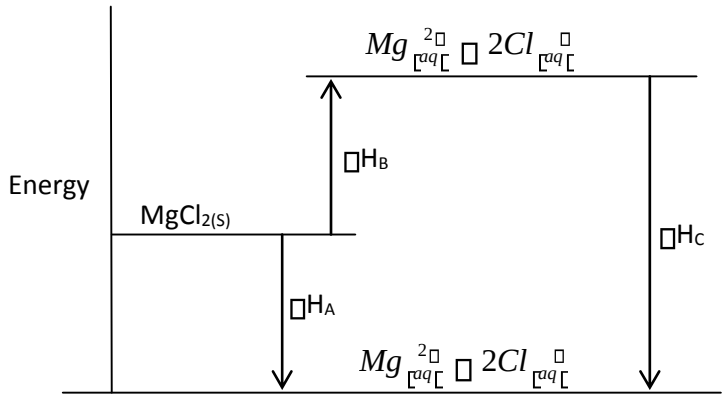
—

(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)

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

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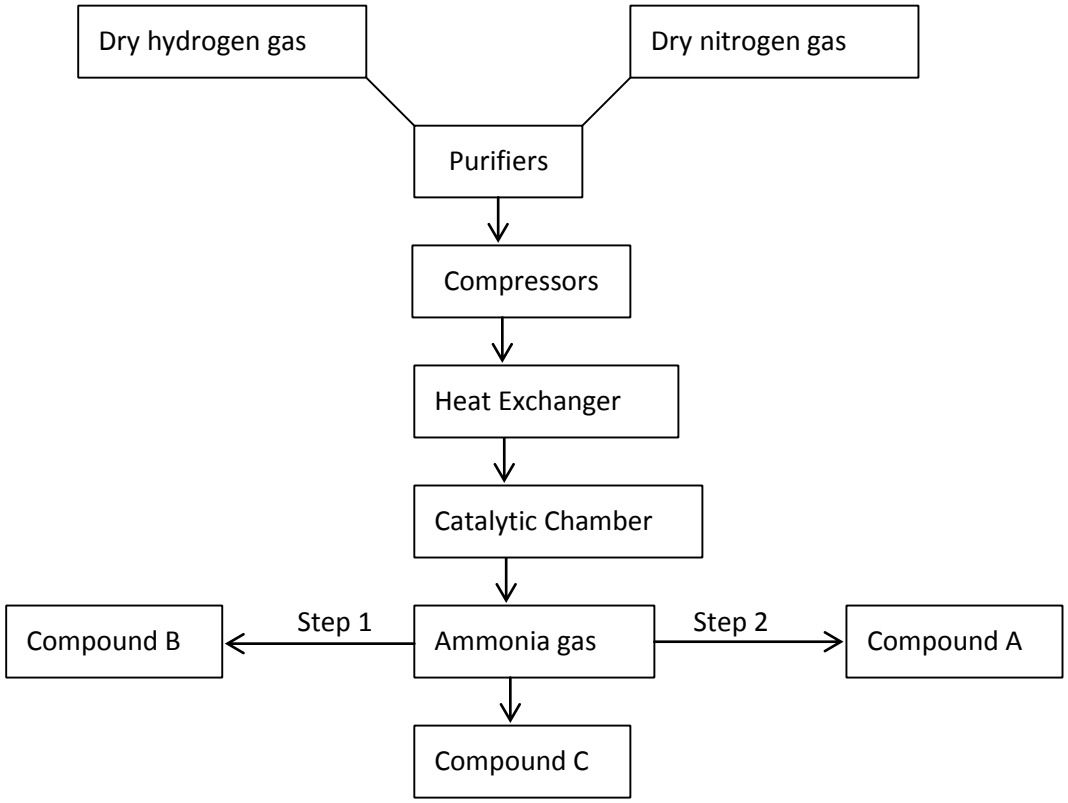
7. The flow chart below shows the large scale manufacture of ammonia gas and some ammonium compounds. Study it and answer the questions that follow.



(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 drop wise then in excess? (2 marks)

KIRINYAGA CENTRAL SUB-COUNTY JOINT EXAMINATION - 2015
233/3
CHEMISTRY
PAPER 3
(PRACTICAL)
CONFIDENTIAL
Each candidate requires:

1. Solution A, 60cm³ of 2.5M HCl
2. Solution B, 100cm³ of 0.05M NaOH
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 $Al_2(SO_4)_3$ (Ratio 1: 1).
17. Pipette filler.
18. Phenolphthalein indicator.
19. 250ml conical flasks (2).
20. 250ml volumetric flask.
21. 1 boiling tube.
22. 1 spatula.

ACCESS TO:

23. Universal indicator solution.
24. Acidified potassium manganate (VII) solution.
25. Bromine water.
26. Conc. Sulphuric (VI) 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.

KIRINYAGA CENTRAL SUB-COUNTY JOINT EXAMINATION - 2015
Kenya Certificate of Secondary Education
233/3
CHEMISTRY
PAPER 3
(PRACTICAL)

JULY/AUGUST, 2015

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)	$\frac{1}{t}$
12	0			
10	2			
8	4			
6	6			
4	8			

(4 marks)

(a) Plot a graph of $\frac{1}{t}$ (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 mark)

(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 10cm³ 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)

(iv) 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.

Observation	Inference
(1mk)	(½mk)

KIRINYAGA CENTRAL SUB-COUNTY JOINT EXAMINATION - 2015

233/1 CHEMISTRY PAPER 1 MARKING SCHEME

1. (a) A 2, 8, 2 (1mk)
B2, 8, 7
(1mk) (b) AB_2 (1mk)

2. (a) NO_2 (1mk) (b) CuO (1mk)

3. (a) Moles of NaOH $\frac{25}{1000} \times 0.1$ (½mk) = 0.0025 (½mk) (1mk)

(b) $H_2X_{(aq)} + 2NaOH_{(aq)} \rightarrow Na_2X_{(aq)} + 2H_2O_{(l)}$

Mole ratio H_2X: NaOH = 1: 2 (½mk)

Moles of $H_2X = \frac{1}{2} \times 0.0025$ (½mk) = 0.00125

$$\frac{00125 \times 1000}{20}^{0.}$$

Concentration in moles per litre (½mk)

= 0.0625 (½mk) (2mks)

4. (a) $CO_{2(g)} + C_{(S)} \rightarrow 2CO_{(g)}$ (1mk)
(b) To absorb the excess/unreacted CO_2 (1mk)
(c) A blue flame would be produced (1mk)
5. (a) Dehydrating agent (1mk)
(b) Oxidising agent (1mk)
6. (a) 50 x 4.2 x (26 – 23) (½mk) = 630J (½mk)
(b) $\frac{25}{1000} \rightarrow 0.5$mol H^+ give 630J (½mk)

0.0125 mol of H^+ give 630J

$\rightarrow$ 1 mole of each $\rightarrow \frac{1}{00125} \rightarrow 630$ (½mk) = 5040KJ (½mk)

0.

$\Delta H_{sol} = -50.4$KJ mol^{-1} (½mk)

7. (a) CH_2 → 12 + 2 = 14

MF = $(CH_2)_n$

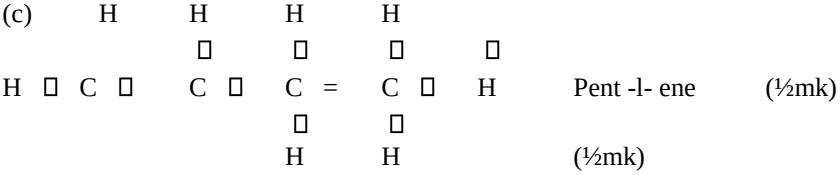
$n \rightarrow \frac{42}{14} \rightarrow 3$ (½mk)

MF = $(CH_2)_3$

= C_3H_6 (½mk)

(b) Alkenes (1mk)

(c)



Pent -l- ene (½mk)

(½mk)

8. (a) Magnesium would react with air in the combustion tube since nitrogen gas has not yet been produced. (1mk) (b) Nitrogen gas (1mk)

(i) $3Mg_{(S)} + N_{2(g)} \rightarrow Mg_3N_{2(S)}$ (1mk)

9. (i) Calcium chloride. (1mk)

(ii) It is economical, (½mk) less fuel is used hence low cost of production. (½mk)

(iii)

- Sodium – potassium alloys is used as coolant in nuclear reactors. (1mk) - Manufacture of sodium cyanide which is used in extraction of gold.
- Manufacture of sodium peroxide, sodium amide etc.
- In street light to produce yellow glow.

10. (i) Equilibrium shift to the right. (1mk)
(ii) Shift to the right. (1mk)
(iii) Shift to the left (equivalent to increase in pressure) (1mk)

11. The rate of diffusion of a gas at constant pressure and temperature is inversely proportional to the square root of it density. (1mk)

(b) $\frac{T_{SO_2}}{T_{O_2}} \rightarrow \frac{M\sqrt{M\,SO_2}}{\sqrt{M.M\,O_2}}$

Time taken for 100cm³ of oxygen gas to diffuse.

$\frac{20}{TO_2} = \frac{\sqrt{64}}{\sqrt{32}}$ (½mk)

$TO_2 = \frac{20\sqrt{32}}{\sqrt{64}} = \frac{20 \times 5.6568}{8}$

= 14.1425 (½mk)

Volume = $\frac{100 \times 30}{14.142}$ (½mk)

= 212.134 sec (½mk)

100cm³ of O_2 → 14.142 sec

?? → 30 sec

→ 1 → → 3 →

12. → → 16→ → → → 18→ (1mk) = 4 + 13.5 = 17.5 (1mk)

→ 4 → → 4 →

13. (a) B – Soapless detergent (1mk)
(b) B (1mk); It lathers easily with hard water. (1mk)

14. (a) $Al_{(aq)}^{3+} + 3OH_{(aq)}^{-} \rightarrow Al(OH)_{3(s)}$ (1mk)

(b) $Al(OH)_4^-$ (1mk)

15. (i) A (1mk)
(ii) C (1mk) it is weakly alkaline hence will neutralize excess acid in the stomach. (1mk)

16. Add excess lead (II) carbonate to nitric (V) acid (½mk).
Filter the excess carbonate. (½mk) Add dilute sulphuric (VI) acid to the filtrate. (½mk)
Filter to obtain lead (II) sulphate as residue. (½mk) Rinse the residue with distilled water (½mk) and allow to dry. (½mk)

17. (a) $38 \propto t \propto \frac{1}{12} \propto 192 \propto t^2 \propto 96 \propto t^2 \propto 48$ (1mk)

$3t_{12} = 540 \text{ days} \quad t_{12} = \frac{540}{3} = 180$

days (1mk)

(b) Uses of radio isotopes in industries
- Quality control in metal sheets, paper
- Detection of flaws in pipes. (1mk)

18. (a) A green precipitate is formed. (1mk)
(b) To prevent sucking back/.To increases the surface area for absorption of the gas. (1mk)

19. (a) Mass of $KClO_3$ = 14g
Mass of water = 26g (½mk)
14g of $KClO_3$ → 26g of water
? → 100g of H_2O

$\frac{14 \times 100}{26}$ (1mk) = 53.846g/100g of H_2O (½mk)

(b) Advantages of hard water
- Ca^{2+} are useful for development of strong bones and teeth. (1mk)

20. (a) A green solid was formed (1mk)

(b) (i) $2HCl_{(g)} + Fe_{(S)} \rightarrow FeCl_{2(S)} + H_{2(g)}$(1mk)

(ii) $2H_{2(g)} + O_{2(g)} \rightarrow 2H_2O_{(g)}$ (1mk)

21. (a) (i) Electrolyte for facilitating flow/movement of ions from one electrode to the other. (1mk)

(ii) Oxidizing hydrogen gas liberated to prevent polarization of the cell and enable contact with electrolyte for electron flow in the external circuit to be achieved. (1mk)

(b) (0.74 + 0.76)V = 1.5V (1mk)

22. (a) $Pb_{2S} + SO_{4aq2} \rightarrow PbSO_{4S}$ (1mk)

(b) Moles of Pb used $\frac{1.26}{207}$ (½mk) = 0.006087

Moles of Pb $(NO_3)_2$ produced = 0.006087

R.F.M of $PbSO_4$ = 207 + 32 + 64 = 303 (½mk)

Moles of $PbSO_4$ = 0.006087

Moles of $PbSO_4$ = 0.006087 x 303 (½mk)

= 1.844g (½mk)

23. The middle part was not burnt because it was in the region of the unburnt gases. (1mk)

The ends were burnt because of complete combustion of the gas at the ends which were hot. (1mk)

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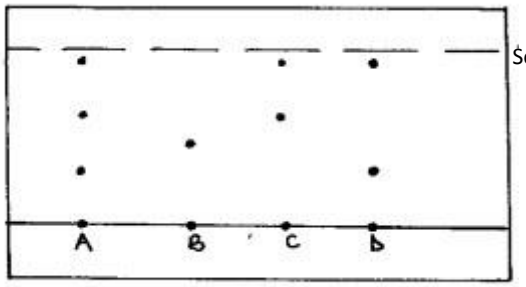
24. (a) C and D (1mk)

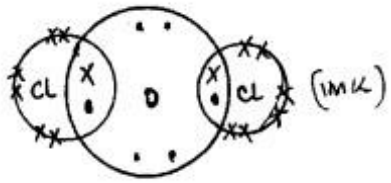
(b) B (1mk)

(c)



Solvent front (1mk)

25.



(b) Has simple molecular structure (1mk) and weak van der waal"s forces between molecules (1mk) that require little heat to break.

~~*J K L M*~~ st and last correct only (1mk) 26. All correct (2mks) 1 *decrea*sin *g reactivity*

27. (a) To melt lead iodide for it to conduct electricity (1mk)

(b) $2I_{l} \rightarrow I_{2g} + 2e$ (1mk)

(c) Electrode A (1mk)

28. Na_2SO_4 H_2O

Mass	1.42	1.8 (½mk)
No of moles	$\frac{1.42}{142}$ = 0.01	$\frac{1.8}{18}$ 0.1 (1mk)
Ratio	$\frac{0.01}{0.01}$	1 $\frac{0.1}{0.01}$ 10 (½mk)

Formular = Na_2SO_4 .$10H_2O$

= 10 (1mk)

29. (a) (i) Particles gaining kinetic energy, temperature increasing. (1mk)

(ii) Particles rearranging themselves as they change from liquid to gas and all the heat supplied used for this rearrangement and no temperature rise occurs. (1mk)

(b) Melting point of naphthalein. (1mk)

30. O.N of Cr in $Cr_2O_7^{2-}$ 6 (½mk)

O.N of Cr in CrO_4^{2-} 3 (½mk)

Cr has undergone reduction from +6 to +3 (1mk)

KIRINYAGA CENTRAL SUB-COUNTY JOINT EXAMINATION - 2015

233/2 CHEMISTRY PAPER 2 MARKING SCHEME 1.

(a) (i) A ½✓and G ½✓

The ionic radius is greater than the atomic radius ✓1

(ii) The oxide of E contains strong electrostatic forces ✓1 since it is ionic while the oxide of G has weak intermolecular forces ✓1 // van der waals forces since it is molecular.

(iii) B and A. ✓1

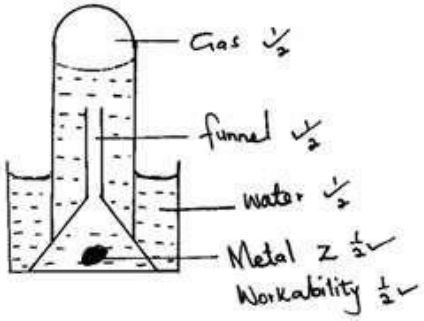
B is the most reactive metal while A is the most reactive non metal ✓1 // B has the largest atomic radius so loses electrons most readily while A has the smallest atomic radius so it gains electrons most readily.

(b) (i) Alkaline – earth metals ✓1

(ii) The amount of energy required to remove ✓1 an electron from an atom when in gaseous state. ✓1

(iii) 2nd ionization energy involves removal of an electron from a positively charged ion ½✓ while 1st ionization energy involves removal of an electron from a neutral atom. ½✓

(iv)



2. (a) D – Sulphur (IV) oxide // SO_2 ½✓

L – Hydrogen sulphide // H_2S ½✓

V – Hydrogen // H_2 ½✓

(b) (i) Compound B – Iron (III) chloride // $FeCl_3$ ½✓

(ii) Compound T – Iron (II) sulphide // FeS ½✓

(iii) Solid A – Iron (III) oxide // Fe_2O_3 ½✓

(iv) Solid Y – Iron (III) hydroxide // $Fe(OH)_3$ ½✓

(v) Solid X – Iron (II) hydroxide // $Fe(OH)_2$ ½✓

(c) Rusting ½✓

(d) Green ✓1

(e) Step 1 $2Fe_{(s)} + 3Cl_{2(g)} \rightarrow 2FeCl_3$ ✓1

Step 5 $FeS_{(s)} + 2HCl_{(aq)} \rightarrow 2FeCl_{2(aq)} + H_2S_{(g)}$ ✓1

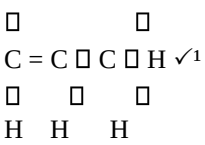
(Penalise ½mk for wrong or missing state symbols)

(f) An oxidizing agent ✓1

3. (a) (i) I Q – C_3H_6 // CH_2 $CHCH_3$ ✓1

II P – C_4H_{10} // CH_3 CH2 CH_2 CH_3✓1

(ii)



(iii) Polypropene ✓1

(iv) Pollutes the environment ✓1 (as it is non-biodegradable)

(v) Alumina // Al_2O_3 ✓1 or Silica // SiO_2

(b) (i)

	Carbon	Hydrogen	Oxygen	
%	64.86	13.51	100 – 78.37 = 21.63	½✓
Moles	$\frac{64.86}{12} = 5.405$	$\frac{13.51}{1} = 1351$	$\frac{21.63}{16} = 1.352$ ½✓	
Moles	$\frac{5.405}{1.352} = 4$	$\frac{13.51}{1.352} = 10$	$\frac{1.352}{1.352} = 1$	½✓

Empirical formula = $C_4H_{10}O$ ½✓

$(C_4H_{10}O)_n$ = 74n

74 ½✓

= 74

n = 1

Molecular formula = $C_4H_{10}O$ ½✓

(ii) Alkanols // Alcohols ✓1

(iii) $2C_4H_{10}O_{(l)} + 2Na_{(S)} \rightarrow 2C_4H_9ONa_{(aq)} + H_{2(g)}$ ✓1

(iv) Displacement ✓1

(v) Butanoic acid ✓1

4. (a) (i) Plotting – All points correctly plotted = (1mk)

9 points correctly plotted = (½mk)

≤9 = (0mk)

Axes + scale – Maximum = (1mk)

Curve – Should be smooth = (1mk)

(ii) $\frac{280 - 180}{40 - 25}$ ✓1 $\times \frac{100}{15} = 6.67 cm^3/s$

To be marked consequentially from students graph.

- Penalize ½mk for wrong or missing units.

(iii) Curve B to be on the right of curve A and levelling at 480cm³ but later than A. ✓1

(iv) $MCO_{3(S)} + 2HNO_{3(aq)} \rightarrow M(NO_3)_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$ ✓1

Moles of CO_2 produced $= \frac{480}{24000}$ ½✓ = 0.02

Moles of MCO_3 = 0.02 ½✓

0.02 mol MCO_3 = 2.5g

1 mol (molar mass) $= \frac{2.5 \times 1}{0.02} = 125$ ½✓

M + 12 + 48 = 125

M = 125 – 60 = 65 ½✓

(b) The yellow colour fades ½✓ // Decolourisation of the mixture. Adding sodium hydroxide lowers the concentration of H^+ ions. ½✓ This makes equilibrium to shift to the right ½✓ i.e. forward reaction is favoured lowering concentration of yellow Br_2 ½✓ molecules.

5. (a) (i) C // C_2 ✓1 Reject C^+

It has an $E^\ominus$ of zero ✓1 // Being used as the standard electrode.

Reject – It has no e.m.f.

(ii) -290V ✓1 Reject A or A2+

(iii) E_{cell} = $E_{red} - E_{ox}$

= +0.34 - -2.38 ½✓

= +2.72V ½✓

(b) (i) B ✓1

(ii) $4OH^-_{(aq)} \rightarrow 2H_2O_{(l)} + O_{2(g)} + 4e$

(iii) Becomes acidic ✓1 // PH lowers, reduces H^+ ions remain in solution as OH^- ions are discharged. ✓1 (iv)

$Cu_{(s)} \rightarrow Cu^{2+}_{(aq)} + 2e$

(c) Q = It

= 0.2 x 5 x 60 x 60 ½✓

= 3600C

$Cu^{2+} + 2e^- \rightarrow Cu$ ½✓

64g → 2 x 96500C y → 360C y

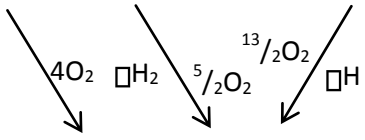
= $\frac{360 \times 64}{2 \times 96500}$ ½✓ = 1.194g ½✓

The cathode increased ½✓ in mass by 1.194g.

6. (a) Energy change in converting reactants A and B to products C and D is the same regardless of ✓1 the route by which the chemical change occurs provided that the initial and final conditions are the same.

(b) (i)

$4C_{(S)} + 5H_{2(g)} \rightarrow C_4H_{10}$



Cycle – (1mk)

Direction of arrows - (½mk)

(ii) $\Delta H_1 - \Delta H_3 = \Delta H_2$ ✓1

$\Delta H_1 = 4(-393) + 5(-286)$

$= -1572 - 1430$

$\Delta H_2 = -3002 - -2877 = -125KJ/mol$ ✓1

(c) Hydration energy is the enthalpy change when gaseous ions are hydrated by water. ✓1Lattice energy is the enthalpy change that occurs when one mole of a crystal structure is formed from its gaseous ions. ✓1

(d) (i) A – Heat of solution ½✓

B – Lattice energy ½✓

C – Hydration energy ½✓

(ii) $\Delta H_A = \Delta H_B + \Delta H_C$ ½✓

(OR any other appropriate form)

(e) Heat value of a fuel is the amount of heat energy produced when a unit mass of a fuel is completely burnt in oxygen. ✓1

(f)

- Environmentally friendly.
- Easy to transport and store.
- High calorific value.
- Readily available.
- Cheap.
- Non-poisonous.
- Burns slowly.

Any two @ (1mk)

7. (a) (i) Hydrogen – Natural gas – e.g. Methane ✓1
- Crude oil
- Electrolysis of acidified water or brine

(ii) Nitrogen - Fractional distillation of liquid air. ✓1

(b) (i) Compressor – Pressure of 200 – 500 atm. ✓1 (ii) Catalytic chamber – Temperature of 400 - 500°C. ✓1
- Finely divided iron.

(c) To compress the gases to high pressure which favour high yield of ammonia. ✓1

(d) $2NH_{3(g)} + H_2SO_{4(aq)} \rightarrow (NH_4)_2SO_{4(aq)}$ ✓1

(e) NH_4NO_3 ✓1

(f) $(NH_4)2SO_4 = 132$ ✓1

% of N $\frac{28}{132} \times 100 = 21.2\%$ ✓1

(g) A pale blue precipitate on addition of a few drops ✓1 precipitate dissolves in excess of C to form a deep blue solution. ✓1

KIRINYAGA CENTRAL SUB-COUNTY JOINT EXAMINATION - 2015
233/3
CHEMISTRY
PAPER 3 (PRACTICAL)
MARKING SCHEME
QUESTION 1

TABLE I (4mks)

	I	II	II
Final reading (cm^3)	12.5	25.0	12.5
Initial reading (cm^3)	0.0	12.5	0.0
Volume used (cm^3)	12.5	12.5	12.5

Marks distributed as follows.

(a) Complete table (1mk)

3 titrations done = (1mk)

Incomplete table with 2 titrations = (½mk)

Incomplete table with one titration done = (0mk)

Penalties

- Wrong arithmetic.
- Inverted table
- Unrealistic titre values (unless explained)

Penalize (½mk) for each to a maximum of (½mk)

(b) Decimal place (1mk)

- Accept only 1 or 2d.p used consistently, otherwise penalize fully.
- Accept inconsistency in the use of zeros as initial burette reading e.g. 0.0, 0.00 or 0.000.

NB: Decimal place tied to 1st and 2nd rows only.

(c) Accuracy (1mk)

- Compare candidates titre value with school value S.V. If one value within ± 0.1 of S.V (1mk)

No value within ± 0.1 of S.V but at least 1 value within ± 0.2 of S.V ± (0mk)

No value within ± 0.2 ± (0mk)

NB: If there is arithmetic error, compare S.V with correctly worked out titre value and award accordingly.

(d) Averaging (1mk)

Values averaged must be shown.

If 3 consistent titrations done and averaged = (1mk)

If 3 titrations done but only 2 are consistent and averaged = (1mk)

If only 2 titrations done, are consistent and averaged = (1mk) Otherwise penalize fully.

CALCULATIONS

(a) $\frac{12.5 + 12.5 + 12.5}{3}$ ½✓= 12.5cm^3 ½✓

(b) (i) Moles in 250cm^3 ± $\frac{0.5}{40}$ 0.0125 *moles* ½✓

$\frac{0125 \times 25^{0.}}{250}$

Moles used = ½✓ = 0.00125 moles ½✓

(ii) Moles of acid reacting = 0.00125 ½✓ (mole ratio 1:1)

12.5cm³ □ 0.00125

250 □ ?

$$\frac{0125 \times 25^{0.}}{250}$$

½✓ = 0.025 moles ½✓

(iii) Molarity of solution A

10cm³ = 0.025

moles 1000 = ?

$\frac{1000 \times 0.025}{10}$ ½✓ = 2.5 moles ½✓

PROCEDURE II

TABLE II

(7 marks)

Volume of Solution A (cm^3)	Volume of distilled water (cm^3)	Concentration of solution A (moles/l)	Time(s)	$\frac{I}{\square_1 \square \square S}$ $\frac{}{t}$
12	0	2.5	25.27	0.0363
10	2	2.08	34.25	0.0292
8	4	1.67	45.45	0.0220
6	6	1.25	69.44	0.0144
4	8	0.83	120.01	0.0083

(4mks) Complete table □

Decimal places (tied to 3rd and 5th column). (1mk)

Accuracy (tied to row (i) to (iv)) (1mk)

Trend (Gradual increase in time) (1mk)

Questions

(b) (i) Read from graph (1mk)

Value of $\frac{I}{\overline{t}}$ (½mk)

Correct answer (½mk)

(ii) Increase in concentration increases the rate of reaction. ✓1

2. (a)

Observation	inference
- Colourless liquid condenses at cooler parts of test tube ✓ - Gas evolved turns red litmus blue ✓ - A white residue remains ✓ (Any two) (1mk)	- Hydrated salt ✓ - $NH\square_4$ *ions*✓ Any two correct ions award (1mk)
(b) (i) - Solid dissolves ½✓ to form a colourless solution ½✓	Mg^{2+}, Al^{3+}, Zn^{2+} present □ any one Or Cu^{2+}, Fe^{2+}, Fe^{3+} absent (½mk)

(ii)

(iii)	White precipitate is formed ½✓ (½mk)	CO_3^{2-}, SO_3^{2-}, Cl^-, CO_3^{4-} present Any two correct ions award (½mk) Penalize the (½mk) for any contradictory ion.
(iv)	A white precipitate forms (½mk)	SO_4^{2-} ions confirmed (½mk)
(v)	White precipitate ½✓ dissolves in excess to form a colourless solution ½✓	Zn^{2+} ✓, Pb^{2+} ✓ or Al^{3+} ✓ Ions present Any 3 ions – (1mk) 2 ions (½mk) 0mk for any only one ion
(vi)	White precipitate ½✓ Insoluble ½✓ in excess	Pb^{2+}, Al^{3+} present Both ions (1mk) One ion (½mk)

3. (a)

A white precipitate ½✓ dissolves ½✓ on warming.	Pb^{2+} ions present ½✓

Observation inference

Dissolves to form ½✓ a colouless homogenous solution ½✓ Polar substance ½✓

(b) (i)

Observation	inference
PH value 1 – 3 ½✓ (specify)	Strong acid present ½✓

(ii)

Observation	Inference
Purple acidified $KMnO_4$ decolorised ✓1	Inference C = C , C C C OR –OH present

(iii)

Observation	Inference
Bromine water decolourised ✓1	C = C , C C C Or –OH present All three (1mk) Two only (½mk)

(iv)

Observation	Inference
Effervescence ½✓	R C (=O) OH ½✓ Present

(v)

Observation	Inference
Sweet smelling Compound formed ✓1	R C (=O) OH ½✓ Present

KASSU JOINT EXAMINATION TEST
(The Kenya Certificate of Secondary Education)
233/1
CHEMISTRY
Paper 1

1. What is the importance of the shape of a conical flask? (1 mark)
2. A mixture consists of sulphur powder and iron filings.
(i) Describe how to obtain sulphur from the mixture using methylbenzene. (2 marks)
(ii) Is the mixture homogeneous or heterogeneous? Explain. (1 mark) 3. Nitrogen gas can be prepared in the laboratory using a mixture of ammonium chloride solution and sodium nitrite solution.
(a) The reaction occurs in two steps. State the two steps in the correct order. (2 marks)
(b) State two uses of nitrogen. (1 mark) 4. (a) Draw structural formulae of two positional isomers with molecular formula C_4H_8. (2 marks) (b) Study the equation below and answer the questions that follow. $C_6H_{14} + Cl_2 \longrightarrow C_6H_{13}Cl + HCl$
(i) State the condition under which this reaction occurs. (1 mark)
(ii) Give the general name of this type of reaction. (1 mark)
5. (a) Define hydration energy. (1 mark) (b) Given that: the hydration energies of Ca^{2+} and Cl^- are -1891 kJ mol^{-1} and -384 kJ mol^{-1} respectively, and that the lattice energy of calcium chloride is +2237 kJ mol^{-1}.Calculate the molar enthalpy change of solution of calcium chloride. (3 marks)
6. The standard electrode potentials of a metal G and iron are given below.
$Fe^{2+}(aq) + 2e \longrightarrow Fe(s)$ -0.44V
$G^{2+}(aq) + 2e \longrightarrow G(s)$ -0.91V
A piece of iron is coated with metal G. If the coating is scratched, would the iron be protected form rusting? Explain. (3 marks)
7. (a) Why is the percentage of carbon (IV) oxide in the atmosphere fairly constant? (1 mark)
(b) Calculate the volume of carbon(IV)oxide in 8,000 m^3 of air contained in a hall. (2 marks) 8. State two conditions that would make the boiling point of water to be higher than 100°C. (2 marks)
9. Explain the effects of the accumulation of nitrogenous compounds in water masses? (2 marks)
10. Study the table below and use it to answer the questions that follow. (The letters do not represent the actual symbols of the elements).

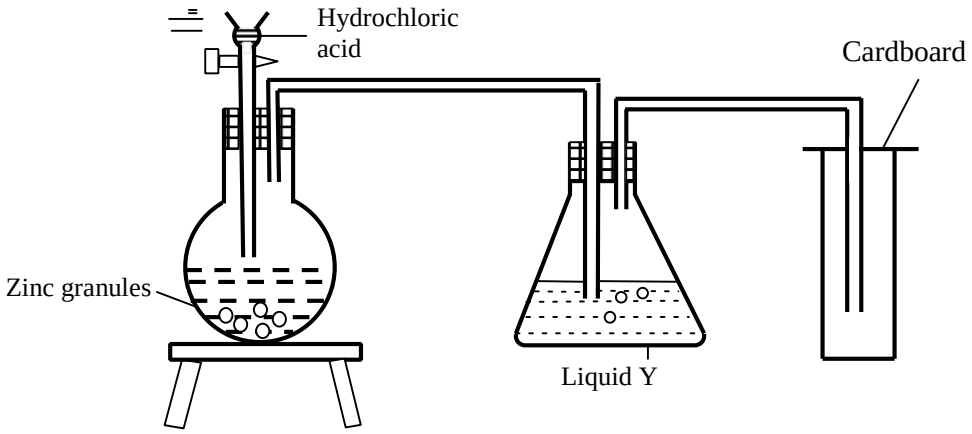
Element	Q	R	S	T	U
Atomic number	5	20	3	18	5
Atomic mass	10	40	7	40	11

(a) Select two letters that represent the same element? Give a reason. (2 marks)
(b) Give the number of neutrons in an atom of element S. (1 mark)
11. Dry carbon (II) oxide gas was passed over heated lead (II) oxide.
(a) Write an equation for the reaction. (1 mark)
(b) Give one industrial application of the above reaction. (1 mark)
(c) Name another gas that can be used in the above reaction. (1 mark)
12. (a) Proteins are obtained from amino acids monomers. Complete the equation below to show the polymer formed. (1 mark)

2 2 2 3 H

(b) Name the type of polymerization shown above. (1 mark)
13. The set up below was used to prepare dry hydrogen gas. Study it and answer the questions that follow.

NCH COOH + H NCHCH COOH ⟶



(i) With a reason, identify the mistake in the set-up above. (1 mark)

(ii) What would be liquid Y? (1 mark)

(iii) Give two physical properties of hydrogen gas (1 mark)

14. Study the following equilibrium equation.

$2X_2(g) + Y_{2(g)} \rightleftharpoons 2X_2Y_{(g)}$ $\Delta H = -197kJ/mol$

(a) Suggest two ways of increasing the yield of X_2Y. (1 mark)

(b) Draw the energy level diagram for the forward reaction. (2 marks)

15. 5.0g of calcium carbonate were allowed to react with $25cm^3$ of 1.0M hydrochloric acid until there was no further reaction. Calculate the mass of calcium carbonate that remained unreacted. (3 marks)
(Ca = 40, C = 12, O = 16)

16. (a) State Graham"s law of diffusion. (1 mark)

(b) $50cm^3$ of Carbon (IV) Oxide diffuses through a porous plate in 15 seconds. Calculate the time taken by $75cm^3$ of Nitrogen (IV) Oxide to diffuse through the same plate under similar conditions. (C = 12, 0 = 16, N = 14) (2 marks)

17. A student fetched water from a river in a limestone area. He used it for washing and realized that it did not lather easily. (i) Name the two ions that prevent lathering. (1 mark)

(ii) Given that the structure of soap is $C_{17}H_{35}COONa$.
Explain by means of ionic equations how the above ions prevent lathering. (2 marks)

18. A student burnt magnesium ribbon in a gas jar full of sulphur (IV) oxide gas.

(i) State two observations made in the gas jar. (2 marks)

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

19. M grams of a radioactive isotope decayed to 5 grams in100 days. The half-life of the isotope is 25 days.

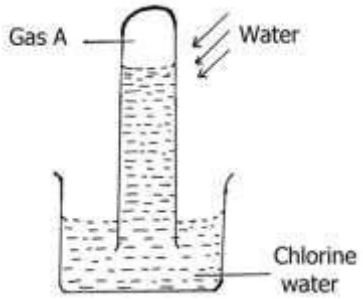
(a) What is meant by half life? (1 Mark)

(b) Calculate the initial mass M of the radioactive isotope. (2 Marks)

20. (i) With the aid of a well labeled diagram, show that the innermost region of a non-luminous flame consist of unburnt gas. (1½ marks)

(ii) Highlight the steps followed when lighting a Bunsen burner. (1½ marks)

21. The diagram below shows an experiment involving chlorine water.

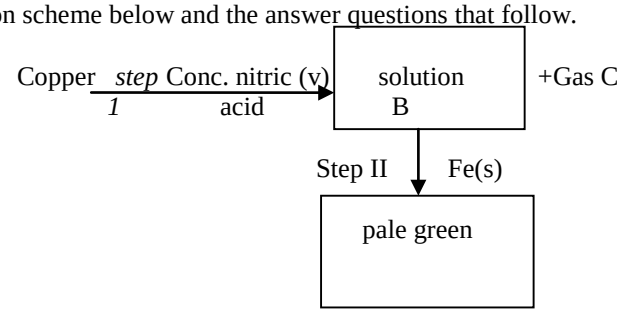


a) State and explain the observations made after 24 hours. (2 marks)

b) Write an equation to show the formation of gas A. (1mark)

c) State one use of chlorine gas. (1mark)

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



solution.

(i) Identify: (2mark)

Solution B

Gas C

(ii) What type of reaction is taking place in step II (1mark)

23. a) Define solubility. (1 mark)

b) In an experiment to determine the solubility in water at 30^0c, the following results were obtained.

Mass of empty evaporating dish = 26.2g

Mass of evaporating dish + saturated solution =

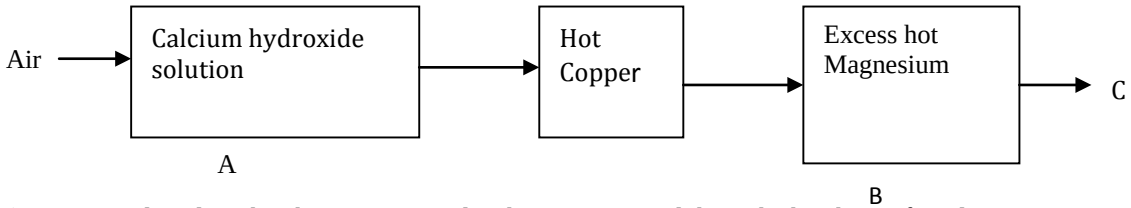
42.4g. Mass of evaporating dish + dry solid Y = 30.4g

Use this data to calculate the solubility of Y at 30^0C. (3 marks)

24. In terms of structure and bonding. Explain why water (H_2O) is a liquid at room temperature while Hydrogen sulphide (H_2S) is a gas. (2 marks)

25. Explain why hard water flowing in lead pipes may be safer for drinking than soft water flowing in the same pipes. (2 marks)

26. Air was passed through reagents as shown below.



i) State and explain the observations made when air is passed through chamber A for a long time. (2 marks)

ii) Name one component in Explain (1 mark)

27. Using dots (·) and crosses (x), draw the dimer structure of aluminum chloride and name the bonds. (Al=13, Cl=17) (2 marks)

28. Iron is extracted from its ore by the blast furnace process.

a) Name the chief ore from which iron is extracted from. (1 mark)

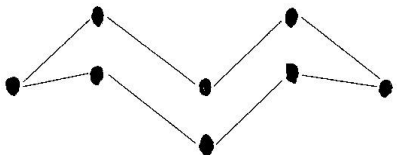
b) An ore is suspected to contain mainly iron. Describe a method that can be used to confirm the presence of iron in the ore. (2 marks)

KASSU JOINT EXAMINATION TEST
(The Kenya Certificate of Secondary Education)
233/2
CHEMISTRY
Paper 2
(Theory)
June 2015

1. The figure below represents a section of the periodic table. Study it and answer questions **(a)** to **(h)**. Note that the letters do not represent the actual symbols of the elements.

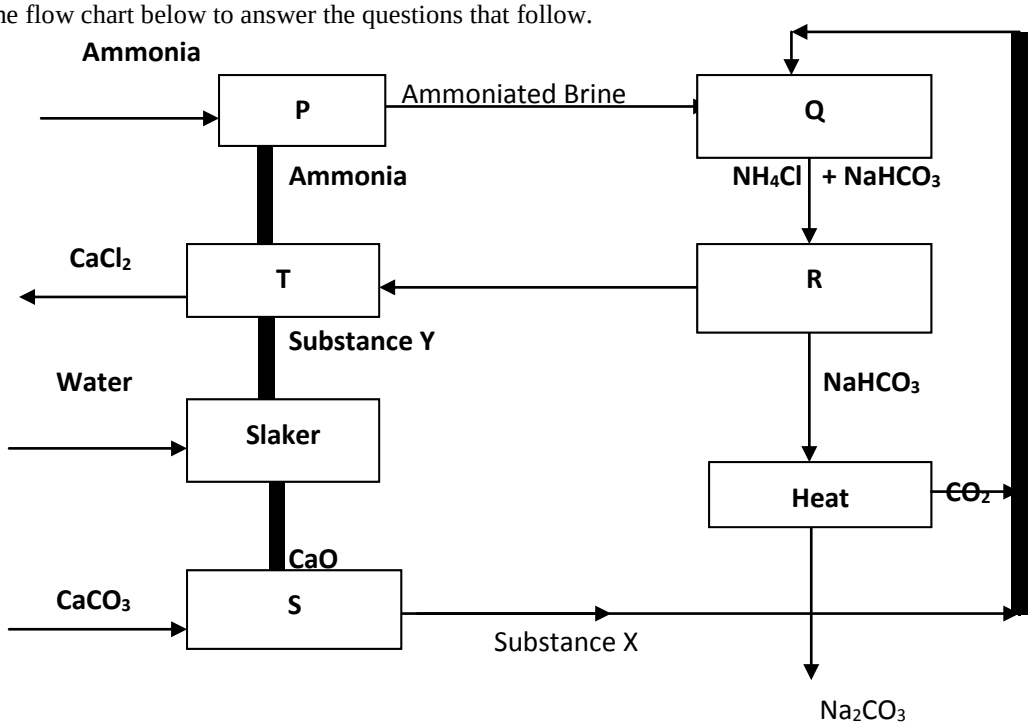
A							D	
B			G	J		F	H	E
C							I	

(a) Consider elements D, H and I
(i) Give the chemical family of these elements. (1 mk)
(ii) How do their ionic size compare. (1 mk)
(iii) Compare and explain the reactivity of the three (2 mks)
elements. (b) (i) Write the electronic configuration of:
Element H (1 mk)
(ii) The ion of element G. (1 mk)
(c) A molecule of one of the elements is shown below. (2 mks)



(i) **Identify** this element from the section of the periodic table and give its actual **symbol** and **name.** (2 mks)
(ii) Explain why this element has a higher boiling point compared to that of oxygen. (2 mks)
(iii) Write an equation to show the reaction between the element named above with oxygen. (1 mk)
(iv) Predict the pH of the oxide of the above element when in water. (1 mk)

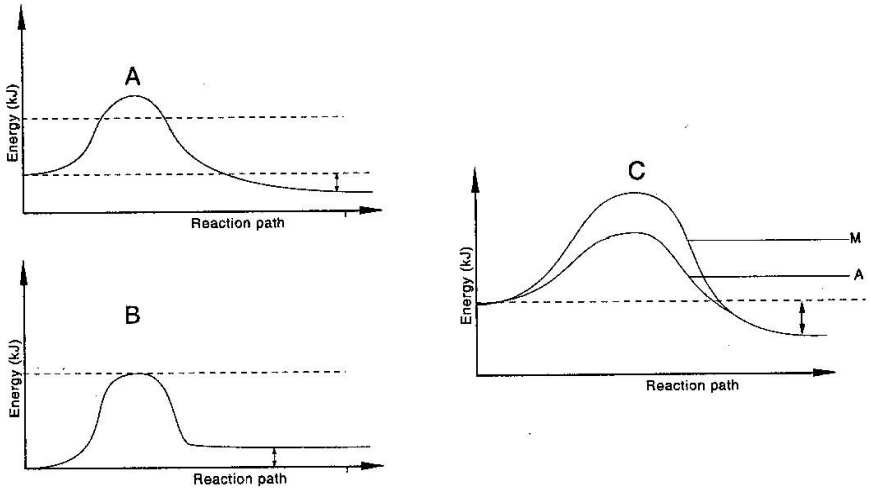
2. Use the flow chart below to answer the questions that follow.



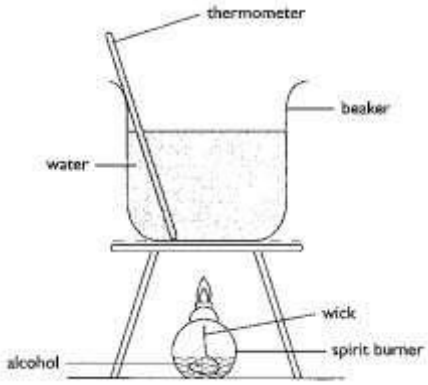
(a) Name the substances labelled: X and Y (2 mks)
(b) Name 2 substances being recycled in the process represented by the flow chart. (2 mks)

(c) Name the process that takes place in: S and R (2 mks)
(d) Give 2 uses of calcium chloride. (1 mk)
(e) Write equations for the reaction that take place in: Q and T (2 mks)
(f) Using ionic equation explain how sodium carbonate can be used to soften hard water. (2mks)
(g) Other than softening of hard water give 2 other uses of sodium carbonate. (1 mk)

3. Consider this group of reaction energy profiles for some different reactions (A, B, C).



(a) Which reaction(s) is: (2 mks)
(i) exothermic
(ii) Endothermic
(b) Explain why the activation energy of A in diagram C is lower than the activation energy of M in the same diagram. (1 mk)
(c) In an experiment to determine the heat of combustion of methanol. CH_3OH, 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	=	22.0^0c
Initial temperature of water	=	36.0^0c
Final mass of lamp an methanol	=	84.75g
Initial mass of lamp and methanol	=	85.10g
Density of water	=	1 g/cm^3

(S.H.C of water = 4.2 $g^{-1}K^{-1}$)

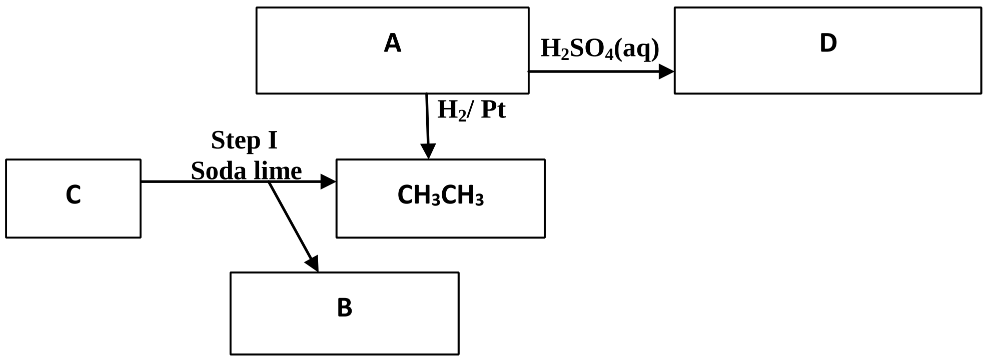
(i) Write an equation for the combustion of methanol. (1 mk)
(ii) Calculate:
(a) Number of moles of methanol used in this experiment. (1 mk)
(b) The heat change for this experiment. (1 mk)
(c) The heat of combustion per mole of methanol. (1 mk)
(d) Explain why the molar heat of combustion for methanol obtained above is different from the theoretical value. (1 mk)
(e) State two factors to consider when choosing a fuel. (1 mk)
(f) Outline two disadvantages of using hydrogen as a source of fuel. (1 mk)

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

(i) $CH_3 – CH_2 – CH – CH_3$
                    |
                 $CH – CH_3$
                    |
                 CH_3

(ii) $CH_3 – C \equiv C – CH_3$

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



(i) Identify A,B,C and D (2 mks)

(ii) Explain how substance A and CH_3CH_3 could be distinguished by burning. (1 mk)

(iii) Give one reason why soda lime is preferred to pure sodium hydroxide in step **I**. (1 mk)

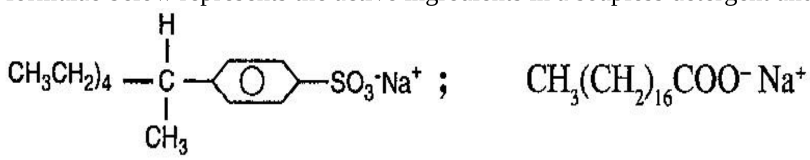
(c) Write down the equation for the reaction between substance A and hydrogen when equal numbers of moles are used. (1 mk)

(d) A student found a bottle containing $CH_3CH_2COO\ CH_3$.

(i) Name the process of formation of the substance above. (1 mk)

(ii) Identify the two substances from which the substance in (d) (i) is derived. (1 mk)

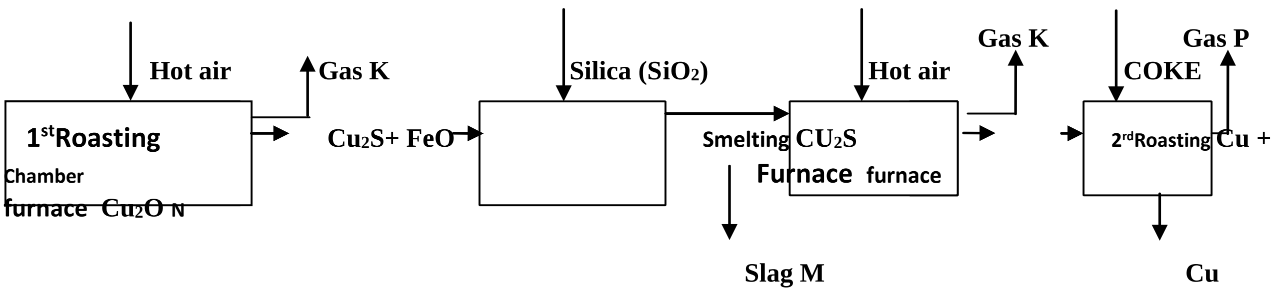
(e) The formulae below represents the active ingredients in a soapless detergent and in soapy detergents respectively.



(i) Give one advantage and one disadvantage of using soapless detergent. (1 mk)

(ii) Explain briefly how the soapy detergents given above may be manufactured. (2 mks)

5. (a) The flow chart below outlines some of the processes involved during extraction of copper from copper pyrites. Study it and answer the questions that follow.



(i) Name gas K. (1 mk)

(ii) Write an equation for the reaction that takes place in the 1st roasting furnace. (1 mk)

(iii) Write the formula of the cation present in the slag M. (1 mk)

(iv) Identify gas P. (1 mk)

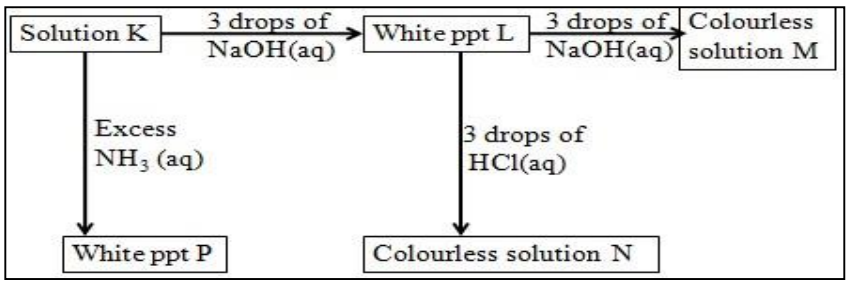
(v) What name is given to the reaction that takes place in chamber N? Give a reason for the answer. (2 mks)

(b) The copper obtained from chamber **N** is not pure. Draw a labeled diagram to show the set up you would use to refine the copper by electrolysis. (3 mks)

(c) 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, S = 32.0) (2 mks)

(d) Give 2 effects that this process could have on the environment. (2 mks)

6. Study the scheme below and use it to answer the questions that follow:



(a) Write the formula of:

(i) Cation in solution K (1 mk)

(ii) White precipitate L (1 mk)

(iii) Colorless solution M (1 mk)

(iv) Colorless solution N (1 mk)

(v) White precipitate P (1 mk)

(b) Write the ionic equation for the reaction for the formation of white precipitate L. (1 mk)

(c) What property of **L** is illustrated in the formation of colorless solution M and N. (1 mk)

(d) Electrical conductivity decreases when temporary hard water is heated. Explain. (2 mks)

(e) When excess iron fillings were dissolved in dilute sulphuric (IV) acid, a pale green solution was obtained. The solution was filtered and divided into two portions.

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

(ii) To the first portion aqueous ammonia was added till in excess. State observation made. (1 mk).

(iii) Write an ionic equation for the reaction in (ii) above. (1 mk)

7. a) State the Faraday"s law of electrolysis (1mk)

b) Calculate how long it would take an aqueous gold (III) chloride cell to coat 2.5 g of gold on a bracelet using a current of 2.5 A. The half reaction has been provided for you.

(Au = 197)

(3mks)

$$\mathbf{Au^{3+}_{(aq)} + 3e^- \longrightarrow Au_{(s)}}$$

c) Two half-cells are connected under standard conditions to make an electrochemical cell.

The two half-cells are a copper-copper (I) ion (**Cu/Cu^+**) and an aluminum-aluminum ion **(Al/Al^{3+}).** Using your the Standard Reduction Potentials below answer. $\mathbf{Al^{3+}_{(aq)} + 3e^- \rightarrow Al_{(s)}}$ **-1.66 V**

$\mathbf{Cu^+_{(aq)} + e^- \rightarrow Cu_{(s)}}$ **+ 0.52 V**

(i) Write the cell representation for the cell obtained when the two half cells are connected. (2mks)

(ii) Identify the reaction that takes place at the anode and at the cathode. (2mks)

(iii) Calculate the emf for the above cell (1mk)

(iv) Write the overall balanced redox reaction for the electrochemical cell. (1mk)

d) An excess of copper solid is dropped into a solution which contains $AgNO_3$, Fe $(NO_3)_3$ and Zn $(NO_3)_2$. Write the equations for any reduction **half-reactions** that occur over time under standard conditions. (1mk)

KASSU JET
Kenya Certificate of Secondary Education
233/3
Paper 3
CHEMISTRY

CONFIDENTIAL

- Solution P ($KMnO_4$)
- Solution Q - (Oxalic acid 0.05m)
- Solution R (Containing 4.9g of $(NH_4)_2SO_4$ $FeSO_4$ $6H_2O$ in 250cm^3 solution).
- 50ml measuring cylinder
- 5 test tubes
- 1 boiling tube
- 250ml glass beaker
- Thermometer
- Stopwatch
- Burette
- Pipette
- Two conical flasks.
- About 1g solid B - ($ZnSO_4$)
- Distilled water
- About 0.5g of solid L. (Oxalic acid)
- Litmus papers
- Metallic spatula
- Means of heating
- Sodium hydroxide solution
- Ammonia solution
- Barium nitrate solution

KASSU JOINT EVALUATION TEST - 2015
Kenya Certificate of Secondary Education
233/3
CHEMISTRY
PAPER 3
PRACTICAL

1. You are provided with:
- Solution P of Potassium manganate (VII).
- 0.05M solution Q of oxalic acid.
- Solution R containing 4.9g of ammonium iron (II) Sulphate, $(NH_4)_2$ $SO_4.FeSO_4.6H_2O$, in 250cm^3 of water.

You are required to:

i) Determine the rate of reaction between oxalic acid and Potassium manganate (VII).

ii) Standardize the solution P.

PROCEDURE I:

Using a measuring cylinder, place 1 cm^3 of solution P into each of the five (5) test-tubes in a rack. Clean the measuring cylinder and use it to place 19 cm^3 of solution Q into a boiling tube. Prepare a water bath by placing about 200 cm^3 of water into a beaker and start to heat. Place a thermometer into solution Q and place it in the warm water until it attains a temperature of 40^0C. Remove the boiling tube from the water – bath and place it in the test-tube rack. Add the first portion of solution P immediately and at the same time start a stop watch. Record the time taken for solution P to be decolourised in table I below. Repeat the procedure at temperatures of 50^0C, 60^0C, 70^0C and 80^0C to complete the table.

Temperature of solution Q (^{0}C)	40	50	60	70	80
Time taken for decolourisation (tsecs)					
1/t sec^{-1}					

i) Plot a graph of 1/t against temperature (X-axis). (3marks) ii) From the graph determine the time taken for the mixture to decolourise at 65^0C (3marks) iii) How does the rate of reaction between oxalic acid and Potassium manganate (VII) vary with temperature? (1mark)

PROCEDURE II

Fill a burette with solution P. Pipette 25cm^3 of solution R into a conical flask and titrate the solution P against solution R until a permanent pink colour just appears. Record your results in table II below and repeat the procedure to fill the table.

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

i) Determine the average volume of P used……..cm^3 (1mark)
(Show how you arrive at your answer)

ii) Calculate the concentration of solution R in moles per litre. (Fe=56, S=32, O=16, N=14, H=1). (2marks)

iii) Find the number of moles of solution R used (1mark)

iv) Given the ionic equation for the reaction is

$5Fe^{2+}(aq) + MnO_4^-(aq) + 8H^+(aq) \longrightarrow 5Fe^{3+}(aq) + Mn^{2+}(aq) + 4H_2O(l)$;

Find the number of moles of solution P used . (1mark)

v) Determine the concentration of the Potassium manganate (VII), solution P in moles per litre. (2 marks)

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

i) Place half a Spaluta full of solid B in a clean dry test-tube and heat gently then strongly.

Observations	Inferences
(1mark)	(1mark)

ii) Place the remaining solid B in a boiling tube and add about $5cm^3$ of distilled water and shake well. Divide the resulting mixture into four portions for the tests below.

Observations	Inferences
(1mark)	(1mark)

a) To the first portion add Sodium hydroxide solution dropwise until in excess.

Observations	Inferences
(1mark)	(1mark)

To the second portion add 2-3 drops of dilute Sulphuric (VI) acid

Observations	Inferences
(1mark)	(1mark)

To the third portion add aqueous ammonia dropwise until in excess.

Observations	Inferences
(1mark)	(1mark)

To the fourth portion add 2-3 drops of barium nitrate solution

Observations	Inferences
(1mark)	(1mark)

b)

c)

d)

3. You are provided with solid L. Carry out the tests below on L and record the observations and inferences in the spaces provide.

a) Place half of solid L in a boiling tube and add about $5cm^3$ of distilled water. Divide the resulting mixture into two portions for the tests below:

i) To the first portion add 2-3 drops of acidified Potassium manganate (VII). [Solution P]

Observations	Inferences
(1mark)	(1mark)

To the second portion dip a piece of blue litmus paper

Observations	Inferences
(1mark)	(1mark)

Place the remaining solid L in a metallic spatula and ignite it.

Observations	Inferences
(1mark)	(1mark)

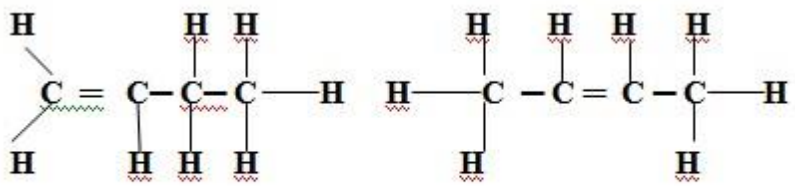
ii)

b)

KASSU JOINT EXAMINATION TEST
(The Kenya Certificate of Secondary Education)
MARKING SCHEME
233/1
CHEMISTRY
Paper 1

(Theory)

1. (a) What is the importance of the shape of a conical flask? (1 mark)
The cone shape allows shaking/swirling without spilling the liquid contents of the flask 1mk
2. A mixture consists of sulphur powder and iron filings.
(i) Describe how to obtain sulphur from the mixture using methylbenzene. (3 marks) **Add excess methylbenzene to the mixture in a beaker (1 mk) and stir (½ mk). Filter (1 mk) to obtain sulpur as a residue (½ mk).**
(ii) Is the mixture homogeneous or heterogeneous? Explain. (2 marks)
Heterogeneous (1 mk). Its components can be recognized by the naked eye or through magnifying glass (1mk)
3. Nitrogen gas can be prepared in the laboratory using a mixture of ammonium chloride solution and sodium nitrite solution.
(a) The reaction occurs in two steps. State the two steps in the correct order. (2 marks)
Ammonium chloride reacts with sodium nitritre to form ammonium nitrite (1 mk) and sodium choride. Ammonium nitrite then decomposes on heating to form nitrogen gas (1mk) and water.
(b) State two applications nitrogen. (1 mark)
Manufacture of ammonia (½ mk) by the Haber process.
As a refrigerant(½ mk)
In electric light bulbs
4. (a) Draw structural formulae of two positional isomers with molecular formula C_4H_8. (2 marks)



(1mk) **(1mk)**

(b) Study the equation below and answer the questions that follow.
$C_6H_{14} + Cl_2 \longrightarrow C_6H_{13}Cl + HCl$
(i) State the condition under which this reaction occurs. (1 mark)
Presence of ultraviolet radiation//sunlight (1mk)

(ii) Give the general name of this type of reaction. **Substitution** (1 mark) 5.

(a) Define hydration energy. (1 mark) **Energy change that occurs when one mole of gaseous ions become hydrated//form weak bonds with water molecules (1mk)**

(b) Given that: the hydration energies of Ca^{2+} and Cl^- are -1891 kJ mol^{-1} and -384 kJ mol^{-1} respectively, and that the lattice energy of calcium chloride is +2237 kJ mol^{-1}.Calculate the molar enthalpy change of solution of calcium chloride. (3 marks)

ΔH_{soln}= Lattice energy + Hydration energy (1mk)
=+2237+(-1891)+2(-384) (1 mk)
= -422 kJ mol^{-1} (1 mk)

6. The standard electrode potentials of a metal G and iron are given below.

$Fe^{2+}(aq) + 2e \longrightarrow Fe(s)$ -0.44V
$G^{2+}(aq) + 2e \longrightarrow G(s)$ -0.91V

A piece of iron is coated with metal G. If the coating is scratched, would the iron be protected from rusting? Explain. (3 marks)

Assume metal G corrodes:
$G(s) + Fe^{2+}(aq) \longrightarrow G^{2+}(aq) + Fe(s)$ (1 mk)
E_{cell}= -0.44 – (-0.91) (½ mk)
= +0.47 V (½ mk)
Iron would be protected from rusting (½ mk) because the e.m.f. is positive (½ mk)

7. (a)Why is the percentage of carbon(IV)oxide in the atmosphere fairly constant? (1 mark)
There is a balance between the processes that produce carbon (IV) oxide and processes that absorb it (1 mk)

(b) Calculate the volume of carbon(IV)oxide in 8,000 m^3 of air contained in a hall.(2 marks)
8,000 x 0.03/100 (1 mk)
= 2.4 m^3 (1 mk)

8. State two conditions that would make the boiling point of water to be higher than 100°C. **Presence of impurities (1 mk)**
At an altitude above sea-level//pressure above 1 atm (760 mmHg) (1 mk)

---

9. Explain the effects of the accumulation of nitrogenous compounds in water masses? (2 marks)
Enhance the growth of algae (1 mk) which deplete the amount of oxygen in water (½ mk) causing the death of fish etc (½ mk)

10. Study the table below and use it to answer the questions that follow. (The letters do not represent the actual symbols of the elements).

Element	Q	R	S	T	U
Atomic number	5	20	3	18	5
Atomic mass	10	40	7	40	11

(a) Select two letters that represent the same element? Give a reason. (2 marks)
Q and U✓ 1 , they are isotopes✓ 1

(b) Give the number of neutrons in an atom of element S. (1 mark)
7-3= **4✓ 1**

11. Dry carbon (II) oxide gas was passed over heated lead (II) oxide.

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

$\xrightarrow{2}$

(b) Give one industrial application of the above reaction. (1 mark) **CO (g) + PbO (s)**
Extraction of metals✓ 1 through reduction of the metal oxide

(c) Name another gas that can be used in the above reaction. (1 mark) **Pb (s) + CO (g) ✓ 1**

- **Hydrogen ✓ 1**
- **Ammonia (any one for 1 mark)**

12. (a) Proteins are obtained from amino acids monomers. Complete the equation below to show the polymer formed. (1 mark)

(b) Name the type of polymerization shown above. (1 mark)
Condensation polymerization ✓ 1; Reject condensational

13. (i) With a reason, identify the mistake in the set-up above. (1 mark)

- **The method of collection is wrong (✓ ½ mark)**
- **The gas is less dense than air (✓½mark) hence can't be collected by downward delivery.**

(ii) What would be liquid Y? (1 mark)

Concentrated sulphuric (VI) acid (✓ 1mark)

(iii) Give two physical properties of hydrogen gas (1 mark)

- **It's colourless ✓½mark**
- **Odourless ✓½ mark**
- **Less dense than air.**

Any two for (½ mark) each

14. Study the following equilibrium equation.

$H_2NCH_2COOH + H_2NCHCH_3COOH \longrightarrow (HNCH_2CONHCHCH_3CO) + 2H_2O$

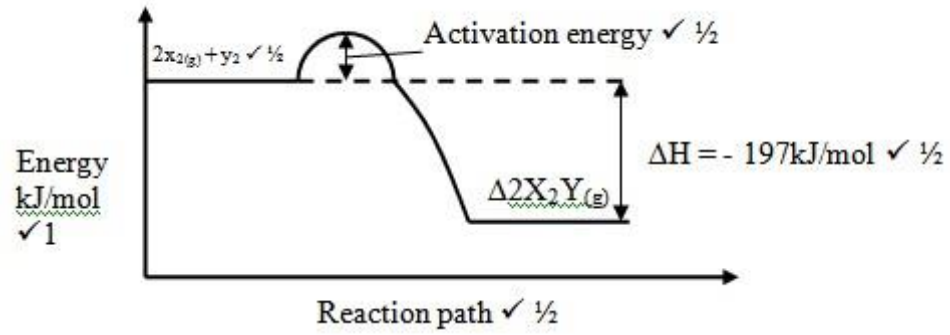
$2X_2(g) + Y_{2(g)} \rightleftharpoons 2X_2Y_{(g)}$ $\Delta H = -197kJ/mol$

(a) Suggest two ways of increasing the yield of X_2Y. (1 mark)

(i) **Lowering the temperature ✓ ½**

(ii) **Increasing pressure ✓ ½**

(b) Draw the energy level diagram for the forward reaction. (2 marks)



i.e. Labeling ✓ ½

- Reactants/products ✓ ½

- ΔH ✓ ½

- Activation energy ✓ ½

15.

$CaCO_3$ (aq) + 2HCl (aq) → $CaCl_2$ (l) + H O 2 (g) + C0 2

5.0g 25cm³ 1.0M

Moles of HCl = $\frac{25 \times 1.0}{1000}$ ✓ ½

= $\frac{25}{1000}$

= 0.025 moles ✓ ½

Moles of $CaCO_3$ = $\frac{1}{2}$ x 0.025 moles

= 0.0125 moles

0.0125 moles = x x = 0.125 x 100 ✓ ½

= 1.25g Mass of $CaCO_3$ un-reacted = 5.00 – 1.25

= 3.75g ✓ ½

16. (a) State Graham"s law of diffusion. (1 mark)

***The rate of diffusion of a gas is inversely proportional to the square root of its density at constant temperature and pressure* ✓ 1mar**

(b) $50cm^3$ of Carbon (IV) Oxide diffuses through a porous plate in 15 seconds. Calculate the time taken by $75cm^3$ of Nitrogen (IV) Oxide to diffuse through the same plate under similar conditions. (C = 12, 0 = 16, N = 14)

$73cm^3$ of CO_2 takes = $\frac{75 \times 15}{50}$ second ✓½ = 22.5 scds✓½

Rmm of CO_2 = 12 + 2 x 16 = 44 ✓ ½ **$TNO_2 = 22.5\sqrt{\frac{46}{44}}$ seconds ✓ ½**

= 23.006s

Rmm of NO_2 = 14 + 2 x 16 = 46 ✓ ½

17. A student fetched water from a river in a limestone area. He used it for washing and realized that it did not lather easily.

(i) Name the two ions that prevent lathering. (1 mark)

Mg^{2+} ✓ ½ // magnesium ions

Ca^{2+} ✓ ½ // calcium ions

(ii) Given that the structure of soap is $C_{17}H_{35}COONa$.

Explain by means of ionic equations how the above ions prevent lathering. (2 marks)

$^{2+}$ $^{-}$ ^{1}

$Ca_{(aq)} + C_{17}H_{35}COO_{(aq)} \longrightarrow C_{17}H_{35}COOCa_{(s)}$ ✓

$Mg^{2+(aq)} + \longrightarrow C_{17}H_{35}COO^{-(aq)}$ $C_{17}H_{35}COOMg_{(aq)}$ ✓1

18. A student burnt magnesium ribbon in a gas jar full of sulphur (IV) oxide gas.

(i) State two observations made in the gas jar. (2 marks)

- **A yellow powder of sulphur was deposited ✓1**
- **White solid of magnesioum oxide is formed ✓1**

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

$2Mg_{(s)} + SO_{2(g)} \longrightarrow 2MgO_{(s)} + S_{(s)}$ ✓1

19. M grammes of a radioactive isotope decayed to 5 grammes in100 days. The half life of the isotope is 25 days.

(a) What is meant by half life? (1 mark)

***Time taken for a given mass of a radioactive isotope to reduce to half its original mass.* ✓1**

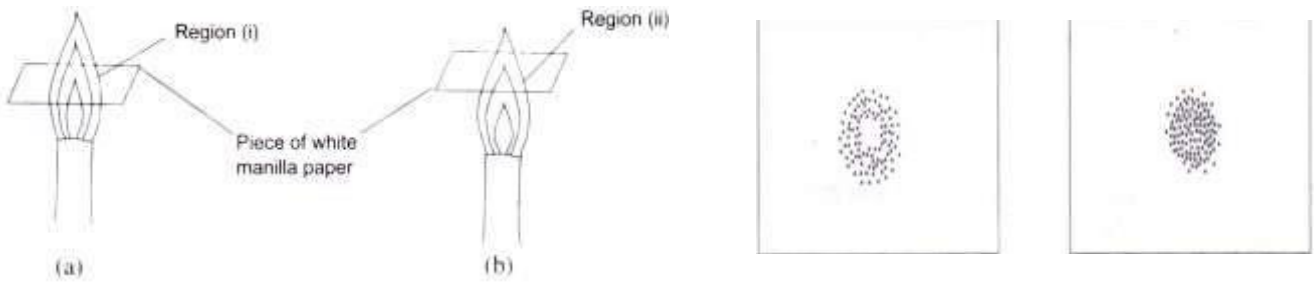
(b) Calculate the initial mass M of the radioactive isotope. (2 marks)

M 25 days → 25 days 25 days → 25 days $\frac{M}{16}$ ✓1 →

$\frac{M}{16}$ **= 5g**

M = 80g ✓ ½ **✓ ½**

20. (i) With the aid of a well labeled diagram, show that the innermost region of a non luminous flame consist of unburnt gas. (1½ marks)



(ii) Highlight the steps followed when lighting a Bunsen burner. (1½ marks) -
Close the air-hole✓½
- Strike a match and place it on top the chimney✓½
- Open the air-hole✓½

---

21. a)
- **Chlorine water changes colour from yellow to colourless** ***1 mk***
- **Chlorine water decomposes to form hydrochloric acid and oxygen** ***1 mk***

b) Write an equation to show the formation of gas A. (1mark)

$2HOCl_{(aq)} \longrightarrow 2HCl_{(aq)} + O_{2(g)}$ ***1 mk***

c) State one use of chlorine gas. (1mark)

- **Bleaching agent -Treatment of water** ***1 mk***

22. i)Identify: (2mark)
Solution B
Copper (II) nitrate√***½mk***
Gas C
Nitrogen (IV) oxide√***½mk***
What type of reaction is taking place in step II (1mark)
Displacement reaction √***1 mk***

23. a) Define solubility. (1 mark)
Is the maximum mass of solute (in grams) required to saturate 100g of water at a particular temperature √1

b) **Mass of saturated solution = (42.4 – 26.2)g = 16.2g***v½mk*
Mass of dry solid Y = (30.4 – 26.2)g = 4.2g√***½mk***
Mass of water = (16.2 – 4.2)g = 12g√***½mk***

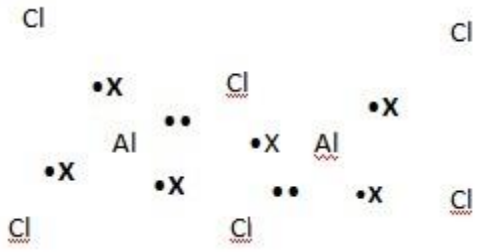
4.2g of solid Y = 12g of H_2O
? = 100g of H_2O
= $\left(\frac{4.2 \times 100}{12}\right)$g /100g of H_2O*1mk* = 35g/100g of H_2O√***½mk***

24. Water molecules are held by hydrogen bond ***1mk*** which is stronger than weak Van der Waals forces between hydrogen sulphide molecules ***1mk***

25.
a) **Hardwater deposits the insoluble Ca^{2+} and Mg^{2+} carbonate / $CaCO_{3(s)}$ and $MgCO_{3(s)}$ on the pipes** ***1mk*** **which prevents lead from dissolving into the water** ***1mk***
Soft water is in direct contact with lead and therefore dissolves the lead leading to lead poisoning ***1mk***

26. i) **Calcium Hydroxide solution absorbs Carbon (IV) oxide to form Calcium Carbonate** √ ***1mk***
Excess carbon (IV) makes the precipitate to dissolve forming colourless calcium hydrogen carbonate ***1mk*** ii)
Argon*1mk*
Neon
They are unreactive. ***1mk***

27.



28. a) **Haematite 1mk**
b) -crush the ore into powder✓½.
-Add excess dilute nitric (V) acid or sulphuric (VI) acid and warm, filter to obtain the filtrate. ✓½ To a portion of the filtrate add aqueous sodium hydroxide or ammonia solution till in excess✓½ ,formation of a green or brown ppt insoluble in excess reagent✓ ½ indicates Fe^{2+} or Fe^{3+},hence the ore contains iron.

KASSU JET
233/2
CHEMISTRY
PAPER 2
(THEORY)
JUNE 2015
TIME: 2 HOUR2

1. a) i) Halogens ii) Ionic radius increases from D to I. this is due to the increase in number of energy levels from D to I. iii) Reactivity reduces from D to I due to increase in atomic radius down the group which leads to a decrease in the strength of nuclear force of attraction.
   (b) (i) Element H
   2,8,7 (1 mk)
   The ion of element G. (1 mk)
   2,8
   (c) i) F- S- Sulphur
   ii) A molecule of sulphur is made of Packard ring of eight atoms joined together by strong covalent bonds while a molecule of oxygen has weak van der waal forces between the molecules hence higher boiling point in sulphur than oxygen.
   iii) $S_{(s)} + O_{2(g)} \longrightarrow SO_{2(g)}$ iv) pH will be below 7 because sulphur (IV) oxide dissolves in water to form acidic solution of sulphurous acid .

2. Use the flow chart below to answer the questions that follow.
   (a) Name the substances labelled: (2 mks)
   X- **carbon (IV) oxide**
   Y- **calcium hydroxide**
   (b) Name 2 substances being recycled in the process represented by the flow chart. (2 mks)
   - **Ammonia gas - Water**
   - **Carbon(IV) Oxide**
   (c) Name the process that takes place in: (2 mks)
   S- **Thermal decomposition** R
   – **Filtration**
   (d) Give 2 uses of calcium chloride. (1 mk)
   - Used in extraction of sodium metal
   - Used as a drying agent
   - Used in countries which experience very low temperatures to aid in defrosting of ice
   - Used in road construction because its highly deliquescent so as to minimize dust
   (e) Write equations for the reaction that take place in: (2 mks)
   Q $NH_{3(g)} + NaCl(aq) + CO_{2(g)} + H_2O_{(l)} \longrightarrow NH_4Cl_{(aq)} + NaHCO3_{(aq)}$
   (split two equations to be awarded full marks ie-1mk for each equation)
   T $CaO(s) + H_2O_{(l)} \longrightarrow Ca(OH)_{2(aq)}$
   (f) Using ionic equation explain how sodium carbonate can be used to soften hard water. (2mks)
   $Mg^{2+}_{(aq)} + CO^{2-}_{3(aq)} \longrightarrow MgCO_{3(s)}$

   $Ca^{2+}_{(aq)} + CO^{2-}_{3(aq)} \longrightarrow CaCO_{3(s)}$

Carbonate ions react with either Ca^{2+} and Mg^{2+} in hard water to form insoluble calcium carbonate and magnesium carbonate which is precipitated out. (without equation no mark)

(g) Other than softening of hard water give 2 other uses of sodium carbonate. (1 mk) - Manufacture of glass
- Manufacture of detergents
- Manufacture of bleaches used in paper industry.(any two correct half a mark each)

3. Consider this group of reaction energy profiles for some different reactions (A, B, C).

(a) Which reaction(s) is: (2 mks)

(i) Exothermic – **A, C (half a mark each)** (ii)
Endothermic - **B**

(b) Explain why the activation energy of A in diagram C is lower than the activation enrgy energy of M in the same diagram. (1 mk)

M has a catalyst which lowers the activation energy

(c) (i) Write an equation for the combustion of methanol. (1 mk)

$2CH_3OH_{(l)} + 3\ O_{2\ (g)} \longrightarrow 2CO_{2(g)} + 4H_2O_{(g)}$

---

ii)Calculate:

(a) Number of moles of methanol used in this experiment. (1 mk)

Mass of methanol = (85.10- 84.78) = 0.32 g

Moles = $\frac{0.32}{32} = 0.01$ **moles**

(b) The heat change for this experiment.

$100 \times 4.2 \times 14 = 5880$ **J OR 5.88 k J**

(c) The heat of combustion per mole of methanol. (1 mk)

0.01= 5.88

1= ?

$\frac{1 \times 5.88}{0.01} = -588\ Kj/mol$

(d) Explain why the molar heat of combustion for methanol obtained above is different from the theoretical value.
- Heat might be lost to the surrounding
- Heat absorption by the apparatus.(half a mark each)

(e) State two factors to consider when choosing a fuel. (1 mk)
- Cost
- Heating value
- Availability
- Ease of transport and storage
- Environmental effect (half a mark for each correct factor)

(f) Outline two disadvantages of using hydrogen as a source of fuel. (1 mk)
- Not readily available
- Its explodes when ignited in air.

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

(i) $CH_3 - CH_2 - CH(CH - CH_3)(CH_3)$ 2,3- dimethylpentane

(ii) $CH_3 - C \equiv C - CH_3$ But-2-yne

(b) (i) Identify (2 mks)

A- Ethene
B- Sodium carbonate
C- Sodium propanoate
D- Ethylhydrogensulphate (Formula to be awarded)

(ii) Explain how substance A and CH_3CH_3 could be distinguished by burning. (1 mk)
- Burn the two separately using non- luminous flame in which A burns in a yellow sooty flame while CH_3CH_3 burns in a blue non- sooty flame.

(iii) Give one reason why soda lime is preferred to pure sodium hydroxide in step I. (1 mk)
- Pure Sodium hydroxide is highly deliquescent hence melts easily leading to attack to the glass

(c) Write down the equation for the reaction between substance A and hydrogen when equal numbers of moles are used.
$CH_2CH_{2(g)} + H_{2(g)} \longrightarrow CH_3CH_{3(g)}$

(d) A student found a bottle containing $CH_3CH_2COO\ CH_3$.

(j) Name the process of formation of the substance above. (1 mk)

Esterification

(ii) Identify the two substances from which the substance in (d) (i) is derived. (1 mk)

- **Methanol**
- **Propanoic acid**

(e) i) Give one advantage and one disadvantage of using soapless detergent. (1 mk)

Advantage – it doesn"t form scum with hard water

Disadvantage- it"s a pollutant because it"s non- biodegradable ii) Explain briefly how the soapless detergents given above may be manufactured. (2 mks)

- **Mix oil with sodium hydroxide solution. Heat and stir. Add sodium chloride to salt out the soap. Filter and wash with cold water.**

5. (a) i) Name gas K.

Sulphur (IV) Oxide

ii) **$2CuFeS_{2(s)} + 3O_{2(g)} \longrightarrow Cu_2S_{(s)} + 2\ FeO_{(s)} + 3SO_{2(g)}$**

iii) Write the formula of the cation present in the slag M. (1 mk)

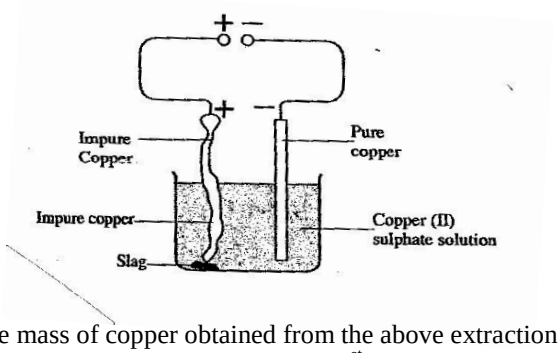
Fe^{2+}

(vi) Identify gas P. (1 mk)

Carbon (IV) Oxide

(vii) **Redox reaction- because Cu_2O is reduced to Cu while the carbon is oxidesed to carbon (IV) Oxide**

(b) The copper obtained from chamber N is not pure. Draw a labeled diagram to show the set up you would use to refine the copper by electrolysis. (3 mks)



(c) 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, S = 32.0) (2 mks)

$$\mathbf{CuFeS2 = 183.5}$$

183.5= 63.5 810=?

$\frac{810\times63.5}{183.5} = \mathbf{280.2997}$ $\frac{210}{280.29997} = \mathbf{74.92\ \%}$

(d) Give 2 effects that this process could have on the environment. (2 mks)

- **Acid rain due to production of sulphur (IV) Oxide which leads to corrosion of iron sheets. - leads to land degradation**

6. Study the scheme below and use it to answer the questions that fol XClow:

(a) Write the formula of:

(i) Cation in solution K (1 mk)

Al^{3+}

(ii) White precipitate L (1 mk)

$Al(OH)_3$

(iii) Colorless solution M (1 mk)

$[Al(OH)4]$

(iv) Colorless solution N (1 mk)

$AlCl_3$

(viii) White precipitate P

$Al(OH)_3$ (1 mk)

(b) Write the ionic equation for the reaction for the formation of white precipitate L. (1 mk)

$Al^{3+}_{(aq)} + 3OH^-_{(aq)} \longrightarrow Al(OH)_{3(s)}$

(ci) What property of L is illustrated in the formation of colorless solution M and N. (1 mk) Amphoterism

(d) Electrical conductivity decreases when temporary hard water is heated. Explain. (2 mks) When hard water is heated the hydrogen carbonate decomposes to solid carbonate salts hence the ions are fixed.

(e) When excess iron fillings were dissolved in dilute sulphuric IV acid, a pale green solution was obtained. The solution was filtered and divided into two portions.

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

$Fe_{(s)} + H_2SO_{4(aq)} \longrightarrow FeSO_{4(aq)} + H_{2\ (g)}$

(ii) To the first portion aqueous ammonia was added till in excess. State observation made. Green precipitate insoluble in excess.

(iii) Write an ionic equation for the reaction in (ii) above. (1 mk)

$Fe^{2+}{}_{(aq)} + 2OH^-_{(aq)} \longrightarrow Fe(OH)_{2(s)}$

7. a) State the Faraday"s law of electrolysis (1mk)

The amount of substance discharged at the electrodes is directly proportional to the quantity of electricity passed.

(b) Calculate how long it would take an aqueous gold (III) chloride cell to coat 2.5 g of gold on a bracelet using a current of 2.5 A. The half reaction has been provided for you. (3mks)

(Au =197)

$Au^{3+}{}_{(aq)} + 3e^- \longrightarrow Au_{(s)}$

$1\ F = 96500$

$3F = 96500 \times 3 = 289500\ C$

$289500 = 197 = 2.5$

$\frac{2.5 \times 289500}{197} = 3673.86\ C$

$Q = It = 3673.86 = 2.5 \times t \quad t = \frac{1469.59}{60} = 24.49\ mins$

---

c)

(i) Write the cell diagram for the cell obtained when the two half cells are connected.

$Al_{(s)} / Al_{(aq)} \ // \ Cu^+{}_{(aq} / Cu_{(s)}$ (1mk) (ii)

Identify which reaction is the anode and which is the cathode. (2mks)

Anode- $Al_{(s)} \longrightarrow Al^{3+}{}_{(aq)} + 3e^-$

Cathode - $Cu^+ + e^- \longrightarrow Cu_{(s)}$

(iii) Calculate the emf for the cel.l (1mk)

$Emf = E_{Reduced} - E_{Oxidised}$

$\mathbf{0.52 - -1.66 = +2.18V}$

(iv) Write the overall balanced redox reaction for the electrochemical cell. (1mk)

$Al_{(s)} + 3Cu^+{}_{(aq} \longrightarrow Al^{3+}{}_{(aq)} + 3Cu_{(s)} + 2.18$

d) An excess of copper solid is dropped into a solution which contains $AgNO_3$, $Fe(NO_3)_3$ and $Zn(NO_3)_2$. Write the ionic equations for any reduction **half cell-reactions** that occur over time under standard conditions. (1mk)

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

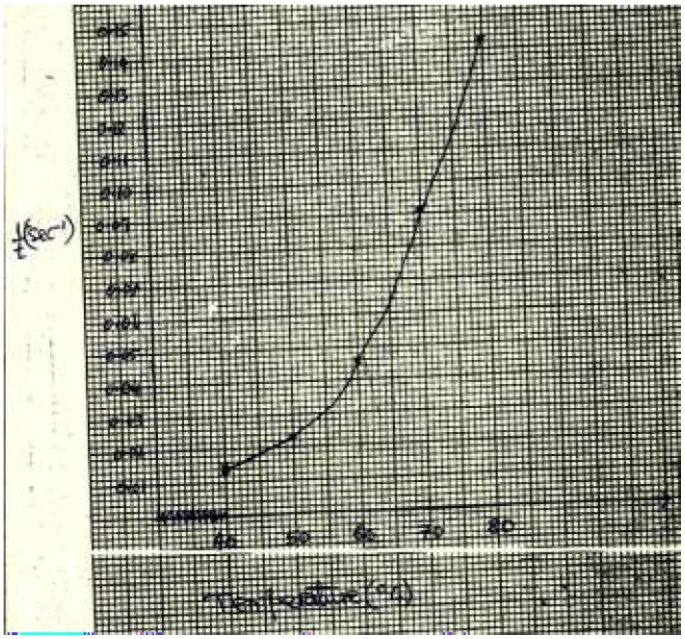
KASSU JOINT EVALUATION TEST
CHEMISTRY
PAPER 3
MAKING SCHEME

1. I. - Complete table. √1*overleaf for expected values*
- Correct use of decimals.√1
- Accuracy. √1
- Trend of values. √1
- Correct arithmetic, I/t √1

Table I

Temp (^{0}C)	40	50	60	70	80
Time (sec)	74	43	22	11	7
1/t (sec-1)	0.0135	0.0232	0.0455	0.0909	0.1428

i) – Correctly labeled axes√1- Overleaf for graph.
- Correct scale √1
- Correctly plotted points and curve. √1



ii) I/t = 0.06√1 t = $\frac{1}{0.06}$
= 16.67 seconds√1

iii) Rate of reaction increase with increase in temperature / rate of reaction almost doubles with every 10^0C rise in temperature.√1

II. – Complete table √1
- Correct use of decimals √1
- Correct arithmetic √1

- Accuracy (Penalise if table is inverted. Accuracy with 1.0 cm^3 S.V) $\surd^1$

Table II

	I	II	III
Final burette reading (cm^3)	12.9	25.7	38.5
Initial burette reading (cm^3)	0.0	12.9	25.8
Volume of solution P used (cm^3)	12.9	12.8	12.7

i) Average titre $= \frac{(12.9+12.8+12.7)}{3}\ cm^3$

$= 12.8\ cm^3 \surd^1$

ii) RFM of $(NH_4)_2\ SO_4.\ FeSO_4.6H_2O = 392$

$\therefore$Concentration $= \frac{19.6}{392} \surd^1$

$= 0.05$ mole $dm^{-3} \surd^1$

---

iii) Moles of R used $= \frac{0.05x25 \text{ moles}}{1000} \surd^1$

$= 0.00125$ moles.

iv) Moles of P used $= \frac{1}{5}x\ 0.00125 \text{ moles} \surd^1$

$= 0.00025$ moles

v) 12.8cm3 of P $\longrightarrow$ 0.00025

1000cm3 of P $\longrightarrow$ $\frac{0.00025 \times 1000}{12.8}$ mole $dm^{-3} \surd^1$

$= 0.0195$ mole $dm^{-3} \surd^1$ **Total 22 marks**

2.i)

ii)

a)

b)

c)

d)

3. a i)

ii)

Observations	Inferences
Colourless gas that condenses on cooler parts forming a colourless liquid. √1	B contains water of crystallization / B is Hydrated. √1

b)

Observations	Inferences
Dissolves forming a colourless solution√1	No coloured ions in B e.g. Fe^{2+} ions,. Fe^{3+} ions or Cu^{2+} ions√1

Observations	Inferences
Forms white precipitate soluble in excess forming a colourless solution. √1	Presence of Zn^{2+} ions, Pb^{2+} ions or Al^{3+} ions√1

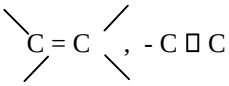
Total 6 marks

Observations	Inferences
No precipitate forms. √1	Absence of Pb^{2+} ions / presence of Zn^{2+}ions or Al^{3+} ions. √1

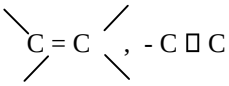
Observations	Inferences
Forms white precipitate soluble in excess forming a colourless solution. √1	Presence of Zn^{2+} ions √1

Observations	Inferences
White precipitate is formed. √1	Presence of SO_4^{2-} ions√1

Total 12 marks

Observations	Inferences
Solution is decolorized√1	

Observations	Inferences
Paper turns pink√1	R-COOH/H^+

Observations	Inferences
Burns with a smoky flame. √1	

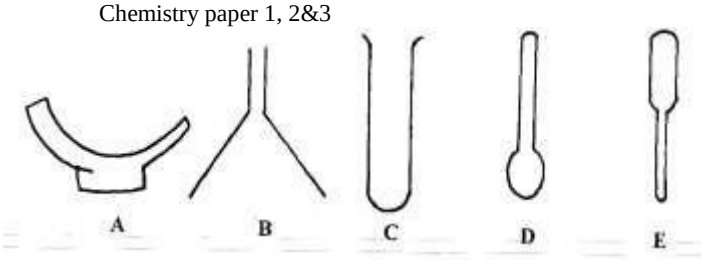
MWINGI CENTRAL DISTRICT JOINT EVALUATION EXAMINATION

233/1
CHEMISTRY
PAPER 1
JULY/AUGUST 2015

1. Use the information in the table below to determine the relative atomic mass of copper. (2 Marks)

Isotope	Fractional abundance
$^{65}_{29}Cu$	0.31
$^{63}_{29}Cu$	0.69

2. The diagrams below represent a list of apparatus which are commonly used in a chemistry laboratory:-



(a) Give the correct order of the apparatus, using the **letters only,** show the correct arrangement that can be used to prepare and investigate the nature of PH of a sample of onion solution. (2 Marks)

(b) Name one chemical substance and apparatus that is needed in the experiment. (1 Mark)

3. Briefly explain an industrial application of the following processes.
   (a) Crystallization. (1½ Marks)
   (b) Fractional distillation. (1½ Marks)
4. Four solutions of pH 7, 2, 8.5 and 13 respectively were each reacted with calcium turnings. Identify two solutions in which hydrogen gas would be produced. Explain each case. (3 Marks)
5. Study the information in the table below and answer the questions that follow. (3 Marks

Ion	Electronic arrangement	Ionic radius (nm)
Na^+	2.8	0.095
K^+	2.8.8	0.133
Mg^{2+}	2.8	0.065

   (a) Explain why the ionic radius of K^+ is greater than that of Na^+ (1 Mark)
   (b) Account for the difference in ionic radius of Mg^{2+} and Na^+ (2 Marks)
6. In an experiment, a few drops of concentrated nitric acid were added to aqueous iron (II) sulphate in a test-tube. Excess ammonia solution was then added to the mixture. (a) State the observations that were made when:-
   (i) Concentrated nitric acid was added to aqueous iron (II) sulphate (1 Mark)
   (ii) Excess ammonia was added to the mixture. (1 Mark)
   (b) Write an ionic equation for the reaction which occurred in a (ii) above. (1 Mark)
7. Describe how you would prepare a dry sample of zinc carbonate in the laboratory starting with zinc chloride solid. (3 Marks)
8. The solubility of salt Y at 60^0 is 40g/100g of water and 48g/100g of water at 100^0C.
   (i) How much salt Y would saturate 190g of water at 100^0C. (1½ Marks)
   (ii) 150g of saturated solution of Y at 100^0C is cooled to 60^0C. Calculate the mass of Y that crystallizes out. (1½ Marks)
9. Below are the bond dissociation energies of some elements.

Bond	Bond energy $kjmol^{-1}$
C-H	414
Cl-Cl	244
C-Cl	326
H-Cl	431

   Calculate the enthalpy change of the reaction. (3Mrks)
   $CH_{4(g)} + 2Cl_{(g)} \rightarrow CH_2Cl_{2(g)} + 2HCl_{(g)}$
10. An oxide of carbon contains 42.8% by mass of carbon and has R.M.M. of 28. What is its molecular formula? (3 marks) (C=12;O=16)
11. Sulphur (IV) oxide gas was bubbled into acidified potassium chromate (VI) and iron (III) sulphate solutions respectively. Explain the observations made in each case.
(i) With potassium chromate (VI). (1mark)
(ii) With iron (III) sulphate. (1mark)
12. A known volume of ozone diffuses through a small hole in 55 seconds; whereas the same amount of chlorine takes 67 seconds under the same conditions.
    Determine the molecular mass of ozone . (Cl=35.5; O=16) (3 marks)
13. (a) Give the systematic names of the following compound: $CHCH=CHCH_2CH_3$. (1 mark)

   (b) Ethane and ethene react with bromine according to the equations given below.
   (i) $C_2H_{6(g)} + Br_{2(g)} \rightarrow C_2H_5Br_{(l)} + HBr_{(g)}$ (ii)
   $C_2H_{4(g)} + Br_{2(g)} \rightarrow C_2H_4Br_{2\,(l)}$
   Name the type of reaction that takes place in (i) and (ii) (2 Marks)
14. An organic compound with the formula $C_4H_{10}O$ reacts with potassium metal to give hydrogen gas and a white solid.
   (a) Write structural formula of the compound. (1 Mark)

(b) To which homologous series does the compound belong? (1 Mark)

(c) Write the equation for the reaction between the compound and potassium metal. (1 Mark)

15. In the Haber process, the optimum yield of ammonia is obtained when a temperature of 450^0C, a pressure of 200 atmospheres and an iron catalyst are used.

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

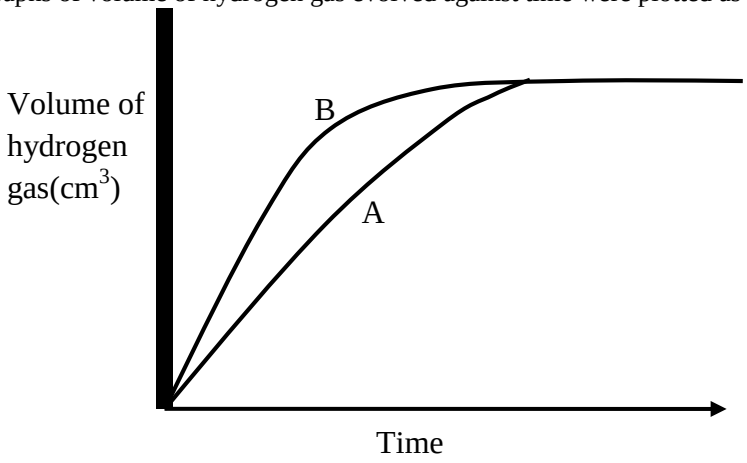
(a) How would the yield of ammonia be affected if the temperature was raised to 600^0C. (1 Mark)

(b) Explain the effect on the yield of lowering the pressure below 200 atmospheres. (1 Mark) 16. Two experiments were carried out as follows and the volume of hydrogen gas evolved measured at intervals of 10 seconds for 100 seconds.

(i) 8cm of magnesium ribbon was added to 1M HCl(aq)

(ii) 8cm of magnesium ribbon was added to 0.5M HCl(aq)

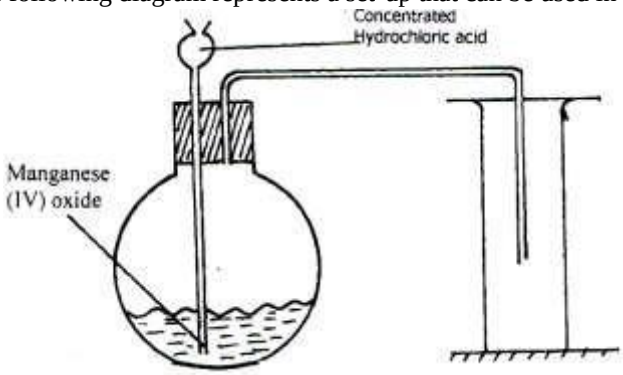
Graphs of volume of hydrogen gas evolved against time were plotted as shown below.



(a) Which of the graphs was obtained for reaction (i). Explain. (2 Marks)

(b) Explain the general shape of the graphs. (1 Mark)

17. The following diagram represents a set-up that can be used in the laboratory to prepare and collect a sample of chlorine gas:



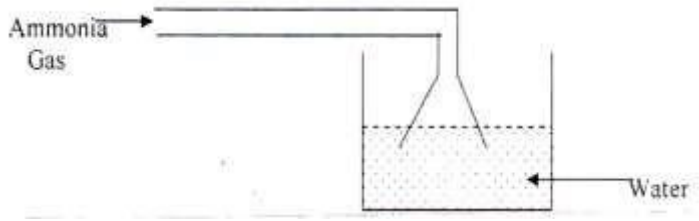
(a) No gas bubbles were produced in the above experiment. Explain the observation. (1 Mark)

(b) Complete the following equation. (1 Mark)

$Cl_{2(g)} + H_20_{(l)}$ Δ

(c) Describe the bleaching property of chlorine water (1 Mark)

18. Ammonia gas was passed into water as shown below.

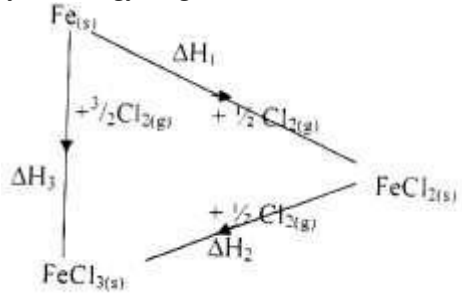


(a) When a red litmus paper was dropped into the resulting solution; it turned blue.

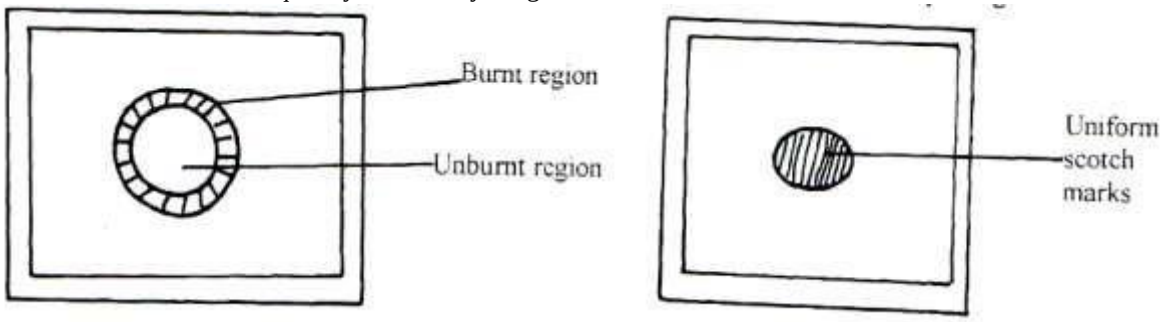
Give a reason to this observation. (1 Mark)

(b) What is the function of the funnel? (1 Mark)

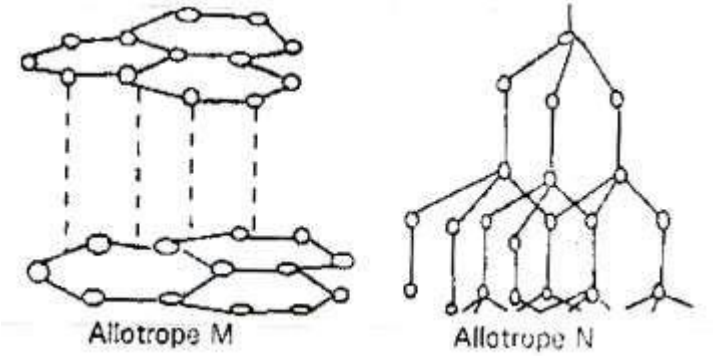
19. During purification of copper by electrolysis, 1.48g of copper were deposited when a current was passed through aqueous copper (II) sulphate for 2 ½ hours. Calculate the amount of current that was passed. (Cu = 63.5; IF = 96500C)
20. Draw a dot (.) and cross (x) diagram to show bonding in carbon (II) oxide. (2 Marks)
21. Write the discharge equations (half equations) for the electrode reactions when molten sodium chloride is electrolyzed using graphite electrodes.
    Anode (1 Mark)
    Cathode (1 Mark)
22. Study the energy diagram and then answer the questions that follow.



    (a) What does ΔH_1 and ΔH_3 represent. (2 Marks)
    (b) Write down the relationship between $\Delta H_{1(l)}$, ΔH_2 and ΔH_3 (1 Mark)
23. The isotope $^{24}_{11}$Na decays by Beta, β-emission to a stable nuclide. The half-life of the isotope is 15 hours 2.0g of $^{24}_{11}$Na is allowed to decay. Determine the mass left after 90 hours. (3 Marks)
24. The diagram below shows the appearance of two pieces of paper placed in different parts of a non-luminous flame of a Bunsen burner and removed quickly before they caught fire.



    (a) What do the experiments show about the outer region of the flame? (1 Mark)
    (b) From the above experiment, which part of the flame is better to use for heating? Give a reason (2 Marks)
25. The following diagrams show the structure of two allotropes of carbon. Study them and answer the questions that follow.



    (i) Name allotropes M and N (1 Mark)
    (ii) Give one use of N. (1 Mark)
    (iii) Which allotrope conducts electricity? Explain. (1 Mark)
26. The formula below represents the active ingredients in a soap and a detergent respectively.
    (I) $CH_3(CH)_{16}\ COO^-Na^+$ (II)
    $CH_3(CH_2)CHCH_3CH_2SO_3^-Na^+$
    (a) Explain why (I) is suitable for washing using water from a river. (1 Mark)

(b) Give one advantage and one disadvantage of II. (2 Marks)

27. Using the following standard electrode potentials to answer the questions that follow.

$Zn2^{+}_{(aq)} + 2e^{-} \rightleftharpoons Zn_{(s)}$ $E^{\ominus}V = -0.76$ $Cl_{2(g)}$

$+ 2e^{-} \rightleftharpoons 2Cl^{-}_{(aq)}$ $E^{\ominus}V = +1.36$

(a) Calculate the e.m.f of the following cell: (2 Marks)

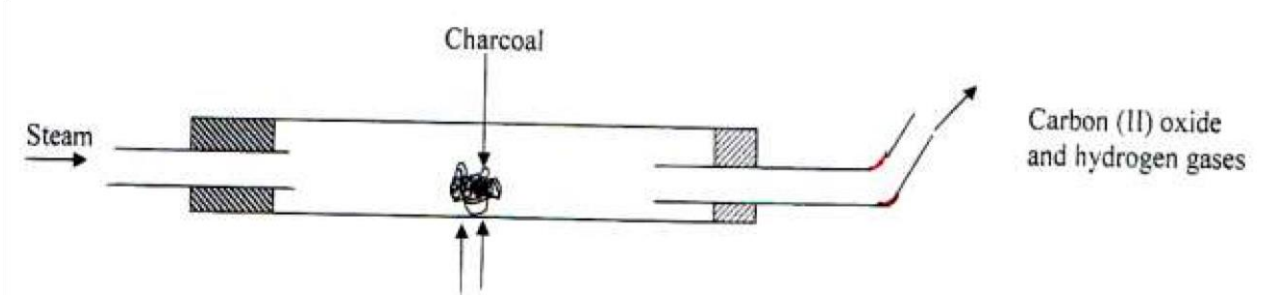
$Zn_{(s)}/Zn^{2+}_{(aq)}//2Cl^{-}_{(aq)}/Cl_{2(g)}$

(b) Write down the equation for the overall cell reaction. (1 Mark)

28. (a) Suppose 180cm3 of a 2.0M solution is diluted to 1.0dm3. What will be the concentration of the resulting solution. (2 Marks)

(b) Why is water not used to put off oil fires? (1 Mark)

29. When steam was passed over heated charcoal as shown in the diagram below hydrogen and carbon (II) oxide gases were formed.



(a) Write the equation for the reaction which takes place. (1 Mark)

(b) Name one use of carbon (II) oxide gas which is also a use of hydrogen gas. (1 Mark)

MWINGI CENTRAL DISTRICT JOINT EVALUATION EXAMINATION
233/2
CHEMISTRY
PAPER 2
JULY/AUGUST 2015

1. (a) The grid given below represents part of the periodic table study it and answer the questions that follow. (The letters do not represent the actual symbols of the elements.)

								A
				B				
	C		D			E		
	F							

(i) What name is given to the group of elements to which C and F belong? (1 Mark)
(ii) Which letter represents the element that is least reactive? (1 Mark)
(iii) What type of bond is formed when B and E react? Explain (2 Marks)
(iv) Write formula of the compound formed where elements D and oxygen gas react. (1 Mark)

(c) Study the information in the table below and answer the questions that follow. (The letter do no represents the actual symbols of the substance.

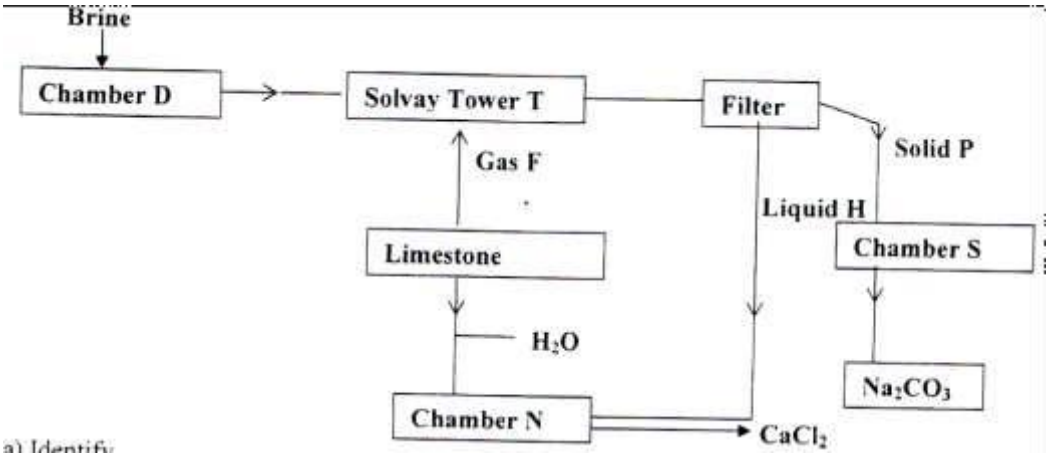
Substance	Melting point ^0C	Boiling point ^0C	Solubility in water	Density at room temp/g/cm^3
H	-117	78.5	Very soluble	0.8
J	-78	-33	Very soluble	0.77×1^{-3}
K	-23	77	Insoluble	1.6
K	-219	-183	Slightly soluble	1.33×10^{-3}

I. (i) Which substance would dissolve in water and would be separated from the solution by fractional distillation. (1 Mark)

(ii) Which substances is a liquid at room temperature and when mixed with water two layers would be formed? (1 Mark)

II. Which letter represents a substance that is a gas at room temperature and which can be collected by.
(i) Over water? (1 Mark)
(ii) By downward displacement of air? Density of air at room temperature = 1.29 x 10-3 g/C (1 Mark) 2.

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



(b) Identify
(i) Gas **F**
(ii) Liquid **H**
(iii) Solid P
(c) State one use of calcium chloride. (1Mark)
(d) Give two reasons why such a plant should be cited near a river. (2 Marks)
(e) Write equations for the reactions occurring in chamber: (2 Marks)

(i) **N**

(ii) **S**

(f) Using an ionic equation, explain how sodium carbonate is used to soften hard water. (1 Mark)

(g) Explain how ammoniacal brine is formed. (1 Mark)

(h) State one use of sodium hydrogen carbonate. (1 Mark)

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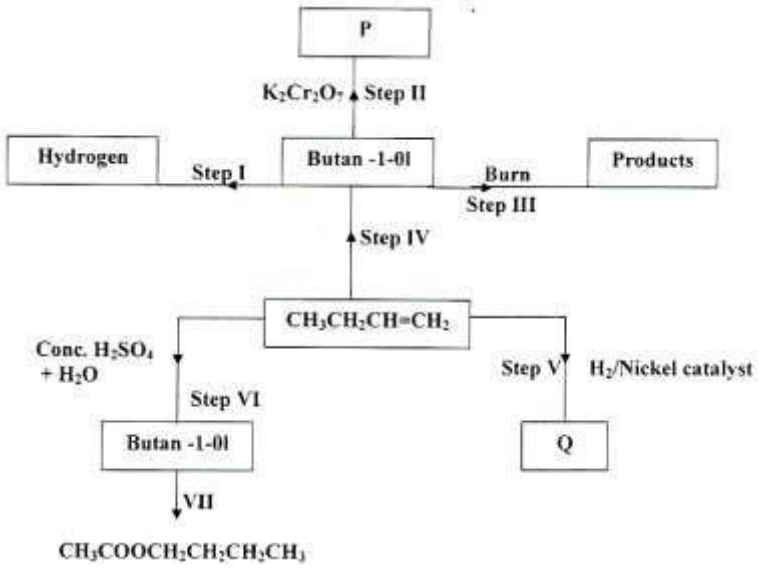
3. Use the information in the scheme below to answer the questions that follow.



(a) Name substance P (1 Mark)

(b) Give the structure and name of compound Q. (1 Mark)

(c) Write the equation for the chemical reaction in steps III (1 Mark)

(d) Name the reagents and conditions necessary for the reaction in

(i) Step IV (1 Mark)

Reagents (1 Mark)

(ii) Step VII

Reagents (1 Mark)

Conditions (1 Mark)

(e) What name is given to the reaction in step VII? (1 Mark)

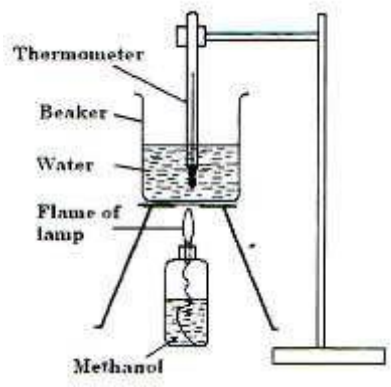
(f) Below are two reactions showing how a long chained alkanoic acid can be converted into detegernt B.

I. $CH_2 - C_{17}H_{35}COOH$
$CH - C_{17}H_{35}COOH + 3H_2O \longrightarrow 3C_{17}H_{35}COOH + C_3H_8O_3$
$CH_2 - C_{17}H_{35}COOH$

II. $3C_{17}H_{35}COOH + 3NaOH \longrightarrow C_{17}H_{35}COONa + 3H_2O$
(Detergent B)

(i) Name the type of reaction in I and II (2 Marks

4. In an experiment to determine the heat of combustion of Methanol, CH_3OH, a student used a set-up like the one shown in the diagram below. Study the set-up and the data below it and answer the questions that follow.



Volume of water	=	$500cm^3$
Final temperature	=	27.0^0C
Initial temperature of water	=	20.0^0C
Final mass of lamp + Methanol	=	22.11g
Initial mass of lamp + Methanol	=	22.98g
Density of water	=	1.0gcm-1
(Specific heat capacity	**=**	***4.2Jg-0C1)***

(a) Calculate
(i) The number of moles of Methanol used in the experiment. (1 Mark)
(C = 12, O = 16, H = 1)
(ii) The heat change in this experiment. (1 Mark)
(iii) The heat of combustion per mole of Methanol. (2 Marks)

(b) Explain why the value of the molar heat of combustion of Methanol obtained in this experiment is different from the theoretical value. (2 Marks)

(c) On the axis below draw an energy level diagram for the combustion of the Methanol. (2 Marks)

(d) The table below gives factors which affect the rate of the reaction between Zinc and Hydrochloric acid.
(i) Complete the table to show how the factors given affect the rate of reaction between Zinc and Hydrochloric acid. (2 Marks)

Factor	Effect on the rate of reaction	Explanation
Using Zinc powder instead of Zinc granules		
Heating the reactants		

(ii) Name the catalyst that will be added to increase the rate of reaction. (1 Mark)
(iii) Write an equation between the metal and acid above. (1 Mark)

5. The following table shows standard electrode potentials for some half reactions E□/Volts

$Ce^{4+(aq)} + e^- \rightarrow Ce^{3+(aq)}$ +1.61
$Fe^{3+(aq)} + e^- \rightarrow Fe^{2+(aq)}$ +0.77
$I_{2(aq)} + 2e^- \rightarrow 2I^-$ +0.54
$Fe^{2+(aq)} + 2e^- \rightarrow Fe_{(s)}$ -0.44
$Zn^{2+}_{(aq)} + 2e^- \rightarrow Zn_{(s)}$ -0.76
$J^{3+} + 3e + 3e \rightarrow J(s)$ x

Reference to the above table answer the following questions (Base on the values given) (a) Which is the strongest reducing agent?

(b) Which substance in the table would be used to oxidize iodide to iodine?

(c) Study the cell representation below and answer the questions that follow.
KNO_3
$Zn_{(s)}/Zn^{2+(aq)}$ // $Fe^{2+(aq)}/Fe_{(s)}$
(i) Identify the anode and the cathode
Anode (1 Mark) Cathode (1 Mark)

(ii) If the two electrodes in (i) above are connected externally, what reactions will take place in each half cell? (1 Mark)

(iii) What is the e.m.f of the cell? (1 Mark)

(iv) What is the role of KNO_3? (1 Mark)

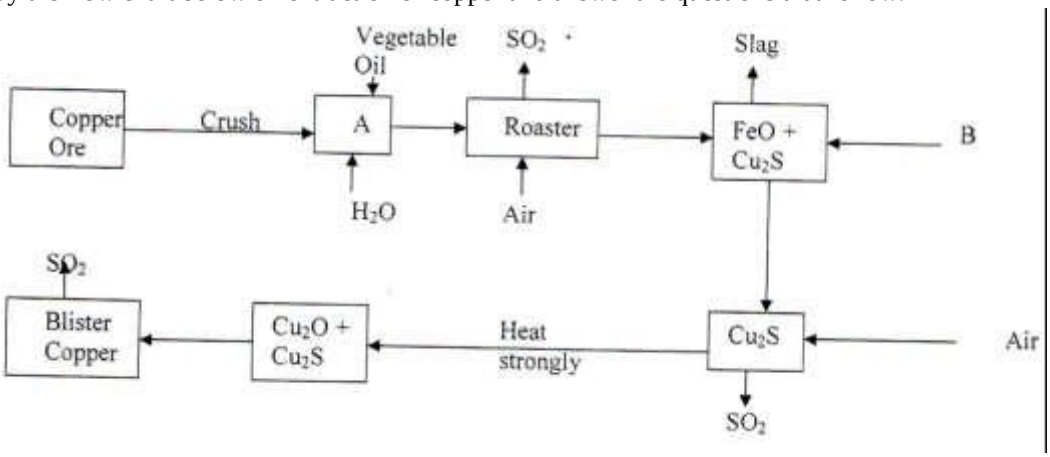
(v) Write an electrochemical equation to show what happens when a Zinc rod is dipped in a solution of iron (II) ions. (1 Mark)

(vi) Explain what happens when KCl is used instead of KNO_3 in a case where $Pb_{(s)}/Pb^{2+}_{(aq)}$ is one of the half cells. (2 Marks)

KNO3

(d) If the e.m.f of the cell $J_{(s)}/J^{3+}_{(aq)}$ // $I_{2(aq)}$ $2I^-_{(aq)}$ is 1.32V, calculate the value for $J^{3+}_{(aq)}/J_{(s)}$ (The value of x) (2 Marks)

6. Study the flow chart below on extraction of copper and answer the questions that follow.



(a) Name the chief copper ore used for the extraction of copper. (1 Mark)

(b) The amount of copper in the copper ore is usually very small. State the method used to separate the impurities from the ore in chamber A. (1 Mark)

(c) (i) What substance is fed into the roaster from chamber A. (1 Mark)

(ii) Write an equation for the reaction that takes place in the roaster. (1 Mark)

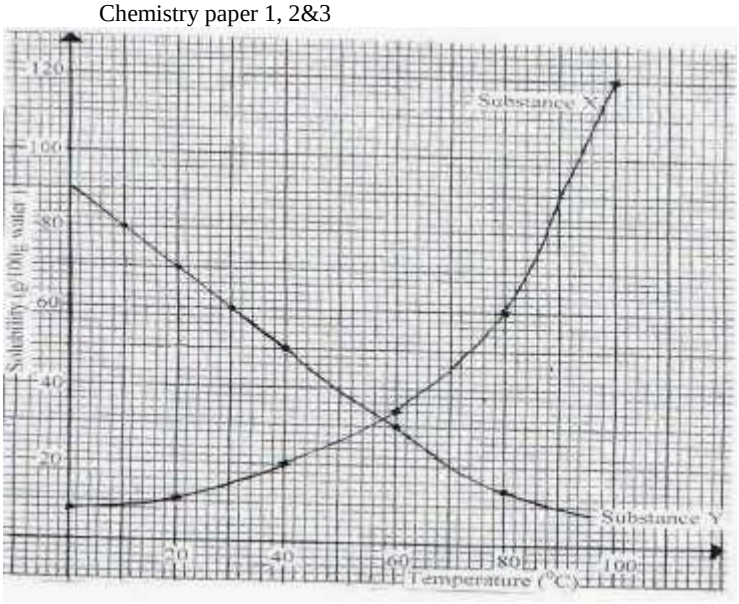
(d) The copper obtained (blister copper) is not pure. Draw a labelled diagram to show the set-up you would use to refine the copper by electrolysis. (2 Marks) (e) Give two side effects that this process would have on the environment. (2 Marks)

(f) Bronze is an alloy of copper and another metal.

(i) Name the other metal. (1 Mark)

(ii) Give one use of bronze. (1 Mark)

7. The solubility curves of substances X and Y are shown on the grid below. Study the curves and answer the questions that follow.



(i) State the effects of temperature on solubility of substance Y. (1 Mark)

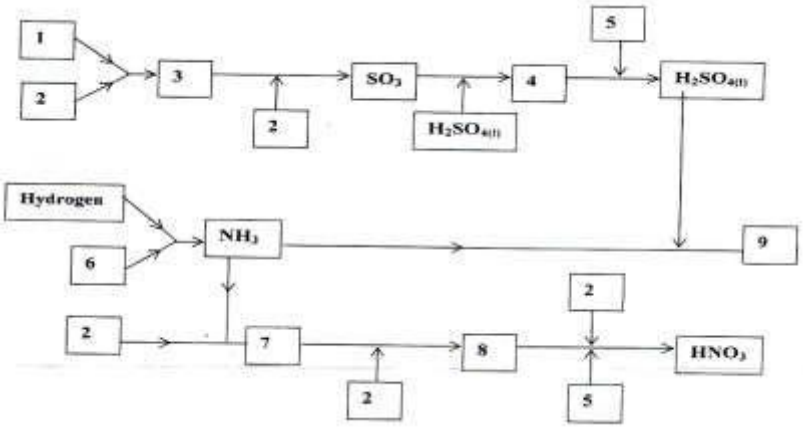
(ii) Calculate the molarity of substance X in a saturated solution of X at 40^0C. (Relative formula mass of X = 101) Assume density of the solution is 1.0g/cm^3) (2 Marks)

(iii) At what temperature do the two substances have the same solubility? (1 Mark)

(iv) Which substance is most likely to be oxygen gas? (1 Mark)

(v) If a saturated solution of substances X is cooled from 800C to 200C, determine the mass of crystals that would be obtained. (2 Marks)

8. The chart below shows some of the chemical needed for the production of ammonia gas, nitric acid and ammonia sulphate in the industry.



(a) Name the chemical that should be in chambers **1,2,4,8** and **9**. (3 Marks)

(b) State three conditions required to convert the chemical substance in chamber 3 to SO3(g) (1 ½ Marks)

(c) Write balanced equation with conditions for the reaction that produces the chemical substance in chamber 7 (2 Marks)

Explain the following with the help of equations. When concentrated sulphuric acid is added to copper turnings and the mixture heated, a reaction takes place producing a blue solution as one of the products, when dilute sulphuric acid is added to copper turnings there is no change even after heating.

MWINGI CENTRAL DISTRICT JOINT EVALUATION EXAMINATION
233/3
CHEMISTRY
PAPER 3
JULY/AUGUST 2015

Question 1

You are provided with:

- ✓ Hydrochloric acid, Solution **A**
- ✓ 0.2M Sodium hydroxide, Solution **B**

- ✓ 0.4g of metal **C**

You are required to determine;

(i) Molar enthalpy change for the reaction between metal **C** and hydrochloric acid. (ii) The molarity of acid A.

Procedure

Using a measuring cylinder, place 100cm^3 of acid A in a 250ml plastic beaker. Record its temperature as t_1. Put metal **C** into the beaker and stir using the thermometer. Record the highest temperature attained as temperature t_2 in table **I** below.

Table I

Final temperature t_2 (^{0}C)	
Final temperature t_1 (^{0}C)	

(a) Determine the temperature change, ΔT^0C (1 ½ Marks)

(b) How many moles of **C** were used in the experiment (C = 24.0) (1 Mark)

(c) Calculate the molar enthalpy change for the reaction.

$C_{(s)} + 2H^+_{(aq)} \rightarrow C^{2+}_{(aq)} + H_{2(g)}$ Given $Q = \frac{Mc\Delta T}{1000n}$, where n is the no. of moles of C that reacted.

(s.h.c = 4.2Jg^{-1}k^{-1}, density of solution = 1g/cm^3) (2 Marks)

PROCEDURE II

Fill the burette with solution **F**. Pipette 25cm^3 of solution **B** into a conical flask. Add 3 drops of phenolphthalein indicator. Run the solution in the burette into the conical flask until the pink colour just disappears. Record your readings in the table **II** below. Repeat the above procedure to complete the table.

TABLE II

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

(a) Find the average volume of solution **F** used (4 Marks)

(b) Calculate

(i) The number of moles of solution **B** used (1 Mark)

(ii) The number of moles of hydrochloric acid in solution **F** that reacted with 25cm3 of solution B. (1 Mark)

(iii) The number of moles of hydrochloric acid in 100cm3 of solution F. (1 Mark)

(iv) The initial number of moles of hydrochloric acid in 100cm3 of solution **A**. (1 Mark)

(v) The molarity of hydrochloric acid, solution **A**. (1 Mark)

Question 2

You are provided with:

(a) Sodium thiosulphate containing 40g/litre, solution **D.**

(b) 2M Hydrochloric acid, solution **E**.

You are required to:

Determine the rate of reaction between sodium thiosulphate and Hydrochloric acid.

Procedure:

Into a 100ml glass beaker, place 20cm^3, of D. Using a pencil, Mark a cross (X) on a white paper. Place a beaker containing solution **D** on the cross X. Add 20cm^3 of solution **E** into solution **E** into solution **D** and at the same time start a stop watch. Shake the beaker and immediately place it on the cross. Observe the cross (X) through the solution (from the top) and record the time (t) in seconds taken for the cross to be longer visible.

Repeat the procedure using the other solutions of **E** diluted with water as indicated in the table III below.

TABLE III

Experiment	1	2	3	4	5
Volume of solution **D** (cm^3)					
Volume of solution **E** (cm^3)					

Volume of water (cm^3)					
Time taken for X to disappear					
1/time					

(3 Marks) (a) Plot a graph of 1/time (y-axis) against volume of solution **E.**

(4 Marks)

(b) (i) From the graph, determine the time taken for the cross (X) to be invisible at 16.5cm3 of solution **E**.

(ii) If the volume of solution **E** in b (i) above was diluted using 3.5cm^3 of water, what would be the concentration of **E** in the mixture in moles/litre. (1 Mark)

(c) Explain the shape of the graph. (1 Mark)

Question 3

Procedure:

You are provided with solid **G** and **H.** Carry out the tests and record your observation and inferences in spaces provided.

(a) Place all solid **G** in a clean boiling tube. Add about 10cm3 of distilled water and shake well.

Observations	**Inferences**
(½ Mk)	(½ Mk)

Divide the solution into 4 portions

(i) To the first portion add 2-3 drops of sodium hydroxide until in excess.

Observations	**Inferences**
(1 Mk)	(1 Mk)

(ii) To second portion add 2-3 drops of aqueous ammonia until excess.

Observations	**Inferences**
(1 Mk)	(1 Mk)

(iii) To the third portion add 3 drops of dilute hydrochloric acid, solution E.

Observations	**Inferences**
(½ Mk)	(½ Mk)

(iv) To the fourth portion, add 3 drops of Lead (ii) nitrate solution followed by dilute nitric acid.

Observations	**Inferences**
(1 Mk)	(1 Mk)

(b) I. Using a clean metallic spatula, heat about one third of solid **H** in a Bunsen burner flame.

Observations	**Inferences**
(1Mk)	(1 Mk)

II. Put the remaining solid **H** in clean test tube. Add distilled water and shake well. Add more water to about ¾ full. Divide the solution into three portions.

(i) Determine the pH of the solution using universal indicator solution.

Observations	**Inferences**
(1 Mk)	(1 Mk)

(ii) To the second portion, add 2 drops of acidified Potassium Manganate (VII) solution.

Observations	**Inferences**
(1 Mk)	(1 Mk)

(iii) To the third portion add sodium hydrogen carbonate solid.

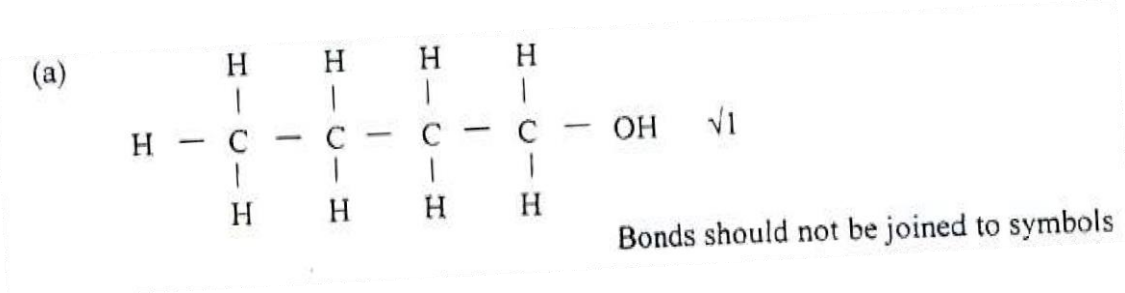
Observations	**Inferences**
(1 Mk)	(1 Mk)

MWINGI CENTRAL DISTRICT JOINT EVALUATION EXAMINATION
233/1
CHEMISTRY
PAPER 1
JULY/AUGUST 2015

MARKING SCHEME

1. 65 x 0.31 ✓ ½ + 63 x 0.69✓ ½
   = 63.62✓1
2. A, D, C, B and E all correct (2 Marks)
   A,D,C,E 1mk
   A,D,C ½ mk otherwise penalize
   correct answers are exclusive
   Universal indicator ✓ ½ / pH chart ✓ ½
   (Alt: given solvent/filter paper)
3. (a) Extraction of salt ✓ ½ at L. Magadi by evaporating water till saturation ✓1 to form crystals ✓ 1 // Extraction of salt from sea water.
   (b) Distillation of crude oil ✓ ½ based on boiling point//liquefaction of liquid air to get nitrogen and oxygen.
4. (i) pH 7 ✓ ½ it is water that reacts with calcium to form calcium hydroxide and hydrogen ✓ 1 //Ca is above hydrogen in reactivity series.
   (ii) pH ✓ ½ - It is acidic solution ✓ ½ from which hydrogen can be displaced by a more reactive metal Ca.
5. (a) K^+ has more energy levels that Na^+✓ 1
   (b) Both are in the same period ✓ ½
   Na^+ radius is larger than Mg^{2+} ✓ ½ because additional electrons in Mg^{2+} are added to same ✓ ½ energy level and there is increase in number of protons in the nucleus leading to more force ✓ ½ of attraction between the protons and electrons making Mg^{2+} smaller than Na^+.
6. (a) (i) The solution changes from green ✓ 1 to brown ✓ 1 3 Marks (ii) A brown ✓ 1 precipitate is formed.
   (b) $Fe^{3+(aq)} + 3OH^{-(aq)} \rightarrow Fe(OH)_{3(s)}$
7. - Add distilled water to $ZnCl_2$ solid ✓ ½ and shake until all solid dissolves ✓ ½ → Add $NaHCO_{3(aq)}$ ✓ ½ or Na_2CO_3 solution to form white precipitate of $ZnCO_{3(g)}$ → Filter ✓ 1 and wash residue with a lot of water ✓ ½ → Dry it between two filter papers.
8. (i) At 100^0C 100g water → 48g of y 190g water → ?
   $\frac{190}{100}$ x 48 ✓ = 91.2g of y ✓ ½
   (ii) In 150g of saturated solution at 1000C mass of y = 50g
   At 600C – mass of y solution = 40g ✓ 1
   → Mass that crystallizes = 50 – 40 = 10g ✓ ½
   Attempt to subtract ✓ 1
9. Heat absorbed for bond breaking = 4 (C – H) + 2(Cl – Cl)
   = 4 x 414 + 2 x 244 = 1656 + 488 = 2144KJ
   Heat evolved for bond formation = 2(C-H) + 2(C – Cl) + 2(H – Cl)
   = 2(-414) + 2 (-326) 2 (-431)
   = (-828) + (-652) + (-862)
   H = -2342
   → H = 2144 – 2342 = -198KJ

10. C O
    42.8 57.2
    12 16
    $\frac{42.8}{12}$ $\frac{57.2}{16}$ ✓ ½
    $\frac{3.567}{3.567}$ $\frac{5.575}{3.567}$ ✓ ½
    1 1.002
    EF C O ✓ ½
    MF = (EF)n
    n = $\frac{RMM}{REF} = \frac{28}{28}$
    n = 1 ✓
    MF = CO ✓ ½
11. (i) Orange potassium dichromate turns green ✓ ½ due to reduction process ✓ ½ // SO_2 is a reducing agent where it reduces chromate (VI) ions to chromium (III) ions.
    (ii) Brown ✓ ½ iron (III) sulphate solution turns green ✓ ½ due to reduction of $Fe^{3+(aq)}$ to $Fe^{2+(aq)}$
12. $\frac{55}{67} = \sqrt{\frac{MO_2}{71}}$ ✓ ½
    $0.8209 = \sqrt{\frac{MO_3}{71}}$ ✓ ½
    $MO_3 = 71 \times 0.6739$ ✓ ½
    = 47.85 ✓ ½
13. (a) Pent 2 – ene ✓ 1
    (b) (i) Substitution ✓
    (ii) Addition ✓
14. (a)



    Bonds should not be joined to symbols
    (b) Alcohol ✓ 1 //Alkanols
    (c) $C_4H_{10}O_{(l)} + K_{(s)}$ → $C_4H_9OK_{(l)} + H_{2(g)}$ ✓ 1
15. (a) Yield decreases ✓ ½ reaction is exothermic ✓ ½ therefore it favoured by low temperatures.
    (b) Yield decreases ✓ ½ since the process is favoured by ✓ ½ high pressure due to Boyle‟s law.
16. (a) B ✓ 1 – Acid had higher concentration ✓ 1
    (b) The reaction rate is initially high ✓ 1 because of high concentration but decreases steadily as concentration also decreases.
17. (a) Heat is necessary *REJECT high temperature ACCEPT, BOIL or if implied 1mk - MnO_3 is a weak oxidizing agent
    (b) $Cl_2O_{(g)} + H_2O_{(l)}$ → $2HOCl_{(aq)}$ C.A.O 1mk

(c) Chlorine water contain $HOCl_{(aq)}$/ $OCl^-_{(aq)}$ ✓ ½

- Which donates oxygen atom to the dye oxidizes/bleaches (accept) ✓½

18. (a) Ammonia dissolves ✓ ½ in water to form ammonia solution which is basic ✓ ½ (b) Increase surface area to avoid sucking back of the gas. ✓ 1

---

19. Equation for deposition of Cu

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

63.5g of Cu(s) require (2 x 96500) C = 193000C ✓ ½

1.48g of Cu require □ ?C

$\left(\frac{1.48}{63.5}\ x\ 193000\right)$C

= 4498.2C ✓ 1

Q = It

4498.2C = I x(150 x 60)S ✓ ½

4498.2C = 9000I

$\frac{4498.2}{9000}$= I

= 0.4998 ampheres □ 0.5 amps ✓ ½

20. Atomic No. C = 6 □ 2.4 O = 8 □ 2.6

✓ 2 C O

21. Anode equation

$2Cl^-_{(l)} \rightarrow Cl_{2(g)} + 2e^-$ ✓1

Cathode equation

$2Na^+_{(l)} + 2e^- \rightarrow 2Na_{(s)}$ ✓

22. (a) □ H_1 – Molar enthalpy of formation of iron (II) chloride ✓1

□ H_3 – Molar enthalpy of formation of iron (III) chloride ✓1

(b) □H_3 = □H_1 + □H_2 ✓

23. No of t ½ = $\frac{90}{15} = 6$

Remaining Fraction = $\left(\frac{1}{2}\right)^6 = \frac{1}{64}$

Mass left = $\frac{1}{64}$ x 2 = 0.03125g

24. (a) It is very hot. ✓ 1

(b) The upper ✓ 1 part. Because all the gases undergo complete ✓1 combustion ✓1

25. (i) N – Diamond ✓ 1 M – Graphite ✓ 1

(ii) Uses of N

- As drilling bits
- As jewellery

(Any other correct)

(iii) M ✓ ½ - Existence of delocalized electrons ✓ ½

26. (i) River water contains $Ca^{2+}_{(aq)}$ and /$Mg^{2+}_{(aq)}$ ✓ ½ which react with soap to form scum ✓ ½

(ii) <u>Advantage</u>

Forms lather quickly with water ✓ 1

<u>Disadvantage</u>

It"s non-biodegradable ✓ ½ therefore causes environment pollution e.g. froth in sewage plants. ✓ ½

27. (a) $E_{cell} = E_{red} – E_{oxidised}$

= +1.36 - (-0.76) ✓ 1

= +2.12V ✓ 1 (Reject if sign is missing)

28. (a) $M_1V_1 = M_2V_2$ $M_1 = 2$

$V_1 = 180cm^3$

$V_2 = 1000$

$M_2 = \frac{2+180}{1000}$

= 0.36M

$1dm^3 = 1000cm^3$ = 1 Litre

□Concentration of new solution = 0.36M ✓ ½

(b) Oil is less dense than water; therefore would float on ✓ ½ the water and burning would continue ✓ ½

29. (a) $C_{(s)} + H_2O_{(g)} \rightarrow CO_{(g)} + H_{2(g)}$

Correct balanced equation with state symbols (1 Mark)

(b) Reducing property ✓ 1 Mark

MWINGI CENTRAL DISTRICT JOINT EXAMINATION 2015
233/2
CHEMISTRY
PP2
MARKING SCHEME

1. (a) (i) Alkaline earth metals
✓ (1mk)
(ii) A ✓ (1mk)
(iii) Covalent ✓ (1mk) – they share electrons while bonding so as to attain noble gas configuration or WTTE ✓ (1mk)
(iv) D2O3 ✓ (1mk)
(v) Immediately before E ✓ (1mk)

(b) (i) H ✓ (1mk)

(ii) K ✓ (1mk)

(iii) I. ✓ (1mk) II. J ✓ (1mk)

2. (a) (i) Carbon (IV) oxide (ii)
Ammonium Chloride
(iii) Sodium hydrogen carbonate

(b) – Extraction of metals e.g aluminium
- Drying of gases

(c) – Water is required as a reactant
- For cooling the solvary tower because the reaction is exothermic

(d) (i) $Ca(OH)_{2(aq)} + NH_4Cl_{(aq)} \rightarrow CaCl_{(aq)} + 2NH_{3(g)} + H_2O_{(l)}$

(ii) $2NaHCO_{3(s)} + CO_{32-(aq)} \rightarrow CaCO_{3(s)}$

(e) $Ca_{2+(aq)} + CO_{32-(aq)} \; CaCO_{3(s)}$

(f) By dissolving ammonia gas in brine

(g) Making baking powder

(a) Butanoic acid

(b) Butane

(c) $CH_3CH_2CH_2OH + 6O_2 \rightarrow 4CO_{2(g)} + 5H_2O$

(d) Reagent: Ethanoic acid
Condition: Conc. Sulphuric acid and heating

(e) Esterification

(f) (i) I. Hydrolysis
II. Saponification

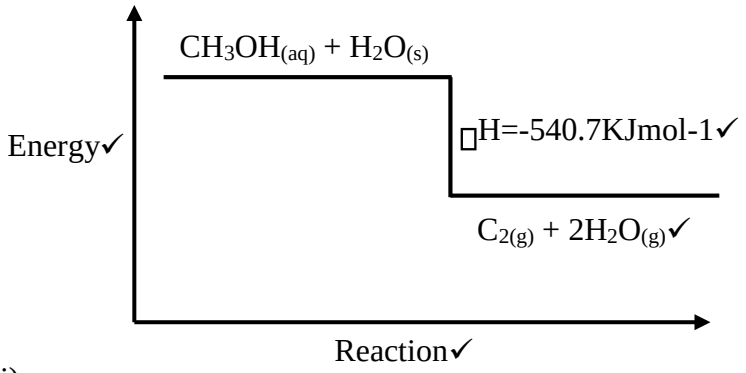
4. (a) (i) Mass of methanol burnt = 22.98 – 22.11g = 0.87 ✓✓
R.F.M of methanol CH_3OH = 12 + 3 + 16 + 1 = 32 32g of CH_3OH makes 1 mole
→ 0.87g will make $\frac{1}{32}$ x 0.87 ✓ = 0.027187 → 0.0272

(ii) Heat change = mc∆T
$= \frac{500}{1000}$ x 4.2 x 7 ✓✓

(iii) If 0.027187 gives 14.7Kj
→ 1 mole = $\frac{14.7}{0.027187}$ x 1 ✓ 540.6995 → 540.7kJmol^{-1}

(b) – The experiment error caused by apparatus i.e. thermometer, weigh balance
- Heat loss that was not accounted for (2 Marks)

(c)



(2 Marks)

(d) (i)

	Effect on the rate of reaction	Explanation
Zinc powder	Faster reaction ✓	Increased powdered Zinc results in faster ✓ rate of reaction because of increased surface area✓, higher collision effect.
Heating	Faster reaction ✓	Increases kinetic ✓ energy resulting in more collision effect after proper orientation

(ii) Copper (II) Sulphate crystals ✓ (1mk)

(iii) $Zn + 2HCl_{(aq)} \rightarrow ZnCl_{2(aq)} + H_{2(g)}$ ✓ (1mk)

5. (a) Zn ✓ (1mk)

(b) Ce^{4+} and Fe^{3+}✓(1mk)

(c) (i) Anode Fe (1mk)

Cathode Zn (1mk)

(ii) $Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e$✓(1mk)

$Fe^{2+}_{(aq)} + 2e \rightarrow Fe_{(s)}$ ✓(1mk)

(iii) E.m.f = 0.76 – 0.4 = 0.32V ✓(1mk)

(iv) Complete the circuit/Balance the ions in the two half cells ✓(1mk)

(v) $Zn_{(s)} + Fe^{2+}_{(aq)} \rightarrow Fe(s) + Zn^{2+}_{(aq)}$ E = +0.32V✓(1mk)

(vi) Reaction will not take place at the electrodes ✓(1mk)

- Lead (II) oxide which is insoluble will be formed and hinder the flow of charges in the salt bridge ✓(1mk)

(d) $J_{(s)}/J^{3+}_{(aq)}$ = 1.32 – 0.54 = 0.78V ✓(1mk)

$\rightarrow J^{3+}_{(aq)}/ J_{(s)}$ = - 0.78V✓(1mk)

6. (a) Copper pyrite ($CuFeS_2$) ✓(1mk)

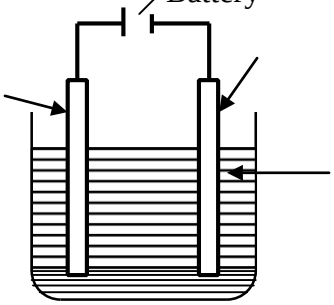
(b) Froth – Floatation ✓(1mk)

(c) (i) $CuFeS_2$ ✓(1mk)

(ii) $2CuFeS_{2(s)} + 7O_{2(g)} \rightarrow Cu_2S_{(s)} + 2FeO_{(s)} + 3SO_{4(l)}$ ✓(1mk)

(d)

Anode (Blister copper) Battery Cathode (pure copper)



Copper (II) Sulphate solution

(e) – Produces SO_2 that causes acid rain
- Mining copper from the ground may led to gapping holes being left in ground (2 Marks)

(f) (i) Zinc ✓ 1 Mark
(ii) Used in making ✓ 1 Mark
- Domestic utensils
- Condenser tube
- Sheets and cartridge

7. (a) (i) Solubility of substances Y decreases with increase in temperature ✓ 1 Mark (ii) Mass per 100g water at 40^0C = 20g ✓ ½ Mark

Moles $\frac{20}{101}$

Molarity = $\frac{20}{101}$ x $\frac{1000}{100}$ ✓1 Mark = 1.980M ✓ ½ Mark

(iii) 58^0C✓ 1 Mark Acc ans within □ 0.5^0C

(iv) Y ✓ 1 Mark

(v) Solubility at 80^0C = 60g ✓ ½ Mark

Solubility at 20^0C = 10g ✓ ½ Mark

Mass of crystals (60 – 10) 50g✓ 1 Mark

8. (a) 1 – Sulphur/Oxygen ✓ ½ Mark (if 1st oxygen 2nd Sulphur)
2. Sulphur/Oxygen ✓ ½ Mark
4. Oleum ½ Mark
6 – Nitrogen ½ Mark
9 – Ammonium Sulphate ½ Mark
8 – Nitrogen (IV) Oxide ½ Mark

(b) – Temperature 450 – 500^{s}C ½ Mark
- Pressure of about 2 – 3 atoms ½ Mark
- Catalyst – Vanadium (V) oxide (V_2O_5)

(c) $NH_{3(g)} + 5O_{2(g)} \xrightarrow{\text{Platinum catalyst/900 C}^0} 4NO_{(g)} + 6H_2O_{(l)}$

(d) Conc. H_2SO_4 acts as a oxidizing agent ½ Mark, but dil. H_2SO_4 is not instead reaction will proceed for a shorter time and stops ½ Mark due to formation of an insoluble sulphate which stops further reaction ½ Mark

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MWINGI CENTRAL DISTRICT JOINT EXAMINATION
233/3
CHEMISTRY
PAPER 3 MARKING
SCHEME

1.

Final temperature t_2 (^{0}C)	$T_2>t_1$
Final temperature t_1 (^{0}C)	S.V

CT ✓ ½

Dp ✓ ½ (Accept whole numbers)

A✓ ½ (Teachers initial temperature) 2

(a) T = Final temperature – Initial temperature

= 29.0 – 26.0 = 3.0 ✓ ½

(b) $\frac{0.04}{24}$= 0.001667 moles

Computation ✓ ½

Answer ✓ ½

(c) m = $100cm^3$ x $1g/cm^3$ = 100g ✓ ½

Q = $\frac{100\ x\ 4.2\ x\ Ans(a)}{1000}$ ✓ ½

= Ans $KJmol^{-1}$✓ ½

NB: Penalise 1 mk for wrong units.

TABLE II

	I	II	III
Final burette readings (cm^3)	22.0	22.0	22.0
Initial burette readings (cm^3)	0.0	0.0	0.0
Volume of solution **F** used (cm^3)	22.0	22.0	22.0

Complete table – 1mk

Conditions

3 readings (consistent) – 1 1

or consistent reading – 0

2 in consistent readings – 0

Penalties

- ✓ Wrong Arithmetic
- ✓ Inverted table
- ✓ Unrealistic readings

NB: For each penalize upto a maximum of ½ mk

Decimal point- 1 mk

- ✓ Accept either 1 or 2 d.p used consistently otherwise penalize fully.
- ✓ If two d.p used 2nd d.p must be either be „0" or „5)
- ✓ Accept inconsistency of 0 i.e 0.O or 0.00 or 0.000

Accuracy – 1mk

- ✓ Compare any one of students readings with the school titre value
- ✓ 1f at least 1 reading with 0.1✓
- ✓ If within 0.2 ✓ ½
- ✓ If not within 0.2 ✓ 0

Principles of averaging

(a) $\frac{22.0+22.0+22.00}{3}$ = ✓ $22cm^3$ ✓ ½

Conditions

If within 1mk

If none within 0 mk

If consistent value average – 0 mk

Correct working, wrong answer – ½ mk

Not working, correct answer – ½ mk

If wrong arithmetic, penalize – ½ mk

Final answer 1mk

Compare the average value with the teachers average value.

- ✓ If within 0.1 – 1mk
- ✓ If not with 0.1 – 0mk Total marks 5 mks

(b) (i) the no. of moles of B ✓ computation ½ mk

$\frac{25\ x\ 0.2}{1000}$= 0.005 ✓ Ans ½

(ii) the no. of moles of acid in F

Mole ratio = 1:1 ✓ mole ratio ½

(iii) moles of acid in $100cm^3$ of F

$\frac{100x0.005}{18.8}$= 0.0266 moles ✓ computation ½ mk

✓ Ans ½

(iv) Initial no. of moles = moles reacted with solid C+ moles reacted with NaOH

= (0.0167 x 2) ✓ + 0.02666 ✓ computation ½ mk

= (0.0333 + 0.02666) moles per 1000cm^3 ✓ Ans ½

= 0.06015 moles ✓ Ans

½ mk (v) Molarity of A

$\frac{1000\ x\ 0.06015}{100}$ = 0.6015✓ computation ½ mk

= 0.602M ✓ Ans ½

2. TABLE III

Experiment	1	2	3	4	5
Volume of solution **D** (cm^3)	40	20	20	20	20
Volume of solution **E** (cm^3)	20	17.5	15.0	12.5	10
Volume of water (cm^3)	0	2.5	5	7.5	10
Time taken for X to disappear	17	25	32	39	46
$\frac{1}{t}$ (sec – 1)	0.0588	0.040	0.0312	0.0256	0.0217

✓ **Complete**

- Reject readings in minutes.
- Filled table and correct computation.

✓ **Decimal table 1 mk**

- Accept $\frac{1}{t}$ to 4th d.p moles divided fully
- Reject $\frac{1}{t}$ in fraction

✓ **Accuracy 1mk**

Tied to school values 1st reading at 0 cm^3 of water 2 sec.

✓ **Trend 1mk**

Increase in time continuously.

(a) GRAPH (See graph paper)

✓ Plotting 1mk

- 5 correct plot 1mk
- 5 plotted, 4 correct plots – ½ mk
- 5 plotted, 1 -3 wrong plots – 0 mk

✓ Scale ½ mk

✓ Labelling ½

✓ Straight line (Line of best fit) 1mk

(b) (i) $\frac{1}{T}$= 3.75 x 10^{-2} sec

= t = 26.67 secs

Accept -2

($_1$ $_1$ $_2$ $_2$ii) C V = C V

2 x 16.5 = C

$_2$ x 20

$C_2 = \frac{2\ x\ 6.35}{20}$ ✓= 1.5M ✓ Computation ✓ ½

Ans ✓ ½

(c) The graph is a straight line. This indicates that the rate of reaction is directly proportional to the concentration of the acid solution E✓ (1mk)

OR (words to the relationship of diluting, decrease in the time, increase in reciprocal)

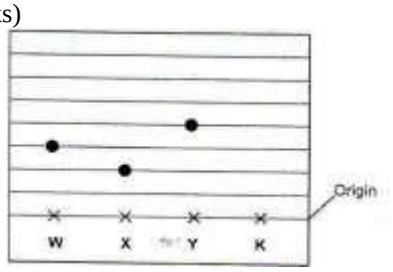
Observations	**Inferences**

(a) Solid dissolves to form a colourless solution (½ Mk)	Soluble salt (½ Mk)
(i) White precipitate ✓ ½ soluble in excess ✓ ½	Al^{3+}, Pb^{2+}, Zn^{2+} ✓ present (3 ions – 1mk, 2 ions – ½ mk, 1 ion – 0 mk Penalize full for contradictory ion)
(ii) White precipitate ✓ ½ insoluble in excess ✓ ½	Al^{3+}, Pb^{2+} present (2 ions – 1mk. 1 ion ½ mk)
(iii) No white precipitate✓ ½	Al^{3+} confirmed ✓ Or Pb^{2+} absent. *Reject if not mentioned in a (i) and (ii) above*
(iv) White precipitate, ½ insoluble in dilute nitric acid.	SO_4^{2-}, Cl- ✓ Two mentioned – 1mk One mentioned – ½ mk
(b) I. (i) Solid melts. ✓ ½ burns with yellow smoky/sooty/luminous flame ✓ ½ II. (i) PH = 4 – 6 ✓ ½ (ii) Purple KMnO4 decolorizes ✓ (iii) Effervescence/hissing sound. ✓ ½	C = C, C □ C- Present 2 group – 1 ✓ 1 group – ½ Presence of R – $COOH/H^+$ ✓ ½ C = C, C □ C- 2 group – 1 ✓ 1 group – ½ Acidic substance/R – COOH/H+ ✓½

WESTLANDS DISTRICT JOINT EXAMINATION 2015
233/1
CHEMISTRY
THEORY
PAPER 1
2 HOURS

Answer all Questions

1. a) The diagram below represents a paper chromatogram of pure W, X and Y. A mixture K contains W and Y only. Indicate on the diagram the chromatogram of K. (2 marks)



b) Show the solvent front. (1 mark)

2. Ammonia is produced in large scale by Haber process.

i) Write an equation for the formation of ammonia gas. (1 mark)

ii) State two optimum conditions for obtaining a high yield of ammonia in the process. (2 marks)

3. The table below gives elements represented by letters which are not the actual symbols.

Element	U	V	W	X	Y	Z
Atomic No.	8	12	13	15	17	20

i) Select an element that can form divalent anion. (1 mark) ii) What is the structure of the oxide of W? (1 mark)

4. A compound has an empirical formula C_3H_6O and relative formula mass of 116.

a) Determine its molecular formula.
(H=1.0, C=12.0, 0=16.0) (2 marks)

b) Calculate the percentage composition of carbon by mass in the compound. (1 mark)

5. In the laboratory, hydrogen sulphide gas is prepared by action of dilute hydrocholoc acid on metal sulphides.

a) Name the metal sulphide that can be used in preparing the gas. (1 mark)

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

c) Give one chemical test for hydrogen sulphide gas. (1 mark)

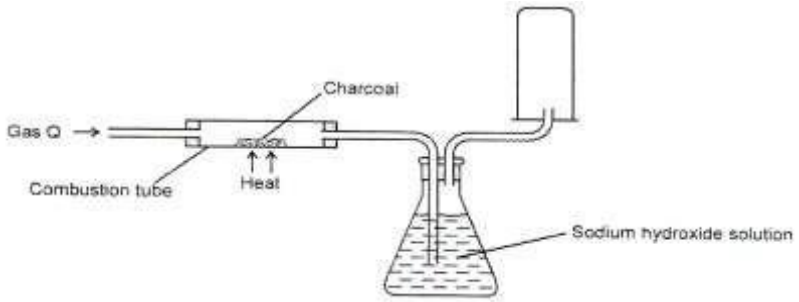
6. The table below gives the solubilities of Potassium Bromide and Potassium Sulphate at 0^0c at 40^0c.

Substance	Solubility/100g water	
Potassium Bromide	55	75
Potassium Sulphate	10	12

When aqueous mixture containing 60g of KBr and 7g of K_2SO_4 in 100g water at 80^0C was cooled to 0^0C, some crystals were formed:

i) Identify the crystals. (1 mark) ii) Determine the mass of the crystals formed. (1 mark) c) Name the method used to obtain the crystals. (1 mark)

7. The diagram below shows an experimental set up for preparing Carbon (II) oxide. Study it and answer the questions that follow.



a) Identify gas Q. (1 mark)

b) State the reason why Carbon (II) Oxide is collected in the manner illustrated. (1 mark)

c) Describe a simple test that can be used to distinguish between Carbon (II) Oxide and Carbon (IV) Oxide. (1 mark)

8. a) Phosphorous is situated immediately below nitrogen in the periodic table. Give two physical differences between the two elements. (2 marks)

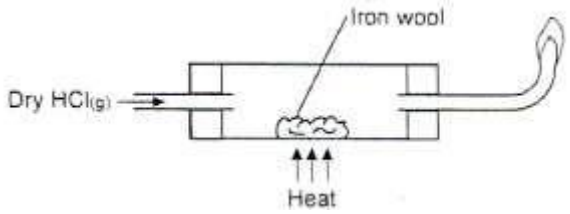
b) Write the chemical symbols of Boron and Silver. (2 marks)

9. Swimming pools are neutralized by adding calcium hypochlorite, $Ca(OCl)_2$ or Sodium hypochlorite, NaOCl. The equilibrium involved is

$$OCl^-_{(aq)} + H_2O_{(L)} \rightleftharpoons HOCl_{(aq)} + OH^-_{(aq)}$$

The species that is best at destroying bacteria and resisting decomposition by sunlight in HOCl. Explain any two reaction conditions that will favour formation of $HOCl_{(aq)}$. (2 marks)

10. Dry hydrogen chloride gas was passed over heated iron wood as shown below.



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

b) Write an equation for the reaction that gave the blue flame. (1 mark)

11. Some crystals of sugar cane were placed in a test-tube and a few drops of concentrated sulphuric (VI) acid added to it.

i) State what was observed. (1 mark)

ii) What name is given to the property of concentrated sulphuric (VI) acid in (i) above. (1 mark) iii) Write an equation for the reaction between glucose, $C_6H_{12}O_6$ and $H_2SO_{4(l)}$. (1 mark)

12. 4.333g of element Q, valency 2, reacts completely with 2.14dm^3 of chlorine gas at s.t.p (Molar gas volume at s.p=22.4dm^3)

i) Write a balanced equation for the reaction that occurs. (1 mark) ii) Find the relative atomic mass of Q. (2 marks)

13. a) Define the term „half-life". (1 mark)

b) W grams of a radioisotope take 100 days to decay to 20g. If the half-life of the element is 25 days, calculate the initial mass W of the radioisotope. (2 marks)

14. The equation for the reaction between hydrogen and bromine is:

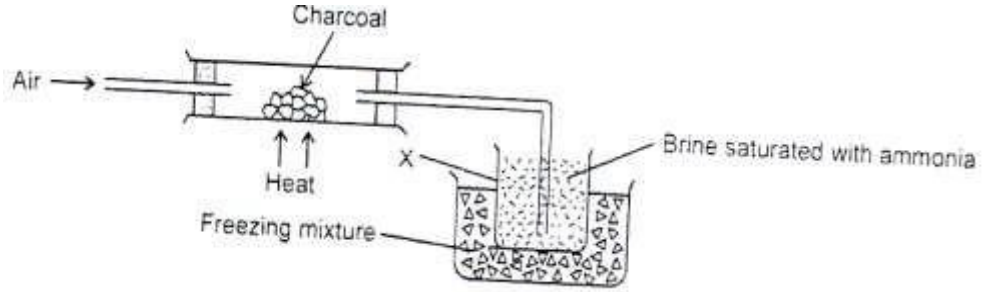
$$H_{2(s)} + Br_{2(g)} \longrightarrow 2HBr_{(g)}$$

Given the following bond energies

Bond	Energy (kJ)
H-H	+435
Br-Br	+224
H-Br	+336

Calculate the energy change for the above reaction. (2 marks)

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



a) Write two equations for the reactions taking place in the apparatus labeled X. (2 marks)

b) Name one of the salts formed at the end of the reaction. How can the salt be obtained from the mixture? (2 marks)

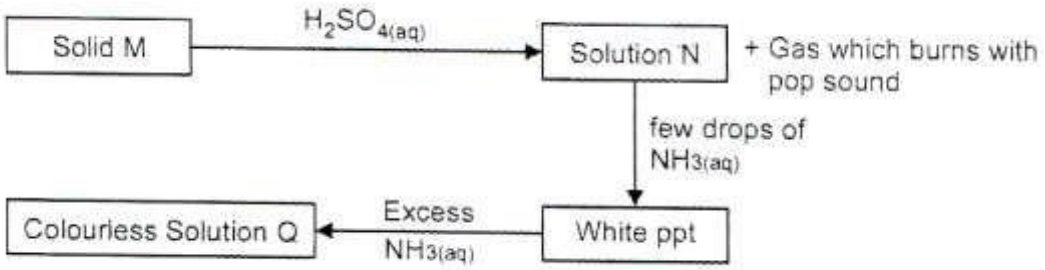
16. 3.22 of hydrated sodium sulphate, Na_2SO_4,XH_2O were heated to a constant mass of 1.42g. Determine the value of X in the formula. ***(Na=23.0, S=32.0, O=16.0, H=1.0)*** (3 marks)

17. Describe how a mixture of sodium carbonate and lead (II) carbonate can be separated. (3 marks)

18. Giving reasons, identify the acid and bases in both forward and backward reactions in the equation below.

$NH_{4(aq)}^{+} + H_2O_{(L)} \rightleftharpoons NH_{3aq)} + H_3O_{(aq)}^{+}$

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



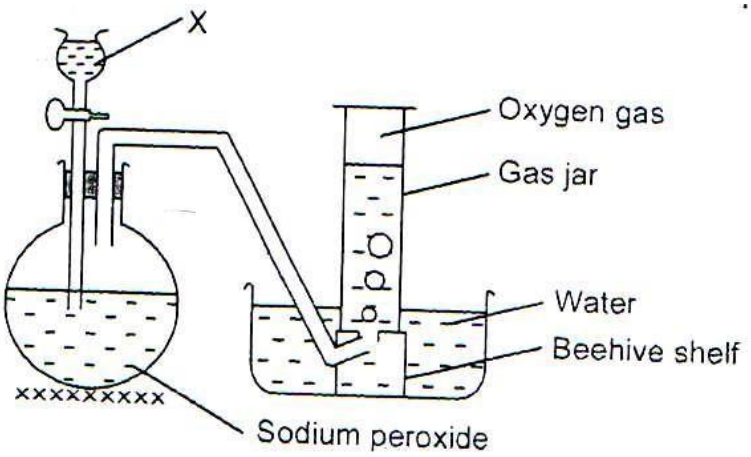
i) Name solid M. (1 mark)

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

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

20. Describe an experimental procedure that can be sued to extract oil from nut seeds. (3 marks)

21. The set up below can be used to prepare oxygen gas. Study it and answer the questions that follow.



a) Identify X. (1 mark)

b) What property of oxygen makes it possible for it to be collected as shown above set-up? (1 mark)

c) Write a chemical equation for taking place in the round-bottomed flask. (1 mark)

22. a) Name two ores from which copper is extracted. (2 marks)

b) During an extraction of copper metal, the ore is subjected to froth floatation. Give a reason why this process is necessary. (1 mark) c) Name one alloy of copper and state its use.

Alloy (1 mark)

Use (1 mark)

23. By using aqueous sodium chloride, describe how a student can distinguish calcium ions from lead ions. (2 marks)

24. The table below shows the test carried out on a sample of water and the results obtained.

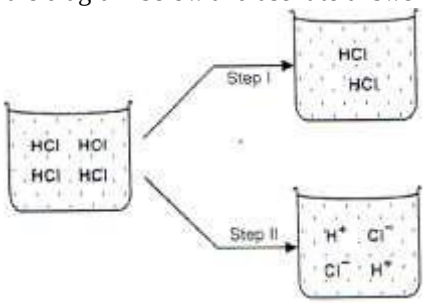
Sample	**Tests**	**Observation**
A	Addition of sodium hydroxide solution in excess	White precipitate which dissolves
B	Addition of excess ammonia	White precipitate
C	Addition of HNO_3 then Barium chloride	White precipitate

a) Identify the anion in water. (1 mark)

b) Write the ionic equation for the reaction in C. (1 mark)

c) Write the formula for the complex ion in A. (1 mark)

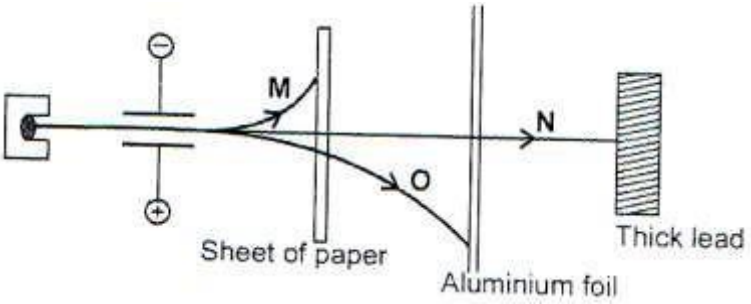
25. Study the diagram below and use it to answer the questions that follow.



a) Identify the solvent used in Step I and Step II.

b) Spatula –endful of sodium hydrogen carbonate was poured into solution B. What observations were made? Explain. (2 marks)

26. Study the diagram below and use it to answer the questions that follow.



Name the radiations: M,N,O

27. Graphite is one of the allotropes of Carbon.

a) Name one other element which exhibits allotropy. (1 mark)

b) Explain why graphite is used in making of pencil leads. (1 mark)

c) Diamond is the hardest known substance by man. Name one use of diamond. (1 mark)

28. a) A dry red litmus paper was dropped onto a gas jar of dry chlorine gas.

i) State the observation made. (1 mark) ii) Explain your observations for (i) above. (1 mark) b) Write an equation for bleaching of a dye by use of chloric II) acid. (1 mark)

29. A solution was made by dissolving 8.2g of calcium nitrate to give 2 litres of solution. (Ca=40.0, N=14.0, 0=16.0) Determine the concentration of nitrate ion in moles per litre. (3 marks)

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CHEMISTRY
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PAPER 2
2 HOURS

Answer all Questions

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 symbols of the elements.

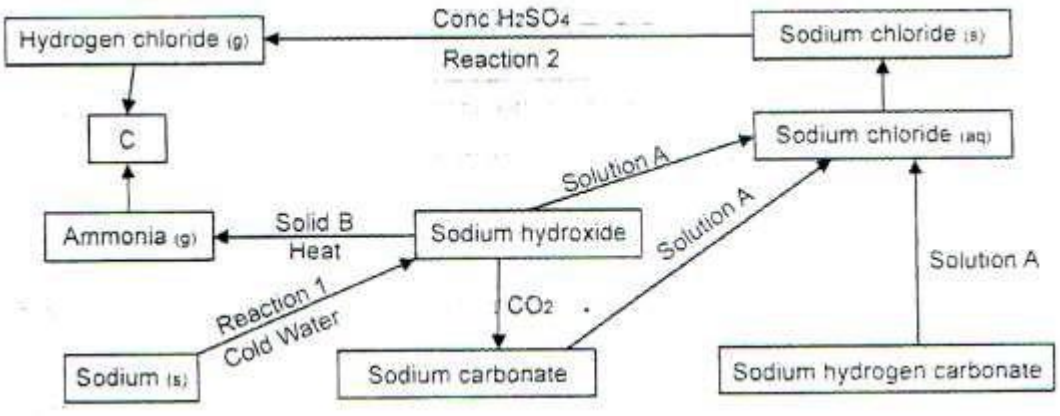
V								A
B	F			G	Z	N	E	
W	J		T	L			H	C
D	K						M	
Y								

(a) What name is given to the family to which:
i) Element E, H and M belong? (1 mark) ii) Elements F, J and K belong? (1 mark)
(b) Write the chemical formula of the;
(c) Name the type of bond and structure formed between reactions of: i) D and N
Bond (1 mark)
Structure (1 mark) ii) T and H
Bond (1 mark)
Structure (1 mark)
(d) i) Ionic radius of element E is bigger than its atomic radius. Explain. (2 marks) ii) The oxide of G has a lower melting point than the oxide of L. Explain. (2 marks)

iii) Explain in terms of bonding and structure the following observation. There is an increase in melting and boiling points from W to T. (1 mark)

(e) Using dot (.0) and cross (x) diagram show bonding in ZV^{+}_{4}. (2 marks)

2. The flow chart summarizes a series of chemical reaction of sodium and its compounds.



(a) Which of the chemicals in the flowchart is used;

i) To make soap. (1 mark) ii) In the manufacture of glass (1 mark) iii) For deicing roads (1 mark) iv) In cake-baking (1 mark)

(b) Briefly describe what would be observed in reaction 1 in the flow chart. (3 marks)

(c) Name (i) solution A. (1 mark) ii)

Write a balanced chemical equation for the reaction between solution A and sodium carbonate. (2 marks)

iii) What type of reaction takes place between solution A and sodium hydroxide solution. (1 mark)

(d) Identify; Solid B (½ mark)

Solid C (½ mark)

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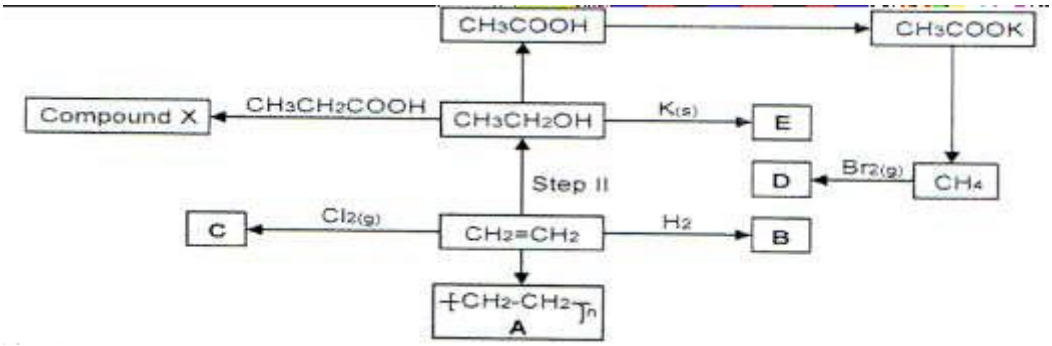
3. The flow chart below shows some chemical reactions.



a) Write the name and formula of the organic compounds;

i) Name Formula (1 mark) ii) C

Name Formula (1 mark) iii) B

Name Formula (1 mark)

a) Write the name of the process that leads to the formation of substance (s).

D

(1 mark)

A (1 mark)

C

1 mark

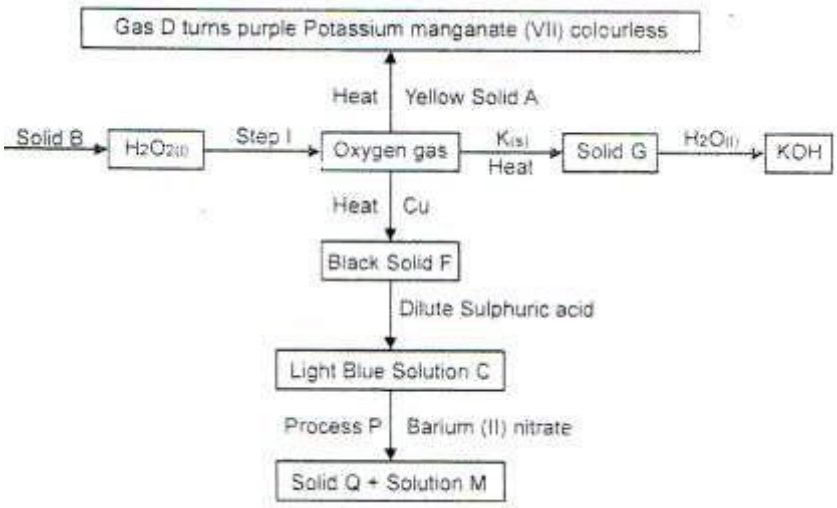
b) Give one necessary condition for the formation of compound X. (1 mark)

c) If the relative molecular mass of compound A is 84,000 units, determine the value of n. (C=12, O=1.0)

d) Write an equation for the reaction leading to the formation of substance E. (1 mark)

e) State and explain the observation made when substances „B" and C2H4 are burnt in excess air. (2marks) **4.**

The flow chart represents preparation and properties of oxygen gas. Study it and answer the questions that follow.



i) Identify the following substances. (2 marks) a) Solid A
b) Gas D
c) Solid Q
d) Solution M

ii) Write a chemical equation for the reaction in step I. (1 mark)

iii) Write the chemical equations for the formation of the following compounds. (3 marks) a) Solid G
b) Gas D
c) Light blue solution C

iv) State the confirmation test for oxygen gas. (1 mark) v)
Write the ionic equation for reaction taking place in process P. (1 mark)
vi) State one industrial use of oxygen. (1 mark)

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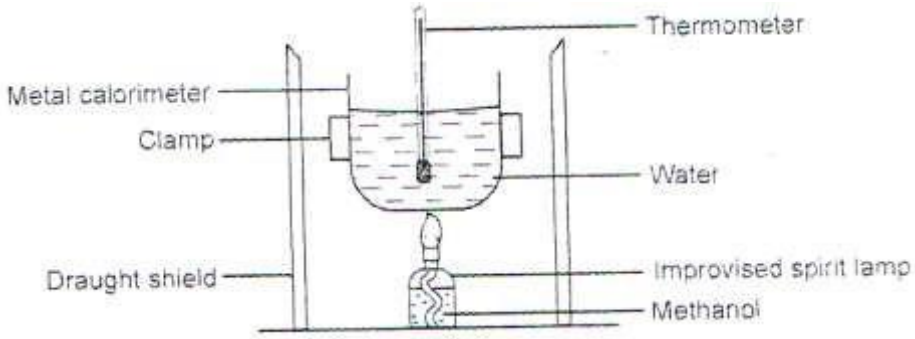
5. The diagram below shows a set-up that was used to determine the molar heat of combustion of methanol.

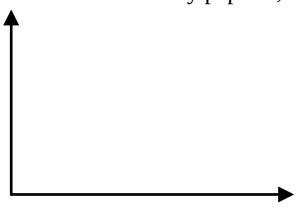


During the experiment, the information below was recorded.
Volume of water=300cm^3
Initial volume of water =24^{0}C
Final temperature of water=47.5^{0}C
Mass of methanol+lamp before burning=142.8g
Mass of methanol+lamp after burning=141.8g
Calculate the;

a) Heat evolved (2 marks)
(Density of water=1g/cm^3, specific heat capacity of water=4.25J/g/k)

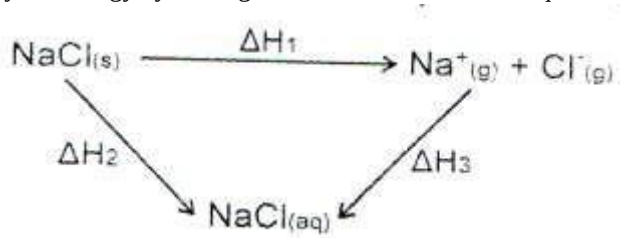
b) Molar heat of combustion of methanol. (3 marks)
(Mass of methanol=32g)

c) i) Write the thermo chemical equation for the combustion of methanol. (1 mark)
ii) Draw an energy level diagram for the reaction in c (i) above. (2 marks)



d) The value of molar heat of combustion of methanol in (b) above obtained is less than the theoretical value. State two sources of error in this experiment. (2 marks)

e) Study the energy cycle diagram below and answer the questions that follow.



i) What does ΔH_1 and ΔH_2 represent? (2 marks)

ΔH_1 ΔH_2 ii) Show the relationship between $\Delta H_1 \Delta\Delta\Delta H_2 \Delta$and ΔH_3. (1 mark)

6. Use the standard electrode potential given below to answer the questions that follow.

			E^0 (volts)
$A_{2(aq)}+2e^-$	⟶	$A_{(s)}$	-2.90
$B_{2(aq)}+ 2^-$	⟶	$B_{(s)}$	-2.38
$C_{2(aq)}+ 2e^-$	⟶	$C_{(s)}$	0.00
$D^{2+}{}_{(aq)}+ 2e^-$	⟶	$D_{(s)}$	+0.34
$\frac{1}{2} F_{2(g)}+e^-$	⟶	$F_{-(aq)}$	+2.87

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

ii) What is the E^0 value of the strongest reducing agent? (2 marks)

iii) In the space provided, draw a labeled diagram of electrochemical cell that would be obtained when the half-cells of elements B and D are combined. (2 marks)

---

iv) Calculate the E^0 value of the electrochemical cell constructed in (iii) above. (1 mark)

b) During the electrolysis of aqueous copper (II) sulphate using copper electrodes, a current of 0.2A was passed through the cell for 5 hours.

i) Write an ionic equation for the reaction that took place at the anode. (1 mark)

ii) Determine the change in mass of the anode which occurred as a result of the electrolysis process. (Cu=63.5, IF=96,500C) (2 marks)

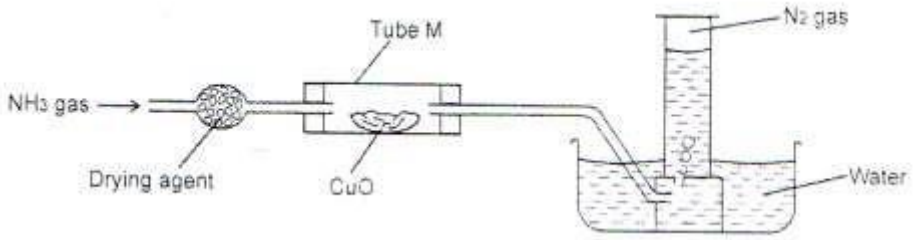
7. a) In the Harbour process, ammonia is produced by the reaction between hydrogen and nitrogen according to the equation.

$N_{2(g)}+3H_{2(g)} \longrightarrow 2NH_3(g)$ ΔH=-ve

Explain how the following would affect the yield of ammonia.

i) Increase in temperature. (1 ½ marks) ii) Increase in pressure. (1 ½ marks)

b) The set up below was used by a student to pass dry ammonia gas over heated copper (II) oxide.



i) Give two observations made in the combustion tube M. (1 mark) ii) Name a suitable drying agent. (1 mark)

c) In the experiment the student passed dry ammonia over 477g of copper (II) oxide until the reaction was complete.

i) Write an equation for the reaction that took place. (1 mark) ii) What property of ammonia is shown by the experiment? (1 mark) iii)

Calculate the mass of the copper produced. (Cu=63.5, O=16) (2 marks) iv)
Calculate the volume of the gas produced at s.t.p. (2 marks)
(Molar gas volume at s.t.p 22.4dm^3)

d) Name one another gas that has this property shown by ammonia. (1 mark)

e) Name the catalyst used in preparation of ammonia and state how it can be made more effective. (1 mark)

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2 HOURS

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1. You are provided with:

- ✓ Solution E, 0.99M hydrochloric acid
- ✓ Solution F containing 15.3g per litre of a basic compound G_2X, $10H_2O$

You are required to

- ✓ Place solution E in a burette.
- ✓ Pipette 25cm3 of solution F into a 250cm3 conical flask. Add two drops of methyl orange indicator and titrate. Record your results in the table below. Repeat the procedure two more tiems and complete table 1.

a (i) **Table I**

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

ii) What is the average volume of solution E? (1 mark)

b) Given that one mole of F reacts with 2 moles of E, calculate the

i) Number of moles of the basic compound, G_2X, $10H_2O$ in the volume of solution F used. (2 marks)

ii) Concentration of solution F in the moles per litre. (2 marks)

iii) Relative formula mass of the basic compound G_2X, $10H_2O$. (2 marks)

iv) Relative atomic mass of G. (Relating formula mass of X=156, atomic masses of H=1.0, O=16.0). (2 marks)

2. You are provided with:

- ✓ Magnesium ribbon labeled solid K.
- ✓ 2.0M hydrochloric acid labeled solution L.
- ✓ Stop watch

You are required to determine the rate of reaction between Magnesium and hydrochloric acid at different concentrations.

Procedure

I Place first test tubes on a test-tube and label them 1, 2, 3, 4 and 5. Using a 10cm^3 measuring cylinder, measure out the volumes of 2.0M hydrochloric acid, solution L as shown in table II and pour them into the corresponding test-tubes. Wash the measuring cylinder and use it to measure the volumes of water as indicated in the table and pour into the corresponding test-tubes.

II Cut out five pieces of each of exactly 1cm length of Magnesium ribbon.

III Transfer all of the solution in test-tube 1 into a clean 100cm^3 beaker. Place one piece of Magnesium into the beaker continuously ensuring that the magnesium is always inside the solution. Record in the table the time taken for the magnesium ribbon to disappear. Wash the beaker each time.

IV Repeat procedure III for each of the solutions in the test-tubes 2, 3, 4 and 5 and complete the table.

Test tube number	1	2	3	4	5
Volume of solution L (cm^3)	10	9	8	7	6
Volume of water (cm^3)	0	1	2	3	4
Time taken (sec)					
Rate of reaction=$^1/_{time}$					

(5 marks) b) i) Plot a graph of rate of reaction against $^1/_{t}$ $(y-axis)$volume of solution L. (3 marks) ii) Use the graph to determine the time that would be taken for a 1cm length of magnesium ribbon to disappear if the

volume of the acid, solution L used was 7.5cm^3. (2 marks) iii) In terms of rate of reaction, explain the shape of your graph. (2 marks)

3. a) You are provided with Solid C. You are required to:

i) Carry out the tests described below on this solid.

ii) Record all your observations and inferences accordingly.

Procedure

i) Place a little amount of solid C in a dry boiling tube and heat it gently.

Observation	Inference
(½ mark)	(½ mark)

ii) Add 10cm^3 of distilled water to the remaining amount of solid C and shake well. Divide the resulting solution into two portions.

Observation	Inference
(1 mark)	(1mark)

iii) Add 3-4 drops of lead (II) nitrate solution to the first portion.

Observation	Inference
(1 mark)	(1 mark)

iv) Add 2M sodium hydroxide, followed by three drops of hydrogen peroxide to the second portion.

Observation	Inference
(1 mark)	(1 mark)

b) You are provided with substance J. You are required to:

i) Carry out the tests described below on the substance J. ii) Record all observations and inferences accordingly. iii) Describe the appearance of J.

Procedure

i) Place a little of substance J in a metallic spatula. Ignite it in a blue Bunsen burner flame.

Observation	Inference
(1 mark)	(1 mark)

ii) Place a little of substance J in a boiling tube. Add some distilled water and shake the mixture well. Test the solution with full range pH paper (universal indicator paper).

Observation	Inference
(1 mark)	(1mark)

iii) Place about 1cm^3 of substance J in a test tube. Add a small piece of sodium hydrogen peroxide.

Observation	Inference
(1 mark)	(1 mark)

iv) To about 3cm^3 of J in a boiling tube, add acidified potassium dichromate (VI) and warm the mixture.

Observation	Inference
(1 mark)	(1 mark)

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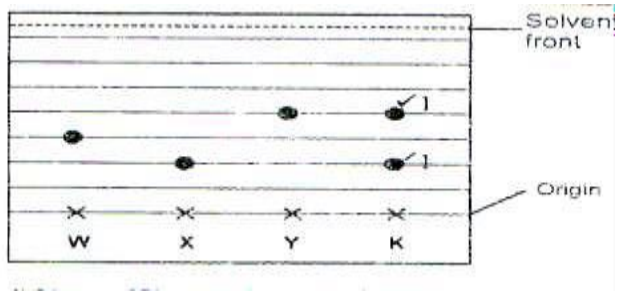

2. i) $N_{2(g)} + 3H_{2(g)} \longrightarrow 2NH_{3(g)}$
ii) - Decrease in temperature ✓1

1.

-Increasing pressure ✓1

3. i) U ✓1
ii) Giant ionic structure ✓1
X has a smaller atomic radius than W because it has more protons and thus its outer most electrons experience a greater nuclear charge than W. ✓1

4. $(E.F.M)_n = (M.F.M)$
$(C_3H_6O)_n=116$ ✓ ½
$[(12\times 3) + (1\times 6) + 16]n=116$
$(36 + 6 + 16)n=116$
$58n=116$
$n=2$ ✓ ½
$(E.F)n = M.F$
$(C_3H_8O)_2=M.F$ ✓ ½
$M.F = C_6H_{16}O_2$ ✓ ½

5. a) Iron (II) sulphide ✓1 (name only) (accept any other metal sulphide other than those that form insoluble chloride)
b) $FeS_{(s)} + 2HCl_{(aq)} \longrightarrow FeCl_{2(aq)} + H_2S(g)$
c) Use lead acelate paper or lead (II) ethanoate paper or soak a paper in lead (II) nitrate solution. The paper turns from white to black. ✓1

6. i) Potassium bromide ✓1

ii Mass of crystals=60 – 55=5g ✓1 iii)
Fractional crystallization ✓1

7. i) Carbon (IV) oxide (name or formula) ✓1
ii It is lighter than air/less dense than air ✓1
iii) CO_2 forms a white precipitate with lime water whereas CO does not ✓1
OR CO burns in a blue flame whereas CO_2 does not.

8. a) Phosphorus exist as a solid at room temperature
Nitrogen exist as a gas
ii) Phosphorous has a higher boiling point and melting point than nitrogen.
b) Boron - B
Silver – G

9. - Addition of dilute sulphuric acid ✓1
Hydrogen ion from acid will react with OH- lowering the concentration.
- Addition of more H_2O or NaOCl or Ca $(OCl)_2$ ✓1 will favour forward reaction due to increased concentration of reactants.

10. a) Grey iron wool changes into green solid of iron (II) chloride ✓1

---

b) $2H_{2(g)} + O_{2(g)} \longrightarrow 2H_2O_{(g)}$ ✓1

11. i) The white crystals of sugar cane changes into a black mass ✓1 ii) Dehydration property ✓1
iii) $C_6H_{12}O_{6(g)} \xrightarrow{H_2SO_{4(l)}} 6C_{(s)} + 6H_2O_{(l)}$ ✓1

12. i) $Q_{(s)} + Cl_{2(g)} \longrightarrow QCl_{2(s)}$ ✓1
ii) 4.333g of Q reacts with 2.14dm^3 $Cl_{2(g)}$
4.333g of Q reacts with 22.4dm^3 $Cl_{2(g)}$

$\frac{4.33 \times 22.4}{2.14} = \frac{97.0592}{2.14} = 45.35$

Penalise ½ mark if unit are indicated (g)/grams

13. a) Time taken for a radioactive isotope to disintegrate into half its original mass ✓1 Or time taken for a given mass of a radioactive isotope to divide into half ✓1

b) 125 days ½ 25 days ¼ 25 days $^1/_8$ 25 days $^1/_{16}$

$\longrightarrow \longrightarrow \longrightarrow \longrightarrow$

$^1/_{16} = 20g$
$^{16}/_{16} = ?$
$^{16}/_{16} \times 20 \times {}^{16}/_1$ ✓ ½ = 320g

14. H2 + Br2 ___ 2HBr
H – H + Br-Br _____ 2(H-Br)
Energy for bond breakage
H – H =435
Br – Br = 224
+659 ✓ ½
Energy for bond formation
2(H-Br) = 2 ×336=-672 ✓ ½
ΔH=+659 + -672=-13kJ ✓1

15. a) (i) $NH_{3(g)} + CO_{2(g)} + H_2O_{(l)} \longrightarrow NH_4HCO_{3(aq)}$ ii) $HN_4HCO_{3(aq)} + NaCl_{(aq)}$ $NH_4Cl_{(aq)} + NaHCO_{3(s)}$ ✓1 c) - Sodium hydrogen carbonate ✓1 (name only)
Or ammonium chloride
- Through filtration ✓1

16. 3.22 – 1.42=1.8 ✓ ½

Na_2SO_4	**H_20**
Mass present 1.42	1.8
	1.8

1.42

Moles 0.01 0.11✓ ½

÷ Smallest $\frac{0.01}{0.01}$ $\frac{0.1}{0.01}$

X=10✓1

17. Add water to the mixture and stir ✓ ½ Sodium carbonate dissolves ✓ ½ Filter ✓ ½ to obtain lead (II) carbonate as residue and sodium carbonate as filtrate. Rinse the residue ✓ ½ with distilled water and dry it between filter papers ✓ ½ evaporate the filtrate (either to saturation then allow saturated solution to cool to form crystals or to dryness ✓ ½ **18.** Forward reaction acid – NH^+ ✓ ½

Base – $H_2O_)$ ✓ ½

Backward reaction acid – H_3O ✓ ½

Base – $2H_3$ ✓ ½

Reason acid is a proton donor and base is a proton acceptor ✓1

19. i) Solid m – zinc metal ✓ ½ ii) $[Zn(NH_3)_4]^{2+}$ ✓1

iii) $Ba^{2+} + SO^{-2}4 \longrightarrow BaSO_{4(aq)}$ ✓ ½

20. - Put some groundnuts in a mortar and crush them using a pestle. ✓ ½

- Add some propanone and continue crushing ✓ ½
- Decant and place the resulting mixture outside the sun. Propanone evaporates leaving behind oil ✓ ½

21. a) X is water ✓1

b) Oxygen is slightly soluble in water ✓ ½

c) $2Na_2O_{2(s)} + 2H_2O \quad \cancel{4NaOH}_{(aq)} + O_{2(g)}$ ✓1

22. a) - Copper pyrite ✓ ½

- Malachite
- Cuprite
- Chalcocits ***Name only*** b) To concentrate the ore

c) Brass -Making musical instruments - Door handles e.t.c.

Bronze – medals

23. Place a sample containing Ca^2 and Pb^{2+} ions in a test tube and add sodium chloride ✓1

Pb^{2+} forms a white precipitate with lead (Pb^{2+}) ions where as Ca^{2+} does not ✓1

24. a) SO_4^{2-} (formula only) $(SO_4^{2-)}$ ✓1

b) $Ba^{2+}{}_{(aq)} + SO^{2-}{}_{4(aq)} \quad \cancel{BaSO}_{4(aq)}$ ✓1

c) $[Al(OH)_4]^-$ ✓1

25. a) Step I – methyl benzene or any organic solvent ✓1

Step II – water ✓1

b) Vigorous effervescence ✓1 because hydrogen chloride gas dissolves in polar solvent water ionizing to hydrogen ions and chloride ions. The hydrogen ions react with the sodium carbonate producing CO_2 gas hence the effervescence. ✓1

26. a) M – alpha

b) N- gamma

c) O – Beta

27. a) Sulphur

b) Presence of weak Vander wall forces between the hexagonal parallel layers/sheets which makes it soft and slippery.

c) i) Jewellery ii) Drill bits

28. a) i) No effect the litmus ✓1

ii) Dry chlorine has no effect on dry litmus paper because there is no moisture to dissolve chlorine hence no chloric (I) acid forms. ✓1

b) $HOCl + Dye \longrightarrow HCl + (Dye + O)$ ✓1
Coloured Water

9. $Ca(NO3)_{2(aq)} \longrightarrow Ca^{2+}(aq) + 2NO^{-3}_{(aq)}$

Moles of $Ca(N)_3)_2$ = grams / 12Fm

$= \frac{8.2}{40+(14\times 2) + (16 \times 6)} = \frac{8.2}{164}$

=0.05moles ✓ ½

0.05 moles ⟶ 2 litres ✓ ½

? ⟶ 1 litre

$\frac{0.05 \times 1}{2}$ =0.025 moles/litre ✓ ½

Mole ratio $Ca(NO_3)_2 : NO_3$ 1 : 2 0.025 : ?

0.025× 2=0.05M ✓1

WESTLANDS DISTRICT JOINT EXAMINATION 2015
233/2
CHEMISTRY
THEORY
PAPER 2

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1. a) i) Halogen ✓1
ii) Alkaline earth metals ✓1
b) i) $T_2(SO_4)_3$✓1
ii) $J(NO_3)_2$✓1
c) i) Bond: Ionic bond ✓1
Structure: Giant ionic structure ✓1
Rej. Ionic
ii) Bond: Covalent ✓1
Structure: Simple molecular structure/molecular structure. ✓1

d) i) E reacts by gaining an electron which weakens the nuclear attraction hence increasing the ionic radius, or the added electron increases repulsive forces to the existing electrons hence increasing ionic radius. ✓2

ii) The oxide of G has a simple molecular structure where molecules are held by weak van der waals forces whereas the oxide of L forms a Giant atomic structure where atoms are held together by strong covalent bonds.

iii) T has stronger metallic forces of attraction compared to W and J due to stronger nuclear attraction in T or more delocalized electrons. ✓1

2. a) i) Sodium hydroxide
ii) Sodium carbonate
iii) Sodium chloride
iv) Sodium hydrogen carbonate

b) Sodium floats on the surface of water because ✓1 it has a low density compared to water. It melts and darts on the surface because the reaction is exothermic ✓1 and release of hat. IT produces a fizzing sound due to evolution of hydrogen gas. ✓1

c) i) Dilute hydrochloric acid ✓1 penalise ½ for omission of dilute.

ii) $Na_2CO_{3(aq)} + 2HCl_{(aq)} \longrightarrow 2NaCl_{(aq)} + H2O_{(l)} + CO_{2(g)}$ ***Penalise ½ for wrong or missing states.***

Mark if equation not balanced.

3. a) i) Name: Ehtylporpanoate ✓½
Formula: $CH_3CH_2COOC_2H_5$ ✓½
ii) Name: 1, 2-dichloroethane ✓1
Formula: CH_2ClCH_2Cl ✓1

b) D - Substitution Bromination ✓1
A - Addition polymerization ✓1
C - Addition chlorination ✓1

c) Warm conc. Sulphuric acid ✓1

d) No. of monomes = Mass of polymers

Mass of one monomer

R.M.M C_2H_4=(12×2 + 1 ×4)=28

=84000
28

=3000 monomers

e) $2CH_3CH_2OH_{(aq)} + 2K_{(s)} \quad 2CH_3CH_2 OK_{(aq)} + H_{2(g)}$

f) Ethane burns with a blue/non luminous ✓½ and ethene burns with a yellow sooty flame ✓½ Ethane is saturated whereas ethene is unsaturated.

4. a) Sulphur powder ✓½

b) Sulphur (IV) oxide ✓½

c) Barium sulphate ✓½

d) Copper (II) nitrate ✓½

ii) $2H_20_{2(l)} \longrightarrow MnO_2 \quad 2H_2O_{(l)} + O_{2(g)}$ ✓1

iii) a) $4K_{(s)} + O_{2(g)} \longrightarrow 2K_2O_{(s)}$ ✓1

b) $S_{(s)} + O_{2(g)} \longrightarrow SO_{2(g)}$ ✓1

c) $CuO_{(s)} + H2SO_{4(aq)} \longrightarrow CuSO_{4(aq)} + H2O_{(l)}$ ✓1

Introduce a glowing splint into a gas jar containing oxygen gas, if the splint relights the gas is oxygen. ✓1

$Ba^{2+}_{(aq)} + SO_4^{2-} \quad BaSO_{4(s)}$ ✓1

iv) - It combines with acetylene to form oxyacetylene used in welding.

- Used in hospitals by people with breathing problems.
- Mountain climbers and deep sea drivers.
- Oxyhydrogen – welding.

5. a) Heat change =MC□t

□t=47.5 – 25=23.5

300 × 4.2 × 23.5 = -29,610 Joules/9.61✓1

b) Moles of methanol = mass
molar mass ✓½

Mass=142.8 – 141.3=1.15g

CH_3OH

Molar mass=1.5 = 0.046875 moles ✓½
32

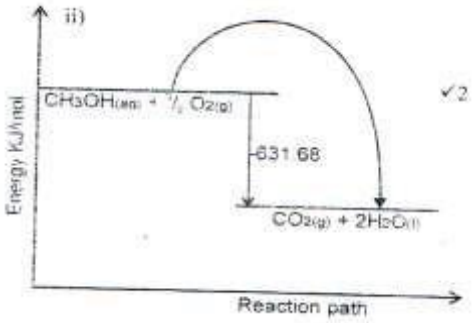
If 0.046875 moles → 29.61kJ
1 ?

29.61 × 1=-631.68kJ ✓½
0.046875

=-631.68kJ ✓1

c) i) $CH_3OH_{(aq)} + 3/2O_{2(g)} \quad CO_{2(g)} + 2H_2O_{(l)}$

□H=-631.68kJ/mol



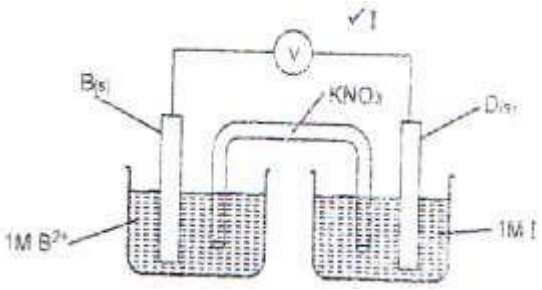
d) - Heat loss to the surrounding and heat gain by the apparatus ✓2

- Wrong reading of the thermometer - Incomplete combustion of methanol e) i) Lattice energy - □H1✓1

□ enthalpy of solution - □H2✓1 ii) □H2 = □H1+□H3✓1

6. a) i) C-because it has an electrode ✓1 potential of 0.00V which is used as a standard reference electrode.

ii) -2.90V iii)



iv) E-cell=Ered – Eox ✓1

=+0.34 – 2.38=+2.72V✓1

b) i) $Cu_{(s)} \longrightarrow Cu^{2+}_{(aq)} + 2e$ ✓1

ii) Q=1 × t

0.2 × 60 × 60 × 5=3,600C ✓1

2 × 96500C 63.5g ✓½

36000C X

$\frac{3600 \times 63.5}{2 \times 9650}$ ✓1 = 1.1845g

7. a) i) The yield would decrease ✓1. This is because ✓1 the forward reaction is exothermic hence an increase in temperature would favour the backward reaction which is endothermic thus decomposes to N2 and H2.

ii) The yield would increase. This is because an increase in pressure favours the reaction where few moles of a gas would be formed hence the forward reaction is favoured leading to more ammonia being formed.

b) i) Copper (II) oxide turns from black to brown. ✓½ ii) A colourless liquid would be formed on the copper parts of the combustion tube M. ✓½ iii) A calcium oxide. ✓1

c) i) $2NH_{3(g)} + 3CuO_{(s)} \longrightarrow 3Cu_{(s)} + N_{2(g)} + 3H_2O_{(l)}$

ii) Reduction property.

iii) No. of moles of CuO=$\frac{477g}{79.5}$ =6 moles ✓1

Moles of Cu=6 moles since mole ratio is 1:1 Mass of Cu=6 × 63.5✓1 =381g

iv) No. of moles of N_2

Mole ratio of CuO:N_2

3 : 1

Moles of N_2=$^6/_3$=2 moles

1 mole of N_2 at s.t.p=22.4dm^3

1 mole 2 × 22.4 =44.8dm^3 e) Hydrogen or carbon (II) oxide ✓1

f) Iron ✓½

By finely dividing it ✓1

WESTLANDS DISTRICT JOINT EXAMINATION 2015
233/3
CHEMISTRY
THEORY
PAPER 3

1.

	I	**II**	**III**
Final burette reading (cm3)	20.1	20.2	20.2
Initial burette reading (cm3)	0.0	0.0	0.0
Vol. of solution S used (cm3)	20.1	20.2	20.2

i) Complete table ✓1

Decimal places ✓1

Accuracy ✓1 Final answer v

ii) Principles of averaging ✓1 b) 1

mole ratio G_2X:HCl (F:F)

2 : 1

0.99 moles of E 1000cm^3 solution

? moles of E 20.17cm^3

$\frac{0.099 \times 20.17}{1000}$=0.00199683moles

=0.001997 moles of E ✓1

$\frac{0.001997}{2}$ = 0.0009985 moles ✓1

ii) 0.009985 moles 25cm^3 0.0009985 moles 1000cm^3

$\frac{0.009985 \times 1000}{}$ ✓1 = 0.03994M ✓1

iii) Molarity = $\frac{gk}{2Fm}$

$0.03994 = \frac{15.3}{RFM}$ ✓1

$RFM = \frac{15.3}{0.03994} = 383.07$

$= 383.07$ ✓1

iv) Relative atomic mass of G(X=156)

$G_2X.\ 10H_2O$

$2G + 156 + 10 \times (1\times2+16) = 383.07$

$2G+156+180=383.07$

$2G+336$

$2G=383.07 - 336$ ✓1

$2G=47.07$

$G=\frac{47.07}{2}$

$G=23.535$

$=23.5$✓1

2. a)

Test tube number	1	2	3	4	5
Volume of solution L (cm)3	10	9	8	7	6
Volume of water (cm3)	0	1	2	3	4
Time taken (sec)	25.66	30.88	41.25	53.64	75.53
Rate of reaction= $^{1}/_{time}$	0.039	0.032	0.024	0.019	0.013
Rate=$_{1/time}$ (10^{-3})	39	32	24	19	13

NB: ½ mark for each value (10 × ½ =5 mks) b) i)

Awarding 3 marks for the graph

Scale – ½ mk (½ for the 2 axes)

Plotting – 1mk

Straight line – 1mk

Labelling axis – ½ mark

---

ii) 1 mk for showing on the graph

1 mk for correct reading

Ans = 23×10^{-3} ✓1

Rate = $\frac{1}{Time}$

$23 \times 10^{-3} = \frac{1}{Time}$

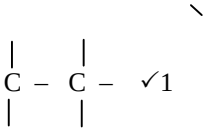
$T = \frac{1}{23\times 10^{-3}} = 43.48$ seconds ✓1

iii) Rate of reaction decreases with decrease volume or increase with increase in volume of solution L.

3. a)

Observation	**Inference**
i) Colourless vapor forms on the cooler part of the boiling tube ✓ ½	C is a hydrated salt or C contains water of crystallization. ✓ ½
ii. Dissolves to form a pale green solution ✓ ½	C is a soluble salt and contains Fe^{2+} ions ✓ ½
iii. A white ppt is formed ✓1	Presence of SO_4^{2-} ✓1
iv. A green ppt is formed ✓1	Fe2+ present which oxidized to Fe^{3+} on addition of H_2O_2 ✓1

b)

Observation	**Inference**
i) It burns with a blue flame. ✓ 1	Absence of – C ≡≡ C -and – C ≡≡≡ C – presence of  ✓1
ii. pH value 6 ✓1	It is weakly acidic ✓1
iii. No effervescence ✓1	Absence of H+ ions ***(ignore mention of R-COOH)*** ✓1
iv. Turns $K_2Cr_2O_7$ from orange to green on warming ✓1	Presence of R-OH ✓ ½ ***Penalise ½ mark for any contradicting functional group***

GATUNDU NORTH SUB-COUNTY COMMON JOINT EXAMINATIONS FORM 4 TERM TW0 2015
233/1
CHEMISTRY (THEORY) PAPER
FORM FOUR
TIME: 2HOURS
JULY/AUGUST 2015

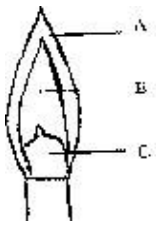
SECTION A
Answer ALL questions.

1. Use the following half cell standard electrode potentials to answer the questions that follow.

Reduction Equation	Electrode Potentials (Volts)
$A^{2+}(aq) + 2e^-$	-0.76
$B^{+}(aq) + 2e^-$	-0.13
$C^{+}(aq) + 2e^-$	+0.84
$D^{+}(aq) + 2e^-$	+0.34

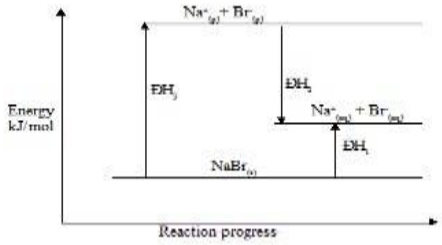
i) Select two half cells which give you the largest e.m.f when combined. (1mark)
ii) Calculate the e.m.f of the cell formed in (i) above (2marks)

2. i) The diagram below represents a non luminous flame of a Bunsen burner. Name the parts labelled A, and C. (1mark)



ii) A luminous flame preferred for lighting. Explain. (1mark)

3. Study the energy level diagram below and answer the questions that follow it.



(1mark)

a) What name is given to the energy changes labelled.
ĐH1

ĐH2

b) Given the following energy values

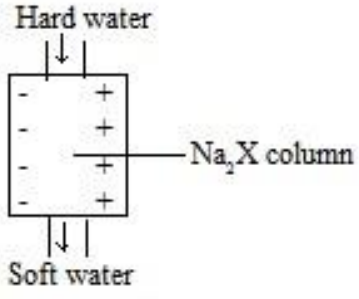
$H_1 = +4kjmol^{-1}$

$H_3 = -741$ kj/mol

Calculate the value of ĐH2 (1mark)

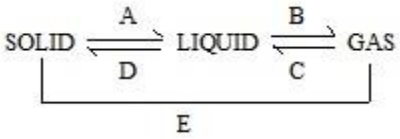
4. Explain how you would obtain lead carbonate from a mixture of lead carbonate and sodium carbonate. (2marks)
5. Hardness in water is caused by dissolved salts.
a) Which cations cause water hardness. (1mark)

b) Explain how the following apparatus soften hard water. (2marks)



6. The flow chart below shows the physical changes of matter. Study it and answer the questions that follow.

a) Name the processes A - E (2mks)



b) Give two examples of substances that undergo process E. (1mk)

7. The table below gives the pH values of solution A - D.

Solution	A	B	C	D
pH	5.0	7	6.5	8.0

Which solution is likely to be

i) Wood ash (½mk) ii) Common salt (½ mk) iii) Rain water (½ mk) iv) Lemon juice (½ mk)

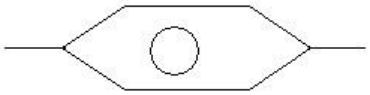
8. A dynamic equilibrium between chromate (VI) ions and chromium ions is as shown below

$$Cr_2O_7^{2-}(aq) + 14H^+(aq) \rightleftharpoons 2Cr^{3+}(aq) + 7\,H_2O(l)$$

Orange Green

State and explain the observations made when dilute sodium hydroxide solutions are added to the equilibrium (2mks)

9. The following is a structure of a cleansing agent



i) State the type of cleansing agent dawn above. (1mk) ii) State one disadvantage of using the cleaning agent drawn above. (1mk) b) State one use of polychloroethene (1mk)

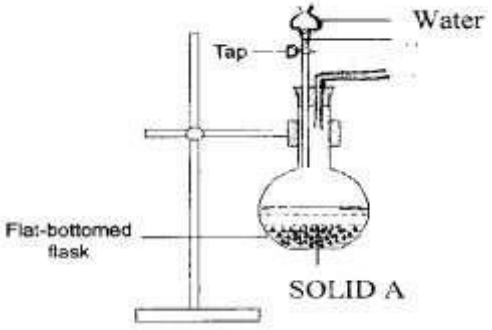
10. The setup below was used to prepare a sample of oxygen gas.

a) Complete the set up. (1mk)

b) Name solid A. (1mk)

c) Write a balanced chemical equation for the reaction that took place. (1mk)

11. Draw the structure and name isomers of butane. (2mks)



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

Elements	A	B	C	D	E
Atomic numbers	12	6	4	6	15
Mass numbers	24	12	9	13	31

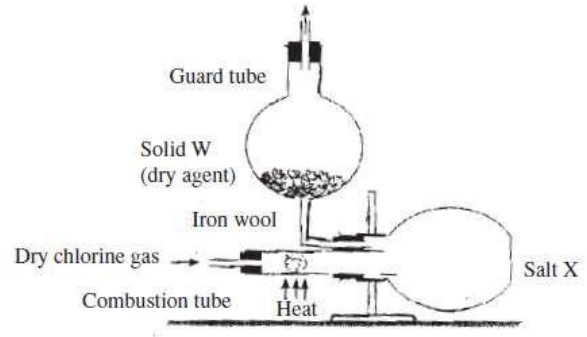
a) Which two letters represent the same element. Give a reason. (2mks)
b) Calculate the number of neutrons in Element C. (1mk)
c) What is the role of neutrons in the nucleus. (1mk)

13. Explain the following observations
a) Atomic radius decreases across period three. (1mk)
b) Sodium is more reactive than magnesium (1mk)

14. a) Name the process by which butene gas molecules are converted to into a giant molecule. (1mk) b) Draw the structure of the giant molecule formed by butene molecules in (a) above (1mk)

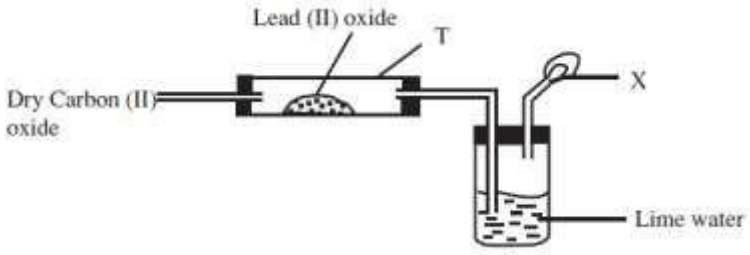
15. Using dots (•) and crosses (X) diagrams, show how the following compounds form .
i) Ammonia (1mk) ii) Nitrogen molecule (1mk)

16. The diagram below shows a setup for preparation of anhydrous salt X. Study it and answer the questions that follow.



a) Identify the method of preparing salts. (½ mk)
b) Give the name of salt X (½ mk)
c) Why is it not possible to collect salt Z in the combustion tube. (1mk)

17. The diagram below shows a reaction of carbon (II) oxide on lead (II) oxide.

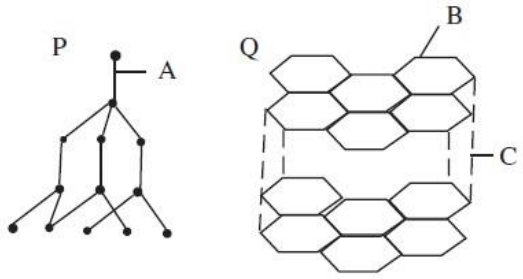


a) Identify the missing condition for this reaction to take place. (½ mk)
b) State the observation made in the combustion tube T at the end of the experiment. (1mk)
c) State two uses of carbon (IV) oxide. (1mk)

18. Calculate the solubility of glucose in water at 40^0C from the following information. (2mks) Mass of evaporating dish = 23.0g
Mass of evaporating dish + saturated solution = 192.0g
Mass of evaporating dish + dish after evaporation = 142.0g

19. The diagram below shows the allotropes of carbon. Study them and answer the questions that follow.

i) Name the allotropes P and Q. (1mk) ii) State the types of bonds labelled A and C. (1mk) iii) Q has a greasy feel. Explain. (1mk) iv) Which of the allotropes is a good conductor of electricity? Explain. (1mk)



20. Study the reaction below and answer the equations that follow

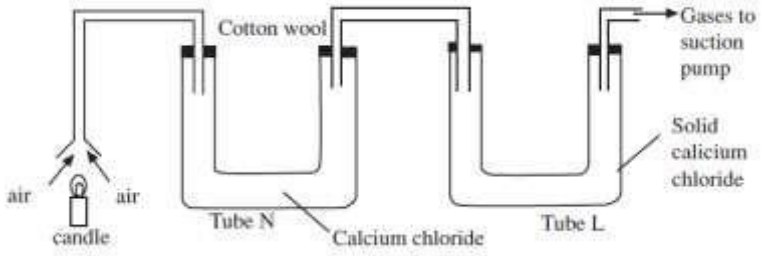
NH3(g) + H2O(l) $NH_4^+(aq) + OH^-(aq)$

a) Define an acid. (½ mk)

b) Identify an acid in the above reaction. Explain your answer. (1mk)

21. a) Candle wax is normally a compound consisting of two elements. Name the elements. (1mk)

b) The set up below was used to investigate the burning of a candle. Study it and answer the questions that follow.



i) What would happen to the burning candle if the pump was put off. Give reasons. (1mk)

ii) State and explain the changes in mass that are likely to occur in tube N by the end of the experiment. (2mks) iv) When the candle was burnt completely, the total mass of the product was found to be greater than the original mass of the candle. Explain. (1mk)

iv) Name another substance that can be used instead of calcium chloride in tube L. (1mk)

22. A radioactive decay series can be represented as below

A → B → C

State the mass number and atomic number of elements B and C. (2mks)

23. Use the grid below to answer the questions that follow.

I	II		III	IV	V	VI	VII	VIII
F								
				Q				
O			B	P		R	S	A
T	E		C				U	
V							Z	

a) Which element forms an ion with a charge of -2. Explain. (1mk)

b) Give the family name of S, U, Z. (½ mk)

c) How do the reactivity of the following compare T and V. (1mk)

d) Select an element with the largest atomic radius. Give a reason. (1mk)

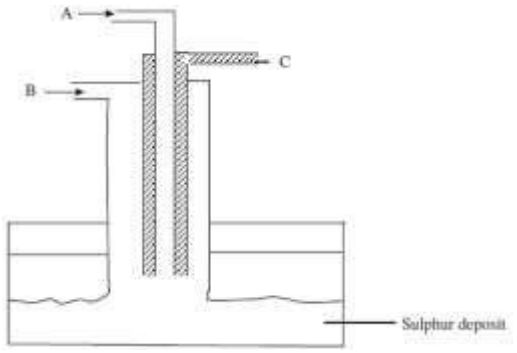
e) Which type of bond exists between B and S. Give a reason? (1½mk)

24. $100cm^3$ of a sample of ethane gas diffuses through a porous pot in 100 seconds. What is the molecular mass of gas Q if $10cm^3$ of the same gas diffuses through the same porous pot in 121 seconds.
(C = 12.0, H = 1.0) (2mks)

25. During purification copper by electrolysis, 1.48 of copper were deposited when a current was passed through aqueous copper (II) sulphate for 2 ½ hours. Calculate the amount of current that was passed. (Cu = 63.5, 1F = 96500C) (3mks)

26. A substance contains 57.5% sodium, 40% oxygen and the rest is hydrogen.
(Na = 23, H = 1.0, O = 16.0). Calculate its simplest formular. (3mks)

27. The diagram below shows extraction of sulphur by frasch process. Study it and answer the questions that follow.



a) Identify the substances that pass through pipes A, B and C. (1½ mks)

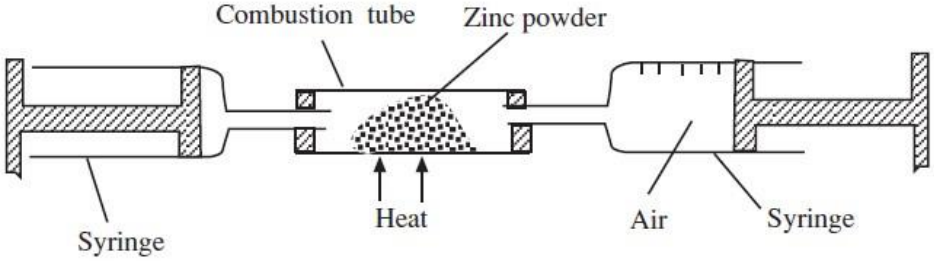
b) Name two allotropes of sulphur. (1mk)

28. Bronze is an alloy of copper and another metal.

i) Name the other metal (½ mk)

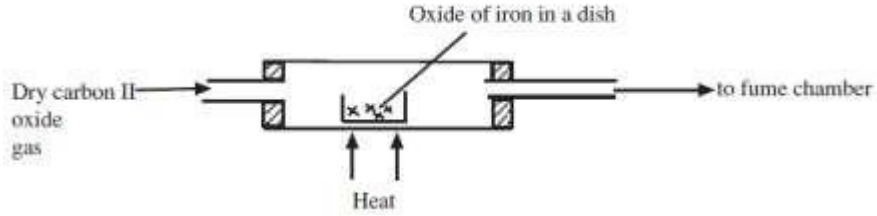
ii) Give one use of bronze (1mk)

29. In an experiment a certain volume of air was passed repeatedly from syringe over heated zinc powder as shown in the diagram below.



The experiment was repeated using excess magnesium powder. In which one of the two experiments was the change in volume of air greatest. Give reasons. (3mks)

30. Excess carbon (II) oxide was passed over heated of an oxide of iron as shown below.



The data obtained was recorded as shown below.

Mass of empty dish = 10.98g

Mass of empty dish + oxide of iron =

Mass of empty dish + residue = 12.66g

i) Write an equation for the reaction which took place in the dish. (1mk)

ii) Determine the formula of the oxide of iron.

(Relative formula mass of the oxide of iron is 232 , Fe = 56.0, O = 16.0) (3mks)

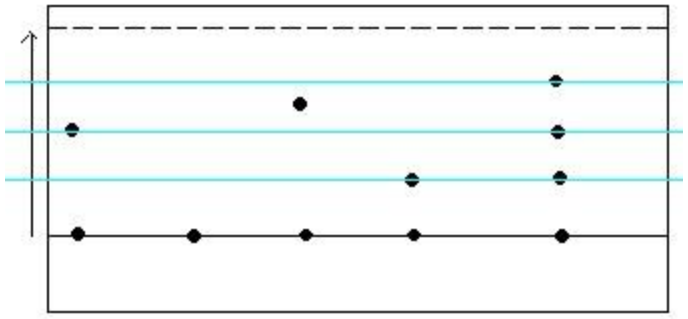
GATUNDU NORTH SUB-COUNTY COMMON JOINT EXAMINATIONS FORM 4 TERM TWO 2015
233/2
CHEMISTRY
(THEORY) PAPER 2
FORMFOUR
TIME: 2HOURS
July /August 2015

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

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

a) Give the formular of the compound formed between C and M. (1mk)
b) Which element form a stable trivalent cation? (1mk)
c) Identify the least reactive element. (1mk)
d) Which element exist as a mono-atomic gas? (1mk) e) Write the electron arrangement of the following ions;
i) N^{+}
ii) C^{2+} (2mks) f) How do atomic radius of C and J compare? Explain. (2mks)
g) Explain how the melting point of J and K compare. (2mks)
h) Identify an element which: (2mks) i) Is the most electronegative ii) Is the strongest reducing agent

2. The diagram below shows chromatograms for five different dyes



a) Name the technique used to separate the dyes. (1mk)

b) What is meant by the term solvent front?
Indicate its position in the diagram. (2mks)

c) Which letters represent? (2mks)

i) Baseline (origin)

ii) Solvent path

d) Which chromatograms were present in dye E? (2mks)

e) Which dye is pure? Explain (2mks)

f) Which dye is

i) Insoluble (Does not move) (1mk)

ii) Most soluble (Moves fastest) (1mk)

g) Give one condition required to separate the chromatograms present in a dye? (1mk)

3. a) What name is give to a compound that contains carbon and hydrogen only? (½ mk)

b) Hexane is a compound containing carbon and hydrogen

i) What method is used to obtain hexane from crude oil? (1mk)

ii) State one use of hexane. (1mk)

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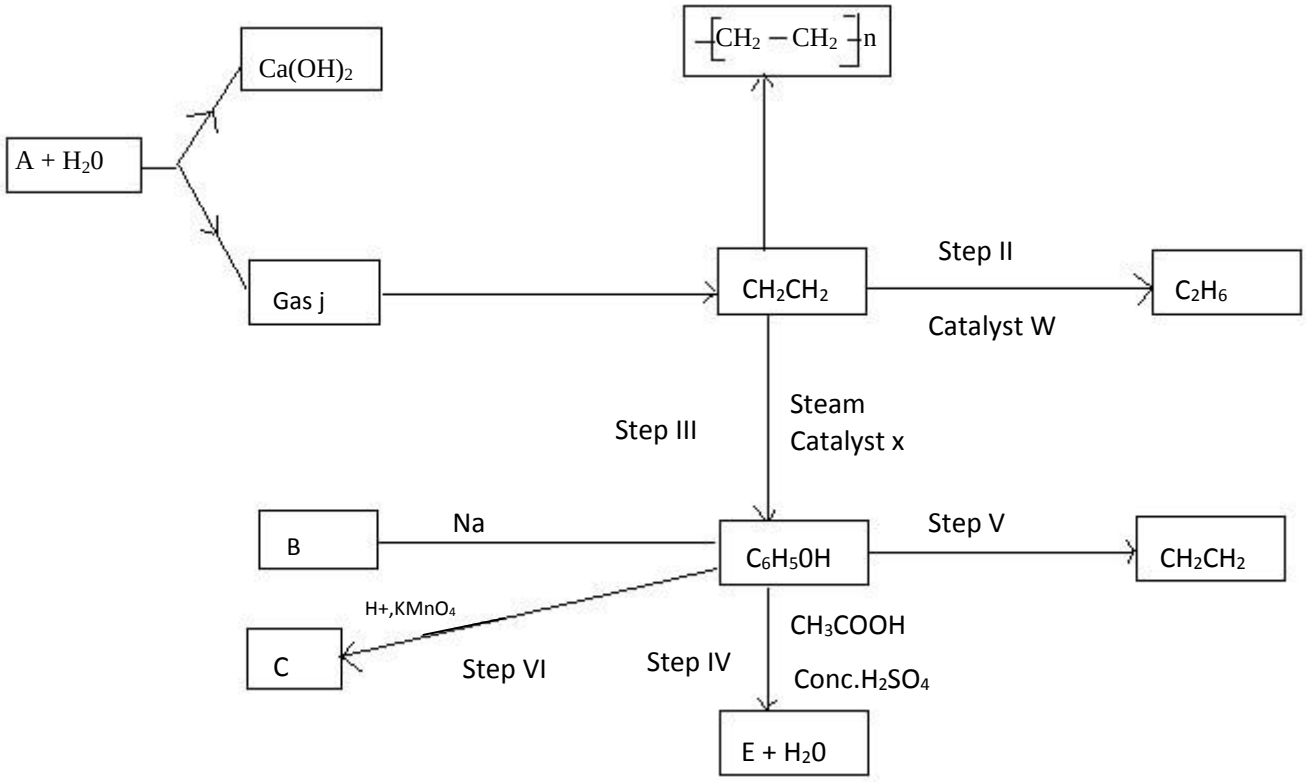
c) Study the flow chart below and answer the questions that follow.



i) Identify substances; A , B ,C and gas J (2mks)

ii) Name steps I , III, IV and V (2mks)

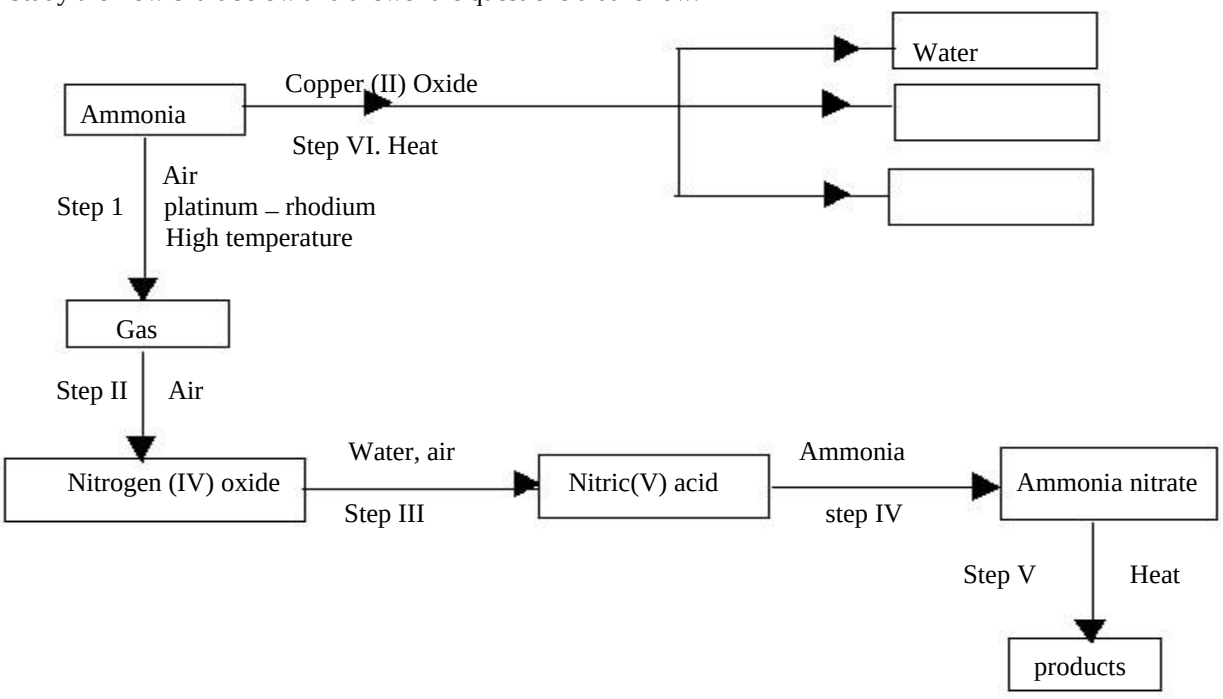
iii) What is the industrial importance of process represented by Step II (1mk)

iv) Name the catalysts W and X (1mk)

v) Draw the structural formula of product E in Step IV. (1mk) vi) Write a correct chemical equation for the reaction that leads to formation of substance B. (1mk) vi) Explain why the reaction between 1g Sodium carbonate and 2M hydrochloric acid is faster than the reaction between 1g Sodium Carbonate and 2M ethanoic acid. (2mks)

4. a) Describe the process by which nitrogen is obtained from air on a large scale. (3mks)

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



i) Identify gas J. (1mk)

ii) Using oxidation numbers, show that ammonia is the reducing agent is step VI. (2mks) iii) Write an equation for the reaction that occurs in Step (IV). (1mk

iv) Give one use of ammonium nitrate. (1mk)

c) The table below shows the observations made when aqueous ammonia was added to cations of elements E,F and G until excess.

Cation of	Addition of few drops of NH_4OH solution	Addition of excess NH_4OH solution
E	White precipitate	Insoluble
F	No precipitate	No precipitate
G	White precipitate	Dissolves

i) Select the cation that is likely to be;
Zn2+ (1mk)
Ca2+ (1mk)

ii) Given the formula of the cation of element E is $E^{3+}(aq)$, write the ionic equation for the reaction between E^{3+} and aqueous NH4OH solution. (1mk)

5. a) The table below shows the standard reduction potential for half-cells. Study it and answer the questions that follow. (Letters are not the actual symbols of the elements)

E^{θ}(Volts)

$\longrightarrow$ $F_2(aq) + 2e \; 2F^-(aq)$; +0.54

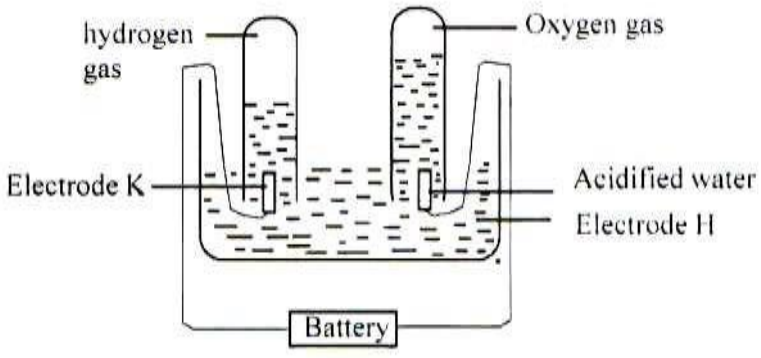
$\longrightarrow$ $G^{2+}(aq) + 2e \; G(s)$; - 0.44

$\longrightarrow$ $H^{2+}(aq) + 2e \; H(s)$; +0.34

$2J^-(aq) + 2e \; J$; 0.00

i) Identify the strongest reducing agent. (1mk) ii) Write the equation for the reaction which takes place When solid G is added to a solution containing H^{2+} ions. (1mk) iii) Calculate the E^0 value for the reaction in (ii) above. (1mk) iv) Construct an electrochemical cell for (ii) above. (3mks)

b) The diagram below shows the apparatus that can be used to electrolyte acidified water to obtain hydrogen and oxygen gases. Study it and answer the questions that follow.



i) Identify the electrode at which oxidation takes place. (1mk) ii) Give a reason why it is necessary to acidify the water. (1mk) iii) Explain why hydrochloric acid is not used to acidify the water. (1mk)

c) During electrolysis of aqueous Copper (II) Sulphate 144,750 coulombs of electricity were used. Calculate the mass of copper metal that obtained. (3mks)
(Cu = 64, I Faraday = 96500 coulombs)

6. Sodium thiosulphate solution reacts with dilute hydrochloric acid according to the following equation.

$S_2O_3^{2-}(aq) + 2H^+(aq) \longrightarrow H_2O(l) + SO_2(g) + S(s)$

In an experiment to study how the rate of reaction varies with concentration. $10cm^3$ of 0.4M Sodium thiosulphate was mixed with $10cm^3$ of 2M hydrochloric acid in a flask. The flask was placed in a white paper marked with a cross X. The time taken for the cross X to be come invisible when view from above was noted and recorded in the table below. The experiment was repeated three items as the temperature using volumes in the table and the results recorded as shown in the table below.

Experiment	Volume of 0.4m thiosulphate (cm^3)	Volume of water (cm^3)	Volume of 2MHCl(cm^3)	Time
1	10	0	10	16
2	7.5	2.5	10	23
3	5.0	5.0	10	32
4	2.5	7.5	10	72

a) i) On the grid provided , plot a graph of the volume of thiosulphate (vertical axis) against time taken for the cross (X) to become invisible. (3mks) ii) From the graph determine how long it would take for the cross (X) to become invisible if the experiment was done.

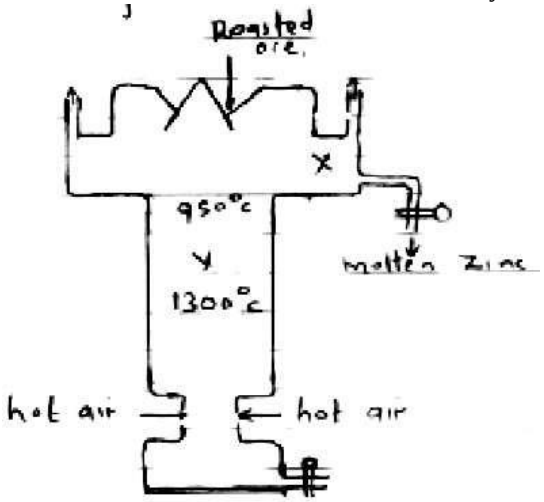
I Using $6cm^3$ of the 0.4M thiosulphate (1mk)

II Using $6cm^3$ of 0.2M thiosulphate solution (1mk) b) i) Using values of experiment I. Calculate

I moles of thiosulphate used. (1mk) II Moles of hydrochloric acid used. (1mk) ii) Explain which of the two reactants in experiment I controlled the rate of the reaction? Explain. (1mk) c) Give two precautions which should be taken in experiments above to ensure that consistent results are obtained. (2mks)

7. The melting and boiling points of zinc are 419^0C and 907^0C respectively. One of the ores of Zinc i) Zinc blende.To extract Zinc, the ore is first roasted in air before introducing it into the furnace.

a) i) Write the formula of the main Zinc compound in Zinc blende (1mk) ii) Explain using an equation why it is necessary to roast the ore in air before introducing it into the furnace. (2mks) b) The diagram below shows a simplified furnace used in the extraction of Zinc. Study it and answer the questions that follow:



i) Name two other substances that are also introduced into the furnace together with roasted ore. (1mk) ii) The main reducing agent in the furnace is carbon (II) oxide. Write two equations showing how it is formed. (2mks) iii) In which physical state is Zinc at point Y in the furnace? Give a reason. (1mk) iv) Suggest a value for the temperature at point X in the furnace. Give a reason. (1mk) v) State and explain one environmental effect that may arise from the extraction of Zinc from Zincblende. (2mks) vi) Give two industrial uses of Zinc. (1mk)

GATUNDU NORTH SUB-COUNTY COMMON JOINT EXAMINATIONS FORM 4 PAPER 3 MOCK 2015 CONFIDENTIAL

This document must not be seen by the candidates whatsoever.

CONFIDENTIAL INSTRUCTION TO SCHOOLS

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

1. 2g Solid D
2. 3 boiling tubes (Pyre recommended)
3. 10ml measuring cylinder
4. Distilled water
5. Filter funnel
6. Filter paper
7. 6 test tubes
8. 10ml liquid F (absolute propan-2-ol)
9. Watch glass
10. Wooden splint
12. Burette
11. 2g sodium carbonate
13. Pipette and pipette filler
14. Thermometer
15. 250ml volumetric flask
16. 1 label
17. 3 conical flasks 250ml
18. 4.5g of solid P (accurately weighted) Oxalic acid

In addition the student should have access to:

19. Water bath (maintained at about 80°C)
20. 2M Sodium hydroxide
21. 2M Sulphuric (VI) acid
22. 2M Hydrochloric acid
23. 2M Barium nitrate
24. 2M Potassium dichromate
25. 2M Ammonium hydroxide
26. 2M Nitric acid
27. Bromine water

NOTES

1. Solid D is prepared by mixing small amounts of Zinc sulphate and Zinc carbonate
2. Potassium dichromate VII is prepared by dissolving 20gm in 400cm³ of 2M H_2SO_4 acid and then topping up to one litre solution.
3. Water bath should be maintained at about 80°C using a low flame to avoid breakage of beaker.

233/3
CHEMISTRY (PRACTICAL)
FORMFOUR

TIME: $2\frac{1}{4}$ HOURS

JUNE/JULY 2015

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1. You are provided with:

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

You are required to determine: i) The solubility of solid **P** at different temperatures ii) The value of **n** in the formula $(HX)n \cdot H_2O$ of solid **P**.

PROCEDURE 1

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 1.

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

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

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

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

Table 1

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

(6mks) i) On a grid plot a graph of the solubility of solid **P** against temperature. (3mks)

ii) Using the 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

1. Transfer the contents of the boiling tube into a 250ml volumetric flask. Rinse the boiling tube with the thermometer with distilled water and add to the volumetric flask. Add more distilled water to make up to 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

(4mks)

Calculate the;

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

i) Average volume of solution P used in the experiment (1mk) ii) Number of moles of sodium hydroxide used in solution Q. (2mks) iii) Number of moles of solution P given that the relative formula mass P, $(HX)_n \cdot 2H_2O$ is 126. (2mks)

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

2. You are provided with a solid labelled D. Carry out the following test, record the observation and make the correct inferences.

a) Place solid D in a boiling tube and add about $40cm^3$ of distilled water while shaking. Filter the mixture and divide the filtrate into four portions, keep the residue for part (b)

i) To the first portion, add sodium hydroxide dropwise till in excess

Observation Inferences
1mk 1mk

ii) To the second portion, add a few drops of dilute sulphuric (VI) acid.

Observation Inferences
1mk 1mk

iii) To the third portion, add few drops of barium nitrate solution. Followed by few drops of dilute hydrochloric acid.

Observation Inferences
1mk 1mk

b) Place the residue in (a) above in a boiling tube. Add dilute nitric (V) acid while shaking till the solid just dissolves. Divide the solution into two portions.

Observation Inferences
(½ mk) (½ mk)

i) To the first portion, add a few drops of sodium hydroxide solution dropwise till in excess.

Observation Inferences
1mk 1mk

ii) To the second portion, add a few drops of ammonia solution then in excess.

Observation Inferences
(½ mk) (½ mk)

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

a) Place about 1cm3 of solution F on a watch glass. Place a burning splint to the solution on the watch glass.

Observation Inferences
1mk 1mk

b) Place about $2cm^3$ of solution F in test tube and add drops of potassium dichromate.

Observation Inferences

c) Place about $2cm^3$ of solution F in a 2nd test tube and add bromine water.

Observation Inferences
1mk 1mk

d) To the 3rd portion of $2cm^3$ of solution F add a spatula of sodium carbonate provided

Observation Inferences
1mk 1mk

GATUNDU NORTH SUB-COUNTY COMMON JOINT EXAMINATIONS
FORM 4 CHEMISTRY PAPER 1 MOCK 2015
MARKING SCHEME

1. i) A and C
ii) $E_{reduced} - E_{oxidised}$ 1
$+0.84 - 0.76$
$+0.84 + 0.76 = +1.6$ 1

2. i) A - Pale blue zone
C - Almost colourless zone

ii) I consists of unburnt tiny particles of hot glowing solid carbon which gives out light.

3. a) ΔH_1 - Heat of solution of NaBr
ΔH_2 Hydration energy of $Na^+ + Br^-$

$\Delta H_2 = \Delta H_1 - \Delta HI$
$= -741 - +4$
$= -745kJ/mol$

4. Add water to the mixture $^1/_2$
Stir to dissolve sodium carbonate $^1/_2$
Filter to obtain lead carbonate residue and sodium carbonate filtrate $^1/_2$
Wash and dry the residue $^1/_2$

5. a) Mg^{2+}
Ca^{2+}
b) The Ca^{2+}/Mg^{2+} from the hard water are exchanged with Na^+ in the column as the hard water passes through hence Ca^{2+}/Mg^{2+} are precipitated and remain fixed in the column while soft waters containing Na^+ flow out the column.

6. a)
A - Melting
B - Evaporation
C - Condensation
D - Freezing
E - Sublimation

b)
Iodine
Iron (II) chloride
Camphor
Dry ice/ solid carbon (IV) oxide
Aluminium chloride
Ammonium chloride

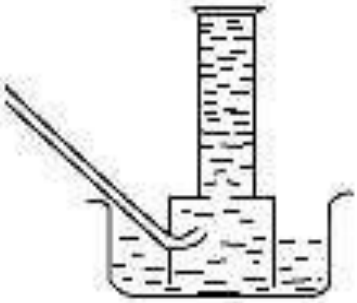
7. i) D
ii) B
iii) B
iv) C

8. The mixture turns orange/orange colour intensity
Hydroxide ions (OH^-) from NaOH react with H^+ ions reducing the concentration
Hence the equilibrium shift to the left/ backward reaction is favoured

9. a) i) Soapless detergent
ii) Non biodegradable
Cause eutrophication
Skin irritation
Affect aquatic life when released in water

b) Plastic rain coats
Plastic pipes PVCs
Electrical insulators
Plastic foot wear/shoes

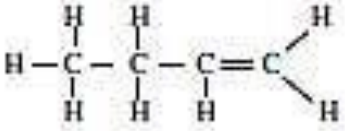
10. a)



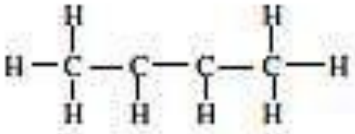
b) Sodium peroxide

c) $2Na_2O_{2(aq)} + 2H_2O_{(l)} \longrightarrow 4NaOH_{(aq)} + O_{2(g)}$

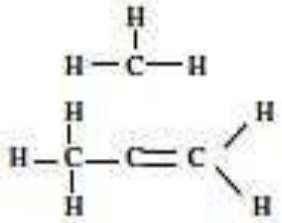
11.



but-1-ene



but-2-ene



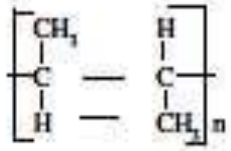
2 methyl propne

12. a) B and D they have the same atomic number
b) 9 – 4 = 5
c) They reduce repulsion among the positively charged protons which reside in the nucleus and have the same charge.

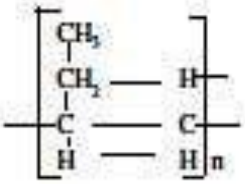
13. a) The number of protons increase across the period, increasing the nuclear attraction of electrons across the period.

b) Across the period, the atomic radius decrease, Sodium has a bigger atomic radius than magnesium. Sodium has less nuclear pull on the outermost electrons which are thus lost readily compared to magnesium.

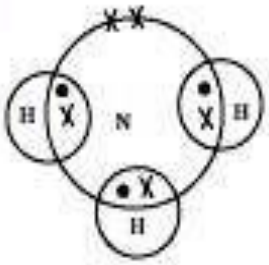
14.



or



15. Ammonia



Nitrogen

16. a) Direct synthesis/direct combination of elements
b) Iron (III) chloride
c) Iron (III) chloride sublimes and the sublimate collects on the cooler parts.

17. a) Heating
b) Yellow lead (II) oxide turned to reddish brown substance when heated then to grey lead metal.

c) - Fire existinguishers
- Refrigeration
- Aerated drinks

18. Mass of solute (glucose) = 142 – 23.0 = 119.0g
Mass of water = 192 – 142 = 50.0g

$$\text{Solubility } \frac{119 \times 100}{50} = 238\text{g}/100\text{g water}$$

19. i) P - Diamond
Q - Graphite

ii) A - Covalent bonds
C - Weak van der waals forces of attraction
iii) Q is made of hexagonal layers that slide over each other since the layers are held by weak van der waals forces of attraction.
iv) Q has delocalized electrons that are not used in bonding which carry electric charges

20. a) Proton donor/Electron acceptor/substance that dissolves in water to produce H ions as the only positively charged ions.

b) H_2O
H_2O donate proton/H^+ to NH_3 to form NH_4

21. Carbon and hydrogen
b) A candle will go off, carbon (IV) oxide and water will accumulate, yet they do not support.

ii) The mass would increase, Calcium oxide is a basic oxide that would combine with carbon (IV) oxide which is an acidic oxide to form calcium carbonate/

iii) The products were oxidized substances of carbon and hydrogen. Oxygen was added to each of the elements present in the candle.

GATUNDU NORTH SUB-COUNTY COMMON EXAMINATIONS
CHEMISTRY FORM 4 PAPER 2 MOCK 2015
MARKING SCHEME

1. a) C_3M_3
   b) E
   c) L
   d) L
   e) i) 2.8.8
   ii) 2.8
   f) J has a smaller radius then C. J has a higher nuclear attraction pulling electrons towards the nucleus.
   g) K has has higher melting point than J. K has a stronger intermolecualr force of attraction than J.
   h) i) I
   ii) N

2. a) Chromatography
   b) Solvent front is the fasthest distance reached by elutins solvent on the adsorbent material. On the diagram H.
   c) i) G
   ii) J
   d) Red, blue, Green
   e) A and C. They only have one chromatogram.
   f) i) B
   ii) E
   g) i) The chromatogram must have different solubility rate.
   ii) The dye must be soluble in the siren solvent

3. a) Hydrocarbon ✓1
   b) i) Fractional distillation ✓1
   iii) Production of hydrogen ✓ during cracking process fuel ✓ (Any one use)
   c) i) A - Calcium carbide/CaC_2 ✓1
   B - Sodium ethoxide ✓
   /CH_3CH_2ONa/C_2H_5ONa
   C - Ethanoic acid / CH_3COOH
   D - Ethyne gas / H–C≡C – H / CHCH
   iii) Step I - Polymerization ✓ 1
   Step II - Hydrogenation ✓1
   Step IV - Esterification ✓1
   Step V - Dehydration ✓ 1
   iii) Manufacture of margarine/solid fats from liquid fats ✓1
   iv) Catalyst W - Nickel ✓1
   Catalyst x - Phosphonic acid ✓1
   v) $CH_3COOCH_2CH_3$ or $CH_3COOC_2H_5$

   or $CH_3C(=O)-CH_2CH_2C-OCH_2CH_3$

   vi) $2C_2H_5OH_{(aq)} + 2Na_{(s)} \longrightarrow 2C_2H_5ONa_{(aq)} + H_{2(g)}$
   BE-1
   vii) HCl is a strong acid and therefore has more H^+ ions than C_2H_5COOH acid. The more the H^+, the faster the reaction.

4. a) Remove dust, Carbon (VI) oxide and water vapour ✓1 through appropriate means.
   - Compress the remaining part of air to 200atm and -200°C to liquity ✓½ it.
   - Carry fractional distillation ✓½. Nitrogen will be the first to boill of ✓½ and is collected as the first ✓½ fraction of the distillate at (-186°C)
   b) i) Nitrogen (I) oxide / N_2O
   ii)
   $NH_{3(g)} + Cu^{2+}O_{(s)} \longrightarrow N_{2(g)} + Cu_{(s)} + H_2O_{(g)=(l)}$

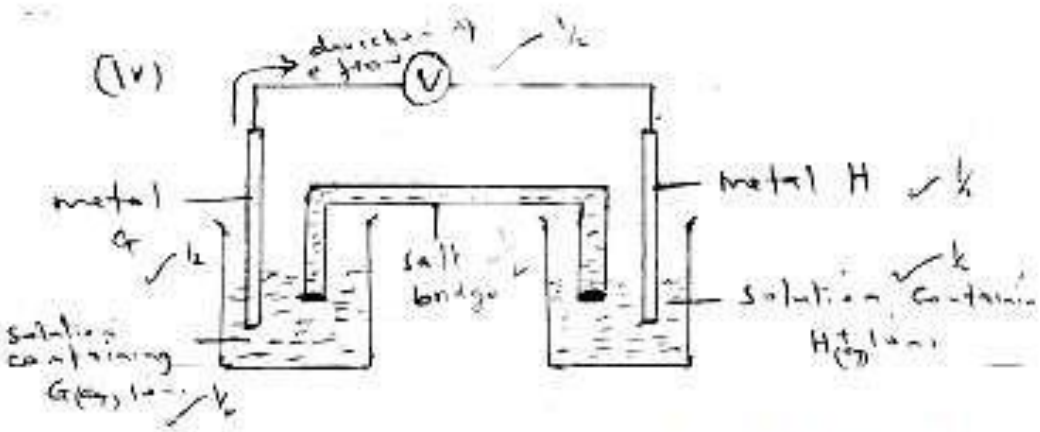
   OS of Cu in Cuo $\Longrightarrow x + -2 = 0$
   $x = +2$ ✓½
   OS of Cu at the end of the r α n = 0 ✓½
   So, Copper has been reduced ✓½ by ammonia hence ammonia is the ✓½ reducing agent.

   iii) $HNO_{3(aq)} + NH_{3(g)} \longrightarrow NH_4NO_{3(s)}$
   BE - ✓½
   SS ✓½
   OI

   iv) Ammonium nitrate is used a s fertilizer ✓1
   - Used to make explosives ✓1
   Any 1 give 1mk
   c) i) Zn^{2+} = G ✓1 or G^{2+} ✓1
   Ca^{2+} - F ✓1 or F^{2+} ✓1

ii) $E^{3+}_{(aq)} + 3OH^-_{(aq)} \longrightarrow E(OH)_{3(s)}$
BE - ✓½
SS - ✓½

5. a) i) G ✓1
ii) $G_{(s)} + 2H^+_{(aq)} \longrightarrow G^{2+}_{(aq)} + H_{2(g)}$ ✓1
iii) Er - EL = 0.34 - (-0.44)
= 0.78V ✓1



b) i) H ✓1
ii) To make water a better electrolyte ✓1
iii) Both Cl^- and OH^- migrate ✓½ to the anode. Hence both chlorine and oxygen will be collected. ✓½

iv) No. of Faradays = $\frac{144750}{96500}$ ✓½ = 1.5 ✓½

$Cu^{2+}_{(aq)} + 2e \longrightarrow Cu_{(s)}$ ✓1
Moles of Copper = $\frac{1.5}{2}$ = 0.75 ✓½

Mass of Copper = 64 x 0.75 ✓½
= 48g

6. i) **SEE GRAPH (3MKS)**
ii) I 27 - 28second ✓1
II 54 - 56 second ✓1
Answer in part II is half that of part I
b) ✓½ ✓½
i) 1 mole of thiosulphate = $\frac{10 \times 0.4}{1000}$ = 0.004moles

II Moles of hydrochloric acid = $\frac{10}{1000}$ x 0.2 ✓½
= 0.02mole ✓½

ii) Thiosulphate - hydrochloric acid is in excess ✓1
c) Same cross (X) should be used in each experiment cross (X) shoule be viewed from same position. ✓1 (any one)

7. a) i) ZnS ✓1
ii) So as to obtain ZnO which is easily reduced by CO to Zn ✓1
$2ZnS_{(s)} + 3O_{2(g)} \longrightarrow 2ZnO_{(s)} + 2SO_{2(g)}$

b) i) - Coke /Carbon any one
- Limestone/$CaCO_3$

ii) $2C_{(s)} + O_{2(g)} \longrightarrow 2CO_{(g)}$ ✓1

$CO_{2(g)} + C_{(s)} \longrightarrow 2CO_{(g)}$ ✓1
iii) Vapour/gas, temperature is above the boiling of zinc. ✓1
iv) 600°C it is condensing/temp is below boiling point of zinc. ✓1
v) Formation of gullies ✓1due to soil containing the ore/CO_2 leading to global warming ✓1
vi) Making blass
- Making -ve terminal in dry cells
-Galvanization of iron sheets.

GATUNDU NORTH SUB-COUNTY COMMON EXAMINATIONS
CHEMISTRY PRACTICAL FORM 4 PAPER 3 MOCK 2015
MARKING SCHEME

1. TABLE I
C.T. - 3
D.P. - 1
AC - 1
TR. 1
(6mks)

2. i) Graph
Scale - $^1/_2$
Label - $^1/_2$
Plots - 1
Line - 1

ii) and iii) from graph (3mks)
Table II
CT - 1
DP - 1
AC - 1
PA - 1
FA - 1
(5mks)

Calculate
I Correct ans
II $\frac{0.2}{1000}$ ✓1 x 25 = 0.005moles ✓1

III 1 mole $(HX)_a.2H_2O$ ⟹ 126
x ⟹ 4.5
$= \frac{4.5}{126}$ ✓1/2
= 0.0357moles ✓1/2
0.0357 ⟹ 250
Ans (2)

$\frac{0.0357}{250}$ x Ans (ii) I = Correct ans ✓1/2

Ans (i) III $(HX)_a.2H_2O$ ⟹ 0.005 mole NaOH
1 mole ⟹ 2moles of NaOH
∴ $(HX)_a.2H_2O$ is ✓1/2
n = 2 ✓1/2
(4mks)

a)

Observation	Inferences
White residue Colourless solution 1mk	Insoluble and soluble salts suspected 1mk

Observation	Inferences
White ppt Soluble in excess 1mk	Pb^{2+}, Al^{3+}, Zn^{2+} 1mk

ii)

Observation	Inferences
-No white ppt No effervescence 1mk	Ba^{2+}, Pb^{2+}, Ca^{2+} absent CO_3^{2-} absent 1mk

iii)

Observation	Inferences
White ppt $^1/_2$mk	SO_4^{2-} $^1/_2$mk

b)

Observation	Inferences
Effervescence Blue litmus turns red 1mk	CO_3^{2-} $^1/_2$mk

i) Observation	Inferences
- White ppt dissolves in excess 1mk	Pb^{2+}, Zn^{2+}, Al^{3+} present 1mk
ii) Observation	Inferences
- White ppt dissolves in excess 1mk	- Zn^{2+} present 1mk
3. a) Observation	Inferences
- Burns with a blue flame ($^1/_2$mk)	- C - OH suspected ($^1/_2$mk)
b) Observation	Inferences
- Purple potassium Mangaoxide (V) decoloured 1mk	$>C=C<$ - C= C – OH 1mk
c) Observation	Inferences
Bromine water not decolourised or 1mk	$>C=C<$ - C ≡ C - absent R - OH present 1mk
d) Observation	Inferences
No effervescence ($^1/_2$mk)	$-C-OH$ absent R - OH confirmed ($^1/_2$mk)