SUKEMO JOINT EXAMINATION
233/1
CHEMISTRY
Paper 1
THEORY
July 2017
2 Hours

1. Solutions can be classified as acids bases or neutral. The table below shows solutions and their pH values.

Solution	pH values
K	1.5
L	7.0
M	14.0

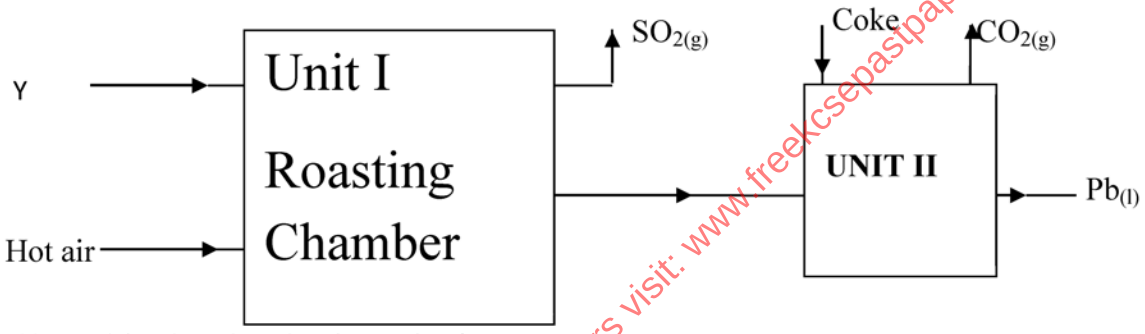
i) Select any pair that would react to form a solution of pH 7 (1mk)
ii) Identify **two** solutions that would react with Aluminium hydroxide. Explain. (2mks)

2. Consider the following reactions for a fuel cell

$2H_{2(g)} + O_{2\,(g)} \rightarrow 2H_2O_{(l)}$

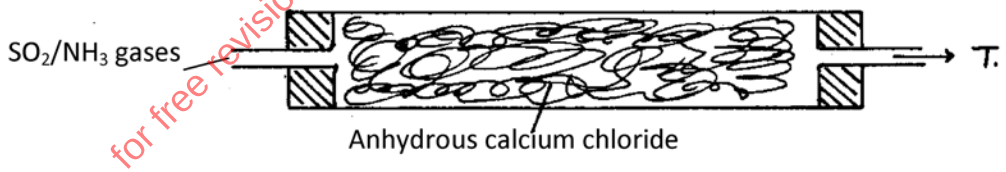
a) Write the reaction at the positive terminal (1mk)
b) Discuss the advantage of a fuel cell pound vehicle over an internal combustion powered vehicle by comparing products formed (2mks)

3. The flow chart below shows some processes involved in the extraction of Lead metal, starting with its ore, Galena.



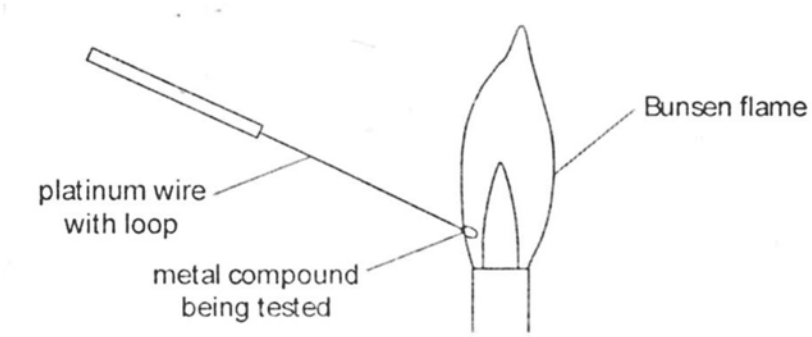
(a). Explain what takes place in roasting furnace. (1mk)
(b). Write a chemical equation for reaction taking place in unit II. (1mk)
(c). State one use of Lead other than in making lead pipes. (1mk)

4. In the set-up in figure was used to separate a mixture of sulphur (IV) oxide and ammonia gases



a) Name gas T. (1mark)
b) What is the intended function of anhydrous calcium chloride? (1mark)

5. A flame test is carried out on three metal solutions of Sodium chloride, Potassium chloride and calcium chloride. The diagram shows the apparatus used



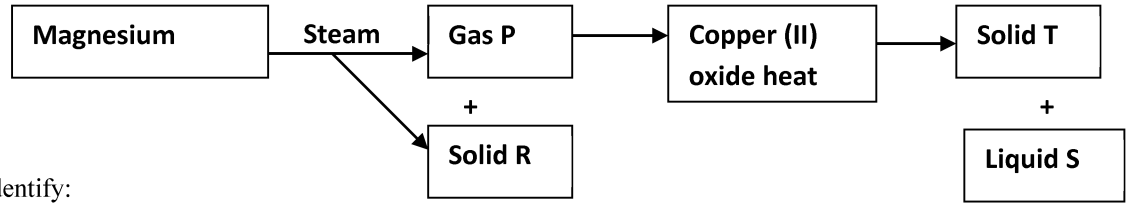
a) i) Suggest two reasons why platinum is a suitable metal to use as the wire in this test. (2mks)
ii) Why is a luminous Bunsen flame not suitable for carrying out a flame test? (1mk)

6. Ethanol and pentane are miscible liquids. Explain how water can be used to separate a mixture of ethanol and pentane. (2mks)

7. A warm red phosphorous was lowered into a gas jar of chlorine using a deflagrating spoon.
   i) State **one** observation made in the experiment. (1mk)
   ii) Identify the substance formed in the above reaction. (1mk)

8. a) Give the structural formula of 3, 3-dimethly pent-l-yne (1mk)
   b) Name the following compounds using the IUPAC system.
   i) $CH_3CH_2CH_2OOCCH_3$ (1mk)
   ii) $CH_3\,CH_2\,CH\,C{=}\,CH$ (1mk)
   Br CH_3

9. Use the chart below to answer the questions that follow.



   Identify: (4mks)
   Gas **P** ……
   Solid **R** ……
   Solid **T** ……
   Liquid **S** ……

10. Calculate the solubility of sugar in water at 40°C from the following information. Mass of evaporating dish = 23.0g
    Mass of evaporating dish + sample of saturated solution = 192.0g
    Mass of evaporation dish + solid after evaporating of solution = 142.0g (3mks)

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

Bond	Bxond 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)

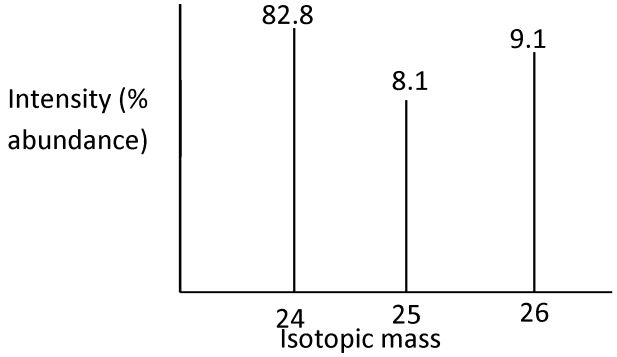
12. Using reagents provided only, explain by means of balanced chemical equations how you could prepare a salt of Zinc carbonate solid. (3mks)
- Zinc powder
- Nitric (V) acid (dilute)
- Water
- Solid sodium carbonate

13. Below is part of the Thorium decay series.
    → → → →
(i) Write an overall nuclear equation for the conversion of to (1mk)
(ii) Give **two** uses of radio isotopes in medicine (2mk)

14. Element **A** has atomic mass 23 and element **B** atomic mass 7 and also have 12 neutrons and 4 neutrons respectively.
a) Write the electron arrangement of **A** and **B** (1mks)
b) Which element has higher ionization energy? Explain (2mks)

15. D grams of potassium hydroxide were dissolved in distilled water to make $100cm^3$ of solution. $50cm^3$ of the solution required $50cm^3$ of 2.0M nitric acid for complete neutralization. Calculate the mass D of potassium hydroxide.(H=1,N=14,O=16,K=39)
    $KOH_{(aq)} + HNO_{3(aq)} \rightarrow KNO_{3(aq)} + H_2O_{(l)}$ (3mks)

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



    Calculate the relative atomic mass of X (2mks)

17. The chemical equations below are the main reactions in large scale manufacture of sodium carbonate.

$NH_{3\,(g)} + CO_{2\,(g)} + H_2O_{(l)} \rightarrow NH_4HCO_{3\,(aq)}$

$NH_4HCO_{3\,(aq)} + NaCl_{(aq)} \rightarrow NaHCO_{3(s)} + NH_4Cl_{(aq)}$

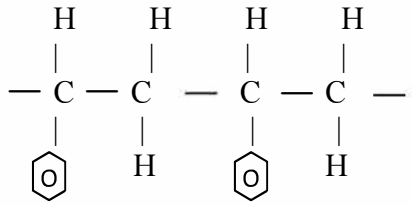
a) State how the **two** products, $NaHCO_3$ and NH_4Cl are separated. (1mk)

b) (i) How is sodium carbonate finally obtained? (1mk)

(ii) Write an equation to show how ammonia is regenerated? (1mk)

18. $20cm^3$ of an unknown gas Q takes 12.6 seconds to pass through small orifice. $10cm^3$ of oxygen gas takes 11.2 seconds to diffuse through the same orifice under the same conditions of temperature and pressure. Calculate the molecular mass of unknown gas Q (O=16) (3mks)

19. . The formula given below represents a portion of polymer

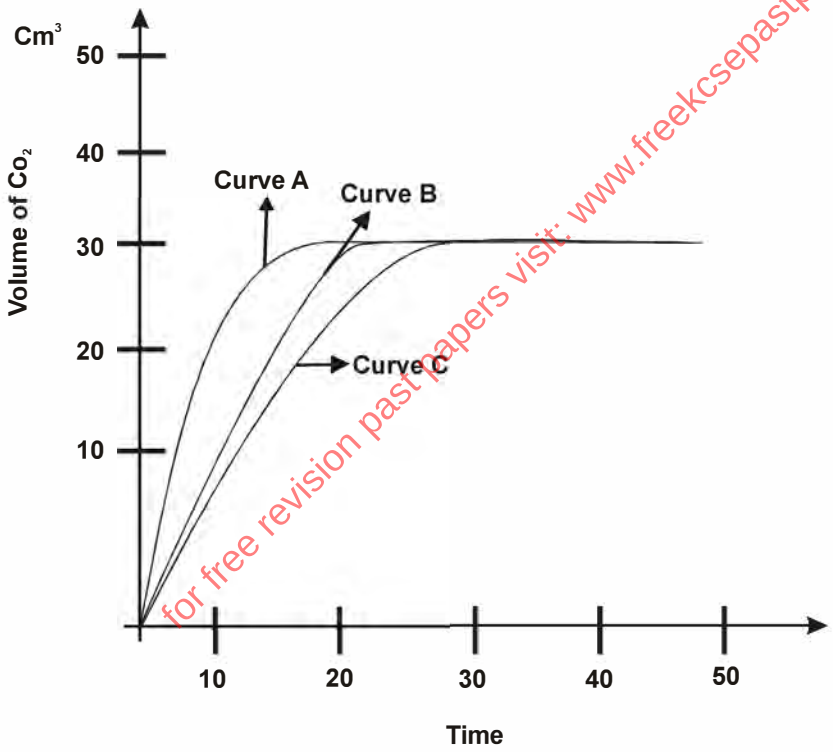


a) Give the name of the polymer (1mk)

b) Draw the structure of the monomer used to manufacture the polymer. (1mk)

c) State one environmental effect of the polymer (1mk)

20. The graphs below were drawn when 15g of marble chips in different physical states were reacted with $50cm^3$ of 2M Hydrochloric acid. They are drawn by measuring the volume of carbon (iv) oxide produced with time.



i) Which curves corresponds to the reactions involving powdered calcium carbonate with the dilute acid (1mrk)

ii) All the graphs eventually flatten out at the same level but at different time. Why do the graphs flatten out at the same level? (1mrk)

iii) Why is curve A very steep at any given point compared to the other curves (1mrk)

21. a) State the Le Chatelier's principle. (1mrk)

b) When aqueous solution of Iron (III) Chloride and potassium thiocyanate are mixed, the equilibrium below is setup.

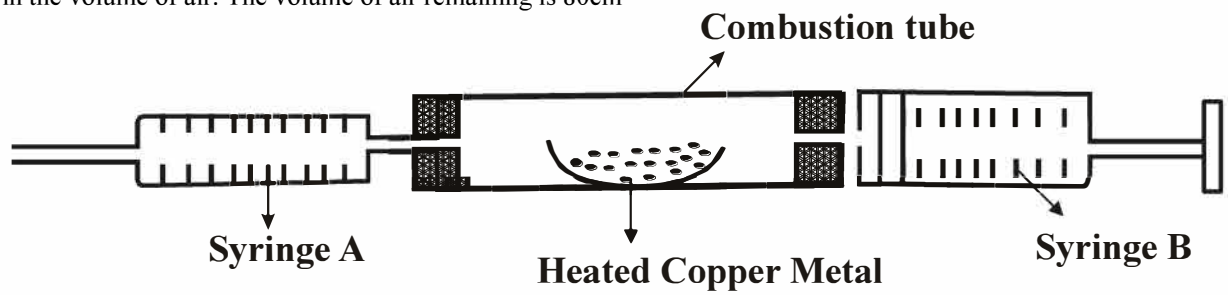
$Fe^{3+}_{(aq)} + CNS^-_{(aq)} \rightleftharpoons [Fe(CNS)]^{2+}$

(yellow (colourless) (red)

State and explain the effect of decreasing the concentration of iron (III) ions for the equilibrium mixture.

(2 mks)

22. 100cm^3 of air is continuously passed through a combustion tube connected to two syringes as shown below. The combustion tube contains some clean granules of copper metal which are heated. The process is repeated until there is no further change in the volume of air. The volume of air remaining is 80cm^3



i) State one observation made in the combustion tube (1mrk)
ii) Work out the percentage of air used after the reaction (1mrk)
ii) List two gases remaining after the reaction (2mrks)

23. In the chemical equation below identify the base and give a reason for your choice. (2mks)

$C_2H_5O^-_{(aq)} + H_2O_{(l)} \rightarrow C_2H_5OH_{(aq)} + OH^-_{(aq)}$

24. A green rocky material is suspected to be the ore malachite, $CuCO_3.Cu(OH)_2$. Describe how you could establish the presence of copper in the ore. (3mks)

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

A B

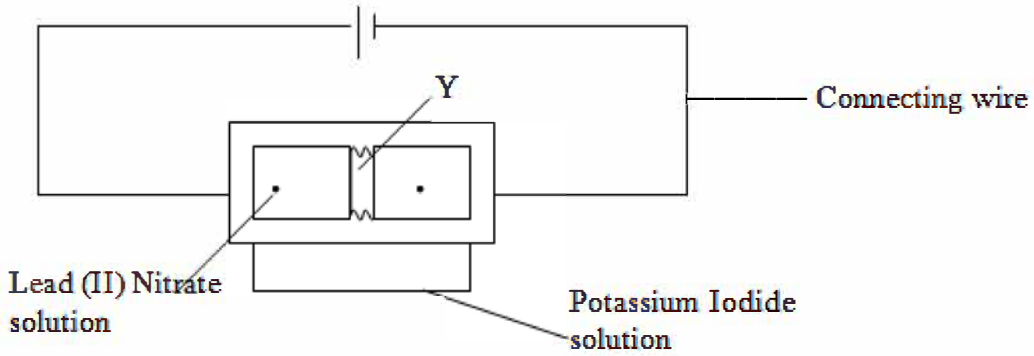
i) Which cleansing agent would be more suitable for washing in water containing Magnesium Sulphate? Explain your answer. (2 mks)
ii) State any advantage that A has over B. (1mk)

26. Study the standard reduction potentials given below and answer the questions that follow. (The letter do not represent the actual symbols of the element)

E^O (volts)						
$P^{2+}_{(aq)}$	+	$2e^-$	→	$P_{(s)}$	-	-0.76
$Q^{2+}_{(aq)}$	+	$2e^-$	→	$Q_{(s)}$	-	-2.37
$R^+_{(aq)}$	+	e^-	→	$R_{(s)}$	-	+ 0.34
$S^{2+}_{(aq)}$	+	$2e^-$	→	$S_{(s)}$	-	-0.14
T_2 (g)	+	$2e^-$	→	$2T^-_{(aq)}$	-	+2.87

(a) The standard reduction potential for $Fe^{2+}_{(aq)}$ is -0.44 volts. Select the element which would best protect iron from rusting. (1mk)
(b) Calculate the E^O value for the cell represented by $S^{2+}_{(aq)} |S_{(s)} || T_{2(g)} |T^-_{(aq)}$ (1mk)
(c) Using the standard reduction potentials above, state and explain the element that would be the strongest reducing agent. (1mks)

27. The diagram below was used to explain the movement of ions in the electrolytes, when an electric current is passed through them.



From the diagram, state and explain the observation expected at Y. (2mks)

28. Sulphur (IV) oxide and Nitrogen (IV) oxide react as shown in the equation below

$SO_{2(g)} + NO_{2(g)} \rightarrow SO_{3(g)} + NO_{(g)}$

(i) Using oxidation numbers of either sulphur or Nitrogen show that this is a **redox** reaction. (2mks)
(ii) **Identify** the reducing agent. (1mk)

SUKEMO JOINT EXAMINATION
233/2
CHEMISTRY
PAPER 2
JULY/AUGUST 2017
TIME: 2 HOURS

1. a) Study the information given below and answer the questions that follow.

Element	Atomic radius (nm)	Ionic radius (nm)	Formula of oxide	Melting point of oxide (°C)
P	0.364	0.421	A_2O	-119
Q	0.830	0.711	BO_2	837
R	0.592	0.485	E_2O_3	1466
S	0.381	0.446	G_2O_5	242
T	0.762	0.676	JO	1054

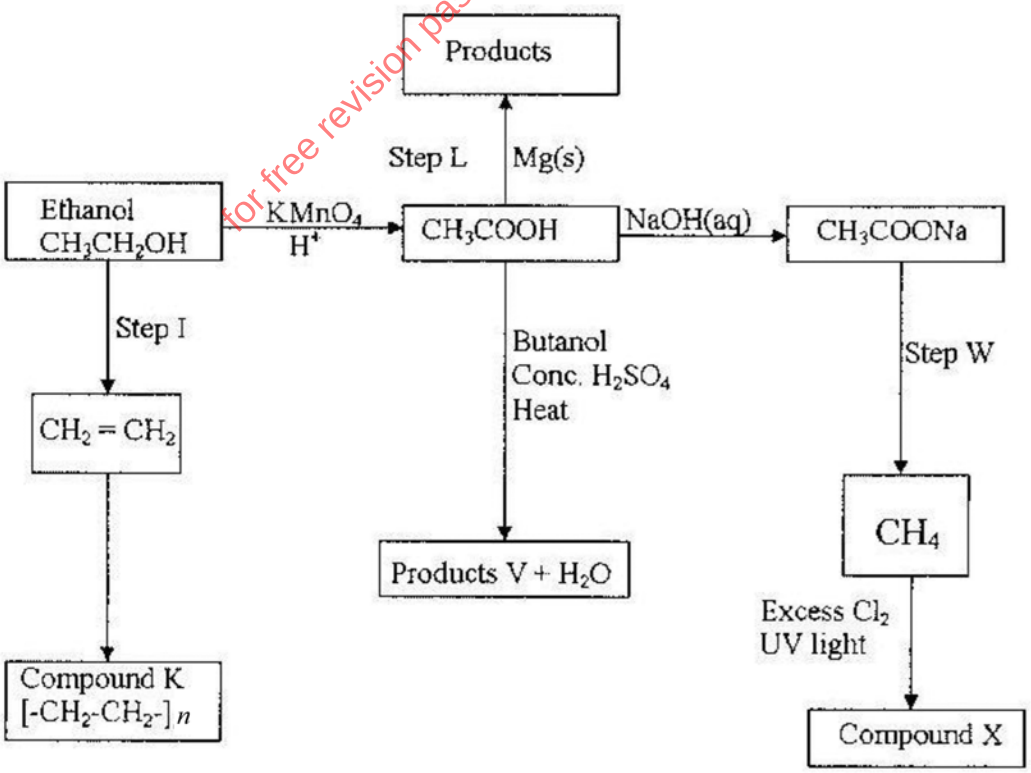
i) Which elements are non-metals? Give a reason. (2mks)
ii) Explain why the melting point of the oxide of R is higher than that of the oxide of S. (2mks)
iii) Give **two** elements that would react vigorously with each other. Explain your answer. (2mks)

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

		Ionization Energy (I.E) in kJ/Mole	
Element	Electronic configuration	1st I.E	2nd I.E
A	2.2	900	1800
B	2.8.2	736	1450
C	2.8.8.2	590	1150

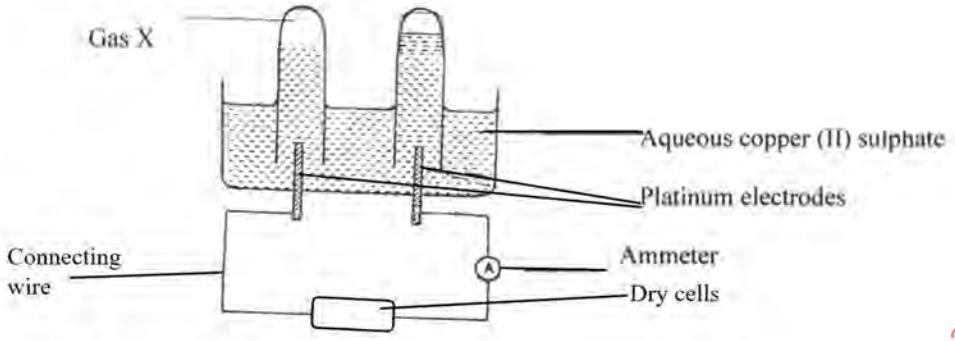
I. What chemical family do the elements A, B and C belong? (1mk)
II. What is meant by the term ionization energy? (1mk)
III. The 2nd ionization energy is higher than the 1st ionization energy of each. Explain (1mk)
IV. Aluminium chloride and sodium chloride are both chlorides of period 3 elements. Use this information to explain the following observations:
(a) A solution of Aluminium chloride in water turns blue litmus paper red while that of sodium chloride does not. (1½mks)
(b) The melting point of sodium chloride (801°C) is higher than that of Aluminium chloride (180°C). (1½mks)

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



(a) i) Name the type of reaction in step 1. (1 mk)
ii) Give the reagent and condition necessary for step 1 to take place. (2 mks)
Reagent
Condition..
(b) Write the equation for the reaction that takes places in step L. (1mk)
(c) Name product V and give the equation responsible for its formation (2 mks)
(d) Give the IUPAC name and structural formula of compound X (2 mks)
(e) State the type of reaction involved in the formation of compound K. (1 mk)
(f) Give the reagent necessary for step W to take place. (1 mk)
(g) If the relative molecular mass of compound K is 44800, determine the value of ***n***. (2 mks)

3. Aqueous copper (II) sulphate was electrolyzed using the set-up represented by the diagram below.



a) i) Name the gas X. (1mk)
ii) Write an ionic equation for the reaction that produces gas X. (1mk)
b) What happens to the pH of the electrolyte during electrolysis? Explain your answer. (2mks)
c) If in the above set-up, copper electrodes were used instead of platinum electrodes.
i) Write the electrode half- equations for the reactions at the anode and the cathode. (2mks)
ii) What happens to the color of the electrolyte during electrolysis? Explain your answer. (2mks)
d) During the electrolysis of copper (II) sulphate solution using copper electrodes, a current of 0.2A was passed through the cell for 5 hours.
i) What is the observation made on the anode electrode? (1mk)
ii) Determine the change in mass of the cathode which occurred as a result of the electrolysis process. (Cu = 64, 1F = 96,500C). (3mks)

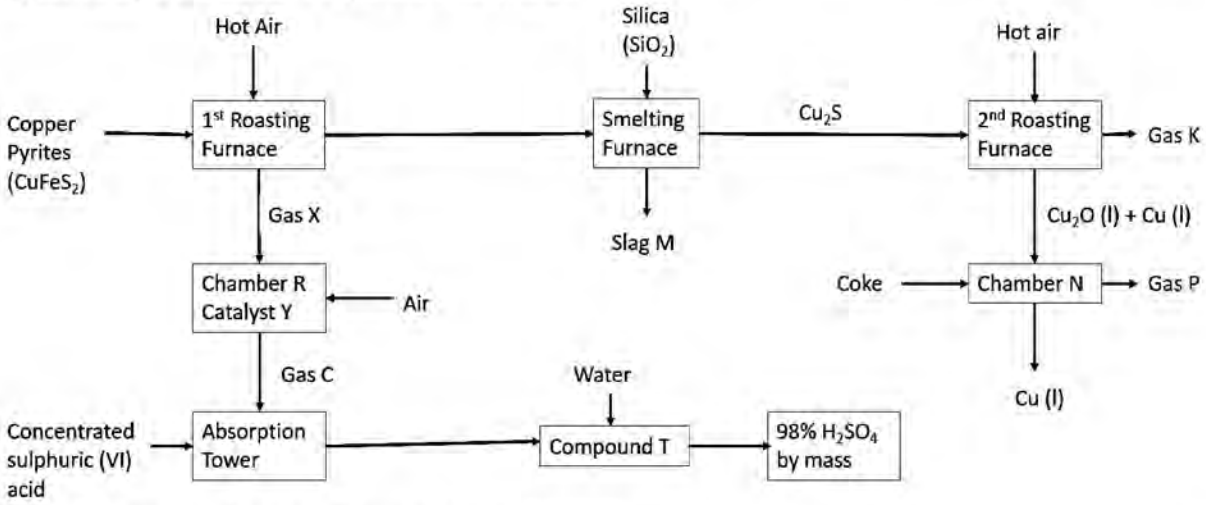
4. a) In an experiment for the manufacture of ammonia from the Haber process, Nitrogen is obtained from liquid air by fractional distillation while hydrogen is obtained from Napha which is a mixture of hydrocarbons containing 5-9 Carbon atoms.
The equations are as shown below:

$$N_{2(g)} + 3H_{2(g)} \longrightarrow 2NH_{3(g)} \quad \Delta H = -92\ kJ/mol$$

$$C_6H_{14(g)} + 6H_2O_{(g)} \longrightarrow 6CO_{(g)} + 13H_{2(g)}$$

Use the above information to answer the questions that follow.
(i) Why is it necessary to purify the gases used in the Haber process? Name one impurity present in these gases other than Carbon (II) oxide and water vapour. (2 mks)
ii) In Haber process finely divided iron is used as a catalyst. How is the efficiency of the catalyst improved? (2 mks)
iii) Write the equation for the laboratory preparation of ammonia. (1 mk)
iv) With reasons state the operating conditions of the Haber industries. (2 mks)
b) One uses of ammonia is in the manufacture of nitric (V) acid through catalytic oxidation.
(i) Name the catalyst used. (1 mk)
(ii) Write an equation for the catalytic oxidation of ammonia. (1 mk)
(iii) Nitric (V) acid obtained in this process is about 60% pure. State how this purity could be increased. (1 mk)
(iv) State one use of Nitric (V) acid other than the manufacture of ammonium nitrate. (1 mk)

5. The flow chart below shows a flow chart that outlines some of the processes involved in the extraction of copper from copper pyrite. Study it and answer the questions that follow.



(a) Write the equations for the reactions that take place in the: (2 mks)
(i) 1st roasting furnace
(ii) Chamber N
(b) (i) Write the formula of the cation present ion the slag M. (1 mk)
(ii) What name is given to the reaction that takes place in chamber N? Give a reason for your answer. (2 mks)
(c) (i) Name the catalyst Y. (½ mk)
(ii) State one commercial use of sulphuric (VI) acid. (½ mk)
(d) (i) 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. (2 mks)
(ii) Given that the mass of copper obtained from the above extraction was 210 kg, determine the percentage purity of the ore (copper pyrites) if 810 kg of it was fed to the 1st roasting furnace. (Cu = 63.5, Fe = 56.0, S = 32.0) (3 mks)

6. The table below shows the volumes of nitrogen (IV) oxide gas produced when 4M nitric (V) acid were reacted with 0.635g of copper at room temperature.

Time (seconds)	Volume of Nitrogen (IV) oxide gas (cm^3)
5	60
15	160
25	240
35	320
45	380
55	430
65	470
75	490
85	500
95	500

a) On the grid provided below, plot a graph of the volume of the gas produced against time. (3 mks)
a) Using the graph, determine the volume of nitrogen (IV) oxide after 30 seconds. (1 mk)
b) On the grid, sketch a graph for the volume of gas against time if the experiment was repeated at 15°C. (1 mk)
c) Use the graph to determine the rate of reaction at the 65th second. (2 mks)
d) Give a reason why hydrochloric acid cannot be used instead of nitric (V) acid. (1 mk)
e) Explain how the rate of the reaction between copper and nitric acid would be affected if the temperature of the reaction mixture was raised. (2 mks)

7. (a) i) What is a fuel? (1 mk)
ii) Calculate the heating value of propane, C_3H_8, given that its molar enthalpy of combustion is 2,200 kJ mol^{-1}. (C=12, H=1) (2 mks)
b) i) Define molar enthalpy of combustion. (1 mk)
ii) Use the information provided by the thermochemical equations below to calculate the molar enthalpy of combustion of ethyne. (3 mks)

$C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = -394$ kJ mol^{-1}
$H_2(g) + ½O_2(g) \rightarrow H_2O(g)$ $\Delta H = -286$ kJ mol^{-1}
$2C(s) + H_2(g) \rightarrow C_2H_2(g)$ $\Delta H = +226$ kJ mol^{-1}

(c) Study the data given below and answer the questions that follow.

Substance/ion	Enthalpy change
$CaCl_2(s)$	Lattice energy = -2,237 kJ mol^{-1}
$Ca^{2+}(g)$	Hydration energy = -1,650 kJ mol^{-1}
$Cl^-(g)$	Hydration energy = -364 kJ mol^{-1}

(i) Determine the molar enthalpy of solution of calcium chloride in water. (2 mks)

(ii) Draw an energy level diagram for the dissolution of calcium chloride in water. (3 mks)

SUKEMO MOCK KCSE EXAMINATION – JULY/AUGUST, 2017
KCSE CHEMISTRY PRACTICAL – PAPER 233/3
CONFIDENTIAL INSTRUCTIONS

Instructions to Schools:

The information contained in this paper is to enable the head of the school and the teacher in charge of Chemistry to make adequate preparation for the Chemistry Practical Examination.

NO ONE ELSE should have access to this paper or acquire knowledge of its content. Great care MUST be taken to ensure that the information herein does NOT reach the candidates either directly or indirectly. The teacher in charge of Chemistry should NOT perform any of the experiments in the SAME room as the candidates nor make the results of the experiment available to the candidates of give any information related to the experiments to the candidates. Doing so will constitute an examination irregularity which is punishable.

In addition to the fittings and apparatus found in a Chemistry laboratory, EACH candidate will require:

1. One Burette, 0-50ml.
2. One 25ml Pipette.
3. Three 250ml Conical Flask
4. One Volumetric Flask.
5. One complete Retort Stand
6. One White Tile
7. One Pipette Filler
8. One Test-tube Rack
9. Six Test-tubes
10. Two Boiling tubes
11. Filter paper *2
12. Filter funnel *1
13. Measuring cylinder 100ml.*1
14. Measuring cylinder 10ml. *1
15. Test tube rack*1 with Test tubes *6
16. Wash bottle filled with distilled water
17. About 0.5g of Solid G supplied in a stoppered container.
18. One metallic spatula.
19. About 1g of solid sodium hydrogen carbonate.

ACCESS TO

1. Source of heat.
2. Acidified Potassium Manganite (VII) supplied into a dropper.
3. Universal indicator
4. PH chart
5. Pure ethanol supplied with a dropper
6. 2M Hydrochloric acid
7. 2M Acidified Barium chloride
8. 2M Sodium hydroxide solution
9. 2M Ammonia solution
10. 2M Nitric acid solution *enough for use in question 2.*

NOTES

1. 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.
2. Solid G is pure oxalic acid.

I. a) Metal FA1 is 0.3g magnesium granules.
b) Solution FA2 is a 1.0M Hydrochloric acid solution.
c) Solution FA3 is a 0.0984M sodium hydroxide solution.
d) Solid FA5 is 2.0g Potassium chlorate, $KClO_3$ crystals.

II. On the day of the Practical Examination, the teacher in charge of Chemistry should perform the experiment as per the procedures given in the question-paper and complete Table 1 and Table 2 for EACH practical session.

- **Solution CB35** which contains two cations and one anion i.e. **$Al_2(SO)_4$ + $CuSO_4$** each being 0.1M in molecular weight, mixed and top up to a litre of distilled water *in a stoppered boiling tube.*
- About 25cm^3 2M Sodium hydroxide solution

SUKEMO JOINT MOCK KCSE EXAMINATION

233/3
Chemistry
(Practical)
July/August 2017
2 ¼ Hours

1. You are provided with:
i) 0.3g of metal **FA1**.
ii) 100cm^3 of a **1.0M** hydrochloric acid solution labelled as solution **FA2**.
iii) 120cm^3 of a **0.0984M** sodium hydroxide solution, labelled as solution **FA3**.
iv) Screened methyl orange indicator solution.

You are required to determine the Relative Atomic Mass of metal **FA1**.

Procedure:

a) Using a burette, measure 50.00cm^3 of solution **FA2** into a clean 250ml beaker.
b) Add the WHOLE AMOUNT of BA1 provided into the beaker containing 50.00cm^3 of solution **FA2** and stir well with a glass rod until ALL the solid metal reacts completely.
c) Transfer the mixture left in the beaker after the reaction into a 250ml volumetric flask. Rinse the beaker as well as the glass rod with distilled water and transfer ALL the rinsings into the volumetric flask. Make up the volume of the solution in the volumetric flask up to the calibration mark with distilled water, cover the flask with a stopper, shake well and label as solution **FA4**.
d) Fill a clean burette with solution **FA4**.
e) Pipette 25.0cm^3 of solution **FA3** into a 250ml conical flask, add 3 drops of screened methyl orange indicator solution and titrate against solution **FA4** from the burette. A change in colour of the mixture from **green** to **pink** marks the end point of the titration. Record your results in Table 1.
f) Repeat the titration TWO more times in order to complete Table 1.

Table 1 (5marks)

Titration	1	2	3
Final burette reading, cm^3			
Initial burette reading, cm^3			
Volume of solution **FA4** used, cm^3			

Average volume of solution **FA4** used = _____ cm^3.

g) Calculations:
i) Calculate the number of moles of HCl in 50.0cm^3 of solution **FA2.** (1mark)
ii) Determine the number of moles of NaOH in 25.0cm^3 of solution **FA3**. (1mark)
iii) Determine the number of moles of HCl in the average volume of solution **FA4** used in the titration. (1mark)
iv) Calculate the moles of HCl left unreacted after the reaction between metal **FA1** and solution **FA2**. (1mark)
v) Determine the moles of HCl that reacted with metal **FA1**. (1mark)
vi) Given that metal **FA1** forms a divalent cation, determine the moles of metal **FA1** that reacted with hydrochloric acid. (1mark)
vii) Determine the Relative Atomic Mass of metal **FA1**. (1mark)

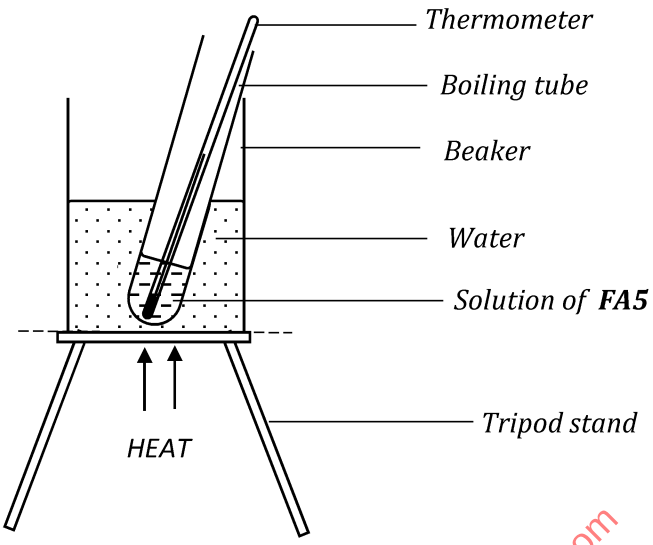
1.(b) You are provided with:
i) 2.00g of solid **FA5**.
ii) a thermometer.
iii) distilled water.
iv) a boiling tube.
v) a hot water-bath.

You are required to determine the temperatures at which solutions of known concentrations of compound **FA5** became saturated and then plot a solubility curve.

Procedure:

a) Transfer the whole amount of solid **FA5** supplied to you into a clean dry boiling tube.
b) Using a burette, add 5.00cm^3 of distilled water into the boiling tube with solid **FA5**.
c) Put the boiling tube into a beaker of hot water bath and warm the boiling tube, whilst continuously stirring the content with a thermometer, until the crystals of **FA5** just dissolve/disappear. (DO NOT BREAK THE THERMOMETER)

Arrangement:



d) Remove the boiling tube from the hot water bath and allow the content to cool slowly while stirring with the thermometer. Note the temperature at which the crystals FIRST form/reappear and record this temperature in Table 2.

e) Add a further 2.00cm^3 of distilled water from the burette into the boiling tube containing the mixture and repeat steps (c) and (d) above. Continue this way until the volume of water added to the boiling tube is 15.00cm

f) Complete Table 2 by calculating the solubility of compound **FA5** in water at the different temperatures.

Table 2:

Total volume of water added (cm^3)	Temperature at which crystals first appear(^{o}C)	Solubility of compound FA5 in water (g/100g of water)
5.00		
7.00		
9.00		
11.00		
13.00		
15.00		

g) On the grid provided plot a graph of solubility of compound FA5 (vertical axis) against temperature (3marks)

i) What is the relationship between the solubility of solid **FA5** and temperature? Explain. (1mark)

ii) From your graph determine the solubility of solid **FA5** in water at 25.0^{0}C. (1mark)

iii) 40.0g of solid **FA5** was dissolved in 100g of water at 90^{0}C. The resulting solution was then cooled to 25.0^{0}C. Determine the mass of crystals of **FA5** that would be formed. (1mark)

2. You are provided with 10cm^3 of solution **CB35** containing **TWO** cations and **ONE** anion. Carry out the tests below and record your observations and inferences in the spaces provided.

a) Add 20cm^3 of 2M aqueous Sodium hydroxide to all of solution CB35 provided. Shake well. Filter the mixture into a conical flask. **retain both the filtrate and the residue**

Observations	Inferences
(1 mark)	(1mark)

b) To about 2cm^3 of the filtrate, add (i.e. about 1cm^3 of the acid) of 2M Nitric acid **drop wise** until in excess. Retain the mixture

Observations	
(½mark)	

Divide the mixture in **(b)** above into TWO portions.

i) To the FIRST portion, add aqueous Sodium hydroxide solution dropwise until in excess.

Observations	**Inferences**
(1 mark)	(1mark)

ii) To the SECOND portion, add 2M aqueous Ammonia solution DROPWISE until in excess.

Observations	Inferences
(1 mark)	(1mark)

c) To about $2cm^3$ of the filtrate, add 3 drops of 2M Hydrochloric acid.

Observations	Inferences
(1mark)	(1mark)

d) To about $2cm^3$ of the filtrate, add about $1cm^3$ of acidified Barium chloride solution.

Observations	Inferences
(1 mark)	(1mark)

e) To the RESIDUE add about $5cm^3$ of dilute Nitric acid and allow it to filter into a test tube. To about $2cm^3$ of this filtrate add 2M aqueous Ammonia solution dropwise until in excess and then filter into a clean test tube.

Observations	Inferences
(1mark)	(½mark)

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

a) Place 1/3 spatula full of solid G into a clean dry test tube and then place $10cm^3$ of ethanol.

Observations	
(½mark)	

b) Using a metallic spatula, scoop a small portion of solid G and ignite in a non-luminous flame.

Observations	Inferences
(1mark)	1mark)

c) Place the remaining solid G into a clean dry boiling tube. Add about 10cm3 of distilled water and shake until the solid dissolves. Divide the mixture obtained into 5 portions.

i) To the 1st portion, add solid Sodium hydrogen carbonate provide

Observations	Inferences
(½mark)	(½mark)

ii) To the 2nd portion, add 3 drops of universal indicator.

Observations	Inferences
(½mark)	(½mark)

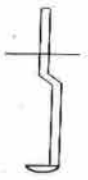
iii) To the third portion, add 4 drops of acidified $KMNO_4$

Observations	Inferences
(1mark)	(½mark)

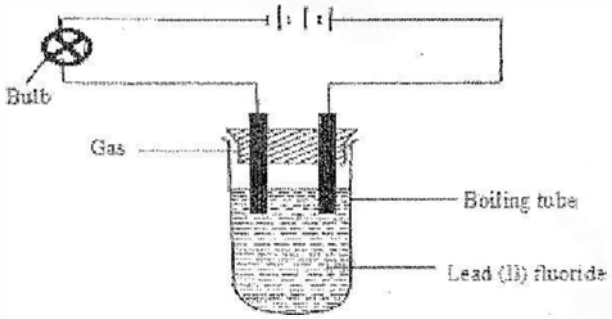
KASSU JOINT EXAMINATION
233/1
CHEMISTRY
Paper 1
THEORY
JUNE 2017
Time: 2 hours

1. Name the following apparatus and state their use (2mks)

a) 

b) 

2. The diagram below shows an experiment for investigating electrical conduction in lead (II) fluoride. Study it and answer the questions that follow.

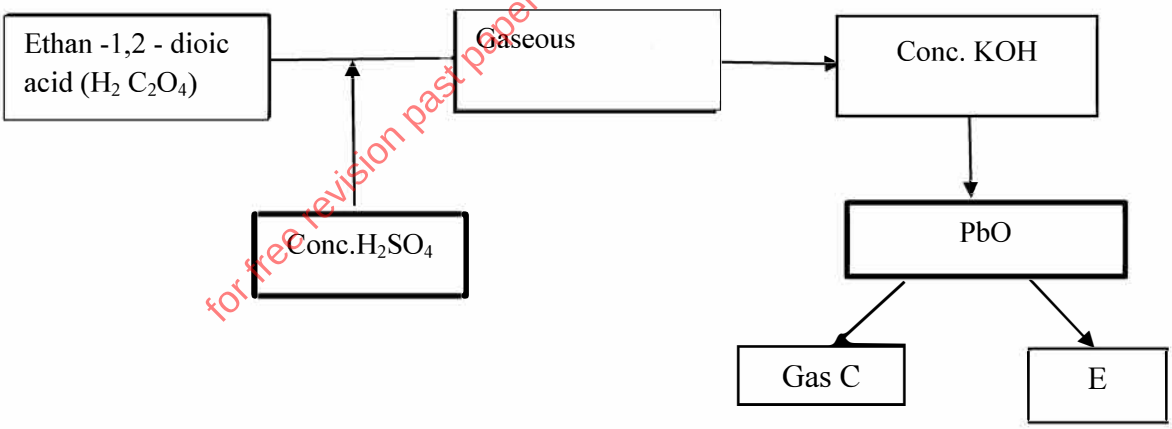


a) Complete the diagram by indicating the condition that is missing and must be present for electrical conductivity to take place. (1mk)

b) State the observation made at the anode. (1mk)

c) On the diagram show the direction of movement of electrons. (1mk)

3. Use the scheme below to answer the following questions



a) Name the type of reaction which takes place between Ethan -1,2 – dioic acid and concentrated sulphuric (VI) acid (1mk)

b) Why is the gaseous mixture passed through concentrated KOH. (1mk)

c) Write the equation for the reaction producing C and E (1mk)

4. Describe how you would prepare crystals of sodium sulphate starting with 200 cm^3 of 2 M sodium hydroxide. (3mks)

5. Using dots (.) and cross (X) diagrams show the bonding in the following;

a) Phosphonium ion (PH_4^+) (P=15,H=1) (1mk)

b) Compound formed between element A and B given the atomic numbers of (A= 11,B = 8) (1mk)

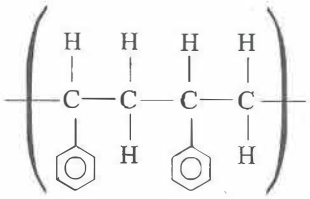
6. A sample of hydrogen chloride was dissolved in water to make 250 cm^3 of a solution. 25cm^3 of the solution required 1M sodium hydroxide for complete neutralization. Determine the mass of hydrogen chloride gas dissolved to make 250 cm^3 of solution (H = 1 ,Cl = 35.5) (3mks)

Draw the structures of the following compounds. (2mks)

i) Ethylbutanoate

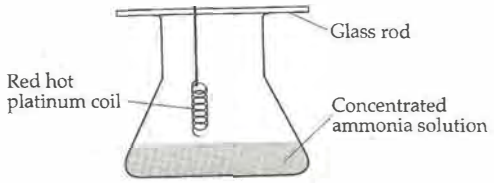
ii) 3-ethyl – 3 – methyl hexane

iii) The structure below represents a portion of a polymer.



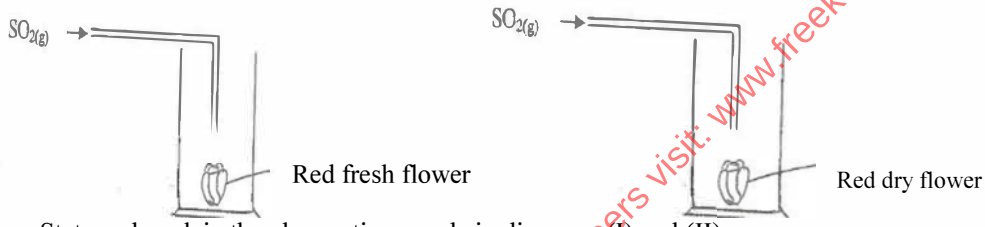
Draw the structure of the monomer and name it. (1mk)

7. The apparatus below was set up to show the catalytic oxidation of ammonia. Study it and answer the questions that follow.



a) State and explain two observations made in the above experiment. (2mks)
b) Write the equation for the reaction that took place during oxidation of ammonia. (1mk)
c) Write the formula of the complex ion formed when excess ammonia gas is passed through a solution containing Zn^{2+}. (1mk)

8. The molecular mass of water is 18 and that of hydrogen sulphide is 34. Boiling point of water is 100˚C and that of hydrogen sulphide is -61˚C . Explain the difference in the boiling point for the two compounds. (2mks)
9. When 0.11 mole of a certain hydrocarbon was burnt in oxygen,19.36 g of carbon(IV) and 5.94 g of water were formed. Determine the molecular formula of the hydrocarbon.
(C =12,O=16,H=1) (3mks)
10. The diagrams below were used to investigate the effect of Sulphur (IV) oxide.

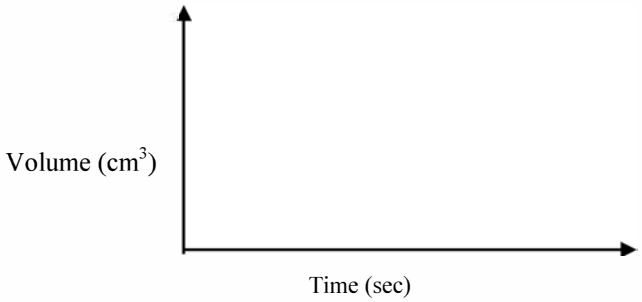


State and explain the observations made in diagrams (I) and (II) (3mks)

11. In the equation below identify the reagent that act as an acid and give a reason. (2mks)
$H_2O_{(l)} + H_2O_{2(aq)} \rightarrow H_3O^+_{(aq)} + HO_{2(aq)}$
13. A fixed mass of gas has a volume of 150 cm^3 at 25 ˚C and 650 mmHg. Calculate the temperature at which the gas will have a volume of 75 cm^3 and a pressure of 700 mmHg. (3mks)
14. Below is a formula of a cleansing agent obtained from alkylcarboxylic acid $H_3(CH_2)_{15}COONa$. Would it be possible to use this cleansing agent to wash clothes containing a dissolved bleaching powder, calcium hypochlorite ($CaOCl_2$)? (2mks)
15. In preparation of bleaching agent excess chlorine gas was bubbled into 15 litres of cold 2 M sodium hydroxide.
a) Write an equation for the reaction between chlorine gas and cold dilute sodium hydroxide. (1mk)
b) Calculate the mass in kilograms of the bleaching agent formed. (2mks)
16. Study the information in the table below and answer the questions that follow (The letters do not represent the actual symbols of the elements)

		Ionization Energy_kJ/Mole	
Element	**Electronic configuration**	**1st ionization energy**	**2nd ionization energy**
A	2.2	900	1800
B	2.8.2	736	1450
C	2.8.8.2	590	1150

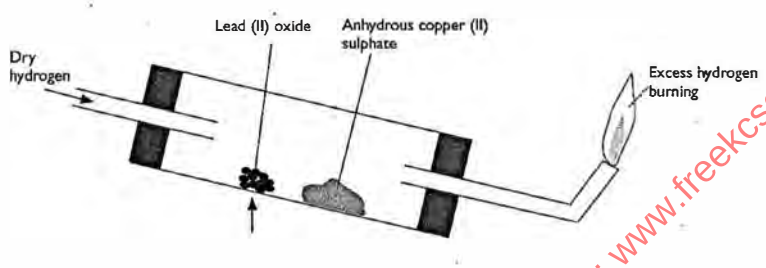
a) What is ionization energy (1mk)
b) Explain why the 2nd ionization energy is higher than the 1st ionization energy. (1mk)
17. An element K has relative atomic mass of 40.2. It has two isotopes of masses 39 and 42. Calculate the relative abundance of each isotope. (3mks)
The equation below represents the contact process for the manufacture of Sulphuric (VI) acid.
$2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)}$ $\Delta H = -197$ Kj/mol
Suggest two changes that can improve the yield of SO_3 (2mks)
18. In a experiment involving the reaction between magnesium and 1 M HCl, the volume (cm^3) of hydrogen gas produced after t (seconds) was measured. The experiment was repeated using the same amount of magnesium reacting with 2 M HCl. On the axis below draw and label the two curves that would be obtained from the two experiments. (2mks)



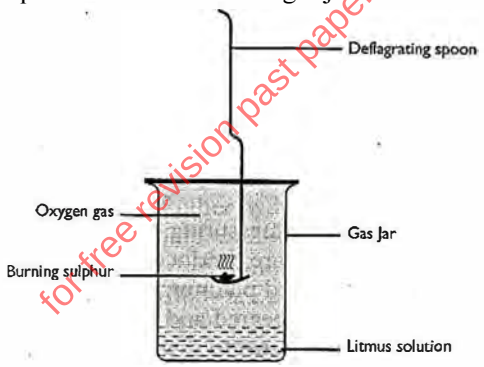
19. A radio isotope X decays by emitting two alpha (α) particles and one beta (β) particle to form $^{214}_{83}Bi$.
a) What is the atomic number of X. (1mk)
b) After 112 days $^1/_{16}$ of the mass of X remained. Determine the half-life of X. (2mks)
20. Use the equations below to answer questions that follow.
$K^+_{(g)} + Cl^-_{(g)} \rightarrow KCl_{(s)} \quad H_1 = -70kJ/mol$
$KCl_{(s)} \rightarrow K^+_{(aq)} + Cl^-_{(aq)} \quad H_2 = +15kJ/mol$
a) What name is given to H_1 (1mk)
b) Calculate the heat change for the process (2mks)

$$K^+_{(g)} + Cl^-_{(g)} \xrightarrow{H_2O} K^+_{(aq)} + Cl^-_{(aq)}$$

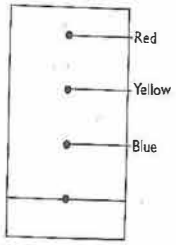
21. Use the diagram below to answer the questions that follow.



a) After the experiment has been running for some time, record two major observations made in the tube. (2mks)
b) Write an equation for the reaction that takes place in the dish containing lead (II) oxide. (1mk)
22. A piece of burning Sulphur was lowered into a gas jar filled with oxygen and containing aqueous litmus solution as shown.



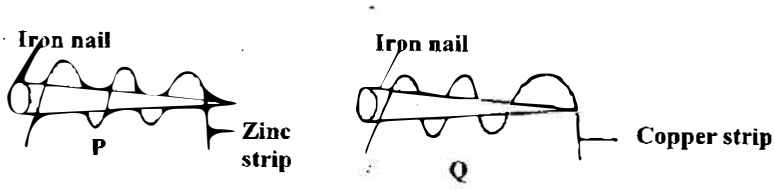
a) State two observations made during the experiment. (2mks)
b) Write an equation for the burning of Sulphur in air. (1mk)
23. A solution containing 9.2 g 0f solute A in 30 cm^3 of water. When cooled, crystals begin to appear at 25°C . Calculate the solubility of solute A at 25 °C. (2mks)
24. The chromatogram below shows the constituents of flower extract using an organic solvent.



a) Describe how you would obtain a solid sample of the red pigment. (2mks)
b) State one property that makes the red pigmet move the furthest. (1mk)
25. a) Name two ores of iron. (2mks)
b) Give the name of the suitable method used in extracting iron from the ore. (1mk)

c) Name one impurity present in pig iron and state one effect of the impurity in the physical property of the physical properties of iron. (2mks)

26. Give a reason for the following safety precautions in the laboratory. (1mk)
    a) Why water should not be poured directly to concentrated sulphuric(VI)acid during dilution.
    b) Why sodium metal should not be handled with bare hands.
27. Catalytic converters found in car exhaust system converts pollutant gases to relatively harmless gases.
    a) Name two pollutant gases and the harmless gases they are converted to. (2mks)
28. Use the diagram below to answer the questions that follow.



    a) In which set – up will the iron – nail rust? Explain (2 mks)
29. A group of students dissolved 20cm^3 of 2M HCl in water and methylbenzene respectively.
    The resulting solutions were shaken thoroughly and used for reactions with various reagents.
    (a) Fill the table below with the correct observations that were made during the experiment.

	Reagent	Solution of hydrogen chloride in water	Solution of hydrogen chloride in methylbenzene
(i)	Methyl orange	(½ mk)	(½ mk)
(ii)	Anhydrous sodium carbonate	(½ mk)	(½ mk)

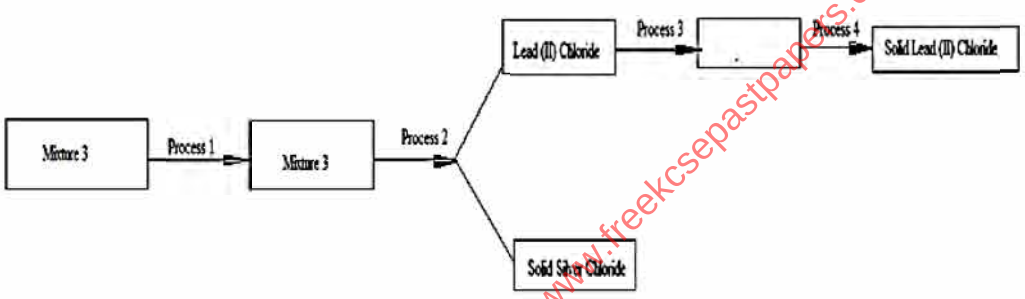
    (ii) Explain the difference in the observations made for the two solutions. (1 mk)

KASSU JIONT EXAMINATION
233/2
CHEMISTRY
Paper 2
JUNE/JULY 2017
Time: 2 hours

1. The table below gives several samples of mixtures. Study the table and answer the questions that follow

Mixture 1 components	**Mixture 2 components**	**Mixture 3 components**	**Mixture 4 components**
Magnesium Sulphate	Water	Silver Chloride	Iron (III) Chloride
Water	Magnesium Sulphate	Lead Chloride	1ron (III) Oxide
Silver Chloride	Magnesium Nitrate	water	-

a). state **one** way in which the composition of a mixture differs from that of a compound (1mk)
b) Describe how **Mixture 1** and **Mixture 2** can be separated into its components
i) Mixture **1** (2mks)
ii) Mixture **2** (2mks)
c). State the main property that makes components of **Mixture 3** separable (1mk)
d). Draw a well labeled diagram of a simple laboratory set up which can be used to separate the components of **Mixture 4** (2mks)
e). The chart below gives a summary of steps which can be used to separate the components of mixture 3. Study it and answer the questions that follow

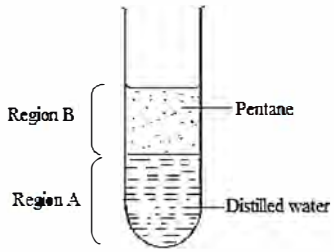


Identify the processes labeled 1,2,3,4 (2 marks)

2. Ethan dioic acid can be used in the laboratory preparation of Carbon (II) Oxide.
a). Name the other reagent and the condition required for the production of Carbon (II) Oxide in this process.
i) Name of reagent (1mark)
ii) Condition (1mark)
b) The volume of gas produced reduces when the gas is passed through an aqueous solution of Potassium hydroxide
i) Explain why the volume reduces (1mk)
ii) What will be the total volume of carbon (II) Oxide produced if 0.6moles of Ethan dioic acid is used in the reaction (all volumes measured at s.t.p, molar gas volume = $22.4dm^3$) (2mks)
iii). State two reasons as to why Carbon (II) Oxide is not easy to detect (1mk)
c). Using dots (●) and crosses (x) to represent electrons, show how bonding occurs between Carbon and Oxygen in Carbon (II) Oxide (1mk)
d). i). Carbon (II) Oxide can be converted into Carbon (IV) Oxide, state one observation made when Carbon (II) Oxide is being converted to Carbon (IV) Oxide (1mk)
ii). What is the role of carbon (IV) Oxide in the Solvay process (1mk)
iii). Besides Carbon (IV) Oxide, name another gaseous substance that is used in the Solvay process (1mk)
e). Sodium Carbonate is extracted from Trona which is a double salt with the formula $Na_2CO_3.NaHCO_3.2H_2O$
i). write down a balanced equation to show how Sodium Carbonate is obtained from trona (1mk)
ii). State why trona is classified as a double salt (1mk)

3. a). A compound **D** of molar mass 88 was found to have the following composition by mass.
Carbon = 54.54 %, Hydrogen =9.09 % and the rest was Oxygen. Find the molecular formula of the compound. (3mks)
b). Draw the structural formula of compound **D** (1mk)
c). Describe how compound **D** can be used to distinguish between Calcium Carbonate and Calcium Sulphate (1mk)
d). i). Name and give the molecular formula of the next member of the homologous series to which compound **D** belongs (2mks)
e). Compound **D** reacted with another compound with the formula NH_2CONH_2.
i). Name two by-products of the reaction (2mks)
ii). Draw the structural formula of the organic compound formed (1mk)

f). About 5 cm^3 of compound **D** was added into a boiling tube containing a mixture of distilled water and pentane. The mixture was shaken and then allowed to stand for about 2 hours. The figure below represents the set up at the end of the 2 hours.

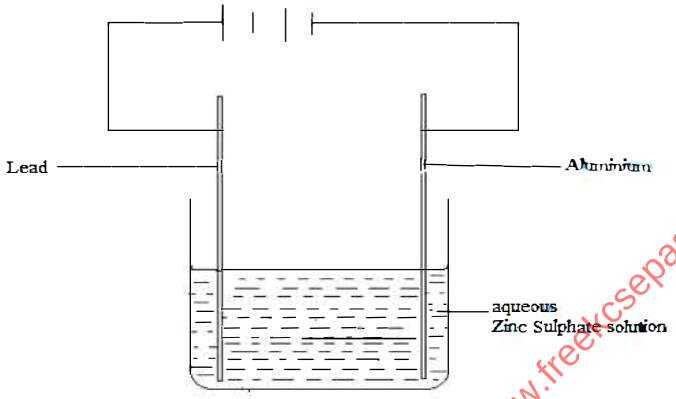


The P^H of the liquid obtained from region **B** at the end of the experiment was found to be 7.0. Explain this observation (2mks)

4. Zinc metal can be extracted from its ores by reduction using carbon or through electrolytic process.

a). Apart from Zinc blende, name another ore from which Zinc metal is extracted (1mk)

b). In the electrolytic process, an electric current is passed through a series of cells containing aqueous solution of pure Zinc Sulphate. The figure below represents one of the cells used in the electrolytic process



i). Write down a balanced equation of reaction that takes place at the:
Anode (1mk)
Cathode (1mk)

ii). Name one major by-product of this electrolytic process (1mk)

iii). A current of 15 Amperes was passed through the cell for 24 hours and 16 minutes. Calculate the moles of the product at the cathode (I F=96500C) (2mks)

iv). State **one** environmental effect which can be associated with the extraction of Zinc from its ores (1mk)

c). The equation given below represents a redox reaction involving elements **X** and **Y**.

$Y^{2+}_{(aq)} + X_{(s)} \rightarrow Y_{(s)} + X^{2+}_{(aq)}$

i). With a reason, identify the reduced species (1mk)

ii). Write down the cell representation for the cell that will formed between the two elements **X** and **Y** (1mk)

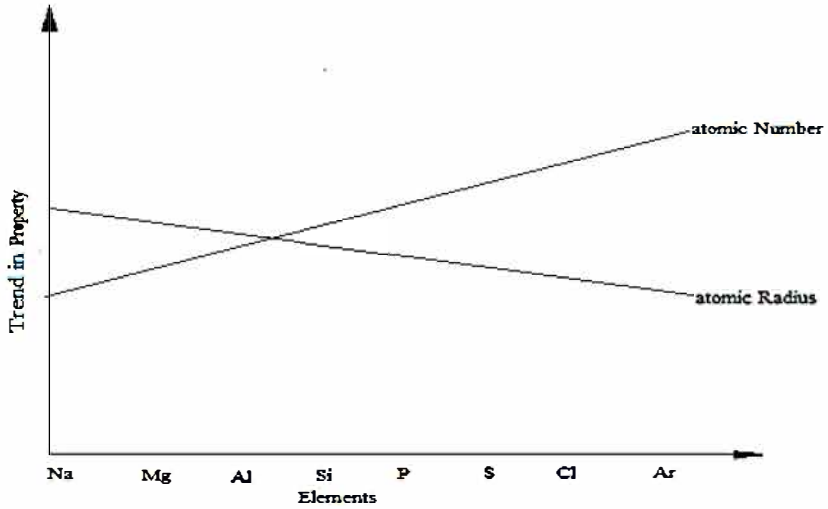
iii). Draw an electrochemical cell involving the half cell of element **X** and the half cell of Hydrogen (2mks)

d). The reaction between Chlorine and aqueous Potassium Iodide can be resented as shown by the equation below

$Cl_{2(g)} + 2KI_{(aq)} \rightarrow 2KCl_{(aq)} + I_{2(s)}$

i). Explain why formation of Iodine is described as an Oxidation process (1mk)

5. The figure below represents trends of some properties of period three elements. Study it answer the questions that follow.



a). Explain the trends shown by the atomic numbers and the atomic radii

i). Atomic number (1mk)
ii). Atomic radii (2maks)

b). on the same axes, sketch the trend of reactivity across the period (1mk)

c). write down the electronic configuration of phosphorous and sulphur in the following compounds
i). H_3PO_4 (P=15) (1 mk)
ii). $Na_2S_2O_3$ (S=16) (1mk)

d). i). One of the elements given in the figure above is stored under water. Identify the element and give a reason as to why it is stored under water (1mk)
ii). State **one** use of aluminium that can be associated with its malleability (1mk)

e). Explain the observation that would be made if the chloride of Phosphorous is exposed to moist air (2mks)

f). distinguish between the terms electro negativity and electron affinity as used in chemistry (2mk)

6. A radioactive isotope of Uranium $^{238}_{92}U$ Undergoes decay by emitting a beta particle.

a). write down a balanced nuclear equation to show this decay process (1mk)

b). i). The half life of Uranium -238 is 4.5 x10^9 years.
What is meant by the term half -life (1mk)

ii). A sample of Uranium with 720 radioactive atoms decayed for 22.5 x 10^9 years. On the grid provided, plot a graph of number of radioactive atoms of uranium -238 against time in years (3mks)

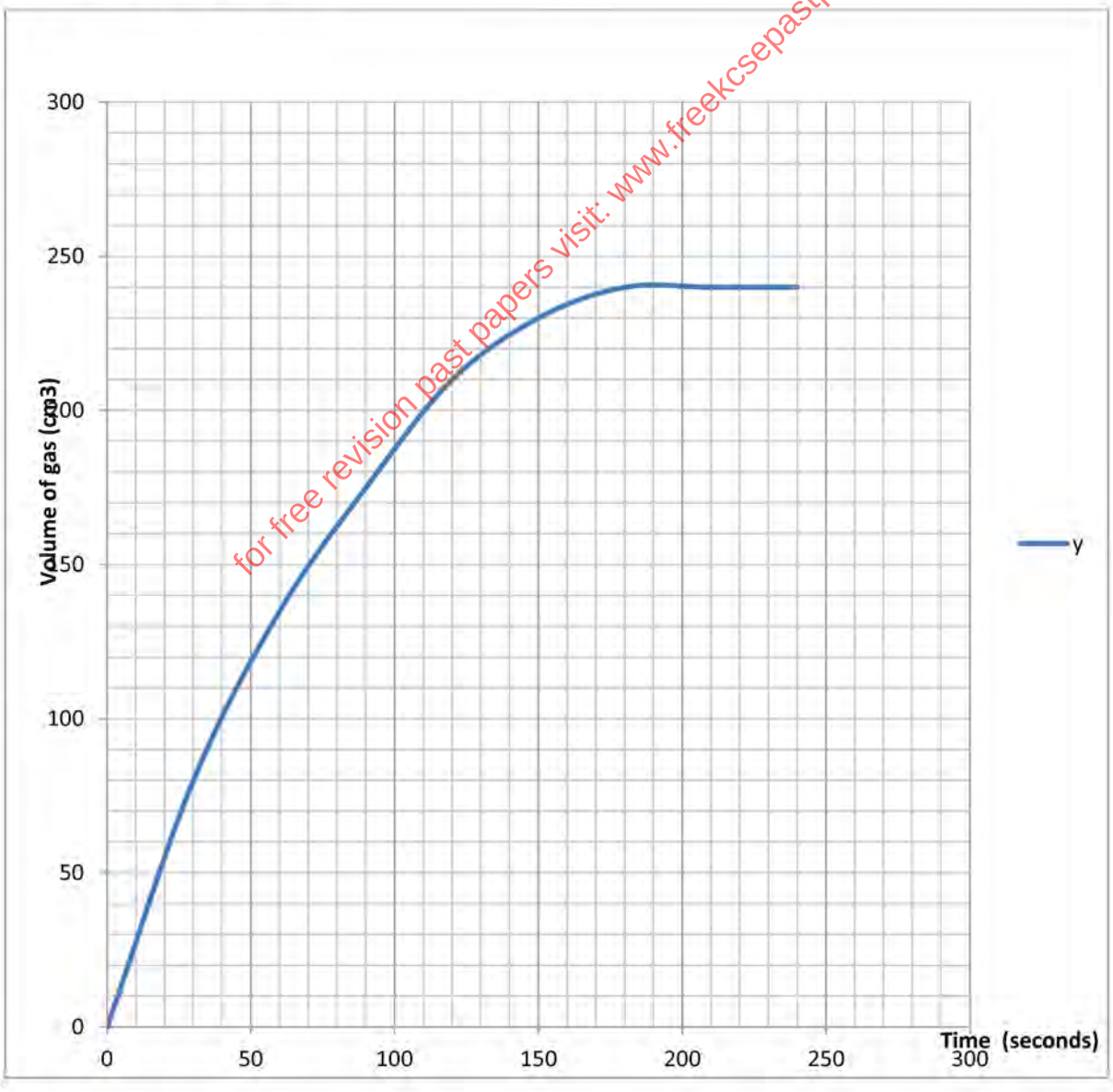
iii). Use the graph to determine the number of radioactive atoms when time is 16.0 x 10^9 years (1mk)

c). Describe **two** ways in which a nuclear reactions differ from a chemical reaction (2mks)

d). Explain the source of electrons in a radioactive process (1mk)

e). state one application of half life (1mk)

7. In a class experiment to study the rate of reaction between Sodium Sulphite and dilute Hydrochloric acid, 1.26g of Sodium Sulphite was reacted with excess 2M Hydrochloric acid. The volume of Sulphur (IV) Oxide evolved was plotted against time as shown in the graph below.



a). Name one piece of apparatus that can be used to measure accurate volume of gas collected. (1mk)

b). What volume of 1.5M Hydrochloric acid would be needed to produce 4.76 litre of Sulphur (IV) Oxide (all volumes measured at r.t.p, molar gas volume = $24.0dm^3$) (2mks)

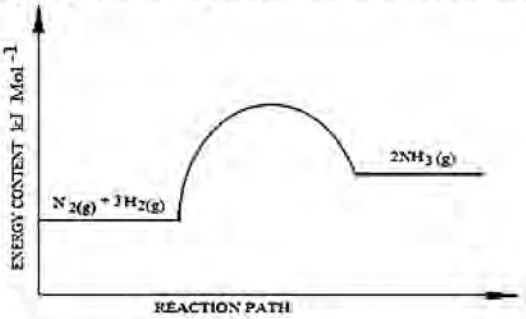
c). Use the graph to determine

i). The rate of production of gas at 120 seconds (2mks)

ii). The rate of production of gas between 30 seconds and 140 seconds (2mks)

d). On the same axes, sketch the graph obtained if the experiment was repeated using 15 cm^3 of 1.5M Hydrochloric acid. (1mk)

e). The reaction between Nitrogen and Hydrogen can be represented as shown in the energy cycle given below



Explain how the yield of Ammonia would be affected if

i). Temperature was reduced (2mks)

ii). Pressure was increased (2mks)

KASSU JET
CHEMISTRY
PRACTICAL
JUNE 2017
CONFIDENTIAL

INSTRUCTIONS TO SCHOOLS:

In addition to usual provisions and fitting in the science laboratory each candidate is expected to have the following.

- One pipette
- One burette
- One pipette filler
- About 60 cm^3 of solution A
- About 100 cm^3 of solution B
- 3 cm of solid C (magnesium ribbon)
- Two 250ml conical flask
- One boiling tube
- 10ml measuring cylinders
- A stop watch/clock
- 500ml distilled water provided in wash bottle
- Means of labeling
- One 100ml glass beaker
- About 1.0g of solid F
- Metallic spatula
- Filter paper
- One filter funnel
- At least 5 dry clean test tubes
- 2 dry boiling tubes
- Acidified potassium chromate (VI) solution
- Acidified potassium manganate (VII)
- Bromine water
- Solid T (maleic acid about 2g)
- -10-110 ^oC thermometer

Access to:

- Source or means of heating
- 2M NaOH supplied with a dropper
- 2M NH_4OH supplied with a dropper
- Potassium iodide solution
- Dilute nitric v acid
- Universal indicator paper and a pH chart
- 1 cm of magnesium ribbon

Notes

- Solution A is 0.7 M sulphuric (VI) acid
- Solution B is 0.5 M sodium hydroxide
- Solid F is a mixture of sodium sulphite and lead (II) carbonate in the ratio 1:1
- Solid T is maleic acid

KASSU JOINT EVALUATION
233/3
CHEMISTRY
PAPER 3
PRACTICAL
June 2017
Time: 2 ¼ Hours

1. You are provided with: 0.7 M sulphuric (VI) acid, solution A
0.5 M sodium hydroxide, solution B
Magnesium ribbon, solid C
You are required to determine the:
- The temperature change when magnesium reacts with excess sulphuric (VI) acid
- Number of moles sulphuric (VI) acid that remain unreacted
- Number of moles of magnesium that reacted

Procedure1:
i) Using a burette measure 50 cm^3 of solution A and place it in a 100ml beaker.
ii) Stir the solution gently with the thermometer making and take its temperature after every half a minute.
iii) Record your results as shown in table I.

Table I

a)

Time (min)	0	½	1	1½	2	2½	3	3½	4	4½	5
Temperature(^oC)											

(3 marks)

iv) After one and half (1½) minutes, put the magnesium ribbon, solid C, in the 50 cm^3 of solution B.
v) Stir the mixture gently with the thermometer and record the temperature of the mixture after every half-minute as shown in the table above up to the fifth minute.
Keep the resulting solution for use in procedure 2
Plot a graph of temperature against time. (3 marks)
Use the results in the table to determine the highest change in temperature (ΔT) for the reaction. (1 mark)

Procedure 2:
Transfer all the solution obtained in procedure 1 into a 250 ml conical flask. Clean the burette and use it to place 50 cm^3 of distilled water into the beaker used in procedure 1. Transfer all the 50 cm^3 into the 250 ml conical flask containing the solution from procedure 1. Label this as solution D. Empty the burette and fill it with solution B. Pipette 25 cm^3 of solution D and place it into an empty 250 ml conical flask. Add 2-3 drops of phenolphthalein indicator and titrate solution B against solution D. Record the results in table II. Repeat the titration of solution B against solution D and complete table II.

b) Table II

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

(4 marks)

i) Calculate the average volume of solution C used. (1 mark)
ii) Calculate the number of moles of:
I. 0.5 M sodium hydroxide used. (1 mark)
II. Sulphuric (VI) acid in 25 cm^3 of solution D (1 mark)
III. Sulphuric (VI) acid in 100cm^3 of solution D (1 mark)
IV. Sulphuric (VI) acid in 50 cm^3 of solution D (1 mark)
V. Sulphuric acid that reacted with magnesium (1 mark)
VI. Magnesium that reacted (1 mark)

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

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

i) Describe the colour of the residue and filtrate. (1 mark)
Residue……
Filtrate……

ii) To about 2 cm^3 of the filtrate in a test tube, add a few drops of acidified potassium chromate (VI) solution.

Observations (1mark)	Inferences (1mark)

iii) To about 2 cm^3 of the filtrate, add sodium hydroxide drop wise until in excess.

Observations (1mark)	Inferences (1mark)

b) i) Place about a third (⅓) of the residue on a metallic spatula and burn it in a Bunsen burner flame.

Observations (1mark)	Inferences (1mark)

ii) Place the remaining residue in a test tube and add about 5 cm^3 of dilute nitric (V) acid

Observations (1mark)	Inferences (1mark)

iii) Describe how to test for lead (II) ions in the solution obtained in b (ii) above.

Observations (2mark)	Inferences (1mark)

iv) Carry out the test in b (iii) above.

Observations (1mark)	Inferences (1mark)

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

a) Place about a third (⅓) of solid T on a metallic spatula and burn it in a Bunsen burner flame.

Observations (1mark)	Inferences (1mark)

b) Place the remaining amount of substance T in a boiling tube and add about 10 cm^3 of distilled water. Divide the mixture into 4 portions.

i) To the first portion, add the magnesium ribbon provided.

Observations (½ mark)	Inferences (½ mmark)

ii) To the second portion, determine the pH.

Method used (2mark)	Inferences (1mark)

iii) To the third portion, add acidified potassium manganate (VII) solution.

Observations (½ mark)	Inferences (½ mark)

iv) To the fourth portion, add acidified potassium chromate (VI) solution.

Observations (½ mark)	Inferences (½ mark)

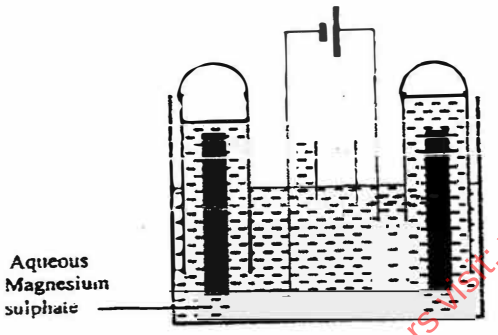
MOKASA
233/2
CHEMISTRY
PAPER 2
2017
TIME: 2 HOURS

1. Use the grid below to answer the questions that follow. Letters do not represent the actual symbol of the elements.

F	I				M		O		
G	J		K	L		N	P	Q	
H									

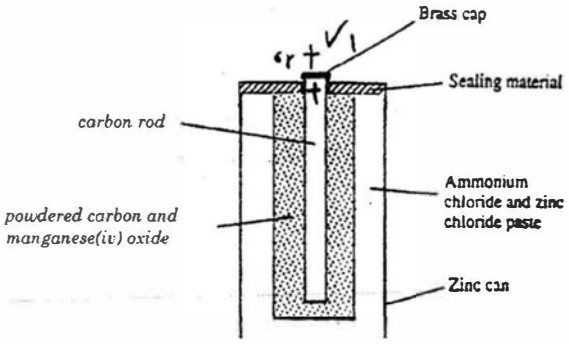
a) What family name is given to elements G and H? (1 mark)
b) State and explain the difference in reactivity between.
   i) I and J (1 ½ marks)
   ii) N and P (1 ½ marks)
c) How does atomic radius of K compare to that of L? Explain. (2 marks)
d) Explain the trend in melting points down the group of elements to which I and J belong. (2 marks)
e) Write down an equation for the reaction between K and P. (1 mark)
f) Give one use of element Q. (1 mark)
i) Write down the electronic arrangement of a stable ion of H. (1 mark)

2. The set-up below was used during the electrolysis of aqueous magnesium sulphate using inert electrodes.



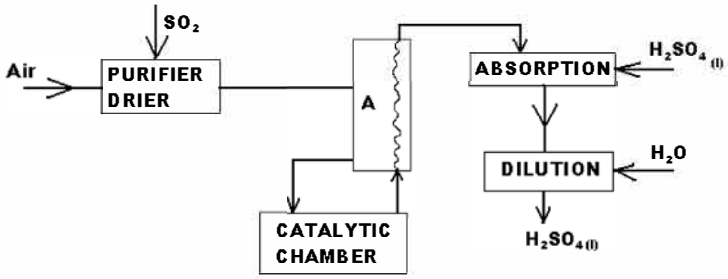
i) Name a suitable pair of electrodes for this experiment. (1 mark)
ii) Identify the anions and cations in the solution. (2 marks)
iii) On the diagram label the cathode. (1 mark)
iv) Write an equation for the reaction that took place at the cathode. (1 mark)
v) Explain the change that occurred to the concentration of magnesium 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 cathode.
(1 Faraday= 96500 coulombs and molar volume of a gas at room temperature is 24000cm^3). (2 marks)
vii) One of the uses of electrolysis is electroplating.
Give two reasons why electroplating is necessary. (1 mark)

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



i) On the diagram, show with a (+) sign the positive terminal (1 mark)
ii) Write the equation for the reaction in which electrons are produced. (1 mark)
iii) Give one disadvantage of dry cells. (1 mark)

3. The scheme below shows the industrial manufacture of sulphuric (VI) acid. Study it and answer the questions that follow.



i) State two functions of the chamber A. **(1mark)**
ii) Explain why concentrated Sulphuric (VI) acid is used in the absorption chamber and not water. **(1mark)**
iii) Write the equation for the reaction that takes place at the absorption chamber **(1mark)**
iv) Name two catalysts that can be used in the catalytic chamber. **(1mark)**
(b) Sulphuric (VI) acid is used in making fertilizers. What volume of ammonia gas will be required to make 25kg of ammonium sulphate? (N=14,H=1.0 S = 32, O = 16.0 Molar gas volume at r.t.p = 24.0dm^3) **(2marks)**
c) The equation below shows the oxidation of Sulphur (IV) oxide to Sulphur (VI) oxide in the contact process.

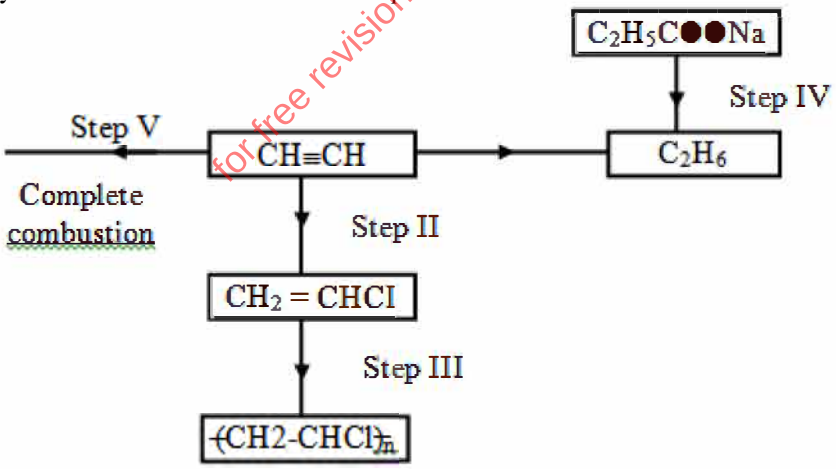
$2SO_{2(g)} + O_{2(g)} \rightarrow 2SO_{3(g)} \quad \Delta H = -196kJ/mol^-$

i) State and explain the effect on the yield of Sulphur (IV) oxide when.
a) the temperature increased. **(1 1/2 marks)**
b) the amount of oxygen is increased. **(1 1/2marks)**

4. Study the following table and then use it to answer the questions that follow.

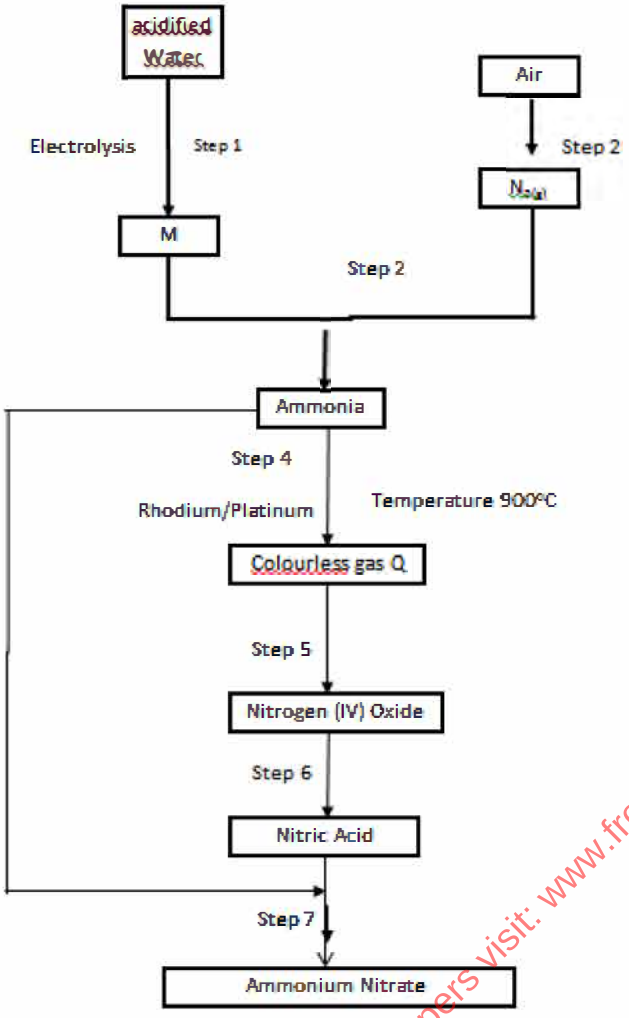
Hydrocarbon	Boiling point (k)
CH_4	112
C_2H_6	184
C_3H_8	231
C_4H_{10}	273
C_5H_{12}	309
C_6H_{14}	342

a) These organic compounds belong to the same homologous series.
i) What is meant by the term homologous series? **(1mark)**
ii) To which homologous series do the above hydrocarbons belong? **(1mark)**
iii) Select one hydrocarbon that would be a liquid at room temperature . **(1mark)**
iv) Compare the boiling point of CH_4 and C_6H_{14} ? Explain your answer **(2marks)**
v) Give one chemical test to distinguish between C_2H_6 and C_2H_4 **(2marks)**
b) Study the scheme below and answer the questions that follow.



(i) Name the reagents used in
Step I (1/2 Mark)
Step II (1/2 Mark)
ii) Write an equation for the complete combustion of CH≡CH (1 Mark)
iii) Explain one disadvantage of the continued use of items made from the compound formed in Step III (1 Mark)

5. Study the flow diagram below and answer the questions that follow:-



(i) Describe how nitrogen is obtained from air (3 marks)
(ii) Name the element M (1 Mark)
(iii) Why is it necessary to use excess air in step 4 (1 Mark
(iii) Write an equation for the reaction in step 7 (1 Mark)
(iv) State two uses of ammonia gas (1 Mark)
(c) State and explain the observations made if a sample of sulphur is heated in concentrated Nitric(V) Acid (2 Marks)

6. a). State Hess' law of constant heat summation (1mark)
b) Use the information below to answer the questions that follow:

$H_{2(g)} + ½\ O_{2(g)} \rightarrow H_2O_{(l)}$ $\Delta H_1 = -286 kJmol^{-1}$
$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ $\Delta H_2 = -394 kJmol^{-1}$
$2C_{(s)} + 3H_{2(g)} + ½\ O_{2(g)} \rightarrow C_2H_5OH_{(l)}$ $\Delta H_3 = -277 kJmol^{-1}$

i) Write a balanced chemical equation for complete combustion of ethanol (1mark)
ii) Draw an energy level diagram to using the heat of combustion of carbon, hydrogen and ethanol. **(1mark)**
iii) Calculate the molar enthalpy of combustion of ethanol. **(2marks)**

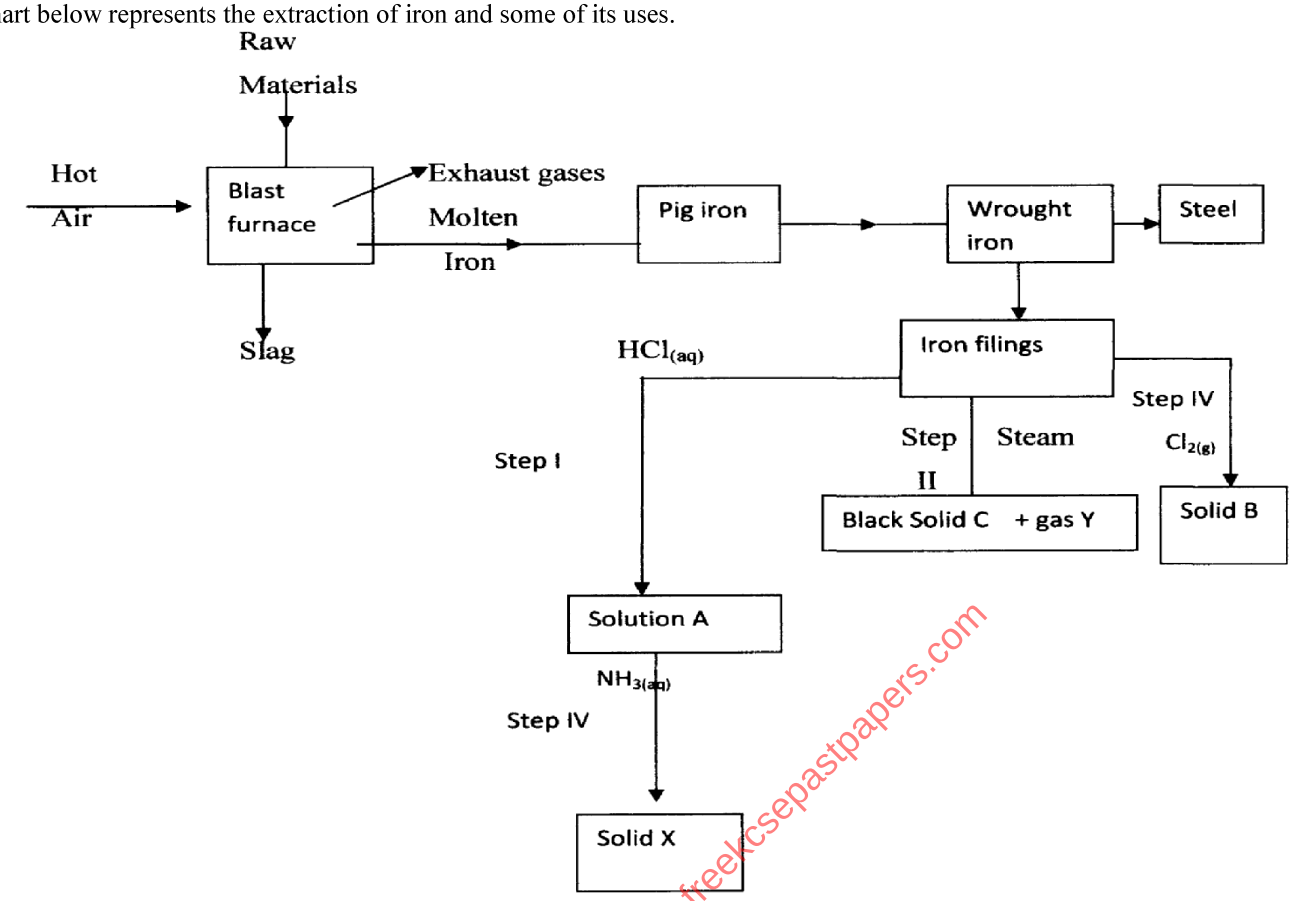
b) Given the following bond energies. Use it to answer questions below.

Bonds	**Bond energies**
C – C	(347kJ mol^{-1})
C – H	(413kJ mol^{-1})
C = C	(612kJ mol^{-1})
H – H	(435.9kJ mol^{-1})

Calculate enthalpy of formation of ethane from its constituent elements. **(2 marks)**

7 a) A student was provided with an ore suspected to contain Fe^{2+} ions, describe an experiment to show how the student can confirm the presence of Fe^{2+} ions in the ore. **(2 marks)**

b) The chart below represents the extraction of iron and some of its uses.



i) Name the chief ore fed into the blast furnace. **(1 mark)**
ii) Name 2 exhaust gases emitted from the blast furnace. **(1 mark)**
iii) Why is it necessary to convert pig iron into wrought iron **(l mark**
iv) Name **(1 mark)**
Solid B
Solid X
v) Write equations for reaction in step II **(1 mark)**
vi) Write an ionic equation for the reaction in step I. **(l mark)**
vii) What observations are made in steps I and IV? **(1 mark)**
viii) State one commercial use of iron. **(1 mark)**
ix) State one environmental effect that may arise from the extraction of iron. **(1 mark)**

8 a) Other than concentration, name two other factors that affect the rate of a reaction. **(1 mark)**

b) In an experiment to determine the rate of reaction between duralumin (an alloy of aluminium, copper and magnesium) and dilute hydrochloric acid, 0.55g of the alloy were reacted with excess 4 M hydrochloric acid. The data in the table below was recorded. Use it to answer the questions that follow.

time (seconds)	Total volume of hydrogen gas produced (cm^3)
0	0
60	220
120	420
180	540
240	620
300	640
360	640
420	640

i) On the grid provided, plot a graph of total volume of hydrogen gas produced (vertical axis) against time. (3 marks)
ii) From the graph, determine the volume of gas produced at the end of 135 seconds. (1 mark)
c) Determine the rte of reaction between the 4^{th} and the 5^{th} minute. (2 marks)
d) Explain why the volume of the gas remains constant after the 300^{th} second. (1 mark)
e) Given that 2.5 cm^3 of the total volume of the hydrogen gas was from the reaction between magnesium and dilute hydrochloric acid, calculate the percentage of mass of aluminium present in the 0.55g of the alloy. (al = 27, Moalr Gas Volume at r.t.p. = 24 litres) (3 marks)

MOKASA
CHEMISTRY
2017
PAPER 3

1. You are provided with;
(i) Solution A – Ferrous ammonium sulphate ($FeSO_4$, $(NH_4)_2SO_4.XH_2O$) containing 8.5g in solution 250cm3 of solution.
(ii) Solution B 0.02M acidified potassium manganate (VII)
You are required to determine the value of X in $FeSO_4.(NH_4)_2SO_4.XH_2O$
PROCEDURE
Fill the burette with solution B. Pipette 25.0cm3 of solution A into A into a clean conical flask and titrate until the solution turns pink. Record your results in table below. Repeat the procedure.
(a)

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

(4 mks)

(b) (i) Calculate the average volume of solution B used (1 mk)
(ii)The number of moles of solution B in volume in (i) above (1 mk)

(c) Given that the reaction is represented by the ionic equation.
$MnO^-_{4(aq)} + 8H^+_{(aq)} \rightarrow Mn^{2+}_{(aq)} + 4H_2O_{(l)}$
Determine;
(i) The number of moles of iron (II) salt solution A in 25.0cm3 of the solution used. (1 mk)
(ii) The concentration of solution A in moles per litre (2 mks)
(iii) The concentration of solution A in grams per litre (2 mks)
(iv) The relative formula mass of iron (II) salt (2 mks)
(v) The value of X in the formula $FeSO_4.(NH_4)_2SO_4.XH_2O$ Fe = 56, N = 14, S = 32, O = 16 (1 mk)

2. You are provided with;
4.0g of solid N.
You are required to determine the solubility of N in distilled water.
Procedure I
i. Fill the burette with distilled water.
ii. Place solid N in a boiling tube.
iii. Transfer 4.0cm^3 of distilled water from the burette into the boiling tube containing solid N.
iv. Heat the mixture while stirring with thermometer to a temperature of 80^{0}C.
v. Allow the solution to cool while stirring with a thermometer.
vi. Record the temperature at which crystals start to form in the table below.
vii. Add a further 2.0cm^3 of distilled water from the burette to the mixture. Repeat procedure (iv) and (v) above and record the crystallization temperature.

Complete table II below by adding volumes of distilled water as indicated **(PRESERVE THE CONTENTS)**

Volume of distilled water	Crystallization temperature	Solubility of solid N in g/100g water
4		
6		
8		
10		
12		

(6 mks)

b) On the grid provided, plot a graph of solubility of N (Y-axis) against crystallization temperature. (3 mks)
c) From the graph, determine
(i) The solubility of N at 500C (1 mk)
(ii) The temperature at which 40g of P dissolves in 50g water. (1 mk)
PROCEDURE II
(i) Place 2cm3 of the preserved solution and add 2 drops of acidified potassium manganate (VII)

Observation	Inference
(1 mk)	(1 mk)

(ii) To 2cm^3 of the preserved solution in a second test add a spatula of sodium hydrogen carbonate powder.

Observation	Inference
(1 mk)	(1 mk)

(iii) To 2cm^3 of the preserved solution in a third test tube add 2 crops of universal indicator.

Observation	Inference
(1 mk)	(1 mk)

3. You are provided with solid Q.

(a) Add about 20cm3 of distilled water to solid Q and shake.

(i)

Observation	Inference
(1 mk)	(1 mk)

Filter the solution and label the filtrate as F and put 4cm3 of the filtrate into three test tubes.

(ii) To the first test tube, add four drops of 2M sodium hydroxide solution, then warm the mixture with moist litmus paper at the mouth of the test tube.

Observation	Inference
(1 mk)	(1 mk)

(iii) To the second solution F add ammonia solution a little until in excess.

Observation	Inference
(1 mk)	(1 mk)

(iv) To the third solution of F add four drops of hydrochloric acid.

Observation	Inference
(1 mk)	(1 mk)

(b) (i) To the residue, add nitric acid just enough to cover the solid.

Observation	Inference
(1 mk)	(1 mk)

(ii) Dip a glass rod in the solution in (i) above and burn in non-luminous flame.

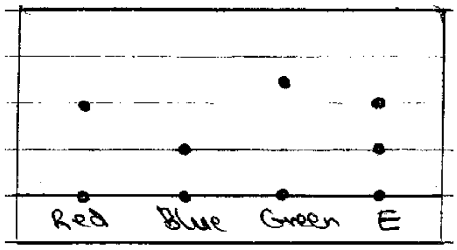
Observation	Inference
(1 mk)	(1 mk)

(iii) To the solution in (i) above, add about three drops of sodium sulphate solution.

Observation	Inference
(1 mk)	(1 mk)

NYERI CENTRAL
CHEMISTRY 233/1
FORM 4
PAPER 1

1. State the difference between the following salts: Efflorescent and hygroscopic salts. (2mks)
2. The diagram below shows chromatograms for three dyes.



(a) Which pure dye is not present in the mixture E? (1mk)
(b) Which of the three pure dyes is the least sticky? Give a reason. (2mks)
(c) Show on the diagram the solvent front. (1mk)

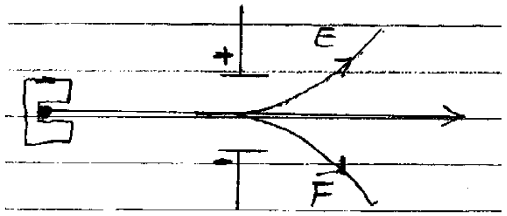
3. A mixture contains aluminium chloride, Copper (II) oxide and potassium Chloride. Describe how each solid substance can be obtained from the mixture. (3mks)
4. Explain in terms of structure and bonding why the boiling point of chlorine is very low while that of sodium oxide is high. (3mks)
5. The table below shows the pH values of solutions P,Q,R and S.

Solution	pH Value
P	2.0
Q	14.0
R	8.7
S	7.0

(a) Identify the strongest base. (1mk)
(b) Which solution is likely to be magnesium hydroxide. (1mk)
(c) Which two solutions would react with zinc(II) oxide. (1mk)

6. (i) Carbon (IV) Oxide neither burns nor support combustion, however burning magnesium continues to burn in it. Explain. (2mks)
(ii) State two properties of Carbon (IV) Oxide that makes it suitable for putting off petrol fires. (1mk)
7. (i) State Graham's Law of diffusion. (1mk)
(ii) $80cm^3$ of Carbon (IV) oxide diffused through a small hole in 40 seconds while $50cm^3$ of hydrogen gas diffused through the same hole under same conditions. Calculate the time taken by the $50cm^3$ of hydrogen to diffuse (H=1,C=12,O=16). (3mks)
8. An element C has atomic number 14 and another element D has atomic number 17.
(i) Using dots(.) and crosses (x) to represent the outermost electrons, show bonding in the compound formed between C and D. (2mks)
(ii) Write the configuration of C and D. (1mk)
9. In terms of structure and bonding, explain why graphite conducts electricity whereas diamond does not. (2mks)
10. (a) Name the chief ore used for extraction of Copper metal (1mk)
(b) State the method used to concentrate the ore mentioned above. (1mk)
11. State and explain the effect on the equilibrium when the pressure is increased in the reaction below. (2mks)
$H_{2(g)} + Cl_{2(g)} \rightarrow 2HCl_{(g)}$
12. (a) State Charle's Law. (1mk)
(b) A ball can hold $1000cm^3$ of air before bursting. The tube contains $975cm^3$ of air at 5^0C. What would happen to the ball if it is taken into a container whose temperature is controlled at 25^0C? Assume the pressure of the gas in the ball remains constant. (3mks)
13. Element Y ahs atomic number 13 while element X has atomic number 12.
(a) Which element has the smallest atomic radius? Explain (2mks)
b) Select the element that has the highest melting point. Explain (2mks)
14. A solid Q was burned in excess oxygen to form an oxide W. When reacted with cold water, the oxide W produced a colourless solution S and a colourless gas which relights a glowing splint.
(a) Give a possible identity of solid Q. (1mk)
(b) Identify solution S. (1mk)
(c) Write the chemical equation for the reaction between oxide W and cold water.(1mk)

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



a) Identify particles E and F. (1mk)

b) Carbon -14 has half-life of 5600 years. This isotope was in an old tree after falling. It was found to have 12.5% Carbon-14 remaining. Determine the time (years) when the old tree was felled. (2mks)

16. a) What are isotope? (1mk)

b) Lithium has two isotopes 7Li and 6Li. If the relative atomic mass of lithium is 6.94. Which
3 3
of the two isotopes is the most abundant? Give a reason. (2marks)

17. The table below gives the atomic numbers of elements represented by letters K,L,M and N.

Element	K	L	M	N
Atomic Number	15	16	17	20

Name the type of bond that exists in the compound formed between:

i) N and L (1mk)

ii) K and M (1mk)

iii) Use a dot (.) and cross (x) diagram to show bonding between K and M. (2mks)

18. (a) State Gay Lussac's Law. (1mk)

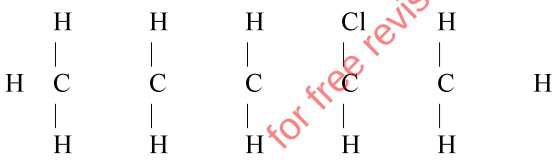
(b) A volume of 50cm^3 of oxygen was exploded in 50cm^3 of Carbon (II) Oxide. What was the volume of the residual gas at room temperature? (2mks)

19. Element K (not actual symbol of element) has isotopes with relative abundances as shown below.

Isotope	Abundance %
$^{10}_{5}K$	18.69
$^{11}_{5}K$	81.31

Calculate the relative atomic mass of element K. (2mks)

20. Compound M reacts with hydrogen Chloride gas to give another compound whose structure is.



(a) Give the structural formula and name of compound M. (2mks)

(b) Write an equation for the reaction which takes place between ethyne and excess Chlorine gas. (1mk)

21. Explain why an organic compound with formula C_3H_6 burns with a more sooty flame than C_3H_8. (2mks)

22. Use the information below to answer the questions that follow.

$C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ ΔH_1=394kJ/mol

$H_{2(g)} + \frac{1}{2} O_{2(g)} \rightarrow H_2O_{(l)}$ ΔH_2=-286kJ/mol

$C_2H_{6(g)} + -O_{2(g)} \rightarrow 2CO_{2(g)} + 3H_{2(l)}O$ ΔH_3=-1560kJ/mol

(a) State Hess's Law. (1mk)

(b) Calculate the molar enthalpy of formation of ethane. (3mks)

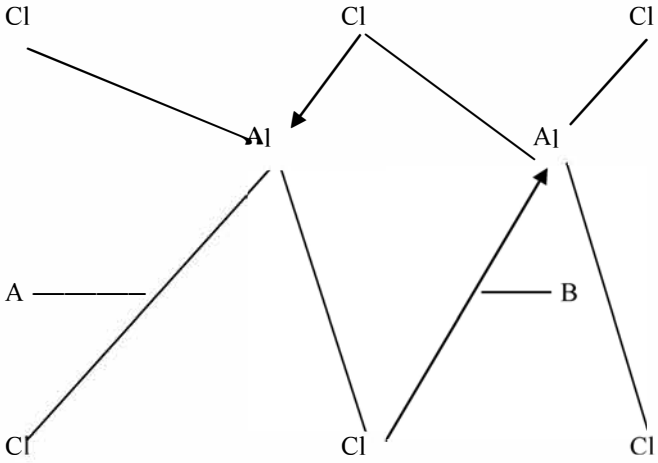
23. A mixture contains iron fillings, sodium Chloride and sand. Describe how each of the solid substance can be obtained from the mixture. (3mks)

24. Calculate the solubility of sodium nitrate if 5g of it saturate 40cm^3 of water. (2mks)

25. Give two ions each that cause water hardness:

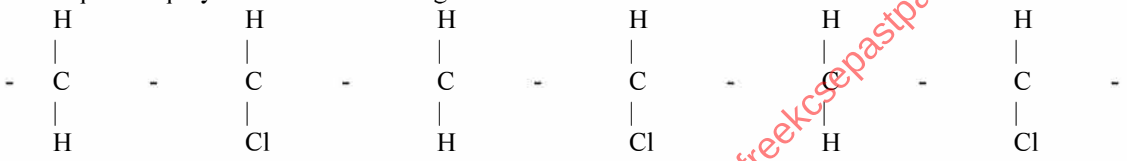
(i) Cations_____ (1mk)
(ii) Anions_____ (1mk)

26. Below is a structure of Aluminium Chloride.



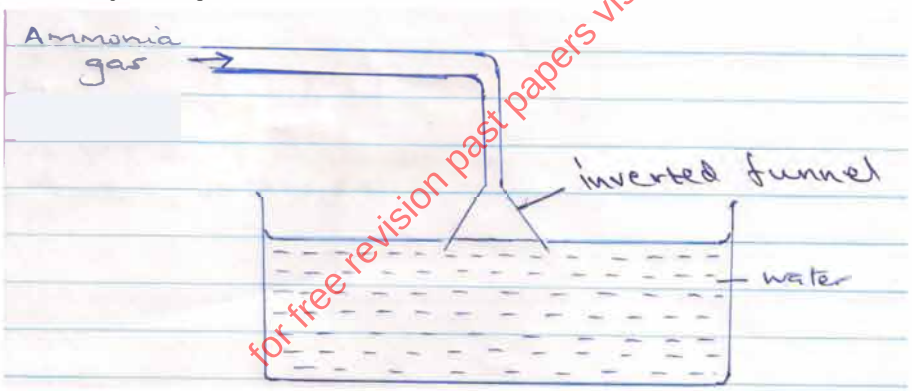
i) Identify the bonds labelled A and B. (2mks)
ii) When aluminium Chloride is dissolved in water, the resultant solution has a pH of 3. Explain. (2mks)

27. A sample of a polymer has the following structure.



a) Name the polymer above. (1mk)
b) The polymer is found to have a molecular mass of 5050g. Determine the number of monomers in the polymer. (H=I, Cl=35.5, C=12) (2mks)

28. Ammonia gas was passed into water as shown below.



(a) Explain why the pH of solution is above 7. (1mk)
(b) What is the use of inverted funnel? (1mk)

NYERI CENTRAL
CHEMISTRY 233/2
FORM 4
PAPER 2

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 elements)*

A				E			H	
	C		D		G			K
B				F			J	

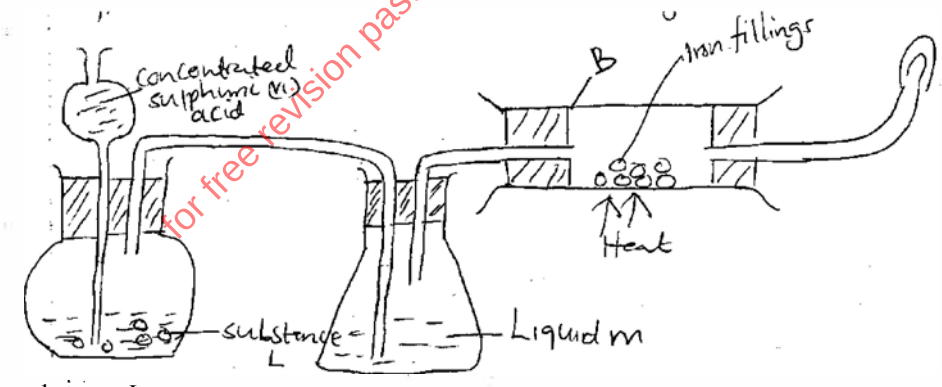
(i) Giving reasons, select the element which is
I. Most reactive non metal (2mks)
II. Most reactive metal (2mks)
(ii) How does reactivity of A compare with that of B. Explain (1mk)
(iii) Explain why the atomic radius of K is smaller than that of G. (1mk)
(iv) An element W forms ion W^{2-}, if w is in period 3, indicate the position of w on the grid. (1mk)
v) Write the formula of the compound formed when C reacts with G. (1mk)

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

Substance	M.P(^{0}C)	B.P(^{0}C)	Electrical conductivity		Solubility in water
		In solid state	In molten state	In molten state	
P	714	Does not conduct	Conducts	Conducts	Very Soluble
Q	-95	Does not conduct	Conducts	Conducts	Insoluble
R	1083	Conducts	Conducts	Conducts	Insoluble
S	-101	Does not conduct	Does not Conducts	Does not conduct	Very soluble
U	-23	77	Does not conduct	Does not conduct	Soluble
V	-219	-183	Does not Conduct	Does not Conduct	Insoluble
W	1560	2600	Does not Conduct	Does not Conduct	Insoluble

(i) Name two substances which are gaseous at room temperature. (1mk)
(ii) Select the substance that could be dissolved in water and be separated from the solution by Fractional distillation. (1mk)
(iii) Which substance could be an electrolyte? (1mk)
(iv) Element U has low M.P and B.P whereas W has high M.P and B.P. Explain .(2mks)

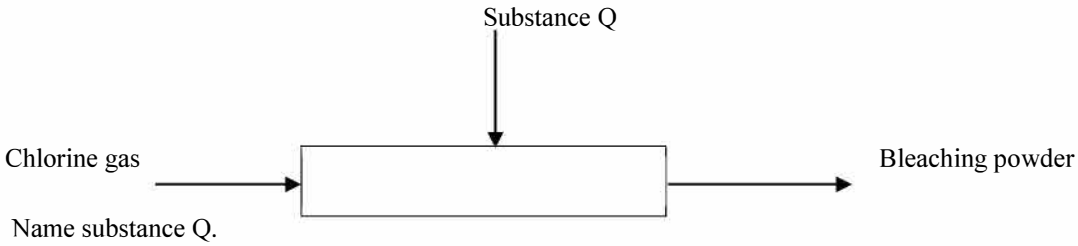
2. The set-up below was used to prepare dry hydrogen chloride gas and investigate its effect on heated Iron fillings.



a) (i) Name substance L. (1mk)
(ii) Name liquid M. (1mk)
(iii) What will be observed in tube B (1mk)
(iv) Write an equation for the reaction that occurs in tube B. (1mk)

b) Explain the following observations:
(i) A while precipitate is formed when hydrogen chloride is passed through aqueous silver nitrate. (1mk)
(ii) Hydrogen chloride gas fumes in ammonia gas. (1mk)
(iii) Hydrogen Chloride gas when dissolved in water forms hydrochloric acid. State 2 uses of hydrochloric acid. (2mks)

c) The diagram below is a representation of an industrial process for the manufacturer of a bleaching powder.



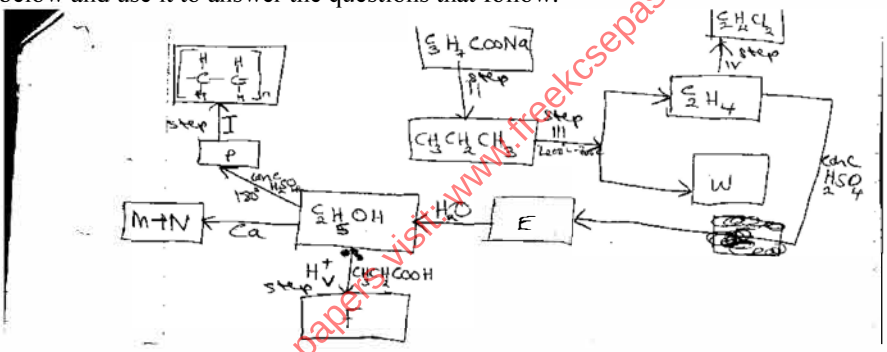
(i) Name substance Q. (1mk)
(ii) Why does the bleaching powder smell chlorine when exposed to air. (1mk)
(iii) State two uses of the bleaching powder. (2mks)

3. A piece of Marble clip (calcium Carbonate) is put in a beaker containing excess of dilute hydrochloric acid which is placed on a reading balance. The mass of the beaker and the contents is recorded every two minutes as shown in the table.

Time (min)	0	2	4	6	8	10	12
Mass (g)	126.4	126.3	126.2	126.10	126.0	126.0	126.0

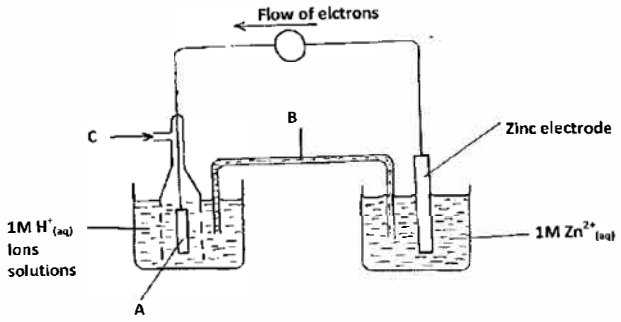
(a) Why is there a continuous loss of mass of the reaction mixture? (1mk)
(b) Write an equation for the reaction taking place. (1mk)
(c) State two different ways by which the reaction could have been made more rapid. (2mks)
d) Why does the mass remains constant after 8 minutes. (1mk)
e) State the observation that would be made if a few drops of silver nitrate solution was added to $1cm^3$ of the resulting solution followed by Ammonia solution. (2mks)
f) State one environmental effects that excess carbon (IV) Oxide in the air causes. (1mk)
g) State two uses of Carbon (IV) Oxide. (2mks)

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



a) Write the name of the processes shown: I,IV,III
b) Write the equation leading to the formation of M and N. (1mk)
c) State the type of reaction in step V (1mk)
d) Write down the name of compound E. (1mk)
e) Give the name and structural formula of compound F. (2mks)
f) Write the equation leaching to the formation of compound F. (1mk)
g) Name Compound
(i) W (1mk)
(ii) P (1mk)

5. The diagram below shows a set-up used to determine the standard electrode potential (E^0) of zinc



(i) I. Label parts A and B. (2 marks)
II Identify substance C. (1mk)

(ii) Write the equations of the reactions that take place at the electrodes. (2mks)
Anode:
Cathode

b) Study the standard electrode potentials given below and answer the questions that follow.
The letters do not represent the actual symbols of the elements.

Half reactions	Electrode potential E^{θ} V
$P^{+}_{(aq)} + e^{-} \rightleftharpoons P_{(s)}$	-2.92
$R^{3+}_{(aq)} + 3e^{-} \rightleftharpoons R_{(s)}$	-1.35
$S^{2+}_{(aq)} + 2e^{-} \rightleftharpoons S_{(s)}$	-0.76
$T^{2+}_{(aq)} + 2e^{-} \rightleftharpoons T_{(s)}$	+0.34
$V^{+}_{(aq)} + e^{-} \rightleftharpoons V_{(s)}$	+0.80
$W_{2(g)} + 2e \rightleftharpoons 2W^{-}_{(aq)}$	+1.36

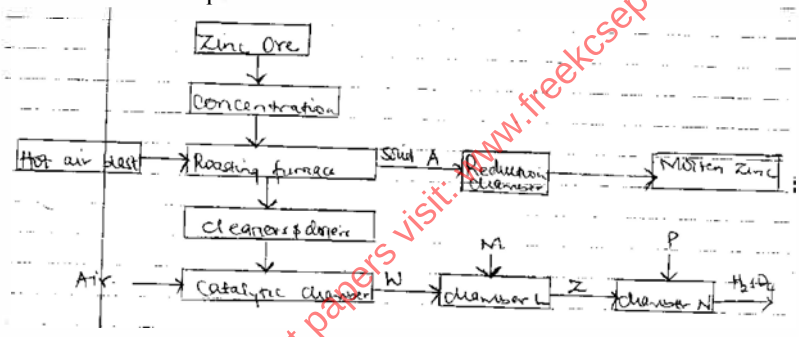
(i) Which reducing agent.
I Strongest reducing agent. Explain (1mk)
II Strongest oxidizing agent. Explain (1mk)

c) During electrolysis of an aqueous solution of a slat of metal Q, a current of 2.0A was passed for 32 minutes and 10 seconds. The mass of metal Q deposited was 2.24g. *(1 Faraday=96500c, RAM of Q=112)*

(i) Calculate the quantity of electricity passed. (2mks)

(ii) Calculate the charge on the ion of metal Q. (2mks)

6. The flow chart below represents the extraction of zinc from its ore and by-product used in the manufacture of sulphuric (VI) acid. Study it and use it to answer the questions that follow.



(a) Name:-

(i) The suitable zinc ore used. (1mk)

(ii) The main impurity in the ore. (1mk)

b) Describe how zinc ore is concentrated. (2mks)

c) Write an equation for the reaction taking place in the roasting furnace. (1mk)

d) Describe what happens in the reduction chamber. (2mks)

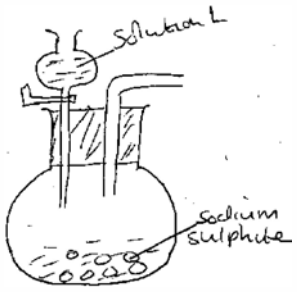
e) Identify substances W,M (2marks)

f) Write the equation for the reaction that occurs in chamber N. (1mk)

g) Explain why sulphur (VI) Oxide is not dissolved directly in water. (1mk)

h) Explain the danger caused by this process to the environment. (2mks)

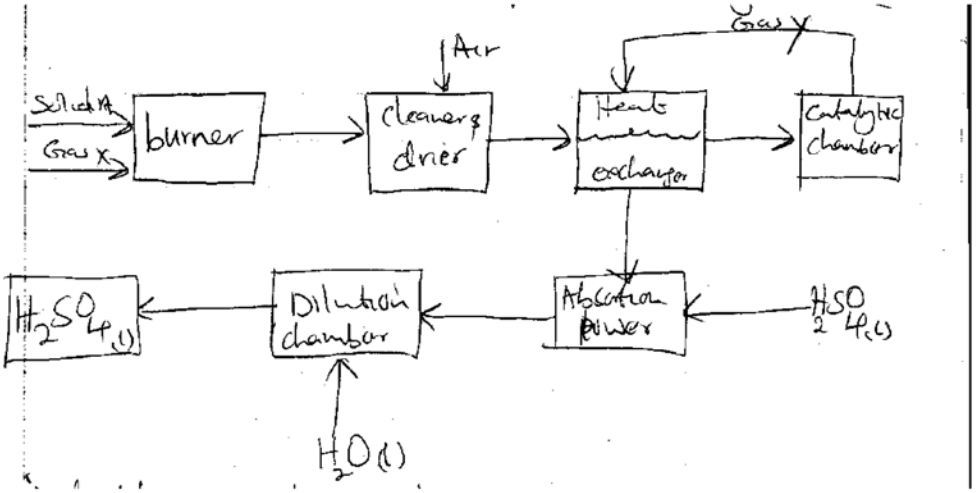
7. A student assembled apparatus as shown below to prepare Sulphur (IV) oxide gas in the laboratory. Study it and answer the questions that follow.



(i) Complete the diagram to show how dry Sulphur (IV) Oxide can be collected. (2mks)

(ii) By use of a chemical equation, explain why fused calcium oxide is not a suitable drying agent for Sulphur (IV) Oxide gas. (2mks)

b) Sulphuric (VI) acid is an important industrial reagent. It is manufactured by the contact process represented by the flow diagram below.



(i) Identify substance:
Solid A (1mk)
Gas X (1mk)
Gas Y (1mk)

(ii) Write balanced chemical equations for the reactions taking place in catalytic chamber. (1mk)

(iii) State two uses of sulphuric (VI) acid. (1mk)

NYERI CENTRAL
CHEMISTRY PRACTICAL
FORM 4
PAPER 233/3
TIME: 2 HOURS
CONFIDENTIAL
SUB-COUNTY EXAM

In addition to the apparatus found in chemistry laboratory, each student will require the following:

1. About $100cm^3$ of solution A.
2. About $100cm^3$ of solution B.
3. About $100cm^3$ of solution C.
4. Burette
5. Pipette
6. Pipette filler
7. Thermometer $0\text{-}110^0C$.
8. Two conical flasks
9. Volumetric flasks.
10. Filter funnel
11. Distilled water $500cm^3$
12. 7 labels
13. 6 dry test tubes
14. 10ml measuring cylinder
15. 2 boiling tubes
16. 1 metallic spatula
17. 0.5g solid x
18. 0.5g $NaHCO^3$.
19. About $4cm^3$ absolute ethanol supplied in a stoppered container.
20. Solid P
21. 2 Litmus papers (1 blue and 1 red)

Access to

1. 2m ammonia solution supplied with a dropper.
2. 0.5m potassium iodide supplied with a dropper.
3. 1m Nitric (V) acid supplied with a dropper.
4. Acidified potassium manganate (VII) supplied with a dropper.
5. 0.1m lead(II) nitrate supplied with a dropper
6. Source of heat
7. 2m H2SO4 supplied with a dropper.
8. Methyl orange indicator.

Note

- Solution A is prepared by dissolving $50cm^3$ of $1.84g/cm^3$ (98%) concentrated sulphuric (VI) acid in about $600cm^3$ distilled water and diluting to one litre of solution. (0.92M H_2SO_4).
- Solution B is prepared by dissolving 8.0g per litre of sodium carbonate in about $500cm^3$ distilled water and diluting to one litre of solution (0.075M Na_2CO_3).
- Solution C is prepared by dissolving 60g of sodium hydroxide pellets in about $700cm^3$ of distilled water and diluting to one litre of solution (1.5mNaOH).
- Solid P is a mixture of $Pb(NO_3)_2$ and Na_2CO_3 in a ratio of 2:1 respectively by mass.
- Solid X maleic acid (0.5g).

NYERI CENTRAL
CHEMISTRY 233/3
FORM 4
(PRACTICAL)
TIME: 2 ¼ HOURS

You are provided with;
- Aqueous Sulphuric (VI) acid labelled solution A
- Solution B containing 8.0g per litre of anhydrous Sodium Carbonate.
- An aqueous solution of substance C labelled solution C.

You are required to determine the:
- Concentration of solution A.
- Enthalpy of reaction between sulphuric (VI) acid and substance C.

A Procedure

Using a pipette and a pipette filler, place 25.0cm^3 of solution A into a 250ml volumetric flask.
Add distilled water to make 250 cm^3 of solution.
Label this solution D.
Place solution D in a burette. Clean the pipette and use it to place 25.0cm3 of solution B into a conical flask. Add 2 drops of methyl orange indicator provided and titrate with solution D.
Record your results in table 1. Repeat the titration two more times and complete the table.

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

Calculate the: (4mks)

(i) Average volume f solution D used. (1mk)

(ii) Concentration of anhydrous Sodium Carbonate in solution B (Na=23.0, O=16.0, C=12.0). (1mk)

(iii) Concentration of Sulphuric (VI) acid in solution D. (1mk)

(iv) Concentration of sulphuric (VI) acid in solution A. (1mk)

b) Label six test tubes as 1,2,3,4,5 and 6. Empty the burette and fill it with solution A from the burette place 2cm^3 of solution A into test-tube number 1. From the same burette, place 4cm^3 of solution A in test-tube number 2. Repeat the process for test-tube nubmers3,4,5 and 6 as shown in table 2. Clean the burette and fill it with solution C. From the burette, place 14cm^3 of solution C into a boiling tube. Measure the initial temperature of solution C to the nearest 0.50C and record it in table 2. Add the contents of test-tube number 1 to the boiling tube containing solution C.
Stir the mixture with the thermometer. Note and record the highest temperature reached in table 2. Repeat the process with the other volumes of solution C given in table 2 and complete the table.(6mks)

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 (^{0}C)						
Highest temperature of mixture (^{0}C)						
Change in temperature, ΔT(^{0}C)						

(i) On the grid provided, draw a graph of ΔT(vertical axis) against volume of solution A used. (3mks)

(ii) From the graph determine:
I the maximum change in temperature. (1mk)
II the volume of solution A required to give the maximum change in temperature. (1mk)

(iii) Calculate the:
I number of moles of sulphuric (VI) acid required to give the maximum change in temperature. (1mk)
II molar enthalpy of reaction between sulphuric (VI) acid and substance C in kilojoules per mole of sulphuric (VI) acid.
Assume the specific heat capacity of solution is .2Jg^{-1}K^{-1} and density of solution is 1.0g cm^{-3}. (2mks)

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

(i) Transfer a half spatula end full of solid P into a clean-dry test tube.
Heat the solid strongly and test any gas produced using litmus papers.

Observations	Inferences
(1mk)	(1mk)

(ii) Place the remaining solid P into a boiling tube. Add about 8cm^3 of distilled water and shake thoroughly. Filter the mixture into another boiling tube. Retain the filtrate for use in (iii) below.

Place the entire residue into a boiling tube. Add all Nitric (V) acid provided in a test tube labeled Z. Divide the resulting mixture into two portions.

(I) To the first portion in test tube add ammonia solution drop wise to excess.

Observations	Inferences
(1mk)	(1mk)

(II) To the second portion in a test tube add two drops of potassium iodide.

Observations	Inferences
(1mk)	(1mk)

(iii) I To $2cm^3$ of the filtrate, add three drops of dilute Nitric (V) acid.

Observations	Inferences
(1mk)	(1mk)

II To $2cm^3$ of the filtrate add 3 drops of Lead (II) Nitrate solution.

Observations	Inferences
(1mk)	(1mk)

3. You are provided with solid X. Carry out the tests below and record your observations and inferences in the table below.

(i) Place one spatula endful of solid x in a test tube and add about 10cm3 of distilled water. Shake well and use for test (i) below.

Observations	Inferences
(1mk)	(1mk)

(ii) To $2cm^3$ of the solution in a test tube, add one spatula endful of sedum hydrogen carbonate.

Observations	Inferences
(1mk)	(1mk)

iii) To $2cm^3$ of solution, add three drops of acidified potassium manganite (VII) solution.

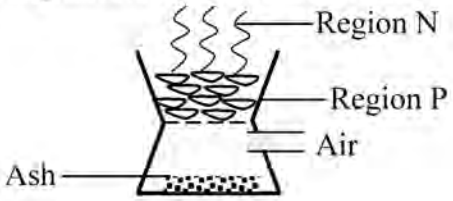
Observations	Inferences
(1mk)	(1mk)

iv) Place about $4cm^3$ of ethanol in a test tube and add two drops of 2M sulphuric VI acid then add a spatula end ful of solid X. Warm the mixture carefully. Shake well and pour the mixture into $20cm^3$ of water in a beaker.

Observations	Inferences
(1mk)	(1mk)

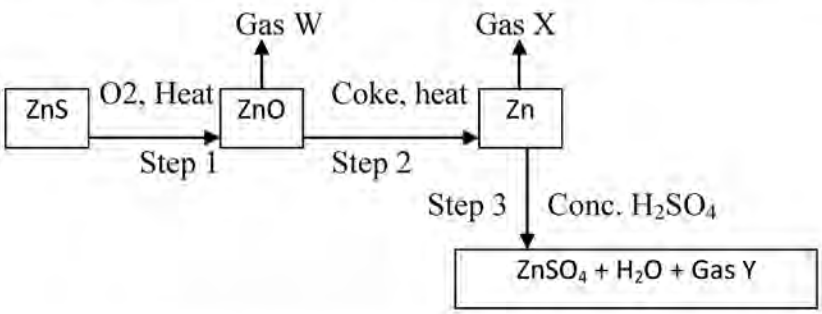
MERU
233/1
CHEMISTRY
PAPER 1
(THEORY)
JULY/AUGUST 2017
TIME: 2 HOURS.

1. (a) When a candle is burnt completely, the total mass of product was found to be greater than the original mass of the candle. Explain. (2 mks)
   (b) What type of change has the candle wax undergone? (1 mk)
2. (a) Identify the ions responsible for the hardness of water. (2 mks)
   (b) Name a method that can be used to remove permanent hardness from water. (1 mk)
3. Explain why there is a general increase in the first ionization energies of the elements in period 3 of the periodic table from left to right. (2 mks)
4. Hydrogen gas is the lightest gas known but has not lived to it expectation to be used in observation balloons. Explain (2 mks)
5. M grammes of a radioactive isotope decayed to 5 grammes in 100 days. The half-life of the isotope is 25 days.
   (a) What is meant by half-life? (1 mk)
   (b) Calculate the initial mass M of the isotope (2 mks)
6. During electrolysis, dilute sulphuric (VI) acid, the volume of hydrogen gas collected is twice the volume of oxygen gas. Use half equations to justify the above statement. (2 mks)
7. The diagram below shows a charcoal burner when in use. Study it and answer the questions that follow.



   (a) Write an equation for the reaction taking place at region P. (1 mk)
   (b) State and explain the observation made at region N. (2 mks)
8. Both chlorine and iodine are halogens.
   (a) To which group in the periodic table do they belong. (1 mk)
   (b) In terms of structure and bonding explain why the boiling point of chlorine is lower than that of iodine. (2 mks)
9. In an experiment to investigate the effect of solvent on substances a student set the shown experiment.

   (a) Compare the rate of fizzing in the two tubes. (1 mk)
   (b) Explain the observations in (a) above. (2 mks)
10. Study the flow chart below and use it to answer the questions that follow.



   (a) Write an equation for the reaction taking place in step 1 (1 mk)

(b) Identify gas X (1 mk)
(c) Name one use of zinc. (1 mk)

11. (a) Compare rusting and combustion. (2 mks)
(b) Give one advantage of rusting and combustion. (1 mk)

12. In an experiment, on rates of reaction, potassium carbonate was reacted with dilute sulphuric (VI) acid.
(a) What would be the effect of an increase in the concentration of the acid on the rate of reaction? (1 mk)
(b) Explain why the rate of reaction is found to increase with temperature. (2 mks)

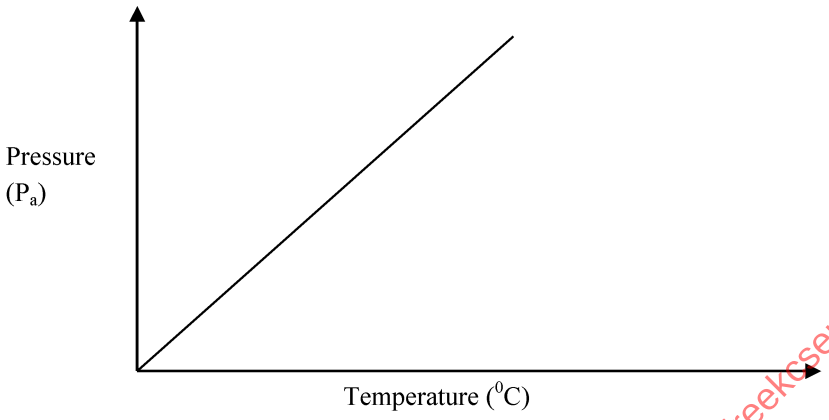
13. The table below shows the first ionization energies of elements D and E.

Element	Ionisation energy kJ/mol
D	494
E	736

(a) What do these values suggest about the reactivity of D compared to that of E. Explain. (2 mks)

14. Starting with 50cm3 of 2M sodium hydroxide, describe how a sample of pure sodium sulphate crystals can be prepared. (3 mks)

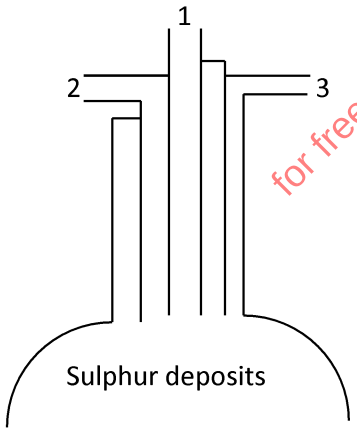
15. The graph shown is of the relationship between pressure and the temperature of a fixed volume of a gas.



(a) State the relationship between pressure and temperature that can be deduced from the graph. (1 mk)
(b) Using kinetic theory, explain the relationship shown in the graph. (2 mks)

16. When 8.53 of sodium nitrate were heated, the mass of oxygen produced was 0.83g. Given the equation of the reaction as
$2NaNO_{3(s)} \rightarrow 2NaNO_2 + O_{2(g)}$
Calculate the percentage of sodium nitrate that was converted to sodium nitrite. (3 mks)
(Na = 23, O = 16, N = 14)

17. Diagramatic representation of the Frasch process used to extract sulphur is shown below.



Identify the substances that passes through pipes; 1,2 AND 3

18. Nitrogen is isolated from the air by removing carbon (IV) oxide and oxygen.
(a) Explain how each is removed. (2 mks)
(i) Carbon (IV) oxide……
(ii) Oxygen……
(b) Give the confirmatory test for nitrogen gas. (1 mk)

19. (a) When excess chlorine gas was bubbled into hot concentrated sodium hydroxide, the following reaction occurs.
$3Cl_2 + 6NaOH_{(aq)} \rightarrow NaClO_{3(aq)} + 5NaCl_{(aq)} + 3\ H_20_{(l)}$
In which product did chlorine undergo oxidation. Explain (2 mks)
(b) Give one use of chlorine. (1 mk)

20. Copper (II) sulphate reacts with barium chloride according to the equation.
$CuSO_{4(aq)} + BaCl_{2(aq)} \rightarrow CuCl_{2(aq)} + BaSO_{4(s)}$ $\Delta H = -17.1kJ/mole$
Calculate the temperature change when 900cm3 of 1M copper (II) sulphate were added to 600cm^3 of 1M Barium chloride. (Assume heat capacity is 4.2Jg^{-1}k^{-1} and density 1g/cm^3 (3 mks)

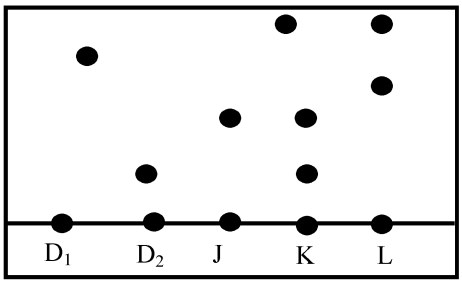
21. Four metals A, B, C and D were each reacted with cold water, hot water and steam and the observations recorded.

Metal	Cold water	Hot water	Steam
A	Reacts slowly	Reacts first	Reacts very first
B	No reaction	No reaction	No reaction
C	Fast	Reacts very first	Reacts explosively
D	No reaction	Reacts slowly	Reacts fast

Arrange these metals in order of reactivity (3 mks)

22. The structure of a detergent can be represented
$R - COO^-Na^+$
(a) What type of detergent is represented by the formula (1 mk)
(b) Explain how the detergent improves the cleaning property of water (2 mks)

23. Samples of urine from three athletes J, K and L were spotted onto a chromatography paper alongside two from illegal drugs D_1 and D_2 shown.



(a) Identify the athlete who had taken an illegal drug (1 mk)
(b) On the paper mark the solvent front. (1 mk)
(c) Which drug is most soluble. (1 mk)

24. (a) What name is given to the compound that acts as an acid and also like a base. (1 mk)

25. The table below gives the solubilities of substances R, S and T at different temperatures.

Substance	Solubility at			
	0^0C	20^0C	40^0C	60^0C
R	0.334	0.16	0.074	0.0058
S	27.60	34.0	40.0	45.5
T	35.70	36.0	40.0	37.3

(a) What is solubility (1 mk)
(b) A saturated solution of S was cooled from 60^0C to 20^0C. State and explain what happens. (2 mks)

26. Describe how in the laboratory you can obtain the pH of solid sodium hydroxide. (3 mks)

27. The figure below shows the interconversion of the 3 states of matter.

(a) Give names of the processes V and W (2 mks)
(b) Name a substance that can undergo process X when left in an open container. (1 mk)

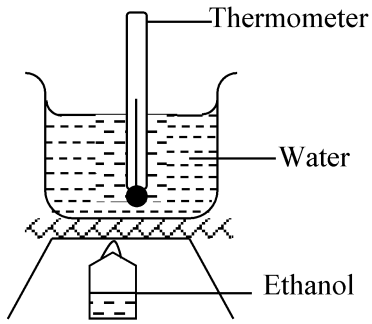
28. Biogas is a mixture of mainly carbon (IV) oxide and methane.
(a) Give a reason why biogas can be used as a fuel. (1 mk)
(b) Other than fractional distillation, describe a method that can be used to determine the percentage of methane in biogas (2 mks)

29. Carbon (IV) oxide, methane, nitrogen (I) oxide and trichloroflouromethane are green – house gases. State one effect of an increased level of these to the environment. (1 mk)

MERU
233/2
CHEMISTRY
PAPER 2
(THEORY)
JULY/AUGUST 2017
TIME: 2 HOURS.

1. (a) Name two factors that should be considered when choosing fuel for cooking. (2 mks)

(b) The diagram below shows a set-up that was used to determine the molar heat of combustion of ethanol.

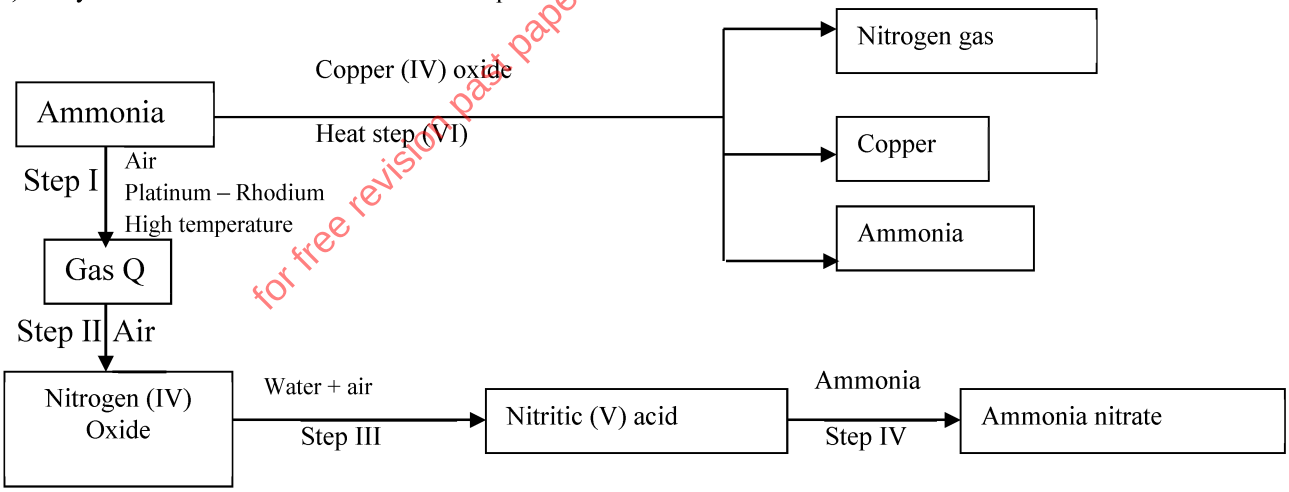


During the experiment the data given below was recorded.
Volume of water = $450cm^3$
Initial temperature = 25^0C
Final temperature of water = 46.5^0C
Mass of ethanol + lamp before burning = 125.5g
Mass of ethanol + lamp after burning = 124.0g
Determine

(i) the amount of heat energy evolved (Density of water = $1g/cm^3$, specific heat capacity = 4.2kJ) (3 mks)
(ii) the molar heat of combustion of ethanol (C = 12.0, H = 1.0, O = 16.0) (2 mks)
(iii) Write the thermochemical equation for the reaction. (1 mk)
(iv) The value obtained in (ii) above is lower than the theoretical value. State two sources of error in the experiment. (2 mks)

(c) Identify two environmental effects of burning fuel. (2 mks)

2. (a) Study the flow chart below and answer the questions below.



(i) Identify gas Q. (1 mk)
(ii) What property of ammonia is applied at step (VI)? (1 mk)
(iii) Write an equation for the reaction occurring at step (VI) (1 mk)
(iv) Give one use of ammonium nitrate. (1 mk)

(b) The table below shows the observations made when aqueous ammonia was added to solutions containing cations A, B and C until in excess.

Cation	Addition of aqueous ammonia	
	Little	Excess
A^{3+}	White precipitate	Insoluble
B^{2+}	No precipitate	No precipitate
C^{2+}	White precipitate	Soluble

(i) Which cation is likely to be Zn2+ (1 mk)

(ii) Write the ionic equation for the reaction between cation A3+ and aqueous ammonia. (1 mk)

(c) Explain why ammonia gas is basic in nature. (2 mks)

3. (a) (i) Describe how lead (II) nitrate is prepared in the laboratory starting with lead (II) oxide. (3 mks)

(ii) Write an equation for the reaction that takes place. (1 mk)

(b) When lead (II) nitrate is heated strongly, the crystals crackle and split because of the gas accumulating inside.

(i) State two other observations made. (2 mks)

(ii) Write an equation for the reaction that takes place when lead (II) nitrate is heated strongly. (1 mk)

(c) State and explain what is observed when sodium hydroxide solution is added to a solution of lead nitrate until the alkali is in excess. (3 mks)

(d) Lead (II) ions reacts with iodide ions as shown by the equation.

$Pb^{2+}_{(aq)} + 2I^{-}_{(aq)} \rightarrow PbI_{2(s)}$

$300cm^3$ of 0.1M solution of iodide ions was added to a solution containing lead (II) ions. Calculate the mass of lead (II) iodide formed Pb = 207, I = 127) (3 mks)

(e) Lead metal is extracted by the roasting of Galena in air as shown.

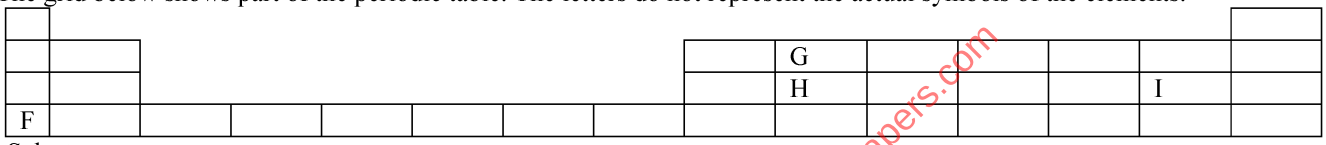
$PbS_{(s)} + O_{2(g)} \rightarrow PbO_{(s)} + SO_{2(g)}$

(i) State how lead is obtained from the lead oxide (PbO) (1 mk)

(ii) Give one use of lead nitrate metal. (1 mk)

(iii) Give one environmental effect of the extraction of lead. (1 mk)

4. (a) The grid below shows part of the periodic table. The letters do not represent the actual symbols of the elements.



(i) Select

I. Element which has the largest atomic radius. (1 mk)

II. Most reactive non-metal. (1 mk)

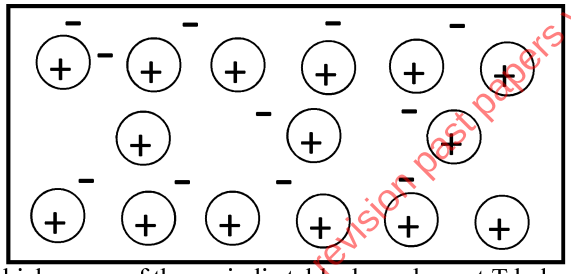
(ii) Show on the grid the position of the element L which forms L^{2+} ions with electronic configuration 2, 8,8 (1 mk)

(iii) State and explain the difference in the atomic radii of elements H and I (2 mks)

(iv) Using crosses (X) and dots (•), show how bonding occurs between F and I. (2 mks)

(v) Both elements G and H reacts with oxygen and form their oxides. In terms of structure and bonding state and explain the difference between the two oxides. (3 mks)

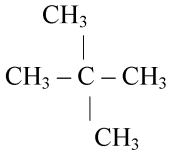
(b) The diagram below is a section of model of the structure of element T.



In which group of the periodic table does element T below. Give reason. (2 mks)

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

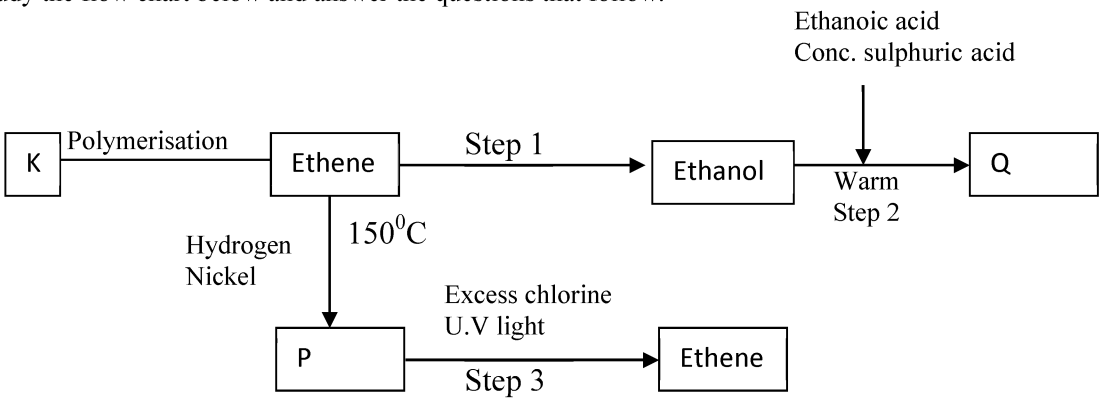
(i)



(ii) $CH_3C \equiv CCH_2CH_3$

(b) Describe a chemical test that can be used in order to distinguish between the two compounds in (a) above. (2 mks)

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



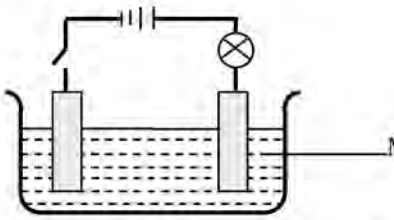
(i) Name the compounds P and Q (2 mks)
(ii) Draw the structural formula of compound K showing two repeat units. (1 mk)
(iii) Give the reagent and condition used in step 1. (2 mks)
(iv) State the types of reaction that takes place in:-
I. Step 2
II. Step 3
(d) The molecular formula of compound R is $C_2H_2Cl_4$. Draw two structural formulae of compound R. (2 mks)
(e) Give 2 uses of ethanol. (2 mks)

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

$A^{2+}_{(aq)} + 2e^- \rightarrow A_{(s)}$ -2.90V
$B^{3+}_{(aq)} + 3e^- \rightarrow B_{(s)}$ -2.38V
$C^{+}_{(aq)} + e^- \rightarrow C_{(s)}$ - 0.00V
$D^{2+}_{(aq)} + 2e^- \rightarrow D_{(s)}$ +0.34V
$\frac{1}{2}F_{(aq)} + e^- \rightarrow F^-_{(aq)}$

(i) What is E value for the strongest reducing agent? (1 mk)
(ii) Draw a well-labelled diagram of the electro-chemical cell that would be obtained when half cells of elements "B" and "D" are connected then calculate its E^{θ} cells (4 mks)
(iii) Explain whether the following reaction can take place (1 mk)
$2F^-_{(aq)} + 2C+_{(aq)} \rightarrow F_{2(aq)} + 2C_{(s)}$

(b) The set-up below was used to electrolyze molten lead (II) iodide.



(i) On the diagram label cathode and anode and also show the direction of electrons flow. (3 mks)
(ii) State and explain the observations made at the anode during the electrolysis. (2 mks)
(iii) A current of 0.5A was passed for two hours. Calculate the mass of lead that was deposited (Pb = 207, Harady = 96500C) (3 mks)
(c) Explain the changes that occur in a solution and at the electrodes in the electrolysis of copper (II) sulphate. (2 mks)

MERU
233/3
CHEMISTRY
PAPER 3

1. You are provided with
- ✓ Solution A which is 0.2M Sodium Hydroxide
- ✓ Solution B which is dilute Sulphuric (VI) Acid
- ✓ Solution C which is a metal carbonate M_2CO_3 which is made by dissolving 2.65g of the salt in 250cm^3 distilled water.

You are required to standardize sulphuric acid then determine the R.A.M of metal M.

I. Procedure

(i) Fill the burette with dilute sulphuric acid, solution B.
(ii) Pipette 25cm^3 of sodium hydroxide, solution A into a flask.
(iii) Add 3 drops of phenolphthalein indicator then titrate it with solution B.
(iv) Record your results in the table below.
(v) Repeat the titration twice to obtain consistent results.

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

(a) Determine the average volume of acid B used. (1 mk)
(b) Calculate the moles of NaOH used in the reaction. (2 mks)
(c) Calculate the moles of H2SO4 used in the titration. (1 mk)
(d) Calculate the morality of H2SO4. (2 mks)

Procedure II

i. Fill a clean burette with solution B.
ii. Pipette 25cm3 solution C and add 3 drops of phenolphthalein then titrate it with solution B from the burette.
iii. Record your result in the table given.

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

(e) Calculate the average volume of B used. (1 mk)
(f) Write the equation for the reaction between the acid and metal carbonate . (1 mk)
(g) Calculate the number of moles of acid solution B. (2 mks)
(h) Calculate the moles of Mcarbonate that reacted with H2SO4. (2 mks)
(i) Calculate the morality of the metal carbonate. (2 mks)
(j) Find the R.A.M of metal M (C = 12, O = 16) (4 mks)

2. You are provided with solid R.

Carry out the tests below and write your observation and inferences in the spaces provided.

(a) Place about half of the solid in a clean dry test tube. Heat it strongly. Test any gas produced using lime water on a glass rod and litmus paper.

Observations	Inferences
(1 mk)	(1 mk)

(b) (i) Place the rest of solid R in a boiling tube. Add about 10cm^3 distilled water, shake well then filter. (Reserve the residue)

Observations	Inferences
(1 mk)	(1 mk)

(ii) Use 2cm3 portion of the titrate and add aqueous sodium hydroxide until in excess.

Observations	Inferences
(1 mk)	(1 mk)

(iii) To 2cm^3 of the filtrate add 3 drops of barium chloride followed by 2cm^3 of 2MHNO_3.

Observations	Inferences
(1 mk)	(1 mk)

(c) (i) Put the residue in a boiling tube, add 8cm3 of 2M nitric acid and shake well.

Observations	Inferences
(1 mk)	(1 mk)

(ii) To 2cm3 portion of the solution add aqueous ammonium hydroxide dropwise until in excess.

Observations 1 mark	Inferences 1 mark

(iii) To another 2cm3 portion add all solid V provided and shake.

Observations	Inferences