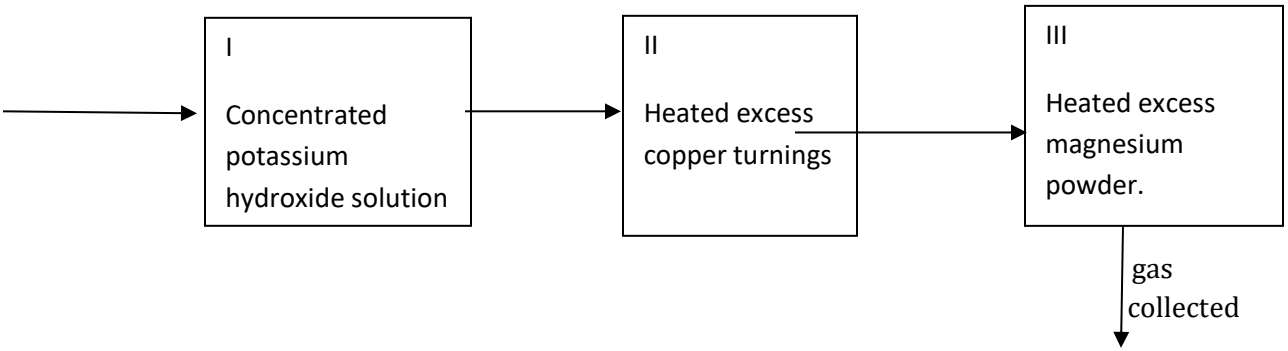
# KCSE CHEMISTRY 2022 LATEST PREDICTION EXAMS

**KCSE PREDICTION 1 2022**
**PAPER 1**

1. Air passed through several reagents as shown below

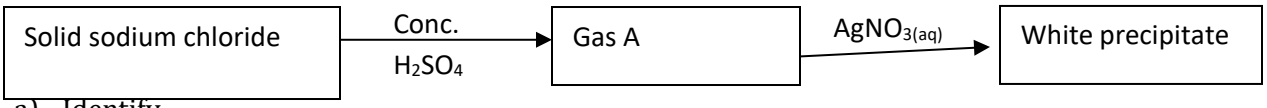



   a) What is the role of conc potassium hydroxide? (1mk)
   b) Write an equation that takes place in step III with Magnesium powder. (1mk)
   c) Name one gas that was collected from the process. (1mk)

2. Name two examples of physical changes. (2mks)
3. A gas at $27^0$C and 750mmHg pressure was found to occupy 360cm$^3$. Calculate the temperature at which the same mass of gas will occupy twice the volume at a pressure of 1000mmHg. (2mks)
4. a) In the equation below, identify the reagent that acts as a base. (1mk)

   $H_2O_{2(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + HO_2^-{}_{(aq)}$

   b) Give a reason for your answer in (a) above (1mk)
5. a) When left in the open air, anhydrous calcium chloride increases in mass. Explain (1mk)
   b) What name is given to the process in a above? (1mk)
6. Study the chart below and answer the questions that follow.




   a) Identify
      i) Gas A (1mk)
      ii) White precipitate. (1mk)
   b) Write an ionic equation for the formation of white precipitate. (1mk)

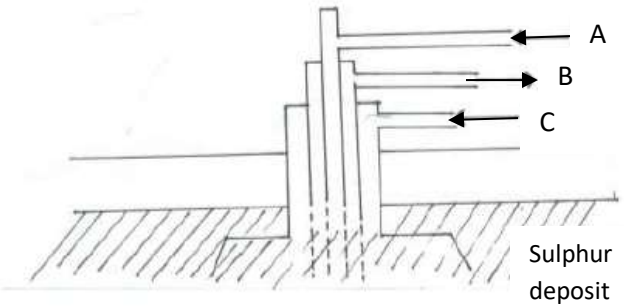
7. A student was supplied with a colourless liquid suspected to be water. Describe a chemical test that would be carried out to show that the liquid was water. (1mk)
8. In an experiment to determine solubility of sodium chloride, 13.2g of saturated sodium chloride solution at $18^0$C was evaporated to dryness. 3.6g of the s alt was left after complete evaporation of water.Determine the solubility of sodium chloride at $18^0$C. (3mks)

9. a) State Graham's law of diffusion. (1mk)

   c) A volume of 120cm$^3$ of nitrogen gas diffused through a membrane in 40 seconds, how long will 240cm$^3$ of carbon (IV) Oxide take to diffuse through the membrane under the same conditions. (2mks)

10. A student was carrying out an experiment using Barium sulphate. The salt accidentally got mixed up with sodium sulphate. Describe how the student would get a dry sample of Barium sulphate. (3mks)

11. The diagram below represents the Frasch process. Study it and answer the questions that follow




   a) Name;
   A ( ½mk)
   B ( ½mk)
   C ( ½mk)

   b) Why is C pumped to the sulphurdeposit. ( ½ mk)

   c) Which property of sulphur enables it to be extracted by the method above.(1mk)

12. An element A has two isotopes $^{50}A$ and $^{52}A$. The relative atomic mass of A is 51.5

   i) Determine the percentage abundance of each isotope. (2mks)

   ii) Define the term isotopy (1mk)

13. Study the table below and answer the questions that follow. The letters are not the actual chemical symbols of the elements.

| Element | Atomic number | Atomic mass |
|---|---|---|
| W | 20 | 40 |
| X | 9 | 19 |
| Y | 10 | 20 |
| Z | 17 | 35.5 |

   i) Identify elements that belong to the same group and give a reason. (2mks)

   ii) Which element is a metal. (1mk)

14. Study the information given in the table below and answer the questions that follow

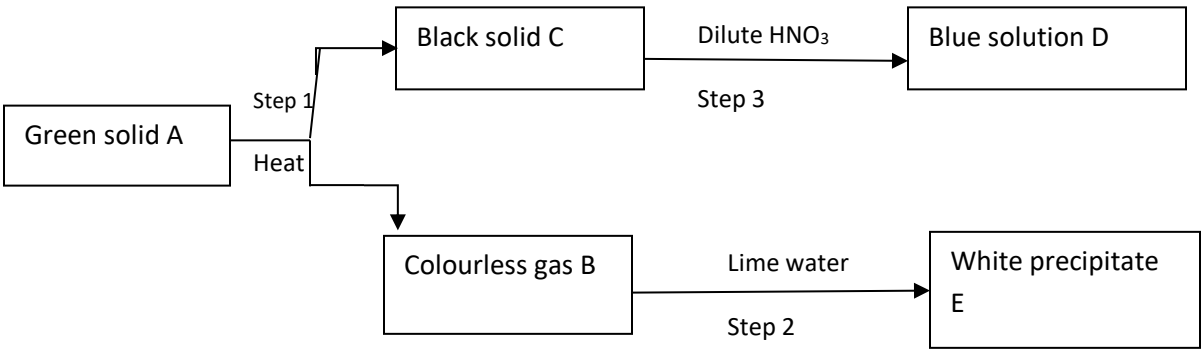
| Bond | C - H | Cl - Cl | C - Cl | H - Cl |
|---|---|---|---|---|
| Average bond enthalpy (KJmol$^{-1}$) Breaking of bond) | 414 | 244 | 326 | 431 |

   a) Calculate the enthalpy change for the reaction (3mks)

   $CH_{4(g)} + Cl_{2(g)} \xrightarrow{uv\ light} CH_3Cl_{(g)} + HCl_{(g)}$

b) Is the reaction exothermic or endothermic?
Explain your answer. (1mk)

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




a) Write the chemical formulae of the following;
i) Green solid A (1mk)
ii) White precipitate E (1mk)

b) Write a chemical equation for the reaction taking place in the following steps.
i) Step 1 ( ½ mk)
ii) Step 3 ( ½ mk)

16. Soap solution was added to the three samples of water and the amount of soap required to form lather with 1 litre of each sample of water before and after boiling was recorded as shown below.

| | I | II | III |
|---|---|---|---|
| Volume of soap before water is boiled | 30 | 5 | 12 |
| Volume of soap after boiling | 30 | 5 | 5 |

a) Explain the change in the volume of soap solution used in experiment III. (1mk)
b) Why was the volume of soap used in experiment II so low. (1mk)

17. a) State Avogadro's law (1mk)

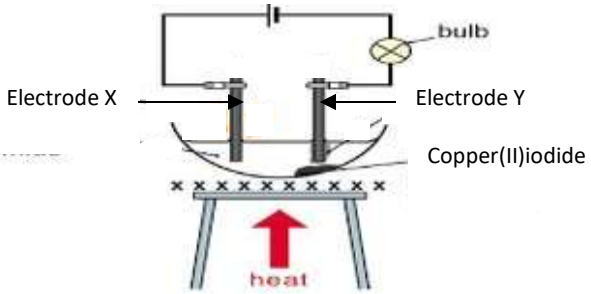
c) $100cm^3$ of hydrogen was mixed with $300cm^3$ of chlorine and the mixture allowed to react. Determine the maximum volume of hydrogen chloride gas that would form. (2mks)

18. The table below shows the tests that were carried out on solid R and the observations made

| Test | Observations |
|---|---|
| i)Solid R was heated. | Solid R turned from white to yellow. |
| ii)Dilute hydrochloric acid was added to solid R. | Colourless solution was formed. |
| iii)To the colourless solution obtained in test II excess sodium hydroxide solution was added. | A white precipitate was formed which dissolved to form a colourless solution. |

Write the formula of cation in;
a) Solid N (1mk)
b) Colourless solution formed in test III (1mk)

19. The diagram below is a set up of apparatus used during electrolysis of molten copper(II) iodide




i) List all ions present in the electrolyte. (2mks)

ii) Write half equations for reactions in electrodes;

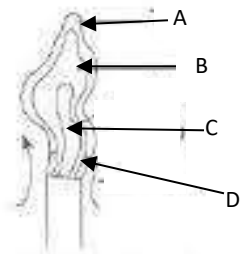
a) X (1mk)

b) Y

20. 2.4 g of magnesium were reacted with excess dilute hydrochloric acid at room temperature and pressure. Calculate the volume of hydrogen that was formed (Molar gas volume at R.T.P = $24dm^3$ Mg = 24) (3mks)
21. Write the chemical formula of sodium sulphate. (1mk)
22. Sulphuric (VI) acid is manufactured using the contact process.
    a) State the catalyst used in the process. (1mk)
    b) State the optimum conditions for the process. (1mk)
    c) Explain how environmental pollution by the process is minimized. (1mk)
23. A student had 2 g of sodium hydroxide and z grammes of sulphuric (VI) acid. Which of the compound contain more of hydrogen atoms. (3mks)
    (H =1, S = 32, O = 16, Na =23)
24. State and explain the observations made when concentrated sulphuric (VI) acid is added to glucose. (2mks)
25. Name an ion which must be present in acidic solution. (1mk)
26. Dry blue litmus paper was put into a gas jar of dry hydrogen chloride gas. State and explain the observations made. (2mks)
27. $250cm^3$ of water was added to $300cm^3$ of 2M sulphuric vi acid. determine the new concentration of the solution (2mks)
28. Liquid P and Q mix forming a solution and have different boiling points.
    i) Name a suitable method of separation that would be used to separate the two liquids. (1mk)
    ii) What property makes it possible to separate the two liquids P and Q. (1mk)
29. Describe a chemical test for chlorine. (2mks)
30. Describe how zinc sulphate crystals can be prepared. (2mks)
31. Use the information in the table to answer questions that follow. (The letters are not the actual chemical symbols of the element)

| Element | Atomic radius (nm) | Ionic radius (nm) |
|---|---|---|
| M | 0.158 | 0.097 |
| N | 0.202 | 0.132 |
| L | 0.133 | 0.061 |

    a) Do these elements belong to a metallic or a non – metallic group? Give a reason. (2mks)
    b) Which element is the most reactive? Explain. (1mk)
32. Study the diagram below and answer the questions that follow

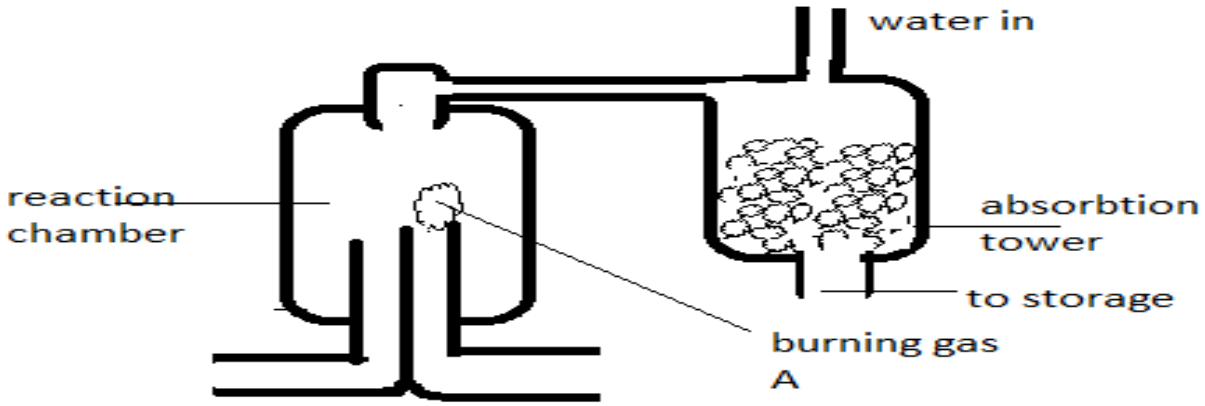



a) Name the flame above (1mk)

b) Name parts A,B,C and D of the flame (2mks)

**PAPER TWO**

1. The above diagram shows a set up that can be used for industrial manufacture of hydrochloric acid. Study it and answer the questions that follow.




i. Identify Burning gas A (1mk)

ii. Write a balanced equation for the reaction that takes place in the reaction chamber (1mk)

ii. Identify two reagents that are used in the laboratory manufacture of hydrochloric acid (1mk)

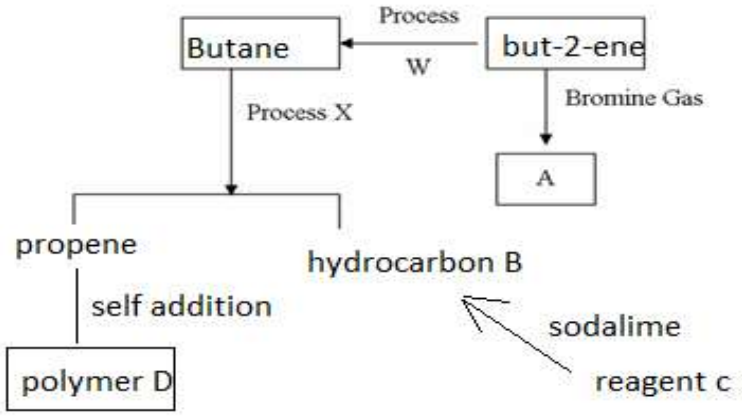
iv. Hydrochloric acid was added to iron powder in a test-tube and shaken thoroughly to mix to 1$cm^3$ of the resulting solution, six drops of aqueous solution of ammonia were added. State and explain the observation made on adding ammonia solution (2mks)

v. Concentrated hydrochloric acid is 35% pure with a density of 1.18$g/cm^3$.Calculate its concentration in moles per litre. H=1, Cl= 35.5 (3mks)

vi. write one industrial use of hydrochloric acid (1mk)

vii. explain the observation made when a moist blue flower is placed in a gas jar containing chlorine gas (2mks)

2 Study the flow chart below then answer the questions that follow.




i.Draw and name two isomers of substance A (4mks)

ii.Name (3mks)

a. process W _____

b. process X _____

c. reagent C _____

ii.Draw two repeated units of polymer D (2mks)

iv.Ethyne is a hydrocarbon belonging to the alkyne homologous family . Identify

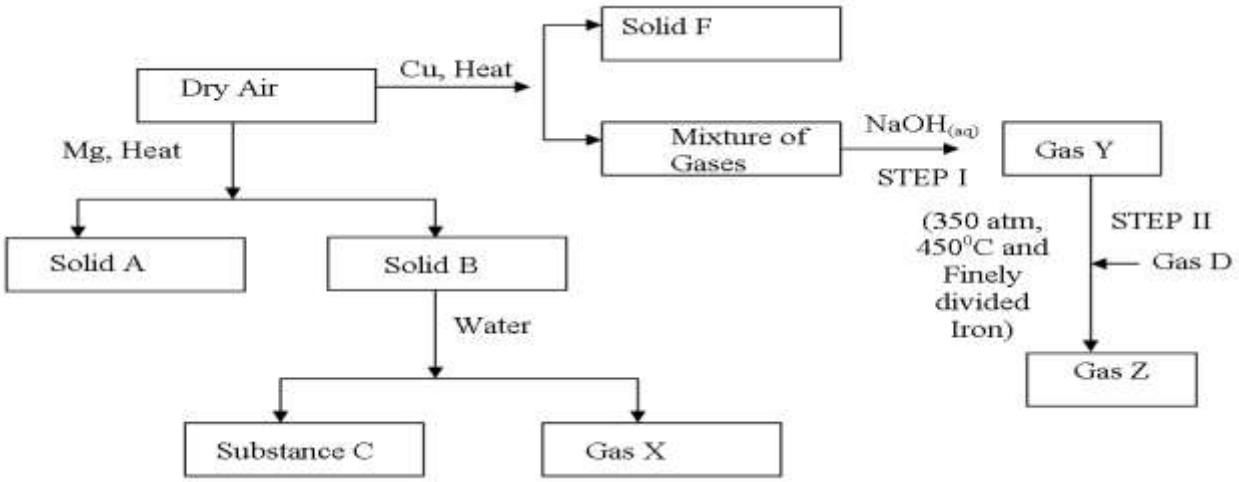
a. two reagents used to prepare ethyne in the laboratory (1mk)

b. Name the third member of this family (1mk)

vi Explain the observation made when ethyne is burned in air (2mks)

3. Study the diagram below that shows some reactions of dry air, then answer the questions that follow.

a)




Identify; (2mks)

i) Solid A _____

ii) Solid B _____

iii) Gas D _____

iv) Gas Z _____

b) Why is the amount of solid B obtained much less than solid A? (2mks)

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c) Write a balanced equation for the reaction between solid B and water (1mk)

e) Which gas is absorbed by sodium hydroxide in step I (1mk)

f) Gas Y obtained in step I is impure, Name one impurity it contains (1mk)

g) What name is given to the process that occur in step II (1mk)

h) 300 liters of ammonia are catalytically oxidized to form nitrogen II oxide which is further oxidized to nitric acid.

i. write a balanced equation for the catalytic oxidation of ammonia (1mk)

ii. which catalyst is used in this process (1mk)

ii. determine the volume of the products in the above reaction (2mk)

4. a) Define the term allotrope (1mk)

b) Identify the two allotropes of sulphur (1mk)

c) In the extraction of sulphur three concentric pipes are sank into the ground 200 m away from the surface. Use a well labeled diagram to describe the above process (3mks)

d) The table below shows some reactions of concentrated sulphuric VI acid. Study it and answer the questions that follow (2mks)

| Reaction of sulphuric acid | Observation | Property of sulphuric acid being investigated |
|---|---|---|
| Reaction with blue copper sulphate crystals | | |
| Moist hydrogen gas is bubbled in and collected in a syringe | | |

e) 50 ml of dilute Sulphuric VI acid was placed in 3 separate beakers and the following substances were added as shown in the table below

| Beaker | A | B | C |
|---|---|---|---|
| | Magnesium powder | Lead carbonate powder | Copper oxide |

Using relevant equations

i. Explain the observation in beaker B and beaker C (3mks)

ii. Magnesium powder in beaker A was replaced with silver powder. Explain the difference in the two reactions (3mks)

5. A student was given water containing suspected to be hard

a) What is hard water? (1mk)

b) The sample was divided into three portions and the following tests were carried out and the following observations were made

| Sample | Test | Observations |
|---|---|---|
| 1 | 10 ml of soap solution was added drop wise till excess | 2ml lather formed |

| | | |
|---|---|---|
| 2 | A sample is boiled | White precipitate |
| 2 | Boiled sample 10ml of soap is added | 10 ml lather formed |

i. Identify the type of hardness in the above sample. Explain (2mks)

ii. Write an equation for the formation of the white precipitate (1mk)

ii. Ammonia solution was added drop wise till excess in the third sample. A white precipitate was observed. Identify the cation present in the water. (1mk)

c) Write one advantage and one disadvantage of hard water (2mks)

Advantage

Disadvantage

d) Salt B has a solubility of 20g/100g of water at 40$^{o}$C. A solution containing 6g of salt B in 10ml of water is cooled to 40$^{o}$C. Calculate the amount of salt that crystalized out (2mks)

A student was provided with Calcium carbonate, sodium hydrogen carbonate , zinc sulphate , ammonium nitrate and Aluminium chloride

Which salts

i. are Insoluble in water (1mk)

ii. forms a white precipitate which dissolves to form a colourless solution when dissolved in excess sodium hydroxide solution (1mk)

ii. write 2 ionic equation for the reaction between zinc sulphate and excess ammonia solution (2mks)

6. Use the table below to answer the following questions. Letters represent the most stable ion of elements in the periodic table

| Ions | $P^{+}$ | $Q^{-1}$ | $R^{-1}$ | $W^{2+}$ | $Y^{3+}$ | $Z^{+}$ |
|---|---|---|---|---|---|---|
| Ionic radius | 0.086 | 0.056 | 0.044 | 0.073 | 0.064 | 0.097 |

a) Explain the trend in the ionic radius of $P^{+}$ and $W^{2+}$ and $Y^{3+}$ given that they are in the same period (3mks)

b) Element Q and R are in the same group.

i. Identify the family name of the group to which they belong (1mk)

ii. Which element is more electronegative? Explain (2mks)

c) Given that ion $P^{+}$ has electronic configuration 2, write the electronic configuration of ion $Z^{+}$

d) Write the formulae of the element formed when Y reacts with oxygen (1mk)

e) Using dot and cross diagrams show the bonding

i. between P and chlorine (1mk)

ii. Two atoms of Q (1mk)

7. a) Define the term heat of solution (1mk)

b) In an experiment to determine the heat of solution 4.8g of ammonium nitrate were added to 100ml of water at 20$^{o}$C. The temperature dropped to 9$^{o}$C.

i. Calculate the heat change in the above experiment given that C= 4.2 J/g/C (2mks)

**ii.** determine the molar heat of solution for the above reaction N=14, O=16 H=1 **(2mks)**

ii. determine the lattice energy of ammonium nitrate given that

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Hydration energy is -12kJ/mol (2mks)

c) Ethanol has a heating value of 14.5kJ/g while methane has a heating value of 10kJ/g. Which of the two fuels has a higher molar heat of combustion C=12, H= 1, O=16 (2mks)

**PAPER 3**

1. You are provided with the following solutions:

- $M_1$ containing 95g of a mixture of sodium carbonate and sodium chloride per litre of solution.

- $M_2$ which is 1MHCl.

You are to determine the percentage of sodium chloride in the mixture.

Proceed as follows. Fill the burette with $M_2$.

Pipette 25.0$cm^3$ of $M_1$ and titrate with $M_2$ from the burette using 3-4 drops of methyl orange indicator.

Stop titrating when a permanent pink colour appears. Repeat experiment and complete the table below.

(a) Table 1

| | I | II | III |
|---|---|---|---|
| Final burette reading ($cm^3$ ) | | | |
| Initial burette reading ($cm^3$ ) | | | |
| Volume of $M_2$ used ($cm^3$ ) | | | |

(4 marks )

(b) Determine the average volume of $M_2$ used. Show your workings. (1 mark)

(c) Determine the number of moles of $M_2$ used. (1 mark)

(d) Write down an ionic equation for the substances that react. (1 mark)

(e) Determine the number of moles of the carbonate used. (1 mark)

(f) Calculate the concentration of sodium carbonate (1 mark)

(g) Determine the mass of sodium carbonate in 1 litre of the solution ( Na = 23, C = 12,O = 16 )
( 1 mark )

(h) Determine the percentage of sodium chloride in the mixture. (1 mark)

2. You are provided with 5.0g of salt T. You are required to determine the solubility of salt T in water at different temperatures.

**Procedure**

(i) Place all salt T into a clean boiling tube.

(ii) Transfer 5cm$^3$ of distilled water from 10ml measuring cylinder into the boiling tube containing salt T. Insert the thermometer into the boiling tube.

(iii) Heat the mixture of salt T and water carefully until all the salt dissolves and the solution is clear.

(iv) Remove the boiling tube from the flame and allow it to cool while stirring with the thermometer carefully and gently. NOTE: The temperature (Ts) at which the crystals first appear.

Record this temperature in the table.

(v) Using the same mixture from (iv) above, add from 10ml measuring 1cm$^3$ of more water and repeat procedures (iii) and (iv) above. Carry out four (4) more experiments and enter you results in the table below.

**NOTE:**

You may fasten cooling for the first two temperatures readings by pouring cold water from the tap on the sides of the boiling tube or insert the boiling tube in a beaker containing cold water

**TABLE II (6 marks)**

| Volume of water added (cm$^3$) | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|
| Crystallization temperature, Ts ($^0$C) | | | | | | |
| Solubility of salt T in g/100g water | | | | | | |

(a) Complete the table by calculating solubility at different temperatures

(b) Plot a graph of solubility of salt T against crystallization temperature Ts. (3 marks )

(c) Use your graph to determine the solubility of Salt T in water at 62$^0$C. (1 mark)

(d) From your graph determine the temperature at which 75g of T will dissolve in 100g of water.

(1mark)

2. You are provided with solid W. Carry out the test and record your observations in the spaces below. Put solid W in a boiling tube. Add about 10cm$^3$ of distilled water and shake. Divide the solution into five portions

(i) To the first portion add sodium hydroxide drop wise then in excess

| Observations | Inferences |
|---|---|
| (1 mark) | (1 mark) |

(ii) To the second portion add 3 drops of sodium sulphate solution

| Observations | Inferences |
|---|---|
| (1 mark) | (1 mark) |

(iii)To the third portion add ammonium hydroxide drop wise then in excess

| Observations | Inferences |
|---|---|
| (½mark) | (1 mark) |

(iv) To the fourth portion, add 3 drops of lead nitrate solution and warm

| Observations | Inferences |
|---|---|
| (1 mark) | (1 mark) |

(v) To the fifth portion, add 3 drops of acidified barium nitrate

| Observations | Inferences |
|---|---|
| (1 mark) | (1 mark) |

2. You are provided with solid X. Carry out the test and record your observations in the spaces below.

(i) Put half of solid X on a metallic spatula and heat using a Bunsen burner

| Observations | Inferences |
|---|---|
| (1 mark) | (1 mark) |

(ii) Put the second half in a boiling tube. Add about 10cm$^3$ of distilled water and shake. Divide the resulting solution into four portions

| Observations | Inferences |
|---|---|
| (1 mark) | ($\frac{1}{2}$ mark) |

(iii) To the first portion add three drops of acidified potassium manganate (VII) and shake

| Observations | Inferences |
|---|---|

| | |
|---|---|
| ($\frac{1}{2}$ mark) | (1 mark) |

(iv) To the second portion add three drops of bromine water and shake

| Observations | Inferences |
|---|---|
| ($\frac{1}{2}$ mark) | (1 mark) |

(v) To the third portion add sodium hydrogen carbonate

| Observations | Inferences |
|---|---|
| ($\frac{1}{2}$ mark) | ($\frac{1}{2}$ mark) |

(vi) To the fourth portion add three drops of universal indicator. Compare the colour of the solution using pH colour chart

| Observations | Inferences |
|---|---|
| ($\frac{1}{2}$ mark) | ($\frac{1}{2}$ mark) |

**KCSE PREDICTION 2 2022**

**PAPER 1**

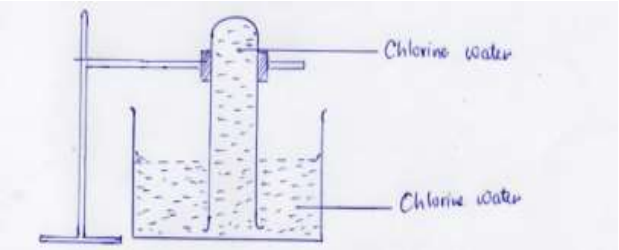
1. Air is a mixture of several different gases, which parts of air;(3Mks)

a) Supports combustion?.....

b) Puts of a burning splint?.....

c)Makes up almost 80% of air?.....

2.In an experiment a test tube full of chlorine water was inverted in chlorine water to as shown in the diagram below and the set up was left in sunlight.




After one day, a gas was found to have collected in the test tube.

(a)Identify the gas.....(1Mk)

(b)What will happen to the PH of the solution in the beaker after one day? Give an explanation. (2Mks

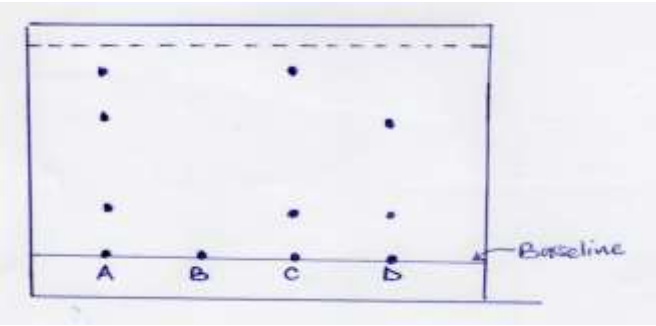
3.Draw the structure and give names of three alkanes having themolecular formula of $C_5H_{10}$. (3Mks)

4.(a)Using electrons in the outermost energy level draw the dot(.)and cross(X )diagram for the molecules $H_2O$ and $CH_4$(H=1, C=12 ) (2Mks)

(1)$H_2O$

(2)$CH_4$

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




(a)Which two dyes when mixed would produce dyeA .(1Mk)

(b)Identify the pure dye.(1Mk)

(C)Define solvent front?(1Mk)

B) Indicate the solvent front in the diagram using the **letter E**.

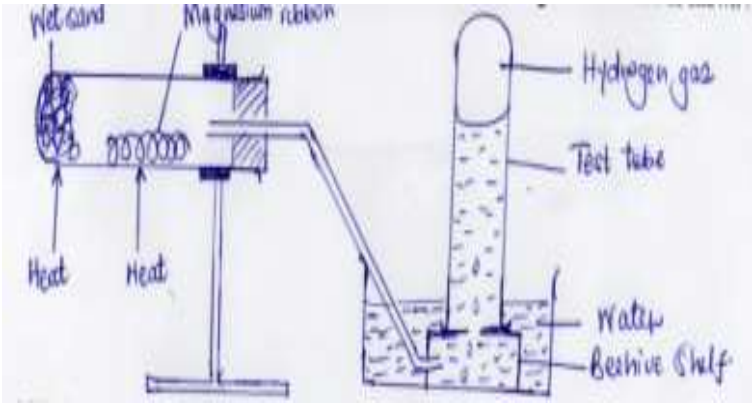
6.A given element **F** has atomic number 14 and consist of isotopes as shown below.

| Isotopes | G | H | J |
|---|---|---|---|
| Isotopes Mass | 28 | 29 | 30 |
| Percentage abundance | 92.2 | 4.7 | 3.4 |

(a)Determine the relative atomic mass of **element F.** (2Mks)

(b)State the group and the period to which element **F** belongs. (1Mk)

7.Hdrogen gas can be prepared by passing steam over heated magnesium ribbon as shown .




(a)Write an equation for the reaction that produce hydrogen gas. (1Mk)

(b)Explain why the delivery tube must be removed from beneath the water before heating is stopped.(1Mk)

(c)Name the method of gas collection used in the experiment. Give a reason.(1Mk)

8.(a)State Charles's law .(1Mk)

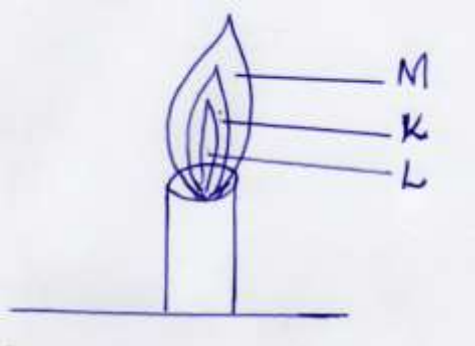
(b)A gas occupies 450cm$^3$ at 27$^0$C.What volume would the gas occupy at 177$^0$C.If its pressure remains constant? (Give the answer in Kelvin) (2Mks)

9.A certain match stick head contains potassium chlorate and sulphur. On striking, the two substances react to produce potassium chloride and sulphur(IV )oxide respectively.

(a)Write an equation to show formation of sulphur (iv )oxide.(1Mks)

(b)Explain the environmental effect of using such matches in large numbers.(2MKS)

10.The figure below shows a flame obtained from a Bunsen burner.




(a)Name the type of flame. (1Mk)

(b)A match stick head was placed at **region L** will not ignite. Explain(1Mk)

(c)Name **region K .**(1Mk)

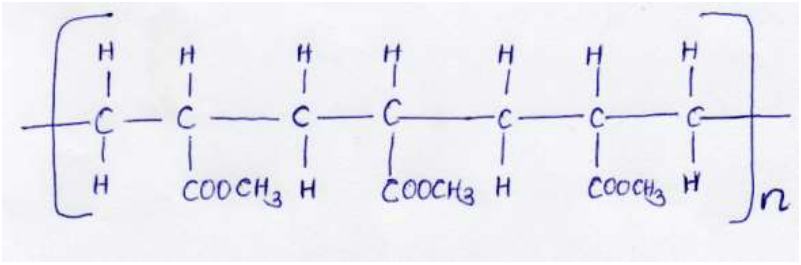
11.Solutions can be classified as Acids, Bases or Neural. The table below shows solutions and their $P^H$ values.

| Solution | $P^H$ values |
|---|---|
| N | 1.5 |
| Q | 7.0 |
| P | 13.0 |

(a)Select any pairs that would react to form a solution of $P^H$ 7.0 (1Mk)

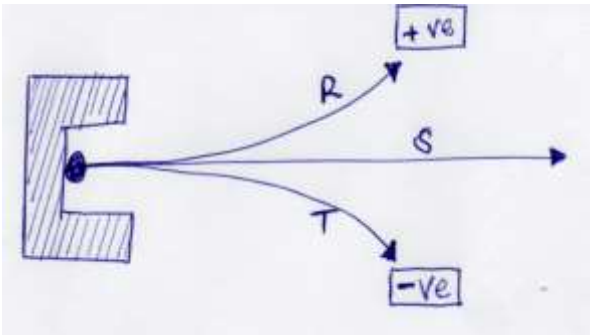
(b)Identify **two**solution that would react with Aluminium hydroxide. Explain. (2Mks)

12.The diagram below shows part of a synthetic polymer. Study it and answer the questions that follows;




(a)Draw the structure of the monomer (1Mk)

13.The diagram below shows the radiation emitted by a radioactive isotope.




Name the radiations.(3mks)

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R:.....

S:.....

T:.....

14.(a)Distinguish between a deliquescent and a hygroscopic substance.(2Mks)

(b)Give one use of a deliquescent substance In the laboratory. (1Mk)

15.Study the flow diagram below and answer the question that follow.



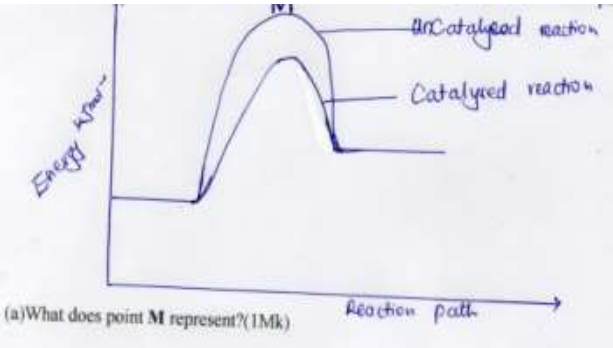

(a)Write an equation for the reaction taking place in **step 1.** (1Mk)

(b) Name **solution V.**(1Mk)

16. (a) state and explain two observations made when magnesium ribbon is lowered into a as jar full of carbon (iv) oxide (3mk)

b) Write a balanced chemical equation or the reaction that took place in a) above(1mk)

17. The energy level diagram below shows the effect of a catalyst on the reaction path.




(b)With reference to the energy level diagram, explain how a catalyst increases the rate of reaction. (2Mks)

18. The table shoes behaviour of metals R, X , Y and Z study it and answer the questions.

| Metal | Appearance on exposure to air | Reaction in water | Reaction with dilute hydrochloric acid |
|---|---|---|---|
| R | Slowly tarnishes | Slow | Vigorous |
| X | Slowly turns white | Vigorous | Violet |
| Y | No change | Does not react | Does not change |
| Z | No change | No reaction | Reacts moderately |

(a) Arrange the metals in the order of reactivity starting with the **most reactive** (2Mks)

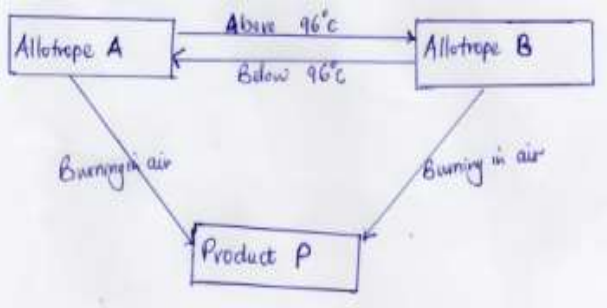
(b)Name a metal which is likely to be ; (2Mks)

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**1**)X:.....

**11**)Y:.....

20. The following chart below shows some properties of two allotropes of **element P**




(a)Name allotrope A(1Mk)

(b)Write an equation to show formation of product P (1Mk)

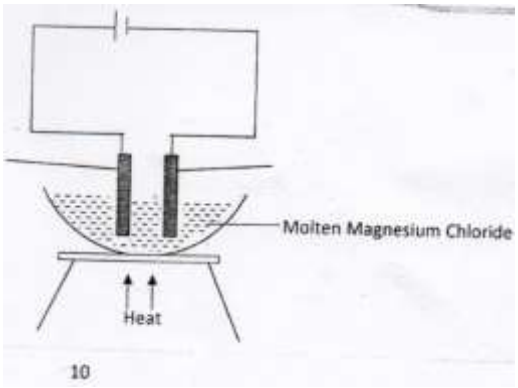
(c)What does 96 $^{0}$C represent? (1Mk)

21.Complete the following table by filling in the missing test and observations. (3Mks)

| NO | Gas | Test | Observation |
|---|---|---|---|
| I. | Ammonia | Put a moist red, then blue litmus into the gas | |
| 2 | Sulphuric(V) oxide | | Paper turns green |
| 3 | Butene | Add a drop of bromine water | |

22.An organic compound contains 24.24%carbon,4.04% hydrogen and the rest chlorine.If its relative molecular mass is 99.What is its molecular formula ?(C=12,H=1 ,Cl=35.5) (3Mks)

23.Study the diagram below and answer the questions that follows




(a)Define the term electrolysis.(2mks)

(b)On the diagram, label the Anode and the Cathode. (1Mks)

(c)Write the equation for reaction taking place at the Cathode. (1Mk)

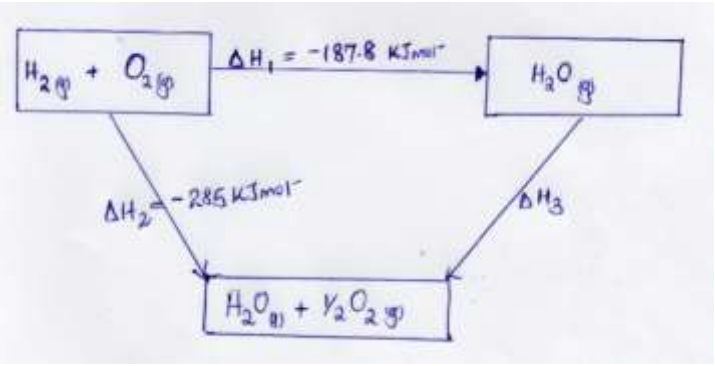
24.Hardness of water may be removed by either boiling or addition of chemicals

(a)Name the two types of water hardness. (2Mks)

(b)A sample of river water was divided into three portions, the table shows the test carried out on the portion and observations made. Complete the table by filling the inferences. (3Mks)

| Test | Observation | Inference |
|---|---|---|
| To the first portion,1cm$^3$ of soap solution was added. | No lather formed | |
| The second portion was boiled ,cooled and 1cm$^3$ of soap solution was added. | No lather was formed | |
| To the third portion ,3cm$^3$ of aqueous sodium carbonate was added ,the mixture filtered and 1cm$^3$ of soap solution added to the filtrate. | Lather formed immediately | |

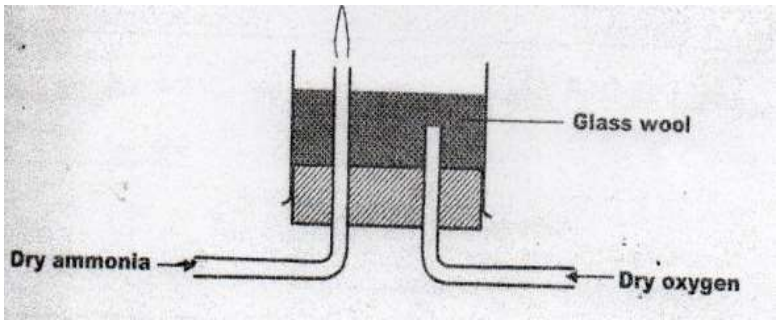
25.The figure below shows an energy cycle diagram.




(a)Give the name of the enthalpy change H1 (1Mk)

(b)Determine the value of H3 (2Mks)

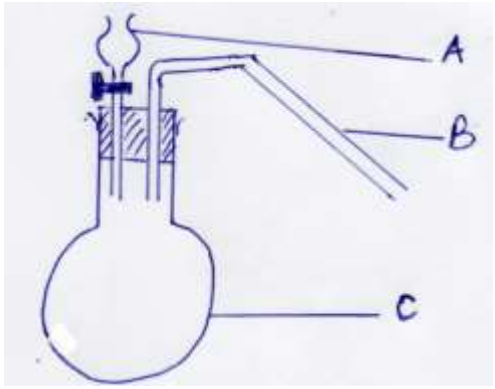
26.Dry ammonia and dry oxygen were reacted as shown in the diagram.




(a)What is the purpose of the glass wool? (1Mk)

(b)What product would be formed if red- hot platinum was introduced in to a mixture of ammonia and oxygen? (1Mk)

27.Study the diagram below.




Identify apparatus A ,B and C. (3mks)

28.Explain why high temperature is required for Nitrogen to react with Oxygen. (2mks)

**PAPER 2**

1. The grid given below represents part of the periodic table. Study it and answer the questions that follow. The le are not the actual symbols of the elements.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | A |
| B | | | | G | | H | E | |
| | J | | I | L | | | | C |
| D | | | | | | | M | |
| Y | | | | | | | | |
| | | | | | | | | |

(i) What name is given to the family of elements to which A and C belong? ( 1 mark )
(ii) Write the chemical formula of the sulphate of element D. ( 1 mark )
(iii ) Which letter represents the most reactive ( 2 marks )
(a) Metal

(b) Non-metal

(iv) Name the bond formed when B and H react. Explain your answer. ( 2 marks )

(v) Select one element that belong to period 4. ( 1 mark )

(vi) Ionic radius of element E is bigger than the atomic radius. Explain. ( 2 marks )

(vii) The electron configuration of a divalent anion of element N is 2.8.8. Induce the Position of element N on the periodic table drawn above. ( 1 mark )

(viii) The oxide of G has a lower melting point than the oxide of L. Explain. ( 1 mark )

(ix) How do the atomic radii of I and C compare. Explain. ( 2 marks )

(x)Explain the trend in the 1st ionization energies of the elements J, I and L.(1mark )

2 a) define the following terms

i) Saturated solution(1mk)

ii) Fractional crystallization(1mk)

b) Solubility of salt X and Y were determined at different temperatures as shown in the following data.

| Temperature (ºC) | | 0 | 20 | 40 | 60 | 80 | 100 |
|---|---|---|---|---|---|---|---|
| Solubility of 100g of water | X | 12 | 30 | 75 | 125 | 185 | 250 |
| | Y | 15 | 20 | 35 | 45 | 65 | 80 |

i. On the grid provided, plot a graph of solubility (vertical axis) against temperature (4mks)

ii. From the graph determine the solubility of each at 50ºC.

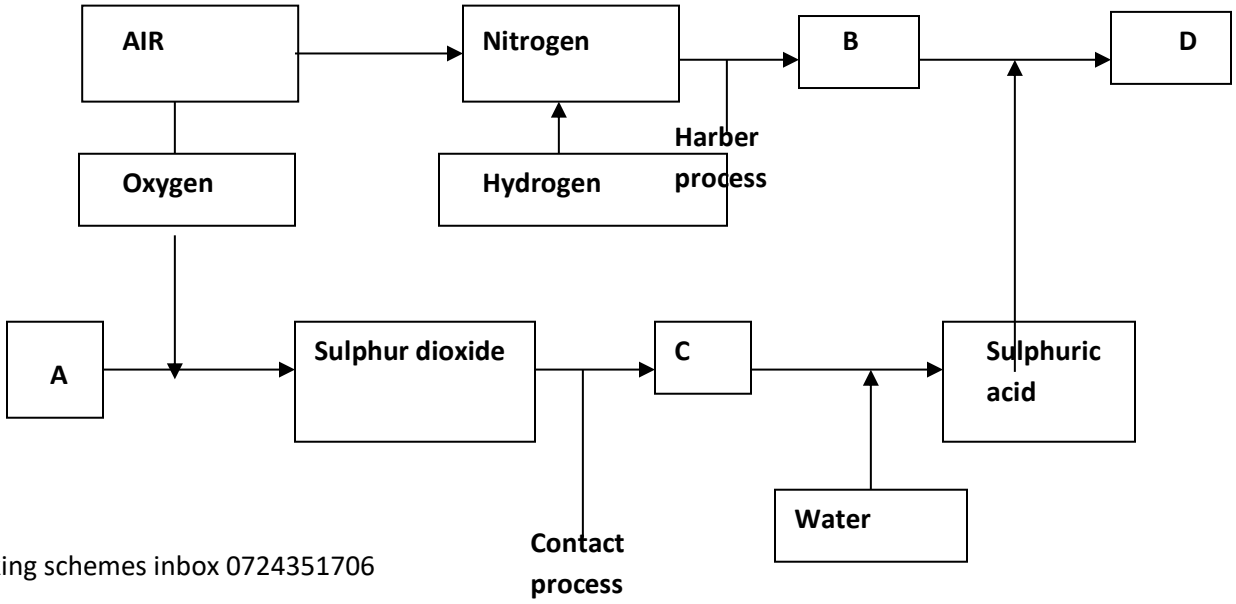
X …….. (1mk)

Y …… (1mk)

iii. At what temperature was the solubility of both salts equal. (1mk)

b)i. What is permanent hardness of water? (1mk)

3. The flow chart below illustrates two industrial processes. Haber and contact processes each with air as one of the starting materials and other chemical reactions.




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a) (i) Give the name of the process by which air is separated into oxygen and nitrogen. (1 mk)

(ii) Apart from oxygen and nitrogen gas produced from process a(i) name any other gas produced in the process above. (1 mk)

b) Name the substances which are represented by the letter. (4 mks)

A……..

B……..

C …….

D……

c) Name the catalyst used in;

(i) The Haber process (1 mk)

(ii) The contact process (1 mk)

(iii) Explain the role of the catalyst in both the Haber and contact process. (2 mks)

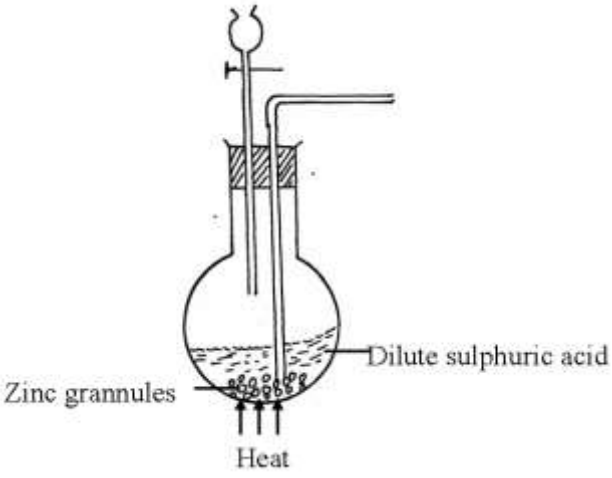
d) (i) Write a balanced equation for formation of compound D. (1 mk)

(ii) Calculate the percentage by mass of nitrogen present in compound D

(N = 14.0, H = 1.0, S = 32.0, O = 16.0) (2 mks)

(iii) Give one use of compound D. (1 mk)

4. A student set-up the arrangement below to prepare and collect dry hydrogen gas




(a) Identify two errors from the section of the arrangement shown above (2mks)

I: ……

II:……

(b) Complete the diagram to show how dry hydrogen gas can be collected. (2mks)

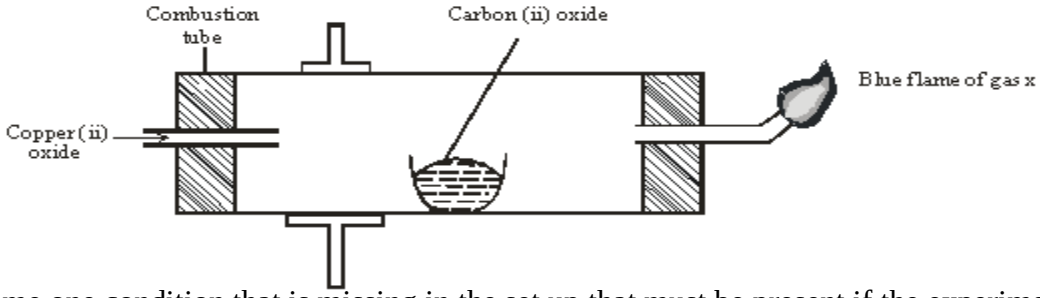
(c) (i) Explain why hydrogen was collected by the method shown above (1mk)

(ii) Write a balanced chemical equation for the reaction that takes place when hydrogen gas is burnt in air. (1mk)

(e)Determine the relative atomic mass of zinc, given that when 6.54g of zinc was used, 2.4litres of hydrogen gas was produced. (Molar gas volume = 24 litres)(3mks)

(c) State any **two non**-industrial uses of hydrogen gas (2mks)

5. The diagram below shows an experiment set-up to investigate a property of carbon (ii) oxide. Study it and answer the questions that follow.




a) Name one condition that is missing in the set up that must be present if the experiment to proceed. **1mark**

b) If the experiment was carried out properly. What observation would be made in the combustion tube? **1mark**

c) Give an equation for the reaction that occurs in the combustion tube. **1 mark**

d) Give an equation for the reaction that takes place as gas x burns. **1 marks**

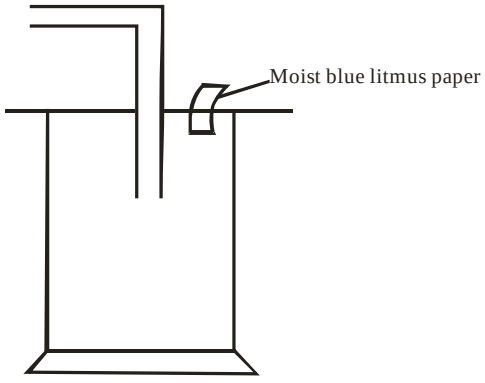
e) Why is it necessary to burn gas x? **1mk**

f) Name the reducing and oxidizing agent. **2marks**
   (i) Reducing agent
   (ii) Oxidising agent

g) Identify any other substance that would have the same effect on copper (ii) oxide as carbon (ii) oxide. **1mark**

h) What would happen if copper (ii) oxide was replaced with sodium oxide? Explain **2mark**

6. Dry chlorine was collected using the set up below.




a) Name a suitable drying agent for chlorine gas? (**1mark)**

b) State one property of chlorine gas which facilitates this method of collection. **1mark**

c) State the observations made on the moist blue litmus paper. (**2marks)**

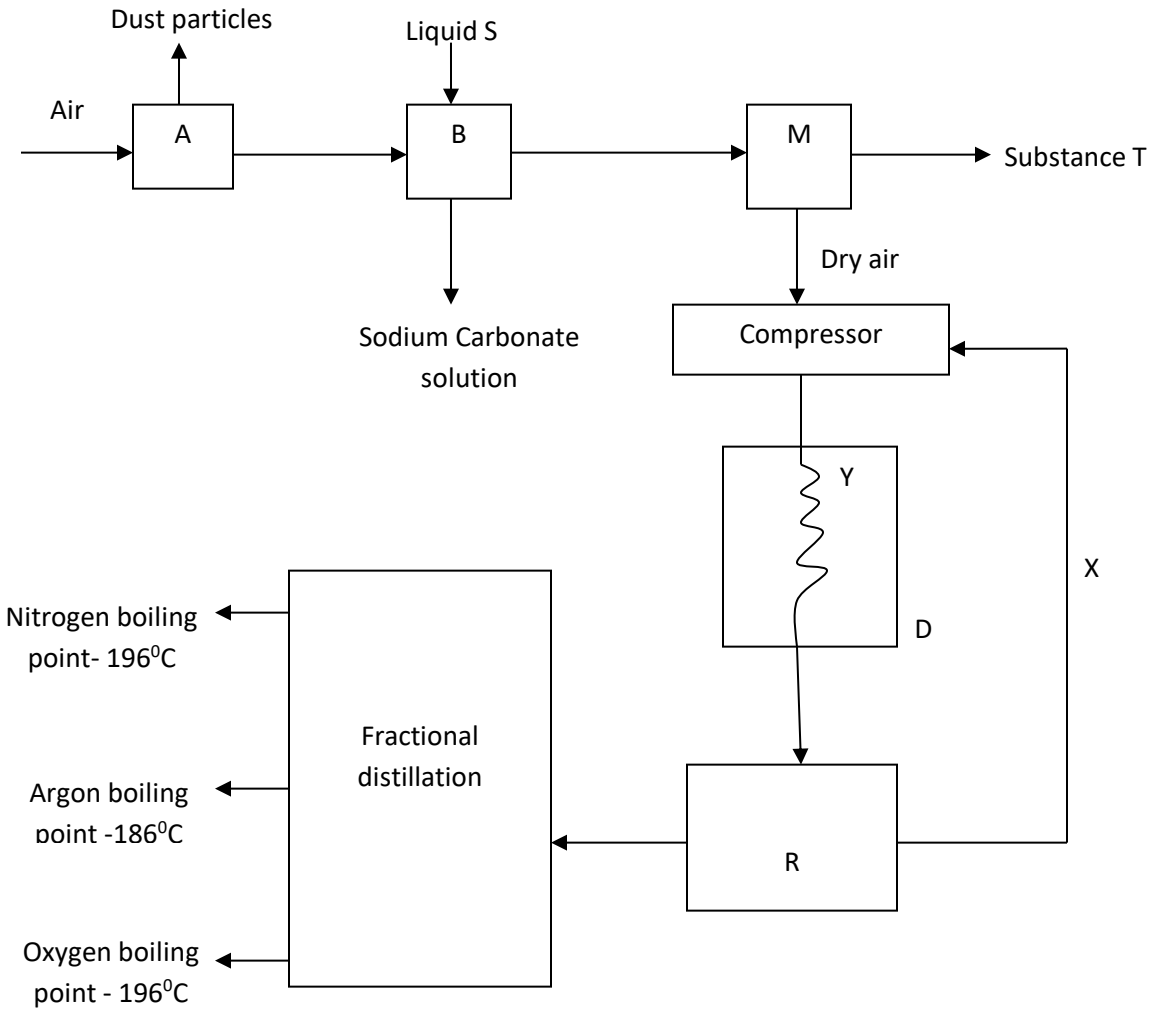
d) Chlorine gas was bubbled through distilled water. With aid of an equation show the formation of chlorine water. **(1mark)**

e) Write the formula of the compounds formed when chlorine gas reacts with warm dry phosphorous. **(2marks)**

f) Chlorine gas is mixed with moist hydrogen sulphide gas, state and explain the observations **(2marks)**

g) Give one use of chlorine gas. **1mark**

7. Fractional distillation of air is used in the industrial manufacture of oxygen. The diagram below shows the process.




a) What processes are taking place in chamber A,B,M and D **2marks**

b) Name;

(i) Liquid S(1mk)

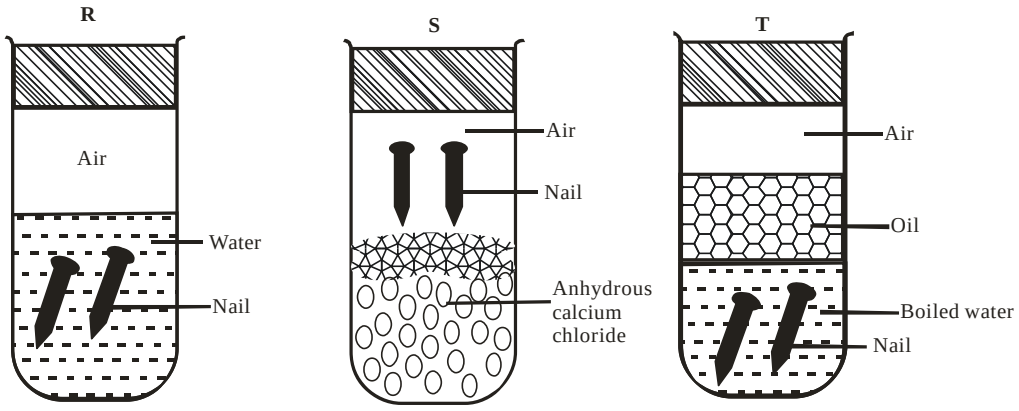
(ii) Substance T(1mk)

c) Explain why part Y in chamber D is curved? **1mark**

d) Give two industrial uses of oxygen gas? **(2marks)**

e) In the laboratory preparation of oxygen, manganese (iv) oxide and hydrogen peroxide are used. Write an equation to show how oxygen gas is formed. **1mark**

f) An investigation was carried out using the set-up below. Study it and answer the questions that follow.




**(i)** State and explain what will happen in the three test-tubes R, S and T after seven days. **2marks**

(ii) Give one reason why some metals are electroplated. **1mark**

**PAPER 3**

1 **You are provided with;**

- Solution K, hydrochloric acid
- Solution L, containing 2g per litre of sodium hydroxide.
- 0.5 g of an impure calcium carbonate, solid **N.**
- You are required to determine the :

(a)Concentration of solution K in moles per litre.

(b) Percentage purity of calcium carbonate, solid **N**

**Procedure I**

Fill the burette with hydrochloric acid, solution K. pipette 25$cm^3$ of sodium hydroxide, solution L into a conical flask. Add 2-3 drops of phenolphthalein indicator and titrate. Record the results in the table. Repeat the procedure two more times.

**Table 1**

| | I | II | III |
|---|---|---|---|
| Final burette reading ($cm^3$) | | | |
| Initial burette reading ($cm^3$) | | | |
| Volume of solution Kused ($cm^3$) | | | |

4mks

a) What is the average volume of solution **K** used (1mk)

b) Determine the concentration of solution L in moles per litre. (1mk( Na= 23,O = 16, H = 1)

c) Determine the number of moles of solution L that reacted with solution K(1mk)

d) Write the equation of the reaction that took place( 1mk)

e) Calculate the number of moles of solution K that reacted( 1mk)

f) Calculate the concentration of solution K in moles per litre. (1mk)

**Procedure II**

Using a measuring cylinder, measure out 100$cm^3$ of solid K into a 250ml beaker. Add all of solid N into the beaker containing solution K. Swirl the mixture and allow the reaction to proceed until offervescence stops. Label this as solution P. Fill the burette with solution P. pipette 25$cm^3$ of solution L into a conical flask. Add 2-3 drops of phenolhthalein indicator and titrate. Record your results in table II below repeat the titration two more times and complete the table

| **Table II** | I | II | III |
|---|---|---|---|
| Final burette reading ($cm^3$) | | | |
| Initial burette reading ($cm^3$) | | | |
| Volume of solution Pused ($cm^3$) | | | |

4mks

(a) Determine the average volume of solution **P** used. 1mk

(b) Calculate the number of moles of hydrochloric acid in solution P used. (1mk)

c) Determine the number of moles of hydrochloric acid in $100cm^3$ of solution P. (1mk)

d) Calculate the:

(i) Moles of hydrochloric acid in $100cm^3$ of the original hydrochloric acid solution K (1mk)

(ii) Moles of the hydrochloric acid that were used up in the reaction with solid N. (1mk

(iii) Moles of calcium carbonate that reacted with hydrochloric acid.(1mk)

e) Given that the relative formula mass of calcium carbonate is 100,calculate the:

(i) Mass of the calcium carbonate that reacted. (1mk)

(ii) Percentage purity of the calcium carbonate, solid N. (1mk)

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

Place all solid T in a boiling tube. Add about $6cm^3$ of distilled water to the solid T and shake the mixture well. Retain the mixture for use in the following tests.

a) Dip a clean glass rod in the mixture obtained above and burn it on a Bunsen burner flame.

| Observation | Inference |
|---|---|
| (1 mark) | (1 mark) |

b) Divide the mixture in the boiling tube into 3 portions.

(i) To the 1st portion, add about $1cm^3$ of barium chloride solution. Retain the resulting mixture for use in (iii) below.

| Observation | Inference |
|---|---|
| (1 mark) | (1 mark) |

(ii) To the mixture in (ii) above, add about $4cm^3$ of dilute hydrochloric acid.

| Observation | Inference |
|---|---|
| (1 mark) | (1 mark) |

(iii) To the 3rd portion, add about 3 drops of acidified potassium manganate (VII) solution.

| Observation | Inference |
|---|---|
| | |
| (1 mark) | (1 mark) |

3.You are provided with solid J. Carry out the test below to identify the compound.

(a) Place ½ spatula of solid J in a hard test tube and heat strongly until no further change. Test the gas produced with litmus paper.

| Observation | Inference |
|---|---|
| | |
| (1/2 mark) | (1/2 mark) |

(b) Place the remaining solid J into a clean boiling tube. Half fill it with distilled water and shake well. Divide the solution into four portions.

(i) To the first portion add dilute sodium hydroxide solution dropwise till in excess.

| Observation | Inference |
|---|---|
| | |
| (1 mark) | (1 mark) |

(ii) To the second portion add ammonia solution dropwise till in excess.

| Observation | Inference |
|---|---|
| | |
| (1 mark) | (1 mark) |

(iii)To the third portion add drops of dilute barium nitrate.

| Observation | Inference |
|---|---|
| | |
| (1 mark) | (1 mark) |

(iv)To the fourth portion add a few drops of dilute nitric acid followed by lead (II) nitrate solution and warm.

| Observation | Inference |
|---|---|
| | |
| (1 mark) | (1 mark) |

Identify Compound J……..… (1 mark)

**KCSE PREDICTION 3 2022**
**PAPER 1**

1.

a. Define the term **half-life** as used in radioactivity. (1mk)

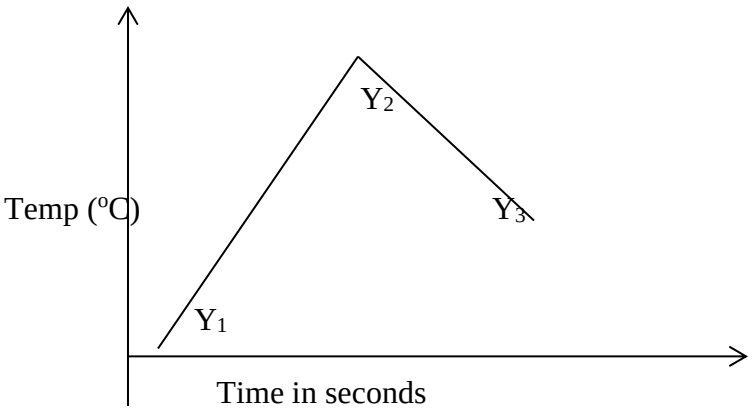
b. 100g of radioactive substance was reduced to 12.5g in 15.6years. **Calculate** the half-life of the substance. (2mks)

2. You are provided with water and usual laboratory apparatus. Describe how you would fully separate solid lead (II) carbonate from a mixture of iron fillings, lead (II) carbonate and sodium carbonate. (3mks)

3. In order to determine the molar heat of neutralization of sodium hydroxide, $100cm^3$ of 1M NaOH and $100cm^3$ of 1M HCI both at the same initial temperature were mixed and stirred continuously with a thermometer. The temperature of the resulting solution was recorded after every 30 seconds until the highest temperature was attained. Thereafter the temperature of the solution was recorded for further two minutes.

a. Write the ionic equation for the reaction which took place. (1mk)

b. The sketch below was obtained when the temperature of the mixture were plotted against time. Study it and answer the questions that follow.

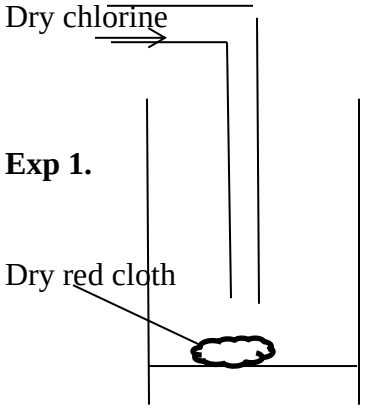



i. What is the significance of point $Y_2$ (1mk)

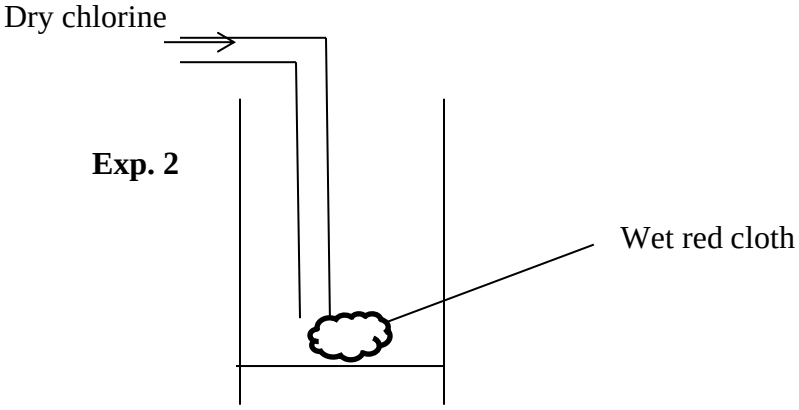
ii. **Explain** the temperature change;
Between $Y_1$ and $Y_2$ (1mk)

Between Y2 and Y3 (1mk)

4. Dry chlorine gas was passed through two pipes of coloured cotton cloth as shown below.




**Exp 1.**




**Exp. 2**

a. **State** what is observed in each of the experiment;
   Experiment 1 (1mk)
   Experiment 2 (1mk)
b. Explain your observation using an equation. (1mk)

5. Two elements **A** and **B** have electronic configuration 2.8.3 and 2.6 respectively.
   a. To which group and period does element B belong? (1mk)
   b. If the two react, what is the formula of the compound they form? (1mk)
6. Iron fillings react with steam according to the equation given below.

$$3Fe_{(s)} + 4H_2O_{(g)} \rightleftharpoons Fe_3O_{4(s)} + 4H_{2\,(g)}$$

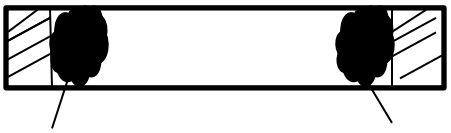
**State** and **explain** the effects of each of the following on the equilibrium.
i. Increase in pressure (2mks)
ii. Addition of magnesium ribbon to the equilibrium mixture. (2mks)

7. Unknown substances had PH values as shown in the table below.

| Substance | PH values |
|---|---|
| A | 6.0 |
| B | 2.0 |
| C | 8.0 |

State which substance is likely to be;
i. Lemon juice (1mk)
ii. Phosphoric (v) acid (1mk)
iii. **Identify** a substance that would be a better electrolyte? (1mk)

8. In an experiment to study diffusion of gases, the following set up was used.



Cotton wool Soaked in Conc Ammonia

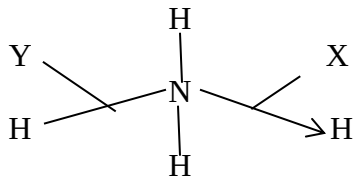
Cotton wool soaked in Conc hydrolic acid

i. **State** and **explain** the observations made in the experiment. (2mks)

ii. Write an equation for the reaction that occurs in the experiment. (1mk)

9. An electric current was passed through molten potassium fluoride using inert electrodes.
   a. Name the products at;
      Anode (1mk)
      Cathode (1mk)
   b. Write an equation for the reaction at the anode. (1mk)
10. During the extraction of copper and zinc from their ores, some of the processes include;
   i. Crushing
   ii. Mixing of the crushed ore with oil and water and bubbling air through it.

   a.
      i. Name the process (ii) above. (1mk)
      ii. What is the purpose of process (ii) above? (1mk)
   b. Bronze is an alloy of copper and another metal. **Identify** the other metal. (1mk)
11. Name **another** gas which is used together with oxygen in welding. (1mk)
12. The structure of ammonium ion is shown below.



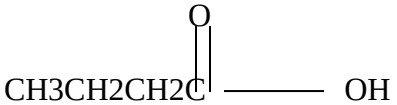

   a. Name the type of bond represented by X and Y
   b. How many electrons are used in bonding in the ammonium ion? (1mk)
13. A dibasic acid $H_2C_2O_4nH_2O$ of concentration 6.3g/dm$^3$ was titrated against NaOH solution. 25cm$_3$ of the acid solution required 15.6cm$^3$ of 0.16MNaOH for complete neutralization. **Calculate** the value of n in the formula. (H=1, O=16, C=12) (3mks)
14. The table below shows the solubility of potassium nitrate and potassium chlorite at various temperatures.

| Salt | Solubility at various temperatures | |
|---|---|---|
| | 50$^o$c | 20$^o$C |
| $KNO_3$ | 86g | 31g |
| $KCIO_3$ | 18g | 8g |

A mixture of salts contains 20g of KNO3 and 18g of $KCIO_3$ in 100g of water at 50$^o$C.
   a. **State** the method which may be used to separate the mixture. (1mk)

   b. If the mixture was cooled from 50$^o$C to 20$^o$C, **state** and **explain** what would be observe. (2mk)

15.
   a. Name the following organic compounds.




(1mk)

CH3CH2CH2CH3 (1mk)

b. Below is a simple representation of a soap molecule.



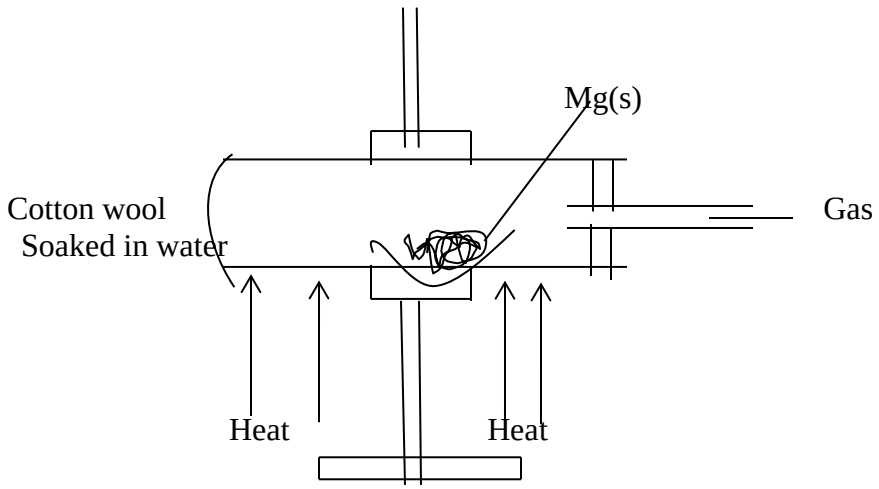
Polar head Non polar head

Using the structure above show how soap removes an oil smear from the fabric below.(2mks)

_____

16. Explain how a sample of lead(ii) chloride can be prepared using the following reagents.
i. Dilute nitric (v) acid
ii.Dilute hydrochloric acid
iii.Lead (ii) carbonate (3mks)

17. The diagram below represents a set up used to react magnesium with steam. Study it and answer the questions that follow below.

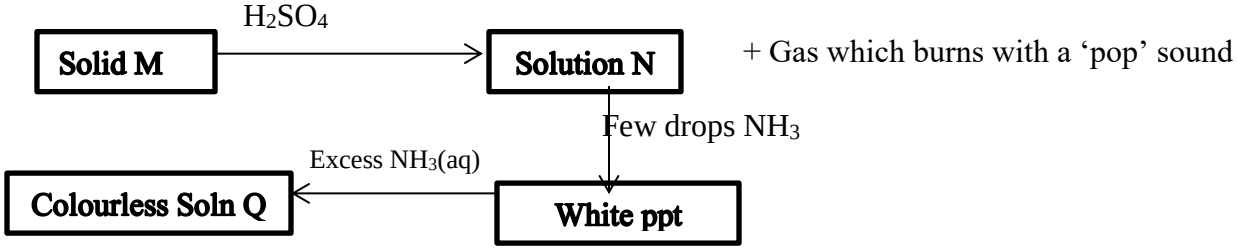



i. **State** the observation made in the combustion tube. (1mk)

ii. Why would it not be advisable to use potassium in place of magnesium In the above set up. (1mk)

iii. Explain **why** cotton wool is heated prior to heating magnesium (1mk)

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




30 for marking schemes inbox 0724351706

i. Name solid **M** (1mk)

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

iii. Write an ionic equation of the reaction between Barium nitrate and solution **N**.(1mk)

19.

a. Below are standard reduction potentials of **3** electrodes.

$Fe^{2+}(aq) + 2e \longrightarrow Fe(s)$ -0.44v

$Zn^{2+}(aq) + 2e \longrightarrow Zn(s)$ -0.76v

$Sn^{2+}(aq) + 2e \longrightarrow Sn(s)$ -0.14v

**Calculate** the electromotive force of a cell formed between $Fe/Fe^{2+}$ half-cell and $Zn/Zn^{2+}$ half-cell. (2mks)

b.Draw a clearly labeled diagram of a set up you would use to electroplate an iron spoon with silver metal. (2mks)

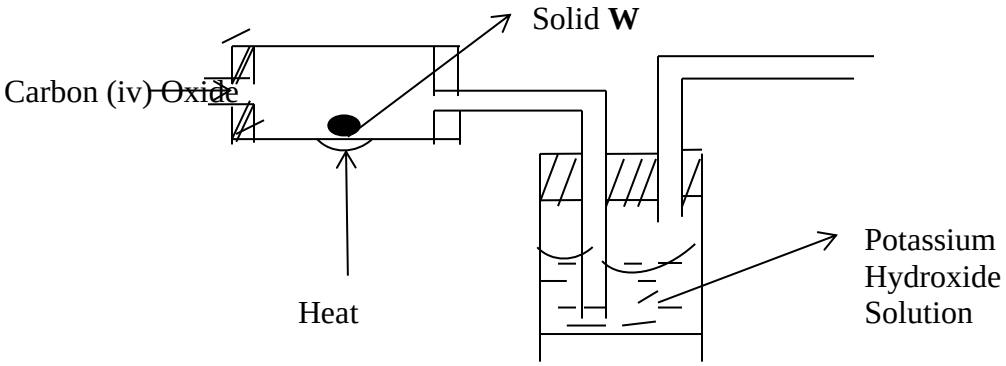
20.

a. Name the **process** of extracting Sulphur. (1mk)

b. What is the **role** of super-heated water? (1mk)

c. State **two** uses of sulphur (1mk)

21. The diagram below shows how carbon (ii) oxide can be prepared starting with carbon (iv) oxide and solid W. study it and answer the questions that follow.




a. With reasons, **state** a suitable location where such an experiment should be rightly conducted. (1mk)

b. What is the purpose of concentrated potassium hydroxide? (1mk)

c. Identify solid **W** (1mk)

22.

a. Explain how you would separate a mixture of nitrogen and oxygen. (2mks)

b. **Draw** a well labeled diagram to show the percentage composition of oxygen in air can be determined. (2mks)

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

$H_2(g) + {}^1\!/_2 O_2 \longrightarrow H_2O(l)$ $\Delta H_1 = -286KJ/Mol$

$C(s) + O_2(g) \longrightarrow CO_2(g)$ $\Delta H_2 = -384KJ/Mol$

$C(s) + 4H_2(g) + {}^{1}{}_{2}O_2(g) \longrightarrow C_3H_7OH \qquad \Delta H3 = -2686.6KJ/Mol$

a. Define '**enthalpy** of formation' (1mk)
b. Determine the molar enthalpy of formation of propanol. (2mks)

24. Most natural water occurs as permanent hard water or temporary hard water.
a. Name **two** compounds that cause;
i. Temporary hardness (1mk)
ii. Permanent hardness (1mk)

b. How is temporary hardness removed from water? (1mk)
c. State **one** disadvantage of using hard water in boilers. (1mk)

25. Both Sodium and Aluminum are metals in period 3 yet sodium has much lower melting point than aluminum. **Explain**. (2mks)

26. Determine the values of X and Y in the equation below.

$${}^{236}_{92}U + {}^{X}_{Y}Ba \longrightarrow {}^{92}_{36}Kr + {}^{1}_{0}Z + Energy$$

x……. Y…….. (1mk)

27. State **two** effects of emitting $SO_2$ in the environment. (1mk)

**PAPER 2**

1.
a. The information below relates to element N, P,Q, Rand S . Study it and answer the questions that follow. The letters are not the actual symbols for the elements.

| Element | Atomic radius(mm) | Ionic radius(mm) | Formula of oxide | Melting point of oxide |
|---|---|---|---|---|
| N | 0.364 | 0.421 | $N_2O$ | -119 |
| P | 0.830 | 0.711 | $PO_2$ | 837 |
| Q | 0.592 | 0.485 | $Q_2O_3$ | 1466 |
| R | 0.381 | 0.446 | $R_2O_5$ | 242 |
| S | 0.762 | 0.676 | SO | 1054 |

i. Name the elements that are metal. **Give** a reason. (2mks)

ii. Compare the melting points of the oxides of S and R in terms of structure and bonding. (2mks)

iii. Name the pair of elements that would react most vigorously with each other?
**Explain** (2mks)

b. The table bedlow has information about chlorides of elements in period 3 of the periodic table: Sulphur to sulphur

| **Chloride** | NaCI | $MgCI_2$ | $AICI_3$ | $SiCI_4$ | $PCI_5$ |
|---|---|---|---|---|---|
| **Melting point ($^oC$)** | 801 | 712 | Sublimes at 183 | -70 | -80 |

What are the possible PH values of the solutions formed when the following chlorides are dissolved in water? Explain

$MgCI_2$ (1mk)

$AICI_3$ (1mk)

c. The molecular formula of Aluminum chloride is AI2CI6. Draw the structural (not dot and cross diagram) of Aluminum chloride indicating clearly the different types of bonds present. (2mks)

d. Using dot (●) and cross (×), draw a diagram to show bonding in sodium chloride. (Na=11, CI=17) (2mks)

2.

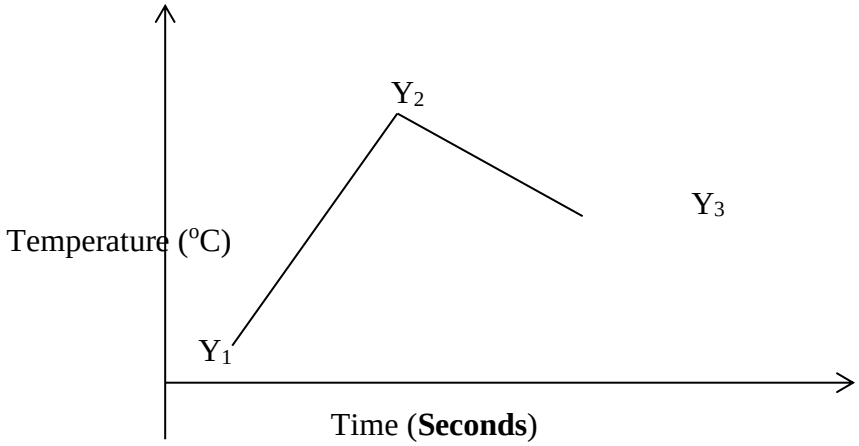
a. What is the molar enthalpy of neutralization? (1mk)

b. In order to determine the molar heat of neutralization of sodium hydroxide, 100cm3 of 1M sodium hydroxide and 1M of hydrochloric acid both at the initial temperature were mixed and stirred continuously using a thermometer. The temperature of the resulting solution was recorded after every 30seconds until the highest temperature was attained. Thereafter the temperature of the solution was recorded for a further two minutes.

i. Why was it necessary to stir the mixture of the two solutions? (1mk)

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

iii. The sketch below was obtained when temperature of the mixture was plotted against time. Study it and answer the questions that follow.




Explain the temperature changes between points
$Y_1$ and $Y_2$ (1mk)

$Y_2$ and $Y_3$ (1mk)

iv. If the initial temperature for both solution was 25°C and the highest temperature was 31.4°C for the mixture. **Calculate;**
Heat change for the reaction (Specific heat capacity of solution=$42Hg^{-1}K^{-1}$, Density of the solution =$1gcm^{-3}$) (2mks)

Molar heat of neutralization of sodium hydroxide. (2mks)

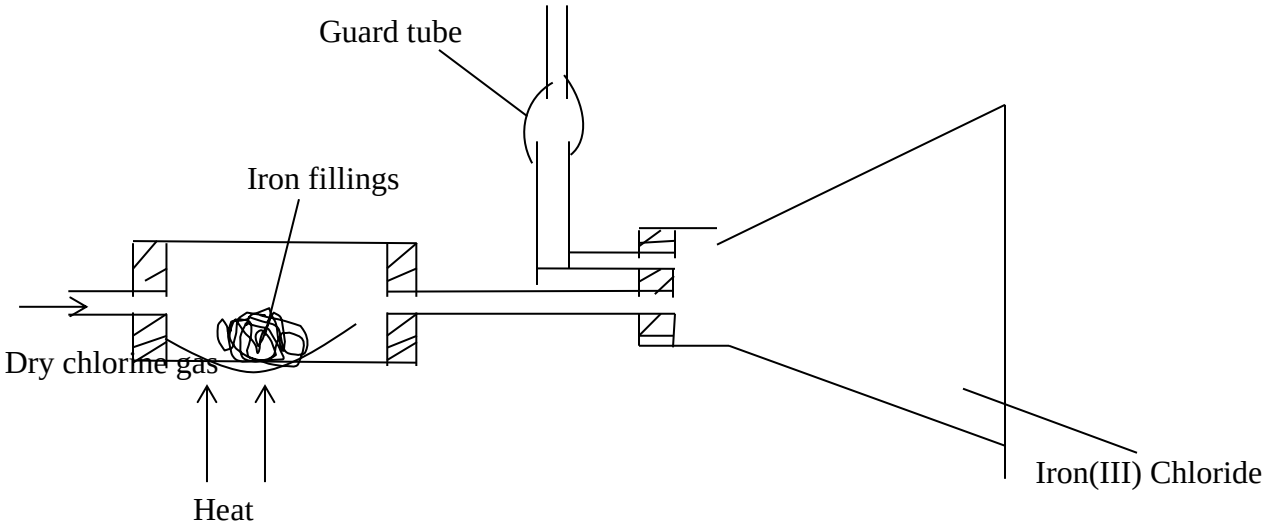
v. **Explain** how the molar heat of neutralization obtained in this experiment would compare with one that would be obtained using 1.0M ethanoic acid and $100cm^3$ of 1M sodium hydroxide solution. (2mks)

**Draw** an Energy level diagram for the reaction represented by reaction between hydrochloric acid and sodium hydroxide solution. (3mks)

3.

a. Give the name of **one** reagent which when reacted with concentrated hydrochloric acid produces chlorine gas. (1mk)

b. The set up below was used to prepare iron (III) chloride using the apparatus shown in the diagram below.




i. State **one** precaution that should be taken in carrying out the above experiment. (1mk)

ii. Explain why
Calcium oxide would be preferred to calcium chloride in the guard tube. (2mks)
It is necessary to pass chlorine gas through the apparatus before heating begins. (2mks)

iii. Write a **chemical** equation for the reaction that took place in the guard tube.(1mk)

iv. What property of Iron (III) chloride makes it possible to be collected as shown in the diagram? (1mk)

v. During the reaction in the combustion tube, the total mass of iron (III) chloride formed was found to be 1.5g. **Calculate** the volume of chlorine gas that reacted with iron. (Fe=56.0, CI=35.5 and molar gas volume at 298k is 24,000$cm^3$) (3mks)

c. **Draw** and **name** the structure of the compound formed when excess chlorine gas is reacted with ethane gas. (2mks)

d. State **one** use of chlorine gas. (1mk)

4.

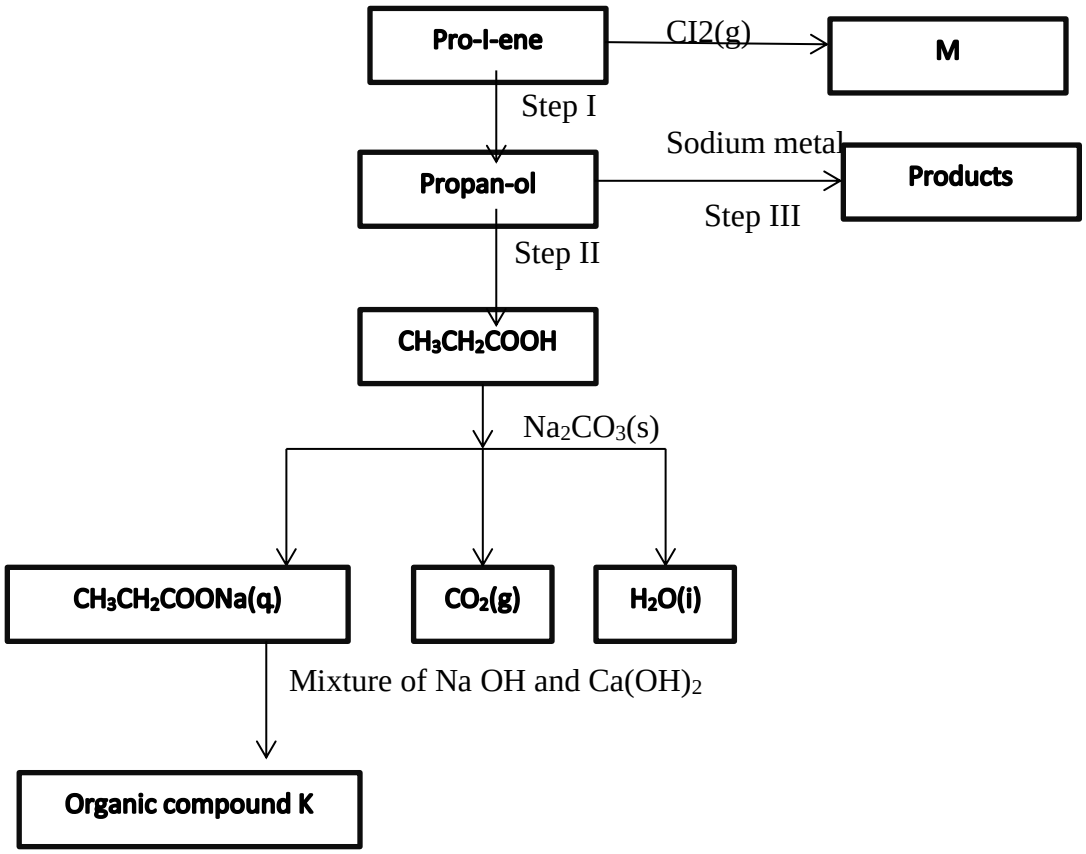
a. Give the systematic names for the following compounds

i. $HCOOCH_2CH_3$ (1mk)

ii. $CH_3CH_2CH_2CHCH2$ (1mk)

iii. CH C $CH_2$ $CH_3$ (1mk)

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




i. Identify the organic compound **K** (1mk)

ii. Write the formula of **M** (1mk)

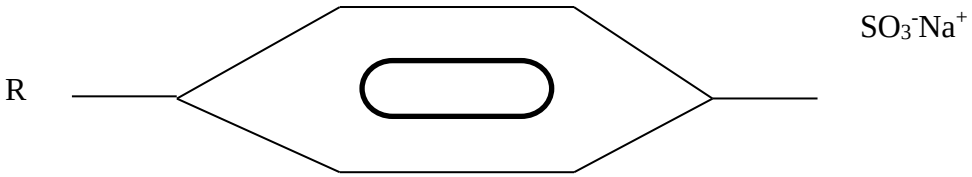
iii. Give **one** reagent that can be used in

Step I (1mk)

Step II (1mk)

iv. Write the equations for the reaction in **step II** (1mk)

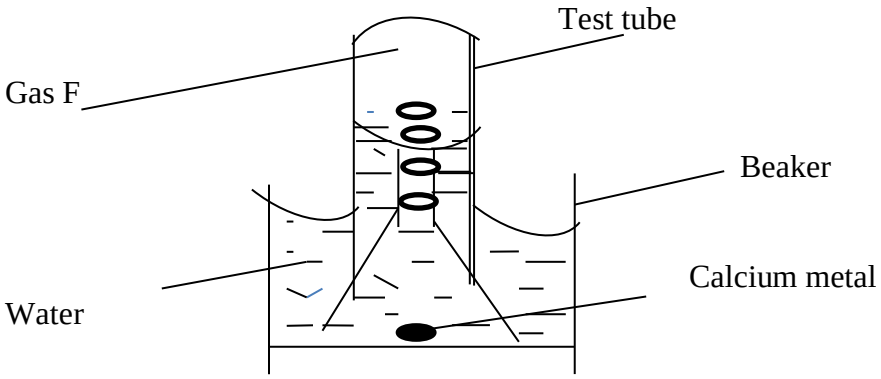
c. The structure below represents a type of cleansing agent.




**Describe** how the cleansing agent removes grease from a piece of cloth. (3mks)

5.

a. The set up below was used to collect gas F, produces by the reaction between water and calcium metal




i. Name gas **F** (1mk)

ii. At the end of the experiment, the solution in the beaker was found to be a week base. **Explain** why the solution is a weak base. (2mks)

iii. Give **one** laboratory use of the solution formed in the beaker (1mk)

b. When excess calcium metal was added to 50cm3 of 2 M aqueous copper (II)nitrate in a beaker, a brown solid and bubbles of gas were observed.

i. Write **two** equations for the reactions which occurred in the beaker. (2mks)

ii. **Explain** why it is not advisable to use sodium metal for this reaction. (2mks)

c. **Calculate** the mass of calcium metal reacted with copper(II)nitrate solution (Relative atomic mass of Ca=40 (2mks0

6.

a. Write the **formula** of the complex Ion formed in each of the reactions below.
i. Lead metal dissolves in hot alkaline solution. (1mk)

ii. Zinc hydroxide dissolves ammonia solution. (1mk0

b. Give the name of each of the processes described below which takes place when the salts are exposed to air for some time.
i. Anhydrous copper (II) sulphate becomes wet. (1mk)

ii. Iron (III) chloride forms an aqueous solution. (1mk)

iii. Fresh crystals of sodium carbonate decahydrate become covered with a powder of solution of carbonate monohydrate. (1mkl)

c. A certain hydrate salt has the following composition by mass. Iron 20.2%, sulphur 11.5%, water 45.5% and the rest oxygen. Its relative formula mass is 278.
i. **Determine** the formula of the hydrated salt (Fe=56,S=52, O=16, H=1) (3mks)

ii. 6.95g of the hydrated salt were dissolved in distilled water and the total volume made to 250$cm^3$ of solution. **Calculate** the concentration of the salt solution. (2mks)

7.The table below shows solubility of potassium nitrate and lead nitrate

| **Temperature $^oC$** | **0** | **20** | **40** | **60** | **80** | **100** |
|---|---|---|---|---|---|---|
| Solubility of $KNO_3$ in 100g of $H_2O$ | 12.5 | 32.5 | 62.5 | 110.0 | 137.5 | |
| Solubility of $Pb(NO_3)$in 100g of $H_2O$ | 37.5 | 52.5 | 69.0 | 87.5 | 110.0 | 131.0 |

i. Draw the solubility curves for both salts on the same axis. (Temperature on the x-axix) (3mks)

ii. A solution of lead nitrate contains 90g of the salt dissolved in 100g of water at 100$^o$C. This solution is allowed to cool to 25$^o$C

At what temperature will crystals first appear? (1mk)

What mass of crystals will be present at 25$^o$C (1mk)

iii. Which of the **two** salts is more soluble at 30$^o$C (1mk)

iv. Determine the concentration of lead nitrate in moles per litre when the solubility of the two salts are the same. **(Pb=207.0, O=16.0, K=39.0, N=14.0)** (3mks)

**PAPER 3**

1. You are provided with :
   Solution **Q**, 2M Hydrochloric acid.
   Solution **P**, 0.15M Sodium thiosulphate
   Solution **R**, Sodium carbonate

   **Procedure 1**

   Measure 20cm$^3$ of 0.15M Sodium thiosulphate (solution **P**) into a 100cm$^3$ a glass beaker. Place the beaker on a white piece of paper with **ink mark 'X'** on it. Measure 20cm$^3$ of 2M hydrochloric acid solution **Q** using a 50cm$^3$ measuring cylinder. Put the acid into the glass beaker containing Sodium thiosulphate and immediately start off the stop watch. Determine the time taken for the **marks 'X'** to become invisible/obscured when viewed from above. Repeat the procedure by measuring different volumes of the acid and adding the volume of the distilled water to complete table 1 below.

   **Table 1**

| **Volume of acid(cm$^3$)** | **Volume of water(cm$^3$)** | **Volume of sodium thiosulphate (cm$^3$)** | **Time taken for mark 'X' to be invisible/obscured(seconds)** | **Reciprocal of time (sec$^{-1}$) $\frac{I}{t}$** |
|---|---|---|---|---|
| 20 | 0 | 20 | | |
| 18 | 2 | 20 | | |
| 16 | 4 | 20 | | |
| 14 | 6 | 20 | | |
| 12 | 8 | 20 | | |
| 10 | 10 | 20 | | |

a. Complete the table below (6mks)
b. Plot a graph of I **(rate)** against volume of acid used. (3mks)
c. Explain the shape of your graph (1mk)

i. Time taken for the cross to be obscured/invisible when the volume of the acid is:
$15cm^3$ (1mk)
……
……
$8cm^3$ (1mk)
……
……

ii. The volume of the acid used if the time taken for the cross to be obscured/invisible is:
40seconds (1mk)
……
……..
43 seconds (1mk)
……
……

**Procedure 2**

Using a $10cm^3$ measuring cylinder, place $10cm^3$ of solution **Q** into a **250ml** volumetric flask. Add about $200cm^3$ of distilled water. Shake well. Add more distilled water to top up to the mark. Labeled this solution **T**. Fill the burette with solution **T**. using a pipette and pipette filler, pipette $25cm^3$ of solution **R** into a conical flask. Add **3 drops** of phenolphthalein and titrate with solution T.

- Record your results in the table
- Repeat the titration two more times and complete the table

**Table 2**

| | I | II | III |
|---|---|---|---|
| Final burette reading($cm^3$) | | | |
| Initial burette reading($cm^3$) | | | |
| Volume of solution T ($cm^3$) added | | | |

(4mks)

a. Determine the :
Average volume of solution **T** used (1mk)
……
……
……
Moles of the acid in the average volume of solution **T** used. (2mk)
……
……
……

Concentration of solution **R** in moles per litre. (2mks)

……

……

……

……

2.

a. Put a spatula end-full of **solid A** into a boiling tube and about $10cm^3$ of distilled water. Shake the mixture well. Divide the resultant solution into **4 equal** portions.

| **Observation** | **Inferences** |
|---|---|
| (½mk) | (1mk) |

b. To the first portion, add a little calcium hydroxide solid and warm. Test any gases produced using both blue and red litimus paper.

| **Observation** | **Inferences** |
|---|---|
| (1mk) | (1mk) |

c. To the second portion, **add 4** drops of hydrogen peroxide solution. Test the gas produced using a glowing splint.

| **Observation** | **Inferences** |
|---|---|
| (1mk) | (1mk) |

d.

i. The solution is also suspected to contain sulphite ions. Using Barium nitrate solution and dilute hydrochloric acid solution. **Describe** how you would confirm presence of the sulphite ions.

| **Observation** | **Inferences** |
|---|---|
| (1mk) | (1mk) |

ii. Carry out the actual test as described in (d) (i) above

| **Observation** | **Inferences** |
|---|---|
| (1mk) | (1mk) |

3. You are provided with solid **B**. carry out the tests below and record your observation and inferences in the spaces provided.

i. Place one third of solid **B** on a metallic spatula. Burn it in a non-luminous flame of the Bunsen burner.

| **Observation** | **Inferences** |
|---|---|
| (1mk) | (1mk) |

ii. Place the remaining solid in a test-tube. Add about **$6cm^3$** of distilled water and shake the mixture well. Divide the resulting mixture into 4 portions.

| **Observation** | **Inferences** |
|---|---|
| | |

| | |
|---|---|
| (½mk) | (½mk) |

a. To the first portion, **add 2** drops of acidified potassium manganite (VII)

| **Observation** | **Inferences** |
|---|---|
| (1mk) | (1mk) |

b. To the second portion, **add 3** drops of acidified potassium dichromate (VI) and warm

| **Observation** | **Inferences** |
|---|---|
| (1mk) | (1mk) |

c. To the third portion, **add 1g** of solid sodium hydrogen carbonate.

| **Observation** | **Inferences** |
|---|---|
| (½mk) | (½mk) |

d. To the fourth portion, **add 5 drops** of ethanol followed by few drops of dilute sulphuric (VI)acid and warm

| **Observation** | **Inferences** |
|---|---|
| (½mk) | (½mk) |

**KCSE PREDICTION 4 2022**
**PAPER I**

1. State and explain the change in mass that occur when the following substances are separately heated in open crucibles.

a) Copper metal **(1 $\frac{1}{2}$ marks)**

……
……

b) Copper (II) nitrate **(1 $\frac{1}{2}$ marks)**

……
……

2. (a) State Graham's law of diffusion **(1 mark)**

……
…… (b) A volume of 120 $cm^3$ of nitrogen gas diffused through a membrane in 40 seconds, how long will 240$cm^3$ of carbon (IV) oxide defuse through the same membrane? **(2 marks)**

3. A reaction of Propane with chlorine gas gave a compound of formula $C_3H_7Cl$.

**a)** What condition is necessary for the above reaction to take place. **(1 mark)**

……

b) Draw the structural formula of the compound $C_3H_7Cl$ **(2 marks)**

4. Name a gas which is used together with Oxygen in welding. **(1 mark)**

……
……

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

(The letters are not the actual symbols of the elements)

| Element | B | C | D | E | F |
|---|---|---|---|---|---|
| Atomic number | 18 | 5 | 3 | 5 | 20 |
| Mass number | 40 | 10 | 7 | 11 | 40 |

(i) Which two letters represent the same elements? Give reason. **(2 marks)**

……

(ii) Give the number of neutrons in an atom of element D. (Show your working) **(1 mark)**

6. A hydrated salt of copper has the formula $CuSO_4.nH2O$. About 25g of the salt was heated until all the water evaporated. If the mass of the anhydrous salt is 16.0g, find the value of n. (Cu = 64.0, S = 32.0, O = 16.0, H = 1) **(3 marks)**

7. The table below shows the pH values of the solutions I, II, III and IV

| **Solution** | **I** | **II** | **III** | **IV** |
|---|---|---|---|---|
| pH | 2 | 7 | 11 | 14 |

a) Which solution is likely to be that of calcium hydroxide? **(1 mark)**

……

b) Select the solution in which a sample of aluminum oxide is likely to dissolve. Give a reason for your answer. **(2 marks)**

……

……

**c)** Select a pair of solutions that would likely give a pH of 7 when equal volumes are reacted with each other. **(1 mark)**

……

……

8. Sodium chloride has a higher melting point than hydrogen chloride, explain. **(2 marks)**

……

……...

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

| substance | M.pt $^{o}$C | B.pt $^{o}$C | Electrical conductivity in solid state | Electrical conductivity in molten state |
|---|---|---|---|---|
| J | 365 | 463 | Nil | Nil |
| K | 1323 | 2773 | Good | Good |
| L | 1046 | 1680 | Nil | Good |
| M | 2156 | 2776 | Nil | Nil |

Place J, K, L and M in the appropriate categories from the following:

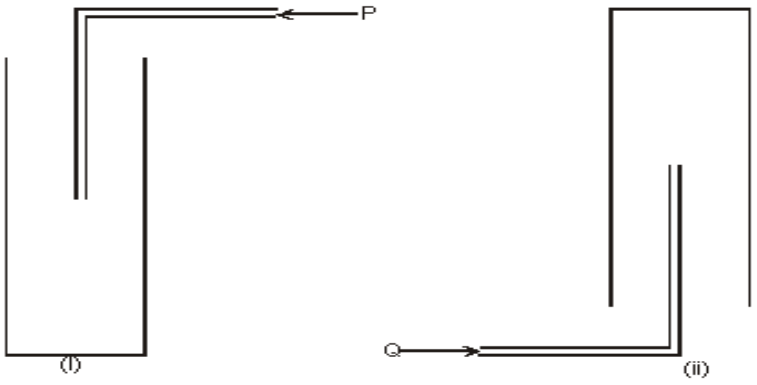
***1.*** Metallic solid _____ **(1 mark)**

***2.*** Covalent network solid _____ **(1 mark)**

***3.*** Ionic solid _____ **(1 mark)**

***4.*** Covalent molecular solid_____ **(1 mark)**

**10.** The diagram below shows how two gases, P and Q were collected.




a) Name the two methods used. **(2 marks)**

(i)..……(ii) ……....

b) State properties of P and Q that enable them to be collected through the methods shown.

**(2 marks)**

……

……...

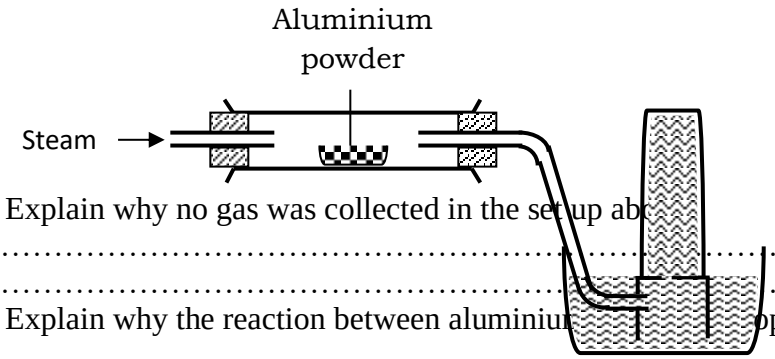
**11.** Study the information in the table below and answer the questions in the table below and answer the questions below the table

| Bond | Bond Energy ($KJmol^{-1}$) |
|---|---|
| C-H | 414 |
| Cl-Cl | 244 |
| C-Cl | 326 |
| H-Cl | 431 |

Calculate the enthalpy change of the following reaction

$CH_{4\,(g)} + Cl_{2\,(g)} \xrightarrow{\text{U.V. light}} CH_3Cl_{(g)} + HCl_{\,(g)}$ **(3 marks )**

**12.** Study the diagram below used to investigate the property of steam on aluminium




**(a)** Explain why no gas was collected in the set up ab **(1 mark)**

……

……

(b) Explain why the reaction between aluminiu ops after a short time.

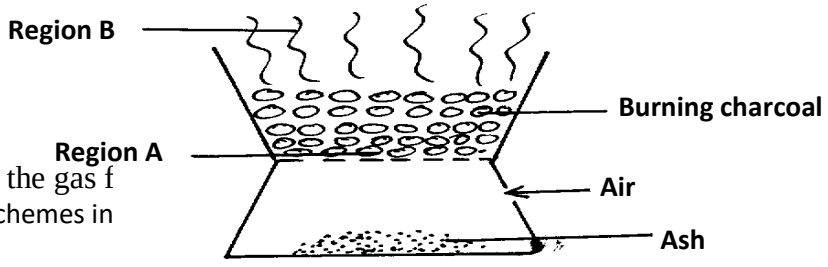
**(2 marks)**

……

……

**13.** A pupil analyzed a commercial vinegar solution by titration and found that 24.5$cm^3$ of 0.09 M sodium hydroxide solution was required for titration of 10 $cm^3$ of vinegar. Calculate the molarity of ethanoic acid $CH_3COOH$ in vinegar. **(3 marks)**

**14.** The diagram below shows a 'jiko' when in use. Study it and answer the questions that follow




(a) Identify the gas f **(1 mark)**

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……

(b) Using an equation, explain what happens at region **A** **(2 marks)**

……

……

**15.** Sodium chloride is contaminated with copper (II) oxide. Explain how pure sodium chloride can be obtained from the mixture. **(3 marks)**

……

……

……

……

……

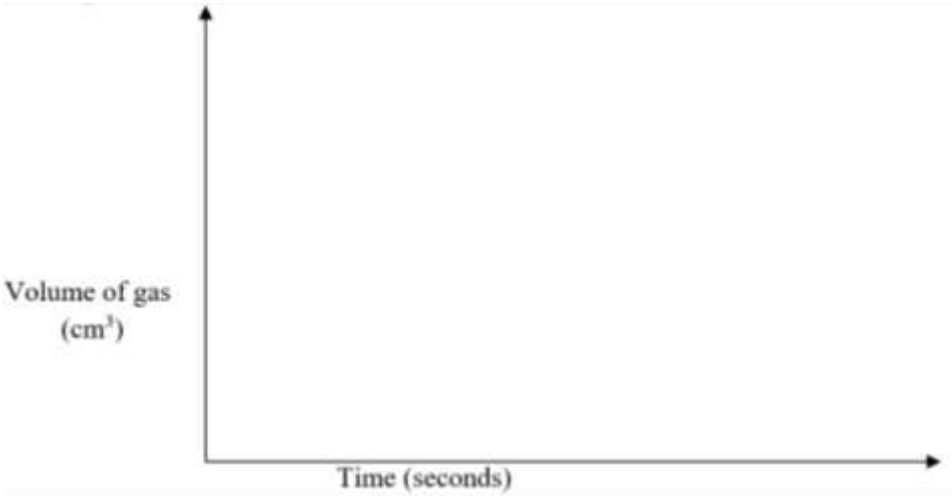
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**16.** The table below gives three experiments on the reaction of excess sulphuric (VI) acid and 0.5g of zinc done under different conditions. In each the volume of gas was recorded at different time intervals.

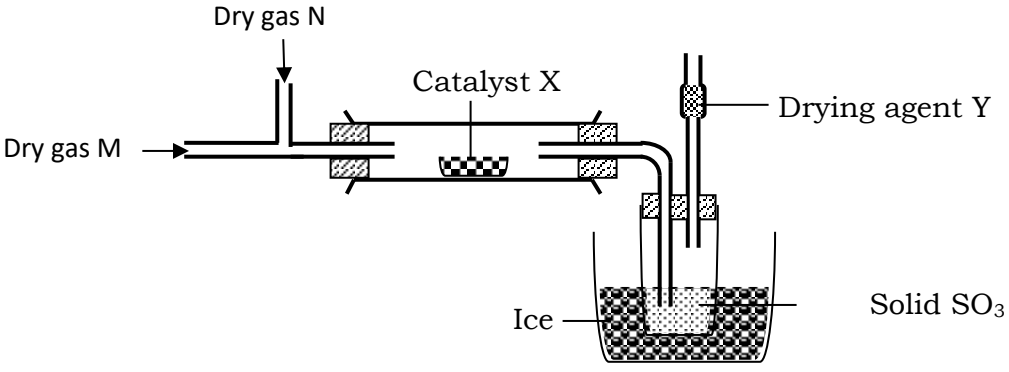
| **Experiment** | **Form of zinc** | **Sulphuric (VI) acid solution** |
|---|---|---|
| I | Powder | 0.8M |
| II | Powder | 1.0M |
| III | Granules | 0.8M |

On the axis below, draw and label the **three curves** that could be obtained from such results.

**(3 marks)**




**17.** The set-up of apparatus below used to prepare sulphur (VI) oxide:




(i) Name Gas N…… and Gas M…….. **(1 mark)**

(ii) Catalyst X ……... **(1 mark)**

(iii) Why is it necessary to use drying agent Y? **(1 mark)**

……

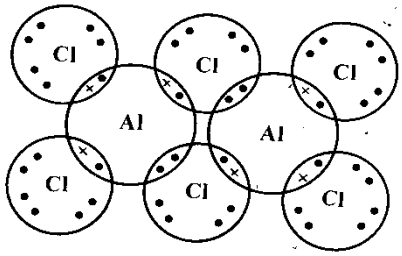
**18.** State and explain the observation made when chlorine gas is bubbled into potassium iodide solution. **(2 marks)**

……

……

……

**19.** The diagram below shows an arrangement of electrons in Aluminium chloride dimer.




**(i)** Write down the formula of the above molecule. **(1 mark)**

……

**(ii) On the diagram**, indicate using an arrow the dative bond. **(1 mark)**

**20.** When Magnesium metal is burnt in air, it reacts with both oxygen and nitrogen gases giving a white solid with black specs. Write two equations for the reactions that take place. **(2 marks)**

……

……

**21.** Below is a representation of an electrochemical cell.

$Pb_{(s)}|Pb^{2+}_{(aq)}||Ag^{+}_{(aq)}|Ag_{(s)}$

a) What does || represent? **(1 mark)**

……

b) Given the following:

| | $E^{\theta}$ (volts) |
|---|---|
| $Pb^{2+}_{(aq)} + 2e^{-} \longrightarrow Pb_{(s)}$ | -0.13 |
| $Ag^{+}_{(aq)} + e^{-} \longrightarrow Ag_{(s)}$ | +0.80 |

Calculate the E.M.F of the electrochemical cell **(2 marks)**

……

**22.** When hot concentrated nitric (V) acid is added to sulphur, a red – brown gas and a colourless liquid are formed.

(i) Write an equation for the reaction. **(1 mark)**

……

……

(ii) Identify the oxidizing agent in the reaction above. **(1 mark)**

……
……

(iii) State **one** environmental hazard of the nitrogen compounds. **(1 mark)**

……

**23.** Draw the dot (.) and cross (x) structure of:

a) Carbon (II) oxide - CO **(2 marks)**

b) Ammonium ion - $NH_4^+$ **(2 marks)**

**24.** Using sodium hydroxide solution, describe a chemical test that can be used to distinguish between copper (II) ions and iron (II) ions. **(3 marks)**

……

……

**25.** State and explain what would be observed if concentrated sulphuric (VI) acid is added to:

(a) Sugar crystals **(1 ½ marks)**

……

……

……

(b) Copper (II) sulphate crystals **(1 ½ marks)**

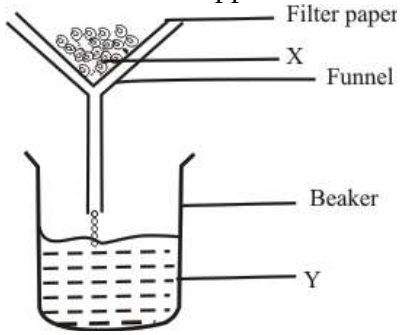
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**26.** When 100 $cm^3$ of 0.5 M sulphuric acid solution, $H_2SO_4$, react with 100 $cm^3$ of 1 M sodium hydroxide solution, NaOH, the temperature rises by 6.85 Kelvins.
(Density = 1.0g/$cm^3$, specific heat capacity = 4.2kJ$kg^{-1}K^{-1}$)
Calculate the molar heat of neutralization described by the equation: **(3 marks)**
$H_2SO_{4(aq)} + 2NaOH_{(aq)} \rightarrow Na_2SO_{4(aq)} + 2H_2O_{(l)}$

**27.** Filtration is carried out in the apparatus shown




a) Name **X** …… **($\frac{1}{2}$ mark)**

b) State **one** property that makes it possible to separate mixtures using filtration. **($\frac{1}{2}$ mark)**

……..

**28.** Calculate the oxidation numbers of sulphur in the following species: **(3 marks)**

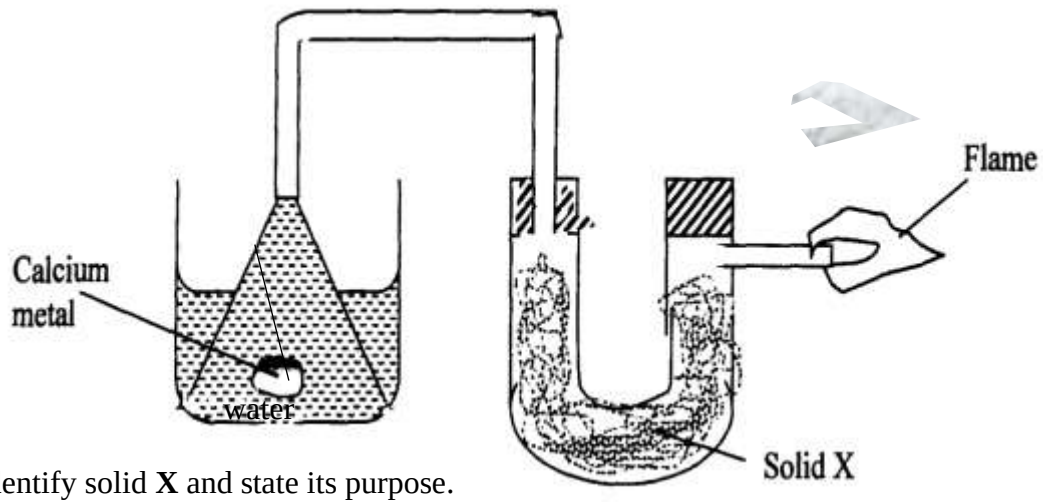
a) $SO_3^{2-}$

b) $SO_3$

c) $S_2O_3^{2-}$

**PAPER 2**

1. i) The setup below was used to investigate the reaction between metals and water.



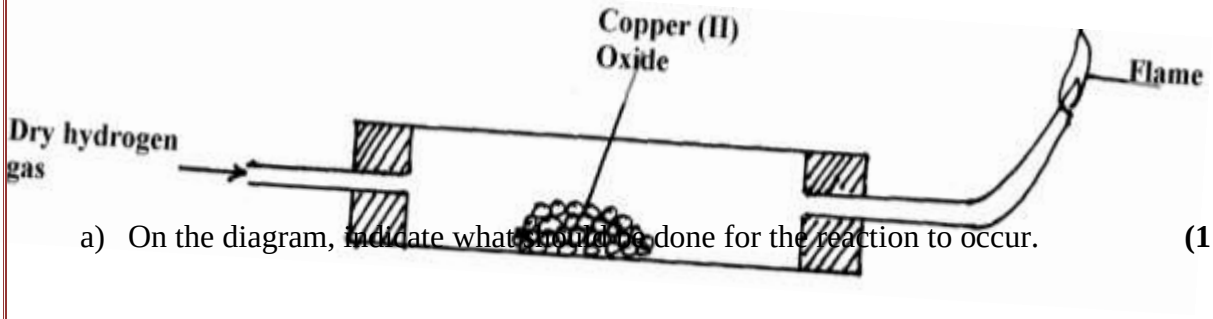

a) Identify solid **X** and state its purpose.
Solid X …… **(½ mark)**

Purpose …… **(½ mark)**

b) Write a chemical equation for the reaction that produces the flame. **(1 mark)**

……

ii) The set-up below was used to investigate the properties of hydrogen.




a) On the diagram, indicate what should be done for the reaction to occur. **(1 mark)**

b) Hydrogen gas is allowed to pass through the tube for some time before it is lit. Explain.
**(1 mark)**

……

……

c) Write an equation for the reaction that occurs in the combustion tube. **(1 mark)**
……
……
……

d) When the reaction is complete, hydrogen gas is passed through the apparatus until it cools down. Explain. **(2 marks)**

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……
……

e) What property of hydrogen is being investigated? **(1 mark)**

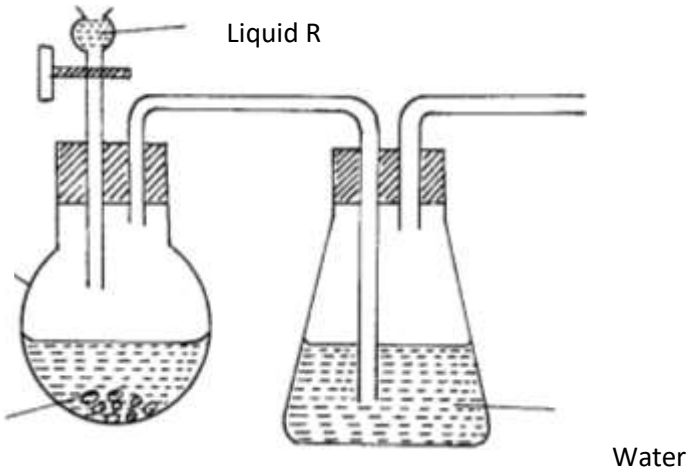
……
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f) What observation confirms the property stated in (**v)** above? **(1 mark)**

……

vii) Why is zinc oxide not used to investigate this property of hydrogen gas? **(1 mark)**

2. I. The diagram below represents an incomplete set-up of apparatus that can be used to prepare and collect dry carbon (iv) oxide gas. Complete the diagram and answer the questions that follow.




a) Complete the above diagram. **(3 marks)**

b) Identify liquid R. …… **(1mark)**

c) Write the equation for the reaction taking place in the flask S. **(1 mark)**

……

d) Explain why it is not advisable to use lead (II) carbonate in place of marble chips. **(1 mark)**

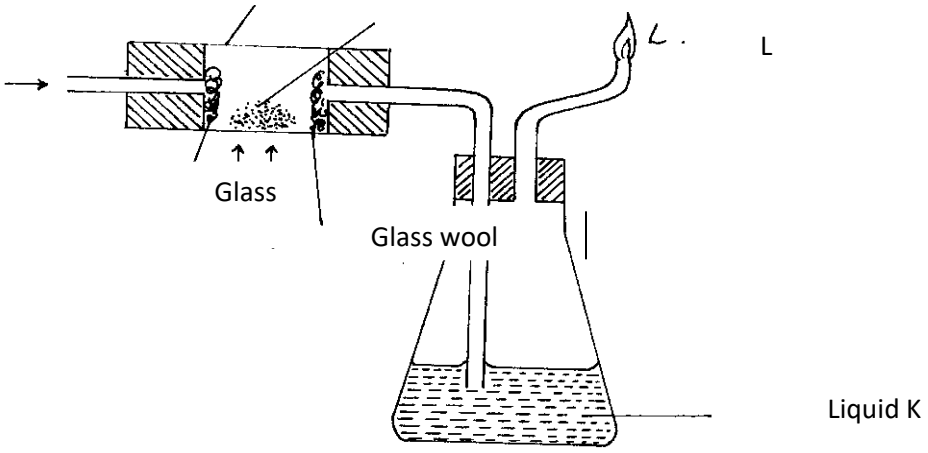
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II. The diagram below is used to investigate the effect of carbon (II) oxide on lead (II) oxide. Study it and answer the questions that follow.

Combustion tube M

Lead (II) oxide

CO




a) Write an equation for the laboratory preparation of carbon (II) oxide. **(1 mark)**

……

b) State and explain the observation in the combustion tube M. **(2 marks)**

……

……

c) Identify liquid K and state its function. **(1 mark)**

……

……

d) Why is it necessary burn excess gas at L. **(1 mark)**

……

……..

3. a) Name the following organic compounds.

i) $CH_3COOCH_2CH_3$ **(1mark)**

……

ii) $CH_3CH_2CHCCHCH_2CH_3$ **(1mark)**

……..

4. a) The fermentation of glucose is catalysed by enzymes from yeast. Yeast is added to aqueous glucose, the solution starts to bubble and becomes cloudy as more yeast cells are formed.

$C_6H_{12}O_{6(aq)} \longrightarrow 2C_2H_5OH_{(aq)} + 2CO_{2(g)}$

The reaction is exothermic. Eventually the fermentation stops when the concentration of ethanol is about 12%.

On a large scale, the reaction mixture is cooled. Suggest a reason why this is necessary. **(1mark)**

(ii) Why does the fermentation stop? Suggest one reason. **(1mark)**

……

……..

(iii) What technique is used to concentrate the aqueous ethanol? **(1mark)**

……
……
b) A compound X contains carbon, hydrogen and oxygen only. X contains **54.54**% of carbon by mass, **9.09**% of hydrogen by mass and **36.37**% of oxygen by mass. (C=12, O=16, H=1)

Determine the empirical formula of compound X. **(2marks)**

……
……
……..

Compound X has a relative molecular mass of 88. Draw the structural formula of compound X. **(2marks)**

c) The table below gives formulae of three organic compounds A, B and C

| Compound | Formulae |
|---|---|
| A | **$C_2H_4O_2$** |
| B | **$C_2H_6O$** |
| C | **$C_2H_6$** |

Giving a reason in each case, select the letter(s) which represent a compound that

Decolourises acidified potassium manganate (VII). **(1mark)**

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……

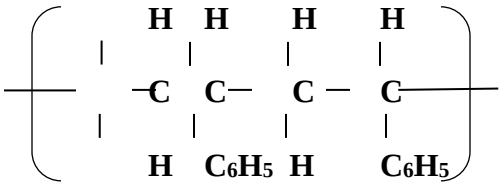
.Gives effervescence with sodium hydrogen carbonate. **(1mark)**

……
……

Undergoes substitution reaction with chlorine gas. **(1mark)**

……
……

d) The following is a small reaction of polystyrene polymer. Study it and answer the questions that follow.



(i) Draw the structure of the monomer unit of polystyrene. **(1mark)**

(ii) Calculate the number of monomers used to form the polystyrene of relative molecular mass of 18096.
( H = 1, C = 12 ) **(1mark)**

5. An experiment was carried out using magnesium ribbon and dilute hydrochloric acid of different concentrations. The time needed to produce 50$cm^3$ of the gas for every experiment was recorded in a table.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Concentration of HCl (moles per litre) | 2.0 | 1.75 | 1.50 | 1.25 | 1.00 | 0.75 | 0.50 | 0.25 |
| Time (seconds) | 8.8 | 10.0 | 11.7 | 14.0 | 17.5 | 18.7 | 35.0 | 70.0 |
| $\frac{1}{time}$ ( $Sec^{-1}$) | | | | | | | | |

Complete the table above for $^{1}/_{time}$. **(4marks)**
Plot a graph of rate i.e $^{1}/_{time}$ against concentration. **(3marks)**

6. When lead (II) Carbonate is reacted with dilute sulphuric (VI) acid, the reaction takes place for a short time and then stops. Explain. **(2marks)**

7. Study the following information and answer the questions below.

| Number of carbon atoms per molecule | Relative molecular mass of hydrocarbon |
|---|---|
| 2 | 26 |
| 3 | 40 |
| 4 | 54 |

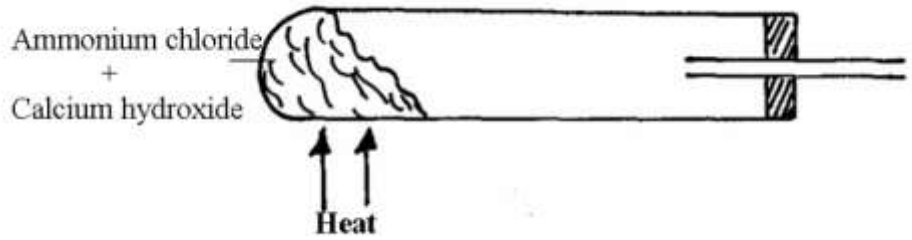
a) Determine the general formula of the hydrocarbons and the homologous series they belong to**.** **(2marks)**

(b) Draw the structure formula of the fourth number of the series. **(1mark)**

(b) Draw the structure formula of the fourth number of the series. **(1mark)**

8. a) A hydrocarbon undergoes the process represented by the equation below to produce two other hydrocarbons. C10H22 X + C6H14 (a) Name the process undergone by the hydrocarbon. **(1mark)**
……
……
(b) State one condition necessary for the process. **(1mark)**
……..
……
(c) To which homologous series does substance X belong? **(1mark)**

9. Complete the diagram to show how a sample of dry ammonia gas can be prepared in the laboratory. **(3marks)**




10. In an experiment to study the properties of concentrated nitric acid, a mixture of the acid and wood charcoal was heated in a boiling tube.
    (a) What observations were made? Explain your answer **(2marks)**

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

11. Three nitrates Q,R, and S were each heated and the products formed were tabulated as shown below. Nitrate Products Q R S Metal Nitrite + Oxygen Metal + Nitrogen IV Oxide + Oxygen Nitrogen I Oxide + water
    a) Identify S …….. **(1mark)**
    R…… **(1mark)**
    b) What is the name given to elements in the same group as Q? **(1mark)**

12. a) An oxide of nitrogen contains 30.4% nitrogen. Its density at s.t.p is 4.11g/dm3. Determine the molecular formula of the compound. (N=14; O=16; moles gas volume = 22.4dm3) **(3marks)**

    b) Magnesium ribbon was burnt in a gas jar of nitrogen. A few drops of water were added to the solid formed in the jar. Write an equation for the second reaction. **(1mark)**

13. In a experiment, 10.6g of a mixture of Anhydrous Sodium Carbonate and Sodium Chloride were dissolved in water to make 100cm3 of a solution required 20.0cm3 of 0.5M Hydrochloric acid solution for complete neutralization. What is the mass of Sodium Carbonate in the mixture? (Na = 23.0, C = 12.0, O = 16.0, Cl = 35.5) **(3marks)**

14. The table below gives some properties of compounds P, Q, R and S Compound M.p (0C) b.p (0C) Conductivity in water P -23 77 Does not conduct Q -19 74 Does not conduct R -85 -61 Conducts S 714

1407 Conducts (a) Which one of the compounds in the table is ionic? Explain.**(1mark)**

……

……

(b) Which one of the compound (s) in the table is/are liquid(s) at room temperature? Give reasons**.**

**(2marks**)

……

……

……

(c) Which of the compound(s) is / are gas(s) at room temperature? Explain. **(1mark)**

15. Given that element A,B and C have atomic numbers 14, 11 and 17 respectively,
draw and name the bonding in the compounds formed using dots (.) and (X), when the following element react.
Name the type of bond formed between B and C
(a) B and C **(2marks)**

(b) A and C **(2marks)**

**PAPER 3**

1. You are provided with;
   - Solution **A**: 0.02M acidified potassium manganate (VII) solution.
   - Solution **B**, which is prepared by dissolving 5.88g of ammonium iron (II) sulphate in 250$cm^3$ of distilled water.
   - Solution **C**: 0.25M oxalic acid.

You are required to:

(i) Determine the number of moles of **B** that react with one of potassium manganate (VII)
(ii) Determine the rate of reaction between solution **C** and **A** at different temperatures.

**Procedure I.**

Fill the burette with solution **A**. using a clean pipette, place 25.0$cm^3$ of solution **B** into a clean conical flask, and titrate with solution **A** until the solution becomes permanent pink. Record your results in table I below. Repeat the procedure two more times to complete table I.**(RETAIN THE REMAINING SOLUTION A FOR USE IN PROCEDURE II)**

a) Table I.

| | **I** | **II** | **III** |
|---|---|---|---|
| Final burette reading($cm^3$) | | | |
| Initial burette reading ($cm^3$) | | | |
| Volume of solution **A** used. ($cm^3$) | | | |

(4 marks)

b) Calculate the:

(i) Average volume of solution **A** used. (1 mark)

……

……

……

(ii) Number of moles of solution **A** used. (1 mark)
(iii) Concentration of solution **B** in moles per litre. (RFM of **B** is **392**) (1 mark)

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……

c) Calculate the number of moles of **B**:

(i) In 25.0cm$^3$ of solution. (1 mark)

……
……
……
……

(ii) Which react with one mole of solution **A(** Acidified potassium manganite (VII) **)** (1 mark)

……
……
……

**Procedure II.**

Place 5 test tube on a test tube rack. Fill the burette with solution **A**. To each test tube place 10.0cm$^3$ of solution A from the burette. Using a clean 10ml measuring cylinder, place 10.0cm$^3$ of solution **C** into a clean boiling tube. Insert a thermometer in solution **C** in the boiling tube. Heat solution C in the warm water bath until it attains a temperature of **40$^0$C**.

Remove the boiling tube from the water bath and place it in a test tube rack. Add the first portion of solution **A** and immediately start a stop watch. Record the time taken for the purple colour of the mixture to decolourise in table 2 below. Repeat the experiment by using 10.0cm$^3$of solution **C** at temperature of**40$^0$C, 500C, 600C, 700Cand 80$^0$C**.Record the time taken in each case in table 2 below.

d) Table 2

| Temperature | **40** | **50** | **60** | **70** | **80** |
|---|---|---|---|---|---|
| Time taken in seconds | | | | | |
| $\frac{1}{Time}(\sec^{-1})$ | | | | | |

($3\frac{1}{2}$ marks)

e) Complete the table by computing $\frac{1}{Time}(\sec^{-1})$ ($2\frac{1}{2}$ marks)

f) Plot a graph of $\frac{1}{Time}(\sec^{-1})$ against temperature. (3 marks)

g) From the graph determine the time that would be taken if the temperature was 52.0$^0$C.( 1 mark)

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……

h) How does the rate of reaction of acidified potassium manganate (VII) with oxalic vary with temperature? (1 mark)

……
……

2. You are provided with solid **P** which is a mixture of two salts. You are required to carry out the tests below on solid **P**. Write you observations and inferences in the spaces provided.

(a) Place the entire solid in a boiling tube. Add about $10cm^3$ of distilled water and shake. Filter the mixture. Retain both the residue and the filtrate.

| Observation | Inference |
|---|---|
| (1mark) | (1mark) |

(b) Divide the filtrate into four portions.

I. To the first portion, add sodium hydroxide solution drop wise until in excess.

| Observation | Inference |
|---|---|
| (1mark) | `` (1 mark) |

II. Dip a nichrome wire loop into the second portion. Hold the wire in a non-luminous Bunsen burner flame.

| Observation | Inference |
|---|---|
| ($\frac{1}{2}$ mark) | ($\frac{1}{2}$ mark) |

III. To the third portion, add 2 drops of Barium nitrate.

| Observation | Inference |
|---|---|
| (1mark) | (1mark) |

IV. To the fourth portion, add 2 drops of acidified potassium manganate (VII)

| Observation | Inference |
|---|---|
| (1mark) | (1mark) |

(c) (i) Scrap the residue from the filter paper and put it in a test tube. Add about $5cm^3$ of dilute nitric (V) acid.

| Observation | Inference |
|---|---|
| (1mark) | (1mark) |

(ii) To about $2cm^3$ of the resultant solution in C(i), add2M ammonia solution dropwise until in excess.

| Observation | Inference |
|---|---|
| (1mark) | (1*mark*) |

3. You are provided with an organic compound labeled **solid T**. Carry out the tests indicated below and write your observations and inferences in the spaces provided.
   a) Put half of **solid T** on a clean metallic spatula and ignite.

| Observations | Inferences |
|---|---|
| (1 mark) | (1 mark) |

   b) Put the remaining **solid T** in a boiling tube. Add $10cm^3$ of distilled water and shake. Divide the mixture into four portions.

i) Using the first portion, determine the $P^H$ of solution T

| Observations | Inferences |
|---|---|
| $(\frac{1}{2}\,mark)$ | $(\frac{1}{2}\,mark)$ |

ii) To the second portion, add sodium hydrogen carbonate solid.

| Observations | Inferences |
|---|---|
| (1 mark) | (1 mark) |

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

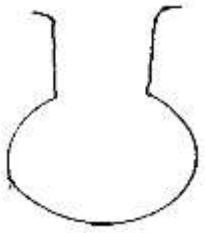
| Observations | Inferences |
|---|---|
| (1 mark) | (1mark) |

**KCSE PREDICTION 5 2022**
**PAPER I**

1. (a) Give two reasons why glass apparatus are used for heating in the laboratory. (2marks)

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.....
.....

(b)The diagram below shows a laboratory apparatus.



(a) Name the apparatus (1 mark)

……

2. (a) State Graham's law of gaseous diffusion (1 mark)

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.....
.....

(b) 60 $cm^3$ of ozone ($O_3$) diffused through a semi permeable membrane in 80 seconds. Calculate the time taken for 90 $cm^3$ of nitrogen (IV) oxide ($NO_2$) to diffuse under the same conditions. (O=16, N=14). (3marks)

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3. The grid below is part of the periodic table. Study it and answer the questions that follow. The letters are not actual symbols of elements.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| A | | | D | E | | | H | I |
| B | C | | M | | F | G | | J |
| | | | | | | | | |

(a) What is the name given to the chemical family of element **C**? (1 mark)

……

b) Compare the ionization energies of **B** and **M**. Explain. (2 marks)

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4. Describe how a sample of Lead (II) chloride can be prepared using the following reagents dilute nitric (V) acid; dilute hydrochloric acid and lead carbonate (3marks)

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5. a) Distinguish between nuclear fission and nuclear fusion. (1 mark)

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.....
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b) Calculate the values of P and Q in the following nuclear equation.

$^{239}_{92}U \rightarrow {}^{p}_{Q}Th + 2\alpha + 2\beta$ (2 marks)

.....
.....
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.....

6. I. When aqueous solution of Iron(II)chloride and potassium thiocyanate are mixed, the equilibrium below was achieved:

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

(brown) (colourless) (blood red)

State and explain the effect of adding a few drops of potassium hydroxide to the equilibrium mixture. (2marks)

.....
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II. Given the reaction below

$Zn_{(s)} + 2HCl_{(aq)} \longrightarrow ZnCl_{2(aq)} + H_{2(g)}$

State how the following factors affect the rate of reaction giving explanation

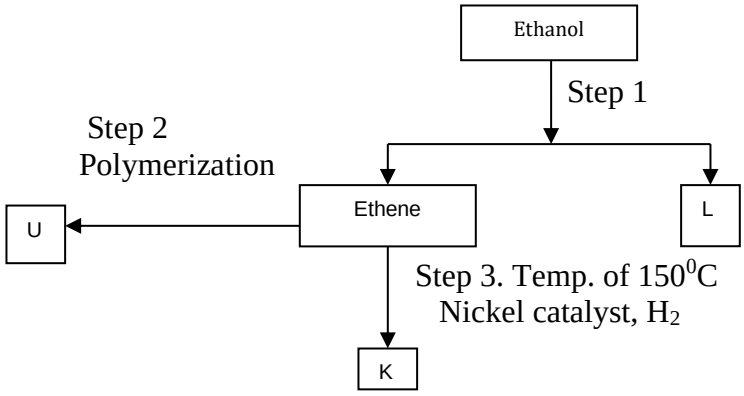
(a) Using Zinc powder instead of granules (1mark)

……
……..……..

(b) Heating the reactants (1mark)

……
……

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




(a) Identify substances : K, U, L (1 mark)

.....

(b) State the conditions for the reaction in step 1 to occur. (1 mark)

……

8. The following data refer to an element X.

| **Isotope** | **P** | **Q** | **R** |
|---|---|---|---|
| Mass | 54 | 56 | 57 |
| %abundance | 6 | 92 | 2 |

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

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.....

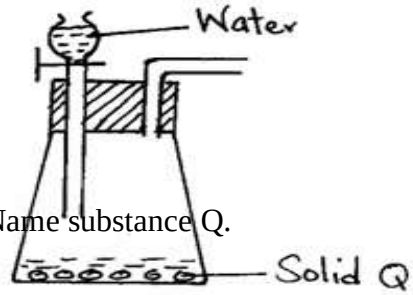
9. a) State Faraday's law of electrolysis (1 mark)

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.....

b) When a current of 2.5 amperes was passed through a cell containing $N^{2+}$ ions of a metal for 25minutes, the mass of the cathode increased by 0.36g. Determine the relative atomic mass of element N. (*1 Faraday = 96500 coulombs*) (3 marks)

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.....
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.....

10. The diagram below represents a set-up used to prepare oxygen gas.




(a) Name substance Q. (½ mark)

.....

(b) Complete the set-up to show how dry oxygen gas is collected. (1½ marks)

(c) Write the equation for the reaction that occurs when magnesium burns in air (1 mark)

.....

11. In an experiment to investigate the reaction between acids and metal carbonates, a student reacted zinc carbonate with dilute hydrochloric acid, and the resulting gas was bubbled in excess through lime water in a boiling tube.

(a) State and explain the observations made in the boiling tube at the end of the experiment. (2 marks)

.....
.....
.....

(b) Write an equation for the reaction took place at the end of the experiment. (1 mark).

……

12. Use the thermo-chemical equations below to answer the questions that follow.

$C_{(s)} + O_{2(g)} \longrightarrow CO_{2(g)}$ $\quad {}_{\Delta}H = -406KJ\ mol^{-1}$

$H_{2(g)} + \frac{1}{2} O_{2(g)} \longrightarrow H_2O_{(l)} \Delta H = -286KJmol^{-1}$

$C_3H_{8(g)} + 5O_{2(s)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(l)} \Delta H = -2209KJmol^{-1}$

Draw an energy cycle diagram and use it to calculate the heat of formation of propane. (3 marks)

13. A student mixed equal volumes of Ethanol and ethanoic acid. He added a few drops of concentrated Sulphuric (VI) acid and warmed the mixture.

(i) Name and write the formula of the main products(1 mark)

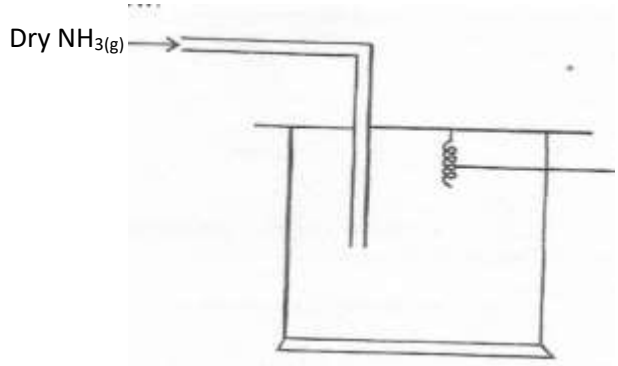
Name……..…….

Formula……..…..

(ii) Which homologous series does the product named in (i) above belong? (1mark)

……

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




(i) Write an equation for the reaction that takes place in the gas jar (1mark)

……..……

(ii) What is the role of hot nichrome wire? (1mark)

……..……

……..

(iii) Write the formula of the complex ion formed when excess ammonia gas is passed through a solution containing $Zn^{2+}$ ions. (1mark)

……..……

15. a) Define the term allotrope (1mark)

.....

.....

(b). Name two non-crystalline allotropes of sulphur (1mark)

.....

(c) Diamond and graphite are both allotropes of carbon. Explain why graphite is used as a lubricant whereas diamond is used as an abrasive. (1 mark)

.....

16. The table below shows PH values of some solutions

| Solution | A | B | C | D |
|---|---|---|---|---|
| PH values | 13 | 7 | 1 | 6.5 |

(a) What solution reacts vigorously with Magnesium metal? (1mark)

……..……

(b) Industrial Hydrochloric acid (1mark)

……..……

(c) Which solution forms complex ions with zinc (II) oxide? (1mark)

……

17. Draw the structural formula for each of the following compounds

(a) 4,4-dimethylpent-2-ene (1mark)

.....

.....

.....

.....

(b) Give the systematic IUPAC name of the following substances

ii) $CH_3$ CH Br CH Br $CH_3$ (1mark)

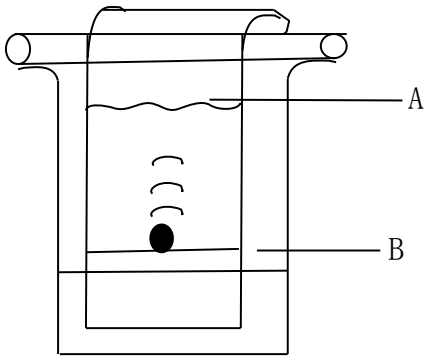
……..

18. A hydrated salt has the following composition by mass. Iron is 20.2%, oxygen is 23.0% sulphur is 11.5%, water 45.3%. Its relative formula mass is 278. Determine the formula of the hydrated salt.

(Fe=56, S=32.0, O=16, H=1) (2marks)

19.

20. The diagram shows the apparatus used to separate different dyes in food colouring.

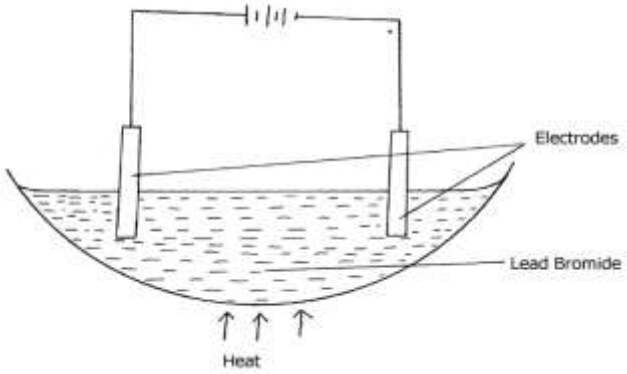



I Name the parts labeled A & B (1 mark)

A: ……

B: ……

II Thediagram below shows electrolysis of lead bromide

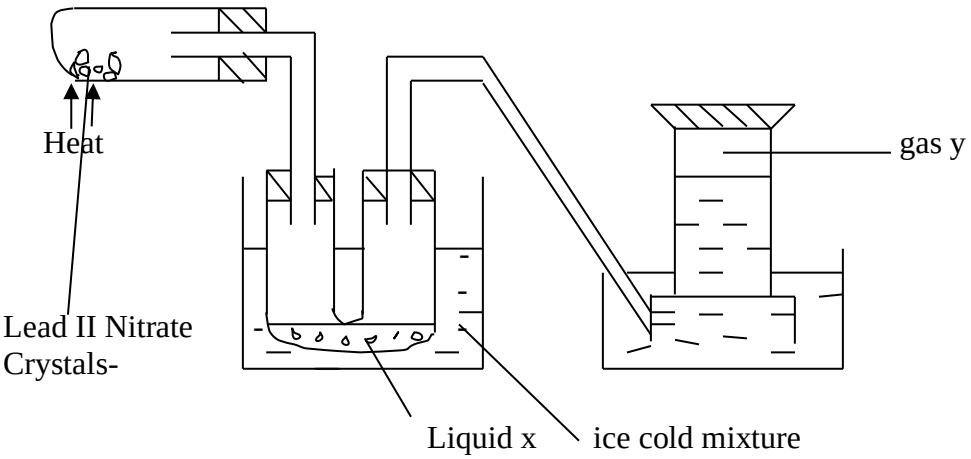



a) Label the anode and cathode (1mark)

b) Write half equations to shows reactions at cathode. (1mark)

……..

21. The set-up below shows the products formed when solid lead (ii) nitrate is heated.




a) Identify:

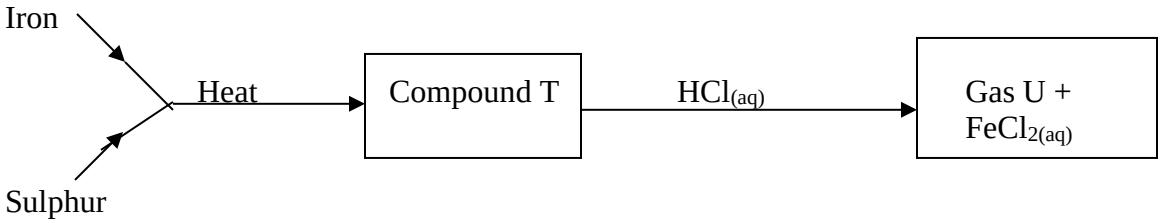
(i) Liquid x …… (½ mark)

(ii) Gas y…… (½ mark)

(iii) Write an equation for the reaction taking place in the combustion tube. (1 mark)

……

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




(a) Name: (i) Compound T _____ (½ mark)

(ii) Gas U _____ (½ mark)

(b) State a physical property that you could use to identify gas U. (1 mark)

……

23. (a) The melting point of phosphorous trichloride is $-918^0$ C and that of sodium chloride is $801^0$ C. Explain the huge difference in their melting points. (2marks)

.....

.....

.....

24. The electronic arrangement of two stable ions $Q^{2+}$ and $P^{2-}$ are 2.8.8 and 2.8.8 respectively.

(a) Write the electron arrangement of neutral atoms **Q** and **P**. (1 mark)

**Q**……..…

**P**……...…

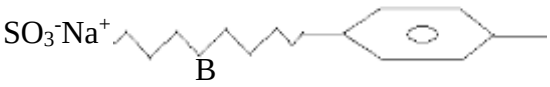
(b) What is the most likely structure of an oxide element **P**? (1 mark)

……

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




A




B

(i) Identify the cleansing agents A and B (1 mark)

**A** ……

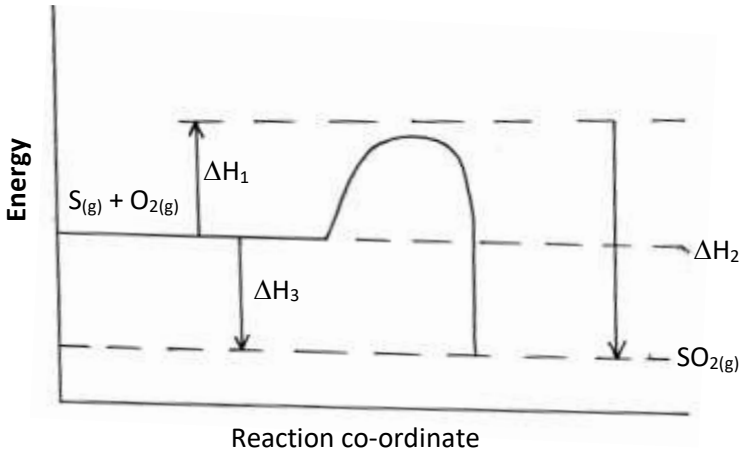
**B** …….

(ii) Explain how the cleaning properties of the above cleansing agents can be improved. (1 mark)

.....

……..

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

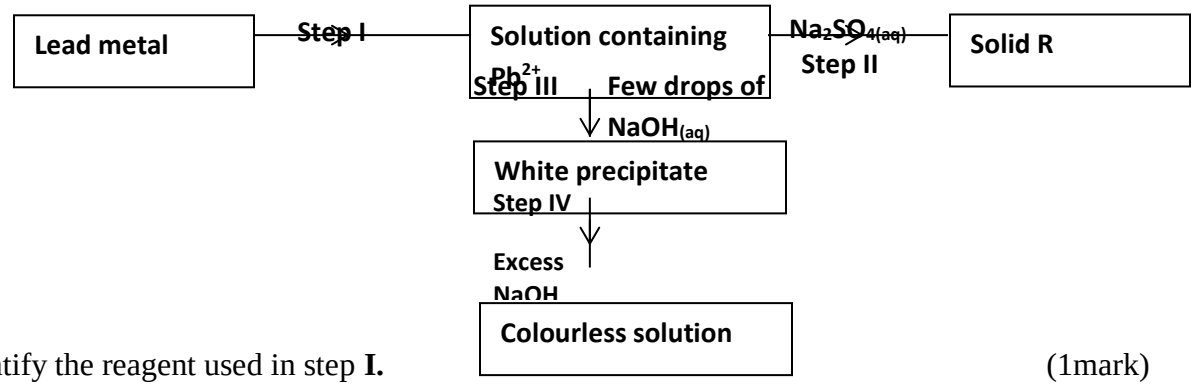



(a) On the diagram indicate the activation energy (1 mark)

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

……..

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




(a) Identify the reagent used in step **I.** (1mark)

……...…

(b) Name solid **R**. (1mark)

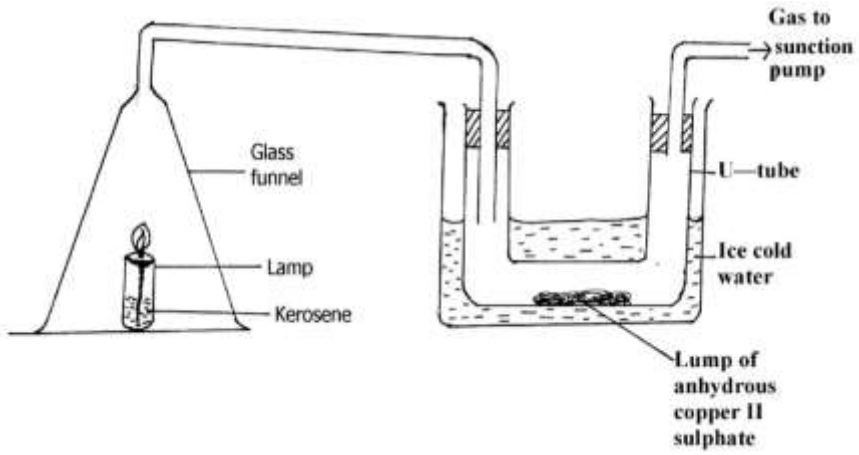
……...…

(c) Explain the observation in step **IV**. (1mark)

.....

.....

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




a) State and explain the observation made in the U- tube. (1½ marks)

.....

.....

.....

.....

b) Explain what will happen to lamp when the suction pump is turned off. (1½ marks)

.....

.....

.....

29. Using dot ( •) and crosses ( x) diagram to represent electrons in the outer most energy levels only show bonding in;

(a) Phosphine molecule.$PH^{+}_{4}$. (P = 15, H = 1) (1 mark)

.....

.....

.....

.....

.....

(b) Ammonia ($NH_3$) (1 mark)

.....

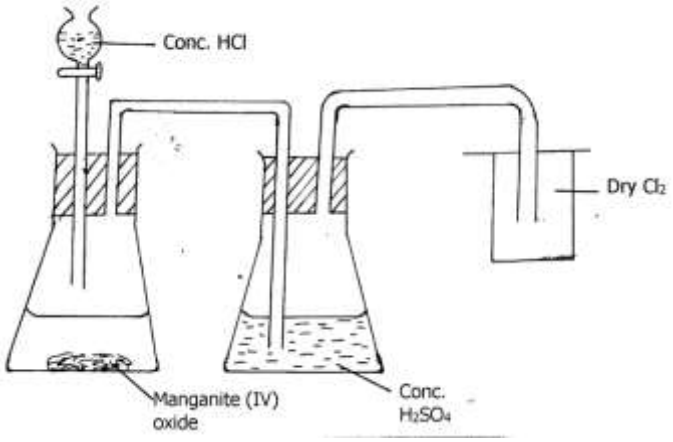
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30. The set up below was used to prepare dry sample of chlorine gas.



a) What is the function of manganese (IV) oxide in the preparation of chloride (1mark)

.....

.....

b) Write a chemical equation for the formation of chlorine gas. (1 mark)

.....

c) Explain the observations made when chlorine gas is bubbled through a solution of iron II sulphate. (2marks)

## PAPER 2

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

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| P | | | | T | V | W | Y | M |
| | Q | | S | U | | X | | |
| | R | | | | | | Z | |

a) What is the name of the chemical family to which element P belongs? (1mk)

……

b) An element N has an atomic number of 15. Write down its electronic arrangement and hence fix it in its right position on the grid above. (2mks)

Electronic arrangement ……

c) Compare the size of the atom of R and that of its ion. Explain your answer. (2mks)

……

……

.....

.....

d) Give the formula of the compound formed between (1mk)

i. P and W ……

ii. T and Y ……..

e) Compare the melting points of element Q and S. Explain. (2mks)

……

……

……

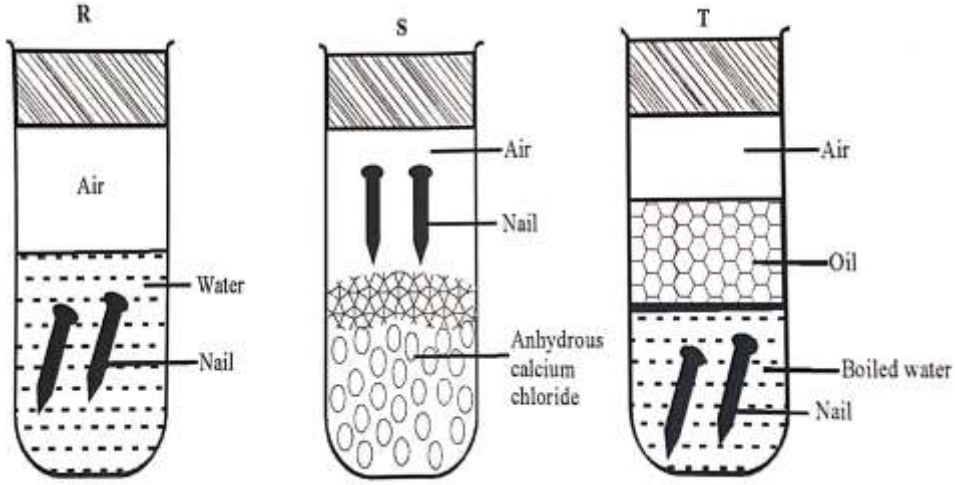
f) Give **two** advantages that element S has over element Q in making electric cables. (2mks)

……

……

g) Draw (a) dot (.) and cross (x) diagram to represent the bonding in compound formed between T and Y (2mks)

2. **(a)**An investigation was carried out using the set-up below. Study it and answer the questions that follow.




ii) State and explain what will happen in two test-tubes R and T after seven days. (2mks)

……

……

……

ii) Give one reason why some metals are electroplated. (1mk)

**(b)** The reduction potential of elements K, L, M, and P are as given below

| IONS | REDUCTION POTENTIAL |
|---|---|
| $K^+$ | -1.46v |
| $L^{2+}$ | +0.49v |
| $M^{2+}$ | -2.69v |
| $N^+$ | +0.52v |
| $P^+$ | -0.86v |

(i) Which letter represents the, strongest reducing agent? Give a reason. (2mks)

……

……

(ii) Which **two** letters represent elements whose half cells would form an electrochemical cell with the largest e.m.f? (1mk)

……

(iii) Calculate the e.m.f of the cell formed in (ii) above (2mks)

(d) During the electrolysis of a molten chloride of metal Q, a current of 0.25A was passed though the molten chloride for 2 hours and 10minutes. Given that 0.9grams of metal Q were deposited at the cathode.

(i) Calculate the quantity of electricity passed (1mk)

(ii) Charge carried by the ions of metal Q given that R.A.M of metal Q is 84 (2mks)

3. (a)(i) Name the allotropies of sulphur (1mk)

.....
.....
.....

(ii) Sulphur is mined using the Frasch process which uses super-heated water at $170^0$c and hot compressed air.

(I) Explain how water at $170^0$c is obtained. (1mk)

.....
.....

(II) State one role of the super-heated water (1mk)

.....
.....
.....

(b) State and explain what happens when wet petals of red flowers are put in a gas jar full of sulphur (IV) oxide (2marks)

.....
.....
.....
.....

(c) Write an equation for the reaction of sulphur(IV) oxide and concentrated Nitric (V) acid (1mark)

.....
.....

(d) (i) Name the catalyst used in contact process (1mark)

.....

(ii) An equilibrium exists as

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$$

State and explain what happens if more oxygen is added to the system (2 marks)

.....

4. (a) A hydrocarbon contains 85% carbon. Its molecular mass is 70g.

(i) Determine its empirical and molecular formula. (C = 12, H = 1). (4mks)

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(ii) Draw **two** positional isomers of the hydrocarbon. (1mk)

(b) In an experiment an organic compound was reacted with absolute ethanol in the presence of concentrated sulphuric (VI) acid to form a compound whose formula is

$CH_3\ CH_2CH_2\ COOCH_2\ CH_3$

(i) Name

I The type of reaction that took place. (1mk)

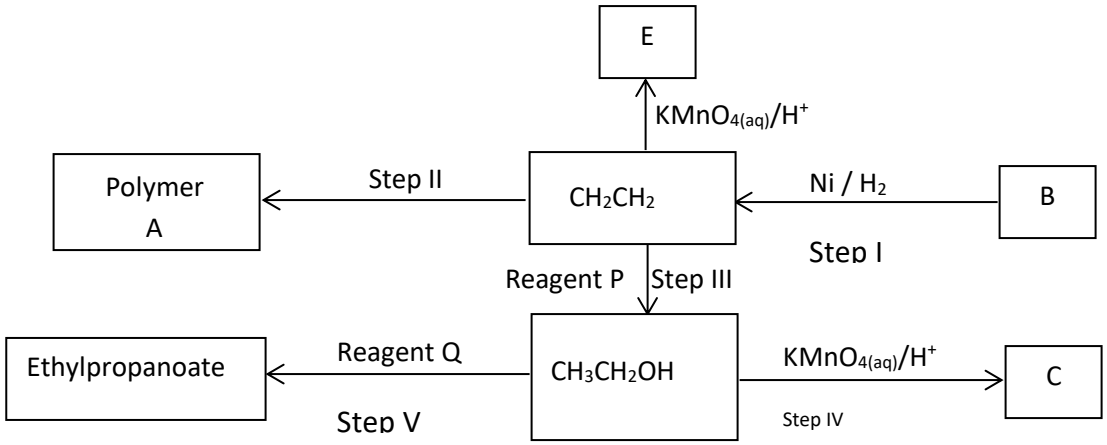
_____

II What is the role of concentrated sulphuric (VI) acid in the experiment?

_____ (½mk)

(ii) Write the structural formula and give the systematic name of the acid used in the above experiment. (2mks)

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




(i) Identify the following compounds.

**B** _____ (½mk)

**C** _____ (½mk)

**A** _____ (½mk)

**E** _____ (½mk)

(ii) Name the process in steps.

**I** _____ (½mk)

**II** _____ (½mk)

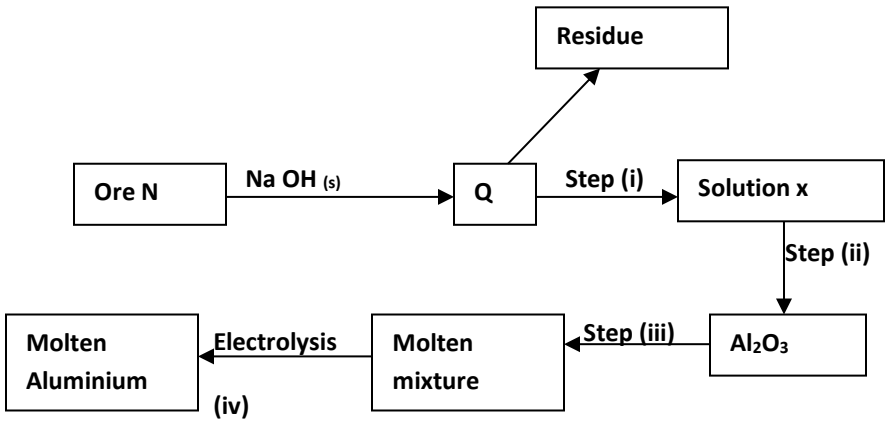
**IV** _____ (½mk)

(iii) Reagent

**P** _____ (½mk)

**Q** _____ (½mk)

***5.*** Study the flow chart below and answer the questions that follow.




(a) Name one Ore of **N.** (1mk)

……

(b) Explain why the ore is first dissolved in excess sodium hydroxide solution (1mk)

……

……

(c) Name the major compound present in the residue. (1mk)

……

(d) Give the formula of the aluminum compound present in solution **X** (1mk)

(e) Explain how to obtain aluminum hydroxide from solution **X** (2mks)

……

……

(f) (i) Write an equation of the reaction that takes place in (e) above (1mk)

……

(ii)What is the role of cryolite ($Na_3 AlF_6$) in the extraction of Aluminium: (1mk)

……

……

(iii) Explain why $Na^+$ and $F^-$ions are not discharged during electrolysis in step (iv) (1mk)

……

……

(iv)Aluminium is a good conductor of electricity. State **two** uses of aluminum based on that property. (2mks)

……

……

***6.*** I. State Le chateliers principle on equilibrium? (1mk)

……

……

……..…..

II. Bromine reacts with water in accordance with the following ionic equation.

$Br_{2\,(aq)} + H_2O(l)$ $\rightleftharpoons$ $Br^-_{(aq)} + OBr^-_{(aq)} + 2H^+_{(aq)}$

Explain how addition of sodium hydroxide solution would affect the given equilibrium. (2mks)

……

……

……

b) 3g of a powdered carbonate of metal **X** of formula $XCO_3$ were mixed with $13.2cm^3$ of 2M hydrochloric acid. The mass of the reaction vessel and its contents was recorded at various times. From these readings, the total loss in mass of the reaction vessel and its contents was calculated and recorded as shown in the table below

| Time (sec) | 30 | 60 | 90 | 120 | 150 | 180 | 210 |
|---|---|---|---|---|---|---|---|
| Total loss in mass (g) | 0.08 | 0.37 | 0.90 | 1.19 | 1.28 | 1.32 | 1.32 |

i) On the grid provided below, draw a graph of total loss in mass (y-axis) against time (3mks)

i) Calculate the rate of reaction at the $120^{th}$ second. (2mks)

……....

ii) Explain why there is no change in mass between 180 and 210 seconds. (1mk)

……

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

iv) Calculate the relative atomic mass of X (C=12.0, O=16.0) (2mks)

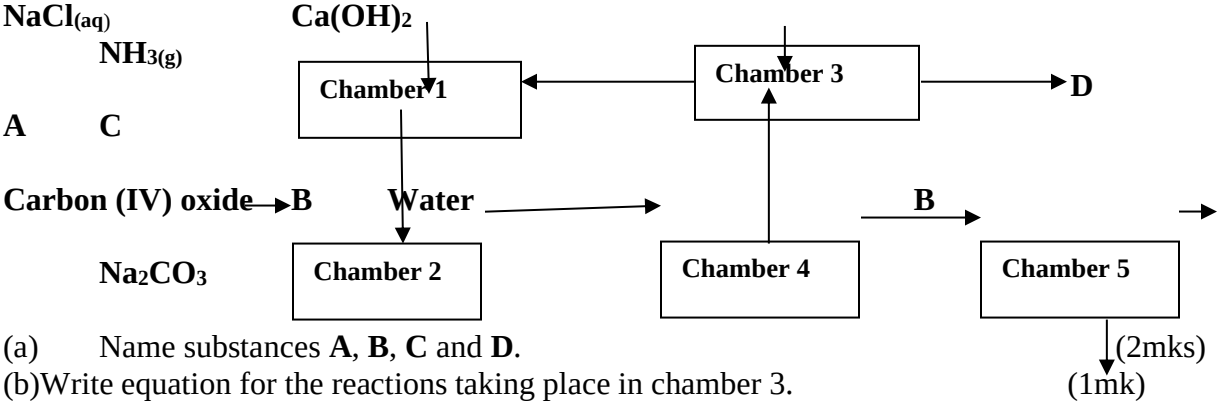
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***7.*** The flow chart below shows industrial manufacture of sodium carbonate.
Study it and answer the questions that follow.




(a) Name substances **A**, **B**, **C** and **D**. (2mks)

(b)Write equation for the reactions taking place in chamber 3. (1mk)

Chamber 3

……

(c) Name the physical process in chamber 4 and 5. (2mks)

Chamber 4

……

Chamber 5

……

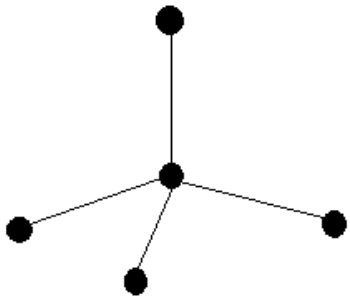
(d) Name **one** source of cheap carbon (IV) oxide for Solvay process. (1mk)

……

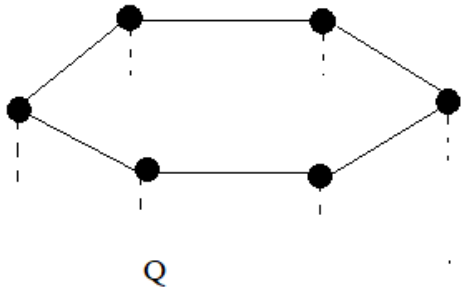
(e) Briefly explain how sodium chloride required for this process is obtained from sea water. (2mks)

……

f) Below are allotropes of carbon.



P



Q

(i) Identify the allotropes

P ……. ½mk

Q …… ½mk

(ii) Allotrope Q can be used as a lubricant. Explain. (2mks)

.....

(iii) Give a reason why burning charcoal jiko in a poorly ventilated room is dangerous. (1mk)

.....

**KCSE PREDICTION 6 2021**
**PAPER 1**

1. An element K has atomic number 20 while element M has atomic number 8.

a) Write the electronic configuration for K and M

K **1mark**

M **1mark**

b) Write the symbol of the most stable ion of K and M

K **1mark**

M **1mark**

2. Molten Lead (II) bromide is electrolyzed using carbon electrodes. Write the half equations of the reactions that occur at the anode and the cathode.

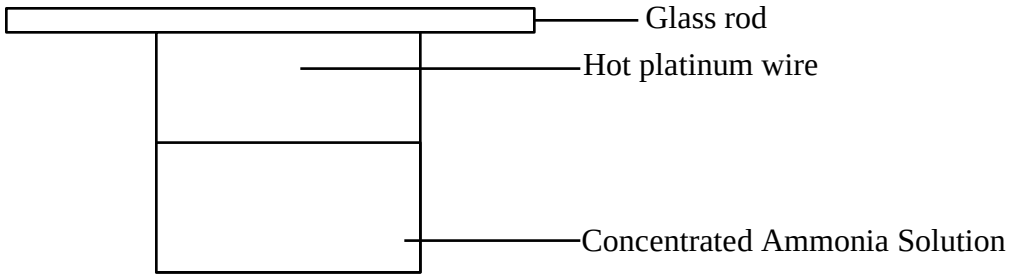
a) Anode **1mark**

b) Cathode **1mark**

3. Explain why the conductivity of metals decreases with increase in temperature. **2marks**
4. Three metal oxides XO, YO, and ZO are heated with powdered metal Y. Hot powdered Y will remove oxygen from XO but not from ZO. Arrange the metals in order of reactivity, starting with the most reactive. **1mark**
5. Some sodium chloride was found to be contaminated with copper (II) oxide. Describe how a sample of sodium chloride can be separated from the mixture. **2marks**

……
……
……

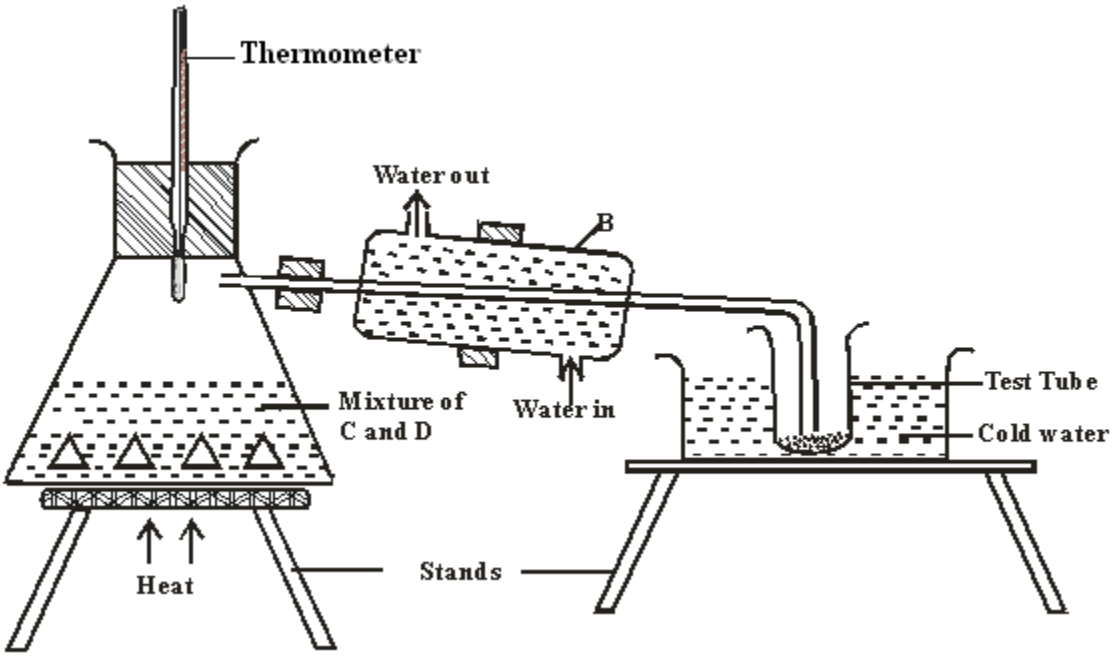
6. Hot platinum wire was lowered into a flask containing concentrated ammonia solution as shown below.




State and explain the observations made. **3marks**

……
……
……
……

7. The set up below represents the apparatus that may be used to separate a mixture of two miscible liquids C and D whose boiling points are $80^0$C and $110^0$C.




a) Name B

…….. **1mark**

b) What is the purpose of the thermometer **1mark**

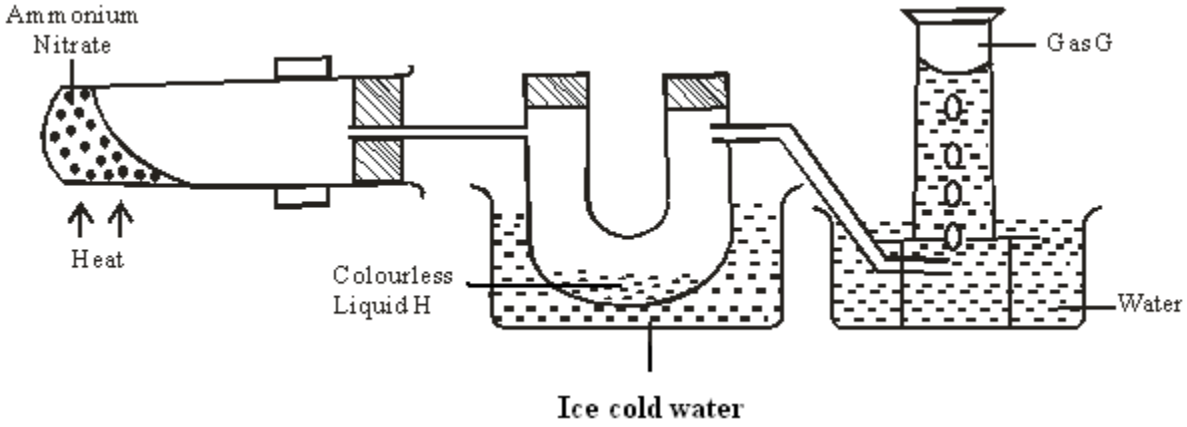
……
……

c) Which liquid was collected in the test tube? **1mark**

……
……

8. Draw a dot (.) and cross (x) diagram to show bonding in carbon (II) oxide. **2marks**

9. Ammonium nitrate was gently heated and the products collected as shown in the diagram.




a) Identify:

i. Colourless liquid H

…… **1mark**

ii. Gas G

…… **1mark**

b) Describe one physical and one chemical test that can be used to identify gas G. **2marks**

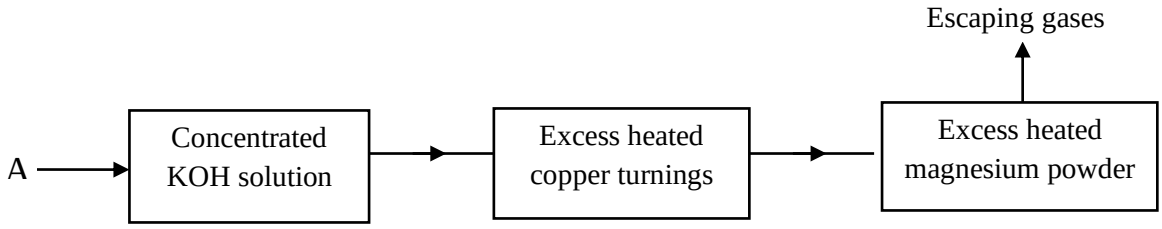
……

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




a) What is the purpose of concentrated potassium hydroxide solution? **1mark**

……

……

b) Write an equation for the reaction which takes place in the chamber with magnesium powder. **1mark**

……

……..

c) Name one gas which escapes from the chamber containing magnesium powder.

……..

Give a reason for your answer **2marks**

……

……

11. Name the following substances.

a) $CH_2\,CH\,CH_2\,CH_3$ **1mark**

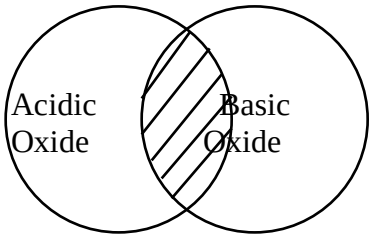
……

……

b) $CH_3\,CH\,CH\,CH_2\,CH_3$ **1mark**

……
……

12. The diagram below shows the acidic and basic oxides fit into the general family of oxides.




a) State the name given to the type of oxide that would be placed in the shaded area. **1mark**
……
……

b) Give the name of any oxide that would be placed in the shaded area. **1mark**
……
……

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

| **Substance** | **Solubility in water** | **Electrical conductivity** | |
|---|---|---|---|
| | | **Solid** | **Molten** |
| A | Insoluble | Good | Good |
| B | Soluble | Poor | Good |
| C | Insoluble | Poor | Poor |

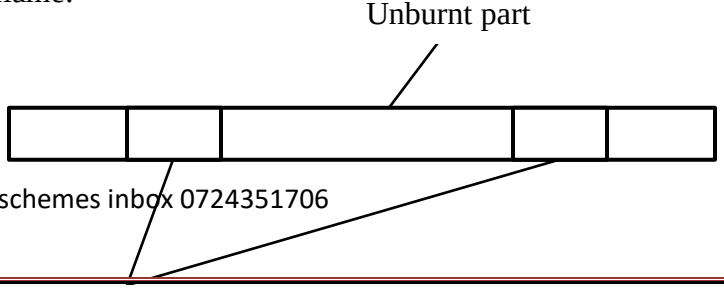
i) Which of the substances is highly likely to be sodium chloride? Explain **2marks**
……
……
……

ii) What type of bond exists in substance A? **1mark**
……
……

iii) State a possible structure in substance C? **1mark**
……
……

14. Laboratory results showed the composition of a compound to be 58.81% barium, 13.72%, sulphur and 27.47% Oxygen. Calculate the empirical formula of the compound. Ba=137, S = 32, O = 16. **2marks**

15. The diagram below shows a wooden splint that was placed horizontally across the middle part of a non-luminous flame.




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a) Explain the observation made **2marks**

……
……
……

b) Explain why non-luminous flame is preferred for heating than the luminous flame. **2marks**

……
……
……

16. $200cm^3$ of oxygen gas took 60 seconds to diffuse through a porous plug. Determine the time taken by $300cm^3$ of sulphur (IV) oxide to diffuse through the same plug under the same conditions.
(O=16, S = 32) **3marks**

17. Explain why?

**i)** Both methane and diamond are covalently bonded. Methane is a gas but diamond is a solid with very high melting point. **2marks**

……
……
……

ii) Ammonia is dissolved in water using an inverted funnel. **1mark**

……
……

18. Explain giving reasons why?

a) Sulphuric acid is not used with marble in the preparation of carbon (IV) oxide **2marks**

……
……
……..……..

b) Water cannot be used to distinguish oil fire. **1mark**

……
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19. A gas occupies $4dm^3$ at $-23^0C$ and 152 mmHg. At what pressure will its volume be halved, if the temperature then is $227^0C$.? **2marks**

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20. a) Sodium, Magnesium and Aluminium are elements in the periodic table. Explain why aluminium has a higher melting and boiling point than sodium and magnesium. **2marks**

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b) The ionization energy of an atom is strongly influenced by three atomic parameters. State two of these parameters. **2marks**

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21. 15$cm^3$ of a solution containing 2.88g/$dm^3$ of an alkali XOH completely reacts with 20$cm^3$ of 0.045M sulphuric acid. Calculate the molarity and relative atomic mass of X present in the alkali. **3marks**

22. Describe how a solid sample of calcium sulphate can be prepared using the following reagents; dilute nitric (v)acid, dilute sulphuric (vi) acid and solid calcium carbonate **4marks**

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23. Crude oil is the main source of organic compounds such as hydrocarbons. The hydrocarbons in the crude oil have to be separated.

a) Name two important hydrocarbons obtained from crude oil. **2marks**

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b) Give the uses of the two hydrocarbons named in (a) above. **2marks**

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24. A hydrocarbon Q was found to decolourise potassium manganate (vii) solution. When two moles of Q were burnt completely six moles of carbon (iv) oxide and six moles of water were formed.

a) Write the structural formula of Q. **1mark**

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**.....**

**b)** Name the homologous series to which Q belongs **1mark**

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……

25. Dilute sulphuric acid was added to a compound X, of magnesium. The solid reacted with the acid to form a colourless solution, Y and a colourless gas Z which formed a white precipitate when bubbled through lime water.

Name:-

(i) Compound X **1mark**

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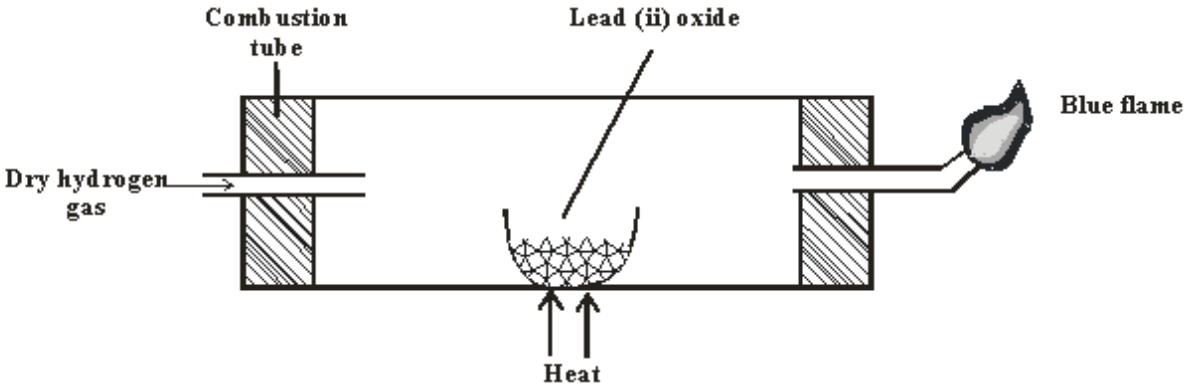
(ii) Solution Y **1mark**

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(iii)Colourless gas Z **1mark**

……

26. When dry hydrogen gas passed over heated Lead (II) oxide in combustion tube, a grey solid was formed.




a) Identify the grey solid. **1mark**

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b) Write the equation of the reaction taking place in the combustion tube. **1mark**

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c) Write the equation involving the blue flame. **2marks**

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27. What do (C F C' S) mean? **1mark**

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……

28.

a) What is meant by the term allotrophy? **1mark**

……

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b) Explain in terms of structure and bonding why graphite is soft with greasy feeling. **2marks**

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**PAPER 2**

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

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| | | | A | | | B | C | D |
| E | F | | | | | | | |
| | | | | | | | G | |
| H | | | | | | | | |

(a) Give the name of the family to which element F belongs. **(1mark)**

(b) Identify an element which forms a stable divalent anion **(1mark)**

(c) Give the formula of:

(i) The compound formed between A and B **(½mark)**

(ii) The sulphate of H **(½mark)**

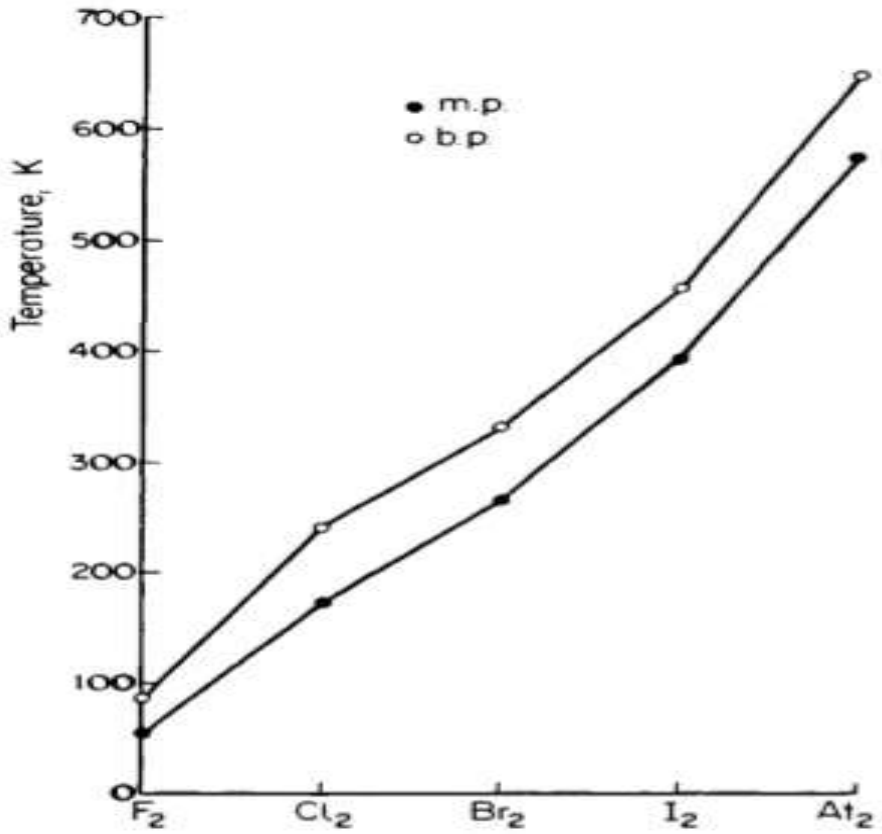
(d) Using dot (.) and cross(x) diagram, show the bonding in the compound formed between E and C. **(2marks)**

(e) Compare the atomic radii of elements C and D. Explain. **(2marks)**

(f) Select the element that has the lowest ionization energy. Explain. **(1mark)**

(g) 0.081g of element A reacts with 20cm$^3$ of dilute hydrochloric acid. Calculate the molarity of the hydrochloric acid. (R.A.M = 27) **(3marks)**

(h) The graph below shows the trend of the melting points and the boiling points of the family to which element G belongs. Explain the trend in the melting points. **(2marks)**



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

(ii) Calculate the heating value of propane, $C_3H_8$, given that its molar enthalpy of combustion is 2200 kJ $mol^{-1}$. . **(2 marks)**

(C=12, H=1)

(b) (i) Define molar enthalpy of combustion. **(1 mark)**

(ii) Use the information provided by the thermochemical equations below to calculate the molar enthalpy of combustion of ethyne. **(3 marks)**

$C(s) + O_2(g) \longrightarrow CO_2(g)$ $\Delta H = -394$ kJ $mol^{-1}$

$H_2(g) + \frac{1}{2}O_2(g) \longrightarrow H_2O(g)$ $\Delta H = -286$ kJ $mol^{-1}$

$2C(s) + H_2(g) \longrightarrow C_2H_2(g)$ $\Delta H = +226$ kJ $mol^{-1}$

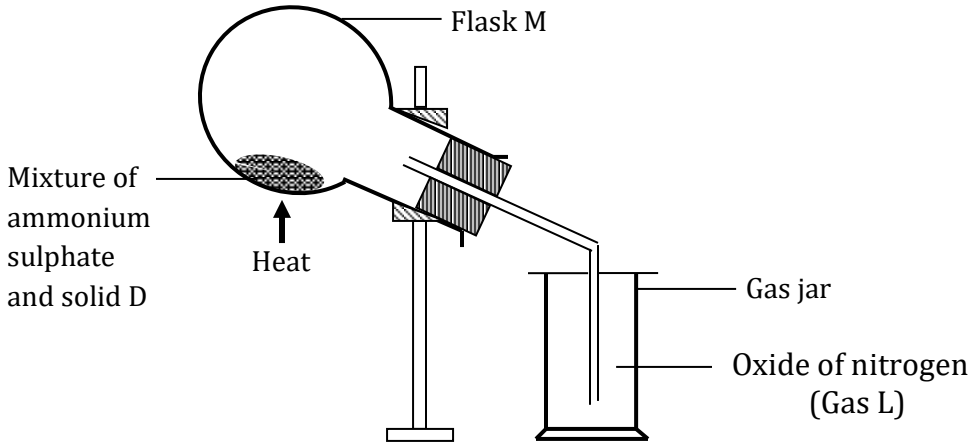
(c) Study the data given below and answer the questions that follow.

| Substance/ion | Enthalpy change |
|---|---|
| $CaCl_2(s)$ | Lattice energy = -2237 kJ $mol^{-1}$ |
| $Ca^{2+}(g)$ | Hydration energy = -1650 kJ $mol^{-1}$ |
| $Cl^-(g)$ | Hydration energy = -364 kJ $mol^{-1}$ |

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

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

3. (a) The diagram below shows the preparation of an oxide of nitrogen. Study the diagram and answer the questions that follow.




(i) Name the solid D. **(1mark)**

(ii) Write the equation for the reaction in the flask M **(1mark)**

(iii) Burning magnesium ribbon was lowered into the gas jar containing gas L. State and explain the observations made. **(2marks)**

(iv) Write the two equations for the reactions taking place in (iii) above. **(2marks)**
I.

II.

(v) A drop of water was added to the product formed in (iii) above. A colourless gas **K** with a choking smell was produced. Write the chemical equation for the production of gas **K** **(1mark)**

(b) (i) Give **two** uses for nitric (V) acid. **(2marks)**

(ii) A factory uses nitric (V) acid and ammonia gas as the only reactants for the preparation of ammonium nitrate. If the daily production of the ammonium nitrate is 4800kg, calculate the mass of ammonia gas used daily in kg. (N=14.0, O = 16.0 H= 1.0) **(3 marks)**

4. A group of form four students of Cockelbet Secondary School carried out an experiment to determine the solubility of potassium chlorate. The table below shows the results obtained.

| | | | | | |
|---|---|---|---|---|---|
| Total volume of water added($cm^3$) | 10.0 | 20.0 | 30.0 | 40.0 | 50.0 |
| Mass of $KClO_3$(g) | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Temperature at which crystals appear($^0C$) | 80.0 | 65.0 | 55.0 | 45.0 | 30.0 |
| Solubility of $KClO_3$($g/100gH_2O$) | | | | | |

(a) Complete the table to show the solubility of $KClO_3$ at different temperatures. **(3marks)**

(b) Plot a graph of mass of $KClO_3$ per 100g water against temperature at which crystals form. **(3marks)**

(c) From the graph, determine ;

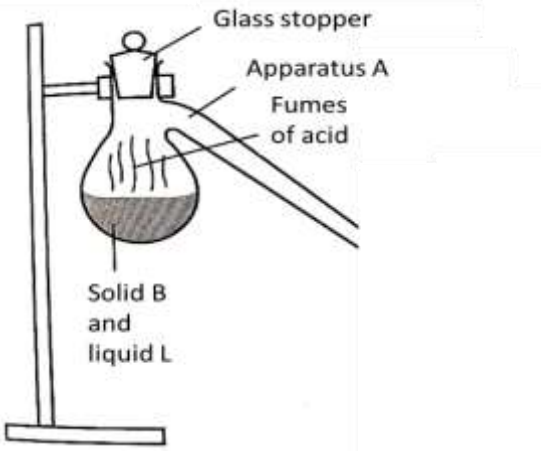
(i) The solubility of $KClO_3$ at $40^oC$. **(1mark)**

(ii) The temperature at which the solubility of $KClO_3$ is 35g/100g water. **(1mark)**

(d) Explain the shape of the graph. **(1mark)**

(e) State **one** application of solubility and solubility curves. **(1mark)**

5. The set up below is used to prepare Nitric (V) acid in the laboratory. Study it and answer the questions that follow.




(a) Complete the set-up. **(3 marks)**

(b) Name substances

B…….. L ……**(2 marks)**

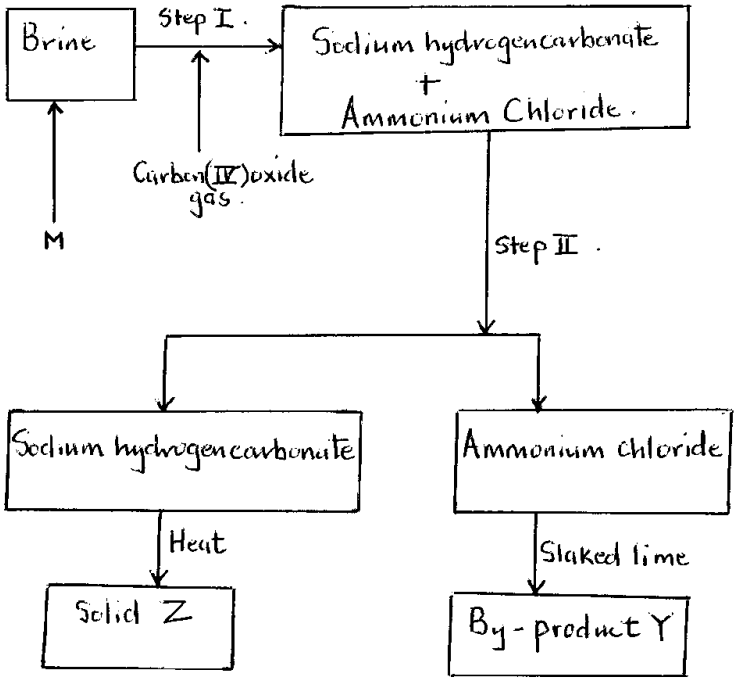
(c) Name apparatus A…… **(1 mark)**

(d) Write an equation between substances B and L **(1 mark)**

(e) During preparation of hydrogen gas Nitric (V) acid is not used. Explain **(2 marks)**

(f) Give two commercial use of Nitrogen **(2 marks)**

6. The flow chart below is a simplified version of the steps in the manufacture of Sodium carbonate.



a) Name three main raw materials of the above process. **(3 marks)**

b) Name substance M. **(1 mark)**

c) Name the process taking place in step II. **(1 mark)**

d) Write a balanced chemical equation to show how product Y is formed. **(1 mark)**

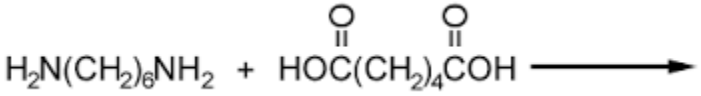
e) 98.123 Kg of Sodium hydrogen carbonate was manufactured in this process.

i) Write a chemical equation for the formation of solid Z. **(1 mark)**

ii) Determine in Kilograms, how much of solid Z was produced in this process.
(Na = 23, H = 1, O = 16, C = 12) **(3 marks)**

7. (a) Draw and name all the isomers of $C_4H_6$ **(2marks)**

(b) The following monomers react to form a polymer:

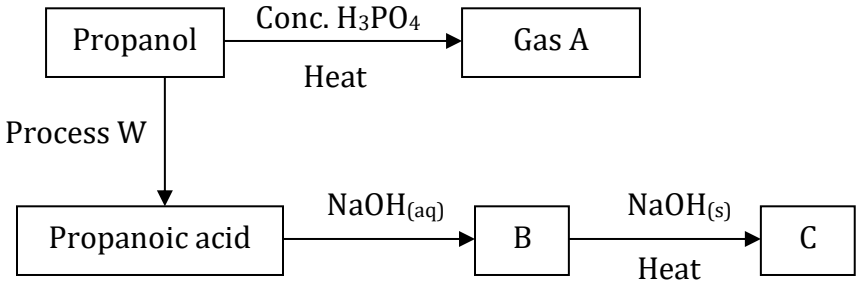


Draw and name the structure of the polymer **(2marks)**

(c) Chlorofluorocarbons have a wide range of uses. However they have been linked to depletion of ozone.
(i) Explain the problem caused by depletion of ozone layer. **(1mark)**

(ii) Give one other environmental problem caused by chlorofluorocarbons. **(1mark)**

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




(i) Name:

I: Process W **(½mark)**

II: Substances A, B and C **(1½marks)**

A:

B:

C:

(ii) Write an equation for the combustion of substance C **(1mark)**

(iii) Give one use of gas A **(1mark)**

(e) Explain how a sample of propan-1-ol could be distinguished from a sample of propanoic acid by means of a chemical reaction **(2marks)**

**PAPER 3**

1. Solution A is prepared by dissolving 6.3g of the organic acid $H_2C_2O_4.nH_2O$ in water to make a litre of the solution.
   Solution B: 0.1M NaOH solution
   Phenolphthalein indicator
   Clamp and stand
   Burette and pipette.

   You are required to determine the value of n in the organic acid $H_2C_2O_4.\ nH_2O$
   **Procedure.**
   Fill the burette with solution A and adjust the volume to zero mark.
   Add 2 to 3 drops of phenolphthalein indicator and titrate solution A against solution B until thecolour just permanently changes. Record your results in the table below. Repeat the procedure two more times to obtain concordant results.
   a)

| **Titration** | **1** | **2** | **3** |
|---|---|---|---|
| Final burette reading ($cm^3$) | | | |
| Initial burette reading ($cm^3$) | | | |
| Volume of solution A used ($cm^3$) | | | |

**4marks**

   b) Calculate the average volume of solution A used. **1mark**

   c) Calculate the moles of sodium hydroxide in the volume of solution B used. **2marks**

   d) Given that solution B - Sodium hydroxide and solution A organic acid react in the ration of 2:1, calculate the number of moles of the organic acid –solution A used? **2marks**

   e) Calculate the moles of organic acid solution A used per litre of solution **2marks**

f) Calculate the relative formula masses of the organic acid solution A **3marks**

g) Calculate the value of n in $H_2C_2O_4.nH_2O$(H=1, C=12, O=16) **3marks**

2. You are provided with CBI. Carry out the test below. Write your observation and inferences in the spaces provided.

a) Using a clean spatula, heat about one third of the solid CBI in a non- luminous Bunsen burner flame.

| Observation | Inferences |
|---|---|
| | |

**1mark** **1mark**

b) Put a half spatula endful of CBI in a test tube. Heat gently and then strongly. Test for any gas produced using litmus papers.

| Observation | Inferences |
|---|---|
| | |

**1mark** **1mark**

c) Put 2$cm^3$ of dilute hydrochloric acid into a test tube. Add ¼ endful of CBI into the test tube. Test for any gas procedure.

| Observation | Inferences |
|---|---|
| | |

**2marks** **2marks**

3. You are provided with solid Q, carry out the test below. Record your observations and inferences in the table. Identify any gas (es) evolved.

   Place all the solid Q provided into boiling tube and add distilled water until the tube is ¼ full. Divide it into five portions.

   a) To the 1st portion add ammonia solution drop wise until excess.

| Observation | Inferences |
|---|---|
| | |

**1mark** **1mark**

   b) (i) To the 2nd portion add sodium hydroxide solution dropwise until in excess. Keep the resulting mixture for the next test.

| Observation | Inferences |
|---|---|
| | |

**1mark** **1mark**

   ii) Warm the preserved mixture from b (i) above

| Observation | Inferences |
|---|---|
| | |

**1mark** **1mark**

c) i) To the 3rd portion add silver nitrate solution. Preserve the mixture for the next test.

| Observation | Inferences |
|---|---|
| | |

**1mark** **1mark**

ii) To the preserved mixture in c (i) above add diluted nitric acid.

| Observation | Inferences |
|---|---|
| | |

**1mark** **1mark**

d) To the 4th portion add dilute Barium nitrate solution followed by dilute nitric acid.

| Observation | Inferences |
|---|---|
| **1mark** | **1mark** |

e) To the 5th portion add 2-3 drops of conc. Nitric acid.
Warm the mixture and allow to cool. Add sodium hydroxide solution dropwise until in excess.

| Observation | Inferences |
|---|---|
| **1mark** | **1mark** |

**KCSE PREDICTION 7 2022**
**PAPER 1**

1. State and explain the observation made when excess ammonia gas reacts with chlorine gas. (2 marks)

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Hydrogen gas reacts with ethene to form ethane. Calculate the volume of hydrogen required to convert 14g of ethene to ethane at S.T.P. (3 marks)

$C_2H_{2\,(g)} + H_{2\,(g)} \longrightarrow C_2H_6$

(C = 12, H = 1, molar gas volume at S.T.P. is 22.4 litres)

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2. The table below shows the relative molecular masses and boiling points of propan-l-ol and Ethanoic acid.

| | Relative Molecular Mass | Boiling point ($^oC$) |
|---|---|---|
| Propan –l-ol | 60 | 36 |
| Ethanoic acid | 60 | 118 |

Explain why the boiling point of Ethanoic acid is higher than that of propan –l-ol and yet they have same molecular mass. (2 marks)

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4. In an experiment an equal amount of iron fillings and sulphur powder was heated in a test tube. The mixture was left to cool then dilute hydrochloric acid added to it.

a) State the observations that were made;

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

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(ii) Dilute hydrochloric acid was added to the mixture after cooling. (1 mark)

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b) Write an equation for the reaction which occurred in a) (ii) above. (1 mark)

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5. a) What is meant by double decomposition? (1 mark)

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b) Starting with 1M sodium sulphate solution, describe how you would prepare dry lead II

sulphate. (2 marks)

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6. 6.84g of aluminium sulphate were dissolved in 200cm$^3$ of water. Calculate the Molar concentrations of the sulphate ions in the solution.(Relative formula mass of aluminium sulphate is 342) (3 marks)

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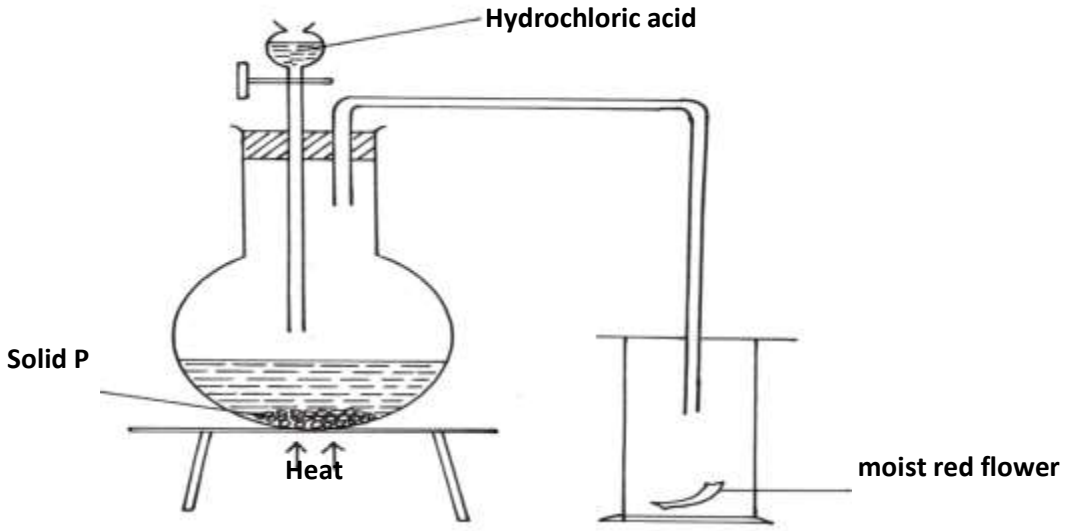
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7. The diagram below shows the set-up that was used to prepare and collect sulphur (iv) oxide gas.




(a) Identify solid P (1 mark)

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(b) (i) Why is it possible to collect sulphur (IV) Oxide as shown? (1 mark)

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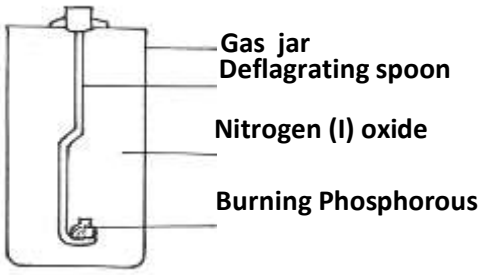
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(ii) What happened to the red flower. (1 mark)

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8. The set-up show how small pieces of red phosphorous are heated in Nitrogen (I) Oxide.



a) Write an equation for the reactions which occur in the gas jar. (1 mark)

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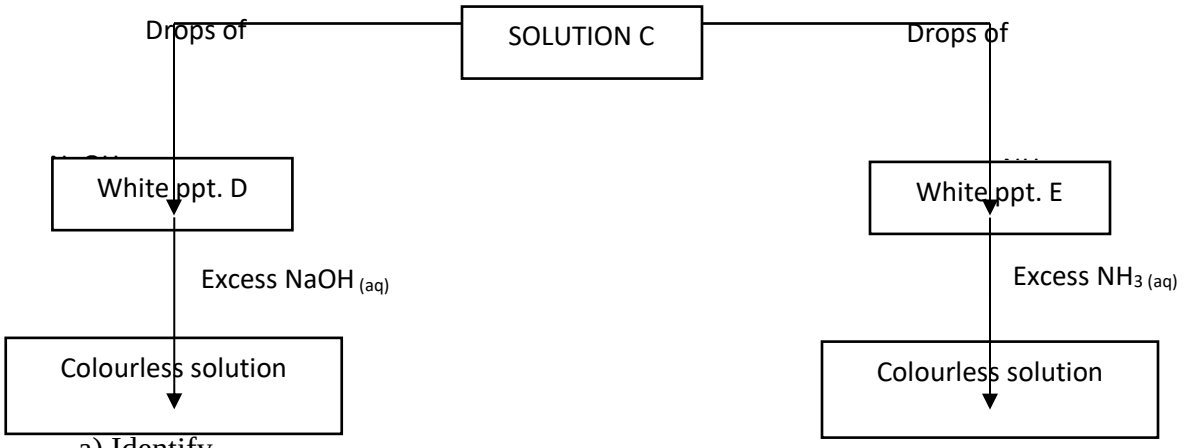
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b) Give **one** use of Nitrogen (I) oxide. (1 mark)

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9. Study the following reactions scheme and answer the questions that follow.




a) Identify

(i) The cations in solution C. (1 mark)

……..……

(ii) The white precipitate E. (1 mark)

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b) Why does precipitate E dissolve in excess sodium hydroxide solution. (1 mark)

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c) Write the formula of the complex ion formed. (1 mark)

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10. Starting with copper metal, describe how a sample of crystals of copper (II) sulphate is prepared in Laboratory. (3 marks)

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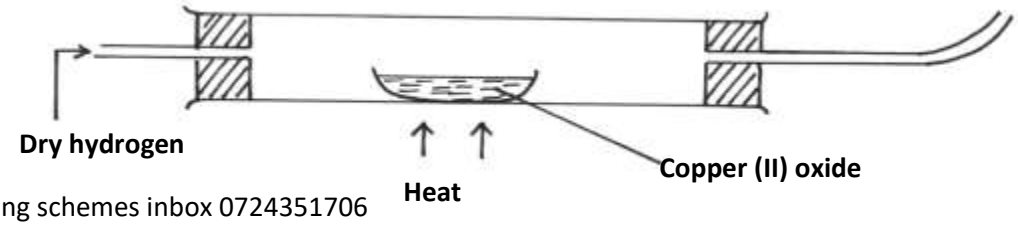
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11. The Set up below shows an experiment where hydrogen gas was passed over heated copper (II) Oxide.



a) State and explain the observations made in the combustion tube during the experiment. (3 marks)

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b) Explain why heat is necessary in this experiment. (1 mark)

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12. a) State Boyle's law (1 mark)

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b) 3 litres of oxygen gas at one atmosphere pressure were compressed to two atmospheres at constant temperature. Calculate the volume occupied by the oxygen gas . (2 marks)

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13. The table below gives some information about elements J,K,L,M which are in the same group of the periodic table. Use the formation to answer the question that follow.

| Element | 1st Ionization energy kJmol-1 | Atomic radius (nm) |
|---|---|---|
| J | 520 | 0.15 |
| K | 500 | 0.19 |
| L | 420 | 0.23 |
| M | 400 | 0.25 |

a) What is meant by ionization energy. (1 mark)

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b) State and explain the relationship between the variations in the first ionization energies and the atomic radii. (2 marks)

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14. When a hydrocarbon fuel burn, one of the main products is acidic gas R.

(a) Identify gas R. (1 mark)

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(b) What effect does gas R have when its concentration in the atmosphere exceeds its

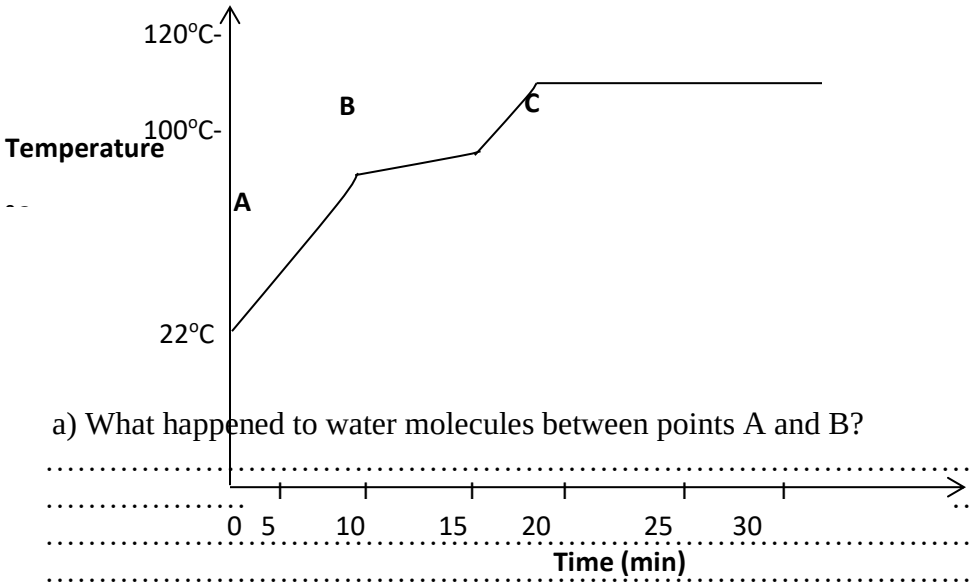
acceptable levels. (1 mark)

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15. The graph below shows a curve obtained when water at 22°C was heated for 10 minutes. Sodium Chloride crystals were added and strongly heated for 15 minutes.




a) What happened to water molecules between points A and B? (1 marks)

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b) Explain why the temperature rise is not steady between points B and C. (2 marks)

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16. Use the table below to answer the questions that follow.

| Substance | A | B | C | D | E |
|---|---|---|---|---|---|
| Symbol | $R\text{-}COO\text{-}Na^+$ | $CH_2OH$<br>\|<br>$CHOH$<br>\|<br>$CH_2OH$ | $\left(-CH_2-CH_2-\right)_n$ | $R\text{-}COOCH_2$<br>\|<br>$R\text{-}COOCH$<br>\|<br>$R\text{-}COOCH_2$ | $R\text{-}OSO_3\text{-}Na^+$ |

a) Which substances is:

I ) A soapless detergent. (½ mark)

……

II) An ester (½ mark)

……

b) Give name to substance B. (1 mark)

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……

c) Write an equation for the reaction between the structure of substance D and Sodium hydroxide solution. (2 marks)

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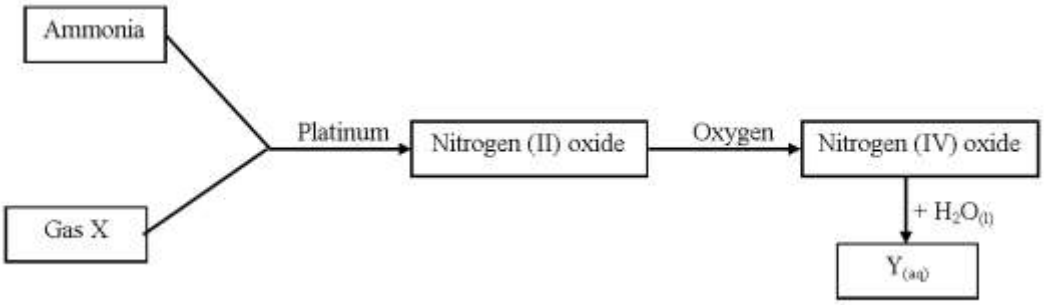
17. When hydrated sample of iron (II) sulphate $FeSO_4.nH_2O$ was heated until there was no further change in mass, the following data was recorded

Mass of evaporating dish = 78.94 g
Mass of evaporating dish + hydrated salt = 84.14 g
Mass of evaporating dish + residue = 81.78 g

Determine the empirical formula of the hydrated salt. (Relative Formula Mass of $FeSO_4$ = 152, $H_2O$ = 18) (3 marks)

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18. Study the flow chart below and answer the questions that follow;




(a) Write an equation for the reaction between gas X and ammonia. (1 mark)

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(b) Write the formulae of the substances present in the mixture $Y_{(aq)}$. (1 mark)

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19. When hydrogen sulphide gas was bubbled into an aqueous solution of iron (III) chloride, a yellow precipitate was deposited.

(a) State another observation that would be made. (1 mark)

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(b) Write an equation of the reaction that took place. (1 mark)

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……

20. The table below shows the atomic numbers of elements P, Q and R.

| Element | P | Q | R |
|---|---|---|---|
| Atomic | 13 | 7 | 12 |

(a) Explain why P and R would not be expected to form a compound. (1 mark)

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……

(b) Write an equation to show the effect of heat on the carbonate of R. (1 mark)
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21. Element T consists of two isotopes $^{62}T$ and $^{64}T$ in the ratio 7 : 3 respectively. Calculate the relative atomic mass of element T. (3 marks)
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……
……
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……

22. Name the process which takes place when:

(a) Solid carbon (IV) oxide changes directly into gas. (1 mark)
……
……

(b) An alcohol reacts with alkanoic acid in the presence of sulphuric acid to form a sweet smelling compound. (1 mark)
……

23. Briefly explain how you would obtain pure sample of lead (II) chloride from a mixture of lead (II) chloride and silver chloride. (2 marks)
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……
……

24. Explain the following observations; very little carbon (IV) oxide is evolved when lead carbonate reacts with dilute hydrochloric acid. (2 marks)
……
……

25. The table below gives some properties of compounds P, Q, R and S

| Compound | B.P. ($^oC$) | M.P. ($^oC$) | Conductivity in water |
|---|---|---|---|
| P | 77 | -23 | Does not conduct |
| Q | 74 | -19 | Does not conduct |
| R | -161 | -185 | Conducts |
| S | 2407 | 714 | Conducts |

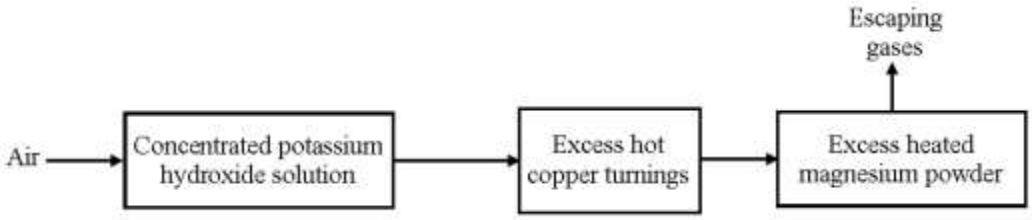
(a) Which one of the compounds in the table is ionic? Explain. (1 mark)
……
……

(b) Give the compound that is liquid at room temperature. (1 mark)
……
……

26. When butan – 1 – ol is oxidized by acidified potassium dichromate, a weak organic acid is formed.
Draw and name the structural formula of the acid obtained from the above reaction. (2 marks)

……
……
……
……
……
……
……

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




(a) Write an equation for the reaction that took place in the chamber with the magnesium powder. (1 mark)
……
……

(b) Name one gas that escapes from the chamber containing magnesium powder. Give a reason for your answer. (1 mark)
……
……

28. A sisal farmer found that when pricked by a sisal thorn, application of a little solution of ash helped to relieve the pain from the affected area. Explain. (2 marks)
……
……

29. Explain why aluminium metal is not extracted from aluminium chloride. (2 marks)
……
……
……

30. Distinguish between a strong acid and concentrated acid. (2 marks)
……
……
……

31. In an experiment to determine the solubility of potassium nitrate at 30°C, a saturated solution was heated in an evaporating dish until there was no further change in mass. The following data was obtained.

Mass of dish + solution = 128.9 g
Mass of dish + dry salt = 103.9 g
Mass of empty dish = 94.3 g

Determine the solubility of potassium nitrate at 30° C. (3 marks)

**PAPER 2**

1. The grid below shows part of the periodic table. Use it to answer the questions that follow. The letters do not represent actual symbols.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | **S** | **U** | **V** |
| **P** | **R** | | | | | **T** | **X** | **W** |
| **Q** | | | | | | | | |
| | | | | | | | | |

(a) Which of the elements has the highest atomic radius? Explain. (2 marks)

……
……
……
……

(b) Identify the most reactive Oxidizing agent. Explain. (2 marks)

……
……
……
……

(c) Compare the atomic radius of P and R. Explain (2 marks)

……
……
……..

(d)Give the formula of one stable ion with an electron arrangement of 2.8 which is:

(i) A Negatively charged divalent ion. (2 marks)

……

(ii) A Positively charged monovalent.

……

(e) Given that the mass number of W is 40. Write down the composition of its nucleus. (2 marks)

……
……
……

(f) Write the formula of the compounds formed between.

(i) Element **R** and **X**. (1 mark)

……

(ii) Give **one** property of the structure formed when R and X bond. (1 mark)

……
……

2. a) Sodium hydroxide pellets were accidentally mixed with sodium chloride-18.2g of the mixture was dissolve in water to make one liter of solution. 100cm3 of the solution was neutralized by $50cm^3$ of 0.45M Sulphuric acid.

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

……
……

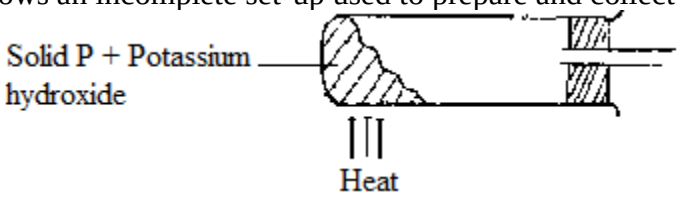
ii) Calculate the;

I. Number of moles of the substance that reacted with sulphuric acid. (1 mark)

II. Number of moles of the substance that would react with sulphuric acid in the one litre of solution. (1 mark)

III. Mass of the unreacted substance in the one litre of solution. (2 marks)
(H = 1.0, Na 23.0, Cl 35.5, 0 = 16.0)

b) The diagram below shows an incomplete set-up used to prepare and collect ammonia gas.




i) Name solid P. (1mark)
……
……

ii) Complete the diagram to show how a dry sample of ammonia gas can be collected. (3 marks)

c) In an experiment, excess ammonia gas was passed over heated copper (II) oxide in a combustion tube.

i) State the observation that was made in the combustion tube at the end of the experiment. (1 mark)

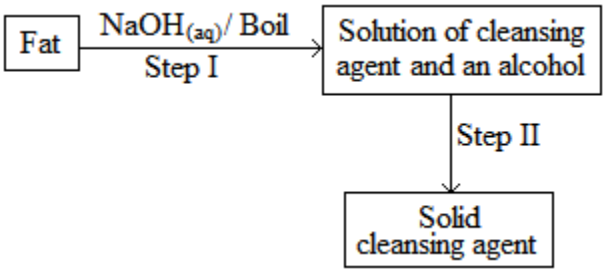
……..
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ii) What property of ammonia is shown in the above reaction? (1mark)

……

iii) Give **one** use of ammonia. (1mark)
……

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




(i) What name is given to the type of cleansing agent prepared by the method above? (½ mark)

……

(ii) Name one chemical substance added in step II. (1 mark)

……

(iii) What is the purpose of adding the chemical substance named in a (ii) above? (1 mark)

……

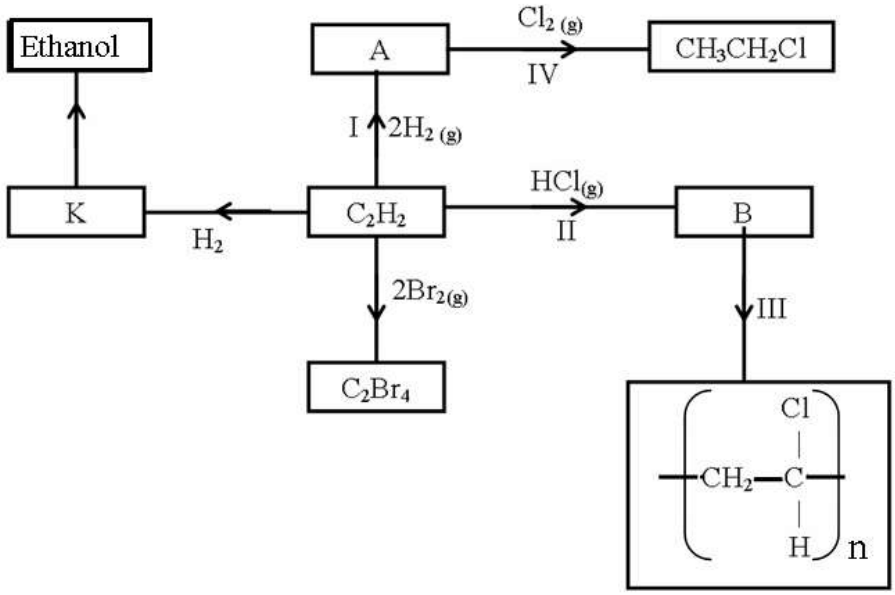
……

(iv) Name any other suitable substance that can be used in step I. (1 mark)

……

(v)Explain how an aqueous solution of the cleansing agent removes oil during washing. (2 marks)

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




(i) Identify the catalyst used in step I (½ mark)

……

(ii) Name the compounds A and B (1 mark)

A……B……..……

(iii) Give **one** disadvantage of compound formed in step III (1 mark)

……

……

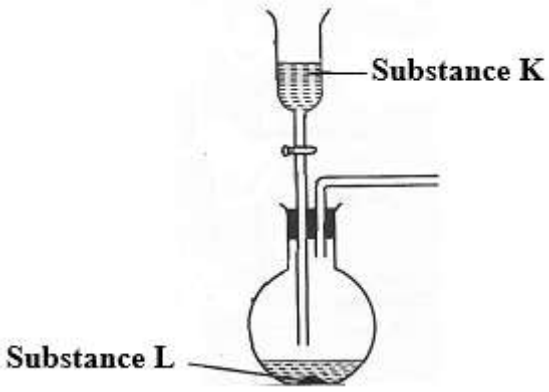
(iv) Name the reactions taking place at steps: (1 mark)

I……IV.....

(v) Describe how substance K is converted to ethanol (2 marks)

……

4. The set-up below can be used to generate a gas.




(a) (i) Complete the table below giving the names of substance **K** and **L** if the gases generated are carbon (IV) oxide and carbon (II) oxide. (2 marks)

| Substance | Carbon (IV) oxide | Carbon (II) oxide |
|---|---|---|
| **K** | | |
| **L** | | |

(ii) Complete the diagram to show how a sample of carbon (II) oxide can be collected. (2 marks)

(iii) State **two** ways that can be used to distinguish carbon (IV) oxide from carbon (II) oxide? (2 marks)

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……
……
……

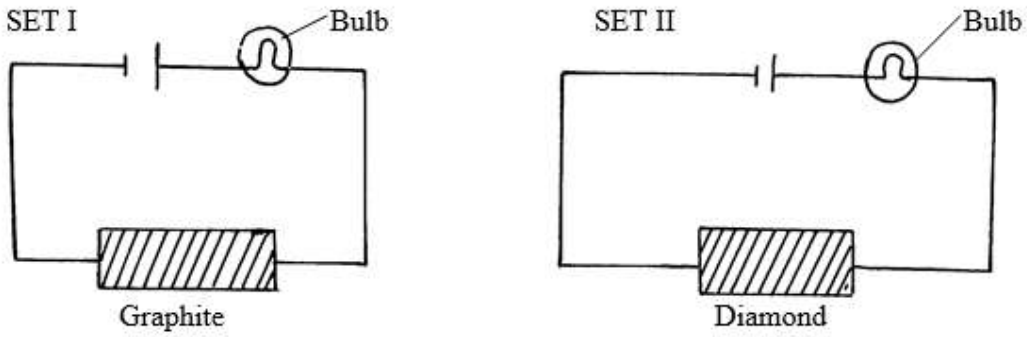
(b) (i) In an experiment, carbon (IV) oxide gas was passed over heated charcoal held in a combustion tube. Write a chemical equation for the reaction that took place in the combustion tube. (1 mark)

……

(ii) State **one** use of carbon (II) oxide. (1 mark)

……

(c) The following set ups were used by Form Two students. Study and use them to answer the questions that follow.




State and explain the difference in observation made in set up I and II above. (3 marks)

……
……
……

5. (a) Define the term solubility. (1 mark)

……
……
……

(b) In an experiment to determine the solubilities of two salts X and Y at different temperatures, a candidate recorded her observations as shown below.

| Temperature ($^oC$) | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
|---|---|---|---|---|---|---|---|---|---|---|
| Solubility of X in g/100 g of $H_2O$ | 14.3 | 17.4 | 20.7 | 25.0 | 28.5 | 33.3 | 40.0 | 47.0 | 55.0 | 64.0 |
| Solubility of Y in g/100 g of $H_2O$ | 25.0 | 27.5 | 30.0 | 32.5 | 35.0 | 37.6 | 40.1 | 42.4 | 45.0 | 48.0 |

(a) On the same axes plot the solubility curves of X and Y. (4 marks)

(b) From your graph to determine;

(i) The solubility of X and Y at 47 $^oC$

Solubility of X (1 mark)

……..

Solubility of Y (1 mark)

……

(ii) The temperature at which the two salts are soluble in water. (1 mark)

……

(c)If 60g of X is dissolved in 100 g of water and heated to 90$^oC$, calculate the amount of salt that crystallized out if cooled to 20 $^oC$. (1 mark)

……

……..

……

(d) State what would happen if a mixture salt X in 100 g of water and 30 g of Y in 100 g of water were cooled from 90 $^oC$ to 70 $^oC$. (3 marks)

……

……

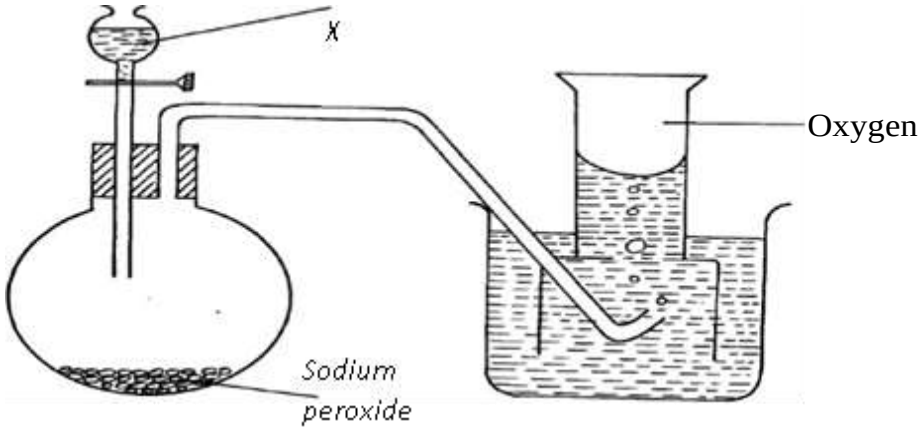
……

(e) State **one** application of solubility. (1 mark)

……

6. (a) An ore is suspected to contain Lead metal. Describe the process that can be used to confirm the presence of Lead in the ore. (3 marks)

(b) The diagram below shows students set-up for the preparation and collection oxygen Gas




(i) Name substance **X** used (1mark)

……

……

(ii) Write an equation to show the reaction of sodium peroxide with the substance named (1mark)

……

……

(iii) Name a two other reagents that can be used to prepare oxygen gas in the laboratory using the apparatus shown above. (1 mark)

……

……..

(iv) How would you confirm that the gas produced was oxygen. (1 mark)

……..

……

(c) Apiece of cleaned magnesium ribbon was burnt in air to form a residue **P** which was then dissolved in water to form solution Q and a colourless gas R. A blue and red litmus paper was

(i) State the components of residue P. (1 mark)

(ii) Identify colourless gas R ……..... (1 mark)

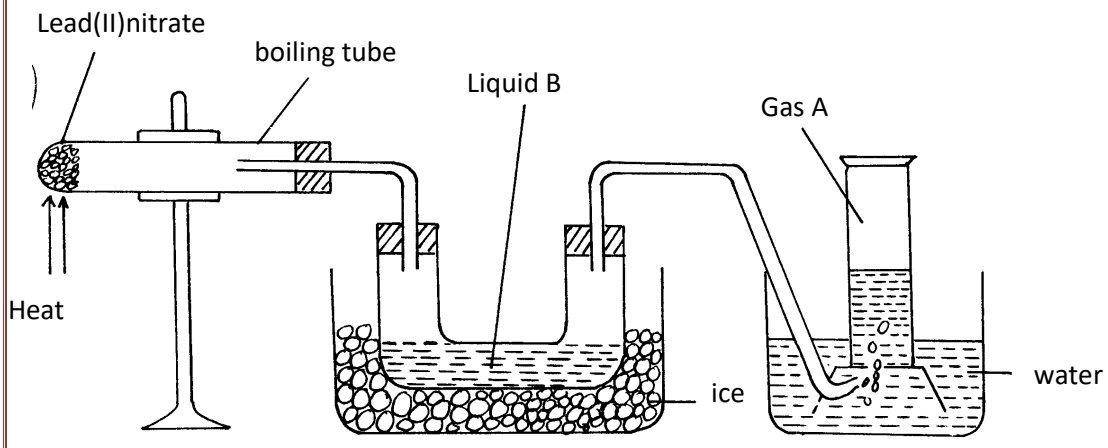
(iii) Write an equation for the formation of solution **Q** and gas **R**. (1mark)

……

……

……

7. The diagram below shows a set-up of apparatus that can be used to prepare nitrogen (IV) oxide. Study it and use it to answer the questions that follow




(a) (i) Write the equation for the reaction that takes place in the boiling tube. (1 mark)

……

(ii) State the observations made in the boiling tube. (2 marks)

……

……..

……..

……

(iii) Explain why lead (II) nitrate is preferred over other metal nitrates in this experiment. (1 mark)

(iv) Describe how gas A can be identified. (1 mark)

……

……

(b) (i) Name liquid B (1 mark)

……..

(ii) Write a chemical equation to show how liquid B is formed in this experiment. (1mark)

(c ) (i) In another experiment, excess aqueous lead (II) nitrate solution was reacted with a solution which contained 2.34g of sodium chloride. Calculate the mass of precipitate formed in this reaction. (Pb = 207, Cl = 35.5, Na = 23) (3 marks)

(ii) Write an ionic equation for the reaction that takes place when nitrogen (IV) oxide reacts with aqueous sodium hydroxide. (1 mark)

……

……..

**PAPER 3**

1. **(20 marks)** You are provided with:
   - Solution **P**, hydrochloric acid
   - Solution **Q,** containing 8.8g per litre of sodium hydroxide.
   - 0.6g of an impure carbonate, solid **B**

   You are required to determine the:
   a) Concentration of solution **P** in moles per litre.
   b) Percentage purity of the carbonate, solid **B**.

   **Procedure I**

   Fill the burette with sodium hydroxide, solution **Q**. Pipette 25.0cm$^3$ of hydrochloric acid, solution **P** into a conical flask. Add 2 – 3 drops of methyl orange indicator and titrate. (The colour of the indicator changes from pink to yellow). Record your results in table 1 below. Repeat the titration two more times and complete the table.

   **Table I**

| | I | II | III |
|---|---|---|---|
| Final burette reading | | | |
| Initial burette reading | | | |
| Volume of solution **Q** used (cm$^3$) | | | |

(4 marks)

a) What is the average volume of solution **Q** used? (1 mark)

b) Determine the:
   (i) Concentration of solution **Q** in moles per litre. (Na = 23.0; O = 16.0, H = 1.0) (1 mark
   (ii) Concentration of solution **P** in mole per litre (2 marks)

   **Procedure II**

   Using a 100ml measuring cylinder, measure out 100cm$^3$ of solution **P** into a 250cm$^3$ beaker.
   Add all of solid **B** into the beaker containing solution **P**. Swirl the mixture and allow the reaction to proceed for about 4 minutes.
   Label the solution obtained here as solution **K**.
   Fill the burette with sodium hydroxide, solution **Q**. Pipette 25.0cm$^3$ of solution **K** into a conical flask. Add 2- 3 drops of methyl orange indicator and titrate. Record your results in table II below. Repeat the titration two more times and complete the table.

   **Table II**

| | I | II | III |
|---|---|---|---|
| Final burette reading | | | |
| Initial burette reading | | | |
| Volume of solution **Q** (cm$^3$) | | | |

(4 marks)

c) What is the average volume of solution **Q** used? (1 mark)
d) Calculate the :

i. Moles of hydrochloric acid in 25.0cm$^3$ of solution **K**. (1 mark)

ii. Moles of hydrochloric acid in 100cm$^3$ of solution **K**. (1 mark)

iii. Moles of hydrochloric acid in 100cm$^3$ of the original hydrochloric acid solution **P**. (1 mark)

iv. Moles of hydrochloric acid that were used up in the reaction with solid **B**. (1 mark)

v. Moles of the carbonate that reacted with hydrochloric acid. (1 mark)

e) Given that the relative formula mass of the carbonate is 72, calculate the:

i. Mass of the carbonate that reacted. (1 mark)

ii. Percentage purity of the carbonate, solid **B**. (1 mark)

**2. (10marks)** You are provided with solid **M**. Carry out the tests below and record your observations and inferences in the spaces provided.

a) Place **all** of solid **M** in a boiling tube and add about 10cm$^3$ distilled water and shake.

| **Observations** | **Inferences** |
|---|---|
| (½mark) | (½ mark) |

b) Divide the solution into five portions of about 2cm$^3$ each.

i. To the first portion, add aqueous sodium hydroxide dropwise until in excess.

| **Observations** | **Inferences** |
|---|---|
| (1mark) | (1mark) |

ii. To the second portion, add aqueous ammonia dropwise until in excess.

| **Observations** | **Inferences** |
|---|---|
| (1mark) | (1mark) |

iii. Dip a glass rod in the third portion and heat it on a burnsen burner flame, identify the colour of the flame produced.

| Observations | Inferences |
|---|---|
| | |
| (½mark) | (½mark) |

iv. To the fouth portion,add about 1cm$^3$ of lead (II) nitrate solution.

| Observations | Inferences |
|---|---|
| | |
| (1mark) | (1mark) |

v. To the fifth portion, add about 1cm$^3$ of dilute sodium hydroxide followed by a small piece of aluminium foil. Warm the mixture gently and carefully. Test any gas produced using blue and red litmus papers.

| Observations | Inferences |
|---|---|
| | |
| (1mark) | (1mark) |

**3. (10marks)**You are provided with solid **W**. Carry out the tests below and record your observations and inferences in the spaces provided.

a) Place about one third of solid **W** on a **metallic** spatula and burn it using a Bunsen burner.

| Observations | Inferences |
|---|---|
| | |
| (1mark) | (1mark) |

b) Place the remaining solid **W** into a boiling tube. Add 10cm$^3$ of distilled water and shake well. Use 2cm$^3$ portions of the mixture for each of the following reactions.

(i) To the first portion, add 2 drops of acidified potassium manganate (VII) and shake well.

| Observations | Inferences |
|---|---|
| | |

(1mark) (1mark)

(ii) To the second portion, add three drops of bromine water

| Observations | Inferences |
|---|---|
| | |

(1mark) (1mark)

(iii) To the third portion put universal indicator paper.

| Observations | Inferences |
|---|---|
| | |

(1mark) (1mark)

(iv) To the fourth portion add a little solid **Y**, sodium hydrogen carbonate.

| Observations | Inferences |
|---|---|
| | |

(½mark) (½mark)

(v) To the fifth portion add about $2cm^3$ of ethanol and warm the mixture.

| Observations | Inferences |
|---|---|
| | |

(½mark) (½mark)

**KCSE PREDICTION 8 2022**
**PAPER 1**

1. The pH values of some solutions labeled **E** to I are given in the table **below**. Use the information to answer the questions that follow.

| pH | 14.0 | 1.0 | 9.0 | 6.5 | 5.0 |
|---|---|---|---|---|---|
| Solution | E | F | G | H | I |

(a) Identify the solution with the highest concentration of hydroxide ions. Explain (1mk)

……

……

(b). Which solution can be used as a remedy for acid indigestion in the stomach? Explain (1mk)

……

……

**(c)** Which solution would react explosively with Potassium metal? (1mk)

……

2. a) Distinguish between ionization energy and electron affinity (2mks)

……

……

……

……

b) The table below shows first ionization energies of metals represented by letters A, B, C and D. The metals are in the same group of the periodic table.

| **Metal** | A | B | C | D |
|---|---|---|---|---|
| **1st ionization energy (kJ/mole** | 402 | 496 | 520 | 419 |

Which of the metals has the largest atomic radius? Explain. (2mks)

……

3. An element: $^{23}_{11}M$

(a) To which chemical family does it belong? ($^1/_2$mk)

……

(b) Write the electron arrangement of the atom. ($^1/_2$mk)

……

(c) Draw the structure of its ion. (1mk)

4. (a) Define electrolysis. (1mk)

……

……

(b) During the electrolysis of molten aluminium oxide, write the equations at the;

Anode - ……. (1mk)

Cathode - ……. (1mk)

5. In an experiment to determine the percentage purity of Sodium carbonate produced in the Solvay process , 2.15g of the sample reacted with exactly 40.0cm$^3$ of 0.5M Sulphuric(VI)acid. Determine the percentage purity of sodium carbonate in the sample.

109 for marking schemes inbox 0724351706

6. **Y** is a product of gaseous reaction which results in an equilibrium mixture being formed.

**Reactants** $\rightleftharpoons$ **Y**

The percentage of **Y** in equilibrium at various temperatures and pressure is shown in the following table.

| Temperature ($^0$C) | 1 atm | 100 atm | 200 atm |
|---|---|---|---|
| 550 | **0.77** | **6.70** | **11.9** |
| 650 | **0.032** | **3.02** | **5.71** |
| 750 | **0.016** | **1.54** | **2.99** |
| 850 | **0.09** | **0.87** | **1.68** |

Use this data to deduce, giving a reason for each case;

a) Whether production of Y is exothermic or endothermic. (2mks)

……
……

b) Whether production of Y **involves** an increase or a decrease in number of moles of gas present. (2mks)

……
……
…….....

7. State and explain what is observed when moist red flowers are dropped in a gas jar containing Sulphur (IV) oxide. (3mks)

……
……
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……
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.....

8. A sample of water collected from **River Nzoia** is suspected to contain chloride ions. Describe an experiment that can be carried out to determine the presence of the chloride ions. (2mks)

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9. During distillation in a laboratory the distillate can be collected either by a beaker or a conical flask.

(a) Define the term distillate. (1mk)

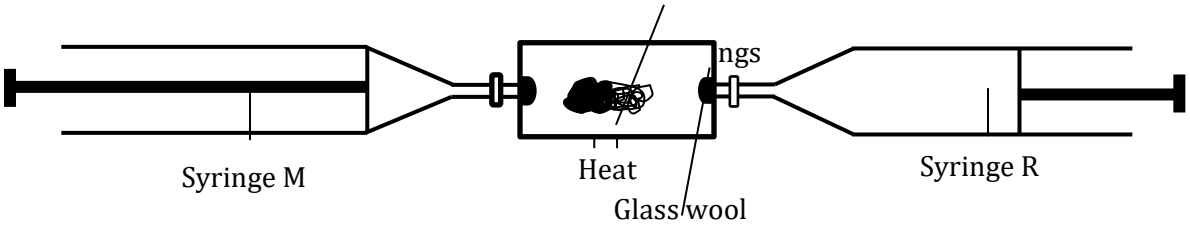
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(b) Explain why a conical flask is the most preferred apparatus for the collection of the distillate. (1mk)

……
……

(c) Draw the diagram of a graduated conical flask. (1mk)

10. In an experiment to determine the proportion of oxygen in air, copper turnings were packed in excess in a long combustion tube connected to two syringes of 110cm$^3$ each in volume. At the beginning of the experiment, syringe R contained 110cm$^3$ of air while syringe **M** was closed and empty as shown.




Air was passed over the heated copper slowly and repeatedly until there was no further change in volume. 97.5cm$^3$ of air remained in syringe M.

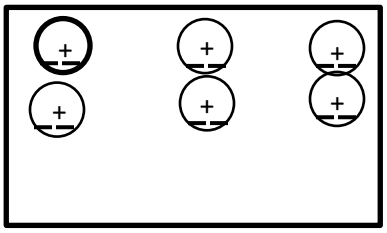
(a) State and explain the observation made in the combustion tube. (2mks)

……
……
……..

(b) If the volume of air in the **combustion tube** at the beginning of the experiment was 23.8cm$^3$ and at the end of the experiment reduced to 10cm$^3$, calculate the percentage of the active part of air. (2mks)

……
……
……..

11. Below is a structure of an element X. Use it to answer the questions that follow.



(a) Name the chemical family to which element X belongs. Give a reason. (2mks)

……
…….....

(b) (i) Define covalent bond. (1mk)

……
……
…….....

(ii) Using dots (●) of cross ( **x** ) diagram, show bonding in Carbon (II) Oxide. (1mk)

12. (a) (i) State ***two*** allotropes of Carbon. (1mk)

……
……
……..

(ii) Explain the differences in their densities. (2mks)

……
……
……..

(b) (i) Name the process used for large scale production of Sodium Carbonate using brine as raw material. (1mk)

……
……
……..

(ii) Write the overall chemical equation for the reaction in the carbonator. (1mk)

……
……

(c) Name two gases recycled in the above process (1mk)

……
……
……..

13. Name the following compounds using the IUPAC system. (3mks)

(i) $CH_3\ CH_2\ CH_2\ CH_2\ C(Br) = CH(CH_3)$

.....

(ii) $CH_3CH_2CH_2COOCH_2CH_2CH_3$

.....

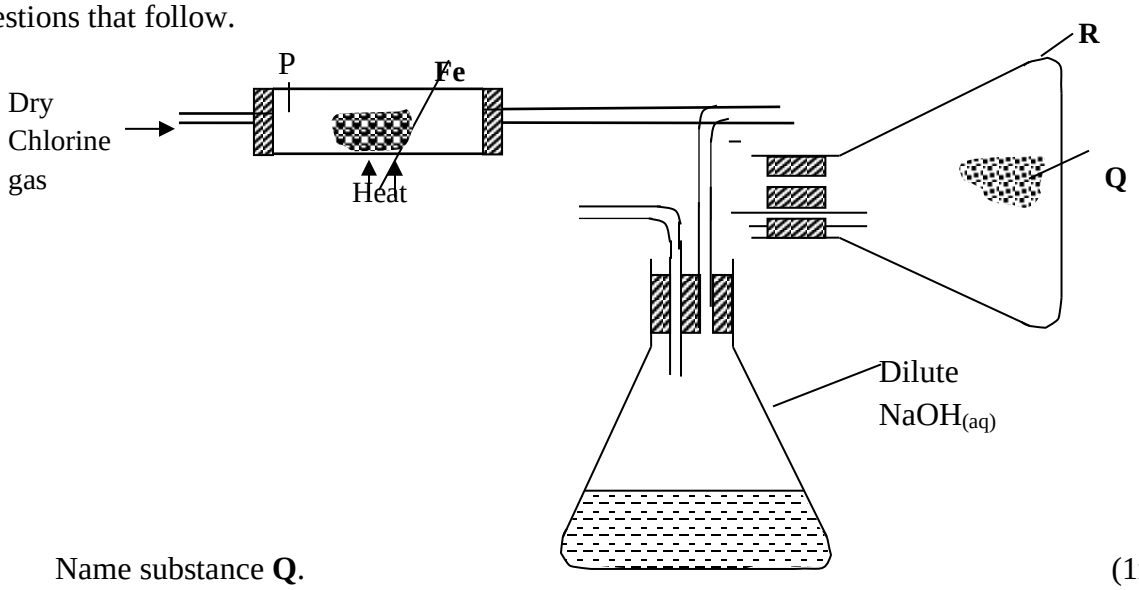
(iii) $CH_3CH(Cl)C(CH_3)CH(Cl)CH_3$

.....

14. Describe how to prepare Ethane gas starting with soda lime (3mks)

……
……
……

15. The diagram below shows how chlorine reacts with metals in the laboratory. Study it and answer the questions that follow.




(a) Name substance **Q**. (1mk)

……

(b) Give a reason why substance Q is not collected in the combustion tube P. (1mk)

……

(c) Write chemical equation for the reaction that occurs in the conical flask containing Sodium hydroxide. (1mk)

……

16. (a) Water sample is found to contain $Mg^{2+}$, $Cl^{-}$, $SO_4^{2-}$, and $Ca^{2+}$. Identify the type of water hardness (1mk)

……

……

(b) Which type of detergent is more suitable with the water sample above. Give a reason (2mks)

……

……

(c) Permanent water hardness cannot be removed by boiling. Explain (1mk)

……

……

……

17. Starting with lead metal, write procedure on preparation of lead(II) nitrate crystals (3mks)

……

……

……

18. The following chemical equations show the effects of heat on nitrates.

$2B(NO_3)_{2(s)} \longrightarrow 2BO_{(s)} + 4NO_{2(g)} + O_{2(g)}$

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

$2CNO_{3(s)} \longrightarrow 2C_{(s)} + 2NO_{2(s)} + O_{2(g)}$

a. Arrange elements A, B and C from the most reactive to the least reactive. ($1^1/_2$mks)

……

……Give one example of element A, B and C. ($1^1/_2$mks)

……

……

……

19. Copper (II) sulphate crystals, a boiling tube, a test-tube, a beaker and other necessary requirements were used in an experiment to determine the type of change that occurred when the crystals were heated.

(a) Draw a labelled diagram to represent the set-up at the end of the first part of the experiment. (3mks)

(b) After the second part of the experiment was done, state the conclusion that was made about the type of change undergone by copper (II) sulphate crystals when heated. (1mk)

……

……

20. (a). Distinguish between chromatography and a chromatogram. (1mk)

……

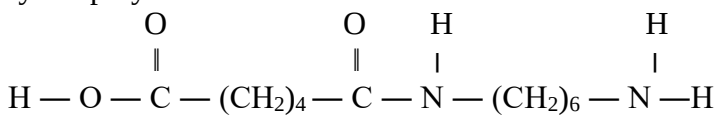
……

……

(b) State the role of chromatography in the administration of international athletics competitions. (1mk)

……
……

21. Study the polymer shown below.



a) Name the polymer. (1mk)

……

b) Identify two monomers that make up the polymer. (2mks)

……..

c) Give one use of the polymer (1mark)

……

22. (a) State Charles law. (1mk)

……

(b) A gas occupies 450cm$^3$ at 27$^0$C. What volume would the gas occupy at 177$^0$C if its pressure remains constant? (2mks)

……
……

23. A colourless liquid was suspected to be water. State two ways to confirm.

(i) Purity of the water. (1mk)

……
……..

(ii) That the liquid was water. (2mks)

……..……
…….

24. Use the following information to answer the questions that follow

**$\Delta H_{lattice}$ $MgCl_2$ = +2489 kJ/ mol**

**$\Delta H_{hydration}$ $Mg^{2+}$ = - 1891 kJ/ mol**

**$\Delta H_{hydration}$ $Cl^-$ = -384 kJ/ mol**

a) Calculate the heat of solution of magnesium chloride. (2mks)

……
……
……..

b) Draw an energy level diagram for the dissolving of magnesium chloride (2mks)

25. i) A solution of aqueous sodium hydroxide is added to a gas jar of nitrogen (IV) oxide and shaken. State and explain the observation made (2mks)

……
……
……..

ii) Write the chemical equation for the reaction above (1mk)

……
……

**PAPER 2**

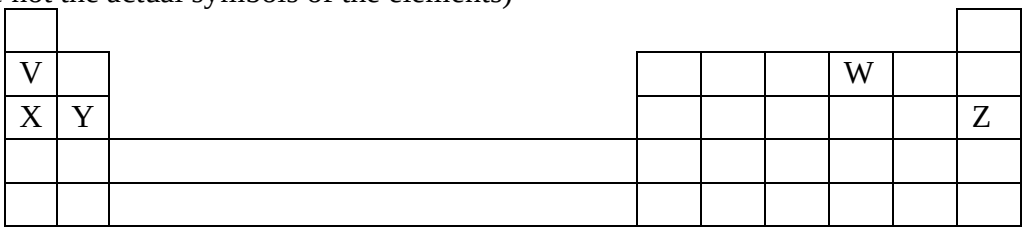
**1.** Use the information in the table below to answer the questions that follow

| Element | Atomic Radii (nm) | Tonic radii nm |
|---|---|---|
| D | 0.231 | 0.133 |
| E | 0.181 | 0.099 |
| F | 0.160 | 0.065 |
| G | 0.195 | 0.114 |

a) i) Are the members in this group likely to be conductor or non – conductors? Explain.(1mk)

ii) Which element would have the lowest atomic number? Explain. (1mk)

b) The grid below represents part of the periodic table. Study it and answer the questions that follow. (The letters are not the actual symbols of the elements)




i) Select the element in period three which has the shortest atomic radius. Give a reason for your answer. (1mks)

ii) Using dots (•) and crosses (x) to represent outermost electrons, draw a diagram to show the bonding in the compound formed when chlorine reacts with element X (1mk)

iii) When three liters of chlorine gas were completely reacted with element Y, 11.85g of the product were formed. Calculate the relative atomic mass of element Y. (R.A.M of chlorine = 35.5, molar gas volume = 24 liters) (3mks)

c ) (i) What is a coordinate bond? (1mk)

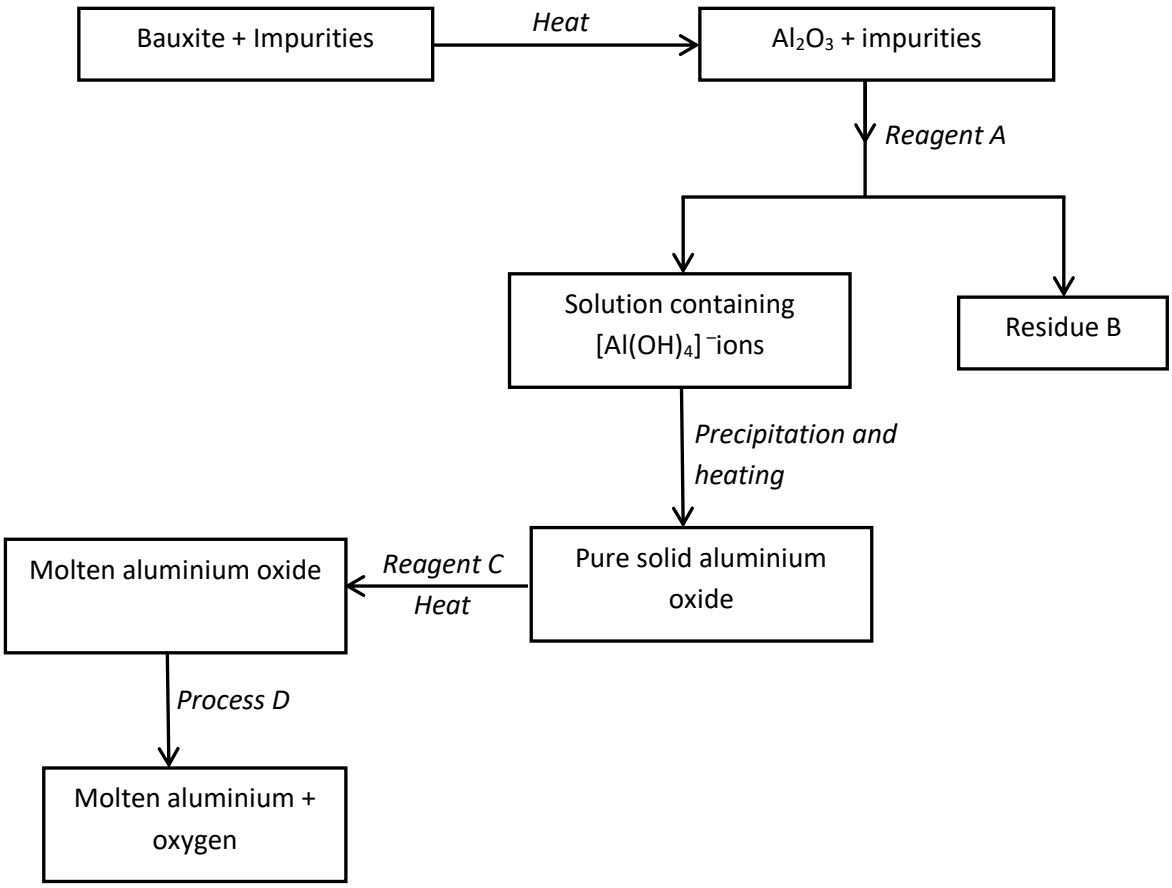
(ii) Draw a dot (•) cross (X) diagram to show bonding in the hydroxonium. $H_3O^+$ ion (H = 1, O = 8). (2mks)

d) Aluminium chloride and sodium chloride are both chlorides of period 3 elements.Use this information to explain the following observations.

I ) A solution of $AlCl_3$ in water turns blue litmus paper red while that of sodium chloride does not. (1½mks)

II) The melting point of sodium chloride (801°C) is higher than that of $AlCl_3$ (180°C). (1½mks)

**2.** The flow chart below shows industrial extraction of aluminium metal. Study it and answer the questions that follow.




a) Name **two** main impurities found in bauxite. (1 mark)

_____

_____

b)Name reagents A and C

Reagent A _____ (1 mark)

Reagent C _____ (1mark

c)Name residue B. Give a reason. (2 marks)

Name _____

Reason _____

_____

d)When 3.12g of hydrated aluminium oxide ($Al_2O_3.nH_2O$) was heated into a constant mass, 2.06g of aluminium oxide was obtained. Determine the value of n in hydrated aluminium oxide. (Al=27.0,O=16.0,H=1.0) (4 marks)

e)Explain why it is necessary to heat aluminium oxide in the presence of reagent C before process D is carried out. (1 mark)

**3.** a) State the particles responsible for conductivity of an electric current in:

i) Solution _____ (1 mark)

ii) A metal _____ (1 mark)

b) Study the electrode potentials for the half cells given below. The letters do not represent the actual symbols of the elements.

Half-cell $E^{\theta}V$

| | | |
|---|---|---|
| $U^{+}_{(aq)} + e^{-} \rightarrow$ | $U_{(s)}$ | –3.02 |
| $V^{2+}_{(aq)} + 2e^{-} \rightarrow$ | $V_{(s)}$ | –2.87 |
| $W^{2+}_{(aq)} + 2e^{-} \rightarrow$ | $W_{(s)}$ | +0.34 |

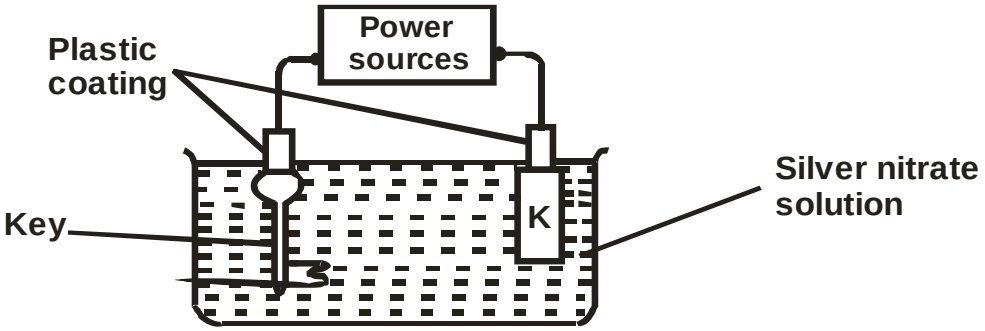
i)Calculate the e.m.f of the cell made by U and V. (1 mark)

ii). Identify the strongest oxidising agent. (1 mark)

iii). Determine the equation of the cell reaction made of U and W. (1 mark)

iv). Show the overall cell representation for the cell reaction in b (ii) above. (1 mark)

c) One use of electrolysis is electroplating as shown below.




i) To what terminal of the power source is the key connected? (1 mark)

ii) Name the most suitable material for electrode K. (1 mark)

iii) Write the: (1 mark)

I. Anode equation (1mk)

Cathode equation (1mk)

iv) If 3A power source was used for five hours, calculate the increase in mass of the key.(Ag=108, 1F=96500C). (3 marks)

**4.** In an experiment to study the rate of a reaction,2.0g of Manganese (IV) oxide was added to 100$cm^3$ of hydrogen peroxide solution at 25°C. The volume of oxygen released was measured at 10 seconds intervals. The results obtained are tabulated below

| Time (sec) | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
|---|---|---|---|---|---|---|---|---|---|---|
| Volume ($cm^3$) | 0 | 60 | 90 | 105 | 112 | 116 | 118 | 120 | 120 | 120 |

(i)Plot a graph of volume of gas (vertical axis) against time and label it X (3mks)

(ii) Use the graph to find:

(I) The volume of gas produced after 25 seconds (1mk)

……

……

(II) The time taken to produce 80$cm^3$ of oxygen (1mk)

……
……

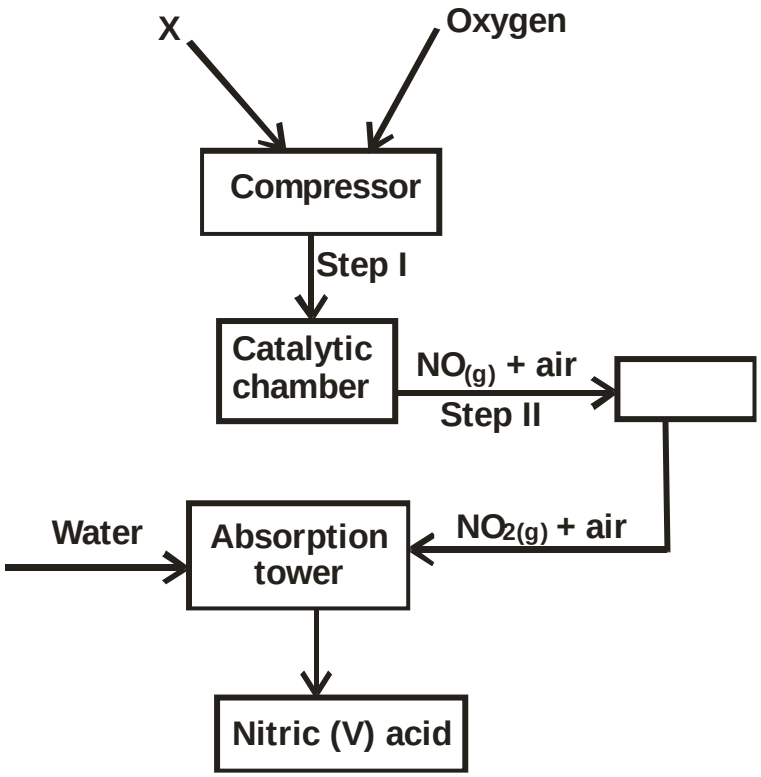
(iii) Explain why the volume of oxygen produced does not exceed 120cm3 (1mk)
……
……

(iv) Sketch a graph Y, on the same grid to show the results if the experiment was repeated using hydrogen peroxide at $10^oC$. Explain (2mks)
……
……

(v) The mass of the solid residue after the experiment was found to be 2.0g when dried. Explain. (1mk)

vi) Draw a diagram to show how the oxygen gas released could have been collected and measured. (2mks)

**5.** The flowchart below shows the large scale manufacture of nitric (V) acid. Study it and answer the questions below.




a) Name substance X. (1 mark)

b) Identify **one** source of X in this process. (1 mark)

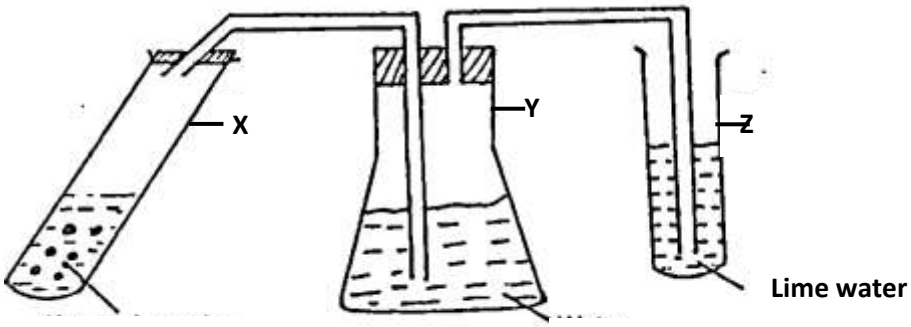
c) Write a balanced equation for the reaction which takes place.
i) At step II. (1 mark)

ii) In the absorption tower (1 mark)

d) Name the catalyst used in this process (1 mark)

e) Why is it not advisable to store nitric (V) acid in a transparent bottle? (1 mark)

f) The apparatus below was arranged to investigate the properties of nitric (V) acid.Study the set-up and answer the questions that follow:




i) Explain what would be observed when blue and red litmus paper is dropped into flask Y after the experiment. (2 marks)

ii) Write an equation for the reaction in test tube X above. (1 mark)

iii) What gaseous products would be expected if concentrated sulphuric (VI) acid was used in place of conc. nitric (V) acid? (1 mark)

**6.** In an experiment to determine the molar heat of displacement when magnesium displaces copper 0.36g of magnesium powder were added to 25cm³ of 1M copper (II) chloride solution, the temperature of solution increased by 43°C. (Cu = 63.5, Mg = 24.0 specific heat capacity 4.2J/g/K).

(i) Other than increase in temperature, state and explain the other observation made. (2 marks)

(ii) Determine the molar heat of displacement of copper. (3 marks)

(b) Given the following reactions

$C_{(S)} + O_{2(g)} \rightarrow CO_{(g)} \quad \Delta H = -110kJ$

$CO_{(g)} + ½\ O_{2(g)} \rightarrow CO_{2(g)} \quad \Delta H = -283kJ$

Using an energy cycle diagram, calculate the molar heat of formation of carbon (IV) oxide. (3 marks)

(c) Study the table of bond energies below.

| Bond | Bond energy $kJmol^{-1}$ |
|---|---|
| H – H | 435 |
| Br – Br | 224 |
| H - Br | 336 |

Use the information to calculate the enthalpy of the reaction shown below. (2mks)

$H_{2(g)} + Br_{2(g)} \rightarrow 2HBr_{(g)}$

7. (a) A hydrocarbon contains 85% carbon. Its molecular mass is 68g.

(i) Determine its empirical and molecular formula. (C = 12, H = 1). (3mks)

(ii) Draw two positional isomers of the hydrocarbon. (2mks)

(iii) Write an equation for the reaction between one of the isomers with chlorine and name the product formed. (2mks)

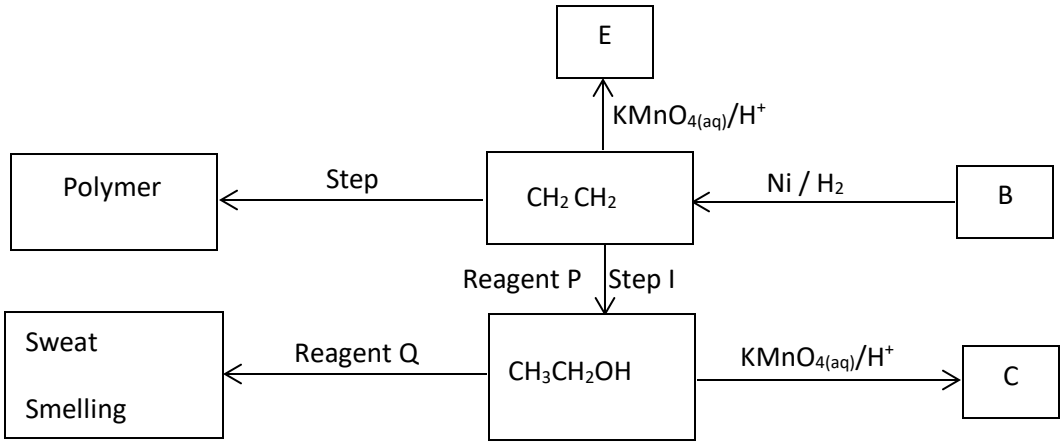
b) In an experiment an organic compound was reacted with absolute ethanol in the presence of concentrated sulphuric (VI) acid to form a compound whose formula is $CH_3\ CH_2\ CH_2\ COOCH_2\ CH_3$

I Name the type of reaction that took place. (1mk)

II To which homologous series does the compound in (b) above belong? (½mk)

(iii) Write the structural formula and give the systematic name of the acid used in the above experiment. (1mk)

(d) Study the flow diagram **below** and answer the questions that follow.




(iv) Identify the following compounds.

**B** _____ (½mk)

**C** _____ (½mk)

**A** _____ (½mk)

**E** _____ (½mk)

(v) Name the process in steps.

**I** _____ (½mk)

**II** _____ (½mk)

**IV** _____ (½mk)

(vi) Reagent

**P** _____ (½mk)

**Q** _____ (½mk)

# PAPER 3

1. You are provided with:-
   - Solution **Q**, 2M Hydrochloric acid.
   - Solution **P**, 0.15M Sodium thiosulphate
   - Solution **R,** Sodium carbonate

**Procedure 1**

Measure $20cm^3$ of 0.15M Sodium thiosulphate (solution **P**) into a $250cm^3$ a conical flask. Place the beaker on a white piece of paper with **ink mark** '**X**' on it. Measure $20cm^3$ of 2M hydrochloric acid solution **Q** using a $50cm^3$ measuring cylinder. Put the acid into the conical flask containing Sodium thiosulphate and immediately start off the stop watch. Determine the time taken for the **mark** '**X**' to become invisible /obscured when viewed from above. Repeat the procedure by measuring different volumes of the acid and adding the volumes of the distilled water to complete Table I below.

**Table I**

| **Volume of acid ($cm^3$)** | **Volume of water ($cm^3$)** | **Volume of sodium thiosulphate ($cm^3$)** | **Time taken for mark 'X' to be invisible/obscured (seconds)** | **Reciprocal of time ($sec^{-1}$) $\frac{1}{t}$** |
|---|---|---|---|---|
| **20** | **0** | **20** | | |
| **18** | **2** | **20** | | |
| **16** | **4** | **20** | | |
| **14** | **6** | **20** | | |
| **12** | **8** | **20** | | |
| **10** | **10** | **20** | | |

a) Complete the table above (6 marks)

b) Plot a graph of 1/t (rate) against volume of acid used (3 marks)

c) Explain the shape of your graph (1 mark)

……

……

……

d) From the graph determine

(i) Time taken for the cross to be obscured/invisible when the volume of the acid is:

I) $15cm^3$ (1 mark)

.....

……

II) $8cm^3$ (1 mark)

.....

.....

(ii) The volume of the acid used if the time taken for the cross to be obscured/invisible is:

I) 40 seconds (1 mark)

……

……

II) 43 seconds (1 mark)

**Procedure 2**

Using a 10 $cm^3$ measuring cylinder, place 10 $cm^3$ of solution Q into a 250 ml volumetric flask. Add about 200 $cm^3$ of distilled water. Shake well. Add more distilled water to top up to the mark. Label this solution T. Fill the burette with solution T. Using a pipette and pipette filler, pipette 25 $cm^3$ of solution R into a conical flask. Add 3 drops of Phenolphthalein indicator and titrate with solution T.

- Record your results in the table.
- Repeat the titration two more times and complete the table.

**Table 2**

| | I | II | III |
|---|---|---|---|
| Final burette reading ($cm^3$) | | | |
| Initial burette reading ($cm^3$) | | | |
| Volume of solution T ($cm^3$) added | | | |

(4 marks)

a) Determine the:-

(I) Average volume of solution T used. (1 mark)

……

(II) Moles of the acid in the average volume of solution T used. (2 marks)

……

……

(IV) Concentration of solution R in moles per litre. (2 marks)

……...

(a) Put a spatula end-full of solid A into a boiling tube and add about 10$cm^3$ of distilled water. Shake the mixture well. Divide the resultant solution into 4 equal portions.

| **Observations** | **Inferences** |
|---|---|
| (½ mark) | (1 mark) |

(b) (i) The solution is suspected to contain **ammonium ions**. Using **calcium hydroxide** **soli**d and **red litmus paper** provided, describe how you would confirm presence of the **ammonium ions**.

| **Description** | **Expected observations** |
|---|---|

| | |
|---|---|
| (1 mark) | (½ mark) |

(ii) Carry out the actual test as described in (b) (i) above.

| **Observations** | **Inferences** |
|---|---|
| (1 mark) | (½ mark) |

(c) To the second portion, add 4 drops of hydrogen peroxide solution. Test the gas produced using a glowing splint.

| **Observations** | **Inferences** |
|---|---|
| (1 mark) | (1 mark) |

(d) (i) The solution is also suspected to contain **sulphite ions**. Using **Barium nitrate solution** and **dilute hydrochloric acid** solution, describe how you would confirm presence of the **sulphite ions**.

| **Description** | **Expected observations** |
|---|---|

| | |
|---|---|
| (1 mark) | (1 mark) |

(ii) Carry out the actual test as described in (d) (i) above.

| **Observations** | **Inferences** |
|---|---|
| (1 mark) | (½ mark) |

2. You are provided with solid B. Carry out the tests below and record your observations and inferences in the spaces provided.
   (i) Place one third of solid B on a metallic spatula. Burn it in a non-luminous flame of the Bunsen burner.

| **Observation** | **Inference** |
|---|---|
| (1 mark) | (1 mark) |

(ii) Place the remaining solid in a test-tube. Add about $6cm^3$ of distilled water and shake the mixture well. Retain the solution for the next procedure.

| **Observation** | **Inference** |
|---|---|
| | |

(1/2 mark) (1/2 mark)

(I)To about $2cm^3$of the solution, add 2 drops of acidified potassium manganate (VII).

| **Observation** | **Inference** |
|---|---|
| (1 mark) | (1 mark) |

(II)To about $1cm^3$ of the solution, add 3 drops of acidified potassium dichromate (VI) and warm.

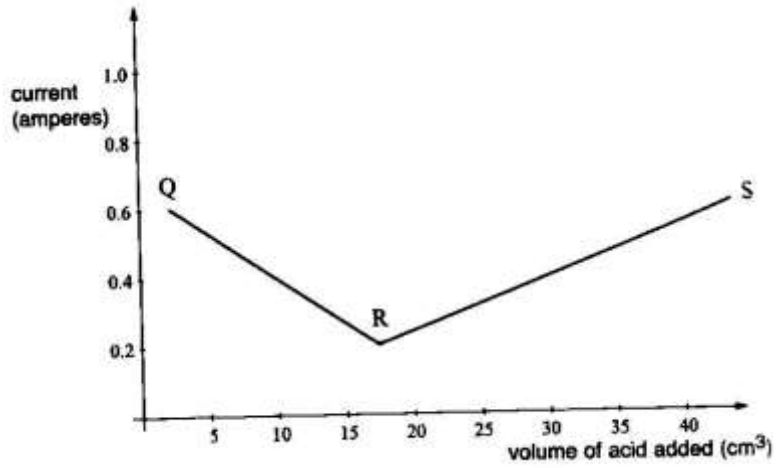
| **Observation** | **Inference** |
|---|---|
| (1/2 mark) | (1/2 mark) |

(III) To about $2cm^3$ of the solution, add 1g of solid A; sodium hydrogen carbonate.

| **Observation** | **Inference** |
|---|---|
| (½ mark) | (½ mark) |

**KCSE PREDICTION 9 2022**
**PAPER 1**

1. The electrical conductivity of barium hydroxide solution was measured after each addition of 1.0 $cm^3$ of dilute sulphuric (VI) acid from a burette. The graph below was obtained.




(a) Write the chemical equation of the reaction that took place. (1 mark)

……

……

(b) Explain the graph between,

(i) Q and R (1 mark)

……

……

……

(ii) R and S (1 mark)

……

……

……

2. A mass of 14.2 g sodium nitrate saturated 32.1 $cm^3$ of water at 32 $^oC$. Determine the solubility of sodium nitrate at 32 $^oC$. (Density of water = 1g/$cm^3$). (2 marks)

……

……

……

……

3. Explain why sulphur is a solid while oxygen is a gas at room temperature. (2 marks)

……

……

……

……

4. Study the electrode potential in the table below and answer the questions that follow.

| | E volts |
|---|---|
| $Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$ | +0.34 |
| $Mg^{2+}_{(aq)} + 2e^- \rightarrow Mg_{(s)}$ | -2.38 |
| $Ag^{+}_{(aq)} + e^- \rightarrow Ag_{(s)}$ | +0.80 |
| $Ca^{2+}_{(aq)} + 2e^- \rightarrow Ca_{(s)}$ | -2.87 |

(a) Identify the strongest reducing agent. (1 mark)

……

(b) What would be observed when magnesium ribbon is dipped in solution of copper (II) sulphate. Explain. (2 marks)

……

……

……

……

5. In a reaction, 0.65 g of impure zinc oxide reacted with 100 $cm^3$ of 0.15 M nitric (V) acid.

(a) Write equation of the reaction. (1 mark)

……

(b) Calculate percentage purity of the zinc oxide sample. (2 marks)
(Zn = 65, O = 16)

……

……

……

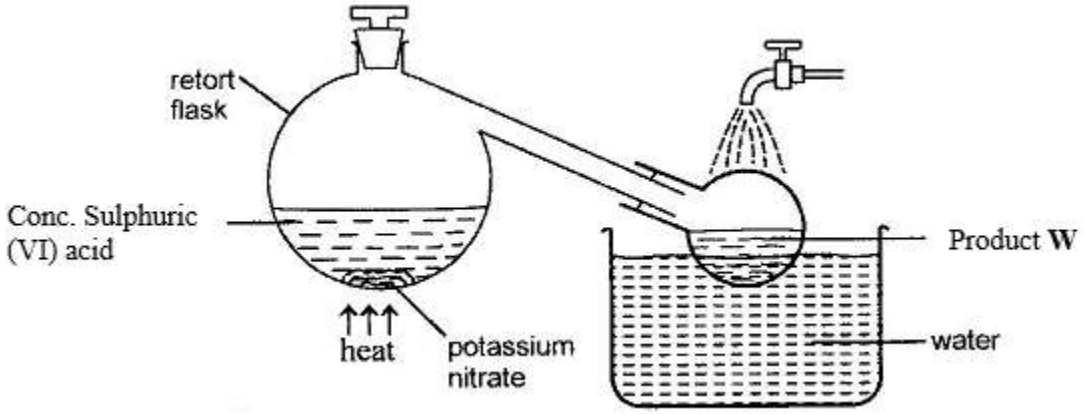
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6. The set up below can be used for the laboratory preparation of product **W**.




(a) Write chemical equation for the reaction that takes place in the retort flask. (1 mark)

……

(b) Explain why product W appears yellow in colour. How is the colour removed?
(2 marks)

……

……

……

……

7. The table below shows information of four elements **A**, **B**, **C** and **D**. Study it and answer the questions that follow. The letters do not represent the actual symbols of the elements.

| Element | Electronic arrangement | Atomic radius | Ionic radius |
|---|---|---|---|
| A | 2.8.2 | 0.136 | 0.065 |
| B | 2.8.7 | 0.99 | 0.181 |
| C | 2.8.8.1 | 0.203 | 0.133 |
| D | 2.8.8.2 | 0.174 | 0.099 |

(a) Which two elements have similar properties? (1 mark)

……

(b) Explain why **B** ionic radius is larger than its atomic radius. (2 marks)

……

……

……

……

8. The production of ammonia gas involves a reversible reaction as shown.

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)} \quad \Delta H = -92\ kJmol^{-1}$$

(a) What condition is necessary for the chemical equilibrium to be established? (1 mark)

……

……

(b) Suggest **two** conditions that are likely to shift the equilibrium from right to left.
(2 marks)

……

……

9. Describe how chloride ions are tested in a solution. (2 marks)

……

……

……

……

……

……

10. The empirical formula of X is $CH_2Br$. Given that 0.235 g of X occupies a volume of 56 $cm^3$ at 546 K and 1 atmosphere pressure, determine its molecular formula.
(H = 1.0, C = 12.0, Br = 80.0, molar gas volume at STP = 22.4 $dm^3$) (3marks)

……

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11. When a piece of sodium metal is place in cold water in a beaker it melts producing a hissing sound, as it moves on the surface of the water. Explain these observations. (3 marks)

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……

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……

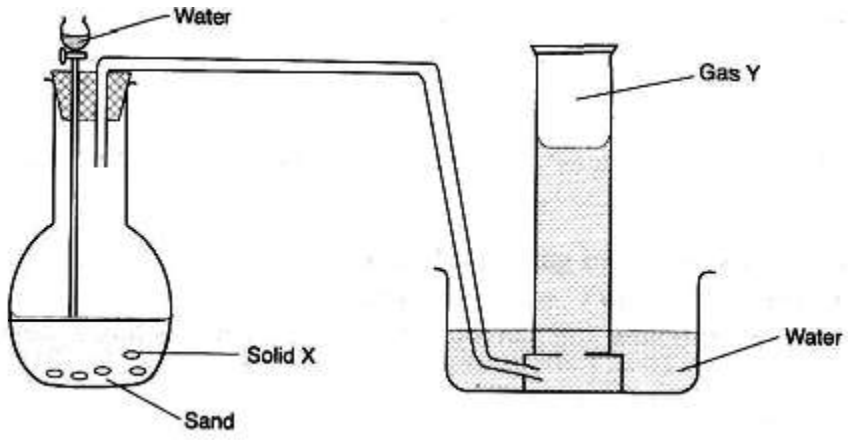
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12. The set-up below was used to prepare a hydrocarbon. Study it and answer the questions that follow.




(a) Identify solid X and gas Y.

Solid X……..... (1 mark)

Gas Y……..... (1 mark)

(b) Write a chemical equation for the complete reaction between gas Y and bromine vapour. (1 mark)

……

13. (a) When excess chlorine gas is bubbled through cold, dilute sodium hydroxide solution, the resulting solution acts as a bleaching agent. Using an equation, explain how the resulting solution acts as a bleaching agent. (1 mark)

……

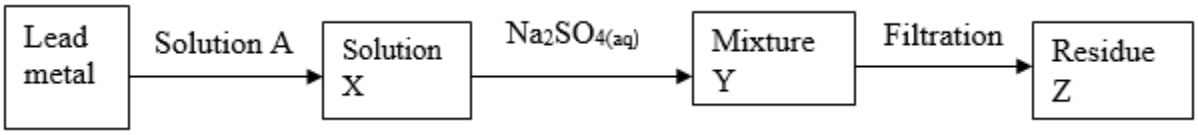
(b). What is observed when chlorine gas is bubbled through a solution of potassium bromide? Explain. (2 marks)

14. (a) Explain why the pH of 1.0 M hydrochloric acid is 1 while that of 1.0 M ethanoic acid is 5.0. (1 mark)

(b) How can a precipitate of barium sulphate be distinguished from that of barium sulphite? (2 marks)

15. **A**, **B**, **C** and **D** are dyes present in a mixture. In a given solvent, **C** is more soluble than **B** and **A** is more soluble than **C**. **D** is the least soluble. Draw an ascending paper chromatogram showing how they would appear when separated using the solvent. (2 marks)

16. The reaction below refers to the preparation of lead (II) sulphate starting with lead metal.




(a) Name solution A…….. (1 mark)

(b) Write an ionic equation for the reaction in (a) above. (1 mark)

……

(c) Explain why it is not possible to prepare residue Z using lead metal and dilute sulphuric acid. (1 mark)

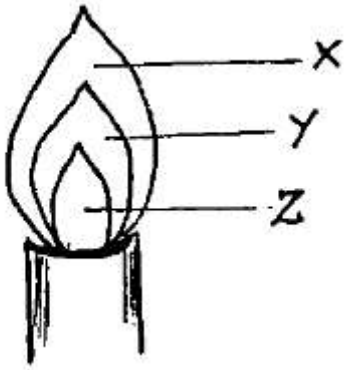
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17. The diagram below represents a Bunsen burner flame. Study it and answer the questions that follow.




(a) Under what condition is the represented flame produced? (1 mark)

……

……

(b) Which of the regions shown represents the hottest part of the flame? (1 mark)

……

(c) Name region Y (1 mark)

……

18. A typical electrolysis cell uses a current of 40,000 amperes. Calculate the mass in kilograms of aluminium produced in one hour. (Al = 27, 1 Faraday = 96,500 coulombs) (3 marks)

19. (a) Distinguish between endothermic and exothermic reaction. (1 mark)

……

……

……

……

(b) Nitrogen reacts with oxygen to form nitrogen (II) oxide according to the following reaction

$N_{2(g)} + O_{2(g)} \rightarrow 2NO_{(g)}$ $\Delta H = +180$ kJmol$^{-1}$

Draw an energy level diagram for this reaction including the activation energy. (2 marks)



20. (a) When a compound T was heated, a brown gas and a residue which was yellow when hot and white when cold were formed. Identify the:

(i) Brown gas…….. (1 mark)

(ii) Residue…… (1 mark)

(b) Name a suitable drying agent for ammonia gas. (1 mark)

……

21. Give the structural formula of the following organic compounds.

(a) 2-Methylbutane

……

……

(b) Pent-2-ene

……

……

(c) Ethylpropanoate

……

……

22. When iron and steam are heated in a closed container, a dynamic equilibrium is reached.

$$3Fe_{(s)} + 4H_2O_{(g)} \rightleftharpoons Fe_3O_{(s)} + 4H_{2(g)}$$

(a) Define the dynamic equilibrium. (1 mark)

……

……

(b) What is the effect on equilibrium if magnesium is added? Explain. (2 marks)

……

……

23. State and explain the observations that would be made when burning magnesium is lowered into a gas jar of sulphur (IV) oxide. (3 marks)

……

……

24. A mixture contains barium sulphate, calcium chloride and dry ice. Describe how the components can be separated. (3 marks)

……

……

25. In the redox reaction below:

$2H^+_{(aq)} + Cr_2O_7^{2-}{}_{(aq)} + 3SO_{2(aq)} \rightarrow 2Cr^{3+}_{(aq)} + 3SO_4^{2-}{}_{(aq)} + H_2O_{(l)}$

Identify the reducing agent. Explain. (2 marks)

……

……

……

……

26 (a) Explain why aluminium utensils do not corrode as easily as iron utensils although aluminium is higher than iron in the reactivity series. (1 mark)

……

……

……

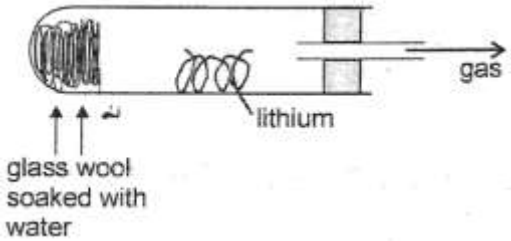
……

(b) State **two** uses of aluminium other than utensils making. (2 marks)

……

……

27. The diagram below represents a set up that was used to react lithium with steam. Study and answer the question that follows.

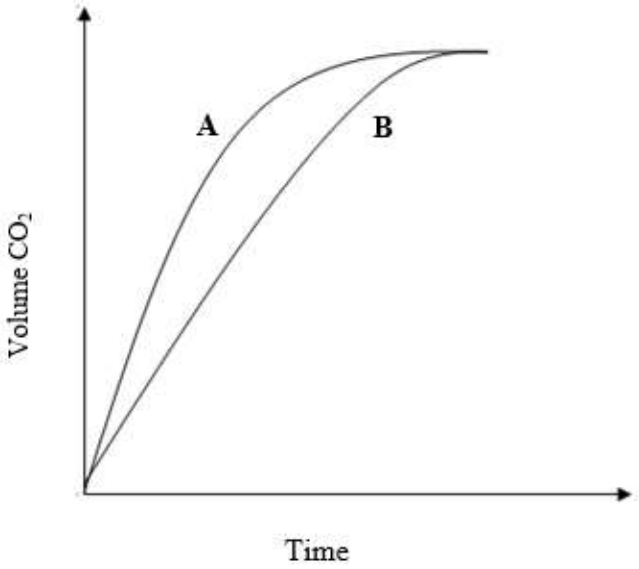



a) Write an equation for the reaction that takes place. (1 mark)

……

b) Why is it not advisable to use potassium metal in place of lithium in the above set-up? (1 mark)

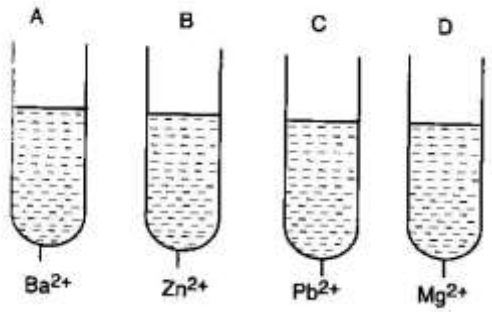
……
……
c) The gas produced above is used for welding. Which other gas is combined with it? (1 mark)
……
28. Using dots (.) and crosses (×) to represent valence electrons, show bonding in:
(a) Nitrogen trifluoride (N = 7, F = 9) (1 mark)
……
……
(b) Sodium oxide (Na = 11, O = 8) (1 mark)
……
……
29. The graphs below were drawn by measuring the volume of hydrogen produced with time when excess zinc metal in different physical states were reacted with 50 $cm^3$ of 2 M hydrochloric acid.




(a) Which curve corresponds to the reactions involving powdered zinc? (1 mark)
……
(b) Both curves eventually flatten out at the same level of hydrogen. Explain. (1 mark)
……
……
……
……

**PAPER 2**

1. A few drops of sulphuric acid were added to four test-tubes containing cations as shown below.




(a) (i) In which test-tubes were white precipitate formed? (1 mark)

……

(ii) Write the chemical formula of the precipitate formed. (1 mark)

……

(iii) State and explain the observations that would be made in test-tube B when aqueous ammonia is added drop-wise until in excess. (2 marks)

……

……

……

……

(iv) State and explain the observation that would be made when little amount of sodium stearate solution are added in test-tube D. (2 marks)

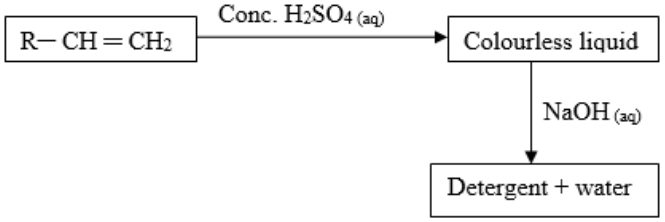
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(b) Study the flow chart below and answer the questions that follow.




(i) What is the type of detergent prepared in this process? (1 mark)

……

(ii) Explain the cleaning of action of the detergent. (2 marks)

……

……

……

……

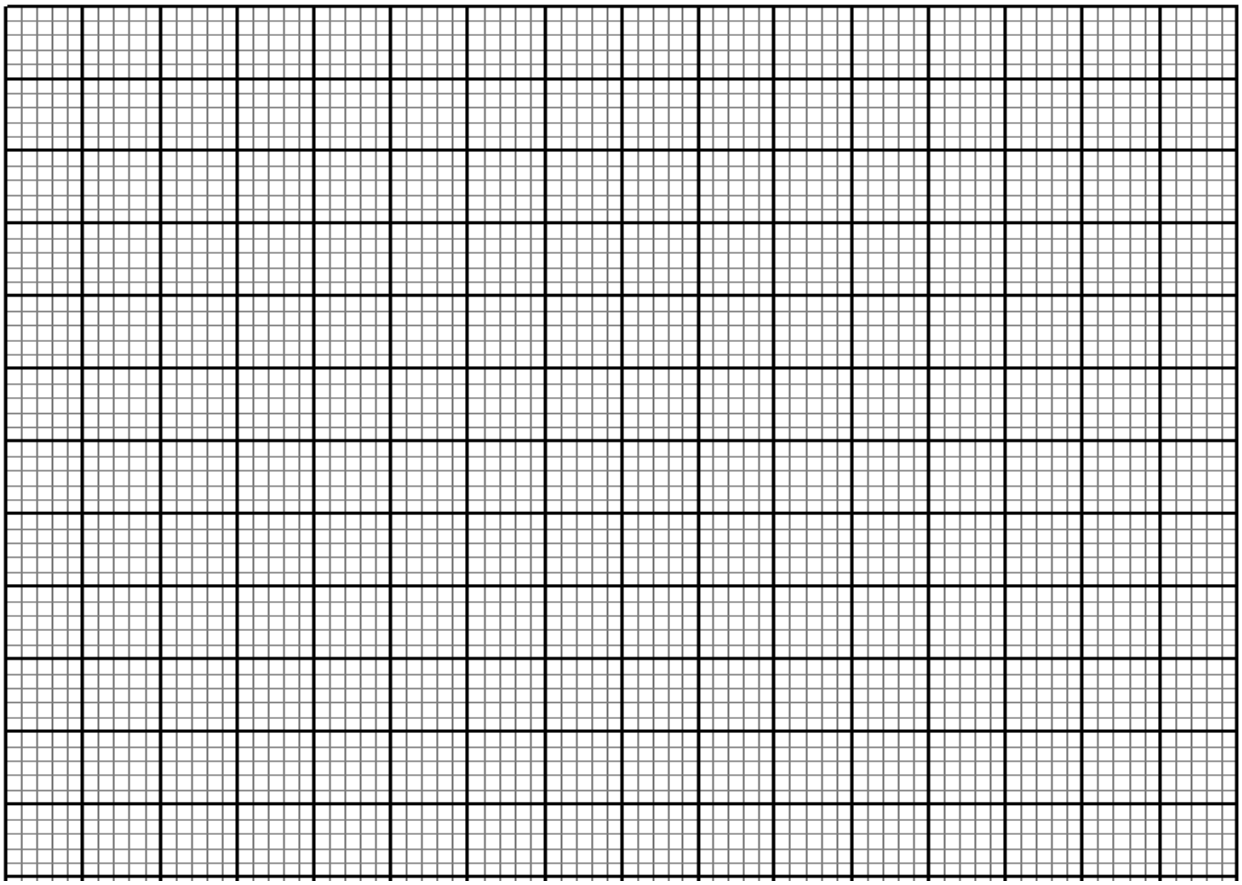
(c) Using an ion equation show how sodium carbonate removes water hardness. (1 mark)

……

2. The table below gives formulae and volumes occupied by 1 g of some gases at s.t.p. Study it carefully to answer the questions that follow.

| Formula of gas | Ne | $C_2H_2$ | $O_2$ | Ar | $NO_2$ | $SO_2$ | $SO_3$ |
|---|---|---|---|---|---|---|---|
| Relative Molecular Mass | 20 | 26 | 32 | 40 | 46 | 64 | 80 |
| Volume ($cm^3$) | 1120 | 862 | 700 | 560 | 487 | 350 | 280 |

(a) Plot a graph of volume of gas (y-axis) against the relative molecular mass. (3 marks)



(b) Use the graph to predict the volume occupied at s.t.p by

(i) 1g of hydrogen chloride gas (Cl=35.5, H=1) (1 mark)

……

(ii) 1g of carbon (II) oxide. (C=12, O=16) (1 mark)

……

(iii) Relative molecular mass of a gas which occupies 508 $cm^3$ per gram at s.t.p. (1 mark)

……

(c) (i) State the Graham's law of diffusion. (1 mark)

……

……

……

……

(ii) A gas X diffuses through a porous plug in 60 seconds. Gas Y which is a quarter the volume of gas X diffuses through the same plug in 22.5 seconds. Calculate the relative molecular mass of gas Y. (Relative Molecular Mass of X = 34) (3 marks)

……

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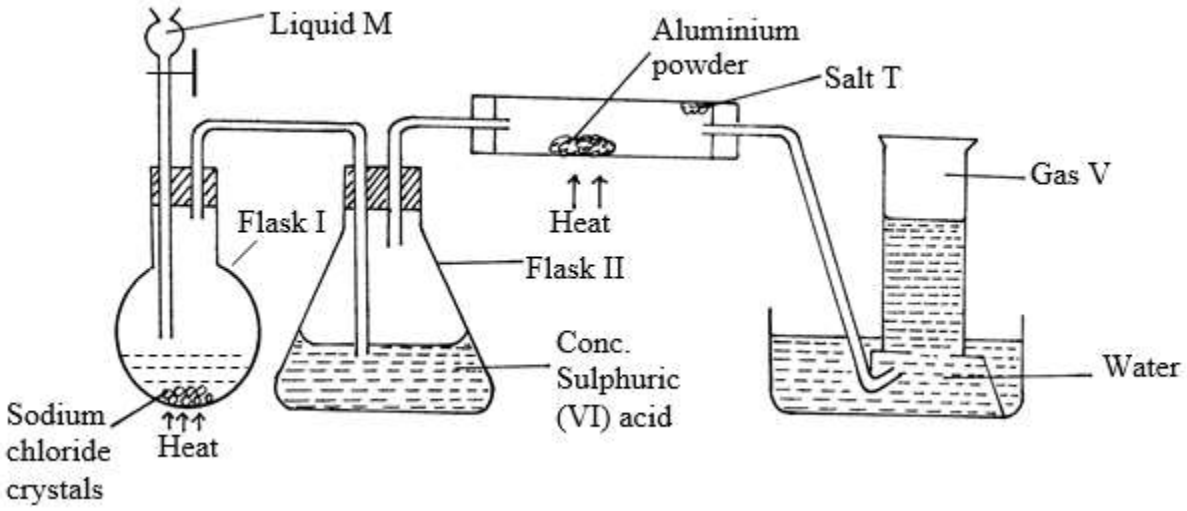
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……

(d) A gas occupies 100 $cm^3$ at 0 $^0C$ and 1 atmosphere pressure. Calculate the temperature at which the volume is double and the pressure is halved. (2 marks)

……
……
……

3. The set up below was used to prepare hydrogen chloride gas and salt T.




(a) Identify the following

(i) Liquid M…… (1 mark)

(ii) Gas V…… (1 mark)

(iii) Salt T…… (1 mark)

(b)Write balanced chemical equations for reactions that occur at:

(i) Flask I (1 mark)

……

(ii) Combustion tube. (1 mark)

……

(c) Name the process that formed salt T as shown in the diagram. (1 mark)

……

(d) Sulphuric (VI) acid is used as a drying agent in this experiment. Explain why calcium oxide is unsuitable for the same purpose in this reaction. (1 mark)

……

……

(e) The water in the beaker was found to have a pH of 2.0 at the end of the experiment. Explain. (1 mark)

……

……

……

(f) Calculate the mass of salt T formed if 480 $cm^3$ of hydrogen chloride gas measured at r.t.p was reacted with aluminium powder. (Al = 27, Cl = 35.5, MGV = 24 $dm^3$) (2 marks)

……

……

(g) In the space provided below, draw a well labelled diagram showing how you would dissolve hydrogen chloride gas in water. (1 mark)

……

……

……

(h) Explain why hydrogen chloride gas dissolved in methylbenzene does not react with calcium carbonate. (1 mark)

……
……

(i) Using equation, state the observation made when a gas jar containing hydrogen chloride gas is opened near an open bottle of liquid ammonia. (1 mark)

……
……

4. (a) The grid given represents part of the periodic table. Study it and answer the questions that follow. (The letters do not represent the actual symbol of the elements)

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | **A** |
| | | | | **B** | | | | |
| | **C** | | **D** | | | **E** | | |
| | **F** | | | | | | | |
| | | | | | | | | |

(i) What name is given to the group of elements to which C and F belong? (1 mark)

……

(ii) Which letter represents the element that is least reactive? (1 mark)

……

(iii) What type of bond is formed when B and E react? Explain. (2 marks)

……

(iv) Write the formula of the compound formed when element D and oxygen gas react. (1 mark)

……

(v) On the grid, indicate with a tick (√) the position of element G which is in the third period of the periodic table and forms $G^{3-}$ ions. (1 mark)

(vi) Compare the atomic sizes of elements C and D. Explain. (2 marks)

……

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

| Substance | Melting point ($^oC$) | Boiling point ($^oC$) | Solubilty in water | Density at room temperature $g/cm^3$ |
|---|---|---|---|---|
| H | -117 | 78.5 | Very soluble | 0.8 |
| J | -78 | -33 | Very soluble | $0.77 \times 10^{-3}$ |
| K | -23 | 77 | Insoluble | 1.6 |
| L | -219 | -183 | Slightly soluble | $1.33 \times 10^{-3}$ |

(i) Which substance is a liquid at room temperature and when mixed with water two layers would be formed? (1 mark)

……

(ii) Determine the melting point of H in Kelvin? (1 mark)

……

(iii) Which letter represents a substance that is a gas at room temperature and which can be Collected by downward displacement of air? (Density of air is $1.29 \times 10^{-3}$ $g/cm^3$ at room

temperature). Explain. (2 marks)

……

……

……

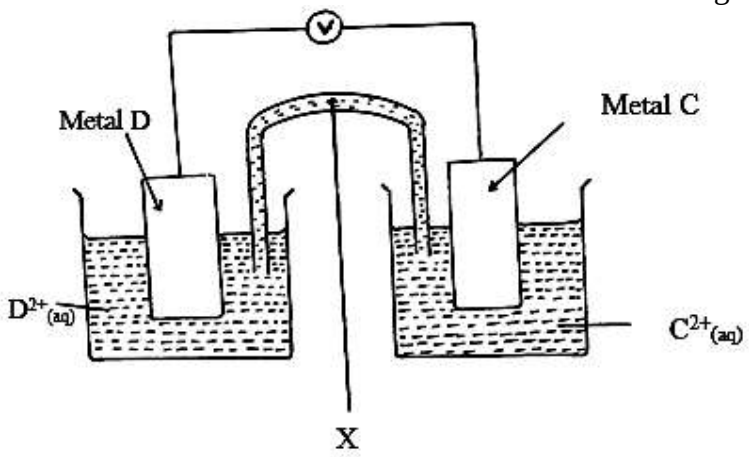
5. (a) The table below gives standard electrode potentials for the metals represented by the letters A, B, C and D. Study it and answer the questions that follow.

| Metal | Standard electrode potential, $E^0$ (Volts) |
|---|---|
| A | -0.13 |
| B | +0.85 |
| C | +0.34 |
| D | -0.76 |

(i) Arrange the metals in a decreasing order of reactivity. (1 mark)

……

Metals C and D were connected to form a cell as shown in the diagram below.




(ii) Write the equations for the reactions that occur at electrodes.

C (1 mark)

……

D (1 mark)

……

(iii) On the diagram, indicate with an arrow the direction in which electrons would flow. (1 mark)

(iv) What is the function of the part labelled X. (1 mark)

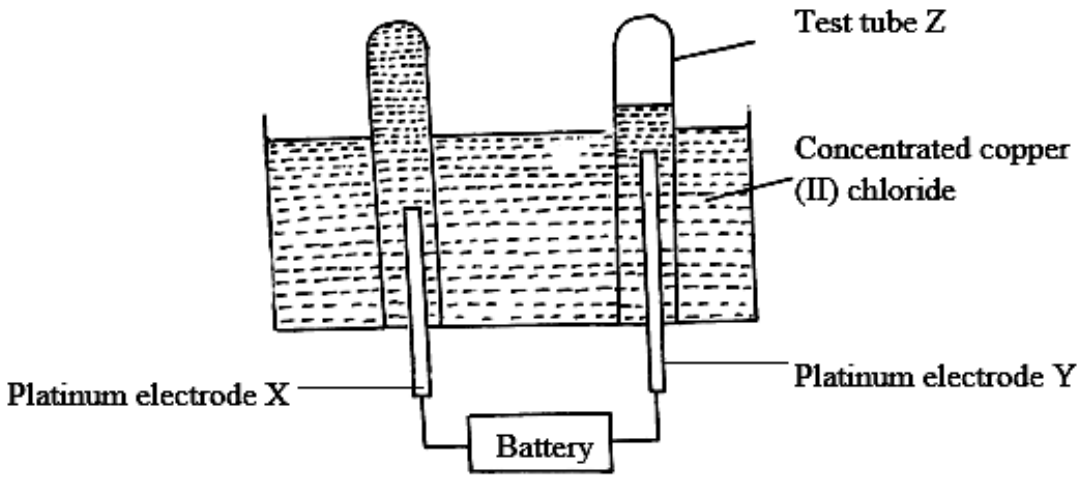
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……

(v) Calculate the e.m.f of the cell formed in the diagram. (1 mark)

(b) An electric current was passed through a concentrated solution of copper (II) chloride as shown in the diagram below.




(i) Write the chemical equation of reaction at cathode? (1 mark)

……

(ii) After sometime test-tube Z was found to contain a mixture of two gases. Explain this observation. (2 marks)

……

(iii) State the observations that would be made at the anode if the platinum electrodes are replaced with copper electrodes. (2 marks)

……

……

6. The list below shows the formula of some organic compounds. Use it to answer the questions that follow. Use the letters $T_1$ to $T_6$.

$T_1$ – $CH_3CH_2CH_2CH_3$
$T_2$ – $CH_3CH_2CH_2COOC_2H_5$
$T_3$ – $CH_3CH_2CH_2CH_2OH$
$T_4$ – $CH_3CH_2CH_2COOH$
$T_5$ – $CH_3CH_2CHCH_2$
$T_6$ – $CH_3CCCH_3$

(a) Select a compound which.

(i) Will produce bubbles of a gas when reacted with sodium carbonate. (1 mark)

……

(ii) Will decolourise both bromine water and acidified potassium permanganate. (1 mark)

……

(iii) Will produce hydrogen gas when reacted with sodium metal. (1 mark)

……

(iv) Represents a saturated hydrocarbon. (1 mark)

……

(v) Is likely to undergo polymerization. (1 mark)

……

(b) Using two molecules show how polymerization in $T_5$ occurs. (1 mark)

……

(c) Name the process by which compound $T_2$ is formed and identify the compounds that were used to form it.

Process (1 mark)

……

Compounds (1 mark)

(d) Compound $T_3$ can be converted to $T_4$ as shown by the equation below.

$C_3H_9OH + O_2 \rightarrow C_3H_7COOH + H_2O$

Given the following information

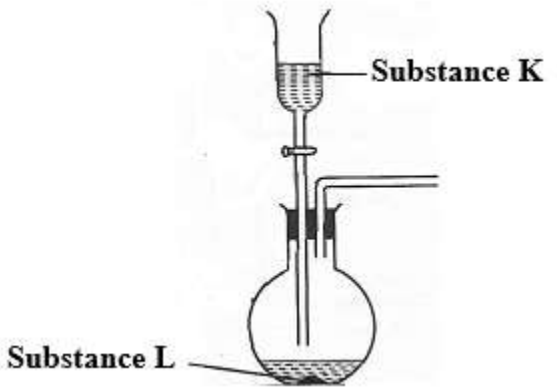
$\Delta H_c$ $C_3H_9OH = -4910$ kJmol$^{-1}$

$\Delta H_c$ $C_3H_7COOH = -4090$ kJmol$^{-1}$

Determine the heat change for the reaction above. (3 marks)

……

7. The set-up below can be used to generate a gas.




(a) (i) Complete the table below giving the names of substance **K** and **L** if the gases generated are carbon (IV) oxide and carbon (II) oxide. (2marks)

| Substance | Carbon (IV) oxide | Carbon (II) oxide |
|---|---|---|
| **K** | | |
| **L** | | |

(ii) Complete the diagram to show how a sample of carbon (II) oxide can be collected. (2marks)

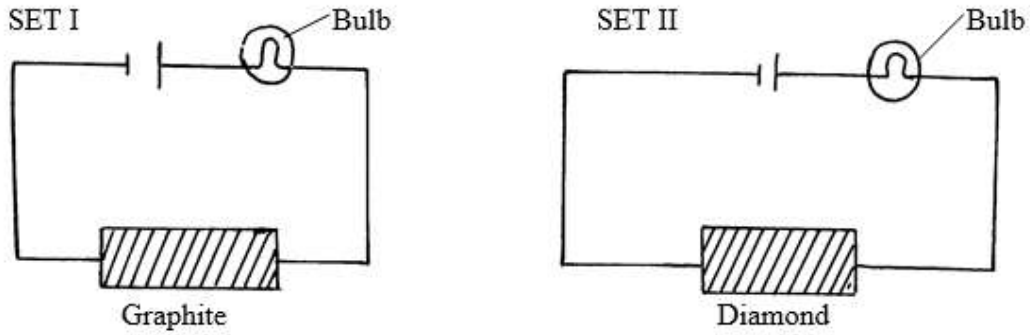
(iii) State two ways that can be used to distinguish carbon (IV) oxide from carbon (II) oxide? (2 marks)

(b) (i) In an experiment, carbon (IV) oxide gas was passed over heated charcoal held in a combustion tube. Write a chemical equation for the reaction that took place in the combustion tube. (1 mark)

……

(ii) State **one** use of carbon (II) oxide. (1 mark)

(c) The following set ups were used by Form Two students. Study and use them to answer the questions that follow.




State and explain the difference in observation made in set up I and II above.(3 marks)

**PAPER 3**

1. You are provided with:

**Solid G**, magnesium powder.
**Solution N**, 0.5 M Ferrous ammonium sulphate hexahydrate.
**Solution M**, containing 3.68 g/l, acidified potassium manganate (VII).
You are required to determine the:
-Molar enthalpy of displacement of iron (II) ions with **Solid G**.
-Mass of magnesium that reacts with **Solution N.**

**Procedure 1**

Using a measuring cylinder, place exactly 100 ml of **solution N** in 250 ml plastic beaker. Allow to stand for about a minute. Measure the initial temperature of the solution and record it in table 1.
Add all of the **solid G** at once to the solution. Stir the mixture carefully with the thermometer and record the highest temperature reached in table 1. **Retain the mixture for use in procedure II.**

(a) Table 1

| | |
|---|---|
| Final temperature ($^oC$) | |
| Initial temperature ($^oC$) | |
| Change in temperature, $\Delta T$ | |

(2 marks)

**Procedure 1I**

Filter the mixture obtained in **procedure I** into a 250 ml volumetric flask. Wash the residue with distilled water and add into the flask. Add more water to make up to the mark. Label this as **solution F**.
Using a pipette and a pipette filler, place 25.0 ml of **solution F** into a 250 ml conical flask. Titrate **solution F** with **Solution M** until a permanent pink colour just appears. Record the readings in table 2.
Repeat the titration two more times and complete table 1.

(b) Table 2

| Titration number | I | II | III |
|---|---|---|---|
| Final burette reading | | | |
| Initial burette reading | | | |
| Volume of **Solution M** used, $cm^3$ | | | |

(4 marks)

(c) Calculate the average volume of **Solution M** used. (1 mark)

……
……

(d) Given the equation for the reaction between manganate (VII) and iron (II) as:

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

Calculate the number of moles of:

(i) Potassium manganate (VII) used. (K = 39, Mn = 55, O = 16) (1 mark)

……
……
……

(ii) Iron (II) ions in 25.0 ml **solution F**. (1 mark)

……
……
……

(iii) Iron (II) ions in 250 ml **solution F**. (1 mark)

……
……
……

(iv) Iron (II) ions in 100 ml **solution N** after the reaction with magnesium. (1 mark)

……
……
……

(v) Iron (II) ions in 100 ml **solution N** before the reaction with magnesium. (1 mark)

……
……
……

(vi) Iron (II) ions that reacted with magnesium. (1 mark)

……
……
……

(e) Calculate the mass of magnesium that reacted. (Mg = 24) (1 mark)

……
……

(f) Calculate the:

(i) Heat change for the displacement reaction of iron (II) with magnesium.
(Assume for the mixture, specific heat capacity = 4.2 $Jg^{-1}K^{-1}$ and density = 1.0 $gcm^{-3}$)
(1 mark)

……
……
……

(ii) Molar enthalpy of displacement of iron (II) with magnesium. (1 mark)

……
……
……

2. You are provided with **solid L**. Carry out the tests below. Record your observations and inferences in the spaces provided.

(a) Place **about half** of **solid L** in a clean test-tube and add about 8 ml of distilled water and shake. **Retain the other half of solid L for use in part (c) while the solution is for use in part (b) (i) to (iv).**

| Observations | Inferences |
|---|---|
| | |
| | |
| | |

(1 mark) (1 mark)

(b) Divide the solution obtained in part (a) above into four portions.
(i) To the first portion, add 2 M ammonium hydroxide solution drop-wise until in excess.

| Observations | Inferences |
|---|---|
| | |
| | |
| | |

(1 mark) (1 mark)

(ii) To the second portion add 2 – 3 drops of barium nitrate solution.

| Observations | Inferences |
|---|---|
| | |
| | |
| | |

(1 mark) (1 mark)

(iii) To the third portion add about equal volume of chlorine water.

| Observations | Inferences |
|---|---|
| | |
| | |
| | |

(1 mark) (1 mark)

(iv) To the fourth add 2 – 3 drops of lead (II) nitrate solution.

| Observations | Inferences |
|---|---|
| | |
| | |
| | |

(1 mark) (1 mark)

(c) Clean a metallic spatula and rinse it with distilled water. Dry the spatula on a Bunsen burner using non-luminous flame for about one minute and then allow it to cool. Place a little of **solid L** on the spatula and heat it strongly with a non-luminous flame.

| Observations | Inferences |
|---|---|
| | |
| | |
| | |

(1 mark) (1 mark)

3. You are provided with:

**Solid W**
Bromine water
Acidified potassium manganate (VII)
Sodium carbonate

**Solid W** is suspected to be an organic compound.

(a) Using the reagents provided describe the tests that could be performed consecutively to confirm which type of organic compound is **Solid W**. Record the tests and expected observations in the spaces provided.

(i)

| Test 1 | Expected Observations |
|---|---|
| | |
| | |
| | |
| | |

(1 mark) (1 mark)

(ii)

| Test 2 | Expected Observations |
|---|---|
| | |
| | |
| | |
| | |

(1 mark) (1 mark)

(iii)

| Test 3 | Expected Observations |
|---|---|
| | |
| | |
| | |
| | |

(1 mark) (1 mark)

(b) Carry out the tests described in (a) above using **solid W** and record the observations and inferences in the spaces provided.

(i) Test 1

| Observations | Inferences |
|---|---|
| | |
| | |
| | |
| | |

(1 mark) (1 mark)

(ii) Test 2

| Observations | Inferences |
|---|---|
| | |
| | |
| | |
| | |

(1 mark) (1 mark)

(iii) Test 3

| Observations | Inferences |
|---|---|
| | |
| | |
| | |
| | |

(1 mark) (1 mark)

**KCSE PREDICTION 10 2022**

## PAPER 1

1. (a) Give ***two*** differences between luminous and non-luminous flames. (2 marks)

……

……

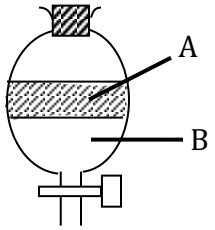
……

(b) How is the non-luminous flame produced? (1 mark)

……

……

2. (a) The apparatus below were used to separate a mixture of liquid A and B.




State ***two*** properties of liquids that make it possible to separate using such apparatus. (2 marks)

……

……

(b) Give the name of the above apparatus. (1 mark)

……

3. (a) Explain why solid Carbon (IV) oxide is preferred over ordinary ice for use by ice cream venders. (1 mark)

……

……

(b) Name one piece apparatus used to measure volume of gases. (1 mark)

……

(c) Draw a diagram of a deflagrating spoon. (1 mark)

4. The table below shows the pH values of solutions P, R, Q and S.

| Solution | P | R | Q | S |
|---|---|---|---|---|
| pH | 2 | 7 | 6.5 | 13.5 |

(a) Which solution represent:

(i) Strong base - …… (1 mark)

(ii) Weak acid - …… (1 mark)

(b) Give an example of solution S. (1 mark)

……

5. 6.95g of hydrated iron (II) sulphate $FeSO_4.nH_2O$ was dissolved in 250 $cm^3$ solution resulting into a 0.1M solution. Determine the value of n. (3 marks) (Fe = 56, O = 16, S = 32, H = 1).

6. Rusting leads to fast wearing out of farm tools and equipment as well as buildings.

(a) Give the chemical name of rust. (1 mark)

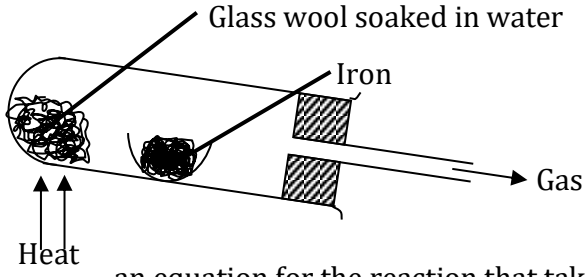
……

(b) What ***two*** conditions accelerate rusting process? (2 marks)

……

……

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




(a) …… an equation for the reaction that take place in the combustion tube. (1 mark)

……

(b) Why would it not be advisable to use potassium in place of iron in the set-up? (1 mark)

……

……

(c) Glass wool should be heated before heating iron. Explain. (1 mark)

……

……

8. I. Name the following organic compounds.

(a) $CH_3\,CH(CH_3)\,CH_2\,CH(Br)\,CH_3$ (1 mark)

……

(b) $HOCH_2 - CHOH - CH_2OH$ (1 mark)

……

II. Given

A $CH_3(CH_2)_{16}\,COO^-\,Na^+$

B $CH_3(CH_2)_6\ CH(CH_3)CH_2\ SO^{-}_3\ Na^{+}$

Identify detergent

A - …… (1 mark)

B - …… (1 mark)

9. In terms of structure and bonding, explain the following.

(a) Graphite is used as a lubricant. (1 mark)

……

……

……

(b) Alluminium is better conductor of electricity then magnesium. (1 mark)

……

……

(c) Water is a liquid at room temperature while hydrogen sulphide is a gas. (1 mark)

……

……

10. (a) Define the term molar latent heat of fusion. (1 mark)

……

……

(b) The molar heat of fusion of ice at $O^0C$ is 6kJ $mol^{-1}$. Calculate the heat change when 36g of ice is converted to 36g of water at $10^0C$. (3 marks) (SHC = $4.2^{-1}g\ K^{-1}$, density = $1.0g/cm^3$, H = 1.0, O = 16.0)

11. Draw a well labeled diagram showing how blister copper is purified. (3 marks)

12. Gas Q with a relative molecular mass of 48 took 50 seconds to diffuse through a porous diaphragm. How long will it take for the same amount of hydrogen Chloride (HCl) to diffuse through the same diaphragm under similar conditions? (H = 1.0, Cl = 35.5).

(3 marks)

13. (a) Calculate the oxidation state of chromium in the ion $Cr_2 O^{2-}$. (1 mark)

(b) Using oxidation numbers, determine from the equation below the species which undergoes oxidation and reduction.

$$2FeCl_{2(aq)} + Cl_{2(g)} \longrightarrow 2Fe\ Cl_{3(aq)}$$

Oxidation - …… (1 mark)

Reduction - …… (1 mark)

14. Given elements A, B and C with atomic numbers 11, 19 and 13 respectively.

(a) Compare the atomic radius of A and C. Explain. (2 marks)

……

……

(b) Compare reactivity of A and B. (1 mark)

……

15. Haber process (the manufacture of ammonia gas) is given by the following equation.

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)} \qquad \Delta H = -92kJ\ mol^{-1}.$$

State and explain the effect of:

(a) Introducing some drops of water to the equilibrium. (1 mark)

……

……

(b) Pumping nitrogen gas to the equilibrium mixture. (1 mark)

……

……

(c) Lowering the temperature of the reaction. (1 mark)

……

……

16. Elements P and Q have the following atomic numbers 19 and 8 respectively.

(i) Using dot (•) and cross draw a diagram to show how the elements form bonds. (1 mark)

17. Describe how sodium sulphate crystals can be prepared starting with $50cm^3$ of 2M sodium hydroxide and 1M sulphuric (VI) acid. (3 marks)

……

……

……

……

……

18. Write ionic equations to show how;

(a) (i) Excess ammonia solution reacts with a solution containing Copper II ions. (1 mark)

……

(ii) Excess sodium hydroxide added to a solution containing $Al^{3+}$ ions. (1 mark)

……

(b) Give the name of the following ion $[Zn(NH_3)_4]^{2+}$ (1 mark)

……

19. (a) Define electrolysis. (1 mark)

……

……

(b) During the electrolysis of molten aluminium oxide, write the equations at the;

Anode - …… (1 mark)

Cathode - …… (1 mark)

20. (a) Give any ***two*** differences between alpha and beta particles. (2 marks)

……

……

(b) A radioactive isotope T decays by emitting three alpha particles to form $^{214}_{83}Bi$ what is the atomic number and mass number T?

Atomic number - …… (1 mark)

Mass number - …… (1 mark)

21. (a) Using acidified potassium dichromate (VI) solution, describe how you would differentiate between sulphur (IV) oxide and hydrogen sulphide. (2 marks)

……

……

……

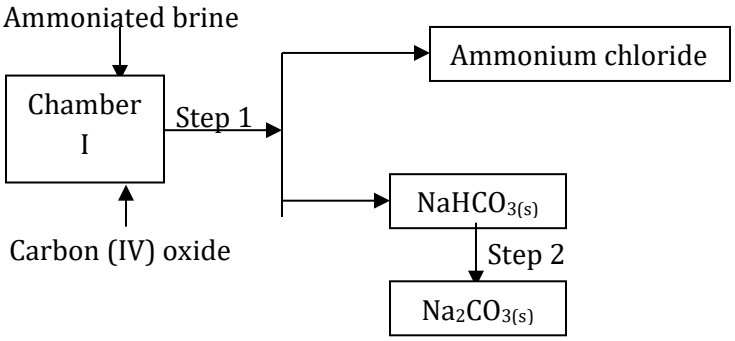
(b) Identify the catalyst preffered in contact process. Explain. (2 mark)

……

……

……

22. Study the following part of the solvay process for the manufacture of sodium carbonate and answer the questions that follows:




(i) State the main source of Carbon (IV) oxide in the process. (1 mark)

……

(ii) Write down the overall equation for the reaction in chamber I. (1 mark)

……

(iii) Name process in step 1. (1 mark)

……

23. (a) The following equation involve hydrochloric acid.

$MnO_{2(s)} + 4HCl_{(aq)} \longrightarrow MnCl_{2(aq)} + 2H_2O_{(l)} + Cl_{2(g)}$

State the type of reaction taking place in the reaction. (1 mark)

……

(b) State ***two*** contrasting chemical properties of hydrogen and chlorine. (2 marks)

……

……

……

24. (a) An element O has two isotopes $^{16}_{8}O$ containing 90% and Isotope $^{18}_{8}O$.

(i) What are isotopes? (1 mark)

……

……

……

(ii) Find the R.A.M of O. (2 marks)

25. (a) When a hydrocarbon is completely burnt in oxygen 4.2g of Carbon (IV) oxide and 1.71g of water were formed.

(a) Determine the empirical formular of the hydrocarbon. (3 marks)

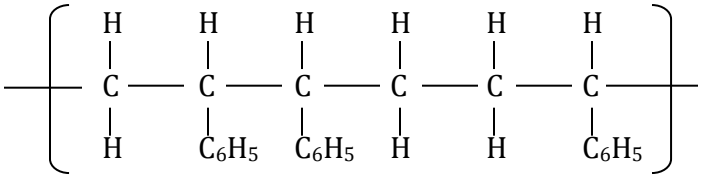
(b) Given that formula mass of compound above is 28. Find the molecular formular. (1 mark)

26. (a) Name the ***two*** types of polymerization. (1 mark)

……

……

(b) Study the section of the polymer below and answer the questions that follow.




(i) Give the name of the polymer above. (1 mark)

……

**PAPER 2**

1. The grid below shows part of the periodic table. Use it to answer the questions that follow. The letters do not represent actual symbols.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | S | U | V |
| P | R | | | | | T | X | W |
| Q | | | | | | | | |
| | | | | | | | | |

(a)Which of the elements has the highest atomic radius? Explain. (2 marks)

……

(b)Identify the most reactive Oxidizing agent. Explain. (2 marks)

……

(c) Compare the atomic radius of P and R. Explain (2 marks)

……

……

(d)Give the formula of one stable ion with an electron arrangement of 2.8 which is:

(iii) A Negatively charged divalent ion. (2marks)

……

(iv) A Positively charged monovalent.

……

(e)Given that the mass number of W is 40. Write down the composition of its nucleus. (2 marks)

……

……

(f)Write the formula of the compounds formed between.

(i)Element R and X. (1 mark)

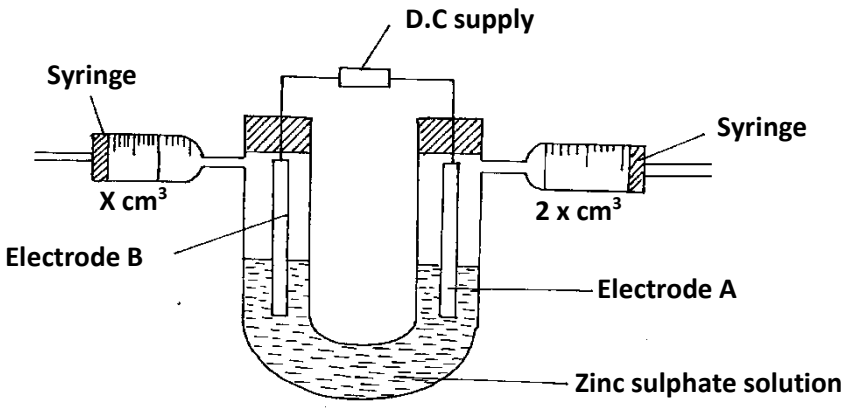
……

(ii)Give one property of the structure formed when R and X bond. (1 mark)

……

……

2. An aqueous solution of zinc sulphate is electrolysed using platinum electrodes as shown in the set up below.




(a) (i) Write a half equation for the reaction taking place at electrode **A.** (1mark)

……

……

(ii) Identify electrodes A and B (2 marks)

……

……

(iii) State and explain the observation at electrode **B** if copper plate was used instead of platinum electrode. (2marks)

……

……

……

……

……

……

(b) 0.22g of metal **Q** is deposited by electrolysis when a current of 0.06A flows for 99 minutes.
(RAM of **Q** = 184, 1F = 96500c)

(i) Find the number of moles of **Q** deposited. (1mark)

……

……

……

……

……

(ii) Determine the value of n in the metallic ion $\mathbf{Q^{n+}}$ (3marks)

……

……

……

……

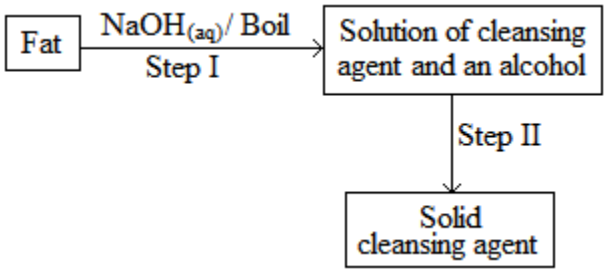
……

……

(c) Determine oxidation number of chlorine in $ClO_3^-$ (1mark)

(d) An iron spoon is to be electroplated with silver. Draw a labelled diagram to represent the set-up that could be used to carryout this process. (2marks)

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




(i)What name is given to the type of cleansing agent prepared by the method above? (1mark)

……

(ii)Name one chemical substance added in step II (1mark)

……

(iii)What is the purpose of adding the chemical substance named in a (ii) above? (1mark)

……

……

(iv)Name any other suitable substance that can be used in step I (1mark)

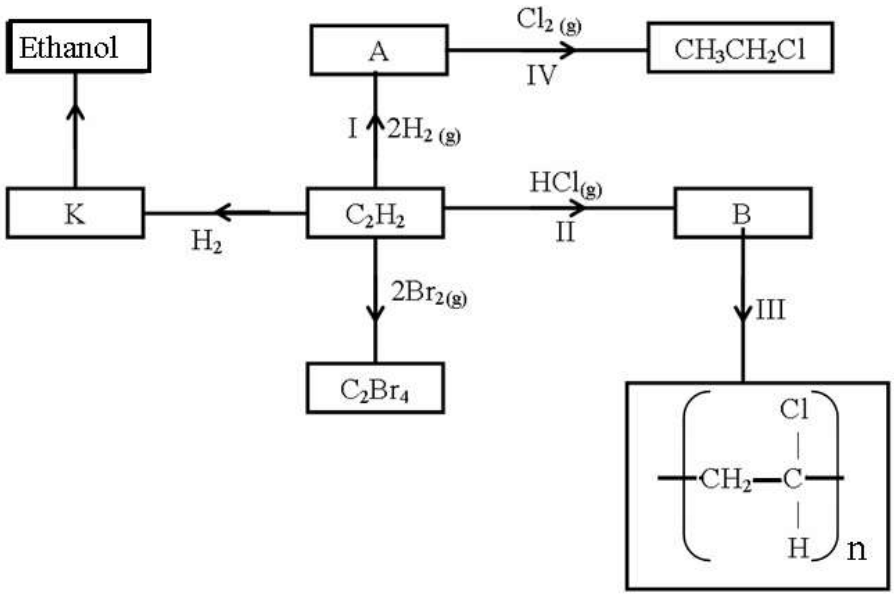
……

(v)Explain how an aqueous solution of the cleansing agent removes oil during washing (2marks)

……

……

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




(i)Identify the catalyst used in step I (1mark)

……

(ii)Name the compounds A and B (2 marks)

A……B……..……

(iii)Give one disadvantage of compound formed in step III (1mark)

……

……

(iv)Name the reactions taking place at steps: (1mark)

I……IV.....

(v)Describe how substance K is converted to ethanol (2marks)

……

……

……..

……

4. (a) State the Hess' law. (1 mark)

……

……

(b) The enthalpies of combustion of calcium, carbon and decomposition of calcium carbonate are indicated below;

$C\,(s) + \frac{1}{2}O_2\,(g) \longrightarrow CaO\,(s)$: $\Delta H$=-635 kJmol$^{-1}$

$C\,(s) + O_2\,(g) \longrightarrow CO_2\,(g)$ $\Delta H$=-394 kJmol$^{-1}$

Enthalpy of decomposition of $CaCO_3$ = +178 kJmol$^{-1}$

(i)Draw an energy cycle diagram that links the enthalpy of formation of calcium carbonate to enthalpies of combustion of calcium, carbon and decomposition of calcium carbonate.
……(2 marks)

(ii)Determine the enthalpy of formation of calcium carbonate. (2 marks)
……
……

(c)Some average bond energies are given below.

| Bond | Energy in kJ $mol^{-1}$ |
|---|---|
| C – C | 348 |
| C – H | 414 |
| Cl – Cl | 243 |
| C – Cl | 432 |
| H – Cl | 340 |

Calculate the energy change for the reaction below. (3 mks)

$C_2H_{6\,(g)} + Cl_{2\,(g)} \longrightarrow CH_3CH_2Cl_{(g)} + HCl_{(g)}$

……
……

5.(a) Define the term solubility. (1 mark)
……
……
……

(b)In an experiment to determine the solubilities of two salts X and Y at different temperatures, a candidate recorded her observations as shown below.

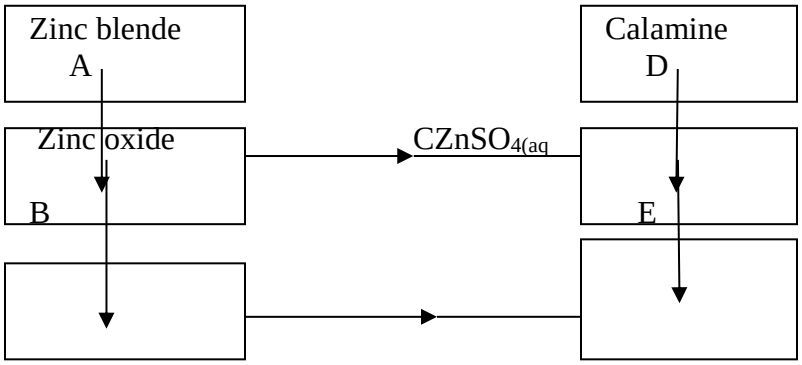
| Temperature ($^oC$) | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
|---|---|---|---|---|---|---|---|---|---|---|
| Solubility of X in g/100 g of $H_2O$ | 14.3 | 17.4 | 20.7 | 25.0 | 28.5 | 33.3 | 40.0 | 47.0 | 55.0 | 64.0 |
| Solubility of Y in g/100 g of $H_2O$ | 25.0 | 27.5 | 30.0 | 32.5 | 35.0 | 37.6 | 40.1 | 42.4 | 45.0 | 48.0 |

(a)On the same axes plot the solubility curves of X and Y. (4 marks)

(b)From your graph to determine;
(i)The solubility of X and Y at 47 $^oC$
Solubility of X (1 mark)
……..Solubility of Y (1 mark)
……(ii)The temperature at which the two salts are soluble in water. (1 mark)
……
(c)If 60g of X is dissolved in 100 g of water and heated to 90$^oC$, calculate the amount of salt that crystallized out if cooled to 20 $^oC$.(1 mark)

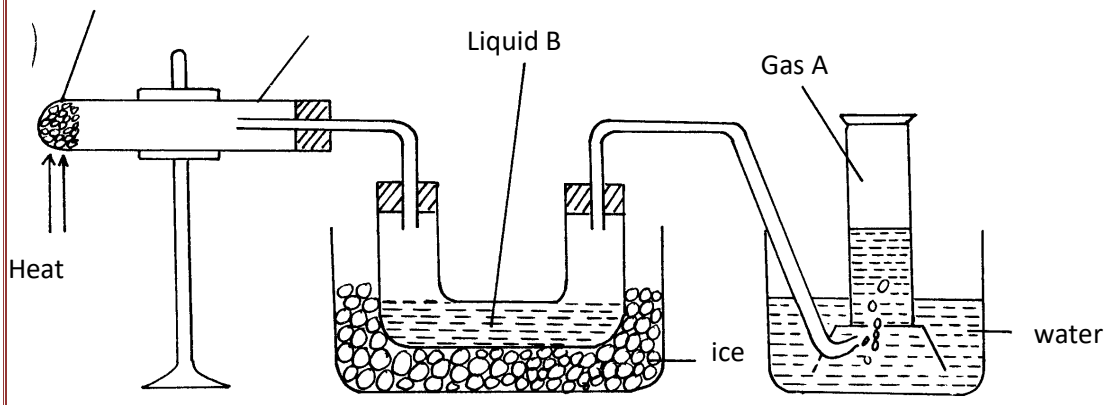
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……
……
……
(d)State what would happen if a mixture salt X in 100 g of water and 30 g of Y in 100 g of water were cooled from 90 $^{o}$C to 70 $^{o}$C. (3 marks)
(e)State one application of solubility.(1 mark)
……
6. The flow chart below shows some processes in the extraction of zinc. Study it and answer the questions that follow.




(a) Name the processes represented by A and E. (2 marks)
A……
E…….
(b) State the reagents required for processes B, C and D. (3marks)
B……C……
……D……
…….(c) Write a chemical equation of the reaction that occurs in process B. (1mark)
……
……(d) With an aid of a diagram, explain how you would obtain a pure sample of zinc by process E
(3 marks)
(e) State two commercial uses of zinc metal. (1 mark)
……
……
……
7. The diagram below shows a set-up of apparatus that can be used to prepare nitrogen (IV) oxide. Study it and use it to answer the questions that follow

Lead(II)nitrate
boiling tube




(a) (i) Write the equation for the reaction that takes place in the boiling tube. (1 mark)

……

(ii) State the observations made in the boiling tube. (2 marks)

……

……

……

……

…… (iii) Explain why lead (II) nitrate is preferred over other metal nitrates in this experiment.

(1 mark)

……

……

(iv) Describe how gas A can be identified. (1 mark)

……

……

(b) (i)Name liquid B (1 mark)

……

(ii) Write a chemical equation to show how liquid B is formed in this experiment. (1mark)

(c ) (i) In another experiment, excess aqueous lead (II) nitrate solution was reacted with a solution which contained 2.34g of sodium chloride. Calculate the mass of precipitate formed in this reaction. (Pb = 207, Cl = 35.5, Na = 23) (3 marks)

……

……

……

……

……

……

(ii) Write an ionic equation for the reaction that takes place when nitrogen (IV) oxide reacts with aqueous sodium hydroxide. (1 mark)

**PAPER 3**

1. You are provided with:

Solution **M** containing 3.95g Potassium Manganate (vii), ($KMnO_4$) per litre of solution.

Solution **N**, containing 49.0g of ammonium Ferrous Sulphate $(NH_4)_2SO_4$. $FeSO_4.6H_2O$ per litre of solution.

You are required to determine the reacting mole ratio of manganate (VII) Ions, $MnO_4$ with Iron (II) ions $Fe^{2+}$.

**PROCEDURE:**

Using and pipette filter transfer 25.0$cm^3$ of solution N into a conical flask. Titrate with solution M in the burette. No indicator is required for this experiment. Record your results in the table below. Repeat the procedure to obtain the accurate volumes.

**Table I**

| | **1st** | **2nd** | **3rd** |
|---|---|---|---|
| Final burette readings $cm^3$ | | | |
| Initial burette readings $cm^3$ | | | |
| Volume of solution M used $cm^3$ | | | |

(4mk)

a) Determine the average volume of solution M used. (1mk)

b) Calculate:

i) The concentration of solution M in moles per litre. (K = 39, Mn = 55, O = 16) (1mk)

ii) The number of moles of solution M that reacted with N (2 mks)

iii) The concentration in moles per litre of solution N in moles per litre (1mks)

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

iv) The number of moles of solution N that reacted with solution M in this experiment (2mks)

c) Given that 1 mole of solution M gives 1 mole of $Mno_4^-$ ions and 1 mole of solution N gives 1 mole of $Fe^{2+}$ ions. Calculate the reaction mole ratio of $Fe^{2+}$ ions to $MnO_4^-$ ions (3mks)

2. You are provided with:
Solution WI – containing 40g of substance Y per litre.
Solution WII – 1M hydrochloric acid solution.
You are required to investigate experimentally the rate of reaction of Y with hydrochloric acid. Y reacts with hydrogen ions in the hydrochloric acid to give a final yellow precipitate. You will in each experiment measure at room temperature, the time taken to produce a certain amount of precipitate that will make the cross on the white piece of paper just invisible.

**PROCEDURE**

On the white piece of paper, make a cross using a pen. Measure $10cm^3$ of solution $W_I$ using a $10cm^3$ measuring cylinder provided and put into $100cm^3$ glass beaker provided and place on the cross. The cross should be visible through the solution from a view point directly above the beaker. Using another measuring cylinder transfer $10cm^3$ of the acid $W_{II}$ to the beaker containing $W_I$ and start the stopwatch immediately after the addition. Looking from above the beaker, stop the watch as soon as the cross becomes invisible. Enter the time taken in the table below. Repeat the experiment using the volumes indicated in the table below each time adding appropriate quantity of distilled water to make up the volume to $10cm^3$ before adding $10cm^3$ of solution $W_{II}$.

| xpt. No | Vol. of $W_I$ used $cm^3$ | Vol. of water $cm^3$ | Vol. of $W_{II}$ $cm^3$ | Time Seconds |
|---|---|---|---|---|
| 1 | 10 | 0 | 10 | |
| 2 | 8 | 2 | 10 | |
| 3 | 6 | 4 | 10 | |
| 4 | 4 | 6 | 10 | |
| 5 | 2 | 8 | 10 | |

(4mks)

a ) Plot a graph of volume $W_I$ against time in seconds (provided graph paper) (3mks)

b) From your graph, state how the volume of $W_I$ varies with time (1mk)

c) What time would $7.0cm^3$ of $W_I$ take to react with $10cm^3$ of $W_{II}$ (1mk)

d) State two factors which must be kept constant during the experiment (1mks)

e) Could the time taken for experiment be shorter or longer if temperature of reacting mixture was at (i) $50^0$C? Sketch a graph on the same axis that would appear for this experiment.(3 mks)

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

a) Place about half of solid F on a metallic spatula and burnt it using a non-luminous flame

| Observations | inferences |
|---|---|
| | |

(1mk) (1mk)

b) Place the remaining solid F in a clean boiling tube and add about $10cm^3$ of water and shake thoroughly.

i) To about $2cm^3$ of the solution F, put the universal indicator solution provided.

| Observations | inferences |
|---|---|
| | |

( ½ mk) ( ½ mk)

ii) To about $2cm^3$ of solution F, add $2cm^3$ of acidified potassium dichromate (VI) and warm to boiling

| Observations | inferences |
|---|---|
| | |

(1mk) (1mk)

iii) To about $2cm^3$ of solution F, add three drops of bromine water

| Observations | inferences |
|---|---|
| | |

(1 mk) (1mk)

You are provided with solid P. Carry out the tests below and record your results in the table.

1. (i) Place all solid P in a boiling tube. Add about 10 $cm^3$ of distilled water and shake vigorously, filter and keep both the residue and filtrate.

| Observations | Inferences |
|---|---|
| | |
| ( ½ mk) | ( ½ mk) |

(ii) To about 2 $cm^3$ of the filtrate add sodium hydroxide dropwise till in excess.

| Observations | Inferences |
|---|---|
| | |
| ( ½ mk) | ( ½ mk) |

2. (a) (i) To about 2 $cm^3$ of the filtrate add ammonia solution till in excess.

| Observations | Inferences |
|---|---|
| | |
| ( ½ mk) | ( ½ mk) |

(ii) To about 2 $cm^3$ of the filtrate add four drops of solution K (lead (II) Nitrate)

| Observations | Inferences |
|---|---|

| | |
|---|---|
| | |
| ( ½ mk) | ( ½ mk) |

(b) Carefully transfer the residue into a test tube and add 5 $cm^3$ of dilute niric (V) acid.

(i) To about 2 $cm^3$ of the solution add a few drops of dilute sulphuric (VI) acid.

| Observations | Inferences |
|---|---|
| | |
| ( ½ mk) | ( ½ mk) |

(ii) T o about 2 $cm^3$ of the solution add ammonia solution drop wise till in excess.

| Observations | Inferences |
|---|---|
| | |
| ( ½ mk) | ( ½ mk) |