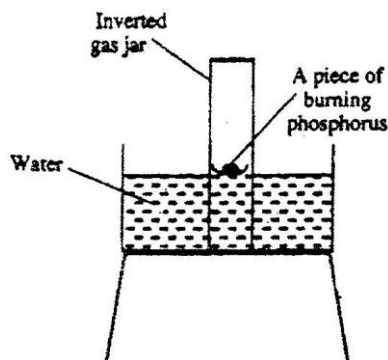## CHEMISTRY PAPER 1 2006
QUESTIONS

1.   (a)   What is meant by isomerism?   (1mark)
      (b)   Draw and name two isomers of butane.   (2 marks)

2.   The diagram below represent a set-up that was used to show that part of air is used during burning.

      a)   Given that phosphorus used was was in excess, draw a diagram of the set-up at the end of the experiment (when there was no further observable change). (1mk)
      b)   Suggest one modification that should be made on the apparatus if the percentage of the air used is to be determined.   (1mk)

3. $60cm^3$ of oxygen gas diffused through a porous partition in 50 seconds. How long would it take $60cm^3$ of sulphur (IV) oxide gas to diffuse through the same partition under the same conditions? (S= 32.0, 0 = 16.0)   (3marks)

4.   a)   Complete the nuclear equation below.

                                                                  (1mark)

      b)   37   37

           A…….   B

           18   17

      (b)   State one:
           (i)   Use of radioisotopes in agriculture   (1mark)
           (ii)   Danger associated with exposure of human beings to radioisotopes
                                                                (1 mark)

5.   The atomic numbers of elements C and D are 19 and 9 respectively. State and explain the electrical conductivity of the compound CD in:
      (a)   Solid state   (1 ½ marks)
      (b)   aqueous state.   (1 ½ marks)

6.   In an experiment to study the properties of concentrated sulphuric acid, a mixture of the acid and wood charcoal was heated in a boiling tube.
      (a)   write the equation of the reaction that took place in the boiling tube.(1mark)
      (b)   Using oxidation numbers, show that reduction and oxidation reactions took place in the boiling tube   (2 mark)
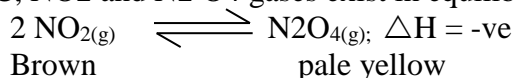
7. A group of compounds called chlorofluorocarbons have a wide range of uses but they also have harmful effects on the environment.
State one:
a) Use of chlorofluorocarbons (1 mark)
b) Harmful effect of chlorofluorocarbons on the environments. (1 mark)

8. when 94.5g of hydrated barium hydroxide, ba(OH)2. nH2O were heated to constant mass, 51.3g of anhydrous barium hydroxide were obtained. Determine the empirical formula of the hydrated barium hydroxide. (3 marks)

9. at 200C, NO2 and N2 O4 gases exist in equilibrium as shown in the equation below
$$2\ NO_{2(g)} \rightleftharpoons N2O_{4(g);}\ \triangle H = \text{-ve}$$
Brown   pale yellow
State and explain the observation that would be made when;
a) A syringe containing the mixture at 200C is immersed in ice-cold water
(1 ½ mks)
b) the volume of the gaseous mixture in a syringe is reduced. (1 ½ mks)

10 Name the process which takes place when:
a) Solid carbon (IV) oxide (dry ice) changes directly into gas (1 mark)
b) A red litmus paper turns white when dropped into chlorine water. (1 mark)
c) Propane gas molecules are converted into a giant molecule (1 mark)

11. a) water from a town in Kenya is suspected to contain chloride ions but not sulphate ions.
Describe how the presence of the chloride ions in the water can be shown. (1 mk)
b) State one advantage of drinking hard water rather than soft water. (1 mk)

12. The table below shows the relative atomic masses and the percentage abundance of the isotopes L1 of element L.

13. The diagram below represents the set-up that was used to prepare and collect hydrogen chloride gas in the laboratory.
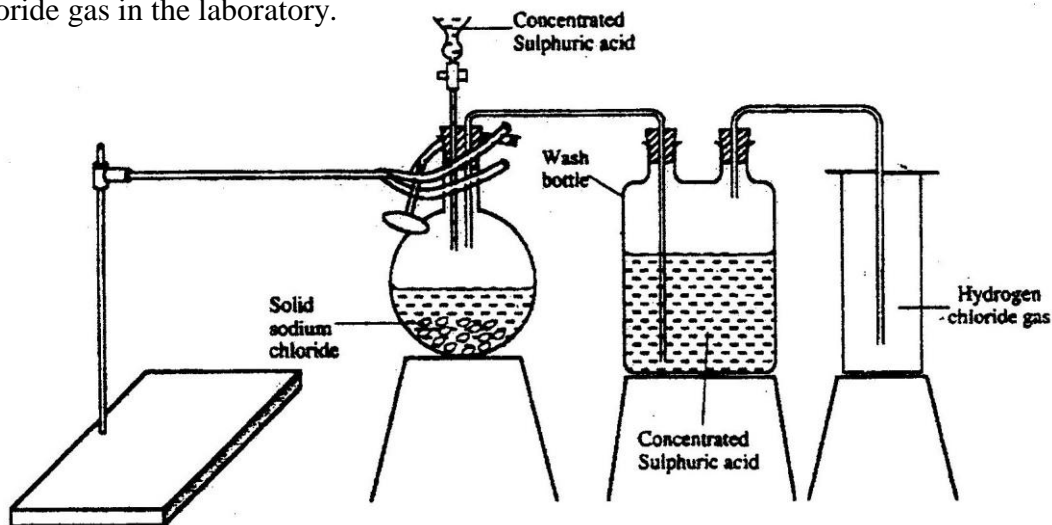
a) State the purpose of concentrated sulphuric acid in the wash bottle. (1 mark)
b) Write an equation for the reaction between dry hydrogen chloride gas and heated iron (1 mark)
c) Hydrogen chloride gas is dissolved in water to make hydrochloric acid. State one use of hydrochloric acid.

14. Below is a list of oxides.
    MgO, $N2O$, K_2O, CaO, and Al_2O_3.
    Select:
    a) A neutral oxide (1 mk)
    b) A highly water soluble basic oxide (1 mark)
    c) An oxide which can react with both sodium hydroxide solution and dilute hydrochloric acid. (1 mk)

15. Study the standard reduction potential given and answer the questions that follow. (The letters are not the actual symbols of the elements).

		Eø (volts)
$M^{2+}_{(aq)} + 2e$	$\rightarrow$ $M_{(s)}$	-0.76
$N2+_{(aq)} + 2e$	$\rightarrow$ $N_{(s)}$	-2.37
$P+_{(aq)} + e$	$\rightarrow$ $P_{(s)}$	+0.80
$Q^{2+}_{(aq)} + 2e$	$\rightarrow$ $Q_{(s):}$	-0.14

    a) The standard reduction potential for Fe $^{2+}$(aq) is -0.44 volts. Select the element which would best protect iron from rusting. (1 mark)
    b) Calculate the E ø value for the cell represented as $M_{(s)} / M^{2+}_{(aq)} // p+_{(aq)} /P_{(s)}$. (2mks)

16 When hydrogen sulphide gas was bubbled into an aqueous solution of iron (III) chloride, a yellow precipitate was deposited. (1mark)
   a) The standard reduction potential for Fe2+ (aq) is -0.44 volts. Select the element which would best protect iron from rusting. (1 mark)
    b) Write an equation for the reaction that took place. (1 mark)
    c) What type of reaction was undergone by hydrogen by hydrogen sulphide in this reaction? (1mark)

17. The first step in the industrial manufacture of nitric acid is the catalytic oxidation of ammonia gas.
    (a) What is the name of the catalyst used? (1 mk)
    (b) Write the equation for the catalytic oxidation of ammonia gas. (1mk)
    (c) Nitric acid is used to make ammonium nitrate, state two uses of ammonium nitrate. (1 mark)

18. Study the diagram below and answer the question that follows.
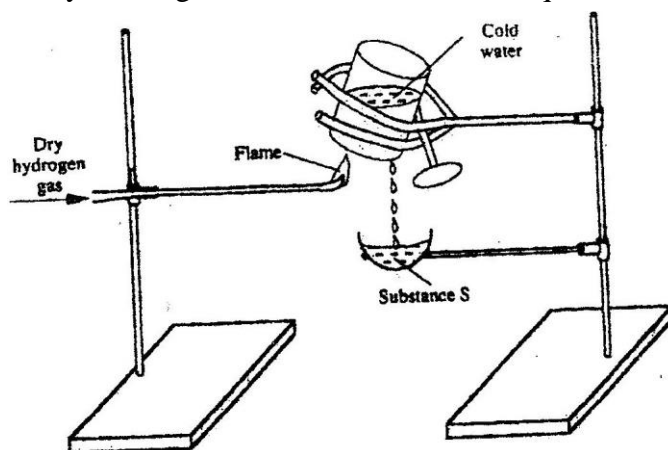
Describe one chemical test that can be carried out to identify substance s. (2 marks)

19. a) starting from solid magnesium hydroxide.   (1mark)
     b) Give one use of magnesium hydroxide.   (1 mark)
20. a) Distinguish between a covalent bond and a co-ordinate bond   (2 marks)
     b) Draw a diagram to show bonding in an ammonium ion.   (1mark)
21. (a) Explain why the metals magnesium and aluminium are good conductors of
     electricity.   (1 mark)
     b) Other than cost, give two reasons why aluminium is used for making
         electric cables while magnesium is not (2mks)
22. The diagram below represents part of a set – up used to prepare and collect gas T.
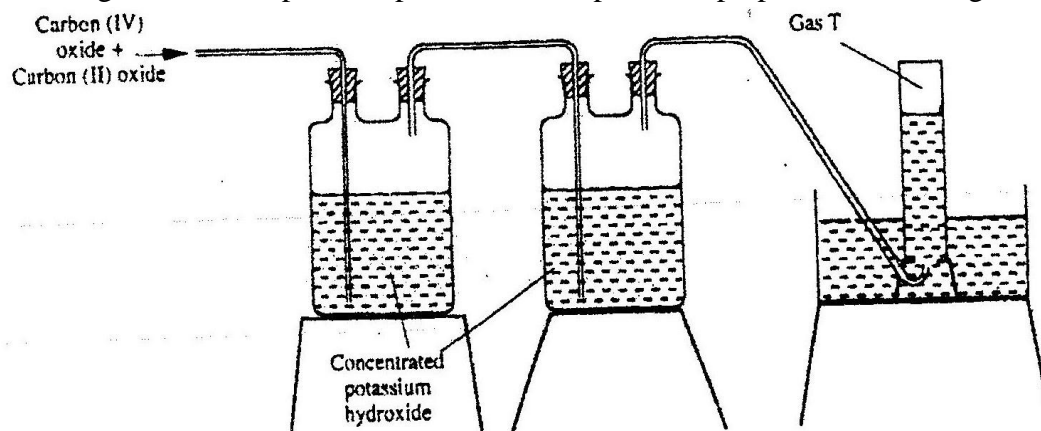
     a) Name two reagents that are reacted to produce both carbon (IV) oxide and
         carbon(II) oxide.(1mk)
     b) Write the equation for the reaction which takes place in the wash bottles.(1mk)

     c) Give a reason why carbon(II) oxide is not easily detected.(1mk)
23. Explain why the boiling point of ethanol is higher than that of hexane.
     (Relative molecular mass of ethanol is46 while that of hexane is 86)
24. a) Complete the table below to show the colour of the given indicator in

Indicator	Colour in	
	Acid solution	Basic solution
Methyl orange	…………….	Yellow
Phenolpthalein	Colourless	……………….

     b) How does the P^H value of 0.1 M potassium hydroxide solution compare with that
of 0.1M aqueous ammonia? Explain.   (2mks)
25. Study the properties of substances V1 to V4 in the table below and answer
     the questions that follow.

| Substance	Solubility in water	Solubility	Melting Point(^{o}C)	Boiling point(^{o}C)
V1	Insoluble	Soluble	-30	250
V2	Insoluble	Insoluble	1535	3000
V3	Insoluble	Soluble	16.8	44.8
V4	Insoluble	Soluble	75	320

     a) Which of the substances are liquids at 240C?
   b) Describe how a mixture containing V2 and V4 can be separed (2mks)

26.   The graph below shows a curve obtained when water at 20oC was heated for 15 minutes.
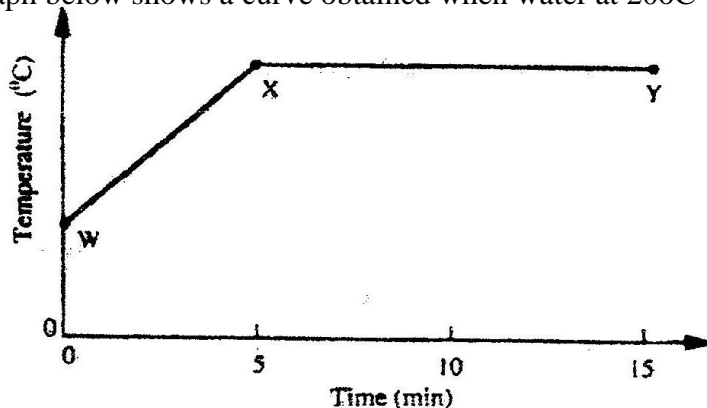
a)   What happens to the water molecules between points W and x?   (1mk)

b)   In which part of the curve does a change of state occur? (1mk)

c)   Explain why the temperature does not rise between points X and Y.   (1mk)

27.   Study the flow chart below and answer the questions that follow.
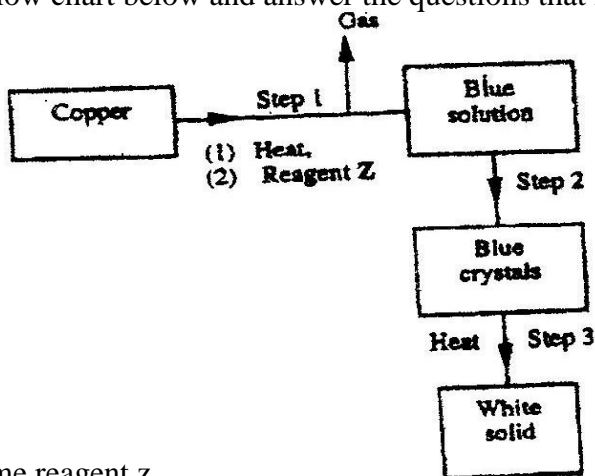
a)   Name reagent z.

b)   Describe the process which takes place in step 2.(1mk)

c)   Identify the white solid.   (1mk)

28.   Study the diagram below and answer the questions that follow.
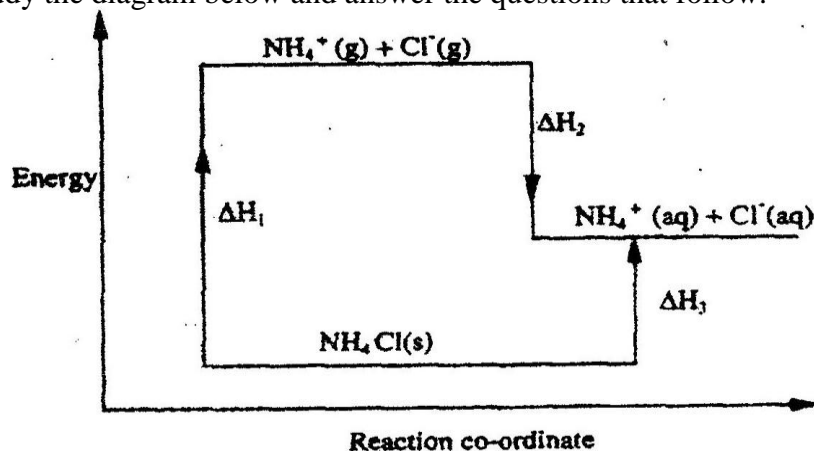
a)   What do $\triangle H_1$ and $\triangle H_2$ represent?   (2mks)

b)   Write an expression to show the relationship between $\triangle H_1, \triangle H_2$ and $\triangle H_3$.(1mk)

CHEMISTRY PAPER 2 (233/2) 2006
QUESTIONS

1. a) What is an electrolyte?   (1mk)
    b) State how the following substances conduct electricity.
        i)   Molten calcium chloride   (1mk)
        ii) Graphite.   (1mks)
    c) The diagram below shows a set up that was used to electrolyse aqueous magnesium sulphate.
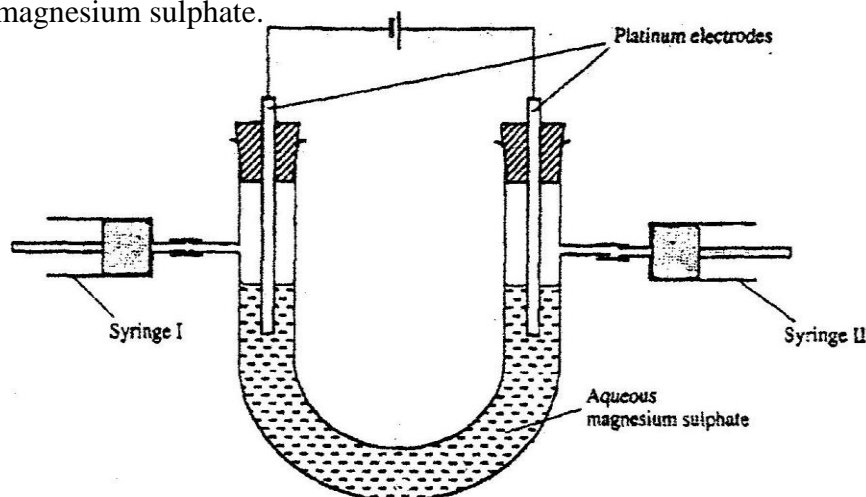
        i)   On the diagram above, using an arrow, show the direction of flow of electrons.   (1mk)
        ii) Identify the syringe in which hydrogen gas would be collected. Explain
                                                               (1mk)
    d) Explain why the concentration of magnesium sulphate was found to have increased at the end of the experiment.   (2mks)
    e) During the electrolysis, a current of 0.72A was passed through the electrolyte for 15 munites.Calculate the volume of gas produced at the anode.(1 Faraday = 96 500 coulombs; molar gas volume is 24000cm^3 at room temperature).   (4mks)

2. a) In an experiment to determine the molar heat of reaction when magnesium displaces copper ,0.15g of magnesium powder were added to 25.0cm^3 of 2.0M copper (II) chloride solution. The temperature of copper (II) chloride solution was 25°C.While that of the mixture was 43°C.
        i)   Other than increase in temperature, state and explain the observations which were made during the reaction.(3mks)
        ii) Calculate the heat change during the reaction (specific heat capacity of the solution = 4.2jg^{-1}k^{-1}and the density of the solution = 1g/cm^3(2mks)
        iii) Determine the molar heat of displacement of copper by magnesium.(Mg=24.0).
        iv) Write the ionic equation for the reaction.(1mk)
        v)   Sketch an energy level diagram for the reaction.(2mks)
    b) Use the reduction potentials given below to explain why a solution containing copper ions should not be stored in a container made of zinc.
 $Zn^{2+}_{(aq)} + 2e \longrightarrow Zn_{(s)}$; $E^{\o} = -0.76v$
        $Cu^{2+}_{(aq)} + 2e \longrightarrow Cu_{(s)}$; $E^{\o} = +0.34v$ (2mks)

3. a) Distinguish between isotopes and allotropes. (2mks)
    b) The chart below is 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

    i)   Select the element in period three which has the shortest atomic radius. Give a reason for you answer.   (2mks)
    ii) Element F has the electronic structure, 2.8.18.4 on the chart above, indicate the position of element F.   (1mks)
    iii) State one use of the elements of which E is a member.   (1mk)
    iv) Write an equation to show the action of heat on the nitrate of element C.
                                                                        (1mks)

    c) When 3 litres of chlorine gas were completely reacted with element D, 11.875g of the product were formed.Dertermine the relative atomic mass of element D.
        (Atomic mass of chlorine = 35.5; molar gas volume = 24litres).(3mks)

4. a) The diagram below shows some processes that take place during the industrial manufacture of sulphuric acid.
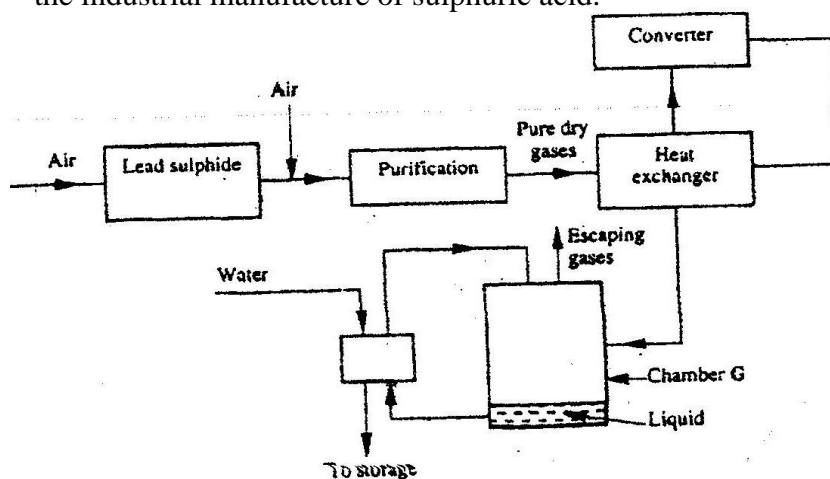
    (i)   Write the equation for the reaction in which sulphur dioxide gas is produced.   (1mk)

    (ii) Why is it necessary to keep the gases pure and dry ?   (1mk)
    (iii) Describe the process that takes place in chamber G.   (1mk)
    (iv) Name the gases that escape into the environment.   (1mk)
    (v)   State and explain the harmful effect on the environment of one of the gases named in (iv) above   (1mk)
    (vi) Give one reason why it is necessary to use a pressure of 2-3 atmoshperes and not more.   (1mk)
    b) (i)   Complete the table below to show the observations made when

concentrated sulphuric acid is added to the substances shown.

(2mks)

Substance	Observation
Iron fillings	
Crystals of white sugar	

(ii) Give reasons for the observations made using:

I iron fillings (1mk)

II Crystals of white sugar. (1mk)

(c) Name one fertilizer made from sulphuric acid. (1mk)

(d) Suggest a reason why BaSO4(apigment made from sulphuric acid) would be suitable in making paint for cars. (1mk)

5. a) What name is given to a compound that contains carbon and hydrogen only? (½)

b) Hexane is a compound containing carbon and hydrogen.

(i) What method is used to obtain hexane from crude oil? (1mk)

(ii) State one use of hexane (1mk)

c) Study the flow chart below and answer the questions that follow.
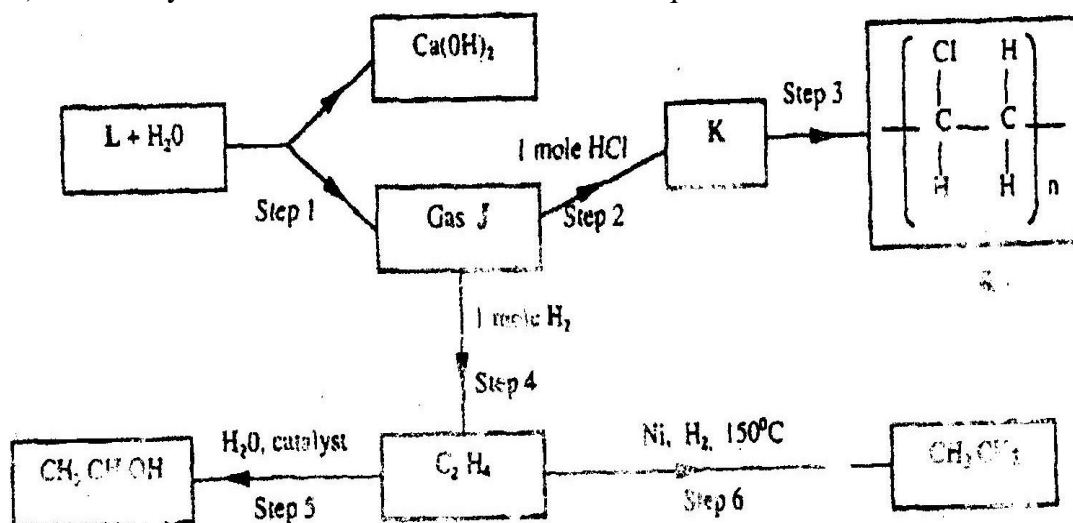
(i) Identify reagent L. (1mk)

(ii) Name the catalyst used in step 5. (1mk)

(iii) Draw the structural formula of gas J. (1mk)

(iv) What name is given to the process that takes place in step 5? (½mk)

d) (i) write the equation for the reaction between aqueous sodium hydroxide and aqueous ethanoic acid. (1mk)

(ii) Explain why the reaction between 1g of sodium carbonate and 2M hydrochloric acid is faster than the reaction between 1g of sodium carbonate and 2M ethanoic acid. (1mks)

6. The extraction of iron from its ores takes place in the blast furnace. Study it and answer the questions that follow.
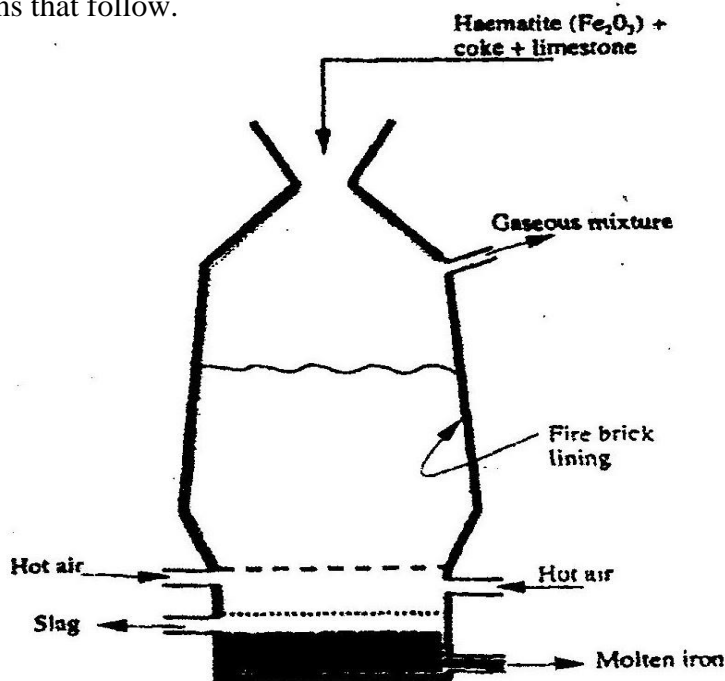
a) Name
(i) One of the substances in the slag (1mk)
(ii) Another iron ore material used in the blast furnance. (1mk)
(iii) One gas which is recycled. (1mk)
b) Describe the process which leacd to the formation of iron in the blast furnace
c) State the purpose of limestone in the blast furnace. (3mks)
d) Give a reason why the melting point of the iron obtained from the blast furnace is 12000 C while tat of pure iron is 15350C (1mk)
(e) State two uses of steel (2mks)

7. The table below shows the volumes of nitrogen dioxide gas produced when different volume of IM nitric acid were each reacted with 2.07 g of lead at room temperature.

Volume of 1 M nitric acid (cm^3)	Volume of nitrogen dioxide gas (cm^3)
5	60
15	180
25	300
35	420
45	480
55	480

a) Give a reason why nitric acid is not used to prepare hydrogen gas. (1mk)
b) Explain how the rate of the reaction between lead and nitric acid would be affected if the temperature of the reaction mixture was raised. (2mks)
c) On the grid provided below, plot a graph of the volume of the gas produced (Vertical axis) against volume of acid. (3 marks)

d) Using the graph, determine the volume of:
   i) Nitrogen dioxide produced when 30cm3 of 1 M nitric acid were reacted with 2.07 g of lead (1mrk)
   ii) 1M nitric acid which would react completely with 2.07g of lead. (1mk)
e) Using the answer in d(i) above, determine:
   i) The volume of 1M nitric acid that would react completely with one mole of lead (pb=207)

   (2mks)
   ii) The volume of nitrogen dioxide gas produced when one mole of lead reacts with excess 1 M nitric room temperature. (1mk)
f) Calculate the number of moles of:
   i) 1M nitric acid that reacted with one mole of lead (1mk)
   ii) nitrogen dioxide produced when one mole of lead were reacted with excess nitric acid. (Molar gas volume of 2400cm^3) (1mk)
g) Using the answers obtained in f (i) and (ii) above, write the equation for the reaction between lead and nitric acid given that one mole of lead nitrate and two moles of water were also produced. (1mk)

CHEMISTRY
PAPER 1
THEORY
OCT./NOV. 2007
2 hours

1. The diagram below shows a "Jiko" when in use. Study it and answer the questions that follow.
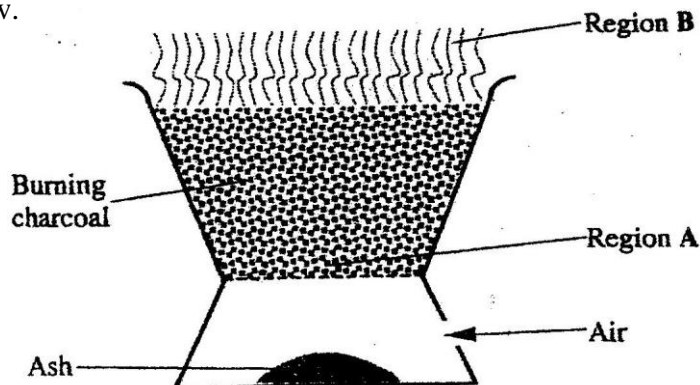
a) Identify the gas formed at region A. (1mk)

………………………………………………………………………………

b) State and explain the observation made at region B. (2mks)

…………………………………………………………………………………

………………………………………………………………………………..

2. 15.0cm³ of ethanoic acid (CH_3COOH) was dissolved in water to make 500cm3 of solution. Calculate the concentration of the solution in moles per litre.
(C=12.0;H=1.0;O=16.0; density of ethanoic acid is 1.05 g/cm^3) (3mks)

…………………………………………………………………………………………..

…………………………………………………………………………………………

…………………………………………………………………………………………

3. Both chlorine and iodine are halogens.
a) What are halogens? (1mk)

…………………………………………………………………………………

b) In terms of structure and bonding, explain why the boiling point of chlorine is lower than that of iodine. (2mks)

…………………………………………………………………………………

4. The diagram below shows a Bunsen burner when in use.
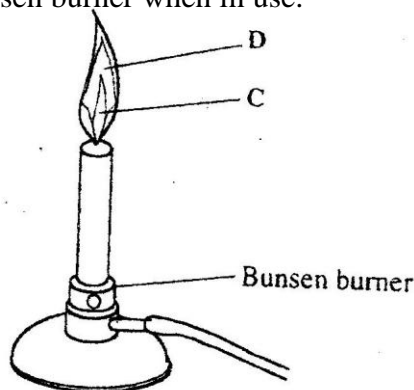
Name the regions labeled C and D.   (2mks)

C   …………………………………………………………………………..

D   ………………………………………………………………………….

5.   When a student was stung by a nettle plant, a teacher applied an aqueous solution
         of ammonia to the affected area of the skin and the student was relieved of pain .Explain.
                                                                                                    (2mks)

         …………………………………………………………………………………………

         ……………………………………………………………………………………………

         ……………………………………………………………………………………………

6.   In an experiment, a few drops of concentrated nitric acid were added to aqueous iron(II)
         sulphate in a test – tube. Excess sodium hydroxide solution was then added to the
         mixture.

         a)   State the observations that were made when:

                 i)   Concentrated nitric acid was added to aqueous iron (II) sulphate(1mk)

                          …………………………………………………………………………

                 ii)   Excess sodium hydroxide was added to the mixture. (1mk)

                          …………………………………………………………………………

         b)   Write and ionic equation for the reaction which occurred in (a) (ii) above.(1mk)

                 ………………………………………………………………………………………..

7.   a)   Use the information given below to draw a labeled diagram of an
                 electrochemical cell that can be constructed to measure the electromotive force
                 between G and J.

                 $G^{2+}(aq) + 2e$ $G(s)$; $E^{\theta} = -0.74$ V

                 $J^{2+}(aq) + 2e$ $J(s)$; $E^{\theta} = -0.14$ V

         b)   Calculate the E^{θ} value for the cell constructed in (a) above. (1mk)

                          ……………………………………………………………………………

                          ……………………………………………………………………………

8.   Explain why there is general increase in the first ionization energies of the
         elements in period 3 of the periodic table from left to right.   (2mks)

9.   Study the flow chart below and answer the question that follows.
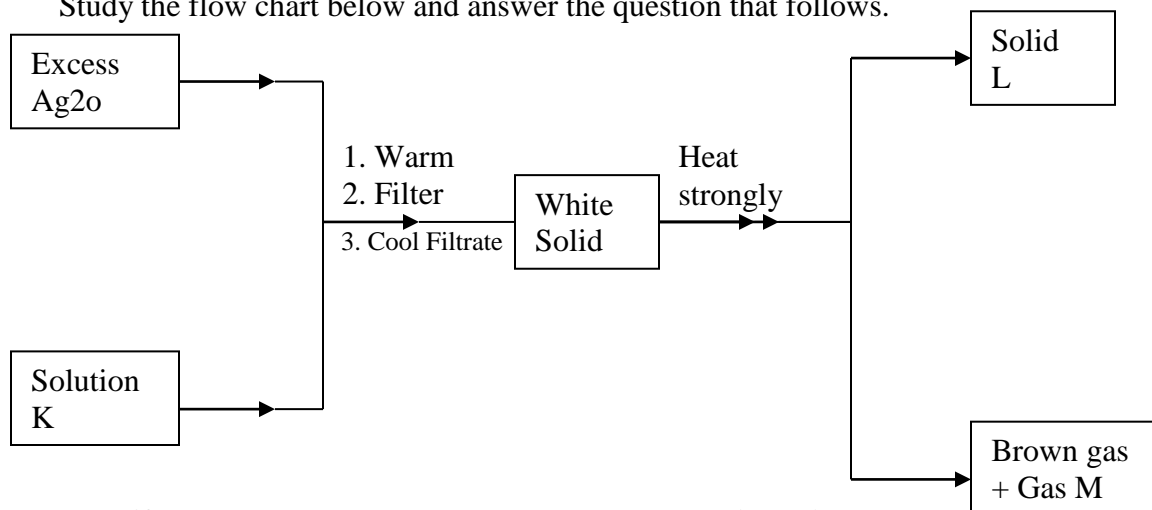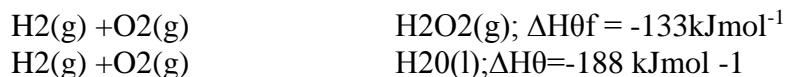

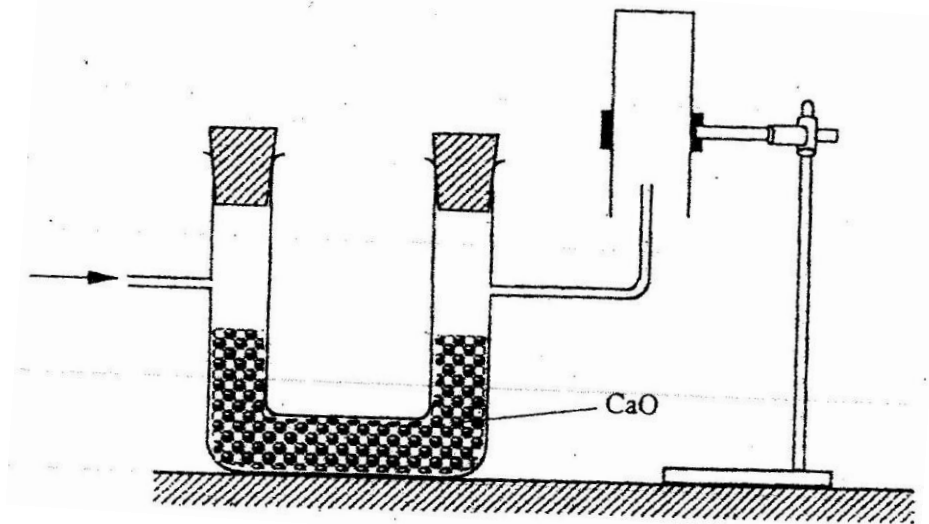**Identify:**   **(3mks)**

a)   Solution K

b)   Solid L

    c)   Gas M

9.   The thermo chemical equations for the formation of hydrogen peroxide under standard conditions are:

$H2(g) +O2(g)$ $H2O2(g)$; $\Delta H\theta f = -133kJmol^{-1}$

$H2(g) +O2(g)$ $H2O(l)$; $\Delta H\theta = -188$ kJmol -1
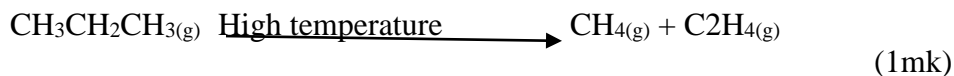
Write the thermo chemical equation for the molar heat of vaporization of hydrogen peroxide.   (2mks)

10.   The set-up below was used to collect a dry sample of a gas.

Give two reasons why the set-up cannot be used to collect carbon (IV) oxide gas.   (2mks)

12.   a)   State the Charles law   (1mk)

        b)   The volume of a sample of nitrogen gas at a temperature of 291 K and 1.0×10^5 Pascal's was $3.5 \times 10^{-2} m3$. Calculate the temperature at which the volume of the gas would be $2.8 \times 10^{-2} m3$ at 1.0×10^5 Pascal.   (2mks)

13.   a)   name the process that takes place when:

           (i)   Crystals of zinc nitrate change into solution when exposed to air (1mk)

           (ii)   An alcohol reacts with an organic acid in the presence of a catalyst to form a sweet smelling compound.   (1mk)

        b)   Propane can be changed into methane and ethane as shown in the equation below;

           $CH_3CH_2CH_{3(g)}$ <u>High temperature</u> $\longrightarrow$ $CH_{4(g)} + C2H_{4(g)}$

                                                           (1mk)

    Name the process undergone by propane.   (1mk)

14.   a)   Distinguish between nuclear fission and nuclear fusion.   (2mks)

        b) Describe how solid wastes containing radioactive substances should be disposed of.

                                                       (1mk)

15.   a)   Explain why permanent hardness in water cannot be removed by boiling.(2mks)

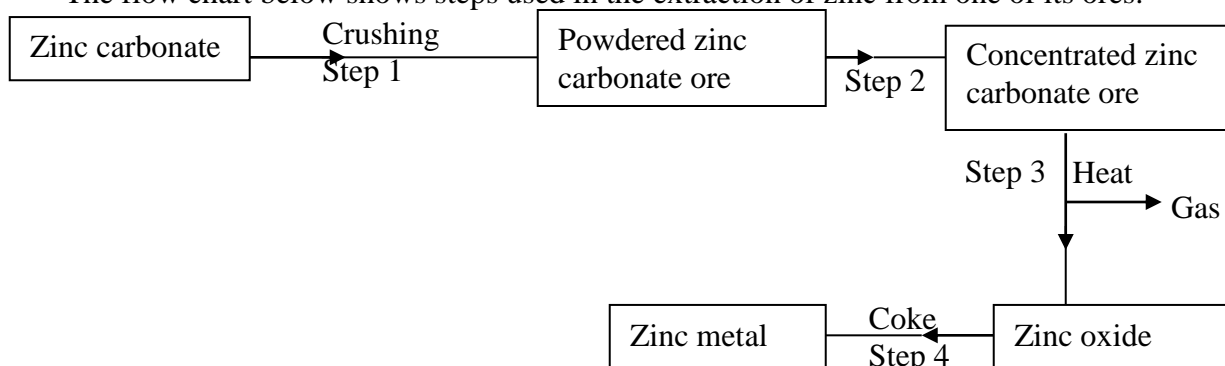   b)   Name two methods that can be used to remove permanent hardness from water.

(1mk)

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

I	Test	Observations
II	Dilute hydrochloric acid was added solid N.	A colourless solution was form
III	To the colourless solution obtained test II, excess sodium hydroxide so was added.	A white precipitate was formed which dissolved to form a colo solution.

Write the formula of the anion in;

a)   Solid N   (1mk)

b)   The colourless solution formed in test III   (1mk)

17.   The relative formula mass of a hydrocarbon is 58. Draw and name two possible structures of the hydrocarbon (C=12.0; H=1.0)   (3mks)

18.   starting with sodium metal, describe how a sample of crystals of sodium hydrogen carbonate may be prepared.   (3mks)

19   The flow chart below shows steps used in the extraction of zinc from one of its ores.

```
┌─────────────────┐   Crushing   ┌─────────────────┐           ┌──────────────────┐
│ Zinc carbonate  │──────────────▶│ Powdered zinc   │──────────▶│ Concentrated zinc│
└─────────────────┘   Step 1     │ carbonate ore   │  Step 2   │ carbonate ore    │
                                  └─────────────────┘           └──────────────────┘
                                                                          │
                                                          Step 3  │ Heat
                                                                          │──────▶ Gas
                                                                          ▼
                  ┌─────────────┐   Coke     ┌─────────────┐
                  │ Zinc metal  │◀───────────│ Zinc oxide  │
                  └─────────────┘   Step 4   └─────────────┘
```

a)   Name the process that is used in step 2 to concentrate the ore.   (1mk)

b)   Write an equation for the reaction which takes place in step 3.   (1 mark)

c)   Name one use of zinc other than galvanizing.   (1mk)

20.   An alcohol has the following composition by mass: hydrogen 13.5%, oxygen 21.6% and carbon 64.9%

a)   Determine the empirical formula of the alcohol(C=12.0; H=1.0')=16.0).

(2mks)

21.   a)   When brine is electrolyzed using inert electrodes, chlorine gas is liberated at the anode instead of oxygen. Explain this observation.

(2mks)

b)   Name the product formed at the cathode.   (1 mk)

22.   6.84g of aluminium sulphate were dissolve in 150cm3 of water. Calculate the molar concentration of the sulphate ions in the solution. (Relative formula mass of aluminium sulphate is 342)

……
……
………………………………………………………………………………………………

23. The table below shows the relative molecular masses and the boiling points of pentane and propan-1-01

|	Relative molecular mass	Boiling point(^oC)
Pentane	72	36
Propan-10-1	60	97

Explain why the boiling point of propane 1-1-01 is higher than that of pentane.   (2mks)

24. State and explain the observations made when excess ammonia gas reacts with chlorine gas   (3mks)

25. The diagram below shows a student's set-up for the preparation and collection of hydrogen gas.
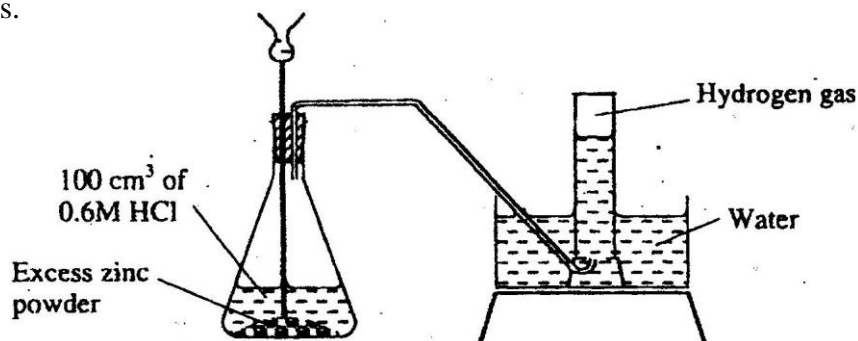
(a) How would the final volume of hydrogen gas produced be affected if 80cm3 of 0,75 M hydrochloric acid was used?   (1mk)

(b) Give a reason why helium is increasingly being preferred to hydrogen in weather balloons.

26. The table below shows the number of valence electrons of the element P, Q and R.

Element	P	Q	R
Number of valence electrons	3	5	2

a)   Explain why p and R would not be expected to form a compound.   (1mk)

b)   Write an equation to show the effect of heat on the carbonate of R   (1mk)

c)   Write the formula for the most stable ion or q.   (1mk)

27. The diagram below formula for the most stable ion of Q.   (1mk)
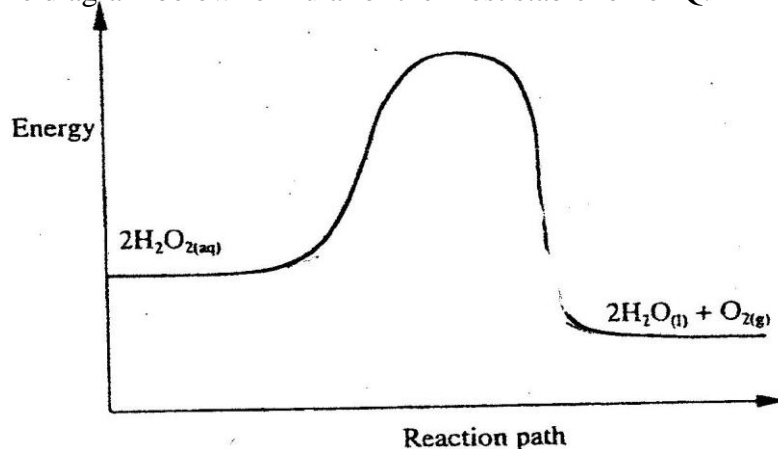
On the same axis, sketch the graph for the decomposition of hydrogen peroxide when manganese (IV) oxide is added.   (2mks)

28. During the electrolysis of aqueous silver nitrate, a current of 5.0a was passed through the electrolysis for 3 hours.
   a)   Write the equation for reaction which took place at the anode.   (1mk)
   b)   Calculate the mass of silver deposited (Ag = 108; IF=96500C)   (2mks)

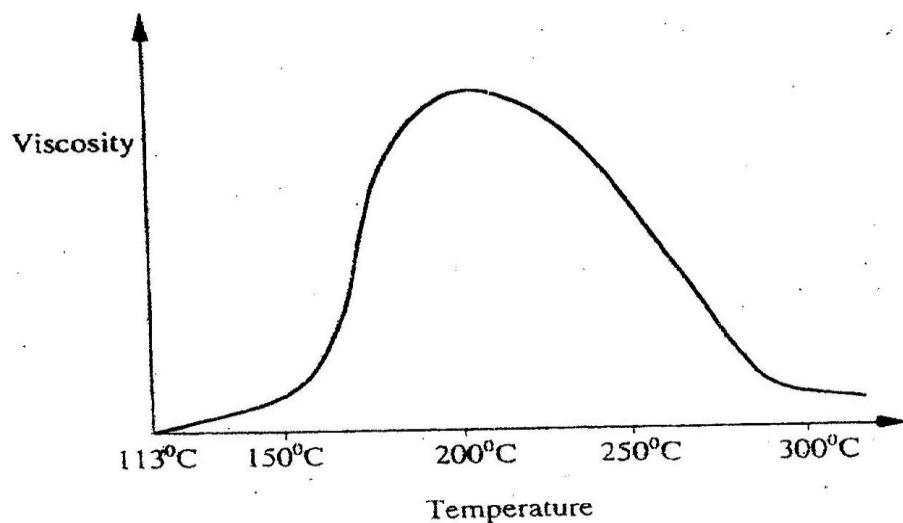29   The diagram below is a section of a model of the structure of element T.
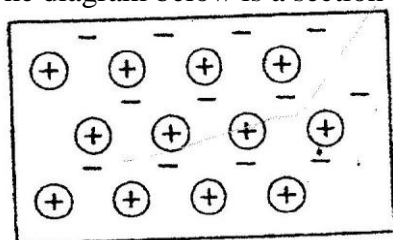
Key

(+)   Charged nucleus

--   An electron

   a) State the type of bonding that exists in T.   (1mk)
   b) In which group of the period table does element T belong? Give a reason.   (2mks)

30. Below is a sketch of a graph showing the change in viscosity? (Ease of flow) with temperature when solid sulphur is heated.

Describe what happens to the sulphur molecules when sulphur is heated from 150^0C to about 200^0C.
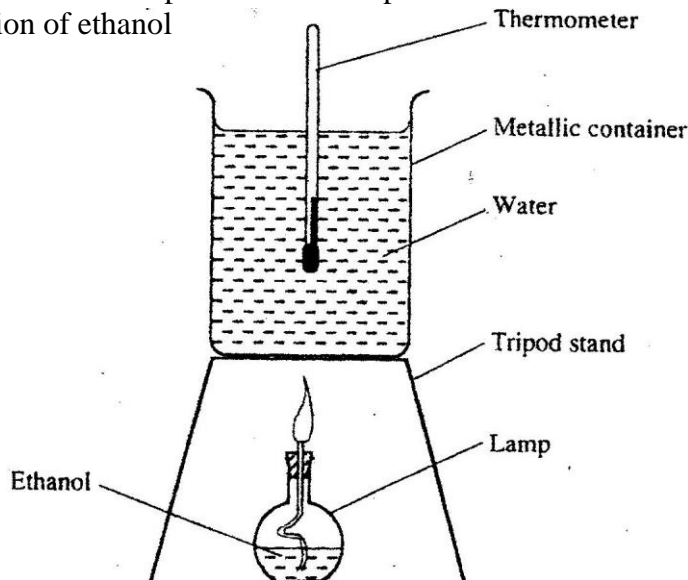
CHEMISTRY
Paper 2
THEORY Oct/Nov. 2007

1. (a) State two factors that should be considered when choosing fuel for cooking (2mks)
   (b) The diagram below represents a set – up that was used to determine the molar heat of combustion of ethanol

During the experiment, the data given below was recorded

Volume of water	450cm^3
Initial temperature of water	25^0 C
Final temperature of water	46.5^{0}C
Mass of ethanol + Lamp before burning	125.5g
Mass of ethanol + lamp after burning	124.0g

Calculate the:
   (i) Heat evolved during the experiment (density of water = 1g/cm^3
      Specific heat capacity of water = 4.2 Jg^{-1}K^{-1} (3 mks)

   (ii) Molar heat of combustion of ethanol (C = 12.0, O = 16.0, H=1.0) (2 mks)

(c) Write the equation for the complete combustion of ethanol (1mk)

(d) The value of the molar heat of combustion of ethanol obtained in (b) (ii) above is lower than the theoretical value. State two sources of error in the experiment. (2 mks)

2. (a) Give the systematic names of the following compounds

    (i) $CH_2 = \underset{\underset{CH_3}{|}}{C} - CH_3$

                                                                         (1 mk)
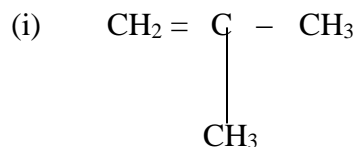
    (ii) $CH_3CH_2CH_2C \equiv CH$ (1mk)

    (b) State the observations made when Propan – I- ol reacts with:
    (i)   Acidified potassium dichromate (VI) Solution   (1mk)

    (ii)   Sodium metal   (1mk)

    (c)   Ethanol obtained from glucose can be converted to ethane as shown below

            $C_6H_{12}O \xrightarrow{\text{Step 1}} C_2H_5OH \xrightarrow{\text{Step II}} CH_2 \equiv CH_2$

            Name and describe the process that take place in steps I and II
            Step I   (1 ½ mks)

            Step II   (1 ½ mks)

    (d)   Compounds A and B have the same molecular formula $C_3H_6O_2$. Compound A
            liberates carbon (IV) oxide on addition of aqueous sodium carbonate while
            compound B does not. Compound B has a sweet smell. Draw the possible
            structures of:
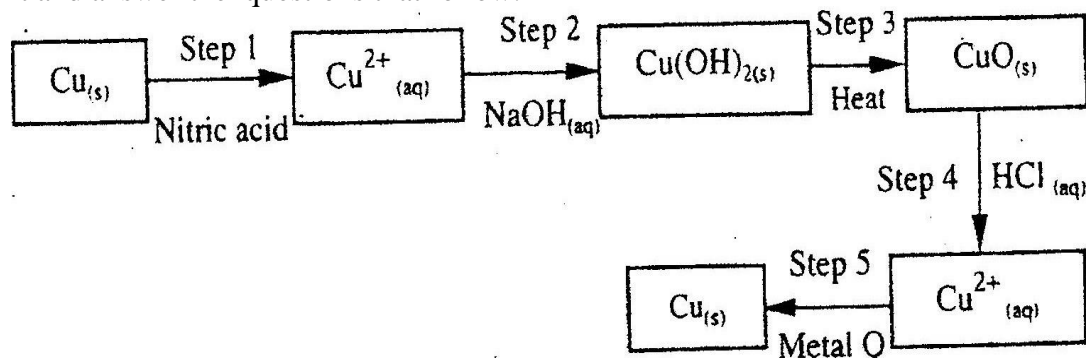   (i) Compound A   (1 mark)

            (ii) Compound B   (1 mk)

    (e)   Give two reasons why the disposal of polymers such as polychloroethane by
            burning pollutes the environment.   (2 mks)

3. The flow chart below shows a sequence of chemical reactions starting with copper study
    it and answer the questions that follow.

(a) In step 1, excess 3M nitric acid was added to 0.5g of copper powder
(i) State two observations which were made when the reactions was in progress   (2mks)

(ii) Explain why dilute hydrochloric acid cannot be used in step 1   (1mk)

(iii)   I   Write the equation for the reaction that took place in step 1 (1mk)

          II   Calculate the volume of 3M nitric that was needed to react completely
                  with 0.5g of copper powder. (Cu = 63.5)   (3 mk)

(b)   Give the names of the types of reactions that took place in steps 4 and 5 (1 mk)
          Step 4
          Step 5

(c)   Apart from the good conductivity of electricity, state two other properties that
          make it possible for copper to be extensively used in the electrical industry. 2mks)

4.   (a)   Methanol is manufactured from carbon (IV) oxide and hydrogen gas according to
   the equation:

$$CO_2(g) + 3H_2(g) \rightleftharpoons CH_3OH(g) + H_2O(g)$$
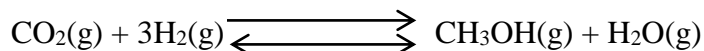
The reaction is carried out in the presence of a chromium catalyst at 700K and 30kPa.
Under these conditions, equilibrium is reacted when 2% of the carbon (IV) oxide is
converted to methanol

      (i)   How does the rate of the forward reaction compare with that of the reverse
             reaction when 2% of the carbon (IV) oxide is converted to methanol?   (1 mk)

      (ii)   Explain how each of the following would affect the yield of methanol:
             I   Reduction   (2mks)

             II   Using a more efficient catalyst   (2mks)

      (iii) If the reaction is carried out at 500K and 30kPa, the percentage of carbon (IV)
             oxide converted to methanol is higher than 2%

             I what is the sign of ΔH for the reaction? Give a reason   (2mks)

             II Explain why in practice the reaction is carried out at 700K but NOT at 500K
                                                                                       (1mk)

(b)   Hydrogen peroxide decomposes according to the following equation:
          $2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$
          In an experiment, the rate of decomposition of hydrogen peroxide was found to
   be 6.0×10^{-8} mol dm^{-3} S^{-1}.

(i)   Calculate the number of moles per dm^3 of hydrogen peroxide that had decomposed within the first 2 minutes   (2mks)

(ii)   In another experiment, the rate of decomposition was found to be 1.8×10^{-7} mol $dm^{-3}S^{-1}$. The difference in two rates could have been caused by addition of a catalyst. State, giving reasons, one other factor that may have caused the difference in two rates of decomposition   (2mks)

5.   (a)   The diagram below represents part of the structure of a sodium chloride crystal. The position of one of the sodium ions in the crystal is shown as $\oplus$
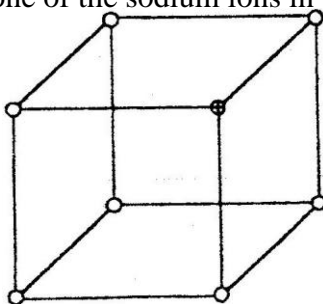
(i)   On the diagram, mark the position of the other three sodium ions   (2 mks)

(ii)   The melting and boiling points of sodium chloride are 801^0C and 1413^0C respectively.
Explain why sodium chloride does not conduct electricity at 25^0C, but does so at temperatures between 801^0 C and 1413^0C (2 mks)

(b)   Give a reason why ammonia gas is highly soluble in water   (2mks)

(c)   The structure of an ammonia ion is shown below:
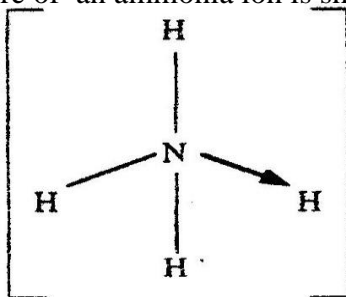
Name the type of bond represented in the diagram by $N \rightarrow H$ (1 mark)

(d)   Carbon exists in different crystalline forms. Some of these forms were recently discovered in soot and are called fullerenes

(i)   What name is given to different crystalline forms of the same element?   (1mk)

(ii)   Fullerenes dissolve in methylbenzene while the other forms of carbon do not.
Given that soot is a mixture of fullerenes and other solid forms of carbon, describe how crystals of fullerenes can be obtained from soot. (3mks)

(iii)   The relative molecular mass of one of the fullerenes is 720. What is the molecular formula of this fullerene? (C=12.00   (1 mk)

6.   (a)   The elements nitrogen, phosphorous and potassium are essential for plant growth.
        (i)   Potassium in fertilizers may be in the form of potassium nitrate Describe how a sample of a fertilizer may be tested to find out if it contained nitrate ions.   (2mks)

        (ii)   Calculate the mass of nitrogen present if a 25kg bag contained pure ammonium phosphate, $(NH_4)_2 HPO_4$. (N = 14.0, H=1.0, P = 31.0, O = 16.0

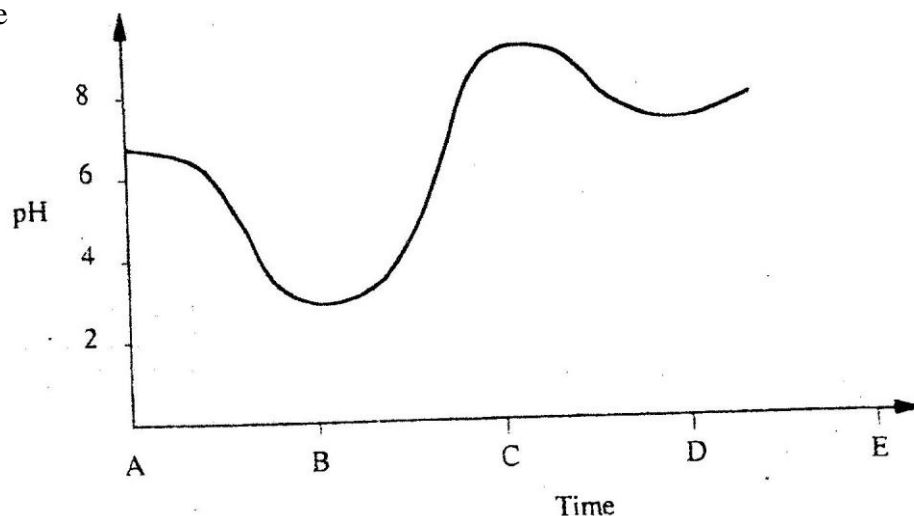   (2mks)

    (b)   The table below shows the solubility of ammonium phosphate in water at different temperatures.

Temperature (C^0)	Solubility of ammonium phosphate in g/100g water
10	63.0
20	69.0
30	75.0
40	82.0
50	89.0
60	97.0

(i) On the grid provided, draw the solubility curve of ammonium phosphate
    (Temperature on x – axis)   (3 mks)
(ii) Using the graph, determine the solubility of ammonium phosphate at 25^0C (1 mk)

(iii) 100g of a saturated solution of ammonium phosphate was prepared at 25^0C
        I   what is meant by a saturated solution?   (1mk)
        II   Calculate the mass of ammonium phosphate which was used to prepare the saturated solution   (2 mks)

    (c)   The graph below shows how the PH value of soil in a farm changed over a period of time

(i)   Describe how the pH of the soil can be determined   (2mks)

(ii)   State one factor that may have been responsible for the change in the soil pH in
       the time interval AB   (1 mk)

7.   The diagram below shows the set up used in an experiment to prepare chlorine gas and
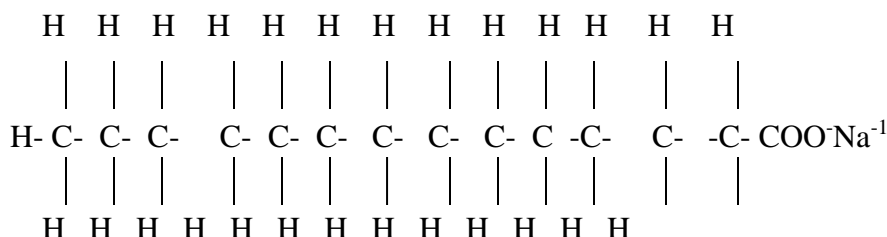   react it with aluminium foil. Study it and answer the question that follow
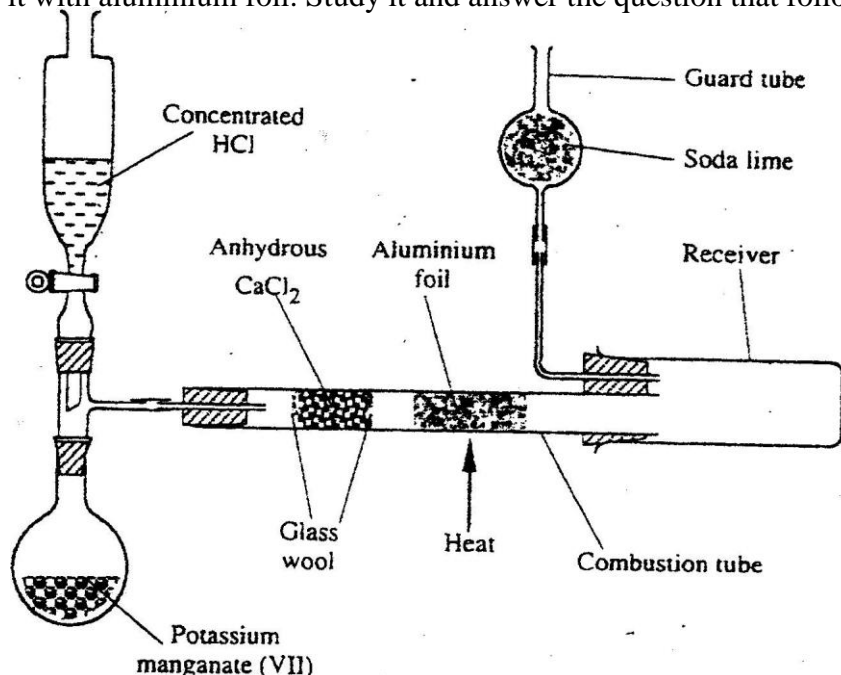
(a)   In the experiment, concentrated hydrochloric acid and potassium manganate (VII)
      were used to prepare chlorine gas. State two precautions that should be taken in
      carrying out this experiment.   (2mks)

(b)   Write the formula of another compound that could be used instead of potassium
      manganate (VII)   (1 mk)

(c)   Explain why it is necessary to allow the acid to drip slowly onto potassium manganate
      (VII) before the aluminium foil is heated.   (2 mks)

(d)   State the property of the product formed in the combustion tube that makes it possible for
      it to be collected in the receiver   (1mk)

(e)   When 1.08g of aluminum foil were heated in a stream of chlorine gas, the mass of the
      product formed was 3.47 g
      Calculate the:
      (i)   Maximum mass of the product formed if chlorine was in excess;
             (Al= 27; Cl = 35.5)
      (ii)   Percentage yield of the product formed   (1 mk)

(f)   Phosphorous trichloride is a liquid at room temperature. What modification should be
      made to set up if it is to be used to prepare phosphorous trichloride? (1 mk)

CHEMISTRY THEORY PAPER 1
OCT/NOV. 2008
2 HOURS

1. A small crystal of potassium manganate (VII) was placed in a beaker water. The beaker was left standing for two days without shaking. State and explain the observations that were made. 2mks)

2. When a hydrated sample of calcium sulphate $CaSO_4$ XH_2O was heated until all the water was lost, the following data recorded;
   Mass of crucible = 30.296 g
   Mass of crucible +hydrated salt = 33.111 g
   Mass of crucible + anhydrous salt = 32.781 g
   Determine the empirical formula of the hydrated salt (Relative formula mass of $CaSO_4$ =136, H2O =18). (3mks)

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

No.	Gas	Test	Observation
I	Chlorine	Put a moist red litmus into the gas	
II	Sulphure (IV) oxide		Paper turns green
III	Butane	Add a drop of bromin water	

4. The structure of a detergent is

   H   H   H   H   H   H   H   H   H   H   H   H   H
   | | | | | | | | | | | | |
   H- C- C- C-   C- C- C- C- C- C- C -C-   C- -C- COO⁻Na⁻¹
   | | | | | | | | | | | | |
   H H H H H H H H H H H H H

   a) Write the molecular formula of the detergent. (1mk)
   b) What type of detergent is represented by the formula? (1mk)
   c) When this type of detergent is used to wash linen in hard water, spots (marks) are left on the linen. Write the formula of the substance responsible for the spots (1mk)

5. Phosphoric acid is manufactured from calcium phosphate according to the following equation.
   $Ca_3(PO_4)_{2(s)} + 3H_2SOv(l) \longrightarrow 2H_3PO_{4(AQ)} + 3 CaSO_{4(S)}$

   Calculate the mass in (Kg) of phosphoric acid that would be obtained if 155 Kg of calcium phosphate reacted completely with the acid
   (Ca=40, P=31, S=32, O=16, H=1) (2mks)

6. The structure below represents a sweet smelling compound

$$CH_3 - CH_2 - CH_2 - \overset{\displaystyle O}{\overset{\displaystyle \|}{C}} - O - CH_2 - CH_2 - CH_3.$$
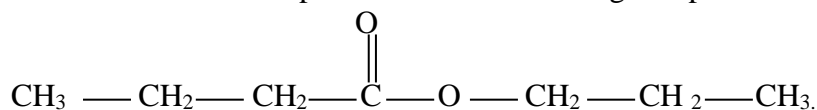
Give the names of the two organic compounds that can be used to prepare this compound in the laboratory. (2mks)

7. a) What are isotopes? (1mk)
   b) Determine the number of neutrons in $_8^{18}O$. (1mk)

8. a) State the observation made at the end of the experiment when a mixture of iron powder and sulphur is heated in a test tube. (1mk)
   b) Write an equation for the reaction the product in (a) above and dilute hydrochloric acid. (1mk)
   c) When a mixture of iron powder and sulphur is heated, it glows more brightly than that of iron fillings and sulphur. Explain this observation (1mk)

9. Zinc reacts with both concentrated and dilute sulphuric (VI) acid. Write equations for two reactions. (2mk)

10. When magnesium was burnt in air, a solid mixture was formed. On addition of water to the mixture a gas which turned moist red litmus paper blue was evolved. Explain these observations.

11. The table below gives atomic numbers of elements represented b the letters a, B, C and D.

Element	A	B	C	D
Atomic number	15	16	17	20

Use the information to answer the questions that follow.
   a) Name the type of bonding that exists in the compound formed when A and D react (1mk)
   b) Select the letter which represents the best oxidizing agent. Give a reason for your answer. (2mks)

12.   In an experiment, a test-tube full of chlorine water was inverted in chlorine water as shown in the diagram below and the set up left in sunlight for one day.
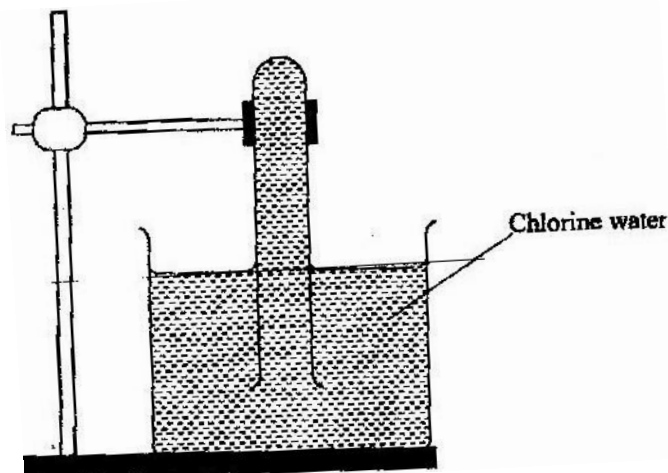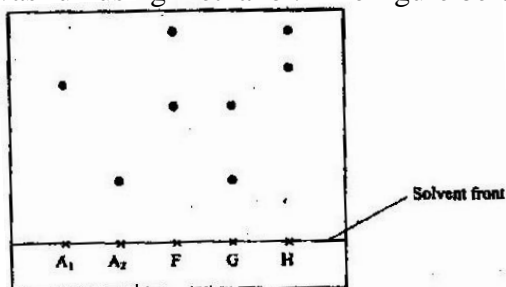

After one day, a gas was found to have collected in the test-tube
a)   Identify the gas.
b)   What will happen to the PH of the solution in the beaker after one day? Give an explanation.   (2mks)

13.   In a laboratory experiment hydrogen gas was passed over heated copper (II) oxide as shown the diagram below.
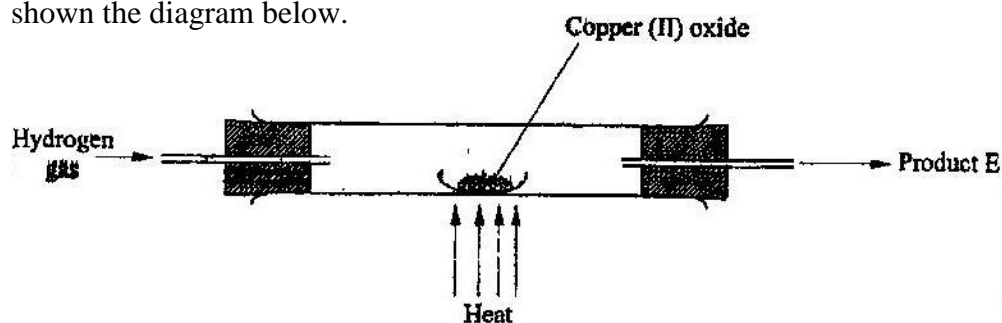
Describe a chemical test that can be used to identify the product e.   (2mks)

14.   Samples of urine from three participants F, G and H at an international sports meeting were spotted onto a chromatography paper alongside two from illegal drugs A_1 and A_2. A chromatogram was run using methanol. The figure below shows the chromatogram.

a)   Identify the athlete who had used an illegal drug.   (1mk)
b)   Which drug is more soluble in methanol?   (1mk)

15. The table below gives the solubilities of substances J, K and L at different temperatures

Substance	Solubility in grammes per 100 g water at			
	0^0C	20^0C	40^0C	60^0C
J	0.334	0.16	0.097	0.0058
K	27.60	34.0	40.0	45.5
L	35.70	36.0	40.0	37.3

Select the substance which, when dissolved in water, heat is given out. Give a reason
.(2mks)

16. Starting with copper metal, describe how a sample of crystals of copper (II) chloride may be prepared in the laboratory. (3mks)

17. A compound whose general formula is M $(OH)_3$ reacts as shown by the equation below.
M $(OH)_{3(s)}$ + $OH_{(aq)}$ $\longrightarrow$ M $(OH)_{4(aq)}$

M $(OH)_{3(s)}$ + $3H^+_{(aq)}$ $\longrightarrow$ $M^{3+}_{(aq)}$ + $3H_2O_{(i)}$

(a) What name is given to compounds which behave like M $(OH)_3$ in the two Reactions (1 mk)
(b) Name two elements whose hydroxides behave like that of M (2 mks)

18. The grid below is part of the periodic table. Use it to answer the questions that follow, (the letters are not the actual symbols of the elements).

a) Indicate on the grid the position of an element represented by letter V whose atomic number is 14. (1mk)
b) Select a letter which reaction between Q and T. (1mk)

19. Select a letter which represents a mono atomic gas. (1mk)

$Zn^{1+}(aq)$ + $2e^-$ $\longrightarrow$ $Zn_{(s)}$ -0.76
$Pb^{2+}(aq)$ +2e- $Pb(s)$ -0.13
$Ag^+ (aq)$ +e^- $Ag_{(s)}$ +0.80
$Cu^{2+}(aq)$ + $2e^-$ $Cu_{(s)}$ +0.30
a) Write the cell representation for the electrochemical cell that would give the highest E (1mk)

b) State and explain the observations made when a copper rod is placed in a beaker containing silver nitrate solution. (2mks)

20. a) State the Graham's law diffusion. (1mk)

b) The molar masses of gases W and X are 16.0 and 44.0 respectively. If the rate of diffusion of W through a porous material is 12cm3s-1 calculate the rate of diffusion of X through the same material. (2mks)

21. The diagram below represents an experiment that was set up to investigate movement of ions during electrolysis.
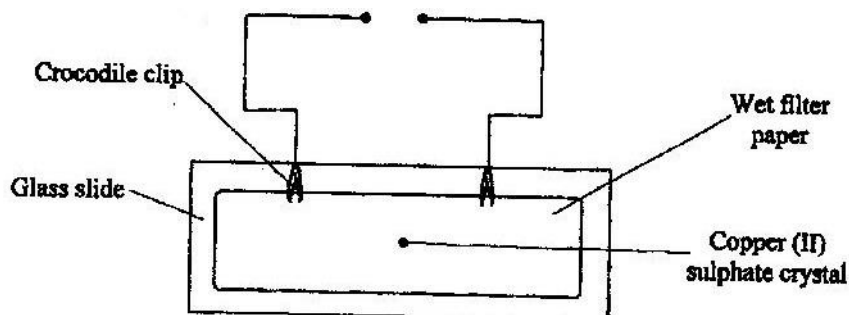
When the circuit was completed, it was noticed that a blue colour spread towards the right.

a) Explain this observation (2mks)

b) Write the equation for the reaction that occurred at the anode. (1mk)

22. The diagram below is part of a set up used in the laboratory preparation of a gas.
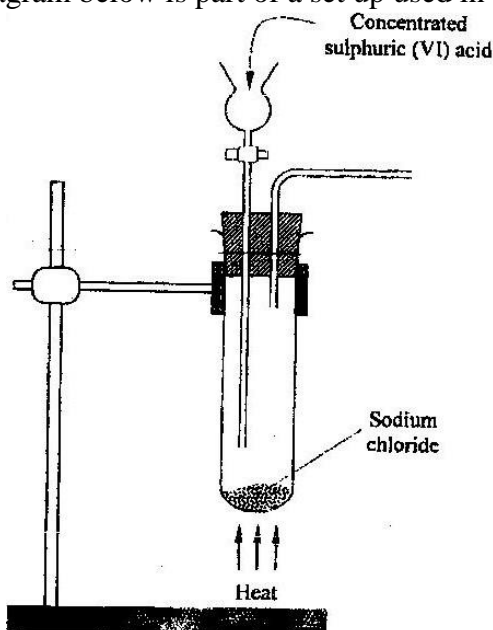
Complete the diagram to show how a dry sample of the gas can be collected.

(3mks)

23. In a closed system, aqueous iron (III) chloride reacts with sulphide gas as shown in the equation below.

$2FeCl_{3(aq)} + H_2S_{(g)}$ $2FeCl_{2(aq)}$ $2HCl_{(aq)} + S_{(s)}$
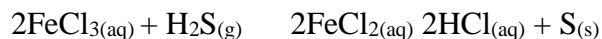
State and explain the observation that would be made if dilute hydrochloric acid is added to the system at equilibrium. (2mks)

24. a) A radioactive substance emits three different particles.
    Give the symbol of the particle with the highest mass. (1mk)

   b) (i) Find the values of Z_1 and Z_2 in the nuclear equation below

$$^{Z_1}_{92}U + ^1_0n \longrightarrow ^{94}_{38}Sr + ^{140}_{Z_0}x_e + 2 ^1_0n$$
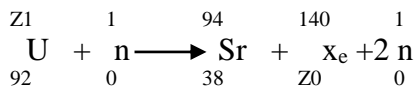
   iii) What type of nuclear reaction is represented in represented in b (i) above? (1mk)

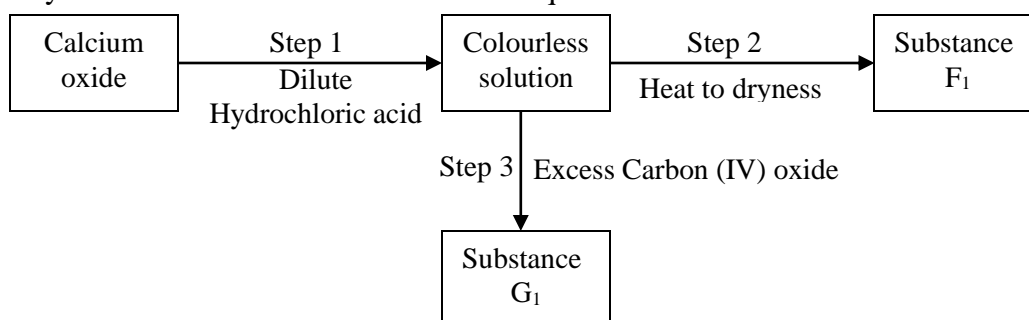Temperature (^0C)

Time (minutes)
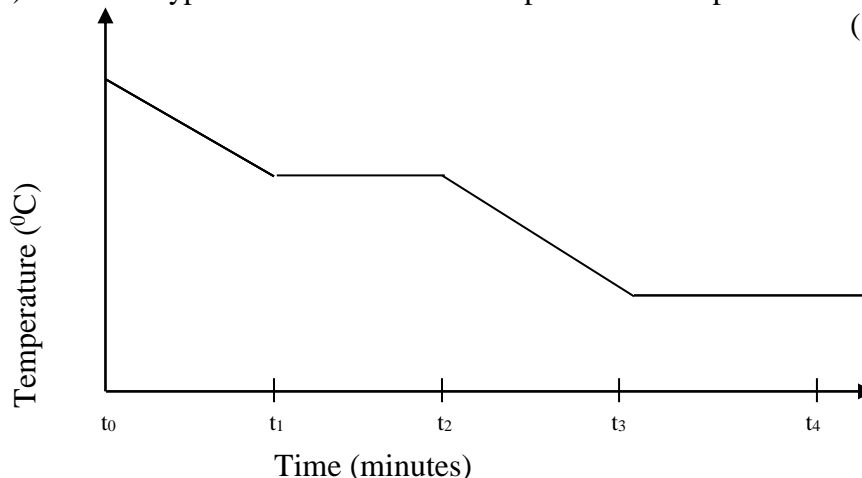
Give the name of the:
   a) Process taking place between t_0 and t_1. (1mk)
   b) Energy change that occurs between t_3 and t_4

26. When solid B_1 was heated, a gas which formed a white precipitate when passed through lime water was produced. The residue was dissolved in dilute nitric (V) acid to form a colourless solution B_2. when dilute hydrochloric acid was added to solution B_2 a white precipitate which dissolved on warning was formed.
    a) Write the formula of the;
       I   Cation in solid B_1 (1mk)
       II   anion in solid B_1 (1mk)
    b) Write an ionic equation for the reaction between the resdue and dilute nitric (V) acid. (1mk)

27. In an experiment to determine the percentage of magnesium hydroxide in an anti-acid, a solution containing 0.50 g of the anti-acid was neutralized by 23.0 cm^3 of 0.010m hydrochloric acid (Relative formula mass of magnesium hydroxide =58)
    a) Mass of magnesium hydroxide in the anti-acid; (2mks)
    b) Percentage of magnesium hydroxide in the anti-acid (1mk)

28. During the extraction of aluminium from its ores; the ore is first purified to obtain alumina.

Molten Alumina

Alumina → Step 1 C_1 Heat → Liquid Alumina → Step 2 Process D_1
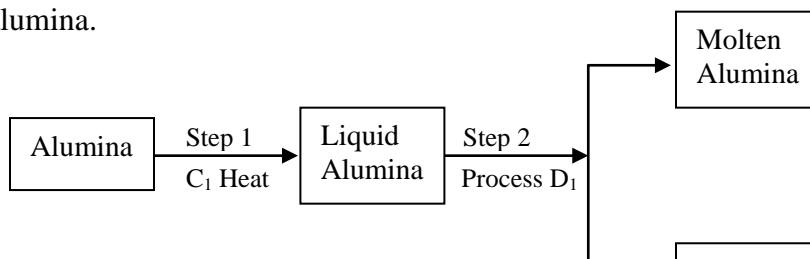
a) Name
   (i)   Substance C_1 (1mk)

   …………………………………………………………………………..
   (ii)   Process D_1 (1mk)

   ……………………………………………………………………………
b) Give two reasons why aluminium is used extensively in the making of cooking
   pans.   (1mk)

29.   A certain mass of a metal E_1 reacted with excess dilute hydrochloric acid at 25^oC. The
      volume of hydrogen gas liberated was measured after every 30 seconds. The results were
      presented as shown in the graph below.
      a)   Name one piece of apparatus that may have been used to measure the volume of
            gas liberated.   (1mk)

      b)   (i)   On the same axis, sketch the curve that would be obtained if the
                   experiment was repeated at 35^0C.   (1mk)

            (ii)   Explain the shape of your curve in b(i) above.   (1mk)

30.   Crude oil contains sulphur. What would be the effect to the environment of using fuel
      containing sulphur?   (1mk)

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

| Calcium oxide | → Step 1 Dilute Hydrochloric acid → | Colourless solution | → Step 2 Heat to dryness → | Substance F_1 |

Step 3 | Excess Carbon (IV) oxide

Substance G_1

      a)   Give the name of the process that takes place in step 1.   (1mk)
      b)   Give;
            (i)   The name of substance G_1
            (ii)   One use of substance F_1

CHEMISTRY PAPER 2 THEORY
OCT /NOV. 2008
233/2
2 HOURS

1. a)   Biogas is a mixture of mainly carbon (IV) oxide and methane.
         (i)   Give a reason why biogas can be used as a fuel.   (1mk)
         (ii)   Other than fractional distillation, describe a method that can be
                used to determine the percentage of methane in biogas.   (3mks)

    b)   A sample of biogas contains 35.2% by mass of methane. A biogas cylinder
         contains 5.0 kg of the gas.
         Calculate the;
    (i)   Number of moles of methane in the cylinder. (Molar mass of methane=16)
                                                                        (2mks)
    (ii) Total volume of carbon (IV) oxide produced by the combustion of methane in the
          cylinder (Molar gas Volume=24.0 dm^{-3+} at room temperature and pressure).
                                            (2mks)

    c)   Carbon (Iv) oxide, methane, nitrogen (I) oxide and trichlorofluoromethane are
         green-house gases.
         (i)   State one effect of an increased level of these gases to the environment.
                                            (1mk)
         (ii)   Give one source from which each of the following gases is released to the
   environment;
                I   Nitrogen (i) oxide   (I mk)
                II   Trichlorofluoromethane.   (1mk)

2   a)   Write an equation to show the effect of heat on the nitrate of:
         (i)   Potassium   (1mk)
    b)   The table below gives information about elements $A_1 A_2 A_3$, and A_4

Element	Atomic Number	Atomic Radius (nm)	Ionic radius (nm)
A_1	3	0.134	0.074
A_2	5	0.090	0.012
A_3	13	0.143	0.050
A_4	17	0.099	0.181

    (i)   In which period of the periodic table is element A_2? Give a reason
                                                                        (2 mks)
    (ii) Explain why the atomic radius of:
          I A_1 is greater than that of A_2;
          II A_4 is smaller than its ionic radius   (2 mks)
    (iii) Select the element which s in the same group as A_3 (1 mk)
    (iv) Using dots (.) and crosses(x) to represent outermost electrons. Draw a
          diagram to show the bonding in the compound formed when A_1 reacts with A_4
                                            (1 mk)

3.   (a) Describe the process by which Nitrogen is obtained from air on a large scale.
                                                                    (4 mks)
       (b) Study the flow chart below and answer the questions that follow.
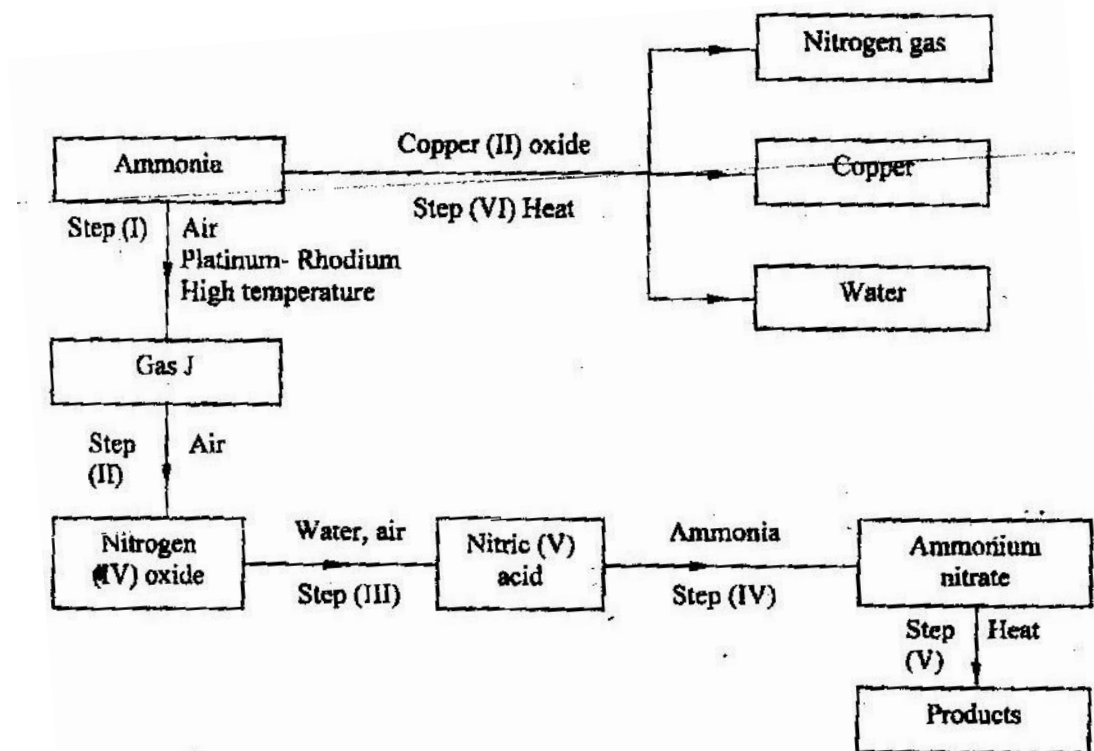
(i)   Identify gas J.   (1 mk)
(ii)   Using oxidation numbers, show that ammonia is the reducing agent in step (VI)
                                                                    (2mks)
(iii)   Write the equation for the reaction that occurs in step (V).   (1mk)
(iv)   Give one use of ammonium nitrate.   (1mk)

c)   The table below shows the observations made when aqueous ammonia was added
        to cations of elements F_2F and G until in excess.

Cation of	Addition of a few drops o Aqueous ammonia.	Addition of excess aqueo ammonia.
E	White precipitate	Insoluble
F	No precipitate	No precipitate
G	White precipitate	Dissolves

(i)   Select the cation that is likely to be Zn^{2+} (1mk)
(ii)   Given that the formula of the cation of element E is E^{2+}, write the ionic equation
        for the reaction between $E^{2+}_{(aq)}$ and aqueous ammonia.   (1mk)

4a) (i) State the Le chatelier's principle. (1mk)

(ii) Carbon (II) oxide gas reacts with steam according to the equation;
$CO_{(g)} + H_2O_{(g)}$ $H_{2(g)} + CO+2_{(g)}$
What would be the effect of increasing the pressure of the system at equilibrium?
Explain. (2mks)

b) The table below gives the volumes of oxygen gas produced at different times when hydrogen peroxide decomposed in the presence of a catalyst.

Time(Sec)	0	10	20	30	40	50	60
Volume of oxygen (cm^3)	0	66	98	110	119	120	120

(i) Name the catalyst used for this reaction (1mk)
(ii) On the grid provided, draw the graph of volume of oxygen gas produced (vertical axis) against time. (3mks)
(iii) Using the graph, determine the rate of decomposition of hydrogen peroxide after 24 seconds. (2mks)
(iv) Give a reason why the total volume of oxygen gas produced after 50 seconds remains constant. (1mk)

5. (a) Alkanes, alkenes and alkynes can be obtained from crude oil. Draw the structure of the second member of the alkyne homologous series. (1mk)

(b) Study the flow chart below and answer the questions that follow
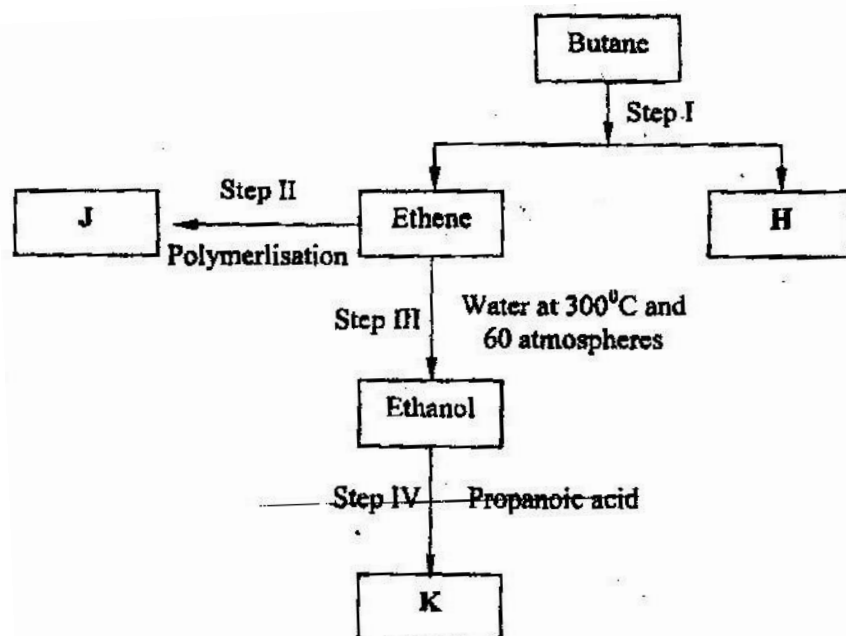
(i) State the conditions for the reaction in step 1 to occur (1 mk)
(ii) Identify substance II (1 mk)
(iii) Give:
I. One advantage of the continued use of substance such as J (1 mk)

II The name of the process that takes place in step III (1 mk)
III The name and the formula of substance K (2mks)

Name:…………………………………

Formula:…………………………………
(iv) The relative molecular mass of J is 16,800. Calculate the number of monomers that make up J.

(c) The table below give the formula of four compounds L,M,N and P

Compound	Formula
L	C_2H_6O
M	C_3H_6
N	$C_3H_6O_2$
P	C_3H_8

Giving a reason in each case, select the letter which represents a compound that:
(i) Decolorizes bromine in the absence of UV light (2 mks)
(ii) Gives effervescence when reacted with aqueous sodium carbonate (2 mks)

6. The diagram below represents a set up that can be used to electrolyze aqueous copper (II) sulphate.
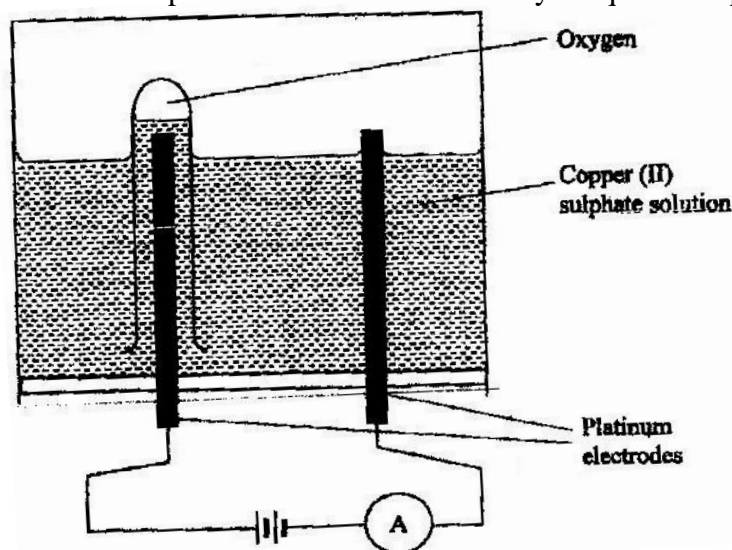
(a) (i) Describe how oxygen gas is produced during the electrolysis (2 mks)
(ii) Explain why copper electrodes are not suitable for this electrolysis (2 mks)

(b) Impure copper is purified by an electrolytic process
(i) Name one ore from which copper is obtained (1 mk)
(ii) Write the equation for the reaction that occur at the cathode during the purification of copper (1 mk)
(iii) In an experiment to electroplate a copper spoon with silver, a current of 0.5 A was passed for 18 minutes. Calculate the amount of silver deposited on the spoon ($\pi =$ 96500 coulombs, Ag = 108) (3mks)

(iv)   Give two reasons why some metals are electroplated   (2mks)

7.   (a)   Define the standard enthalpy of formation of a substance   (1 mk)
       (b)   Use the thermo chemical equations below to answer the questions that
               follow.

   1. $C_2H_6(g) + \frac{7}{2} O_2(g) \rightarrow 2Co_2(g) + 3H_2o$ (i); $\Delta H_1 - 1560$kjmol^{-1}

   2. $C_{(graphite)} + O_2 (g) \rightarrow Co_2(g)$; $\Delta H_2 = -394$kJmol^{-1}

   3. $H_2(g) + \frac{1}{2} O_2 (g) \rightarrow H_2o(g)$ $\Delta H_3 = -286$kJmol^{-1}

       (i)   Name two types of heat changes represented by ΔH_3 (2 mks)
       (ii)   Draw an energy level diagram for the reaction represented by equation 1
       (iii)   Calculate the standard enthalpy of formation of ethane   (2 mks)
       (iv)   When a sample of ethane was burnt, the heat produced raised the temperature of
               500g of water by 21. 5 K, (specific heat capacity of water = 4.2Jg^{-1}K).
               Calculate the:
               I.   Heat change for the reaction   (2 mks)
               II.   Mass of ethane was burnt. (relative formula mass of ethane= 30)
                                                                               (2 mks)

CHEMISTRY 2009

PAPER 1

1.   The ionization energies for three elements A. B and C are shown in the table

below:

Element	A	B	C
Ionisation energy (kJ/mole)	519	418	494

a)   what is meant by ionization energy?   (1 mk)

b)   which element is the strongest reducing agent? Give a reason.   (2 mks)

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

a)   write an equation to show how boiling removes hardness of water. (1 mk)

b)   name two chemicals that are used to remove hardness of water.   (2 mks)

3.   The atomic number of sulphur is 16.

Write the electron arrangement of sulphur in the following: (2

mks)

a) H_2s;

b) SO^2_3

4.   An experiment was set up as shown in the diagram below:
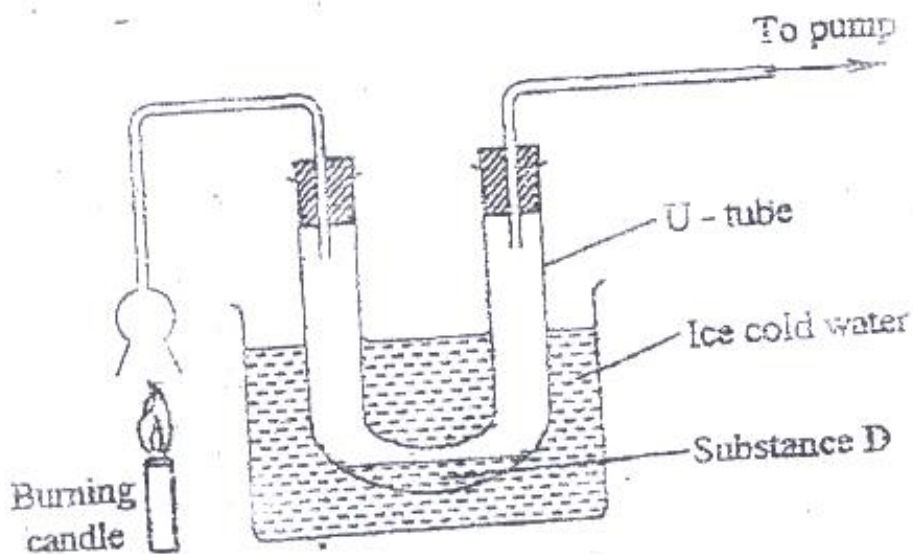
a)

Identify substance D.   (1 mk)

b)   Describe how the other product of the burning candle could be prevented

from getting into the environment.   (2

mks)

5.   In terms of structure and bonding, explain why the melting point of oxygen is

much

lower than that of sodium.   (3 mks)

6.   An isotope of element E has 34 neutrons and its mass number is 64. E forms a

cation with 28 electrons. Write the formula of the cation with 28 electrons. Write

the formula of the cation indicating the mass and atomic numbers.

(1mk)

7.   When aluminium oxide was electrolysed, 1800kg of aluminium metal were

obtained.

a) Write equation for the formation of aluminium metal   (1 mk)

b) Calculate the quantity of electricity in faradays used (Al=27)   (2 mks)

8.   Using dots (.) and crosses (x) , show bonding in:

a)   The compound formed when nitrogen reacts with fluorine

(Atomic numbers F=9, N=7);   (1mk)

b)   Sodium oxide.

(Atomic numbers Na= 11, 0 = 8)   (1 mk)

9.   a)   what is meant by molar heat of solution?   (1 mk)

b)   the lattice energy of sodium bromide and hydration energies of sodium

and bromide ions are: 733,406 and 335 kJmol $^{-1}$ respectively.

i)   Complete the energy cycle diagram below by inserting the values of

∇H_1, ∇H_2, and ∇H_3 (1 ½

mks)
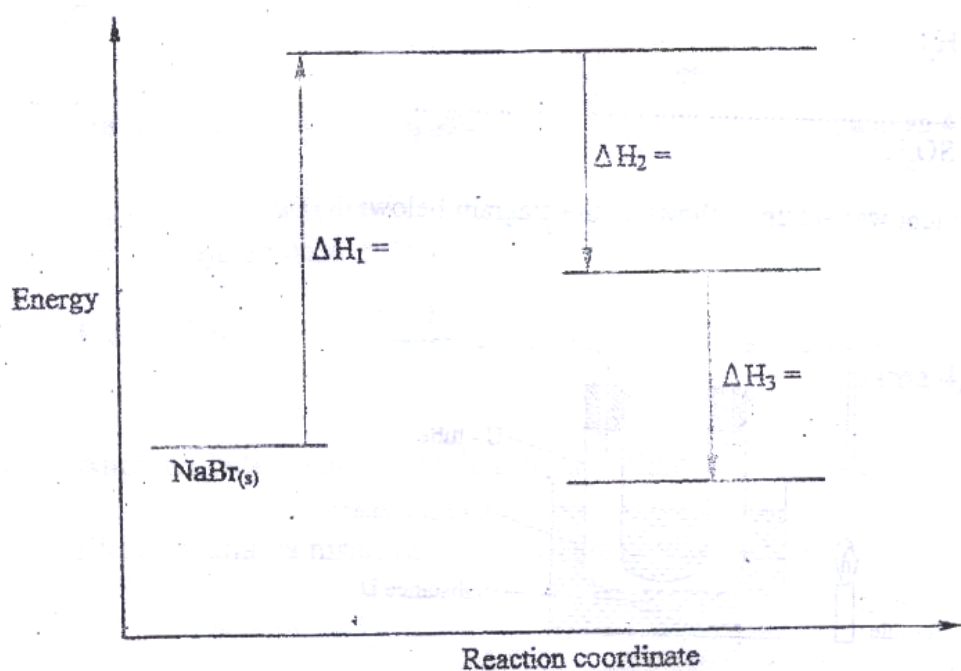
ii)   Determine the molar heat of solution of solid sodium bromide.   (½ mk)

10. Hydrogen and oxygen can be obtained by electrolysis of acidified water.

    Using equations for the reactions at the electrodes, explain why the volume of

    hydrogen obtained is twice that of oxygen. (2mks)

11. Starting with 50 cm^3 of 2.8M sodium hydroxide, describe how a sample of pure

    sodium sulphate crystals can be prepared. (3

    mks)

12. The standard reduction potentials of two half –cells are:

    $Ag^+_{(aq)}$ + e $AG_{(s)}$;   E = 0.80V

    $2H_2O_{(l)}$ + 2e $H_{2(g)}$ + $2OH_{(aq)}$; E^1 = 0.83V
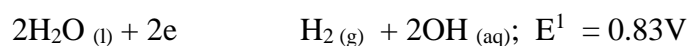
    Draw a labelled diagram of an electro chemical cell that can be constructed using

    the two half –cells (3

    mks)

13. When 8.53 of sodium nitrate were heated in an open test-tube the mass of oxygen gas produced was 0.83 g . Given the equation of the reaction as

$$2NaNO_{3(s)} \quad 2NaNO_{2(s)} + O_{2(g)}$$
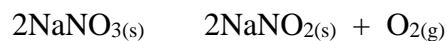
Calculate the percentage of sodium nitrate that was converted to sodium nitrite (Na = 23.0 N = 14.0 O = 16.0) (3 mks)

14. a) Draw and name the structure of the compound formed when one mole of ethyne reacts with one mole of hydrogen bromide. (2mks)

b) Draw the structures of the alkynes whose molecular formula is C_4H_6 (1 mk)

15.   a student used the set up shown in the diagram below in order to study the

reactions of some metals with steam. The experiment was carried out for ten

minutes
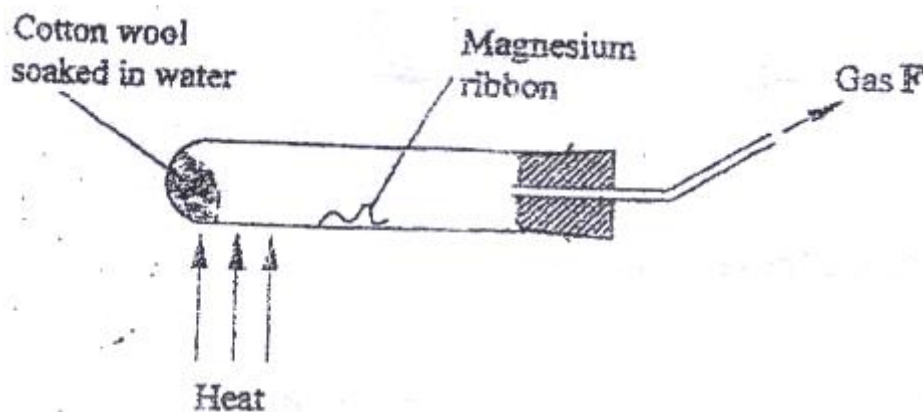
a)   What observation would be made if gas F is ignited?   (1 mk)

b)   When the experiment was repeated using iron powder instead of

magnesium

ribbon very little gas F was obtained.

i)   Give a reason for this observation   (1 mk)

ii)   What change in the conditions of the experiment should the student

have made in order to increase the volume of gas F Produced?

(1mk)

16. The solubility curve of potassium nitrate is shown below.

    a) Determine the solubility of potassium nitrate at 50^0C (1 mk)

    b) Determine the molar concentration of saturated potassium nitrate at 50^0C

    (K=39.0 0= 16.0 N= 14.0 and density of water 1 $g/cm^{3)}$ (2 mks)
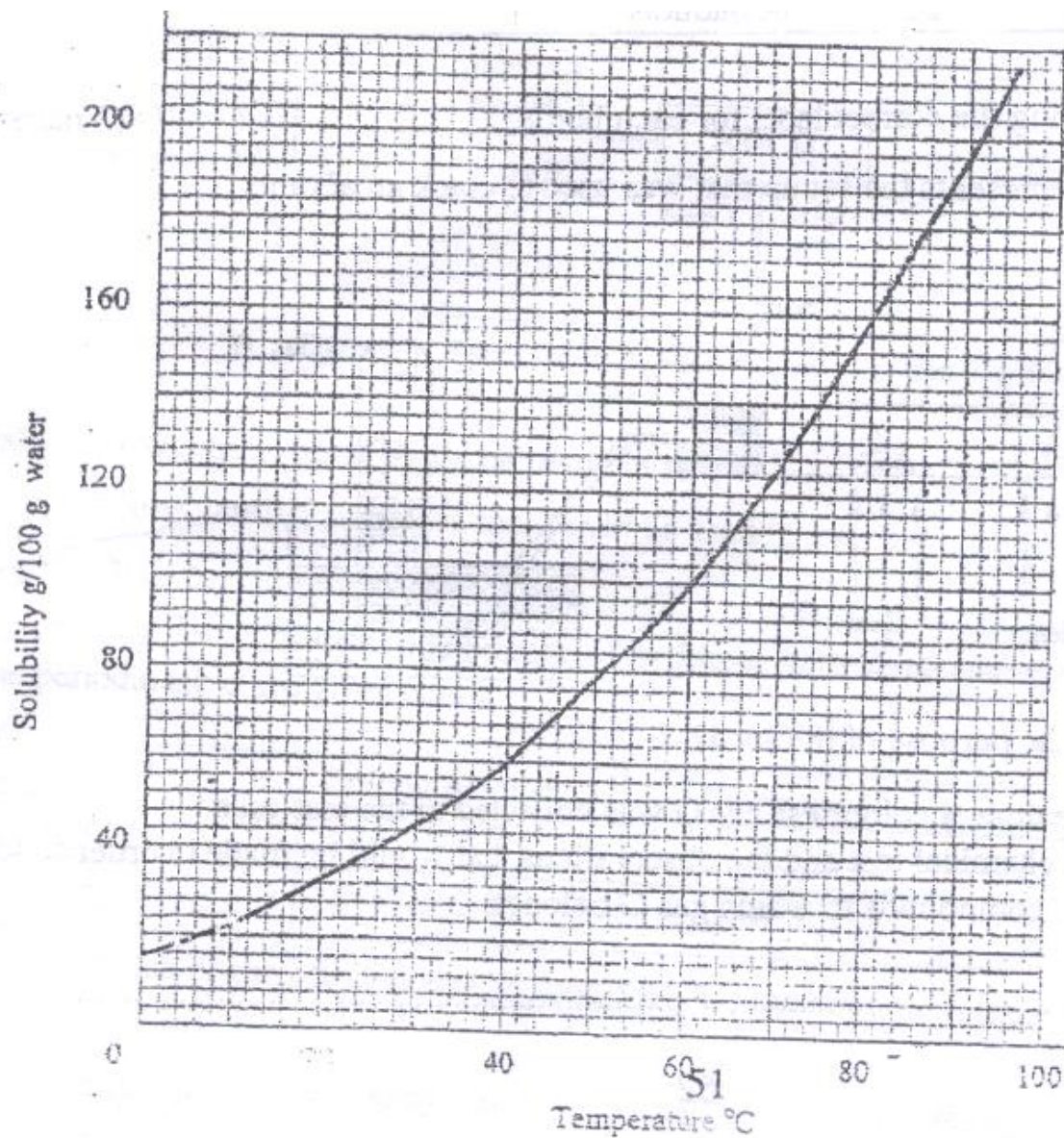
17. The structure of methanoic acid is
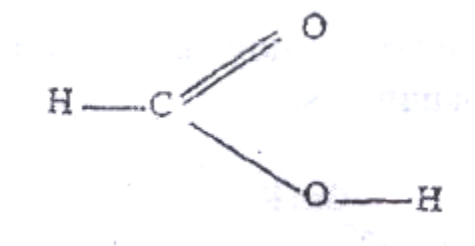
What is the total number of electrons used for bonding in a molecule of methanoic acid? Give reasons. (2 mks)

18. Bottles of sodium carbonate, sodium chloride and sugar have lost their labels.

A student prepares and tests an aqueous solution of a sample from each bottle.

The results obtained are as shown in the table below.

Bottle	PH	Electrical Conductivity	Correct label
1	7	Conducts	
2	7	Does not conduct	
3	10	conducts	

Complete the table by filling the correct label for each bottle. (3 mks)

19) The figure below represents the set up that was used to crack an alkane.
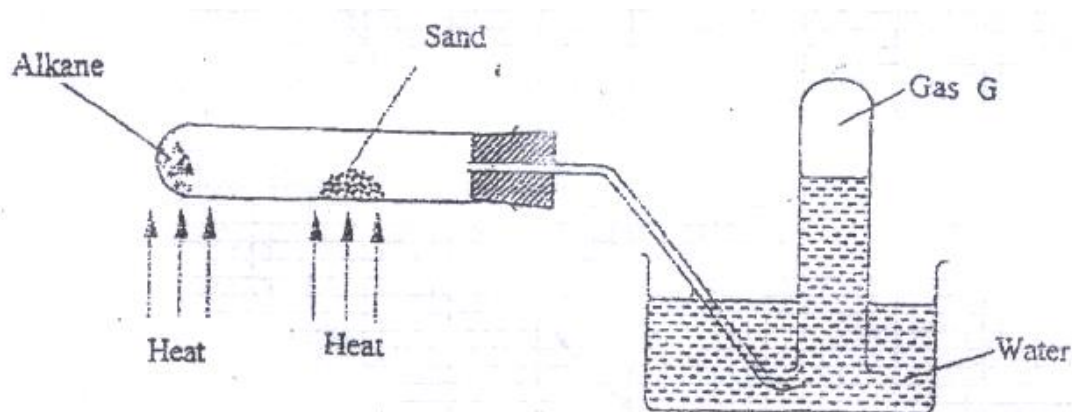
a) What was the purpose of the sand? (1 mk)

b) After some time, a colourless gas G collected in the test-tube.

Describe a chemical test and the observations that would be made in

ordered to identify the class of compounds to which gas G belongs.

(2 mks)

20. Classify the following processes as either chemical or physical. (3

mks)

Process	Type of change
a) Heating copper (II) sulphate crystals	
b) Obtaining kerosene from crude oil	
c) Souring of milk	

21.   Give the name of the product formed when magnesium reacts with phosphorus.

(1

mk)

22.   a student added very dilute sulphuric (VI) acid to four substances and recorded
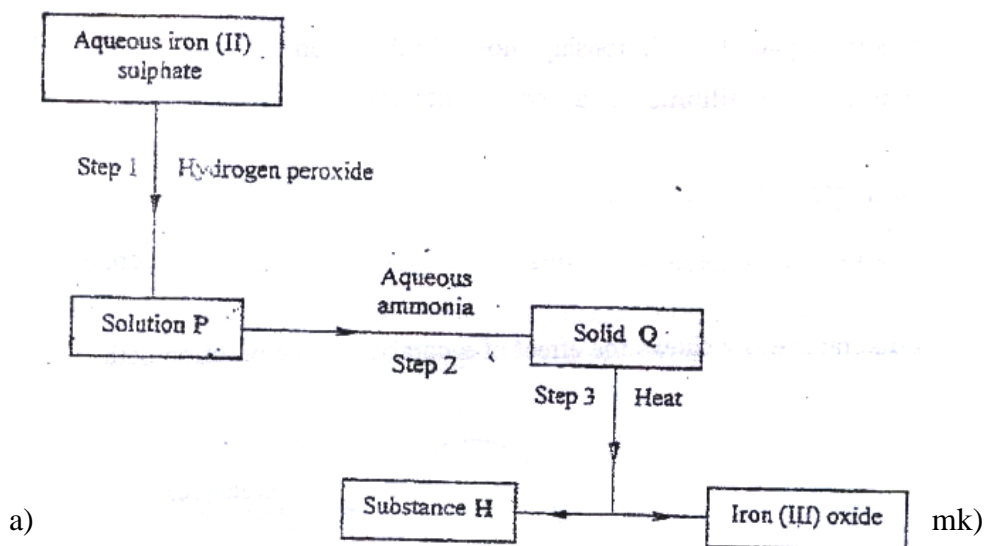
the observations shown in the table below.

Test	Substance	Gas given off
1	Sodium	Yes
2	Iron	No
3	Carbon	Yes
4	Copper	No

For which tests are the observations wrong? Explain   (3 mks)

23.   Use the flow chart below to answer the questions that follow.

a)

b)   Name another substance that could be used in step 2.   (1 mk)

c)   Give the name of substance H.   (1 mk)

24.   The boiling points of some compounds of hydrogen with some elements in groups 4

        and 6 of the periodic table are given below.

Compound	Boiling point (^0C)	Compound	Boiling point(^0C)
CH_4	-1640	H_2O	100.0
SIH_4	-112.0	H_2S	-61.0

a)   Which of the compounds CH_4 and SIH_4 has stronger intermolecular

forces?   (1 mk)

b)   Explain why the boiling points of H_2O and H_2S show different trends from

that of CH_4 and SIH_4 (2mks)

25.   For each of the following reactions, state the observation and write the formula of

the

Compound responsible for the observation:

a)   Bromine water is added to aqueous potassium iodide;   (1 ½ mks)

b)   Excess aqueous ammonia is added to copper (II) hydroxide (precipitate).

(1 ½ mks)

26. The graph below shows the relationship between pressure and the temperature of a

gas in a fixed volume container.

Pressure

(Pa)
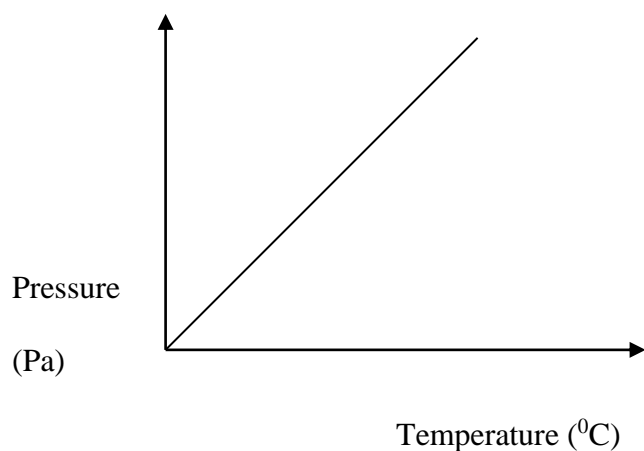
Temperature (^{0}C)

a) State the relationship between pressure and temperature that can be deduced

from the graph. (1 mk)

b) Using kinetic theory, explain the relationship shown in the graph. (2 mks)

27. The following reaction is in equilibrium in a closed container

$C_{(s)}$ + $H_2O_{(g)}$ ⇌ $CO_{(g)}$ + $H_{2(g)}$
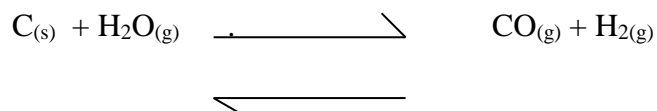
State giving reasons how an increase in pressure would affect the amount of hydrogen. (2 mks)

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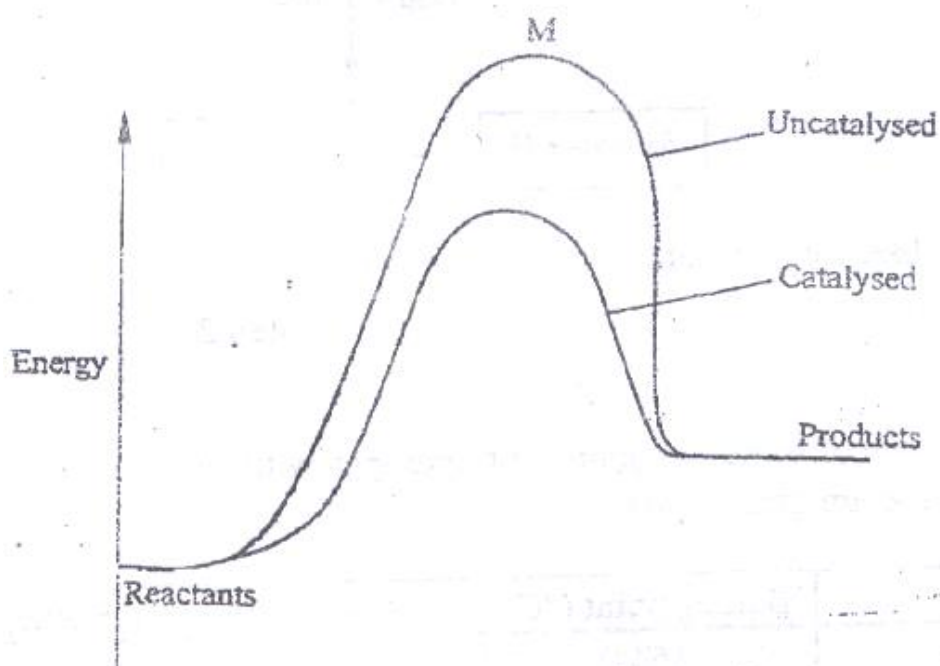

a) What does point M represent? (1 mk)

CHEMISTRY

PAPER 2

1. a) Two reagents that can be used to prepare chlorine gas are manganese (IV)

   oxide and concentrated hydrochloric acid.

   i) Write an equation for the reaction. (1 mk)

   ii) Give the formula of another reagent that can be reacted with

   concentrated hydrochloric acid to produce chlorine gas.

   (1 mk)

   iii) Describe how the chlorine gas could be dried in the laboratory (2mks)

   b) In an experiment, dry chlorine gas was reacted with aluminium as shown

in

   figure 1.
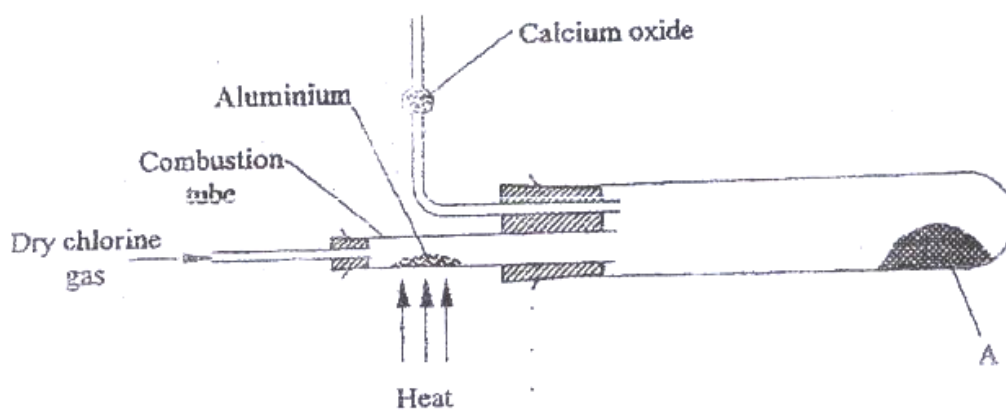
   i) Name substance A. (1 mk)

      ii)   Write an equation for the reaction that took place in the

              combustion tube.

                    (1mk)

      iii)   0.84 g of aluminium reacted completely with chlorine gas.

              Calculate the volume of chlorine gas used (Molar gas volume is

              $24dm^3$, al = 27).

                                      (3

              mks)

      iv) Give two reasons why calcium oxide is used in the set up.   (2

              mks)

2   a)   Draw the structures of the following compounds: (2

mks)

      i)   2- methylbut -2 ene;

      ii)   heptanoic acid

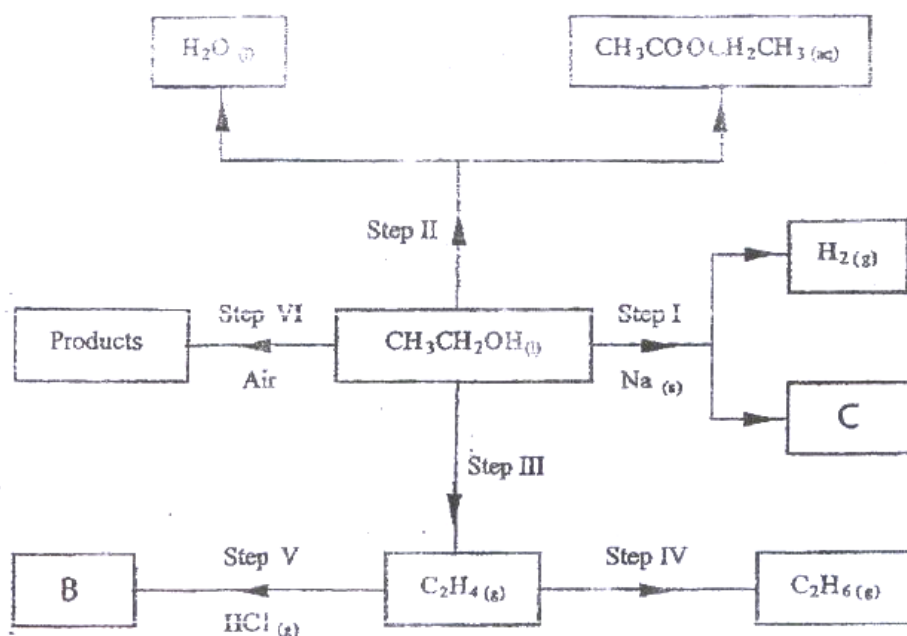   b)   Describe a physical test that can be used to distinguish between methanol

              and hexanol.   (2

              mks)

      c)   Use the flow chart below to answer the questions that follow.

i) Name:

    (I)   the type of reaction that occurs in step II;   (1 mk)
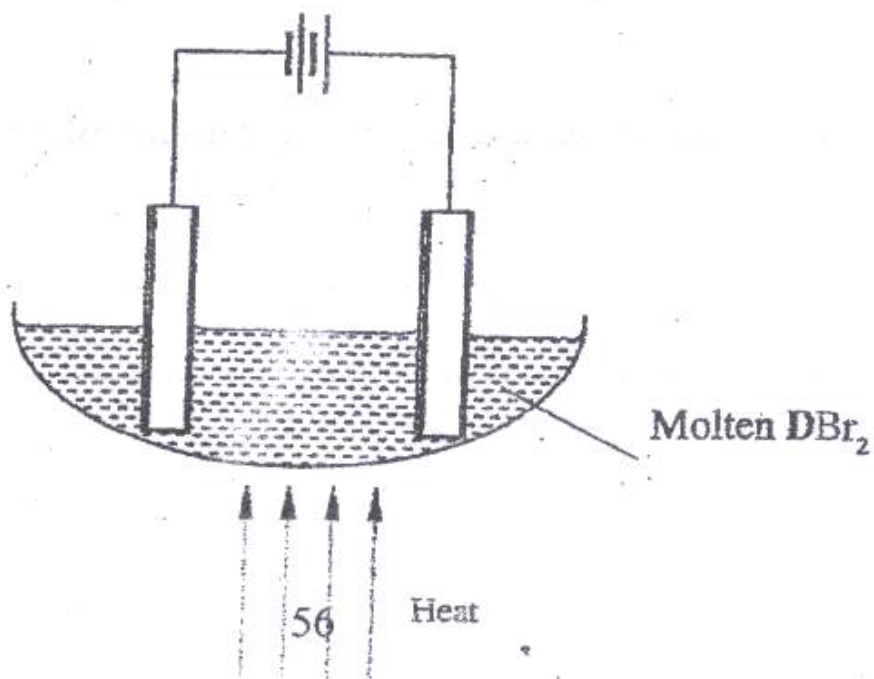
    (II)   Substance B.   (1 mk)

ii)   Give the formula of substance C.   (1 mk)

iii)   Give the reagent and the conditions necessary for the reaction in

step (IV)

    (3mks)

3   The set-up below (figure 2) was used to electrolyse a bromide of metal D DBr_2.

Molten DBr$_2$

56   Heat

i)   Write equation for the reactions at the

        I   cathode   (1 mk)

   II   anode   (1mk)

ii)   The electrodes used in the experiment were made of carbon   and metal D.

        which of the two electrodes was used as the anode? Give a reason.   (2

mks)

iii)   Give a reason why this experiment is carried out in a fume cupboard.
(1 mk)

iv) When a current of 0.4 A was passed for 90 minutes, 2.3 1 g of metal D were

deposited.

I   Describe how the amount of metal D deposited was determines.

(3 mks)

II   Calculate the relative atomic mass of metal D. (I Faraday = 96500

coulombs)   (3

mks)

4.   a)   the schematic diagram shows part of the Solvay process used for the

manufacture of sodium carbonate.
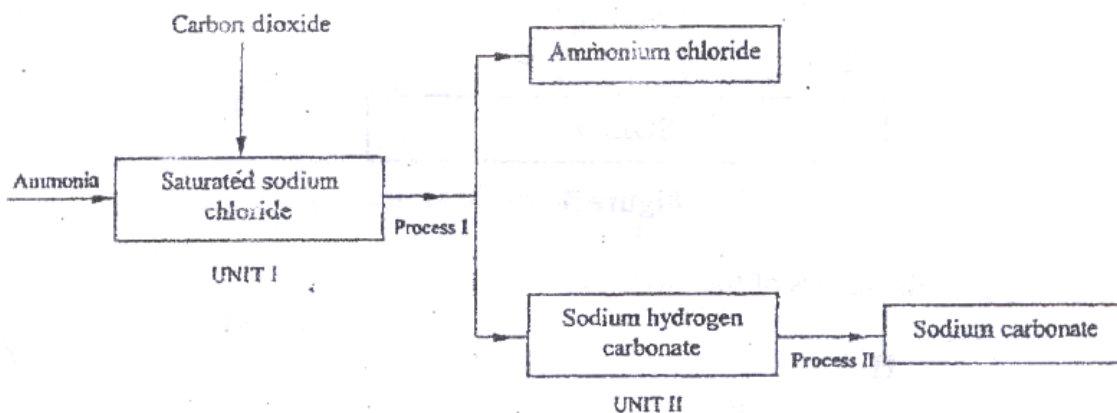
i)   Explain how the sodium chloride required for this process is obtained

from sea water.   (2 mks)

ii)   Two main reactions take place in UNIT I . The first one is the

formation of ammonium hydrogen carbonate.

I.   Write an equation for this reaction   (1 mk)

II.   Write an equation for the second reaction   (1 mk)

iii)   State how the following are carried out: (2 mks)

I   Process I

II)   Process II

iv)In an experiment to determine the percentage purity of the sample of

sodium carbonate produced in the Solvay process, 2.15 g of the

sample reacted completely with $40.0cm^3$ of 0.5 M sulphuric acid.

I calculate the number of moles of sodium carbonate that

reacted.   (2 mks)

II Determine the percentage of socium carbonate in the

sample.

(Na= 23.0, C= 12.0, O = 16.0) (2 mks)

b) Name two industrial uses of sodium carbonate (2 mks)

have been identified and others labelled.

Figure 3
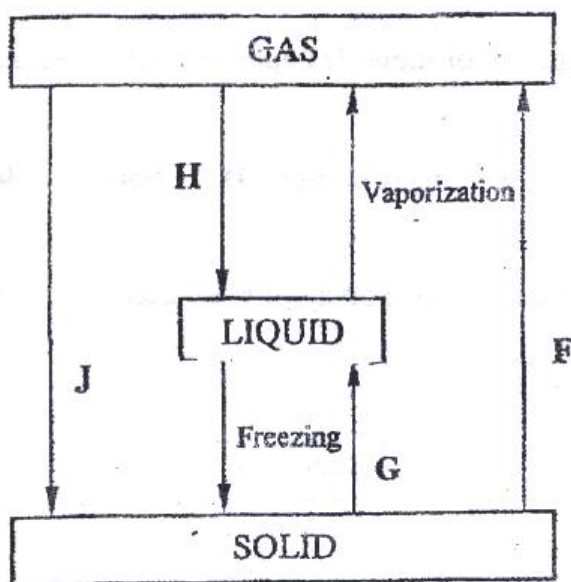
i) Give the

names of the processes

I H   (1 mk)

II   G   (1 mk)
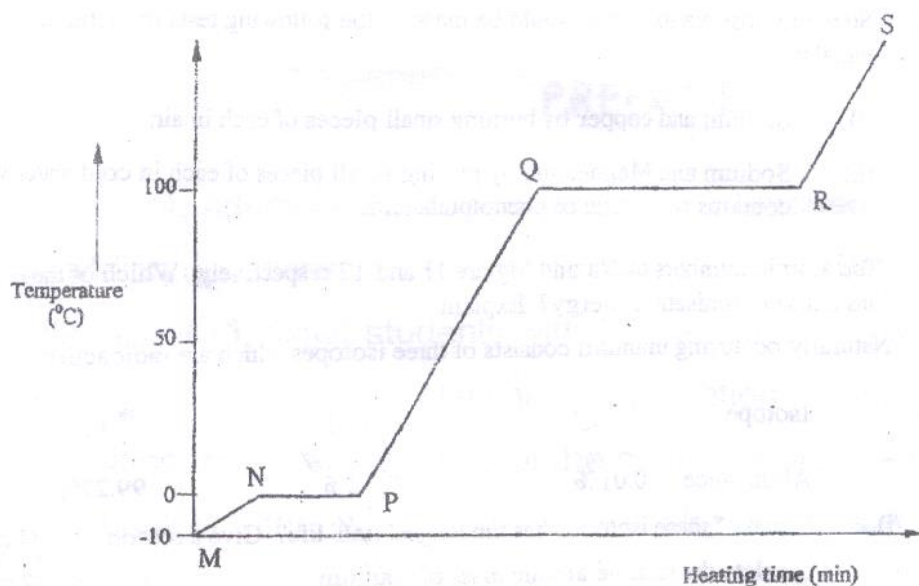
ii)   Name one substance that can undergo process F when left in an

open

container in the laboratory.   (1 mk)

iii)   The process J is called deposition. Using water as an example,

write

an equation that represents the process of deposition.   (1 mk)

b)   Figure 4 shows the beating curve for water.

i)   Give the names of the intermolecular forces of attraction in the

segments;

I   MN   (1mk)

II   RS   (1 mk)

ii)   The heats of fusion and vaporization of water are 334.4 Jg^{-1} and

1159.4 Jg^{-1} respectively.

I   Explain why there is a big difference between the

two.(2mks)

II   How is the difference reflected in the curve?   (1 mk)

c)   Coal, oil and natural gas are major sources of energy. They are known as

fossil fuels. Hydrogen is also a source of energy.

i)   State and explain two reasons why hydrogen is a very attractive

fuel compared to fossils.   (3 mks)

ii)   State one disadvantage of using hydrogen fuel instead of fossil

fuels.

6.   a)   Study the table below and complete it. (W^{-1} and X^{4+} are not the actual

symbols of the ions).   (2

mks)

Iron	Number of protons	Number of neutrons	Mass Number	Electron arrangement
W	……………..	20	…………….	2.8.8
X^{4+}	14	……………	28	…………..

b) State the observation that would be made in the following tests to

distinguish between:

i) Sodium and copper burning pieces of each in air.   (2 mks)

ii) Sodium and Magnesium by placing small pieces of each in

cold

water which contains two drops of phenolphalein.   (2mks)

c) The atomic numbers of Na and Mg are 11 and 12 respectively.

Which

of the elements has a higher ionization energy? Explain.   (2mks)

d) Naturally occurring uranium consists of three isotopes which are

radioactive.

Isotope   234   235   238

                     U   U   U

Abundance   0.01%   0.72%   99.27%

        i)   Which of these isotopes has the longest half-life? Give a reason

                                                  (1 mk)

        ii)   Calculate the relative atomic mass of uranium   (2mks)

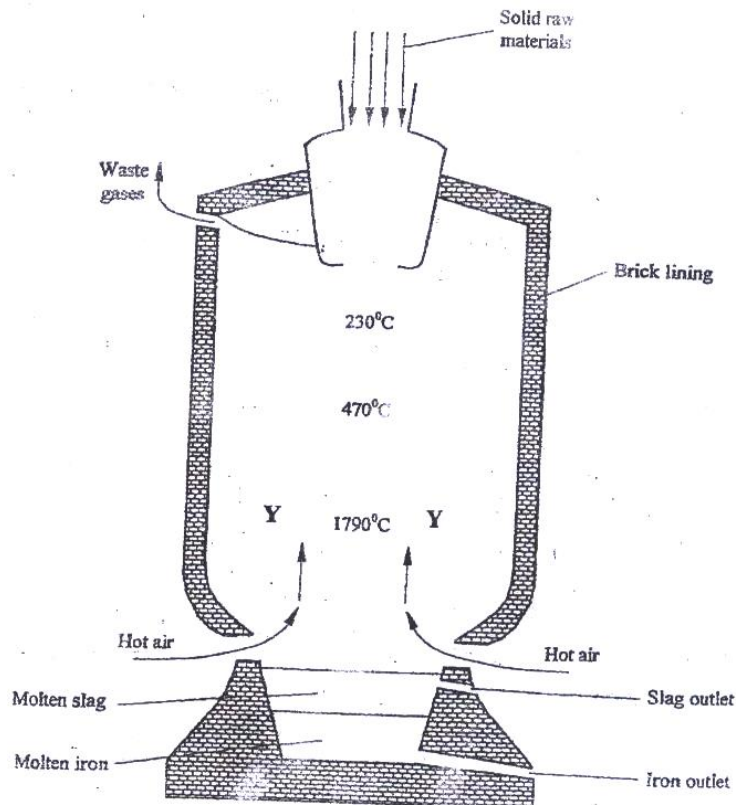   iii) $^{235}_{92}U$ Is alpha emitter. If the product of the decay of this nuclide is thorium (Th) . Write a nuclear equation for the

             process.   (1mk)

7.   Iron is obtained from haematite using a blast furnace shown if figure 5 below.

a) Four raw materials are required for the production of iron. Three of these are

iron oxide, hot air and limestone

Give the name of the fourth raw material (1 mk)

b) Write an equation for the reaction in which carbon (IV) oxide is converted

into carbon (II) oxide. (1mk)

c) Explain why the temperature in the region marked Y is higher than that of the

incoming hot air. (2 mks)

d) State one physical property of molten slag other than density that allows it to

be separated from molten iron as shown in figure 5. (1mk)

e) One of the components of the waste gases is Nitrogen (IV) oxide

describe the adverse effects it has on the environment. (2mks)

f) Iron from the blast furnace contains about 5% carbon

    i) Describe how the carbon content is reduced.   (2mks)

    ii) Why is it necessary to reduce the carbon content?   (1 mk)