Name: ......**MARKING SCHEME**.............................. Index No. ....

School: ....Class.....................Adm. No.....................................

Sign...Date: ....

233/1
CHEMISTRY
PAPER 1
JULY 2018
TIME: 2 HOURS

MOKASA JOINT EVALUATION EXAMINATION

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

INSTRUCTIONS TO THE CANDIDATES:-

- Write you **name** and **index number** in the spaces provided.
- Answer *all* the questions in the spaces provided.
- Mathematical tables and electronic calculators may be used
- All working **MUST** be clearly shown where necessary.

For Examiner's Use Only

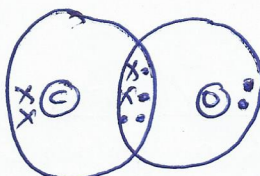| Question	Maximum score	Candidate's score
1-29	80	

This paper consists of 10 printed pages. Candidates should check to ascertain that all pages are printed as indicated and that no questions are missing

1. Draw and label the flame produced when the air-hole of the Bunsen burner is fully closed (2mks)
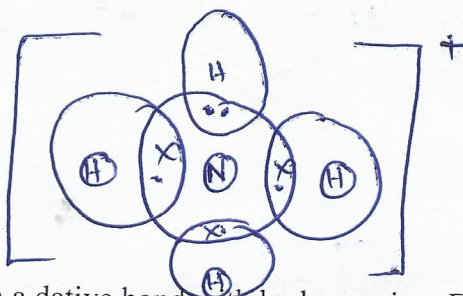

— Thin outer pale blue zone
— Bright yellow zone
— Almost colourless zone
— Blue zone
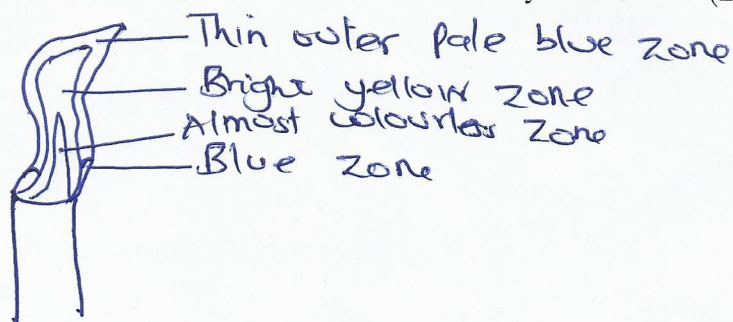
2. a) Using dots(•) and crosses(x), show bonding in:
   i. Carbon (II) oxide (1 mk)

   ii. Ammonia molecule (1 mk)

   b) Ammonia molecule can form a dative bond with hydrogen ion. Explain. (1 mk)

   Ammonia has a lone (unshared) pair of electrons which forms a dative with hydrogen ion

3. a) Explain the trend in the physical state down group VII elements. (2 mks)

   Physical state changes from gas to liquid to solid. This is due to increase in the intermolecular forces of attraction due to increase in mass.

   b) State one use of halogens (1mk)
   — Chlorine is used in making bleaches used in paper pulp etc.
   — Fluorine is used to make PTFE a synthetic fibre.

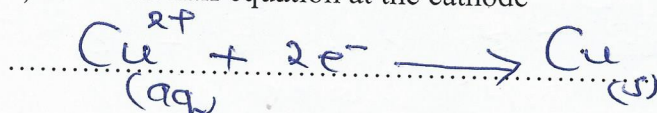4. Copper (II) chloride crystals were subjected to heat until it is molten. Electrolysis was then carried out

   a) State the observations made at the anode (1mk)

   Greenish-yellow fumes are seen.

   b) Write the half equation at the cathode (1mk)

   $$Cu^{2+}_{(aq)} + 2e^- \longrightarrow Cu_{(s)}$$

5. a) State two laboratory rules observed when handling poisonous gases   (2 mks)

    - They should be prepared in a fume chamber or in the open.

    b) Give two examples of poisonous gases mentioned in (a) above.   (1mk)

    Chlorine, Fluorine, Bromine, Iodine, carbon (II) oxide, H_2S, NO_2 SO_2 or SO_3 any 2.

6. Carbon (IV) oxide is a greenhouse gas. It is given a greenhouse factor 1 other gases are given a green house factor that compares their effect with carbon (IV) oxide. The green house effect increases as the factor value increases. The table below gives some information about four different gases.

Gas	Green house factor	% of the gas in the atmosphere
CO_2	1	0.036
CH_4	30	0.0017
N_2O	160	3.0×10^{-4}
CCl_3F	21000	2.8×10^{-8}

    a) State one possible consequences of an increased greenhouse effect.   (1mk)

    Rise in global temperatures | global warming.

    b) Give one source of methane.   (1 mk)

    Distillation of crude oil

    c) Why is an increase in percentage of methane more worrying than the same percentage of increase carbon (iv) oxide.   (1 mk)

    Methane is easily flammable than carbon (IV) oxide.

7. (a) State the Lechatelier's principle.   (1mk)

    "When a change in conditions is applied to a system in equilibrium, the system moves so as to oppose that change".

    (b) The equation for dissolution of bismuth(III) chloride in water is

    $BiCl_{3(aq)}$ + $H_2O_{(l)}$ $\rightleftharpoons$ $BiOCl_{(s)}$ + $2Cl^-_{(aq)}$ + $2H^+_{(aq)}$
    (colourless)   (white)
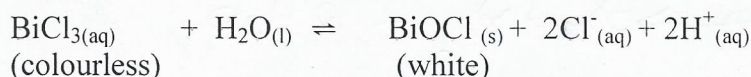
    Explain the effect on the position of equilibrium if sodium hydroxide solution is added to the mixture at equilibrium.   (2mks)

    Addition of NaOH lowers the concentration of H^+ ions. The equilibrium shifts to the right to produce H^+. More white BiOCl is formed

8. (a) State Gay-Lussac's law (1mk)

When gases react, they do so in volumes That bear a sim ratio to one another and to the products if gaseous, temp. and pressure remaining constant

(b) Under certain conditions, methane reacts with steam to form carbon (II) oxide and hydrogen only. Calculate the total volume of the gas that can be formed when 100cm³ of steam reacts completely with methane. (2mks)

$$CH_{4(g)} + H_2O_{(g)} \rightarrow CO_{(g)} + 3H_{2(g)}$$
1 vol   1 vol   1 vol   1 vol

1cm³ of H₂O react to produce 1cm³ and 3cm³ of H₂O
100cm³ of steam produces 100cm³ of CO and 300cm³ of H₂
Total volumes of the gases formed = 100 + 300 cm³ = 400cm³

9. Diamond and graphite are allotropes of carbon.

(i) What are allotropes? (1mk)

Different forms of an element in the same physical state

(ii) Explain why graphite conducts electricity while diamond does not. (1mk)

— The 4th valence electron of carbon in graphite is delocali while all the four valence electrons in carbon are used in cova bond

(iii) Diamond is used to drill through hard rocks (1 mk)

It has strong covalent bonds and the atoms are closely packed.

10. Starting with Lead (ii) oxide, describe how lead (II) sulphate can be prepared in the laboratory. (3mks)

React excess Lead (IV) oxide with dilute nitric (V) acid while stirring. Filter excess lead (IV) oxide to obtain Lead nitrate Filtrate. To the filtrate add dilute H₂SO₄ (or Na₂SO₄, K₂SO₄) — Filter to obtain PbSO₄(s). Rinse with distilled water and dry between filter paper.

11. A mass of 3.2g of XOH reacts completely with 20cm³ of 2M sulphuric (VI) acid. (O=16, H=1)

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

$$2XOH_{(aq)} + H_2SO_{4(aq)} \rightarrow X_2SO_{4(aq)} + H_2O_{(l)}$$
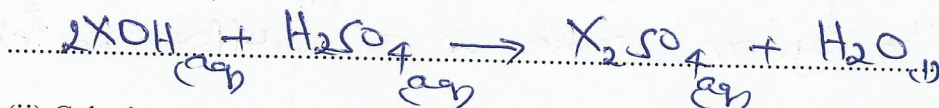
(ii) Calculate the relative atomic mass of X in the formula XOH. (2mks)

Moles of $H_2SO_4 = \dfrac{2 \times 20}{1000} = 0.04$ moles

Moles of XOH = 2 × 0.04 = 0.08 moles

RFM = $\dfrac{3.2}{0.08}$ = 40   X + 16 + 1 = 40   X = 40 − 17 = 23

24. The diagram below shows an iron bar, which supports a bridge. The iron bar is connected to a piece of magnesium metal.
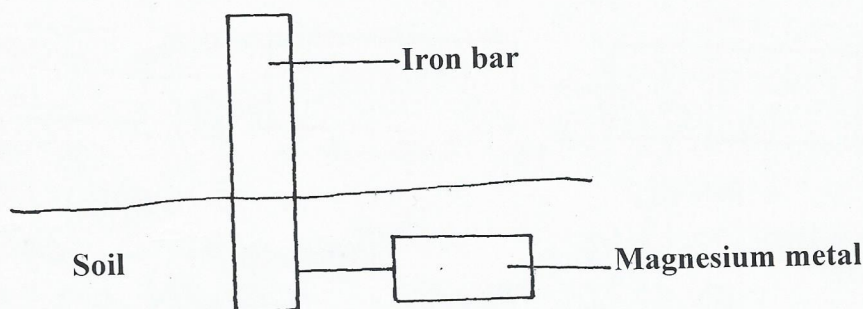
Explain why it is necessary to connect the piece of magnesium metal to the Iron bar. (2mks)

Magnesium is more reactive than Iron. It reacts with water and air readily than iron preventing is from rusting.

25. The table gives the reactions between metals S, T, U and some substances.

Metal	Reaction with air	Reaction with water	Reaction with dilute acid
S	Reacts	Does not react	Reacts
T	Does not react	Does not react	Does not react
U	Reacts	Reacts	Vigorous reaction

(a) Which metal is likely to be magnesium? (1mk)

U

(b) Which metal may be used to make a cooking pot? (1mk)

S

(c) Arrange the three metals in order of reactivity starting with the most reactive. (1mk)

U > S > T

26. a) What do you understand by the term molar enthalpy of displacement of an element? (1mk)

This is the enthalpy change that occur when one mole of a substance is displaced from a solution of its ions

b) During a displacement reaction, excess iron powder was added to 25cm^3 of 0.5M copper(II) sulphate solution. The temperature rose from 18.5°C to 33.0°C. Calculate the molar enthalpy of displacement of copper in copper (II) sulphate solution (specific heat capacity is 4.2 Jg^{-1}K^{-1}, Density of the solution = 1.0g/cm^3) (2mks)

ΔT = 33.0 − 18.5 = 14.5K

Mass of solution = 25 × 1g/cm^3 = 25g

ΔH = 25 × 4.2 × 14.5 = 1522J

No. of moles of copper ion displaced
= 25 × 0.5 = 0.0125 moles

molar enthalpy of displacement

= 1522.5 / 0.0125

= −121 800 J/mol

or −121.8 kJ/mol.

27. Below is a simplified scheme of Solvay process. Study it and answer the questions that follow.

Brine ↘
           → [PROCESS I] → [PROCESS II] →NaHCO₃→ [PROCESS III] → Sodium Carbonate
Ammonia ↗   ↑
solution   gas R
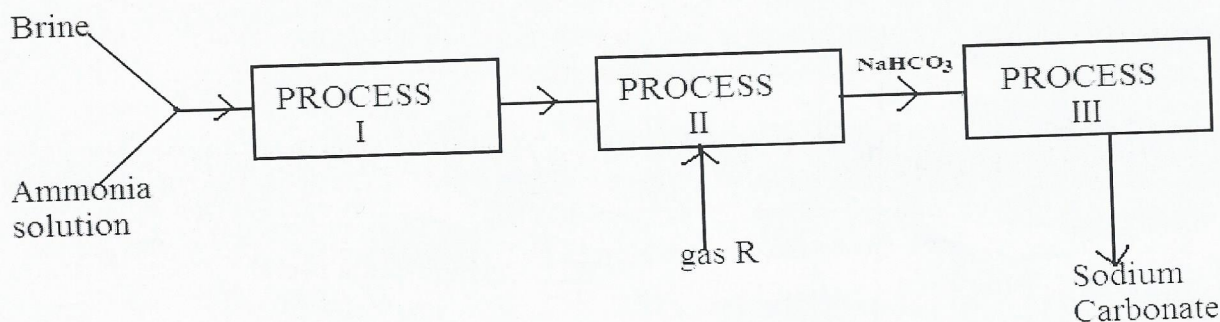
(a) Identify gas **R**.   (½mk)

~~Carbon (IV) oxide gas~~

(b) Write an ~~ionic~~ equation for the process III.   (1mk)

$2 NaHCO_{3(s)} \xrightarrow{Heat} Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(l)}$
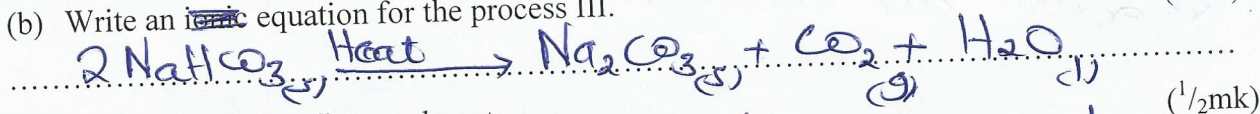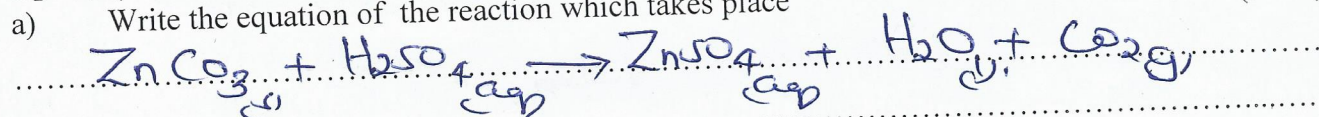
(c) Give one use of sodium carbonate.   (½mk)

~~Softening Water / Making glass / Paper Industry / Making detergents.~~

28. 4.275g of a mixture of zinc sulphate and zinc carbonate reacted completely with 25cm³ of 0.1 M
H₂SO₄. (Zn =65, C=12,O=16)   (1 mk)
a)   Write the equation of the reaction which takes place

$ZnCO_{3(s)} + H_2SO_{4(aq)} \longrightarrow ZnSO_{4(aq)} + H_2O_{(l)} + CO_{2(g)}$

b)   Calculate the number of moles of sulphuric (VI) acid in the 25cm³   (1mk)

$Moles = \dfrac{M \times V}{1000} = \dfrac{0.1 \times 25}{1000} \cdots \cdot \frac{1}{2} = 0.0025 \; moles$

c)   Find the percentage(%) mass of zinc sulphate in the mixture   (1 mk)

moles of ZnCO₃ = 0.0025 (mole ratio of ZnCO₃ : H₂SO₄ = 1 : 1)

Mass = moles × RFM   Mass of ZnSO₄ = 4.275 - 0.3125

= 0.0025 × 125   = 3.96   % = $\dfrac{3.96 \times 100}{4.275}$ = 92.6%

= 0.3125g.   (½mk)

29. (i)   Name one drying agent for hydrogen chloride

~~Concentrated Sulphonic(VI) acid.~~

(ii) State and explain the observation that would be made when hydrogen chloride gas is bubbled
into a solution of silver nitrate.   (1½ mks)

~~A white Precipitate is formed. Silver chloride
is formed which is a white solid.~~

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12. Hydrogen sulphide gas was mistakenly dried using concentrated sulphuric acid.

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

$$3H_2S_{(g)} + H_2SO_{4(l)} \rightarrow 4S_{(s)} + H_2O_{(l)}$$
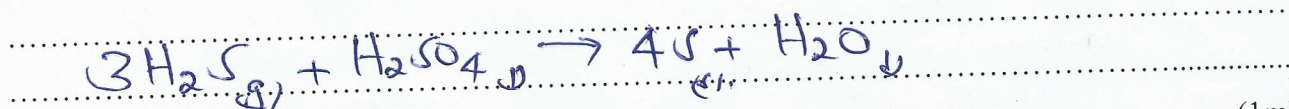
b) Using oxidation numbers, identify the reducing agent. (1mk)

H_2S as it is oxidized to sulphur. oxidation no. Increases from -2 to 0. ✓

$$3H_2S + H_2SO_{4(l)} \rightarrow 4S_{(s)} + H_2O_{(l)}$$
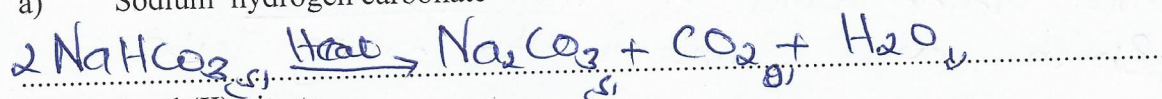O·N of $S = -2$ O·N of $S = 0$
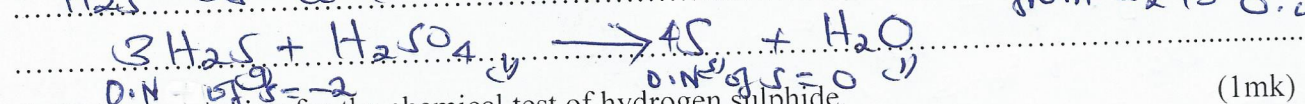
c) Write an equation for the chemical test of hydrogen sulphide. (1mk)

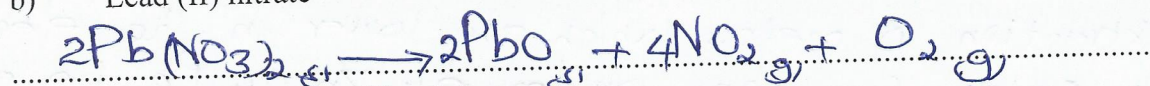13. Write equations to show the effect of heat on the following salts: (1mk)

a) Sodium hydrogen carbonate

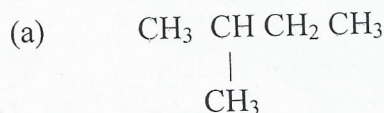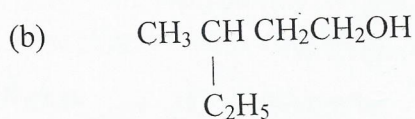$$2NaHCO_{3(s)} \xrightarrow{Heat} Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(l)}$$

b) Lead (II) nitrate (1mk)

$$2Pb(NO_3)_{2(s)} \rightarrow 2PbO_{(s)} + 4NO_{2(g)} + O_{2(g)}$$

c) Anhydrous copper (II) sulphate (1mk)

$$2CuSO_{4(s)} \rightarrow 2CuO_{(s)} + SO_{2(g)} + SO_{3(g)}$$

14. Give the systematic names of the following compounds.

(a) CH₃ CH CH₂ CH₃
       |
      CH₃

2-Methyl butane (1 mk)

(b) CH₃ CH CH₂CH₂OH
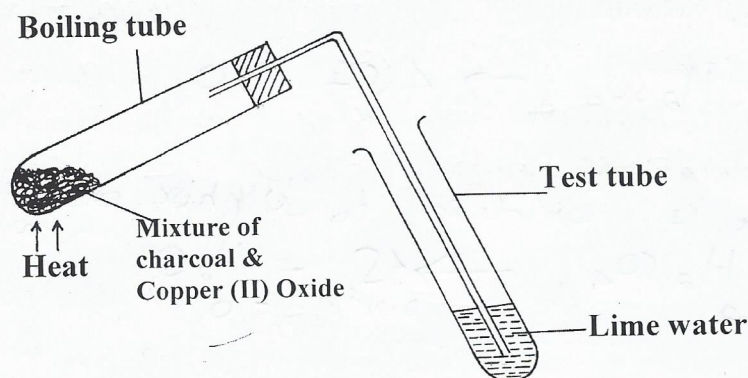 |
     C₂H₅

3- Methyl Pene-1-ol (1 mk)

(c)
O
‖
CH₃CH₂ C O CH₂CH₂CH₂CH₃
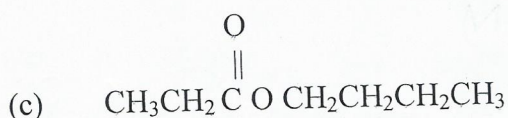
Butyl propanoate (1 mk)

15. The set up below was used to investigate a chemical property of carbon. Study it and answer the questions that follow.

(i) What observations were made on heating the mixture. **(2mks)**
— Lime water forms a white precipitate
— Brown solid forms in the boiling tube.

(ii) What is the industrial application of carbon in terms of property investigated above. **(1mk)**
Extraction of metals which are lower in the electrochemical series from their oxides e.g Zn, Cu, Pb, Fe etc.

16. A farmer took a sample of soil from his farm for testing. Its PH was found to be 5.0.

a) Explain how the PH was determined. **(2 mks)**
— The soil was dissolved in water and universal indicator added to the filtrate. The PH was established from its PH chart.

b) He was then advised to treat the soil before the next planting season. Explain. **(1 mk)**
The soil was weakly acidic and was advised to neutralize using a base. e.g quick lime.

17. (a) Suppose 180cm³ of a 2.0M solution is diluted to 1.0dm³. What will be the concentration of the resulting solution. **(2 mks)**
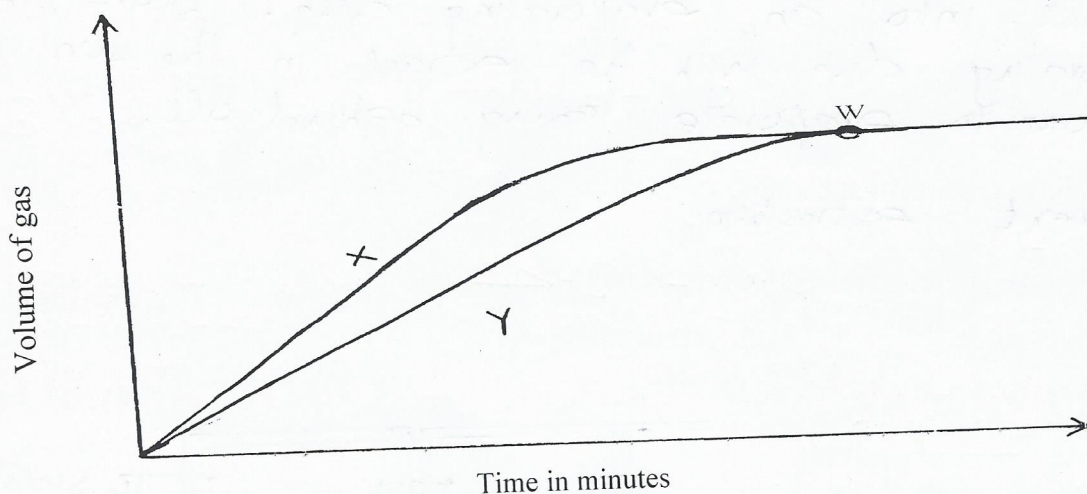
$$M_1 V_1 = M_2 V_2$$

$$M_2 = \frac{M_1 V_1}{V_2} \qquad \frac{2.0 \times 18.0}{1000}$$

$$= 0.36 \, M$$

(b) Why is water not used to put off oil fires ? **(1 mk)**
Oil is less dense than water; therefore would float on the water and burning would continue
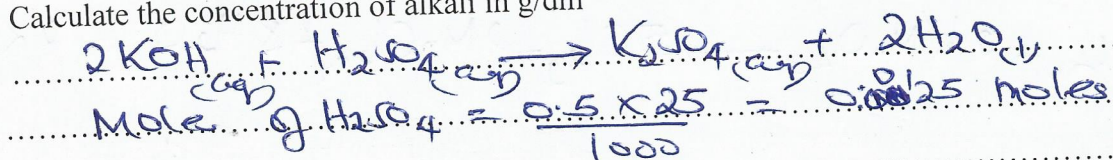
18. Curves X and Y shown below were obtained when equal masses of magnesium ribbon and magnesium powder were reacted separately with aqueous acids of the same concentration.

a) Explain which gas corresponds to
I Magnesium ribbon.....................Y.. ($^{1}/_{2}$mk)

II Magnesium powder ....X.. ($^{1}/_{2}$mk)

b) Why do the two curves meet at point W. (1mk)

The reaction had reached completion / all the reactants had been used.

19. 36cm^3 of a solution of potassium hydroxide requires 25cm^3 of 0.5M sulphuric acid to neutralize it. Calculate the concentration of alkali in g/dm^3 (3mks)

$2KOH_{(aq)} + H_2SO_{4(aq)} \rightarrow K_2SO_{4(aq)} + 2H_2O_{(l)}$

Moles of $H_2SO_4 = \dfrac{0.5 \times 25}{1000} = 0.0125$ moles

Moles of $KOH = 2 \times 0.0125 = 0.025$ moles

Molarity of $KOH = \dfrac{0.025 \times 1000}{36} = 0.6944$ M

Concentration in g/dm3 $= 0.6944 \times 56 = 38.89$ g

20. Some wet coloured flowers were put inside a gas jar containing sulphur (IV) oxide gas.

a) State and explain using and equation the observations made (2 mks)

The flowers are bleached (decolourised). SO_2 in water forms H_2SO_3 which ionizes to give SO_3^{2-} ions

$H_2SO_{3(aq)} \rightleftharpoons H^+_{(aq)} + SO^{2-}_{3(aq)}$ $SO_3^{2-} + [O] \rightarrow SO_4^{2-}{}_{(aq)}$
From flower

b) How is the above reaction different from the one of chlorine gas? (1mk)
Chlorine bleaches by oxidation and the bleaching is permanent.
SO_2 bleaches by reduction and is temporary.

Form Four   7

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21. (i) Describe how one can obtain oil from macadamia nuts in the laboratory. (2 ½ mks)

- Crush the nuts in a mortar using a pestle. Add Propanone/ethanol as you continue crushing. Decant the extract into an evaporating dish. Leave the evaporating dish with the extract in the sun for Propanone to evaporate leaving behind oil.

(½mk)

(ii) Name the above method of separation

Solvent extraction

22. The diagram below shows a set –up for preparation chlorine gas.

Concentrated HCl

Potassium manganate VII

Water

Concentrated Sulphoric (VI) acid

Moist blue litmus paper
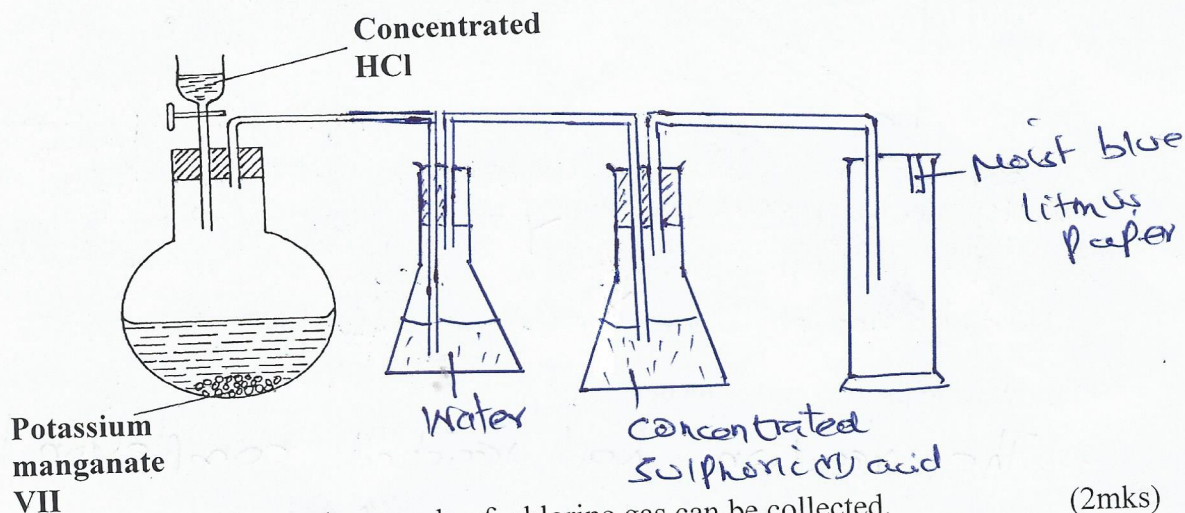
a) Complete the set-up to show how a dry sample of chlorine gas can be collected. (2mks)

b) Write the equation for the reaction that produces chlorine gas. (1mk)

$$16HCl_{(aq)} + 2KMnO_{4(s)} \longrightarrow 5Cl_{2(g)} + 2MnCl_{2(aq)} + 8H_2O_{(l)} + 2KCl_{(aq)}$$
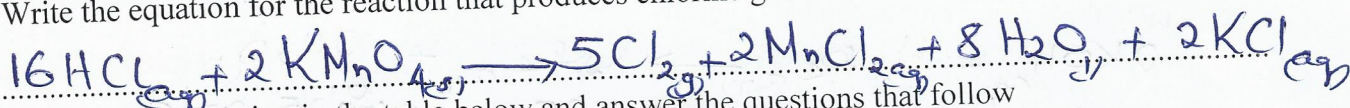
23. Study the information in the table below and answer the questions that follow

Bond	Bond energy (KJmol^{-1})
C – H	414
Cl – Cl	244
C – Cl	326
H – Cl	431

Calculate the enthalpy change of the reaction

$$CH_{4(g)} + 2Cl_{2(g)} \longrightarrow CH_2Cl_{2(g)} + 2HCl_{(g)}$$

(2mks)

Heat absorbed for bond breaking
4(C–H) + 2(Cl–Cl)
= 4(414) + 2(244) = 1656 + 488 = 2144 KJ
= +2144 KJ

Heat evolved in bond formation
2(C–H) + 2(C–Cl) + 2(H–Cl)
= 2(-414) + 2(-326) + 2(-431)
= -828 + (-652) + (-862)
= -2342 KJ

ΔH = 2144 – 2342 = –198 KJ/mol

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Form Four   8