Name: .... *M/s* .... Class: .... Adm.No................

School: .... Date: ....

Sign:..

233/2
CHEMISTRY
Paper 2
MARCH/APRIL 2018
Time: 2 hours

MOKASA JOINT EXAMINATION - 2018

Kenya Certificate to Secondary Education

CHEMISTRY PAPER 2

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES
- *Write your name, admission number, date and school in the spaces provided.*
- *Answer **all** the questions in the spaces provided.*
- *All working must be clearly shown where necessary.*
- *Scientific calculators may be used.*

FOR EXAMINERS' USE ONLY

Questions	Maximum Score	Candidate's Score
1	12	
2	12	
3	10	
4	10	
5	13	
6	13	
7	10	
TOTAL	**80**	

This paper consists of **11** printed pages. Candidates are advised to check and to make sure all pages are as indicated and no question is missing.
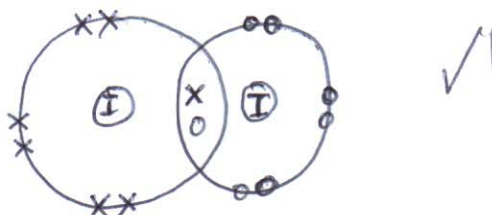
1.   Below is a grid representing part of the periodic table. The letters do not represent the actual chemical symbols of the elements. Study it and answer the questions that follow.

F			G			H	I	J
	K		L	M		N	Y	
P								

(a)   Using dots (•) and crosses (×) to represent electrons, show bonding in;

I.   Molecule of I   (1 mark)
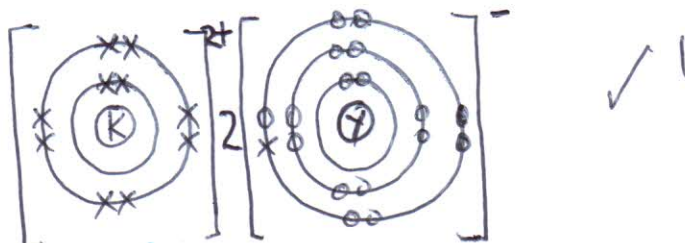

✓1

II.   Compound formed between K and Y.   (1 mark)

✓1

III.   Name the types of bonds formed in (a) above.   (1 mark)

I   -   Covalent ✓1

II   -   Ionic ✓1

(b)   A chloride of M was dissolved in water and the resultant solution tested using litmus papers. State and explain the observations made.   (2 marks) ✓1

Observations: Blue litmus paper changed to red and ✓ red remained red.

Explanation: Chloride of M, hydrolyses in water forming ✓1 an acidic solution showing the observations.

(c)   Compare the atomic radius of K and N. Explain.   **(2 marks)**

N has a smaller atomic radius than K✓! N has more protons which increases nuclear attraction✓/ making it smaller.

(d)   Explain why element L is used in overhead electric cables whereas K is not. **(1 mark)**

✓ L is a better conductor of electricity than K. ✓ It is also lighter, hence used in over head, than K.

(e)   What is the name of the chemical family to which J belongs?   **(1 mark)**

Noble gases.

(f)   A burning piece of element K was lowered in a gas jar containing carbon (IV) oxide gas.

    (i)   State and explain the observations made.   **(2 marks)**

— It continues to burn, forming a white solid and a black substance. The heat produced decomposes CO_2 to C and O_2, which enables✓ K to continue burning forming white oxide of K.

    (ii)   Write an equation for the reaction that took place in the gas jar. **(1 mark)**

$$2K_{(s)} + CO_{2(g)} \longrightarrow 2KO_{(s)} + C_{(s)}$$
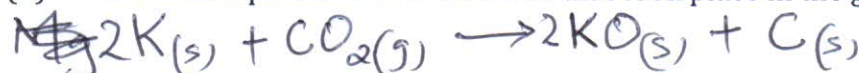
2.   (a)   In order to obtain some dilute aqueous ethanol, a solution of sugar and yeast is made. The mixture is then kept under warm conditions for some time. The sugar is broken down into simpler sugars, glucose by enzymes in the yeast to produce ethanol.

    (i)   What name is given to the process described above?   **(1 mark)**
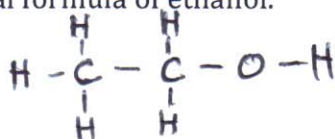
Fermentation

    (ii)   Write the equation for the formation of the dilute aqueous solution of ethanol.   **(1 mark)**
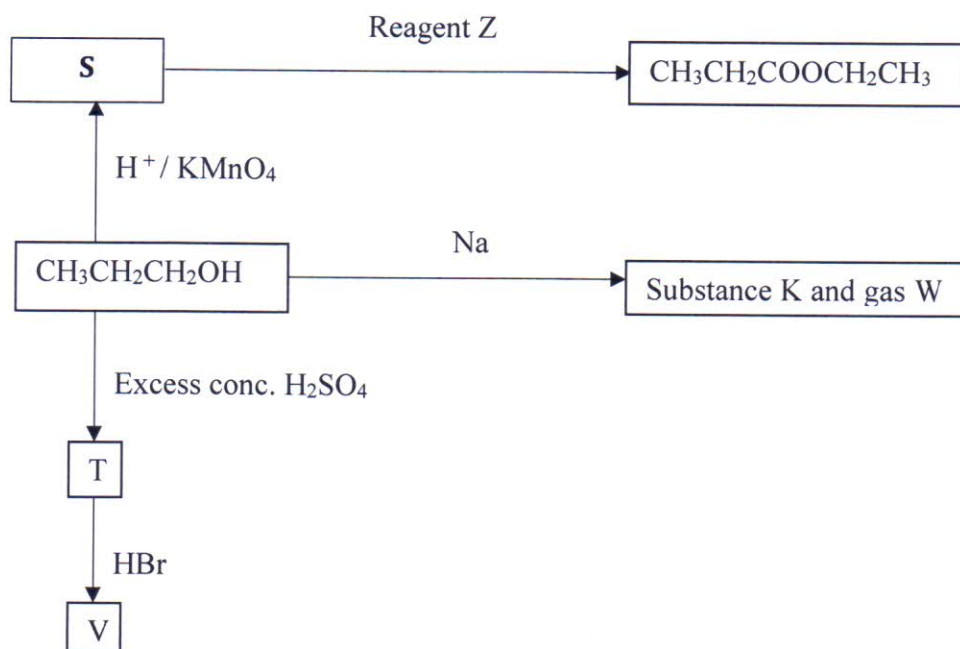
$$C_6H_{12}O_{6(aq)} \xrightarrow[\text{Warm}]{\text{Yeast}} 2CH_3CH_2OH_{(aq)} + CO_{2(g)}$$
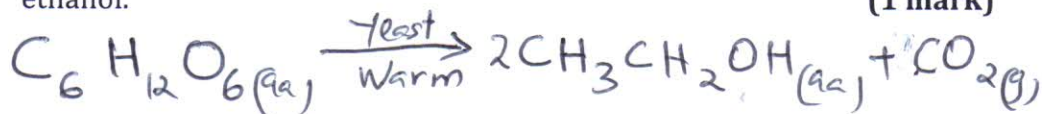
    (iii)   About 10% by volume of ethanol is produced by the method described. What process would the 95% by volume of ethanol be obtained? **(1mk)**

Fractional distillation

    (iv)   Write the structural formula of ethanol.   **(1mk)**

$$H-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle H}{|}}{C}}-O-H$$

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

Reagent Z

| S | $\xrightarrow{\text{Reagent Z}}$ | $CH_3CH_2COOCH_2CH_3$ |

$H^+ / KMnO_4$ ↑

$CH_3CH_2CH_2OH$ $\xrightarrow{\text{Na}}$ Substance K and gas W

Excess conc. H_2SO_4 ↓

T

HBr ↓

V

a) Name;   S   Propanoic acid   (4mks)

        K   sodium propoxide

        T   Prop-1-ene / propene

        Z   Ethanol

b) Write the equation for the formation of substance V. Give the name of V.   (2mks)

$$CH_3CH=CH_{2(g)} + HBr_{(g)} \longrightarrow CH_3CHBrCH_{3(g)} ✓'$$

$$2\text{-bromopropane} ✓'$$
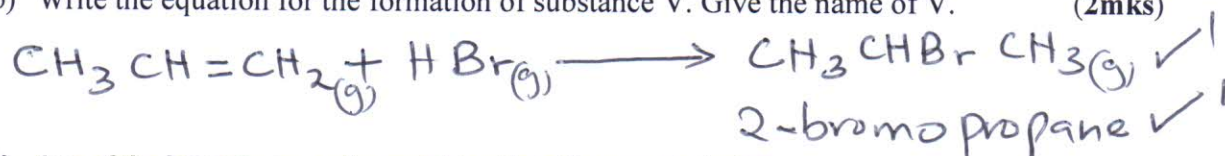
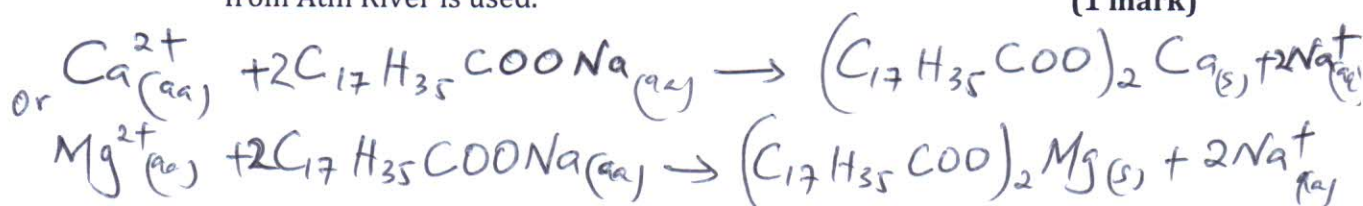c) One of the largest users of vegetable oils is the soap industry.

        (i)   Name the process of manufacturing soap.   (1 mark)

            Saponification

        (ii)   Using an equation, explain why the efficiency of soap is reduced when water
               from Athi River is used.   (1 mark)

$$\text{or } Ca^{2+}_{(aq)} + 2C_{17}H_{35}COONa_{(aq)} \longrightarrow (C_{17}H_{35}COO)_2Ca_{(s)} + 2Na^+_{(aq)}$$

$$Mg^{2+}_{(aq)} + 2C_{17}H_{35}COONa_{(aq)} \longrightarrow (C_{17}H_{35}COO)_2Mg_{(s)} + 2Na^+_{(aq)}$$

3.   (a)   Liquid A has a boiling of 56^0C while liquid B has a boiling point of 110^0C. State the method used to separate the two liquids. Give a reason.   **(2 marks)**

— Simple distillation ✓
— Boiling points range is wide $> 40^0C$.

(b)   Study the flow chart below showing the main stages involved in fractional distillation of liquid air.
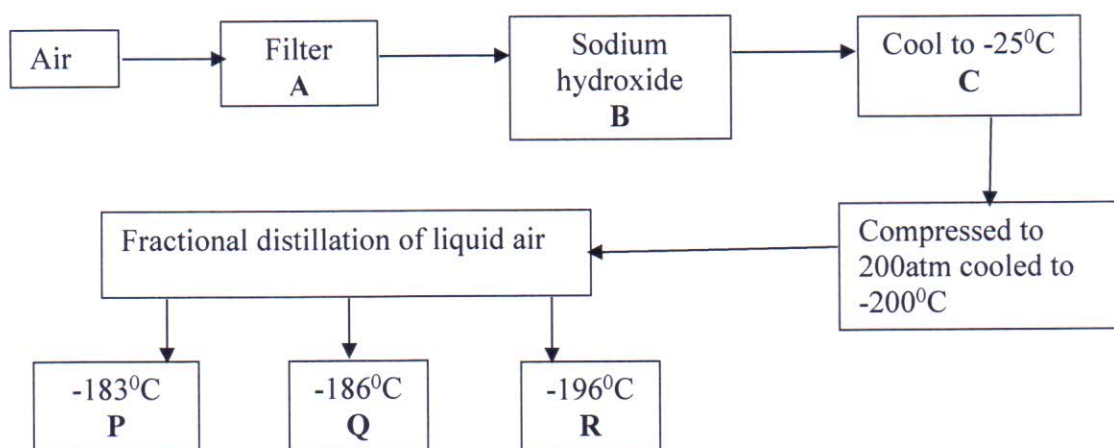
(i)   Name substances removed through A, B and C.   **(1 ½ mark)**

A   —   Dust particles

B   —   Carbon (iv) oxide

C   —   Water vapour

(ii)   What is the role of the compressor?   **(1 mark)**

To liquify the air

(iii)   Name **one** other substance that can be used in place of sodium hydroxide.   **(1 mark)**
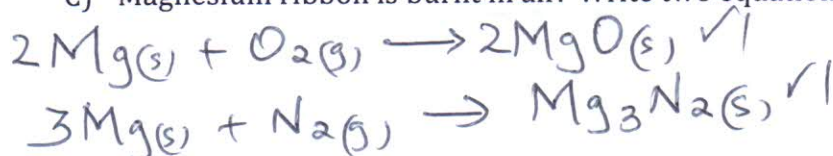
Potasium hydroxide

(iv)   Name the gases P, Q, R.   **(1 ½ mark)**

P   —   Oxygen

Q   —   Argon

R   —   Nitrogen

(v)   What colour is liquid air?   **(1 mark)**

Pale blue

C)   Magnesium ribbon is burnt in air. Write two equations for the products formed.   **(2 marks)**

$$2Mg_{(s)} + O_{2(g)} \longrightarrow 2MgO_{(s)} ✓$$
$$3Mg_{(s)} + N_{2(g)} \longrightarrow Mg_3N_{2(s)} ✓$$

4. (a) The table below shows the results obtained when Sammy carried out an experiment to study how $200cm^3$ of hydrogen peroxide solution at 20^0C decomposed when 4.0g of manganese (IV) oxide was added. Volume of oxygen was measured after every 10 seconds.

Time(Sec)	0	10	20	30	40	50	60	70	80	90
Volume(cm^3)	0	60	90	105	112	116	118	120	120	120

Plot a graph of volume of gas against time and label it X. **(3 marks)**

S ½
A ½
P ✓1
C ✓1
3mks
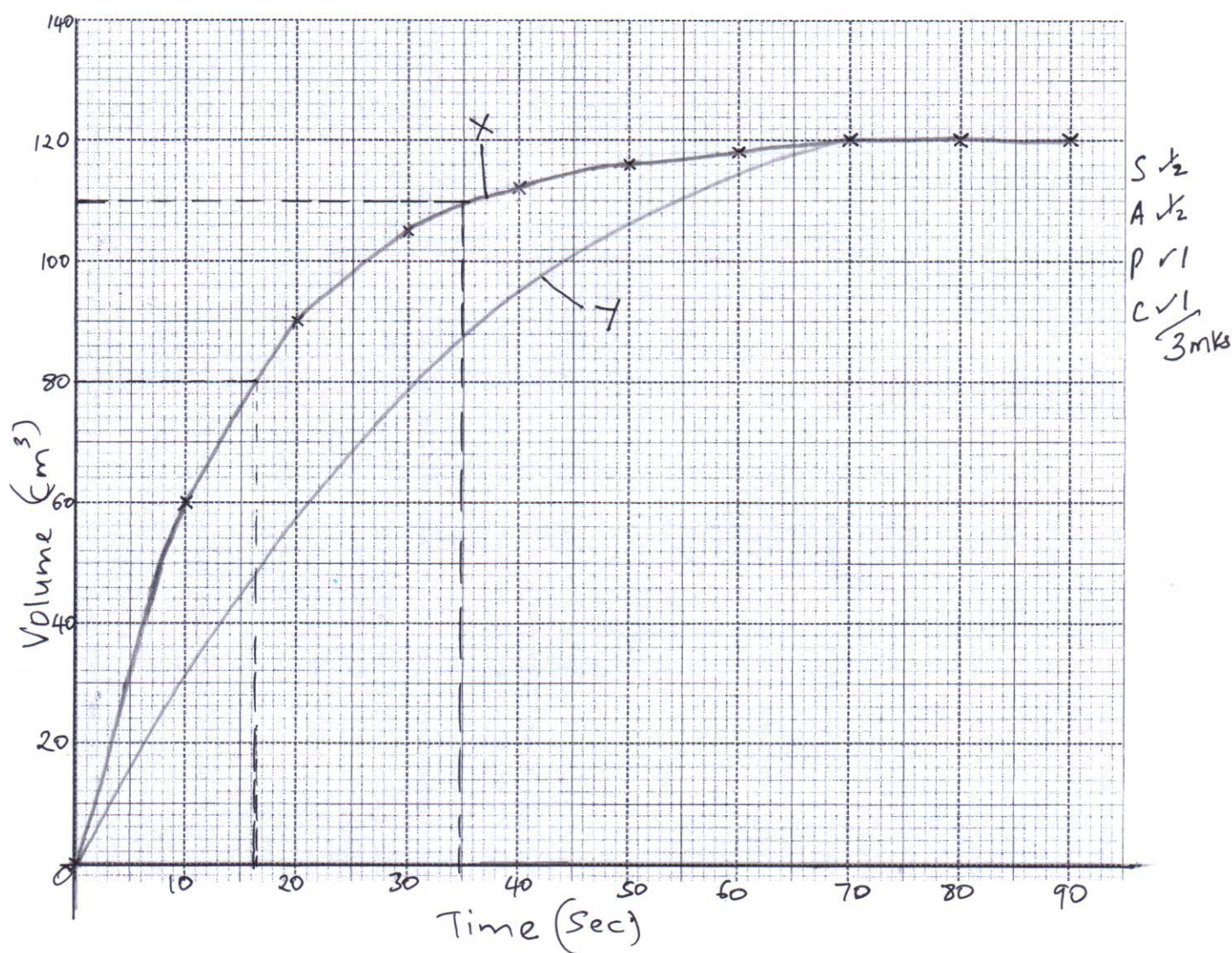
(b) Use your graph to find the;

(i) Volume of gas produced after 35 seconds. **(1 mark)**

$110 cm^3$ ✓1 ±1

(ii)   Time needed to produce 80cm³ of gas.   **(1 mark)**

16. sec ±1

(c)   Explain why the volume of oxygen produced does not exceed 120cm³. **(1 mark)**

All the hydrogen peroxide had decomposed, thus no more oxygen gas produced.

(d)   Sketch graph Y on the same grid to show the results when hydrogen peroxide at 10°C is used. Explain. At lower temperature, the **(2 marks)** rate of reaction is low, thus taking longer time. ✓|

e.   The mass of the solid residue after the experiment was found to be 4.0g. Explain.

Manganese (iv) oxide is the catalyst, which **(2 marks)** does not change during the reaction as it does not take part in the reaction.

5.   The flow chart below shows how sulphuric (VI) acid is produced on a large scale.
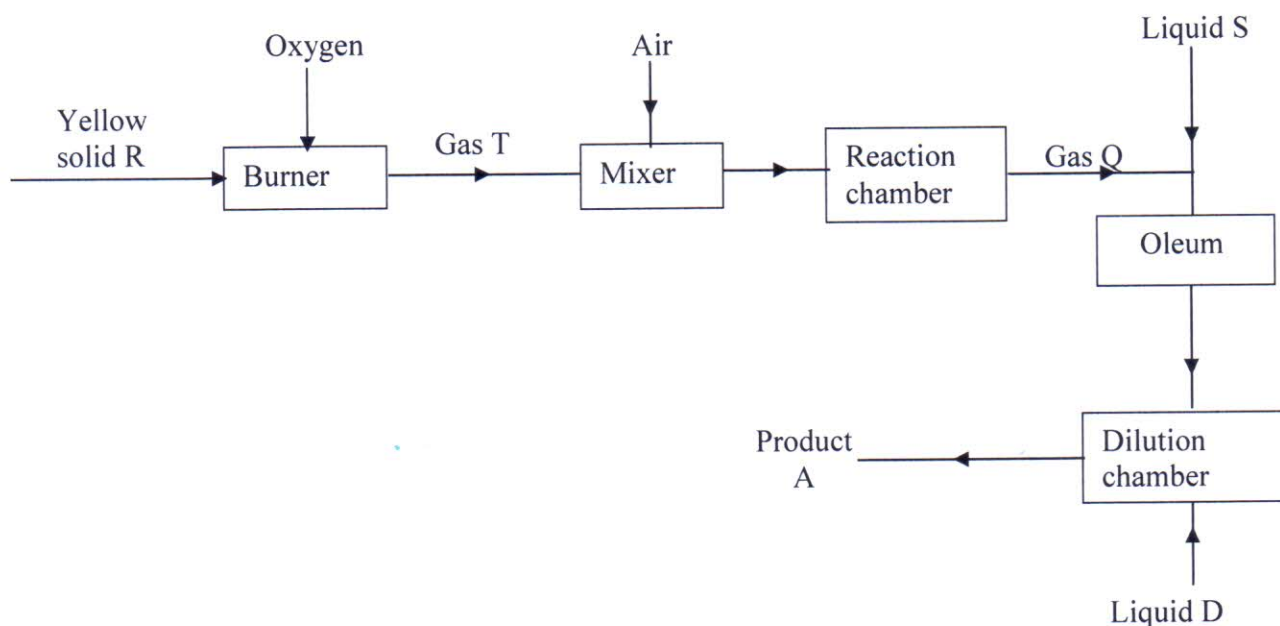
(a)   Identify the following: **(4 marks)**

(i)   Gas T   - SO₂ | Sulphur (iv) oxide ✓|

(ii)   Gas Q   - SO₃ | Sulphur (vi) oxide ✓|

(iii)   Liquid S – Concentrated Sulphuric(vi) acid ✓|

(iv)   Liquid D – Water ✓|

(b)   Which catalyst is most suitable in the reaction chamber? Give a reason for your answer.   **(2 mark)**

✓ Vanadium (v) oxide (V₂O₅) ✓|
✓ It is not easily poisoned by the impurities ✓| and cheap.

(c)   Write an equation for the reaction between liquid S and gas Q.   **(1 mark)**

$$SO_{3(g)} + H_2SO_{4(L)} \rightarrow H_2S_2O_{7(L)}$$
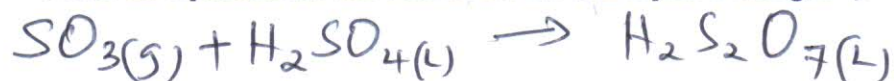
(d)   What would you observe if concentrated sulphuric (VI) acid is added to cane sugar? Explain.   **(2 marks)**

- Black Mass is formed.
- Concentrated H_2SO_4 dehydrates sugar forming a black Mass Carbon.

(e)   State two uses of dilute Sulphur (VI) acid.   **(2 marks)**

- Mfr q -fertilisers
    - detergents
    - Plashes
    - dyes & paints

- used in lead acid accumulator

f)   According to Le'-Chatelier's principle, what optimum conditions should be adopted in the above large scale manufacture of sulphuric (VI) acid to obtain maximum yield of Sulphur (VI) oxide?   **(2 marks)**

- High pressure q 2-3 atm ✓ ½ should specify
- Low temperature q 450°C ✓½

6.   The diagram below represents a set-up to determine the molar heat of combustion of propanol.
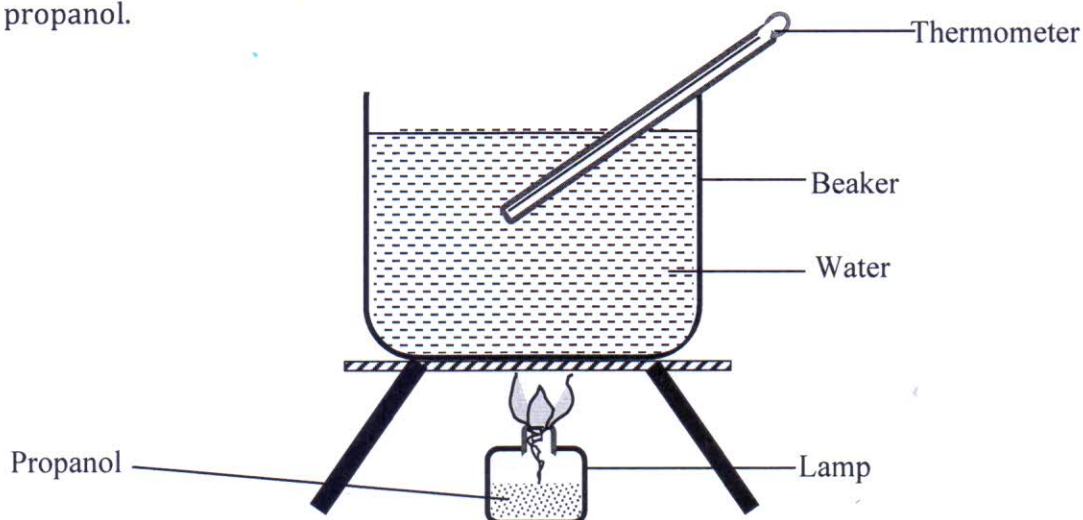
(a)   What do you understand by the term 'molar heat of combustion'?   (1mk)

It is the enthalpy change that occurs when one mole of a substance is completely burned in oxygen.

(b) During the experiment, the data given below was recorded.

Mass of water	200g
Initial temperature of water	20.5°C
Final temperature of water	47.0°C
Initial mass of lamp + propanol	30.42g
Final mass of lamp + propanol	29.98g
Specific heat capacity of water	4.2kJ/kg/K

C =12, H = 1, O = 16

    (i)   Calculate the temperature change. **(1 mark)**

$$47 - 20.5 = 26.5 °C$$

    (ii)   Calculate the mass of propanol burnt? **(1 mark)**

$$30.42 - 29.98 = 0.44g$$

    (iii)   Calculate the molar heat of combustion of propanol. **(2 marks)**

$$\Delta H = mc\Delta T$$
$$= \frac{200}{1000} \times 4.2 \times 26.5 = 22.26 \, kJ$$

R.M.M $CH_3CH_2CH_2OH = 60$

If $0.44g$ evolved $22.26kJ$
$60g$ "

$$\frac{60 \times 22.26}{0.44} = -3035.45 \, kJ/mole$$

(c) Write down a thermochemical equation for the complete combustion of propanol. **(1 mark)**

$$C_3H_7OH_{(l)} + 9/2 O_{2(g)} \longrightarrow 3CO_{2(g)} + 4H_2O_{(l)}$$

    (ii)   Draw an energy level diagram for the reaction in this experiment. **(2 marks)**

✓ Correct Placement of the equation

✓ Correct shape

Energy kJ

$C_3H_7OH_{(l)} + 9/2 O_{2(g)}$

$\Delta H = -3035.45 \, kJ/mole$

$3CO_{2(g)} + 4H_2O_{(l)}$

Reaction path
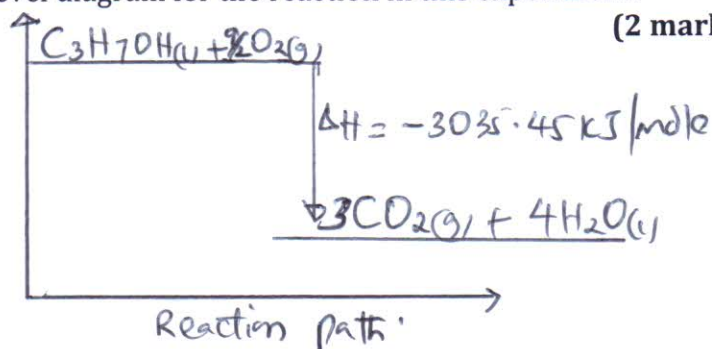
(d) Define the term 'fuel'. — A substance that **(1 mark)** produces useful energy when it undergoes a chemical or nuclear reaction.

(e) What is a heating value of a fuel? **(1 mark)** The amount of heat energy given out when a unit mass of a fuel is completely burned in oxygen.

(f) Determine the heating value of propanol in this experiment. **(1 mark)**

Heating Value $= \dfrac{\text{Molar enthalpy}}{R.M.M} = \dfrac{3035.45}{60} = 50.5908 \text{ KJ/g}$

g) Other than the heating value of a fuel, state any other **two** factors that one has to consider when choosing a fuel. **(1 mark)**
   - Availability   — Ease and rate of combustion.
   - Ease of storage
   - Cost
   - Environmental effects

h) It has been suggested that all motor vehicles must be fitted with electronically controlling gadget mixer of air and fuel. Why do you support this suggestion? **(1 mark)**

To ensure complete combustion of fuel; to minimise the production of CO which is poisonous.

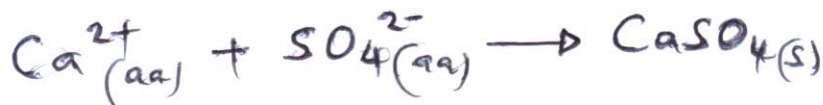7. Study the flow chart below and use it to answer the questions that follow:
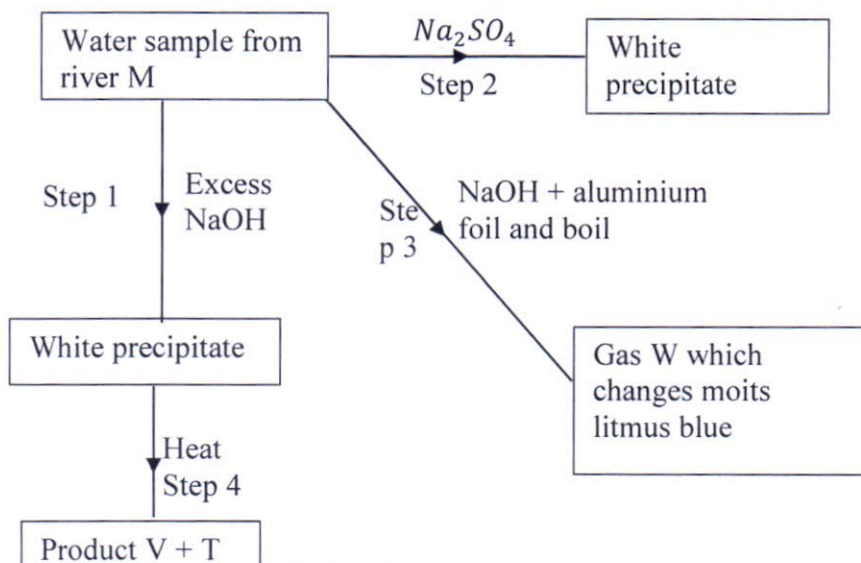
(a) Write down two possible cations in the water basing on step 1 only. (1 mark

$$Ca^{2+}, Mg^{2+}$$

(b) Give ionic equation for reaction in step 2. (1 mark)

$$Ca^{2+}_{(aq)} + SO_4^{2-}_{(aq)} \longrightarrow CaSO_{4(s)}$$

(c) Write the equation for reaction in step 4. (1 mark)

$$Ca(OH)_{2(s)} \longrightarrow CaO_{(s)} + H_2O_{(l)}$$

(d) Write the formula of the anion in the water. (1 mark)

$$NO_3^-$$

(e) Name one source of the compound found in river M above. (1 mark)

– Agricultural fertilizers, industrial wastes

(f) State the effect of the anion in (d) above to the water in the river.

Eutrophication / Rapid growth of algae in (1 mark) water bodies due to nutrients (fertilizes), using all oxygen, resulting to death of animals.

(g) Study the equation below:

$$Na_2CO_3 \bullet 10H_2O \xrightarrow[\text{Y}]{\text{Process}} Na_2CO_3 \bullet H_2O + 9H_2O$$

(i) Name process Y. (1 mark)

Efflorescence.

(ii) Give one main difference between salt $Na_2CO_3 \bullet 10H_2O$ and $Na_2CO_3 \bullet H_2O$ (1 mark)

$Na_2CO_3 \cdot 10H_2O$ is crystalline while $Na_2CO_3 \cdot H_2O$ is in powder form.

(iii) Explain why magnesium chloride should always be kept in a desiccator. (1 mark)

It readily absorbs moisture from the atmosphere

iv) Write a chemical equation to show the effect of heat on lead (II) nitrate.

$$2 Pb(NO_3)_{2(s)} \longrightarrow 2PbO_{(s)} + 4NO_{2(g)} + O_{2(g)} \text{ (1 mark)}$$