Name...Marking...Scheme...........Adm No..........Class............

Signature............................

Date...............................

CHEMISTRY ,233/2

March, 2020

2 hours

MOKASA I EXAM

(Kenya Certificate of Secondary Education)

Instructions

- ✓ Write your name, admission number and class in the spaces provided above.
- ✓ Sign and write the date of examination in the spaces provided above.
- ✓ Answer **all** the questions in the spaces provided in the question paper.
- ✓ All working **must** be clearly shown where necessary.
- ✓ This paper consists of **11** printed pages. Confirm this and that no questions are missing.

For Examiner's Use Only

Question	Maximum Score	Candidate's score
1	10	
2	11	
3	12	
4	12	
5	11	
6	13	
7	11	
Total	80	

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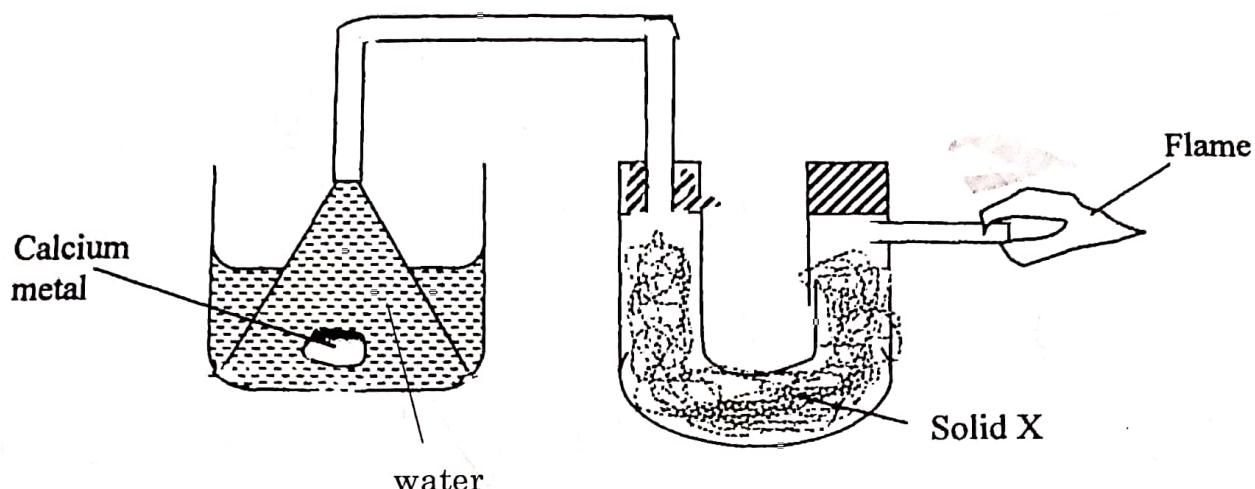

a) Identify solid X and state its purpose.
Solid X .Anhydrous. Calcium. Chloride./Calcium. Oxide. ✓½ (½ mark) Accept formulas

Purpose .to. dry. the. hydrogen. gas.. ✓½.. (½ mark)

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

$$2H_{2(g)} + O_{2(g)} \longrightarrow 2H_2O_{(g)} ✓1$$
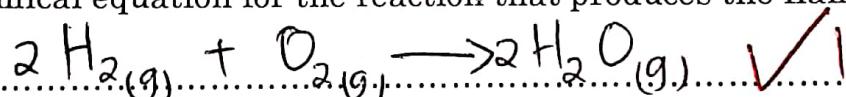
ii) The set-up below was used to investigate the properties of hydrogen.
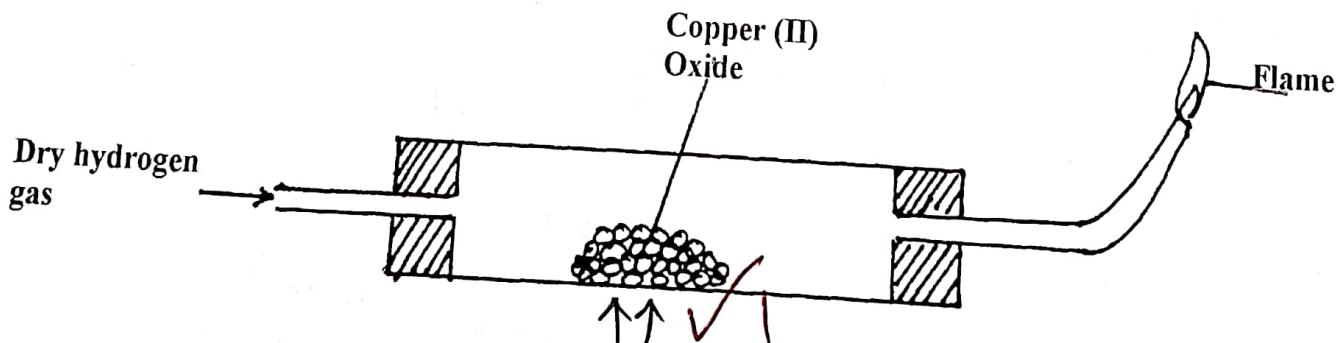
I.   On the diagram, indicate what should be done for the reaction to occur.
(1 mark)

II.   Hydrogen gas is allowed to pass through the tube for some time before it is lit. Explain. to drive away air to avoid explosion ✓ (1 mark)
.....to. avoid. re-oxidation. of. hot. copper. by. air.

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

$$CuO_{(s)} + H_{2(g)} \longrightarrow Cu_{(s)} + H_2O_{(l)} ✓1$$

1
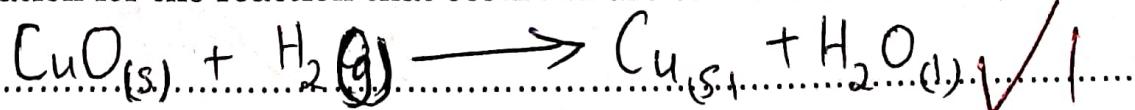
iv) When the reaction is complete, hydrogen gas is passed through the apparatus until it cools down. Explain. **(2 marks)**

So as to avoid re-oxidation of the hot copper metal by oxygen in air. ✓

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

Reducing Property ✓

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

black CuO turns to brown Cu solid ✓ / A colourless liquid formed.

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

Zinc is above hydrogen in the reactivity series/ More reactive hence Hydrogen cannot displace Zinc. ✓

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

Liquid R
Flask S
Marble chips
Water
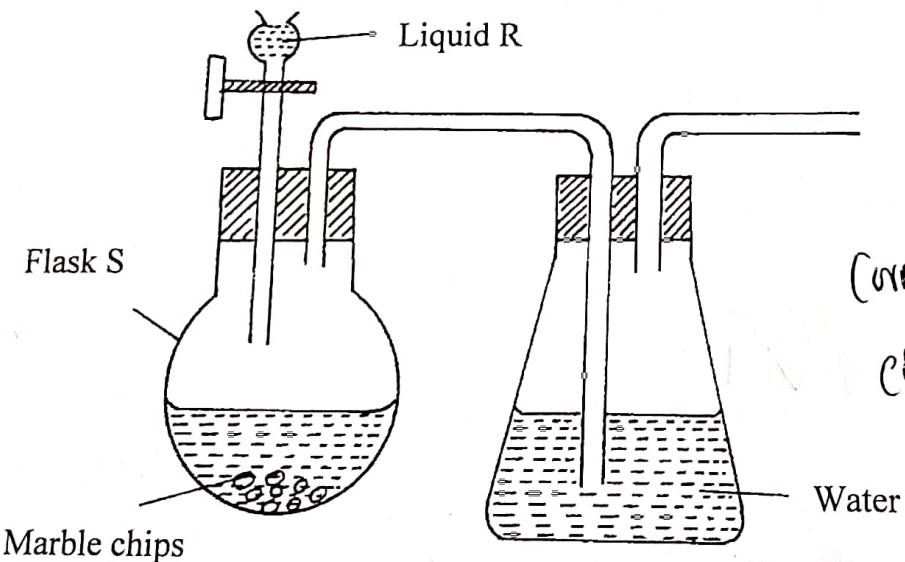
Workability = 1 mk
Correct drying agent = 1 mk
collection -downward delivery -1 mk

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

b) Identify liquid R. dilute hydrochloric acid ✓ **(1 mark)**

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

$$CaCO_{3(s)} + 2HCl_{(aq)} \longrightarrow CaCl_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$$
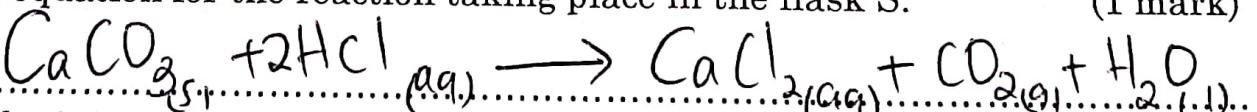
d) Explain why it is not advisable to use lead (II) carbonate in place of marble chips. **(1 mark)**

lead II Carbonate forms insoluble Salt of lead II chloride which coats the Carbonate Preventing further reaction. ✓ (w.t

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

Combustion tube M
Lead (II) oxide
CO
L
Glass wool
Glass wool
Liquid K
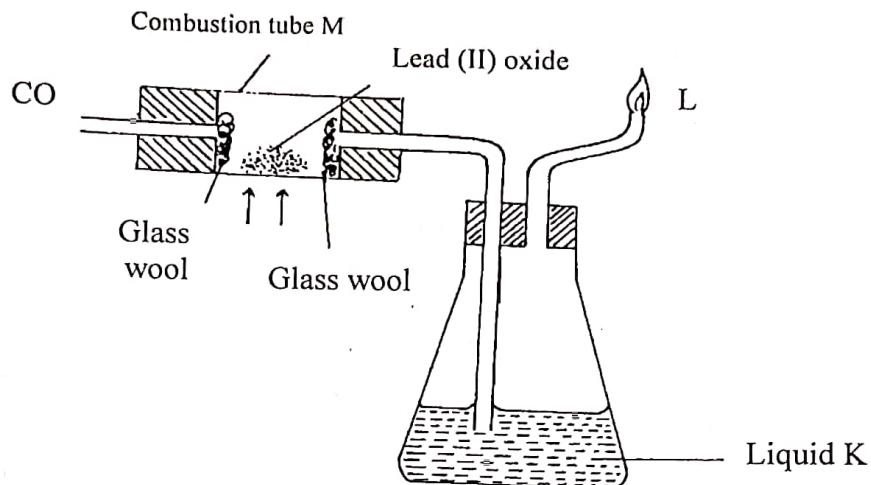
a) Write an equation for the laboratory preparation of carbon (II) oxide. (1 mark)

$HCOOH_{(s)} \xrightarrow{H_2SO_{4(L)}} CO_{(g)} + H_2O_{(l)}$ OR $H_2C_2O_4 \xrightarrow{Conc\ H_2SO_4} CO_{(g)} + CO_{2(g)} + H_2O_{(l)}$
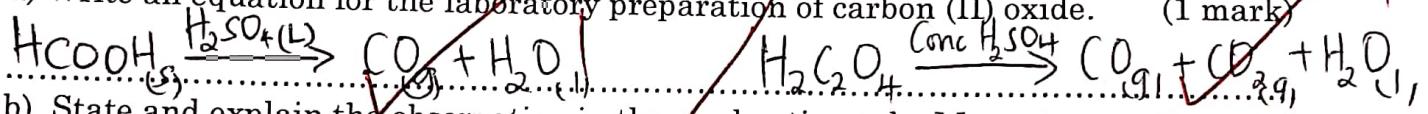
b) State and explain the observation in the combustion tube M. (2 marks)

Orange solid turns grey. CO reduces hot lead II oxide to form lead Metal.

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

Calcium hydroxide ✓½

to absorb the CO_2 formed when CO is oxidized ✓½

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

CO is poisonous hence should not be released into the atmosphere.

3. (a) Name the following organic compounds.
   i) $CH_3COOCH_2CH_3$ (1mark)

.... Ethylethanoate ✓

   ii) $CH_3CH_2CHCCHCH_2CH_3$ (1mark)

.... Hept-3,4-diene ✓

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(b) Study the flow diagram below and use it to answer the questions that follow.
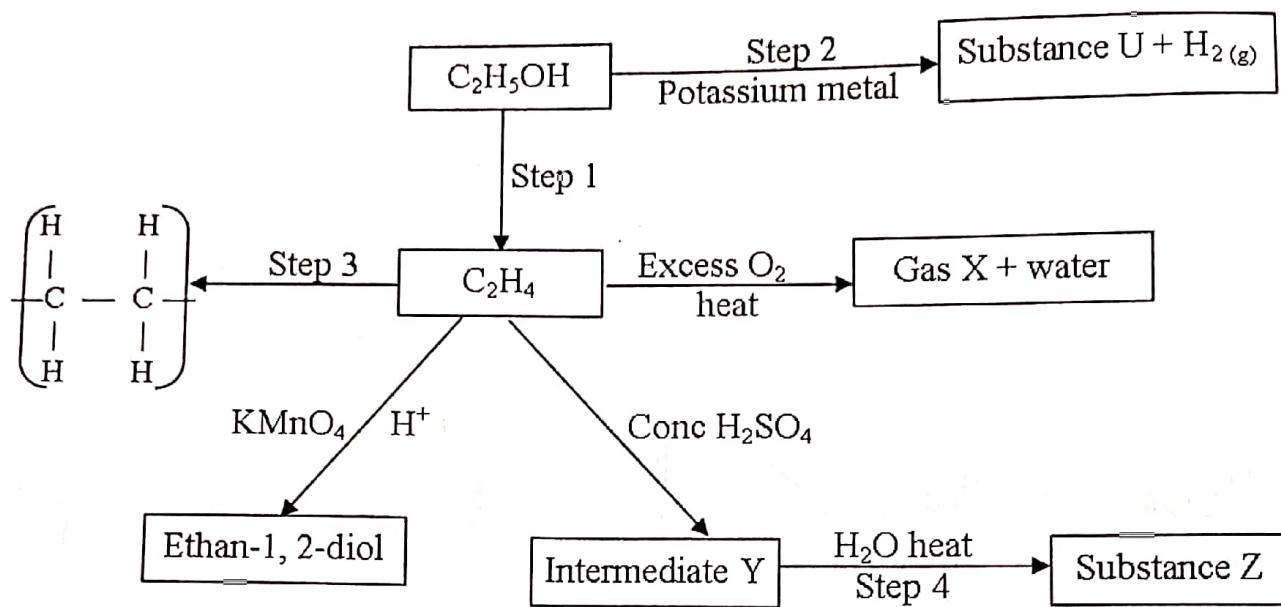
(i)   Name the compounds;
      U................... Potassium Ethoxide. ✓ ½ ....   (½ mark)
      Gas X............... Carbon (IV) oxide. ✓ ½ ,   (½ mark)
      Intermediate Y.... Ethyl hydrogen sulphate ✓ ½   (½ mark)

(ii) Name the process which leads to the formation of substance Z from the
intermediate Y.   (1 mark)
.... Hydrolysis ✓ ....

(iii) Identify the reagent and the condition for step 1   *Penalize range*
Reagent ✗ ...... Heating up to (160° C - 180° C)......
                                                                            (1 mark)
Condition ...... Concentrated Sulphuric VI acid......
                                                                            (1 mark)
iv) State one disadvantage for the continued use of items made from compound
formed in step 3.   --- non-biodegradable ✓ ½ (1 mark)
.....Cause environmental pollution sn6 ✓ ½ --- burn to produce poisonous gases ✓ ½
v) Write a balanced equation for the reaction taking place in step 2.   (1 mark)
..............2 C₂H₅OH ———— 2K ———→ 2C₂H₅OK + H₂(g)

$$2\,C_2H_5OH_{(l)} \;+\; 2K_{(s)} \;\longrightarrow\; 2C_2H_5OK_{(aq)} \;+\; H_{2(g)}$$

4
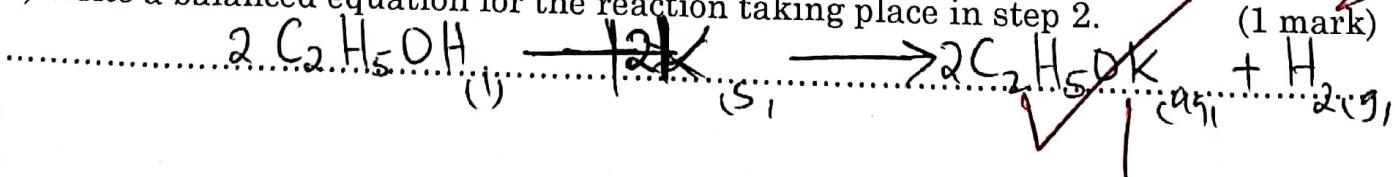
c)Below are structures of two cleaning agents

$$R - COO \cdot Na^+ \quad \ldots\ldots\ldots A$$

$$R - \langle O \rangle - OSO_3^- Na^+ \ldots B$$
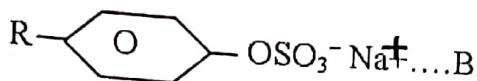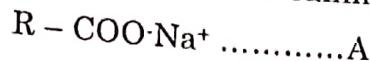
i)Identify the cleaning agent suitable to be used in water containing calcium chloride. ....B......✓...... (1 mark)

ii)State one advantage of using cleaning agent A.
......forms......scum......with hard water. /Not readily lather hard water

iii) Name the cleaning agent A. ......Soapy detergent /soap ✓ (½ mark)

d) Ethanol is an important organic solvent. It can be prepared by the fermentation of glucose, $C_6H_{12}O_6$. Give two conditions necessary or the reaction to take place.

(1 mark)

......Warming up to 30°C ✓½
......Yeast...... ✓½

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

C					F	G		H	I		
D	E										K
										J	

i) Identify the most reactive non-metal. Explain. (2 marks)
I. Most electronegative / Has smallest atomic radius hence readily gains electrons

ii) What is the name given to the family of elements of which I and J belong? (½ mark)
......Halogens ✓½

iii) Using dots (•) and crosses (×) to represent electrons, show bonding in the compound formed between C and H. (2 marks)
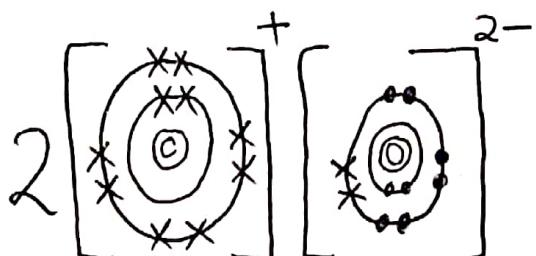
2 or 0 for any wrong
Must show nucleus.

iv) How does the atomic radius of F compare with that of I. Explain. (2 marks)

I has smaller atomic radius than F. I has More Protons than F hence stronger nuclear charge than F. ( )

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

Substance	M	N	O	P	Q	R
M.P. °C	801	1356	-101	26	-39	113
B.P °C	1410	2850	-36	154	457	445
Electrical conductivity in solid state	Poor	Poor	Poor	Poor	Good	Poor
Electrical conductivity in molten state	Good	Poor	Poor	Poor	Good	Poor

i) Explain why substance M is a good conductor in molten state and not in solid state. (2 marks)

In solid state, ions g M are in fixed Position. In molten state, ions are Mobile ( )

ii) What is the most likely structure of substance N. Explain. (1 ½ marks)

Giant atomic / covalent structure / ½

N has highest Melting and boiling point due to uniformity of strong covalent bonds,

iii) Identify, with reasons, a substance that exists as a liquid at room temperature. (2 marks)

Q ( ) : Its melting point is lower than room temperature and boiling point higher than room temperature

5. The flow chart below shows a sequence of reaction involving a mixture of **two** salts, mixture **M**. Study it and answer the questions that follow.

```
                          ┌─────────────┐
                          │  Mixture M  │
                          └─────────────┘
                  Step (I)   (i) Addition of water
                             (ii) Filtration

        ┌──────────────┐                      ┌────────────┐
        │   Solid N    │                      │ Solution P │
        └──────────────┘                      └────────────┘
                            Step (IV)   (i) Acidified barium
     Step (II)   Heat                        nitrate solution
                                         (ii) Filteration
   ┌────────────────────┐    ┌──────────────────┐    ┌──────────────┐
   │ Black solid Q and  │    │Colourless solution│    │ White solid  │
   │ gas which forms a  │    └──────────────────┘    └──────────────┘
   │ white precipitate  │
   │ when bubbled       │    Step (VII)   Excess aqueous
   │ through calcium    │
   │ hydroxide solution.│    ┌──────────────────┐
   └────────────────────┘    │ White Precipitate│
                             │ which dissolves to│
  Step (III)  Dilute         │ form a colourless │
  acid        sulphuric (VI) │ solution          │
   ┌──────────────────┐      └──────────────────┘
   │ Blue solution S  │
   └──────────────────┘
```

Step (IV) Excess aqueous   Step (V) magnesium powder
           ammonia

┌──────────────┐   ┌──────────────┐
│ Deep blue   │   │ Products   │
│ Solution I   │   └──────────────┘
└──────────────┘

I. a) write the formula of the following:
   (i) Anion in solid Q...................... $O^{2-}_{(aq.)}$ ✓ *statesymbol Must* .... (1 mark)
   (ii) The two salts present in mixture M.   (2 marks)
   .... $ZnSO_4$ ✓ ....
   .... $CuCO_3$ ✓ .... *Reject names* ....

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b) Write an ionic equation for the reaction in step VI. (1 mark)
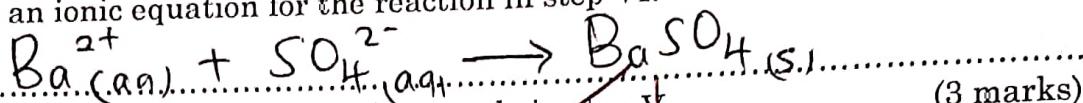
$$Ba^{2+}_{(aq)} + SO_4^{2-}_{(aq)} \longrightarrow BaSO_{4(s)}$$

c) State and explain two observations made in step V. (3 marks)

Blue colour of solution fades.

Deposits of red-brown solid. Magnesium displaces

Copper II ions since it is more reactive than Copper.

II. a) You are provided with copper solid, sodium carbonate solid, dilute hydrochloric acid, distilled water and dilute nitric (v) acid. Describe how you can prepare crystals of copper (II) carbonate. (3 marks)

Clean Copper metal using dilute HCl$_{(aq)}$

React excess Copper with dilute HNO_3; filter and retain the filtrate,

Add distilled water to Na_2CO_3, stir to obtain Na_2CO_3 solution.

Add $Cu(NO_3)_{2(aq)}$ to $Na_2CO_{3(aq)}$ to obtain $CuCO_3$ and $NaNO_{3(aq)}$

filter to obtain $CuCO_{3(s)}$ residue. Wash the residue with

distilled water and dry between filter papers. Award to 3 Max

(b) Name the industrial process by which the sodium carbonate used in II (a) above can be obtained. (1 mark)

Solvay Process

6. (a) From an experiment, 25.0cm³ of hydrochloric acid required 20.0cm³ of 0.02M sodium carbonate for a complete reaction. Calculate:

(i) The number of moles of sodium carbonate used. (1 mark)

$$\text{Moles of } Na_2CO_3 = \frac{20 \times 0.02}{1000} = 0.0004 \text{ moles}$$

(ii) The number of moles of hydrochloric acid used. (1 mark)

$$Na_2CO_{3(aq)} + 2HCl_{(aq)} \longrightarrow 2NaCl_{(aq)} + CO_{2(g)} + H_2O_{(l)}$$
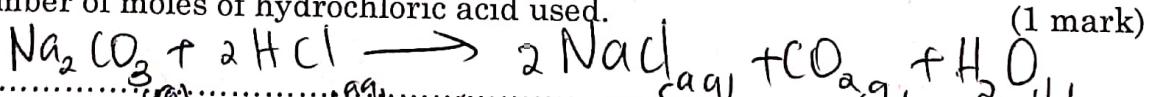
Mole ratio $Na_2CO_3 : HCl$

1 : 2   moles of $HCl = 2 \times 0.0004$

$= 0.0008$ moles

(iii) The molarity of the acid. (1 mark)

$$\text{Molarity} = \frac{0.0008 \times 1000}{25} \quad \checkmark \frac{1}{2}$$

$$= 0.032 \, M \quad \checkmark \frac{1}{2}$$

(b) A solution of sodium hydroxide was found to contain 12.4g/dm³ of sodium hydroxide. 25cm³ of this solution reacted with 15cm³ of a solution of sulphuric (VI) acid. (Na=23.0, H=1.0, S=32.0, O=16.0)   (1 mark)

(i) Find the molarity of the sodium hydroxide solution

R.F.M of NaOH = 23 + 16 + 1 = 40

$$\text{Molarity} = \frac{g/\text{Litre}}{R.F.M} = \frac{12.4}{40} = 0.31 M \quad \checkmark \frac{1}{2}$$

(ii) Calculate the number of moles of sodium hydroxide solution used.   (1 mark)

$$\text{Moles of NaOH} = 0.31 \times \frac{25}{1000} \quad \checkmark \frac{1}{2} = 0.0078 \, \text{moles} \quad \checkmark \frac{1}{2}$$

(iii) Calculate the number of moles of the acid used.   (2 marks)

$$2NaOH_{(aq)} + H_2SO_{4(aq)} \longrightarrow Na_2SO_{4(aq)} + 2H_2O \quad \checkmark 1$$
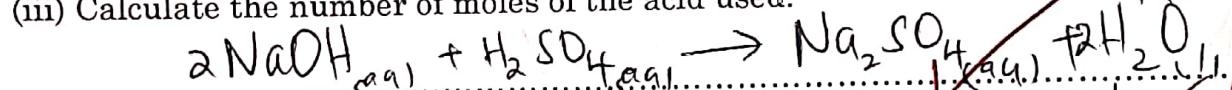
$$\text{Moles of } H_2SO_4 = \frac{0.0078}{2} \quad \checkmark \frac{1}{2} = 0.0039 \, \text{moles} \quad \checkmark \frac{1}{2}$$

(iv) Determine the concentration of the sulphuric (VI) acid solution in g/dm³.   (3marks)

$$R.F.M \ H_2SO_4 = (2\times1) + 32 + (4\times16) = 98 \quad \checkmark \frac{1}{2}$$

$$\text{Molarity of } H_2SO_4 = \frac{0.0039 \times 1000}{15} \quad \checkmark \frac{1}{2}$$

$$= 0.26 M \quad \checkmark \frac{1}{2}$$

$$g/dm^3 = \text{Molarity} \times R.F.M \quad \checkmark \frac{1}{2}$$
$$= 0.26 \times 98$$
$$= 25.48 \, g/dm^3 \quad \checkmark 1$$

(b). (i) State the Charles law.   (1 mark)

The Volume of a fixed mass of gas is directly proportional to its absolute temperature at constant pressure ✓1

(ii) A certain mass of gas occupies 146 dm³ at 291K and 98.31 kPa. What will be its temperature if its volume is reduced to 133dm³ at 101.325 kPa?   (2 marks)

$$T_2 = \frac{P_2 V_2 T_1}{P_1 V_1} = \frac{101.325 \times 133 \times 291}{98.31 \times 146} \quad \checkmark 1 = 273.219 \, K \quad \checkmark 1$$

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7. (a) Define a saturated solution. (1 mark)

A solution that cannot dissolve anymore solute at a particular temperature. Reject any temperature

(b) The table below represent the solubilities of sodium nitrate and Sulphur (IV) oxide at different temperatures.

Temperature (ºC)	10	18	26	34	42
Solubility of sodium nitrate (g/ 100g of water)	20	29	40	53	68
Solubility of sulphur (IV) oxide (g/ 100g of water)	78	55	45	40	36

On the grid provided below, plot a graph of solubilities of sodium nitrate and Sulphur (IV) oxide against temperature. (4 marks)
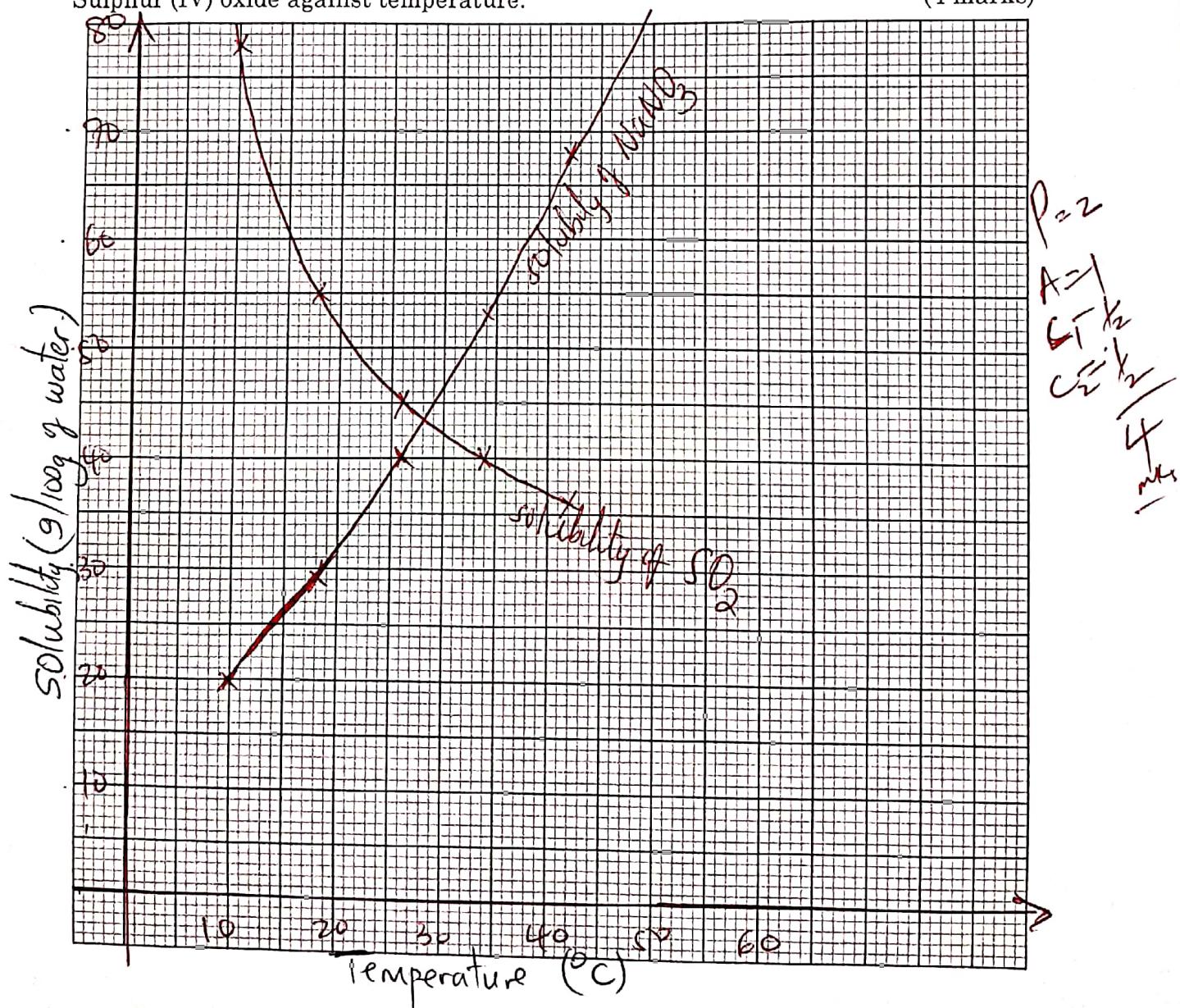
Using the graph;

i. Determine the solubility of Sulphur (IV) oxide at 16°C. (½ mark)

......58g/100g of water. ✓ ½ Must show on graph.

ii. The concentration, in moles per litre, of sodium nitrate at 16 °C. (assume density of solution is 1 g/cm³) (Na=23, O=16, N=14). NaNO₃ (3 marks)

at 16°C 27g/100g of water ✓ ½ | RFM = 23+14+16×3 ✓ ½

100 cm³ = 27g

= $\frac{100 cm³ × 27g}{100cm³}$ = 270g ✓

| = 85

Moles = $\frac{270}{85}$ = 3.176M ✓
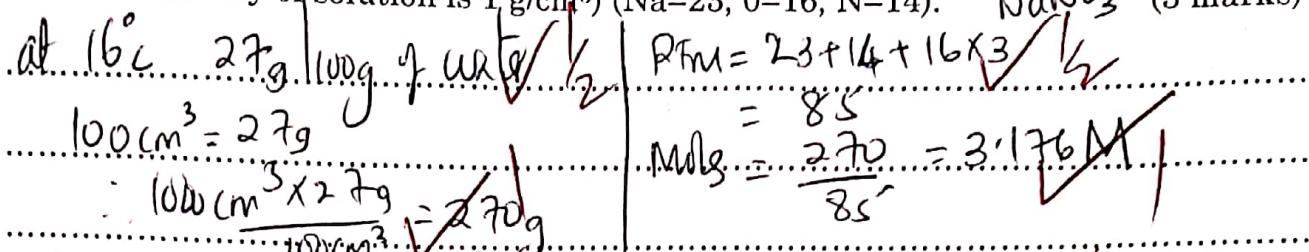
iii. Mass of crystals formed when a solution of sodium hydroxide is cooled from 40°C to 26°C. (2 marks)

at 40°C = 63g/100g water ✓ ½   26°C = 40g/100g of water

Mass = 63 - 40 = 23g ✓ ½
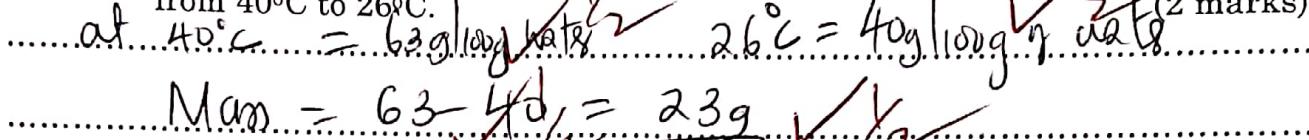
iv. What is the relationship between solubility of sodium nitrate and temperature? (1 mark)

As temperature increases, solubility of NaNO₃ increases. ✓

(c) Give one advantage of hard water. (½ mark)

Provides Calcium - essential nutrient / used in brewing ✓ ½

(d) Explain why the reaction between 1g of sodium carbonate with 2M hydrochloric acid is faster than between 1g of sodium carbonate with 2M ethanoic acid. (1 mark)

HCl is a strong acid, CH₃COOH is a weak acid ✓

CH₃COOH partially dissociates while HCl dissociate fully; some energy is used in fully ionising CH₃COOH. ✓