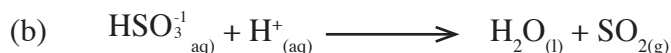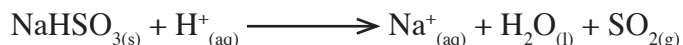**4.6   CHEMISTRY (233)**

4.6.1 Chemistry Paper 1 (233/1)

1.   Increasing the size of the air hole/increase the amount of air/open air holes competely.   (1)

2.   (a) HSO_3^- (1)

(b) $HSO_{3\ (aq)}^{-1} + H^+_{(aq)} \longrightarrow H_2O_{(l)} + SO_{2(g)}$

or

$NaHSO_{3(s)} + H^+_{(aq)} \longrightarrow Na^+_{(aq)} + H_2O_{(l)} + SO_{2(g)}$

3.   (a)   • The anhydrous copper (II) Sulphate turns from white to blue. (1)

• A grey solid is formed/droplets of a colourless liquid condense at cool part.(1)

(b)   Reducing property.(1)

4.   • Add soluble carbonate/Add soluble hydroxide.   (1)
• Filter out the zinc carbonate/filter the zinc hydroxide.   (1)
• Heat strongly the $ZnCO_3$ to decompose it to form ZnO/Heat strongly the $Zn(OH)_2$ to decompose it to form ZnO.   (1)

OR

-       Heat to evaporate the water. (1)
-       Heat $ZnSO_4$ solid to decompose (1) to form ZnO/yellow solid. (1)

5.   (a)   delocalised electrons. (1)

(b)   ions in the melt. (1)

6. $\dfrac{T_1}{T_2} = \sqrt{\dfrac{M_1}{M_2}}$ (½)   Ethane $(C_2H_6) = 30$ (½)

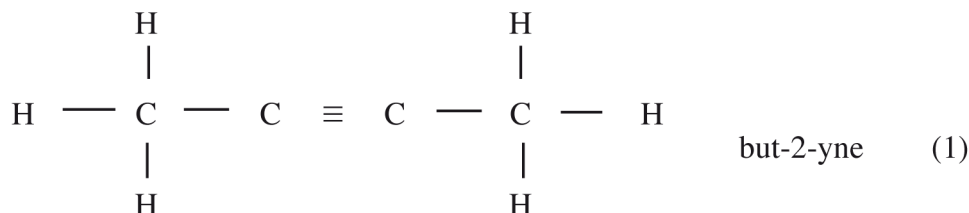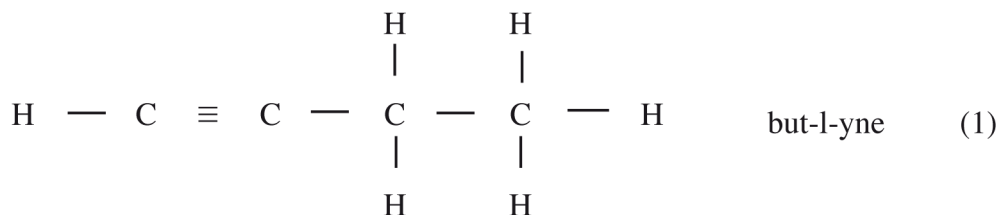$\left(\dfrac{121}{100}\right) = \sqrt{\dfrac{Q}{30}}$ (1)

$\left(\dfrac{121}{100}\right)^2 = \dfrac{Q}{30}$
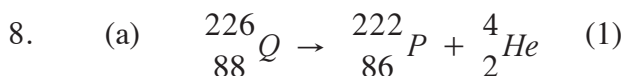
$\left(\dfrac{121}{100}\right)^2 x\ 30 = Q$

        43.923 = Q
        44 = Q   (1)

7. (a)

$$H - C \equiv C - C - C - H \qquad \text{but-l-yne} \qquad (1)$$

(with H atoms on the third and fourth carbons, top and bottom)

$$H - C - C \equiv C - C - H \qquad \text{but-2-yne} \qquad (1)$$

(with H atoms on the first and fourth carbons, top and bottom)

(b) Used in packaging - cushions electronics in boxes/insulation/models/ceiling strips/ crates or binding. (1)

8. (a) $\quad ^{226}_{88}Q \rightarrow \ ^{222}_{86}P + \ ^{4}_{2}He \quad$ (1)

(b) (i) Cobalt 60 is used to detect the activity of the thyroid gland. (1)

(ii) To sterise equipment/treatment of cancer/radio active Na for disorders in blood circulation/Barium meal for ulcers/detect fractures in bones. (1)

9. The molecules of ethanoic acid interact through strong hydrogen bonding (1) forming a dimer while molecules of pentane have weak van der waals forces. (1) NB/ Ethanoic acid has hydrogen bonds while pentane does not have.

10. (a) Roast ore in air/heat in air. (1)

$$2CuFeS_{2(s)} + 4O_{2(g)} \longrightarrow Cu_2S_{(s)} + 2FeO_{(g)} + 3SO_{2(g)}$$
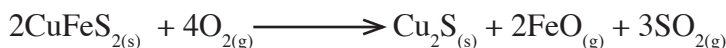
(b) • Acid rain that corrodes stone work on buildings/land gulleys/dust pollution. (1)

• SO2 when breathed in causes bronchitis/chlorosis in plants. (1)

11. Z is SO_2/ sulphur (IV) oxide. (1)

M is H_2SO_3/ sulphuric (IV) acid. (1)

12. A (1) and D (1)
A is acidic it will neutralise $Pb(OH)_{2(aq)}$ to form salt and water, ($\frac{1}{2}$)
D is a strong base it will react with $Pb(OH)_{2(aq)}$ to form a complex ion. ($\frac{1}{2}$)
Lead (II) hydroxide is amphoteric.

13. Moles of NaOH $\frac{18}{1000} \times 0.1 = 0.0018$ $(\frac{1}{2})$

Moles of acid $\frac{18}{1000} \times 0.1 \times \frac{1}{2} = 0.0009$ $(\frac{1}{2})$

Moles in 100 cm³

$\frac{18}{1000} \times 0.1 \times \frac{1}{\cancel{2}} \frac{\cancel{100}^{\cancel{4}^{2}}}{25} = 0.0036 \ moles$ $\quad 0.0036 \times \frac{100}{25}$ $\quad (\frac{1}{2})$

Ratio of acid : Carbonate

   1 : 1

Original moles of acid $= \frac{100}{1000} \times 0.05$

$= 0.005 /0.53g$ $\quad (\frac{1}{2})$

$0.005 - 0.0036 = 0.0014$ moles $/ 0.3816g$ $\quad (\frac{1}{2})$

Mass of $Na_2CO_3 = 0.0014 \times 106 / 0.53 - 0.3816$

$= 0.1484 \ g = 0.1484 \ g$ $\quad (\frac{1}{2})$

14. (a) Total volume of solution $= 40 \ cm^3 / 40 \ g$ $\quad (\frac{1}{2})$

$\Delta H = 40 \times 6.7 \times 4.2$ $\quad (\frac{1}{2})$

$= 1125.6/1000$

$= 1.1256 \ KJ$

Moles of acid $\frac{20}{1000} \times 1 = 0.02 \ moles$ $\qquad \frac{1125.6}{0.02}$ $\quad (\frac{1}{2})$

0.02 moles $= \quad 0.1256 \ KJ$

   1 mole $= \frac{1.1256}{0.02}$ $(\frac{1}{2})$ $\qquad$ -56280 j/mol $(\frac{1}{2})$

$= -56.28 \ KJ / mol$ $(\frac{1}{2})$

(b)   Some energy is used to ionise the weak acid first before it can neutralise. So not all energy is used in neutralisation. (1)

15.   (a) $3CuO_{(s)} + 2NH_{3(g)} \longrightarrow 3Cu_{(s)} + N_{2(g)} + 3H_2O_{(l)}$ (1)

    (b)   It changed purple (1)

        The excess ammonia makes solution basic which turns purple with universal indicator.
    (1)

16.   (a)   (i)   It turned brown /blue/violet/green. (1)

        (ii)   The water level rose up the gas jar/occupy space left by reacted O_2. (1)

    (b)   The brown colour would be more since the salt accelerates rusting/rust faster. (1)
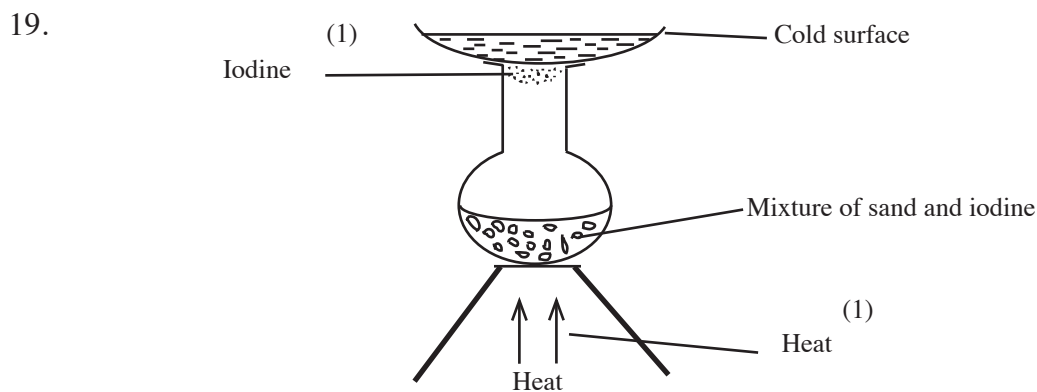
17.   (a)   Rate increases.   (1)

    (b)   Temperature increases the kinetic energy (1) of the particles increasing the number of collisions. (1)
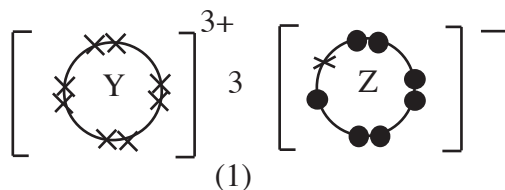
18.   (a)   N (1)

    (b)   R (1)

    (c) M_3N_2 (1)

19.

20.   Vanadium (V) oxide is cheaper (1) and is not easily poisoned by impurities. (1)

21.   Y = 2.8.3   Z = 2.7   (1)

$$\left[\begin{array}{c} Y \end{array} \right]^{3+}_{} 3 \quad \left[\begin{array}{c} Z \end{array} \right]^{-}$$

(1)

22.   (a)   Condensation of alcohol with higher boiling point so that it runs back to the flask as the alcohol with lower boiling point distills over. (1)

       (b)   Methanol. (1) It has a lower boiling point due to the size of carbon chain when compared with propanol. (1)

23.   (a)   Step 1 is neutralisation. (1)

       (b)   Step II is soda lime/ mixture of NaOH and CaO. (1)

       (c)   Fuel/making ethene/making hydrogen gas. (1)

24.   (a)   Anode - Oxygen /O_2 (1)

              Cathode - Hydrogen / H_2 (1)

       (b) $2Cl^-_{aq)} \longrightarrow Cl_{2(g)} + 2e$

25.

	C	H	Cl	
Mass(g)	37.21	7.75	55.04	$(\frac{1}{2})$
	$\dfrac{37.21}{12}$	$\dfrac{7.75}{1}$	$\dfrac{55.04}{35.5}$	$(\frac{1}{2})$
Moles	$\dfrac{3.10}{1.55}$	$\dfrac{7.75}{1.55}$	$\dfrac{1.55}{1.55}$	$(\frac{1}{2})$
Ratio	2 :	5 :	1	

Empirical formula C_2H_5Cl $(\frac{1}{2})$
Empirical mass   = $2 \times 12 + 5 + 35.5 = 64.5$
                64.5n =   65
                   n =   65/64.5
                   n =   1 $(\frac{1}{2})$

          $\therefore$ molecular formula = C_2H_5Cl $(\frac{1}{2})$

26. Natural polymers are biodegradable (1) and are expensive. (1)
   Affected by acids/Not easily recyled.

27. (a) Acetone / ethanol / propanone / propanol. (1)

   (b) The solvent dissolves the organic compound indicator present in the flowers / it is an
   organic solvent. (1)

28. (a) It absorbs carbon (IV) oxide present in the air. (1)

   (b) Copper /$Cu_{(s)}$ (1)

   (c) It has rare noble gases which have not been removed / Argon. (1)

29. (a) A radical is a compound formed when elements combine to form ions / free unstable
   atoms or molecules / a group of free unstable atoms exist in a compound /group of
   atoms with a common charge. (1)

   (b)

Element	N	S
H	NH_4^+	////////////
O	NO_2^- NO_3^- (1)	SO_3^{2-}; $S_2O_3^{2-}$ SO_4^{2-}; $S_2O_7^{2-}$ (1)

30. (a) A colourless gas is formed /chlorine water decompose to give oxygen $(\frac{1}{2})$
   The colour of solution changes from green to colourless / chlorine water becomes
   hydrochloric acid. $(\frac{1}{2})$
   The level of solution in the gas jar drops oxgen formed occupies space pushing water
   downwards. $(\frac{1}{2})$

      (choose any 2)

   (b) $6KOH_{(aq)} + 3Cl_{2(g)} \longrightarrow KClO_{3(aq)} + 5KCl_{(aq)} + 3H_2O_{(l)}$ (1)

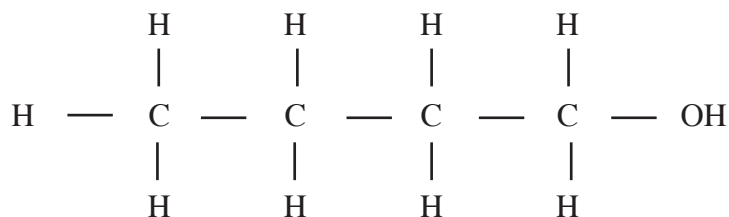## 4.6.2 Chemistry Paper 2 (233/2)
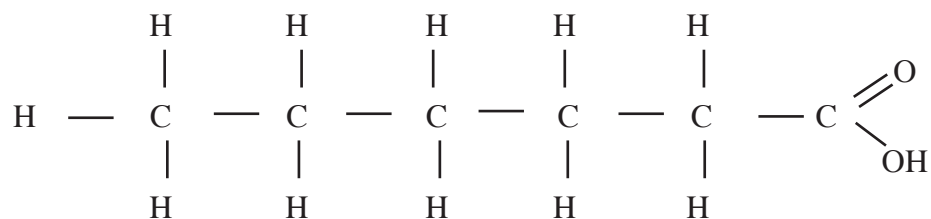
1. (a) (i)   Sodium chloride / potassium chloride /rock salt.

                                                                            (1 mark)
        (ii) Concentrated sulphuric (VI) acid   (1 mark)

        (iii) Grey solid turns green   (1 mark)

        (iv) $Fe_{(s)} + 2\ HCl_{(g)} \longrightarrow FeCl_{2(s)} + H_{2(g)}.$ (1 mark)

        (v)   To avoid explosion.   (1 mark)

    (b) (i) I   The gas reacts with silver nitrate to form insoluble silver chloride.

                                                                            (1 mark)

                  II   Both gases form ammonium chloride which is white.

                                                                            (1 mark)

        (ii) -   To make hydrochloric acid.
              -    Manufacture of ammonium chloride.
              -    Manufacture of PVC.
              -    Making chloroethene /vynil chloride   (1 mark)

    (c) (i) Q is $Ca(OH)_2$ (aq) /calcium chloride   (1 mark)

        (ii) Presence of Ca^{2+} which make water hard / forms scum.

                                                                            (1 mark)

2. (a) (i) K - Has largest atomic radius / it most readily loses its outermost electron.

        (ii) B /N   (1 mark)

        (iii) D / Mg   (1 mark)

        (iv) A $^{(1)}$ It has the smallest/smaller atomic radius/ its outermost electron is
              more/most strongly held by nucleus.$^{(1)}$
                                                                            (2 marks)

        (v) P^H is seven (7). The chlorides of group 1 elements are neutral salts.
                                                                            (2 marks)

    (b) (i) Both $CaCl_2$ and $MgCl_2$ have mobile ions in molten state $^{(1)}$ while both CCl_4 and
              $SiCl_4$ are molecular compounds with no mobile ions $^{(1)}$.

        (ii) Neon has molar mass of 20 while Flourine has a molar mass of 38 (1).
              Therefore Neon diffuses faster. $^{(1)}$ Since it has a lower molecular mass the
              faster the rate of diffusion.

3.   (a)   (i)

$$H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - OH$$

(1 mark)

$$H - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - \underset{\underset{H}{|}}{\overset{\overset{H}{|}}{C}} - C \overset{O}{\underset{OH}{\diagdown}}$$

(1 mark)

(b)   (i)   Yeast/enzymes/zymase/temperature of 35 - 40 °C.   (2 marks)

(ii)   Acidified $KMnO_4$ or $K_2Cr_2O_7$ (1 mark)

(iii)   P = Ethene / C_2H_4 (1 mark)

T = Methane / CH_4 (1 mark)

(iv)   Addition of CaO or NaOH   (1 mark)

(v)   Converting oils into fats.   (1 mark)
Manufacture of mangarine /hardening oils.

(c) $CH_3 CH_2 OH \longrightarrow$ 1370 kJ$^{(1)}$

R.M.M. of CH3CH2OH $46^{(\frac{1}{2})}$

1 litre (780g) = $\dfrac{1370 \times 780}{46}$ (1)

= 23,230.43 kj $^{(\frac{1}{2})}$

(d)   Fuel
Solvent
Anti-septic
Manufacture of synthetic fibres
Manufacture of gasohol

Manufacture of ethanoic acid/vinegar
Used in themometers
Manufacture of other organic compounds.
Any 2 (2 marks)

4. (a) - Pressure
   - Concentration
   - Catalyst
   - Particle size/surface area
   - Light intensity (1 mark)

   (b) (i) Draw a tangent to the graph at 12 min. (1)
       Determine change in volume$(\frac{1}{2})$ /Calculate gradient.
       Determine change in time.$(\frac{1}{2})$
       Divide change in volume by change in time (1)

   (ii) AB Low production of gas(1) while BC the rate is very high because

   catalyst B was added. (1)

   (iii) $2H_2O_{2(aq)} \longrightarrow O_{2(g)} + 2H_2O_{(l)}$ (1)

   (c) (i) Lowering the temperature shifts the equilibrium to the right /favours the
       forward reaction. (1) Hence more SO_3 will be produced. (1)

   (ii) Platinum or Vanadium pentoxide/vanadium (v) oxide / V_2O_5/ platinised
       asbestos
                    any (1 mark)

5. (a) (i) Cation present in solution **D** is H^+ (1 mark)

   (ii) $Ba^{2+}_{(aq)} + SO^{2-}_{4(aq)} \longrightarrow BaSo_{4(s)}$ (1)

   (iii) Zinc disappears /zinc dissolves.
        Blue colour disappears and brown solid is deposited.(1)
        Zinc being more reactive than copper displaces /Cu^{2+} ions from solution, copper
        which is brown is formed.(1)

        Apparatus feels warm/reaction is exothermic.

   (iv) The reaction forms $CaSO_4$ which is insoluble (1) the insoluble $CaSO_4$
        coats the surface of calcium preventing further reaction. (1)

   (v) Making plaster of paris / making plaster. (1)

(b)   Dissolve sodium chloride in distilled water. $(\frac{1}{2})$ Add aqueous lead nitrate. (1)
Filter the mixture, $(\frac{1}{2})$ wash residue with distilled water. $(\frac{1}{2})$
Dry residue in oven at controlled temperatures/ between filter papers.$(\frac{1}{2})$

(c)   (i)   It absorbs moisture/water. / deliquescent / hygroscopic (1)

       (ii)   Conc. H_2SO_4 (1) / $H_2SO_{4(l)}$ / concentrated sulphuric (VI) acid/

6.
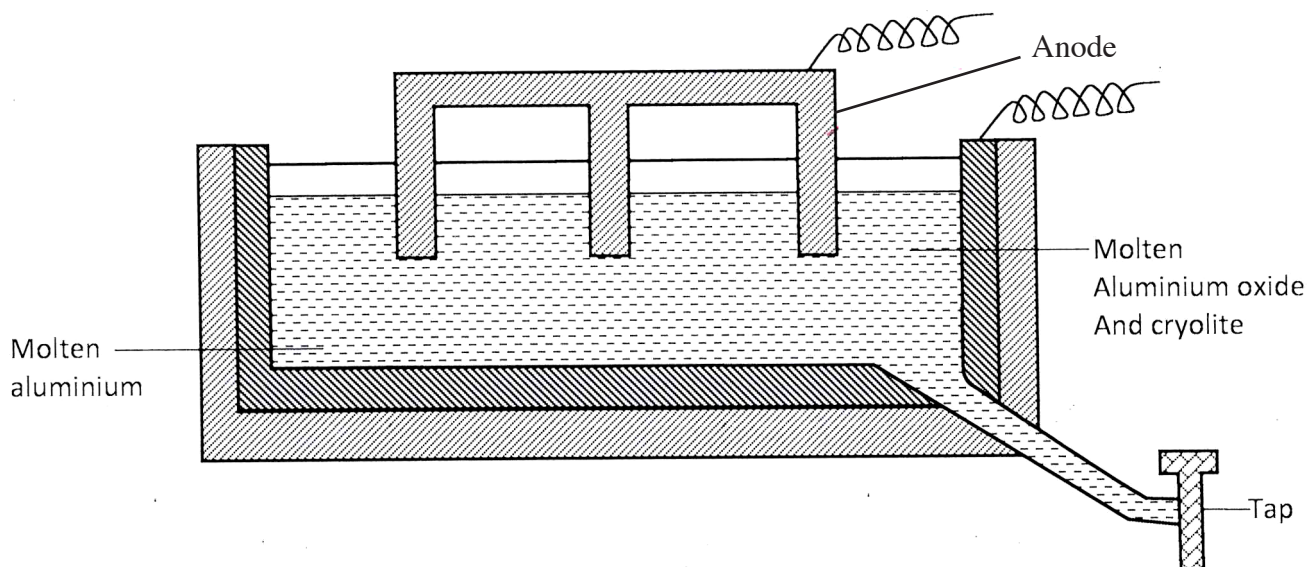
(a)   On the diagram (1)

(b) $2O^{2-}_{(l)} \longrightarrow O_{2(g)} + 4e$ (1)

(c)   Below 950 °C, the electrolyte is not in molten state.(1)

(d)   Aluminium is more reactive than carbon (coke)(1) therefore the reduction process is not possible / carbon / carbon (II) oxide / coke cannot reduce Al_2O_3.

(e)   -   Aluminium is less reactive than Sodium (1) ∴ It is preferentially discharged.

       -    Al^{3+} ions are in higher concentration than Na^+.(1)

(g)   -   Global warming due to production of CO_2 / F_2 pollution. (1)

       -    Creation of gullies during excavation. (1)

(f)   -   Light (1)

       -    Strong (1)
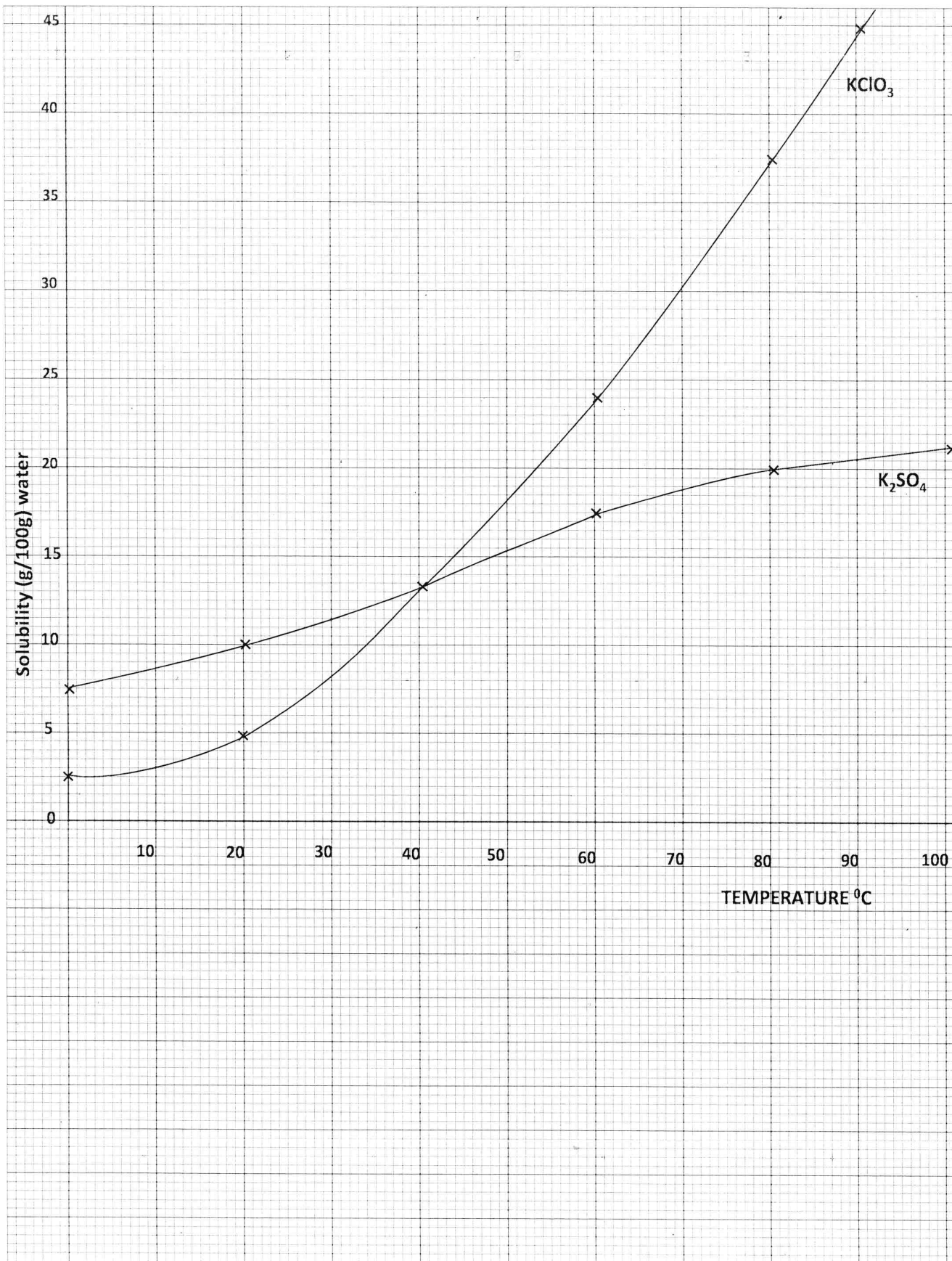
7. (a) Solvent molecules move further apart hence more solid particles dissolve / creating more space for solid particles[1]

∴ The solubility increases.[1]

(b) (i)   (3 marks)

(ii) (I) Value read from the graph [1]

(II) 10.5 g (value read) (1)

(iii) Salt identified from the graph [1]

(iv) Solubility of $K_2SO_4 = 12.8$ $(\frac{1}{2})$ g/100 g

$$\text{Mass of } K_2SO_4 \text{ in 100 cm}^3 = \frac{12.8 \times 1000}{100} \; (\tfrac{1}{2})$$

$$= 128 \text{ g} \; (\tfrac{1}{2})$$

Molar mass of $K_2SO_4 = 174\text{g}$ $(\tfrac{1}{2})$

$$\text{Conc of } K_2SO_4 = \frac{128}{174} \; (\tfrac{1}{2}) = 0.7356M \; (\tfrac{1}{2})$$

(v)
Filter crystals of K_2SO_4 $(\tfrac{1}{2})$
Dry between filter papers. $\tfrac{1}{2}$)

4.6.3 Chemistry Practical Paper 3 (233/3)

1. **Table 1**

	I	II	III
Final burette reading	41.20	19.20	38.00
Initial burette reading	22.00	0.10	19.00
Volume of solution K used (cm³)	19.20	19.10	19.00

(3 marks)

(i) Average $\dfrac{19.2 + 19.1 + 19.0}{3}$ = 19.10 cm³

(1 mark)

(ii) Moles of Sodium thiosulphate $= \dfrac{19.1 \times 0.1}{1000}$ (1)

$= 0.00191$ (1)

∴ Moles of Copper ions in 25 cm³ $= 0.00191$

Moles in 250 cm³ $= 0.00191 \times 10$

$= 0.0191$ (1)

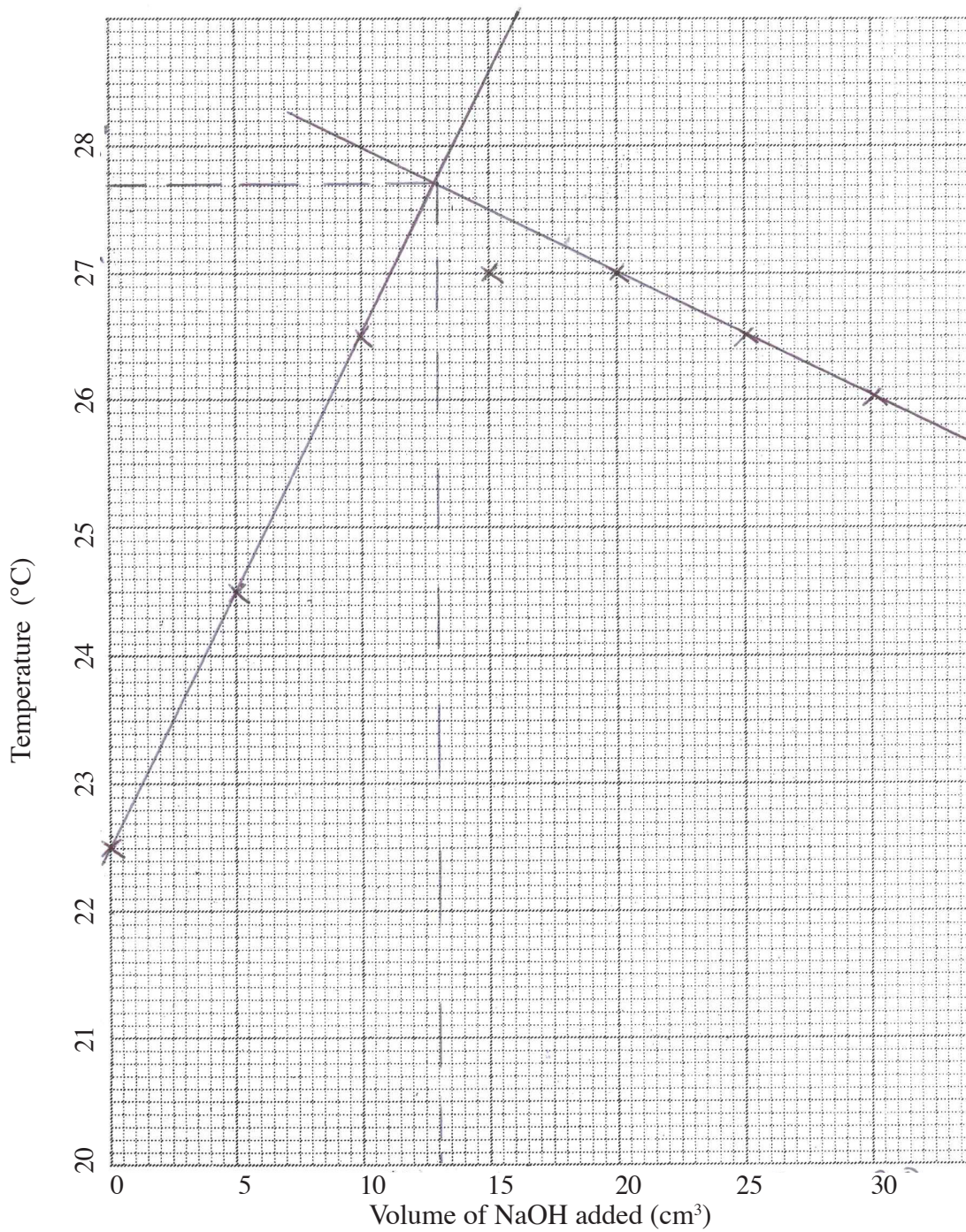Concentration of Copper ions $= \dfrac{0.0191 \times 1000}{25}$ (1)

$= 0.764$ M ($\frac{1}{2}$)

2. **Table 2**

Volume of NaOH added (cm³)	0	5	10	15	20	25	30
Maximum Temperature (°C)	22.5	24.5	26.5	27.0	27.0	26.5	26.0

(3½ marks)

(i) Graph

Temperature (°C) vs Volume of NaOH added (cm³)

(3 marks)

(ii)   I   13.0 ± 0.2   1 mark for working

                                                                    1 mark for value

        II $\triangle T = 5.2\,°C \pm 0.1$ 1 mark

(ii) $\triangle H = 33 \times 5.2 \times 4.2$

        $= 720.72\,J$ (1)

416

$$\text{Moles of } Cu^{2+} = \frac{20 \times 0.764}{1000}$$

$$= 0.01528 \qquad (\frac{1}{2})$$

$$1 \text{ mole} \qquad = \frac{720.721}{0.01528} \quad (1)$$

$$= -47.2 \text{ KJMol}^{-1} \qquad (\frac{1}{2})$$

2. (a) White crystalline substance. (1 mark)

(b) **Observations** **Inferences**

Colourless liquid condenses on the cool parts of T-Tube leaving behind a white solid

Hydrated salt or salt contains water of crystallisation

(1 mark) (1 mark)

(c) Solid dissolves to form colourless solution.

P is soluble in water
No coloured ions

(1 mark) (1 mark)

(d) (i) White PPt formed

SO_4^{2-}, SO_3^{2-} or CO_3^{2-} present

(1 mark) (2 marks)

(ii) No effervescence or no bubbles

SO_4^{2-}, present or SO_3^{2-} or CO_3^{2-} absent

(1 mark) (1 mark)

(iii) White PPt

Mg^{2+} present

(1 mark) (1 mark)

(e) Cation

Mg^{2+} or Magnesium ions $(\frac{1}{2})$

anion

SO_4^{2-} or Sulphate ions $(\frac{1}{2})$

3.   (a)

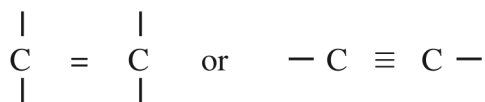| **Observations**	**Inferences**

Burns with a yellow sooty
flame or luminous flame.

$$\begin{array}{ccc} | & & | \\ C & = & C \\ | & & | \end{array} \quad \text{or} \quad -C \equiv C-$$

Organic compound with high
C:H ration
aromatic compound, long chain
organic compound.

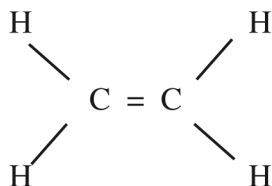(1 mark)   (1 mark)

(b)   (i) Efferescence observed

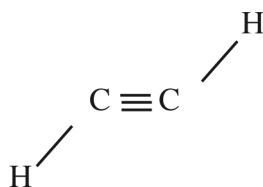Has a - COOH group
or carboxylic/alkanoic acid.

(1 mark)   (1 mark)

(ii) Decolourised

Could be an alcohol or has

$$\begin{array}{cc} H & \quad H \\ \diagdown & \diagup \\ C & = C \\ \diagup & \diagdown \\ H & \quad H \end{array}$$

or

$$\begin{array}{cc} & H \\ & \diagup \\ C \equiv C & \\ \diagup & \\ H & \end{array}$$

(1 mark)   (1 mark)