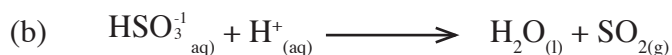## 4.6 CHEMISTRY (233)

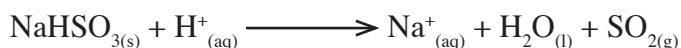### 4.6.1 Chemistry Paper 1 (233/1)

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)

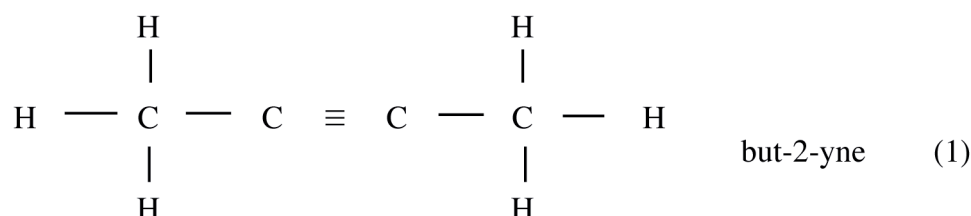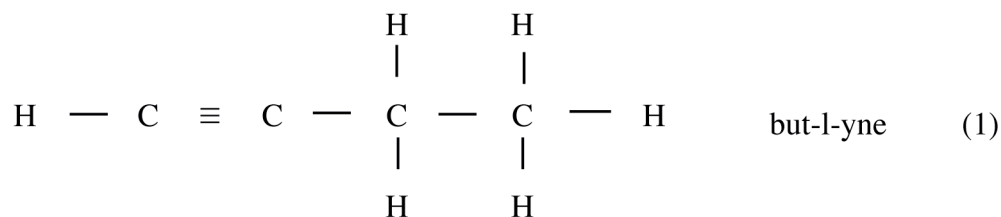   $\left(\dfrac{121}{100}\right) = \sqrt{\dfrac{Q}{30}}$ (1)

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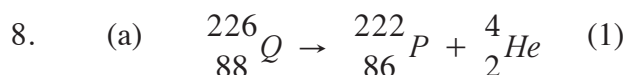
   $\left(\dfrac{121}{100}\right)^2 x\ 30 = Q$

   $43.923 = Q$
   $44 = Q$ (1)

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7. (a)



but-l-yne (1)



but-2-yne (1)

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

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

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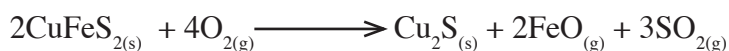
(b) • Acid rain that corrodes stone work on buildings/land gulleys/dust pollution. (1)

• 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 $\dfrac{18}{1000} \times 0.1 = 0.0018$ $(\frac{1}{2})$

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

Moles in 100 cm³

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

Ratio of acid : Carbonate

   1 : 1

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

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

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

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

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

14.  (a)  Total volume of solution $= 40$ cm³ / 40 g $(\frac{1}{2})$

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

$= 1125.6/1000$

$= 1.1256$ KJ

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

0.02 moles $=$ 0.1256 KJ

1 mole $= \dfrac{1.1256}{0.02}$ $(\frac{1}{2})$ $\qquad$ -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)
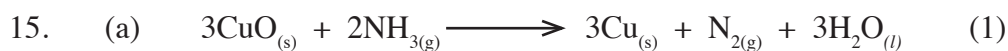
    (b)    It changed purple  (1)

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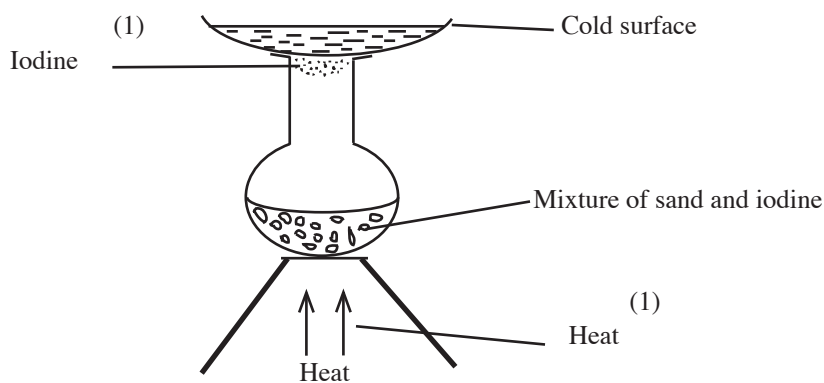
    (b)    Temperature increases the kinetic energy (1) of the particles increasing the number of collisions. (1)

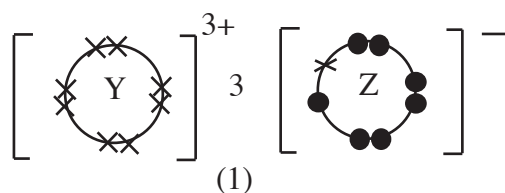18.    (a)    N (1)

    (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)

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

(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)     $2Cl^-_{aq)} \longrightarrow Cl_{2(g)} + 2e$
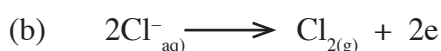
25.

|  | 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 x 12 + 5 + 35.5  =  64.5
              64.5n  =     65
                  n  =     65/64.5
                  n  =     1          $(\frac{1}{2})$

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

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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 | $NO_2^-$<br>$NO_3^-$<br>(1) | $SO_3^{2-}$; $S_2O_3^{2-}$<br><br>$SO_4^{2-}$; $S_2O_7^{2-}$<br>(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. $(\frac{1}{2})$
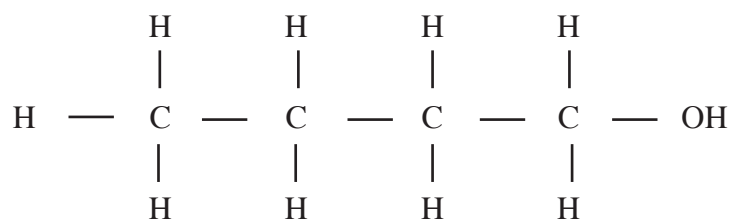
            (choose any 2)

        (b)     $6KOH_{(aq)} + 3Cl_{2(g)} \longrightarrow KClO_{3(aq)} + 5KCl_{(aq)} + 3H_2O_{(l)}$     (1)
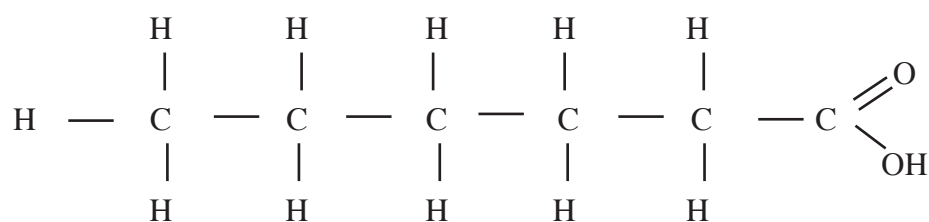
### 4.6.2 Chemistry Paper 2 (233/2)

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.

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3.   (a)   (i)

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

(1 mark)

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

(1 mark)

(b)   (i)   Yeast/enzymes/zymase/temperature of 35 - 40 $^{o}$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

410

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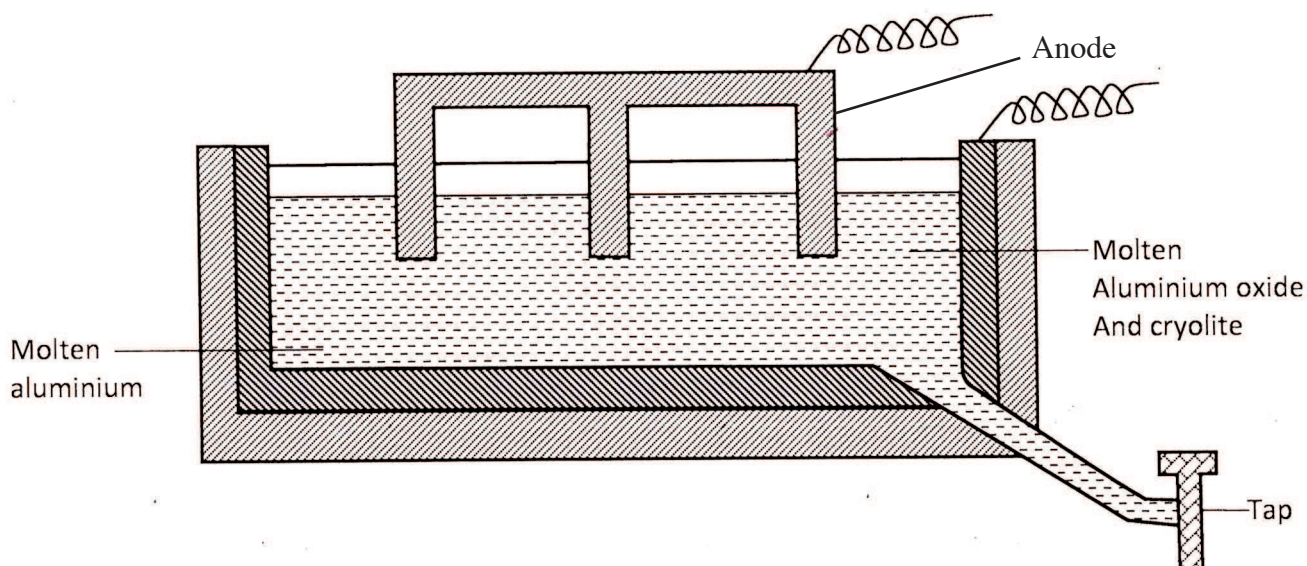Used in themometers
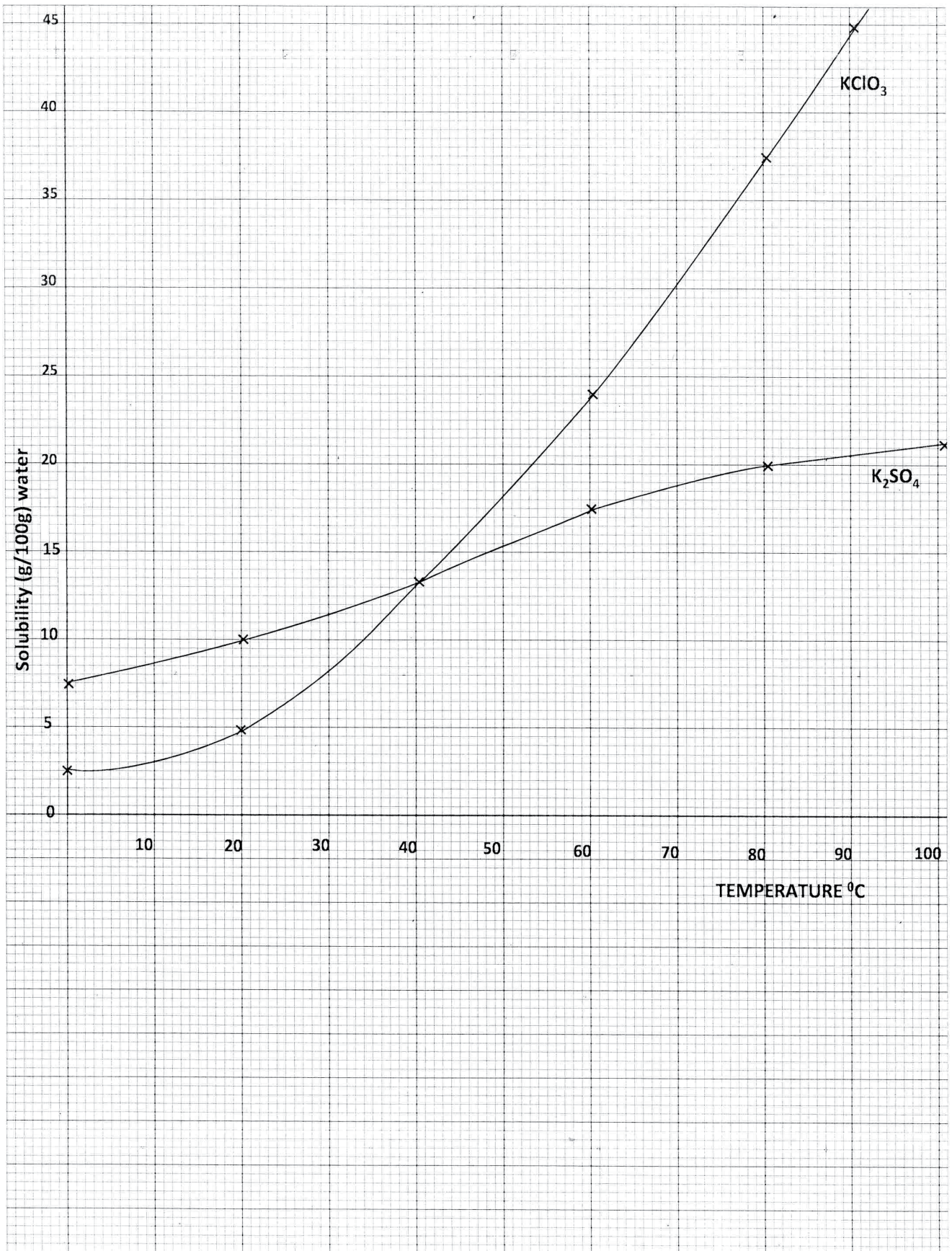Manufacture of other organic compounds.
Any 2 (2 marks)

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 ºC, 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 $^{(1)}$ $\therefore$ 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 $^{(1)}$

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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

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

   $$= 128 \text{ g} \left(\frac{1}{2}\right)$$

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

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

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

### 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 (cm$^3$) | 19.20 | 19.10 | 19.00 |

(3 marks)

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

(1 mark)

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

$= 0.00191$   (1)

$\therefore$ Moles of Copper ions in 25 cm$^3$ $= 0.00191$

Moles in 250 cm$^3$ $= 0.00191 \times 10$

$= 0.0191$   (1)

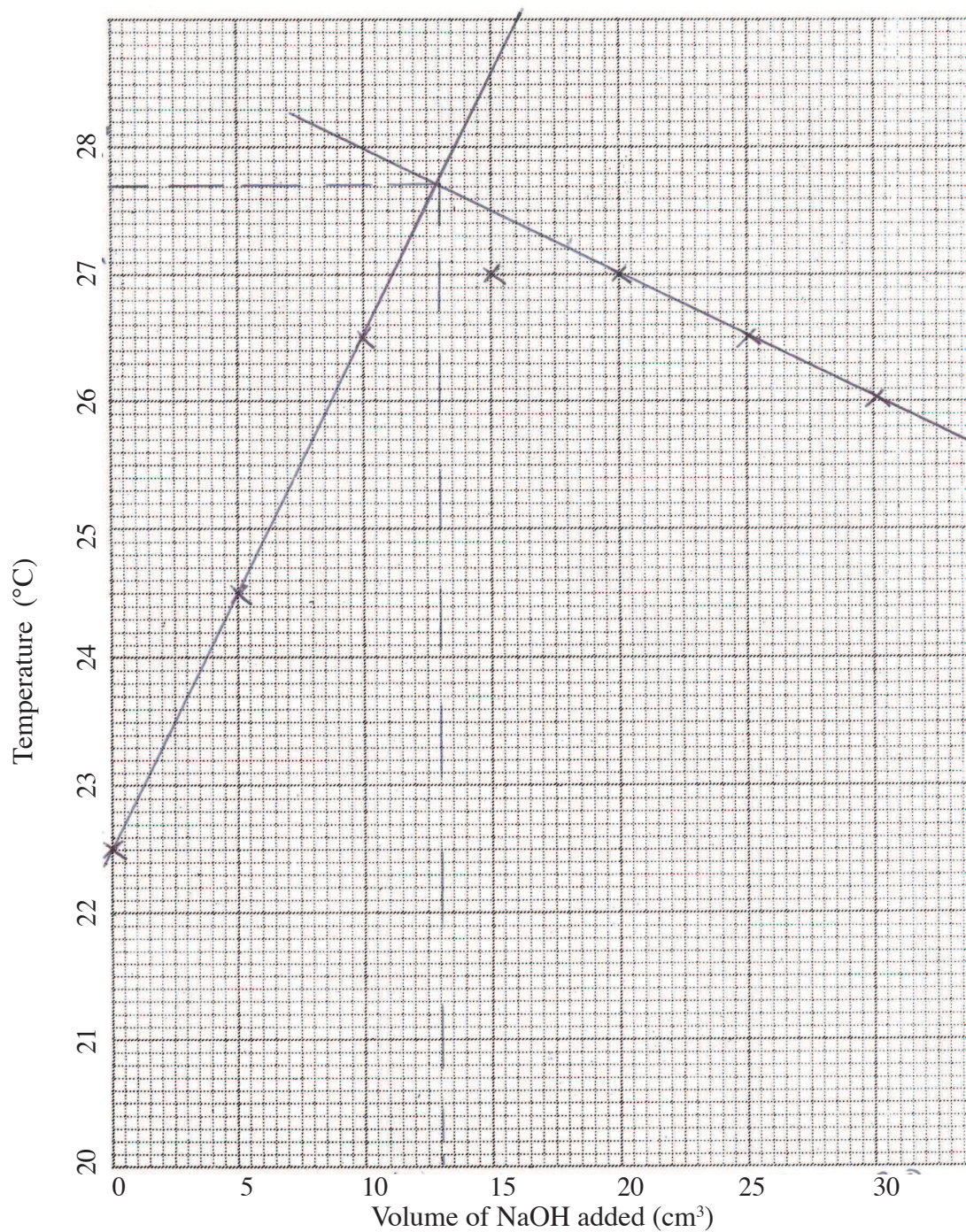Concentration of Copper ions $= \dfrac{0.0191 \times 1000}{25}$   (1)

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

2. **Table 2**

| Volume of NaOH added (cm$^3$) | 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

Graph of Temperature (°C) against 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)

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

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

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

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

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

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

| 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 ($\tfrac{1}{2}$)
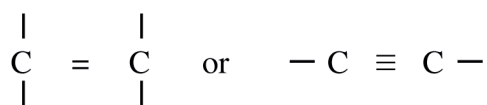
      anion — $SO_4^{2-}$ or Sulphate ions ($\tfrac{1}{2}$)

3.    (a)

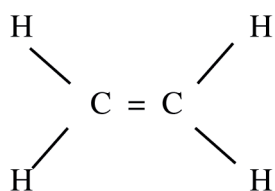| Observations | Inferences |
|---|---|
| Burns with a yellow sooty flame or luminous flame. | $\underset{\mid}{\overset{\mid}{C}} = \underset{\mid}{\overset{\mid}{C}}$  or   $- C \equiv C -$ <br><br>Organic compound with high C:H ration aromatic compound, long chain organic compound. |
| (1 mark) | (1 mark) |

(b)    (i)  Efferescence observed
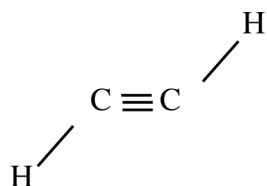
Has a - COOH group
or carboxylic/alkanoic acid.

(1 mark)                    (1 mark)

(ii)  Decolourised

Could be an alcohol or has

$$\underset{H}{\overset{H}{\diagdown}} C = C \underset{H}{\overset{H}{\diagup}}$$

or

$$\underset{H}{\overset{}{}} C \equiv C \overset{H}{\diagup}$$

(1 mark)                    (1 mark)