4.6 CHEMISTRY (233)

4.6.1 Chemistry Paper 1 (233/1)

1. (a) X is water. : (1) or H_2O

   (b) It is slightly soluble in water. : (1) and denser than air.

   (c) · Used in hospitals to resuscitate patients. : (½)
   · Used in welding when mixed with acetylene in the ocy-acetylene flame. : (½)
   · Used by divers and mountaineers.
   · Rocket fuel, hospitals for breathing, steel making.

2. (a) $2NaHCO_{3(s)} \xrightarrow{heat} Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(g)}$: (1)

   (b) $2AgNO_{3(s)} \rightarrow Ag_{(s)} + 2NO_{2(g)} + O_{2(g)}$: (1)

   (c) $2FeSO_{4(s)} \rightarrow Fe_2O_{3(s)} + SO_{2(g)} + SO_{3(g)}$: (1)

3. · Crush the seeds in a mortar : (½) using a pestle.
   · Add a suitable solvent (acetone / propanone : (½)).
   · Filter out the solid matter. : (½)
   · Evaporate the filterate to obtain oil. : (½)

4. (a) Aluminium has a stronger metallic : (1) bond because it has more delocalised electrons than sodium. : (½)

   (b) Sulphur has a ringed structure of S_8 : (1) molecules whiles chlorine is diatomic. The forces in sulphur are stronger than chlorine. : (½)

5. (a) It does not sublime. : (1)

   (b) Cut a piece of Sodium : (½) metal, place it on a deflagrating spoon, heat it briefly : (½) then lower it : (½) into a gas jar of chlorine . It will continue burning forming Sodium Chloride. : (½)

6. (a) $Cu^{2+}_{(aq)} + 2e \rightarrow Cu_{(s)}$: (1)

   (b) 63.5 g require 2 x 96500 C

   $$1.184g = \frac{2 \times 96500 \times 1.184}{63.5}$$

   3598.6 coulombs : (1)

   Q = It
   3586.5 = 2 x t
   $\frac{3586.5}{2}$ = t

   1799.3 s = t : (½)

   1799.2
   60
   = 29.988

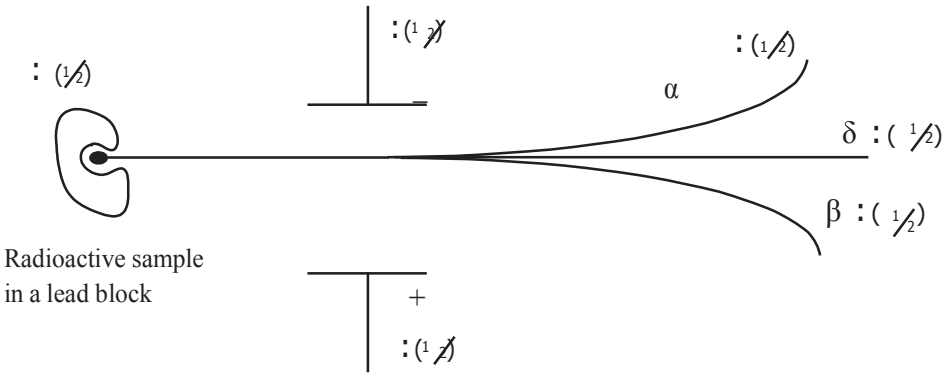
   - 30 minutes : (½)

7. (a) (i) X - Calcium carbide : (1) or CaC_2

(ii) Y - $CH_2 = CHCl$ Chloroethene : (1) or vinylchloride

(b) · Floor tiles : (½)
· Rain coats : (½)
· Plastic bags : (½)
} Any 2

8.



Working diagram, α should be deflected less than β because of its heavier mass.

(Accept any other working diagram)

9. In water, HCl is ionised : (½) into H^+ and Cl^- the Chloride ions are oxidised to chlorine gas by potassium permanganete. : (½)

In methylbenzene, HCl remains in molecular : (½) form i.e HCl. The Chloride is not available for oxidation hence no reaction. : (½)

10. (a) T (1)

(b) 15 g : (1)

(c) Fractional crystallization : (1)

11. (a) $N_2H_{4(g)} + O_{2(g)} \rightarrow N_{2(g)} + 2H_2O_{(g)}$: (1)

(b) Bond breaking energy

$163 + 4\ (388) + 496$

$= 2211$ kJ : (½)

Bond making energy

$944 + 4\ (463)$

$= -2796$ kJ : (½)

Ethalpy change = Bond breaking + Bond making energies.

2211 + (-2796) : (1)

= -585 kJ/mol : (1)

12. (a) The acidified permanganete will be decolourised : (½). (purple to colourless)

The permanganate (VII) is reduced to manganese (II) ion. : (1 2) /

(b) (i) A white precipitate forms. : (1)

(ii) $Ba^{2+}_{(aq)} + SO^{32-}_{(aq)} \rightarrow BaSO_{3(s)}$: (1)

13. (a) $[Zn(NH_3)]_{2+4}$: (1)

(b) $Zn^{2+}_{(aq)} + Mg_{(s)} \rightarrow Zn(s) + Mg^{2+}_{(aq)}$: (1) $ZnCl_{(2)(aq)} + Mg_{(s)} \rightarrow Zn_{(s)} + MgCl_{2(aq)}$

14. (a) Charles Law

At constant pressure, the volume of a fixed mass of gas is directly proportional to its absolute temperature. : (1)

(b)

$P_1 = 98.39$ kPa
$V_1 = 146$ dμ^3
$T_1 = 18 + 273 = 361$ K

$P_2 = 101$ kPa
$V_2 = 133$
$T_2 = ?$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$T_2 = \frac{P_2V_2T_1}{P_1V_1}$$

$$T_2 = \frac{100 \times 133 \times 361}{98.39 \times 146} \quad \surd(1)$$

$$T_2 = \frac{4849313}{14364.94} \quad \surd(1)$$

$T_2 = 273.22$ K

15. (a) R and T : (1)

(b) T : (1)

16. X- Zinc granules : (1)
The gradient of the graph is less steep : (1) because there is less surface area. : (1)

17. (a) $N_{2\,(g)} + O_{2(g)} \rightarrow 2NO_{(g)}$: (1)

(b) Because nitrogen is inert. : (1)

(c) Nitrogen (II) oxide is oxidised to Nitrogen (IV) oxide which is a pollutant. : (1)

18. (a) Water : (1)

(b) Bubbles of gas : (½) and a white ppt : (½)
CO_2. : (½) reacts to give $CaCO_3$: (½)

19. (a) These are different forms carbon in the same physical state. : (1)

(b) The hexagonal graphite rings have weak Van der Waals forces between the layers that allow the layers to slide over each other : (1) while in diamond the atoms are held by strong Covalent bonds. : (1)

20. (a) The atomic radii increase with increase in atomic number. This is due to increase in energy levels. : (1)

(b) The group II elements have more protons than group I elements : (1) hence this increases the nuclear attraction for the outer electrons. : (1)

21. (a) Cu^{2+} : (1) or copper ions

(b) Cl^- : (1) and OH^- : (1)

22. (a) Copper pyrites : (1) chalcocite, malachite

(b) To concentrate the ore : (1)

(c) - Brass
: (½)
- Batteries
: (½) : (1)

23. (a) $100 - 25 = 75\ cm^3$

(b) $C_xH_y + O_2 \rightarrow CO_2 + H_2O$

$15\ cm^3 \quad 75\ cm^3 \quad 45\ cm^3$: (1)

1 5 3

$C_xH_y + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$

x = 3 H = 8

C_3H_8 : (1)

24. $Ca(NO_3)_2 \rightarrow Ca^{2+} + 2NO_3^-$: (1)

RMM of $Ca(NO)_2$ = 164 : (½) : (½)

Concentration of $Ca(NO_3)_2$ = 4.1 g// 1

Molarity = $\frac{\text{Conc. in g/l}}{RMM}$

= $\frac{4.1}{164}$

= 0.025M : ($\frac{1}{2}$)

1 mole $Ca(NO_3)_2$ / 2 moles Nitrate
0.025 m / 2 # 0.025
0.05M : ($\frac{1}{2}$)

25. It would remain unchanged : (1)
There is no water to form hypochlorous acid : (1)

26. When aqueous sodium chloride is added to Ca^{2+}. There is no ppt : (1) while a white ppt is formed when aqueous sodium chloride is added to a solution containing Pb^{2+}. : (1)

27. (a) N. : (1) being a weak acid provides few H^+ to be neutralised by OH^- hence there is a slight increase in temperature. : (1)

(b) $CH_3COOH_{(aq)} + KOH_{(aq)} \rightarrow CH_3COOK_{(aq)} + H_2O_{(l)}$: (1)

28. (a) Experiments 1 and 3. : (1)

(b) In experiment 1, the ions in K_2CO_3 are tightly held in position and cannot move : (1) while sugar solution does not have ions that can carry a current in solution. : (1)

29. $^{1}_{1}H$ mass 18 : (1)

$^{2}_{1}H$ mass 20 : (1)

4.6.2 Chemistry Paper 2 (233/2)

1. (a) (i) **R** - (1) it has the largest atomic radius with the weakest nuclear attraction for outermost electron (1).

(ii) Across the period the atomic radius decreases due to the increase in nuclear attraction (1). Number of electrons in **P** is greater than in **H**.

(iii) $2M(s) + 2H_2O(\ell) \longrightarrow 2MOH(aq) + H_2(g)$ (1)

Moles of $H_2 = \frac{200}{24000} = 0.0083$ ^1h

Moles of $M = 0.0083 \times 2 = 0.0166$ ^1h

$\frac{\text{Moles of M}}{\text{RAM}} = 0.0166$

Mass of $M = 0.0166 \times 7$ ^1h

Mass of $M = 0.117$ g ^1h

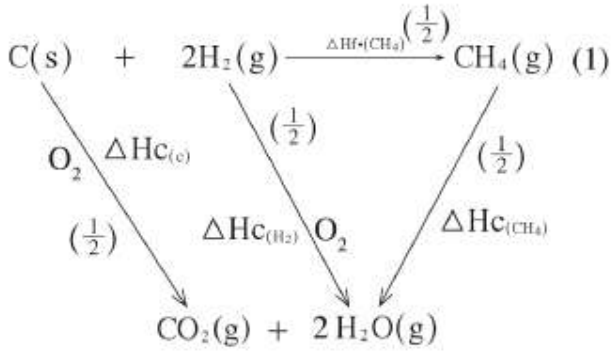
(b) (i) **W** - (1) forms a basic oxide which forms an ionic bond (1).

(ii) **Y** - (1) the oxide is gaseous that forms a neutral solution (1).

(iii) **U** - (1) the oxide is solid at room temperature, which is acidic with covalent bond (1).

2. (a) (i) This is the heat absorbed or evolved when one mole of any substance is formed from its constituent elements in their normal states. (1 mark)

(ii) I



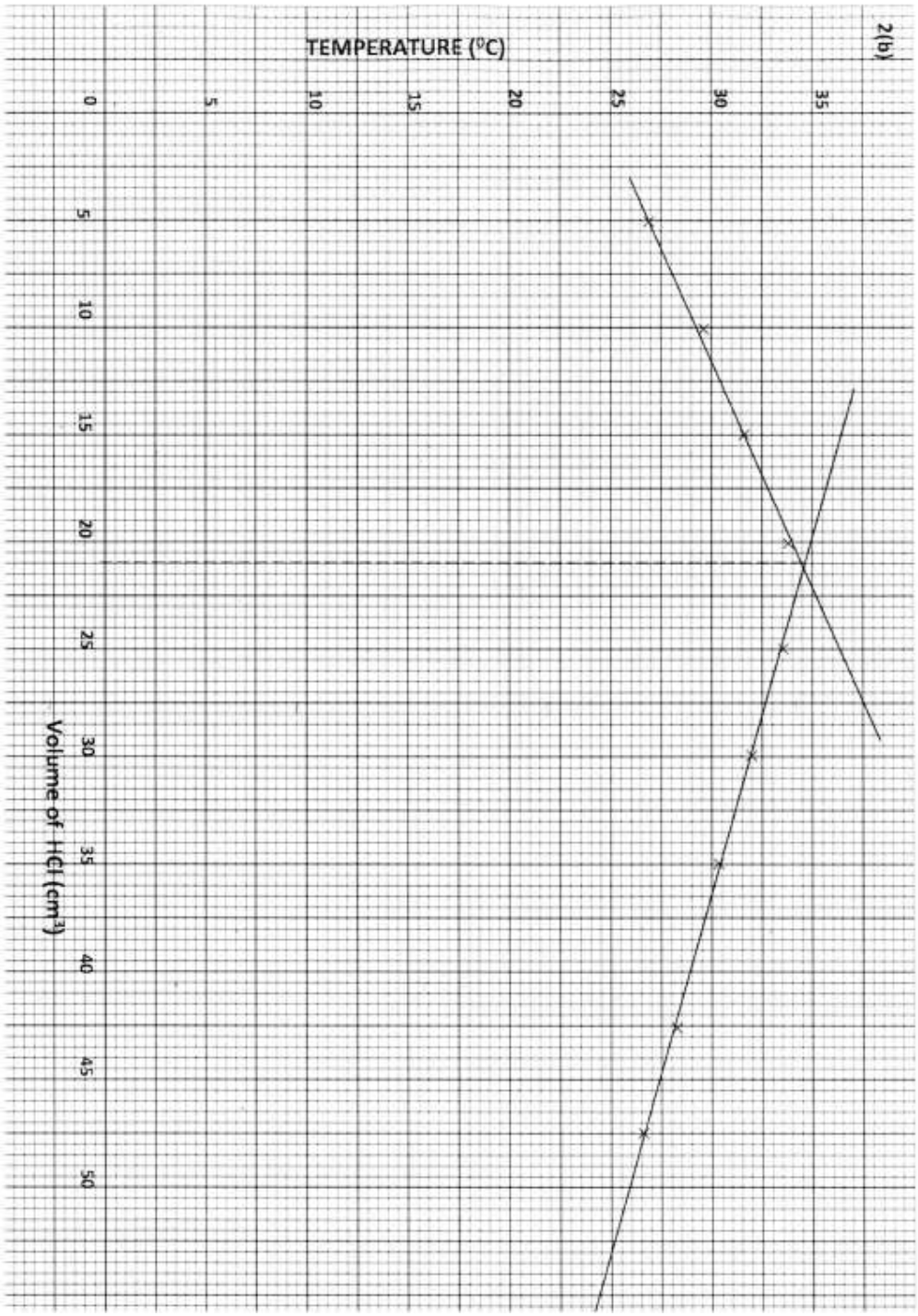
II $3Hf^{\wedge}CH_4h = 3Hc^{\wedge}ch + 2\,3\,Hc^{\wedge}H_2h - 3Hc^{\wedge}CH_4h$

$= -393 + 2^{\sim} -286h + 890$ (1)

$= -965 + 890$

$= -75\ kJ\ mol^{-1}$ (1)

(b) (i) (3 marks)



(ii) I 34.8□ ^-½h

II 21.2 cm³ HCl ^-½h

(iii) 50 # 9.8 # 4.2 (1)

= 2058 Joules (1)

(c) The molar heat of neutralisation between a strong acid and a weak base is low because some of the heat is used to ionise (1) the weak base before neutralization. For strong acid and strong base they are completely ionised.

3. (a) (i) Hot compressed air (1)

(ii) To melt the sulphur and maintain it in molten state (1)

(iii)
- low melting point of sulphur (1)
- insolubility of sulphur in water (1)
- less dense than water

(b) (i) $S_{(s)} + O_{2(g)} \rightarrow SO_{2(g)}$ (1)

(ii) To dry the SO_2 and air (1)

(iii) Vanadium (v) oxide (1) and platinum (1) or titanium

(iv)
- it provides the reactants (SO_2 and O_2) with enough energy to react (1)
- it removes heat from the product hence preventing decomposition (1) or conserves heat, or recycles heat or reduces cost of production.

Accept any other.

(c)
- contributes to acid rain which corrodes buildings (1)

OR
- causes aquatic solutions to be acidic hence affecting aquatic life etc.
- poisonous/toxic

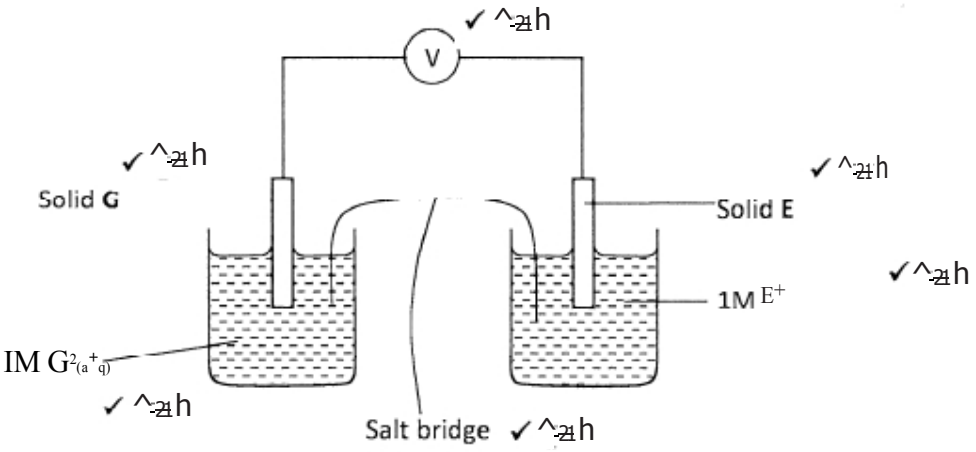
(d) Turns black (1) conc H_2SO_4 removes hydrogen and oxygen from the sugar molecule leaving only carbon which is black (1). Dehydration of sugar forms carbon which is black.

4. (a) (i) Gas Y is chlorine. (1)

(ii)
- sodium and hydrogen ions migrate to the cathode (1). The hydrogen ions are preferentially discharged, liberating hydrogen gas.
- chlorine and hydroxide ions migrate to the anode (1). The chloride ions are preferentially discharged liberating chlorine gas.
- the sodium ions migrate to the cathode through the membrane (1).
- the sodium ions combine with the hydroxide ions to form sodium hydroxide (1).

(iii) Glass making/paper manufacture (1), unclogging of drains, etching $NaClO_3$, Purification of bauxite.

(b) (i)



(ii) EMF = 0.8 + 2.87 (1)

= 3.67V (1)

(iii) H will go into solution as H^{2+} ions (1) since it is more reactive than E hence displacing E^{+} ions which are deposited as solid (1).

5. (a) Test the acidity using a litmus pager. There will be no change on litmus when dipped into a solution of sodium sulphate (1). The litmus paper turns to red when dipped into a solution of sodium hydrogen sulphate (I).

OR

Add a solid carbonate to each solution. No effervescence observed when the carbonate is added to a solution of sodium sulphate. Effervescence is observed when the carbonate is added to a solution of sodium hydrogen sulphate.

(b) Add dilute nitric acid to lead to form a soluble salt, $Pb(NO_3)_2$, add a soluble salt sodium sulphate to form insoluble $PbSO_4$ and soluble Na_2SO_4 $\frac{1}{2}$ separate by filtrating. Wash the $PbSO_4$ with distilled water to remove traces of soluble salt, Na_2SO_4. Then dry the salt between filter papers.

(c) (i) I $NH_4NO_{3(s)} \rightarrow N_2O_{(g)} + 2H_2O_{(g)}$ (1)

II $2Fe(OH)_{3(S)} \longrightarrow Fe_2O_{3(s)} + 3H_2O_{(l)}$ (1)

(ii) The colour changes from pale green to brown (1) . The iron (II) is oxidised to iron (III) chloride by hydrogen peroxide (1)

(iii) Carbon monoxide (1)

6. (a) A proton has a +ve charge while a neutron has no charge (1)

(b) Substances undergo radioactive decay or disintergration. (1)

(c) - causes genetic mutation (1)
- can cause death (1)
- prone to cancer

(d) (i) I Atomic mass of a = 4 (1)

II Atomic number of b = 2 (1)

(ii) Fusion (1)

(e) (i) This is the time taken for half of the radioactive isotope to decay (1)

(ii) 288——144——72 — 36 — 18 — 9

` 5 half lives (1)

$\frac{40}{5} = 8$ days (1)

7. (a) (i) Propanoic acid (1)

(ii) Pent - 1 - ene (1)

(iii) But - 1 - yne (1)

(b) (i) Ethane (1)

(ii) $C_3H_6Cl_2$ (1)

(iii) I Water/steam/Conc. H_2SO_4 (1)

II Acidified potassium dichromate (VI)

(iv) $2CH_3CH_2CH_2OH + 2Na \rightarrow 2CH_3CH_2CH_2ONa + H_2$ (1)

(c) Cleansing agent has the hydrophilic ^-21h and hydrophobic ends ^-21h, the hydrophobic end is attracted to grease ^-21h while the hydrophilic end is attracted to water ^-21h during agitation the grease is pulled off ^-21h the cloth then surrounded by soap molecules ^-21h

4.6.3 Chemistry Practical Paper 3 (233/3)

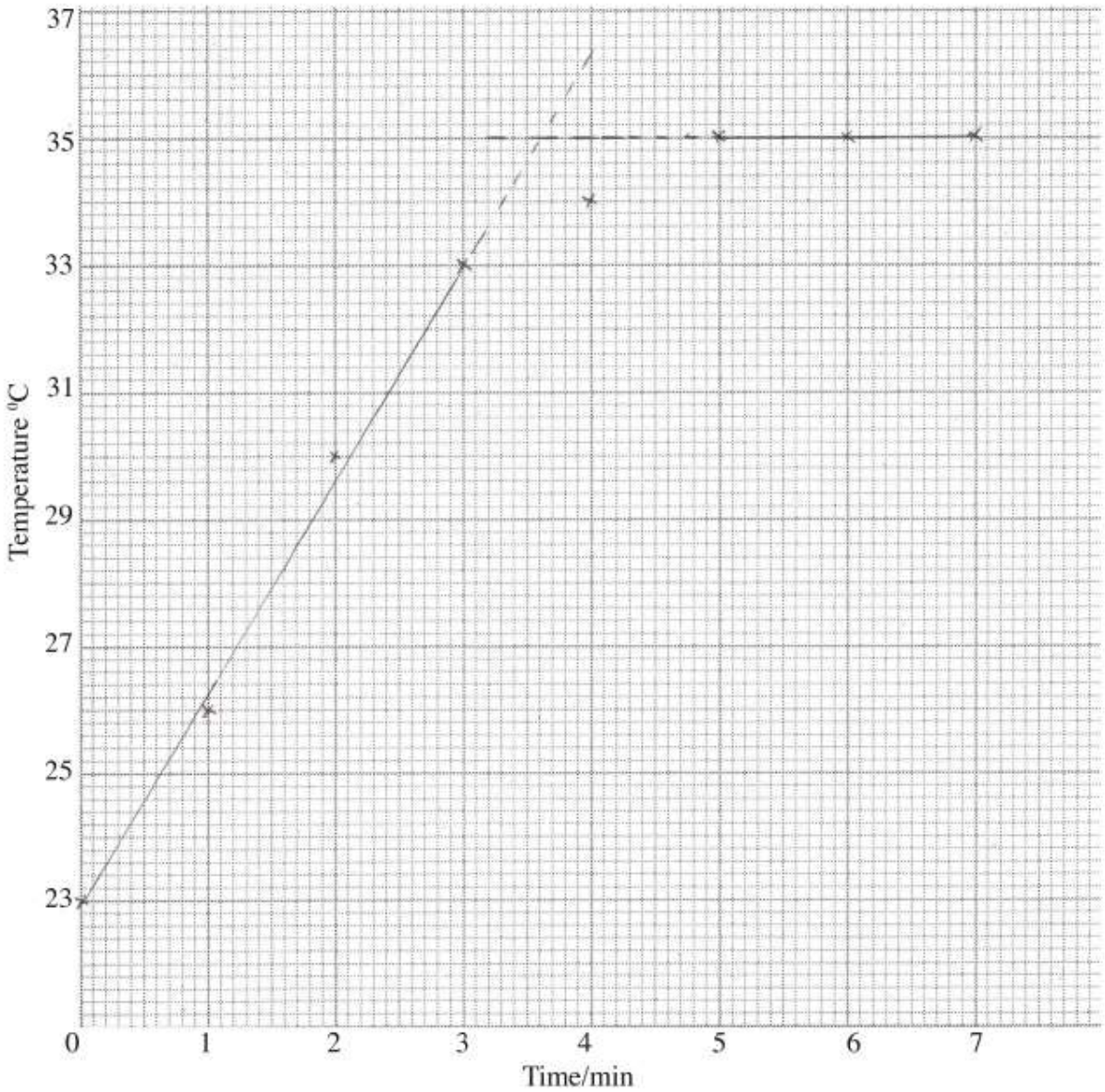
Procedure I

1. Table 1

Time (Min.)	0	1	2	3	4	5	6	7
Temperature (^{0}C)	23.0	26.0	30.0	33.0	34.0	35.0	35.0	35.0

$\frac{1}{2}$ mark for each correct entry, Maximum (3 marks)

(a) (i) (3 marks)



(ii) (I) $\Delta T = 35 - 23 = 12^0C$. (1 mark)

(II) 3 minutes 36 seconds. ($\frac{1}{2}$ mark)

(iii) $\Delta H = 50 \times 4.2 \times 12$
$= 2520$ joules. (2 marks)

Procedure II

Table 2

	I	II	III
Final burette reading	24.50	25.00	34.20
Initial burette reading	0.00	1.00	10.20
Volume of solution C (cm^3)	24.50	24.00	24.00

(4 marks)

(a) Average volume $= \frac{24.5 + 24.0 + 24.0}{3}$ √
$= 24.17\ cm^3$ √$\frac{1}{2}$ ($\frac{1}{2}$ mark)

(b) (i) Moles of MnO_4^- $= \frac{0.02 \times 24.17}{1000}$ √$\frac{1}{2}$
$= 4.83 \times 10^{-4}$ √$\frac{1}{2}$ (1 mark)

(ii) Moles of Fe^{2+} $= 5 \times 4.83 \times 10^{-4}$ √$\frac{1}{2}$
$= 2.417 \times 10^{-3}$ √$\frac{1}{2}$ (1 mark)

(iii) Moles of Fe^{2+} in 250 $cm^3 = 2.417 \times 10^{-3} \times 10$ √$\frac{1}{2}$
$= 2.417 \times 10^{-2}$ √$\frac{1}{2}$ (1 mark)

(c) Molar heat of displacement $= \frac{2520}{2.417 \times 10^{-2}}$ √(1) (1 mark)

$= 104261.48$ Joules √(1) (1 mark)

2 (a)

(i)

Observations	**Inferences**	
- White solid turns yellow - Splint extinguished - On cooling solid is white - Colourless, odourless gas. (max. 1 mark)	Probably CO_2 gas given off. $\therefore CO_3^{2-}$ or HCO_3^-, ZnO formed (max. 1 mark)	(2 marks)

(ii)

Observations	**Inferences**	
- effervescence/bubbles - colourless, odourless gas (1 mark)	CO_3^{2-} present (1 mark)	(2 marks)

(iii)

Observations	**Inferences**	
- White ppt soluble in excess (1 mark)	Zn^{2+} present (1 mark)	(2 marks)

(b) (i)

Observations	**Inferences**	
White ppt insoluble in excess (1 mark)	Pb^{2+} or Al^{3+} Mg^{2+} (1 mark)	(2 marks)

(ii)

Observations	**Inferences**	
- No effervescence - No white ppt (1 mark)	CO_3^{2-} SO_3^{-2} absent Pb^{2+} absent **or** Al^{3+} and Mg^{2+} present (1 mark)	(2 marks)

(iii)

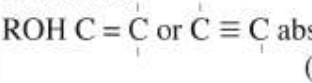
Observations	**Inferences**	
White ppt (1 mark)	SO_4^{2-} present (1 mark)	(2 marks)

3. (a)

Observations	Inferences
Melts and then burns with a sooty/ smoky/Luminous flame/yellow flame. (1 mark)	Long chain organic compound or  (1 mark)

(2 marks)

(b) (i)

Observations	Inferences
Not decolourised (1 mark)	ROH  absent (1 mark)

(2 marks)

Observations	Inferences
Effervescence/bubbling Colourless gas (1 mark)	Carboxylic acid present. H^+ or H_3O^+ or RCOOH (1 mark)

(2 marks)

Method used	Inferences
- Add 2 drops of universal indicator to solution. - Match the colour of solution to the pH chart paper - Read off pH. (2 marks)	- pH is 1 or 2 - Solution is strongly acidic (1 mark)

(3 marks)