5.4 CHEMISTRY (233)

5.6.1 Chemistry Paper 1 (233/1)

1. (a) Carbon (IV) Oxide and Carbon (II) Oxide

   (b) CO_2
   - Fire extinguishers
   - Fizzy drinks
   - Food preservative
   - Solvay process

   Choose 1

   CO
   - Manufacture of fuel (water gas)
   - Reduction in the extraction of metals
   - Manufacture of methanol

   Choose 1

2. Add water to dissolve $CuSO_4$ while Fe_2O_3 does not. Filter out the undissolved Fe_2O_3
   Wash residue with plenty of distilled water to remove traces of the filtrate.
   Dry the residue between filter papers.

3. Grey Solid deposited PbO has been reduced to lead metal. A colourless liquid condenses on the cooler parts of the combustion tube. The hydrogen has been oxidised to water.

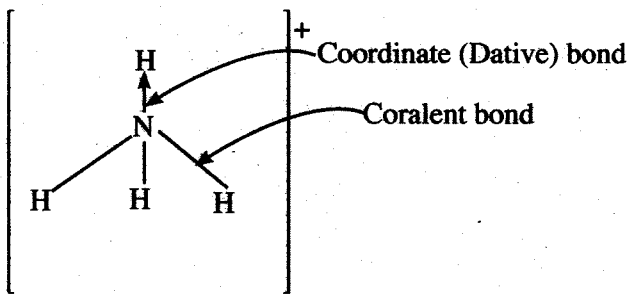
4. (a) BDAC
   Across the period the atomic radius decreases.

   (b) D
   Across the period the conductivity increase due to increase in delocalised electrons.

5. The water must contain impurities. The presence of impurities elevates the boiling point.

6. (i) Copper (II) Sulphate; at 40°C only 28g is soluble leaving undissolved $CuSO_4$
   Pb (NO_3) all dissolves.

   (ii) 35 - 28 = 7g

7. 

8. $H_2SO_{4(aq)} + 2NaOH_{(aq)} \rightarrow Na2SO_{4(aq)} + H_2O(l)$

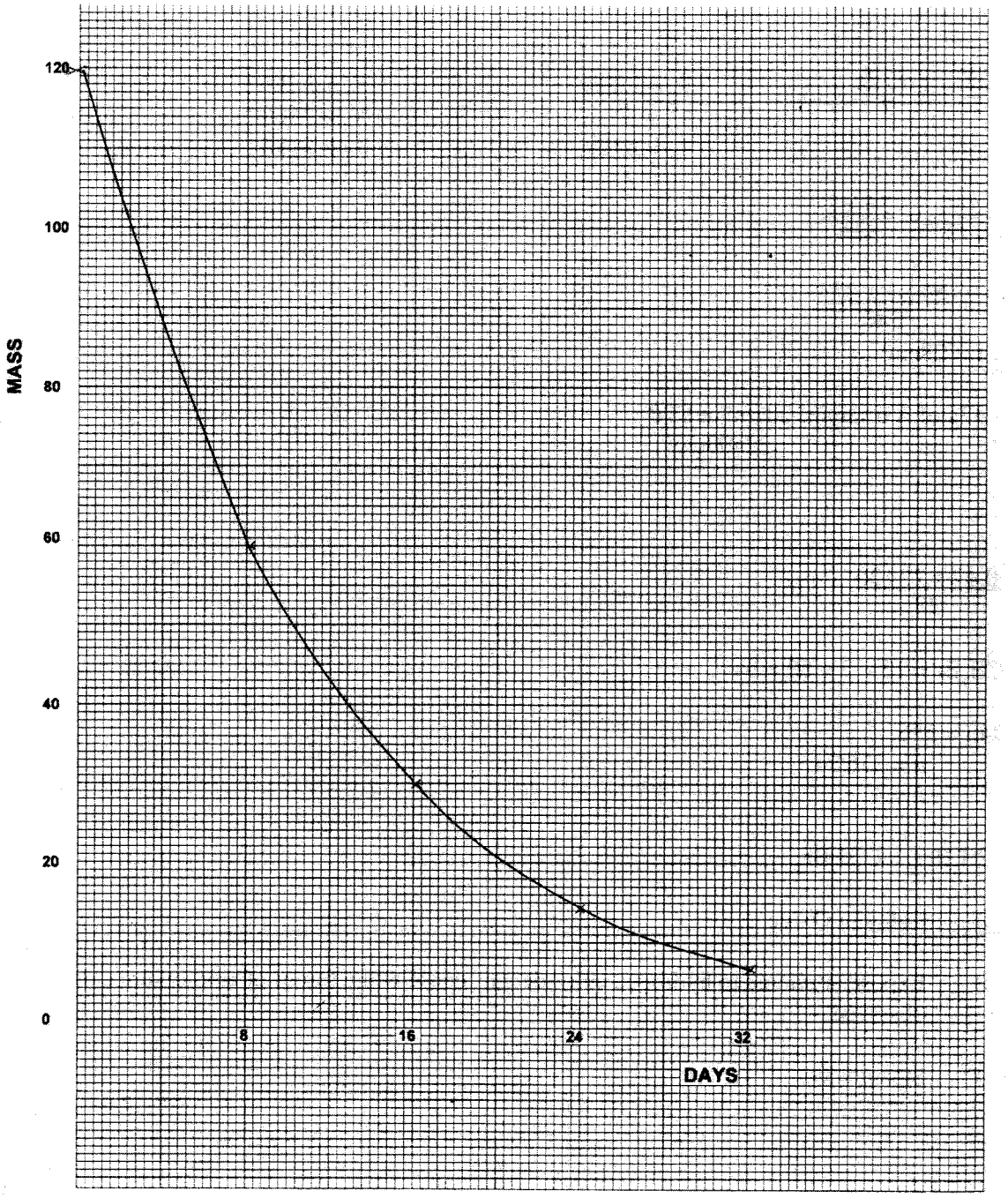
   Moles of NaOH $\frac{36}{1000} \times 0.1 = 0.0036$

Moles of acid in 100 cm^3 = $\frac{100 \times 0.0018}{10} = 0.018$

R.M.M. of $H_2SO_4 = 98^{(\frac{1}{2})}$

$0.0018 \times 98 = 0.1764g^{(\frac{1}{2})}$

9.



10. (a) Mg^{2+}, Ca^{2+}

(b) The Ca^{2+} and Mg^{2+} exchange with Na^{+} on the ions exchange resin.(1)

$2R - Na + Ca^{2+} \longrightarrow R_2 - Ca + Na^{+}$

$2R - Na + Mg^{2+} \longrightarrow R_2 - Mg + Na^{+}$

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

$P_2 = 1$ litre
$V_2 = ?$
$T_2 = 273K$

$P_1 = 1$ atm
$V_1 = 56cm^3$
$T_1 = 546K$

$\frac{1 \times V_1}{273} = \frac{56 \times 1}{546}$

$V_1 = \frac{56 \times 1 \times 273}{546}$

$V1 = 28cm^3$

0.47g of A occupies $28cm^3$ at STP
? $22400cm^3$

$\frac{0.47 \times 22400}{28} = 376$

$CH_2Br = 12 + 2 + 80 = 94$

$94n = 376$
$n = 376/94$
$n = 4$

$(CH_2Br)_4 = C_4H_8Br_4$

12. (a) Calcium Oxide

(b) Expose ammonia to hydrogen chloride gas, dense white fumes of ammonium chloride are observed.

(c) Steam/water

13. The catalyst has no effect on the position of equilibrium.
The catalyst will increase the rate of forward and backward reactions to the same extent.

14. Ionisation energy

This is the energy required to remove an electron from an atom in its gaseous state.

Electron affinity:

This is the energy change that results in the formation of an ion when an atom gains an electron.

15. (a) Represents salt bridge.

(b) EMF = $E\ominus$ gaining - $E\ominus$ losing

= +0.80 - (-0.13)
= +0.93V

16. (a) S, H, V, T (2) - If only 1st and last letters are correct

(b) $T(s) + V^{2+}(aq) \longrightarrow T^{2+}(aq) + V(s)$

17. (a) Heat of reaction

(b) Using a catalyst
Catalyst reduce activation energy.

18. (a) Sulphur (IV) Oxide is oxidised
The change in Oxidation state for

$SO_2 \longrightarrow H_2SO_4$
$X = +4 \longrightarrow X = +6$

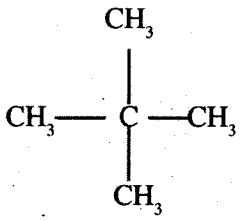
Since it is increasing, this is oxidation.

(b)
- Preservative for Jams and fruits
- Bleaching in the paper industry
- Fumigant
- Disinfectant

19. The level of water in glass tube would go down this is because hydrogen gas being less dense than air diffuses through the porous bag, forcing the level of water in the glass tube to go down while the level of water in the beaker rises slightly.

20. $CH_3 - CH_2 - CH_2 - CH_2 - CH_3$ Pentane

2 - methylbutane



2, 2- dimethylpropane

21. - Plastic bottles
- Packaging of materials
- Tooth brush handles.

Any 1 (1)

22. (a) (i) Maleable - Can be hammed into sheets

(ii) Ductile - Can be drawn into wires

(b) (i) Saucepans

(ii) Electrical transmission lines

23. • Weigh copper carbonate
• Heat $CuCO_3$ to constant mass in a combustion tube
• Reduce CuO using dry H_2/NH_3 or CO
• Allow to cool and reweigh to get mass of copper
• $\% = \frac{Mass\ of\ Cu}{Mass\ of\ CuCO_3} x\ 100$

24. (a) No air due to boiling.

(b) • Aluminium being very reactive forms a layer of Al_2O_3 on the metal making it impervious to moisture.
• Aluminium being more reactive than iron protects the iron through sacrificial protection/ cathodic protection.

25. $2KOH(aq) + H_2SO_{4(aq)} \longrightarrow K_2SO_{4(aq)} + H_2O.$

Moles of KOH $\frac{200}{1000} \times 2 =$ 0.4 moles

$Moles\ of\ H_2SO_4 = \frac{0.4}{2} = 0.2\ moles$

x = $100cm^3$

Mix $200cm^3$ of 2M KOH with $100cm^3$ of 2M H_2SO_4. Concentrate the mixture to drive off excess water, crystallise using a water bath, then dry crystals between filter papers.

26. • Add Na_2CO_3 or $NaHCO_3$ to each, with ethanoic acid there will be effervescence, no reaction with ethanol.

• Add acidified potassium dichromate (VI) or acidified potassium manganate (VII) ethanol will decolarise acidified potasium manganate (VII) and change acidified potasium dichromate (VI) from orange to green. Ethanoic acid has no reaction with the reagent.

27. (a) Group is 5
Period is 3

(b) (i) Noble gases/inert gases

(ii) Used in fluorescence lamps, x-rays tubes

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

(b) Oxygen

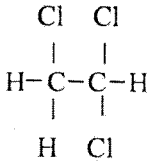
There will be a higher concentration of the hydroxide ion in the dilute solution.
The hydroxide ion being higher in the electromotive series than the chloride ion will then be preferentially discharged.

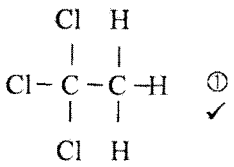
29. (a) No change or no effect
Presence of water is necessary to form H^+ and Ocl^- ions which change the litmus paper

(b) Add dilute hydrochloric acid to each of the salts. $BaSO_3$ gives effervesence and the salt dissolves. There is no effervesence or effect on $BaSO_4$.

5.4.2 Chemistry Paper 2 (233/2)

1. (a)





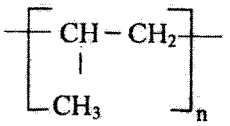
① ✓

(b)
- Bubble each through acidified potassium dichoromate (VI) √1 with ethene the solution changes from orange to green √½ while in ethane the solution remains orange. √½
- Bubble each through acidified Potassium manganate(VII) √1 with ethene the solution changes from purple to √½ colourless while in ethane the solution remains purple. √½
- Add a few drops of bromine water √1 with ethene the solution changes from orange/ brown √½ to colourless, while in ethane the solution remains orange / brown. √½
- Ethene burns with yellow or sooty flame.
  Ethane burns with non-luminous or blue flame.

Choose any 2

(c) (i) Concentrated sulphuric (VI) acid or Al_2O_3 or H_3PO_4. √1

(ii)



① ✓

(iii) $2CH_3CH_2COOH + Na_2CO_3 \longrightarrow 2CH_3CH_2COONa_{(aq)} + CO_{2(g)} + H_2O$ (1)

(iv) $2CH_3CH_2CH_2OH + 9O_2 \longrightarrow 6CO_2 + 8H_2O$ (1)

Moles of $CO_2 = \frac{18}{24}$ (½)

Moles of $CH_3CH_2CH_2OH = \frac{18}{24} \times \frac{1}{3}$ (½)

R.M.M. of $CH_3CH_2CH_2OH = 60$ (½)

$$\text{Mass} = \frac{18}{24} \times \frac{1}{3} \times 60 = 15\text{ g} \quad (½)$$

2. (a) C √ (1) has the smallest atomic radius and is the most electronegative element in the periodic table. √1 / as one traverses the period number of protons increases hence the nuclear attraction increases.

(b) (i) $AB_2/AB/CO_2$ or CO √1
(ii) Covalent bond √1

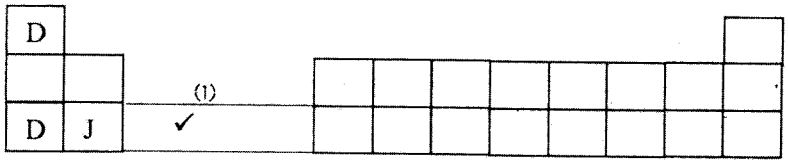
(c) (i) Halogens √1

(ii) $C_{2(g)} + 2H^-_{(aq)} \longrightarrow 2C^-_{(aq)} + H_{2(g)}$ √1

(d) F has a giant atomic √½ structure with strong √½ covalent bond which is strong and difficult to break hence high melting point. While G although it exhibits covalent bond it has simple √½ molecular structure with weak van der waal's forces between its molecules √½ hence the low melting point.

(e) D_2O √½ and D_2O_2 √½

(f)



3. (a) (i) Concentrated √1 sulphuric (VI) acid.

(ii) Potassium nitrate √1

(iii) To condense the fumes or vapour of nitric (V) acid into liquid √1

(b) (i) Nitric acid (V) will corrode the rubber √1

(ii) The reaction produces nitrogen monoxide (colourless) √½ which is oxidised by oxygen from the air to form nitrogen(IV) oxide. √½

(c) (i)
- Water
- Alkanes
- Biogas
- Water gas

√2 } any 2

(ii) $NH_3 + HNO_3 \longrightarrow NH_4NO_3$ √1

Mass of NH_4NO_3 = 80 √½

either

Moles of $NH4NO_3 = \frac{4800}{80} \times 10^3 = 6 \times 10^4$

Moles of NH_3 = 6×10^4 √½

Mass of $NH_3 = \frac{6 \times 17 \times 10^4}{1000}$

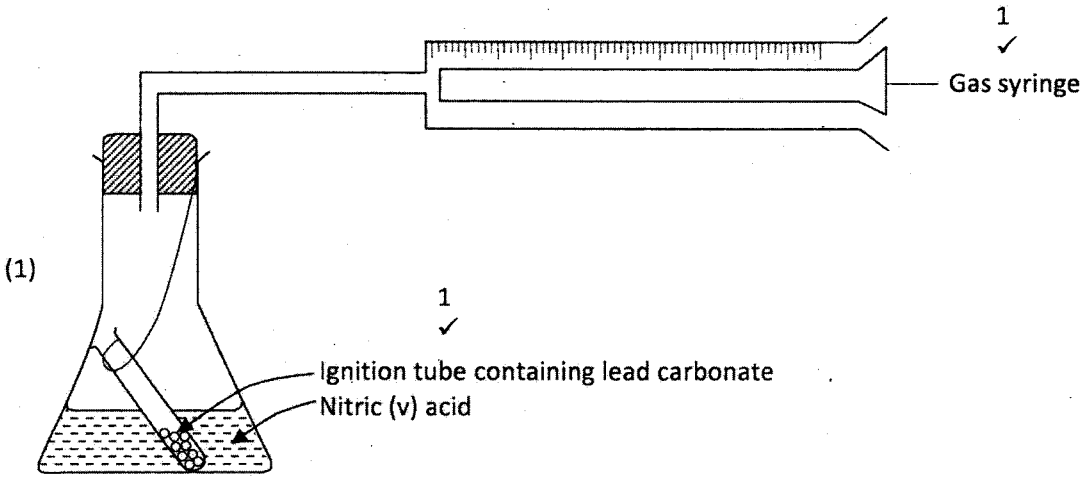
= 1020 kg

(iii) Explosives eg. T.N.T.
Production of polymers (terylene)
Textile dyes.
Manufacture of drugs

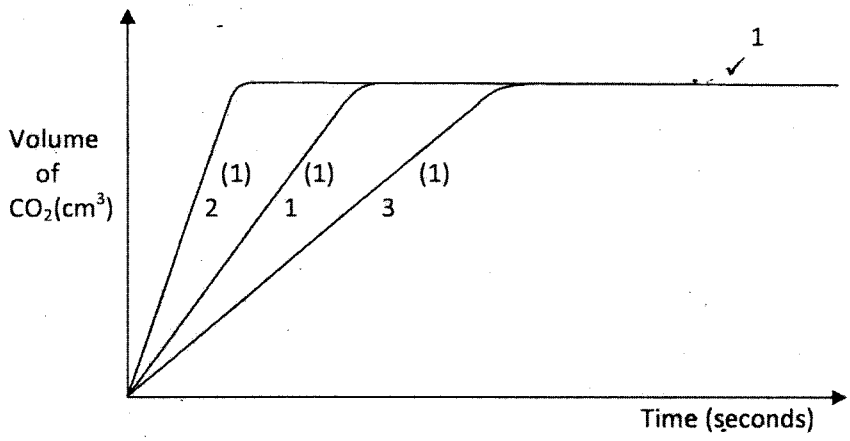
√2 } any 2

4. (a) Surface area/particle size √1.

(b) (i)



(ii)



(iii) $PbCO_{3(s)} + 2HNO_{3(aq)} \longrightarrow Pb(NO_3)_2$√1 $+ CO_{2(g)} + H_2O_{(l)}$

(c) With hydrochloric acid an insoluble lead chloride is formed, √½ which coats the lead carbonate √½ preventing the reaction between the acid and the carbonate from proceeding. √1

(d) The reaction would shift to the left changing the solution from colourless to yellow/ orange √1. Addition of HCl creates excess H^+ which disturbs the equilibrium so it shifts to the left to get rid of the excess H^+ ions. √1

5. (a) (i) The anode is X. √1 Since hydrogen is liberated at the cathode which is Y. √1

(ii) $4OH^-_{(aq)} \longrightarrow 2H_2O_{(l)} + O_{2(g)} + 4e$ √1

(iii) The hydrogen ions and hydroxide ions which form water (1) are discharged at the electrodes leaving $MgSO_4$ concentrated. The amount of water electrolysed is more than the amount of water formed at the anode. √1

(iv) Blue litmus remains √½ blue while the red litmus remains red√½. Indicating that the solution is neutral. √1

(b) Quantity of electricity = 0.3 x 30 x 60
= 540 √1
Oxygen requires 4 Faradays √½ of electricity

$24\ dm^3 = 4 \times 96500$ √½
$? = 540$

$$\frac{24 \times 540}{4 \times 96500} = 0.32\ dm^3$$

(c) Electroplating
Purification of metals

6. (a) (i) Cu^{2+} √1

(ii) $CuCO_3$ √1 / $ZnSO_4$ √1

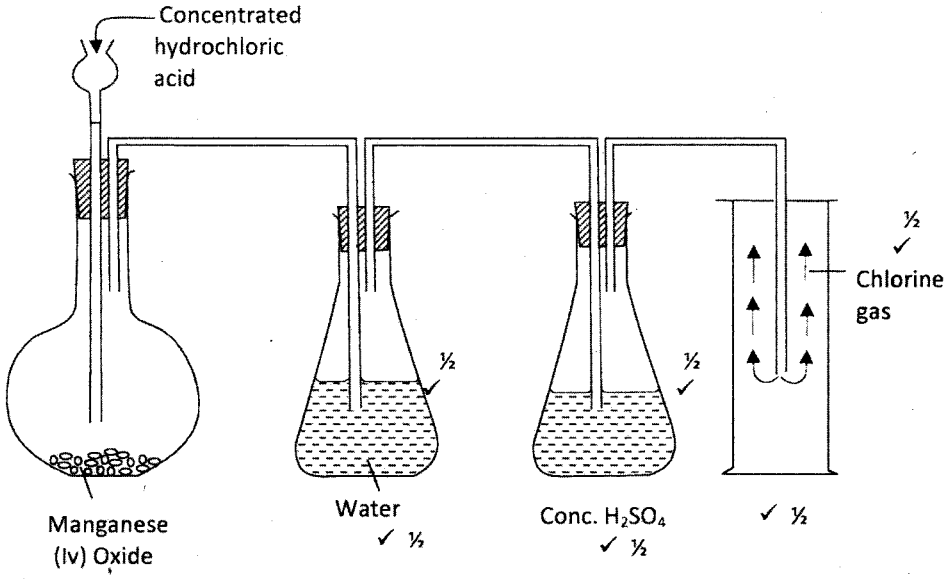
(b) $Ba^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} \longrightarrow BaSO_{4(s)}$ √1

(c) The solution changes from blue to colourless √1 and a brown solid is formed. √1
The magnesium which is above copper in the reactivity series displaces the copper ions √1 from the solution. Apparatus become warm. The reaction is exothermic.

(d) (i) Add nitric (V) acid to √½ lead oxide, filter√½, add a soluble sulphate/ sulphuric acid to the filtrate √½. Filter √½, and wash residue with distilled water √½ to remove traces of the filterate, then dry residue between √½ filter papers /oven.

(ii) Determine the melting √1 point, if it is pure the melting point will be constant. √1

7. (a) (i)



(ii) Potassium Manganate (VII) $\surd\frac{1}{2}$ and remove heat $\surd\frac{1}{2}$.

PbO_2 and heat OR $CaOCL_2$ No heating.

(iii) I. $2Fe_{(s)} + 3Cl_{2(g)} \longrightarrow 2FeCl_{3(s)}$ (1)

II. $3Cl_{2(g)} + 6NaOH_{(aq)} \longrightarrow NaCl_{(aq)} + NaClO_{3(aq)} + 3H_2O_{(l)}$ (1)

(b)

	Cl	O
Mass	0.07	1.12
RAM	35.5	16
Moles	$\frac{0.07}{35.5}$	$\frac{1.12}{16}$
	$\frac{0.02}{0.02}$	$\frac{0.07}{0.02}$
	1	$\frac{7}{2}$
	2 :	7

Empirical formula Cl_2O_7 $\surd 1$

(c) Sterilising drinking water supplies $\surd$
Manufacture of hydrochloric acid $\surd$
Manufacture of plastics $\surd$
Manufacture of chloroform $\surd$
Manufacture of bleaching agents $\surd$

(Any 2)

5.4.3 Chemistry Practical Paper 3 (233/3)

1. Table 1

	I	II	III
Final burette reading	17.45	32.90	36.05
Initial burette reading	2.10	17.45	20.60
Volume of solution B used (cm^3)	15.35	15.45	15.45

(4 marks)

(a) (i) Average volume

$$= \frac{15.35 + 15.45 + 15.45}{3}$$

$= 15.42cm^3$ (1 mark)

(ii) Moles of sodium thiosulphate used

$$= \frac{0.05 \times 15.42}{1000} \quad (\frac{1}{2})$$

7.71×10^{-4} moles $(\frac{1}{2})$ (1 mark)

(b) (i) Number of moles of A in $25.0cm^3$

mole ratio A : $Na_2S_2O_3 . 5H_2O$
1 : 6

$7.71 \times 10^{-4}/6 = 1.28 \times 10^{-4}$ moles. (1 mark)

(ii) Concentration of solution A in mol dm^3

1.28×10^{-4} moles in $25cm^3$
? moles in $1000cm^3$

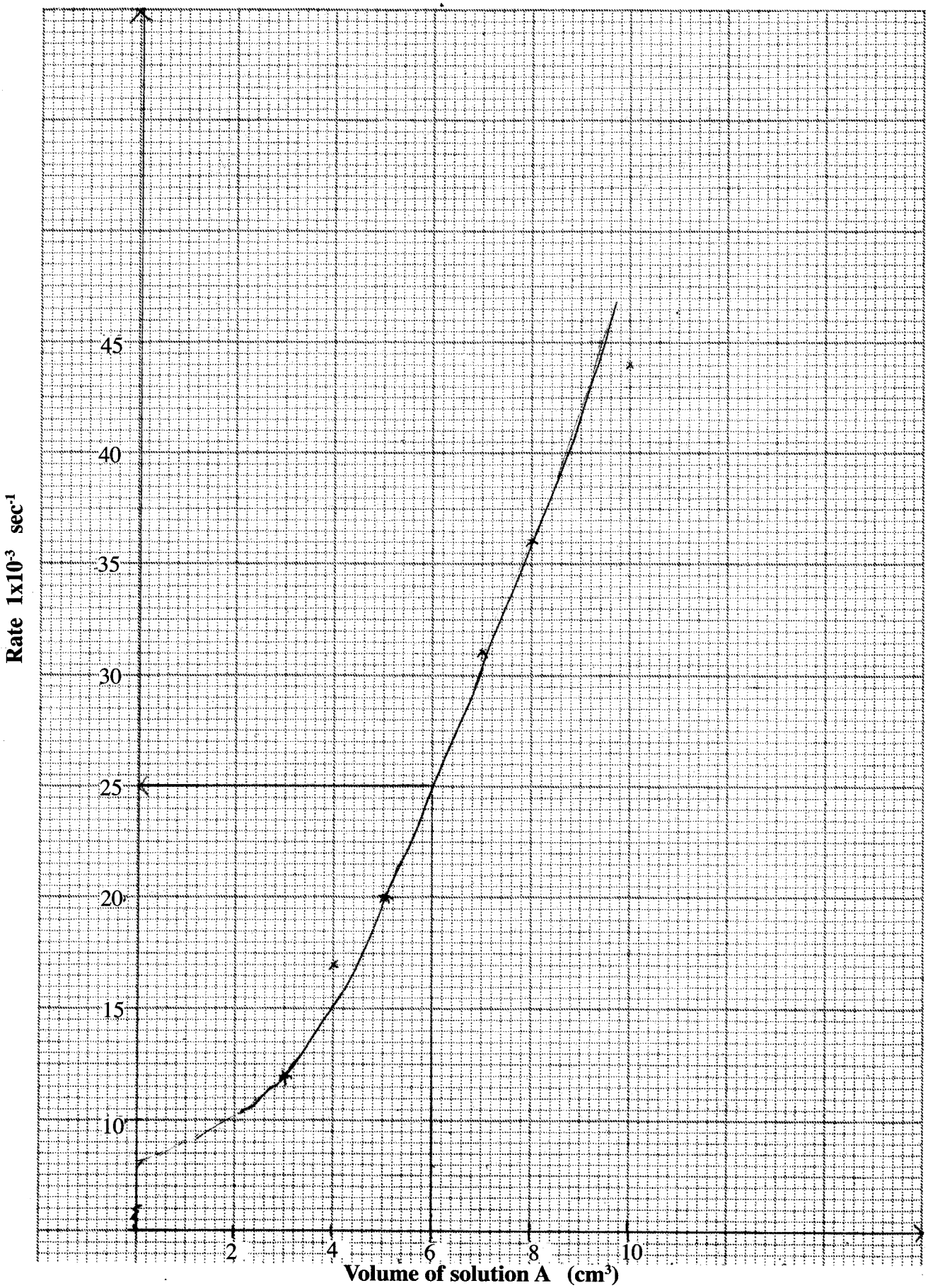
$1.28 \times 10^{-4} \times 1000/25$ (1)
5.12×10^{-3} moles/dm^{-3} (1) (2 marks)

Table 2

Test tube number	1	2	3	4	5	6
Volume of distilled water (cm^3)	0	2	3	5	6	7
Volume of solution A (cm^3)	10	8	7	5	4	3
Time (s)	22.5	28.0	32.0	50.0	57.5	85.0
Rate = $1/Time$ (s^{-1})	0.044	0.036	0.031	0.020	0.017	0.012
	(1)	(1)	(1)	(1)	(1)	(1)

(6 marks)

(a) Graph of Rate (3 marks)



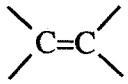
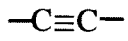
(b) Time taken for $4cm^3$ of distilled water.

$\therefore$ $6cm^3$ of solution A is added.
from the graph = $25x10^{-3}$ sec^{-1} (1)
= 40 seconds (1) (2 marks)

2. Observation

(a) (i)	(I)	A white precipitate (1)	Presence of Pb^{2+}, Ba^{2+} or Ca^{2+} (1) *1 mark for all the 3 ions* *½ mark for 2 correct ions* *0 mark for one or none*
	(II)	No white precipitate (1)	Absence of Pb^{2+} (1)
	(III)	No white precipitate (1)	SO_4^{2-}, SO_3^{2-}, CO_3^{2-} ions absent (1) *1 mark all the 3* *½ mark for 2 ions correct* *0 mark for one or none*
	(IV)	No white precipitate (1)	Cl^- ions absent (1)
(ii)		Effervescence ½/Bubbles/Fizzing Colourless gas produced ½ Turns red litmus blue ½ Blue litmus remained blue ½ (2 marks)	NO^-_3 present (1)
			(Total 11 marks)

3.

	Observations	Inferences
(a)	No effervescence (1)	Compound/solution F **not acidic** H^+ or R-COOH absent. (1)
(b) (i)	Burns with a sooty/smoky ½ luminous/yellow flame ½	Unsaturated cpd (1) $>C=C<$ Long chain hydrocarbon or $-C\equiv C-$
(ii)	Some white suspension/solid remains undissolved ½	Compound slightly/partially soluble in water ½
(c) (i)	Effervescence ½ Colourless gas produced ½	Mixture is acidic (1) RCOOH present
(ii)	Not decolourized (1)	 absent (1)  absent

(Total 9 marks)