1 (a) Chorofluorocarbon **[1 mark]**

(b) *Two marks for two from*:

(aerosol) propellants

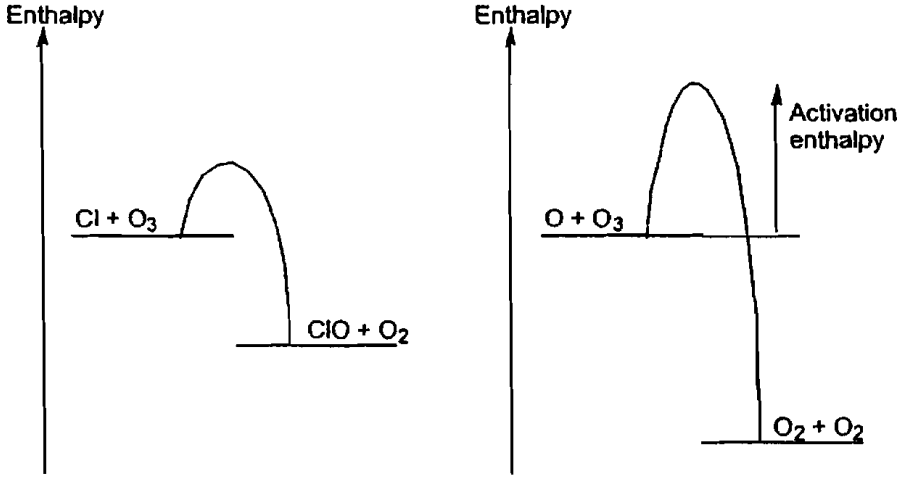
blowing plastics

degreasing solvent. **[2 marks]**

(c) (i) Enthalpy profile line drawn correctly with higher maximum than for reaction in **Equation 1.1** [1 mark]

Activation enthalpy correctly labelled [1 mark]

[2 marks]



Reaction in **Equation 1.1** Reaction in **Equation 1.3**

(ii) Chlorine atoms regenerated (*or* unchanged) at the end of the reactions in **Equations 1.1 and 1.2** [1 mark]

Activation enthalpy of catalysed route lower [1 mark]

More collisions with enough energy to react [1 mark]

Thus, route involving chlorine atoms is faster [1 mark]

[4 marks]

(d) A radical has an unpaired electron **[1 mark]**

(e) He was unaware of the reactions in the stratosphere (*or* similar/related point) **[1 mark]**

(f) *Two marks for two from:*

inexpensive

low ODP

suitable volatility

unreactive in use;

reactive in troposphere

low Greenhouse factor. **[2 marks]**

(g) (i) C–I bond weaker than C–Cl bond **[1 mark]**

(ii) Silver nitrate solution [1 mark]

yellow precipitate [1 mark]

$Ag^+(aq) + I^-(aq) \rightarrow AgI(s)$ [equation, 1 mark]

[state symbols (if equation correct), 1 mark]

[4 marks]

OR

Chlorine water [1 mark]

solution goes from colourless to brown [1 mark]

$Cl_2(aq) + 2I^-(aq) \rightarrow 2Cl^-(aq) + I_2(aq)$ [equation, 1 mark]

[state symbols (if equation correct), 1 mark]

[4 marks]

Total 18 marks

2 (a) (i) **A copper atom:** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^1$ [2 marks]

[ending $3d^9 4s^2$ scores 1 mark]

a Cu^{2+} ion $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^9$ [1 mark]

[3 marks]

(ii)

Element		**from**	**to**
Copper	reduced	+2	0
Fe	oxidised	+2	+3
S	oxidised	– 2	+4

One mark for each element

One mark for both oxidation states of each element **[4 marks]**

(iii) $M_r(CuFeS_2) = 184$ [1 mark]

$\frac{0.50}{100} \times \frac{64}{184} \times 100$ [1 mark]

$= 0.17\%$ [1 mark, allow max 3 sig. fig.]

[3 marks]

(iv) Large amounts of waste [1 mark]

which cause an eyesore *or* need a lot of energy for disposal

or cause a large hole to be dug *or* destroy habitats [1 mark]

[2 marks]

(b) (i) **Oxidation:** $Fe \rightarrow Fe^{2+} + 2e^-$ **[1 mark]**

Reduction: $Cu^{2+} + 2e^- \rightarrow Cu$ **[1 mark]**

(ii) $Fe(s) + Cu^{2+}(aq) \rightarrow Fe^{2+}(aq) + Cu(s)$ [equation, 1 mark]

[state symbols (if equation correct), 1 mark]

[2 marks]

(iii) Copper surrounded by several water molecules [1 mark]

Oxygen atoms of water molecules point towards copper [1 mark]

Correct charge (2+) shown on copper ion and δ– on oxygen [1 mark]

[3 marks]

(c) (i) Smaller surface area [1 mark]

More collisions per second [1 mark]

Faster reaction [1 mark]

[3 marks]

(iii) More collisions with energy [1 mark]

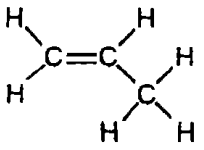
greater than activation enthalpy [1 mark]

Faster reaction [1 mark]

[3 marks]

Total 25 marks

3 **(a)** *One mark for correct structure:*



[1 mark]

(b) **(i)** Shake alkene with bromine water [1 mark]

Mixture goes colourless [1 mark]

[2 marks]

(ii) (Carbon-carbon) double bond [1 mark]

has high electron density [1 mark]

Description of mechanism in words or through a diagram:

Approaching bromine molecule becomes polarised so that the

end that is positively charged is attracted towards the double bond [1 mark]

Br^+ reacts with the double bond [1 mark]

[4 marks]

(iii) Electrophilic [1 mark]

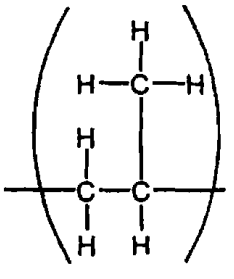
addition [1 mark]

[2 marks]

(c) **(i)** *Two marks for correct structure:*

idea of repeating unit (bracket not essential) [1 mark]

detail correct [1 mark]



[2 marks]

(ii) $\frac{1.0 \times 10^6}{42}$ [1 mark]

$= 2.4 \times 10^4$ [1 mark]

(two marks for correct answer with no working; allow 1 or 2 sf) **[2 marks]**

(d) Chains not all the same length **[1 mark]**

(e) (i) Isotactic - chains more regular [1 mark]

Chains pack together better [1 mark]

[2 marks]

(ii) Strong attractive forces between chains [1 mark]

Chains do not move past each other easily so fibre strong [1 mark]

[2 marks]

Total 18 marks

4 (a) Distilling flask, joined without leaks to next part, heat source and liquid shown or labelled [1 mark]

Thermometer shown with bulb opposite outlet to condenser [1 mark]

Condenser with correct water connections [1 mark]

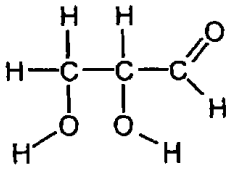
Collection of liquid (not in sealed apparatus) [1 mark]

[4 marks]

5 (a) Central OH (*or* CHOH) of glyceraldehyde *or* lactic acid [1 mark]

(b) Aldehyde group [1 mark]

Rest of structure



[1 mark]

[2 marks]

(c) (i) Dilute sulphuric acid [1 mark]

Potassium (*or* sodium) dichromate solution [1 mark]

Reflux/heat [1 mark]

[3 marks]

(ii) From **Orange** to **Green** [1 mark for each]

[2 marks]

(d) Sodium hydroxide solution contains $\frac{0.0500 \times 22.2}{1000}$ moles NaOH [1 mark]

$= 1.11 \times 10^{-3}$ moles NaOH

Reacts with 1.11×10^{-3} moles lactic acid [1 mark]

Concentration lactic acid solution = $1.11 \times 10^{-3} \times 40 = 0.044(4)$ mol dm^{-3}

[1 mark; *allow 2 or 3 sf*]

[3 marks]

(e) Diagram (or words) describing:

initial spot on chromatogram [1 mark]

solvent in container (level below spot) [1 mark]

container covered [1 mark]

location by u.v. *or* iodine [1 mark]

single spot obtained [1 mark]

[5 marks]

Total 16 marks

6 (a) **Covalent Bond:**

Atoms share [1 mark]

a pair of electrons [1 mark]

which holds them together [1 mark]

[3 marks]

(b) (i) Carbon–oxygen bond is polarised, with partial negative charge on oxygen [1 mark]

Carbon dioxide is a linear molecule, O=C=O [1 mark]

The dipoles cancel [1 mark]

[3 marks]

(ii) Instantaneous dipole – induced dipole

accept alternatives, such as *Van der Waals* **[1 mark]**

(c) (i) Diagram showing:

surface with gas and water labelled [1 mark]

carbon dioxide molecules moving in [1 mark]

and out of solution [1 mark]

clear indication that, at equilibrium, rate of entry to solution equals

rate of loss from solution [1 mark]

[4 marks]

(ii) Molecules can now escape from bottle and concentration of $CO_2(g)$

above liquid surface falls (*or* pressure falls) [1 mark]

Rate of molecules entering solution is less than rate of molecules leaving

(*or* position of equilibrium moves to left to counteract change) [1 mark]

Concentration of $CO_2(aq)$ falls [1 mark]

[3 marks]

(d) Diagram to show:

Radiation coming into Earth and going out form the Earth [1 mark]

Correct change of frequency/wavelength (*or* u.v./visible in, i.r. out) [1 mark]

Atmospheric gases absorb outgoing radiation [1 mark]

Vibrational energy transfered to thermal energy [1 mark]

Process shown as taking place in the troposphere [1 mark]

Quality of written communication: a clear diagram with appropriate labels making correct use of scientific terms such as troposphere, radiation, relection, absorption, wavelength/frequency [1 mark]

[6 marks]

(e) (i) Diagram to show:

Atoms bonded as stated in question with tetrahedral arrangement of bonds around silicon **[1 mark]**

(ii) Weak intermolecular forces in CO_2 [1 mark]

broken easily (to form gas) [1 mark]

Strong covalent bonds in SiO_2 [1 mark]

must break (to form liquid), not enough energy to do this at room temperature (so solid) [1 mark]

Quality of written communication: a minimum of 2 linked sentences, presenting a logical argument in which scientific terms such as, covalent bond, intermolecular force, molecular structure, giant/network structure, are used correctly [1 mark]

[5 marks]

Total 26 marks