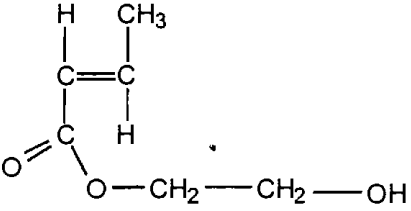
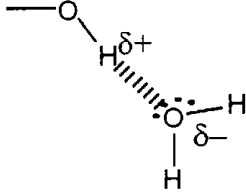
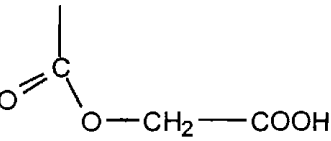


1 e ii	They are recycled/not used up/ <u>remain</u> unchanged (AW) (1); Catalysts provide a route with <u>lower activation enthalpy/energy</u> (<i>accept; They lower the activation e.</i>) (1)	2
1 e iii	CFCs/halogenoalkanes/ named halogenoalkanes <i>NOT chlorine</i>	1
1 e iv	radical(s)	1

2 a	copper(II) oxide (1); copper(I) oxide (1) <i>ignore gaps</i>	2
2 b i	$\text{CO}_3^{2-} + 2\text{H}^+ \rightarrow \text{CO}_2 + \text{H}_2\text{O}$ (2) $\text{CO}_3^- + \text{anyH}^+ \rightarrow \text{CO}_2 + \text{anything}$ scores (1) $\text{CO}_3^{2-} + \text{H}^+ \rightarrow \text{CO}_3^-$ (1) $\text{CO}_3^{2-} + 2\text{H}^+ \rightarrow \text{H}_2\text{CO}_3$ (1)	2
2 b ii	protons are transferred (AW) (1); carbonate/ CO_3^{2-} (<i>allow ecf on formula from (i)</i>) (1)	2
2 b iii	They are unaffected/ unreacted/spectator ions / they go from the lattice/malachite(1); They end up in solution/ form copper chloride (<i>but NOT "molecules" or copper-chlorine bonding implied</i>) (1)	2
2 c	$3s^2 3p^6 3d^{10} 4s^1 / 4s^1 3d^{10}$ (2) $3s^2 3p^6 3d^9 4s^2 / 4s^2 3d^9$ scores (1)	2
2 d i	M_r chalcopryrite = 184 (1) <i>stated or implied</i> $\% \text{Cu} = 64 \times 2 / 184 = 0.70(\%)$ [1] <i>2 sig figs (mark separately and award provided answer is less than 2%)</i> (1)	3
2 d ii	froth flotation or a description (<i>in which case ignore name</i>)	1
2 e i	$4\text{CuFeS}_2 + 10.5\text{O}_2 \rightarrow 4\text{Cu} + 2\text{FeO} + \text{Fe}_2\text{O}_3 + 8\text{SO}_2$ +2 0 0 +2 +3 +4 all correct (3); four/five correct (2); two/three correct (1) <i>Do not award third mark if signs follow numbers</i>	3
2 e ii	sulphur dioxide/ SO_2 (1); is toxic/harmful to life/causes respiratory problems/ causes acid rain (1) <i>IGNORE any other reasons given</i>	2
2 f i	$M_r \text{SO}_2 = 64$ (1) <i>stated or implied</i> $320/64 = 5$ (1)	2
2 f ii	Twice as many moles of NaOH as SO_2 <i>stated or implied</i> (1) (10 moles) volume = moles/conc. <i>stated or implied</i> (1) (10/0.5) calculation leading to answer (1) (20 dm ³)	3

3 a	 <p>double bond (1) completely correct (any chemically correct representation) (1)</p>	2
3 b	covalent/hydrogen (bonds)	1
3 c	 <p>hydrogen bond between H on one and O on other (1) <i>allow dotted line but not continuous line</i> at least one lone pair shown as starting point of bond (1)</p> <p>δ^+/δ^- shown correctly on O and H forming bond(1) (CON if OH⁻ shown, rather than -OH)</p> <p>straight line between two oxygens involved (1) (CON if OH₂ shown)</p>	4
3 d	primary (1) attached to carbon which is attached to one carbon/attached to -CH ₂ /end of chain(1) <i>depends on first mark</i>	2
3 e i	 <p>-COOH correct (can be displayed) (1) rest of structure correct (i.e. no extra CH₂) (1) <i>OH on top bond scores (0)</i></p>	2
3 e ii	(potassium) dichromate (1); (sulphuric) acid (1); reflux/ heat (AW) (<i>if first mark scored</i>) (1)	3
3 f	they are less abrasive (AW) to the eye/ they allow gases to pass through/more flexible <i>allow more comfortable/can absorb tears/keep eyes moist/ last longer</i>	1

4 a i	brown/red/red-brown/brown-orange/red-orange (NOT orange) (1) liquid (1) <i>mark separately</i>	2
4 a ii	chlorine is more reactive because it displaces bromine/oxidises/takes electrons away from Br^- <i>ora reason must be given</i>	1
4 a iii	Br^- on left and Br/Br_2 and $e^{(-)}$ on right (only) scores (1) Completely correct: $2\text{Br}^- \rightarrow \text{Br}_2 + 2e^{(-)}$ (2) <i>electrons may be subtracted from LHS</i> <i>IGNORE state symbols</i>	2
4 a iv	oxidation (<i>ecf from a iii</i>) NOT redox	1
4 b	toxic (vapour)/ respiratory problems (1); corrosive/ dangerous to/blisters/damages skin (1)	2
4 c	$\text{Ag}^+(\text{aq}) + \text{Br}^-(\text{aq}) \rightarrow \text{AgBr}(\text{s})$ formation of AgBr (or another formula) (1); completely correct (1) <i>allow doubled</i> state symbols, provided $(\text{aq}) + (\text{aq}) \rightarrow (\text{s})$ (1)	3
4 d i	bromine is decolorised (1) NOT "clear"	1
4 d ii	<p>either BOTH partial charges OR arrow (1)</p> <p>(allow cyclic) (1)</p> <p>'+' on carbon (or ring) (1)</p>	4
4 e i	light (<i>on its own or qualified "visible", "uv" "sun", "radiation"</i>) / u.v. (radiation)	1
4 e ii	homolytic	1
4 e iii	initiation	1
4 e iv	hydrogen bromide (<i>accept hydrobromic acid and HBr</i>) (1)	1
4 e v	bromoethane (1) <i>ALLOW 1-bromoethane</i>	1