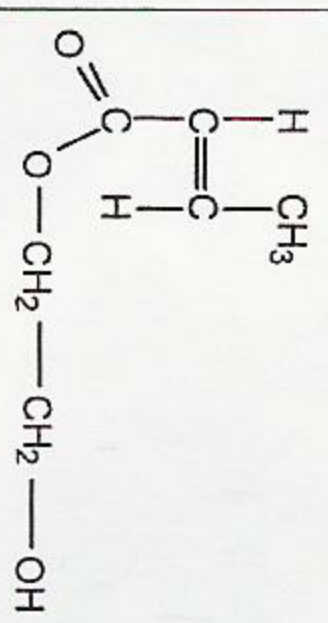
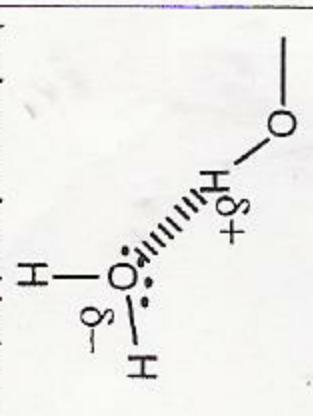
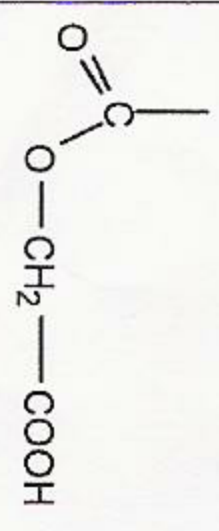
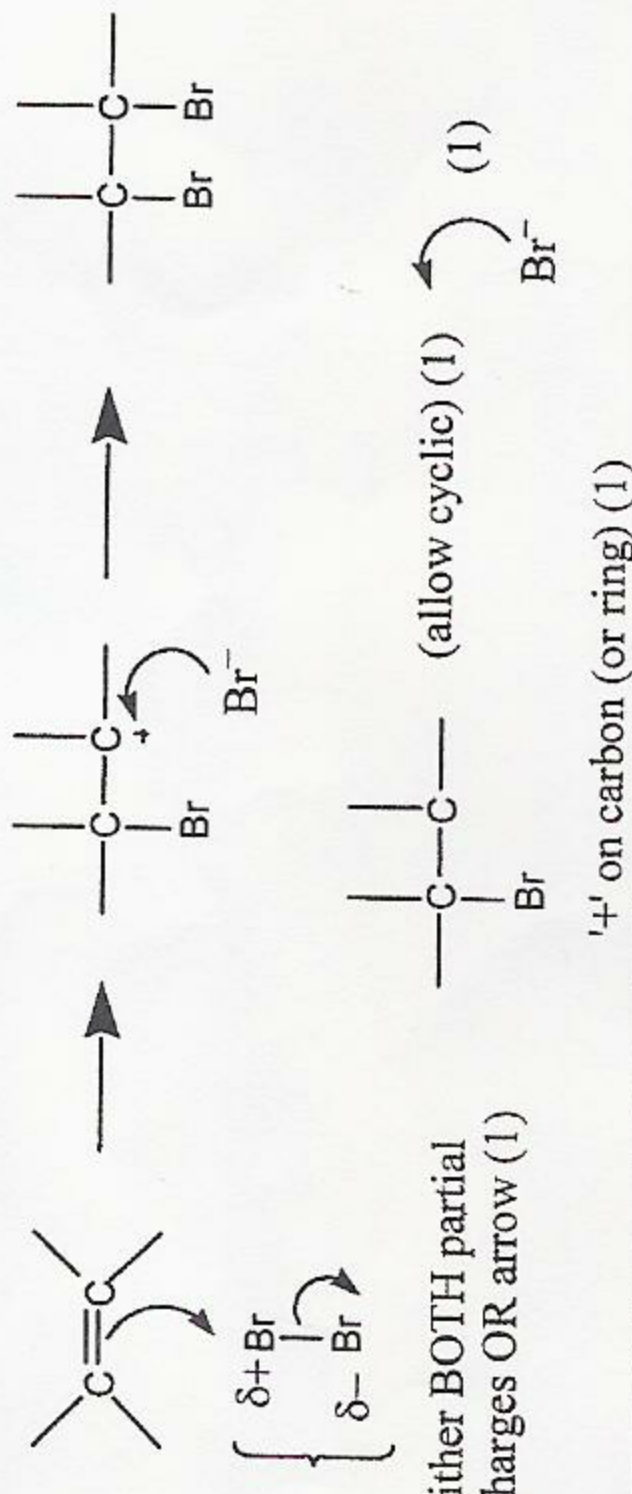


3 a	 <p>double bond (1) completely correct (any chemically correct representation) (1)</p>	2
3 b	covalent/hydrogen (bonds)	1
3 c	 <p>hydrogen bond between H on one and O on other (1) allow dotted line but not continuous line at least one lone pair shown as starting point of bond (1) δ^+/δ^- shown correctly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

3 g i	two from C=C (1) lack of free rotation/planar/cannot twist (1) two different groups on each carbon atom (1) trans (1)	3
3 g ii	permanent (dipole) (-) permanent dipole (NOT p.d.-p.d. or dipole-dipole)	1
3 g iii	poly(ethene) more flexible because chains can slide over each other (1) more easily (1) instantaneous (dipole)-induced dipole forces/Van der Waals forces in poly(ethene) (1) intermolecular forces (however described) in poly(ethene) weaker than those in PMMA (1) if imf in PMMA described, allow ecf from 3gii or variants eg "dipole-dipole" IGNORE references to side-chains, tangling etc QWC: At least two sentences, logical, two italicised terms used correctly.	4
		1

4 a i	brown/red/red-brown/brown-orange/red-orange (NOT orange) (1) liquid (1) mark separately	2
4 a ii	chlorine is more reactive because it displaces bromine/oxidises/takes electrons away from Br^- ora reason must be given	1
4 a iii	Br^- on left and Br/Br_2 and e^- on right (only) scores (1) Completely correct: $2\text{Br}^- \rightarrow \text{Br}_2 + 2\text{e}^-$ (2) electrons may be subtracted from LHS IGNORE state symbols	2
4 a iv	oxidation (ecf from a iii) 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) allow doubled state symbols, provided (aq) + (aq) \rightarrow (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>Br^-</p> <p>δ^+ on carbon (or ring) (1)</p>	4
4 e i	light (on its own or qualified "visible", "uv" "sun", "radiation")/u.v. (radiation)	1
4 e ii	homolytic	1
4 e iii	initiation	1
4 e iv	hydrogen bromide (accept hydrobromic acid and HBr) (1)	1
4 e v	bromoethane (1) ALLOW 1-bromoethane	1

<p>Abbreviations, annotations and conventions used in the Mark Scheme</p>	<p>= alternative and acceptable answers for the same marking point = separates marking points = answers which are not worthy of credit = words which are not essential to gain credit = (underlining) key words which must be used to gain credit = error carried forward = alternative wording = or reverse argument</p> <p>/ ; NOT () — ecf AW ora</p>
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Question	Expected Answers	Marks
1 a i	Visible/ light	1
1 a ii	infrared NOT heat	1
1 b i	they/carbon dioxide/CO ₂ /molecule/bonds vibrates/bends/stretch (1); more/faster (AW)(1); <i>second mark tied to first</i> gain/increase in <u>vibrational</u> energy scores (2) /IGNORE references to kinetic energy and molecules heating up	2
1 b ii	<i>Assume advantage followed by disadvantage unless stated</i> Advantages: Warmed planet (1); so that life could evolve (1) or continues to warm planet (1) so that life can survive/ specified agricultural change (1) Disadvantages: Too much warming/global warming (1) will lead to ice caps melting/climate change/Gulf stream stopping/sea levels rising/flash floods (1) Mention of uv or ozone is a CON to second mark in the pair concerned. QWC Written in sentence(s); grammatical; spelling correct (allow one error in either)	4
1 c	CO ₂ / molecules leaving and entering solution (1); at the same rate (1) mark separately if refers to some process or "reaction".	2
1 d i	The <u>u.v.</u> (radiation/light) (needed to give a tan) (1) cannot pass through/absorbed by glass (1) <i>must refer to radiation. NOT "reflected by"</i>	2
1 d ii	O ₃ → O ₂ + O (1) hv (over arrow) (1) mark separately accept O ₃ + hv	2
1 e i	ClO + O ₂ (1); ClO + O (1) /IGNORE dots	2

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

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