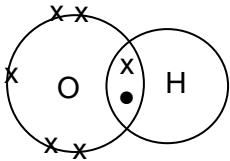


Chemistry B (Salters)

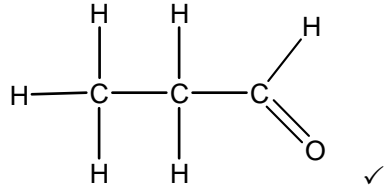
Mark Scheme

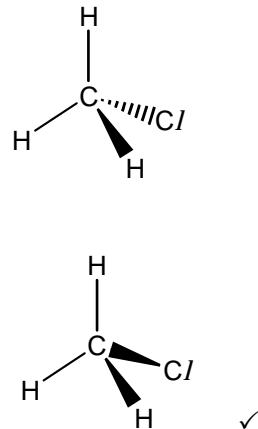
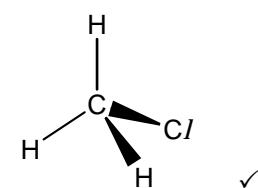
Question			Expected Answers	Marks	Additional Guidance
1	(a)		<p>Incomplete combustion ✓</p> <p>of hydrocarbons ✓</p>	2	<p>ALLOW not enough oxygen or air linked to the idea of combustion / uncomplete combustion</p> <p>Second mark depends on the first. ALLOW fossil fuel or named fossil fuel / carbon in the fuel / organic fuel DO NOT ALLOW just 'fuel' or carbon as the fuel</p>
	(b)		<p>Toxic / poisonous / reduces the capacity of blood to carry oxygen around the body / AW ✓</p> <p>AND</p> <p>Any one from:</p> <p>causes (photochemical) smog ✓</p> <p>oxidised to CO₂ which is a greenhouse gas / reacts with O₂ to form CO₂ which is a greenhouse gas ✓</p>	2	<p>ALLOW respiratory problems, but not breathing problems. IGNORE harmful / dangerous</p> <p>Answer must have the CO₂ AND the greenhouse gas for this alternative. ALLOW global warming instead of greenhouse gas.</p>
	(c)	(i)	Homolytic (fission) / homolysis ✓	1	IGNORE 'photochemical dissociation'

Question			Expected Answers	Marks	Additional Guidance
		(ii)	$464 \times 1000 \checkmark$ Energy value/ 6.02×10^{23} AND a correct evaluation (= $7.71 \times 10^{-19} \text{ J}$) \checkmark	2	One mark is for converting from kJ to J (ie: multiplying by 1000) The other is for dividing their energy value by 6.02×10^{23} (the Avogadro constant) ALLOW 2 or more sig. figs. but rounding must be correct. In order to score the second mark, there must be a correct evaluation of their expression. A completely correct answer on its own scores both marks.
		(iii)	Answer to (c)(ii)/ $6.63 \times 10^{-34} \checkmark$ $= 1.16 \times 10^{15} \checkmark$ 3 sig. fig. \checkmark	3	DO NOT ALLOW the second mark for evaluating any other expression (eg: answer to (c)(ii) $\times 6.63 \times 10^{-34}$) ALLOW sig. fig. mark for any 3 sig. fig. answer that follows from any calculation (even if their evaluation of their calculation is incorrect). A completely correct answer on its own scores all marks, including the sig. fig. mark.
(d)	(i)		(A particle) with one (or more) unpaired electron(s). \checkmark	1	Answer must be in the context of an electron as part of some sort of particle. IGNORE 'free' or 'lone' or single electron.
		(ii)	 bond electrons \checkmark rest of structure \checkmark	2	Any symbols can be used to represent the electrons (including the same symbol for all electrons). Candidate does not have to draw circles for electron shells. Non-bonding electrons do not have to be shown in pairs. It MUST be clear that a pair of electrons (with any symbols) is being shared between the H and the O for the first mark. IGNORE any inner electron shells.

Question			Expected Answers	Marks	Additional Guidance
		(iii)	propagation ✓ one radical is used and replaced by another / AW ✓	2	ALLOW there is a radical on both sides of the equation. Mark independently.
	(e)		SiO ₂ : giant covalent / network solid / lattice / whole structure held together by covalent bonds / diagram ✓ CO ₂ : simple molecular / molecules / O=C=O / AW ✓ <i>comparison of forces</i> : <u>weak</u> intermolecular bonds (or forces) in CO ₂ / less energy needed to separate molecules / bonds in SiO ₂ are stronger than CO ₂ intermolecular bonds (or forces) ✓	3	IGNORE 'intermolecular bonds' in SiO ₂ / giant molecule / giant structure Marks can be given for a labelled / annotated diagram IGNORE 'covalent'. Any type of intermolecular bonds can be named and can be abbreviated. It must be clear that the intermolecular bonds in CO ₂ are being discussed, not the covalent bonds.
	(f)	(i)	0.008 / 8×10^{-3} ✓	1	

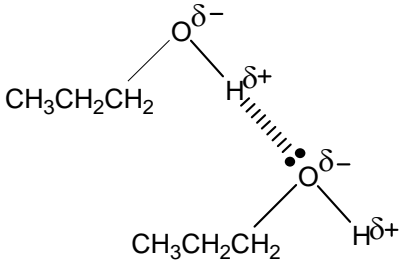
Question			Expected Answers	Marks	Additional Guidance
		(ii)	<p>Any four points from:</p> <p>1 Sun emits UV ✓</p> <p>2 Earth absorbs some of the energy (from the Sun) / heats up ✓</p> <p>3 Earth radiates emits / re-emits IR ✓</p> <p>4 (CO₂) absorbs IR radiation ✓</p> <p>5 making <u>bonds</u> vibrate (more) ✓</p> <p>6 turned into kinetic energy that raises the temperature / transfers kinetic energy to thermal energy or heat or it warms the atmosphere or Earth. ✓</p> <p>7 some CO₂ molecules radiate IR (which warms Earth) ✓</p> <p>AND</p> <p>more CO₂ molecules means more radiation is absorbed / more CO₂ means greater temperature increase / enhancing the greenhouse effect / causing global warming / warming the atmosphere / Earth / planet more ✓</p> <p>QWC - mark for connection of ideas: idea of linking IR absorption to vibrations of bonds / increase in temperature (marking point 4 linked to 5 or 6) ✓</p>	6	<p>IGNORE other types of radiation from the Sun.</p> <p>DO NOT ALLOW Earth reflects IR in point 3.</p> <p>Award marks for points 5 and 6 if the wrong frequency range of radiation is given as being absorbed in 4. (eg candidate states CO₂ absorbs UV).</p>
	(g)	(i)	aldehyde(s) ✓	1	ALLOW alkanal(s)
		(ii)	$\text{CO} + \text{C}_2\text{H}_4 + \text{H}_2 \rightarrow \text{CH}_3\text{CH}_2\text{CHO}$ ✓✓	2	<p>ALLOW C₃H₆O or full structural formula for propanal.</p> <p>Completely correct scores both marks.</p> <p>Correct formula for ethane / correctly identifies H₂ as the reducing agent scores 1 of the mark.</p>

Question			Expected Answers	Marks	Additional Guidance
		(iii)		1	
			Total	29	

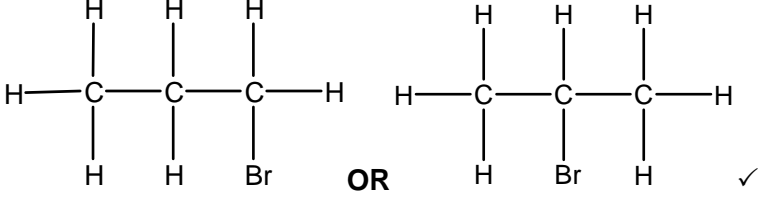
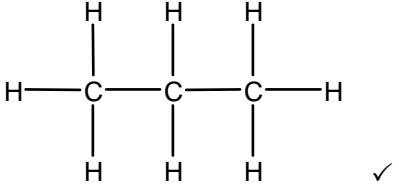
Question			Expected Answers	Marks	Additional Guidance
2	(a)		Bromoalkane(s) / halogenoalkane(s) ✓	1	ALLOW halokane(s) / haloalkane(s) / halogenoalkane
	(b)	(i)	$\text{CH}_3\text{OH} + \text{HBr} \rightarrow \text{CH}_3\text{Br} + \text{H}_2\text{O}$ ✓✓ Right hand side ✓ Left hand side ✓	2	ALLOW CH_4O / BrH / BrCH_3 IGNORE state symbols
		(ii)	Nucleophilic ✓ Substitution ✓	2	Any clear indication scores the mark eg: circled. If more than two choices indicated, each extra response CONs a correct answer.
	(c)	(i)	Amine(s) ✓	1	ALLOW small spelling error.
		(ii)	CH_3NH_2 / CH_5N ✓	1	
	(d)		$\delta+$ on C and $\delta-$ on Cl ✓	1	IGNORE $\delta+$ on Hs. DO NOT ALLOW $\delta-$ on Hs
	(e)		 OR  bond angle 109° ✓	2	ALLOW other 3-D representations of the molecule. ALLOW chlorine in any position. Diagram needs to be as shown on the left or one bond in the plane, with two going into the plane of the page and one coming out (or vice versa). DO NOT ALLOW two bonds in the same plane at 180° . ACCEPT bond angle values in the range $100 - 112^\circ$

Question			Expected Answers	Marks	Additional Guidance
	(f)		<p>Any two from:</p> <ol style="list-style-type: none"> 1. chloromethane is not broken down / unreactive in the troposphere / lower atmosphere ✓ 2. but is broken down / photodissociated (in the stratosphere) / AW by ✓ 3. high energy UV / high frequency UV ✓ 4. (breakdown of chloromethane) producing chlorine atoms / chlorine radicals ✓ <p>AND</p> <p>(products of chloromethane) <u>catalyse</u> ozone breakdown / AW ✓</p> <p>C–Br bond is weaker (than C–C) ORA ✓</p> <p>so can be broken in the <u>troposphere</u> / molecule reacts in the <u>troposphere</u> / reacts before reaching the stratosphere ✓</p>	5	<p>ALLOW 'radiation' for 'UV'</p> <p>Points 2 and 4 can be scored from a reaction equation.</p> <p>QWC: To gain this mark, candidate must use the word catalyst or a derivative of it, spelled correctly and used in a grammatically correct way (eg: do not award for 'it catalyse the breakdown of ozone').</p> <p>ALLOW 'catalyze'.</p>
	(g)	(i)	(concentration) values were low ✓	1	Answers need to show that values were less and not just different from the expected ones.
			Total	15	

Question			Expected Answers	Marks	Additional Guidance
3	(a)	(i)	addition ✓	1	DO NOT ALLOW additional.
		(ii)	propene ✓ $ \begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}-\text{C}=\text{C}-\text{H} \\ \\ \text{H} \end{array} $ ✓	2	ALLOW prop-1-ene DO NOT ALLOW prop-2-ene Mark independently. No ecf for the second mark.
	(b)	(i)	bromine (water) ✓	1	ALLOW Br ₂
		(ii)	(from) brown / orange / yellow ✓ (to) colourless ✓	2	ALLOW any combination of these colours, but no others for the first mark (eg no mark for red / brown). DO NOT ALLOW clear for the second answer
	(c)		$ \begin{array}{cc} \text{CH}_3 & \text{CH}_3 \\ & \\ \text{C} & = & \text{C} \\ & \\ \text{H} & \text{H} \\ \text{(Z)} & \quad \quad \quad \checkmark \end{array} $ $ \begin{array}{cc} \text{CH}_3 & \text{H} \\ & \\ \text{C} & = & \text{C} \\ & \\ \text{H} & \text{CH}_3 \\ \text{(E)} & \quad \quad \quad \checkmark \end{array} $	2	Name and structure required for the mark in each case Correct structures with names swapped round scores 1 mark. Diagrams do not have to show correct bond angles. A correct representation of but-2-ene scores 1.
	(d)		instantaneous (dipole) - induced dipole ✓	1	ALLOW temporary dipole–induced temporary dipole / van der Waals forces
	(e)	(i)	low flexibility / resistant to chemical attack / does not react with water / unreactive / not prone to stress fractures / high <u>tensile</u> strength / abrasion resistant / impermeable / insoluble / rigid ✓	1	IGNORE strong, hard, durable, tough, malleable, dense, high melting point, can be moulded or remoulded. ALLOW waterproof or ‘will not wear away’.
		(ii)	bags ✓	1	IGNORE food wrap / cling film / packaging.
			Total	11	

Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	 <p>hydrogen bond between correct atoms ✓</p> <p>lone pair on relevant O in line with H bond ✓</p> <p>partial charges shown, δ^- on each O and δ^+ on each H ✓</p> <p>O–H–O straight ✓</p>	4	<p>Hydrogen bond can be shown in other forms, but not as a solid line.</p> <p>Second mark, but NOT third mark, can be scored if the hydrogen bond is between incorrect atoms.</p>
		(ii)	<p>Any three from:</p> <ol style="list-style-type: none"> 1. intermolecular bond in propene is instantaneous dipole-induced dipole ✓ 2. hydrogen bonds / intermolecular bonds (in propan-1-ol) are stronger than those in propene (ORA) ✓ 3. intermolecular bonds must be broken for the liquid to boil ✓ 4. more <u>energy</u> is needed to break them (ORA) ✓ <p>AND</p> <p>QWC - mark for connection of ideas: idea of linking strength of intermolecular bonds to amount of energy needed to break them ✓</p>	4	<p>ALLOW van der Waals'</p> <p>DO NOT ALLOW harder / easier</p> <p>DO NOT ALLOW 'higher temperature' for 'more energy'.</p>

Question			Expected Answers	Marks	Additional Guidance											
	(b)		Elimination ✓	1	ALLOW any indication of chosen answer (eg: circling). DO NOT ALLOW the mark if more than one answer has been chosen.											
	(c)	<table border="1"><tr><th>reagent</th><th>conditions</th></tr><tr><td>sulfuric / phosphoric acid ✓</td><td>heat / reflux ✓</td></tr><tr><td></td><td>concentrated ✓</td></tr><tr><td colspan="2">OR</td></tr><tr><td>alumina / silica / pumice / porous pot ✓</td><td>heat ✓</td></tr><tr><td></td><td>with (propan-1-ol) vapour ✓</td></tr></table>	reagent	conditions	sulfuric / phosphoric acid ✓	heat / reflux ✓		concentrated ✓	OR		alumina / silica / pumice / porous pot ✓	heat ✓		with (propan-1-ol) vapour ✓	3	ALLOW correct formula for reagent. ALLOW temperatures over 100°C for the heat mark Sulfuric acid AND alumina: CON reagent mark (but can still score condition marks). Clear alternatives (ie: sulfuric acid OR alumina) scores the mark. ALLOW c. for concentrated. Aqueous / water CONs the concentrated mark. The conditions marks may only be awarded if candidate has written an appropriate reagent, even if they have made a small mistake, eg: sulfuric without acid, or wrong formula (like AIO) (Concentrated) sulfuric acid with dichromate and heat scores zero. IGNORE references to pressure conditions.
reagent	conditions															
sulfuric / phosphoric acid ✓	heat / reflux ✓															
	concentrated ✓															
OR																
alumina / silica / pumice / porous pot ✓	heat ✓															
	with (propan-1-ol) vapour ✓															
	(d)	rate of forward reaction = rate of back reaction ✓ <u>concentrations</u> of reactants and products remain constant / closed system ✓	2	IGNORE references to steady state.												
	(e)	(i) amount of <u>propene</u> produced decreases ✓ (increased pressure) pushes (position of) <u>equilibrium</u> to the left/to the reactants / side with fewest molecules ✓	2	MUST mention equilibrium for the second mark. Mark independently.												
		(ii) amount of <u>propene</u> produced increases ✓ (increased temperature) pushes (position of) <u>equilibrium</u> in the endothermic direction / to the right / to the products ✓	2	MUST mention equilibrium for the second mark. Mark independently.												

Question			Expected Answers	Marks	Additional Guidance
	(f)		<p>Any three from:</p> <ol style="list-style-type: none"> 1. increased pressure increases number of particles per unit of volume ✓ 2. more collisions occur ✓ 3. (more collisions) per unit of time ✓ 4. rate increases/gets faster ✓ 	3	<p>ALLOW 'particles are closer together' for the first point DO NOT ALLOW 'reactants are closer together'.</p> <p>More frequent collisions / collisions occur more often covers two points ✓✓ IGNORE more likely to collide / greater chance of collisions in point 2.</p>
	(g)	(i)		1	ALLOW any clear representations of a structural formula, eg: CH ₃ CHBrCH ₃
		(ii)		1	ALLOW CH ₃ CH ₂ CH ₃
	(h)		platinum ✓	1	ALLOW Pt.
			Total	10	

Question			Expected Answers	Marks	Additional Guidance
5	(a)		<p>Chemical that: causes another chemical to be oxidised / is itself reduced / decreases in oxidation state / is an electron acceptor / removes electrons from another chemical ✓</p> <p>O₂ / (potassium) manganate(VII) ✓</p> <p>AND either</p> <p>(Oxidises) iron from oxidation state +2 / Fe(II) ✓</p> <p>to +3 / Fe(III) ✓</p> <p>OR</p> <p>(Manganese reduced) from Mn(VII) / +7 / manganate(VII) ✓</p> <p>to Mn(IV) / +4 / manganese(IV) oxide ✓</p>	4	<p>ALLOW 'chemical that oxidises another chemical' / oxidising agent.</p> <p>IGNORE references to change in pH.</p> <p>ALLOW permanganate / MnO₄⁻ / KMnO₄</p> <p>Fe²⁺ to Fe³⁺ scores 1.</p>
	(b)		<p>Al³⁺ (aq) + 3HCO₃⁻ (aq) → Al(OH)₃ (s) + 3CO₂ (g / aq) ✓✓✓</p> <p>Correct species ✓</p> <p>Balanced ✓</p> <p>State symbols ✓</p>	3	<p>Second and third marks depend on the first.</p> <p>ALLOW Al³⁺ (aq) + HCO₃⁻ (aq) → Al(OH)₃ (s) for one mark, if no other mark is scored (IGNORE any other chemicals)</p>
	(c)		<p>Calcium hydroxide / calcium oxide ✓</p> <p>Sodium carbonate ✓</p> <p>Hydrogencarbonate ✓</p>	3	<p>IGNORE a correct oxidation state for Ca and Na</p> <p>ALLOW 'hydrogen carbonate' but NOT 'bicarbonate'</p>
	(d)		<p>Calcium ions more highly charged or more positive (than sodium ions) / mention of Ca²⁺ <u>and</u> Na⁺ ✓</p> <p>so are more strongly attracted to the negative charge on the resin / (R)COO⁻ / anion groups ✓</p>	2	<p>IGNORE references to reactivity.</p> <p>DO NOT ALLOW just 'attracted to the resin'.</p>

Question			Expected Answers	Marks	Additional Guidance
	(e)		moles $\text{Ca}^{2+} = (800/1000) \times 0.002 (=0.0016) \checkmark$ moles $\text{Na}^+ = 2 \times \text{moles } \text{Ca}^{2+} (= 0.0032) \checkmark$ mass $\text{Na}^+ = \text{moles } \text{Na}^+ \times 23 = (0.0032 \times 23 = 0.0736 / 0.074) \text{ (g)} \checkmark$	3	Mass $\text{Na}^+ = 0.0368 / 0.037$ scores 2.
	(f)		Any five points from: 1. kills bacteria / kills pathogens / disinfectant \checkmark 2. cheap compared to other water treatment chemicals. \checkmark 3. Cl_2 or chlorine is a gas, making it difficult to contain / it spreads easily. \checkmark 4. toxic / poisonous \checkmark 5. causes respiratory problems / breathing problems \checkmark 6. forms by-products / THMs that are suspected carcinogens \checkmark 7. dissolves in rivers / local water supplies \checkmark 8. forming bleach and acid \checkmark 9. (bleach and acid) kill life forms in the water \checkmark	5	DO NOT ALLOW just 'cheap'. Answer must have 'gas' and either 'difficult to contain' or 'spreads easily' to gain the mark. ALLOW Cl_2 / chlorine is a gas so needs a strong container. IGNORE 'difficult to store / difficult to transport' DO NOT ALLOW harmful / irritant / dangerous instead of toxic. Answer must have 'by-products / THMs' and 'suspected carcinogens' to gain the mark.
			Total	20	