

Chemistry B (Salters)

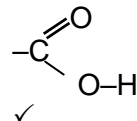
Mark Scheme

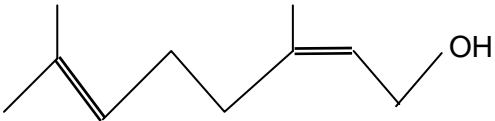

Question			Expected Answers	Marks	Additional Guidance
1	a		I in $\text{I}^- = -1$ ✓ I in $\text{IO}_3^- = +5$ ✓	2	Must have a sign for mark to be awarded. ALLOW 1 mark for 1– AND 5+
	b	i	Sulfur ✓	1	ACCEPT S DO NOT ACCEPT sulfur dioxide / SO_2
		ii	$[\text{IO}_3^-] = 174.9 \times 0.15$ & correct evaluation ($= 26.235 \text{ g dm}^{-3}$) ✓ 26 g dm^{-3} (2 significant figures) ✓	2	ALLOW first mark if candidate works out $M_r = 175$, then calculates concentration as 26.25 g dm^{-3} If they work out the M_r incorrectly and use it, they do not get ECF Award significant figure mark for an answer that is the correct 2 significant figures value of a shown calculation The correct answer on its own scores both marks
		iii	$\text{IO}_3^- + \underline{6}\text{H}^+ + \underline{6}\text{e}^- \rightarrow \text{I}^- + 3\text{H}_2\text{O}$ ✓✓ 6 in front of H^+ ✓ $6\text{e}^- / 6\text{e}$ ✓	2	Mark separately
	c	i	(Pale) yellow ✓ Precipitate / solid / suspension ✓	2	Mark separately DO NOT ALLOW off white / cream or combinations with yellow IGNORE cloudy IGNORE changes of colour on standing ALLOW ppt or minor spelling error
		ii	$\text{Ag}^+ (\text{aq}) + \text{I}^- (\text{aq}) \rightarrow \text{AgI} (\text{s})$ ✓✓ Equation ✓ State symbols ✓	2	Completely correct equation (i.e. without spectator ions) scores the first mark ALLOW answer with multiples Mark state symbols separately – must have the idea of $(\text{aq}) + (\text{aq}) \rightarrow (\text{s})$ [ignore (aq) with nitrate]

Question			Expected Answers	Marks	Additional Guidance
	d		<p>Electron movements / AW ✓</p> <p>(in the molecules) create an uneven distribution of charge, leading to a temporary / instantaneous (dipole) AW ✓</p> <p>(The temporary / instantaneous dipole) in one molecule creates / induces a dipole in a neighbouring molecule, then attracts it AW ✓</p>	3	<p>Answers must clearly indicate that electrons are in different places at different times (e.g. ALLOW 'at any one time electrons may be closer to one end of a molecule than the other')</p> <p>DO NOT ACCEPT electron density changes</p> <p>DO NOT ACCEPT 'electrons are orbiting/spinning'</p> <p>Marking points 2 and 3: Each need both parts to score. (i.e. mp2 – creates uneven distribution AND temporary dipole; mention of ions negates this mark)</p> <p>Examples of alternative wording for the first part of mp 2 ('uneven distribution of charge') are: 'δ+ and / or δ⁻' or '<u>partial</u> positive and/or negative charge' or a diagram showing these</p> <p>e.g.: Candidate can write 'induces a partial charge' for 'induces a dipole'</p> <p>DO NOT ACCEPT 'forms a bond' for 'attracts'</p>
	e	i	<p>1s²2s²2p⁶3s²3p⁵ ✓✓</p> <p>Completely correct ✓✓ If incorrect, but has 17 electrons ✓</p>	2	<p>ALLOW upper or lower case letters but numbers must be superscripts</p> <p>ALLOW [Ne] 3s²3p⁵ for 2 marks</p>
		ii	<p>5p⁵ ✓</p>	1	<p>ALLOW upper or lower case letters but numbers must be superscripts, except</p> <p>ALLOW ECF for subscript numbers if used in (e)(i) and (e)(ii)</p>
		iii	<p>Gain of electrons ✓</p>	1	<p>IGNORE references to oxidation state</p>

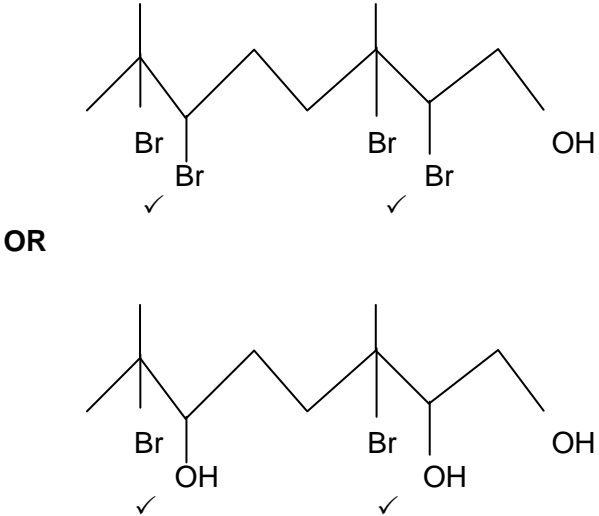
Question			Expected Answers	Marks	Additional Guidance
		iv	<p>C/atom is smaller (than I atom) / has fewer (occupied) electron shells / outer (occupied) electron shell closer to nucleus / outer sub-shell for C/ is 3p but 5p for iodine OR A ✓</p> <p>So extra electron added or gained (during reactions) is more strongly attracted by the nucleus / extra electron added or gained has less shielding from nuclear attraction OR A ✓</p>	2	<p>IGNORE references to electronegativity ALLOW energy levels for electron shells</p> <p>The answer must have attraction by the nucleus for an added/gained electron</p>
			Total	20	

Question			Expected Answers	Marks	Additional Guidance
2	a		$C_{10}H_{20}O$ ✓✓ 10 Cs ✓ The rest ✓	2	ALLOW $C_{10}H_{19}OH$ for both marks Mark independently
	b		Alcohol ✓ Alkene ✓	2	ALLOW hydroxyl DO NOT ALLOW hydroxy IGNORE C=C double bond Each additional answer CONs a mark
	c		Primary ✓ The C to which the OH is attached is joined to one other C / there are 2 Hs on the C to which the OH is joined / OH is on the end of a chain ✓	2	Can refer to R groups ALLOW 'it' for OH
	d	i	(Potassium / sodium) dichromate / chromate / correct formula Acidified / (sulfuric) acid / H_2SO_4 / H^+ ✓	2	Mark independently IGNORE dichromate oxidation state if dichromate written in words (ALLOW minor spelling error) IGNORE formula if correct name is given ALLOW (potassium) manganate / permanganate / correct formula ALLOW hydrochloric acid / HCl / nitric acid / HNO_3 for second mark IGNORE 'concentrated' DO NOT give credit for conc. sulfuric acid as the only reagent Any additional reagent, other than water, negates the dichromate/manganate mark, but candidate can still score the acid mark

Question			Expected Answers	Marks	Additional Guidance
		ii	<p>Orange (solution) ✓ Turns green ✓</p> <p>For manganate / permanganate in (d)(i) colours are: Purple (solution) ✓ Turns <u>colourless</u> / <u>decolourised</u> ✓ DO NOT ALLOW clear for colourless ACCEPT brown for second colour with manganate</p>	2	<p>Mark separately</p> <p>DO NOT ACCEPT orange or green in combination with any others (e.g. blue/green)</p>
		iii	Carboxylic acid / carboxyl ✓	1	<p>ALLOW minor spelling error DO NOT ALLOW carboxylic on its own DO NOT ALLOW carbonyl or COOH</p>
		iv	 <p>✓</p>	1	<p>ALLOW OH (i.e. without the O–H bond)</p> <p>ECF if put aldehyde for (iii)</p>

Question			Expected Answers	Marks	Additional Guidance
	e	i	<p>Either</p>  <p>OR</p>  <p>Z formation for C=C near OH ✓</p> <p>Rest of structure ✓</p>	2	<p>ALLOW 1 mark for a correctly drawn Z arrangement for the C=C near the OH, even if there is an error in the rest of the structure</p> <p>1st mark should be awarded, even if incorrect bond angles shown</p> <p>2nd mark dependent on the first</p>
		ii	Two identical groups / methyl groups on one C of C=C ✓	1	IGNORE functional (groups)

Question			Expected Answers	Marks	Additional Guidance
	f	i	<p>Either Bromine water / turns from brown / orange / yellow ✓ to colourless ✓</p> <p>OR Alkene turns from colourless ✓ to brown /orange/yellow (when excess bromine added) ✓</p> <p><u>Both</u> AW compounds are unsaturated / have C=C / have alkene groups ✓</p>	3	<p>If the candidate's answer does not clearly state which chemical the colour change refers to, assume it is the bromine</p> <p>DO NOT ALLOW red or combinations including red for initial colour</p> <p>DO NOT ALLOW 'clear' instead of 'colourless'</p> <p>ALLOW 'have double bonds'</p>
		ii	<p>A greater volume of bromine water is added to geraniol than to citronellol before the reaction is complete ORA ✓</p> <p>Because geraniol has two alkene groups / two C=C / is more unsaturated (than citronellol) ORA ✓</p>	2	<p>ALLOW 'more bromine water is needed' or similar wording IGNORE answers in terms of reaction rate or time for the 1st mark</p> <p>ALLOW 'It needs more drops because it has more double bonds'</p>

Question			Expected Answers	Marks	Additional Guidance
		iii	 <p>OR</p>	2	<p>For either answer, the remainder of the molecule must be correct for the second mark to be awarded. Each error in the remainder of the structure CONs a mark</p> <p>ALLOW answer with one Br and one OH added across each double bond either way round</p>
		iv	<p>Electrophilic ✓</p> <p>Addition ✓</p>	2	<p>Any clear indication scores the marks (e.g. ringed)</p> <p>More than two indicated: each additional incorrect answer indicated CONs a correct answer</p>
			Total	24	

Question			Expected Answers	Marks	Additional Guidance
3	a		Burning fuel in vehicle engines / putting fertilisers onto soil ✓	1	Answer must be an <u>activity</u> (e.g. driving a vehicle) DO NOT ACCEPT 'burning a fuel' without a context ACCEPT nitrogen and oxygen reacting in a vehicle engine
	b	i	NO ✓	1	Any clear indication scores the marks (e.g. ringed) More than one indicated: the additional incorrect answer indicated CONs a correct answer
		ii	Unpaired electron ✓	1	IGNORE 'lone electron', 'free electron', 'spare electron' or 'single electron' and references to which atom has the unpaired electron ALLOW have odd number of electrons
		iii	Termination ✓	1	
	c	i	No bond breaking ✓	1	ALLOW ' <u>only</u> formation of bonds'
		ii	The concentrations of the reacting particles are low / low abundance / few particles / few collisions / low pressure ✓	1	ALLOW temperature is low / very low / cold ALLOW high temperature needed for reaction to occur ALLOW the particles are far apart

Question			Expected Answers	Marks	Additional Guidance
		iii	<p>Any four from:</p> <p>1. Rate is greater when temperature is higher <i>ORA</i> ✓</p> <p>2. (At higher temperatures) particles have more energy/move faster ✓</p> <p>3. More particle collisions ✓</p> <p>4. per unit of time ✓</p> <p>5. More collisions have (total) energy of at least the activation energy / more successful collisions ✓</p> <p>QWC – for linking: Link made between greater energy/move faster and increased rate (mp 2 & 1) ✓</p>	5	<p>Please use annotations on answer in appropriate places</p> <p>Reverse argument allowed throughout</p> <p>MP3: Must be clear that collisions are between particles, not reactants or similar wording MP3: DO NOT ACCEPT more chance of / likelihood of collisions</p> <p>More frequent collisions scores mp 3 and 4</p> <p>MP5: DO NOT ALLOW more particles have energy greater than E_a</p> <p>Please indicate QWC mark using red cross or green tick on the right of the pencil icon on the answer screen. DO NOT ACCEPT links between temperature and rate for the QWC mark</p>
	d	i	$O_3 + O \rightarrow 2O_2$ / $O_2 + O_2$ ✓	1	DO NOT ALLOW with extra chemicals not cancelled
		ii	NO is not used up in the reaction / NO is reformed / chemically unchanged <i>AW</i> ✓	1	

Question			Expected Answers	Marks	Additional Guidance
		iii	Catalyst is in the same (physical) state <u>as the reactants</u> ✓	1	ALLOW phase ALLOW NO or 'it' for catalyst
		iv	(Catalysts) provide an alternative (AW): route / pathway / path / intermediate ✓ with lower <u>activation</u> energy / enthalpy ✓	2	Mark separately
	e	i	(Ozone) stops <u>UV</u> ✓ (UV) of high energy / high frequency / short wavelength ✓ which could otherwise cause <u>skin</u> cancer / damage to DNA / damage to eyes / damage to immune system / cell mutation / affects crops ✓	3	DO NOT ALLOW 'protects us from UV' or 'reflects UV' DO NOT ALLOW high intensity radiation ALLOW UVC / UVB / 10^{16} Hz / 200–320 nm ✓
		ii	(Causes) <u>photochemical</u> smog / breathing problems / respiratory problems / lung damage / toxic ✓	1	ALLOW deterioration of rubber
			Total	20	

Question			Expected Answers	Marks	Additional Guidance
4	a	i	1,1,1,2-Tetrafluoroethane ✓✓ Tetrafluoroethane ✓ 1,1,1,2 ✓	2	Mark independently IGNORE commas and dashes ALLOW minor spelling errors ALLOW 1 mark for numbers if given in two parts: such as 1,1,1-trifluoro-2-fluoroethane DO NOT ALLOW other numbers, such as 2,2,2,1 or the reverse
		ii	Advantage: lower / low ODP (AW) ✓ Disadvantage: (more) expensive ✓	2	In both parts, each additional answer CONs the mark
		iii	Compound D ✓	1	
	b	i	$M_r(\text{C}_4\text{H}_9\text{OH}) = 74.0 / 74$ and $M_r(\text{C}_4\text{H}_9\text{Br}) = 136.9$ ✓	1	ACCEPT 137
		ii	Either: $5/136.9$ ✓ $\times 74 = 2.7 \text{ g}$ ✓ OR $74/136.9$ ✓ $\times 5 = 2.7 \text{ g}$ ✓	2	ALLOW ECF from incorrect values for M_r ALLOW any number of significant figures IGNORE rounding errors
		iii	[Answer from (ii) / 45] $\times 100 \text{ g} = 6.0 \text{ g}$ ✓	1	ALLOW any number of significant figures
	c	i	(Boil a liquid) in a container (AW) attached to a <u>vertical</u> / <u>upright</u> condenser ✓	1	Mark can be obtained for correct apparatus diagram

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		ii	<p>Any two from:</p> <p>Increases rate of reaction ✓</p> <p>Allows <u>boiling</u> for a long time ✓</p> <p>Stops loss of volatiles / products / reactants ✓</p> <p>Stops liquids catching fire ✓</p>	2	<p>DO NOT ACCEPT stops gas(es) escaping</p> <p>ALLOW stops products escaping as gases</p>
	d	i	<p>Put into a separating funnel ✓</p> <p>Run off the lower or 1-bromobutane layer (AW) / pipette off the top or water layer ✓</p>	2	<p>Mark independently</p> <p>DO NOT ACCEPT 'pour off / decant off the top layer'</p> <p>It must be clear in the candidate's answer that the organic layer is the bottom layer</p>
		ii	<p>(Anhydrous) sodium sulfate <i>or other salt with an anhydrous and hydrated form</i> ✓</p>	1	<p>ALLOW <u>conc.</u> H₂SO₄ / silica gel, but not just silica</p> <p>ALLOW correct formula</p>
		iii	<p>Distillation ✓</p>	1	<p>IGNORE fractional</p>
			Total	16	

Question		Expected Answers	Marks	Additional Guidance
5	a	<p>1. UV radiation of high energy / short wavelength / high frequency ✓</p> <p>2. causes the <u>bonds</u> in the molecule to break / causes photodissociation / breaks molecules to form radicals ✓</p> <p>3. Example: water molecules / reference to figure 2 ✓</p> <p>4. <u>Homolytic</u> (fission) / (bond breaks) <u>homolytically</u> / <u>homolysis</u> occurs (underlined word must be spelt correctly) ✓</p>	4	<p>Please use annotations on answer in appropriate places</p> <p>ACCEPT UV has enough energy</p> <p>Not just splitting for second mark IGNORE bonds between molecules</p> <p>MP3: Can be scored from a correct equation</p> <p>MP4: Tick or cross needs to be with 'homolytic', not with the pencil icon</p>
	b	<p>Either:</p> <p>3.5/80 (= 0.0437) ✓</p> <p>Answer x 91 = 3.98 ✓</p> <p>OR</p> <p>3.5 x 91 (= 318.5) ✓</p> <p>Answer / 80 = 3.98 ✓</p>	2	<p>ALLOW values from 76 to 82%</p> <p>IGNORE significant figures in final answer</p>
	c	<p>Carbonates / named carbonate ✓</p> <p>Decomposing / breaking down ✓</p>	2	<p>Correct equation scores both marks</p> <p>Rocks decomposing for 2nd mark</p>
	d	<p><u>Bonds</u> absorb/take in (IR) ✓</p> <p><u>Bonds</u> vibrate (more) ✓</p>	2	<p>Mark independently</p>
	e	<p>Peak/trough/absorption ✓</p> <p>at between 2500–3640 (cm^{-1}) ✓</p>	2	<p>ALLOW any range from 2500 to 3800</p> <p>Mark independently</p> <p>IGNORE references to other peaks/troughs</p>

	f	<p>Either: $0.0014/1000 (= 1.4 \times 10^{-6}) \checkmark$ ppm deuterium = (answer/100) x 1000000 =0.014 ppm✓</p> <p>OR $(0.0014/100) \times 1000000 (= 14) \checkmark$ ppm deuterium = answer / 1000 = 0.014 ✓</p>	2	<p>One mark for calculating % deuterium One mark for converting from % to ppm</p> <p>ACCEPT answers that have 0.028 for ppm of water molecules that contain deuterium</p>
	g	<p><i>Any five from:</i></p> <ol style="list-style-type: none"> 1. Mars is further from the Sun ORA ✓ 2. On Mars, gaseous water has become liquid / solid / liquid water does not evaporate ✓ 3. On Mars, CO₂ has become solid ✓ 4. On Mars, CO₂ reacted / combined with rocks / locked up in rocks ✓ 5. Mars has a 'runaway refrigerator' (effect) ✓ 6. On Earth outgassing increased the amount of CO₂ (in the atmosphere) ✓ 7. Mars has a minimal <u>greenhouse effect</u> / Earth has a greater <u>greenhouse effect</u> (than Mars) ✓ <p>QWC – <i>for connection of ideas:</i> Either: <i>Link made between reduced amounts of water vapour / carbon dioxide in Mars' atmosphere and lessening of greenhouse effect / description of greenhouse effect (mp 2/3 and 7)</i> OR <i>Link made between greater amount of H₂O (g) / CO₂ in Earth's atmosphere and greater greenhouse effect / description of greenhouse effect (mp 5 and 7)</i></p>	6	<p>Please indicate QWC mark using red cross or green tick on the right of the pencil icon on the answer screen</p> <p>ALLOW mark for QWC, even if description of greenhouse effect has minor errors, as QWC is for the link being made</p>
		Total	20	