

# **Chemistry B (Salters)**

Advanced Subsidiary GCE F332

Chemistry of Natural Resources

## **Mark Scheme for June 2010**

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Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

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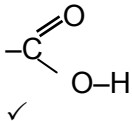
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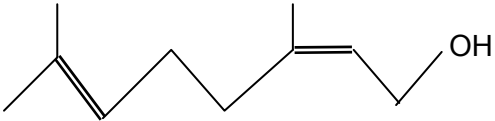

Question		Expected Answers	Marks	Additional Guidance
1	a	I in $I^- = -1$ ✓ I in $IO_3^- = +5$ ✓	2	Must have a sign for mark to be awarded. <b>ALLOW</b> 1 mark for 1- <b>AND</b> 5+
	b	i Sulfur ✓	1	<b>ACCEPT S</b> <b>DO NOT ACCEPT</b> sulfur dioxide / $SO_2$
		ii $[IO_3^-] = 174.9 \times 0.15$ & correct evaluation ( $= 26.235 \text{ g dm}^{-3}$ ) ✓ $26 \text{ g dm}^{-3}$ (2 significant figures) ✓	2	<b>ALLOW</b> first mark if candidate works out $M_r = 175$ , then calculates concentration as $26.25 \text{ g dm}^{-3}$ 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 $IO_3^- + \underline{6}H^+ + \underline{6}e^- \rightarrow I^- + 3H_2O$ ✓✓ 6 in front of $H^+$ ✓ $6e^- / 6e$ ✓	2	Mark separately
	c	i (Pale) yellow ✓ Precipitate / solid / suspension ✓	2	Mark separately <b>DO NOT ALLOW</b> off white / cream or combinations with yellow <b>IGNORE</b> cloudy <b>IGNORE</b> changes of colour on standing <b>ALLOW</b> ppt or minor spelling error
		ii $Ag^+ (aq) + I^- (aq) \rightarrow AgI (s)$ ✓✓ Equation ✓ State symbols ✓	2	Completely correct equation (i.e. without spectator ions) scores the first mark <b>ALLOW</b> answer with multiples Mark state symbols separately – must have the idea of $(aq) + (aq) \rightarrow (s)$ [ignore (aq) with nitrate]

Question		Expected Answers	Marks	Additional Guidance
	<b>d</b>	<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. <b>ALLOW</b> 'at any one time electrons may be closer to one end of a molecule than the other')</p> <p><b>DO NOT ACCEPT</b> electron density changes</p> <p><b>DO NOT ACCEPT</b> 'electrons are orbiting/spinning'</p> <p><b>Marking points 2 and 3:</b> Each need both parts to score. (i.e. mp2 – creates uneven distribution <b>AND</b> 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><b>DO NOT ACCEPT</b> 'forms a bond' for 'attracts'</p>
	<b>e i</b>	<p><math>1s^2 2s^2 2p^6 3s^2 3p^5</math> ✓✓</p> <p>Completely correct ✓✓ If incorrect, but has 17 electrons ✓</p>	2	<p><b>ALLOW</b> upper or lower case letters but numbers must be superscripts</p> <p><b>ALLOW</b> [Ne] <math>3s^2 3p^5</math> for 2 marks</p>
	<b>ii</b>	$5p^5$ ✓	1	<p><b>ALLOW</b> upper or lower case letters but numbers must be superscripts, except</p> <p><b>ALLOW</b> ECF for subscript numbers if used in <b>(e)(i)</b> and <b>(e)(ii)</b></p>
	<b>iii</b>	Gain of electrons ✓	1	<b>IGNORE</b> references to oxidation state

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 ORA ✓</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 ORA ✓</p>	2	<p><b>IGNORE</b> references to electronegativity <b>ALLOW</b> energy levels for electron shells</p> <p>The answer must have attraction by the nucleus for an added/gained electron</p>
<b>Total</b>			<b>20</b>	

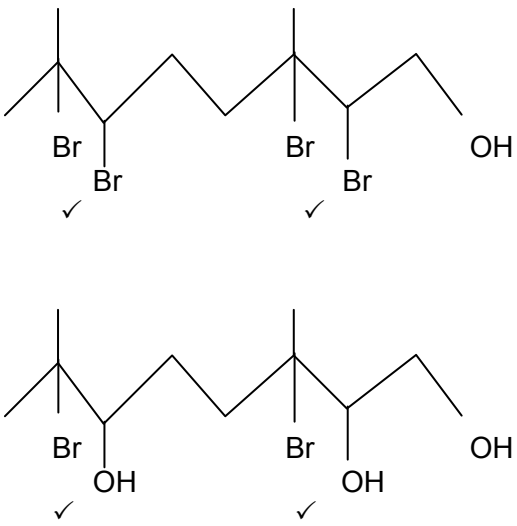
Question		Expected Answers	Marks	Additional Guidance
2	a	C <sub>10</sub> H <sub>20</sub> O ✓✓ 10 Cs ✓ The rest ✓	2	<b>ALLOW</b> C <sub>10</sub> H <sub>19</sub> OH for both marks Mark independently
	b	Alcohol ✓ Alkene ✓	2	<b>ALLOW</b> hydroxyl <b>DO NOT ALLOW</b> hydroxy <b>IGNORE</b> C=C double bond Each additional answer <b>CONs</b> 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 <b>ALLOW</b> 'it' for OH
	d i	(Potassium / sodium) dichromate / chromate / correct formula  Acidified / (sulfuric) acid / H <sub>2</sub> SO <sub>4</sub> / H <sup>+</sup> ✓	2	Mark independently <b>IGNORE</b> dichromate oxidation state if dichromate written in words ( <b>ALLOW</b> minor spelling error) <b>IGNORE</b> formula if correct name is given <b>ALLOW</b> (potassium) manganate / permanganate / correct formula  <b>ALLOW</b> hydrochloric acid / HCl / nitric acid / HNO <sub>3</sub> for second mark <b>IGNORE</b> 'concentrated'  <b>DO NOT</b> give credit for <b>conc.</b> 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	Orange (solution) ✓ Turns green ✓  For manganate / permanganate in (d)(i) colours are: Purple (solution) ✓ Turns <u>colourless</u> / <u>decolourised</u> ✓ <b>DO NOT ALLOW</b> clear for colourless <b>ACCEPT</b> brown for second colour with manganate	2	Mark separately  <b>DO NOT ACCEPT</b> orange or green in combination with any others (e.g. blue/green)
iii	Carboxylic acid / carboxyl ✓	1	<b>ALLOW</b> minor spelling error <b>DO NOT ALLOW</b> carboxylic on its own <b>DO NOT ALLOW</b> carbonyl or COOH
iv		1	<b>ALLOW</b> OH (i.e. without the O–H bond)  ECF if put aldehyde for (iii)

Question		Expected Answers	Marks	Additional Guidance
e	i	<p><b>Either</b></p>  <p><b>OR</b></p>  <p>Z formation for C=C near OH ✓</p> <p>Rest of structure ✓</p>	2	<p><b>ALLOW</b> 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	<b>IGNORE</b> functional (groups)



Question		Expected Answers	Marks	Additional Guidance
	f i	<p><b>Either</b> Bromine water / turns from brown / orange / yellow ✓ to colourless ✓</p> <p><b>OR</b> 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><b>DO NOT ALLOW</b> red or combinations including red for initial colour</p> <p><b>DO NOT ALLOW</b> 'clear' instead of 'colourless'</p> <p><b>ALLOW</b> '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><b>ALLOW</b> 'more bromine water is needed' or similar wording</p> <p><b>IGNORE</b> answers in terms of reaction rate or time for the 1st mark</p> <p><b>ALLOW</b> '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 <b>CONs</b> a mark</p> <p><b>ALLOW</b> 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 <b>CONs</b> a correct answer</p>
<b>Total</b>		<b>24</b>	

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) <b>DO NOT ACCEPT</b> 'burning a fuel' without a context <b>ACCEPT</b> 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 <b>CONs</b> a correct answer
		ii	Unpaired electron ✓	1	<b>IGNORE</b> 'lone electron', 'free electron', 'spare electron' or 'single electron' and references to which atom has the unpaired electron  <b>ALLOW</b> have odd number of electrons
		iii	Termination ✓	1	
	c	i	No bond breaking ✓	1	<b>ALLOW</b> ' <u>only</u> formation of bonds'
		ii	The concentrations of the reacting particles are low / low abundance / few particles / few collisions / low pressure ✓	1	<b>ALLOW</b> temperature is low / very low / cold <b>ALLOW</b> high temperature needed for reaction to occur <b>ALLOW</b> the particles are far apart

Question		Expected Answers	Marks	Additional Guidance
	iii	<p>Any <b>four</b> from:</p> <ol style="list-style-type: none"> <li>1. Rate is greater when temperature is higher <i>ORA</i> ✓</li> <li>2. (At higher temperatures) particles have more energy/move faster ✓</li> <li>3. More particle collisions ✓</li> <li>4. per unit of time ✓</li> <li>5. More collisions have (total) energy of at least the activation energy / more successful collisions ✓</li> </ol> <p><b>QWC</b> – for linking: Link made between greater energy/move faster and increased rate (mp 2 &amp; 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: <b>DO NOT ACCEPT</b> more chance of / likelihood of collisions</p> <p>More frequent collisions scores mp 3 <b>and</b> 4</p> <p>MP5: <b>DO NOT ALLOW</b> more particles have energy greater than <math>E_a</math></p> <p>Please indicate QWC mark using red cross or green tick on the right of the pencil icon on the answer screen. <b>DO NOT ACCEPT</b> links between temperature and rate for the QWC mark</p>
<b>d</b>	<b>i</b>	$O_3 + O \rightarrow 2O_2 / O_2 + O_2$ ✓	1	<b>DO NOT ALLOW</b> with extra chemicals not cancelled
	<b>ii</b>	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	<b>ALLOW</b> phase <b>ALLOW</b> 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	<b>DO NOT ALLOW</b> 'protects us from UV' or 'reflects UV'  <b>DO NOT ALLOW</b> high intensity radiation <b>ALLOW</b> UVC / UVB / $10^{16}$ Hz / 200–320 nm ✓
	ii	(Causes) <u>photochemical</u> smog / breathing problems / respiratory problems / lung damage / toxic ✓	1	<b>ALLOW</b> deterioration of rubber
<b>Total</b>			<b>20</b>	

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

Question		Expected Answers	Marks	Additional Guidance
	ii	<p>Any <b>two</b> 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><b>DO NOT ACCEPT</b> stops gas(es) escaping</p> <p><b>ALLOW</b> stops products escaping as gases</p>
d	i	<p>Put into a separating funnel ✓</p> <p>Run off the <b>lower</b> or 1-bromobutane layer (<i>AW</i>) / pipette off the <b>top</b> or water layer ✓</p>	2	<p>Mark independently</p> <p><b>DO NOT ACCEPT</b> '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	(Anhydrous) sodium sulfate <i>or other salt with an anhydrous and hydrated form</i> ✓	1	<p><b>ALLOW</b> <u>conc.</u> H<sub>2</sub>SO<sub>4</sub> / silica gel, but not just silica</p> <p><b>ALLOW</b> correct formula</p>
	iii	Distillation ✓	1	<b>IGNORE</b> fractional
<b>Total</b>			<b>16</b>	

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><b>Please use annotations on answer in appropriate places</b></p> <p><b>ACCEPT</b> UV has enough energy</p> <p>Not just splitting for second mark <b>IGNORE</b> 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><b>Either:</b></p> <p><math>3.5/80 (= 0.0437)</math> ✓</p> <p>Answer x 91 = 3.98 ✓</p> <p><b>OR</b></p> <p><math>3.5 \times 91 (= 318.5)</math> ✓</p> <p>Answer / 80 = 3.98 ✓</p>	2	<p><b>ALLOW</b> values from 76 to 82%</p> <p><b>IGNORE</b> 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 (<math>\text{cm}^{-1}</math>) ✓</p>	2	<p><b>ALLOW</b> any <u>range</u> from 2500 to 3800</p> <p>Mark independently</p> <p><b>IGNORE</b> references to other peaks/troughs</p>



f	<p><b>Either:</b>  <math>0.0014/1000 (= 1.4 \times 10^{-6}) \checkmark</math>  ppm deuterium = (answer/100) x 1000000  =0.014 ppm<math>\checkmark</math></p> <p><b>OR</b>  <math>(0.0014/100) \times 1000000 (= 14) \checkmark</math>  ppm deuterium = answer / 1000 = 0.014 <math>\checkmark</math></p>	2	<p>One mark for calculating % deuterium  One mark for converting from % to ppm</p> <p><b>ACCEPT</b> answers that have 0.028 for ppm of water molecules that contain deuterium</p>
g	<p>Any <b>five</b> from:</p> <ol style="list-style-type: none"> <li>1. Mars is further from the Sun ORA <math>\checkmark</math></li> <li>2. On Mars, gaseous water has become liquid / solid / liquid water does not evaporate <math>\checkmark</math></li> <li>3. On Mars, CO<sub>2</sub> has become solid <math>\checkmark</math></li> <li>4. On Mars, CO<sub>2</sub> reacted / combined with rocks / locked up in rocks <math>\checkmark</math></li> <li>5. Mars has a 'runaway refrigerator' (effect) <math>\checkmark</math></li> <li>6. On Earth outgassing increased the amount of CO<sub>2</sub> (in the atmosphere) <math>\checkmark</math></li> <li>7. Mars has a minimal <u>greenhouse effect</u> / Earth has a greater <u>greenhouse effect</u> (than Mars) <math>\checkmark</math></li> </ol> <p><b>QWC</b> – for connection of ideas:  <b>Either:</b>  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)  <b>OR</b>  Link made between greater amount of H<sub>2</sub>O (g) / CO<sub>2</sub> in Earth's atmosphere and greater greenhouse effect / description of greenhouse effect (mp 5 and 7)</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><b>ALLOW</b> mark for QWC, even if description of greenhouse effect has minor errors, as QWC is for the <b>link</b> being made</p>
<b>Total</b>		<b>20</b>	

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