

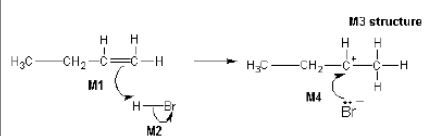
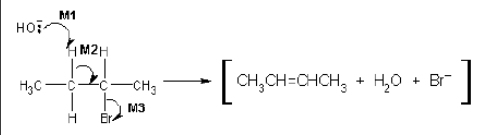
CHERRY HILL TUITION AQA CHEMISTRY AS PAPER 11 MARK SCHEME

Question	Part	Sub Part	Marking Guidance	Mark	Comments
1	(a)		$2s^2 2p^6 3s^1$	1	$1s^2$ can be rewritten Allow $2s^2 2p_x^2 2p_y^2 2p_z^2 3s^1$ Allow subscripts and capitals
1	(b)	(i)	Energy/enthalpy (needed) to remove one mole of electrons from one mole of atoms/compounds/molecules/elements OR Energy to form one mole of positive ions from one mole of atoms OR Energy/enthalpy to remove one electron from one atom In the gaseous state (to form 1 mol of gaseous ions)	1	Energy given out loses M1 M2 is dependent on a reasonable attempt at M1 Energy needed for this change $X(g) \rightarrow X^+(g) + e^{-}$ = 2 marks This equation alone scores one mark
1	(b)	(ii)	$Mg^+(g) \rightarrow Mg^{2+}(g) + e^{-}$ $Mg^+(g) + e^{-} \rightarrow Mg^0(g) + 2e^{-}$ $Mg^+(g) - e^{-} \rightarrow Mg^{2+}(g)$	1	Do not penalise MG Not equation with X
1	(b)	(iii)	Electron being removed from a positive ion (therefore need more energy)/ electron being removed is closer to the nucleus/ Mg^+ smaller (than Mg)/ Mg^+ more positive than Mg	1	Allow from a + particle/ species Not electron from a higher energy level/or higher sub-level More protons = 0
1	(b)	(iv)	Range from 5000 to 9000 $kJ\ mol^{-1}$	1	
1	(c)		Increase Bigger nuclear charge (from Na to Cl)/more protons electron (taken) from same (sub)shell/ similar or same shielding/ electron closer to the nucleus/smaller atomic radius	1 1 1	If decrease CE = 0/3 If blank mark on QWC If no shielding = 0 Smaller ionic radius = 0
1	(d)		Lower Two/pair of electrons in (3)p orbital or implied repel (each other)	1 1 1	If not lower CE = 0/3 If blank mark on Allow does not increase Not 2p M3 dependent upon a reasonable attempt at M2
1	(e)		Boron/B or oxygen/O/ O_2	1	
Question	Marking Guidance		Mark	Comments	
2 (a)(i)	M1 0 M2 (+) 5		2	Accept Roman V for M2	
(a)(ii)	$I_2 + 10HNO_3 \longrightarrow 2HIO_3 + 10NO_2 + 4H_2O$		1	Accept multiples	
(b)	M1 $IO_3^- + 6H^+ + 5I^- \longrightarrow 3I_2 + 3H_2O$ M2 $NaIO_3$ OR IO_3^- OR iodate ions OR iodate(V) ions etc. Accept "the iodine in iodate ions" but NOT "iodine" alone		2	For M1, ignore state symbols Credit multiples Accept $2\frac{1}{2}I_2 + \frac{1}{2}I_2$ as alternative to $3I_2$ Electrons must be cancelled For M2 Do not penalise an incorrect name for the correct oxidising agent that is written in addition to the formula. Accept "the iodine / I in iodate ions" but NOT "iodine" alone	
(c)(i)	Iodine OR I_2		1	Insist on correct name or formula	
(c)(ii)	$H_2SO_4 + 6H^+ + 6e^- \longrightarrow S + 4H_2O$ $SO_4^{2-} + 8H^+ + 6e^- \longrightarrow S + 4H_2O$		1	Ignore state symbols Credit multiples Do not penalise absence of charge on the electron	
(d)	hydrogen sulfide OR H_2S OR hydrogen sulphide		1		

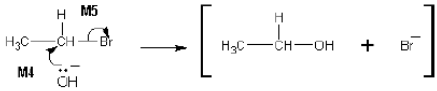
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(e)(i)	$\text{Ag}^+ + \text{I}^- \longrightarrow \text{AgI}$ ONLY	1	Ignore state symbols No multiples	
(e)(ii)	The (yellow) precipitate / solid / it does not dissolve / is insoluble OR turns to a <u>white solid</u> OR stays the same OR no (visible/ observable) change OR no effect / no reaction	1	ignore "nothing (happens)" ignore "no observation"	
(e)(iii)	The silver nitrate is acidified to <ul style="list-style-type: none"> react with / remove <u>(an)ions that would interfere</u> with the test prevent the formation of other <u>silver precipitates / insoluble silver compounds</u> that would interfere with the test remove (other) <u>ions that react with the silver nitrate</u> react with / remove carbonate / hydroxide / sulfite (ions) 	1	Ignore reference to "false positive" Do not penalise an incorrect formula for an ion that is written in addition to the name. If only the formula of the ion is given, it must be correct	
(f)(i)	An <u>electron donor</u> OR (readily) <u>donates / loses / releases / gives (away) electron(s)</u>	1	Penalise "electron pair donor" Penalise "loss of electrons" alone Accept "electron donator"	
(f)(ii)	$\text{Cl}_2 + 2\text{e}^- \longrightarrow 2\text{Cl}^-$	1	Ignore state symbols Do not penalise absence of charge on electron Credit $\text{Cl}_2 \longrightarrow 2\text{Cl}^- - 2\text{e}^-$ Credit multiples	
(f)(iii)	For M1 and M2, iodide ions are stronger reducing agents than chloride ions, because M1 Relative size of ions Iodide ions / they are <u>larger / have more electron levels(shells)</u> (than chloride ions) / <u>larger atomic / ionic radius</u> OR <u>electron to be lost/outer shell/level</u> (of the iodide ion) is <u>further</u> the nucleus OR <u>iodide ion(s) / they have greater / more shielding</u> OR converse for <u>chloride ion</u> M2 Strength of attraction for electron(s) <u>The electron(s) lost /outer shell/level electron</u> from (an) <u>iodide ion(s) less strongly held by the nucleus</u> compared with that lost from a <u>chloride ion</u> OR converse for a <u>chloride ion</u>	2	Ignore <u>general statements</u> about Group VII trends or about halogen molecules or atoms. Answers must be specific CE=0 for the clip if "iodine ions / chlorine ions QoL " CE=0 for the clip if "iodide ions are bigger molecules / atoms" QoL Insist on <u>iodide</u> ions in M1 and M2 or the use of it / they / them, in the correct context (or <u>chloride</u> ions in the converse argument) Must be comparative in both M1 and M2	
Question	Marking Guidance	Mark	Comments	
3 (a)	For 2 marks at least <u>one correct reference either to M_r or value to 5 decimal places</u> required M1 Compounds <u>1 and 3</u> (butanal and butanone) have the same M_r (to 5dp) because either <ul style="list-style-type: none"> they contain the <u>same</u> number of atoms of the same / each element are <u>both</u> $\text{C}_4\text{H}_8\text{O}$ have the <u>same molecular formula</u> contain the <u>same number</u> of C,H and O atoms M2 Compound <u>2</u> (pentane) has a different M_r (to 5dp) because either <ul style="list-style-type: none"> it has <u>different</u> numbers of atoms of different elements is C_5H_{12} / <u>only contains</u> C and H <u>different molecular formula</u> does not contain oxygen (atom) / C=O 	2	QoL (associated with the bold statement here) It may be possible to award 2 marks if there is a clear statement about oxygen having a different precise A_r in the context of the comparison NB The word "similar" does not mean "the same"	
(b)	With Tollens' (reagent) M1 <u>silver mirror</u> OR <u>black solid/precipitate</u> (NOT silver (mirror) precipitate) M2 (stays) colourless OR no change / no reaction OR no silver mirror	With Fehling's (solution) M1 <u>Red solid/precipitate</u> (Credit orange or brown <u>solid</u>) M2 (stays) blue OR no change / no reaction OR no red solid OR no (red) precipitate	2	NB No mark is awarded for the reagent If no reagent given allow 1 mark for a consistent statement of M1 and M2 For M2, ignore "nothing (happens)" And ignore "no observation"

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Question	Marking Guidance	Mark	Comments
4 (a)(i)	Increases	1	
(a)(ii)	Decreases	1	
(a)(iii)	Increases	1	
(b)	<p>Calcium has a higher melting point than strontium, because</p> <p>Correct reference to size of cations/proximity of electrons</p> <p>M1 (For Ca) delocalised <u>electron(s) closer to cations / positive ions / nucleus</u></p> <p>OR cations / positive ions / atoms are smaller</p> <p>OR cation / positive ion / atom or it has fewer (electron) shells / levels</p> <p>Relative strength of metallic bonding</p> <p>M2 (For Ca) has stronger attraction between the cations / positive ions / nucleus and the delocalised electron(s)</p> <p>OR</p> <p><u>stronger metallic bonding</u></p> <p>(assume argument refers to Ca but accept converse argument for Sr)</p>	2	<p>CE = 0 for reference to molecules or intermolecular forces or covalent bonds</p> <p>Ignore "Van der Waals forces (between atoms)" but penalise if between 'molecules'</p> <p>Ignore general Group 2 statements</p> <p>Answers must be specific</p> <p>Penalise M1 if Ca or Sr is said to have <u>more or less</u> delocalised electrons</p> <p>Ignore reference to shielding</p>
(c)(i)	<p>Sulfuric acid / it contains <u>sulfate ions / SO₄²⁻</u></p> <p>OR</p> <p><u>Sulfuric acid</u> would form a (white) <u>precipitate</u></p>	1	<p>Do not penalise an <u>additional</u> but incorrect formula for sulfate ion.</p> <p>If only the formula of the sulfate ion is given, it must be correct</p>
(c)(ii)	Ba ²⁺ + SO ₄ ²⁻ → BaSO ₄ ONLY	1	<p>Ignore state symbols</p> <p>No multiples</p>
Question	Marking Guidance	Mark	Comments
5 (a)	Position(al) (isomerism)	1	
(b)	 <p>M1 must show an arrow from the double bond towards the H atom of the H-Br molecule</p> <p>M2 must show the breaking of the H-Br bond.</p> <p>M3 is for the structure of the secondary carbocation.</p> <p>M4 must show an arrow from the lone pair of electrons on the negatively charged bromide ion towards the positively charged carbon atom of either a primary or secondary carbocation.</p> <p>NB The arrows here are double-headed</p>	4	<p>Penalise one mark from <u>their</u> total if half-headed arrows are used</p> <p>M1 Ignore partial negative charge on the double bond.</p> <p>M2 Penalise partial charges on H-Br bond if wrong way and penalise formal charges</p> <p>Penalise M3 if there is a bond drawn to the positive charge</p> <p>Penalise once only in any part of the mechanism for a line and two dots to show a bond</p> <p><u>Maximum any 3 of 4 marks</u> for wrong reactant or primary carbocation.</p> <p>If Br₂ is used, <u>maximum 2 marks</u> for their mechanism</p> <p>Do not penalise the use of "sticks"</p>
(c)	 <p>M1 must show an arrow from the lone pair on oxygen of a negatively charged hydroxide ion to a <u>correct</u> H atom</p> <p>M2 must show an arrow from a C-H bond adjacent to the C-Br bond towards the appropriate C-C bond. Only award if an arrow is shown attacking the H atom of an adjacent C-H (in M1)</p> <p>M3 is independent provided it is from their <u>original molecule</u>.</p> <p>Award full marks for an E1 mechanism in which M2 is on the correct carbocation.</p> <p>NB The arrows here are double-headed</p>	3	<p>Penalise one mark from <u>their</u> total if half-headed arrows are used</p> <p>Penalise M1 if covalent KOH</p> <p>Penalise M3 for formal charge on C of the C-Br or incorrect partial charges on C-Br</p> <p>Penalise M3 if an extra arrow is drawn from the Br of the C-Br bond to, for example, K⁺</p> <p>Ignore other partial charges</p> <p>Penalise once only in any part of the mechanism for a line and two dots to show a bond.</p> <p><u>Maximum any 2 of 3 marks</u> for wrong reactant or wrong product (if shown) or a mechanism that leads to but-1-ene</p> <p>Accept the correct use of "sticks" for the molecule except for the C-H being attacked</p>

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Question	Marking Guidance	Mark	Comments
6 (a)	<p>M1 $C_6H_{12}O_6 \longrightarrow 2CH_3CH_2OH + 2CO_2$ ($2C_2H_5OH$)</p> <p>M2 fermentation</p> <p>M3 $CH_3CH_2OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$ (C_2H_5OH)</p> <p>M4 <u>A specified process</u> e.g. planting / harvesting / transport / extracting sugar / distilling ethanol solution / fertiliser production etc.</p> <p>M5 The specified process <u>uses / burns</u> (fossil) <u>fuel that releases CO_2</u></p>	5	Mark independently For M1 and M3 ignore state symbols and credit multiples For M1 and M3 penalise C_2H_6O once only For M5, "releases / increases carbon emissions" is insufficient as an alternative to <u>releases CO_2</u>
(b)	<p>M1 sodium or potassium hydroxide / NaOH / KOH</p> <p>M2 depends on correct M1 warm / heat / reflux <u>and</u> aqueous or (aq) or water</p> <p>M3 nucleophilic substitution</p>  <p>NB The arrows here are double-headed</p> <p>M4 must show an arrow from the lone pair of electrons on the oxygen atom of the negatively charged hydroxide ion to the C atom.</p> <p>M5 must show the movement of a pair of electrons from the C—Br bond to the Br atom. Mark M5 independently provided it is from their <u>original molecule</u>.</p> <p>For M4 and M5, award full marks for an S_N1 mechanism</p> <p>M6 One statement from</p> <ul style="list-style-type: none"> The yield is (very) low / not a high yield OR elimination occurs / ethene formed The rate of reaction slow <u>Bromoethane</u> has to be manufactured / made first <u>Bromoethane</u> is expensive 	6	Mark on to M2 from hydroxide ion Ignore OH^- if KOH/ OH^- For M2 ignore "dilute" For M2 penalise $T > 100\text{ }^\circ\text{C}$ Acidified KOH/NaOH or H_2SO_4 with KOH/NaOH loses M1 and M2 For M3, both words required Penalise M4 if covalent NaOH / KOH is used Penalise one mark from M4 or M5 if half-headed arrows are used Penalise M5 for formal charge on C of the C-Br or incorrect partial charges on C-Br Penalise once only for a line and two dots to show a bond. For M4 and M5, maximum 1 of 2 marks if wrong reactant is used. Penalise M5 if an extra arrow is drawn from the Br of the C-Br bond to, for example, K^+ Do not penalise the use of "sticks" For M6 ignore references to other costs and expenses
(c)	<p>M1 <u>concentrated</u> phosphoric acid / <u>conc.</u> H_3PO_4 OR <u>concentrated</u> sulfuric acid / <u>conc.</u> H_2SO_4</p> <p>M2 hydration or (electrophilic) addition</p> <p>For M3 and M4 any two from</p> <ul style="list-style-type: none"> <u>Excess</u> ethene OR <u>Excess</u> steam / water / H_2O OR remove the ethanol as it forms OR recycle the ethene <u>Specified</u> Pressure $50\text{ atm} \leq P \leq 100\text{ atm}$ OR $5000\text{ kPa} \leq P \leq 10000\text{ kPa}$ OR $5\text{ MPa} \leq P \leq 10\text{ MPa}$ <u>High</u> Temperature unless they give a value that is not in the ranges given here; OR $300\text{ }^\circ\text{C} \leq T \leq 600\text{ }^\circ\text{C}$ OR $570\text{ K} \leq T \leq 870\text{ K}$ 	4	Answers in any order Ignore reference to support medium in M1 Do not apply the list principle to these three chosen criteria in M3 and M4 Accept a reference to "low temperature" if they specify a correct temperature range or a correct temperature in the range

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7 (a)(i)	C	1	
(a)(ii)	A	1	
(a)(iii)	D	1	
(a)(iv)	B	1	
(b)	<p>M1 Br₂ OR bromine (water) OR bromine (in CCl₄ / organic solvent)</p> <p>Either order</p> <p>M2 cyclohexane OR A or the alkane: remains orange / red / yellow / brown / the same OR no reaction OR reference to colour going to cyclohexane layer</p> <p>M3 cyclohexene OR D or the alkene: decolourised / goes colourless / loses its colour</p> <p>Alternatives : potassium manganate(VII)</p> <p>M1 KMnO₄ in acid M2 purple M3 colourless</p> <p>M1 KMnO₄ in alkali / neutral M2 purple M3 brown solid</p> <p>Give appropriate credit for the use of iodine and observations</p>	3	<p>If M1, has no reagent or an incorrect reagent, CE=0</p> <p>Ignore "acidified"</p> <p>For M1 penalise Br (or incorrect formula of other correct reagent), but mark on</p> <p>For M1, it must be a whole reagent and/or correct formulae</p> <p>If oxidation state given in name, it must be correct.</p> <p>For M2 credit "no change"</p> <p>Ignore "nothing"</p> <p>Ignore "nothing happens"</p> <p>Ignore "no observation"</p> <p>For M3, ignore "goes clear"</p> <p>No credit for combustion observations</p>
(c)	<p>M1 <u>acidified potassium or sodium dichromate</u></p> <p>OR eg H₂SO₄ / K₂Cr₂O₇ OR H⁺ / K₂Cr₂O₇</p> <p>OR correct combination of formula and name</p> <p>M2 oxidation OR oxidised OR redox</p> <p>M3 secondary / 2° (alcohol)</p>	3	<p>For M1, it must be a whole reagent and/or correct formulae</p> <p>If oxidation state given in name, it must be correct.</p> <p>Do not penalise incorrect attempt at formula if name is correct or <i>vice versa</i></p> <p>Credit acidified potassium chromate(VI) / H₂SO₄ + K₂CrO₄</p>
(d)	<p>M1 (free-) radical substitution (mechanism)</p> <p>M2 Br₂ → 2Br•</p> <p>M3 Br• + CH₄ → •CH₃ + HBr</p> <p>M4 Br₂ + •CH₃ → CH₃Br + Br•</p> <p>M5 Condition</p> <p>ultra-violet / uv / sun light</p> <p>OR high temperature</p> <p>OR 125 °C ≤ T ≤ 600 °C</p> <p>OR 400 K ≤ T ≤ 870 K</p>	5	<p>M1 both words required</p> <p>Penalise absence of dot once only.</p> <p>Penalise + or – charges every time</p> <p>Accept dot anywhere on methyl radical</p> <p>Accept a <u>correct</u> termination step for 1 mark if neither M3 nor M4 are scored; otherwise ignore termination steps</p> <p>Mark independently</p> <p>NB If Cl₂ is used, penalise every time (this may be for M2, M3 and M4)</p> <p>If cyclohexane is used, penalise every time (this may be for M3 and M4)</p> <p>For M5 ignore "heat"</p>