

Question Number	Acceptable Answers	Reject	Mark
<b>1(a)(i)</b>	<p>A chiral molecule is non-superimposable on its mirror image / 3D molecule with no plane of symmetry <b>(1)</b></p> <p>2-hydroxypropanoic acid has a carbon atom which is asymmetric / has <b>four</b> different groups attached <b>(1)</b></p> <p><b>Middle</b> carbon labelled in any clear way <b>(1)</b> e.g.</p> $  \begin{array}{ccccccc}  & & \text{H} & & \text{OH} & & \text{O} \\  & &   & &   & &    \\  \text{H} & - & \text{C} & - & \text{C} & - & \text{C} & - & \text{OH} \\  & &   & &   & & & & \\  & & \text{H} & & \text{H} & & & &   \end{array}  $ <p>ALLOW asymmetric C described but not labelled</p> <p>IGNORE references to rotation of plane polarized light</p>	<p>just 'non-superimposable'</p> <p>just 'no plane of symmetry'</p> <p>Molecules for groups</p>	<b>3</b>

Question Number	Acceptable Answers	Reject	Mark
<b>1(a)(ii)</b>	<p>2-hydroxypropanoic acid formed in muscles is a single (allow pure) enantiomer /(optical) isomer ALLOW Unequal mixture of enantiomers /(optical) isomers <b>(1)</b></p> <p>2-hydroxypropanoic acid formed in milk is a racemic mixture / equimolar mixture of the two enantiomers / racemate <b>(1)</b></p> <p>If milk and muscles are reversed but the rest is correct, one mark is awarded</p>	<p>Just "not a racemic mixture"</p> <p>Just 'a mixture of enantiomers'</p>	<b>2</b>

Question Number	Acceptable Answers	Reject	Mark
<b>1(b)(i)i)</b>	<p><b>First step</b> NaOH(aq) / KOH(aq) or names <b>(1)</b></p> <p>Second mark dependent on first being correct</p> <p><b>Second step</b> HCl(aq) / hydrochloric acid / H<sub>2</sub>SO<sub>4</sub>(aq) / sulfuric acid</p> <p>ALLOW HNO<sub>3</sub> / nitric acid /dil HCl / (dil) H<sub>2</sub>SO<sub>4</sub> / (dil) HNO<sub>3</sub> or any strong acid (name or formula) including HBr((aq)) and HI((aq)) <b>(1)</b></p> <p>IGNORE Omission of (aq) and references to temperature Ethanolic /alcoholic solutions</p> <p>ALLOW One mark for correct two reagents in the wrong order One mark for 'alkali / OH<sup>-</sup> followed by acid / H<sup>+</sup> /H<sub>3</sub>O<sup>+</sup>'</p>	<p>OH<sup>-</sup> / alkali</p> <p>H<sup>+</sup> / H<sub>3</sub>O<sup>+</sup> /acid</p>	<b>2</b>

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<b>1(b)(ii)i)</b>	<p><b>first mark</b> (Stand alone) A racemic mixture is not formed</p> <p>OR</p> <p>More of one enantiomer /(optical) isomer is formed</p> <p>OR</p> <p>Only one enantiomer /(optical) isomer is formed <b>(1)</b></p> <p><b>Second mark</b> (Stand alone) (Some of the) reaction is S<sub>N</sub>2 <b>(1)</b></p> <p><b>Third mark</b> (Stand alone) Nucleophile / OH<sup>-</sup> only attacks from one side of the molecule / from the opposite side to leaving group <b>(1)</b></p> <p>ALLOW Use of 'intermediate' for 'transition state' in description of S<sub>N</sub>2 Reverse argument based on S<sub>N</sub>1 forming a racemic mixture</p>	<p>Carbocation (for molecule)</p>	<b>3</b>

Question Number	Acceptable Answers	Reject	Mark
<b>1(c)(i)</b>	Nucleophilic (1)		<b>2</b>
	Addition (1)	S <sub>N</sub> 1/S <sub>N</sub> 2	

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<b>1(c)(ii)</b>	Cyanide (ion) / CN <sup>-</sup> / C≡N <sup>-</sup> / :C≡N <sup>-</sup> / <sup>-</sup> CN	HC C≡N	<b>1</b>

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<b>1(c)(i)</b>	<p>Both curly arrows (1)</p> <p>Intermediate (1)</p> <p>ALLOW</p> <p>Omission of lone pair</p> <p>Curly arrow from anywhere on nucleophile including from charge or nitrogen</p> <p>Formation of charged canonical form followed by attack of cyanide ion</p> <p>IGNORE δ<sup>+</sup>/δ<sup>-</sup> even if unbalanced</p>	<p>Omission of charges (penalise once only)</p> <p>Full charges on ethanal</p> <p>—C—NC in intermediate</p>	<b>2</b>

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<b>1 (c)</b>	<p>Racemic mixture / equal amounts of the two enantiomers / racemate formed (1)</p> <p>Stand alone mark</p> <p>CHO / aldehyde group is (trigonal) planar (1)</p> <p>ALLOW ethanal / molecule is (trigonal) planar</p> <p>Cyanide (ion) / <math>\text{CN}^-</math> / nucleophile attacks (equally) from above or below / either side (of the molecule) (1)</p> <p>Penalise use of intermediate / ion for aldehyde group <b>once</b> only</p> <p>Third mark cannot be awarded if the reaction is described as a nucleophilic substitution</p>	<p>Intermediate / carbonyl group / <math>\text{C}_=\text{O}</math> is planar</p> <p>two positions Intermediate</p>	<b>3</b>

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<b>1 (d) (i)</b>	<p>Any value /range within the range <math>3750\text{--}2500\text{ cm}^{-1}</math> due to <math>\text{O}\text{--}\text{H}</math> / <math>\text{OH}</math> / <math>\text{--OH}</math></p> <p>IGNORE <math>\text{COOH}</math> / <math>\text{CO}_2\text{H}</math> / carboxylic acid</p>	<p>Wavenumbers alone</p> <p><math>\text{OH}</math> in alcohol</p>	<b>1</b>

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<b>1 (d) (ii)</b>	<p>These three marks are stand alone</p> <p><math>\text{Q}</math> is due to <math>\text{C}=\text{O}</math> (1)</p> <p>The (<math>\text{C}=\text{O}</math>) aldehyde range is <math>1740\text{--}1720\text{ cm}^{-1}</math> <b>and</b> (<math>\text{C}=\text{O}</math>) carboxylic acid range is <math>1725\text{--}1700\text{ cm}^{-1}</math> (1)</p> <p>So the peaks / absorptions cannot be used to distinguish these two compounds because they overlap. OR The (broad) absorption <math>\text{Q}</math> covers both the aldehyde and the carboxylic acid ranges (1)</p> <p>ALLOW 'too close'/'quite similar' for 'overlap'</p>	<p>Carboxylic acid / <math>\text{COOH}</math> group</p> <p>Just 'cannot be used to distinguish the compounds'</p>	<b>3</b>

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<b>1(e)</b>	<p>If reagent incorrect, observation mark can only be awarded for a near miss</p> <p>Test positive for ethanal</p> <table border="1"> <thead> <tr> <th>Reagent (1)</th> <th>Observation (1)</th> </tr> </thead> <tbody> <tr> <td>Tollens'</td> <td>Silver mirror / black / grey <b>ppt</b></td> </tr> <tr> <td>Fehling's / Benedict's</td> <td>Red-brown <b>ppt</b></td> </tr> <tr> <td>2,4-DNP(H) / Brady's reagent</td> <td>Orange / red / yellow <b>ppt</b> ALLOW brick-red <b>ppt</b></td> </tr> </tbody> </table> <p>Test positive for 2-hydroxypropanoic acid</p> <table border="1"> <thead> <tr> <th>Reagent (1)</th> <th>Observation (1)</th> </tr> </thead> <tbody> <tr> <td>PCl<sub>5</sub> / Phosphorus (V)chloride / phosphorus pentachloride</td> <td>Steamy fumes* ALLOW gas evolved turns (blue) litmus / UI red</td> </tr> <tr> <td>Named metal carbonate (solution)</td> <td>Effervescence ALLOW <b>gas / CO<sub>2</sub></b> evolved turns lime water cloudy</td> </tr> <tr> <td>Sodium hydrogencarbonate (solution)</td> <td>Effervescence ALLOW <b>gas / CO<sub>2</sub></b> evolved turns lime water cloudy</td> </tr> <tr> <td>Magnesium (&amp; water)</td> <td>Effervescence</td> </tr> <tr> <td>Ethanol &amp; H<sub>2</sub>SO<sub>4</sub>/named strong acid</td> <td>Sweet / fruity / pear drops / glue smell</td> </tr> <tr> <td>Ethanoic acid &amp; H<sub>2</sub>SO<sub>4</sub>/named strong acid</td> <td>Sweet / fruity / pear drops / glue smell</td> </tr> </tbody> </table> <p>ALLOW Na and effervescence / gas evolved pops with a lighted splint for 2-hydroxypropanoic acid (2)</p> <p>ALLOW fizzing / bubbling for effervescence</p> <p>IGNORE names of product</p> <p>IF two tests given for one substance both must be correct for full marks</p> <p>*misty fumes / white fumes / gas for fumes</p>	Reagent (1)	Observation (1)	Tollens'	Silver mirror / black / grey <b>ppt</b>	Fehling's / Benedict's	Red-brown <b>ppt</b>	2,4-DNP(H) / Brady's reagent	Orange / red / yellow <b>ppt</b> ALLOW brick-red <b>ppt</b>	Reagent (1)	Observation (1)	PCl <sub>5</sub> / Phosphorus (V)chloride / phosphorus pentachloride	Steamy fumes* ALLOW gas evolved turns (blue) litmus / UI red	Named metal carbonate (solution)	Effervescence ALLOW <b>gas / CO<sub>2</sub></b> evolved turns lime water cloudy	Sodium hydrogencarbonate (solution)	Effervescence ALLOW <b>gas / CO<sub>2</sub></b> evolved turns lime water cloudy	Magnesium (& water)	Effervescence	Ethanol & H <sub>2</sub> SO <sub>4</sub> /named strong acid	Sweet / fruity / pear drops / glue smell	Ethanoic acid & H <sub>2</sub> SO <sub>4</sub> /named strong acid	Sweet / fruity / pear drops / glue smell	<p>Iodine in alkali / iodoform test Acidified potassium dichromate</p> <p>Smoke Just 'fumes'</p> <p>Any indicator as sole test</p> <p>incorrect formulae of reagents</p>	<b>4</b>
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