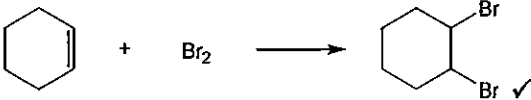

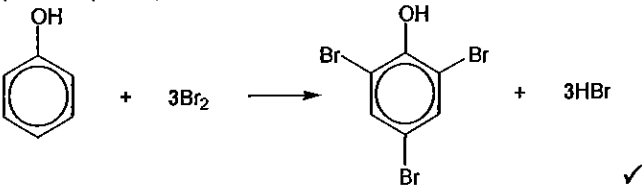


Unit 4 AP2

2814

Mark Scheme

January 2010

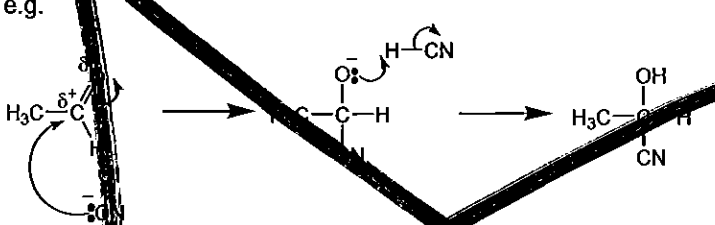
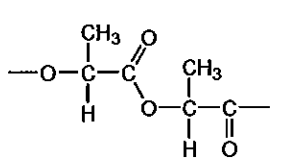
Qu.	Expected answers	Marks
7	<p>reaction with cyclohexene</p> <p>(electrophilic) addition ✓</p>  <p>(π-)electrons are localised / not delocalised ✓</p> <p>reaction with benzene</p> <p>(electrophilic) substitution ✓</p>  <p>(π-)electrons are delocalised ✓</p> <p>reaction with phenol</p> <p>(electrophilic) substitution ✓</p>  <p>lone pair of electrons from O are delocalised around the ring ✓</p> <p>explaining reactivity in the context of any compound</p> <p>valid discussion of relative electron density (around the ring) ✓</p> <p>valid discussion of relative polarisation of the bromine or the (electrostatic) attraction of electrophiles to the ring ✓</p> <p style="text-align: right;">any 10 out of 11 marks</p>	<p>allow 'added', 'adds' etc</p> <p>allow molecular formulae in the equations</p> <p>allow Br⁺ to give H⁺ in the equation</p> <p style="text-align: right;">10</p>
QWC	<p>Mark for at least two sentences or bullet points in context with correct spelling, punctuation and grammar ✓</p>	<p style="text-align: right;">1</p>
		11

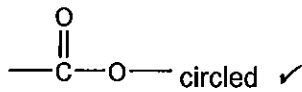
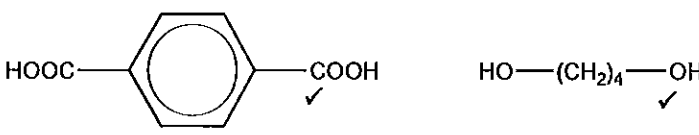
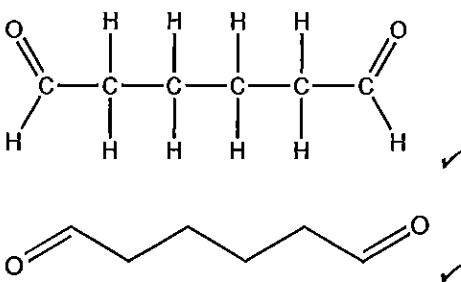
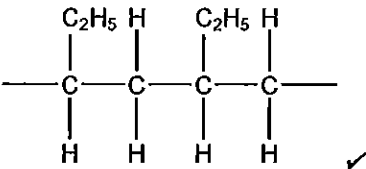
Qu.	Expected Answers	Marks
5 (a)	hex-3-en al ✓ ✓ ALLOW 'ene' ALLOW '-1-al'	2
(b)	<div style="text-align: center;"> </div>	5
(c)	<div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> $\begin{array}{c} \text{CH}_3\text{CH}_2 \quad \text{CH}_2\text{CHO} \\ \diagdown \quad / \\ \text{C}=\text{C} \\ / \quad \backslash \\ \text{H} \quad \text{H} \end{array}$ <p><i>cis</i> ✓</p> </div> <div style="text-align: center;"> $\begin{array}{c} \text{CH}_3\text{CH}_2 \quad \text{H} \\ \diagdown \quad / \\ \text{C}=\text{C} \\ / \quad \backslash \\ \text{H} \quad \text{CH}_2\text{CHO} \end{array}$ <p><i>trans</i> ✓</p> </div> </div> <p>ALLOW one mark for two correct structures with incorrect labels</p> <p>ALLOW ecf on minor side chain errors</p>	2
[Total: 9]		

Qu.	Expected Answers	Marks																
6 (a)	<p>To confirm aldehyde or ketone</p> <p>2,4-dinitrophenylhydrazine / Brady's reagent ✓ red / orange / yellow ... solid / ppt / crystals ✓</p> <p>To distinguish between aldehyde or ketone</p> <p>warm with ✓ ammoniacal silver nitrate / Tollens' reagent ✓ → silver (mirror) ✓ / acidified $\text{Cr}_2\text{O}_7^{2-}$ → green</p>	<p>DO NOT ALLOW recrystallise etc for the 2nd mark</p> <p>ALLOW any other suitable tests e.g. Fehlings, MnO_4</p>	5															
(b) (i)	M written next to the peak at $m/e = 106$ ✓	1																
(ii)	$\text{C}_7\text{H}_8\text{O}$ / $\text{C}_6\text{H}_5\text{CHO}$ $\text{C} = 7$ ✓ $\text{H} = 6$ and $\text{O} = 1$ ✓	<p>ALLOW ecf on H5 if the peak at 105 labelled</p>	2															
(c)	<table border="1" style="width: 100%; text-align: center;"> <tbody> <tr> <td> $\begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & \text{H} & & \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{CHO} & \\ & & & & & & \\ & \text{H} & \text{H} & \text{H} & \text{H} & & \end{array}$ ✓ </td> <td> $\begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & & & \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{CHO} & & \\ & & & & & & \\ & \text{H} & \text{CH}_3 & \text{H} & & & \end{array}$ ✓ </td> </tr> <tr> <td> $\begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & & & \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{CHO} & & \\ & & & & & & \\ & \text{H} & \text{H} & \text{CH}_3 & & & \end{array}$ ✓ </td> <td> $\begin{array}{ccccccc} & \text{H} & \text{CH}_3 & & & & \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{CHO} & & & \\ & & & & & & \\ & \text{H} & \text{CH}_3 & & & & \end{array}$ ✓ </td> </tr> </tbody> </table>	$\begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & \text{H} & & \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{CHO} & \\ & & & & & & \\ & \text{H} & \text{H} & \text{H} & \text{H} & & \end{array}$ ✓	$\begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & & & \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{CHO} & & \\ & & & & & & \\ & \text{H} & \text{CH}_3 & \text{H} & & & \end{array}$ ✓	$\begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & & & \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{CHO} & & \\ & & & & & & \\ & \text{H} & \text{H} & \text{CH}_3 & & & \end{array}$ ✓	$\begin{array}{ccccccc} & \text{H} & \text{CH}_3 & & & & \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{CHO} & & & \\ & & & & & & \\ & \text{H} & \text{CH}_3 & & & & \end{array}$ ✓	4												
$\begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & \text{H} & & \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{C} & - \text{CHO} & \\ & & & & & & \\ & \text{H} & \text{H} & \text{H} & \text{H} & & \end{array}$ ✓	$\begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & & & \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{CHO} & & \\ & & & & & & \\ & \text{H} & \text{CH}_3 & \text{H} & & & \end{array}$ ✓																	
$\begin{array}{ccccccc} & \text{H} & \text{H} & \text{H} & & & \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{CHO} & & \\ & & & & & & \\ & \text{H} & \text{H} & \text{CH}_3 & & & \end{array}$ ✓	$\begin{array}{ccccccc} & \text{H} & \text{CH}_3 & & & & \\ & & & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{CHO} & & & \\ & & & & & & \\ & \text{H} & \text{CH}_3 & & & & \end{array}$ ✓																	
(d)	<table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th></th> <th>D</th> <th>E</th> <th>F</th> </tr> </thead> <tbody> <tr> <td>No of peaks and areas</td> <td>3 peaks ratio: 3:1:6 ✓</td> <td>4 peaks ratio: 3:2:2:3 ✓</td> <td>2 peaks ratio: 2:3 / 4:6 ✓</td> </tr> <tr> <td>chemical shifts (ppm)</td> <td>2.0–2.9 (×2) 0.7–1.6 ✓</td> <td>2.0–2.9 (×2) 0.7–1.6 1.2–1.4 ✓</td> <td>2.0–2.9 0.7–1.6 ✓</td> </tr> <tr> <td>splitting AW to describe</td> <td>singlet doublet / 1:1 ✓ (multiplet)</td> <td>singlet 2 x triplet / 1:2:1 ✓ (multiplet)</td> <td>triplet / 1:2:1 quartet / 1:3:3:1 ✓</td> </tr> </tbody> </table> <p>on D and E. IGNORE any splitting given for the multiplet</p>		D	E	F	No of peaks and areas	3 peaks ratio: 3:1:6 ✓	4 peaks ratio: 3:2:2:3 ✓	2 peaks ratio: 2:3 / 4:6 ✓	chemical shifts (ppm)	2.0–2.9 (×2) 0.7–1.6 ✓	2.0–2.9 (×2) 0.7–1.6 1.2–1.4 ✓	2.0–2.9 0.7–1.6 ✓	splitting AW to describe	singlet doublet / 1:1 ✓ (multiplet)	singlet 2 x triplet / 1:2:1 ✓ (multiplet)	triplet / 1:2:1 quartet / 1:3:3:1 ✓	9
	D	E	F															
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QWC	For at least two relevant sentences in which the meaning is clear with correct spelling, punctuation and grammar (ALLOW bullet points and note form where appropriate).	1																

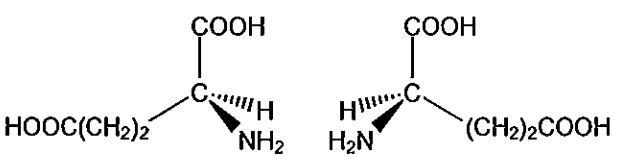
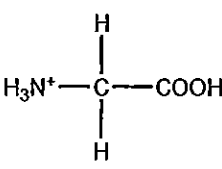
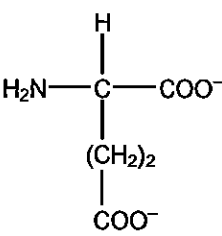
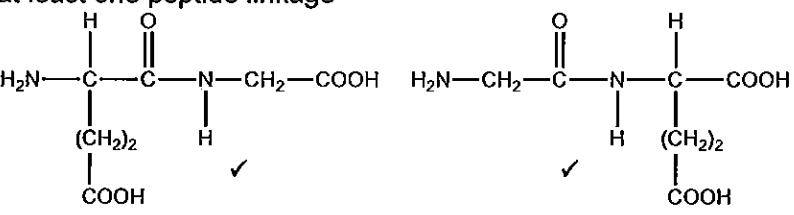
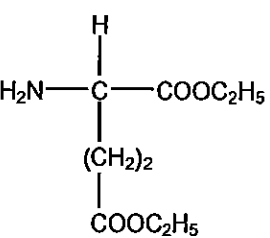
[Total: 12]

12

Qu.	Expected Answers	Marks
3 (a) (i)	<p>mechanism</p> <p>arrow from C of CN to C ✓</p> <p>dipole and curly arrow breaking π-bond on C=O ✓</p> <p>structure of the intermediate ✓</p> <p>curly arrow to H of HCN / H₂O / H⁺ ✓</p> <p>e.g.</p>  <p>reagents HCN + KCN / H₂SO₄ / KCN ✓</p> <p>ALLOW NaOH / HCN</p>	5
(ii)	<p>type of reaction: hydrolysis ✓</p> <p>equation / - e.g.</p> $\text{CH}_3\text{CH}(\text{OH})\text{CN} + 2\text{H}_2\text{O} \longrightarrow \text{CH}_3\text{CH}(\text{OH})\text{COOH} + \text{NH}_3$ $\text{CH}_3\text{CH}(\text{OH})\text{CN} + 2\text{H}_2\text{O} + \text{H}^+ \longrightarrow \text{CH}_3\text{CH}(\text{OH})\text{COOH} + \text{NH}_4^+$ <p>H₂O / NH₃ ✓ rest of the equation and balancing ✓</p>	3
(b)	<p>lactic acid has a chiral centre / optical isomers ✓</p> <p>laboratory sample has both optical isomers / stereoisomers</p> <p>fermentation would contain only one optical isomer AW ✓</p> <p>DO NOT ALLOW just isomers</p>	2
(c) (i)	 <p>ester link ✓ rest of structure also correct ✓</p>	2
(ii)	<p>renewable = made from plants that can be grown AW</p> <p>biodegradable = broken down by bacteria etc AW</p> <p>reason linked to biodegradability</p> <p>e.g. less landfill / less harm to animals / broken down by hydrolysis / no need to burn so no harmful gases etc AW ora</p> <p>reason linked to renewability</p> <p>e.g. does not increase atmospheric CO₂ AW ora</p> <p>ANY two for ✓✓</p>	2
(d)	$2\text{CH}_3\text{CH}(\text{OH})\text{COOH} \longrightarrow \text{C}_6\text{H}_8\text{O}_4 + 2\text{H}_2\text{O}$ <p>H₂O as product / 2x lactic acid as reactants ✓</p> <p>rest of the equation correct and balanced ✓</p> <p>ALLOW any combination of molecular or structural formulae</p>	2
[Total: 6		

Qu.	Expected answers	Marks
3 (a)		<p>allow the right hand carbon included</p> <p>1</p>
(b) (i)	hexan(e)dioic acid	ignore -1,6- 1
(ii)		<p>do not allow C₆H₄ here</p> <p>do not allow O-H here</p> <p>2</p>
(c) (i)		<p>must be fully displayed here</p> <p>allow one mark for two correct structures of hexanal</p> <p>2</p>
(ii)	$C_6H_{10}O_2 + 2[O] \rightarrow C_6H_{10}O_4$	allow correct structural / displayed / skeletal formula 1
(iii)	(O-H) absorption appears at 2500–3300 (cm ⁻¹)	1
(d)		1
(e)	ecoflex® = condensation and poly(but-1-ene) = addition	1
(f)	atactic has side chains on <u>random</u> sides ✓	do not allow 'just regular' or 'irregular', nor just 'groups'
	isotactic has side chains on the same side	allow one mark for a correct (2D or 3D) diagram of isotactic with at least 6C if not scored in words

10

Qu.	Expected answers	Marks
2 (a)	$\text{H}_2\text{NCH(R)COOH}$ ✓ (allow any order as long as CH not split)	1
(b)	glutamic acid has / glycine does not have ... a chiral carbon / four different groups attached to a carbon ✓ glutamic acid forms two non-superimposable (mirror images) / is asymmetric ✓	
		allow ECF on side group errors
	correct 3-D diagram of one isomer of glutamic acid ✓ attempt at a 3-D diagram to show the other isomer ✓	allow poor connectivity here
(c) (i)	 ✓	allow poor connectivity here too
(ii)		one COO ⁻ ✓ rest of the molecule ✓
(d)	at least one peptide linkage ✓	allow CONH
		or the dipeptide formed using the glutamic acid side chain
(e) (i)	(conc) H_2SO_4 ✓ allow HCl or H^+ but not anything with H_2O present	1
(ii)		one ester group ✓ rest of the structure ✓
		14