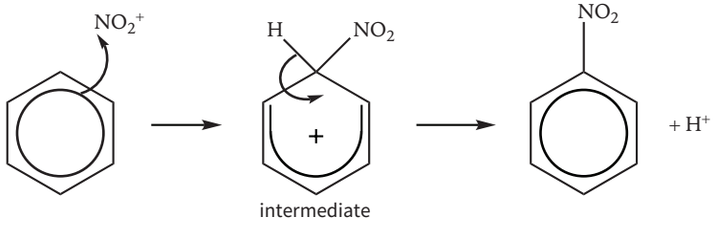
A Level OCR Chemistry

Chapter 20 – answers

Question	Answers	Extra information	Mark	AO Spec reference
1(a)	Planar ring structure with delocalised electrons Bond length shorter than cyclohexane (but not as short as a double bond.)		1 1 1	6.1.1
1(b)	Benzene is a more stable molecule than cyclehexatriene. Benzene is less exothermic than cyclohexatriene because there is resonance in the structure/delocalisation of the electrons.	Less exothermic/more endothermic/releases less energy	1 1 1 1	6.1.1, M0.1,
1(c)	Bromine (water) Benzene – no change/no (visible) reaction/colour stays the same Cyclohexane – decolourisation of the solution, colour turns from brown/orange to colourless		1 1 1	4.1.3, 6.1.1,
2(a)(i)	Concentrated H_2SO_4 and concentrated HNO_3 $2\ H_2SO_4 + HNO_3 \rightarrow 2\ HSO_4^- + NO_2^+ + H_3O^+$ **OR** $H_2SO_4 + HNO_3 \rightarrow HSO_4^- + NO_2^+ + H_2O$		1 1	6.1.1
2(a)(ii)			1 1 1	6.1.1
2(a)(iii)	Electrophilic substitution		1	6.1.1

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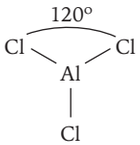
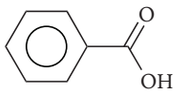
2(b)	 VSEPR Theory – 3 pairs of bonding electrons and no lone pairs Around central Al atom, all repel equally Trigonal planar 120°		 1 1 1 1	2.2.2, M4.1, M4.2
3(a)	Addition reactions would disrupt the rings of delocalised electrons / destabilise the structure.		1	6.1.1
3(b)(i)	Ethanoyl chloride	reject Acetyl chloride	1	4.1.1
3(b)(ii)		Allow skeletal or displayed structure	1	4.1.1, 6.1.1
3(c)	M_r of ethanoyl chloride = 78.5 g mol^{-1} 8/78.5 = 0.1019… mol Benzene is the limiting reagent M_r of C = 120 g mol^{-1} Mass of C = 120 × 0.075 = 9 g Percentage yield = 7.8/9 × 100 = 87 %		1 1 1 1 1	2.1.3 M0.0, M0.2, M2.2
4(a)	Alkenes have high(er) electron density / electron density of benzene is not high (enough) Electrons localised in alkene / delocalised π system in benzene High electron density is needed to create a dipole in Br_2 / polarise Br_2 / attract Br_2	Allow converse argument	1 1 1	6.1.1
4(b)	Br_2 AND one of: Fe OR $AlBr_3$ OR $FeBr_3$	Must have both Br_2 AND an halogen carrier for the mark	1	6.1.1

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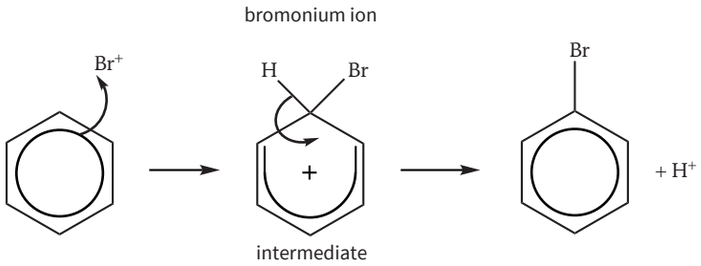
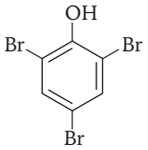
4(c)		**1** mark for = curly arrow from ring to X^+ **1** mark for intermediate with delocalisation shown over half of the ring **1** mark for arrows from C–H bond back into ring	1 1 1	6.1.1
4(d)	Bromobenzene		1	4.1.1, 6.1.1
5(a)	 2, 4, 6-tribromophenol		1 1	6.1.1
5(b)	The oxygen (p-orbital) donates electron density to the ring increasing electron density, and increasing the susceptability of the ring to attack.	Allow converse argument	1 1 1	6.1.1
5(c)	Moles phenol = mass/M_r = 2350×10^{-3} / 94 g mol^{-1} = 0.025 mol Moles Br_2 = 0.0375 Mass Br_2 = 159.8 × 0.0375 = 6.00 g	Penalise only once for incorrect conversions of units.	1 1 1	2.1.3 M0.0, M0.2, M2.2
6(a)	Test for carboxylic acid: The addition of sodium carbonate, Na_2CO_3 to the solution will produce effervescence, which will turn limewater cloudy Test for alkene: Shake solution through with bromine water, the bromine water will turn from brown to colourless.		1 1 1	6.3.1
6(b)(i)	3		1	6.3.2

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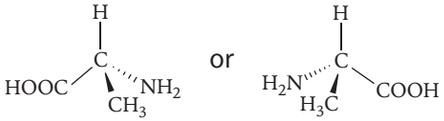
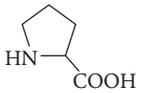
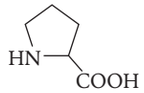
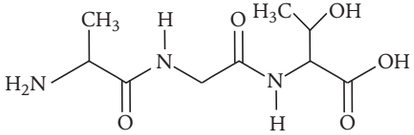
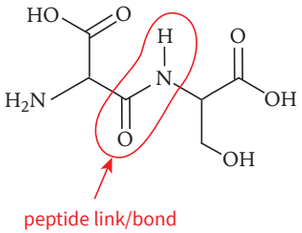
Question	Answers	Extra information	Mark	AO Spec reference
6(b)(ii)	1		1	6.3.2
6(b)(iii)	3		1	6.3.2
6(c)	Spectrum for X: Carbonyl peak/absorption for C=O at 1630 – 1820 (cm^{-1}) (broad) Peak/absorption for acidic –OH at 2500-3300 (cm^{-1}) Sepctrum for Z: Alkene peak/absoprtion for C=C at (1620 – 1680 cm^{-1})		 1 1 1	4.2.4
6(d)	Propanoic acid		1	4.1.1

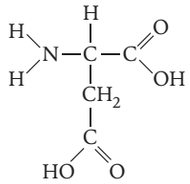
Skills box answers:

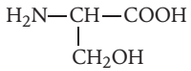
1.  or

2.  or 

3. 

and one of: 

or 



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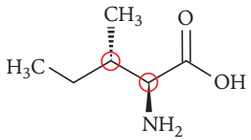
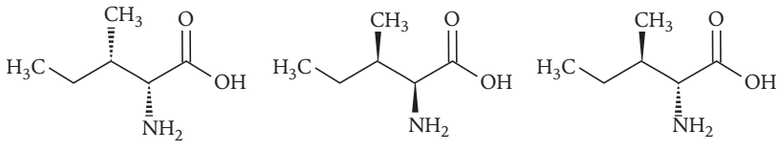
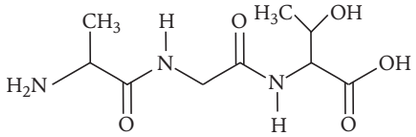
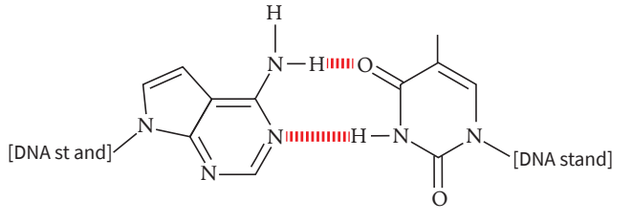
4.

trans	*cis*
for example: 	for example: 
Students' diagrams must clearly show octahedral arrangement	

5.

trans	*cis*
	
Students' diagrams must clearly show square planar arrangement	

6. For example