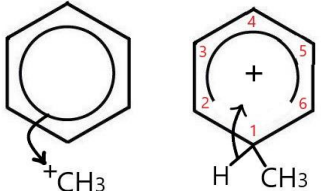
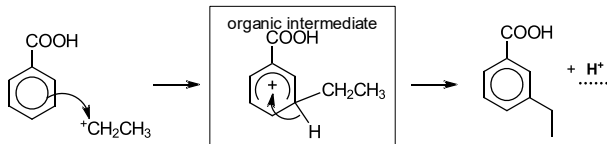
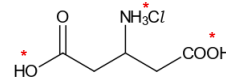
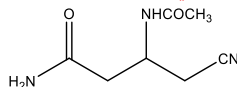
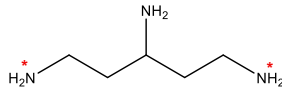


9(a)	- all C atoms are sp^2 hybridised - bonds between C atoms are σ and π - C–C σ bonds are formed by overlap of sp^2 hybrid orbitals - C–C π bonds are formed by overlap of p orbitals - bonds between C and H atoms are σ - C–H bonds are formed by overlap of sp^2 hybrid orbitals and s orbitals Any two [1], any four [2], all six [3]
9(b)	CH_3Cl and $AlCl_3$
9(c)	 M1: curly arrow from within hexagon towards ^+C M2: intermediate, usual rules for horseshoe and + charge M3: curly arrow from C–H bond into ring AND H^+ product
9(d)	M1: HNO_3 AND H_2SO_4 M2: concentrated AND $25^\circ C \leq T \leq 60^\circ C$
9(e)	alkaline $KMnO_4$
9(f)	4-nitrobenzoic acid
9(g)	(hot) concentrated HCl and Sn
9(h)	M1: perform step 3 before step 2 OR perform step 2 before step 1 M2: $COOH$ is 3-directing OR NO_2 is 3-directing

5(a)	M1 and M2: any two [1], all three [2] • (hexagonal ring) planar / (trigonal) planar • 120° • sp^2 hybridised M3: p orbitals overlap sideways / laterally (with each other above and below the ring) forming π bonds M4: σ bonds form when sp^2 / hybridised orbitals overlap end-on-end / head on												
5(b)(i)	M1: (reaction 5) Pt / Ni + H_2 (+ heat) M2: (reaction 6) $(CH_3)_2CHCOCl$ + $AlCl_3$ (+ heat)												
5(b)(ii)	reduction / hydrogenation												
5(c)(i)	(CH_2CH_3) group directs to 2-, 4- (and 6-) positions AND due to being an electron donating group												
5(c)(ii)	$CH_3CH_2Br + FeBr_3 \rightarrow CH_3CH_2^+ + FeBr_4^-$												
5(c)(iii)	 M1: curly arrow from inside / touching the hexagon to (CH_2) group / C^+ charge M2: structure of the intermediate M3: curly arrow from C-H bond into / onto the ring AND formation / loss of H^+												
5(c)(iv)	$H^+ + FeBr_4^- \rightarrow HBr + FeBr_3$												
6(a)	$sp = 1$ AND $sp^2 = 1$ AND $sp^3 = 3$												
6(b)(i)	acid-base / neutralisation AND hydrolysis												
6(b)(ii)	reaction 7  reaction 8  reaction 9  any two * [1], any three * [2], any five * [3], all six * [4]												
6(c)(i)	five / 5												
6(c)(ii)	<table><tr><td>proton environment</td><td>a</td><td>b</td><td>c</td></tr><tr><td>name of splitting pattern</td><td>doublet</td><td>multiplet</td><td>doublet</td></tr><tr><td>chemical shift range, δ / ppm</td><td>2.2–3.0</td><td>3.2–4.0</td><td>2.0–3.0</td></tr></table> any three [1], all six [2]	proton environment	a	b	c	name of splitting pattern	doublet	multiplet	doublet	chemical shift range, δ / ppm	2.2–3.0	3.2–4.0	2.0–3.0
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