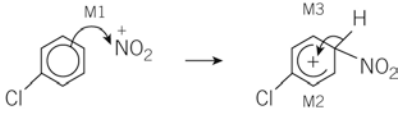
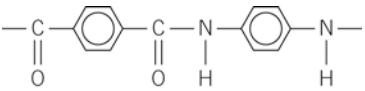
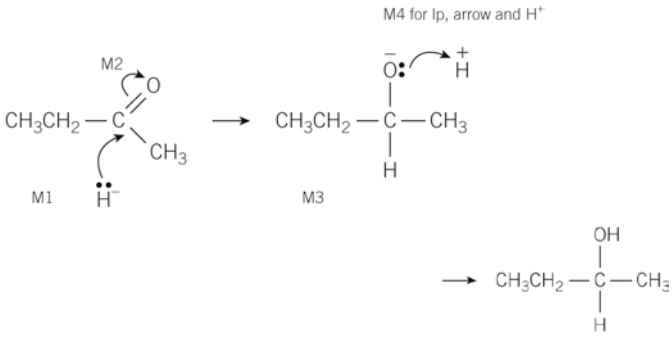
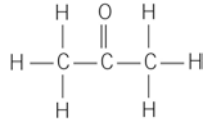
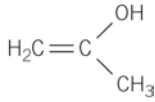
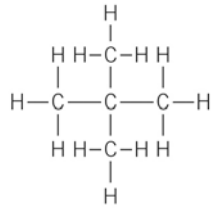
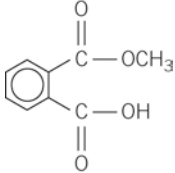


Question number	Answer	Marks	Guidance
1 (a)	Hydrogen bond(ing)	1	Penalise mention of any other type of bond.
1 (b) (i)	Ammonia is a nucleophile Benzene repels nucleophiles	1 1	Allow ammonia has a lone pair. Allow (benzene) attracts/reacts with electrophiles. OR benzene repels electron rich species or lone pairs OR C—Cl bond is short / strong / weakly polar
1 (b) (ii)	H ₂ /Ni OR H ₂ /Pt OR Sn/HCl OR Fe/HCl	1	Ignore dil/conc of HCl Ignore the term 'catalyst'. Allow H ₂ SO ₄ with Sn and Fe but not conc. Ignore NaOH following correct answer. Not NaBH ₄ nor LiAlH ₄
1 (b) (iii)	conc HNO ₃ conc H ₂ SO ₄ HNO ₃ + 2H ₂ SO ₄ → NO ₂ ⁺ + H ₃ O ⁺ + 2HSO ₄ ⁻ OR using two equations: HNO ₃ + H ₂ SO ₄ → H ₂ NO ₃ ⁺ + HSO ₄ ⁻ H ₂ NO ₃ ⁺ → H ₂ O + NO ₂ ⁺	1 1 1	If either or both conc missed can score 1 for both acids Allow 1:1 equation HNO ₃ + H ₂ SO ₄ → NO ₂ ⁺ + H ₂ O + HSO ₄ ⁻
1 (b) (iv)	Electrophilic substitution 	1 3	Ignore position or absence of Cl in M1 but must be in correct position for M2. M1 arrow from within hexagon to N or + on N. Allow NO ₂ ⁺ in mechanism. Bond to NO ₂ must be to N for structure mark M2. Gap in horseshoe must be centred around correct carbon (C1). + in intermediate not too close to C1 (allow on or "below" a line from C2 to C6). Allow M3 arrow independent of M2 structure. Ignore base removing H in M3 + on H in intermediate loses M2 not M3

2 (a)	<p>Sn / HCl OR Fe / HCl</p> <p>Equation must use molecular formulae $C_6H_4N_2O_4 + 12[H] \rightarrow C_6H_8N_2 + 4H_2O$</p> 	<p>1</p> <p>2</p> <p>2</p>	<p>Ignore reference to Sn as a catalyst with the acid Allow H₂ (Ni / Pt) but penalise wrong metal But NOT NaBH₄ LiAlH₄ Na / C₂H₅OH not conc H₂SO₄ nor any HNO₃ Ignore subsequent use of NaOH</p> <p>12[H] and 4H₂O without correct molecular formula scores 1 out of 2 Allow + 6H₂ if H₂ / Ni used Allow –CONH– or –COHN– or –C₆H₄–</p> <p>Mark two halves separately : lose 1 each for</p> <ul style="list-style-type: none"> • error in diamine part • error in diacid part • error in peptide link • missing trailing bonds at one or both ends • either or both of H or OH on ends <p>Ignore <i>n</i></p>
2 (b)	<p>H₂ (Ni / Pt) but penalise wrong metal</p> <p>CH₂</p> <p>In benzene 120°</p> <p>In cyclohexane 109° 28' or 109½°</p>	<p>1</p> <p>1</p> <p>1</p> <p>1</p>	<p>NOT Sn / HCl, NaBH₄ etc.</p> <p>Allow 108°–110° If only one angle stated without correct qualification, no mark awarded</p>

2 (c) (i)	<p>Nucleophilic addition</p>  <p>M2</p> <p>M1</p> <p>M4 for lp, arrow and H⁺</p> <p>M3</p>	1 4	<p>M2 not allowed independent of M1, but allow M1 for correct attack on C⁺</p> <p>+ rather than δ⁺ on C=O loses M2</p> <p>M3 is for correct structure including minus sign but lone pair is part of M4</p> <p>Allow C₂H₅</p> <p>M1 and M4 include lp and curly arrow</p> <p>Allow M4 arrow to <u>H</u> in H₂O (ignore further arrows)</p>
2 (c) (ii)	<p>Planar C=O (bond/group)</p> <p>Attack (equally likely) from either side</p> <p>(about product): Racemic mixture formed OR 50:50 mixture or each enantiomer equally likely</p>	1 1 1	<p>Not just planar molecule</p> <p>Not just planar bond without reference to carbonyl</p>
3 (a)	 <p>A</p> <p>H₂C=CH-CH₂OH or </p> <p>B</p>	1 1	<p>allow CH₃COCH₃</p> <p>must show C=C</p> <p>Penalise sticks once per pair</p>
3 (b)	<p>C CH₃CH₂CH₂CH₂CH₃</p>  <p>D</p>	1 1	<p>NOT cyclopentane which is only C₅H₁₀</p> <p>Penalise sticks once per pair</p>
3 (c)	<p>E CH₃CH₂COOCH₃</p> <p>F CH₃COOCH₂CH₃</p>	1 1	<p>Allow C₂H₅CO₂CH₃</p> <p>Allow CH₃CO₂CH₂CH₃ or CH₃CO₂C₂H₅</p> <p>Penalise sticks once per pair</p>

3 (d)	<p>G</p> $\begin{array}{c} \text{CHO} \\ \\ \text{H}-\text{C}-\text{CH}_3 \\ \\ \text{CH}_2\text{CH}_2\text{CH}_3 \end{array} \quad \text{or} \quad \begin{array}{c} \text{CHO} \\ \\ \text{H}-\text{C}-\text{CH}_3 \\ \\ \text{CH}(\text{CH}_3)_2 \end{array} \quad \text{or} \quad \begin{array}{c} \text{CH}_2\text{CHO} \\ \\ \text{H}-\text{C}-\text{CH}_3 \\ \\ \text{CH}_2\text{CH}_3 \end{array}$ <p>allow C₃H₇ allow C₃H₇ allow C₂H₅</p>	1	not C ₅ H ₁₁ nor C ₄ H ₉ Penalise sticks once per pair
	<p>H</p> $\begin{array}{c} \text{CH}_3 \\ \\ \text{H}-\text{C}-\text{COCH}_3 \\ \\ \text{CH}_2\text{CH}_3 \end{array}$ <p>allow C₂H₅</p>	1	
3 (e)	<p>I</p> $\begin{array}{c} \text{H} \\ \\ \text{CH}_3\text{CH}_2\text{NCH}_2\text{CH}_3 \end{array}$	1	allow C ₂ H ₅
	<p>J</p> $\begin{array}{c} \text{H} \\ \\ \text{CH}_3\text{NCH}(\text{CH}_3)_2 \end{array}$	1	NOT C ₃ H ₇ Penalise sticks once per pair
4 (a)	chromatography	1	allow any qualification, e.g., GLC, TLC, GC, HPLC
4 (b)	5	1	
	Allow 320(.0) or 322(.0)	1	
4 (c)	Use of excess air/oxygen or high temperature (over 800#°C) or remove chlorine-containing compounds before incineration	1	
4 (d) (i)	Si(CH ₃) ₄ allow SiC ₄ H ₁₂ allow displayed formula and do not penalise sticks	1	Not TMS
4 (d) (ii)	3	1	
5 (b) (iii)	All three marks are independent		
	(base or alkaline) Hydrolysis (allow close spelling)	1	Allow (nucleophilic) addition-elimination or saponification Not reacts with NaOH
	δ^+ C in polyester	1	
	reacts with OH ⁻ or hydroxide ion	1	
5 (c) (i)	$\begin{array}{c} \text{H} \\ \\ \text{H}-\text{C}-\text{C} \\ \quad \quad \quad // \quad \quad \quad \backslash \\ \text{H} \quad \quad \quad \text{O} \quad \quad \quad \text{O}-\text{H} \end{array}$	1	Allow CH ₃ COOH or CH ₃ CO ₂ H
5 (c) (ii)	(nucleophilic) <u>addition-elimination</u> OR (nucleophilic) addition followed by elimination	1	Both addition and elimination needed and in that order Do not allow electrophilic addition-elimination /

			esterification Ignore acylation
5 (c) (iii)	any two from: ethanoic anhydride is <ul style="list-style-type: none"> less corrosive less vulnerable to hydrolysis less dangerous to use, less violent/exothermic/vigorous reaction OR more controllable rxn does not produce toxic/corrosive/harmful fumes (of HCl) OR does not produce HCl less volatile 	2	NOT COST List principle beyond two answers
5 (d)		1	
5 (e) (i)	ester	1	Do not allow ether Ignore functional group/linkage/bond
5 (e) (ii)	12 or twelve (peaks)	1	
5 (e) (iii)	160 – 185	1	Allow a number or range within these limits Penalize extra ranges given Ignore units