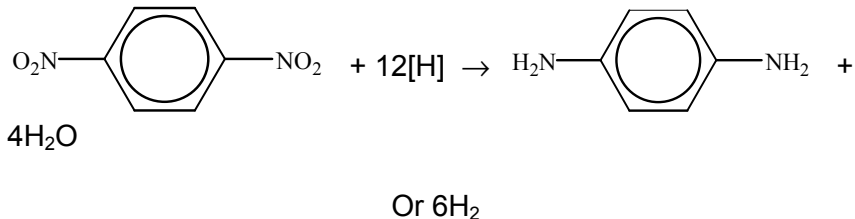
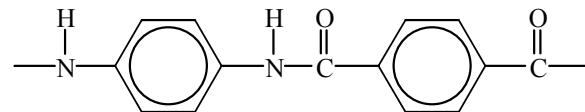
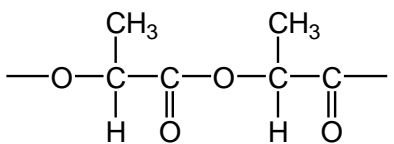
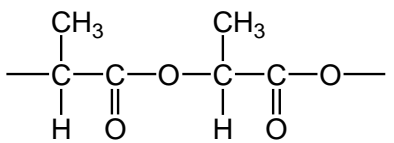


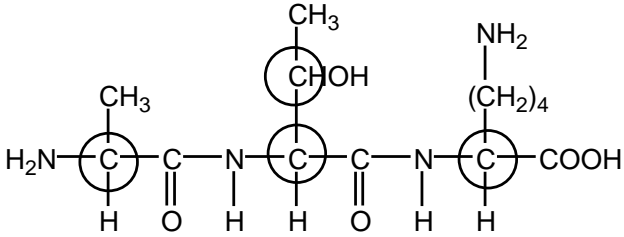
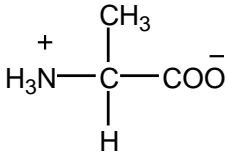
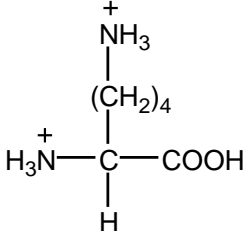
Polymers Answers

8	(c)	(i)	<p>H_2/Ni or H_2/Pt or Sn/HCl or Fe/HCl (conc or dil or neither) allow dil H_2SO_4 ignore mention of NaOH</p> <p>  </p>	1	Not NaBH_4 Not LiAlH_4 Not $\text{Na}/\text{C}_2\text{H}_5\text{OH}$ not conc H_2SO_4 or any HNO_3
8	(c)	(ii)	<p>  </p> <p>1st mark for correct peptide link 2nd mark for the rest correct including trailing bonds</p>	2	allow $-\text{CONH}-$ ignore $[]_n$ as in polymer
8	(c)	(iii)	<p>M1 Kevlar is <u>biodegradeable</u> but polyalkenes not</p> <p>M2 Kevlar has <u>polar</u> bonds / is a (poly) amide / has peptide link</p> <p>M3 can be hydrolysed/attacked by nucleophiles/acids/bases/enzymes</p> <p>M4 polyalkenes <u>non polar</u> /has <u>non-polar</u> bonds</p>	1 1 1 1	allow Kevlar is <u>more</u> biodegradeable comment on structure of Kevlar comment on structure of polyalkenes but not just strong bonds

Question	Marking Guidance	Mark	Comments
8(a)(i)	(As a) soap	1	Allow washing, cleaning, degreasing, detergents
8(a)(ii)	(Bio)diesel or biofuel or fuel for cars/lorries	1	Allow <u>to make</u> soap
8(a)(iii)	(Cationic) surfactant /detergent /fabric softener /germicide / shampoos /(hair) conditioners /spermicidal jelly	1	Allow cleaning
8(b)(i)	(Poly)ester Terylene OR PET	1 1	Allow polyester
8(b)(ii)	(Poly)amide Kevlar OR nylons	1 1	Ignore numbers with nylons Allow polyamide(e)
8(b)(iii)	(Independent marks) Hydrogen bonding in b(ii) Imfs in (b)(ii) are stronger OR H bonding stronger than dipole-dipole/van der Waals/ dispersion/London forces in b(i)	1 1	CE = 0

5(c)(i)	$\text{CH}_3\text{CH}(\text{OH})\text{COOH} + \text{NaOH} \rightarrow \text{CH}_3\text{CH}(\text{OH})\text{COONa} + \text{H}_2\text{O}$ OR $\text{CH}_3\text{CH}(\text{OH})\text{COOH} + \text{OH}^- \rightarrow \text{CH}_3\text{CH}(\text{OH})\text{COO}^- + \text{H}_2\text{O}$	1	Not ambiguous mol formulae for product - must show COONa or CO ₂ Na or COO ⁻ or CO ₂ ⁻	
5(c)(ii)	$[\text{H}^+] = K_a$ OR $\text{pH} = \text{p}K_a$	1		
	$\text{pH} = 3.86$	1	Allow more than 2 decimal places but not fewer.	
5(c)(iii)	M1	buffer	1	Ignore acidic but penalise alkaline or basic.
	Any two out of the three marks M2 , M3 & M4			
	M2	Large lactate concentration in buffer OR sodium lactate completely ionised	Max 2	Ignore reaction of H ⁺ with OH ⁻ Ignore reference to equilibrium unless it is shown.
	M3	added acid reacts with/is removed by lactate ion or A ⁻ or sodium lactate or salt OR equation $\text{H}^+ + \text{A}^- \rightarrow \text{HA}$		
M4	ratio $[\text{HA}]/[\text{A}^-]$ stays almost constant	Ignore H ⁺ or pH remains constant.		
5(d)(i)	 OR 	No marks if ester link missing Correct ester link allow —COO— All rest correct with trailing bonds	1	NB Correct answer scores 2
			1	Ignore <i>n</i> here (compare with 5(d)(iv)). Ignore brackets. If OH or COOH on either or both ends, lose one, ie dimer scores 1 If more than two repeating units, lose 1
5(d)(ii)	(Poly)ester ie allow ester	1	Not terylene. Ignore spaces and brackets in answer.	

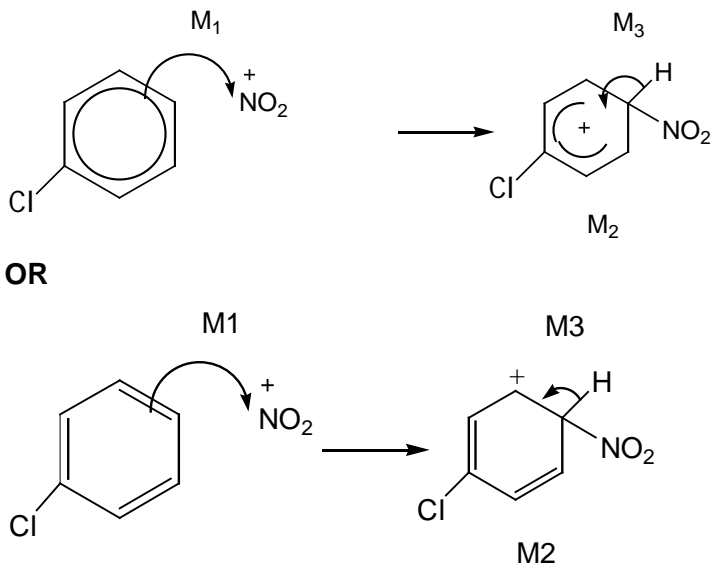
5(d)(iii)		1	Allow any <u>cyclic C₆H₈O₄</u>
5(d)(iv)		1	Penalise <i>n</i> here (compare with 5(d)(i)) Ignore brackets. Not allow Ph for phenyl.
5(d)(v)	In landfill, no air or UV, to assist decay OR not enough water or moisture (to hydrolyse polyester)	1	Allow landfill has/contains: no or few bacteria / micro-organisms / enzymes compared with compost heap OR less oxygen OR <u>lower</u> temperature.

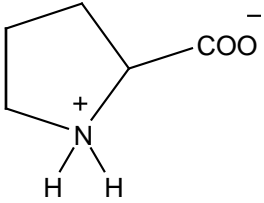
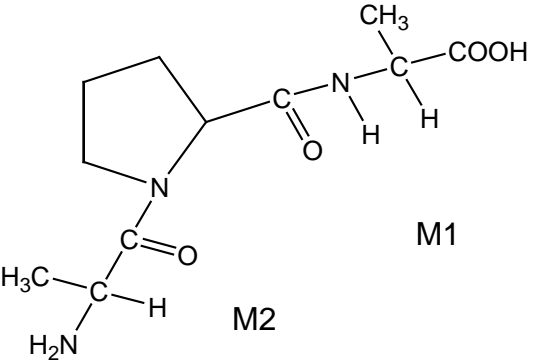
Question	Marking Guidance	Mark	Comments
4(a)(i)		1	These four only
4(a)(ii)		1	Allow -NH_3^+ and $^+\text{NH}_3\text{-}$
4(a)(iii)	<p><u>2-amino-3-hydroxybutanoic acid</u></p> <p>Do not penalise commas or missing hyphens</p>	1	Ignore 1 in butan-1-oic acid Penalise other numbers
4(a)(iv)		1	Allow -NH_3^+ and $^+\text{NH}_3\text{-}$

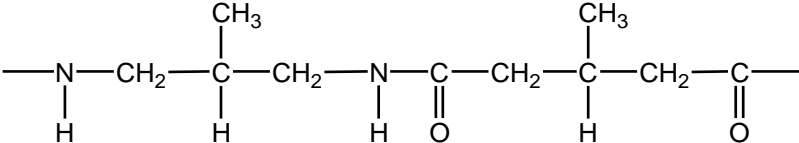
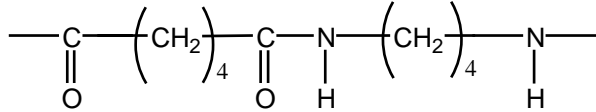
4(b)(i)	Condensation	1	Allow polyester
4(b)(ii)	<u>propane-1,3-diol</u>	1	Must have e Allow 1,3-propan <u>e</u> diol
4(c)(i)	Addition	1	Not additional
4(c)(ii)	$\begin{array}{c} \text{H} \quad \text{F} \\ \quad \\ \text{C}=\text{C} \\ \quad \\ \text{H} \quad \text{F} \end{array} \quad \text{and} \quad \begin{array}{c} \text{F} \quad \text{CF}_3 \\ \quad \\ \text{C}=\text{C} \\ \quad \\ \text{F} \quad \text{F} \end{array}$ <p>OR</p> $\begin{array}{c} \text{F} \quad \text{F} \\ \quad \\ \text{C}=\text{C} \\ \quad \\ \text{F} \quad \text{F} \end{array} \quad \text{and} \quad \begin{array}{c} \text{F}_3\text{C} \quad \text{H} \\ \quad \\ \text{C}=\text{C} \\ \quad \\ \text{F} \quad \text{H} \end{array}$	1 for each structure within each pair	Allow monomers drawn either way round Allow bond to F in CF ₃
4(d)	c	1	If wrong, CE = 0
	C-C or C-F bonds too strong	1	

Question	Marking Guidance	Mark	Comments
4(a)	Hydrogen <u>bond</u> (ing)	1	Allow H bonding. Penalise mention of any other type of bond.
4(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
4(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

4(b)(iii)	<p><u>conc HNO₃</u></p> <p><u>conc H₂SO₄</u></p> $\text{HNO}_3 + 2\text{H}_2\text{SO}_4 \longrightarrow \text{NO}_2^+ + \text{H}_3\text{O}^+ + 2\text{HSO}_4^-$ <p>OR using two equations</p> $\text{HNO}_3 + \text{H}_2\text{SO}_4 \longrightarrow \text{H}_2\text{NO}_3^+ + \text{HSO}_4^-$ $\text{H}_2\text{NO}_3^+ \longrightarrow \text{H}_2\text{O} + \text{NO}_2^+$	<p>1</p> <p>1</p> <p>1</p>	<p>If either or both conc missed can score 1 for both acids</p> <p>Allow 1:1 equation</p> $\text{HNO}_3 + \text{H}_2\text{SO}_4 \longrightarrow \text{NO}_2^+ + \text{H}_2\text{O} + \text{HSO}_4^-$
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4(b)(iv)	<p><u>Electrophilic substitution</u></p>  <p>OR</p>	<p>1</p> <p>3</p>	<ul style="list-style-type: none"> Ignore position or absence of Cl in M1 but must be in correct position for M2 M1 arrow from within hexagon to N or <u>+ on N</u> Allow NO_2^+ in mechanism. Bond to NO_2 must be to N for structure mark M2 Gap in horseshoe must be centered around correct carbon (C1). + in intermediate not too close to C1 (allow on or “below” a line from C2 to C6). M3 arrow into hexagon unless Kekule. Allow M3 arrow independent of M2 structure. Ignore base removing H in M3 + on H in intermediate loses M2 not M3
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Question	Marking Guidance	Mark	Comments
7(a)(i)		1	Allow CO_2^- and NH_2^+
7(a)(ii)	<p>NOTE – Two marks for this clip</p> 	1 1	<p>M1 for alanine section bonded through N M2 for alanine section bonded through C But penalise error in proline ring</p> <p>Allow MAX 1 for correct tripeptide in polymer structure</p>
7(b)(i)	<u>3-methylpent-2-ene</u>	1	Ignore <i>E-Z</i> , commas, spaces or missing hyphens
7(b)(ii)	<u>4-amino-3-methylbutanoic acid</u>	1	Ignore commas, spaces or missing hyphens

7(b)(iii)		1	<p>or any polyamide section containing 8 carbons plus two C=O plus two N-H, such as</p>  <p>Trailing bonds are required</p>
7(b)(iv)	<p>Non polar OR no polar groups/bonds (for attack by water / acids / alkalis / nucleophiles or for hydrolysis)</p> <p>C-C bonds are strong</p>	1	