

TWO (a)	$\begin{array}{c} \text{O} \\ \\ -\text{C}-\text{N}- \\ \\ \text{H} \end{array}$ <p>One link is circled.</p>	TWO of	THREE of	
(b)	<p>One set of monomers (can be in any order)</p> $\begin{array}{c} \text{O} \qquad \qquad \qquad \text{O} \\ \qquad \qquad \qquad \\ \text{HO}-\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{C}-\text{OH} \\ \qquad \qquad \qquad \\ \text{HO} \qquad \qquad \qquad \text{OH} \end{array}$ <p style="text-align: center;">OR</p> $\begin{array}{c} \text{O} \qquad \qquad \qquad \text{O} \\ \qquad \qquad \qquad \\ \text{Cl}-\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{C}-\text{Cl} \\ \qquad \qquad \qquad \\ \text{Cl} \qquad \qquad \qquad \text{Cl} \end{array}$ <p style="text-align: center;">AND</p> $\text{H}_2\text{N}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{H}_2\text{N}$	<ul style="list-style-type: none"> • Amide linkage is correctly circled in nylon structure. • One monomer is drawn correctly. 	<ul style="list-style-type: none"> • Both monomers correct. 	<ul style="list-style-type: none"> • Both monomers correct. <p style="text-align: center;">AND</p>
(c)(i)	6-amino hexanoic acid	<ul style="list-style-type: none"> • Nylon (6) monomer correctly named. 		
(ii)	$\begin{array}{ccccccc} \text{O} & & \text{H} & & \text{O} & & \text{H} \\ & & & & & & \\ -\text{C}-(\text{CH}_2)_5-\text{N}-\text{C}-(\text{CH}_2)_5-\text{N}-\text{C}-(\text{CH}_2)_5-\text{N}- \\ & & & & & & \\ & & \text{O} & & & & \text{H} \end{array}$	<ul style="list-style-type: none"> • Polymer chain for Nylon (6) correct. 	<ul style="list-style-type: none"> • Polymer chain for Nylon (6) correct. 	
(d)	<p>The acid would hydrolyse the rope. This would cause the amide linkages to break and form the monomers. The rope would lose strength.</p> $\begin{array}{c} \text{O} \\ \\ \text{H}_3\text{N}^+-\text{(CH}_2\text{)}_5-\text{C} \\ \\ \text{OH} \end{array}$ <p>OR products from nylon 6,6.</p>	<ul style="list-style-type: none"> • Recognises that acid causes the rope to lose strength / break / hydrolyse. 	<ul style="list-style-type: none"> • States that the reaction is hydrolysis and the rope will lose strength. • Correct organic hydrolysis structure. (amine or salt) 	<p>Acidic hydrolysis of nylon is fully discussed. Includes:</p> <ul style="list-style-type: none"> • Organic structure given. • Description of amide linkage breaking. (Either state amide link or description of the hydrolysis and amide correct in (a).) • Strength / tensile strength decreases.

THREE (a)	<p>A = fluoroethanoic acid (2 fluoroethanoic acid) B = propanoyl chloride C = 1-bromobutane D = hexan-2-one</p>	TWO of • Any three structures are correctly named.	TWO of	<ul style="list-style-type: none"> • Correct equations are written for the formation of an amide and an amine. AND
(b)(i)	$\text{H}_3\text{C}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{Cl} + \text{NH}_3 \rightarrow \text{H}_3\text{C}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{NH}_2 + \text{HCl}$ <p>not (aq) or reaction with amine (no aq or alc)</p>	<ul style="list-style-type: none"> • One equation is correctly written for the formation of an amide or an amine. (Organic product only acceptable.) (Word eqn.) 	<ul style="list-style-type: none"> • Correct equations are written for the formation of an amide AND an amine. (Organic product only acceptable.) (Word eqn.) 	AND
(ii)	$\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{Br} + \text{NH}_3 \rightarrow \text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_2-\text{NH}_2 + \text{HBr}$	<ul style="list-style-type: none"> • Correct laboratory procedure to distinguish amine / amide provided. (ONE outcome.) 	<ul style="list-style-type: none"> • Correct laboratory procedure to distinguish amine / amide provided and the different outcomes identified. 	<ul style="list-style-type: none"> • Correct laboratory procedure to distinguish amine / amide provided and the different outcomes identified. AND
(iii)	<p>Damp red litmus will turn blue in the presence of the amine but no change with the amide (or clearly indicate solution / add water / aqueous). OR Universal indicator. OR Add $\text{Cu}^{2+}(\text{aq})$ the amine will form a deep blue solution and no reaction with the amide.</p>	<ul style="list-style-type: none"> • Correct apparatus identified. 	<ul style="list-style-type: none"> • Correct apparatus identified and recognises that refluxing prevents loss of products or reactants. OR	<ul style="list-style-type: none"> • Correct apparatus identified and recognises that refluxing prevents loss of reactants or products. AND
(c)(i)	D		<ul style="list-style-type: none"> • Correct apparatus identified and recognises that refluxing increases rate of reaction / recognise need for heat (Eg going to completion with example.) 	<ul style="list-style-type: none"> • Increases the rate of reaction without losing reactants or products / recognise need for heat.
(ii)	<p>Refluxing allows the solution to be heated, which increases the rate of the chemical reaction. The reflux apparatus prevents the loss of volatile organic reactants or products.</p>			

FOUR	A	$\begin{array}{c} \text{O} \\ \parallel \\ \text{H}_3\text{C}-\text{CH}_2-\text{C} \\ \\ \text{O}-\text{CH}_2-\text{CH}_2-\text{CH}_3 \end{array}$ propyl propanoate	Reagent 1 = NaOH(aq)	THREE correct consecutive structures. OR names PLUS one linking condition.	No more than two errors. (Allow incorrect structure with its correct name as one error.)	Correct. One minor error. Eg reagent 2 NaOH without (aq). Eg propanol without 1.		
	B	sodium propanoate	Reagent 2 = NaOH(aq), accept NaOH(aqc) if D = acid chloride, Na ₂ CO ₃ (aq).					
	C	$\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{OH}$ propan-1-ol (1-propanol)	Reagent 3 = PCl ₅ / SOCl ₂ / PCl ₃ .					
	D	$\begin{array}{c} \text{O} \\ \parallel \\ \text{H}_3\text{C}-\text{CH}_2-\text{C} \\ \\ \text{OH} \end{array}$ propanoic acid	OR				$\begin{array}{c} \text{O} \\ \parallel \\ \text{H}_3\text{C}-\text{CH}_2-\text{C} \\ \\ \text{Cl} \end{array}$ propanoyl chloride	Reagent 4 = Cr ₂ O ₇ ²⁻ / H ⁺ or MnO ₄ ⁻ / (H ⁺) / Fehling / Benedicts/ Tollens or if D is given as acid chloride, accept PCl ₅ / SOCl ₂ / PCl ₃ / methanol or other alcohol + acid to give ester in D.
	OR methylpropanoate							
	E	$\begin{array}{c} \text{O} \\ \parallel \\ \text{H}_3\text{C}-\text{CH}_2-\text{C} \\ \\ \text{H} \end{array}$ propanal	OR				$\begin{array}{c} \text{O} \\ \parallel \\ \text{H}_3\text{C}-\text{CH}_2-\text{C} \\ \\ \text{OH} \end{array}$ propanoic acid	
F	$\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2\text{Cl}$							

Judgement Statement

Achievement	Achievement with Merit	Achievement with Excellence
3 A OR 2 M	3 M	3 E OR 2 E + 2 M