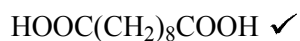




ALLOW $\text{H}_2\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$



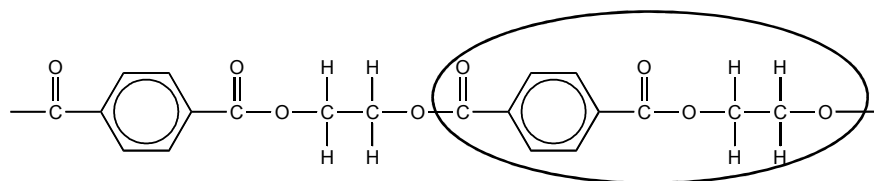
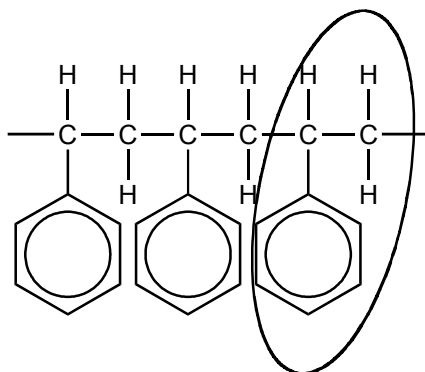
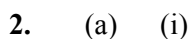
ALLOW $\text{HOOCCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{COOH}$

ALLOW CO_2H for COOH

ALLOW acid chloride, $\text{ClOC}(\text{CH}_2)_8\text{COCl}$

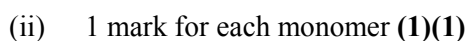
ALLOW displayed formulae or skeletal formulae

[2]

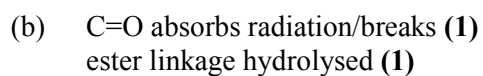


1 mark for each repeat unit (1)(1)

2

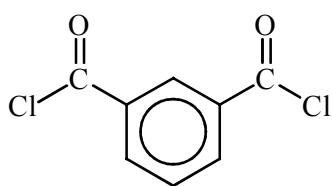


2

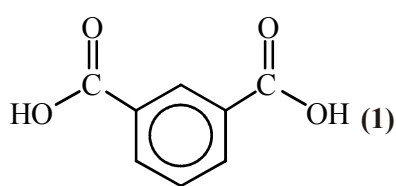


2

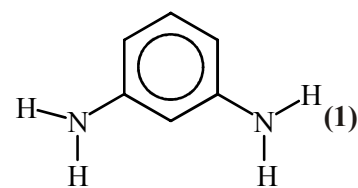
[6]



or



(1)



(1)

2

- (ii) any valid suggestion to explain or describe stronger intermolecular forces – e.g. Nomex is planar so packs together more easily / greater H-bonding / Van der Waals' / forces between molecules **(1)** AW
(ignore arguments based on *Mr*)

1

[3]

4. (a)

$\begin{array}{c} \text{HO}-\overset{\text{O}}{\parallel}{\text{C}}-(\text{CH}_2)_4-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH} \\ \text{H}_2\text{N}-(\text{CH}_2)_e-\text{NH}_2 \end{array}$	$\begin{array}{c} \text{H} \quad \text{CN} \\ \diagdown \quad / \\ \text{C}=\text{C} \\ / \quad \diagdown \\ \text{H} \quad \text{H} \end{array} \quad \text{(1)}$
$\left[\begin{array}{c} \text{O} \quad \text{O} \\ \parallel \quad \parallel \\ -\text{C}-\text{C}-\text{N}-\text{C}-\text{N}- \\ \quad \\ \text{H} \quad \text{H} \end{array} \right]$ <p>monomers connected by NHCO (1) correct repeat shown (1)</p>	$\left[\begin{array}{c} \text{H} \quad \text{CN} \\ \quad \\ -\text{C}-\text{C}- \\ \quad \\ \text{H} \quad \text{H} \end{array} \right]$
condensation	addition

(1) for both

4

(b) (i) $\text{PCl}_5 / \text{SOCl}_2$

1

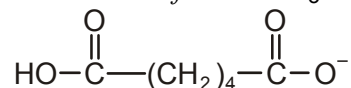
(ii) HCl

1

(c) $\text{H}_3\text{N}^+-(\text{CH}_2)_6-\text{NH}_3^+ \quad \text{(1)} \quad ^-\text{O}-\overset{\text{O}}{\parallel}{\text{C}}-(\text{CH}_2)_4-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}^-$

2

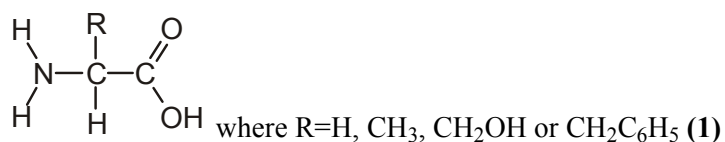
allow 1 mark for: both $\text{H}_3\text{N}^+-(\text{CH}_2)_6-\text{NH}_3^+$ and



(d) (i) 4

1

(ii)



1

(iii) any three different chemically or biologically correct differences between amino acids and the nylon monomers **(1)(1)(1)** - eg

- protein monomers are amino acids / nylon monomers are a (di)amine/base and a (di)acid
- protein monomers have different types/R groups / nylon monomers are two types/no variation
- protein monomers have stereo/optical isomers/are chiral
- protein monomers have higher melting points/
form zwitterions

other possible answers include:

- nylon monomers have longer chain length/no other functional groups / no aromatic content / are symmetrical etc
don't allow comparisons solubility or M_r

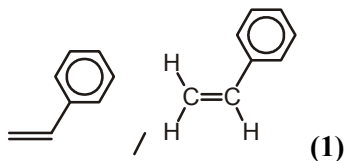
3

[13]

5. (i) addition (polymerisation) **(1)**
NOT additional

1

(ii)



1

(iii) π -bond breaks **(1)**

many molecules join / a **long** chain forms /
equation to show this using 'n' **(1)**

2

[4]