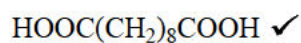




ALLOW $\text{H}_2\text{NCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_2$



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

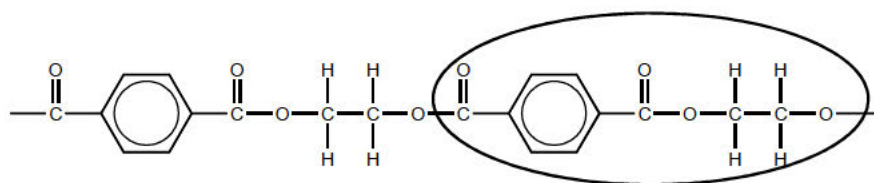
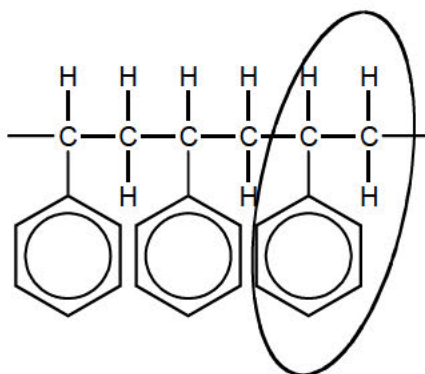
ALLOW CO_2H for COOH

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

ALLOW displayed formulae or skeletal formulae

[2]

2. (a) (i)



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

2

(ii) 1 mark for each monomer (1)(1)

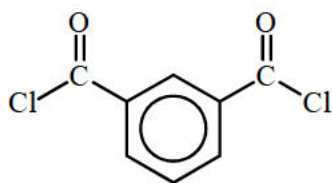
2

(b) $\text{C}=\text{O}$ absorbs radiation/breaks (1)
ester linkage hydrolysed (1)

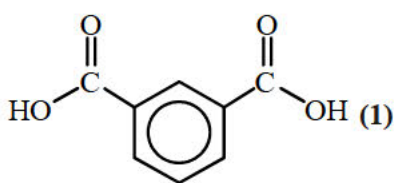
2

[6]

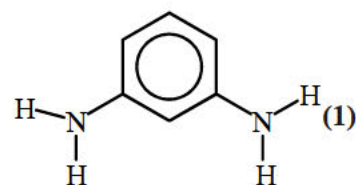
3. (i)



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 *M_r*)

1

[3]

4. (a)

$\text{HO}-\overset{\text{O}}{\parallel}{\text{C}}-(\text{CH}_2)_4-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$ $\text{H}_2\text{N}-(\text{CH}_2)_6-\text{NH}_2$	$\begin{array}{c} \text{H} \quad \text{CN} \\ \diagdown \quad / \\ \text{C}=\text{C} \\ / \quad \diagdown \\ \text{H} \quad \text{H} \end{array} \quad \text{(1)}$
$\left[\begin{array}{c} \text{O} \quad \text{O} \\ \parallel \quad \parallel \\ -\text{C}-\text{(CH}_2)_4-\text{C}-\text{N}-(\text{CH}_2)_6-\text{N}- \\ \quad \\ \text{H} \quad \text{H} \end{array} \right]$ monomers connected by NHCO (1) correct repeat shown (1)	$\left[\begin{array}{c} \text{H} \quad \text{CN} \\ \quad \\ -\text{C}-\text{C}- \\ \quad \\ \text{H} \quad \text{H} \end{array} \right]$
condensation	addition

(1) for both

4

(b) (i) PCl_5 / SOCl_2

1

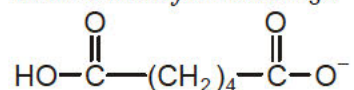
(ii) HCl

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

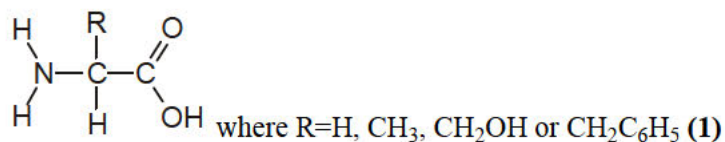
allow 1 mark for: both $\text{H}_3\text{N}^+-(\text{CH}_2)_6-\text{NH}_3^+$ and



(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

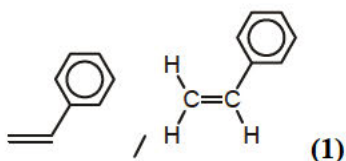
3

[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]