1. $H_2N(CH_2)_6NH_2$ ✓

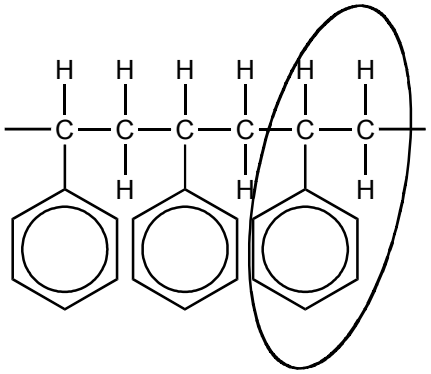
ALLOW *$H_2NCH_2CH_2CH_2CH_2CH_2CH_2NH_2$*

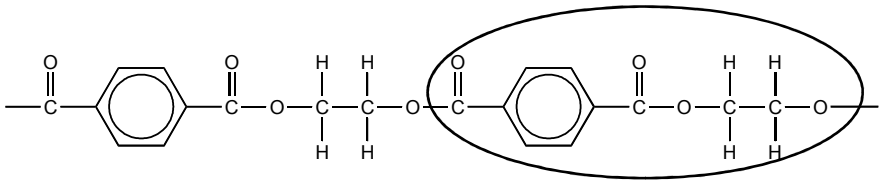
$HOOC(CH_2)_8COOH$ ✓

ALLOW *$HOOCCH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2COOH$*
ALLOW *CO_2H for COOH*
ALLOW *acid chloride, $ClOC(CH_2)_8COCl$*
ALLOW *displayed formulae or skeletal formulae*

[2]

2. (a) (i)





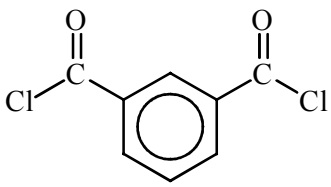
1 mark for each repeat unit **(1)(1)** 2

(ii) 1 mark for each monomer **(1)(1)** 2

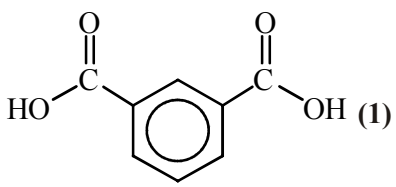
(b) C=O absorbs radiation/breaks **(1)**
ester linkage hydrolysed **(1)** 2

[6]

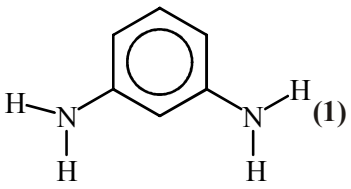
3. (i)



or



(1)



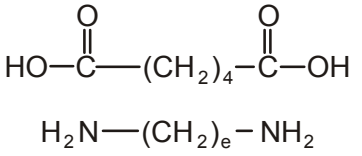
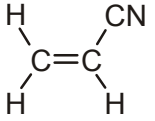
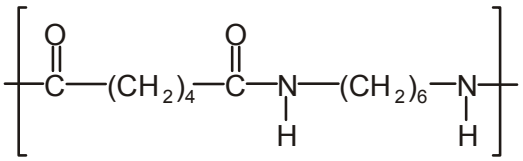
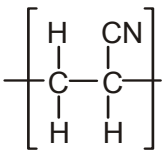
(1)

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]

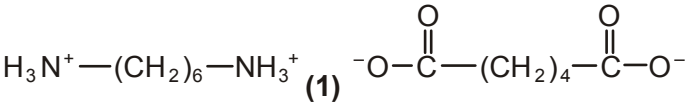
4. (a)

	 **(1)**
 monomers connected by NHCO **(1)** correct repeat shown **(1)**	
condensation	addition

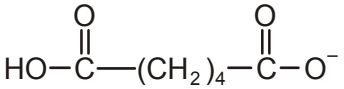
(1) for both 4

(b) (i) PCl_5 / $SOCl_2$ 1

(ii) HC*l* 1

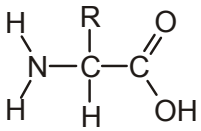
(c)  **(1)** 2

allow 1 mark for: both $H_3N^+—(CH_2)_6—NH_3^+$ *and*



(d) (i) 4 1

(ii)

 where R=H, CH_3, CH_2OH or $CH_2C_6H_5$ **(1)** 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 3

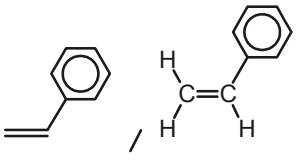
don't allow comparisons solubility or M_r

[13]

5. (i) addition (polymerisation) **(1)** 1

NOT additional

(ii)



(1) 1

(iii) π-bond breaks **(1)**

many molecules join / a **long** chain forms / equation to show this using 'n' **(1)** 2

[4]