Nylon: Questions

1. The flow diagram summarises the process used to make Nylon

(a) The molecular formula of hexamethylene diamine is C₆H₁₆N₂.

What is the molecular formula of adipic acid? ____________________________ [1]

(b) Choose the best words from the list to describe the five processes labelled in the flow diagram. You may choose each answer once, more than once or not at all.

<table>
<thead>
<tr>
<th>Acid-base</th>
<th>Combustion</th>
<th>Dehydration</th>
<th>Oxidation</th>
<th>Reduction</th>
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</thead>
<tbody>
<tr>
<td>1 __________; 2 __________;</td>
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<td>3 __________; 4 __________;</td>
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<td>5 __________</td>
<td>[5]</td>
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(c) (i) Finish the equation for the reaction of adiponitrile with hydrogen to produce hexamethylene diamine.

\[
C_6H_8N_2 + \_\_\_H_2 \rightarrow C_6H_{16}N_2
\]  [1]
(ii) Calculate the mass of hydrogen needed to produce 116 tonnes of hexamethylene diamine.

\[ {} \text{ tonnes [2]} \]

Nylon salt is formed from \( \text{NH}_2(\text{CH}_2)_6\text{NH}_2 \) and \( \text{HOOC}(\text{CH}_2)_4\text{COOH} \). In aqueous solution it forms two ions \( \text{"NH}_3(\text{CH}_2)_6\text{NH}_3" \) and \( \text{"OOC}(\text{CH}_2)_4\text{COO}" \).

(a) What changes take place to the hexamethylene diamine and adipic acid molecules when the Nylon salt is formed?

\[ {} \text{[2]} \]

(b) Why is the Nylon salt soluble in water?

\[ {} \text{[2]} \]

(c) Nylon produced from adipic acid and hexamethylene diamine is called Nylon 6:6. The structure of another type of Nylon, called Nylon 6:10, is

\[ \text{H} - \text{O} - \text{(CH}_2)_8 - \text{C} - \text{N} - \text{(CH}_2)_6 - \text{N} - \text{H} \]

(i) Draw the structures of the monomers used to make it.
(ii) Explain the naming system used for these Nylons.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________ [2]

(d) Another type of Nylon – Nylon 6 – is produced by the polymerisation of a single monomer. The monomer contains two reactive groups. One is an acid group and one is a basic group. The structure of the monomer is:

\[ \text{H}_2\text{N(CH}_2\text{)}_n\text{COOH} \]

(i) What is the value of \( n \)? _____________________________________________ [1]

(ii) Draw the structure of the polymer.