Polyesters and polyamides

AQA 7405 · A level

Show your working where needed.

Name _____ Date _____

1. Read two polymer chains

Chain A contains …-CH_2CH_2-O-C(=O)-CH_2-C(=O)-O-CH_2CH_2-…

Chain B contains …-CH_2CH_2-NH-C(=O)-CH_2-C(=O)-NH-CH_2CH_2-…

Copy the linking group in each chain. Name each link and classify its polymer.

2. From two monomers to one repeat

Write one repeat unit of the polyester formed from $HOCH_2CH_2OH$ and $HOOCCH_2CH_2COOH$. Show the continuation bond at each end.

3. Find a diamine and diacid

Use the polyamide repeat -[NH-CH_2-CH_2-NH-C(=O)-CH_2-C(=O)]-. Give condensed structures for the diamine and dicarboxylic acid that could make it.

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4. Two polymerisation reactions

Propene gives polymer P. A mixture of a diol and a dicarboxylic acid gives polymer Q. Explain what happens to the reacting bonds or groups, name each type of polymerisation and state any other product.

5. Calculate a repeat-unit mass

$HO(CH_2)_3OH$ has M_r 76 and $HOOC(CH_2)_2COOH$ has M_r 118. Calculate M_r for one long-chain polyester repeat containing one fragment of each monomer. Use $M_r(H_2O) = 18$ and ignore end groups.

6. Use alkaline hydrolysis

Give both organic products from complete hydrolysis of -[O-CH_2-CH_2-O-C(=O)-CH_2-CH_2-C(=O)]- with hot excess aqueous NaOH. Show the charge or counter-ions of any salt.

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7. Use acidic hydrolysis

Draw the organic products of completely hydrolysing -[NH-CH_2-CH_2-NH-C(=O)-CH_2-C(=O)]- with excess hot dilute HCl. Include any charges in the final mixture.

8. Explain two material properties

A polyamide has N-H and C=O in each repeat. A polyalkene contains only C and H. Explain why the polyamide can show stronger attractions between chains and why it can be hydrolysed.

9. Extra challenge · Calculate a polymer yield from a repeat

$HO(CH_2)_4OH$ (M_r 90) and $HOOC(CH_2)_2COOH$ (M_r 118) form a polyester. Draw a repeat unit and calculate the mass of polyester expected from 0.100 mol of each monomer. Ignore end groups and use $M_r(H_2O)$ = 18.

Hot aqueous NaOH is then added to the polymer. Give both organic products and explain why carrying out the same treatment on a polyalkene leaves its backbone intact.

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