Polymers (polyamides and polyesters)

**2019**

Nylon 6,6 is used to make airbags. The monomers used to make nylon 6,6 are shown below:

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(i) Draw a section of the nylon 6,6 polymer chain to show TWO repeating units.

(ii) Explain why nylon 6,6 is referred to as a condensation polymer.

**2018**

Glycolic acid can be used to make polyglycolic acid (PGA), a polyester used to make dissolvable stitches. The structure of glycolic acid is shown below:

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(i) Draw a section of the PGA polymer chain to show THREE repeating units.

(ii) Identify and explain the type of reaction occurring in the formation of PGA.

**2017**

Nomex® is a polymer used in firefighters’ suits. Nomex® is made up of two different monomers bonded

together to form the polymer chain.

A small portion of the structure of Nomex® is shown below.



(a) Explain the structure of the polymer, Nomex®.

In your answer, you should include:

• the name of the functional group linking the monomers

• a drawing of both monomers

• a classification of the type of polymer formed, with an explanation to justify your choice.

(b) Polymers such as Nomex® can be hydrolysed by either aqueous acid or base.

Show the products of the hydrolysis of Nomex® using:

(i) aqueous acid

(ii) aqueous base.

**2015**

A form of the polymer nylon can be made from the two monomers below.



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(i) Draw the repeating unit of the polymer formed if these two monomers are used

Consider the formation of this form of nylon in a laboratory.

(ii) Describe the type of reaction occurring, and explain why this reaction results in a polymer.

(iii) Explain why sebacoyl chloride is dissolved in a non-polar organic solvent rather than in water

(iv) Elaborate on the reaction that will occur if a dilute aqueous solution of acid is mixed with the newly formed polymer.

**2014**

The following polymer will, under the correct conditions, hydrolyse.



(i) Draw the monomer(s) from which this polymer is formed.

(ii) Discuss the hydrolysis of the polymer.

In your answer you should include:

• the conditions under which it can be hydrolysed

• structures of the organic products formed as a result of hydrolysis.

**2012**

The structures of Polymer A and Polymer B are given below.



(a) In the boxes below, identify the monomers from which these polymers are made.

(b) One of the polymers from above can be hydrolysed using NaOH(*aq*).

Identify the polymer and draw structures for the organic products of the hydrolysis.

(c) Nylon 6,10 can be made from the monomers below.



Steps for the formation of Nylon 6,10 are given below:

1. 2 g of the diamine is dissolved in 25 mL of water.

2. 2.5 mL of sebacoyl chloride is dissolved in 25 mL of a non-polar organic solvent.

3. The dissolved sebacoyl chloride is poured into the diamine solution.

4. 5 g of NaHCO3 is added.

5. The nylon is extracted from the interface between the diamine and sebacoyl chloride layers.

• Identify the repeating unit of the polymer formed.

• Explain why the diamine is water soluble.

• Explain why the sebacoyl chloride is dissolved in a non-polar organic solvent.

• Explain why NaHCO3 is added.

**2010**

The polymer commonly known as Kevlar is used to make bullet-proof vests and bicycle tyres.

It can be made in a condensation reaction from either of the following pairs of monomers:

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However, the second pair of monomers needs to be heated for the polymerisation reaction to take place.

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Discuss these polymerisation reactions. Your answer should include:

• a repeating unit of the polymer chain

• reasons for the choice of monomers

• identification of the functional group in the polymer

• a reason why this is classified as a condensation reaction

• a comparison of the two pairs of monomers, including the reason that the second reaction will not take place without heating.

**2009**

Kodel is a polymer with the following structure:



(a) (i) Identify TWO monomers for this structure.

(ii) Explain why this type of polymer is known as a **condensation polymer**.

(b) Compound **X** is a polymer which can be hydrolysed to give a single monomer, Compound **Y**, which

has the molecular formula C3H6O3.

Compound **Y** will turn blue litmus red, and can exist as enantiomers (optical isomers). It will react with

acidified potassium dichromate to form Compound **Z**, which has the molecular formula C3H4O3.

Compound **Z** does not react with Tollens’ reagent.

(i) Draw the structures of Compounds **Y** and **Z**.

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