CAIE Chemistry IGCSE

11.8 Polymers

Flashcards

Define polymers

Define polymers

Polymers are large molecules built up from many smaller molecules, known as monomers, joined together by covalent bonds.

How is poly(ethene) formed?

How is poly(ethene) formed?

Ethene monomers undergo addition polymerisation to form the long chain polymer poly(ethene).

Draw the displayed structure of the repeat unit of poly(ethene)

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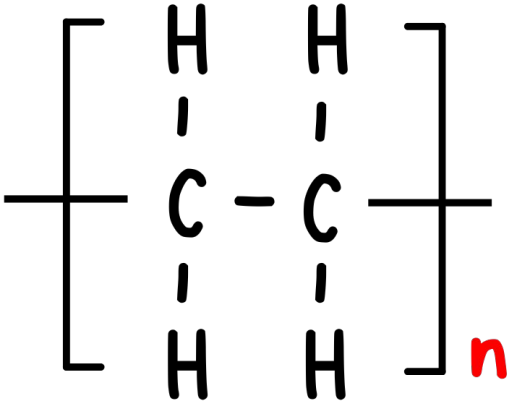


poly(ethene)

What are plastics?

What are plastics?

Plastics are made from polymers

What are some properties of plastics?

What are some properties of plastics?

Some are:

- Non-biodegradable
- Chemically unreactive
- Mixed with other chemicals/materials

What are some common uses of plastics?

What are some common uses of plastics?

- Bags
- Bottles
- Food packaging
- Toys

Describe the environmental impact of plastics disposed in landfills

Describe the environmental impact of plastics disposed in landfills

Non-biodegradable plastics are disposed in landfill sites, where they continue to build up and accumulate as they are unable to be broken down by decomposers

Describe the environmental impact of plastics accumulating in oceans

Describe the environmental impact of plastics accumulating in oceans

Plastics also end up in oceans due to improper disposal where they accumulate and cause harm to aquatic life, ending up in the food chains and causing biological harm

Describe the environmental impact of plastics being incinerated (burnt)

Describe the environmental impact of plastics being incinerated (burnt)

- Carbon dioxide, a greenhouse gas, is released
- Plastics that contain chlorine, such as PVC, burn and release toxic hydrogen chloride gas
- Carbon monoxide, a toxic gac, is released into the atmosphere if incomplete combustion is done

How can polymers differ in terms of their linkages?

(extended only)

How can polymers differ in terms of their linkages? (extended only)

Polymers can have different linkages depending on what monomers they are made from. The different polymer linkages are:

- Simple C-C linkage
- Amide linkage
- Ester linkage

How can polymers differ from one another?

(extended only)

How can polymers differ from one another? (extended only)

- Different repeat units
- Different linkages

What is the difference between addition and condensation polymerisation? (extended only)

What is the difference between addition and condensation polymerisation? (extended only)

Addition polymerisation	**Condensation polymerisation**
Forms a polymer from alkene monomers	Forms a polymer by reacting compounds with two different functional groups together
The C=C bond is removed from the monomers to form a saturated polymer	A small molecule such as water is produced
Addition polymers are long chains of C-C single bonds	Condensation polymers can be polyesters with ester linkages or polyamides with amide linkages

How is a polyamide formed?
(extended only)

How is a polyamide formed? (extended only)

Two types of monomers react. One monomer contains two carboxylic acid groups (dicarboxylic acid) and the other contains two amine groups (diamine). Water is also produced.

How is a polyester formed?
(extended only)

How is a polyester formed? (extended only)

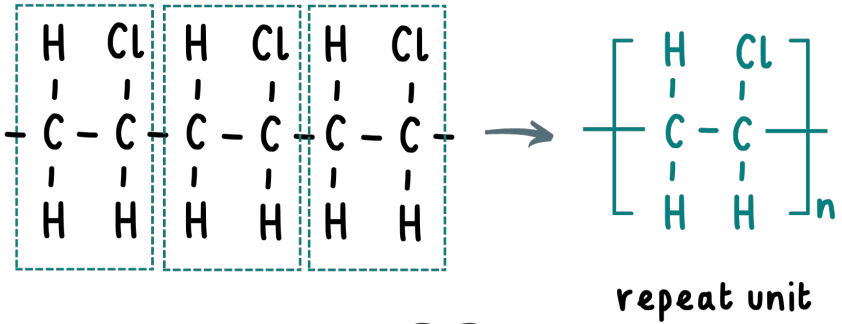
Two types of monomers react. One monomer contains two carboxylic acid groups (dicarboxylic acid) and the other contains two alcohol groups (diol). Water is also produced.

How can the repeat unit of an addition polymer be identified?

(extended only)

How can the repeat unit of an addition polymer be identified? (extended only)

1. Spot which group is being repeated in the long-chain molecule
2. Draw the repeat unit by itself
3. Draw square brackets around it and add a small *n* on the lower right hand corner to represent the number of repeating units in the polymer chain.

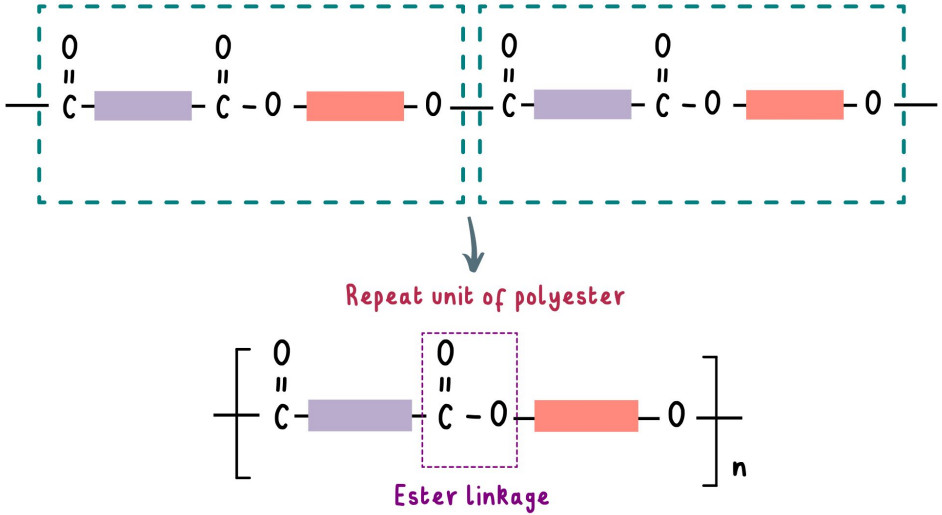


How can the repeat unit of a polyester be identified?

(extended only)

How can the repeat unit of a polyester be identified? (extended only)

1. Spot which group is being repeated in the long-chain molecule
2. Draw the repeat unit by itself
3. Draw square brackets around it and add a small *n* on the lower right hand corner to represent the number of repeating units in the polymer chain.
4. A repeat unit of a polyester will have a -C=O and an -O- on either side



How can the repeat unit of a polyamide be identified?

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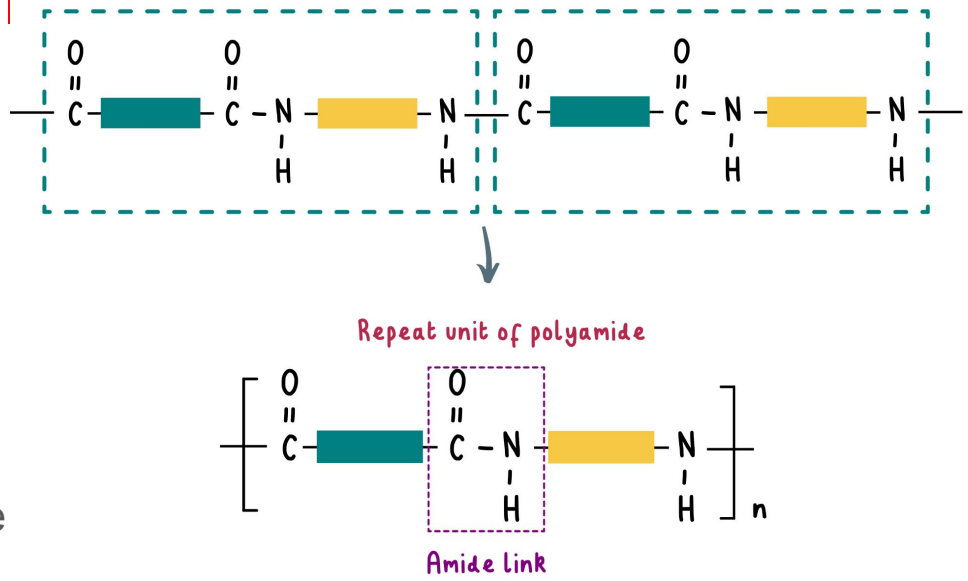
How can the repeat unit of a polyamide be identified? (extended only)

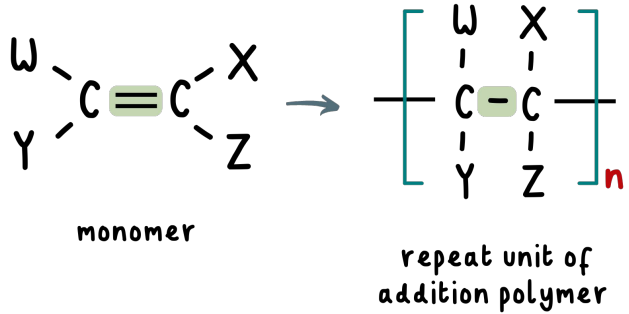
1. Spot which group is being repeated in the long-chain molecule
2. Draw the repeat unit by itself
3. Draw square brackets around it and add a small *n* on the lower right hand corner to represent the number of repeating units in the polymer chain.
4. A repeat unit of a polyamide will have a -C=O and a -NH- on either side



How can the repeat unit of an addition polymer be drawn from its monomer? (extended only)

How can the repeat unit of an addition polymer be drawn from its monomer? (extended only)

1. Replace the double C=C bond to a single C-C covalent bond
2. Both carbon atoms have bonds extended out of the square brackets
3. An *n* is written on the lower right hand corner of the square brackets

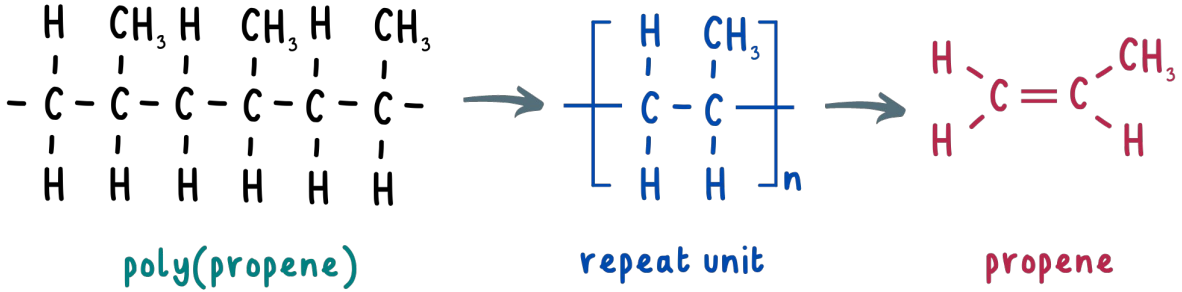


How can the alkene monomer be drawn from the structure of the its polymer?

(extended only)

How can the alkene monomer be drawn from the structure of the its polymer? (extended only)

1. Identify the repeat unit in the polymer structure and draw it separately
2. Replace the single C-C covalent bond with a double C=C bond to convert it to its alkene
3. Erase the square brackets and carbon extended bonds to ensure each carbon only has 4 bonds.

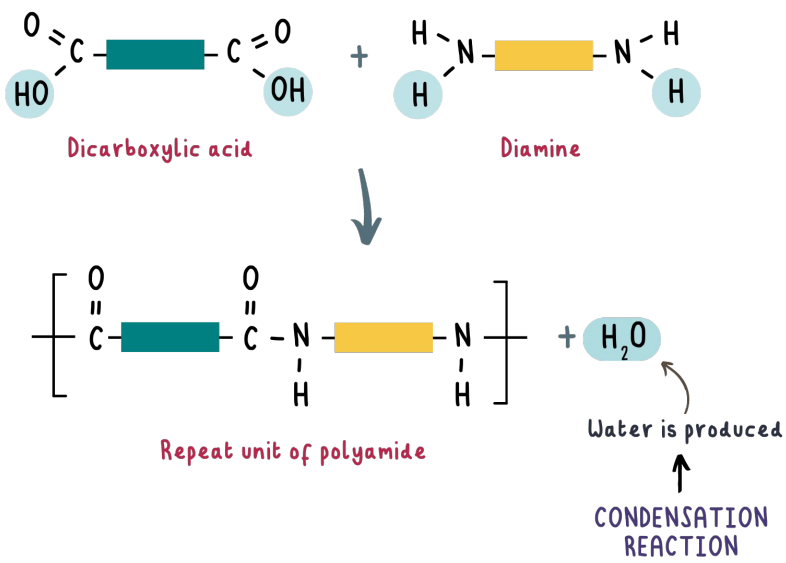


How can the repeat unit of a polyamide be drawn from its monomers?

(extended only)

How can the repeat unit of a polyamide be drawn from its monomers? (extended only)

1. The hydroxyl groups (-OH) on either side of the dicarboxylic acid is removed and combined with the H atoms that are removed from the amine groups ($-NH_2$) on either side of the diamine to form water
2. The remaining monomers are joined together by an amide linkage



How can the monomers be drawn from the structure of a polyamide?

(extended only)

How can the monomers be drawn from the structure of a polyamide? (extended only)

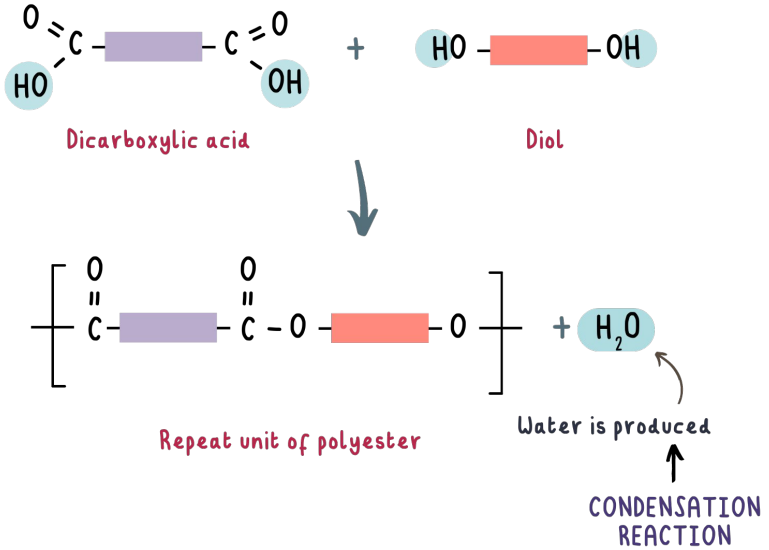
1. Identify the repeat unit in the polyamide structure and draw it separately
2. The amide linkage is broken by the addition of water (hydrolysis reaction)
3. The monomers are separated into dicarboxylic acid (with a carboxyl group on either end of the molecule) and a diamine (with an amine group on either end of the molecule)

How can the repeat unit of a polyester be drawn from its monomers?

(extended only)

How can the repeat unit of a polyester be drawn from its monomers? (extended only)

1. The -OH on either side of the dicarboxylic acid is removed and combined with the H atoms that are removed from the hydroxyl groups on either side of the diol to form water
2. The remaining monomers are joined together by an ester linkage



How can the monomers be drawn from the structure of a polyester?

(extended only)

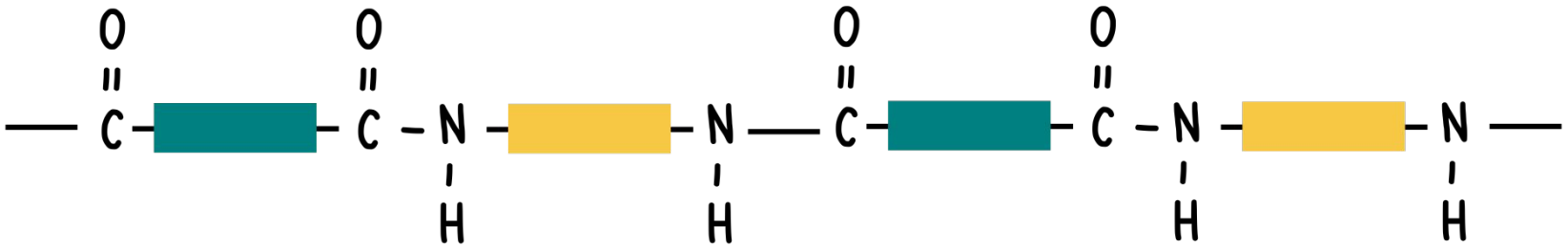
How can the monomers be drawn from the structure of a polyester? (extended only)

1. Identify the repeat unit in the polyester structure and draw it separately
2. The ester linkage is broken by the addition of water (hydrolysis reaction)
3. The monomers are separated into dicarboxylic acid (with a carboxyl group on either end of the molecule) and a diol (with a hydroxyl group on either end of the molecule)

How can the structure of nylon be presented?

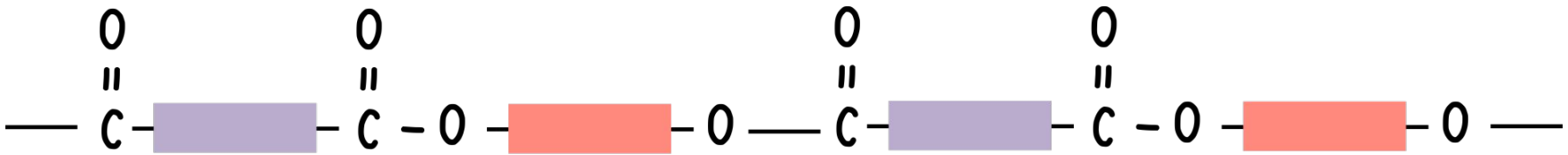
(extended only)

How can the structure of nylon be presented? (extended only)



How can the structure of PET be presented?
(extended only)

How can the structure of PET be presented? (extended only)



How can PET be converted back to its monomers?

(extended only)

How can PET be converted back to its monomers? (extended only)

PET can be converted back into monomers (dicarboxylic acid and diol) through hydrolysis and re-polymerisation

What are proteins?
(extended only)

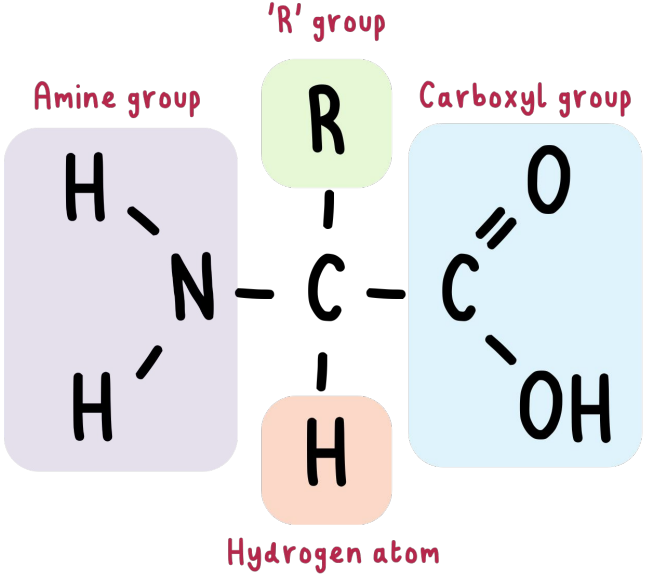
What are proteins? (extended only)

Proteins are natural polyamides, made from amino acid monomers

Draw the general structure of an amino acid

(extended only)

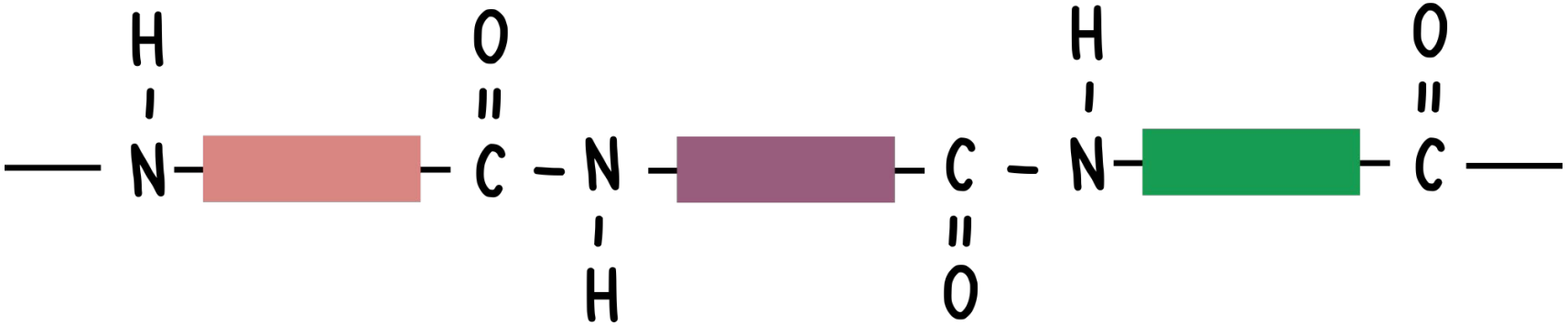
Draw the general structure of an amino acid (extended only)



How can the structure of a protein be presented?

(extended only)

How can the structure of a protein be presented? (extended only)



How can proteins be converted into amino acids?

(extended only)

How can proteins be converted into amino acids? (extended only)

Hydrolysis

Hydrolysis uses water to split up the protein polymer into its amino acid monomers.