CAIE Chemistry A-level

Topic 35 - Polymerisation

(A level only)

Flashcards

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What is condensation polymerisation?

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What is condensation polymerisation?

The joining together of monomers to form a polymer with the release of a small molecule, such as water or HCl.

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What monomers can be reacted together to form a polyester?

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What monomers can be reacted together to form a polyester?

Either:

- A monomer containing two carboxylic acid groups and a monomer containing two alcohol groups.
- Two monomers each containing both an alcohol and a carboxylic acid group.

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Describe the formation of an ester link

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Describe the formation of an ester link

A condensation reaction occurs. H^+ is lost from the -OH of an alcohol and OH^- is lost from the -COOH of the carboxylic acid. Water is formed when these ions combine. The organic molecules join to form the -COOC- ester link.

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During the formation of an ester bond, HCl may form instead of water. Why?

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During the formation of an ester bond, HCl may form instead of water. Why?

An acyl chloride (-COCl) may be used instead of a carboxylic acid (-COOH) to form an ester bond. The chlorine is lost from an acyl chloride during a condensation reaction which bonds to a hydrogen atom to form hydrogen chloride.

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What monomers can be reacted together to form a polyamide?

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What monomers can be reacted together to form a polyamide?

Either:

- A monomer containing two carboxylic acid groups and a monomer containing two amine groups.
- Two monomers each containing both a carboxylic acid group and an amine group.

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Describe the formation of an amide link

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Describe the formation of an amide link

A condensation reaction occurs. H^+ is lost from the $-NH_2$ of an amine and OH^- is lost from the -COOH of the carboxylic acid. Water is formed when these ions combine. The organic molecules join by forming the -CONH- amide link.

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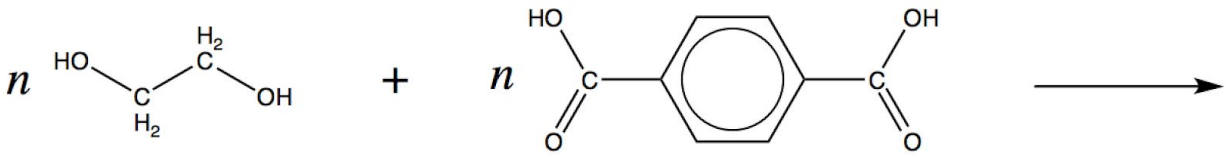
The monomers below are used to form Terylene. Draw the structure of this polymer, labelling the type of link formed



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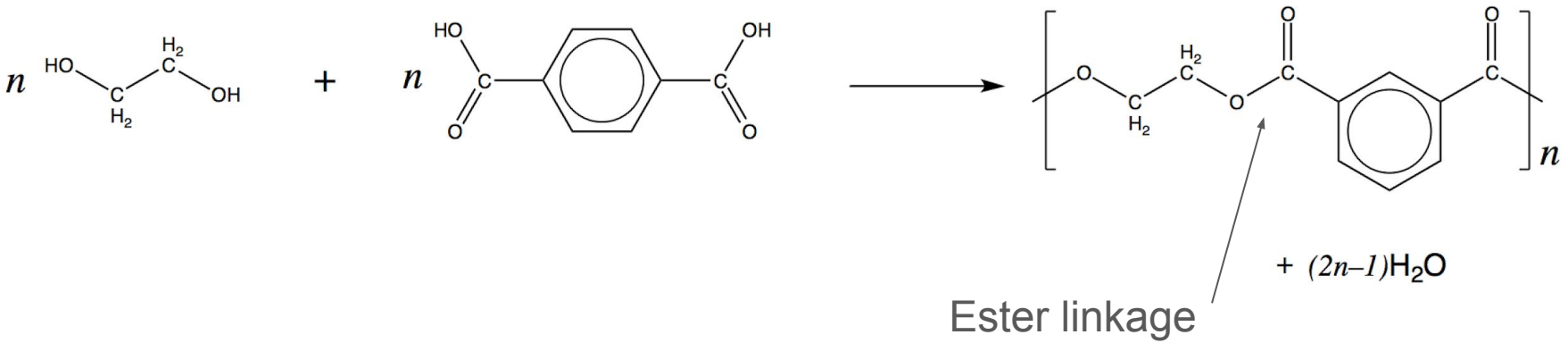

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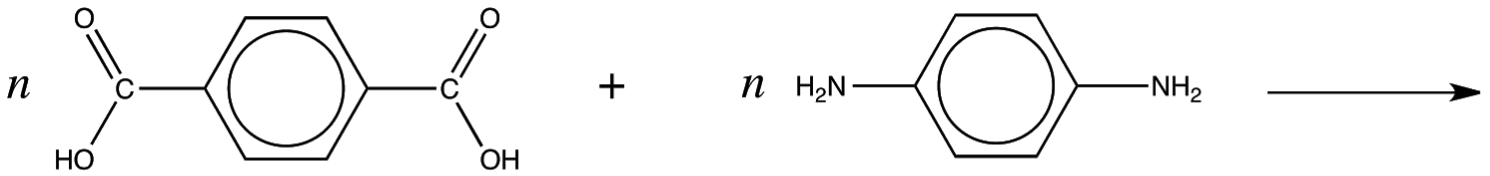
The monomer below is used to form Kevlar. Draw the structure of the polymer formed, labelling the type of link formed.



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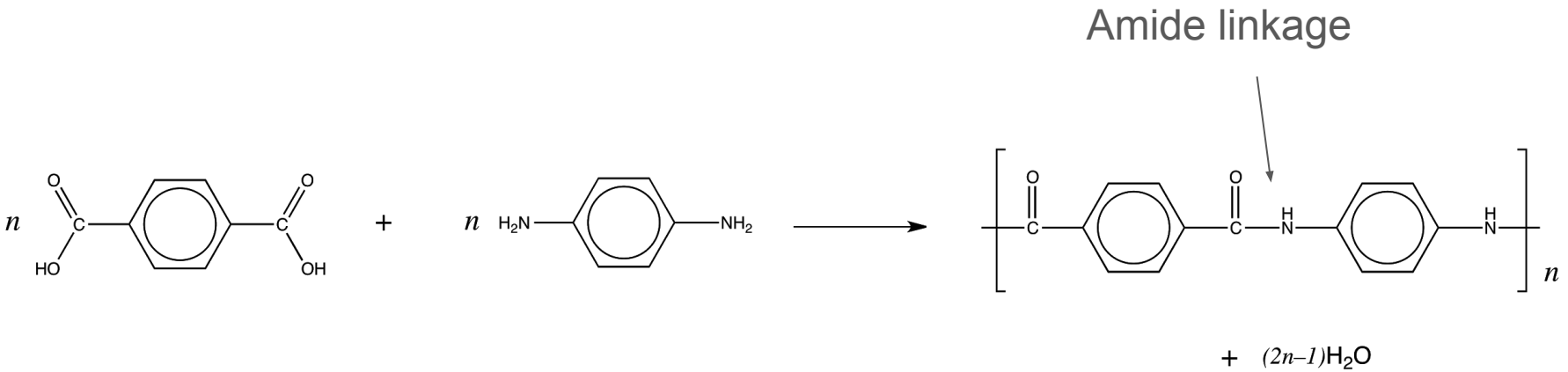

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What is a repeat unit?

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What is a repeat unit?

A structure that appears in a molecule many times. This may be made up of one monomer or several monomers.

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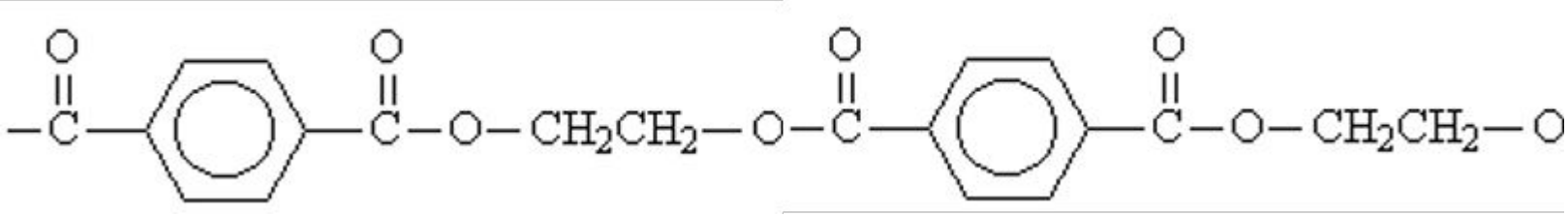
Identify the monomers in the polymer below



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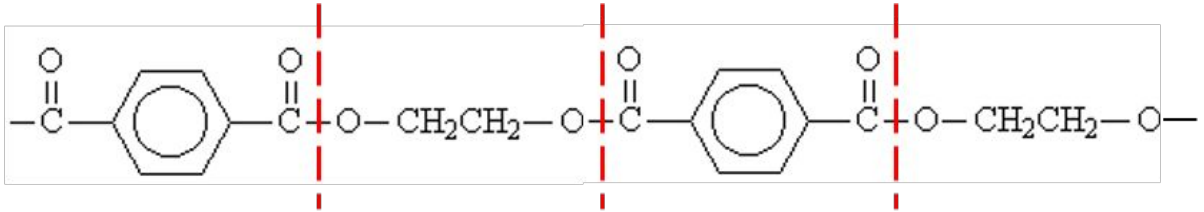
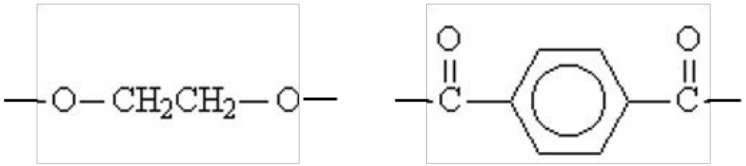
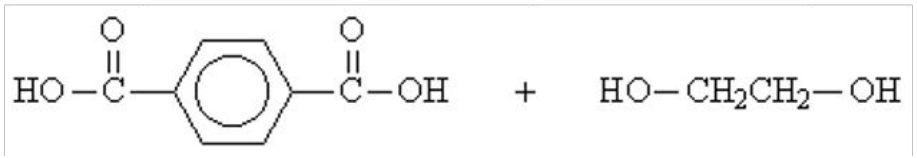
Identify the monomers in the polymer below

Polymer





Monomers



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What are the differences between addition polymerisation and condensation polymerisation?

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What are the differences between addition polymerisation and condensation polymerisation?

Addition polymerisation	**Condensation polymerisation**
Monomers contain C=C double bonds.	Monomers contain -OH and -COOH or -COCl for polyesters. Monomers contain -NH_2 and -COOH or -COCl for polyamides.
Polymer main chain only contains C-C single bonds.	Main chain contains nitrogen or oxygen atoms as well as carbon atoms.
The polymer is the only product of the reaction.	The polymer and a small molecule like water or HCl are formed during the reaction.

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How does the presence of side chains affect the properties of a polymer?

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How does the presence of side chains affect the properties of a polymer?

The side chains mean that the polymer chains are less able to pack closely together so the material has a low density. This also means that there are fewer points of contact between molecules so the van der Waals forces are weaker and less energy is needed to overcome them. As a result, the melting and boiling points of branched polymers are lower.

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What are the types of intermolecular forces? List them in order from strongest to weakest

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What are the types of intermolecular forces? List them in order from strongest to weakest

- Hydrogen bonding.
- Permanent dipole-dipole.
- Van der Waals forces.

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How do intermolecular forces affect the properties of Teflon (PTFE)?

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How do intermolecular forces affect the properties of Teflon (PTFE)?

Although Teflon has relatively weak van der Waals forces, there are no side branches so the molecules pack closely together. As a result, more van der Waals forces form between the chains so the melting point is high as lots of energy is needed to overcome these forces.

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How do intermolecular forces affect the properties of kevlar?

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How do intermolecular forces affect the properties of kevlar?

Hydrogen bonds form between the strands (between the O in C=O and the H in N-H), causing the molecules to line up in a sheet. This makes the polymer very strong and means the melting point of kevlar is very high as a lot of energy is required to overcome hydrogen bonds.

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Which monomers make up proteins? Draw the general structure of this monomer

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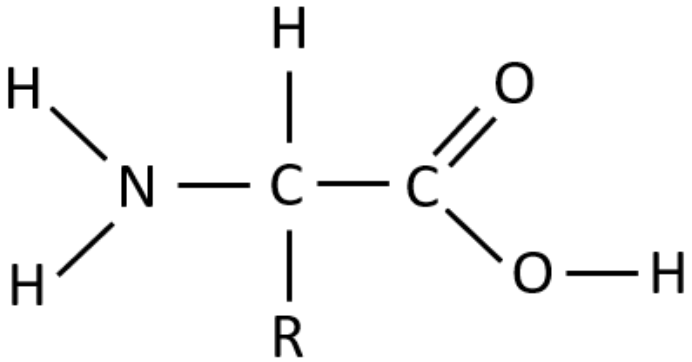
Which monomers make up proteins? Draw the general structure of this monomer

Amino acids



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What groups do amino acids contain?

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What groups do amino acids contain?

Amine group ($-NH_2$) and carboxylic acid group($-COOH$).

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Describe the primary, secondary and tertiary structure of a protein

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Describe the primary, secondary and tertiary structure of a protein

Primary - sequence of amino acids.

Secondary - hydrogen bonding holds the amino acid chain in an α-helix or β-sheet.

Tertiary - final 3D shape of a protein (inc. primary and secondary), held by interactions between R groups.

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What do hydrogen bonds form between as part of the secondary structure of a protein?

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What do hydrogen bonds form between as part of the secondary structure of a protein?

Between the lone pair of electrons on oxygen in C=O and the hydrogen in N-H.

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Why are poly(alkenes) difficult to biodegrade?

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Why are poly(alkenes) difficult to biodegrade?

Poly(alkenes) do not biodegrade easily because they are chemically inert.

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What happens when certain polymers are exposed to light?

CC BY NC ND

What happens when certain polymers are exposed to light?

Certain polymers degrade/break down in the presence of light. UV light causes the chains to break so that the material crumbles.

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How can polyesters and polyamides be biodegraded?

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How can polyesters and polyamides be biodegraded?

By undergoing hydrolysis

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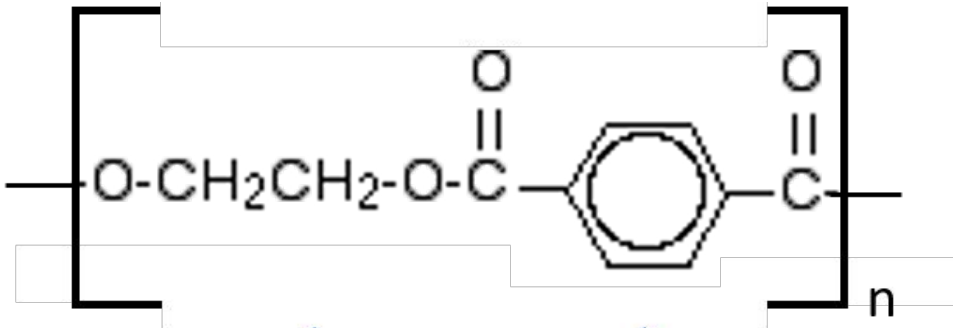
Draw the structures of the products that form when the polyester below undergoes acid and base hydrolysis



Jim Clark, 'Polyesters', Chemguide

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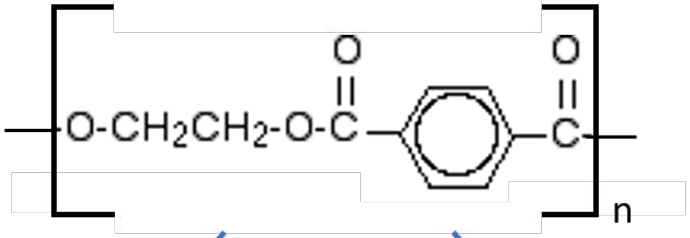
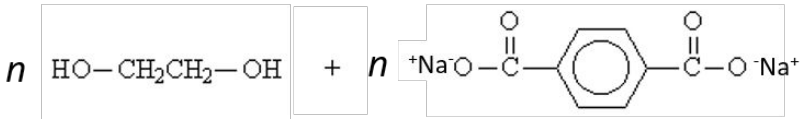
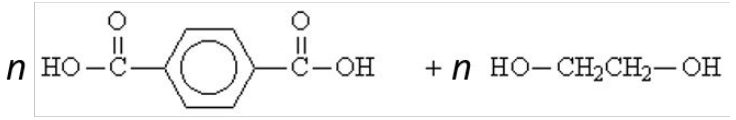


NaOH/ H_2O
Base hydrolysis

H^+/ H_2O
Acid hydrolysis





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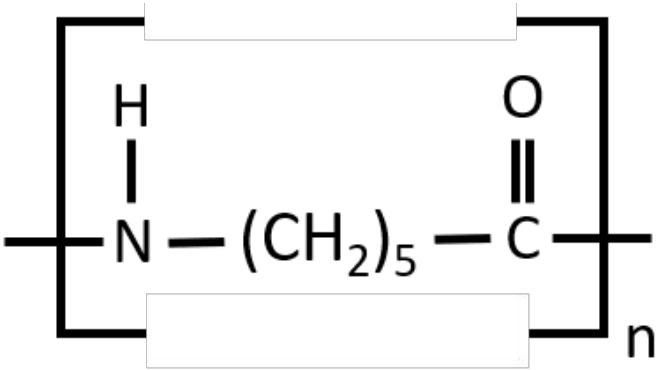
Draw the structures of the products that form when the polyamide below undergoes acid and base hydrolysis



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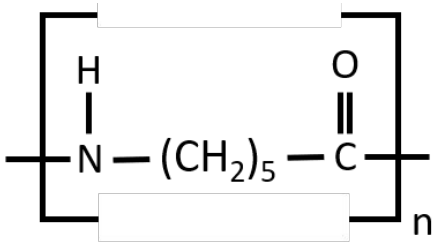

$NaOH/ H_2O$
Base hydrolysis

H^+/ H_2O
Acid hydrolysis

n $H_2NCH_2CH_2CH_2CH_2CH_2COO^-Na^+$

n $H_3\overset{+}{N}CH_2CH_2CH_2CH_2CH_2COOH$

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Draw the general structure of the product formed when a protein undergoes acid hydrolysis

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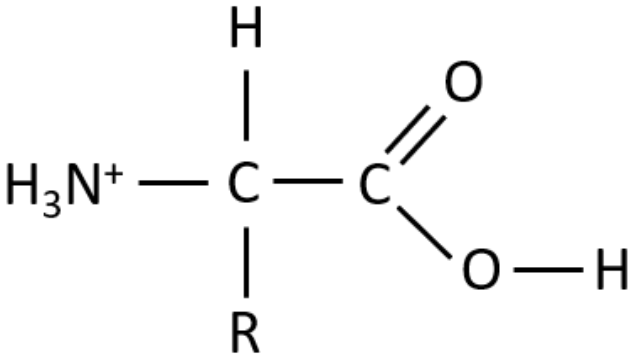
Draw the general structure of the product formed when a protein undergoes acid hydrolysis

Amino acids are formed. As the amino acids are in an acidic solution, the -NH_2 group accepts a proton.



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