

# AQA Chemistry A-level

## 3.3.12: Polymerisation

### Detailed Notes

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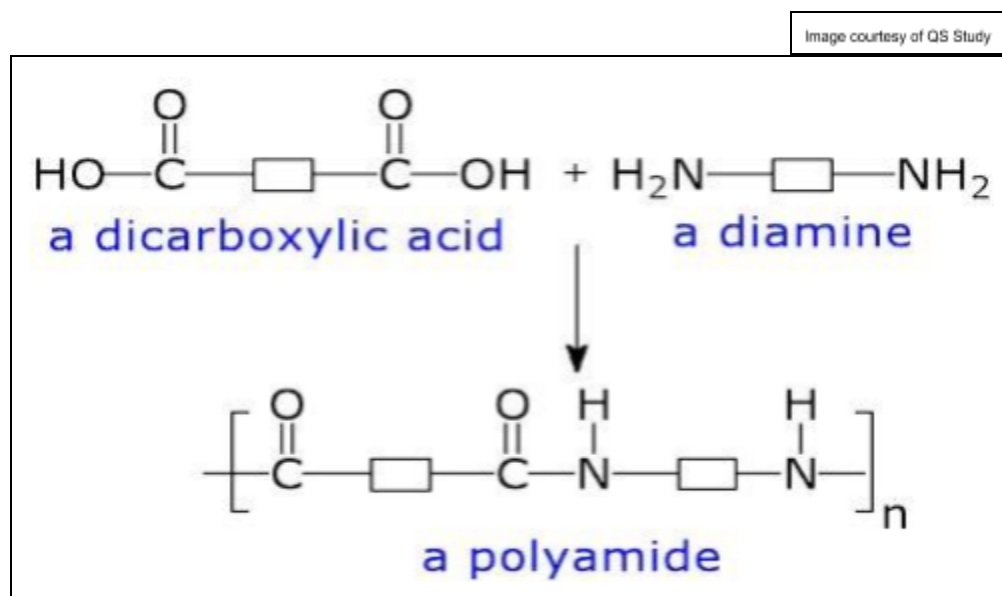
### 3.3.12.1 - Condensation Polymers

Condensation polymers form when a **water molecule is removed** from the species of a reaction. There are three main types of condensation polymers.

#### Polyamides

These are formed in a reaction between **dicarboxylic acid and a diamine**. A molecule of water is removed, leaving an **amide linkage**.

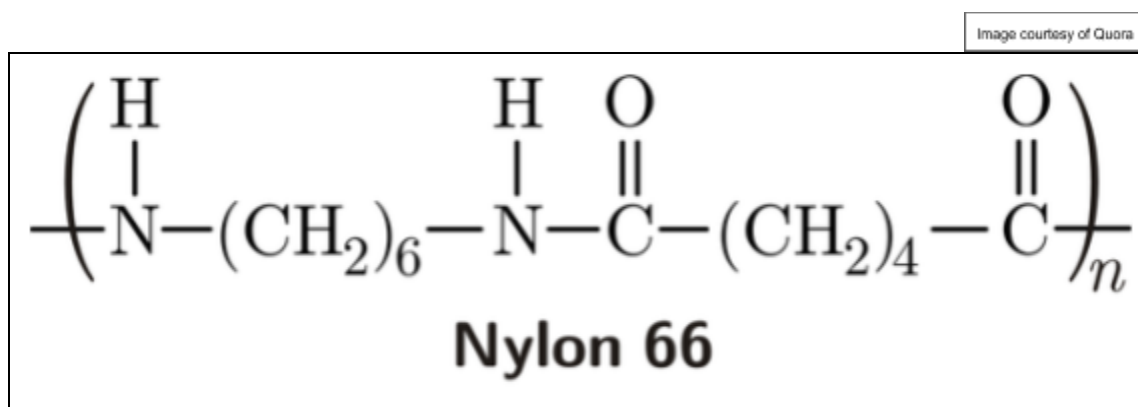
Example:



**-CONH-** is the amide linkage.

Examples of polyamides include **nylon-6,6** made from hexamethylenediamine and hexanedioic acid.

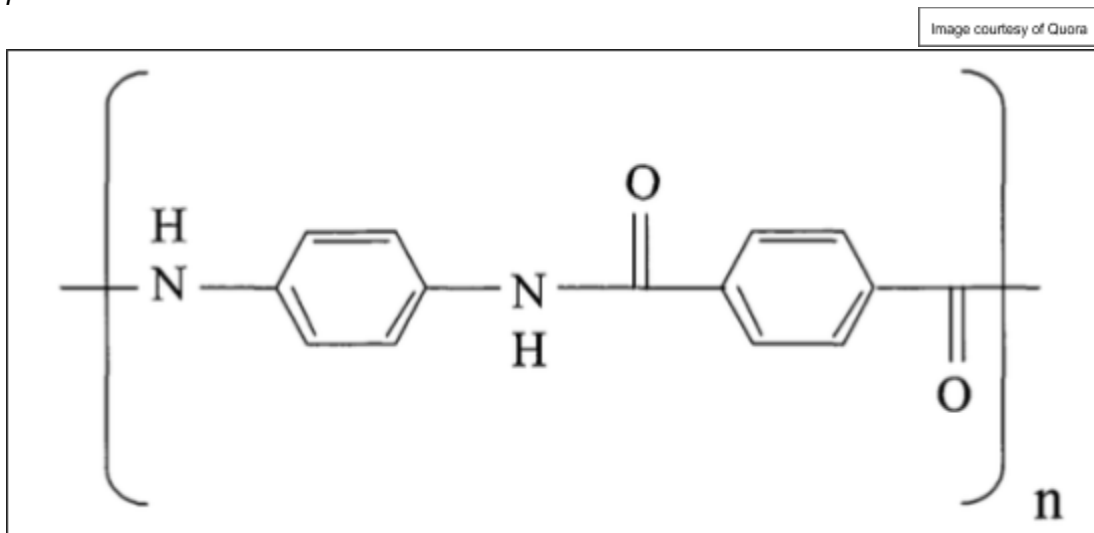
Example:





**Kevlar** is another common polyamide made from 1,4-benzenedicarboxylic acid and 1,4-benzenediamine.

Example:

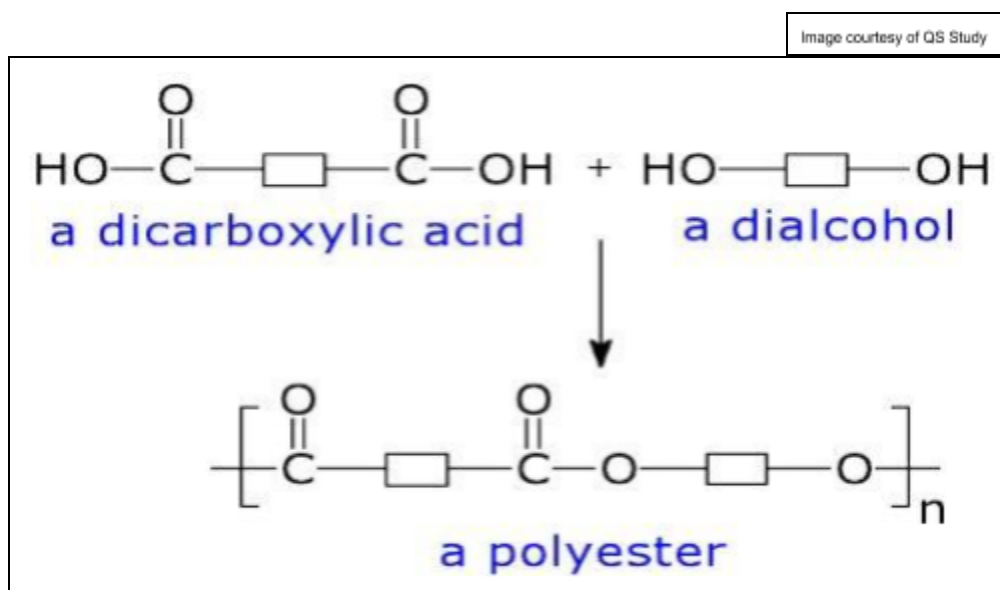


Polyamides are commonly formed from **long chain molecules** which provides them with **strength**.

### Polyesters

These are formed in a reaction between **dicarboxylic acids and a diol**, producing an **ester linkage**.

Example:



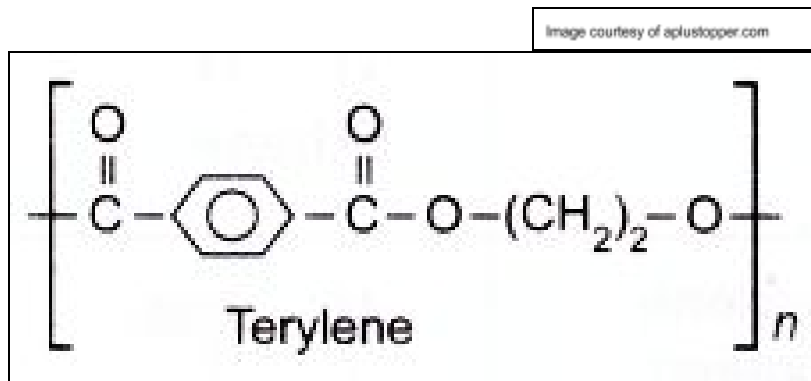
**-COO-** is the ester linkage.





**Terylene (PET)** is a common polyester made from ethanediol and 1,4-benzenedicarboxylic acid.

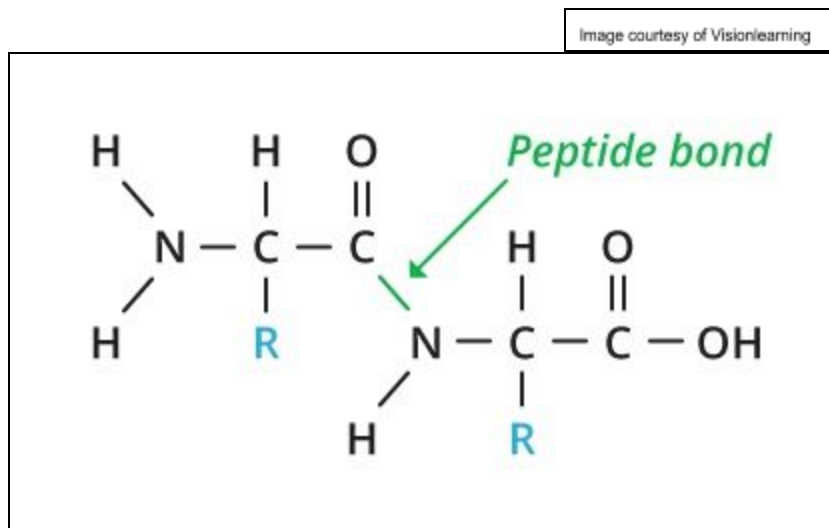
Example:



### Polypeptides

These molecules are formed from **multiple amino acids**. A single monomer can produce a polymer due to the presence of both a **-NH** and **-OH** group.

Example:



**-CONH-** is the peptide linkage.





## Hydrolysis

Condensation polymers can be **broken down** back into the constituent molecules by the **addition of H<sub>2</sub>O**. This is because water is attracted to the **polar regions** of the polymer meaning the links can be broken down.

Example:

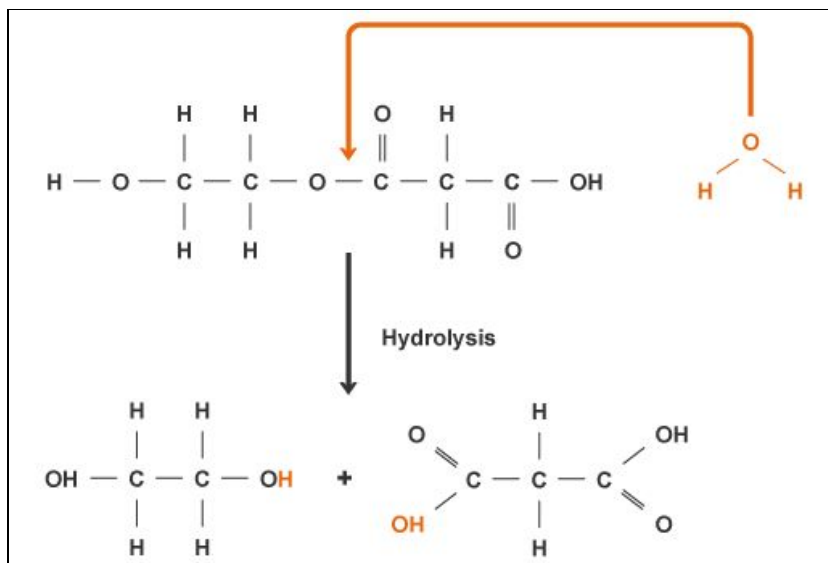


Image courtesy of Socratic

## Uses of Condensation Polymers

Condensation polymers contain **polar bonds** such as those in the ester and amide links. **Hydrogen bonding** and **dipoles** can also form between separate polymer chains, holding them together in a strong structure.

Example:

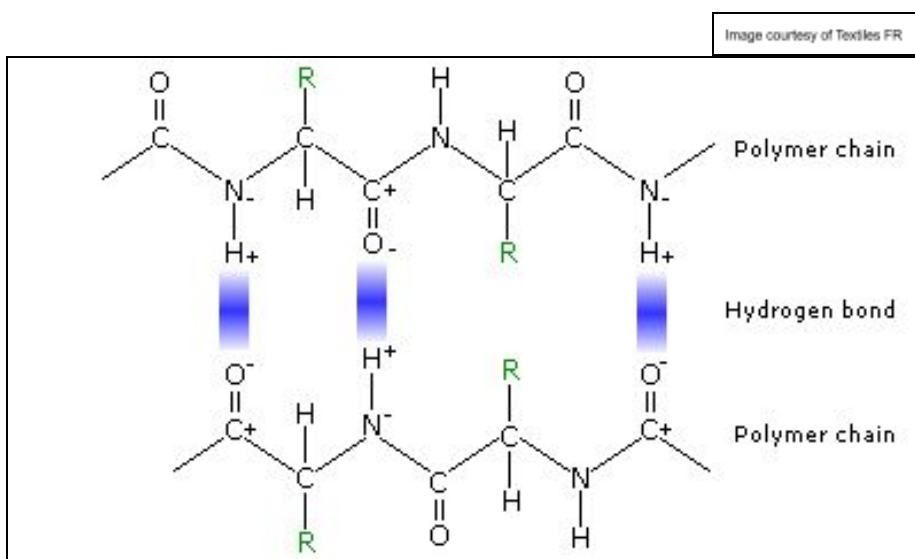


Image courtesy of Textiles FR

This makes the polymers very useful for things such as **bulletproof vests** and **heat protective materials**.



### 3.3.12.2 - Disposal of Polymers

All polymers are very useful but can be **hard to get rid of as waste products**.

Polyalkenes (addition polymers) are very **inert** with **non-polar bonds** meaning they are not easily broken down by species in nature. They are **non-biodegradable**. Therefore they have to be broken down by **burning** which produces harmful products such as  $\text{SO}_2$  or  $\text{CO}$ , this can lead to acid rain.

Polyesters and polyamides can be broken down through **hydrolysis** due to the **polarity** within the polymer molecules. Therefore they are **biodegradable** and can be broken down easily in nature by naturally occurring water or moisture. This means polyester and polyamides can be put into **landfill** and will gradually break down.

Some plastics can also be **recycled**, saving natural resources and reducing the amount of waste that has to be put into landfill. However, it is a **difficult and time consuming** process as all the plastics have to be **sorted and washed** before they can be recycled.

*Example:*

