413 - TERM 2

POLYMERS

11

CONDENSATION POLYMERS

DEFINITION

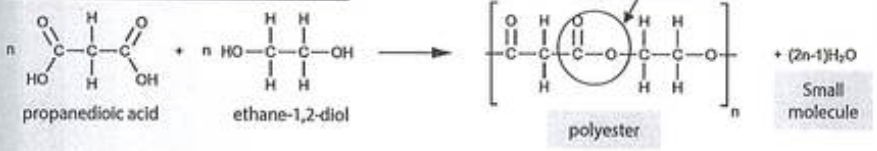
Condensation polymers are formed when monomers react, forming the polymer along with a small molecule such as water or HCl.

POLYESTERS

2 MONOMERS

These two reactions are very similar apart from the small molecule produced.

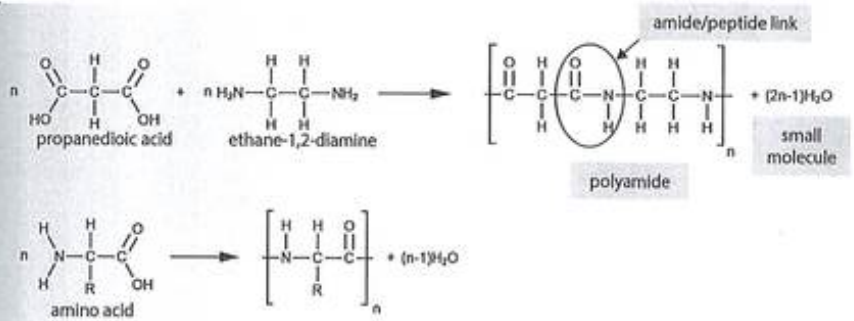
DICARBOXYLIC ACIDS AND DIOLS



POLYAMIDES

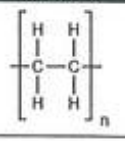
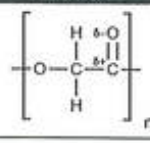
This reaction can also be done using diacyl chlorides rather than a carboxylic acid.

Amino acids can also polymerise to form condensation polymers.



REACTIVITY OF POLYALKENES

Polyalkenes are highly unreactive and so break down very slowly. This is because, unlike polyesters and polyamides, which have a polar C=O bond, polyalkenes contain a continuous chain of carbons attached by non-polar C–C bonds.

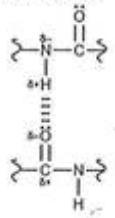
Polyalkene	Polyester
	

USES OF POLYMERS

Polymer	Type of link	Uses
Nylon(6,6)	Amide	Making long, strong cords for ropes and clothing
Terylene	Ester	Used to make fabrics which don't crease
Kevlar	Amide	Used to make strong plastics, e.g. for bulletproof vests

INTERMOLECULAR FORCES

The permanent dipoles in condensation polymers lead to permanent dipole-dipole forces between polymer chains (as well as induced dipole-dipole forces). Polyamides also have hydrogen bonding between polymer chains.



The strong intermolecular forces result in high melting points and boiling points because many of these forces must be broken to melt the polymer.

POLYMER DISPOSAL: KEY IDEAS

COMBUSTION

Waste polymers can be burned to produce energy, but this also releases CO_2 and possibly other pollutants.

TOXIC PRODUCTS

Combustion of polymers can produce toxic chemicals such as HCl. These should be removed and safely disposed of.

FEEDSTOCK RECYCLING

Polymers are broken down into monomers to produce new polymers, e.g. plastics. This improves sustainability.



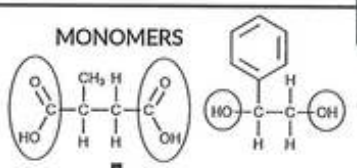
DEGRADABLE POLYMERS

Polymers which break down easily are being developed to reduce landfill. Polyesters and polyamides can be hydrolysed and can be biodegradable. **Biodegradable polymers** are broken down completely, by organisms such as bacteria, into carbon dioxide and water.

PREDICTING STRUCTURES

REPEAT UNIT FROM MONOMERS

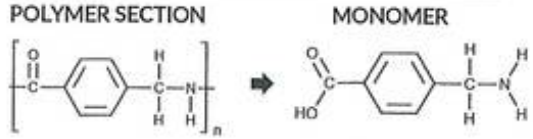
These monomers will form an ester link because they are a dicarboxylic acid and a diol.



EXAM TIP

Remember that a small molecule is lost (in this case water, H_2O) when the ester link is formed.

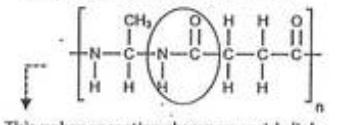
MONOMER(S) FROM A POLYMER SECTION



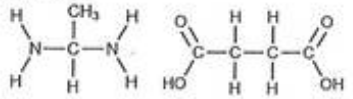
This polymer section shows the repeat unit, which is only one monomer long. The monomer must contain a carboxylic acid and an amine group.

THE TYPE OF POLYMERISATION

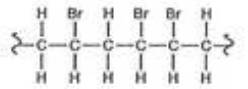
CONDENSATION POLYMER



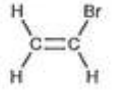
This polymer section shows an amide link, which means that the polymer was formed by a condensation reaction. It is made from two monomers:



ADDITION POLYMER



There is a continuous carbon chain, so this polymer must have been formed by addition polymerisation. The monomer is:



EXAM TIP

When identifying monomers, always think:

1. Condensation or addition?
2. One monomer or two?
3. If condensation, polyester or polyamide?

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