Exercise walk-through

Degradable polymers ▪ 35.3

eXercise

You must be able to

- explain why poly(alkene)s are hard to biodegrade
- explain why polyesters and polyamides are biodegradable
- describe how hydrolysis breaks the links

Method — Why some polymers degrade and others do not

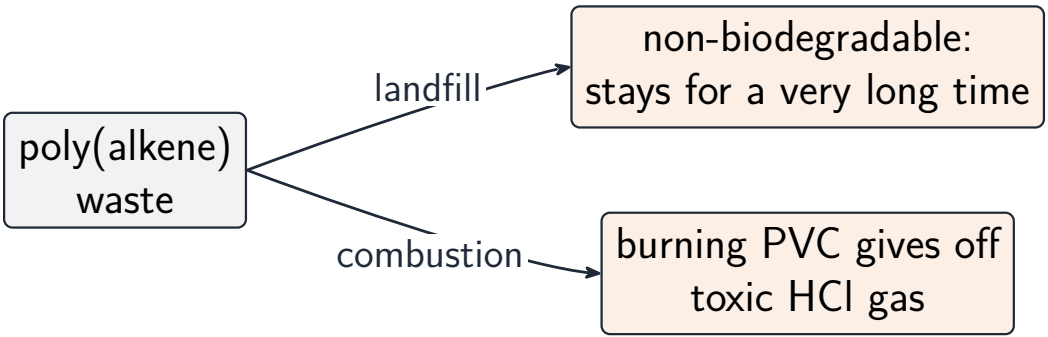
PET bottles are a polyester — a condensation polymer whose ester links can be hydrolysed, so it can be broken down and recycled

- **poly(alkene)s** (e.g. poly(ethene)): only strong, non-polar C–C and C–H bonds → chemically inert → hard to **biodegrade**, last a long time.
- **polyesters / polyamides:** have **ester** or **amide** links → these can be broken by acidic or alkaline **hydrolysis** → biodegradable.
- some polymers are made **photodegradable** (light breaks them down).

Method — Why some polymers degrade and others do not

A bale of crushed clear plastic drinks bottles collected for recycling

Method — Why some polymers degrade and others do not



Degradable polymers break down on disposal

Practice 2.1 ▪ 1 mark

State why poly(ethene) is hard to biodegrade.

Solution 2.1

Method: Why some polymers degrade and others do not

Worked steps

it has only strong, non-polar C–C and C–H bonds, which are chemically inert B1.

Practice 2.2 ▪ 1 mark

Name the reaction that breaks the links in a polyester.

Solution 2.2

Method: Why some polymers degrade and others do not

Worked steps

hydrolysis B1.

Exam-style 3.1 ▪ 1 mark

Poly(alkene)s are hard to biodegrade because they contain only:

A polar ester links

B amide links

C strong, non-polar C–C and C–H bonds

D C=C double bonds

Solution 3.1

Method: Why some polymers degrade and others do not

A polar ester links

B amide links

C strong, non-polar C–C and C–H bonds ✓

D C=C double bonds

Worked steps

C. Only strong, non-polar C–C and C–H bonds — chemically inert.

Exam-style 3.2 ▪ 1 mark

A polyester can be broken down by:

A addition

B hydrolysis of the ester links

C combustion only

D none of these

Solution 3.2

Method: Why some polymers degrade and others do not

A addition

B hydrolysis of the ester links ✓

C combustion only

D none of these

Worked steps

B. The ester links can be hydrolysed.

Exam-style 3.3 ▪ 3 marks

Explain why a polyamide is biodegradable but poly(propene) is not.

Solution 3.3

Method: Why some polymers degrade and others do not

Worked steps

a polyamide has amide links that can be broken by acidic or alkaline hydrolysis **M1**; poly(propene) has only inert C–C and C–H bonds with no hydrolysable links **M1**; so the polyamide is biodegradable while poly(propene) is not **A1**.

Exam-style 3.4 ▪ 1 mark

Suggest **one** environmental advantage of replacing a poly(alkene) packaging with a polyester.

Solution 3.4

Method: Why some polymers degrade and others do not

Worked steps

the polyester can be hydrolysed/biodegraded, so it does not persist in the environment as waste B1.