A-LEVEL CHEMISTRY • EXERCISE SHEET

35.3 Degradable polymers

Name: _____ Class: _____ Date: _____ **Total: 8 marks**

KEY WORDS biodegradable 可生物降解 • hydrolysis 水解 • poly(alkene) 聚烯烃 • degradable polymers 可降解聚合物 • polyester 聚酯

Objective

Build the skills to answer exam questions on **degradable polymers** 可降解聚合物 — why poly(alkene)s last so long, and why polyesters and polyamides can be broken down.

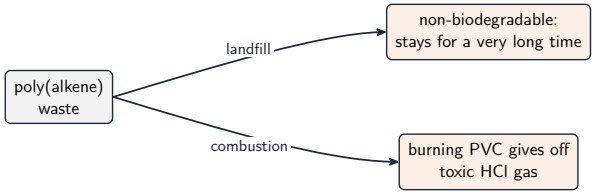
You must be able to:

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

1 Worked examples

■ 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



Degradable polymers break down on disposal

- **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).

2 Practice

2.1 State why poly(ethene) is hard to biodegrade. [1]

2.2 Name the reaction that breaks the links in a polyester. [1]

3 Exam-style questions

3.1 Poly(alkene)s are hard to biodegrade because they contain only: [1]

- **A** polar ester links
- **B** amide links
- **C** strong, non-polar C–C and C–H bonds
- **D** C=C double bonds

3.2 A polyester can be broken down by: [1]

- **A** addition
- **B** hydrolysis of the ester links
- **C** combustion only
- **D** none of these

3.3 Explain why a polyamide is biodegradable but poly(propene) is not. [3]

3.4 Suggest **one** environmental advantage of replacing a poly(alkene) packaging with a polyester. [1]

Solutions

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

2.2 hydrolysis.

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

3.2 B. The ester links can be hydrolysed.

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

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