# Exercise walk-through

## Predicting the type of polymerisation ▪ 35.2

eXercise

# You must be able to

- use the monomer's structure to predict the polymerisation type
- recognise addition (C=C, nothing lost) vs condensation (two groups, small molecule lost)

# Method — Which type?

| Clue | Type |
|---|---|
| monomer has a C=C, **nothing** else lost | **addition** |
| each monomer has **two** functional groups; a small molecule is lost; chain has ester/amide links | **condensation** |

# Method — Which type?

**addition polymerisation**

- monomer has a **C=C**
- the double bond opens and the monomers join
- **nothing else** is lost

e.g. ethene $\rightarrow$ poly(ethene)

**condensation polymerisation**

- each monomer has **two** functional groups
- a **small molecule** ($H_2O$ or HCl) is lost
- ester or amide links form

e.g. a polyester or polyamide

# Method — Which type?

polyester (ester links)

$$\cdots\text{–CO–O–R–O–CO–R}'\text{–CO–O–}\cdots$$

break each link; add back –OH and –H

$$\text{HO–R–OH} \quad + \quad \text{HOOC–R}'\text{–COOH}$$

diol dicarboxylic acid

*Find the monomers to predict the polymerisation type*

## Practice 2.1 ▪ 1 mark

State the type of polymerisation when ethene forms poly(ethene).

# Solution 2.1

Method: Which type?

**Worked steps**

addition polymerisation B1.

## Practice 2.2 ▪ 1 mark

State the type of polymerisation when a small molecule is lost at each link.

# Solution 2.2

Method: Which type?

**Worked steps**

condensation polymerisation B1.

# Exam-style 3.1 ▪ 1 mark

A monomer with **one** C=C and no other functional group will undergo:

**A** addition polymerisation

**B** condensation polymerisation

**C** neither

**D** hydrolysis

# Solution 3.1

Method: Which type?

- **A** addition polymerisation ✓
- **B** condensation polymerisation
- **C** neither
- **D** hydrolysis

**Worked steps**

**A**. One C=C and nothing lost → addition polymerisation.

# Exam-style 3.2 ▪ 1 mark

Which observation shows that a polymer formed by **condensation**?

**A** the monomer had a C=C

**B** no small molecule was lost

**C** water (or HCl) was released and the chain has ester/amide links

**D** the polymer is an alkene

# Solution 3.2

**A** the monomer had a C=C

**B** no small molecule was lost

**C** water (or HCl) was released and the chain has ester/amide links ✓

**D** the polymer is an alkene

**Worked steps**

**C**. Releasing a small molecule and having ester/amide links shows condensation.

## Exam-style 3.3 ▪ 3 marks

For each monomer, predict the type of polymerisation and justify it:

(a) $CH_2{=}CHCl$ (chloroethene)

(b) $HOCH_2CH_2OH + HOOC(CH_2)_4COOH$

(c) a single amino acid $H_2NCH_2COOH$

# Solution 3.3

Method: Which type?

**Worked steps**

(a) addition — it has a C=C and nothing is lost **B1**.
(b) condensation — two two-group monomers join, losing water → polyester **B1**.
(c) condensation — the amino acid has two groups (–$NH_2$ and –COOH), losing water → polyamide **B1**.

## Exam-style 3.4 ▪ 2 marks

Explain how you could tell, from the **product** alone, whether a polymer was made by addition or condensation.

# Solution 3.4

Method: Which type?

**Worked steps**

an addition polymer has a saturated C–C backbone with no links (the repeat unit is just the monomer) M1; a condensation polymer has ester or amide links along the chain, which can be hydrolysed back to two monomers A1.