4.3 Synthetic polymers

Name: _____ Class: _____ Date: _____ **Total: 21 marks**

Objective

Cover synthetic polymers (4.44–4.50C): addition polymerisation from monomers, drawing repeat units and recovering monomers, disposal problems, (C) condensation polymerisation to polyesters. Original IGCSE-level practice.

1 Key knowledge and worked examples

■ Monomer to repeat unit

monomer: ethene — repeat unit of poly(ethene)

$$H_2C = CH_2 \longrightarrow -[CH_2 - CH_2]-_n$$

open the C=C double bond, draw the two bonds out to the brackets

Open the C=C into two single bonds pointing out, wrap in brackets with n. Reverse it to recover the monomer: close the two outward bonds into a C=C. Required examples: poly(ethene), poly(propene), poly(chloroethene), PTFE.

■ Why polymers are a disposal problem

They are **inert and do not biodegrade** – they persist in landfill; burning can release **toxic gases**.

■ (C) Condensation to polyester

A **dicarboxylic acid + diol** link through ester bonds, releasing **water** at each link – a polyester chain. Some polyesters (biopolyesters) biodegrade.

2 Practice

2.1 Define monomer and addition polymer. [2]

2.2 Draw or describe the repeat unit of poly(propene), given propene $CH_3–CH=CH_2$. [2]

2.3 Name the monomer of poly(chloroethene). [1]

2.4 Give two problems in disposing of addition polymers. [2]

2.5 (C) What two monomers react in condensation polymerisation, and what small molecule forms? [3]

3 Exam-style questions

3.1 Chloroethene polymerises. Draw the monomer's displayed formula and the repeat unit of poly(chloroethene), and state how the two drawings relate. [4]

3.2 Explain why most addition polymers do not rot in landfill, and one problem with burning them. [3]

3.3 (C) Ethanedioic acid (HOOC–COOH) reacts with ethanediol (HO–CH_2–CH_2–OH). Describe the polymer formed and write what is released at each link. [4]

Solutions

2.1 Monomer – a small molecule that joins to many others; addition polymer – a long chain of monomers joined by addition, opening C=C.

2.2 –[CH(CH_3)–CH_2]–$_n$: brackets around the two carbons with the CH_3 side group, single bonds out, subscript n.

2.3 Chloroethene.

2.4 Inert – do not biodegrade, so they persist; burning releases toxic gases.

2.5 (C) A dicarboxylic acid and a diol; water.

3.1 Monomer: H_2C=CHCl displayed with the double bond. Repeat unit: –[CH_2–CHCl]–$_n$ – brackets, single bonds out, n. Relation: the double bond opens into the two outward single bonds of the repeat unit.

3.2 Their C–C bonded chains are inert – no enzymes break them, so microbes cannot rot them; burning can release toxic gases such as hydrogen chloride from PVC.

3.3 (C) A polyester – ester links (–COO–) join the two monomers alternately into a long chain; each link releases one molecule of water: the acid's –OH + the alcohol's –H.