

Polyester: Johnstone's triangle

Learning objectives

- 1 Suggest ways to mitigate the environmental impact of the polyester PET.
- 2 Describe how a polyester is formed.
- 3 Interpret representations of monomer molecules.

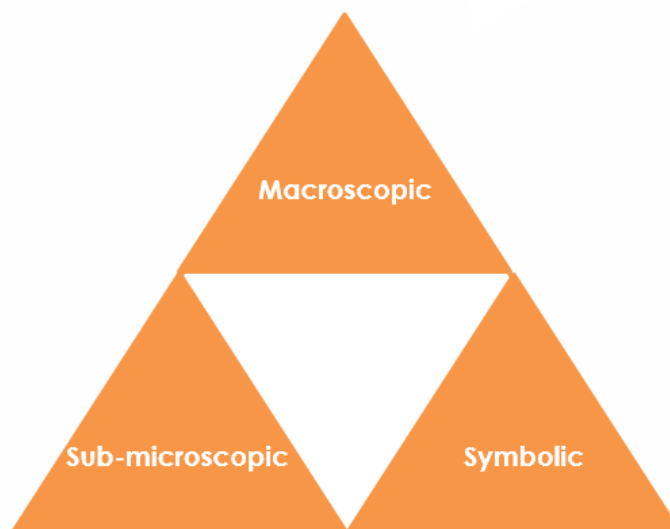
Introduction

Polyesters are formed by the reaction of diol and dicarboxylic acid monomers. During the process, water molecules are eliminated and therefore the process is called condensation polymerisation.

Johnstone's triangle

In chemistry, we make sense of the things that we can see by representing what we can't see using formulas, equations, diagrams and models.

Johnstone's triangle is a way of thinking about these different concepts as different corners of a triangle:



- Macroscopic – what we can see. Think about the properties we can observe, measure and record.
- Sub-microscopic – smaller than we can see. Think about the particle or atomic level.
- Symbolic – representations. Think about how we represent chemical ideas using symbols and diagrams.

Being able to connect and move between these three different levels is important for scientific understanding.

Macroscopic – what we can see

The polyester PET can be spun into fibres. Name **one** everyday item that is made from PET.

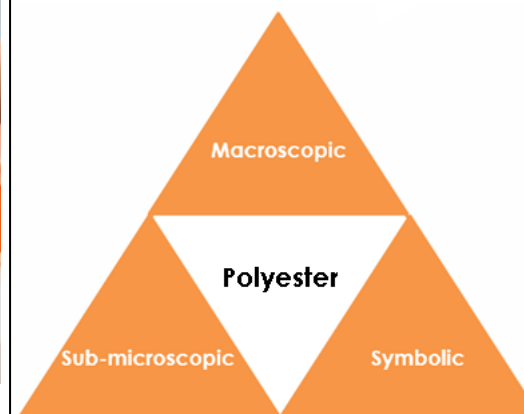
PET can also be used to make bottles. Give **one** environmental disadvantage of PET.

Give **two** ways in which PET waste can be reduced.

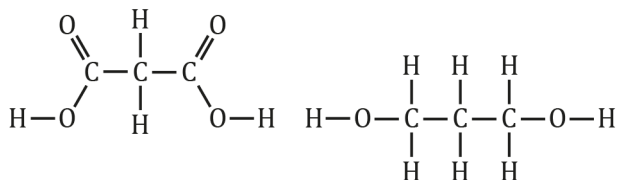
1. _____
2. _____



Image ©: Shutterstock/lovelyday12

**Sub-microscopic – smaller than we can see**

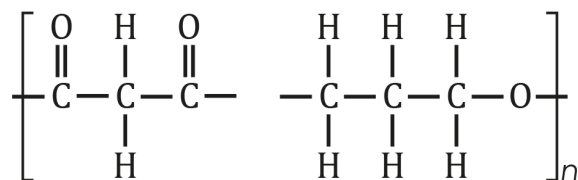
Circle the atoms that are eliminated (lost) when the two monomers react.



Give the formula of the molecule that is eliminated. _____

What special feature of the monomers allows a chain to form?

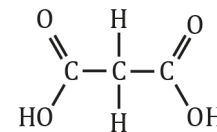
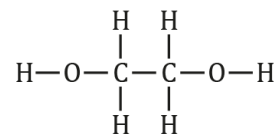
Complete the displayed formula for the repeating unit of the polymer.

**Symbolic – representations**

A polyester is made from two different monomers.

1. A diol which has two alcohol functional groups ($-\text{OH}$)
2. A dicarboxylic acid which has two carboxylic acid functional groups ($-\text{CO}_2$)

Circle the two functional groups in each displayed formula



The monomers are sometime represented using a rectangle.

The rectangle represents the carbon chain. $\text{HO}-\square-\text{OH}$

Draw a displayed formula to show the carbon chain in the diol monomer.