Polymers – GCSE Chemistry

CONTENTS:

1. Introduction

- Polymers are all around us, found in plastic bags, clothes, non-stick pans, and even in our DNA.
- Many small molecules called **monomers** join together to form a large molecule known as a **polymer**.
- In this blog, we'll explore how polymers are formed, their main types, common uses, and how recycling helps reduce pollution from non-biodegradable plastics.

2. What is a Polymer?

- A polymer is a large molecule made up of many repeating smaller units called monomers.
- These monomers link together in long chains through strong covalent bonds.
- Polymers can be:

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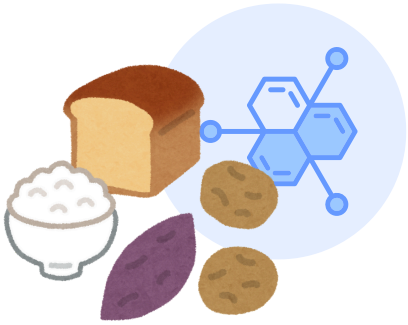
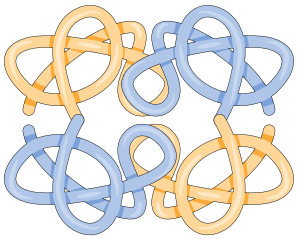
- **Natural:**

DNA



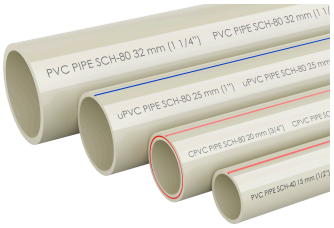
Starch



Protein

- **Synthetic:**

Polyethylene



PVC

Teflon

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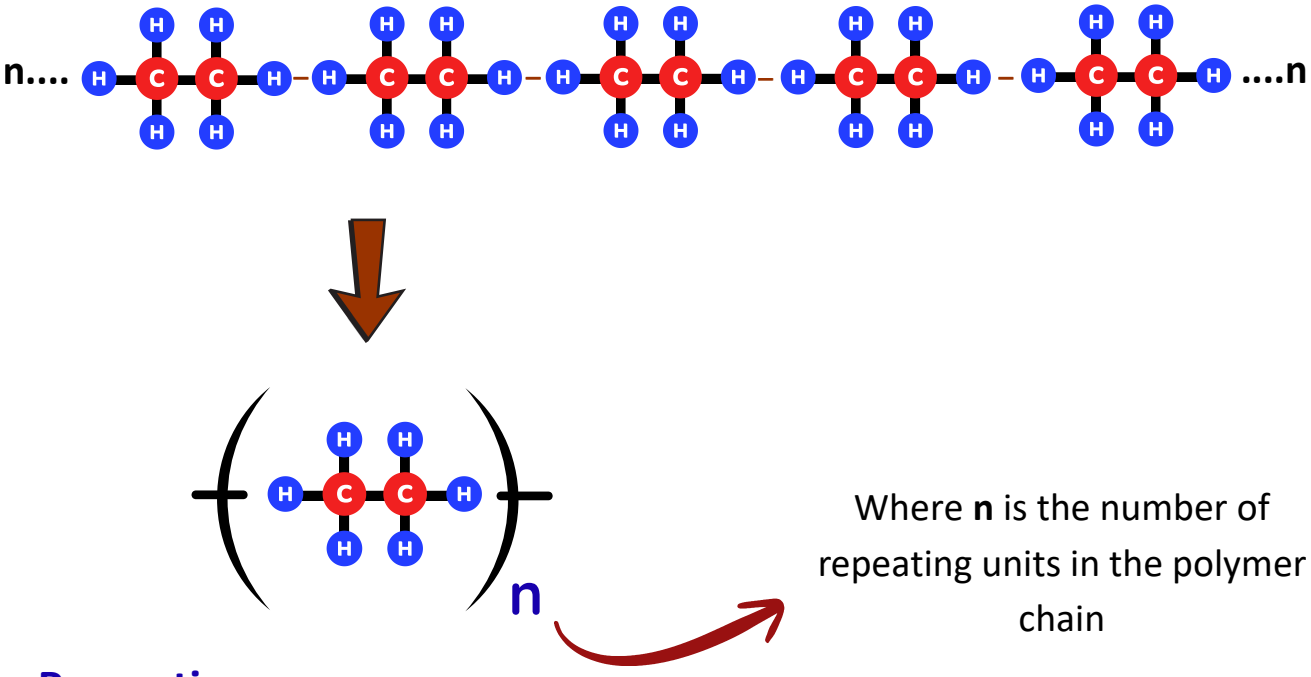
3. What is the structure of polymers and how is it represented?

- Polymers are made of long chains of repeating units called monomers, linked by strong covalent bonds.
- These units are identical in structure.
- Instead of writing the units again and again, they are shown in brackets with lines extending from each side to indicate the continuous chain.
- **Example:** Poly(ethene) has the repeating unit:



Properties:

- The properties of polymers depend on the chain length and the strength of intermolecular forces.
- Longer chains and stronger forces make polymers tougher, harder, and more durable.
- Shorter chains make polymers softer and more flexible.

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4. Classification of polymers

Polymers can be classified based on how they are formed and where they come from:

- **Addition Polymers:**
  - Addition polymers are formed when many alkene monomers join together.
  - So, the double bonds in the monomers break, and the monomers link in a long chain.
  - In this reaction, no other molecules are produced.
  - **Example:** Poly(ethene) is made from ethene ($\mathbf{C_2H_4}$).

$$\{CH_2{-}CH_2\}_n$$

- **Condensation Polymers:**
  - Condensation polymers are formed when two different monomers, each with two reactive ends, join together.
  - Each time the monomers link, a small molecule such as water ($\mathbf{H_2O}$) is released.
  - **Example:** Polyester is made from a diol (**–OH** at both ends) and a dicarboxylic acid (**–COOH** at both ends). The polymerisation reaction is:

$$n HO{-}CH_2{-}CH_2{-}OH + n HOOC{-}C_6H_4{-}COOH \rightarrow \{O{-}CH_2{-}CH_2{-}O{-}CO{-}C_6H_4{-}CO\}_n + n H_2O$$

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5. What are the different types of polymers?

- Polymers come in various types based on the monomers they are formed from and the properties they show.
- Each type has its own distinct features and uses that make it suitable for different purposes in daily life.
- Here are the main examples:

Polymer	Monomer	Common Uses
Poly(ethene)	Ethene	Plastic bags, wire coatings
Poly(propene)	Propene	Buckets, ropes, containers
PVC	Chloroethene	Window frames, pipes
Polyester	Diol + Dicarboxylic acid	Fabrics, plastic bottles
DNA	Nucleotides	Carries genetic information
Starch	Sugars (glucose units)	Energy storage in plants
Proteins	Amino acids	Builds and repairs tissues

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6. Uses of Polymer

- Polymers play a major role in our daily lives and in various industries due to their wide range of useful properties such as flexibility, strength, and durability.
- Below are some important examples of how different polymers are used around us:

  - **Poly(propene)** is strong and flexible, ideal for containers, ropes, buckets, and packaging.


  - **PVC (Poly(chloroethene))** is tough and durable, used for window frames, pipes, flooring, and cable insulation.


  - **PTFE (Teflon)** is non-stick and heat-resistant, used in cookware, waterproof clothing, and machinery coatings.


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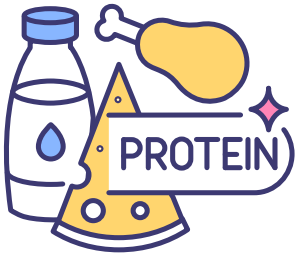
- **Polyesters** are light and strong, used in fabrics, bottles, and packaging films.

- **Natural polymers** like starch, proteins, and DNA are used in food storage, body repair, and genetic information storage.



7. FAQs

1. What is a polymer?

A polymer is a large molecule made of many small repeating units called monomers joined together in long chains.

2. What are monomers?

Monomers are small molecules, often containing double bonds, that can join together to form polymers.

3. What is polymerisation?

Polymerisation is the chemical reaction where many monomers link together to form a polymer.

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4. What are the two main types of polymerisation?
Addition polymerisation and condensation polymerisation.

5. What happens during addition polymerisation?
Alkene monomers with C=C double bonds join to form a polymer, and no other product is formed.

6. What are condensation polymers?
They form when two different monomers react together, releasing a small molecule like water each time a bond forms.

7. What are the properties of polymers and why do they differ?
They differ because of the forces between chains — weak forces make flexible plastics, while strong forces make rigid ones.

8. What is the relationship between polymers and their monomers?
Polymers are made when many monomers join together; the repeating unit in the polymer has the same atoms as the monomer.

9. Why are many polymers non-biodegradable?
They contain strong covalent bonds and are chemically unreactive, so microbes cannot break them down easily.

10. What are some common uses of polymers?
Polymers are used in bags, bottles, pipes, ropes, clothing, coatings, and non-stick cookware.