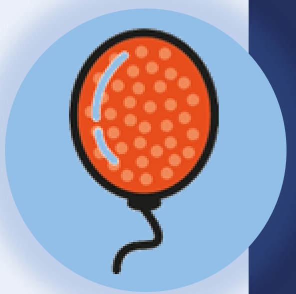
Polymers

Answer the questions below.

1. Define a hydrocarbon.
   A compound that contains carbon and hydrogen atoms only.
2. Name the type of bonding found in hydrocarbons.
   Covalent
3. State the general formula of the alkanes.
   C_nH_{2n+2}
4. Describe how fractional distillation is used to separate crude oil.
   Crude oil is heated and hydrocarbons are evaporated. Then condense at different temperatures depending on their boiling points.
5. Explain the difference between reusing and recycling.
   Reusing involves using the same product again, but recycling involves a process of making the materials from the product into something else.



Do Now

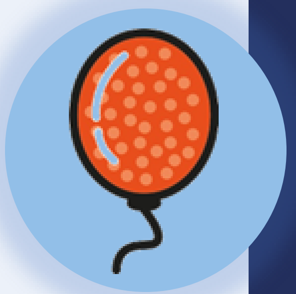
Polymers

Do Now:

1. Define a hydrocarbon.
2. Name the type of bonding found in hydrocarbons.
3. State the general formula of the alkanes.
4. Describe how fractional distillation is used to separate crude oil.
5. Explain the difference between reusing and recycling.

Drill:

1. Describe the structure of diamond.
2. Describe the structure of graphite.
3. Explain why graphite conducts electricity but diamond does not.



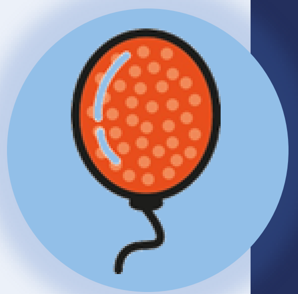
Do Now

Polymers

Read Now:

The word polymer comes from Greek and means ‘many parts’. A polymer isa very long molecule made up of many units. Polymers can be naturally occurring or synthetic (man-made) and we use many examples in our daily lives. One of the most important naturally occurring polymers is DNA, which is found in the nuclei of all our cells. Other naturally occurring polymers are proteins and starch. These naturally occurring polymers make up an important part of our diet, but they must be digested into small soluble products before being absorbed into our blood stream. Products made from synthetic polymers are all around us, including plastic products, silicone products, nylon and polyester clothing.

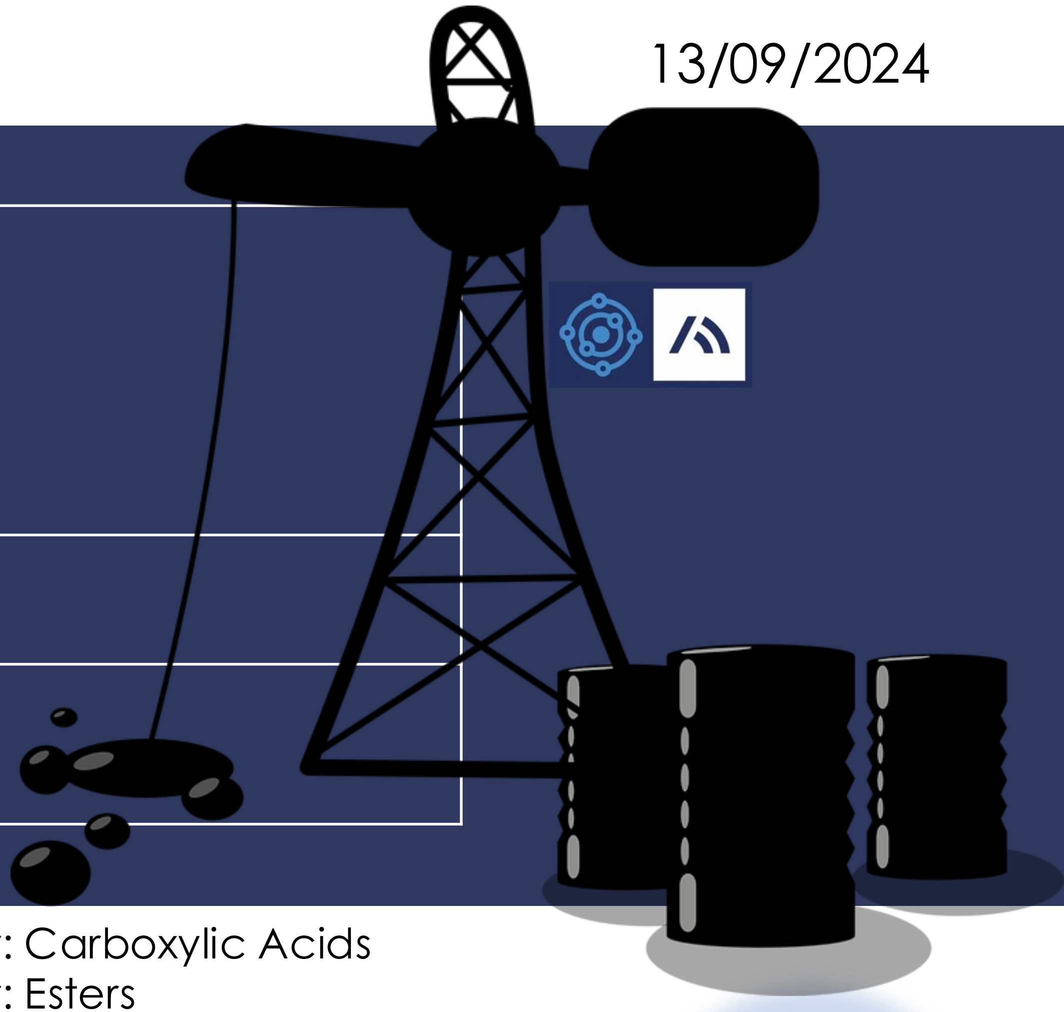
1. Define a polymer.
2. Define synthetic.
3. Give three examples of naturally occurring polymers.
4. Explain why naturally occurring polymers found in foods must be digested.
5. Give an example of a synthetic polymer.



Do Now

Ark Curriculum+

13/09/2024



Polymers

C5.1.12

Science Mastery

Lesson Objectives

Following this lesson, students will be able to:

- Define a polymer
- Chemistry only: Explain the difference between thermosoftening and thermosetting polymers
- Chemistry only: Explain how the properties of a polymer make it suited to a function

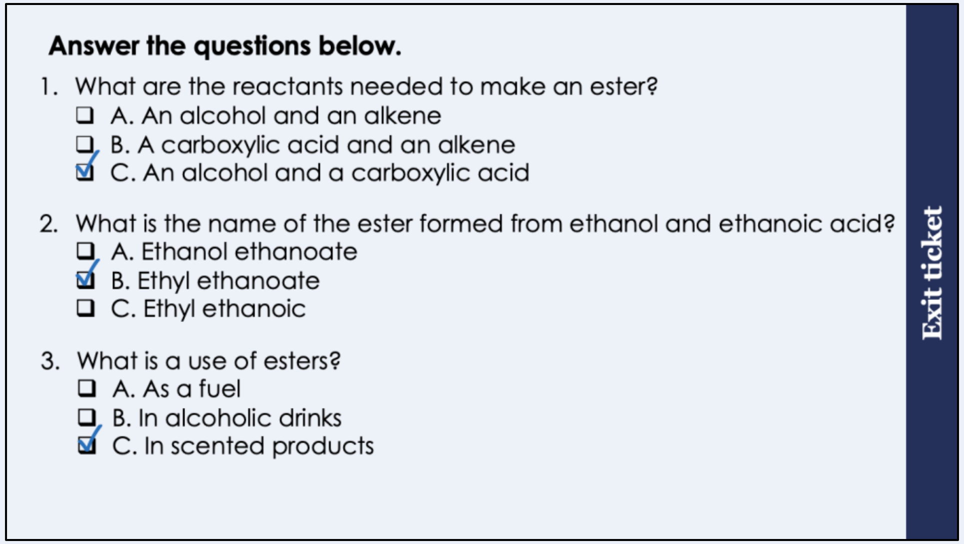
Key Words:

polymer	monomer	thermosoftening
thermosetting	crosslinks	

This is the fix-it portion of the lesson

The **fix-it** is an opportunity to respond to gaps in knowledge, especially those identified by the **pre-unit quiz**.

- The teacher should customise this slide as needed, to facilitate
  - **reteach**, **explanation, demonstration** or **modelling** of ideas and concepts that students have not yet grasped or have misunderstood.
  - **practise** answering specific questions or of key skills.
  - **redrafting** or **improving** previous work.



Answer the questions below.

1. What are the reactants needed to make an ester?
   - ❑ A. An alcohol and an alkene
   - ❑ B. A carboxylic acid and an alkene
   - ☑ C. An alcohol and a carboxylic acid
2. What is the name of the ester formed from ethanol and ethanoic acid?
   - ❑ A. Ethanol ethanoate
   - ☑ B. Ethyl ethanoate
   - ❑ C. Ethyl ethanoic
3. What is a use of esters?
   - ❑ A. As a fuel
   - ❑ B. In alcoholic drinks
   - ☑ C. In scented products

Exit ticket

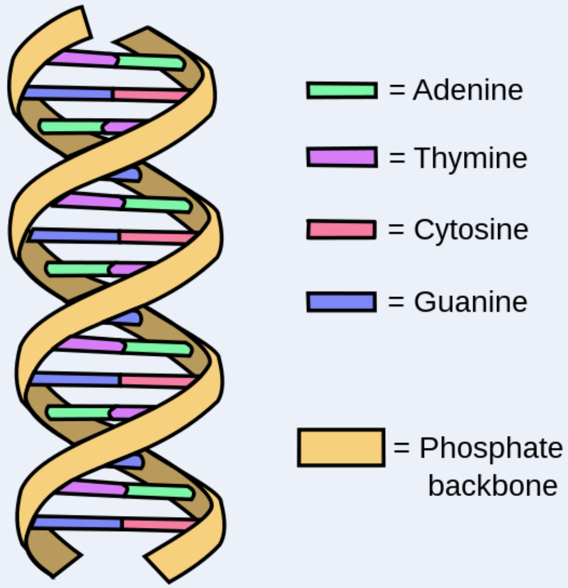
Fix-it

Word: Polymer

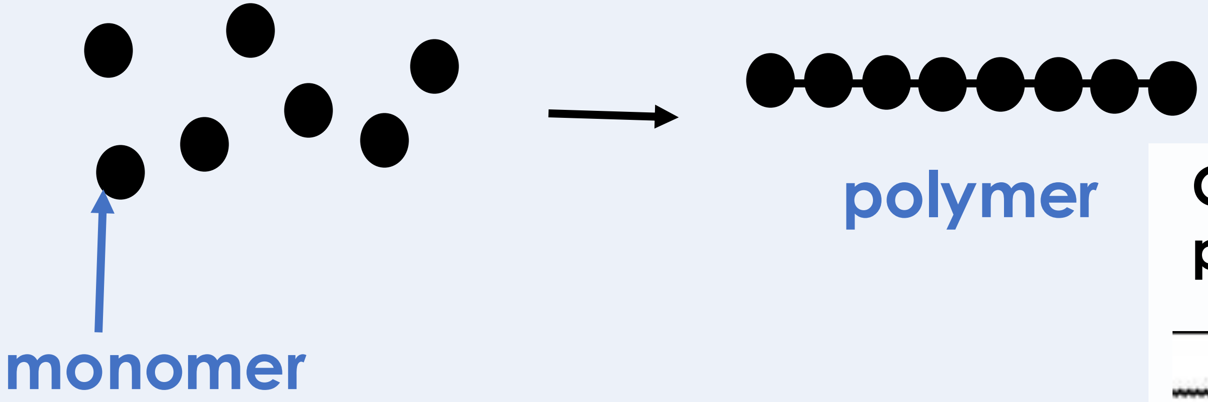
Comes from:

	Poly-	*-mer*
	'many'	*'units'*

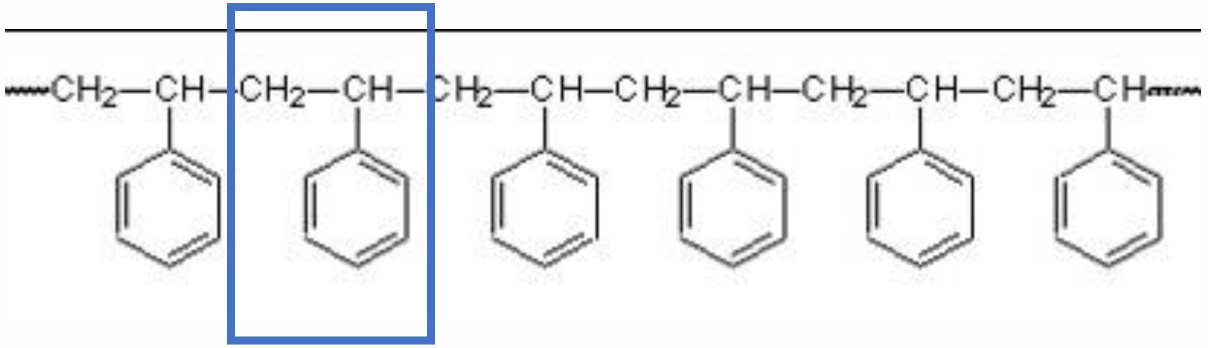
Definition: A **polymer** is a very long molecule made up of many units.



DNA



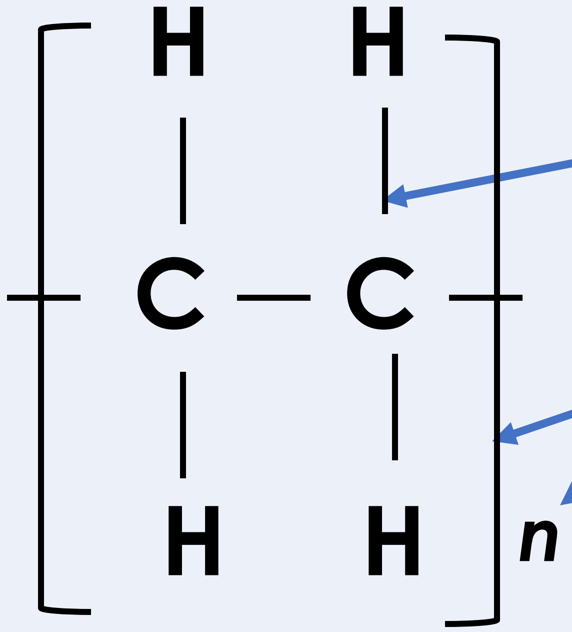
Can you spot the repeating unit in this polymer?



Introduction

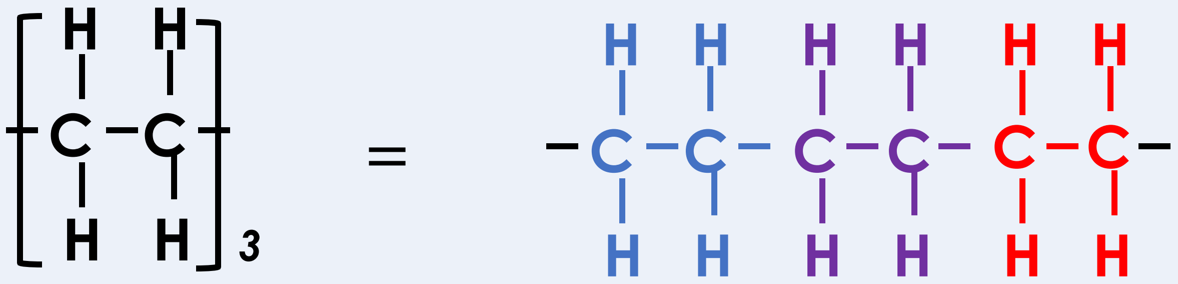
Representing polymers with a formula

We can represent a polymer with a displayed formula.



a single line represents a single strong covalent bond

The bracket and *n* mean that the part in the brackets is repeated *n* number of times



Why don't we just draw out the full formula every time?

Many polymers are very very very long molecules which would take too long to draw

Introduction

Properties of polymers

The properties of a polymer depend on **two** things:

- the monomers it is made from
- the conditions that the polymer is made in

This means that different polymers have different uses.

LDPE: Low density poly(ethene)

- unreactive
- flexible
- can be made into a film

HDPE: High density poly(ethene)

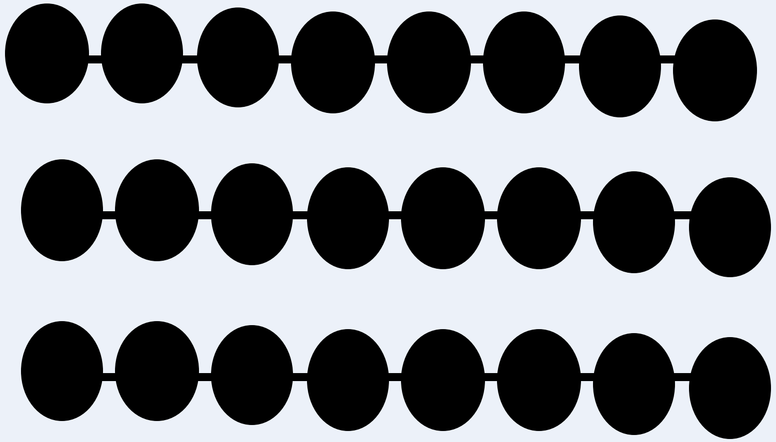
strong
flexible
resistant to chemicals

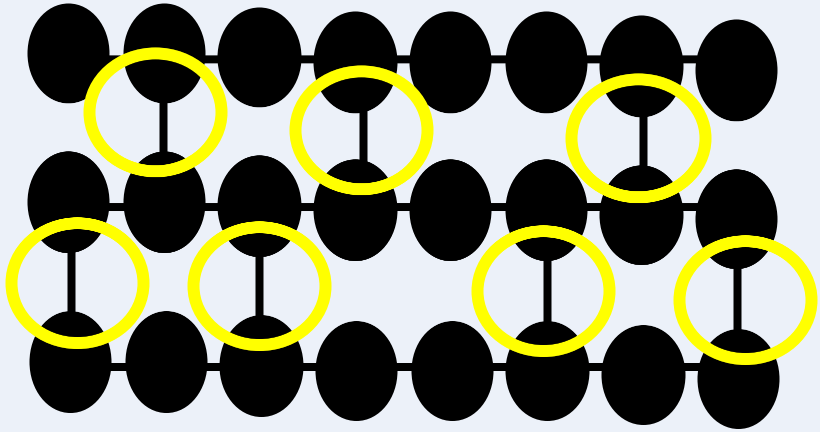
Thermosoftening and Thermosetting plastics

We can put plastics (polymers) into 2 categories depending on how they respond to heating:

Thermosoftening polymers melt when heated.

Thermosetting polymers do not melt when heated.

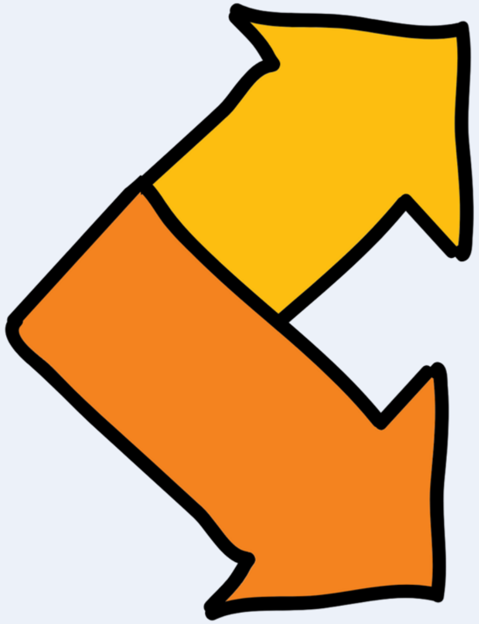




What is the difference in structure?

Can you explain the difference between these two terms?

Covalent bonds



Intermolecular forces

Where is each found?

Are they weak or strong?

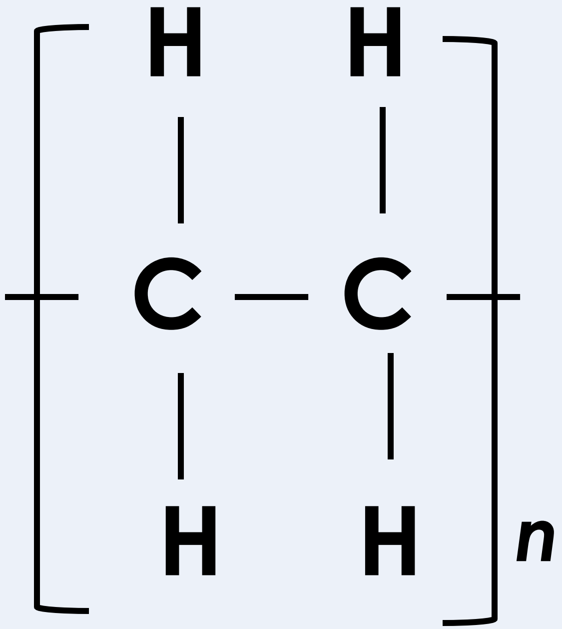
How much energy is needed to overcome each?

Where are they found in thermosoftening polymers?

Where are they found in thermosetting polymers?

Talk Task

What does the displayed formula below represent?



1. What does this show the formula for?
   A repeating unit of a polymer
2. How many repeating units are in the polymer molecule?
   36
3. How many carbon atoms are in the polymer molecule?
   72
4. How many hydrogen atoms are in the polymer molecule?
   144
5. What is represented by each straight line?
   A covalent bond

Check for understanding

Drill

1. What is a polymer?
2. What kind of bonding occurs between monomers in a polymer?
3. What does the *n* represent in the general formula for a polymer?
4. Name the forces that act between the polymer molecules.
5. State whether these forces are weak or strong
6. Describe the state of polymers at room temperature
7. What determines the properties of polymers?

Chemistry only

8. What happens to thermosetting polymers when heated?
9. What happens to thermosoftening polymers when heated?
10. Explain why these polymers behave differently when heated.

Check for understanding

Drill answers

1. Long chain molecules made of many units
2. Covalent bonding
3. *n* represents the number of repeating units of the polymer
4. Intermolecular forces act between the polymer molecules
5. These forces are relatively strong
6. Polymers are solids at room temperature
7. The properties of polymers are determined by the monomers that make them up and the conditions that they are made in.
8. Thermosetting polymers do not melt when heated.
9. Thermosoftening polymers melt when heated.
10. Thermosetting polymers contain crosslinks, which are covalent bonds between molecules. These require much more energy to overcome, so they have much higher melting points.

Check for understanding

I: Explain: *to use scientific understanding to make something clear or state the reason for something happening*

Example question:

Explain how the properties of a thermosetting polymer makes it useful for a pasta drainer.

Model answer:

- Thermosetting polymers contain **crosslinks**, which are covalent bonds between molecules
- These require a lot of energy to overcome, so thermosetting polymers have **high melting points** and **do not melt when heated**
- <u>This means</u> they will not melt when hot food is placed in them

To ‘explain’ your answer should:

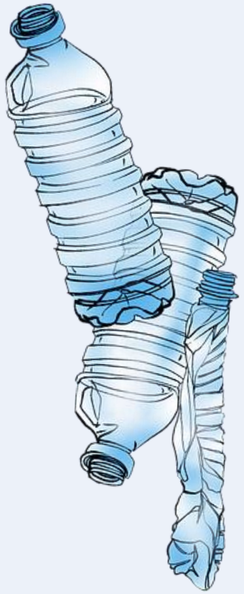
- Begin with a **scientific statement**.
- Use ‘this means that’, ‘because’ or ‘so’ **to link your statement to the question.**

Writing like a scientist

We: Explain: *to use scientific understanding to make something clear or state the reason for something happening*

Example question:

Many recyclable plastic bottles are made from thermosoftening polymers.
Explain how the properties of a thermosoftening polymer make them suitable for recycling.



Model answer:

- Thermosoftening polymers contain **weak** intermolecular forces between molecules
- These do not require a lot of energy to overcome, so thermosoftening polymers have **low melting points** and **melt when heated**
- This means they can be melted and reshaped to be recycled into other products

To 'explain' your answer should:

- Begin with a **scientific statement**.
- Use 'this means that', 'because' or 'so' **to link your statement to the question.**

You: Explain: *to use scientific understanding to make something clear or state the reason for something happening*

Example question:

Firefighters' helmets are made from thermosetting polymers.
Explain how the properties of a thermosetting polymer make them suitable for this purpose.

Model answer:

- Thermosetting polymers contain **crosslinks**, which are covalent bonds between molecules
- These require a lot of energy to overcome, so thermosetting polymers have **high melting points** and **do not melt when heated**
- <u>This means</u> they will not melt when exposed to high temperatures

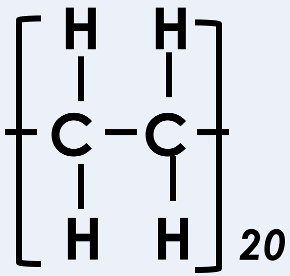
To 'explain' your answer should:

- Begin with a **scientific statement**.
- Use 'this means that', 'because' or 'so' **to link your statement to the question.**

Writing like a scientist

Answer the questions below.

1. How many carbon atoms will the polymer represented by this diagram have?
   - [ ] A. 20
   - [x] B. 40
   - [ ] C. 80



2. What is between polymer molecules?
   - [ ] A. Covalent bonds
   - [x] B. Intermolecular forces
   - [ ] C. Electrostatic attraction

3. What is the difference between thermosetting and thermosoftening polymers?
   - [x] A. Thermosoftening polymers melt when heated
   - [ ] B. Thermosetting polymers melt when heated
   - [ ] C. Thermosoftening polymers contain crosslinks

Exit ticket

Lesson C5.1.12	
What was good about this lesson?	What can we do to improve this lesson?

Send us your feedback by clicking this link
or by emailing sciencemastery@arkonline.org
Thank you!

Feedback