

Chem!stry

Name: ()

Class:

Date: / /

Polymers – Macroconcept: Models

Polymers (derived from the Greek *poly* meaning “many” and *meros* meaning “part”) are very large molecules of very high relative molecular mass (*macromolecules*) which are formed when 100s or 1000s of smaller molecules (*monomers*) bond together (*polymerise*).

Polymers can be either synthetic (for example *poly(ethene)* which is manufactured from *ethene*) or naturally occurring (for example *proteins* which are made from *amino acids*).

Polymers can be classified according to the diagram shown below:

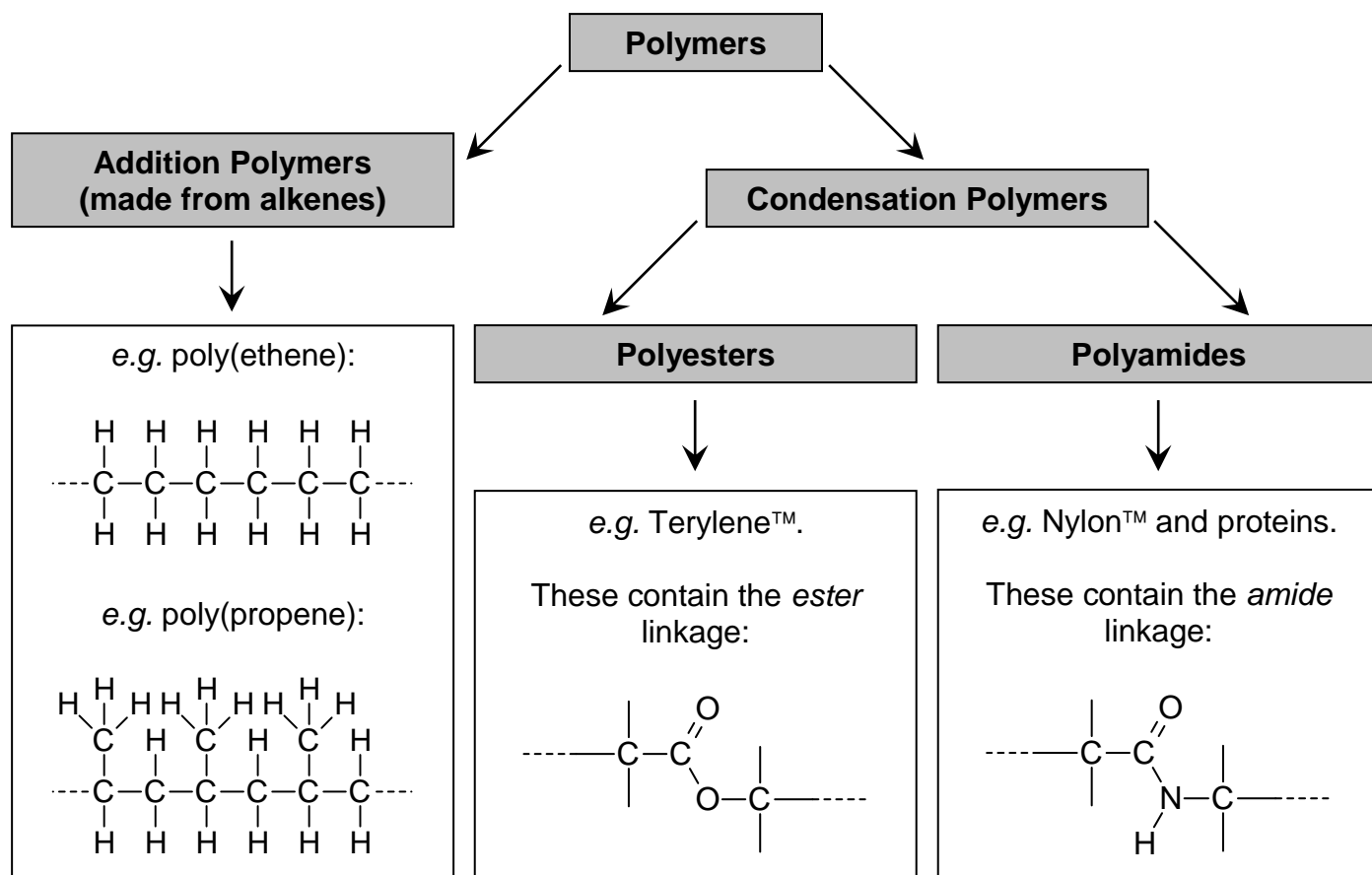


Figure 1. The classification of polymers.

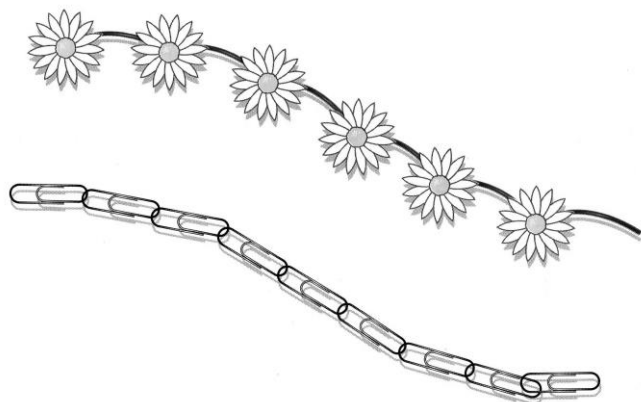
Question 1.

What do you understand by the term *monomer*?

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Question 2.

The diagram below shows some abstract examples of polymers. State how each of the structures shown in the diagram represents a polymer. What is the monomer in each example? What are the limitations of these models? Where else are models used to help scientists understand abstract and / or complex ideas?



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Figure 2. Abstract models of polymers.

Addition Polymers

When many thousands of *alkene* molecules are heated to a high temperature and pressure, they join together to form a single giant covalent structure as outlined in the diagram below:

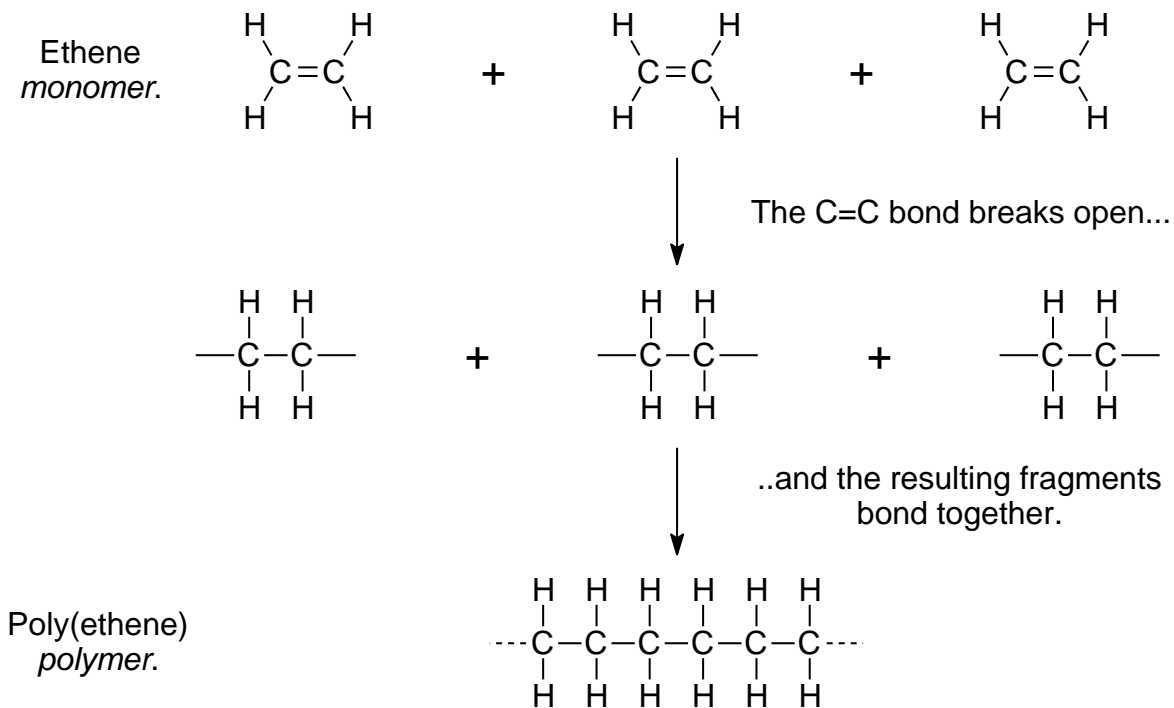
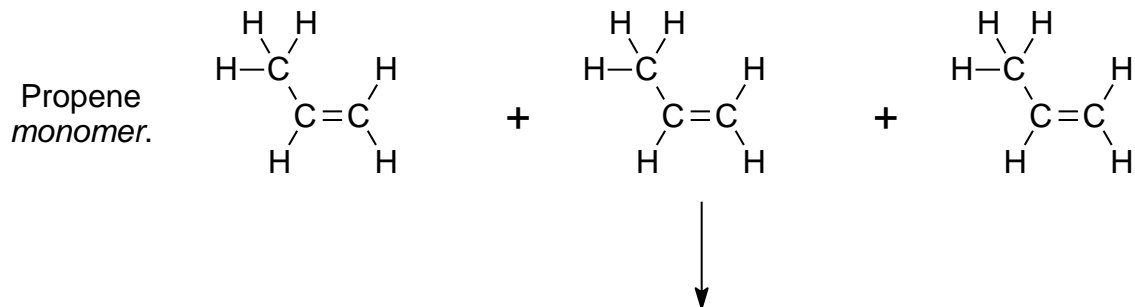


Figure 3. The polymerisation of *ethene* to form *poly(ethene)*.

Question 3.

Working in groups, construct models of *propene* using the molecular modelling kits that have been provided. Now join the individual propene molecules together to form a model of the addition polymer *poly(propene)*. Copy the structure of the polymer into the space provided below:

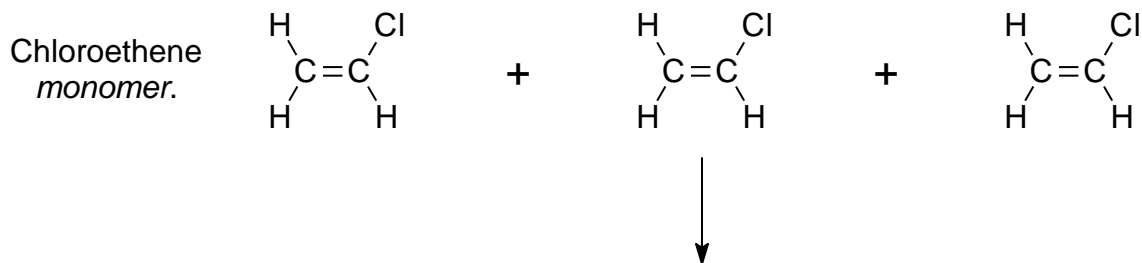


Part of the structure of poly(propene):

Equation for preparation of poly(propene): $n\text{C}_3\text{H}_6 \rightarrow \dots\dots\dots$

Question 4.

Working in groups, construct models of *chloroethene* using the molecular modelling kits that have been provided. Now join the individual chloroethene molecules together to form a model of the addition polymer *poly(chloroethene)*. Copy the structure of the polymer into the space provided below:



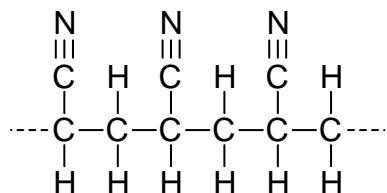
Part of the structure of poly(chloroethene):

Equation for the preparation of poly(chloroethene): $n\text{C}_2\text{H}_3\text{Cl} \rightarrow \dots\dots\dots$

Question 5.

Give the full structural formula of the monomer that was used to make each of the following polymers:

a)



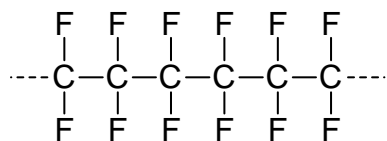
Poly(propenenitrile)

Made from...

Structure of monomer:

Name of monomer:

b)



Poly(tetrafluoroethene)

Made from...

Structure of monomer:

Name of monomer:

Condensation Polymers

Condensation polymers are made from molecules that contain two carboxylic acid functional groups ($-\text{COOH}$) and either molecules that contain two alcohol functional groups ($-\text{OH}$) or molecules that contain two amine functional groups ($-\text{NH}_2$).

This type of polymer is known as a condensation polymer because as a pair of monomers bond together, a molecule of water is formed.

In the example given below, a molecule of water is removed from between each of the monomers resulting in the formation of an ester, thus forming a *polyester*.

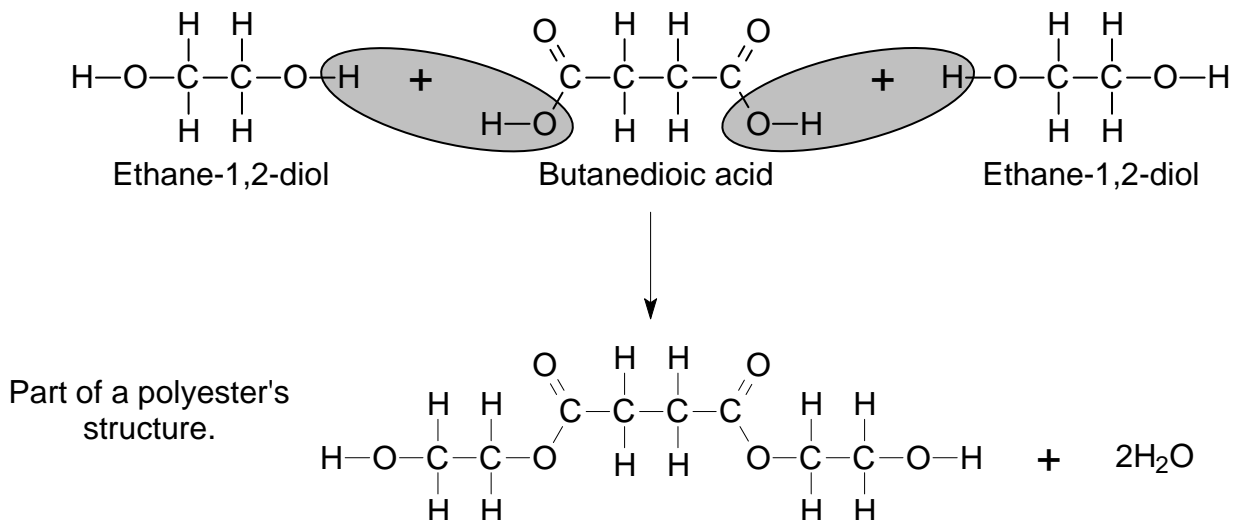
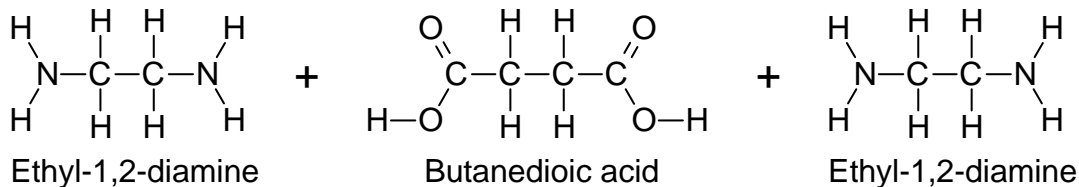


Figure 4. The formation of a polyester is an example of a condensation reaction.

Question 6.

Construct molecular models of butanedioic acid and ethyl-1,2-diamine. Join the monomers together by eliminating water from between the carboxylic acid and amine functional groups to form the polyamide *Nylon*TM. **Note:** NylonTM takes its name from the names of the two cities, **New York** and **London**. Copy the structure of NylonTM into the space provided below:

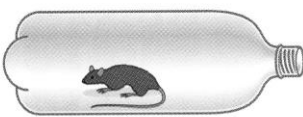


↓ Loss of water from between the monomers.

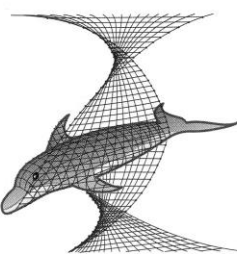
Part of the structure of NylonTM:

Environmental Considerations

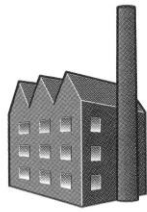
With reference to the terms *biodegradable* and *non-biodegradable* and with reference to the following diagrams, state the long term effects of polymers on the Earth's environment and comment on what can be done to tackle the problem:




Plastic bottles can trap animals.



Plastic nets can trap sea animals.



We can burn plastics but some give off poisonous gases when they burn.



PE **HDPE** **PET**

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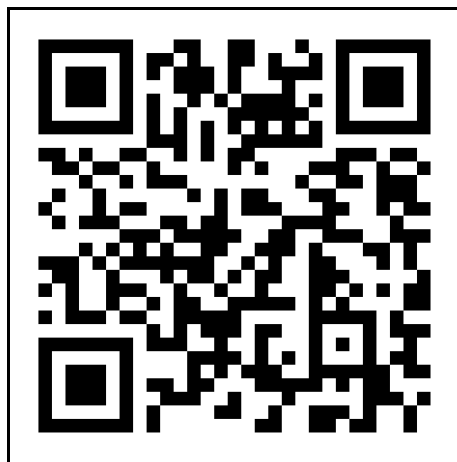
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• *New Edition Chemistry* (Second Edition), Bryan Milner and Jean Martin, Cambridge University Press, 2001, ISBN: 3125806038.

- Scan the QR code given below for the answers to this assignment.



http://www.chemist.sg/polymers/polymer_notes_ans.pdf