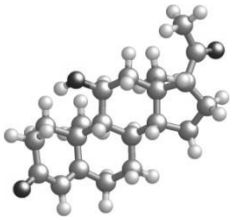

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Date: …… **/** …… **/** ……

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:

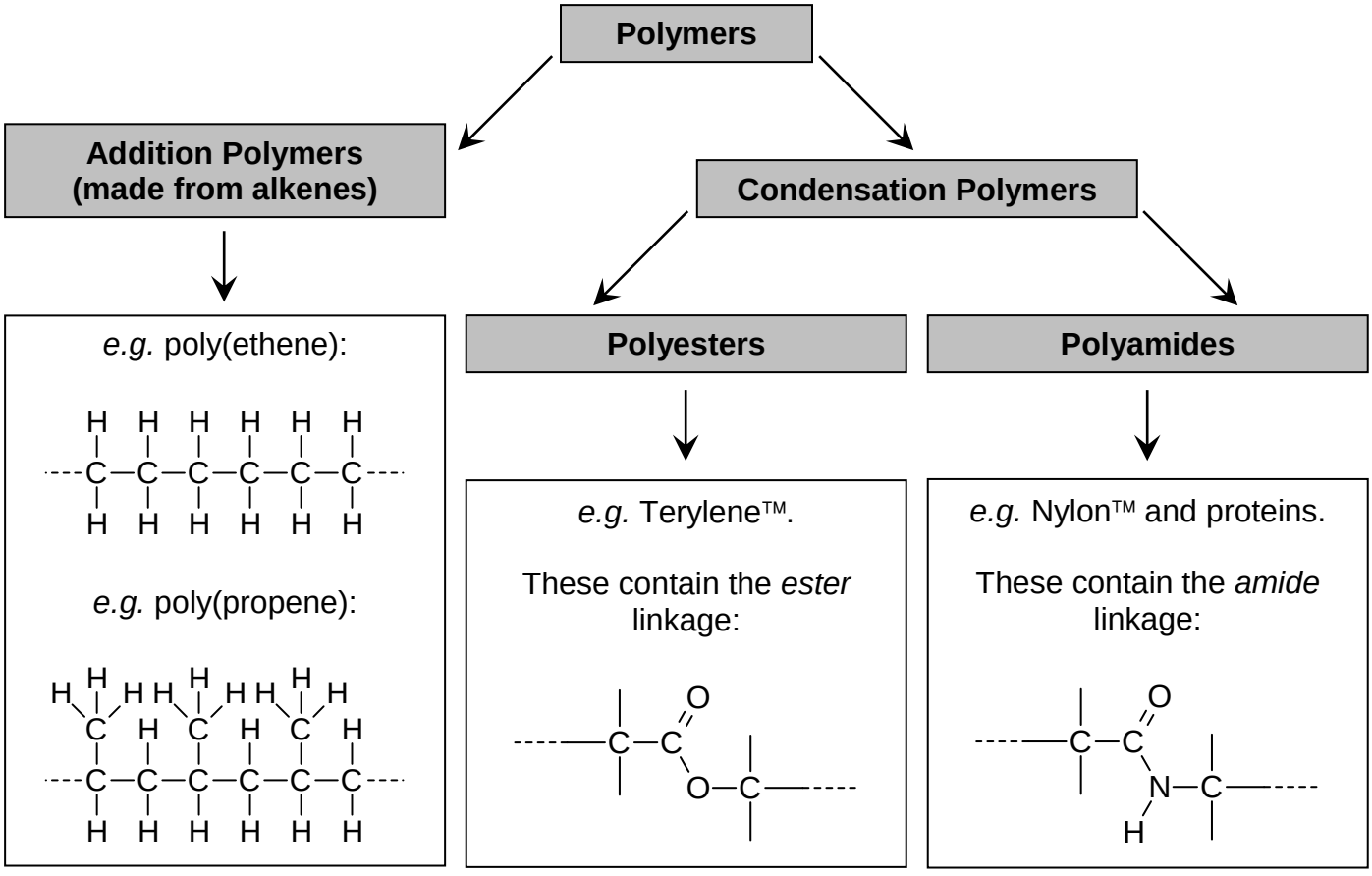

Figure 1. The classification of polymers.

Question 1.

What do you understand by the term *monomer*?

……

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?

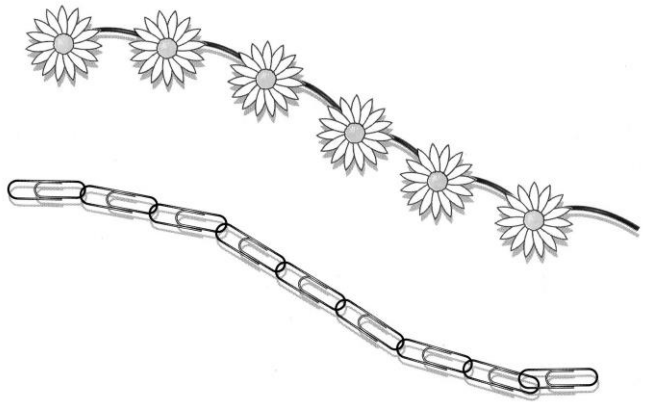

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Figure 2. Abstract models of polymers.

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:

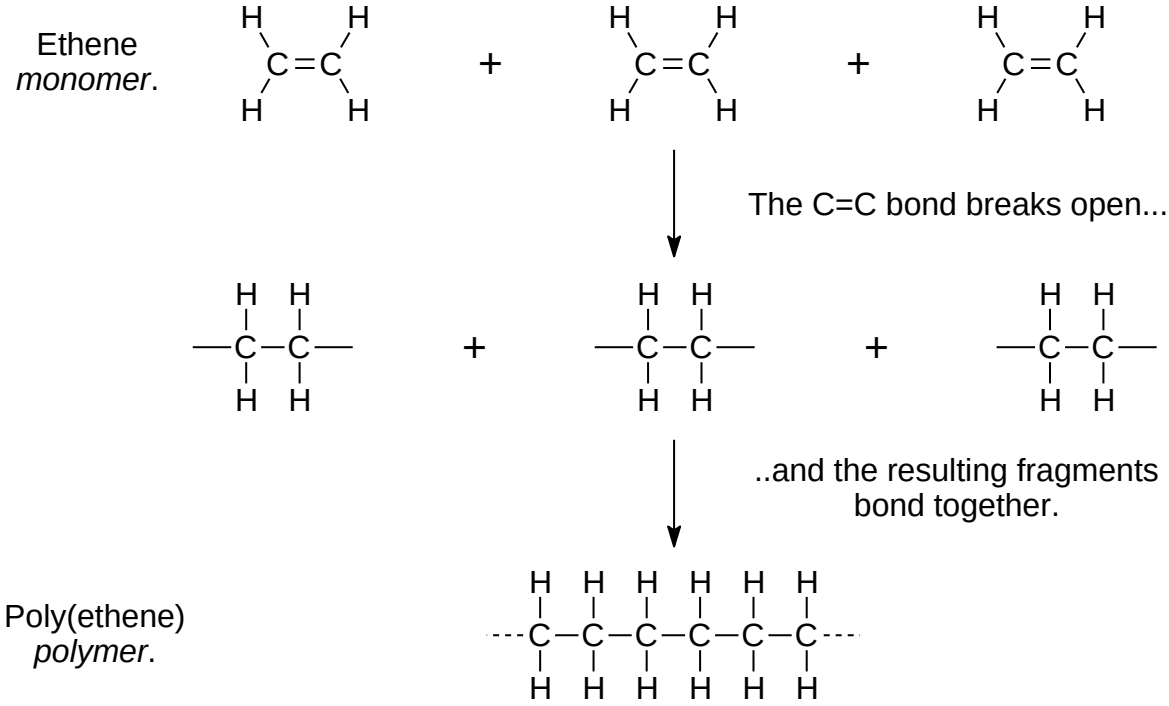
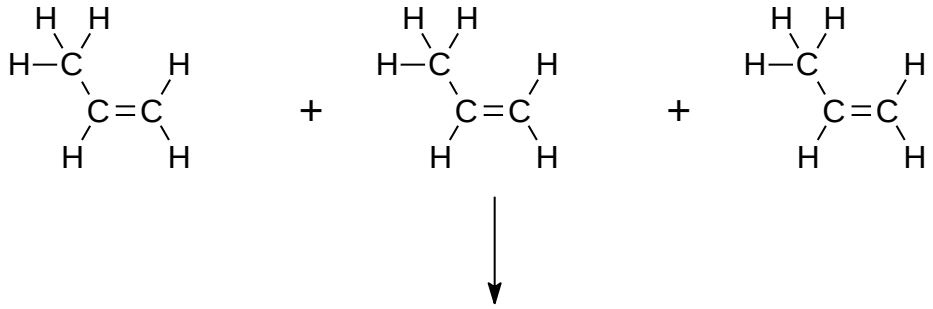


Figure 3. The polymerisation of *ethene* to form *poly(ethene)*.

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:

Propene *monomer*.



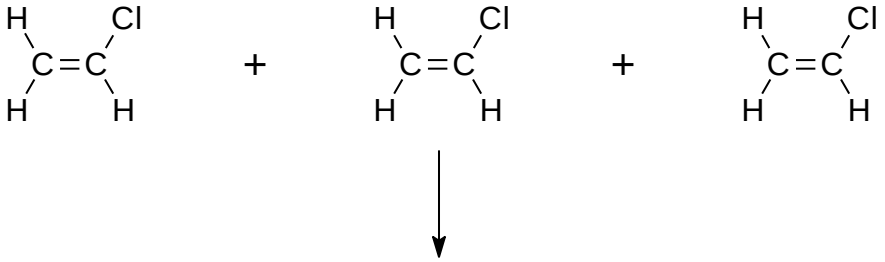
Part of the structure of poly(propene):

Equation for preparation of (poly)propene: $n C_3H_6 \rightarrow$ ……

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:

Chloroethene *monomer*.



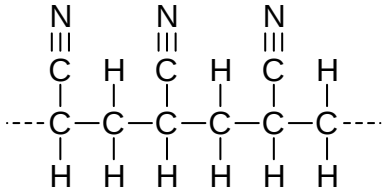
Part of the structure of poly(chloroethene):

Equation for the preparation of poly(chloroethene): $n C_2H_3Cl \rightarrow$ ……

Question 5.

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

a)



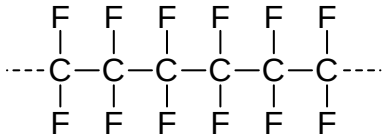
Poly(propenenitrile)

Made from…

Structure of monomer:

Name of monomer: ……...

b)



Poly(tetrafluoroethene)

Made from…

Structure of monomer:

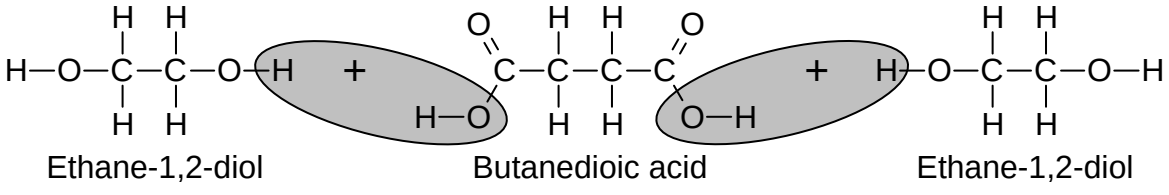
Name of monomer: ……...

Condensation Polymers

Condensation polymers are made from molecules that contain two carboxylic acid functional groups (–COOH) and either molecules that contain two alcohol functional groups (–OH) or molecules that contain two amine functional groups ($–NH_2$).

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*:



Ethane-1,2-diol Butanedioic acid Ethane-1,2-diol

Part of a polyester's structure.

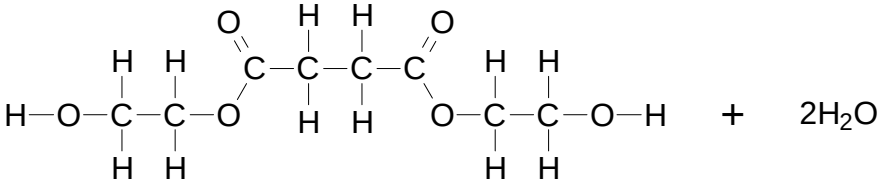
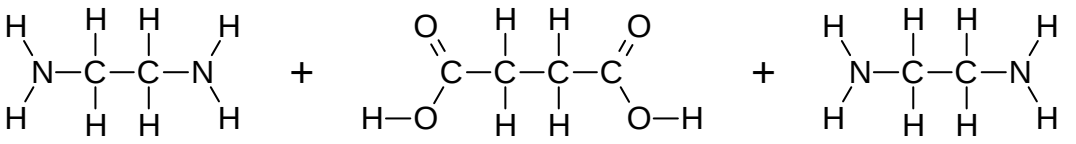


Figure 4. The formation of a polyester is an example of a condensation reaction.

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*™. **Note:** Nylon™ takes its name from the names of the two cities, **N**ew **Y**ork and **Lon**don. Copy the structure of Nylon™ into the space provided below:



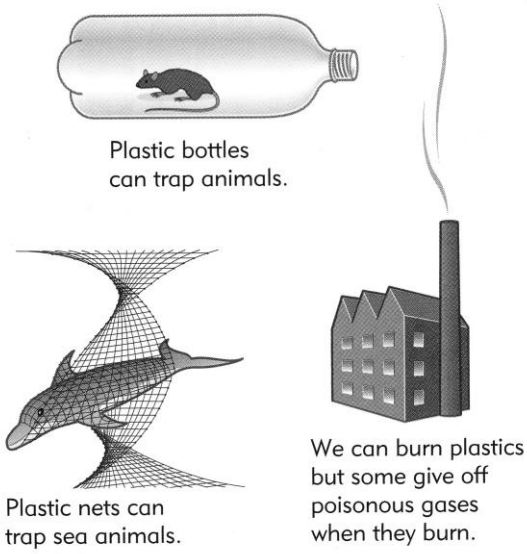
Ethyl-1,2-diamine + Butanedioic acid + Ethyl-1,2-diamine

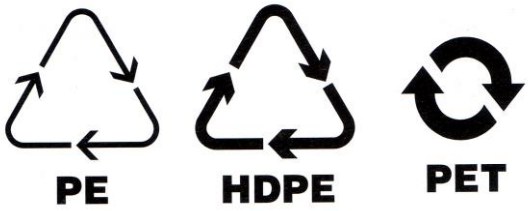
Loss of water from between the monomers.

Part of the structure of Nylon™:

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:





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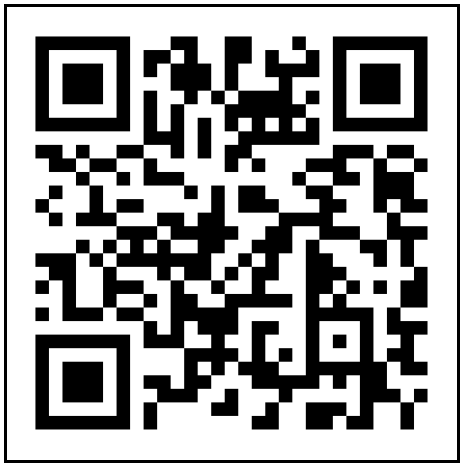
• *New Edition Chemistry* (Second Edition), Bryan Milner and Jean Martin, Cambridge University Press, 2001, ISBN: 3125806038.

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



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