

Polymer

Past Year Topical Questions

Oct/Nov 2002

(c) Alkenes polymerise by addition.

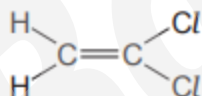
(i) Explain the term *polymerise*.

.....
.....[2]

(ii) What is the difference between addition polymerisation and condensation polymerisation?

.....
.....[2]

(iii) Poly(dichloroethene) is used extensively to package food. Draw its structure. The structural formula of dichloroethene is drawn below.



[2]

(d) Steel may be coated with another metal, eg zinc or chromium, or with a polymer, eg poly(chloroethene), to prevent rusting.

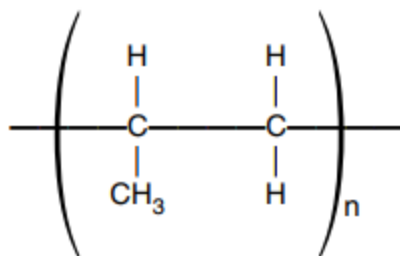
(i) Suggest a property of poly(chloroethene) that makes it suitable for this purpose.

.....[1]

May/June 2003

(d) Alkenes can polymerise.

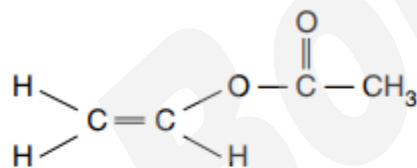
(i) Deduce the name and structural formula of the monomer from the structure of the polymer.



name of monomer

structural formula

(ii) Draw the structure of the polymer formed from the following monomer.



[4]

- (iii) Describe the pollution problems caused by the disposal of polymers in landfill sites and by burning.

landfill sites

.....[2]

burning

.....[1]

Oct/Nov 2003

- (c) Photosynthesis is another example of a photochemical reaction. Glucose and more complex carbohydrates are made from carbon dioxide and water.

- (i) Complete the equation.



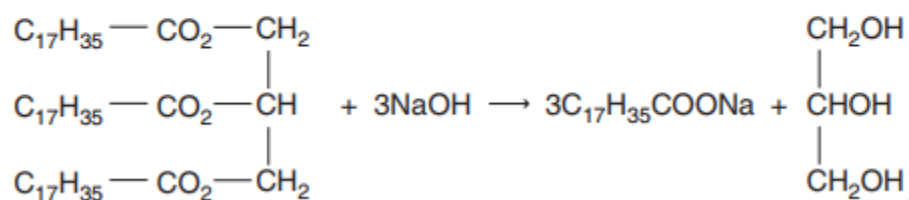
- (ii) Glucose can be represented as



Draw the structure of a more complex carbohydrate that can be formed from glucose by condensation polymerisation.

Oct/Nov 2003

(b) The following equation represents the alkaline hydrolysis of a naturally occurring ester.



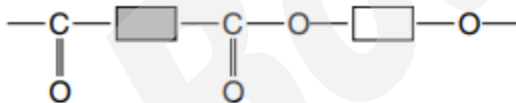
(i) Which substance in the equation is an alcohol? Underline the substance in the equation above.

[1]

(ii) What is the major use for compounds of the type $\text{C}_{17}\text{H}_{35}\text{COONa}$?

.....[1]

(c) A polymer has the structure shown below.



(i) What type of polymer is this?

.....[1]

(ii) Complete the following to give the structures of the two monomers from which the above polymer could be made.



[2]

(d) Esters are frequently used as solvents in chromatography. A natural macromolecule was hydrolysed to give a mixture of amino acids. These could be identified by chromatography.

(i) What type of macromolecule was hydrolysed?

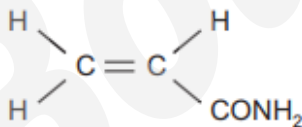
.....[1]

(ii) What type of linkage was broken by hydrolysis?

.....[1]

May/June 2004

6 In 2002, Swedish scientists found high levels of acrylamide in starchy foods that had been cooked above 120 °C. Acrylamide, which is thought to be a risk to human health, has the following structure.



(a) (i) It readily polymerises to polyacrylamide. Draw the structure of this polymer.

[2]

- (ii) Starch is formed by polymerisation. It has a structure of the type shown below. Name the monomer.



..... [1]

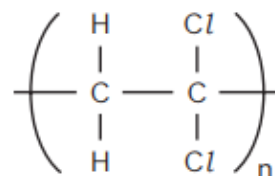
- (iii) What are the differences between these two polymerisation reactions, one forming polyacrylamide and the other starch?

..... [2]
.....

Oct/Nov 2004

- 6 Polymers are extensively used in food packaging. Poly(dichloroethene) is used because gases can only diffuse through it very slowly. Polyesters have a high thermal stability and food can be cooked in a polyester bag.

(a) (i) The structure of poly(dichloroethene) is given below.



Draw the structural formula of the monomer.

[1]

- (ii) Explain why oxygen can diffuse faster through the polymer bag than carbon dioxide can.

[2]

- (b) (i) A polyester can be formed from the monomers HO-CH₂CH₂-OH and HOOC-C₆H₄-COOH. Draw the structure of this polyester.

[2]

- (ii) Name a naturally occurring class of compounds that contains the ester linkage.

	[1]
--	-----

- (iii) Suggest what is meant by the term *thermal stability*.

	[1]
--	-----

- (c) (i) Describe **two** environmental problems caused by the disposal of plastic (polymer) waste.

	[2]
--	-----

- (ii) The best way of disposing of plastic waste is recycling to form new plastics. What is another advantage of recycling plastics made from petroleum?

	[1]
--	-----

- (iii) Draw the structure of the polymer formed from but-2-ene.

	[2]
--	-----

May/June 2005

3 A South Korean chemist has discovered a cure for smelly socks. Small particles of silver are attached to a polymer, poly(propene), and this is woven into the socks.

(a) (i) Give the structural formula of the monomer.

[1]

(ii) Draw the structural formula of the polymer.

[2]

(iii) Suggest which one, monomer or polymer, will react with aqueous bromine and why?

.....

..... [2]

May/June 2005

- (iv) The synthetic polymer, nylon, has the same linkage as proteins. Draw the structural formula of nylon.

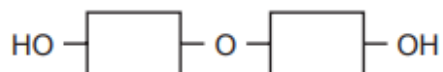
[3]

- (b) Enzymes called carbohydrases can hydrolyse complex carbohydrates to simple sugars which can be represented as $\text{HO} - \square - \text{OH}$. Draw the structure of a complex carbohydrate.

Oct/Nov 2006

8 The three types of food are carbohydrates, proteins and fats.

(a) Aqueous starch is hydrolysed to maltose by the enzyme amylase.
The formula of maltose is:



Starch is hydrolysed by dilute sulphuric acid to glucose.



(i) What is an enzyme?

..... [1]

(ii) Draw the structure of starch.

[1]

- (iii) Name the technique that would show that the products of these two hydrolyses are different.

..... [1]

- (b) Proteins have the same linkage as nylon but there is more than one monomer in the macromolecule.

- (i) Draw the structure of a protein.

[2]

- (ii) What class of compound is formed by the hydrolysis of proteins?

..... [1]

- (c) Fats are esters. Some fats are saturated, others are unsaturated.

- (i) Write the word equation for the preparation of the ester, propyl ethanoate.

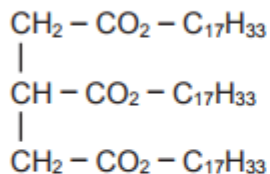
..... [2]

- (ii) Deduce the structural formula of this ester showing each individual bond.

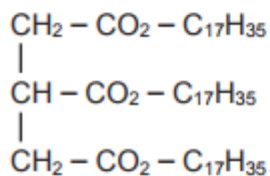
[2]

(iii) How could you distinguish between these two fats? [4]

Fat 1 has the formula



Fat 2 has the formula



test

result with fat 1

result with fat 2 [3]

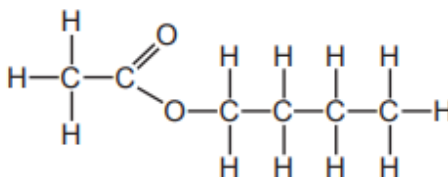
(iv) Both of these fats are hydrolysed by boiling with aqueous sodium hydroxide. What type of compounds are formed?

..... and [2]

May/June 2007

7 Esters, fats and polyesters all contain the ester linkage.

(a) The structural formula of an ester is given below.



Name **two** chemicals that could be used to make this ester and draw their structural formulae. Show all bonds.

names and [2]

structural formulae

(b) (i) Draw the structural formula of a polyester such as *Terylene*.

[2]

(ii) Suggest a use for this polymer.

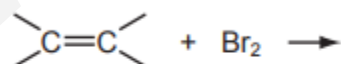
..... [1]

- (c) Cooking products, fats and vegetable oils, are mixtures of saturated and unsaturated esters.

The degree of unsaturation can be estimated by the following experiment. 4 drops of the oil are dissolved in 5 cm³ of ethanol. Dilute bromine water is added a drop at a time until the brown colour no longer disappears. Enough bromine has been added to the sample to react with all the double bonds.

cooking product	mass of saturated fat in 100 g of product/g	mass of unsaturated fat in 100 g of product/g	number of drops of bromine water
margarine	35	35	5
butter	45	28	4
corn oil	10	84	12
soya oil	15	70	10
lard	38	56

- (i) Complete the one blank space in the table. [1]
- (ii) Complete the equation for bromine reacting with a double bond.



[2]

- (iii) Using saturated fats in the diet is thought to be a major cause of heart disease. Which of the products is the least likely to cause heart disease?

..... [1]

May/June 2008

8 Large areas of the Amazon rain forest are cleared each year to grow soya beans. The trees are cut down and burnt.

(a) Why do these activities increase the percentage of carbon dioxide in the atmosphere?

.....
..... [2]

(b) Soya beans contain all three main food groups. Two of which are protein and carbohydrate.

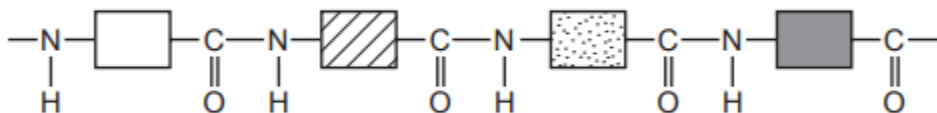
(i) What is the third group?

..... [1]

(ii) Draw the structural formula of a complex carbohydrate such as starch.

[3]

- (iii) Compare the structure of a protein with that of a synthetic polyamide. The structure of a typical protein is given below.



How are they similar?

.....

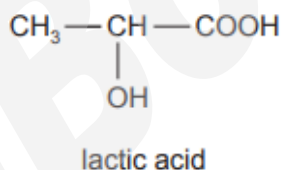
How are they different?

.....

..... [3]

May/June 2009

- 8 Lactic acid can be made from corn starch.



It polymerises to form the polymer, polylactic acid (PLA) which is biodegradable.

- (a) Suggest two advantages that PLA has compared with a polymer made from petroleum.

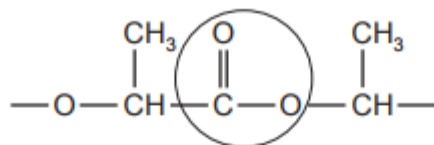
.....

.....

.....

..... [2]

(b) The structure of PLA is given below.



(i) What type of compound contains the group that is circled?

..... [1]

(ii) Complete the following sentence.

Lactic acid molecules can form this group because they contain both an

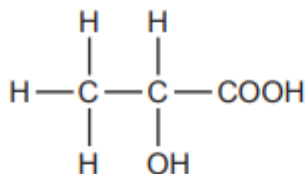
..... group and an group. [2]

(iii) Is the formation of PLA, an addition or condensation polymerisation? Give a reason for your choice.

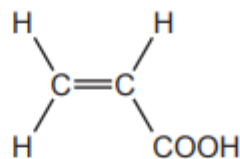
.....

 [2]

(c) When lactic acid is heated, acrylic acid is formed.



lactic acid



acrylic acid

(i) Complete the word equation for the action of heat on lactic acid.

lactic acid → + [1]

(ii) Describe a test that would distinguish between lactic acid and acrylic acid.

test

result for lactic acid

result for acrylic acid [3]

(iii) Describe a test, other than using an indicator, which would show that both chemicals contain an acid group.

test

result

..... [2]