

POLYMERS 4

Q1. Polymers have properties that depend on what they are made from and the conditions under which they are made.

(a) Which row in the table contains two molecules that are both easily made into polymers?

| | | |
|---|-------------|--|
| 1 | C_3H_6 | |
| 2 | C_4H_{10} | |
| 3 | C_5H_{12} | |
| 4 | C_4H_8 | |

(1 mark)

Poly(ethene) was first produced by heating ethene under high pressure and to high temperatures. Later, it was found that poly(ethene) could be produced at much lower temperatures and pressures if an aluminium catalyst was used.

(b) An advantage of using a catalyst is that the poly(ethene) could be . . .

- 1 improved by including aluminium in its structure.
- 2 manufactured with different alkenes.
- 3 manufactured by polymerisation of ethane.
- 4 more economic to produce.

(1 mark)

(c) The poly(ethene) produced using lower temperatures and pressures has a higher density. This has enabled manufacturers to . . .

- 1 develop a wider range of products.
- 2 use different types of monomer to make poly(ethene).
- 3 use the polymers as fuels.
- 4 develop products that do not burn.

(1 mark)

(d) Many products are made using poly(ethene). Which of the following is likely to be the most environmentally friendly way to deal with these products when they become waste?

- 1 allow the poly(ethene) to biodegrade
- 2 put the poly(ethene) in landfill sites
- 3 burn the poly(ethene) and use the energy released to produce electricity
- 4 melt the poly(ethene) and make new products

(1 mark)

Q2. In a molecule of ethene, (C_2H_4), one or more of the hydrogen atoms can be replaced by fluorine. Polymers can be made from these monomer molecules that contain fluorine. Increasing the number of fluorine atoms makes these polymers less reactive.

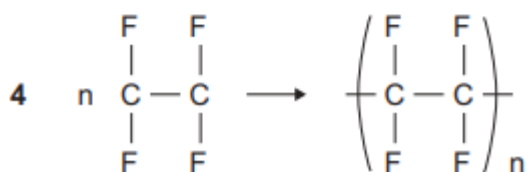
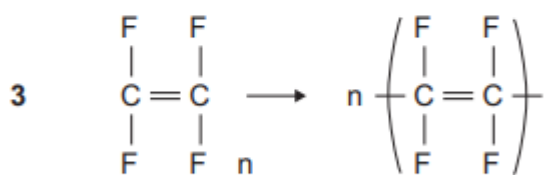
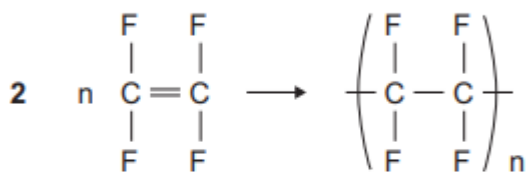
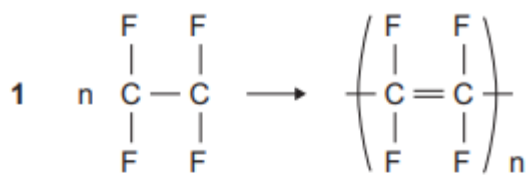
(a) Which of the following monomers would form the most reactive polymer?

- 1 $CHF = CH_2$
- 2 $CHF = CF_2$
- 3 $CH_2 = CF_2$
- 4 $CF_2 = CF_2$

(1 mark)

The polymer poly(tetrafluoroethene) formed from the monomer $CF_2 = CF_2$ was discovered accidentally in 1938.

(b) Which equation represents the polymerisation of this monomer?



(1 mark)

(c) Poly(tetrafluoroethene) is a thermosoftening polymer.

This means that this polymer . . .

- 1 softens when first heated, then hardens, but cannot afterwards be remoulded.
- 2 can be repeatedly softened by heating and remoulded.
- 3 contains only small molecules that are rearranged on heating.
- 4 has weak bonds between the long molecules which become stronger on heating.

(1 mark)

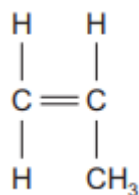
(d) Pipes to carry corrosive hydrofluoric acid can be made from poly(tetrafluoroethene).

This suggests that this polymer . . .

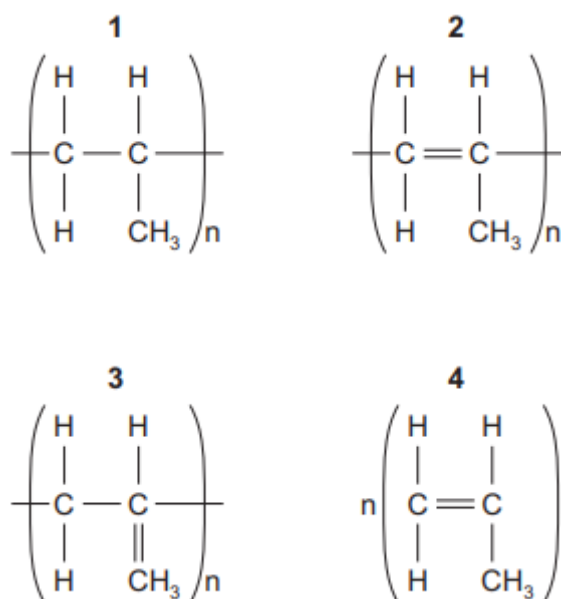
- 1 is a good lubricant.
- 2 does not dissolve in any solvent.
- 3 is unreactive.
- 4 is more reactive than hydrofluoric acid.

(1 mark)

Q3. The formula for propene can be shown as:



(a) The polymer, poly(propene), will have the formula:



(1 mark)

(b) Which statement about propene and poly(propene) is correct?

- 1 Both compounds are unsaturated.
- 2 Only poly(propene) reacts with bromine.
- 3 Only poly(propene) could be produced by cracking oil fractions.
- 4 Only propene reacts with hydrogen.

(1 mark)

(c) Poly(propene) is a thermosoftening polymer.

This means that . . .

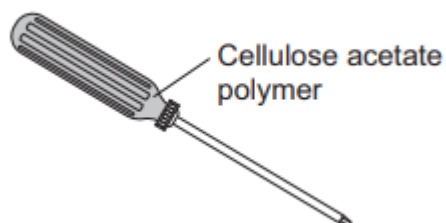
- 1 it can be moulded into many shapes.
- 2 it softens when heated and hardens when it cools.
- 3 it hardens when it is heated to give a rigid structure.

4 it is resistant to heat.

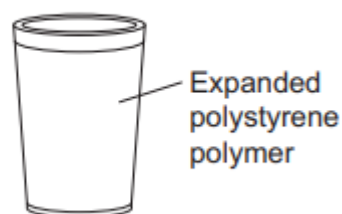
(1 mark)

Q4. The drawings show four different objects. Each object is made using a different polymer.

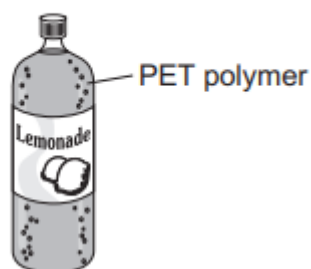
A Screwdriver



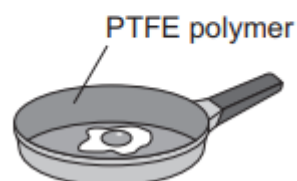
B Disposable coffee cup



C Bottle for soft drinks



D Frying pan



The table below shows some properties of four different polymers.

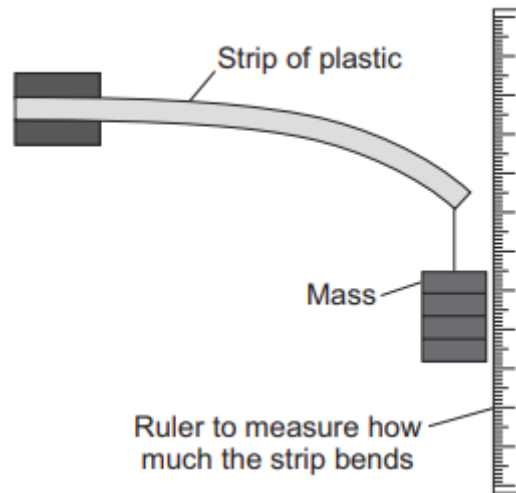
Match the polymers used in objects, A, B, C and D, with the numbers 1–4 in the table.

| Properties of the polymer | |
|---------------------------|---|
| 1 | It forms a non-stick surface that can be strongly heated. |
| 2 | It is strong, lightweight, transparent and can be recycled. |
| 3 | It is strong, rigid and a good electrical insulator. |
| 4 | It is a good heat insulator and has a very low density. |

(4 marks)

Q5. A student used the apparatus shown in the diagram to measure the flexibility of a strip of plastic. The strip of plastic was 5 mm thick. The student did the test again using the same piece of plastic and recorded the results of both tests.

He did identical tests using three more strips of the same plastic but each with a different thickness. All four strips were the same length.



The results are shown in the table.

| Thickness of the plastic strip in mm | How much the plastic strip bends downwards in mm | |
|--------------------------------------|--|--------|
| | Test 1 | Test 2 |
| 5 | 27 | 25 |
| 10 | 18 | 20 |
| 15 | 12 | 8 |
| 20 | 8 | 7 |

(a) The plastic strip giving the most unreliable results is the one with a thickness of . . .

- 1 5 mm.
- 2 10 mm.
- 3 15 mm.
- 4 20 mm.

(1 mark)

- (b)** Which one of the following is controlled to make sure the investigation is a fair test?
- 1 the mass added
 - 2 the thickness of the plastic strip
 - 3 the width of the ruler
 - 4 the distance the plastic strip bends

(1 mark)

- (c)** To improve the reliability of the results, you can . . .

- 1 use different lengths of plastic strip.
- 2 use plastic strips with a wider range of thicknesses.
- 3 ask another student to repeat the tests.
- 4 do the tests at a higher temperature.

(1 mark)

- (d)** Which one of the following correctly describes the relationship in the results?

- 1 As the thickness increases, the flexibility decreases.
- 2 The thickness does not affect the flexibility.
- 3 The flexibility is proportional to the mass added.
- 4 The longer the plastic strip, the less it bends.

(1 mark)

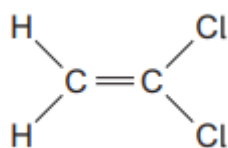
Q6. Worldwide, about 20 billion wine bottle stoppers are produced each year.

In recent years, the traditional cork stoppers have been gradually replaced by screw-top stoppers.

Cork is the bark from the cork-oak tree. The cork is cut off about every ten years. Tens of thousands of people in Portugal depend on cork for their jobs. Used cork can be recycled.

A screw-top stopper can be made of aluminium, with a polymer sealant inside. The sealant is usually made of poly(ethene) or poly(vinylidene chloride). Extraction of aluminium from its ores is expensive and a lot of energy is needed. It is difficult to separate the polymer from the aluminium cap to allow aluminium to be recycled.

Vinylidene chloride has the structure:

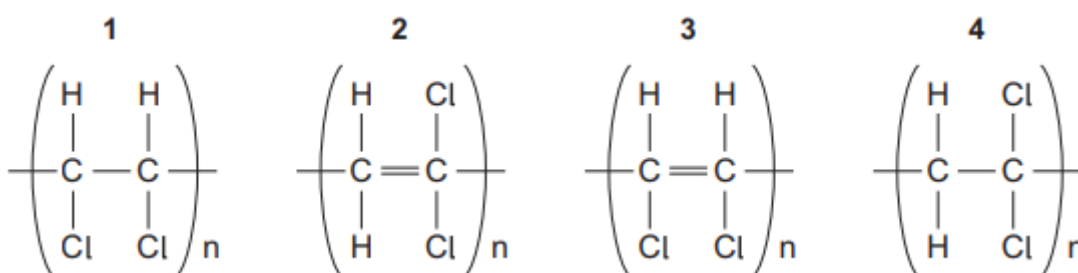


(a) One difference between ethene and vinylidene chloride is that . . .

- 1 only ethene is an unsaturated compound.
- 2 only vinylidene chloride will react with iodine.
- 3 only vinylidene chloride is obtained from crude oil.
- 4 only ethene is a hydrocarbon.

(1 mark)

(b) The formula for poly(vinylidene chloride) is . . .



(1 mark)

(c) There are two likely consequences of wine companies using metal screw-top stoppers with polymer sealants instead of cork. Which row in the table correctly shows the two likely consequences?

| | | |
|----------|---------------------------------------|--|
| 1 | increased use of crude oil | loss of jobs in Portugal |
| 2 | reduction in carbon dioxide emissions | loss of jobs in Portugal |
| 3 | reduction in carbon dioxide emissions | loss of important forest habitat |
| 4 | increased use of crude oil | reduced amount of material put in landfill |

(1 mark)

- (d) Scientists are researching the consequences of using screw-top stoppers with polymer sealants instead of cork.

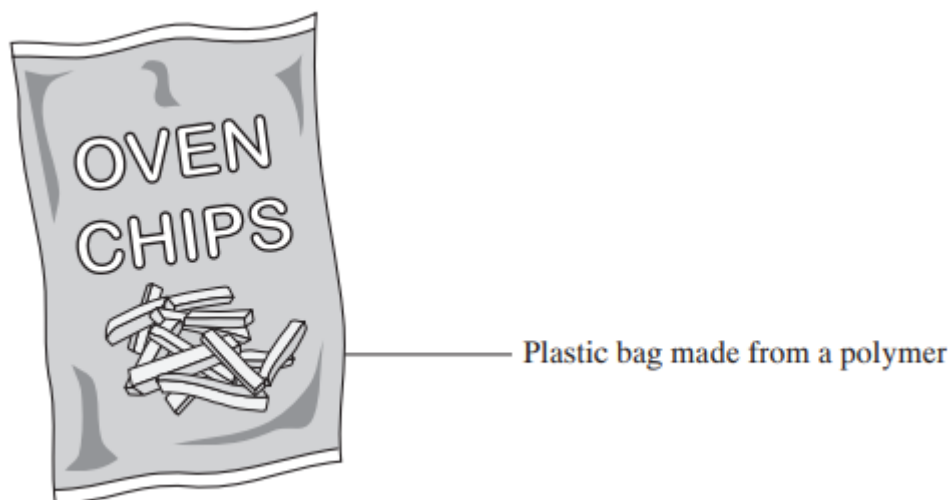
Which row in the table below gives the correct description of an issue and its impact?

| | Issue | Impact |
|---|---------------|-------------------------------|
| 1 | ethical | effect on the price of wine |
| 2 | social | effect on some communities |
| 3 | environmental | effect on the quality of wine |
| 4 | economic | effect on cork forest habitat |

(1 mark)

- Q7. Polymers are used to make many materials that people need.

Plastic bags are used to carry, protect and store food. Plastic bags are made from polymers.



- (i) Ethene is the small molecule (the monomer) used to make the polymer for this plastic bag. Name the polymer that is made from ethene.

(1 mark)

(ii) Use the correct word from the box to complete the sentence about ethene.

| | | |
|-------------------|------------------|-----------------|
| condensing | corroding | cracking |
|-------------------|------------------|-----------------|

Ethene is made by breaking down large hydrocarbon molecules into smaller hydrocarbon molecules by a process called _____.

(1 mark)

Total marks (25)