AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.7.3.1

Addition polymerisation

Past-paper questions

Tier	**Higher**
Question groups	**24**
Available paper years	**2007–2024**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.7.3.1 Addition polymerisation

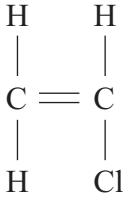
Question 01

March 2007 | CHY1B | Original Q8 | Legacy

QUESTION EIGHT

Window frames for double glazing can be made from the plastic PVC, poly(vinyl chloride).

Poly(vinyl chloride) is made from the polymerisation of vinyl chloride molecules which have the structure:



8A Vinyl chloride molecules can be described as . . .

1 alkenes.

2 polymers.

3 saturated.

4 unsaturated.

8B Vinyl chloride belongs to a family of chemicals that have the general formula . . .

1 C_nHCl

2 $C_nH_{n-1}Cl$

3 $C_nH_{n+1}Cl$

4 $C_nH_{2n-1}Cl$

8C In the polymerisation process, vinyl chloride molecules are . . .

1 catalysts.

2 monomers.

3 additives.

4 emulsifiers.

4.7.3.1 Addition polymerisation

8D PVC window frames do not need much maintenance because they are . . .

1 cheap to replace.

2 easily painted.

3 non-biodegradable.

4 rigid.

Turn over for the next question

4.7.3.1 Addition polymerisation

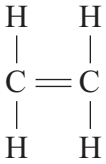
Question 02

June 2007 | CHY1B | Original Q2 | Legacy

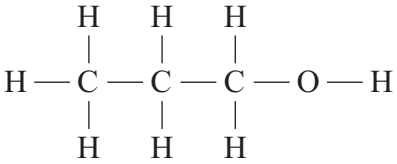
QUESTION TWO

This question is about the formulae for four compounds.

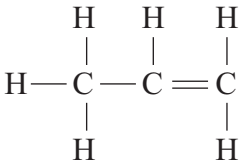
Match formulae, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.



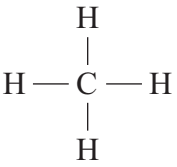
A



B



C



D

	Description
1	It is an unsaturated hydrocarbon with three carbon atoms in each molecule.
2	It is the monomer from which poly(ethene) is made.
3	It is the alkane that was present in Earth's early atmosphere.
4	It is not a hydrocarbon.

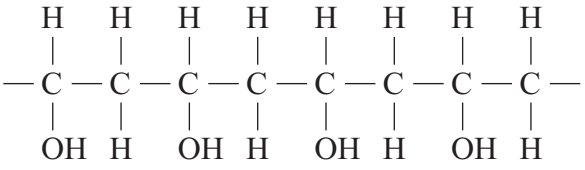
4.7.3.1 Addition polymerisation

Question 03

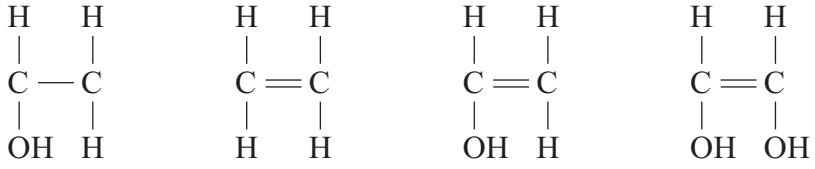
June 2007 | CHY1B | Original Q4 | Legacy

QUESTION FOUR

Poly(vinyl alcohol) has this structure:



4A The monomer from which poly(vinyl alcohol) is made can be represented by . . .



1 **2** **3** **4**

Poly(vinyl alcohol) reacts with a solution of sodium borate to form 'slime'.
Slime can be fluid or, when almost solid, it can retain its shape.

A student measured the relationship between the spread of a lump of slime and the concentration of the sodium borate solution used to make it.
She called this 'the slump test'.

The student followed this procedure:

- make a sample of slime using 50 cm^3 of 4 % poly(vinyl alcohol) solution and 5 cm^3 of a 1 % solution of sodium borate
- stir the mixture for 2 minutes
- measure out 50 cm^3 of the slime produced and make this into a disc shape
- place this disc on paper and mark its outline with a pencil line
- leave for 5 minutes
- mark the new outline of the slime with a pencil
- calculate the increase in area of the disc
- repeat, using different concentrations of sodium borate to make the slime.

4B The student would have achieved greater accuracy in the test if she had . . .

1 used a smaller piece of slime.

2 stirred the reacting mixture for more than 2 minutes.

3 allowed the slime to spread for less than 5 minutes.

4 controlled the starting area of the slime discs.

Question 03 · continued

4C One variable that she did not control was . . .

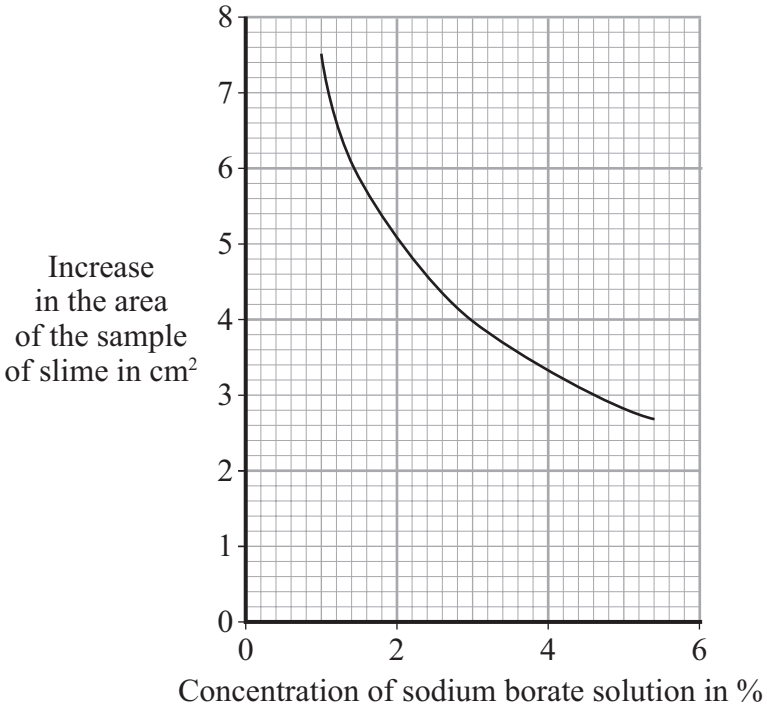
1 the concentration of the poly(vinyl alcohol).

2 the room temperature during the slump test.

3 the volume of the sodium borate solution.

4 the volume of the slime.

4D The student's results are shown on the graph.



The graph shows that . . .

1 the increase in area is directly proportional to the concentration of the sodium borate solution.

2 there is a linear relationship between the increase in area and the concentration of the sodium borate solution.

3 the increase in area is reduced as the sodium borate solution becomes more concentrated.

4 there is no relationship between the size of the disc and the concentration of the sodium borate solution.

4.7.3.1 Addition polymerisation

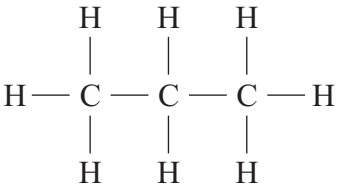
Question 04

November 2007 | CHY1B | Original Q2 | Legacy

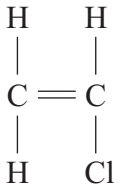
QUESTION TWO

This question is about the formulae of four organic compounds.

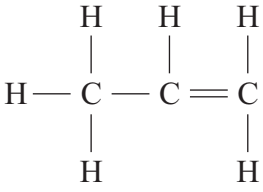
Match the formulae, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.



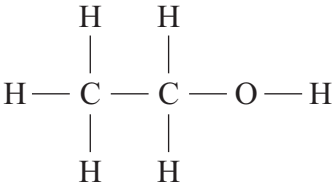
A



B



C



D

	What we can say about the organic compound
1	It is a saturated hydrocarbon useful as a fuel.
2	It is a monomer from which the polymer, polyvinylchloride, can be made.
3	It is the formula for ethanol.
4	It belongs to a group of hydrocarbons with the general formula C_nH_{2n}

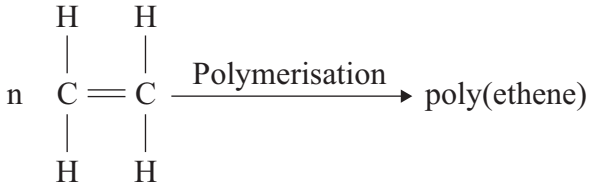
4.7.3.1 Addition polymerisation

Question 05

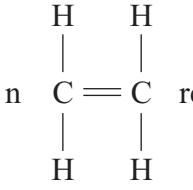
November 2007 | CHY1B | Original Q6 | Legacy

QUESTION SIX

The equation shows how poly(ethene) is made.



6A



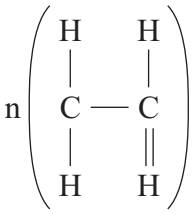
1 one molecule of poly(ethene).

2 one molecule of ethene.

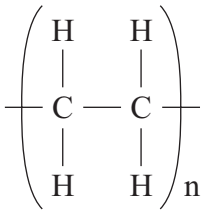
3 two molecules of ethene.

4 many molecules of ethene.

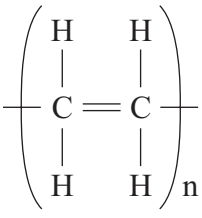
6B The formula for poly(ethene) is . . .



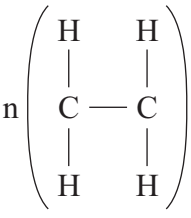
1



2



3



4

4.7.3.1 Addition polymerisation

Question 05 · continued

6C Which row in the table correctly shows the differences between the monomer molecules and the polymer molecule formed from them in this reaction?

	Monomer molecule	Polymer molecule
1	small, saturated	large, unsaturated
2	large, saturated	small, saturated
3	small, unsaturated	large, saturated
4	large, unsaturated	small, unsaturated

6D Poly(ethene) is not used to make plastic kettles because . . .

1 it is a thermosetting polymer.

2 it is too heavy.

3 it is opaque.

4 it is a thermosoftening polymer.

4.7.3.1 Addition polymerisation

Question 06

March 2008 | CHY1BP | Original Q9 | Legacy

QUESTION NINE

The general equation for the complete combustion of an alkane is:

$$2C_nH_{2n+2} + (3n+1)O_2 \rightarrow 2nCO_2 + 2(n+1)H_2O$$

Use this information to help you to answer the following questions.

9A Why are alkanes with few carbon atoms likely to be better fuels?

1 They require less oxygen so are less likely to be completely burned.

2 They require less oxygen so are more likely to be completely burned.

3 They require more oxygen so are less likely to be completely burned.

4 They require more oxygen so are more likely to be completely burned.

9B The formula of hexane is C_6H_{14}

How many molecules of oxygen are needed to burn one molecule of hexane?

1 $9\frac{1}{2}$

2 19

3 $21\frac{1}{2}$

4 43

9C What is the general equation for the combustion of an alkene (C_nH_{2n})?

1 $C_nH_{2n} + 1\frac{1}{2}nO_2 \rightarrow nCO_2 + nH_2O$

2 $C_nH_{2n} + 1\frac{1}{2}nO_2 \rightarrow nCO_2 + 2nH_2O$

3 $C_nH_{2n} + 3nO_2 \rightarrow nCO_2 + nH_2O$

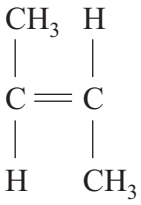
4 $C_nH_{2n} + 3nO_2 \rightarrow nCO_2 + 2nH_2O$

4.7.3.1 Addition polymerisation

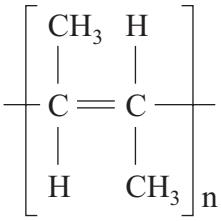
Question 06 · continued March 2008 | CHY1BP | Original Q9 | Legacy

9D Alkene molecules can be bonded together to form polymers.

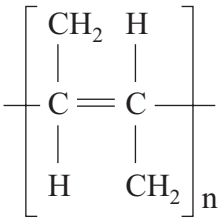
Which polymer would be produced from this alkene?



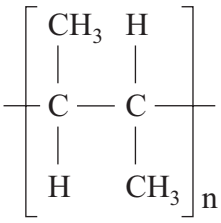
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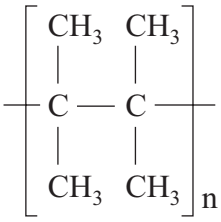
2



3



4



END OF TEST

4.7.3.1 Addition polymerisation

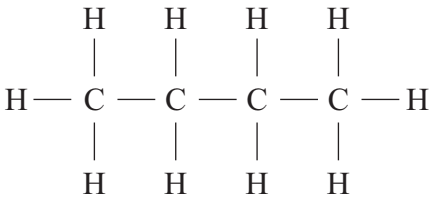
Question 07

June 2008 | CHY1BP | Original Q2 | Legacy

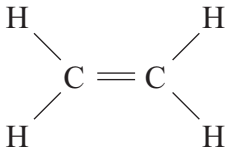
QUESTION TWO

This question is about carbon compounds.

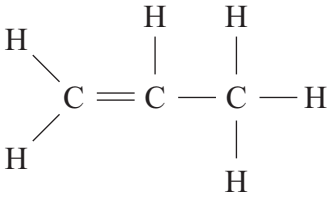
A



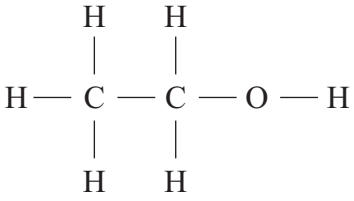
B



C



D



Match carbon compounds, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

	What we can say about the carbon compound
1	It is **not** a hydrocarbon.
2	It has the molecular formula C_2H_4
3	It is the monomer from which poly(propene) is made.
4	It can be cracked to produce propene.

4.7.3.1 Addition polymerisation

Question 08

June 2008 | CHY1BP | Original Q7 | Legacy

QUESTION SEVEN

This question is about polymers.

Poly(propene) is made from the alkene, propene.

7A Which one of the following statements about the formation of poly(propene) from propene is correct?

1 The product will readily react with bromine.

2 The reaction involves thermal decomposition.

3 The reaction involves cracking.

4 The product is a saturated hydrocarbon.

7B The term thermosoftening is used to describe how poly(propene) behaves on heating.

This means that poly(propene) must therefore . . .

1 **not** be used for packaging in warm countries because it will soften.

2 contain only short chain molecules which move around easily on heating.

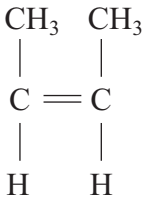
3 have chemical bonds between the chains which break on heating.

4 be capable of being shaped on heating.

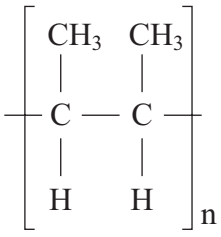
4.7.3.1 Addition polymerisation

Question 08 · continued June 2008 | CHY1BP | Original Q7 | Legacy

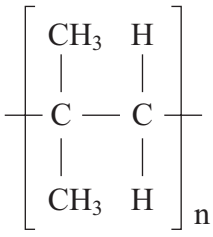
7C Which one of the following polymers can be formed by polymerising the alkene with this formula?



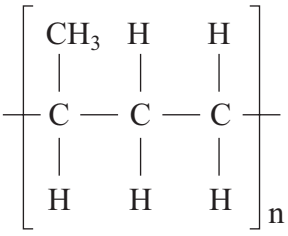
1



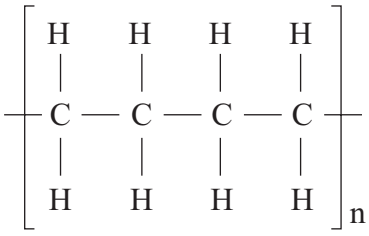
2



3



4



7D Which one of the following statements about polymer waste is correct?

All polymer waste . . .

1 can be easily recycled.

2 will biodegrade when placed in landfill sites.

3 will contribute to global warming if burned.

4 is easily removed from other waste by adding water because the polymer waste will sink to the bottom.

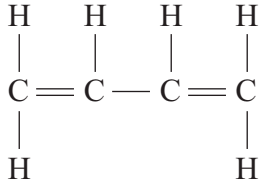
4.7.3.1 Addition polymerisation

Question 09

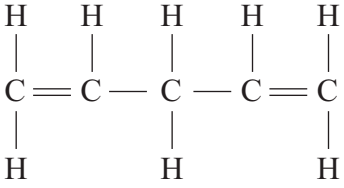
November 2008 | CHY1BP | Original Q8 | Legacy

QUESTION EIGHT

Butadiene and pentadiene both contain two double carbon carbon bonds. Their structures are shown below.



Butadiene



Pentadiene

8A Butadiene and pentadiene would belong to a family of compounds having the general formula . . .

1 C_nH_{2n-2}

2 C_nH_{2n}

3 C_nH_{2n+2}

4 C_2H_{2n-4}

Butadiene can be polymerised to form a polymer, poly(butadiene) whose structure is represented by

$$\left[CH_2 - CH = CH - CH_2 \right]_n$$

8B Which one of the following statements regarding butadiene and poly(butadiene) is **not** true?

Both would . . .

1 be classed as unsaturated.

2 react with bromine and iodine.

3 be formed by cracking certain oil fractions.

4 react with hydrogen in the presence of a catalyst.

4.7.3.1 Addition polymerisation

Question 09 · continued

8C Butadiene is called the monomer in the polymerisation reaction because it . . .

1 has two double carbon carbon bonds.

2 forms the repeat unit in the polymer.

3 is an unsaturated hydrocarbon.

4 is obtained from oil.

8D Poly(butadiene) is used to make tyres for motor cars.

The most environmentally friendly way to get rid of used tyres is . . .

1 to burn them.

2 to dissolve them in a solvent and dispose of the solution.

3 to break down the long polymer chains into smaller molecules.

4 to put them in landfill sites.

4.7.3.1 Addition polymerisation

Question 10 March 2009 | CHY1BP | Original Q4 | Legacy

QUESTION FOUR

Scientists have developed a process to convert plastics such as nylon back to their original monomers.

4A What is the monomer used to make the polymer called poly(chloroethene)?

1 ethene

2 ethane

3 chloroethene

4 chloroethane

4B Which of the following is **not** an advantage of returning a polymer back to its monomer?

1 reduces the amount of plastic going into landfill sites

2 oil reserves will last longer

3 uses up excess supplies of monomers

4 avoids recycling of plastics

4C Plastics that can be broken down by microorganisms are described as . . .

1 unsaturated.

2 thermosetting.

3 thermoplastic.

4 biodegradable.

4D At a supermarket, customers can get vouchers for school equipment when they use their own bags for shopping.

The advantage of this scheme is that . . .

1 the supermarket can order more bags.

2 less plastic has to be manufactured.

3 queues will be shorter.

4 the plastic will be easier to recycle.

4.7.3.1 Addition polymerisation

Question 11

June 2009 | CHY1BP | Original Q5 | Legacy

QUESTION FIVE

Alkenes that have one or more hydrogen atoms replaced by fluorine can be polymerised to make thermosoftening polymers. Replacing hydrogen atoms with fluorine is a very expensive process.

Increasing the number of fluorine atoms in the polymers makes them very unreactive. Polymers with more fluorine atoms in their molecules are more resistant to heat damage. However, if they are subjected to intense heat, they can burn and release some very toxic fumes.

5A Which one of the following monomers would result in the least reactive polymer?

1 $CHF=CH_2$

2 CHF=CHF

3 $CH_2=CF_2$

4 $CF_2=CF_2$

5B The monomer CHF=CHF . . .

1 is saturated.

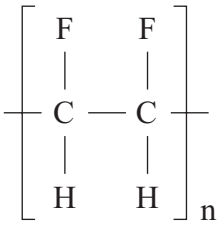
2 does **not** react with bromine.

3 reacts with hydrogen in the presence of a catalyst.

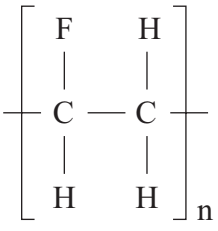
4 can be produced by cracking alkanes.

5C Which polymer would result from polymerisation of CHF=CHF?

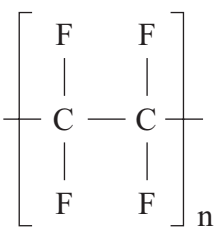
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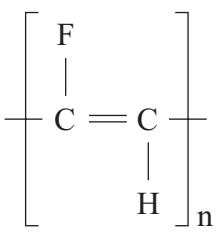
2



3



4



4.7.3.1 Addition polymerisation

Question 11 · continued

5D Which statement would **not** apply to objects made from polymers containing a lot of fluorine?

1 They can be disposed of safely in an incinerator.

2 They are resistant to breakdown by microorganisms.

3 They are expensive to manufacture.

4 They can be used to make kitchen utensils.

Turn over for the next question

4.7.3.1 Addition polymerisation

Question 12

November 2009 | CHY1BP | Original Q5 | Legacy

QUESTION FIVE

AQA-Dri is a material with a polymer coating. The polymer called poly(tetrafluoroethene) is produced from the monomer tetrafluoroethene, C_2F_4. AQA-Dri is useful for making outdoor clothing because it prevents rain droplets from passing through the pores of the material, but allows water vapour formed during sweating to escape.

5A Which of the following statements explains the useful properties of AQA-Dri?

1 The pores in AQA-Dri are smaller than the molecules in sweat.

2 Water molecules are small enough to pass through AQA-Dri.

3 The pores in AQA-Dri are smaller than water molecules.

4 Water droplets are smaller than the pores in AQA-Dri.

5B Old documents become dry and brittle. AQA-Dri is used to help to flatten old documents, rather than wetting them with a fine water sprayer.

This is because . . .

1 AQA-Dri will let the documents absorb water more quickly.

2 water droplets will not moisten the documents enough to let them flatten.

3 water sprayers make the documents too wet, so they become even more fragile.

4 water sprayers are a low technology, out-of-date solution to the problem.

5C In the 1950s, the inventors of AQA-Dri intended to use poly(tetrafluoroethene) as an electrical insulator. Today, it has many uses.

This is because . . .

1 scientists are constantly discovering new electrical insulators.

2 chemical companies are always trying to find new applications for their products.

3 chemical companies are trying to find alternative ways of waterproofing fabrics.

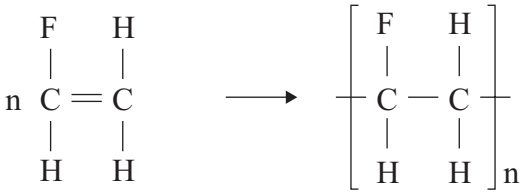
4 scientists stop testing the properties of materials once they are discovered.

4.7.3.1 Addition polymerisation

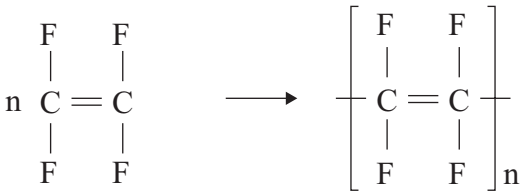
Question 12 · continued

5D Which of the following is the correct equation for the formation of poly(tetrafluoroethene) from tetrafluoroethene?

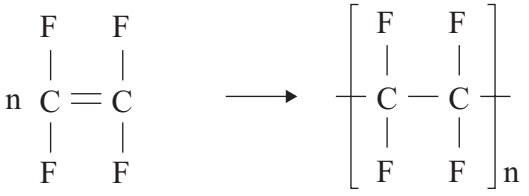
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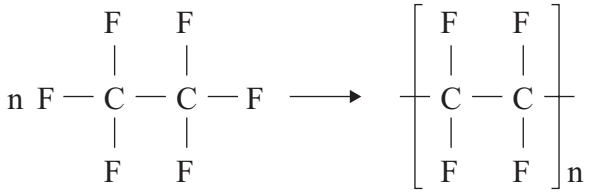
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3



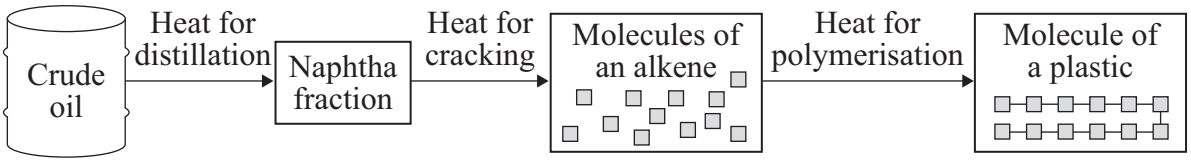
4



4.7.3.1 Addition polymerisation

Question 13

6 To make a plastic, such as poly(ethene), from crude oil involves many processes.



6 (a) Describe how crude oil is separated into fractions.

.....

.....

.....

.....

.....

(2 marks)

6 (b) Ethene is produced by cracking the hydrocarbons in the naphtha fraction.

6 (b) (i) Balance the symbol equation for this reaction.

$C_{10}H_{22}$	→	C_4H_{10}	+	C_2H_4
decane		butane		ethene

(1 mark)

6 (b) (ii) Describe how cracking is carried out.

.....

.....

.....

.....

.....

(2 marks)

4.7.3.1 Addition polymerisation

Question 13 · continued

for mark

6 (c) Alkanes, such as butane (C_4H_{10}), do **not** form polymers.

Alkenes, such as ethene (C_2H_4), do form polymers.

Explain these statements.

.....

.....

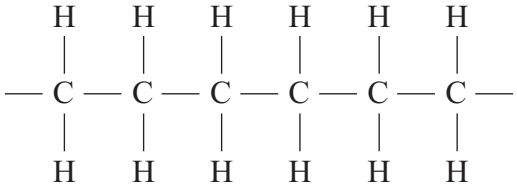
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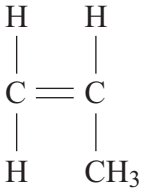
.....

(2 marks)

6 (d) Ethene molecules form the polymer poly(ethene). One molecule in poly(ethene) will contain thousands of carbon atoms. The diagram represents part of a poly(ethene) molecule.



Propene molecules form the polymer poly(propene).



Propene molecule

Draw a diagram to represent part of a poly(propene) molecule.

(2 marks)

9

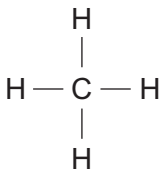
4.7.3.1 Addition polymerisation

Question 14

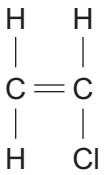
QUESTION TWO

This question is about the formulae of four carbon compounds, **A**, **B**, **C** and **D**.

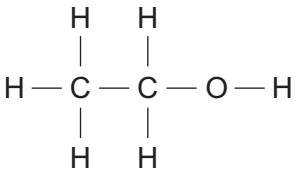
A



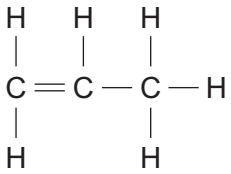
B



C



D



Match formulae, **A**, **B**, **C** and **D**, with the numbers **1–4** in the table.

1	It is an unsaturated hydrocarbon.
2	It is the alkane that was present in Earth's early atmosphere.
3	It is made by reacting ethene with steam.
4	It is the monomer from which the polymer, poly(chloroethene) is made.

4.7.3.1 Addition polymerisation

Question 15

June 2010 | CHY1BP | Original Q3 | Legacy

QUESTION THREE

This equation shows the thermal decomposition of a hydrocarbon.

$$C_8H_{18} \longrightarrow \text{an alkane} + \text{an alkene}$$

3A What is the name of this process?

1 polymerisation

2 cracking

3 combustion

4 hydrogenation

3B In this decomposition, . . .

1 the hydrocarbon vapour is heated with iodine.

2 the hydrocarbon is mixed with hydrogen and heated.

3 the hydrocarbon vapour is passed over a hot catalyst.

4 the hydrocarbon is liquefied, then passed over a catalyst.

3C The alkene produced . . .

1 is an unsaturated compound.

2 has molecules in which each carbon atom has two bonds.

3 is unreactive.

4 will burn to produce carbon dioxide and hydrogen.

4.7.3.1 Addition polymerisation

3D Poly(ethene) is a polymer that is made from an alkene.

The polymer is . . .

1 produced by thermal decomposition.

2 a thermosoftening polymer.

3 produced by cracking.

4 biodegradable.

Turn over for the next question

4.7.3.1 Addition polymerisation

Question 16

QUESTION EIGHT

Four hydrocarbons, **K**, **L**, **M** and **N**, were each analysed to measure their carbon and hydrogen content.

The results are shown in the table.

	Hydrocarbon			
	K	**L**	**M**	**N**
Number of hydrogen atoms in each molecule	8	20	8	12
Number of carbon atoms in each molecule	4	10	16	5

8A From the table we can deduce that . . .

1 none of the four is an alkene.

2 **K** and **L** are alkenes.

3 only **M** is an alkene.

4 only **N** is an alkene.

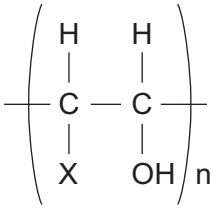
8B Hydrocarbon **N** cannot be used to make a polymer because its molecules . . .

1 are too short.

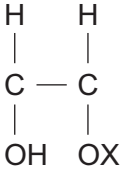
2 have an odd number of carbon atoms.

3 have fewer carbon atoms than hydrogen atoms.

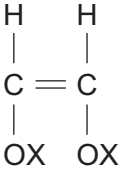
4 do not have a carbon carbon double bond.

8C The polymer with the formula  where 'n' is a large number, could be made from the monomer . . .

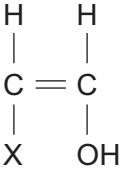
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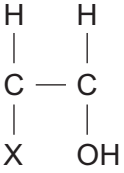
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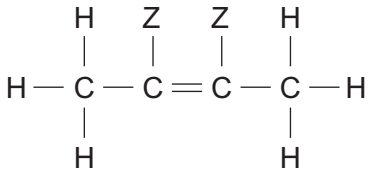


4



4.7.3.1 Addition polymerisation

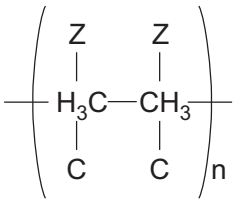
Question 16 · continued

8D The monomer  is made into a polymer.

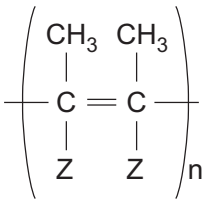
In the formulae below, 'n' is a large number.

The polymer may be represented as . . .

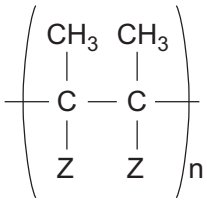
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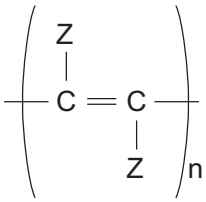
2



3



4



4.7.3.1 Addition polymerisation

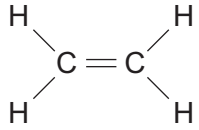
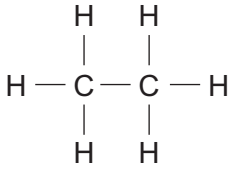
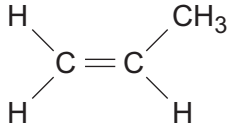
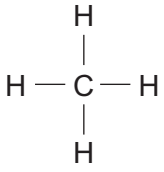
Question 17

November 2011 | CHY1BP | Original Q5 | Legacy

QUESTION FIVE

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

5A 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	

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.

5B 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.

4.7.3.1 Addition polymerisation

Question 17 · continued

November 2011 | CHY1BP | Original Q5 | Legacy

5C 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.

5D 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

4.7.3.1 Addition polymerisation

Question 18

June 2015 | CH2HP | Original Q3 | Legacy

3 This question is about metals and alloys.

3 (a) Explain how electricity is conducted in a metal.

To gain full marks you must include a description of the structure and bonding of a metal.

[4 marks]

.....

.....

.....

.....

.....

.....

.....

.....

3 (b) Describe how the structure of an alloy is different from the structure of a pure metal.

[2 marks]

.....

.....

.....

.....

3 (c) Alloys are used to make dental braces and coins.

3 (c) (i) Nitinol is an alloy used in dental braces.

Why is Nitinol used in dental braces?

[1 mark]

.....

.....

4.7.3.1 Addition polymerisation

Question 18 · continued

3 (c) (ii) Suggest **one** reason why coins are not made of pure copper.

Do **not** give cost as a reason.

[1 mark]

.....

.....

3 (c) (iii) Some coins are made from an alloy of aluminium.

Complete the sentence.

[1 mark]

Aluminium is manufactured by the electrolysis of a molten mixture of

cryolite and ..... .

3 (c) (iv) Banks keep coins in poly(ethene) bags. These bags are made from low density poly(ethene).

High density poly(ethene) can also be made from the same monomer.

How can the same reaction produce two different products?

[1 mark]

.....

.....

3 (d) Give **two** reasons why instrumental methods of analysis are used to detect impurities in metals.

[1 mark]

.....

.....

.....

11

4.7.3.1 Addition polymerisation

Question 19

June 2018 | 8462/2H | Original Q6

0 6 This question is about polymers.

0 6 . 1 Polyesters are produced when monomers join together and lose a small molecule.

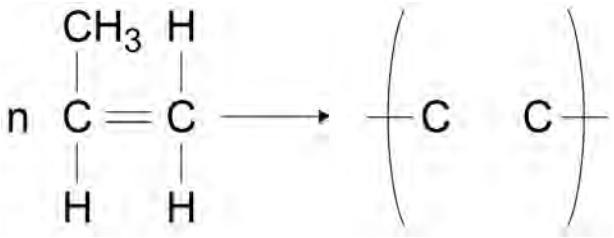
Name the small molecule lost.

[1 mark]

0 6 . 2 Poly(propene) is produced from propene.

Complete the structure of poly(propene) in the equation.

[3 marks]



0 6 . 3 Carpets are made from:

- poly(propene)
- wool
- a mixture of poly(propene) and wool.

Poly(propene) wears out more slowly than wool.

A mixture of poly(propene) and wool to make carpets is more sustainable than using just poly(propene) or just wool.

Suggest why.

[2 marks]

4.7.3.1 Addition polymerisation

Question 19 · continued

Polymer fibres are used to make firefighter uniforms.

Table 3 shows some properties of two polymer fibres.

Table 3

	Polymer fibres	
Property	**Poly(propene)**	**Polyester**
Density in g/cm^3	0.90	1.38
Melting point in °C	165	260
Flame resistance	Poor	Good
Water absorption	Low	High

0 6 . 4 Evaluate the suitability of poly(propene) and polyester for firefighter uniforms.

[4 marks]

10

4.7.3.1 Addition polymerisation

Question 20

June 2019 | 8462/2H | Original Q6

0 6 **Figure 5** shows a surfer on a surfboard.

Figure 5



Surfboards are made from polymers.

Surfboards have a poly(styrene) core and an outer skin.

0 6 . 1 **Figure 6** shows the displayed structural formula of poly(styrene).

Figure 6

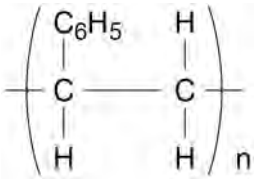
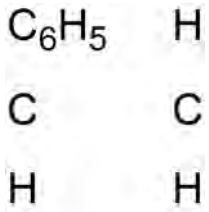


Figure 7 shows an incomplete displayed structural formula of the monomer styrene.

Complete **Figure 7**.

[2 marks]

Figure 7



4.7.3.1 Addition polymerisation

Question 20 · continued

The outer skin of surfboards contains a polyester.

Two monomers, **A** and **B**, are needed to make the polyester.

Figure 8 shows how these two monomers are represented.

Figure 8



Monomer **A** Monomer **B**

0 6 . 2 Name the functional group in monomer **B**.

[1 mark]

0 6 . 3 Monomers **A** and **B** join together to produce a polyester and a small molecule.

Name the small molecule.

[1 mark]

0 6 . 4 Why does this type of polyester melt when it is heated?

[2 marks]

4.7.3.1 Addition polymerisation

Question 20 · continued

The outer skin of surfboards is a composite material.

The composite material contains glass fibres surrounded by a polyester.

0 6 . 5 Draw **one** line from each material to the description of that material.

[2 marks]

Material	Description of the material
	Hydrocarbon
Glass fibres	Matrix
	Monomer
Polyester	Polypeptide
	Reinforcement

0 6 . 6 The outer skin makes the surfboard more expensive.

Suggest **two** reasons why an outer skin is added to the poly(styrene) core.

[2 marks]

1 _____

_____

2 _____

_____

10

4.7.3.1 Addition polymerisation

Question 21

November 2021 | 8462/2H | Original Q4

0 4 This question is about poly(ethene) and polyesters.

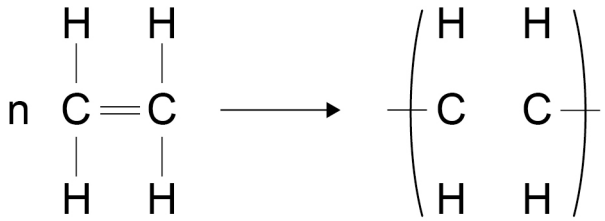
0 4 . 1 Poly(ethene) is produced from ethene.

Figure 3 shows part of the displayed structural formula equation for the reaction.

Complete **Figure 3**.

[2 marks]

Figure 3



0 4 . 2 Poly(ethene) is a thermosoftening polymer.

Suggest why poly(ethene) is easier to recycle than thermosetting polymers.

[2 marks]

0 4 . 3 Ethene produces different forms of poly(ethene).

How can different forms of poly(ethene) be produced from ethene?

[1 mark]

4.7.3.1 Addition polymerisation

Question 21 · continued

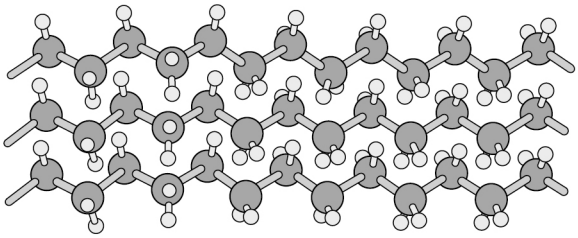
0 4 . 4 Two different forms of poly(ethene) are:

- high density poly(ethene) (HDPE)
- low density poly(ethene) (LDPE).

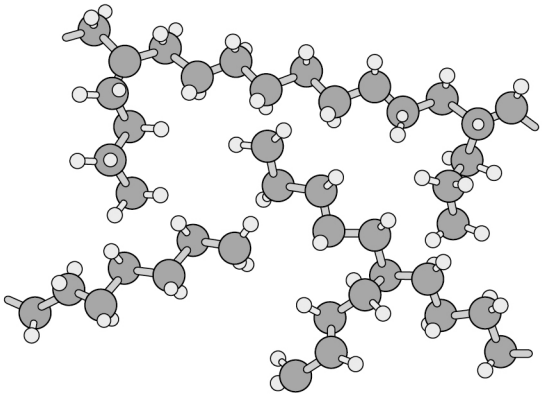
Figure 4 represents part of the structures of HDPE and LDPE.

Figure 4

HDPE



LDPE



Explain why HDPE has a higher density than LDPE.

[2 marks]

Question 4 continues on the next page.

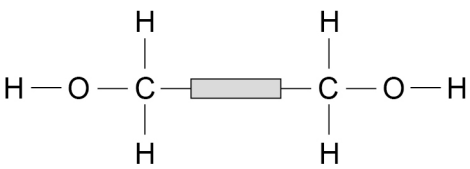
4.7.3.1 Addition polymerisation

Question 21 · continued

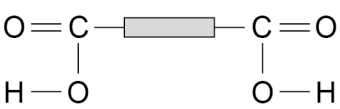
Figure 5 shows three monomers, **A**, **B** and **C**.

Monomer **A** can react with monomer **B** and with monomer **C** to produce polyesters.

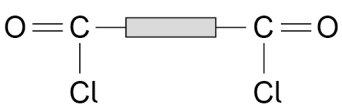
Figure 5



Monomer **A**



Monomer **B**



Monomer **C**

0 4 . 5 Draw a circle on **Figure 5** around an alcohol functional group.

[1 mark]

0 4 . 6 Complete **Table 2** to show the formula of the small molecule produced when:

- monomer **A** reacts with monomer **B**
- monomer **A** reacts with monomer **C**.

[1 mark]

Table 2

Reacting monomers	Formula of small molecule produced
A and **B**	
A and **C**	

9

4.7.3.1 Addition polymerisation

Question 22

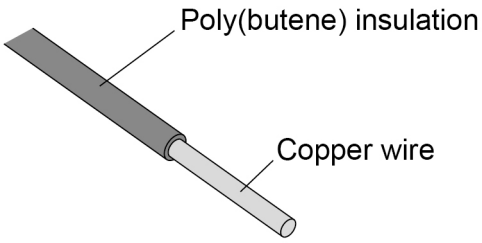
June 2022 | 8462/2H | Original Q1

0 1 This question is about copper wire and copper compounds.

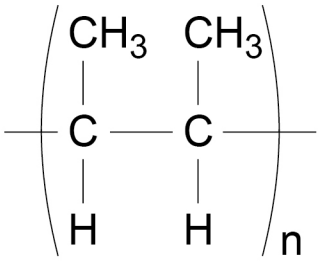
Copper is used to make electrical wires.

Figure 1 shows how copper electrical wire is insulated using an addition polymer called poly(butene).

Figure 1



0 1 . 1 The addition polymer poly(butene) has the displayed structural formula:

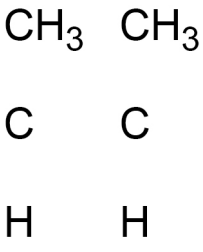


Poly(butene) is produced from the monomer butene.

Complete **Figure 2** to show the displayed structural formula of butene.

[2 marks]

Figure 2



4.7.3.1 Addition polymerisation

Question 22 · continued

Copper can be obtained by recycling scrap copper wire.

0 1 . 2 Suggest why poly(butene) insulation must be removed from scrap copper wire before the copper is recycled.

[1 mark]

0 1 . 3 Describe how scrap copper wire can be recycled to make new copper water pipes.

[2 marks]

0 1 . 4 Suggest **two** reasons why recycling scrap copper is more sustainable than extracting copper from copper ores.

[2 marks]

1

2

Question 1 continues on the next page

4.7.3.1 Addition polymerisation

Question 22 · continued

Copper sulfate is a compound of copper.

Copper sulfate solution contains copper(II) ions and sulfate ions.

0 1 . 5 A solution can be added to copper sulfate solution to show the presence of copper(II) ions.

Name the solution added.

Give the result of the test.

[2 marks]

Name of solution added _____

_____

Result _____

_____

0 1 . 6 Describe **one** test to show the presence of sulfate ions in copper sulfate solution.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

11

4.7.3.1 Addition polymerisation

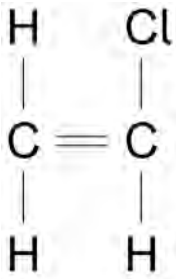
Question 23

June 2023 | 8462/2H | Original Q8

0 8 This question is about polymers.

Chloroethene can be used to produce an addition polymer called poly(chloroethene).

The displayed structural formula of chloroethene is

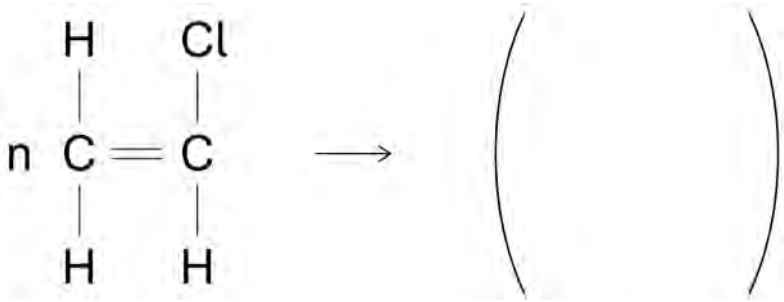


0 8 . 1 Draw a circle around the functional group on the displayed structural formula that allows chloroethene to produce an addition polymer.

[1 mark]

0 8 . 2 Complete the equation for the production of poly(chloroethene) from chloroethene.

[3 marks]



0 8 . 3 Poly(ethene) can be strengthened with wood particles to make a building material.

The building material consists of a wood particle reinforcement embedded in a poly(ethene) matrix.

What general name is given to materials like this?

[1 mark]

4.7.3.1 Addition polymerisation

Question 23 · continued

0 8 . 4 The amino acid beta-alanine has the formula

$$H_2NCH_2CH_2COOH$$

Beta-alanine polymerises to produce a polypeptide and a small molecule.

Name the small molecule produced when beta-alanine polymerises.

[1 mark]

0 8 . 5 An amino acid can be represented as:



The relative formula mass (M_r) of this amino acid is 75

Calculate the relative formula mass of the section of this amino acid molecule represented by



Relative atomic masses (A_r): H = 1 C = 12 N = 14 O = 16

[2 marks]

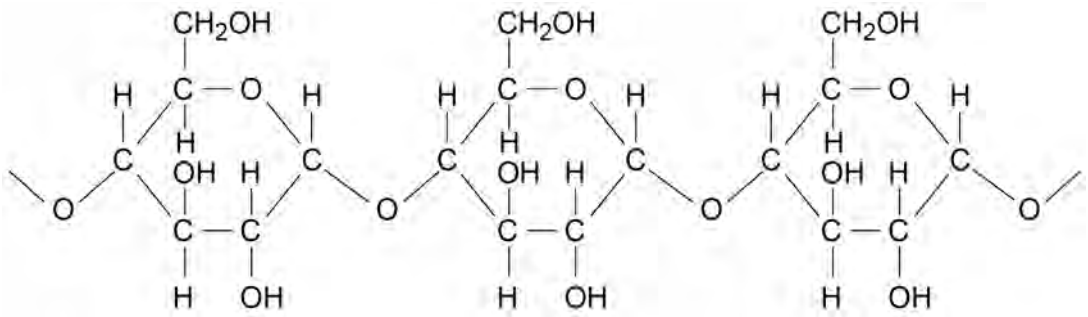
Relative formula mass = _____

4.7.3.1 Addition polymerisation

Question 23 · continued

Figure 6 represents part of a naturally occurring polymer molecule produced from glucose.

Figure 6



0 8 . 6 Draw a circle around the repeating unit in the polymer in **Figure 6**.

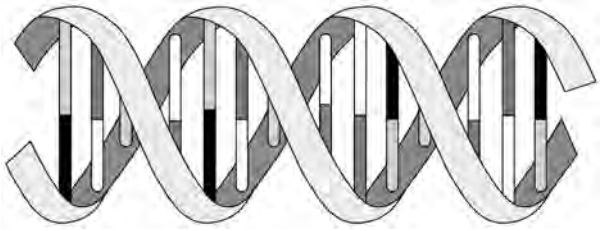
[1 mark]

0 8 . 7 Suggest the identity of this polymer.

[1 mark]

Figure 7 represents the structure of a naturally occurring polymer.

Figure 7



0 8 . 8 Give the general name for the four different monomers which make up the structure shown in **Figure 7**.

[1 mark]

0 8 . 9 Name the **shape** of the structure shown in **Figure 7**.

[1 mark]

12

4.7.3.1 Addition polymerisation

Question 24

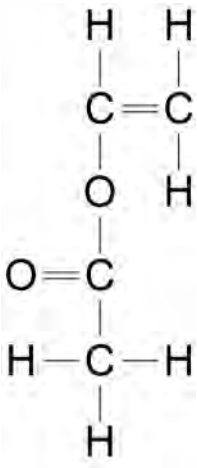
June 2024 | 8462/2H | Original Q8

0 8 This question is about monomers and polymers.

Compound **A** has an alkene functional group and an ester functional group.

Figure 8 represents a molecule of compound **A**.

Figure 8



0 8 . 1 Draw a circle around the alkene functional group on **Figure 8**.

[1 mark]

0 8 . 2 Describe what will be seen when compound **A** is shaken with bromine water.

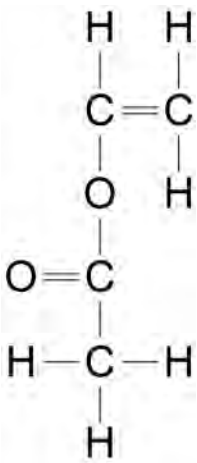
[2 marks]

Question 8 continues on the next page

4.7.3.1 Addition polymerisation

0 8 . 3 **Figure 9** is a repeat of **Figure 8**.

Figure 9



Draw a circle around the ester functional group on **Figure 9**.

[1 mark]

0 8 . 4 Compound **A** has the formula $C_4H_6O_2$

Compound **A** is flammable.

Write a balanced equation for the complete combustion of compound **A**.

[3 marks]

_____ + _____ → _____ + _____

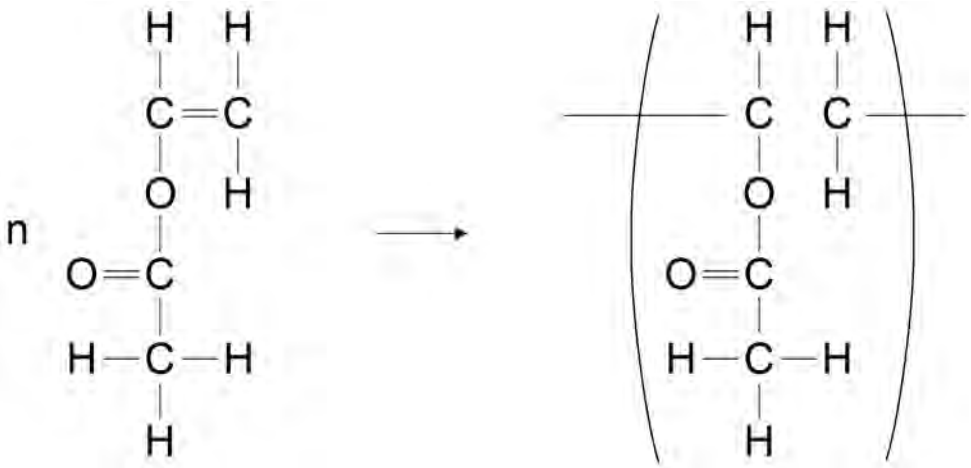
4.7.3.1 Addition polymerisation

Question 24 · continued

0 8 . 5 Many molecules of compound **A** join together to form polymer **B**.

Complete the displayed formula equation which represents this reaction.

[2 marks]



0 8 . 6 What type of polymer is polymer **B**?

[1 mark]

Tick (✓) **one** box.

- Addition polymer ☐
- Condensation polymer ☐
- DNA ☐
- Protein ☐

Question 8 continues on the next page

4.7.3.1 Addition polymerisation

Question 24 · continued

Polymer **B** is a polymer which melts when heated.

0 8 . 7 What word is used to describe polymers which melt when heated?

[1 mark]

0 8 . 8 Explain why some polymers do **not** melt when heated.

[2 marks]

13