AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.10.3.3

Ceramics, polymers and composites

Past-paper questions

Tier	**Higher**
Question groups	**31**
Available paper years	**2007–2025**

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.

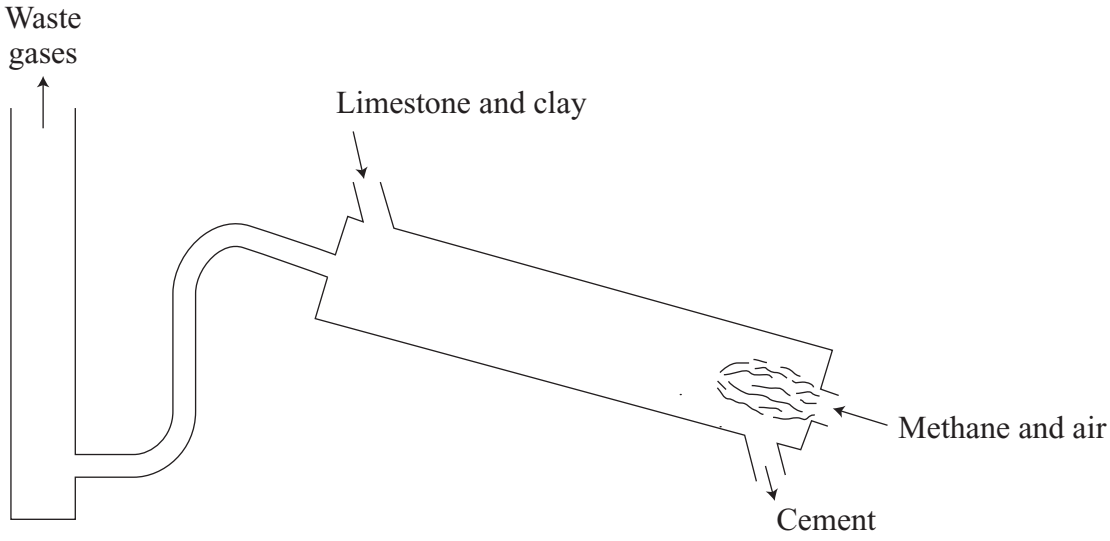
4.10.3.3 Ceramics, polymers and composites

Question 01

June 2007 | CHY1H | Original Q1 | Legacy

1 Limestone contains the compound calcium carbonate, $CaCO_3$.

(a) Limestone is used to make cement in a rotary kiln.



Use the information in the diagram to name the **two** main waste gases from this rotary kiln.

1 .....

2 .....

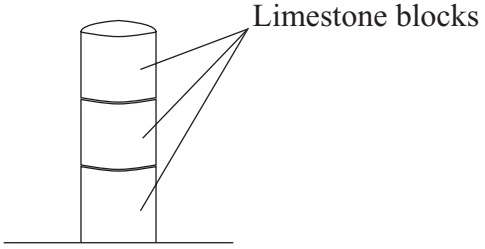
(2 marks)

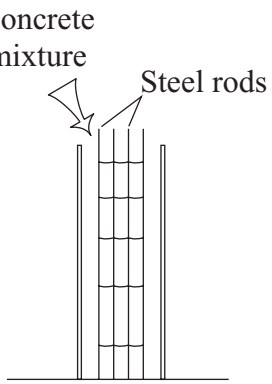
4.10.3.3 Ceramics, polymers and composites

Question 01 · continued

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(b) Columns used as supports for buildings can be made from materials such as limestone blocks or concrete.





Concrete is a mixture of cement, sand, small stones and water

From the diagrams, name which you think is the better material for making a column.

.....

Give **three** advantages for your choice of material.

1 .....

.....

2 .....

.....

3 .....

.....

(3 marks)

5

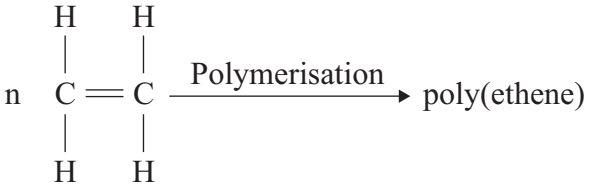
4.10.3.3 Ceramics, polymers and composites

Question 02

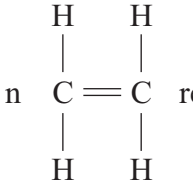
November 2007 | CHY1B | Original Q6 | Legacy

QUESTION SIX

The equation shows how poly(ethene) is made.



6A



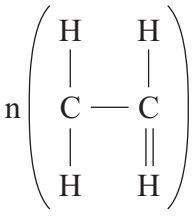
1 one molecule of poly(ethene).

2 one molecule of ethene.

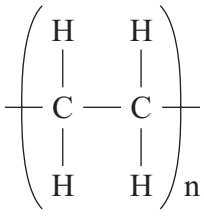
3 two molecules of ethene.

4 many molecules of ethene.

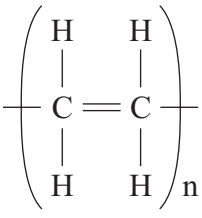
6B The formula for poly(ethene) is . . .



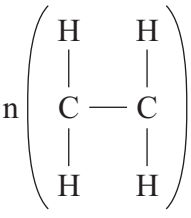
1



2



3



4

4.10.3.3 Ceramics, polymers and composites

Question 02 · 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.

4.10.3.3 Ceramics, polymers and composites

Question 03

2 Soda-lime glass is made by heating, to above 1500 °C, a mixture of:

soda (sodium carbonate), Na_2CO_3
limestone (calcium carbonate), $CaCO_3$
sand (silicon dioxide), SiO_2

(a) (i) Which element do all of these compounds contain?

.....

(1 mark)

(ii) Explain what the formula Na_2CO_3 shows about the compound.

.....

.....

.....

.....

(2 marks)

(b) Calcium carbonate breaks down when heated to above 1500 °C.

(i) Write a word equation to show what happens.

..... → ..... + ...

(2 marks)

(ii) What is the name of this type of chemical reaction?

.....

(1 mark)

4.10.3.3 Ceramics, polymers and composites

Question 03 · continued

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(c) The melting point of soda-lime glass is about 750 °C.
The raw materials for making soda are limestone and common salt (sodium chloride).
There are almost unlimited amounts of the raw materials available to manufacture soda-lime glass.

From the information given, what is the most important reason for recycling soda-lime glass?

.....

.....

(1 mark)

7

Turn over for the next question

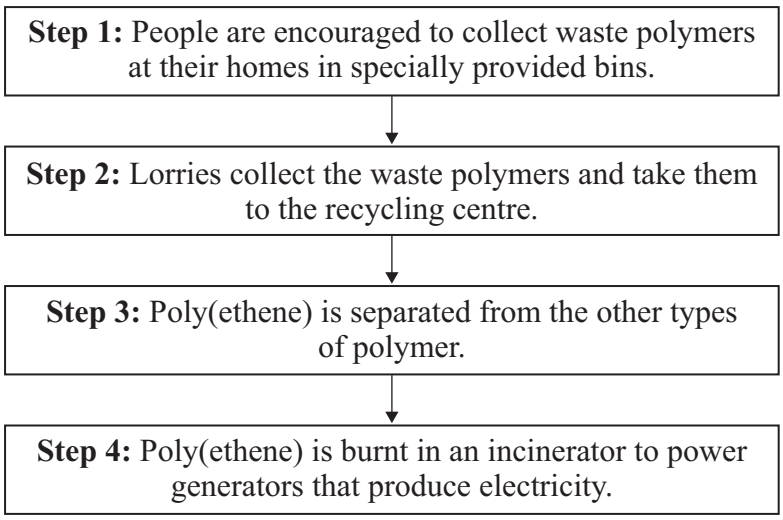
4.10.3.3 Ceramics, polymers and composites

Question 04

June 2008 | CHY1BP | Original Q3 | Legacy

QUESTION THREE

The flow chart shows how the waste poly(ethene) from our homes can be used.



3A One problem associated with **Step 1** is that . . .

1 some people do **not** put their waste polymers in the special bins.

2 people prefer to burn their waste polymers.

3 poly(ethene) is toxic.

4 waste polymers rot and begin to smell.

3B One problem associated with **Step 2** is that . . .

1 burning diesel fuel in lorries can increase global warming.

2 people do **not** know where the recycling centres are.

3 the bins of waste polymers are very heavy.

4 the lorries are hard to recognise.

4.10.3.3 Ceramics, polymers and composites

Question 04 · continued

3C One problem associated with **Step 3** is that . . .

1 all polymers are the same colour.

2 polymers **cannot** be melted down.

3 polymers are magnetic.

4 separating polymers costs money.

3D One reason why all waste polymers are **not** burned in **Step 4** is that . . .

1 burning polymers can produce toxic gases.

2 polymers are poor conductors of electricity.

3 some polymers melt before burning.

4 burning polymers produces too much heat.

Turn over for the next question

4.10.3.3 Ceramics, polymers and composites

Question 05

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.

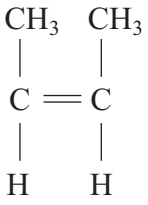
3 have chemical bonds between the chains which break on heating.

4 be capable of being shaped on heating.

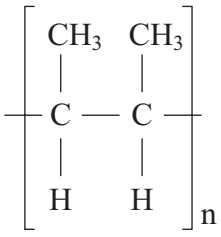
4.10.3.3 Ceramics, polymers and composites

Question 05 · continued

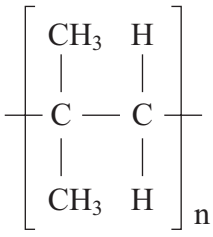
7C Which one of the following polymers can be formed by polymerising the alkene with this formula?



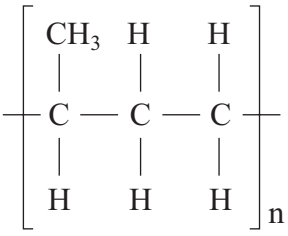
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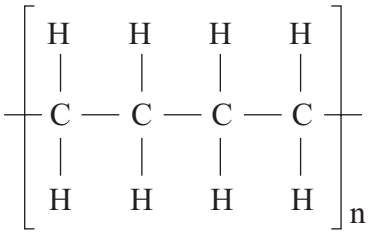
2



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.

4.10.3.3 Ceramics, polymers and composites

Question 06

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.

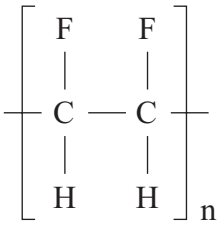
2 does **not** react with bromine.

3 reacts with hydrogen in the presence of a catalyst.

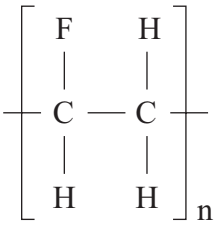
4 can be produced by cracking alkanes.

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

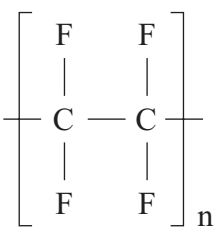
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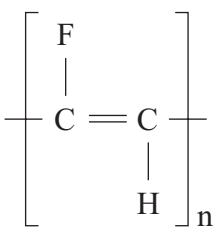
2



3



4



4.10.3.3 Ceramics, polymers and composites

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

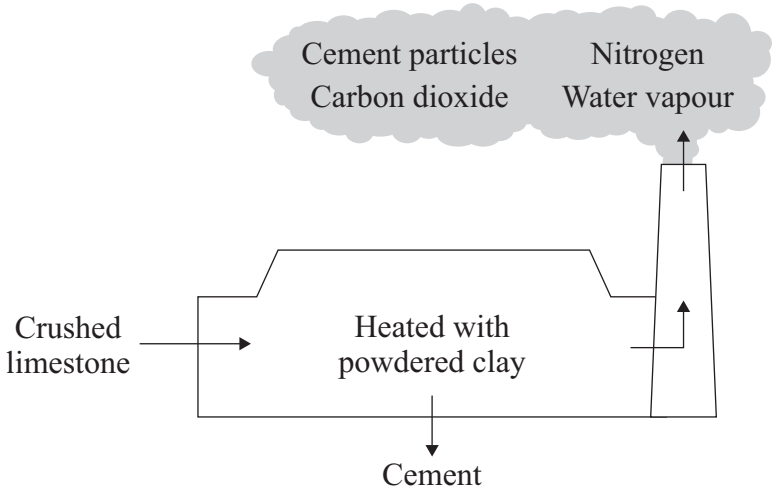
4.10.3.3 Ceramics, polymers and composites

Question 07

June 2009 | CHY1H | Original Q1 | Legacy

1 A limestone quarry is in an area of natural beauty and near several villages.
The company operating the quarry wants planning permission to build a new cement works in the quarry.

The diagram shows some of the substances used and produced at a cement works.



1 (a) Limestone is mainly calcium carbonate, $CaCO_3$.
Write the correct number in the box to complete each sentence.

1 (a) (i) The formula shows that calcium carbonate, $CaCO_3$,

contains ☐ different elements.

(1 mark)

1 (a) (ii) Calcium carbonate, $CaCO_3$, contains a total number of ☐ atoms.

(1 mark)

4.10.3.3 Ceramics, polymers and composites

Question 07 · continued

for mark

1 (b) The company wants the new cement works because the nearest cement works is 100 km from the quarry. The company argues that a new cement works sited inside the quarry would reduce carbon dioxide emissions.

Suggest why the new cement works might reduce carbon dioxide emissions.

.....

.....

.....

(1 mark)

1 (c) Residents from the villages near the quarry are concerned that there will be atmospheric pollution from the new cement works.

1 (c) (i) Name and explain how **one** of the emissions from the chimney causes atmospheric pollution.

Name of emission: .....

Explanation: .....

.....

(2 marks)

1 (c) (ii) Suggest what the company could do to reduce this atmospheric pollution.

.....

.....

(1 mark)

6

4.10.3.3 Ceramics, polymers and composites

Question 08

June 2009 | CHY1H | Original Q6 | Legacy

6 (a) PEX is a material that is used as an alternative to copper for hot water pipes. PEX is made from poly(ethene).

6 (a) (i) Describe how ethene forms poly(ethene).

.....

.....

.....

.....

(2 marks)

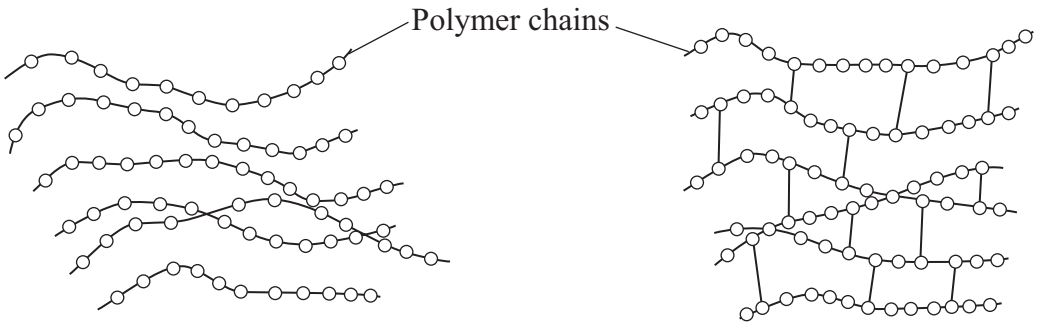
6 (a) (ii) PEX is a shape memory polymer. What property does a shape memory polymer have?

.....

.....

(1 mark)

6 (a) (iii) The simplified structures of poly(ethene) and PEX are shown.



Poly(ethene) **PEX**

Poly(ethene) is a thermoplastic that softens easily when heated.

Suggest and explain how the structure of PEX changes this property.

.....

.....

.....

.....

.....

(3 marks)

4.10.3.3 Ceramics, polymers and composites

Question 08 · continued

for mark

6 (b) Copper was considered to be the most suitable material to use for hot water pipes. PEX is now used as an alternative material for hot water pipes.

Copper is extracted from its ore by a series of processes.

1 The low-grade ore is powdered and concentrated.
2 Smelting is carried out in an oxygen flash furnace. This furnace is heated to 1100 °C using a hydrocarbon fuel. The copper ore is blown into the furnace with air, producing impure, molten copper.
3 Oxygen is blown into the impure, molten copper to remove any sulfur. The copper is cast into rectangular slabs.
4 The final purification of copper is done by electrolysis.

PEX is made from crude oil by a series of processes.

1 Fractional distillation
2 Cracking
3 Polymerisation
4 Conversion of poly(ethene) into PEX

Suggest the possible environmental advantages of using PEX instead of copper for hot water pipes.

.....

.....

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.....

(4 marks)

10

4.10.3.3 Ceramics, polymers and composites

Question 09

March 2010 | CHY1AP | Original Q7 | Legacy

QUESTION SEVEN

Glass is made by heating limestone with silicon dioxide at 1700 °C. Sodium carbonate and potassium carbonate are also added.

7A Limestone contains calcium carbonate. The reaction between calcium carbonate and silicon dioxide produces calcium silicate. The equation for this reaction is:

$$CaCO_3 + SiO_2 \rightarrow \mathbf{X} + CO_2$$

X represents the formula for calcium silicate.

The equation will be balanced if the formula for calcium silicate is . . .

1 $CaSiO_2$

2 $CaSi_2O$

3 $CaSiO_3$

4 Ca_2SiO_2

Glass sheets are produced by pouring hot liquid glass onto molten tin. The glass floats on top of the molten tin and is allowed to cool. The viscosity of the hot liquid glass needs to be just right when poured onto the molten tin.

The viscosity of hot liquid glass depends partly on its temperature. The viscosity also depends on the composition of the glass.

The table shows how the lowest pouring temperature depends on the amounts of sodium and potassium in the glass.

Sodium percentage (%)	Potassium percentage (%)	Lowest pouring temperature in °C
0	20	450
4	16	400
10	10	390
16	4	395
18	2	410
20	0	440

4.10.3.3 Ceramics, polymers and composites

Question 09 · continued

7B The manufacturer wants to use the lowest pouring temperature for the glass.

In what range of sodium content should further work be done to determine the lowest pouring temperature?

1 0% to 10%

2 4% to 16%

3 10% to 18%

4 16% to 20%

7C Listed below are four possible reasons why the manufacturer wants to use the lowest pouring temperature.

Reason **K** – It uses less energy
Reason **L** – It reduces the loss of glass by evaporation
Reason **M** – It makes the process cheaper
Reason **N** – It increases carbon emissions

Which of these are the most likely reasons for using the lowest pouring temperature?

1 Reasons **K** and **L**

2 Reasons **K** and **M**

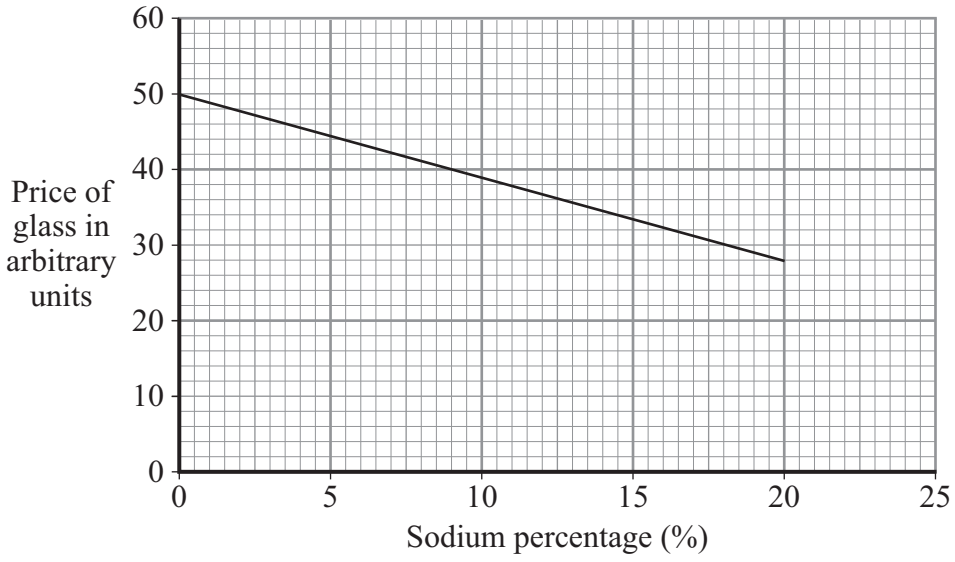
3 Reasons **L** and **N**

4 Reasons **M** and **N**

Question 7 continues on the next page

Question 09 · continued

7D The graph shows how the price of glass depends on the sodium percentage (%).



Use the information from the table on page 24 and the graph above.

What will be the effects of increasing the sodium percentage in the glass from 10% to 20%?

1 to decrease the price of the glass and decrease the pouring temperature

2 to decrease the price of the glass and increase the pouring temperature

3 to increase the price of the glass and decrease the pouring temperature

4 to increase the price of the glass and increase the pouring temperature

4.10.3.3 Ceramics, polymers and composites

Question 10

March 2010 | CHY1BP | Original Q5 | Legacy

QUESTION FIVE

Some properties of two forms of poly(ethene) are shown in the table.

Polymer	Density in kg per m^3	Tensile strength in MPa
Low-density poly(ethene) – LDPE	925	16
High-density poly(ethene) – HDPE	950	28

The molecules of low-density poly(ethene) and high-density poly(ethene) are represented in the diagrams.

Low-density poly(ethene) – LDPE



High-density poly(ethene) – HDPE



5A The reason for the differences in strength and density between LDPE and HDPE is that . . .

1 they contain different elements in their structure.

2 they were made under different conditions.

3 they have different colours added.

4 different monomers are used to make the chains.

5B HDPE has a higher density than LDPE because . . .

1 it is stronger.

2 more plastic is used to make LDPE.

3 the polymer molecules pack closer together in HDPE.

4 LDPE has shorter polymer chains.

4.10.3.3 Ceramics, polymers and composites

Question 10 · continued March 2010 | CHY1BP | Original Q5 | Legacy

5C Which is the most appropriate method for disposal of a non-biodegradable polymer such as poly(ethene)?

1 freeze it so that it returns to the original monomer

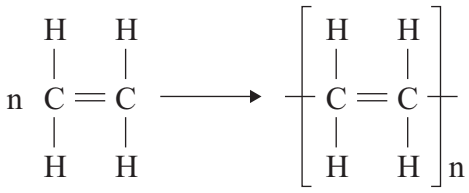
2 dispose of it at sea

3 bury it in the ground

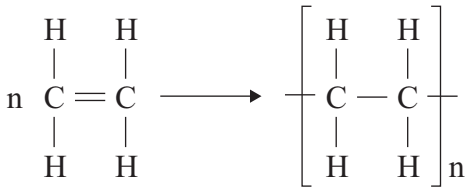
4 break it down by adding microorganisms

5D Which one of the following is the correct balanced equation for the polymerisation of ethene to form poly(ethene)?

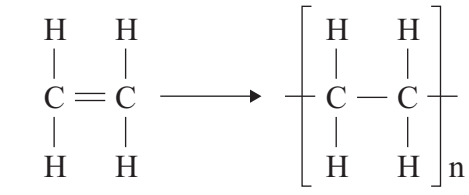
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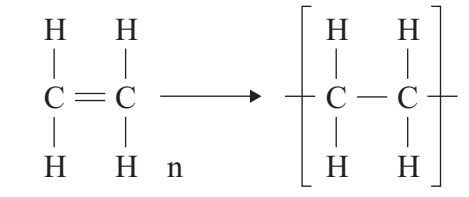
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3



4



4.10.3.3 Ceramics, polymers and composites

Question 11 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.

4.10.3.3 Ceramics, polymers and composites

Question 11 · continued

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

4.10.3.3 Ceramics, polymers and composites

Question 12

November 2010 | CHY1BP | Original Q4 | Legacy

QUESTION FOUR

The equation shows the thermal decomposition of a hydrocarbon.

$$C_6H_{14} \longrightarrow \underset{\text{Ethene}}{C_2H_4} + \text{Substance } \mathbf{K}$$

4A What is the formula for substance **K**?

1 CH_4

2 C_2H_6

3 C_4H_{10}

4 C_8H_{18}

4B Ethene, C_2H_4 is . . .

1 an alkane.

2 an alkene.

3 a saturated hydrocarbon.

4 a polymer.

4C Ethene, C_2H_4 can form polymers because . . .

1 it contains both carbon atoms and hydrogen atoms.

2 it contains twice as many carbon atoms as hydrogen atoms.

3 the carbon atoms and hydrogen atoms are linked by single bonds.

4 there is a double bond between the carbon atoms.

4D Poly(ethene) is used to make shopping bags.

A problem with poly(ethene) is that . . .

1 it is not waterproof.

2 it cannot be coloured.

3 it is not broken down by microorganisms.

4 it is a thermosetting polymer.

4.10.3.3 Ceramics, polymers and composites

Question 13

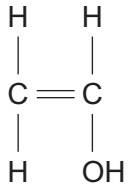
November 2010 | CHY1BP | Original Q7 | Legacy

QUESTION SEVEN

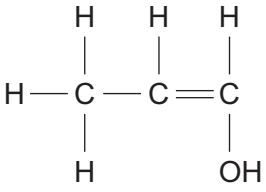
This question is about compounds that contain a double carbon carbon bond.

7A The structures of ethenol and propenol are shown below.

Ethenol



Propenol



Ethenol and propenol belong to a family of compounds with the general formula . . .

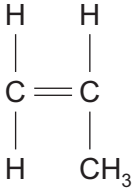
1 C_nH_nOH

2 $C_nH_{2n}OH$

3 $C_nH_{2n-1}OH$

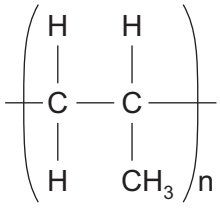
4 $C_nH_{2n+1}OH$

The formula for propene can be shown as:

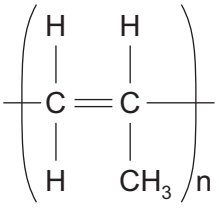


7B The polymer, poly(propene), will have the formula:

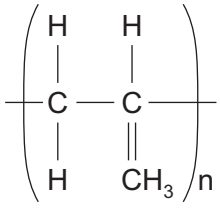
1



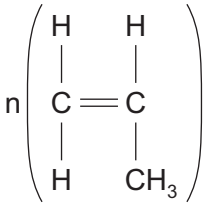
2



3



4



4.10.3.3 Ceramics, polymers and composites

7C 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.

7D 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.

Turn over for the next question

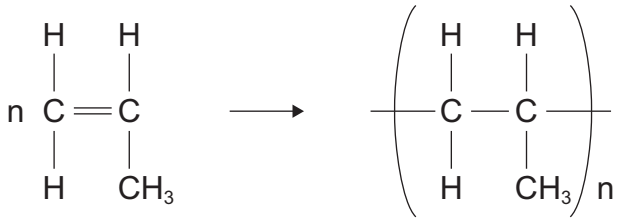
4.10.3.3 Ceramics, polymers and composites

Question 14

March 2011 | CHY1BP | Original Q4 | Legacy

QUESTION FOUR

The equation shows a chemical reaction.



Small molecules of hydrocarbon **X**

Large molecule of hydrocarbon **Y**

4A Hydrocarbon **X** is . . .

1 an alkane.

2 a polymer.

3 an alkene.

4 a catalyst.

4B Hydrocarbon **Y** is . . .

1 an unsaturated compound.

2 a polymer.

3 an alkene.

4 a monomer.

4C Poly(propene) is a thermosoftening polymer so it **cannot** be used to make . . .

1 buckets.

2 food containers.

3 non-stick coating for frying pans.

4 washing-up bowls.

4.10.3.3 Ceramics, polymers and composites

Question 14 · continued

4D Putting poly(propene) and other polymer waste into landfill creates a problem because this type of waste . . .

1 is very lightweight and blows about.

2 is not biodegradable.

3 does not dissolve in water.

4 is very dense and sinks deep underground.

Turn over for the next question

4.10.3.3 Ceramics, polymers and composites

Question 15

June 2011 | CHY1BP | Original Q8 | Legacy

QUESTION EIGHT

This question is about the cracking of hydrocarbons.

8A Which of the following is a correctly balanced equation for the cracking of $C_{15}H_{32}$ in which two different alkenes are produced?

1 $C_{15}H_{32} \rightarrow 2C_2H_4 + C_3H_6 + C_8H_{18}$

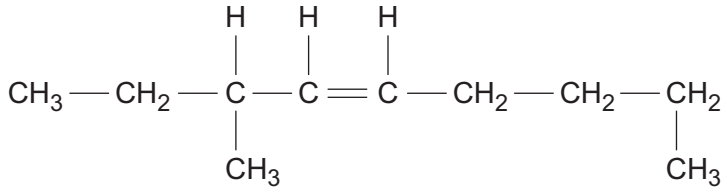
2 $C_{15}H_{32} \rightarrow 2CH_4 + C_3H_6 + C_4H_{10} + C_6H_{12}$

3 $C_{15}H_{32} \rightarrow 2C_3H_6 + C_9H_{20}$

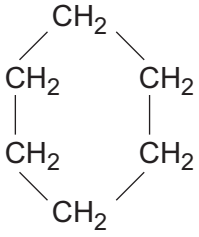
4 $C_{15}H_{32} \rightarrow C_4H_{10} + C_5H_{10} + C_6H_{14}$

8B Which of the following hydrocarbons that could be produced by the cracking of C_9H_{20} has the general formula C_nH_{2n} and decolourises bromine water?

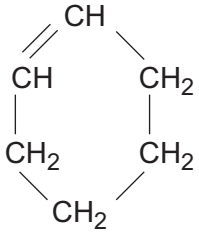
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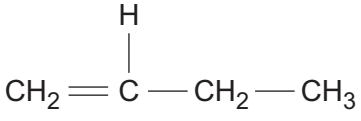
2



3



4

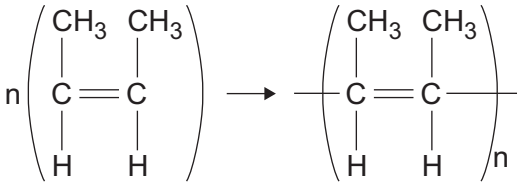


4.10.3.3 Ceramics, polymers and composites

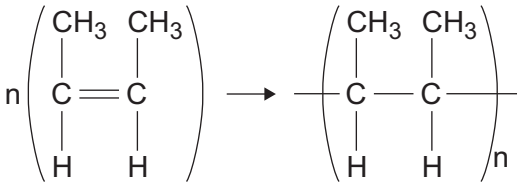
Question 15 · continued

8C Which of the following equations represents the polymerisation of butene?

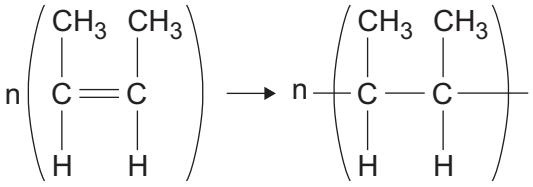
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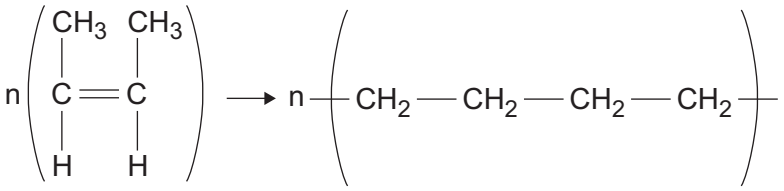
2



3



4



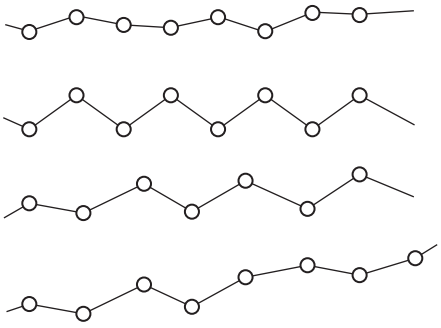
Question 8 continues on the next page

4.10.3.3 Ceramics, polymers and composites

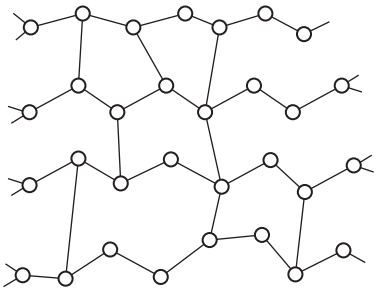
Question 15 · continued

8D The diagram shows the structures of a thermosoftening polymer and a thermosetting polymer.

Thermosoftening polymer



Thermosetting polymer



Which row in the table describes the properties of the two types of polymer?

	Thermosoftening polymer		Thermosetting polymer	
	Property 1	**Property 2**	**Property 1**	**Property 2**
1	Polymer molecules able to slide	Chemical bonds between the chains	Melt on heating	Short chain lengths
2	Long chain lengths	No chemical bonds between the chains	Chemical bonds between the chains	Polymer molecules able to slide
3	Long chain lengths	No chemical bonds between the chains	Do not melt on heating	Chemical bonds between the chains
4	Chemical bonds between the chains	Melt on heating	No chemical bonds between the chains	Long chain lengths

4.10.3.3 Ceramics, polymers and composites

Question 16

November 2011 | CHY1AP | Original Q5 | Legacy

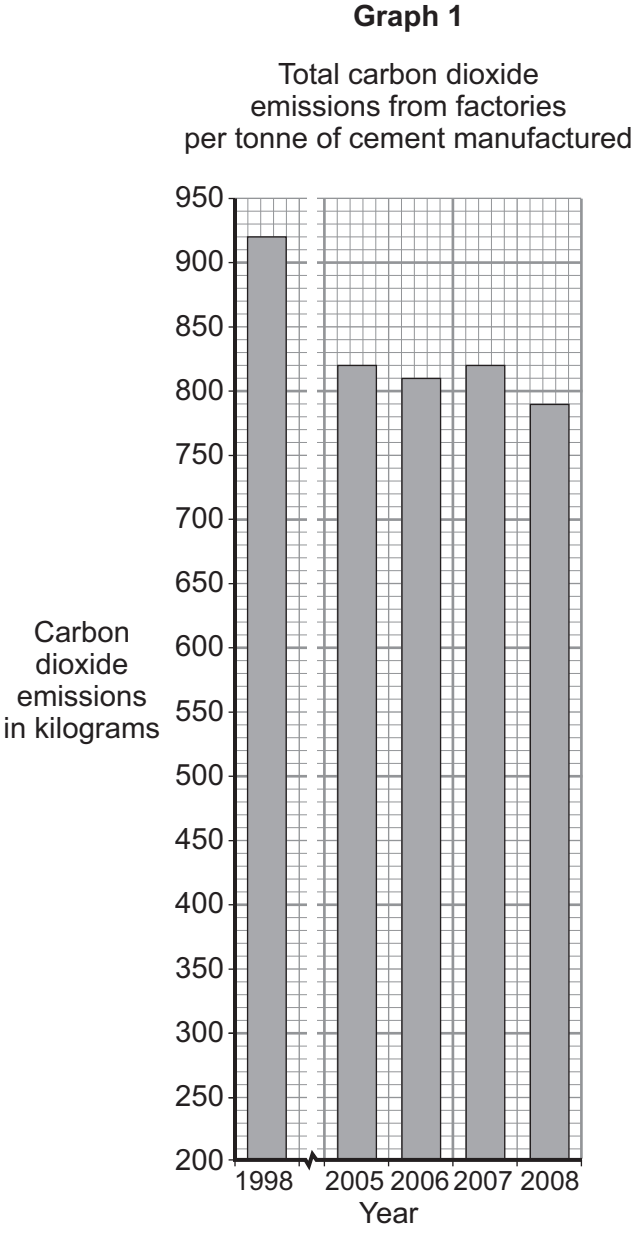
QUESTION FIVE

Cement is made in a rotary kiln, from a mixture of limestone and clay. The kiln is heated by burning a hydrocarbon fuel in air.

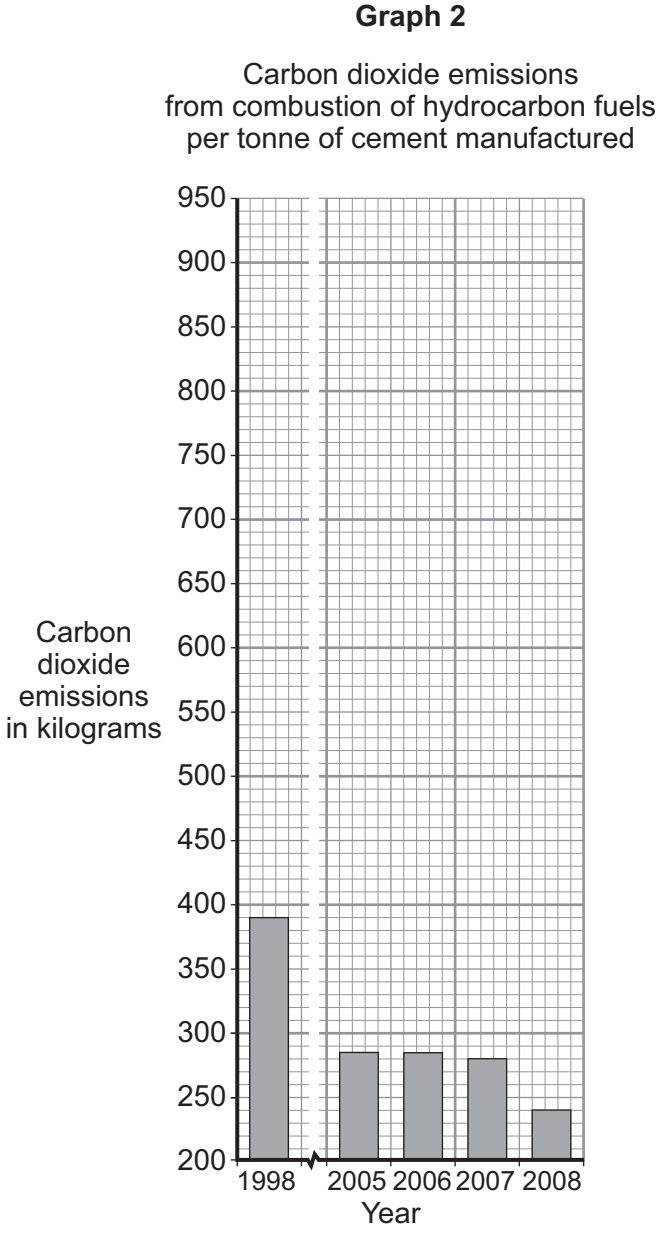
The cement industry needs to reduce carbon dioxide emissions.

Graphs 1 and **2** show carbon dioxide emissions from cement manufacture in Britain, between 1998 and 2008.

Graph 1



Graph 2



4.10.3.3 Ceramics, polymers and composites

Question 16 · continued

5A A correct conclusion from the information in the graphs is that . . .

1 the largest reduction in total emissions of carbon dioxide was from 1998 to 1999.

2 the largest reduction in emissions of carbon dioxide from combustion of hydrocarbon fuels was from 2007 to 2008.

3 from 2007 to 2008, total emissions of carbon dioxide, per tonne of cement manufactured, reduced by 40 kilograms.

4 from 2007 to 2008, emissions of carbon dioxide from combustion of hydrocarbon fuels, per tonne of cement manufactured, reduced by 40 kilograms.

5B What was the percentage reduction in emissions of carbon dioxide from combustion of hydrocarbon fuels at cement factories between 1998 and 2008?

1 16.2 %

2 38.5 %

3 61.5 %

4 84.4 %

5C What proportion of the carbon dioxide released during cement manufacture in 2006 came from combustion of hydrocarbon fuels?

1 0.23

2 0.35

3 0.61

4 0.85

5D Most of the carbon dioxide released during cement manufacture comes from . . .

1 hydrocarbons.

2 limestone.

3 quicklime.

4 slaked lime.

4.10.3.3 Ceramics, polymers and composites

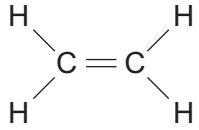
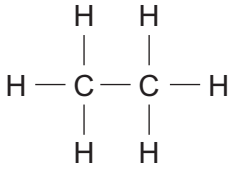
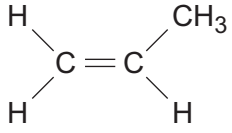
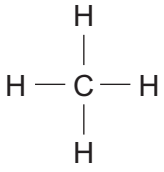
Question 17

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.

4.10.3.3 Ceramics, polymers and composites

Question 17 · continued

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

4.10.3.3 Ceramics, polymers and composites

Question 18

June 2012 | CH1HP | Original Q5 | Legacy

5 Calcium carbonate is found in limestone.
Limestone is used as a building material.
Limestone is also used to make calcium oxide and calcium hydroxide.

5 (a) Limestone is heated to make calcium oxide.

5 (a) (i) Calcium oxide reacts with a substance to produce calcium hydroxide.
Name the substance.

.....

(1 mark)

5 (a) (ii) Calcium hydroxide reacts with a substance to produce calcium carbonate.
Name the substance.

.....

(1 mark)

5 (b) Limestone reacts with acids.

5 (b) (i) Balance the chemical equation for the reaction of calcium carbonate with hydrochloric acid.

$$CaCO_3 + HCl \longrightarrow CaCl_2 + CO_2 + H_2O$$

(1 mark)

5 (b) (ii) Buildings made from limestone are affected by the products from burning fossil fuels containing sulfur.

Explain why.

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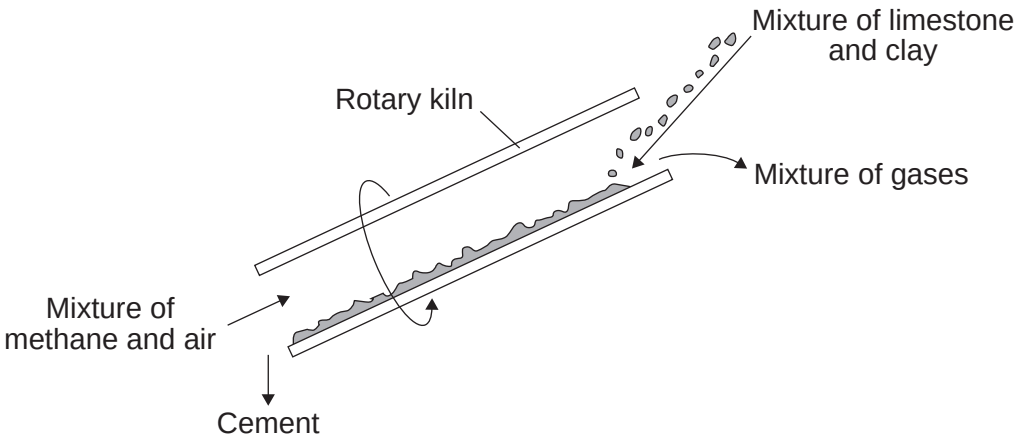
.....

(2 marks)

4.10.3.3 Ceramics, polymers and composites

Question 18 · continued

5 (c) When a mixture of limestone and clay is heated in a rotary kiln cement is produced.
Burning a mixture of methane and air heats the kiln.
Clay does not decompose in the kiln.



5 (c) (i) Carbon dioxide is one of the main gases in the mixture of gases coming out of the kiln.

Give **two** reasons why.

.....

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.....

(2 marks)

5 (c) (ii) Name the other main gas in the mixture of gases coming out of the kiln.

Give a reason why there is a high percentage of this gas in the mixture of gases coming out of the kiln.

Name of gas .....

Reason .....

.....

.....

(2 marks)

9

4.10.3.3 Ceramics, polymers and composites

Question 19

January 2013 | CH2HP | Original Q4 | Legacy

4 Thermosoftening polymers can be used to make plastic bottles and food packaging.

4 (a) The reaction to produce polymers uses a catalyst.

Why does the catalyst work for a long time before it needs replacing?

.....

.....

(1 mark)

4 (b) Thermosoftening polymers would **not** be suitable for packaging very hot food.

Explain why in terms of their properties and structure.

.....

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(2 marks)

4.10.3.3 Ceramics, polymers and composites

Question 19 · continued

4 (c) Compounds from food packaging must not contaminate the food.

Food can be tested for contamination using gas chromatography linked to mass spectroscopy (GC-MS).

4 (c) (i) Gas chromatography can separate substances in a mixture of compounds.

Describe how, as fully as you can.

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(3 marks)

4 (c) (ii) What information does the molecular ion peak give about the molecule?

.....

.....

(1 mark)

7

4.10.3.3 Ceramics, polymers and composites

Question 20

June 2013 | CH1HP | Original Q5 | Legacy

5 The amount of carbon dioxide in the Earth's atmosphere has changed since the Earth was formed.
The amount of carbon dioxide continues to change because of human activities.

5 (a) Cement is produced when a mixture of calcium carbonate and clay is heated in a rotary kiln. The fuel mixture is a hydrocarbon and air.

Hydrocarbons react with oxygen to produce carbon dioxide.
Calcium carbonate decomposes to produce carbon dioxide.

5 (a) (i) Complete each chemical equation by writing the formula of the other product.

$$CH_4 + 2O_2 \longrightarrow 2 \text{ .....} + CO_2$$

$$CaCO_3 \longrightarrow \text{.....} + CO_2$$

(2 marks)

5 (a) (ii) Hydrocarbons and calcium carbonate contain *locked up* carbon dioxide.

What is *locked up* carbon dioxide?

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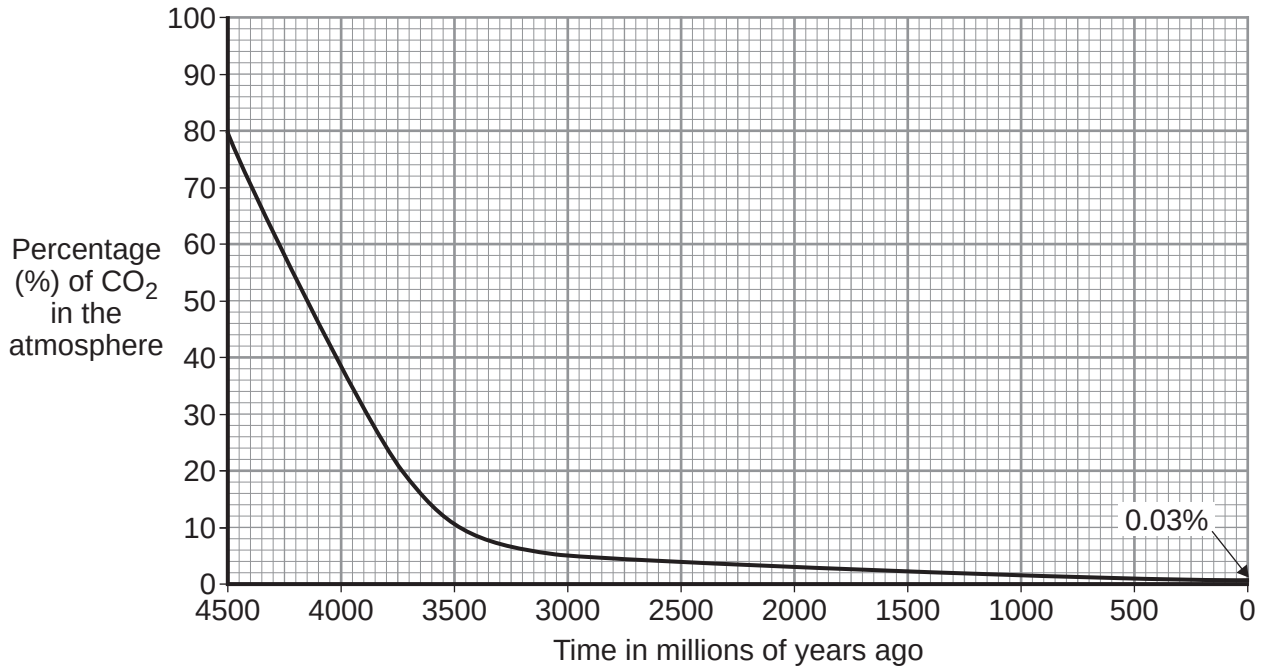
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(2 marks)

Question 20 · continued

5 (b) **Graph 1** shows how the percentage of carbon dioxide in the atmosphere changed in the last 4500 million years.

Graph 1



Use information from **Graph 1** to answer these questions.

5 (b) (i) Describe how the percentage of carbon dioxide has changed in the last 4500 million years.

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(2 marks)

5 (b) (ii) Give **two** reasons why the percentage of carbon dioxide has changed.

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.....

(2 marks)

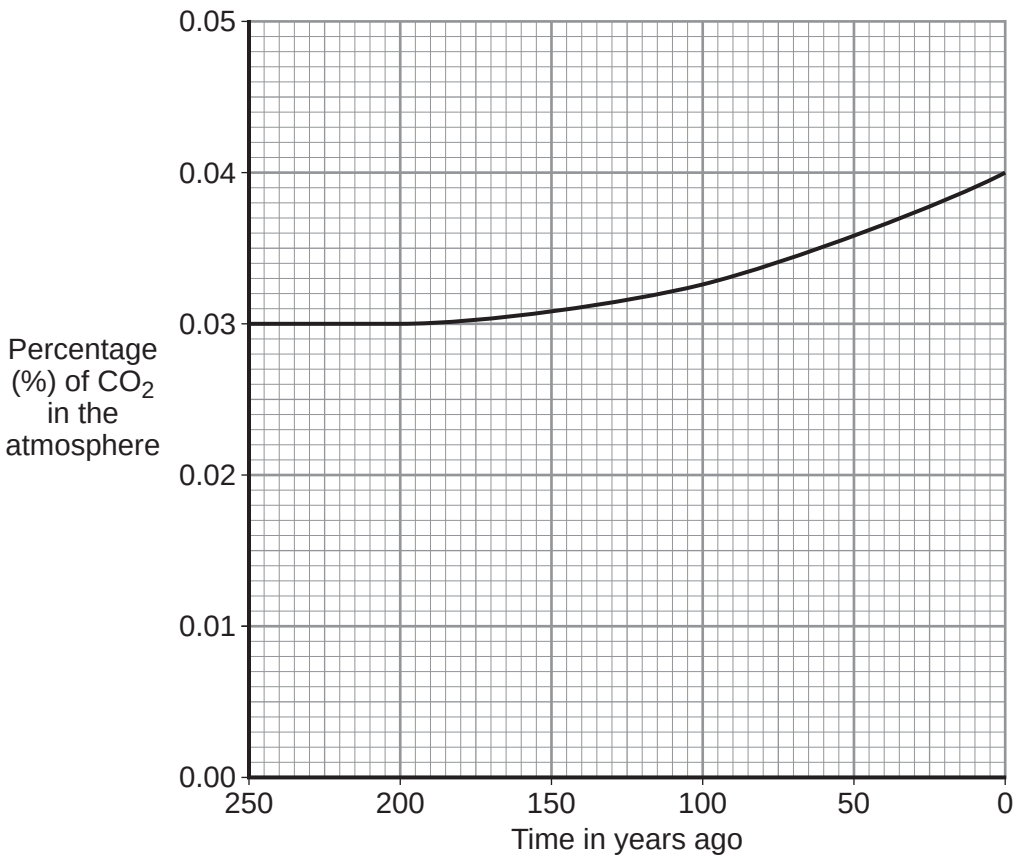
Question 5 continues on the next page

4.10.3.3 Ceramics, polymers and composites

Question 20 · continued

5 (c) **Graph 2** shows how the percentage of carbon dioxide in the atmosphere changed in the last 250 years.

Graph 2



Should we be concerned about this change in the percentage of carbon dioxide?

Explain your answer.

.....

.....

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.....

(2 marks)

10

4.10.3.3 Ceramics, polymers and composites

Question 21

June 2013 | CH2HP | Original Q5 | Legacy

5 Oil rigs are used to drill for crude oil.



5 (a) Drill heads are made from steel. Steel is an alloy.

Explain why alloys are harder than pure metals.

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(3 marks)

4.10.3.3 Ceramics, polymers and composites

Question 21 · continued

5 (b) Drill heads also contain diamonds.

Describe, as fully as you can, the structure and bonding in diamond.

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(4 marks)

5 (c) Polymers are produced from crude oil.

Describe the structure and bonding in a thermosoftening polymer and explain why thermosoftening polymers melt when heated.

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(4 marks)

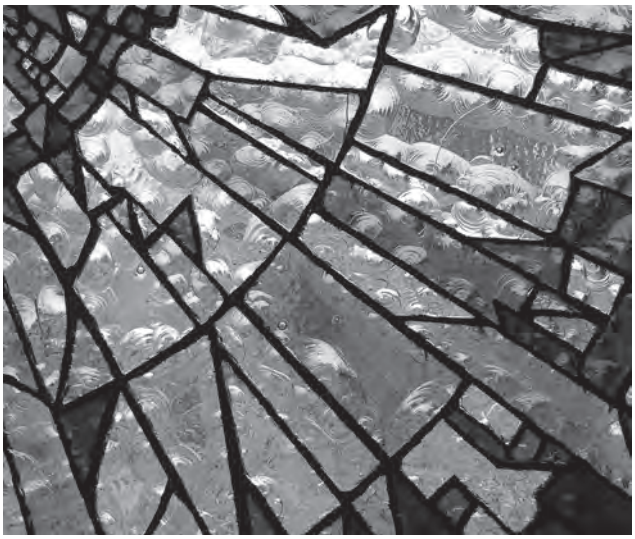
11

4.10.3.3 Ceramics, polymers and composites

Question 22

June 2014 | CH2HP | Original Q7 | Legacy

7 Glass is made from silicon dioxide.



7 (a) Silicon dioxide has a very high melting point.

Other substances are added to silicon dioxide to make glass. Glass melts at a lower temperature than silicon dioxide.

Suggest why.

[1 mark]

.....

.....

7 (b) Sodium oxide is one of the substances added to silicon dioxide to make glass.

7 (b) (i) Sodium oxide contains Na^+ ions and O^{2-} ions.

Give the formula of sodium oxide.

[1 mark]

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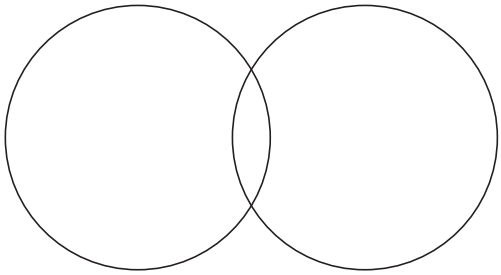
4.10.3.3 Ceramics, polymers and composites

Question 22 · continued

7 (b) (ii) Sodium oxide is made by heating sodium metal in oxygen gas.

Complete the diagram to show the outer electrons in an oxygen molecule (O_2).

[2 marks]



7 (c) Glass can be coloured using tiny particles of gold. Gold is a metal.

Describe the structure of a metal.

[3 marks]

.....

.....

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.....

.....

7

4.10.3.3 Ceramics, polymers and composites

Question 23

June 2015 | CH1HP | Original Q2 | Legacy

2 Limestone is used to make many different materials.

2 (a) Heating limestone produces calcium oxide and carbon dioxide.

Complete the sentences.

2 (a) (i) The main compound in limestone is calcium ..... .
[1 mark]

2 (a) (ii) The reaction to produce calcium oxide from limestone is thermal ..... .
[1 mark]

2 (a) (iii) Calcium hydroxide is produced when calcium oxide reacts with ..... .
[1 mark]

2 (a) (iv) Calcium hydroxide is used to neutralise acids because it is an ..... .
[1 mark]

Question 2 continues on the next page

Question 23 · continued

2 (b) Cement is made from limestone and clay.

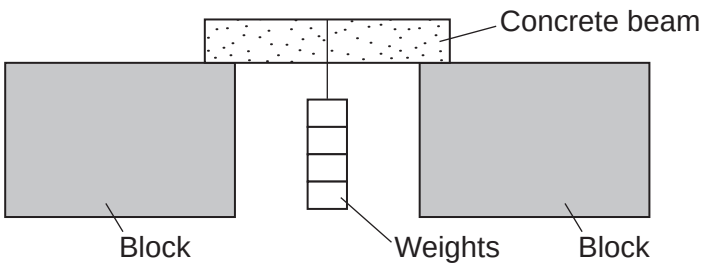
Concrete is made by mixing cement with water, sand and aggregate (small pieces of rock).

A group of students did an investigation on the amount of aggregate needed to make the strongest concrete beam.

The students used this method:

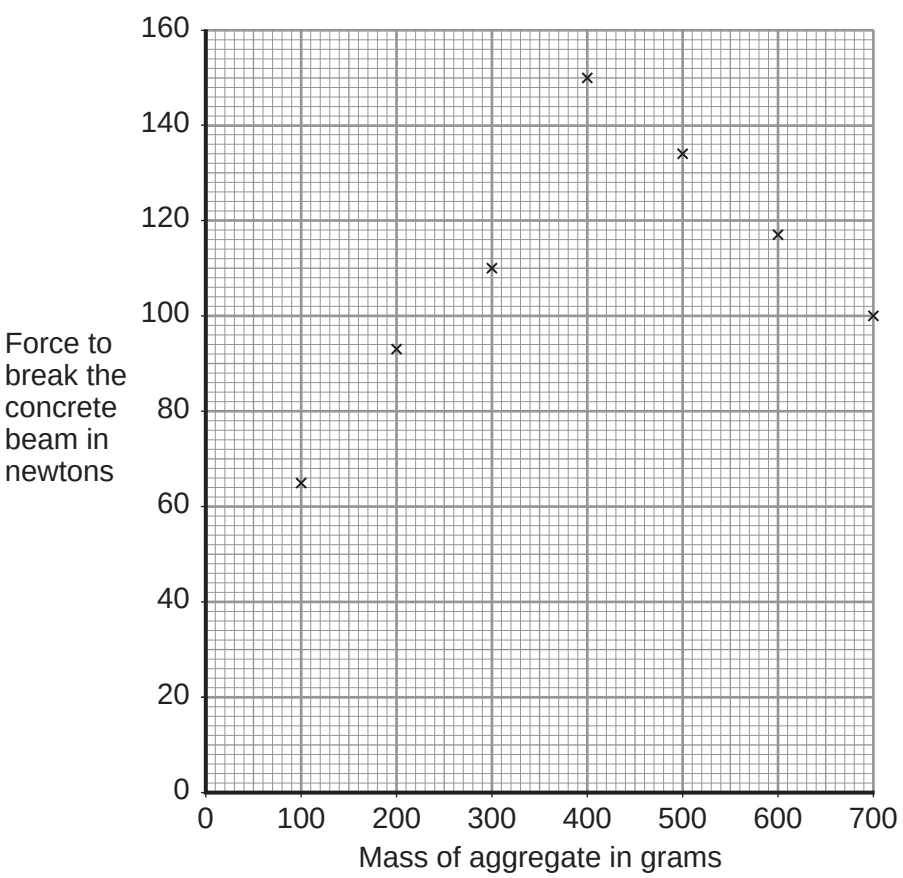
- use the same mass of cement and the same mass of sand but change the mass of aggregate to make seven different concrete mixtures
- use the different concrete mixtures to make beams of the same size
- add weights, as shown in **Figure 2**, until the concrete beam breaks.

Figure 2



The students' results are plotted on the graph in **Figure 3**.

Figure 3



4.10.3.3 Ceramics, polymers and composites

Question 23 · continued

2 (b) (i) One of the points is anomalous.

Complete the graph in **Figure 3** by drawing **two** straight lines of best fit.

[2 marks]

2 (b) (ii) Describe **one** way the students could improve the method so that their results are more accurate for each graph point.

[2 marks]

.....

.....

.....

.....

2 (b) (iii) What force is needed to break a concrete beam containing no aggregate?

Show your working on the graph.

[2 marks]

Force = ... newtons

2 (b) (iv) One of the students concluded that:

'The force needed to break a concrete beam increases as the mass of aggregate increases.'

The student's conclusion is **not completely** correct. Use values from the graph to explain why.

[3 marks]

.....

.....

.....

.....

.....

.....

13

4.10.3.3 Ceramics, polymers and composites

Question 24

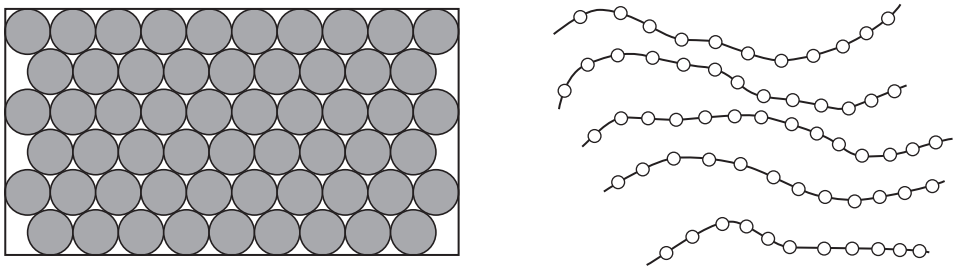
June 2017 | CH2HP | Original Q2 | Legacy

2 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Metals and thermosoftening polymers have different properties.

Figure 3 shows structures of a metal and a thermosoftening polymer.

Figure 3



Explain how the properties of a metal and a thermosoftening polymer relate to their structures.

In your answer you should describe the structures of a metal and a thermosoftening polymer.

[6 marks]

4.10.3.3 Ceramics, polymers and composites

Question 25

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.

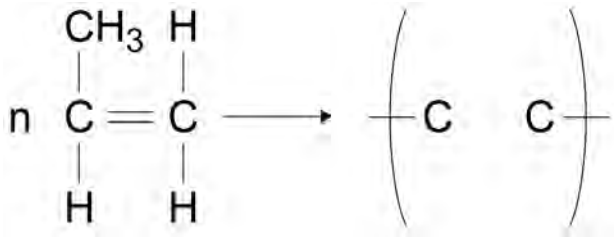
Name the small molecule lost.

[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]

4.10.3.3 Ceramics, polymers and composites

Question 25 · 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

4.10.3.3 Ceramics, polymers and composites

Question 26

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

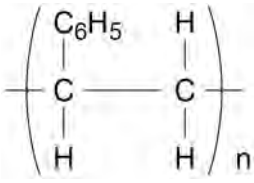
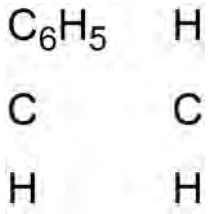


Figure 7 shows an incomplete displayed structural formula of the monomer styrene.

Complete **Figure 7**.

[2 marks]

Figure 7



Question 26 · 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]

4.10.3.3 Ceramics, polymers and composites

Question 26 · continued

June 2019 | 8462/2H | Original Q6

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

4.10.3.3 Ceramics, polymers and composites

Question 27

November 2020 | 8462/2H | Original Q5

0 5 This question is about materials used to make food plates.

Food plates are made from paper, polymers or ceramics.

Table 2 shows information about plates of the same diameter made from each of these materials.

Table 2

	Food plate material		
	Paper	**Polymers**	**Ceramics**
Raw material	Wood	Crude oil	Mined clay
Number packaged in 10 dm^3 cardboard box	500	100	50
Average number of times used	1	400	1000
Biodegradable?	Yes	No	No
Recyclable?	Yes	Yes	No

0 5 . 1 **Table 2** does **not** show information about energy usage.

Suggest **two** pieces of information about energy usage which would help to produce a complete life cycle assessment (LCA) for the three food plate materials.

[2 marks]

1 _____

_____

2 _____

_____

4.10.3.3 Ceramics, polymers and composites

Question 27 · continued

0 5 . 2 Evaluate the use of these materials for making food plates.

You should use features of life cycle assessments (LCAs).

Use **Table 2**.

[4 marks]

0 5 . 3 Describe how ceramic food plates are produced from clay.

[2 marks]

8

4.10.3.3 Ceramics, polymers and composites

Question 28

November 2021 | 8462/2H | Original Q4

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

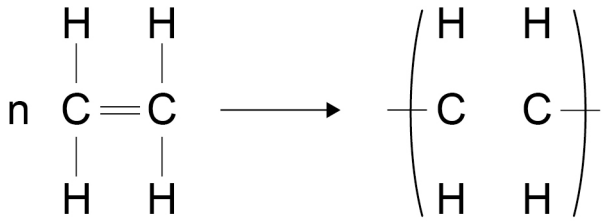
0 4 . 1 Poly(ethene) is produced from ethene.

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]

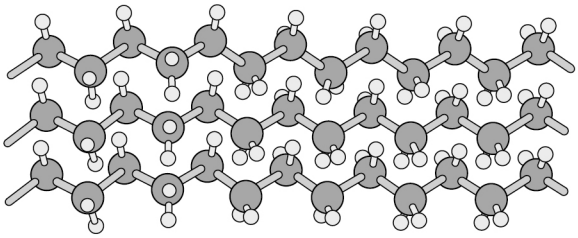
0 4 . 4 Two different forms of poly(ethene) are:

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

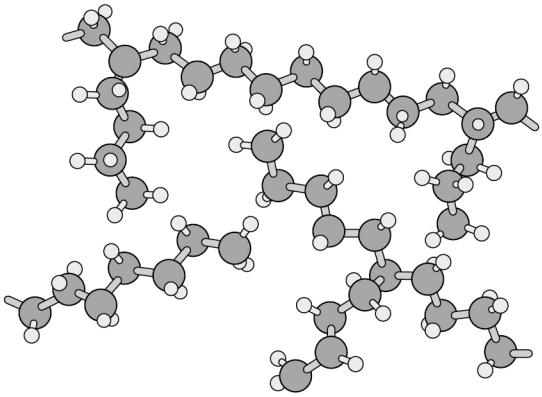
Figure 4 represents part of the structures of HDPE and LDPE.

Figure 4

HDPE



LDPE



Explain why HDPE has a higher density than LDPE.

[2 marks]

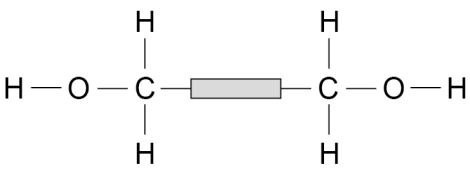
Question 4 continues on the next page.

Question 28 · continued

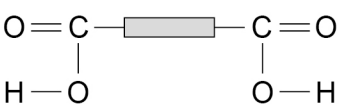
Figure 5 shows three monomers, **A**, **B** and **C**.

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

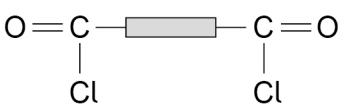
Figure 5



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

4.10.3.3 Ceramics, polymers and composites

Question 29

June 2024 | 8462/2H | Original Q6

0 6 This question is about materials used to make bicycles.

Figure 6 shows a bicycle.

Figure 6



Table 3 shows information about two materials used to make bicycle frames.

Table 3

	Material	
	Aluminium alloy	**Bamboo**
Raw material	aluminium ore	bamboo plant
Cost of frame in £	250	1500
Strength in arbitrary units	290	193
Mass in kilograms	1.6	2.4
Lifespan in years	6–10	10–15
One method of disposal at end of life	recycled to make new products	burned to produce heat energy

4.10.3.3 Ceramics, polymers and composites

Question 29 · continued

0 6 . 1 Evaluate the use of aluminium alloy and of bamboo for making bicycle frames.

Use **Table 3**.

[6 marks]

0 6 . 2 Explain why aluminium alloy bicycle frames do **not** need protection from corrosion.

[2 marks]

Question 6 continues on the next page

4.10.3.3 Ceramics, polymers and composites

Question 29 · continued

0 6 . 3 Bicycle chains are made from an alloy of iron.

Bicycle chains rust without protection.

Paint is **not** used to protect bicycle chains from rusting.

Suggest how bicycle chains can be protected from rusting.

[1 mark]

0 6 . 4 Bicycle frames can also be made from a composite of carbon fibres embedded in a polymer resin.

What description is given in this composite to:

- the carbon fibre component
- the polymer resin component?

[2 marks]

Carbon fibre _____

Polymer resin _____

11

4.10.3.3 Ceramics, polymers and composites

Question 30

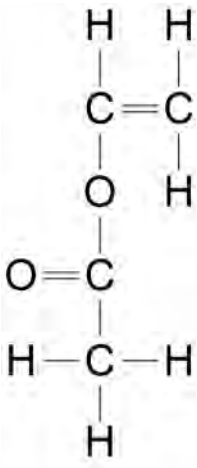
June 2024 | 8462/2H | Original Q8

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]

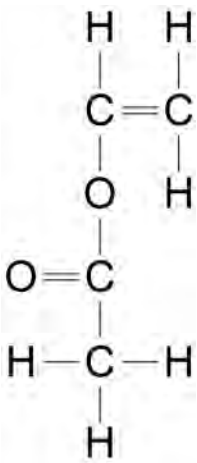
0 8 . 2 Describe what will be seen when compound **A** is shaken with bromine water.

[2 marks]

Question 8 continues on the next page

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]

_____ + _____ → _____ + _____

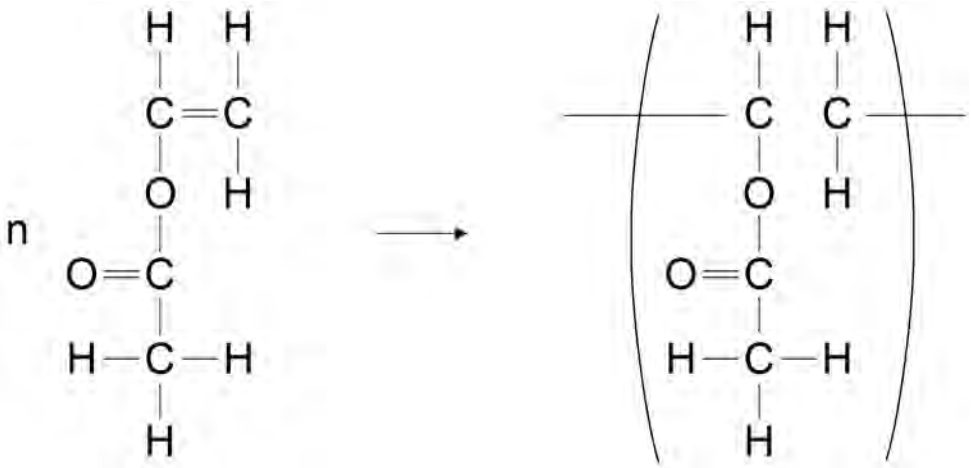
4.10.3.3 Ceramics, polymers and composites

Question 30 · 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

4.10.3.3 Ceramics, polymers and composites

Question 30 · 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

4.10.3.3 Ceramics, polymers and composites

Question 31

June 2025 | 8462/2H | Original Q7

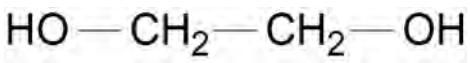
0 7 This question is about polymers.

A condensation polymer is produced from two different compounds, **A** and **B**.

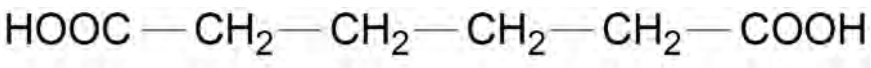
Figure 4 represents a molecule of **A** and a molecule of **B**.

Figure 4

A



B



0 7 . 1 Name compound **A** and compound **B**.

[2 marks]

A _____

B _____

0 7 . 2 Compound **A** and compound **B** react to produce a condensation polymer.

Name the type of condensation polymer produced from compound **A** and compound **B**.

[1 mark]

_____

0 7 . 3 Name the small molecule lost when molecules of compound **A** and of compound **B** react.

[1 mark]

_____

4.10.3.3 Ceramics, polymers and composites

Question 31 · continued

Glycine is an amino acid.

Glycine can produce condensation polymers.

0 7 . 4 Name the type of condensation polymer produced when glycine polymerises.

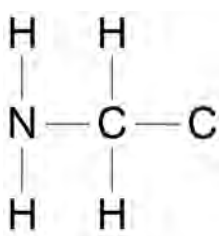
[1 mark]

_____

0 7 . 5 Complete **Figure 5** to show the displayed structural formula of glycine.

[1 mark]

Figure 5



0 7 . 6 Which polymer is produced when different amino acids are combined in the same chain?

[1 mark]

Tick (✓) **one** box.

- Cellulose ☐
- DNA ☐
- Protein ☐
- Starch ☐

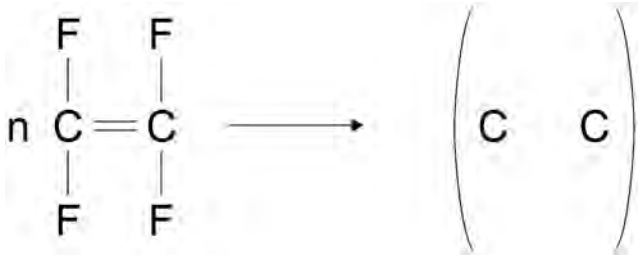
4.10.3.3 Ceramics, polymers and composites

Question 31 · continued

The polymer poly(tetrafluoroethene) is produced from the monomer tetrafluoroethene (C_2F_4).

0 7 . 7 Complete the equation for the production of poly(tetrafluoroethene) from tetrafluoroethene.

[3 marks]



0 7 . 8 Poly(tetrafluoroethene) is a thermosoftening polymer.

Some other polymers are thermosetting polymers.

Describe the structure of a thermosetting polymer.

[2 marks]

12