AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.10.3.3

Ceramics, polymers and composites

Past-paper questions

Tier	**Foundation**
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

January 2007 | CHY1F | Original Q4 | Legacy

4 Limestone contains calcium carbonate.

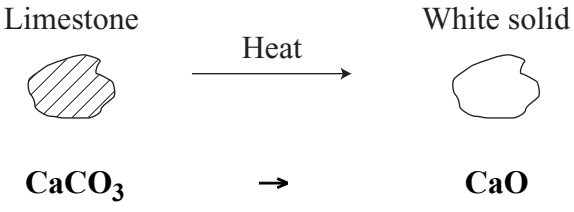
(a) Calcium carbonate has the formula $CaCO_3$.

Complete the sentence by writing in the correct numbers.

The formula of calcium carbonate is made up of 1 calcium atom, ... carbon atom(s) and ..... oxygen atom(s).

(2 marks)

(b) When limestone is heated it forms two other compounds.



$$\mathbf{CaCO_3} \rightarrow \mathbf{CaO} + \mathbf{CO_2}$$

(i) State **one** safety precaution that you should take when heating limestone.

.....

(1 mark)

(ii) Name the white solid produced.

.....

(1 mark)

(iii) Why does a piece of limestone lose mass as it is heated?

.....

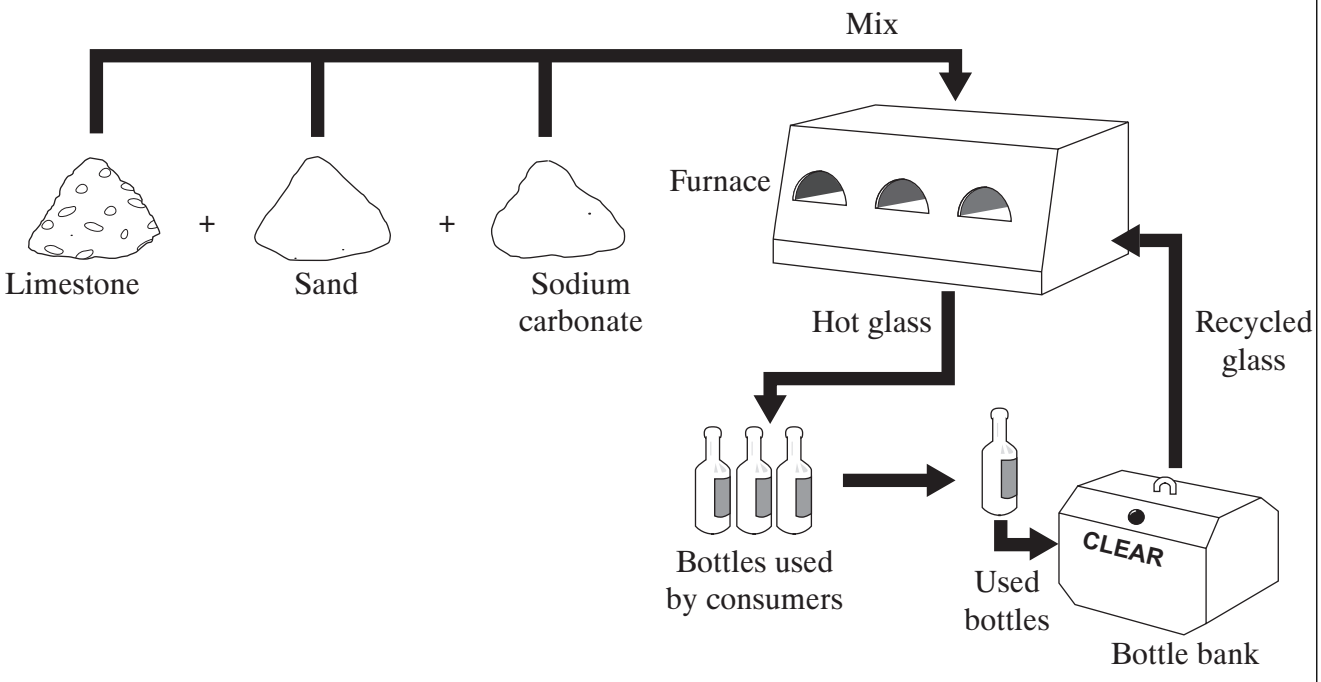
.....

(1 mark)

Question 01 · continued

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(c) Limestone is used to manufacture glass. Glass is made by heating a mixture of limestone, sand and sodium carbonate in a furnace.
The reaction requires a high temperature. If some recycled glass is added, the reaction takes place at a lower temperature.



Suggest **two** reasons why people are encouraged to recycle glass.

1 .....

.....

2 .....

.....

(2 marks)

Question 4 continues on the next page

Question 01 · continued

BLANK

(d) A company wants to quarry limestone. There are some houses near the quarry.



Residents in the houses say that they do not want a quarry next to them.

(i) Suggest **two** reasons why they do not want the quarry next to them.

1 .....

.....

2 .....

.....

(2 marks)

(ii) Suggest **one** possible benefit to the residents of having a quarry near their houses.

.....

.....

(1 mark)

10

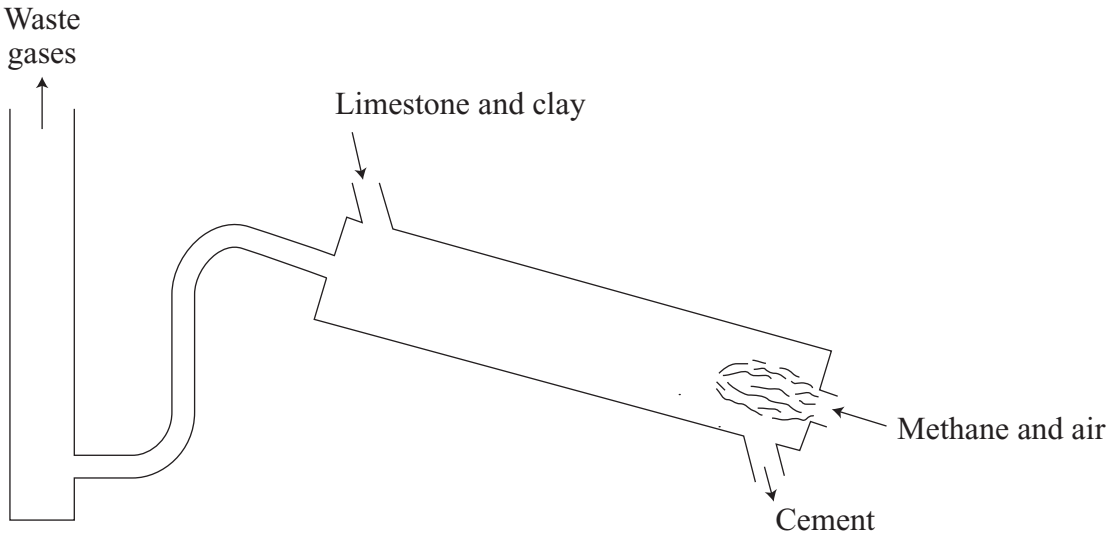
4.10.3.3 Ceramics, polymers and composites

Question 02

June 2007 | CHY1F | Original Q6 | Legacy

6 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 .....

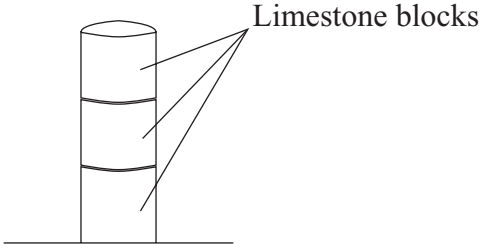
(2 marks)

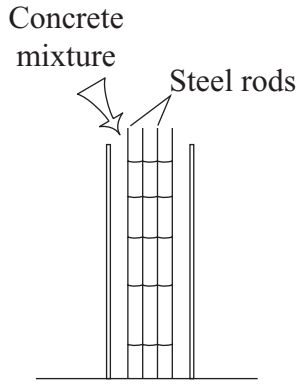
4.10.3.3 Ceramics, polymers and composites

Question 02 · 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

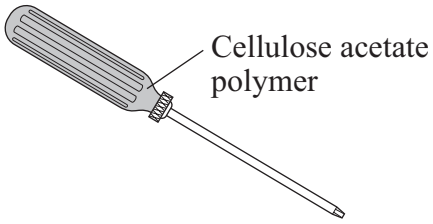
Question 03

November 2007 | CHY1B | Original Q2 | Legacy

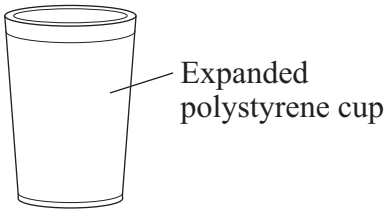
QUESTION TWO

This question is about the properties of polymers and their uses.

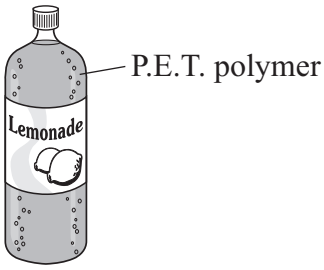
The drawings show four different objects. Each is made using a different polymer.



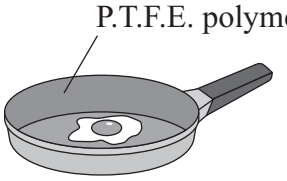
A Screwdriver



B Disposable coffee cup



C Bottle for soft drinks



D Frying pan

The table below shows some properties of four different polymers.

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

	Properties of the polymer
1	It forms a non-stick surface that can be strongly heated.
2	It is strong but light, transparent and can be recycled.
3	It is strong, rigid and a good electrical insulator.
4	It is a good heat insulator, very light and cheap to make.

4.10.3.3 Ceramics, polymers and composites

Question 04

8 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)

(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

4.10.3.3 Ceramics, polymers and composites

Question 05

March 2008 | CHY1BP | Original Q5 | Legacy

QUESTION FIVE

The table shows some of the properties of four polymers.

	Polymer	Properties
A	Polystyrene	brittle, cheap
B	PTFE	withstands high temperatures, non-stick
C	Perspex	rigid, transparent
D	Acrilan	strong, can be stretched into fibres

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

	How the polymer could be used
1	It could be used as a substitute for glass.
2	It could be used as a substitute for wool.
3	It could be used to make throw-away packaging.
4	It could be used as a coating on cooking pans.

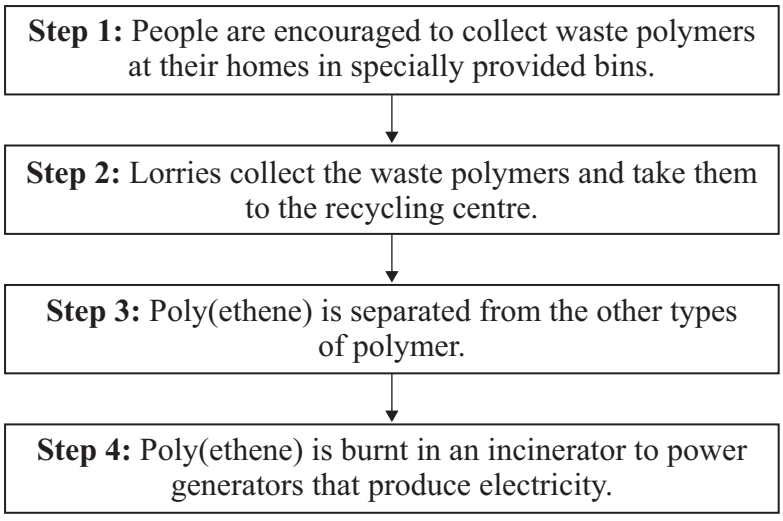
4.10.3.3 Ceramics, polymers and composites

Question 06

June 2008 | CHY1BP | Original Q8 | Legacy

QUESTION EIGHT

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



8A 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.

8B 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.

8C 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.

8D 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

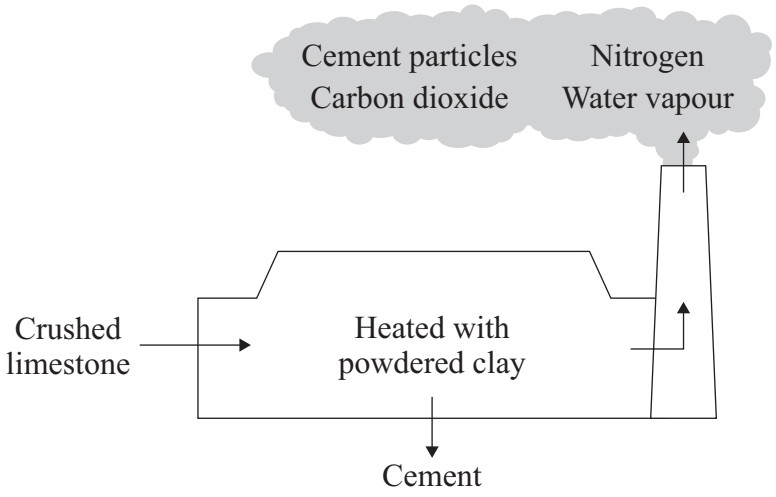
4.10.3.3 Ceramics, polymers and composites

Question 07

June 2009 | CHY1F | Original Q6 | Legacy

6 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.



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

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

contains ☐ different elements.

(1 mark)

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

(1 mark)

6 (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)

4.10.3.3 Ceramics, polymers and composites

Question 07 · continued

for mark

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

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

Name of emission: .....

Explanation: .....

.....

(2 marks)

6 (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

November 2009 | CHY1AP | Original Q7 | Legacy

QUESTION SEVEN

Test tubes used in school laboratories can be made from soda-lime glass or from boro-silicate glass.

Typical compositions of these two types of glass are shown in **Table 1**.

Table 1

	Percentage (%) composition					
	Silicon oxide	**Aluminium oxide**	**Calcium oxide**	**Magnesium oxide**	**Sodium oxide**	**Boron oxide**
Soda-lime glass	60–75	1	5–12	4	12–18	0
Boro-silicate glass	70–81	2–7	0.1	0	4–8	7–13

7A For boro-silicate glass, which of the following oxides shows the smallest range of percentage composition?

1 silicon oxide

2 aluminium oxide

3 sodium oxide

4 boron oxide

7B Boro-silicate glass has a higher melting point than soda-lime glass.

From the information given in **Table 1**, it is valid to conclude that this is because boro-silicate glass . . .

1 does **not** contain any magnesium oxide.

2 contains less silicon oxide.

3 has a different composition.

4 contains more oxides.

4.10.3.3 Ceramics, polymers and composites

Question 08 · continued

Table 2 shows information about soda-lime and boro-silicate glass test tubes.

Table 2

	Cost of one test tube in pence	Density in g per cm^3	Average number of times it can be used	Melting point in °C
Soda-lime glass test tube	8	2.52	4	500
Boro-silicate glass test tube	18	2.23	12	1200

7C Schools use large numbers of test tubes.

The decision to buy soda-lime or boro-silicate glass test tubes for use in schools depends on . . .

1 the density and melting point.

2 the cost and how many times the test tube can be used.

3 the composition and density.

4 the melting point and quantities of impurities.

7D In an experiment, a student needs to heat a substance in a test tube to 700 °C.

She selects a boro-silicate glass test tube rather than a soda-lime glass test tube because the boro-silicate glass test tube . . .

1 contains less silicon oxide.

2 is more expensive.

3 has a higher density.

4 has a melting point above 700 °C.

4.10.3.3 Ceramics, polymers and composites

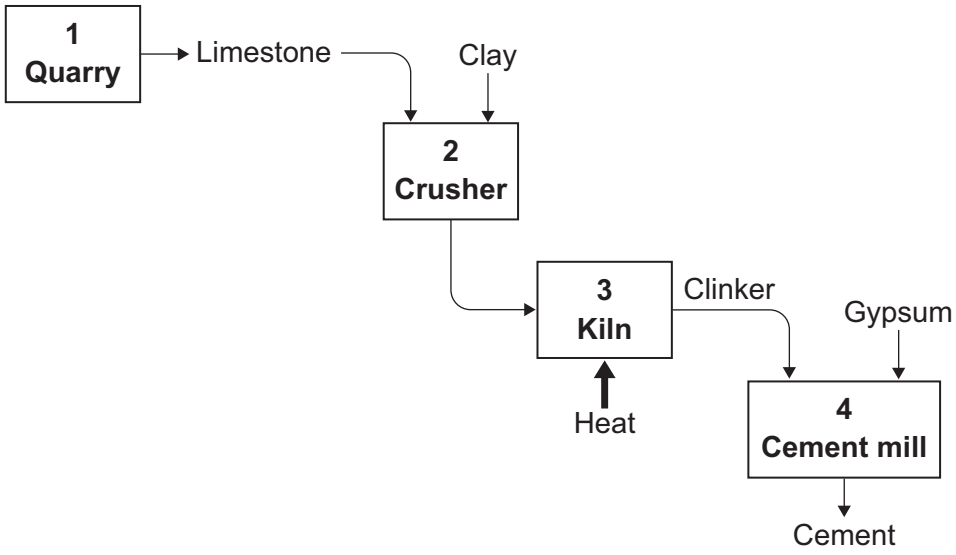
Question 09

June 2010 | CHY1AP | Original Q1 | Legacy

QUESTION ONE

Limestone, clay and gypsum are natural substances that can be quarried.

The flow chart shows how they are used to make cement.



Match statements, **A**, **B**, **C** and **D**, with the numbers **1–4** on the flow chart.

A It is where thermal decomposition takes place.

B It is where only natural substances are mixed.

C It is where a natural substance is mixed with a man-made substance.

D It is where limestone is obtained.

4.10.3.3 Ceramics, polymers and composites

Question 10

June 2010 | CHY1BP | Original Q8 | Legacy

QUESTION EIGHT

This equation shows the thermal decomposition of a hydrocarbon.

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

8A What is the name of this process?

1 polymerisation

2 cracking

3 combustion

4 hydrogenation

8B 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.

8C 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.

8D 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.

4.10.3.3 Ceramics, polymers and composites

Question 11

November 2010 | CHY1BP | Original Q9 | Legacy

QUESTION NINE

The equation shows the thermal decomposition of a hydrocarbon.

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

9A What is the formula for substance **K**?

1 CH_4

2 C_2H_6

3 C_4H_{10}

4 C_8H_{18}

9B Ethene, C_2H_4 is . . .

1 an alkane.

2 an alkene.

3 a saturated hydrocarbon.

4 a polymer.

9C 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.

9D 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.

END OF TEST

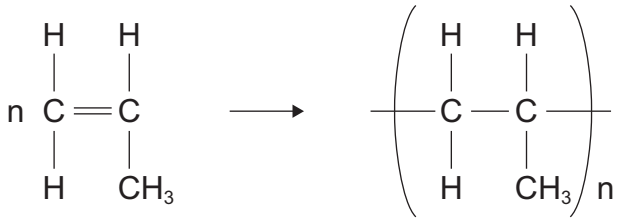
4.10.3.3 Ceramics, polymers and composites

Question 12

March 2011 | CHY1BP | Original Q9 | Legacy

QUESTION NINE

The equation shows a chemical reaction.



Small molecules of hydrocarbon **X**

Large molecule of hydrocarbon **Y**

9A Hydrocarbon **X** is . . .

1 an alkane.

2 a polymer.

3 an alkene.

4 a catalyst.

9B Hydrocarbon **Y** is . . .

1 an unsaturated compound.

2 a polymer.

3 an alkene.

4 a monomer.

9C 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 12 · continued

9D 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.

END OF TEST

4.10.3.3 Ceramics, polymers and composites

Question 13

November 2011 | CHY1BP | Original Q2 | Legacy

QUESTION TWO

Different polymers have different properties.

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

A can withstand high temperatures and is non-stick

B can be stretched into fibres

C makes a very light, solid foam which is a good heat insulator

D strong, rigid and a good electrical insulator

	Uses
1	to make disposable cups for hot drinks
2	to make the coating on frying pans
3	to make shirts and trousers
4	to make the handles of tools

4.10.3.3 Ceramics, polymers and composites

Question 14

5 Cement is made by heating a mixture of clay and limestone in a kiln.

5 (a) Many kilns are heated by burning natural gas (methane) in air.

A chemical equation for the burning of methane is:

$$CH_4 + 2O_2 \rightarrow 2H_2O + CO_2$$

Describe this reaction in words.

Give the names of the molecules **and** the numbers of each molecule in this chemical equation.

.....

.....

.....

.....

(2 marks)

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

Limestone contains calcium carbonate.
There is a large deposit of limestone under an area of natural beauty.
A company wants to quarry this limestone and build a kiln near to the quarry to make cement.

Area of natural beauty



A quarry



Explosives will be used to extract the limestone out of the ground.

Heavy machinery will be used to lift and crush the limestone.

Lorries will be used to transport the limestone to the kiln to make cement.

The lorries and the heavy machinery will use diesel fuel.

4.10.3.3 Ceramics, polymers and composites

Question 14 · continued

Quarrying limestone and making cement will have an impact on everything near the area.

Describe the positive and the negative impacts of quarrying limestone and making cement.

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(6 marks)

8

4.10.3.3 Ceramics, polymers and composites

Question 15

June 2012 | CH2FP | Original Q2 | Legacy

2 Gold and gold ions are used as catalysts.

2 (a) An atom of gold is represented as:

$$^{197}_{79}Au$$

Complete the sentences.

The atomic number of gold is ..... .

The number of electrons in an atom of gold is ..... .

(2 marks)

2 (b) Scientists have found that gold nanoparticles are very good catalysts.

Draw a ring around the correct answer to complete the sentence.

A gold nanoparticle contains a few | hundred / thousand / million | atoms.

(1 mark)

2 (c) The formation of a gold ion (Au^{3+}) from a gold atom (Au) is shown in the symbol equation.

$$Au \rightarrow Au^{3+} + 3e^-$$

2 (c) (i) Complete the sentence.

The particles lost when a gold atom becomes a gold ion

are called ..... .

(1 mark)

2 (c) (ii) Draw a ring around the correct answer to complete the sentence.

The number of these particles lost when a gold atom becomes a gold ion is | one. / two. / three. |

(1 mark)

4.10.3.3 Ceramics, polymers and composites

Question 15 · continued

2 (d) Gold ions are used as a catalyst in the reaction to make chloroethene.

How does a catalyst help a reaction?

.....

(1 mark)

2 (e) Chloroethene can react to make a thermosoftening polymer.

2 (e) (i) Draw a ring around the correct answer to complete the sentence.

When heated, a thermosoftening polymer will

dissolve.

melt.

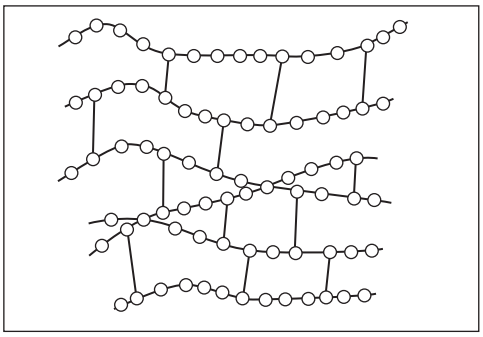
solidify.

(1 mark)

2 (e) (ii) Polymer **B** is a different type of polymer.

The diagram shows the structure of polymer **B**.

Polymer B



How can you tell from the diagram that polymer **B** is **not** thermosoftening?

.....

.....

(1 mark)

8

4.10.3.3 Ceramics, polymers and composites

Question 16

January 2013 | CH2FP | Original Q4 | Legacy

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

4 (a) Why are thermosoftening polymers **not** suitable for storing very hot food?

.....

.....

(1 mark)

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

Why are catalysts used in chemical reactions?

.....

.....

(1 mark)

4 (c) Compounds from food packaging must not get into food.

Gas chromatography can be used to separate compounds in food.

The output from the gas chromatography column can be linked to an instrument which can identify the compounds.

4 (c) (i) Name the instrument used to identify the compounds.

.....

.....

(1 mark)

4 (c) (ii) Give **one** reason why instrumental methods of analysis are used to identify the compounds.

.....

.....

(1 mark)

4 (d) Poly(ethene) is a thermosoftening polymer.

Poly(ethene) can be made with different properties. The properties depend on the conditions used when poly(ethene) is made.

Suggest **two** conditions which could be changed when poly(ethene) is made.

.....

.....

(2 marks)

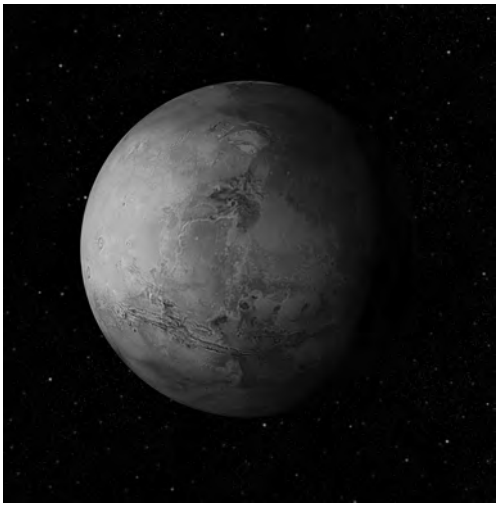
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4.10.3.3 Ceramics, polymers and composites

Question 17

June 2013 | CH2FP | Original Q5 | Legacy

5 This question is about the planet Mars.



5 (a) Mars is a red colour in the sky at night.

The red colour of Mars is because of iron oxide.

Iron oxide is an ionic compound.

Draw a ring around the correct answer to complete the sentence.

Ionic compounds are made of

- giant lattices.
- polymer chains.
- simple molecules.

(1 mark)

5 (b) Many spacecraft have been sent to Mars. Parts of these spacecraft are made from polymers.

5 (b) (i) Polymers that behave like shape memory alloys are used in spacecraft.

The shape memory polymers are cooled and compressed. These polymers are stored on the spacecraft until needed.

Suggest how the polymers could be made to return to their original shape.

.....

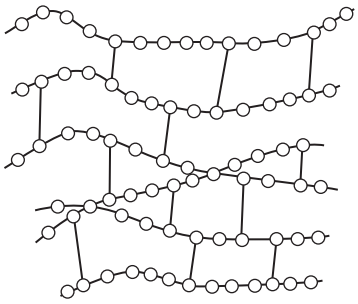
(1 mark)

4.10.3.3 Ceramics, polymers and composites

Question 17 · continued

5 (b) (ii) Thermosetting polymers are used for the tiles on the outside of spacecraft.

The diagram shows the structure of a thermosetting polymer.



Explain, in terms of structure, why some polymers are thermosetting.

.....

.....

.....

.....

(2 marks)

5 (c) Instrumental methods such as GC–MS are used to analyse substances found on Mars.

In GC–MS, gas chromatography columns are linked to mass spectrometers.

5 (c) (i) What does gas chromatography do to the substances?

.....

.....

(1 mark)

5 (c) (ii) Give **two** reasons for using instrumental methods for analysis.

1 .....

.....

2 .....

.....

(2 marks)

7

4.10.3.3 Ceramics, polymers and composites

Question 18

June 2014 | CH2FP | Original Q2 | Legacy

2 Dental braces are made from nitinol wires. Nitinol is a mixture of metals.



2 (a) Nitinol can return to its original shape after being deformed.

Draw a ring around the correct answer to complete the sentence.

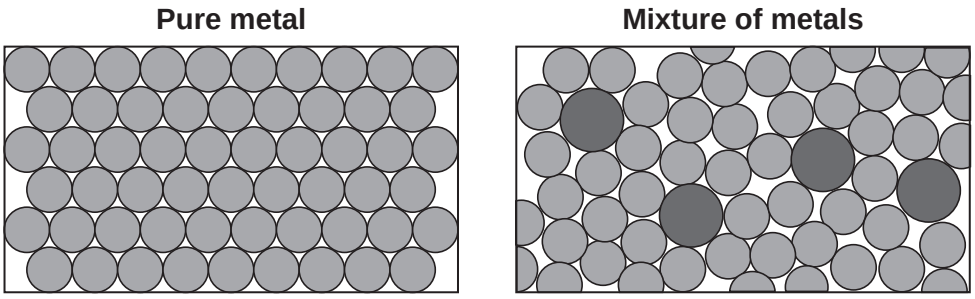
[1 mark]

Nitinol is a shape memory

alloy.
catalyst.
polymer.

2 (b) **Figure 2** shows the arrangement of atoms in a pure metal and in a mixture of metals.

Figure 2



The mixture of metals is harder than the pure metal.

Use **Figure 2** to explain why.

[2 marks]

.....

.....

.....

.....

4.10.3.3 Ceramics, polymers and composites

Question 18 · continued

2 (c) Gold and stainless steel are also used for dental braces.

Suggest **two** factors to consider when choosing which metal to use for dental braces.

[2 marks]

.....

.....

.....

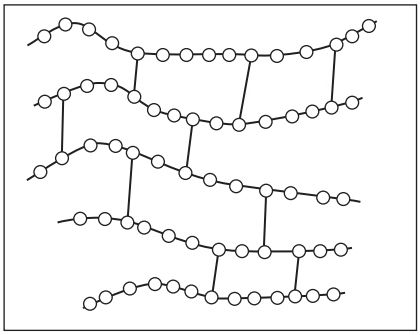
.....

2 (d) A thermosetting polymer is used to hold dental braces on the teeth.

Figure 3 shows the structure of a thermosetting polymer.

Figure 3

Thermosetting polymer



How can you tell from **Figure 3** that the polymer is thermosetting?

[1 mark]

.....

.....

6

4.10.3.3 Ceramics, polymers and composites

Question 19

June 2015 | CH1FP | Original Q5 | Legacy

5 Limestone is used to make many different materials.

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

Complete the sentences.

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

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

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

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

Question 5 continues on the next page

Question 19 · continued

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

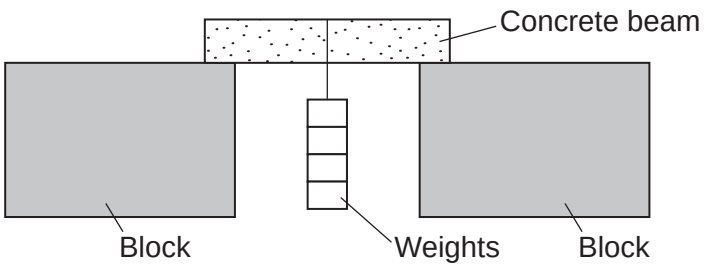
Concrete is made by mixing cement with water, sand and aggregate (small pieces of rock).

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

The students used this method:

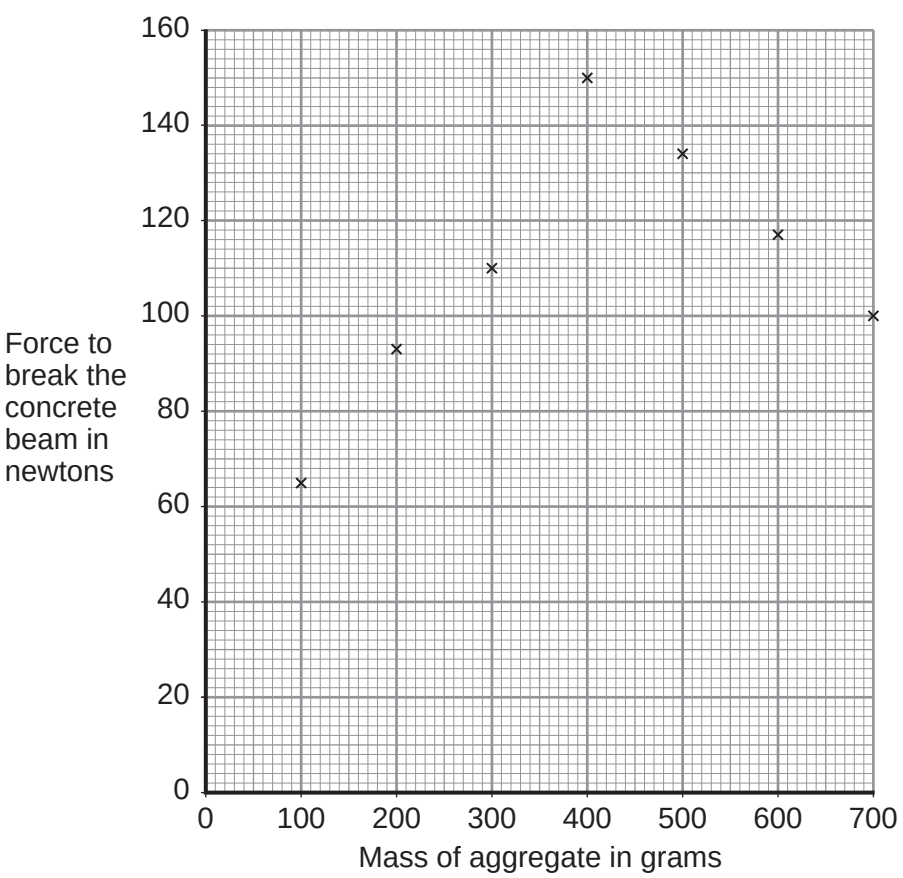
- use the same mass of cement and the same mass of sand but change the mass of aggregate to make seven different concrete mixtures
- use the different concrete mixtures to make beams of the same size
- add weights, as shown in **Figure 7**, until the concrete beam breaks.

Figure 7



The students' results are plotted on the graph in **Figure 8**.

Figure 8



4.10.3.3 Ceramics, polymers and composites

Question 19 · continued

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

Complete the graph in **Figure 8** by drawing **two** straight lines of best fit.

[2 marks]

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

[2 marks]

.....

.....

.....

.....

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

Show your working on the graph.

[2 marks]

Force = ... newtons

5 (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 20

June 2016 | CH2FP | Original Q2 | Legacy

2 This question is about substances containing carbon atoms.

2 (a) Diamond is made of carbon atoms.

2 (a) (i) Diamond is used for tips of drills.

Figure 3 shows a drill.

Figure 3



Give **one** reason why diamond is used for tips of drills.

[1 mark]

_____

_____

2 (a) (ii) Diamond nanoparticles can be made.

Use the correct answer from the box to complete the sentence.

[1 mark]

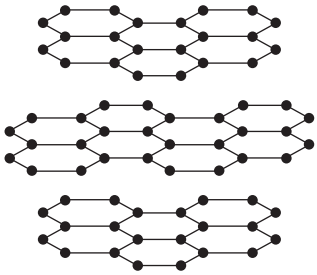
hundred	**million**	**thousand**

Nanoparticles contain a few _____ atoms.

2 (b) Graphite is made of carbon atoms.

Figure 4 shows the structure of graphite.

Figure 4



4.10.3.3 Ceramics, polymers and composites

Question 20 · continued

June 2016 | CH2FP | Original Q2 | Legacy

2 (b) (i) What type of bonding does graphite have?

[1 mark]

Tick (✓) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

2 (b) (ii) How many carbon atoms does each carbon atom bond to in graphite?

[1 mark]

Tick (✓) **one** box.

1 ☐

2 ☐

3 ☐

4 ☐

2 (b) (iii) What is a property of graphite?

[1 mark]

Tick (✓) **one** box.

Dissolves in water ☐

Has a low melting point ☐

Soft and slippery ☐

Question 2 continues on the next page

4.10.3.3 Ceramics, polymers and composites

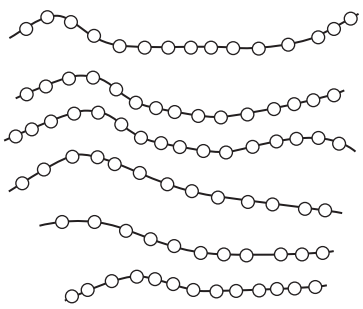
Question 20 · continued

2 (c) Poly(ethene) is made of carbon and hydrogen atoms.

Poly(ethene) is a thermosoftening polymer.

Figure 5 shows the structure of a thermosoftening polymer.

Figure 5



2 (c) (i) Complete the sentence.

[1 mark]

Between the polymer chains in a thermosoftening polymer there

are no _____ .

2 (c) (ii) Use the correct answer from the box to complete the sentence.

[1 mark]

condense	**dissolve**	**melt**

Heating would cause a thermosoftening polymer to _____ .

2 (c) (iii) Many ethene molecules react together to make poly(ethene).

Different types of poly(ethene) can be made by changing the conditions for the reaction. Suggest **two** conditions that could be changed.

[2 marks]

1 _____

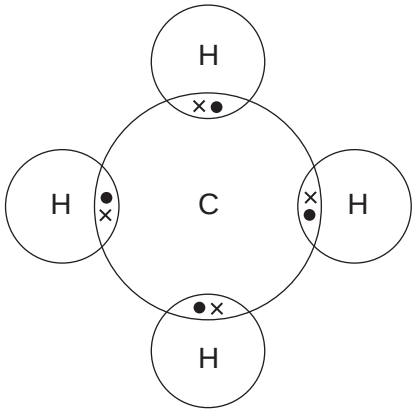
2 _____

4.10.3.3 Ceramics, polymers and composites

Question 20 · continued

2 (d) **Figure 6** shows how the atoms are bonded in methane.

Figure 6



2 (d) (i) What is the formula for methane?

[1 mark]

Tick (✓) **one** box.

C_4H ☐

CH_4 ☐

C_4H_4 ☐

2 (d) (ii) Methane has a low boiling point.

What does methane consist of?

[1 mark]

Tick (✓) **one** box.

Charged ions ☐

A giant lattice ☐

Small molecules ☐

11

4.10.3.3 Ceramics, polymers and composites

Question 21

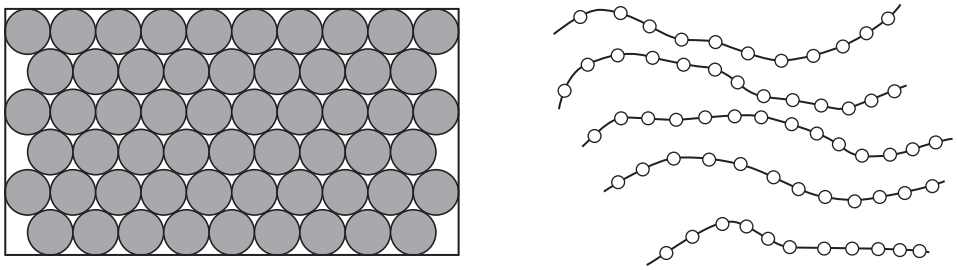
June 2017 | CH2FP | Original Q6 | Legacy

6 **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 12 shows structures of a metal and a thermosoftening polymer.

Figure 12



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 22

0 3 Polymers are used to make fabrics.

Table 1 shows some properties of two polymers.

Table 1

Property	Polymer J	Polymer K
Density in g/cm^3	0.9	1.4
Melting point in °C	165	260
Flame resistance	Poor	Good
Water absorption	Low	High

0 3 . 1 Polymer fabrics are used to make firefighter uniforms.

Complete **Table 2** by deciding for each property whether polymer **J** or polymer **K** is **best** for firefighter uniforms.

Use **Table 1**.

Density has been completed for you.

[2 marks]

Tick **three** boxes.

Table 2

Property	Polymer J	Polymer K
Density in g/cm^3	✓	
Melting point in °C		
Flame resistance		
Water absorption		

4.10.3.3 Ceramics, polymers and composites

Question 22 · continued

0 3 . 2 A firefighter uniform made from polymer **J** has a mass of 6.0 kg

Calculate the mass of a uniform of the same size made from polymer **K**.

Use **Table 1** and the equation:

$$\text{mass of uniform made from polymer K} = \frac{\text{density of polymer K}}{\text{density of polymer J}} \times 6.0$$

[2 marks]

Mass of uniform made from polymer **K** = _____ kg

0 3 . 3 Polymers **J** and **K** are both thermosoftening polymers.

Polymer **L** is a thermosetting polymer.

Why would polymer **L** be better than polymers **J** and **K** for firefighter uniforms?

[1 mark]

Tick **one** box.

- Polymer **L** burns easily ☐
- Polymer **L** does not biodegrade ☐
- Polymer **L** will not melt ☐

Question 3 continues on the next page

4.10.3.3 Ceramics, polymers and composites

Question 22 · continued

Polymers **J** and **K** are made from crude oil.

In the past, firefighter uniforms were made from wool.

Wool is obtained from sheep.

0 3 . 4 Why are many fabrics made from polymers instead of wool?

[1 mark]

Tick **one** box.

- Polymers are man-made ☐
- Polymers are more hard-wearing ☐
- Wool is more easily available ☐
- Wool is more flame resistant ☐

0 3 . 5 Why is wool more sustainable than polymers **J** and **K** for making firefighter uniforms?

[2 marks]

4.10.3.3 Ceramics, polymers and composites

Question 22 · continued

Turn over for the next question

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

4.10.3.3 Ceramics, polymers and composites

Question 23

November 2020 | 8462/2F | Original Q6

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

Plates are made from ceramics, paper or poly(propene).

0 6 . 1 Paper plates are biodegradable and recyclable.

Which stage of a life cycle assessment (LCA) would contain this information?

[1 mark]

Tick (✓) **one** box.

- Disposal at the end of useful life ☐
- Extracting and processing raw materials ☐
- Manufacturing and packaging ☐
- Use and operation during lifetime ☐

0 6 . 2 Which **two** processes are used to make ceramic plates?

[2 marks]

Tick (✓) **two** boxes.

- Forming a composite ☐
- Galvanising with zinc ☐
- Heating in a furnace ☐
- Melting sand and boron trioxide ☐
- Shaping wet clay ☐

4.10.3.3 Ceramics, polymers and composites

Question 23 · continued

Poly(propene) is produced from an alkene.

0 6 . 3 Complete the sentences.

[2 marks]

The name for very large molecules such as poly(propene) is _____.

The name of the alkene used to produce poly(propene) is _____.

0 6 . 4 The alkene needed to make poly(propene) is produced from crude oil.

Which **two** processes are used to produce this alkene from crude oil?

[2 marks]

Tick (✓) **two** boxes.

- Chromatography ☐
- Cracking ☐
- Fermentation ☐
- Fractional distillation ☐
- Quarrying ☐

0 6 . 5 What type of bond joins the atoms in a molecule of poly(propene)?

[1 mark]

Tick (✓) **one** box.

- Covalent ☐
- Ionic ☐
- Metallic ☐

4.10.3.3 Ceramics, polymers and composites

Question 23 · continued

Table 4 shows information about two polymers used to make plates.

Table 4

Polymer	Effect of heating the polymer
A	does not melt
B	melts at 50 °C

0 6 . 6 What type of polymer is polymer **A**?

Use **Table 4**.

[1 mark]

0 6 . 7 Why does polymer **A** behave differently to polymer **B** when heated?

You should refer to crosslinks in your answer.

[1 mark]

10

4.10.3.3 Ceramics, polymers and composites

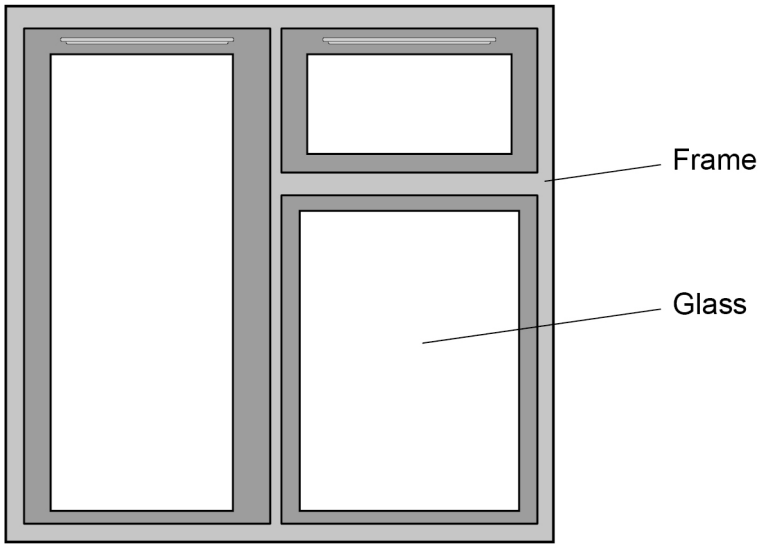
Question 24

November 2021 | 8462/2F | Original Q3

0 3 This question is about substances used to make windows and window frames.

Figure 2 shows a window.

Figure 2



0 3 . 1 Glass is made by heating sand with **two** other materials.

Which **two** other materials are used to make glass?

[2 marks]

Tick (✓) **two** boxes.

- Clay ☐
- Graphite ☐
- Limestone ☐
- Sodium carbonate ☐
- Sodium hydroxide ☐

4.10.3.3 Ceramics, polymers and composites

Question 24 · continued

Window frames need to be:

- easy to install
- resistant to damage.

The polymers poly(chloroethene) and HDPE are used to make window frames.

Table 3 shows information about poly(chloroethene) and HDPE.

Table 3

Property	Poly(chloroethene)	HDPE
Density in g/cm^3	1.4	0.92
Relative strength	72	25

0 3 . 2 Suggest **one** advantage of using poly(chloroethene) compared with HDPE to make window frames.

Give **one** reason for your answer.

Use **Table 3**.

[2 marks]

Advantage _____

_____

Reason _____

_____

0 3 . 3 Suggest **one** advantage of using HDPE compared with poly(chloroethene) to make window frames.

Give **one** reason for your answer.

Use **Table 3**.

[2 marks]

Advantage _____

_____

Reason _____

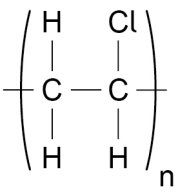
_____

4.10.3.3 Ceramics, polymers and composites

Question 24 · continued

0 3 . 4 **Figure 3** shows the displayed structural formula of poly(chloroethene).

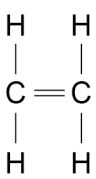
Figure 3

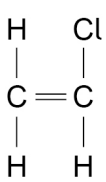


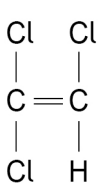
Which monomer is used to make poly(chloroethene)?

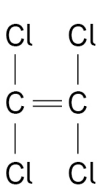
[1 mark]

Tick (✓) **one** box.

 ☐

 ☐

 ☐

 ☐

4.10.3.3 Ceramics, polymers and composites

Question 24 · continued

0 3 . 5 Chlorine gas is used to produce poly(chloroethene).

Describe a test to identify chlorine gas.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

0 3 . 6 Wood can be used instead of polymers to make window frames.

- Polymers are unreactive.
- Polymers are produced from crude oil.
- Wood breaks down in wet conditions.
- Wood is produced from trees.

Suggest **one** advantage of using polymers and **one** advantage of using wood to make window frames.

[2 marks]

Advantage of polymers _____

_____

Advantage of wood _____

_____

Question 3 continues on the next page

Question 24 · continued

Window frames can also be made from an alloy of aluminium.

0 3 . 7 6.00 kg of the alloy is used to make a window frame.

Table 4 shows the mass of each element in 6.00 kg of the alloy.

Table 4

Element	Mass in kg
Aluminium	5.94
Magnesium	0.04
Silicon	0.02

Calculate the percentage of aluminium in 6.00 kg of the alloy.

[2 marks]

Percentage of aluminium = _____ %

0 3 . 8 Why is an alloy used instead of pure aluminium to make window frames?

[1 mark]

14

4.10.3.3 Ceramics, polymers and composites

Question 25

June 2022 | 8462/2F | Original Q5

0 5 Ammonia is produced in the Haber process.

The raw materials for the Haber process are nitrogen and hydrogen.

0 5 . 1 Draw **one** line from each raw material to the source of that raw material.

[2 marks]

Raw material	Source of raw material
	Air
	Clay
Nitrogen	
	Limestone
Hydrogen	
	Natural gas
	Sand

0 5 . 2 What are the states of nitrogen and of hydrogen when used in the Haber process?

[1 mark]

Tick (✓) **one** box.

State of nitrogen	State of hydrogen	
Gas	Gas	☐
Gas	Liquid	☐
Liquid	Gas	☐
Liquid	Liquid	☐

4.10.3.3 Ceramics, polymers and composites

Question 25 · continued

0 5 . 3 The word equation for the production of ammonia is:

nitrogen + hydrogen ⇌ ammonia

The atom economy of the reaction is 100%.

How does the word equation show that the atom economy is 100%?

[1 mark]

Tick (✓) **one** box.

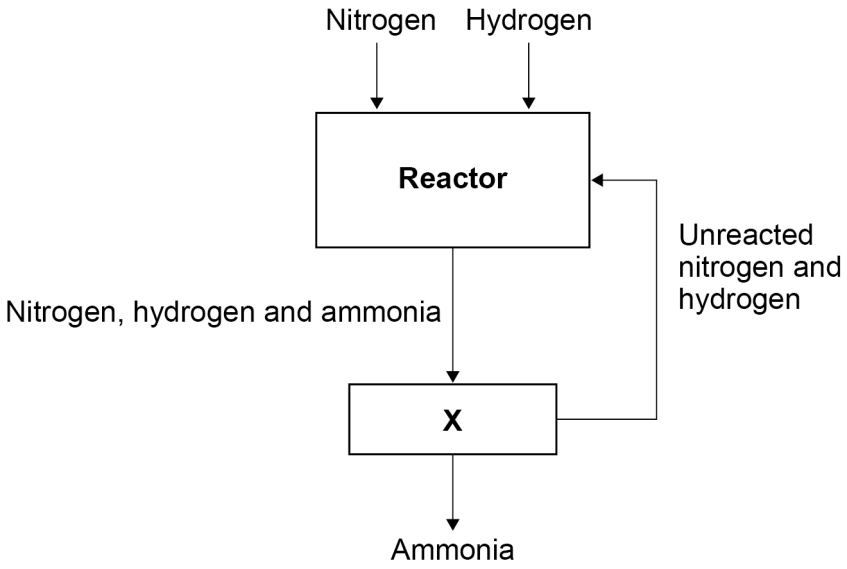
- The reaction is reversible. ☐
- There are two reactants. ☐
- There is one product. ☐

4.10.3.3 Ceramics, polymers and composites

Question 25 · continued

0 5 . 4 **Figure 5** represents the Haber process.

Figure 5



A mixture of nitrogen, hydrogen and ammonia enters **X**.

Complete the sentences.

Choose answers from the box.

[2 marks]

evaporated	**filtered**	**liquefied**	**recycled**

In **X**, the mixture is cooled.

The ammonia can be removed from **X** because the ammonia is

_____.

The unreacted nitrogen and hydrogen are

_____.

4.10.3.3 Ceramics, polymers and composites

Question 25 · continued

Table 8 shows the percentage yield of ammonia at different pressures.

Table 8

Pressure in atmospheres	Percentage (%) yield of ammonia
50	20
100	33
150	44
200	52
250	59
300	64

4.10.3.3 Ceramics, polymers and composites

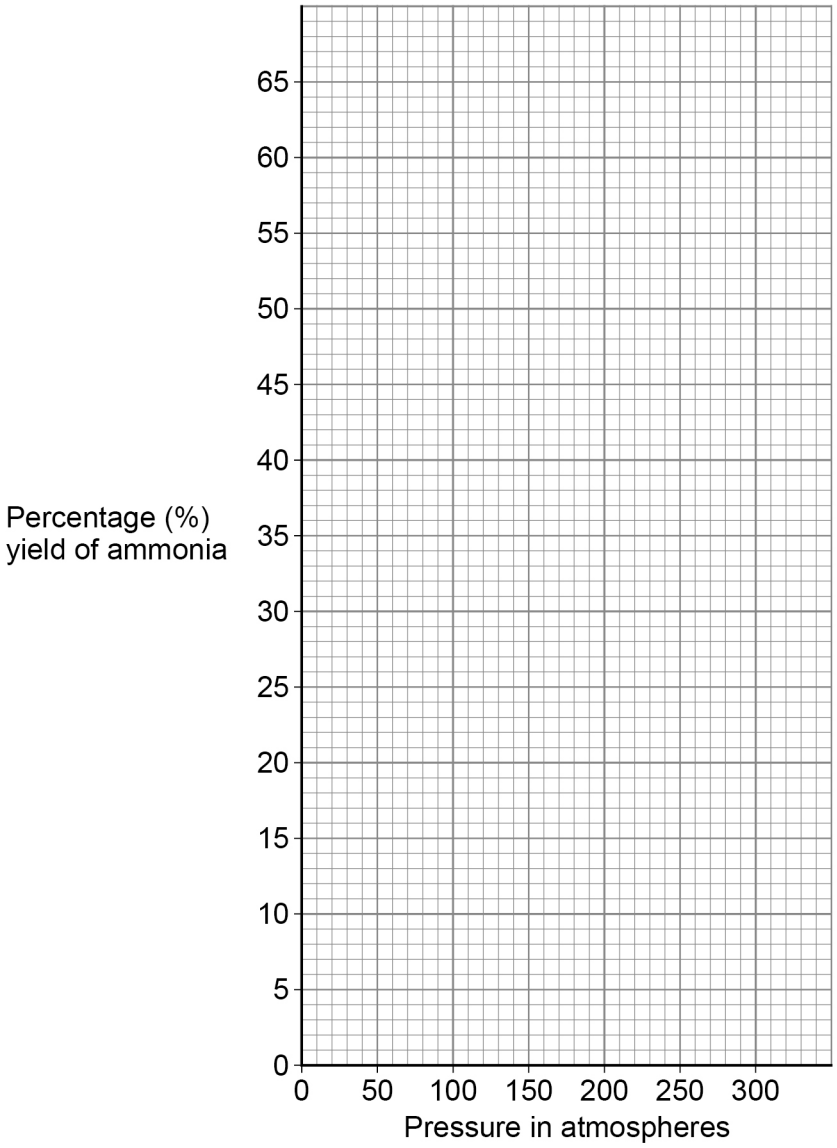
Question 25 · continued

0 5 . 5 Plot the data from **Table 8** on **Figure 6**.

Draw a line of best fit.

[3 marks]

Figure 6



0 5 . 6 What is the effect of increasing the pressure on the percentage yield of ammonia?

Use **Table 8**.

[1 mark]

10

4.10.3.3 Ceramics, polymers and composites

Question 26

June 2023 | 8462/2F | Original Q2

0 2 This question is about glass and polymers.

Beakers can be made from borosilicate glass or poly(propene).

Table 1 shows information about materials used to make beakers.

Table 1

	Material used to make beakers	
	borosilicate glass	**poly(propene)**
Temperature at which melting begins in °C	850	160
Flammability	does not burn	burns
Resistance to impact	shatters	tough
Cost of 100 cm^3 beaker in £	1.50	2.00

0 2 . 1 Suggest **two** reasons why a Bunsen burner should **not** be used to heat a liquid in a poly(propene) beaker.

Use **Table 1**.

[2 marks]

1 _____

_____

2 _____

_____

0 2 . 2 Poly(propene) beakers are more expensive than borosilicate glass beakers.

Suggest **one** reason why using poly(propene) beakers instead of borosilicate glass beakers could save money.

Use **Table 1**.

[1 mark]

_____

_____

0 2 . 3 Which is a raw material used to make borosilicate glass?

[1 mark]

Tick (✓) **one** box.

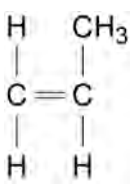
Boron trioxide ☐

Clay ☐

Limestone ☐

Poly(propene) is produced from propene.

The displayed structural formula of propene is:



0 2 . 4 **Table 2** shows some information about the elements in one molecule of propene.

Table 2

Symbol for element	Name of element	Number of atoms of element in one molecule of propene
C		
H		

Complete **Table 2**.

[2 marks]

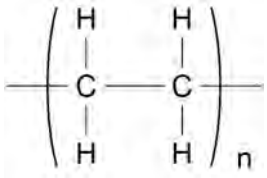
4.10.3.3 Ceramics, polymers and composites

Question 26 · continued

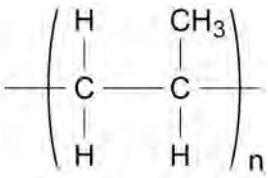
0 2 . 5 Which structure is the repeating unit of poly(propene)?

[1 mark]

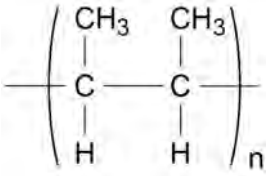
Tick (✓) **one** box.



☐



☐



☐

0 2 . 6 Poly(propene) is produced in three stages:

- **Stage 1:** separating large alkane molecules from crude oil
- **Stage 2:** producing propene molecules from large alkane molecules
- **Stage 3:** joining many propene molecules together.

Name **Stage 1**, **Stage 2** and **Stage 3**.

Choose answers from the box.

[3 marks]

cracking	**fermentation**	**fractional distillation**
polymerisation	**reverse osmosis**	

Stage 1 is _____.

Stage 2 is _____.

Stage 3 is _____.

4.10.3.3 Ceramics, polymers and composites

Question 26 · continued

0 2 . 7 A molecule of hexene contains a double carbon–carbon bond.

Many hexene molecules join together to form poly(hexene).

Which **two** words describe a hexene molecule in this process?

[2 marks]

Tick (✓) **two** boxes.

- Alkene ☐
- Catalyst ☐
- Composite ☐
- Element ☐
- Monomer ☐

12

4.10.3.3 Ceramics, polymers and composites

Question 27

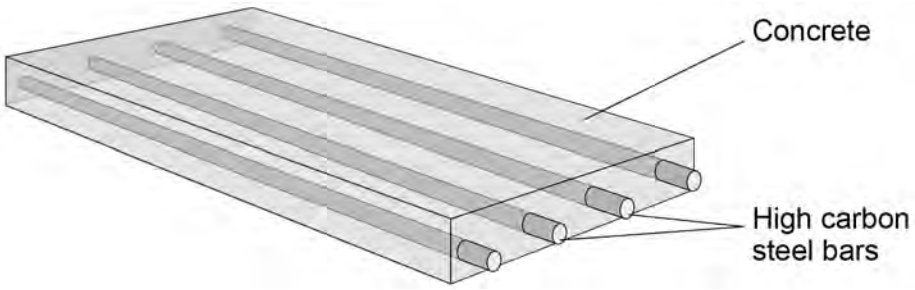
0 7 This question is about materials.

Pre-stressed concrete is a composite material.

The concrete is strengthened using high carbon steel bars.

Figure 8 shows the structure of a piece of pre-stressed concrete.

Figure 8



0 7 . 1 Which **two** words describe the high carbon steel bars?

[2 marks]

Tick (✓) **two** boxes.

- Alloy ☐
- Binder ☐
- Matrix ☐
- Ore ☐
- Reinforcement ☐

4.10.3.3 Ceramics, polymers and composites

Question 27 · continued

Limestone is mainly calcium carbonate.

Limestone is a raw material used in the production of concrete.

0 7 . 2 In the first part of the production of concrete:

- air is heated by burning methane
- the hot air is used to heat limestone
- the limestone decomposes.

The equation for the decomposition of limestone is:

calcium carbonate → calcium oxide + carbon dioxide

Give **two** ways in which a greenhouse gas is released in this process.

[2 marks]

1 _____

_____

2 _____

_____

0 7 . 3 How could a sample of limestone be tested to show the presence of carbonate ions?

Complete the sentences.

Choose answers from the box.

[2 marks]

barium chloride	**hydrochloric acid**	**limewater**
sodium hydroxide		**universal indicator**

The substance added to the limestone is _____.

The gas produced is identified using _____.

Question 7 continues on the next page

4.10.3.3 Ceramics, polymers and composites

Question 27 · continued

Table 4 gives some information about plain concrete and pre-stressed concrete.

Table 4

	Plain concrete	Pre-stressed concrete
Cost in £ per m^3	75	225
Density in kg per m^3	2300	2500
Strength in arbitrary units	600	3000

0 7 . 4 Explain why pre-stressed concrete rather than plain concrete is used to make bridges that carry heavy lorries.

Use **Table 4**.

[2 marks]

4.10.3.3 Ceramics, polymers and composites

Question 27 · continued

0 7 . 5 **Figure 9** shows a garden path made of plain concrete slabs.

Figure 9



Suggest **two** reasons why plain concrete rather than pre-stressed concrete is used to make slabs for garden paths.

Use **Table 4**.

[2 marks]

1 _____

_____

2 _____

_____

10

4.10.3.3 Ceramics, polymers and composites

Question 28

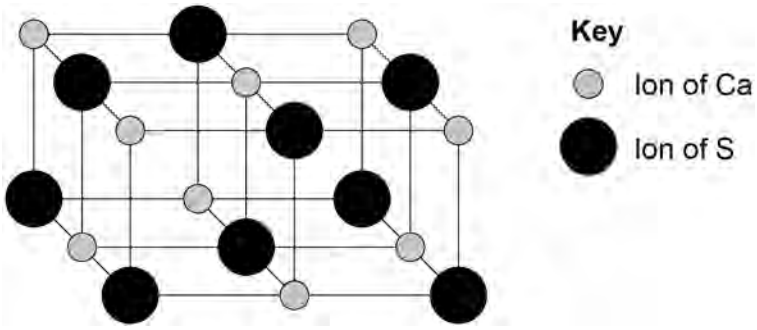
June 2025 | 8462/1F | Original Q9

0 9 This question is about structure and bonding.

Calcium sulfide is an ionic compound.

Figure 13 represents the structure of calcium sulfide.

Figure 13



0 9 . 1 Determine the empirical formula of calcium sulfide.

[1 mark]

Empirical formula _____

Question 9 continues on the next page

4.10.3.3 Ceramics, polymers and composites

Question 28 · continued

0 9 . 2 Calcium is in Group 2 of the periodic table.

Sulfur is in Group 6 of the periodic table.

Describe what happens when a calcium atom reacts with a sulfur atom.

Answer in terms of electrons and ions.

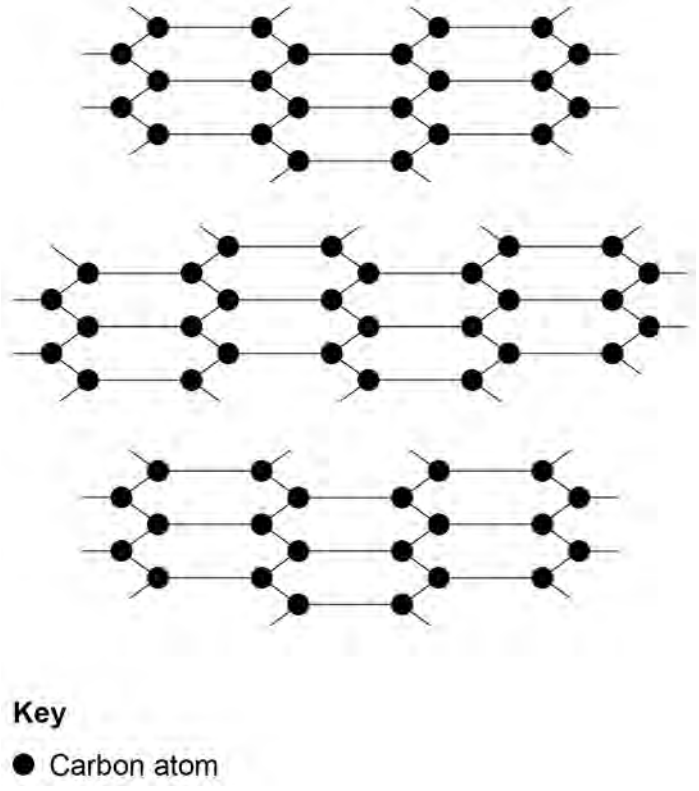
[4 marks]

4.10.3.3 Ceramics, polymers and composites

Question 28 · continued

Figure 14 shows the structure of graphite.

Figure 14



0 9 . 3 Describe the structure and bonding of graphite.

[4 marks]

Extra space

4.10.3.3 Ceramics, polymers and composites

Question 28 · continued

0 9 . 4 Substances that consist of small molecules do **not** conduct electricity.

Give **one** reason why.

[1 mark]

0 9 . 5 Methane consists of small molecules.

Poly(ethene) is a polymer.

Why does poly(ethene) have a higher melting point than methane?

[1 mark]

Tick (✓) **one** box.

- Poly(ethene) has more covalent bonds to break than methane. ☐
- Poly(ethene) has no intermolecular forces to overcome. ☐
- Poly(ethene) has stronger covalent bonds to break than methane. ☐
- Poly(ethene) has stronger intermolecular forces to overcome than methane. ☐

11

4.10.3.3 Ceramics, polymers and composites

Question 29

June 2025 | 8462/2F | Original Q2

0 2 Alkanes and alkenes are hydrocarbons.

Hydrocarbon molecules are made up of hydrogen and carbon atoms only.

An alkene has the formula C_3H_6

0 2 . 1 Which alkene has the formula C_3H_6?

[1 mark]

Tick (✓) **one** box.

Butene ☐

Ethene ☐

Propene ☐

0 2 . 2 How many atoms are there in a molecule of C_3H_6?

[1 mark]

Tick (✓) **one** box.

2 ☐ 3 ☐ 6 ☐ 9 ☐

0 2 . 3 Which is a use of C_3H_6?

[1 mark]

Tick (✓) **one** box.

Making a polymer ☐

Making ammonia ☐

Making glass ☐

0 2 . 4 The percentage (%) by mass of each element in a molecule of C_3H_6 is:

- hydrogen 14%
- carbon 86%.

Figure 1 shows the percentage by mass of hydrogen in a molecule of C_3H_6

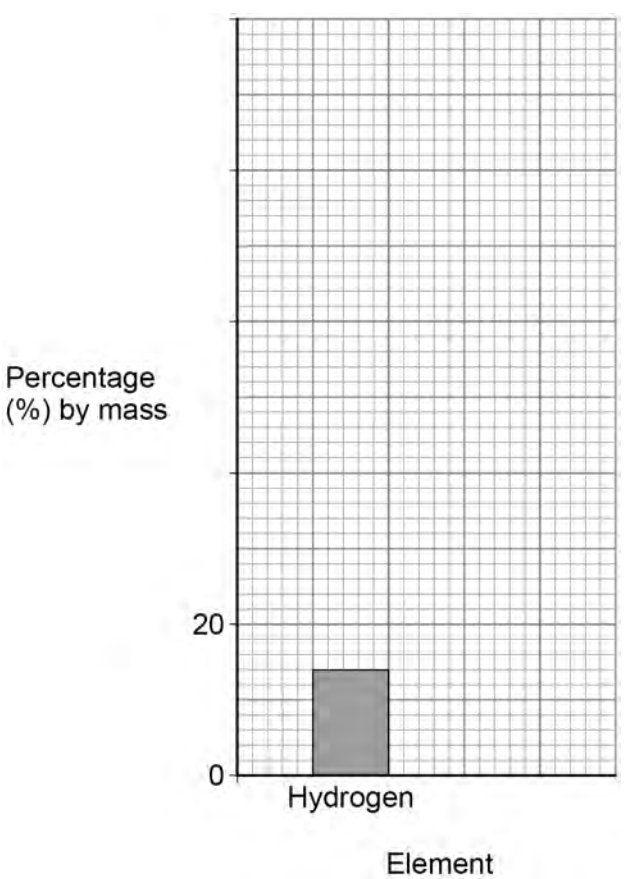
Complete **Figure 1**.

You should:

- complete the *y*-axis scale
- plot the percentage by mass of carbon as a bar
- label the bar plotted for carbon.

[3 marks]

Figure 1



4.10.3.3 Ceramics, polymers and composites

Question 29 · continued

Alkanes can be cracked to produce alkenes and smaller alkane molecules.

0 2 . 5 Describe a test for alkenes.

Give the result of the test.

[2 marks]

Test _____

_____

Result _____

_____

0 2 . 6 $C_{10}H_{22}$ can be cracked to produce C_3H_6 and an alkane.

Complete the equation for the reaction.

[1 mark]

$$C_{10}H_{22} \longrightarrow C_3H_6 + C___H_{16}$$

0 2 . 7 Complete the sentence.

Choose the answer from the box.

[1 mark]

ceramics	**fertilisers**	**fuels**

Smaller alkanes from cracking are useful as _____.

4.10.3.3 Ceramics, polymers and composites

Question 29 · continued

High temperatures between 450 °C and 750 °C are used in cracking reactions.

0 2 . 8 Which statement describes the molecules at 750 °C compared with the molecules at 450 °C?

[1 mark]

Tick (✓) **one** box.

- The molecules collide more frequently at 750 °C. ☐
- The molecules have less energy at 750 °C. ☐
- The molecules move more slowly at 750 °C. ☐

0 2 . 9 How does the rate of reaction at 750 °C compare with the rate of reaction at 450 °C?

[1 mark]

_____

_____

12

4.10.3.3 Ceramics, polymers and composites

Question 30

June 2025 | 8462/2F | Original Q3

0 3 Cement, concrete and steel are building materials.

Cement contains calcium oxide.

Calcium oxide reacts with water to produce calcium hydroxide.

The equation for the reaction is:

calcium oxide + water ⇌ calcium hydroxide

0 3 . 1 How does the equation show that this reaction is reversible?

[1 mark]

0 3 . 2 The forward reaction is exothermic.

What type of reaction is the reverse reaction?

[1 mark]

0 3 . 3 When excess water is added to 20 g of calcium oxide, 23 kJ of energy is released.

Calculate the energy released when excess water is added to 4 g of calcium oxide.

[2 marks]

Energy released = _____ kJ

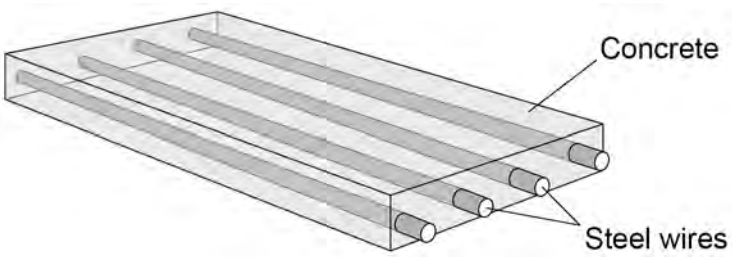
4.10.3.3 Ceramics, polymers and composites

Question 30 · continued

Pre-stressed concrete contains steel wires within the concrete.

Figure 2 shows the structure of a piece of pre-stressed concrete.

Figure 2



0 3 . 4 Pre-stressed concrete is a composite.

Draw **one** line from each component of a composite to a material in pre-stressed concrete.

[2 marks]

Component of composite	Material in pre-stressed concrete
	Concrete
Binder	
	Pre-stressed concrete
Reinforcement	
	Steel wires

0 3 . 5 Which metal do **all** steels contain?

[1 mark]

_____

4.10.3.3 Ceramics, polymers and composites

Question 30 · continued

0 3 . 6 Bricks are also building materials.

Bricks are ceramics.

Which material is used to make bricks?

[1 mark]

Tick (✓) **one** box.

Aluminium ☐

Clay ☐

Poly(ethene) ☐

8

Turn over for the next question

4.10.3.3 Ceramics, polymers and composites

Question 31

June 2025 | 8462/2F | Original Q4

0 4 Ammonia is produced in the Haber process.

The word equation for the reaction to produce ammonia is:

nitrogen + hydrogen ⇌ ammonia

0 4 . 1 Draw **one** line from each element to a source of that element.

[2 marks]

Element	Source of element
Nitrogen	Air
Hydrogen	Clay
	Limestone
	Natural gas
	Sand

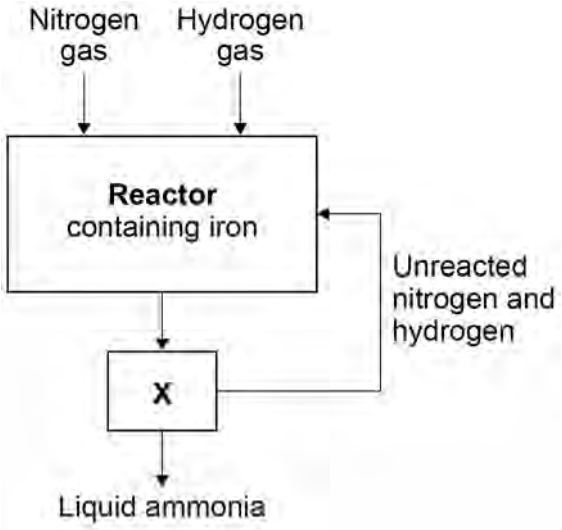
4.10.3.3 Ceramics, polymers and composites

Question 31 · continued

Ammonia is a gas at room temperature.

Figure 3 shows how ammonia is produced from nitrogen and hydrogen.

Figure 3



0 4 . 2 Which process takes place at **X** in **Figure 3**?

[1 mark]

Tick (✓) **one** box.

Cooling ☐

Filtering ☐

Melting ☐

0 4 . 3 Complete the sentence.

Use **Figure 3**.

[1 mark]

The iron in the reactor is used as a _____.

4.10.3.3 Ceramics, polymers and composites

Question 31 · continued

Table 1 shows the world production of ammonia between 1990 and 2020.

Table 1

Year	World production of ammonia in arbitrary units
1990	120
2000	130
2010	155
2020	165

0 4 . 4 How did the world production of ammonia change between 1990 and 2020?

Use **Table 1**.

[1 mark]

0 4 . 5 Determine the mean change in mass of ammonia produced per year between 2000 and 2020.

Use **Table 1** and the equation:

$$\text{mean change in mass produced per year} = \frac{\text{change in mass produced between 2000 and 2020}}{\text{number of years}}$$

[4 marks]

Change in mass = _____ arbitrary units

Number of years = _____

Mean change = _____ arbitrary units per year

4.10.3.3 Ceramics, polymers and composites

Question 31 · continued

Most of the ammonia produced in the Haber process is used to make fertilisers.

0 4 . 6 Which is a reason for the change in the world production of ammonia shown in **Table 1**?

[1 mark]

Tick (✓) **one** box.

- Change in amount of acid rain ☐
- Change in global temperatures ☐
- Change in world population ☐

0 4 . 7 Fertilisers produced using ammonia contain nitrogen.

Which **two** compounds used in fertilisers contain nitrogen?

Use the periodic table.

[2 marks]

Tick (✓) **two** boxes.

- $Ca(NO_3)_2$ ☐
- $Ca_3(PO_4)_2$ ☐
- KCl ☐
- K_2SO_4 ☐
- $(NH_4)_2SO_4$ ☐

12