AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.2.2.6

Giant covalent structures

Past-paper questions

Tier	**Higher**
Question groups	**27**
Available paper years	**2008–2025**

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.

4.2.2.6 Giant covalent structures

Question 01

January 2008 | CHY1H | Original Q2 | Legacy

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?

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(1 mark)

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

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(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?

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(1 mark)

4.2.2.6 Giant covalent structures

Question 01 · 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?

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(1 mark)

7

Turn over for the next question

4.2.2.6 Giant covalent structures

Question 02

January 2008 | CHY2H | Original Q4 | Legacy

4 The *electrolysis* of sodium chloride solution produces useful substances.

(a) Explain the meaning of *electrolysis*.

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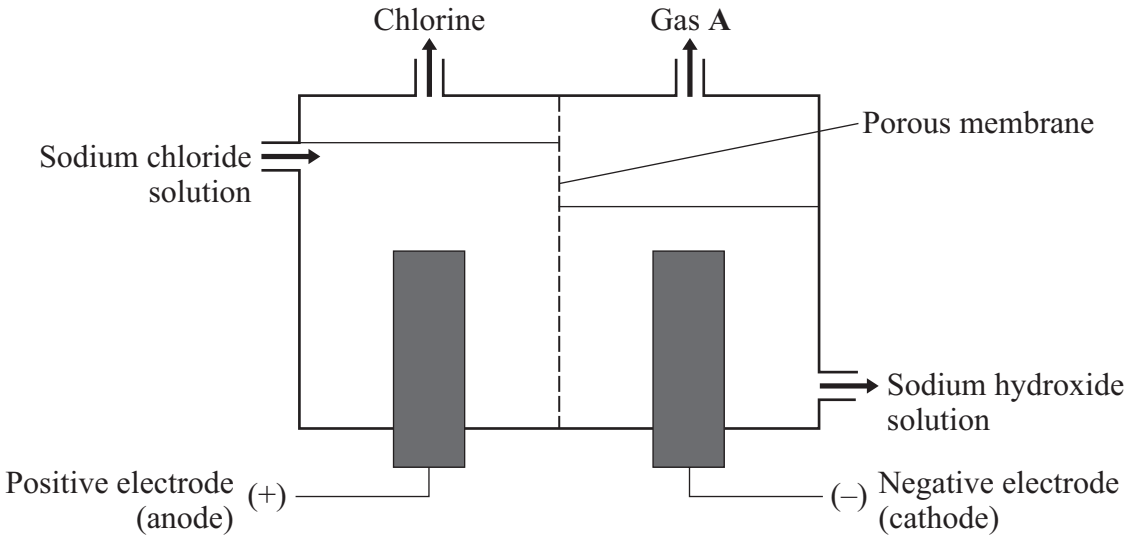
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(2 marks)

(b) The diagram shows an apparatus used for the electrolysis of sodium chloride solution.



The electrolysis produces two gases, chlorine and Gas **A**.

Name Gas **A** .....

(1 mark)

(c) The electrodes used in this process can be made of graphite. Explain why graphite conducts electricity.

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(2 marks)

5

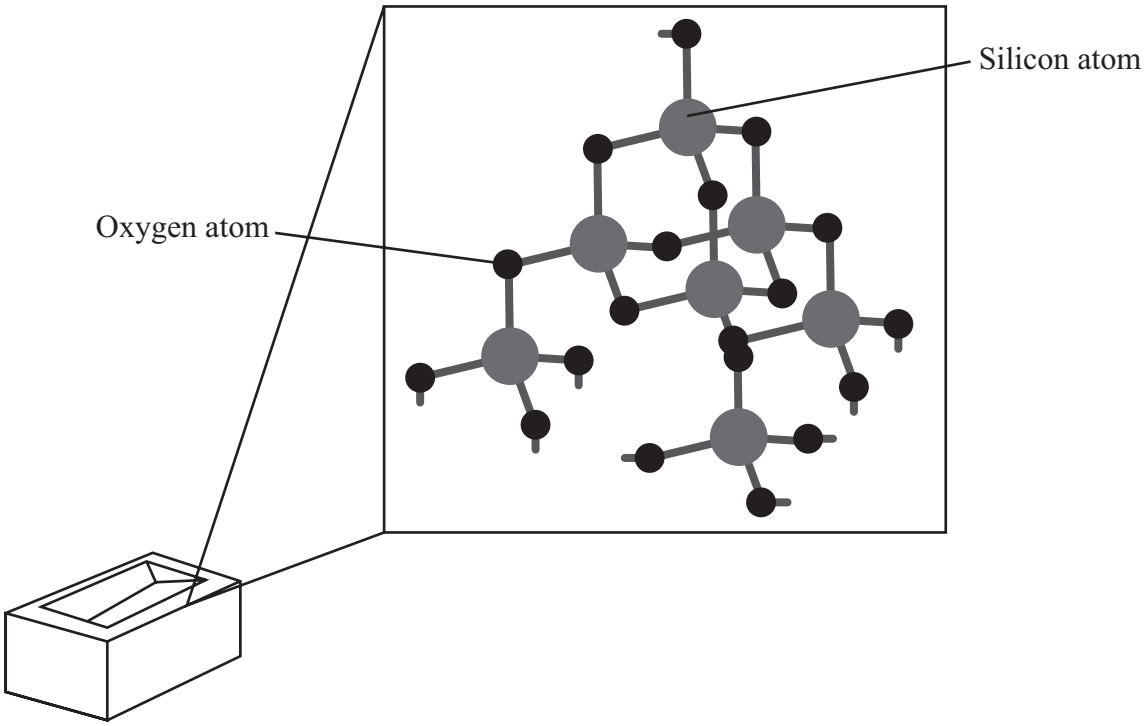
4.2.2.6 Giant covalent structures

Question 03

June 2008 | CHY2H | Original Q4 | Legacy

4 Bricks made from silica (silicon dioxide) are used to line furnaces that operate at high temperatures.

Part of the structure of silica is shown in the diagram.



Suggest and explain why silica is used to make bricks for high-temperature furnaces.
In your answer, you should refer to the structure of, and bonding in, silica.

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(4 marks)

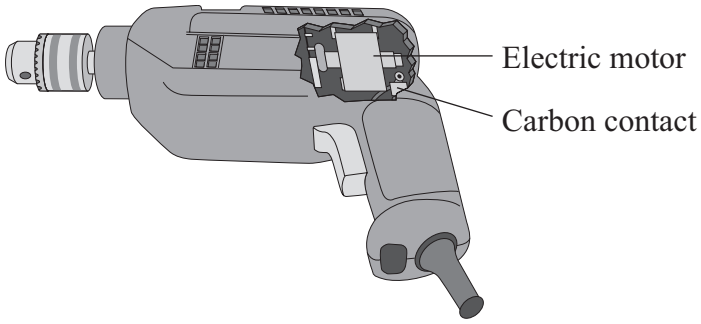
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4.2.2.6 Giant covalent structures

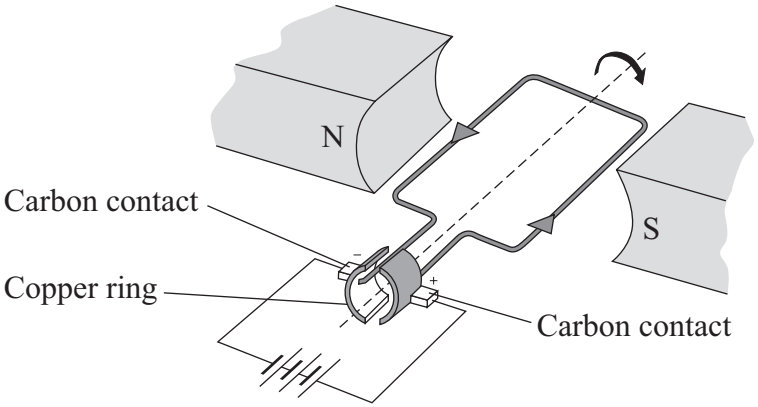
Question 04

June 2009 | CHY2H | Original Q4 | Legacy

4 This drill contains an electric motor.



The diagram below shows the main parts of an electric motor.



4.2.2.6 Giant covalent structures

Question 04 · continued

for mark

The carbon contacts are made of graphite. Springs push the contacts against the copper ring. The contacts conduct electricity to the copper ring. The copper ring rotates rapidly but does not stick or become worn because the graphite is soft and slippery.

Graphite has properties which are ideal for making the contacts in an electric motor.

Explain, in terms of structure and bonding, why graphite has these properties.

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(5 marks)

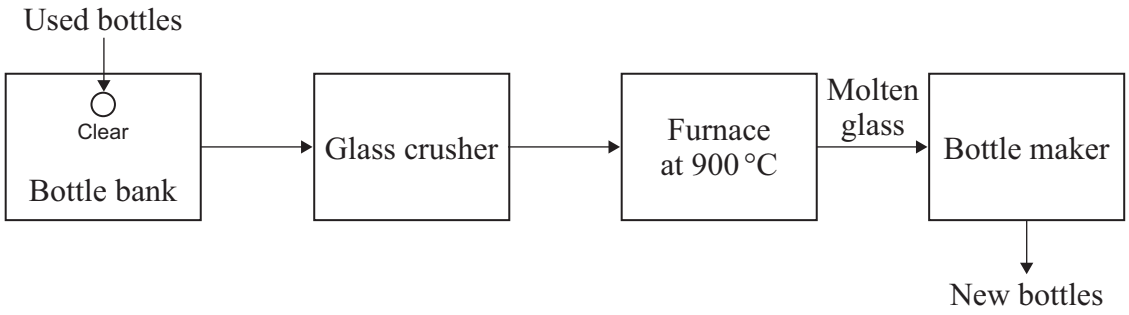
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4.2.2.6 Giant covalent structures

Question 05

2 In recent years we have become more aware of the need to recycle glass.

2 (a) Used glass bottles can be recycled if they are put into bottle banks.



2 (a) (i) Suggest **one** reason why light bulbs should **not** be put into bottle banks.

.....

.....

(1 mark)

2 (a) (ii) Very few glass bottles are reused (used more than once).

Suggest **one** reason why.

.....

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(1 mark)

2 (a) (iii) New glass bottles can also be produced by heating, at 1700 °C, a mixture of the following raw materials:

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

Explain why the use of recycled glass to make glass bottles produces less carbon dioxide than making glass bottles from these raw materials.

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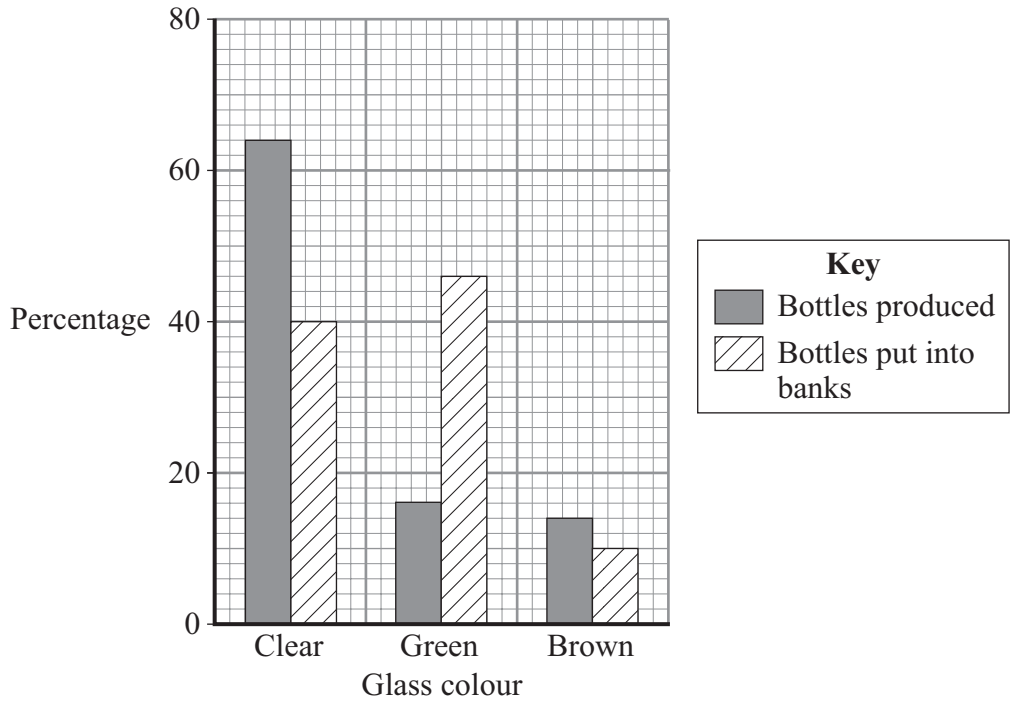
(2 marks)

4.2.2.6 Giant covalent structures

Question 05 · continued

for mark

2 (b) The bar chart shows the percentages of glass bottles produced and the percentages of glass bottles put into bottle banks in the UK.



2 (b) (i) The percentage of green glass bottles produced is 16%.
What is the percentage of green glass bottles put into bottle banks?

Percentage = ... %

(1 mark)

2 (b) (ii) More green glass bottles are put into bottle banks than are made in the UK.
Suggest **one** reason why.

.....

.....

(1 mark)

2 (b) (iii) Suggest and explain **one** problem resulting from the percentage of clear glass bottles produced in the UK.

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(2 marks)

8

4.2.2.6 Giant covalent structures

Question 06

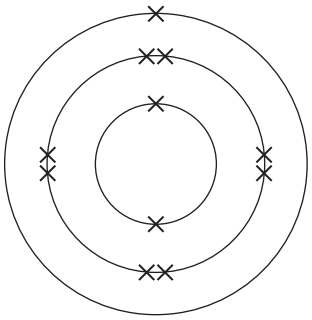
January 2010 | CHY2H | Original Q1 | Legacy

1 Sodium chloride is a raw material.

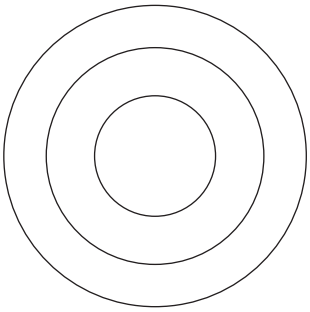
1 (a) The electronic structure of a sodium atom is shown below.

Complete the diagram for the electronic structure of a chlorine atom. A chlorine atom has 17 electrons.

Sodium atom



Chlorine atom



(1 mark)

1 (b) When sodium and chlorine react to form sodium chloride they form sodium ions (Na^+) and chloride ions (Cl^-).

How does a sodium atom change into a sodium ion?

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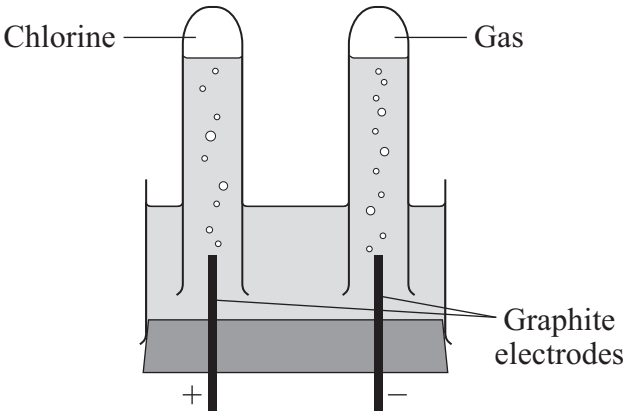
(2 marks)

4.2.2.6 Giant covalent structures

Question 06 · continued

for mark

1 (c) The diagram shows apparatus used in a school laboratory for the electrolysis of sodium chloride solution.



The solution contains sodium ions (Na^+), chloride ions (Cl^-), hydrogen ions (H^+) and hydroxide ions (OH^-).

1 (c) (i) Why do chloride ions move to the positive electrode?

.....

(1 mark)

1 (c) (ii) Name the gas formed at the negative electrode.

.....

(1 mark)

Question 1 continues on the next page

4.2.2.6 Giant covalent structures

for mark

1 (d) Chlorine and chlorine compounds are used to bleach wood pulp that is used to make paper.

The article below is from a newspaper.

> Local people have been protesting outside a paper factory. They say:
> 'We want the company to stop using chlorine compounds. Chlorine compounds release poisons into the environment. The company should use safer compounds.'
>
> The company replied:
> 'Chlorine has been used safely for many years to treat drinking water. Only tiny amounts of chlorine are released, which cause no harm. Using other compounds will be more expensive and may put us out of business.'

1 (d) (i) Why are some local people worried about the use of chlorine compounds?

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(1 mark)

1 (d) (ii) Why might other local people want the company to continue to use chlorine compounds?

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(1 mark)

1 (d) (iii) It is decided to have an enquiry.
Why should this be done by independent scientists?

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(1 mark)

8

4.2.2.6 Giant covalent structures

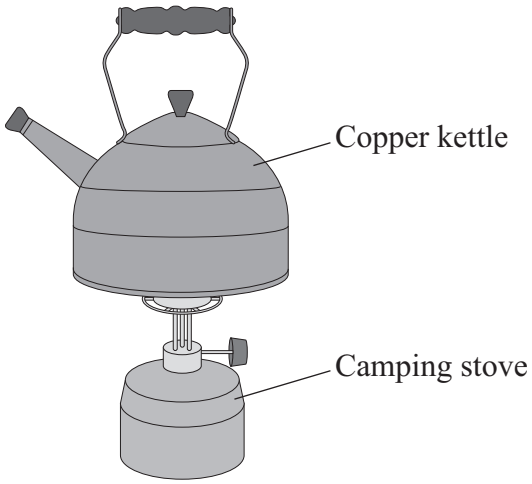
Question 07

January 2010 | CHY2H | Original Q4 | Legacy

4 The picture shows a copper kettle being heated on a camping stove.

Copper is a good material for making a kettle because:

- it has a high melting point
- it is a very good conductor of heat.



4 (a) Explain why copper, like many other metals, has a high melting point.
You should describe the structure and bonding of a metal in your answer.

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(4 marks)

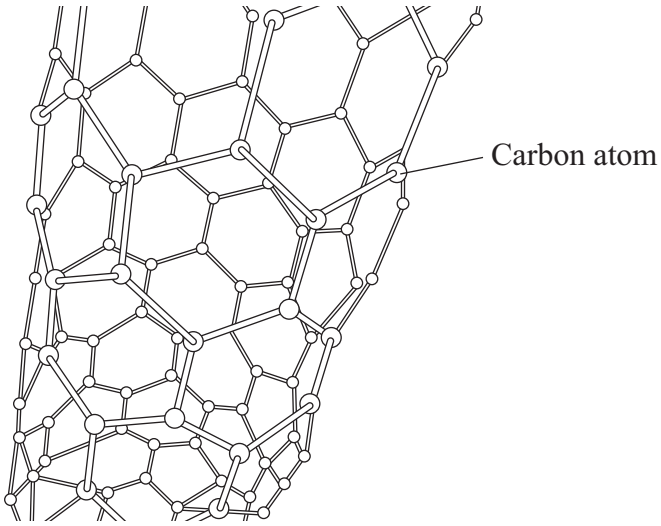
4.2.2.6 Giant covalent structures

for mark

4 (b) An aeroplane contains many miles of electrical wiring made from copper. This adds to the mass of the aeroplane.

It has been suggested that the electrical wiring made from copper could be replaced by lighter carbon nanotubes.

The diagram shows the structure of a carbon nanotube.



4 (b) (i) What does the term 'nano' tell you about the carbon nanotubes?

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(1 mark)

4 (b) (ii) Like graphite, each carbon atom is joined to three other carbon atoms.

Explain why the carbon nanotube can conduct electricity.

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(2 marks)

7

4.2.2.6 Giant covalent structures

Question 08

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

Question 08 · 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**

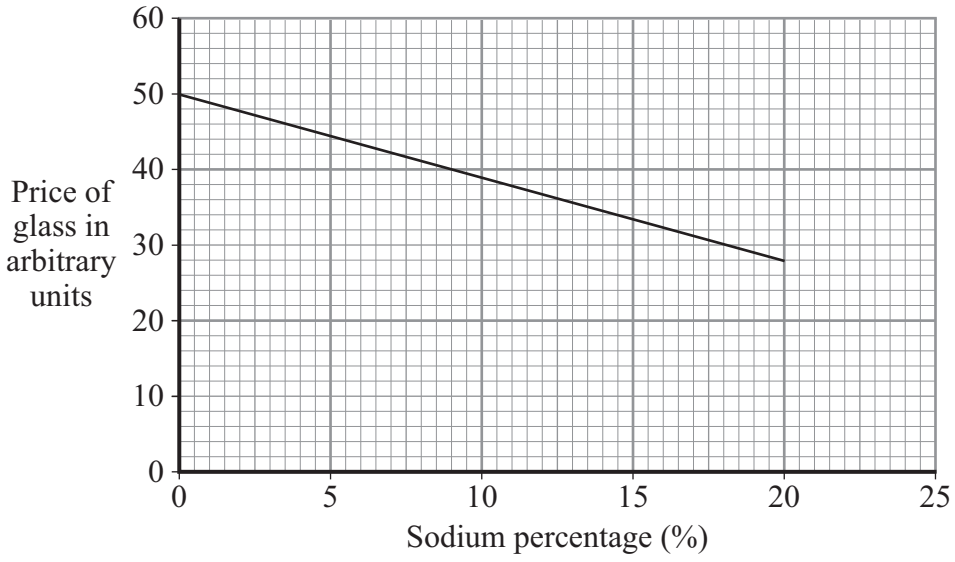
4 Reasons **M** and **N**

Question 7 continues on the next page

4.2.2.6 Giant covalent structures

Question 08 · 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

4.2.2.6 Giant covalent structures

Question 09

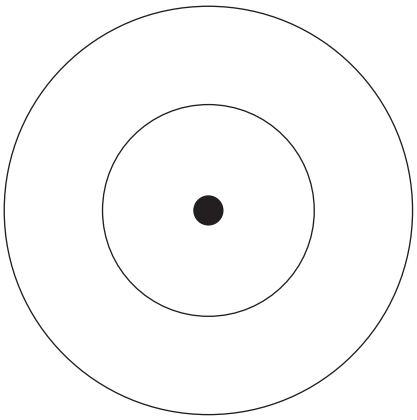
June 2010 | CHY2H | Original Q3 | Legacy

3 Pure carbon can exist in two forms, diamond and graphite.

3 (a) Complete the diagram to show the electronic structure of a carbon atom.

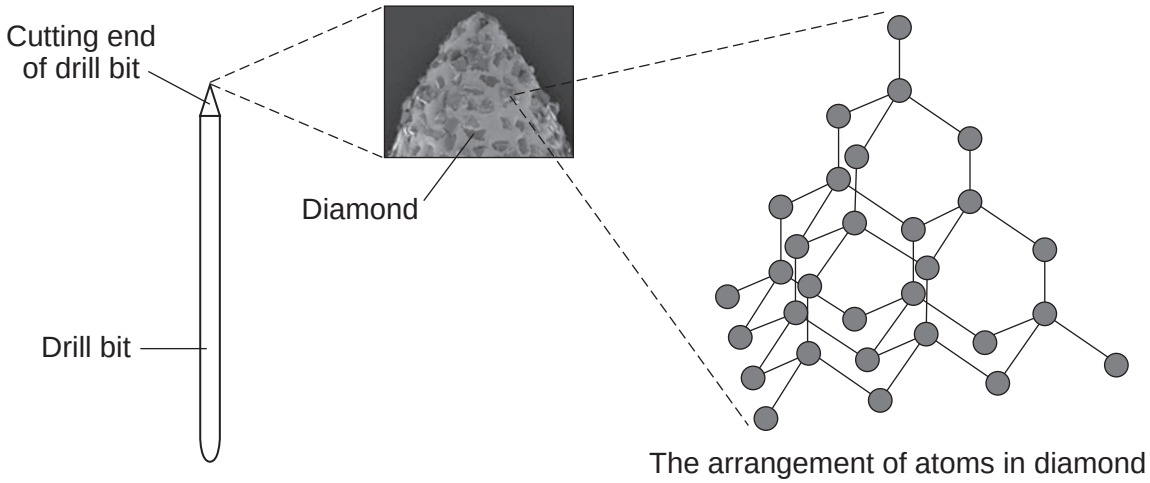
A carbon atom has 6 electrons.

Show the electrons as crosses (x).



(1 mark)

3 (b) A drill bit is used to cut holes through materials. The cutting end of this drill bit is covered with very small diamonds.



4.2.2.6 Giant covalent structures

Question 09 · continued

3 (b) (i) What property of diamond makes it suitable for use on the cutting end of a drill bit?

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(1 mark)

3 (b) (ii) Explain, as fully as you can, why diamond has this property. Use your knowledge of the structure and bonding of diamond and the information shown opposite to help you to answer this question.

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(3 marks)

3 (c) Explain why graphite is a good conductor of electricity and why diamond does **not** conduct electricity.

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(3 marks)

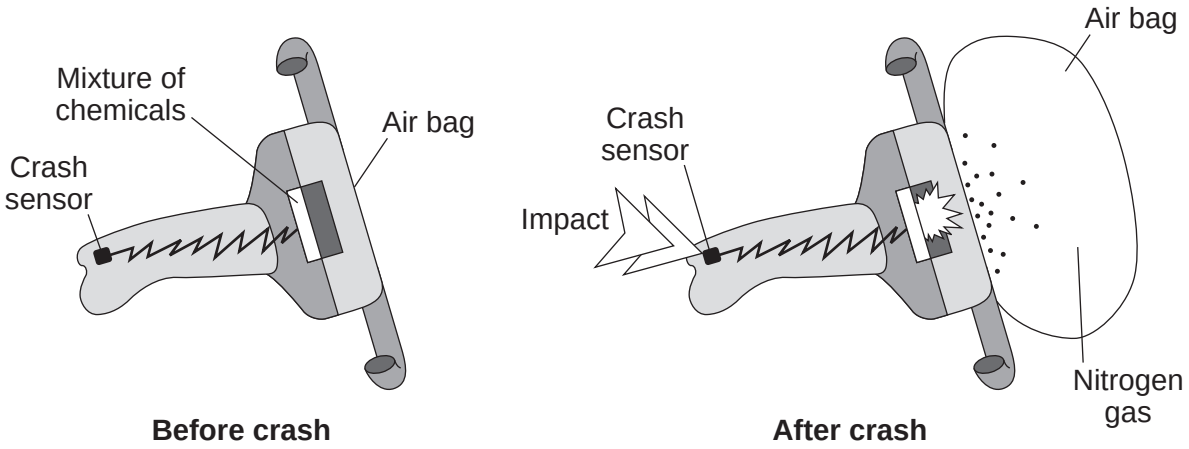
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4.2.2.6 Giant covalent structures

Question 10

June 2010 | CHY2H | Original Q4 | Legacy

4 Air bags are used to protect the passengers in a car during an accident. When the crash sensor detects an impact it causes a mixture of chemicals to be heated to a high temperature. Reactions take place which produce nitrogen gas. The nitrogen fills the air bag.



4 (a) The mixture of chemicals contains sodium azide (NaN_3) which decomposes on heating to form sodium and nitrogen.

$$2NaN_3 \rightarrow 2Na + 3N_2$$

A typical air bag contains 130 g of sodium azide.

4 (a) (i) Calculate the mass of nitrogen that would be produced when 130 g of sodium azide decomposes.

Relative atomic masses (A_r): N = 14; Na = 23

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Mass of nitrogen = ... g

(3 marks)

4.2.2.6 Giant covalent structures

Question 10 · continued June 2010 | CHY2H | Original Q4 | Legacy

4 (a) (ii) 1 g of nitrogen has a volume of 0.86 litres at room temperature and pressure.

What volume of nitrogen would be produced from 130 g of sodium azide?

(If you did not answer part (a)(i), assume that the mass of nitrogen produced from 130 g of sodium azide is 80 g. This is **not** the correct answer to part (a)(i).)

.....

Volume = ... litres
(1 mark)

4 (b) The sodium produced when the sodium azide decomposes is dangerous.
The mixture of chemicals contains potassium nitrate and silicon dioxide which help to make the sodium safe.

4 (b) (i) Sodium reacts with potassium nitrate to make sodium oxide, potassium oxide and nitrogen. Complete the balancing of the equation for this reaction.

$$10Na + ...KNO_3 \rightarrow .....Na_2O + K_2O + N_2$$

(1 mark)

4 (b) (ii) The silicon dioxide reacts with the sodium oxide and potassium oxide to form silicates.

Suggest why sodium oxide and potassium oxide are dangerous in contact with the skin.

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(1 mark)

6

4.2.2.6 Giant covalent structures

Question 11

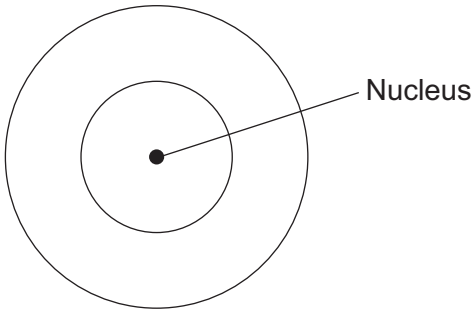
January 2012 | CH1HP | Original Q1 | Legacy

1 The picture shows a diamond ring.



1 (a) Diamond is a form of carbon. A carbon atom has six electrons.

Draw the electronic structure of a carbon atom.



(1 mark)

1 (b) A gold atom has an atomic number of 79 and a mass number of 197.

Complete the table to show the name and number of each sub-atomic particle in this gold atom.

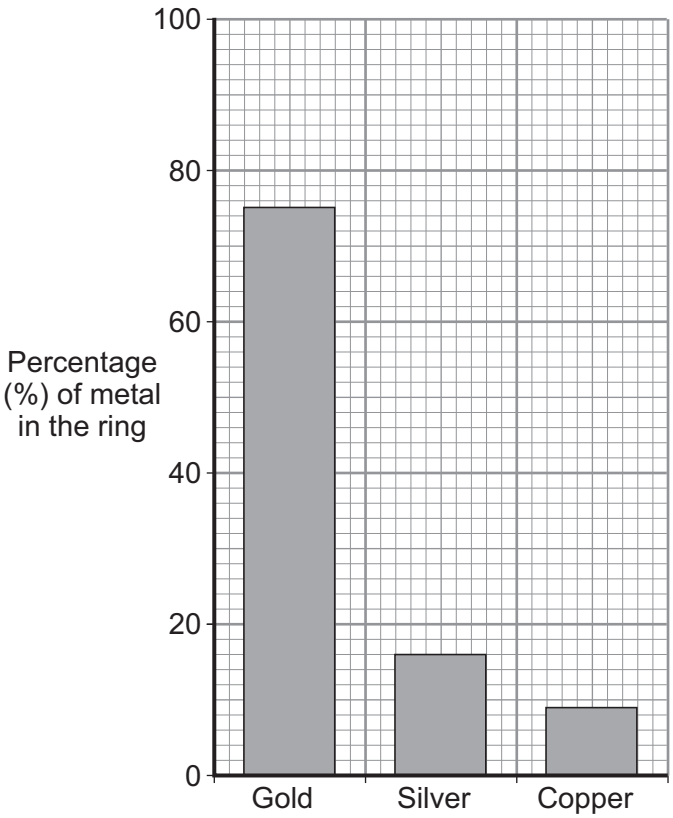
Name	Number
Proton	79
Electron	.....
.....	.....

(3 marks)

4.2.2.6 Giant covalent structures

Question 11 · continued

1 (c) The bar chart shows the composition of this gold ring.



1 (c) (i) Give the percentage of the other two metals in this gold ring.

Silver is ..... % and copper is ..... %

(1 mark)

1 (c) (ii) This gold ring is not made from 100 % gold.

Give **two** reasons why.

1 .....

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.....

2 .....

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(2 marks)

7

4.2.2.6 Giant covalent structures

Question 12

January 2012 | CH1HP | Original Q4 | Legacy

4 Cans for food and drinks are made from steel or aluminium.
The main metal in steel is iron.



4 (a) Iron is extracted by heating a mixture of iron oxide and carbon in a blast furnace.

4 (a) (i) Name this type of reaction.

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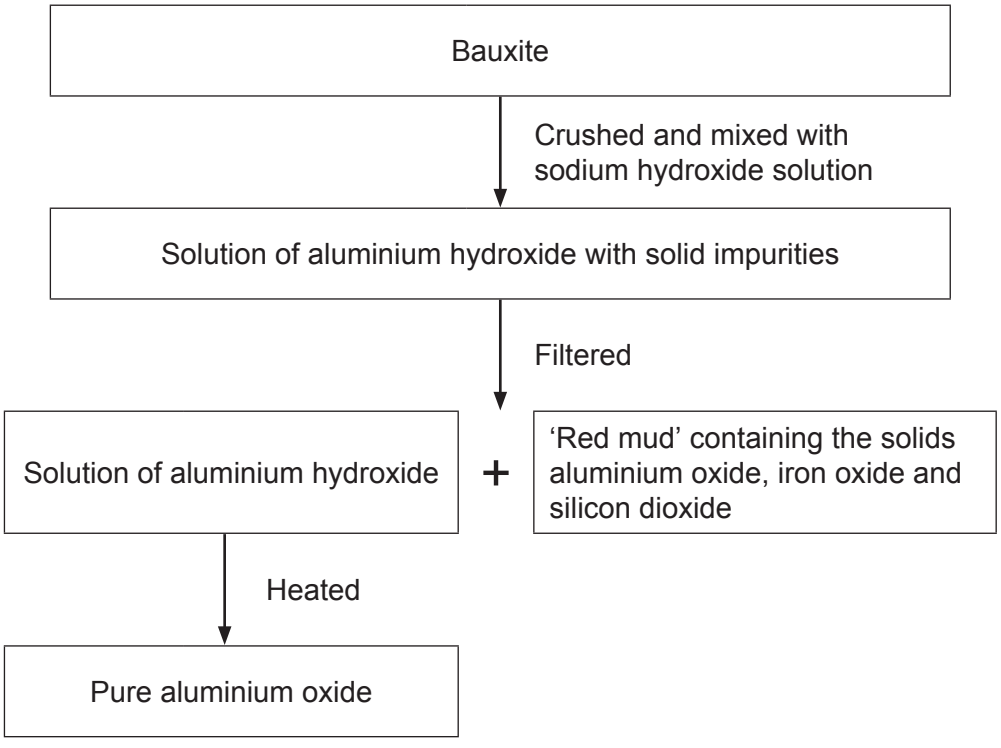
(1 mark)

4 (a) (ii) Balance the symbol equation for this reaction.

$2Fe_2O_3$ + ... C → ..... Fe + ... CO_2

(1 mark)

4 (b) Aluminium ore, bauxite, contains aluminium oxide, iron oxide and silicon dioxide.
Aluminium is extracted by electrolysis of aluminium oxide.



4.2.2.6 Giant covalent structures

Question 12 · continued

The 'red mud' which is dumped in very large ponds contains:

Name of solid	Percentage (%)
Aluminium oxide	10
Iron oxide	65
Silicon dioxide	25

4 (b) (i) 100 tonnes of bauxite produced 50 tonnes of pure aluminium oxide and 50 tonnes of 'red mud'.

What percentage of aluminium oxide did the bauxite contain?

.....

Answer = ... %

(1 mark)

4 (b) (ii) Apart from the solids shown in the table, name **one** other substance that would be in the 'red mud'.

.....

(1 mark)

4 (b) (iii) The purification of the aluminium oxide is usually done near to the bauxite quarries.

Suggest **one** reason why.

.....

(1 mark)

4 (c) Aluminium is used to make many things including cans.

During one year in the USA:
- 100 billion aluminium cans were sold
- 55 billion aluminium cans were recycled.

Give **one** environmental impact of recycling aluminium cans and **one** ethical or social impact of recycling aluminium cans.

Environmental .....

.....

Ethical or social .....

.....

(2 marks)

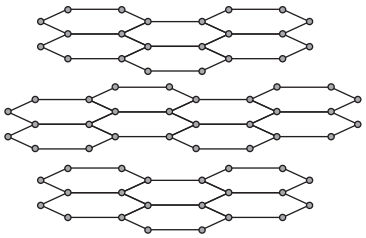
4.2.2.6 Giant covalent structures

Question 13

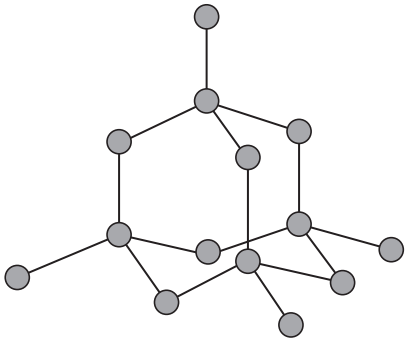
June 2012 | CH2HP | Original Q7 | Legacy

7 Graphite and diamond are different forms of the element carbon.
Graphite and diamond have different properties.

The structures of graphite and diamond are shown below.



Graphite



Diamond

7 (a) Graphite is softer than diamond.

Explain why.

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(4 marks)

4.2.2.6 Giant covalent structures

Question 13 · continued

7 (b) Graphite conducts electricity, but diamond does not.

Explain why.

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(3 marks)

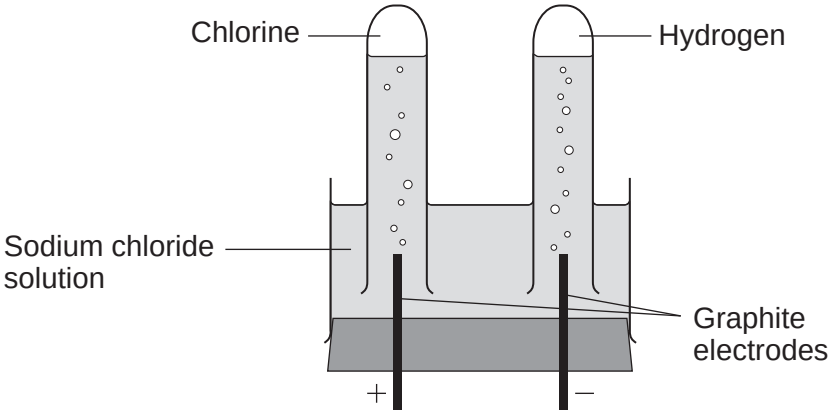
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4.2.2.6 Giant covalent structures

Question 14

2 The electrolysis of sodium chloride solution is an industrial process.

The diagram shows the apparatus used in a school experiment.



2 (a) One of the products of the electrolysis of sodium chloride solution is hydrogen.

2 (a) (i) Why do hydrogen ions move to the negative electrode?

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(1 mark)

2 (a) (ii) How does a hydrogen ion change into a hydrogen atom?

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(1 mark)

4.2.2.6 Giant covalent structures

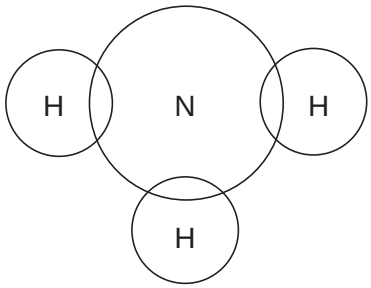
Question 14 · continued

2 (b) Hydrogen is used to make ammonia (NH_3).

Complete the diagram to show the bonding in ammonia.

Use dots (●) and crosses (x) to show electrons.

Show only outer shell electrons.



(2 marks)

2 (c) The table shows the ions in sodium chloride solution.

Positive ions	Negative ions
hydrogen	chloride
sodium	hydroxide

In industry, some of the waste from the electrolysis of sodium chloride solution is alkaline and has to be neutralised.

2 (c) (i) Which ion makes the waste alkaline?

.....

(1 mark)

2 (c) (ii) This waste must be neutralised.

Write the ionic equation for the neutralisation reaction.

.....

(1 mark)

Question 2 continues on the next page

4.2.2.6 Giant covalent structures

Question 14 · continued

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

The electrolysis of sodium chloride solution also produces chlorine and sodium hydroxide.

In industry, the electrolysis of sodium chloride solution can be done in several types of electrolysis cell.

Some information about two different types of electrolysis cell is given below.

	Mercury cell	**Membrane cell**
Cost of construction	Expensive	Relatively cheap
Additional substances used	Mercury, which is recycled. Mercury is toxic so any traces of mercury must be removed from the waste.	Membrane, which is made of a polymer. The membrane must be replaced every 3 years.
Amount of electricity used for each tonne of chlorine produced in kWh	3400	2950
Quality of chlorine produced	Pure	Needs to be liquefied and distilled to make it pure.
Quality of sodium hydroxide solution produced	50% concentration. Steam is used to concentrate the sodium hydroxide solution produced.	30% concentration. Steam is used to concentrate the sodium hydroxide solution produced.

Use the information and your knowledge and understanding to compare the environmental and economic advantages and disadvantages of these **two** types of electrolysis cell.

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4.2.2.6 Giant covalent structures

Question 15

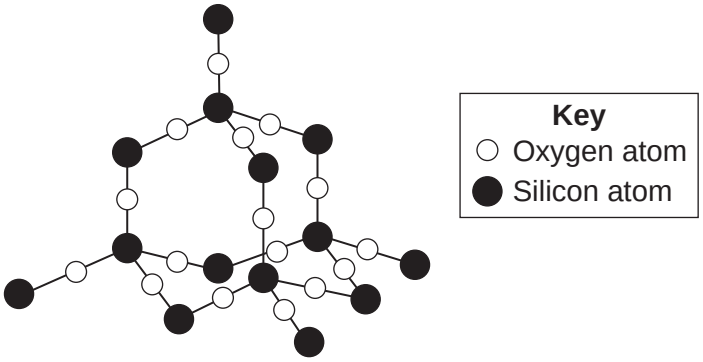
January 2013 | CH2HP | Original Q6 | Legacy

6 Silicon dioxide is used as a lining for furnaces.

Furnaces can be used to melt iron for recycling.



The diagram shows a small part of the structure of silicon dioxide.



Explain why silicon dioxide is a suitable material for lining furnaces.

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(4 marks)

4

4.2.2.6 Giant covalent structures

Question 16

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)

4.2.2.6 Giant covalent structures

Question 16 · continued June 2013 | CH2HP | Original Q5 | Legacy

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)

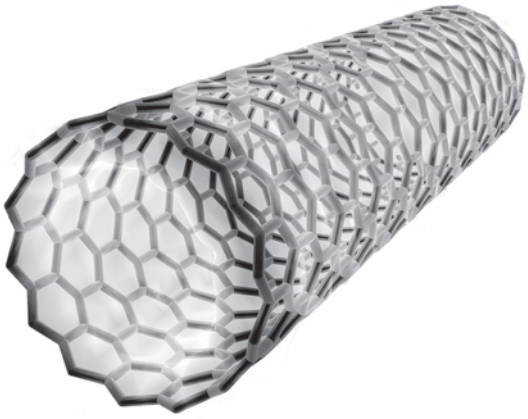
11

4.2.2.6 Giant covalent structures

Question 17

June 2014 | CH2HP | Original Q5 | Legacy

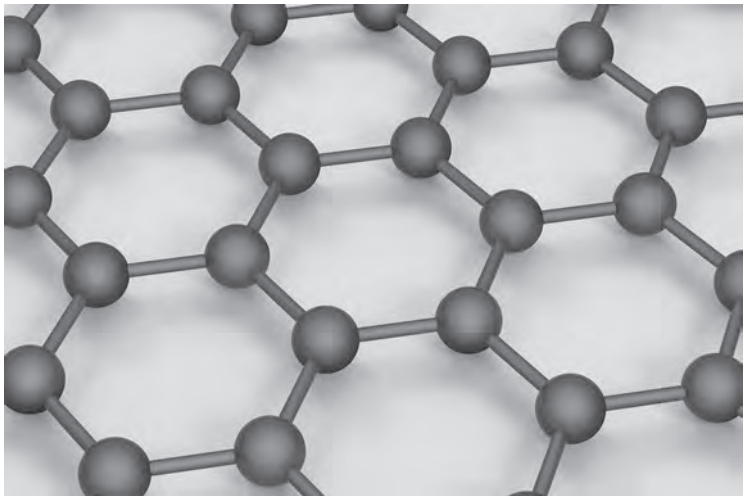
5 Carbon atoms are used to make nanotubes.



Carbon atoms in a nanotube are bonded like a single layer of graphite.

Figure 5 shows the structure of a single layer of graphite.

Figure 5



4.2.2.6 Giant covalent structures

Question 17 · continued

June 2014 | CH2HP | Original Q5 | Legacy

5 (a) Suggest why carbon nanotubes are used as lubricants.

[2 marks]

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5 (b) Explain why graphite can conduct electricity.

[2 marks]

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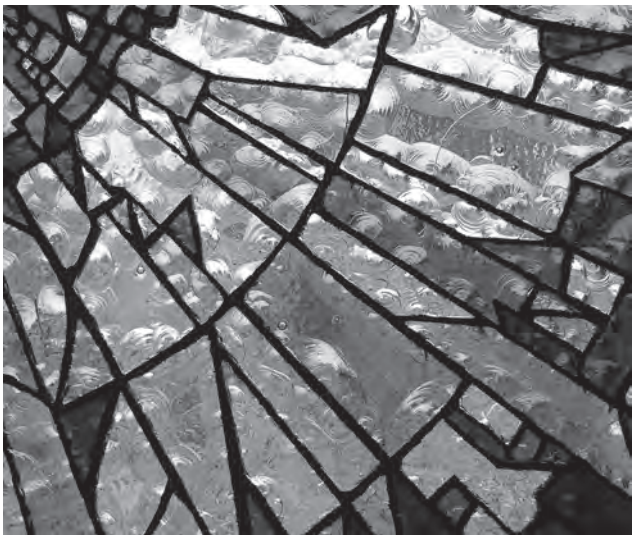
4

4.2.2.6 Giant covalent structures

Question 18

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]

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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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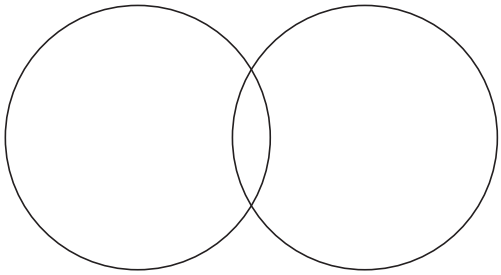
4.2.2.6 Giant covalent structures

Question 18 · continued June 2014 | CH2HP | Original Q7 | Legacy

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

4.2.2.6 Giant covalent structures

Question 19

June 2016 | CH2HP | Original Q6 | Legacy

6 This question is about the properties and uses of materials.

Use your knowledge of structure and bonding to answer the questions.

6 (a) Explain how copper conducts electricity.

[2 marks]

6 (b) Explain why diamond is hard.

[2 marks]

6 (c) Explain why thermosetting polymers are better than thermosoftening polymers for saucepan handles.

[2 marks]

6

4.2.2.6 Giant covalent structures

Question 20

June 2017 | CH2HP | Original Q3 | Legacy

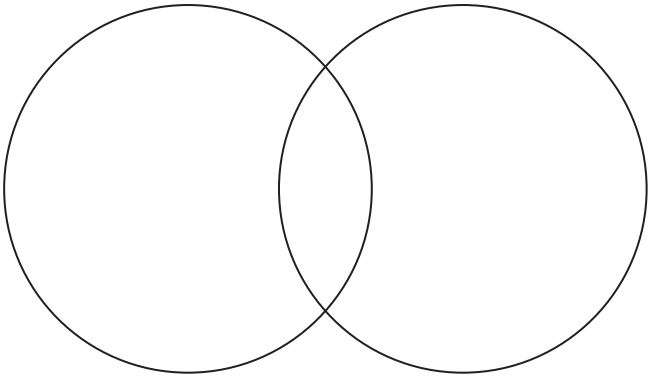
3 This question is about oxygen and substances containing oxygen.

3 (a) (i) Complete **Figure 4** to show the arrangement of the outer shell electrons in an oxygen molecule.

Use dots (•) and crosses (×) to represent the electrons.

[2 marks]

Figure 4



3 (a) (ii) Name the type of bonding in an oxygen molecule.

[1 mark]

_____

3 (a) (iii) Explain why oxygen has a low boiling point.

[2 marks]

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_____

4.2.2.6 Giant covalent structures

Question 20 · continued

3 (b) Magnesium oxide is produced when oxygen reacts with magnesium.

3 (b) (i) **Balance** the equation for the reaction.

[1 mark]

$$Mg + O_2 \longrightarrow MgO$$

3 (b) (ii) Magnesium oxide contains magnesium ions (Mg^{2+}) and oxide ions (O^{2-}).

Describe what happens, in terms of electrons, when magnesium atoms react with oxygen atoms to produce magnesium oxide.

[3 marks]

3 (b) (iii) Magnesium oxide nanoparticles can be made.

What are nanoparticles?

[1 mark]

Question 3 continues on the next page

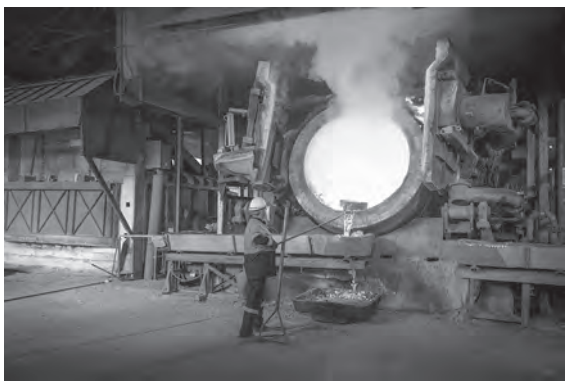
4.2.2.6 Giant covalent structures

Question 20 · continued

3 (c) **Figure 5** shows a furnace lined with silicon dioxide (SiO_2).

The temperature in the furnace is 1500 °C.

Figure 5



Explain, in terms of structure and bonding, why silicon dioxide is used to line furnaces.

[3 marks]

13

4.2.2.6 Giant covalent structures

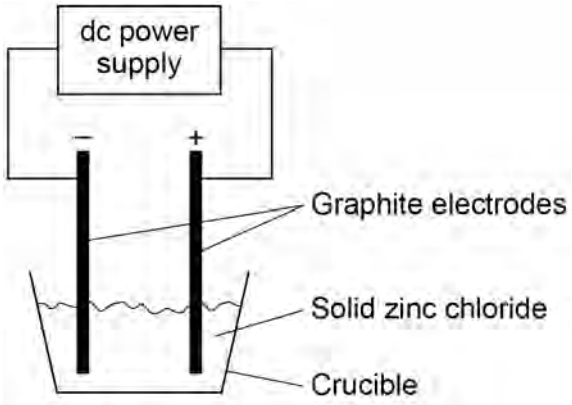
Question 21

June 2018 | 8462/1H | Original Q6

0 6 A student investigated the electrolysis of different substances.

Figure 6 shows the apparatus.

Figure 6



0 6 . 1 Explain why electrolysis would **not** take place in the apparatus shown in **Figure 6**.

[2 marks]

0 6 . 2 Explain why graphite conducts electricity.

Answer in terms of the structure and bonding in graphite.

[3 marks]

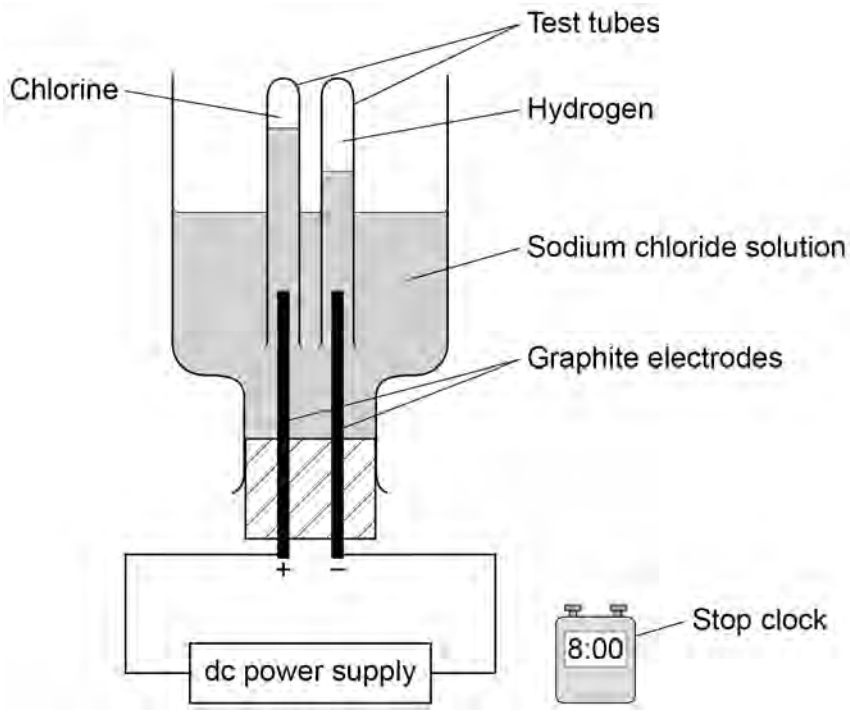
4.2.2.6 Giant covalent structures

Question 21 · continued

The student investigated how the volume of gases produced changes with time in the electrolysis of sodium chloride solution.

Figure 7 shows the apparatus.

Figure 7



0 6 . 3 The student made an error in selecting the apparatus for this investigation.

How should the apparatus be changed?

Give **one** reason for your answer.

[2 marks]

4.2.2.6 Giant covalent structures

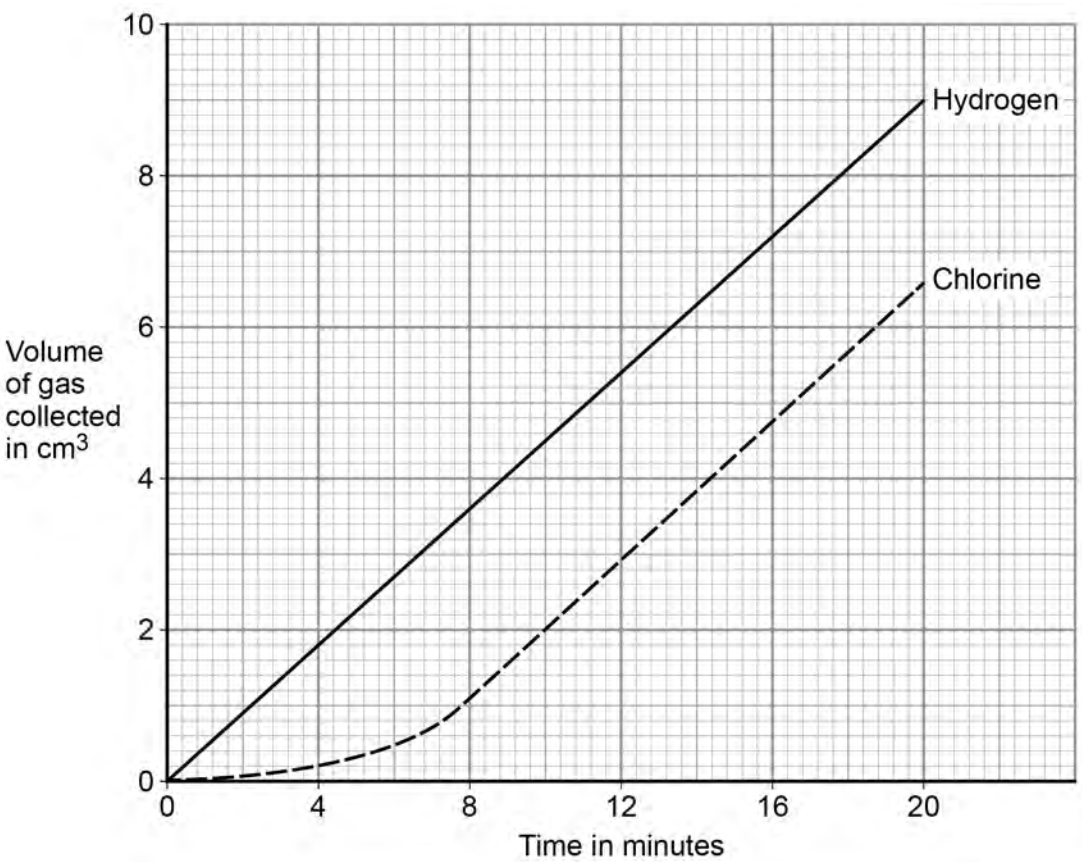
Question 21 · continued

Another student used the correct apparatus.

This student measured the volumes of gases collected every minute for 20 minutes.

Figure 8 shows the student's results.

Figure 8



0 6 . 4 Describe the trends shown in the results.

Use values from **Figure 8**.

[3 marks]

4.2.2.6 Giant covalent structures

Question 21 · continued

0 6 . 5 The number of moles of each gas produced at the electrodes is the same.

No gas escapes from the apparatus.

Suggest **one** reason for the difference in volume of each gas collected.

[1 mark]

0 6 . 6 Calculate the amount in moles of chlorine collected after 20 minutes.

Use **Figure 8**.

The volume of one mole of any gas at room temperature and pressure is 24.0 dm^3

Give your answer in standard form.

[3 marks]

Moles of chlorine = _____ mol

14

4.2.2.6 Giant covalent structures

Question 22

November 2020 | 8462/1H | Original Q1

0 1 This question is about structure and bonding.

0 1 . 1 Which **two** substances have intermolecular forces between particles?

[2 marks]

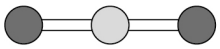
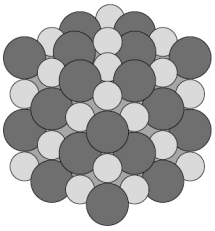
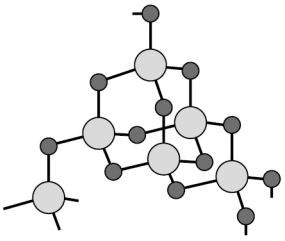
Tick (✓) **two** boxes.

- Diamond ☐
- Magnesium ☐
- Poly(ethene) ☐
- Sodium chloride ☐
- Water ☐

0 1 . 2 **Table 1** shows the structures of three compounds.

Table 1

Diagrams not to scale

Compound	Structure
Carbon dioxide	
Magnesium oxide	
Silicon dioxide	

4.2.2.6 Giant covalent structures

Question 22 · continued

Compare the structure and bonding of the three compounds:

- carbon dioxide
- magnesium oxide
- silicon dioxide.

[6 marks]

8

4.2.2.6 Giant covalent structures

Question 23

November 2020 | 8462/2H | Original Q3

0 3 This question is about hydrocarbons.

Hexane and hexene are hydrocarbons containing six carbon atoms in each molecule.

Hexane is an alkane and hexene is an alkene.

0 3 . 1 Draw **one** line from each hydrocarbon to the formula of that hydrocarbon.

[2 marks]

Hydrocarbon	Formula
	C_6H_8
Hexane	C_6H_{10}
	C_6H_{12}
Hexene	C_6H_{14}
	C_6H_{16}

0 3 . 2 Bromine water is added to hexane and to hexene.

What would be observed when bromine water is added to hexane and to hexene?

[2 marks]

Hexane _____

_____

Hexene _____

_____

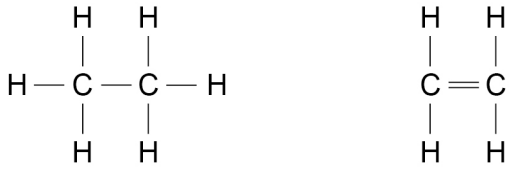
4.2.2.6 Giant covalent structures

Question 23 · continued

0 3 . 3 Ethane is an alkane and ethene is an alkene.

Figure 1 shows the displayed structural formulae of ethane and of ethene.

Figure 1



Ethane **Ethene**

Compare ethane with ethene.

You should refer to:

- their structure and bonding
- their reactions.

[6 marks]

10

4.2.2.6 Giant covalent structures

Question 24

November 2021 | 8462/1H | Original Q1

0 1 This question is about carbon and its compounds.

Fullerenes are molecules of carbon atoms.

The first fullerene to be discovered was Buckminsterfullerene (C_{60}).

0 1 . 1 What shape is a Buckminsterfullerene molecule?

[1 mark]

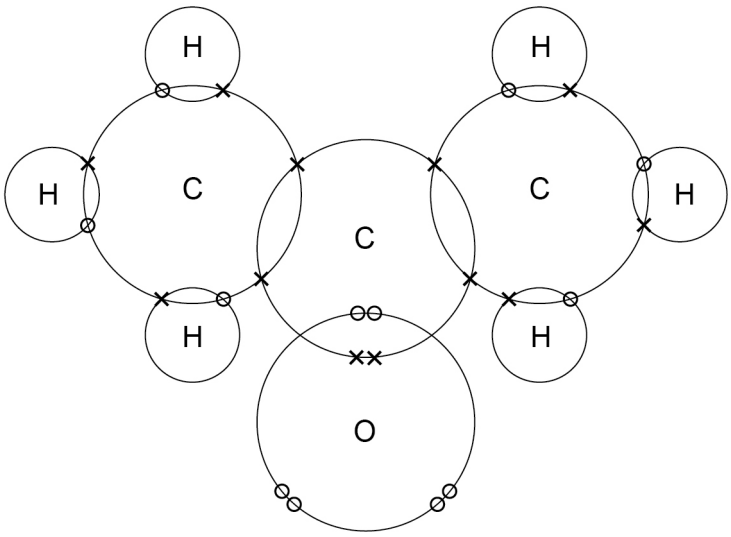
0 1 . 2 Give **one** use of a fullerene.

[1 mark]

Propanone is a compound of carbon, hydrogen and oxygen.

Figure 1 shows the dot and cross diagram for a propanone molecule.

Figure 1



4.2.2.6 Giant covalent structures

Question 24 · continued

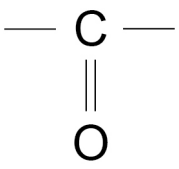
0 1 . 3 Complete **Figure 2** to show a propanone molecule.

Use a line to represent each single bond.

Use **Figure 1**.

[1 mark]

Figure 2



0 1 . 4 Determine the molecular formula of propanone.

Use **Figure 1**.

[1 mark]

Molecular formula = _____

0 1 . 5 Propanone is a liquid with a low boiling point.

Why does propanone have a low boiling point?

[1 mark]

Tick (✓) **one** box.

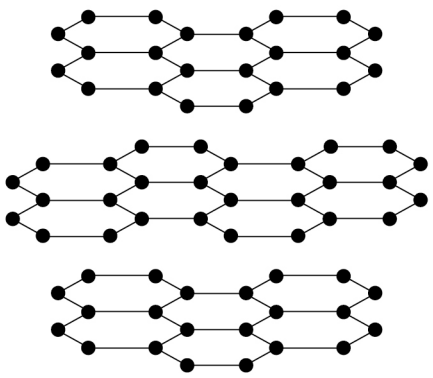
- The covalent bonds are strong. ☐
- The covalent bonds are weak. ☐
- The intermolecular forces are strong. ☐
- The intermolecular forces are weak. ☐

4.2.2.6 Giant covalent structures

Question 24 · continued

0 1 . 6 **Figure 3** represents the structure of graphite.

Figure 3



Explain why graphite is:

- a good electrical conductor
- soft and slippery.

You should answer in terms of structure and bonding.

[6 marks]

11

4.2.2.6 Giant covalent structures

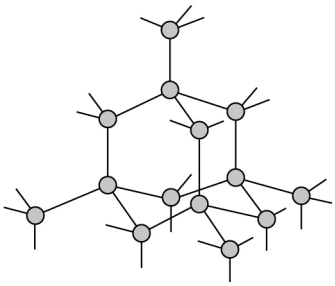
Question 25

June 2022 | 8462/1H | Original Q3

0 3 This question is about different forms of carbon.

Figure 5 represents the structure of diamond.

Figure 5



Key
○ Carbon atom

0 3 . 1 Describe the structure and bonding of diamond.

[3 marks]

0 3 . 2 Explain why diamond has a very high melting point.

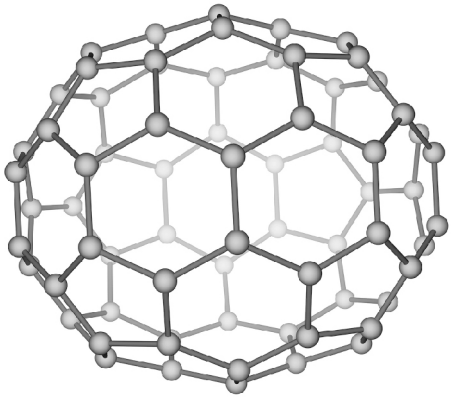
[3 marks]

4.2.2.6 Giant covalent structures

Question 25 · continued

Figure 6 represents the molecule C_{70}

Figure 6



0 3 . 3 What is the name of this type of molecule?

[1 mark]

Tick (✓) **one** box.

Fullerene ☐

Graphene ☐

Nanotube ☐

Polymer ☐

0 3 . 4 Molecules such as C_{70} can be used in medicine to move drugs around the body.

Suggest **one** reason why the C_{70} molecule is suitable for this use.

[1 mark]

4.2.2.6 Giant covalent structures

Question 25 · continued

0 3 . 5 Calculate the number of C_{70} molecules that can be made from one mole of carbon atoms.

The Avogadro constant = 6.02×10^{23} per mole

[3 marks]

Number of molecules = _____

11

4.2.2.6 Giant covalent structures

Question 26

June 2022 | 8462/1H | Original Q7

0 7 This question is about silicon and compounds of silicon.

0 7 . 1 The reactivity series sometimes includes non-metals such as carbon, hydrogen and silicon.

Silicon can be extracted by reducing silicon dioxide with different substances.

The equation for one possible reaction is:

$$2\,C(s) + SiO_2(s) \rightarrow Si(s) + 2\,CO(g)$$

Explain what this reaction shows about the position of silicon in the reactivity series.

[2 marks]

0 7 . 2 Aluminium also reduces silicon dioxide.

Carbon is used rather than aluminium to reduce silicon dioxide because carbon is cheaper than aluminium.

Carbon can be obtained by heating coal.

Aluminium is obtained from aluminium oxide.

Explain why aluminium is more expensive than carbon.

[2 marks]

4.2.2.6 Giant covalent structures

Question 26 · continued

Magnesium also reduces silicon dioxide.

The equation for the reaction is:

$$2\,Mg(s) + SiO_2(s) \rightarrow Si(s) + 2\,MgO(s)$$

0 7 . 3 Give **one** reason why the products are difficult to separate if magnesium is used to reduce silicon dioxide.

[1 mark]

0 7 . 4 Calculate the minimum mass in grams of magnesium needed to completely reduce 1.2 kg of silicon dioxide.

Relative atomic masses (A_r): O = 16 Mg = 24 Si = 28

[5 marks]

Minimum mass of magnesium = _____ g

4.2.2.6 Giant covalent structures

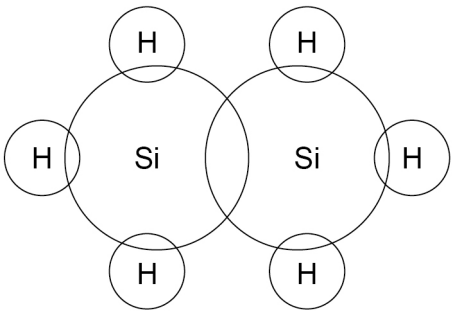
Question 26 · continued

Si_2H_6 is a covalent compound of silicon and hydrogen.

0 7 . 5 Complete **Figure 9** to show the outer shell electrons in a molecule of Si_2H_6

[1 mark]

Figure 9



0 7 . 6 Si_2H_6 reacts with oxygen.

The equation for the reaction is:

$$2\,Si_2H_6(g) + 7\,O_2(g) \rightarrow 4\,SiO_2(s) + 6\,H_2O(g)$$

30 cm^3 of Si_2H_6 is reacted with 150 cm^3 (an excess) of oxygen.

Calculate the total volume of gases present after the reaction.

All volumes of gases are measured at the same temperature and pressure.

[4 marks]

Volume of gases = _____ cm^3

15

4.2.2.6 Giant covalent structures

Question 27

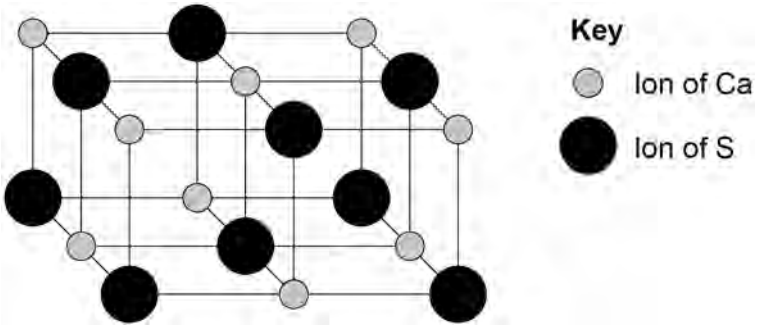
June 2025 | 8462/1H | Original Q2

0 2 This question is about structure and bonding.

Calcium sulfide is an ionic compound.

Figure 2 represents the structure of calcium sulfide.

Figure 2



0 2 . 1 Determine the empirical formula of calcium sulfide.

[1 mark]

Empirical formula _____

Question 2 continues on the next page

4.2.2.6 Giant covalent structures

Question 27 · continued

0 2 . 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.

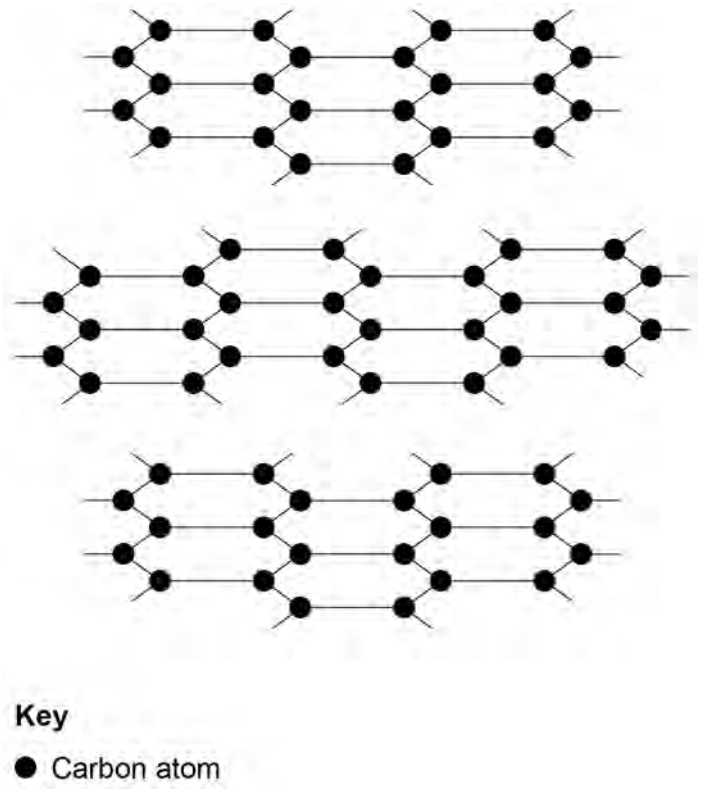
[4 marks]

4.2.2.6 Giant covalent structures

Question 27 · continued

Figure 3 shows the structure of graphite.

Figure 3



0 2 . 3 Describe the structure and bonding of graphite.

[4 marks]

Extra space

4.2.2.6 Giant covalent structures

Question 27 · continued

0 2 . 4 Substances that consist of small molecules do **not** conduct electricity.

Give **one** reason why.

[1 mark]

0 2 . 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