AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.2.2.6

Giant covalent structures

Past-paper questions

Tier	**Foundation**
Question groups	**29**
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 | CHY1F | Original Q8 | Legacy

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

4.2.2.6 Giant covalent structures

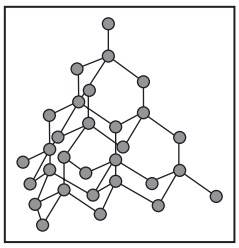
Question 02

January 2008 | CHY2F | Original Q2 | Legacy

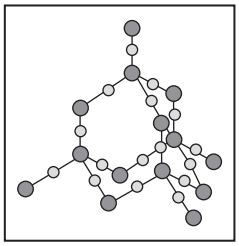
2 This question is about giant structures. Diamond, graphite and silicon dioxide all have giant structures.

(a) The diagrams show the structures of these three substances.

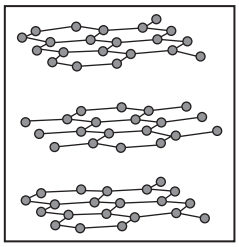
Draw a line from each structure to its name.



Silicon dioxide



Graphite



Diamond

(2 marks)

4.2.2.6 Giant covalent structures

Question 02 · continued

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(b) Complete the sentences using words from the box.

covalent	**four**	**hard**	**ionic**
shiny	**soft**	**three**	**two**

(i) Diamond, graphite and silicon dioxide have high melting points because all the atoms in their structures are joined by strong ..... bonds.
(1 mark)

(ii) In diamond each atom is joined to ..... other atoms.
(1 mark)

(iii) Diamond can be used to make cutting tools because it has a rigid structure which makes it very ..... .
(1 mark)

(iv) In graphite each atom is joined to ..... other atoms.
(1 mark)

(v) Graphite can be used to make pencils because it has a structure which makes it ..... .
(1 mark)

(c) When a diamond is heated to a high temperature and then placed in pure oxygen it burns. Carbon dioxide is the only product.

Name the element in diamond. .....
(1 mark)

8

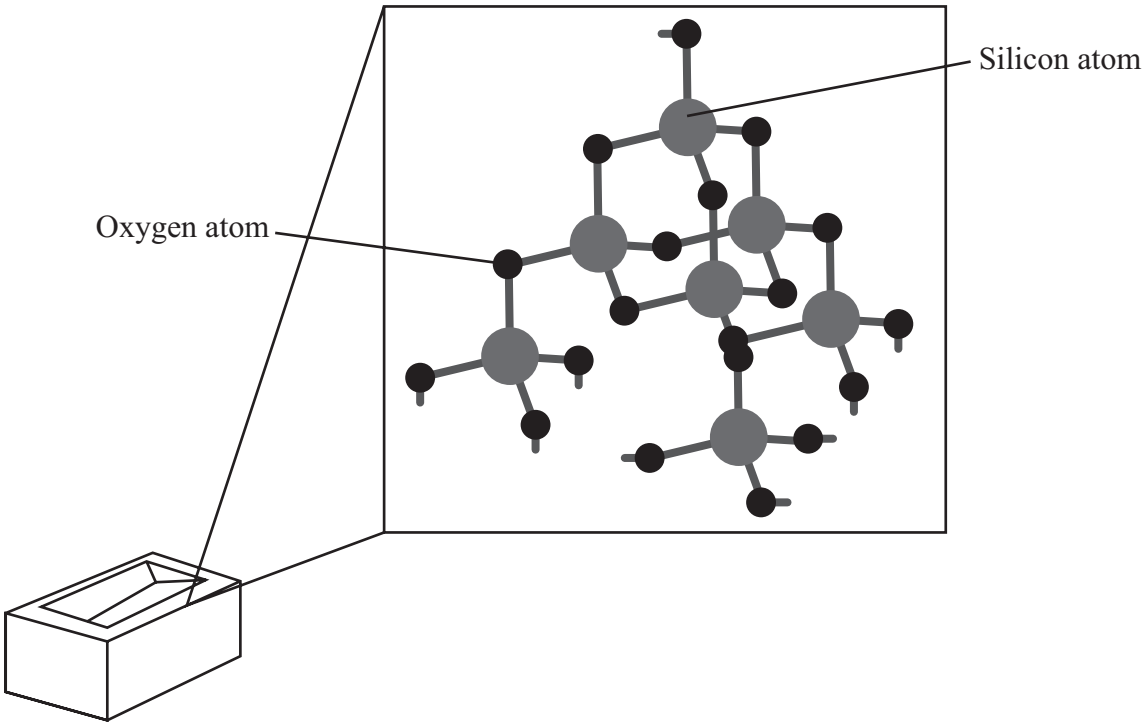
4.2.2.6 Giant covalent structures

Question 03

June 2008 | CHY2F | Original Q3 | Legacy

3 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.



Use words from the box to complete the sentences.

covalent	**giant**	**low**	**small**
four	**high**	**six**	**weak**

One reason for using silica to make bricks for high-temperature furnaces is that silica has a ..... melting point.

Silica has this property because it is a ..... structure in which each silicon atom is joined to ..... oxygen atoms by ..... bonds.

(4 marks)

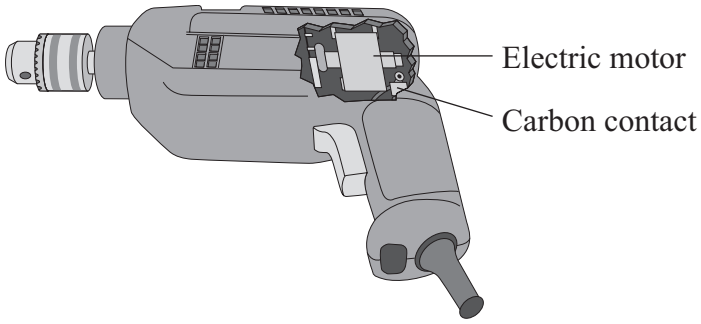
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4.2.2.6 Giant covalent structures

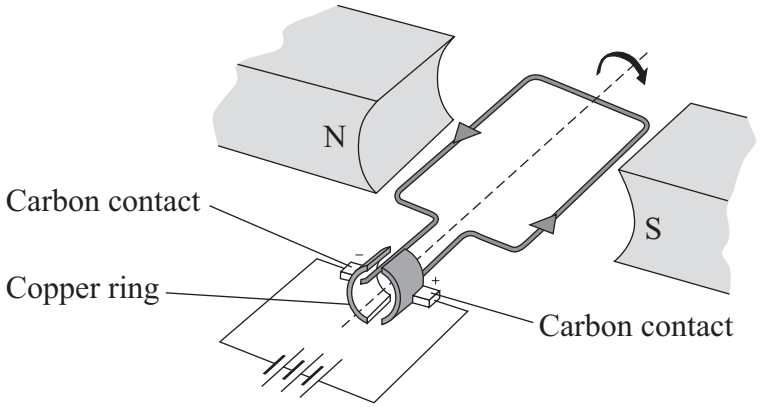
Question 04

June 2009 | CHY2F | Original Q5 | Legacy

5 This drill contains an electric motor.



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



The carbon contacts are made of graphite. Springs push the contacts against the copper ring. The carbon 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.

5 (a) Using this information give **two** properties that make graphite suitable for making the carbon contacts.

1 .....

.....

2 .....

.....

(2 marks)

4.2.2.6 Giant covalent structures

Question 04 · continued

for mark

5 (b) (i) Draw a ring around the correct word in each box to complete the sentence.

Each carbon atom in graphite is joined to

two / three / four	other carbon atoms by	covalent / ionic / metallic	bonds.

(2 marks)

5 (b) (ii) Tick (✓) the statement which explains why graphite is soft and slippery.

Statement	Tick (✓)
It is made of layers of atoms.	
It is made of small molecules.	
It is an ionic compound.	

(1 mark)

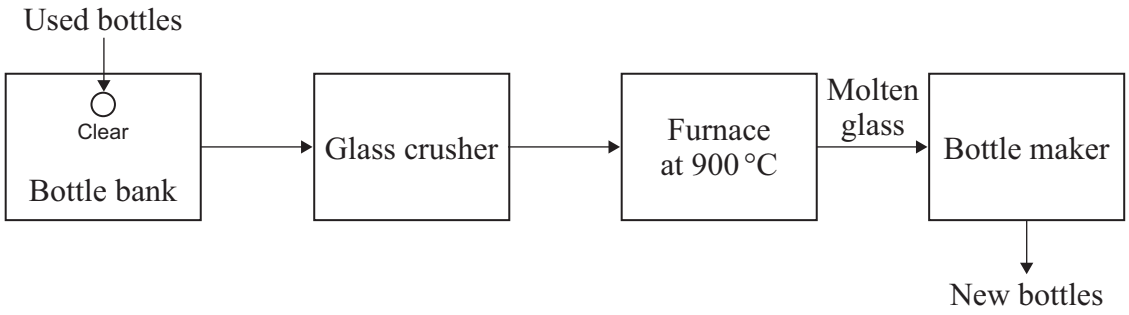
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4.2.2.6 Giant covalent structures

Question 05

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

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



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

.....

.....

(1 mark)

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

Suggest **one** reason why.

.....

.....

(1 mark)

7 (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.

.....

.....

.....

.....

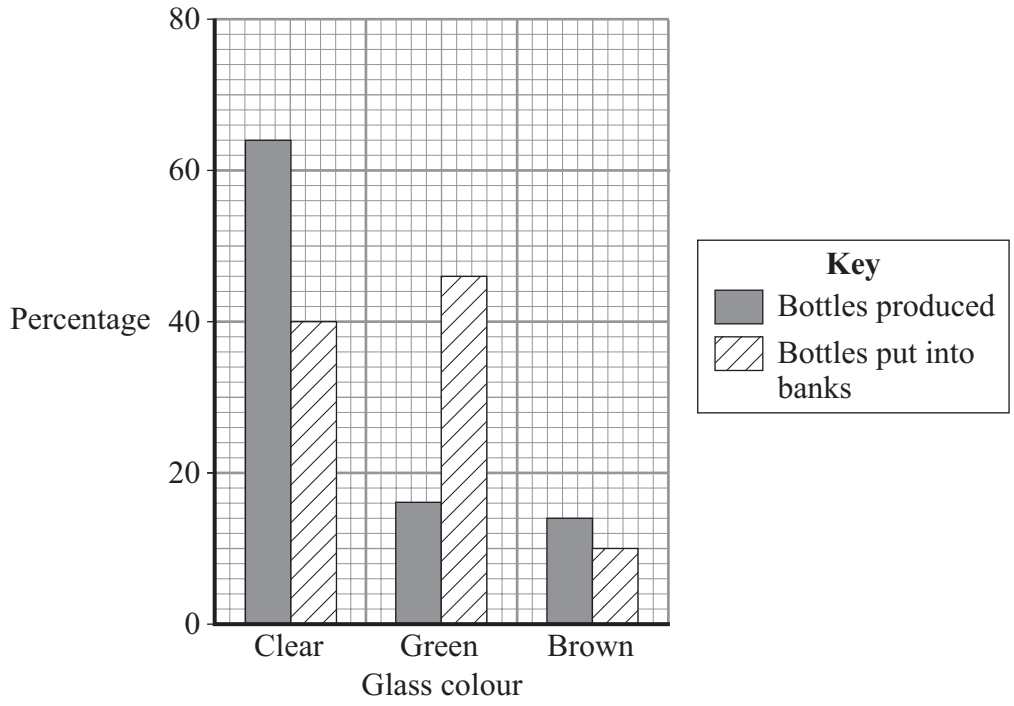
(2 marks)

4.2.2.6 Giant covalent structures

Question 05 · continued

for mark

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



7 (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)

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

.....

.....

(1 mark)

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

.....

.....

.....

.....

(2 marks)

8

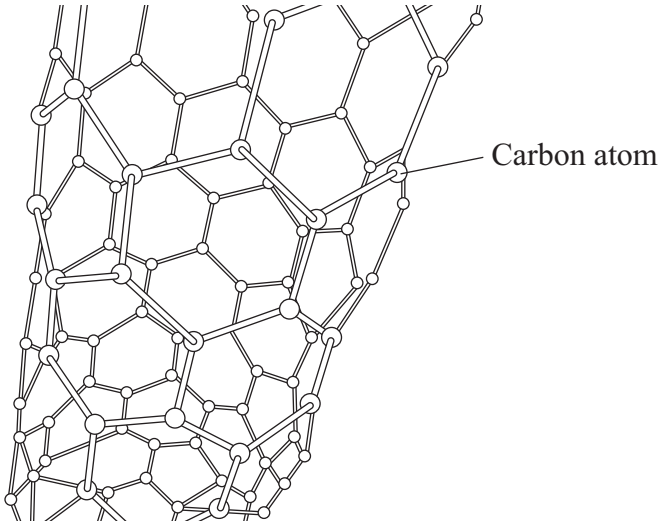
4.2.2.6 Giant covalent structures

Question 06

4 Lightweight handlebars for bicycles are made from materials containing carbon nanotubes.

Carbon nanotubes are lightweight but very strong.

The diagram shows the structure of a carbon nanotube.



4 (a) What does the term 'nano' tell you about the diameter of carbon nanotubes?

Tick (✓) the correct answer in the table.

Answer	Tick (✓)
The diameter of the tube is very small.	
The diameter of the tube is large.	
The diameter of the tube is very large	

(1 mark)

4.2.2.6 Giant covalent structures

Question 06 · continued

for mark

4 (b) Look at the diagram and then draw a ring around the correct word to complete each sentence.

4 (b) (i) Carbon nanotubes are similar to graphite because each carbon atom is joined to

two
three
four

other carbon atoms.

(1 mark)

4 (b) (ii) The carbon atoms are joined by

covalent
ionic
metallic

bonds.

(1 mark)

4 (b) (iii) Carbon nanotubes are very strong because the

atoms
bonds
electrons

are hard to break.

(1 mark)

4

4.2.2.6 Giant covalent structures

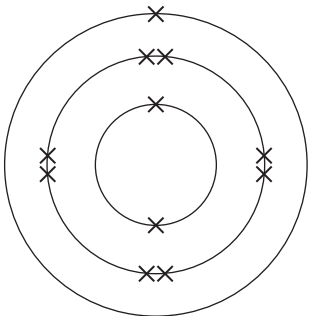
Question 07

7 Sodium chloride is a raw material.

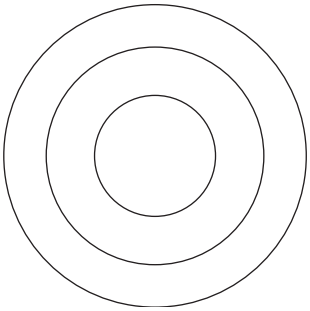
7 (a) The electronic structure of a sodium atom is shown below.

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

Sodium atom



Chlorine atom



(1 mark)

7 (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?

.....

.....

.....

.....

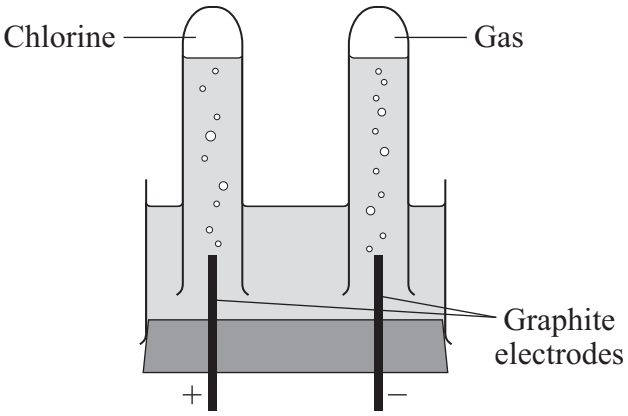
(2 marks)

4.2.2.6 Giant covalent structures

Question 07 · continued

for mark

7 (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^-).

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

.....

(1 mark)

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

.....

(1 mark)

Question 7 continues on the next page

4.2.2.6 Giant covalent structures

Question 07 · continued

for mark

7 (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.'

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

.....

.....

(1 mark)

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

.....

.....

(1 mark)

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

.....

.....

(1 mark)

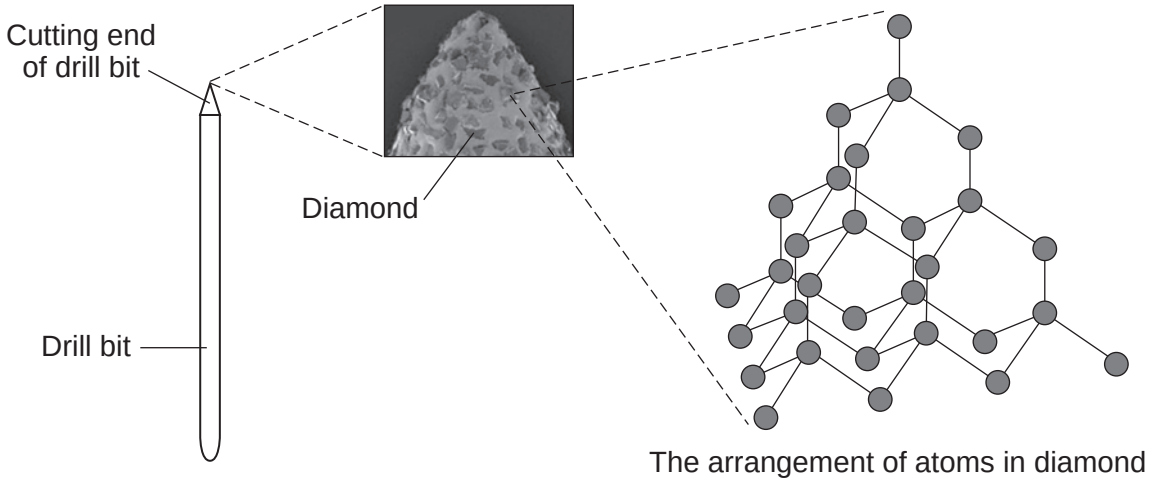
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4.2.2.6 Giant covalent structures

Question 08

June 2010 | CHY2F | Original Q4 | Legacy

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



The arrangement of atoms in diamond

Draw a ring around the correct word in each box.

4 (a) Diamond is made from [carbon / nitrogen / oxygen] atoms.

(1 mark)

4 (b) Diamond has a giant structure in which [none / some / all] of the atoms are joined together.

(1 mark)

4 (c) The atoms in diamond are joined together by [covalent / ionic / metallic] bonds.

(1 mark)

4.2.2.6 Giant covalent structures

Question 08 · continued

4 (d) In diamond each atom is joined to [two / three / four] other atoms.

(1 mark)

4 (e) Diamond is suitable for the cutting end of a drill bit because it is [hard. / shiny. / soft.]

(1 mark)

5

Turn over for the next question

4.2.2.6 Giant covalent structures

Question 09

January 2011 | CHY2F | Original Q2 | Legacy

2 The picture shows a wooden bowl.
The pieces of wood used for this bowl were dyed different colours.



The artist who made the bowl explained why he dissolved the coloured dyes in methanol.

> I use different coloured dyes dissolved in methanol.
> I use methanol because with dyes dissolved in water the wood needs to be soaked for a longer time.
> The bowl dries more quickly if I use methanol instead of water.

2 (a) The artist uses methanol instead of water.

Give **two** reasons why.

1 .....

.....

2 .....

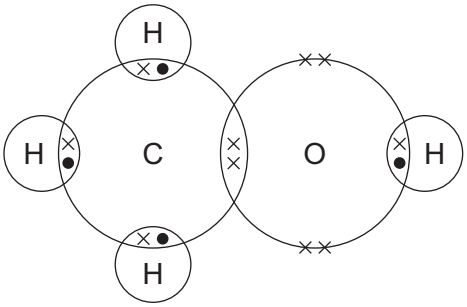
.....

(2 marks)

4.2.2.6 Giant covalent structures

Question 09 · continued

2 (b) The diagram shows how the atoms are bonded in methanol.



Draw a ring around:

2 (b) (i) the formula of methanol

CH_4O **CH^4O** **CHO_4**

(1 mark)

2 (b) (ii) the type of bonding in methanol.

covalent **ionic** **metallic**

(1 mark)

2 (c) Methanol has a low boiling point.

Tick (✓) the reason why.

Reason why	Tick (✓)
It has a giant covalent structure.	
It is made of small molecules.	
It has a giant metallic structure.	

(1 mark)

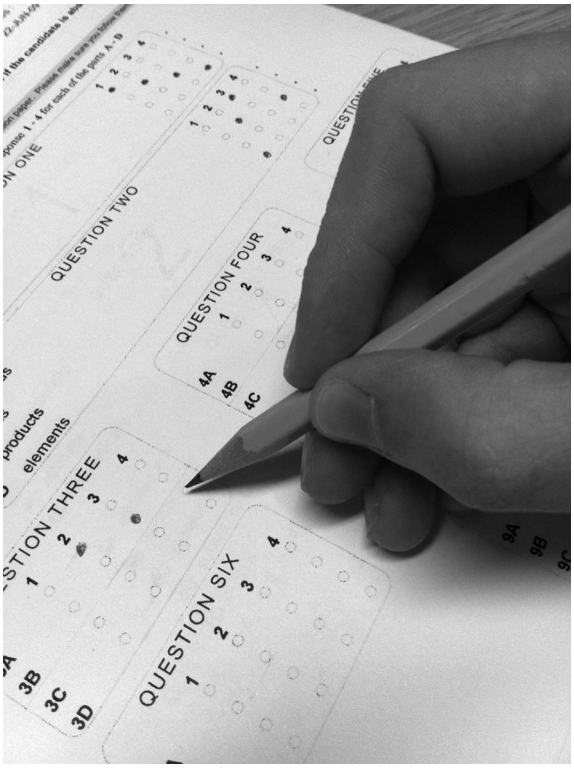
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4.2.2.6 Giant covalent structures

Question 10

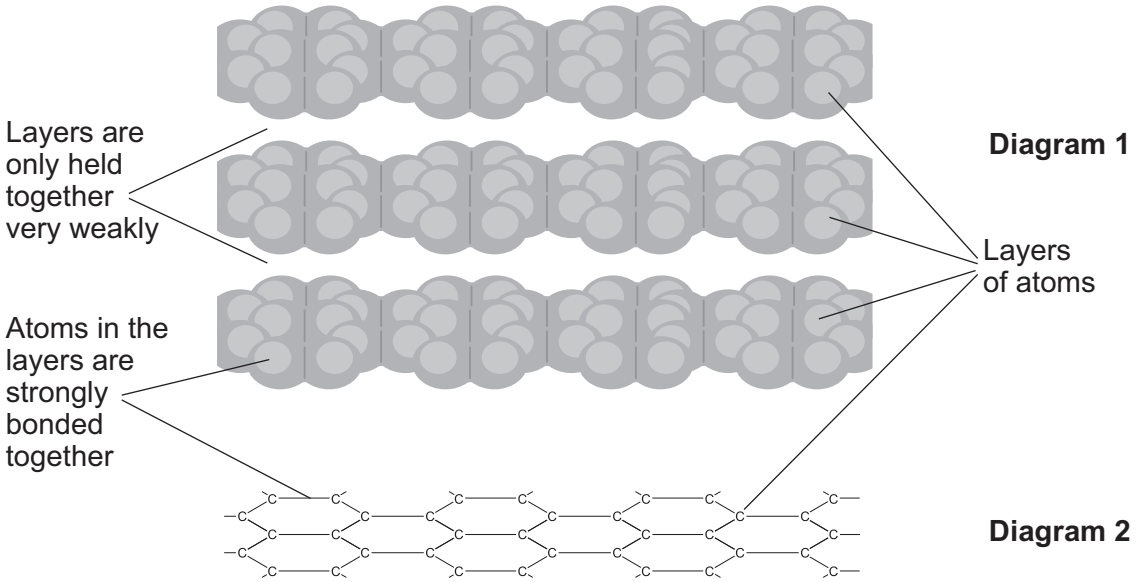
June 2011 | CHY2F | Original Q3 | Legacy

3 The picture shows a student using a pencil to complete a multiple choice answer sheet.



The pencil contains graphite. Graphite rubs off the pencil onto the paper.

Diagrams 1 and **2** show how the atoms are arranged in graphite.



3 (a) Use **Diagram 2** and your Data Sheet to help you to name the element from which graphite is made.

.....

(1 mark)

4.2.2.6 Giant covalent structures

Question 10 · continued

3 (b) Use **Diagram 1** to help you explain why graphite can rub off the pencil onto the paper.

.....

.....

.....

.....

(2 marks)

3 (c) Draw a ring around the type of bond which holds the atoms together in each layer.

covalent **ionic** **metallic**

(1 mark)

4

Turn over for the next question

4.2.2.6 Giant covalent structures

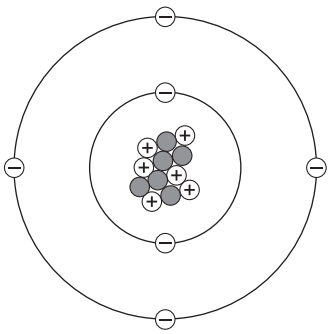
Question 11

January 2012 | CH1FP | Original Q1 | Legacy

1 The picture shows a diamond ring.



1 (a) Diamond is a form of carbon. The diagram represents a carbon atom.



Complete the table to show the name and charge of each type of particle in the carbon atom.

Name of particle	Charge
proton	
neutron	0
	–1

(2 marks)

4.2.2.6 Giant covalent structures

Question 11 · continued

1 (b) Use the Chemistry Data Sheet to help you to answer these questions.

1 (b) (i) Draw a ring around the correct answer to complete the sentence.

Gold and carbon are

- compounds.
- elements.
- mixtures.

(1 mark)

1 (b) (ii) Complete the sentence.

Gold and carbon have different properties because gold is a metal and carbon is a ..... .

(1 mark)

1 (c) Draw a ring around the correct answer to complete each sentence.

Pure gold is not used to make the ring because pure gold is too

- hard.
- reactive.
- soft.

The gold ring is made by mixing pure gold with other metals to form

- a compound.
- an atom.
- an alloy.

(2 marks)

Question 1 continues on the next page

4.2.2.6 Giant covalent structures

Question 11 · continued

1 (d) The data in the table shows some information about the three metals in the gold ring.

Name of metal	Atomic number	Percentage (%) of metal
gold	79	
silver	47	16
copper	29	9

Draw **one** line from each question to its correct answer.

Question	Answer
What is the percentage of gold in this ring?	29
	61
How many electrons are there in a copper atom?	75
How many neutrons are in an atom of silver with a mass number of 108?	79

(3 marks)

9

4.2.2.6 Giant covalent structures

Question 12

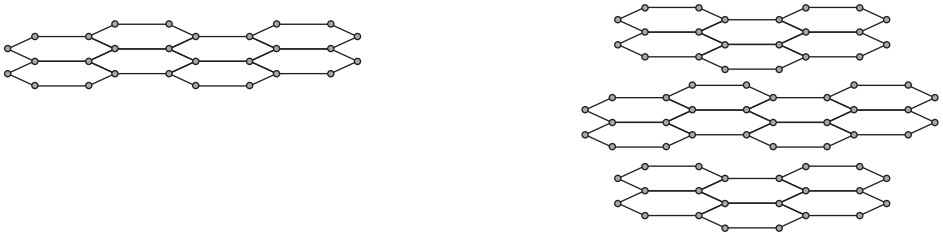
June 2012 | CH2FP | Original Q5 | Legacy

5 Read the information.

Graphene

Scientists have made a new substance called graphene.
The bonding and structure of graphene are similar to graphite.

Graphene is made of a single layer of the same atoms as graphite.



Graphene **Graphite**

Use the information above and your knowledge of graphite to answer the questions.

5 (a) This part of the question is about graphene.

Choose the correct answer to complete each sentence.

5 (a) (i)

ionic	covalent	metallic

The bonds between the atoms in graphene are ..... .

(1 mark)

5 (a) (ii)

chromium	carbon	chlorine

Graphene is made of ..... atoms.

(1 mark)

5 (a) (iii)

2	3	4

In graphene each atom bonds to ..... other atoms.

(1 mark)

4.2.2.6 Giant covalent structures

Question 12 · continued

5 (b) This part of the question is about graphite.

Graphite is used in pencils.

Explain why. Use the diagrams to help you.

.....

.....

.....

.....

(2 marks)

5

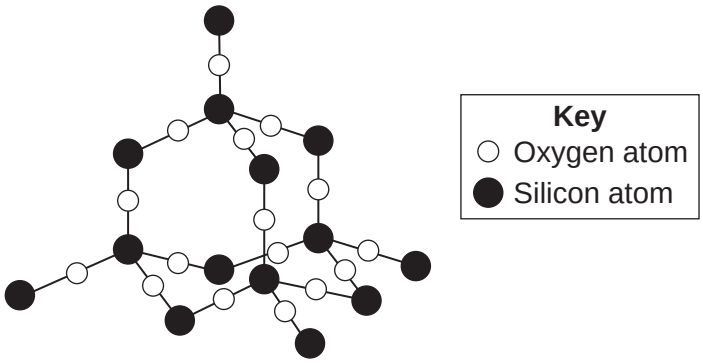
Turn over for the next question

4.2.2.6 Giant covalent structures

Question 13

January 2013 | CH2FP | Original Q2 | Legacy

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



2 (a) Use the diagram above to answer the question.

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

In silicon dioxide, each silicon atom is bonded with

two

three

four

oxygen atoms.

The bonds in silicon dioxide are

ionic.

covalent.

metallic.

(2 marks)

4.2.2.6 Giant covalent structures

Question 13 · continued

2 (b)



Silicon dioxide is used as the inside layer of furnaces.

Suggest why.

.....

.....

(1 mark)

2 (c) Nanowires can be made from silicon dioxide.

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

The word 'nano' means the wires are very

brittle.
thick.
thin.

(1 mark)

4

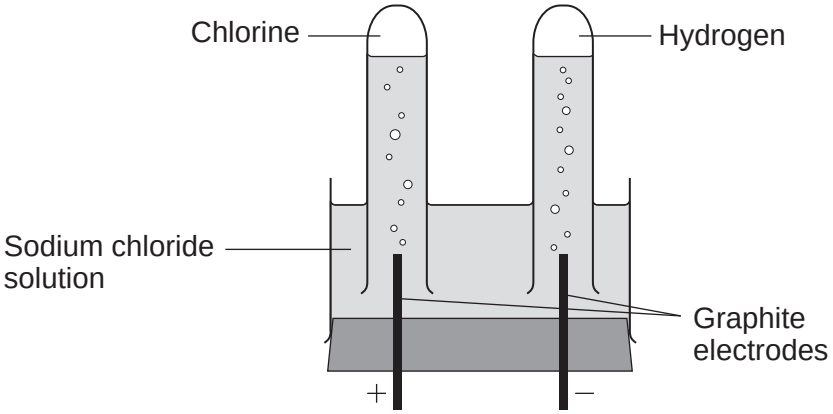
4.2.2.6 Giant covalent structures

Question 14

January 2013 | CH2FP | Original Q8 | Legacy

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

The diagram shows the apparatus used in a school experiment.



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

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

.....

.....

(1 mark)

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

.....

.....

(1 mark)

4.2.2.6 Giant covalent structures

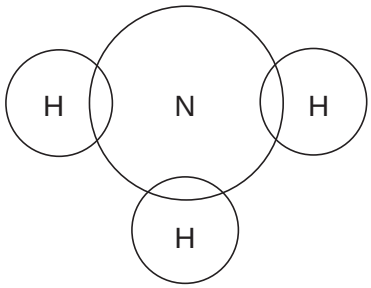
Question 14 · continued

8 (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)

8 (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.

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

.....

(1 mark)

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

Write the ionic equation for the neutralisation reaction.

.....

(1 mark)

Question 8 continues on the next page

4.2.2.6 Giant covalent structures

Question 14 · continued

8 (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

June 2013 | CH2FP | Original Q3 | Legacy

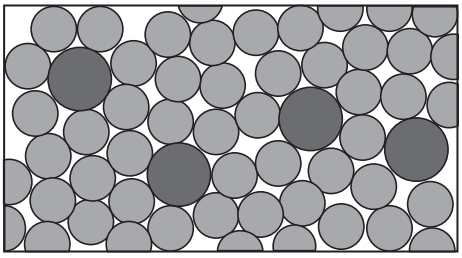
3 Oil rigs are used to drill for crude oil.



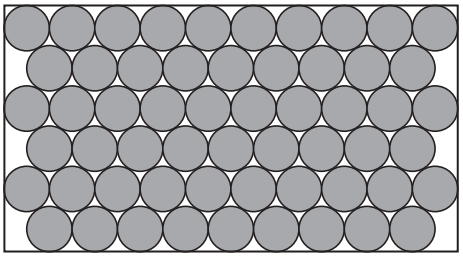
3 (a) Drills are made from an alloy of iron.

The diagrams show the particles in the alloy and in pure iron.

Alloy



Pure iron



Use the diagrams to explain why the alloy is harder than pure iron.

.....

.....

.....

.....

(2 marks)

3 (b) Drill heads contain diamonds.

Tick (✓) **two** reasons why diamonds are hard.

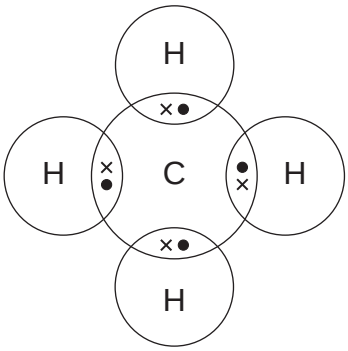
Reason	Tick (✓)
Diamonds have a giant covalent structure.	
Diamonds have high melting points.	
Diamonds are unreactive.	
Diamonds have strong bonds between carbon atoms.	

(2 marks)

4.2.2.6 Giant covalent structures

Question 15 · continued

3 (c) Methane gas is often found where crude oil is found.
The diagram shows how atoms bond in methane.
Only the outer electrons are shown.



3 (c) (i) Draw a ring around the correct answer to complete the sentence.

Methane is

a compound.

an element.

a mixture.

(1 mark)

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

The formula of methane is

C_4H_4

C_4H

CH_4

(1 mark)

3 (c) (iii) Name the type of bond between the carbon and hydrogen atoms in methane.

.....

(1 mark)

3 (d) Explain why methane is a gas at 20 °C.

.....

.....

.....

.....

(2 marks)

9

4.2.2.6 Giant covalent structures

Question 16

June 2014 | CH2FP | Original Q1 | Legacy

1 This question is about diamonds.

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

1 (a) Diamonds are found in meteorites.

1 (a) (i) Meteorites get very hot when they pass through the Earth's atmosphere, but the diamonds do not melt.

Diamond has a [high / low / very low] melting point.

[1 mark]

1 (a) (ii) Most diamonds found in meteorites are nanodiamonds.

A nanodiamond contains a few [hundred / thousand / million] atoms.

[1 mark]

1 (b) Diamonds are used for the cutting end of drill bits.

Diamonds can be used for drill bits because they are [hard. / shiny. / soft.]

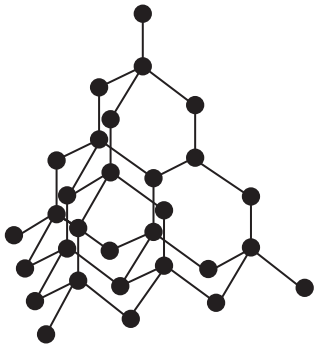
[1 mark]

4.2.2.6 Giant covalent structures

Question 16 · continued

1 (c) **Figure 1** shows the arrangement of atoms in diamond.

Figure 1



1 (c) (i) Diamond is made from [carbon / nitrogen / oxygen] atoms.

[1 mark]

1 (c) (ii) Each atom in diamond is bonded to [three / four / five] other atoms.

[1 mark]

1 (c) (iii) Diamond has a giant [covalent / ionic / metallic] structure.

[1 mark]

1 (c) (iv) In diamond [all / none / some] of the atoms are bonded together.

[1 mark]

7

4.2.2.6 Giant covalent structures

Question 17

June 2015 | CH2FP | Original Q4 | Legacy

4 This question is about electrolysis.

4 (a) Metal spoons can be coated with silver.
This is called electroplating.

Suggest **one** reason why spoons are electroplated.

[1 mark]

.....

.....

4 (b) When sodium chloride solution is electrolysed the products are hydrogen and chlorine.

4 (b) (i) What is made from chlorine?

[1 mark]

Tick (✓) **one** box.

Bleach ☐

Fertiliser ☐

Soap ☐

4 (b) (ii) Sodium chloride solution contains two types of positive ions, hydrogen ions (H^+) and sodium ions (Na^+).

Why is hydrogen produced at the negative electrode and **not** sodium?

[1 mark]

Tick (✓) **one** box.

Hydrogen is a gas. ☐

Hydrogen is less reactive than sodium. ☐

Hydrogen ions move faster than sodium ions. ☐

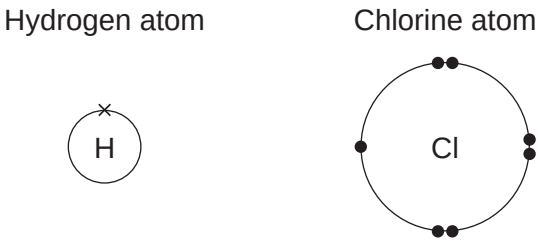
4.2.2.6 Giant covalent structures

Question 17 · continued

4 (b) (iii) Hydrogen and chlorine can be used to produce hydrogen chloride.

The diagrams in **Figure 4** show how the outer electrons are arranged in an atom of hydrogen and an atom of chlorine.

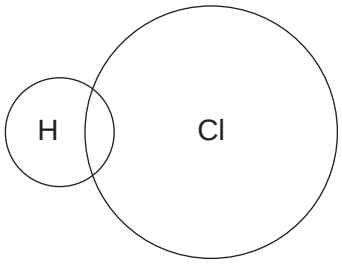
Figure 4



Complete **Figure 5** to show how the outer electrons are arranged in a molecule of hydrogen chloride (HCl).

[1 mark]

Figure 5



4 (b) (iv) What is the type of bond in a molecule of hydrogen chloride?

[1 mark]

Tick (✓) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

Question 4 continues on the next page

4.2.2.6 Giant covalent structures

Question 17 · continued

4 (b) (v) Why is hydrogen chloride a gas at room temperature (20 °C)?

[2 marks]

Tick (✓) **two** boxes.

Hydrogen chloride has a low boiling point. ☐

Hydrogen chloride has a high melting point. ☐

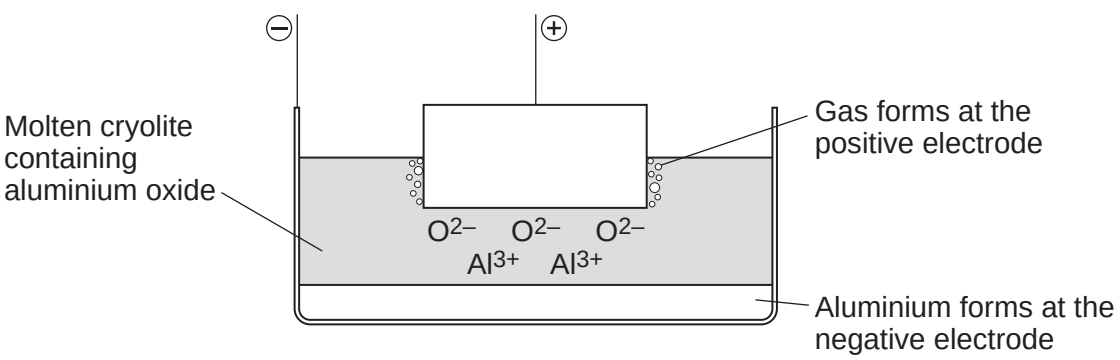
Hydrogen chloride is made of simple molecules. ☐

Hydrogen chloride does not conduct electricity. ☐

Hydrogen chloride has a giant structure. ☐

4 (c) Aluminium is produced by electrolysis of a molten mixture of aluminium oxide and cryolite.
This is shown in **Figure 6**.

Figure 6



4 (c) (i) Name a gas produced at the positive electrode.

[1 mark]

.....

4.2.2.6 Giant covalent structures

Question 17 · continued

4 (c) (ii) Aluminium ions move to the negative electrode.

Explain why.

[2 marks]

.....

.....

.....

.....

4 (c) (iii) At the negative electrode, the aluminium ions gain electrons to produce aluminium.

What is this type of reaction called?

[1 mark]

Tick (✓) **one** box.

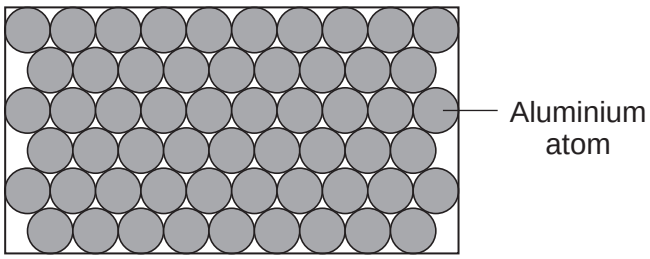
Combustion ☐

Oxidation ☐

Reduction ☐

4 (c) (iv) Aluminium has layers of atoms, as shown in **Figure 7**.

Figure 7



Complete the sentence.

[1 mark]

Metals can be bent and shaped because the layers of atoms can ..... .

Question 4 continues on the next page

4.2.2.6 Giant covalent structures

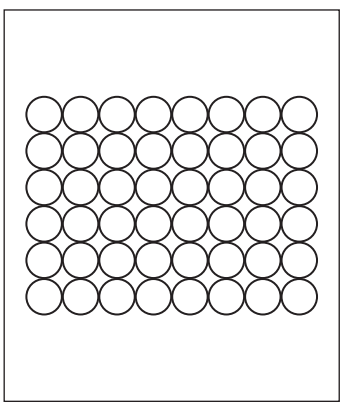
Question 17 · continued

4 (d) Electrodes used in the production of aluminium are made from graphite.

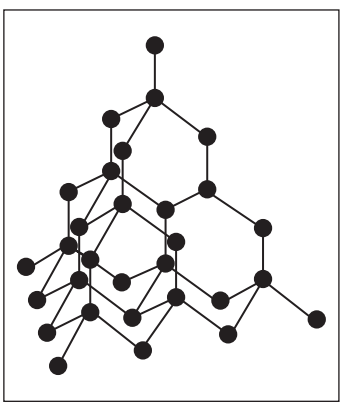
4 (d) (i) Which diagram, **A**, **B** or **C**, shows the structure of graphite?

[1 mark]

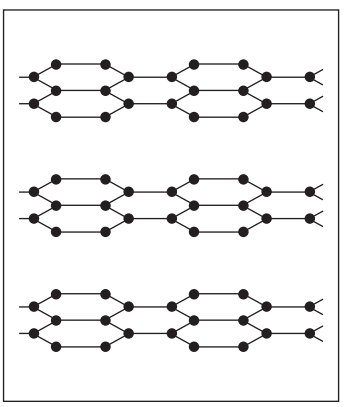
A



B



C



The structure of graphite is shown in diagram ☐.

4 (d) (ii) The temperature for the electrolysis is 950 °C.

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

[1 mark]

cross links	**a giant ionic lattice**	**strong covalent bonds**

The graphite does not melt at 950 °C because

graphite has ..... .

14

4.2.2.6 Giant covalent structures

Question 18

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]

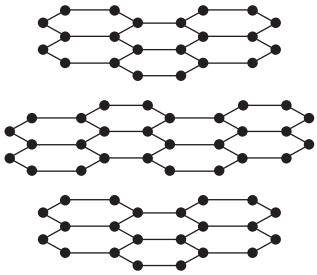
hundred	**million**	**thousand**

Nanoparticles contain a few _____ atoms.

2 (b) Graphite is made of carbon atoms.

Figure 4 shows the structure of graphite.

Figure 4



4.2.2.6 Giant covalent structures

Question 18 · continued

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

4.2.2.6 Giant covalent structures

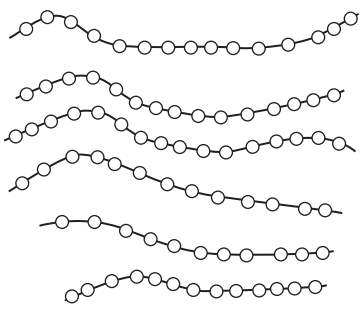
Question 18 · continued

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 _____

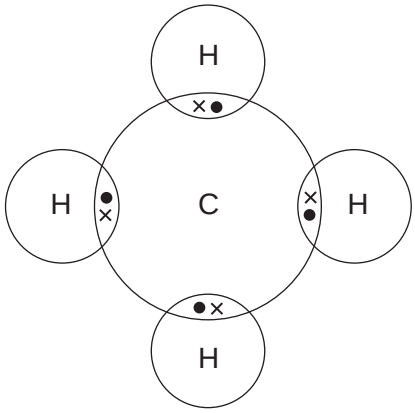
2 _____

4.2.2.6 Giant covalent structures

Question 18 · 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

4.2.2.6 Giant covalent structures

Question 19

June 2017 | CH2FP | Original Q2 | Legacy

2 This question is about sulfuric acid, copper sulfate and ethene.

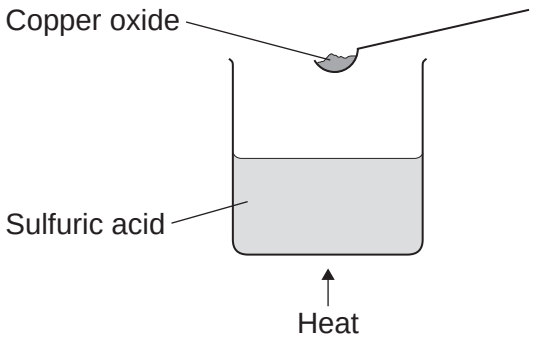
2 (a) A student added copper oxide to sulfuric acid to make copper sulfate.

The word equation for the reaction is:

sulfuric acid + copper oxide ⟶ copper sulfate + water

Figure 4 shows the first stage of the student's method.

Figure 4



2 (a) (i) The state symbol for CuO is missing from the equation below.

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

[1 mark]

aq	g	l	s

H_2SO_4 (aq) + CuO (___) ⟶ $CuSO_4$ (aq) + H_2O (l)

2 (a) (ii) Why is the sulfuric acid heated?

[1 mark]

_____

_____

Question 2 continues on the next page

4.2.2.6 Giant covalent structures

Question 19 · continued

2 (a) (iii) Which of these values could be the pH of sulfuric acid?

[1 mark]

Tick (✓) **one** box.

1 ☐

7 ☐

11 ☐

14 ☐

2 (a) (iv) Why does the student continue to add copper oxide until some is left at the end of the reaction?

[1 mark]

Tick (✓) **one** box.

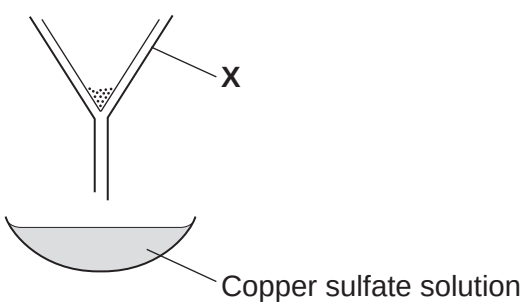
To make bigger copper sulfate crystals. ☐

To make sure all the copper oxide has reacted. ☐

To make sure all the sulfuric acid has reacted. ☐

2 (b) **Figure 5** shows the second stage of the student's method.

Figure 5



4.2.2.6 Giant covalent structures

Question 19 · continued

2 (b) (i) Name the apparatus labelled **X** on **Figure 5**.

[1 mark]

_____

2 (b) (ii) What could the student do to the copper sulfate solution to get copper sulfate crystals?

[1 mark]

_____

_____

2 (c) The student weighed the copper sulfate crystals.

Why was the mass of the copper sulfate crystals less than the student expected?

[1 mark]

Tick (✓) **one** box.

The student added too much copper oxide. ☐

The student left some copper sulfate crystals in the apparatus. ☐

The student weighed the copper sulfate crystals when they were wet. ☐

2 (d) The equation shows the reaction when blue hydrated copper sulfate crystals are heated.

hydrated copper sulfate $\rightleftharpoons$ anhydrous copper sulfate + water

2 (d) (i) What colour is anhydrous copper sulfate?

[1 mark]

_____

2 (d) (ii) What would you see if water is added to anhydrous copper sulfate?

[1 mark]

_____

4.2.2.6 Giant covalent structures

Question 19 · continued

2 (e) Ethene and sulfuric acid are used to make many substances.

Table 1 shows data about wealth of countries, ethene production and sulfuric acid production.

Table 1

Country	Wealth of country in billions of dollars	Ethene production in kilotonnes	Sulfuric acid production in kilotonnes
A	4000	13 900	36 000
B	1300	4 400	6 600
C	1290	2 700	26 000
D	460	1 500	2 500

2 (e) (i) Use the correct answer from the box to complete the sentence.

[1 mark]

alloys	chlorine	graphite	polymers

Ethene is used to make _____ .

2 (e) (ii) Describe the relationship, if any, between the wealth of a country and the production of ethene.

[1 mark]

_____

_____

2 (e) (iii) Describe the relationship, if any, between the wealth of a country and the production of sulfuric acid.

[1 mark]

_____

_____

12

4.2.2.6 Giant covalent structures

Question 20

June 2017 | CH2FP | Original Q3 | Legacy

3 This question is about oxygen and substances containing oxygen.

3 (a) Oxygen is a gas at room temperature.

3 (a) (i) What type of bonding holds the atoms together in oxygen?

[1 mark]

Tick (✓) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

3 (a) (ii) Which **two** statements about oxygen are true?

[2 marks]

Tick (✓) **two** boxes.

Oxygen consists of a giant lattice. ☐

Oxygen consists of small molecules. ☐

Oxygen conducts electricity. ☐

Oxygen is an alloy. ☐

Oxygen has a low boiling point. ☐

Question 3 continues on the next page

4.2.2.6 Giant covalent structures

Question 20 · continued

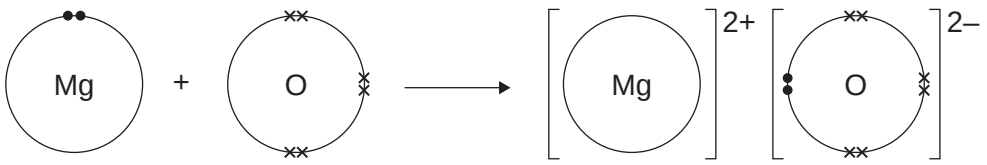
3 (b) Magnesium oxide is produced when magnesium reacts with oxygen.

3 (b) (i) **Figure 6** shows what happens to the electrons in the outer shells when a magnesium atom reacts with an oxygen atom.

The dots (•) and crosses (×) represent electrons.

Only the outer electrons are shown.

Figure 6



Describe, in terms of electrons, what happens when a magnesium atom reacts with an oxygen atom to produce magnesium oxide.

[4 marks]

4.2.2.6 Giant covalent structures

Question 20 · continued

3 (b) (ii) Nanoparticles of magnesium oxide can be made.

Which **two** statements about nanoparticles are true?

[2 marks]

Tick (✓) **two** boxes.

- Nanoparticles are very small atoms. ☐
- Nanoparticles can return to their original shape after being deformed. ☐
- Nanoparticles contain a few hundred atoms. ☐
- Nanoparticles contain millions of molecules. ☐
- Nanoparticles have a high surface area to volume ratio. ☐

3 (c) Silicon dioxide has a very high melting point.

Silicon dioxide does not conduct electricity when molten.

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

[1 mark]

giant covalent	giant ionic	metallic

The structure of silicon dioxide is _____ .

10

4.2.2.6 Giant covalent structures

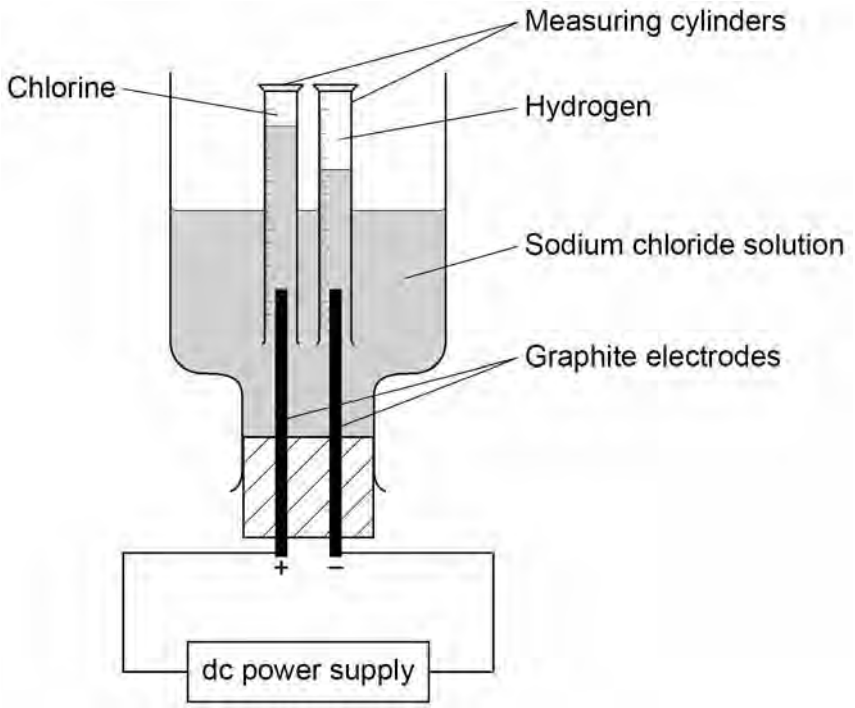
Question 21

June 2018 | 8462/1F | Original Q4

0 4 A student investigated the electrolysis of sodium chloride solution.

Figure 4 shows the apparatus.

Figure 4



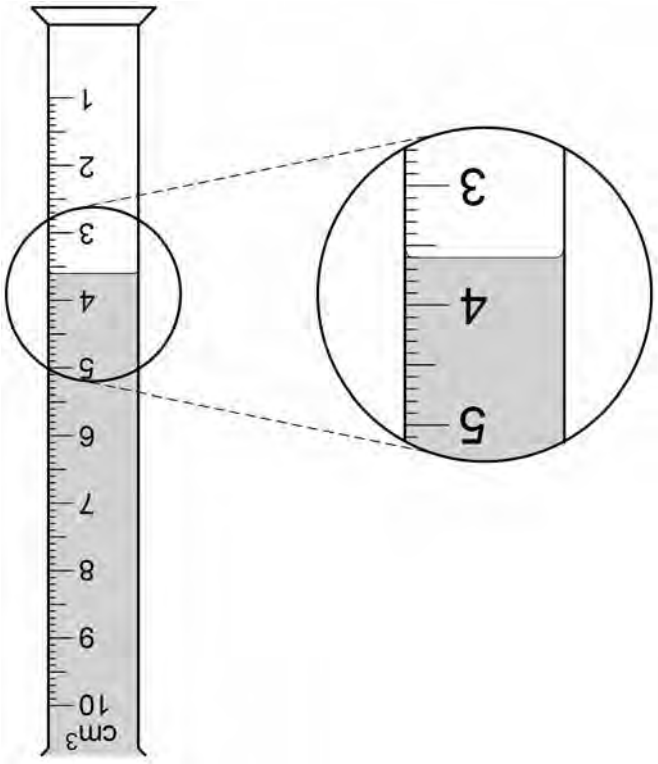
The student measured the volume of gas collected in each measuring cylinder every minute for 20 minutes.

4.2.2.6 Giant covalent structures

Question 21 · continued

0 4 . 1 **Figure 5** shows the volume of hydrogen gas collected in the measuring cylinder after 8 minutes.

Figure 5



What is the volume of hydrogen gas collected?

[1 mark]

Volume = _____ cm^3

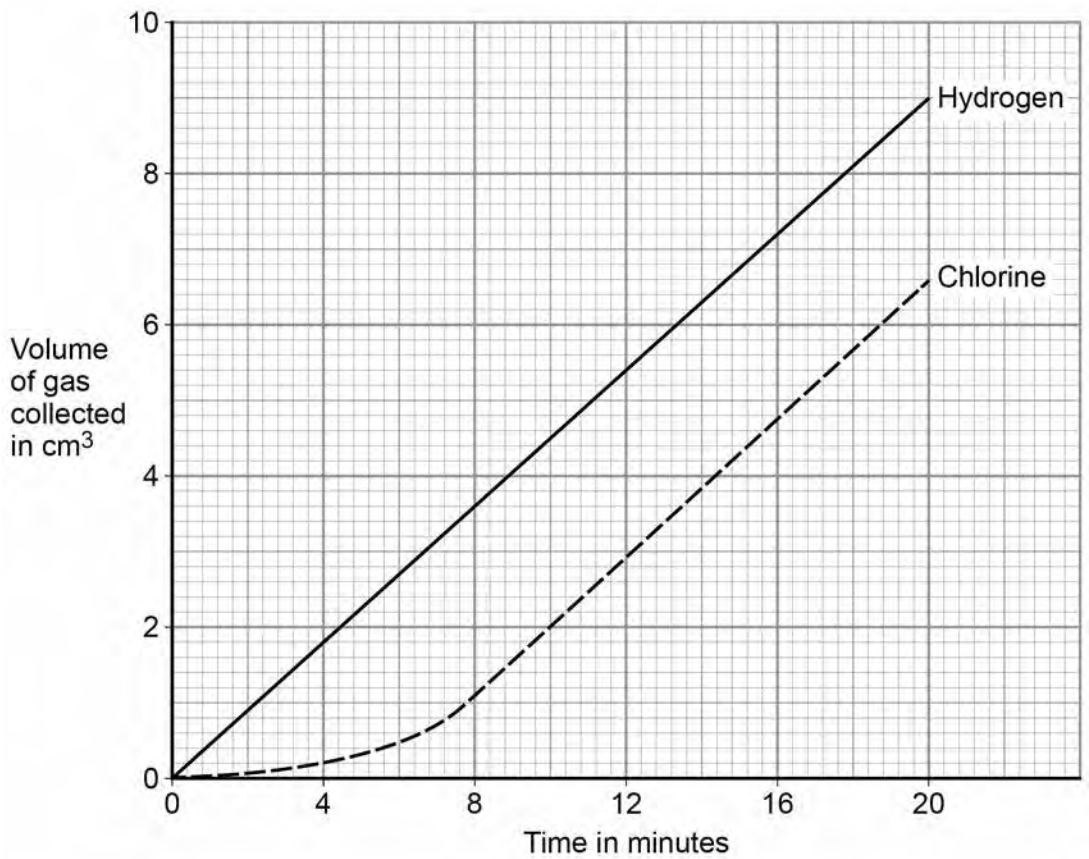
Question 4 continues on the next page

4.2.2.6 Giant covalent structures

Question 21 · continued

Figure 6 shows the results of the investigation.

Figure 6



0 4 . 2 Which of the lines on **Figure 6** show that the volume of gas collected is directly proportional to the time?

[1 mark]

Tick **one** box.

- Both lines ☐
- Chlorine line only ☐
- Hydrogen line only ☐
- Neither line ☐

4.2.2.6 Giant covalent structures

Question 21 · continued

0 4 . 3 Which of the lines on **Figure 6** show a positive correlation between the volume of gas collected and time?

[1 mark]

Tick **one** box.

- Both lines ☐
- Chlorine line only ☐
- Hydrogen line only ☐
- Neither line ☐

Question 4 continues on the next page

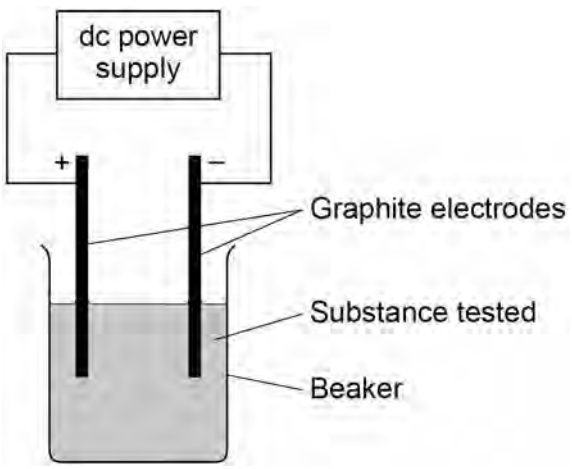
4.2.2.6 Giant covalent structures

Question 21 · continued

A teacher demonstrates the electrolysis of different substances using graphite electrodes.

Figure 7 shows the apparatus used.

Figure 7



0 4 . 4 Why can graphite conduct electricity?

[1 mark]

Tick **one** box.

Graphite exists in layers of atoms. ☐

Graphite has a giant structure. ☐

Graphite has a high melting point. ☐

Graphite has delocalised electrons. ☐

4.2.2.6 Giant covalent structures

Question 21 · continued

0 4 . 5 The teacher demonstrates the electrolysis of:

- molten zinc chloride
- potassium bromide solution.

Complete **Table 3** to predict the products.

Choose answers from the box.

[4 marks]

chlorine	**bromine**	**hydrogen**	**oxygen**	**potassium**	**zinc**

Table 3

Substance electrolysed	Product at cathode (negative electrode)	Product at anode (positive electrode)
Molten zinc chloride		
Potassium bromide solution		

4.2.2.6 Giant covalent structures

Question 22

November 2020 | 8462/1F | Original Q4

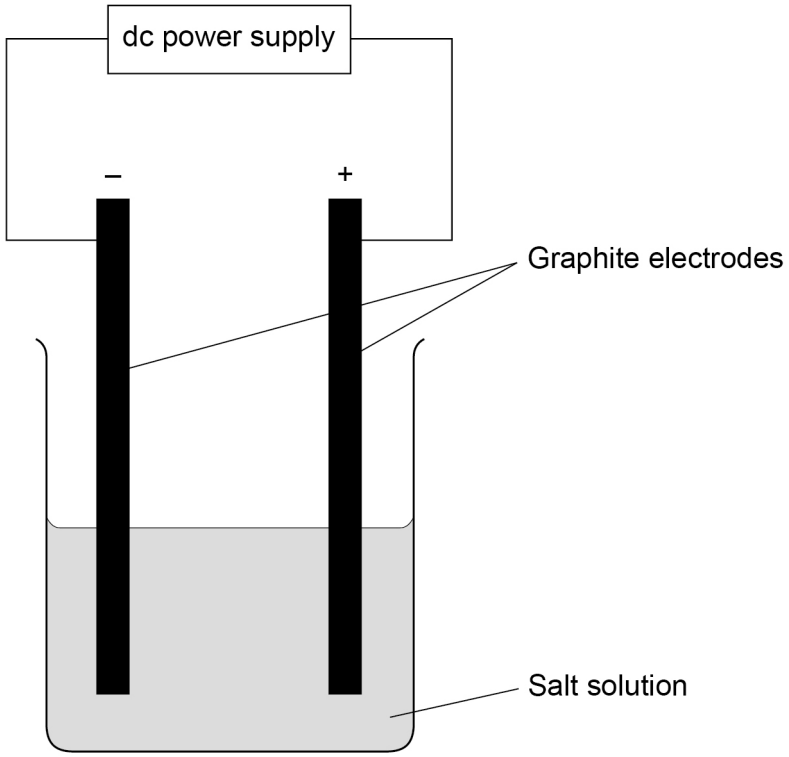
0 4 This question is about electrolysis.

A student investigated the hypothesis:

'The electrolysis of a salt solution produces a metal at the negative electrode and a gas at the positive electrode.'

Figure 4 shows the apparatus used.

Figure 4



0 4 . 1 What observation would be made at each electrode if the hypothesis is correct?

[2 marks]

Observation if metal produced at the negative electrode _____

_____

Observation if gas produced at the positive electrode _____

_____

4.2.2.6 Giant covalent structures

Question 22 · continued

Table 3 shows the student's results.

Table 3

Salt solution	Product at the negative electrode	Product at the positive electrode
Copper chloride	Copper	Chlorine
Potassium nitrate	Hydrogen	Oxygen
Silver nitrate	Silver	Oxygen

0 4 . 2 Which salt solution in **Table 3** does **not** match the student's hypothesis?

Give **one** reason why.

[2 marks]

Salt solution _____

Reason _____

_____

0 4 . 3 Give **two** reasons why graphite is used for the electrodes.

[2 marks]

1 _____

_____

2 _____

_____

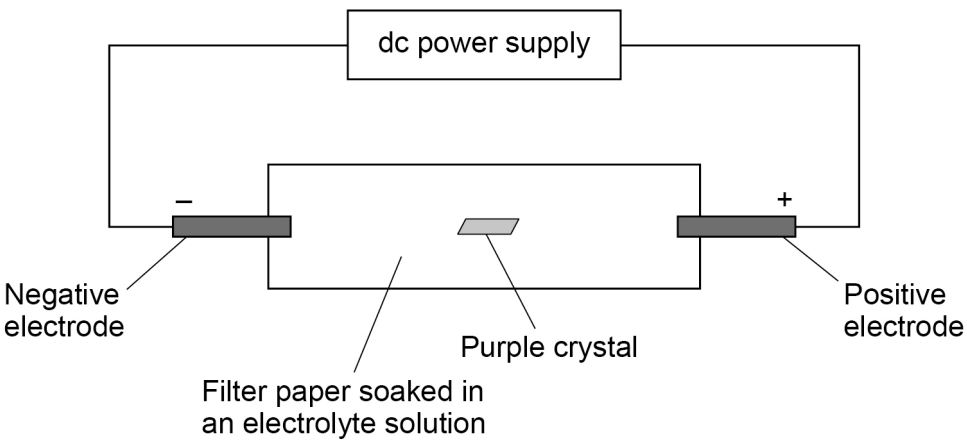
4.2.2.6 Giant covalent structures

Question 22 · continued

A different student investigated what happens during electrolysis.

Figure 5 shows the apparatus.

Figure 5



The purple crystal contained:

- colourless positive ions
- purple coloured negative ions.

The purple crystal dissolved in the electrolyte solution.

0 4 . 4 What happens to the purple coloured ions?

Give **one** reason for your answer.

[2 marks]

Tick (✓) **one** box.

The ions do not move. ☐

The ions move towards the negative electrode. ☐

The ions move towards the positive electrode. ☐

Reason _____

_____

8

4.2.2.6 Giant covalent structures

Question 23

November 2020 | 8462/1F | Original Q8

0 8 This question is about structure and bonding.

0 8 . 1 Which **two** substances have intermolecular forces between particles?

[2 marks]

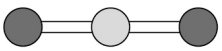
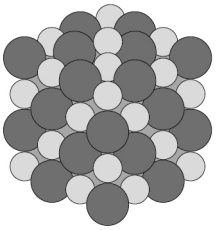
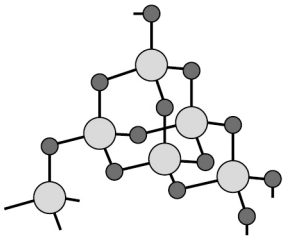
Tick (✓) **two** boxes.

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

0 8 . 2 **Table 5** shows the structures of three compounds.

Table 5

Diagrams not to scale

Compound	Structure
Carbon dioxide	
Magnesium oxide	
Silicon dioxide	

4.2.2.6 Giant covalent structures

Question 23 · 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 24

November 2021 | 8462/1F | Original Q8

0 8 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 8 . 1 What shape is a Buckminsterfullerene molecule?

[1 mark]

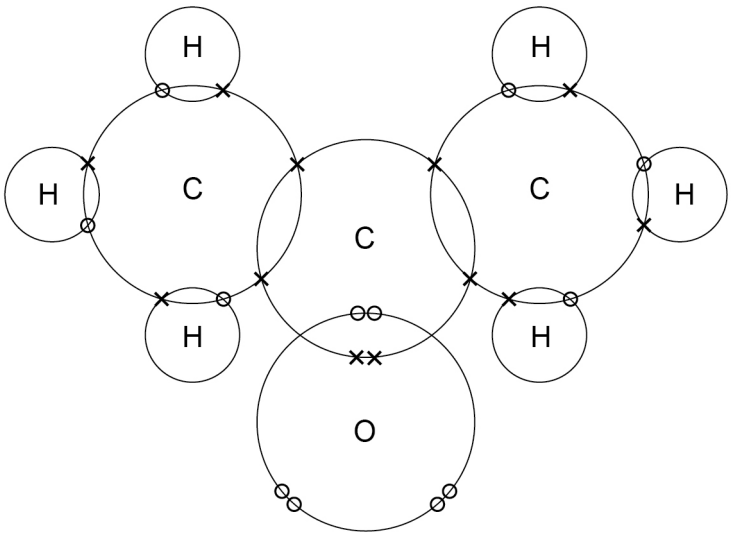
0 8 . 2 Give **one** use of a fullerene.

[1 mark]

Propanone is a compound of carbon, hydrogen and oxygen.

Figure 13 shows the dot and cross diagram for a propanone molecule.

Figure 13



4.2.2.6 Giant covalent structures

Question 24 · continued

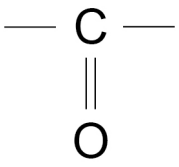
0 8 . 3 Complete **Figure 14** to show a propanone molecule.

Use a line to represent each single bond.

Use **Figure 13**.

[1 mark]

Figure 14



0 8 . 4 Determine the molecular formula of propanone.

Use **Figure 13**.

[1 mark]

Molecular formula = _____

0 8 . 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. ☐

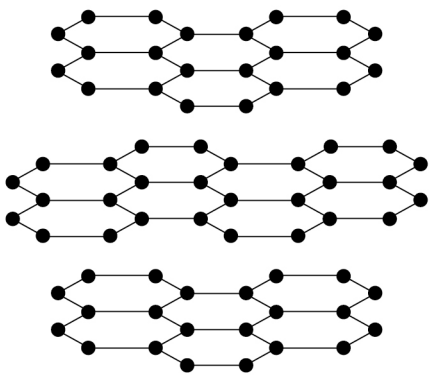
The intermolecular forces are weak. ☐

4.2.2.6 Giant covalent structures

Question 24 · continued

0 8 . 6 **Figure 15** represents the structure of graphite.

Figure 15



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

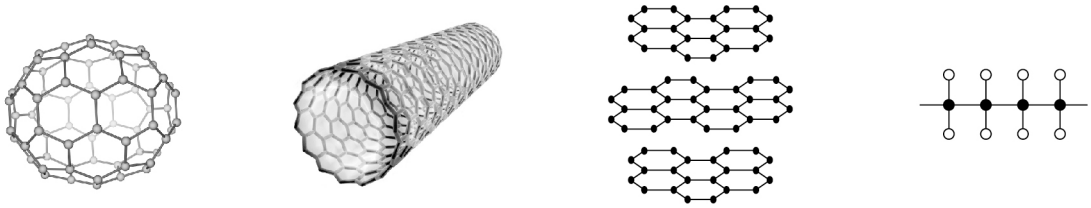
Question 25

June 2022 | 8462/1F | Original Q6

0 6 This question is about carbon and compounds of carbon.

Figure 9 shows diagrams that represent different structures.

Figure 9



A **B** **C** **D**

Use **Figure 9** to answer questions **06.1** and **06.2**.

0 6 . 1 Which diagram represents graphite?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

0 6 . 2 Which diagram represents poly(ethene)?

[1 mark]

Tick (✓) **one** box.

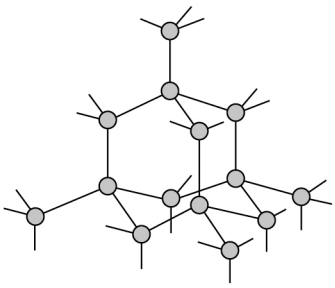
A ☐ **B** ☐ **C** ☐ **D** ☐

4.2.2.6 Giant covalent structures

Question 25 · continued

Figure 10 represents the structure of diamond.

Figure 10



Key

Carbon atom

0 6 . 3 How many covalent bonds does each carbon atom form in diamond?

[1 mark]

0 6 . 4 Which is a property of diamond?

[1 mark]

Tick (✓) **one** box.

Conducts electricity ☐

Low melting point ☐

Very hard ☐

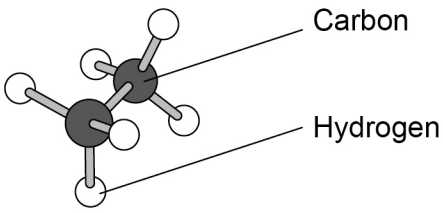
Question 6 continues on the next page

4.2.2.6 Giant covalent structures

Question 25 · continued

0 6 . 5 **Figure 11** shows a model of a molecule.

Figure 11



Complete the molecular formula of the molecule.

[1 mark]

Molecular formula = C__ H__

Carbonic acid is a compound of carbon.

The formula of carbonic acid is H_2CO_3

0 6 . 6 Which ion is produced by carbonic acid in aqueous solution?

[1 mark]

Tick (✓) **one** box.

H^+ ☐ OH^- ☐ O^{2-} ☐

0 6 . 7 Calculate the relative formula mass (M_r) of carbonic acid (H_2CO_3).

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

[2 marks]

Relative formula mass (M_r) = _____

8

4.2.2.6 Giant covalent structures

Question 26

June 2023 | 8462/1F | Original Q3

0 3 This question is about carbon.

0 3 . 1 Which type of substance is carbon?

[1 mark]

Tick (✓) **one** box.

Compound ☐

Element ☐

Mixture ☐

0 3 . 2 Carbon has isotopes with mass numbers 12, 13 and 14.

Complete the sentences.

Choose answers from the box.

[2 marks]

electrons	**ions**	**molecules**	**neutrons**	**protons**

The isotopes of carbon have the same number of _____.

The isotopes of carbon have a different number of _____.

4.2.2.6 Giant covalent structures

Question 26 · continued

0 3 . 3 12 g of carbon contains 6.02×10^{23} atoms.

Which expression is used to calculate the mass of one atom of carbon?

[1 mark]

Tick (✓) **one** box.

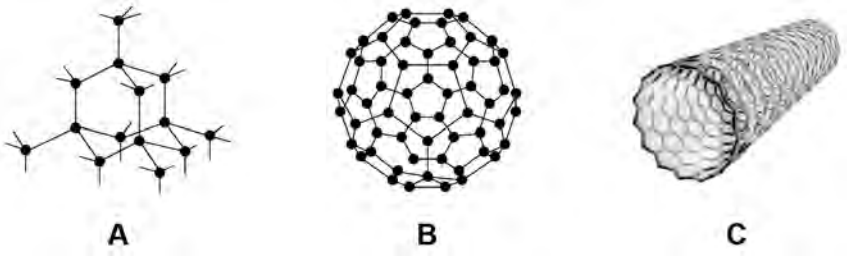
$\frac{12}{6.02 \times 10^{23}}$ ☐

$\frac{6.02 \times 10^{23}}{12}$ ☐

$12 \times 6.02 \times 10^{23}$ ☐

0 3 . 4 **Figure 2** shows diagrams that represent different forms of carbon.

Figure 2



Which diagram in **Figure 2** represents Buckminsterfullerene?

[1 mark]

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐

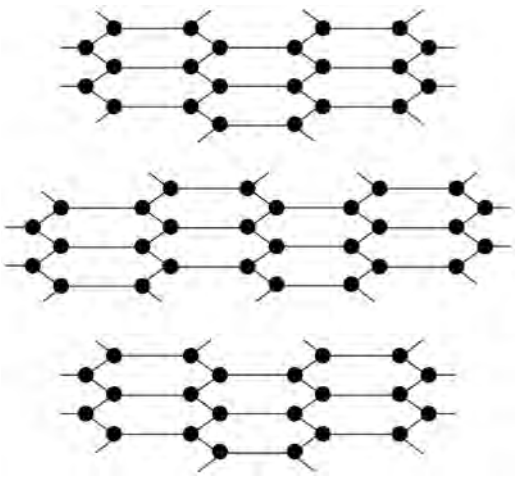
Question 3 continues on the next page

4.2.2.6 Giant covalent structures

Question 26 · continued

0 3 . 5 **Figure 3** represents part of the structure of graphite.

Figure 3



Draw **one** line from each property of graphite to the structural feature that is the reason for that property.

[2 marks]

Property	Structural feature
	Graphite has hexagonal rings of carbon atoms.
Graphite conducts electricity.	The bonds between carbon atoms in the layers are strong.
Graphite is soft.	There are no covalent bonds between layers of atoms.
	There are delocalised electrons in graphite.

7

4.2.2.6 Giant covalent structures

Question 27

June 2024 | 8462/1F | Original Q4

0 4 This question is about small particles.

0 4 . 1 What is the approximate number of atoms in a nanoparticle?

[1 mark]

Tick (✓) **one** box.

- A few hundred atoms ☐
- A few thousand atoms ☐
- A few million atoms ☐
- A few billion atoms ☐

0 4 . 2 Nanoparticles of some elements can be used as catalysts.

Which element is most likely to be used as a catalyst?

Use the periodic table.

[1 mark]

Tick (✓) **one** box.

- Aluminium ☐
- Iron ☐
- Magnesium ☐

Question 4 continues on the next page

4.2.2.6 Giant covalent structures

Question 27 · continued

0 4 . 3 Nanoparticles are used in sun creams and in wound dressings.

A wound dressing is placed next to the skin to prevent infection.

Figure 8 shows a wound dressing.

Figure 8



Table 2 shows some information about substances used in the form of nanoparticles.

Table 2

Substance	Property
Carbon	Strong
Silicon dioxide	Hard
Silver	Kills bacteria
Titanium dioxide	Blocks light

4.2.2.6 Giant covalent structures

Question 27 · continued

June 2024 | 8462/1F | Original Q4

Draw **one** line from each use to the best substance for that use.

[2 marks]

Use	Substance
	Carbon
Sun creams	Silicon dioxide
Wound dressings	Silver
	Titanium dioxide

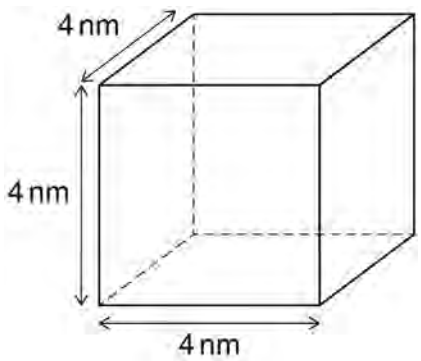
Question 4 continues on the next page

4.2.2.6 Giant covalent structures

Question 27 · continued

0 4 . 4 **Figure 9** shows a cubic nanoparticle.

Figure 9



Calculate:

- the surface area of the cubic nanoparticle
- the volume of the cubic nanoparticle
- the simplest whole number ratio of surface area : volume for the cubic nanoparticle.

Use the equation:

surface area of cubic nanoparticle = 6 × surface area of one face

[6 marks]

Surface area of cubic nanoparticle = _____ nm^2

Volume of cubic nanoparticle = _____ nm^3

Simplest whole number ratio of surface area: volume = _____ : _____

10

4.2.2.6 Giant covalent structures

Question 28

June 2024 | 8462/1F | Original Q5

0 5 This question is about carbon and carbon compounds.

An atom of carbon is represented as:

(Mass number) 13
(Atomic number) 6 C

0 5 . 1 What is the number of protons in this atom of carbon?

Tick (✓) **one** box.

[1 mark]

1 ☐ 6 ☐ 7 ☐ 13 ☐

0 5 . 2 What is the number of neutrons in this atom of carbon?

Tick (✓) **one** box.

[1 mark]

1 ☐ 6 ☐ 7 ☐ 13 ☐

0 5 . 3 What is the number of electrons in this atom of carbon?

Tick (✓) **one** box.

[1 mark]

1 ☐ 6 ☐ 7 ☐ 13 ☐

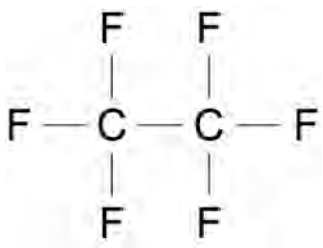
Question 5 continues on the next page

4.2.2.6 Giant covalent structures

Question 28 · continued

0 5 . 4 **Figure 10** shows the structure of a carbon compound.

Figure 10



Complete the formula of the carbon compound.

[1 mark]

C__ F__

0 5 . 5 Methane:

- is a carbon compound
- exists as small molecules
- has a low boiling point.

What is the reason for the low boiling point of methane?

[1 mark]

Tick (✓) **one** box.

Covalent bonds **and** intermolecular forces are weak. ☐

Only covalent bonds are weak. ☐

Only intermolecular forces are weak. ☐

4.2.2.6 Giant covalent structures

Question 28 · continued

June 2024 | 8462/1F | Original Q5

0 5 . 6 Buckminsterfullerene (C_{60}) is a form of carbon.

Buckminsterfullerene was the first fullerene to be discovered.

What is the shape of a buckminsterfullerene molecule?

[1 mark]

Tick (✓) **one** box.

Cubic ☐

Cylindrical ☐

Spherical ☐

Question 5 continues on the next page

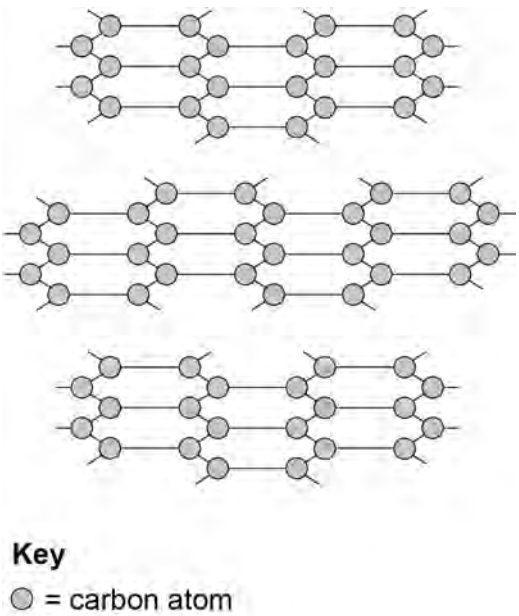
4.2.2.6 Giant covalent structures

Question 28 · continued

0 5 . 7 Graphite is a form of carbon.

Figure 11 represents the structure of graphite.

Figure 11



How many covalent bonds does each carbon atom form in graphite?

[1 mark]

Tick (✓) **one** box.

1 ☐

2 ☐

3 ☐

4 ☐

4.2.2.6 Giant covalent structures

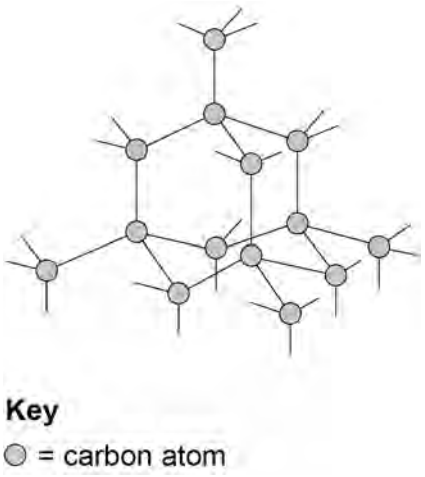
Question 28 · continued

June 2024 | 8462/1F | Original Q5

0 5 . 8 Diamond is another form of carbon.

Figure 12 represents the structure of diamond.

Figure 12



Describe the structure and bonding in diamond.

[3 marks]

10

4.2.2.6 Giant covalent structures

Question 29

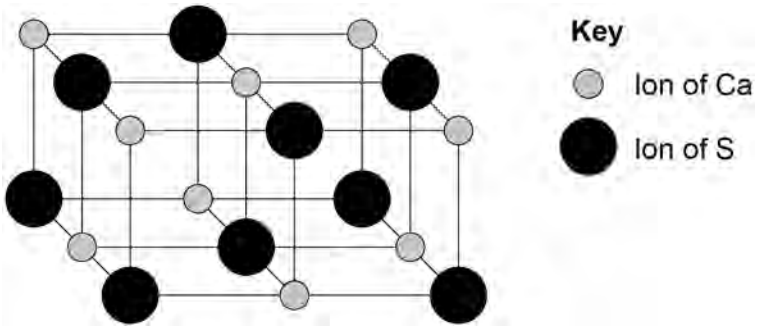
June 2025 | 8462/1F | Original Q9

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

4.2.2.6 Giant covalent structures

Question 29 · 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.

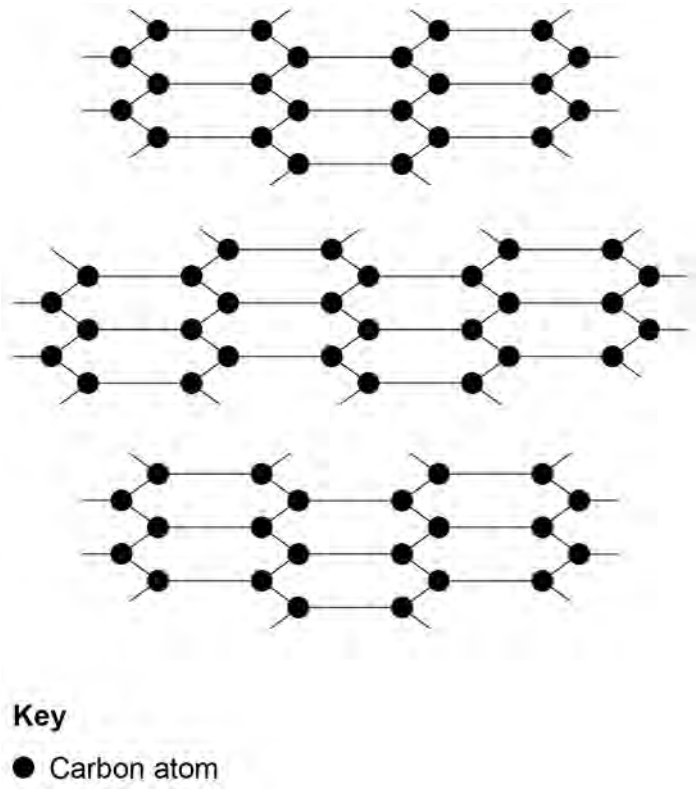
[4 marks]

4.2.2.6 Giant covalent structures

Question 29 · continued

Figure 14 shows the structure of graphite.

Figure 14



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

[4 marks]

Extra space

4.2.2.6 Giant covalent structures

Question 29 · 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. ☐

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