AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.2.3.3

Graphene and fullerenes

Past-paper questions

Tier	**Foundation**
Question groups	**4**
Available paper years	**2018–2024**

Using this booklet

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

Name: _____ **Date:** _____

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

5.2.3.3 Graphene and fullerenes

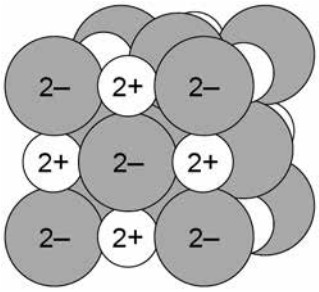
Question 01

June 2018 | 8464/C/1F | Original Q1

0 1 This question is about structure and bonding.

0 1 . 1 **Figure 1** shows part of the structure of calcium oxide (CaO).

Figure 1



What type of bonding is present in calcium oxide?

[1 mark]

Tick **one** box.

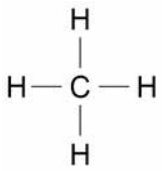
- Covalent ☐
- Ionic ☐
- Macromolecular ☐
- Metallic ☐

5.2.3.3 Graphene and fullerenes

Question 01 · continued June 2018 | 8464/C/1F | Original Q1

0 1 . 2 **Figure 2** shows a particle of methane (CH_4).

Figure 2



What type of particle is present in **Figure 2**?

[1 mark]

Tick **one** box.

An ion ☐

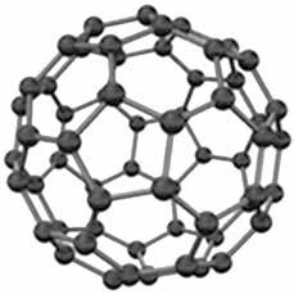
A lattice ☐

A molecule ☐

A polymer ☐

0 1 . 3 **Figure 3** shows the structure of C_{60}

Figure 3



Complete the sentence.

Choose the answer from the box.

[1 mark]

diatomic	**giant ionic**	**a fullerene**	**giant metallic**

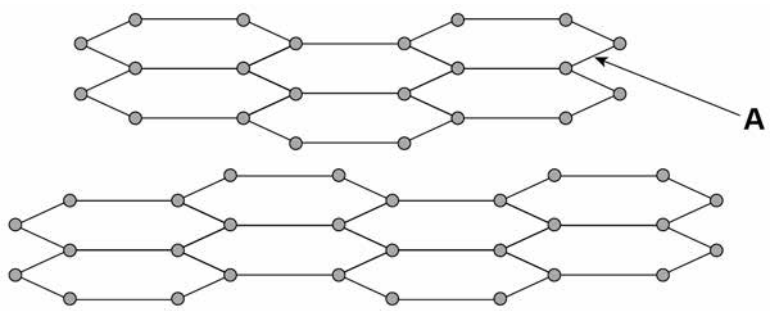
The structure of C_{60} is _____ .

5.2.3.3 Graphene and fullerenes

Question 01 · continued

Figure 4 shows the structure of graphite.

Figure 4



0 1 . 4 What type of bond is labelled **A** in **Figure 4**?

[1 mark]

Tick **one** box.

covalent ☐

double ☐

ionic ☐

metallic ☐

0 1 . 5 In graphite, each carbon atom forms bonds with other carbon atoms as shown in **Figure 4**

How many electrons does **one** carbon atom use to form **one** bond?

[1 mark]

Tick **one** box.

1 ☐ **2** ☐ **3** ☐ **4** ☐

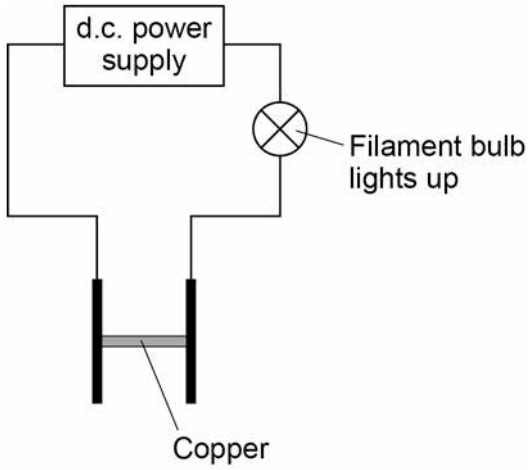
5.2.3.3 Graphene and fullerenes

Question 01 · continued

An electric current is passed through copper.

Figure 5 shows the apparatus used.

Figure 5



0 1 . 6 Complete the sentence.

Choose the answer from the box.

[1 mark]

gas	**liquid**	**solid**	**solution**

Figure 5 shows that copper conducts electricity as a _____ .

0 1 . 7 Complete the sentence.

Choose the answer from the box.

[1 mark]

atoms	**electrons**	**ions**	**molecules**

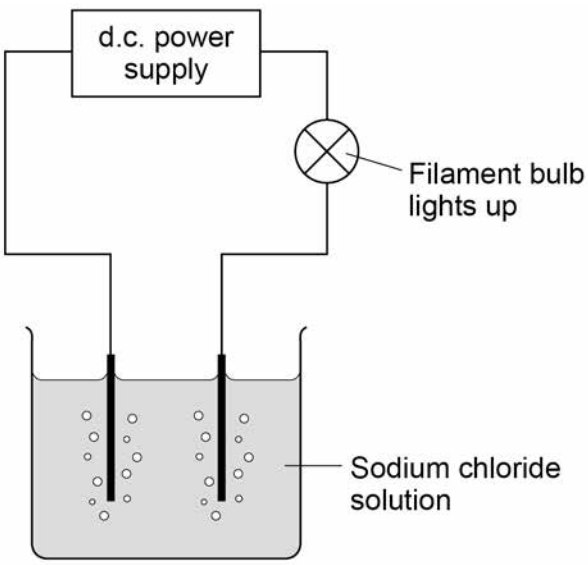
Copper conducts electricity because of the movement of delocalised _____ .

5.2.3.3 Graphene and fullerenes

Question 01 · continued

0 1 . 8 **Figure 6** shows the apparatus used to investigate the effect of electricity on sodium chloride solution.

Figure 6



Complete the sentence.

Choose the answer from the box.

[1 mark]

dissolved	**gaseous**	**molten**

Figure 6 shows that sodium chloride conducts electricity when _____ .

5.2.3.3 Graphene and fullerenes

Question 01 · continued

0 1 . 9 Sodium chloride is made up of ions.

Figure 7 shows the apparatus used to investigate the effect of electricity on solid sodium chloride and molten sodium chloride.

Figure 7

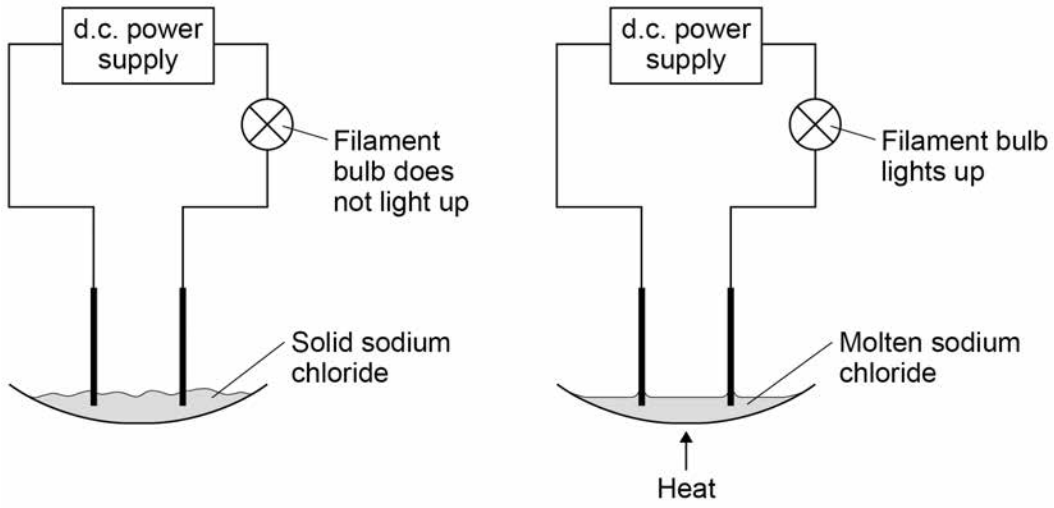


Table 1 shows the results.

Table 1

	Solid sodium chloride	Molten sodium chloride
Observation	The filament bulb does not light up	The filament bulb lights up
Deduction	Does not conduct electricity	Does conduct electricity

Draw **one** line from each statement to the correct reason.

[2 marks]

Statement	Reason
Solid sodium chloride does not conduct electricity.	The ions are fixed.
	The ions are mobile.
Molten sodium chloride conducts electricity.	The ions are neutral.
	The ions are vibrating.

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5.2.3.3 Graphene and fullerenes

Question 02

November 2021 | 8464/C/1F | Original Q3

0 3 Carbon can exist in a number of different structures.

0 3 . 1 What is the approximate radius of a carbon atom?

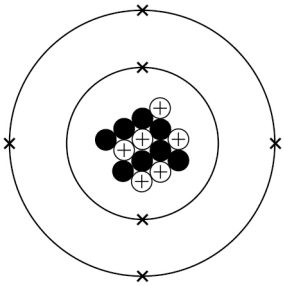
[1 mark]

Tick (✓) **one** box.

0.1 m ☐ 0.1 mm ☐ 0.1 nm ☐

0 3 . 2 **Figure 3** shows an atom of carbon.

Figure 3



Describe the atomic structure of this carbon atom.

You should include the number of electrons, neutrons and protons.

[6 marks]

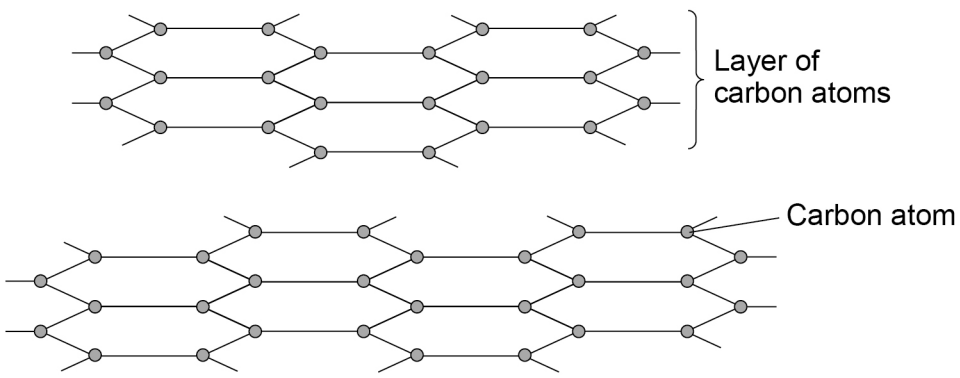
5.2.3.3 Graphene and fullerenes

Question 02 · continued

In graphite the carbon atoms are held together by bonds.

Figure 4 represents part of the structure of graphite.

Figure 4



0 3 . 3 How many bonds does each carbon atom have in graphite?

Use **Figure 4**.

[1 mark]

Tick (✓) **one** box.

1 ☐ 2 ☐ 3 ☐ 4 ☐

0 3 . 4 What type of bonds hold the carbon atoms together in graphite?

[1 mark]

Tick (✓) **one** box.

Covalent ☐

Ionic ☐

Metallic ☐

5.2.3.3 Graphene and fullerenes

Question 02 · continued

0 3 . 5 Lubricants allow objects to slide over each other easily.

Suggest why graphite can be used as a lubricant.

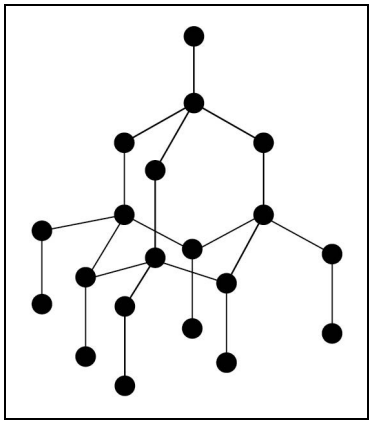
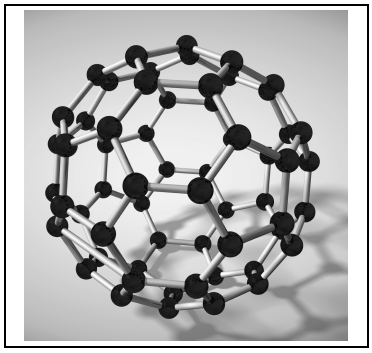
Use **Figure 4**.

[1 mark]

0 3 . 6 The two structures represent different forms of carbon.

Draw **one** line from each structure to the form of carbon.

[2 marks]

Structure	Form of carbon
	Buckminsterfullerene
	Diamond
	Graphene
	Nanotube

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5.2.3.3 Graphene and fullerenes

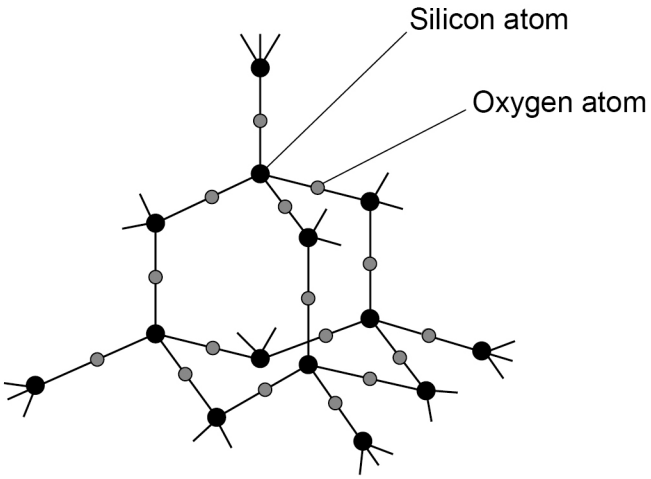
Question 03

June 2022 | 8464/C/1F | Original Q3

0 3 This question is about structure and bonding.

Figure 6 represents part of the structure of silicon dioxide.

Figure 6



0 3 . 1 What type of structure is silicon dioxide?

[1 mark]

Tick (✓) **one** box.

Giant covalent ☐

Ionic lattice ☐

Simple molecular ☐

0 3 . 2 Each oxygen atom forms two bonds.

What is the number of bonds formed by each silicon atom?

Use **Figure 6**.

[1 mark]

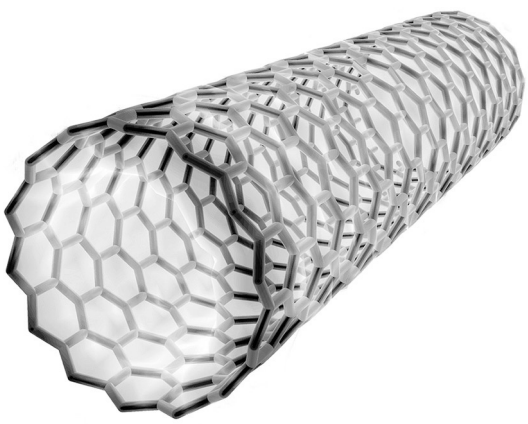
_____

5.2.3.3 Graphene and fullerenes

Question 03 · continued

Figure 7 represents part of a fullerene.

Figure 7



0 3 . 3 Complete the sentence.

Choose the answer from the box.

[1 mark]

hexagons	**octagons**	**squares**	**triangles**

The structure of fullerenes is based on _____ .

0 3 . 4 Complete the sentence.

Choose the answer from the box.

[1 mark]

carbon	**hydrogen**	**oxygen**

The fullerene molecule shown in **Figure 7** is made from

atoms of _____ .

5.2.3.3 Graphene and fullerenes

Question 03 · continued

0 3 . 5 What is the fullerene molecule shown in **Figure 7** used for?

[1 mark]

Tick (✓) **one** box.

- Electronics ☐
- Hand warmers ☐
- Sports injury packs ☐

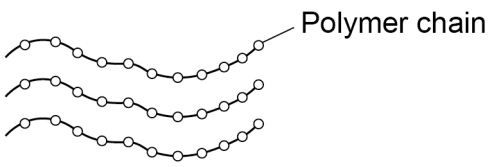
Question 3 continues on the next page

5.2.3.3 Graphene and fullerenes

Question 03 · continued

Figure 8 represents part of the structure of a polymer.

Figure 8



0 3 . 6 What holds the atoms together in a polymer chain?

[1 mark]

Tick (✓) **one** box.

Covalent bonds ☐

Ionic bonds ☐

Metallic bonds ☐

0 3 . 7 Complete the sentence.

Choose the answer from the box.

[1 mark]

atomic	**intermolecular**	**macromolecular**

In **Figure 8** the polymer chains are held together by

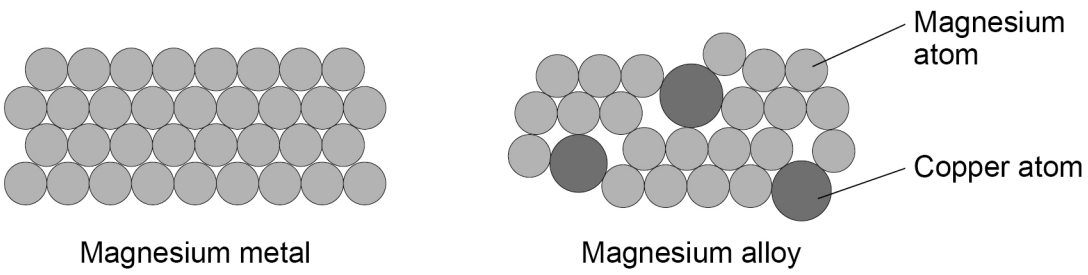
_____ forces.

5.2.3.3 Graphene and fullerenes

Figure 9 represents part of the structures of:

- magnesium metal
- a magnesium alloy.

Figure 9



0 3 . 8 Calculate the percentage of copper atoms in the alloy.

[3 marks]

Number of magnesium atoms in the alloy = _____

Number of copper atoms in the alloy = _____

Total number of atoms in the alloy = _____

_____

Percentage of copper atoms in the alloy = _____ %

0 3 . 9 Explain why the magnesium alloy is harder than magnesium metal.

Use **Figure 9**.

[3 marks]

_____

_____

_____

_____

_____

_____

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5.2.3.3 Graphene and fullerenes

Question 04

0 2 Carbon is in Group 4 of the periodic table.

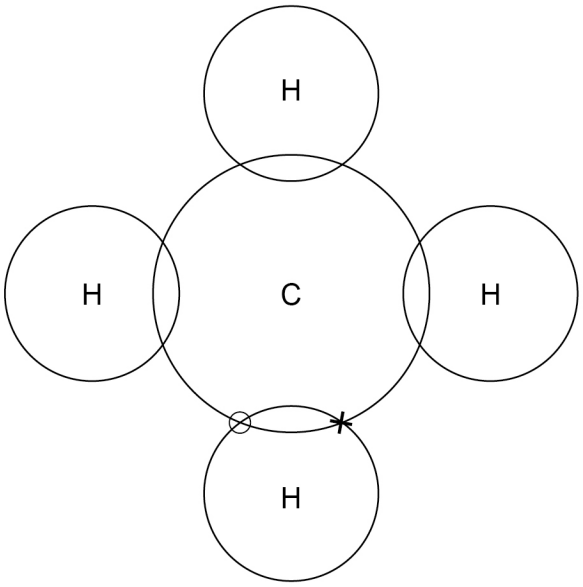
0 2 . 1 Methane contains carbon and hydrogen atoms.

A carbon atom has 4 electrons in the outer shell.

A hydrogen atom has 1 electron in the outer shell.

Complete the dot and cross diagram for a methane molecule.

[2 marks]



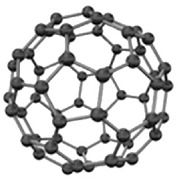
5.2.3.3 Graphene and fullerenes

Question 04 · continued

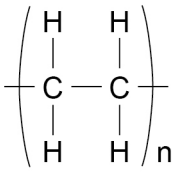
0 2 . 2 Which diagram represents the structure of diamond?

[1 mark]

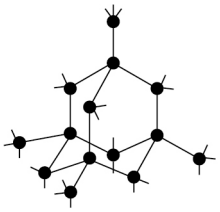
Tick (✓) **one** box.



☐



☐



☐

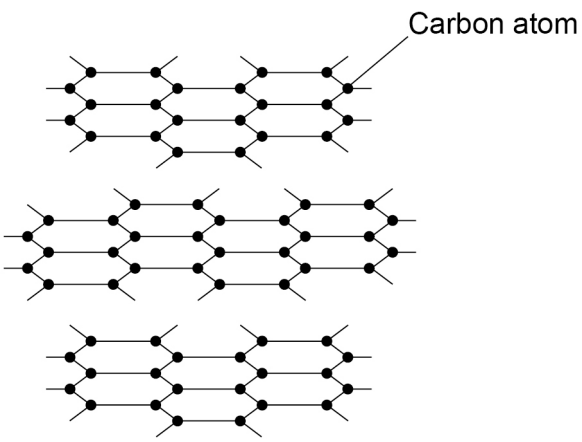
Question 2 continues on the next page

5.2.3.3 Graphene and fullerenes

Question 04 · continued

Figure 3 represents part of the structure of graphite.

Figure 3



0 2 . 3 In graphite each carbon atom forms covalent bonds.

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

[1 mark]

Tick (✓) **one** box.

1 ☐ 2 ☐ 3 ☐ 4 ☐

0 2 . 4 Graphite conducts electricity.

Which particles carry electrical charge through graphite?

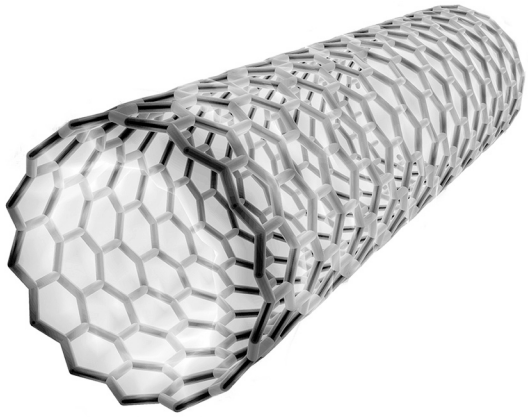
[1 mark]

5.2.3.3 Graphene and fullerenes

Question 04 · continued

Figure 4 represents the structure of a fullerene.

Figure 4



0 2 . 5 Where are fullerenes used?

[1 mark]

Tick (✓) **one** box.

In electronic components ☐

In self-heating cans ☐

In sports injury packs ☐

0 2 . 6 Describe the structure of the fullerene shown in **Figure 4**.

[2 marks]

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