AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.2.3.3

Graphene and fullerenes

Past-paper questions

Tier	**Foundation**
Question groups	**6**
Available paper years	**2010–2024**

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.

4.2.3.3 Graphene and fullerenes

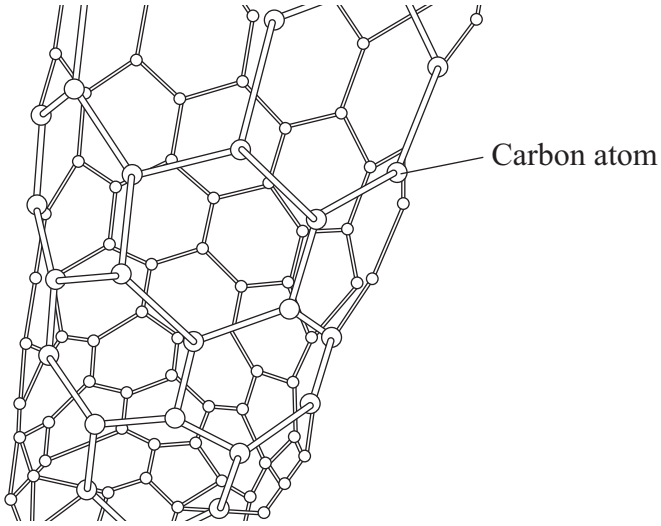
Question 01

January 2010 | CHY2F | Original Q4 | Legacy

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)

4.2.3.3 Graphene and fullerenes

Question 01 · 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

4.2.3.3 Graphene and fullerenes

Question 02

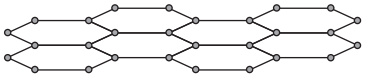
June 2012 | CH2FP | Original Q5 | Legacy

5 Read the information.

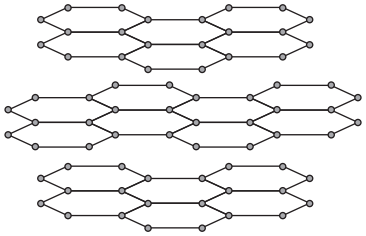
Graphene

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)

4.2.3.3 Graphene and fullerenes

Question 02 · 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

4.2.3.3 Graphene and fullerenes

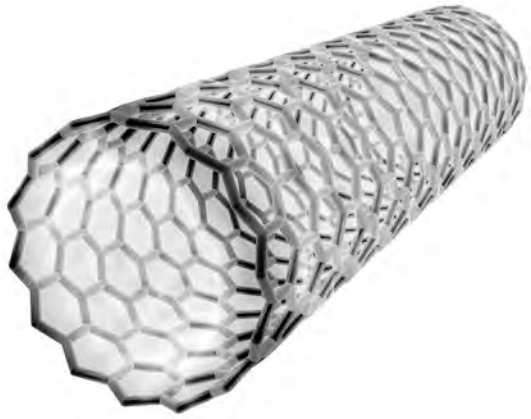
Question 03

June 2019 | 8462/1F | Original Q10

1 0 This question is about materials and their properties.

1 0 . 1 **Figure 13** shows a carbon nanotube.

Figure 13



The structure and bonding in a carbon nanotube are similar to graphene.

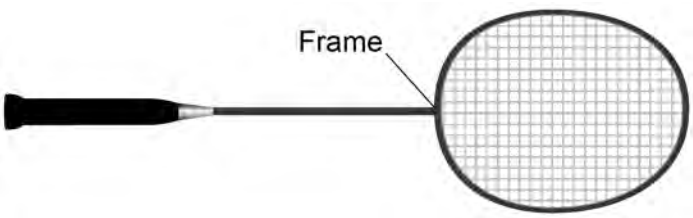
Carbon nanotubes are used in electronics because they conduct electricity.

Explain why carbon nanotubes conduct electricity.

[2 marks]

1 0 . 2 **Figure 14** shows a badminton racket.

Figure 14



4.2.3.3 Graphene and fullerenes

Question 03 · continued

Table 4 shows some properties of materials.

The materials could be used to make badminton racket frames.

Table 4

Material	Density in g/cm^3	Relative strength	Relative stiffness
Aluminium	2.7	0.3	69
Carbon nanotube	1.5	60	1000
Wood	0.71	0.1	10

Evaluate the use of the materials to make badminton racket frames.

Use **Table 4**.

[4 marks]

Question 10 continues on the next page

4.2.3.3 Graphene and fullerenes

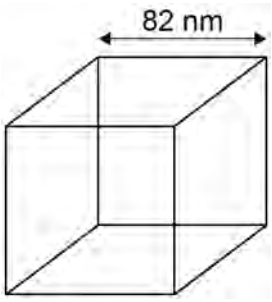
Question 03 · continued

Zinc oxide can be produced as nanoparticles and as fine particles.

1 0 . 3 A nanoparticle of zinc oxide is a cube of side 82 nm

Figure 15 represents a nanoparticle of zinc oxide.

Figure 15



Calculate the surface area of a nanoparticle of zinc oxide.

Give your answer in standard form.

[3 marks]

Surface area = _____ nm^2

1 0 . 4 Some suncreams contain zinc oxide as nanoparticles or as fine particles.

Suggest **one** reason why it costs less to use nanoparticles rather than fine particles in suncreams.

[1 mark]

4.2.3.3 Graphene and fullerenes

Question 04

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]

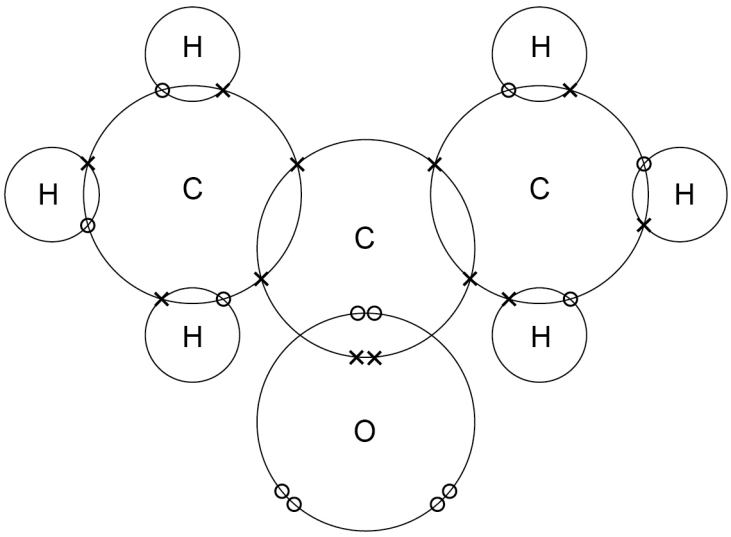
0 8 . 2 Give **one** use of a fullerene.

[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



4.2.3.3 Graphene and fullerenes

Question 04 · continued

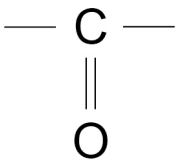
0 8 . 3 Complete **Figure 14** to show a propanone molecule.

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. ☐

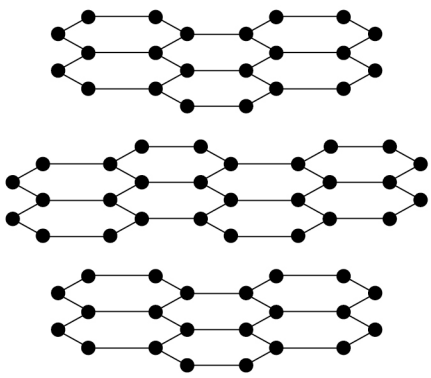
The intermolecular forces are strong. ☐

The intermolecular forces are weak. ☐

4.2.3.3 Graphene and fullerenes

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]

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4.2.3.3 Graphene and fullerenes

Question 05

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 _____.

4.2.3.3 Graphene and fullerenes

Question 05 · 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.

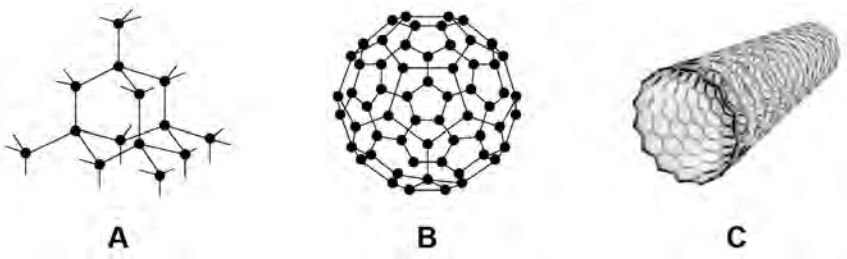
$\frac{12}{6.02 \times 10^{23}}$ ☐

$\frac{6.02 \times 10^{23}}{12}$ ☐

$12 \times 6.02 \times 10^{23}$ ☐

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** ☐

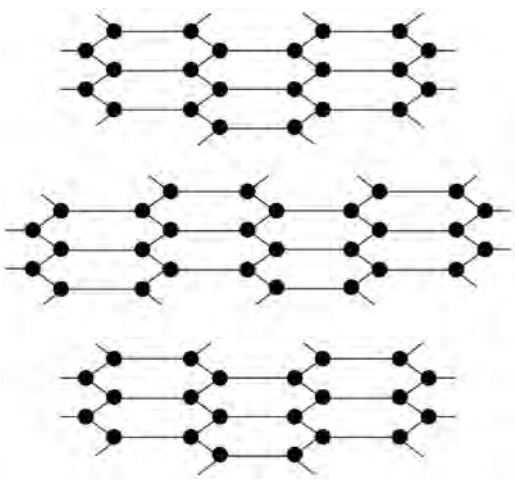
Question 3 continues on the next page

4.2.3.3 Graphene and fullerenes

Question 05 · 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.

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4.2.3.3 Graphene and fullerenes

Question 06

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 ☐

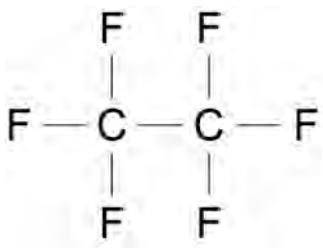
Question 5 continues on the next page

4.2.3.3 Graphene and fullerenes

Question 06 · 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. ☐

4.2.3.3 Graphene and fullerenes

Question 06 · continued

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

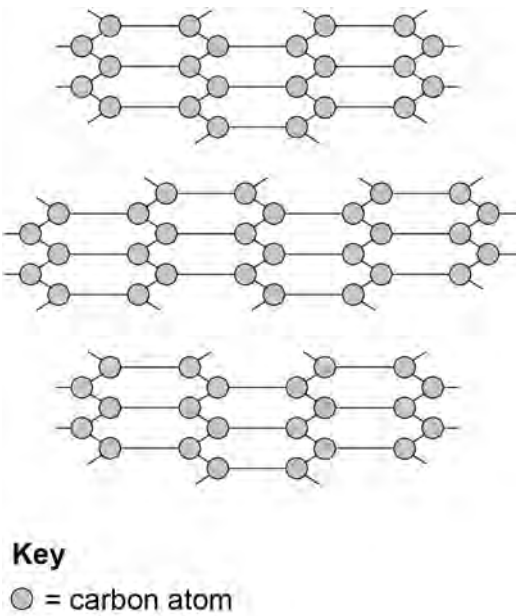
4.2.3.3 Graphene and fullerenes

Question 06 · 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 ☐

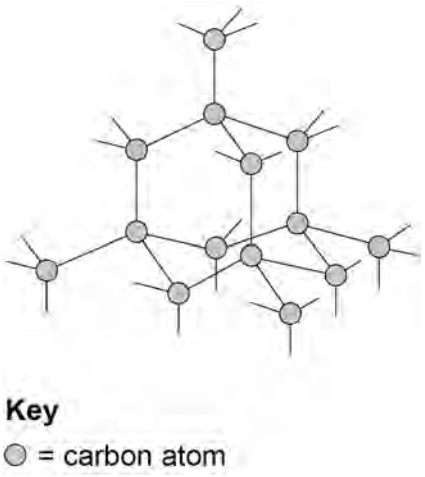
4.2.3.3 Graphene and fullerenes

Question 06 · continued

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]

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