AQA GCSE Combined Science - Trilogy | 8464

SPECIFICATION POINT 5.2.3.3

Graphene and fullerenes

Mark schemes and examiner comments

Tier	**Higher**
Question groups	**2**
Available paper years	**2021–2024**

Using this booklet

1. Booklet answer numbers match the question booklet.
2. Use the original question number within marking tables.
3. Examiner comments are included where available.

Name: _____ **Date:** _____

Where a precise marking extract is unavailable, the full source document is included in an appendix. Any missing mark scheme is explicitly identified.

5.2.3.3 Graphene and fullerenes

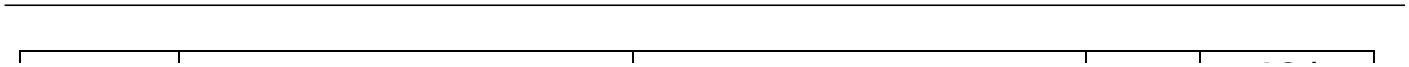
Answer 01 · Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	C_{60}		1	AO1 5.2.3.3
04.2	(graphite has) delocalised electrons (so the delocalised electrons) carry electrical charge through the structure	 allow (so the delocalised electrons) move through the structure	1 1	AO1 5.2.3.2
04.3	carbon atoms have different sizes to iron atoms / ions (so carbon atoms) distort the layers of iron atoms / ions (therefore) the layers cannot slide		1 1 1	AO1 5.2.2.7
04.4	(percentage and mass of other elements) 28.08 (%) = 16.29 (g) (mass of fork) = $\frac{16.29}{28.08} \times 100$ (g) = 58.01 (g) (mass of iron = $\frac{71.92}{100} \times 58.01$) = 41.72 (g)	 allow (mass of fork – mass of other elements) = 41.72 (g) allow 41.7 (g) allow correct use of incorrect calculation of mass and / or percentages	 1 1 1 1	AO2 5.2.2.7
Total			**10**	

5.2.3.3 Graphene and fullerenes

Answer 01 · Mark scheme

November 2021 | 8464/C/1H | Original Q4



5.2.3.3 Graphene and fullerenes

Answer 02 · Mark scheme

June 2024 | 8464/C/1H | Original Q8

Question 8

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.1	hexagonal (rings of carbon atoms)		1	AO1 5.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.2	any **one** from: • nanotechnology • materials	ignore references to electronic use allow suitable use such as: • sporting equipment • body armour allow drug delivery	1	AO1 5.2.3.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.3	(number of moles =) $\frac{2380}{6.02 \times 10^{23}}$ $= 3.95 \times 10^{-21}$ (mols)	 allow 3.953488×10^{-21} (mols) correctly rounded to at least 2 significant figures	1 1	AO2 5.2.3.3 5.3.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
08.4	each (carbon) atom forms three covalent bonds (so) one electron from each (carbon) atom is delocalised (so these) delocalised electrons carry (electrical) charge through the structure / nanotube	 ignore throughout for through ignore current / electricity	1 1 1	AO3 5.2.3.3

Total Question 8	7

5.2.3.3 Graphene and fullerenes

Answer 01 · Examiner comments November 2021 | 8464/C/1H | Original Q4

Question 4 (standard, standard / high and high demand)

04.1 The formula of Buckminsterfullerene was known by just over half of students.

04.2 Approximately one quarter of students gained one mark for delocalised electrons. Few gained the second mark for stating that these delocalised electrons carry electrical charge through the structure.

Answer 01 · Examiner comments November 2021 | 8464/C/1H | Original Q4

04.3 A small number of students knew that layers cannot slide in an alloy and understood that the carbon atoms distort the layers of iron atoms. Very few students recognised that carbon and iron atoms have different sizes.

04.4 Just under one fifth of students successfully completed this calculation. In calculations students must show all their working.

5.2.3.3 Graphene and fullerenes

Answer 02 · Examiner comments

June 2024 | 8464/C/1H | Original Q8

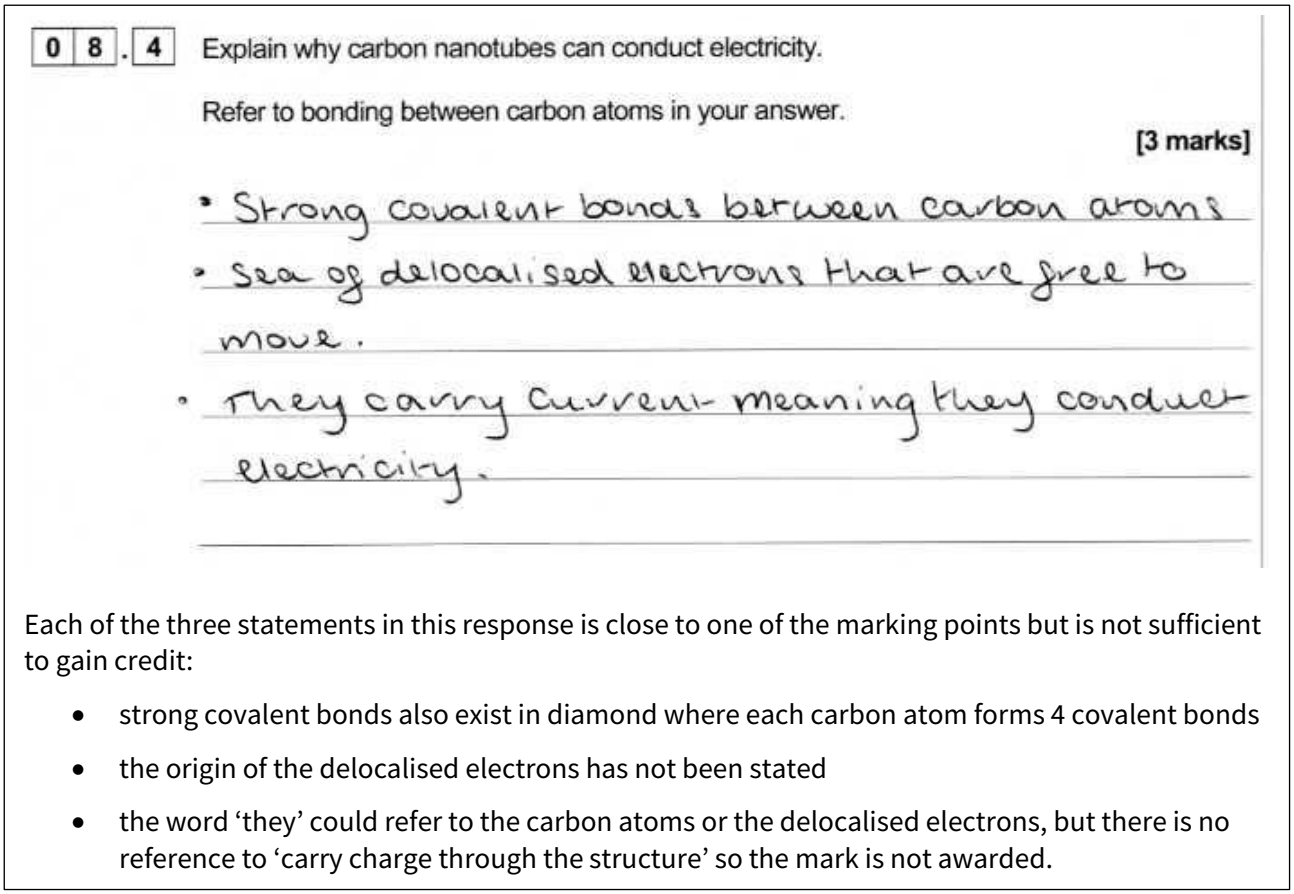
Question 8 (standard & high demand)

08.1 A third of students scored one mark. A diagram was included to help students describe the structure of fullerenes as based on hexagonal rings of carbon atoms.

08.2 A third of students gave an appropriate use of nanotubes.

08.3 In this question students were asked to calculate the number of moles of carbon in a nanotube that contains 2380 carbon atoms. Students needed to divide the number of carbon atoms by the Avogadro constant. Just under 20% of students gained 1 mark with about half of these being able to continue and evaluate the expression correctly.

08.4 Students found it challenging to explain why carbon nanotubes can conduct electricity. Responses were frequently too vague to access a marking point. Those who looked at the diagram of the nanotube would have seen that each atom forms three covalent bonds. Students might have linked the hexagonal structure as also being present in the more familiar structures of graphene and graphite where one electron from each atom is delocalised and that these delocalised electrons carry electrical charge through the structure.



0 8 . 4 Explain why carbon nanotubes can conduct electricity.

Refer to bonding between carbon atoms in your answer.

[3 marks]

- Strong covalent bonds between carbon atoms
- Sea of delocalised electrons that are free to move.
- They carry current- meaning they conduct electricity.

Each of the three statements in this response is close to one of the marking points but is not sufficient to gain credit:

- strong covalent bonds also exist in diamond where each carbon atom forms 4 covalent bonds
- the origin of the delocalised electrons has not been stated
- the word ‘they’ could refer to the carbon atoms or the delocalised electrons, but there is no reference to ‘carry charge through the structure’ so the mark is not awarded.

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5.2.3.3 Graphene and fullerenes

Contact us

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