

Structure and bonding of carbon: teacher guidance

These **Knowledge check worksheets** provide a series of questions to assess learners' knowledge and understanding of this topic at the end of a period of teaching or as revision. They are available at Foundation and Higher level and as fully editable versions so you can adapt them to suit learners' needs. Use for individual student work in class or at home. Find the full set of answers below.

Also available to assess this topic:

- **Review my learning worksheets:** available with three levels of scaffolded support to help build confidence in every learner. Use before, during or after teaching the relevant topic, to understand progress and identify misconceptions, rsc.li/44igB7V.
- **In context worksheets** ask learners to apply their knowledge to interesting contexts from everyday life, helping them develop their skills and prepare for examination. Including calculation questions to practise mathematical skills within a genuine chemical context, rsc.li/4chQelw.

Answers

Foundation

1

A	graphite
B	fullerene
C	diamond
D	graphene
E	nanotube

[5 marks]

[Note: You may wish to pause and check answers to this first question or encourage self-assessment so that learners can refer to their answers for the rest of the questions.]

2 (a) four

[1 mark]

(b)

Substance	Number of single covalent bonds formed by each carbon atom
diamond	4
graphite	3
graphene	3
fullerenes	3

[4 marks]

(c) i. giant covalent structure

[1 mark]

ii. giant covalent structure

[1 mark]

iii. molecular

[1 mark]

3 (a) covalent bonds

[1 mark]

(b) intermolecular forces

[1 mark]

(c) Buckminsterfullerene

[1 mark]

4 (a) any two of:

[2 marks]

- Diamond has a tetrahedral structure; graphite has layers of hexagonally bonded carbon atoms.
- Carbon atoms each make four covalent bonds in diamond; carbon atoms each make three covalent bonds in graphite.
- There are no delocalised electrons in diamond; graphite has delocalised electrons.
- Intermolecular forces exist between the layers in graphite; there are no intermolecular forces between layers in diamond.

[Learners may have other valid answers.]

(b) delocalised electrons

[1 mark]

(c) Graphite has layers of carbon atoms [1 mark] that can slide over each other [1 mark].

[2 marks]

5 (a) **D.** C₆₀

[1 mark]

- (b) spherical/football shaped [1 mark]
- (c) Fullerenes are ball shaped/hollow [1 mark], so drug molecules can be placed inside the fullerene molecule [1 mark]. [2 marks]

[Total: 25 marks]

Higher tier

1 (a)

A	graphite
B	fullerene
C	diamond
D	graphene
E	nanotube

[5 marks –1 per correct row]

- (b) diamond [1 mark]
- (c) the single unpaired electron is delocalised [1 mark]
- (d) i. giant covalent structure [1 mark]
- ii. giant covalent structure [1 mark]
- iii. molecular structure [1 mark]

2 (a) C_{60} [1 mark]

- (b) For example: A Buckminsterfullerene molecule has carbon atoms bonded together with **covalent** bonds in **hexagons** and **pentagons**. The molecules are **spherical** and **hollow**. [1 mark for each word used correctly] [5 marks]
- (c) Drugs could be placed inside the hollow molecules. [1 mark]
- (d) The spherical molecules could act as ball bearings. [1 mark]

- 3 (a) When diamond and graphite melt, strong [1] covalent bonds are broken [1]. A lot of energy is needed to break the bonds and the melting point is high [1]. When the Buckminsterfullerene melts, intermolecular forces need to be overcome [1]. These are weak [1] and little energy is required to overcome them, so the melting point is low [1]. [6 marks]
- (b) The carbon atoms are bonded tetrahedrally in diamond [1]. This is a strong structure and diamond is hard [1]. The carbon atoms are bonded in layers in graphite with weak intermolecular forces between the layers [1]. The layers easily rub off and graphite is soft [1]. [4 marks]
- (c) They both have delocalised electrons. [1 mark]

4 (a)

Property of graphene	How the structure explains the property
High strength	Strong covalent bonds exist between the carbon atoms.
Low weight	Graphene is one atom thick.
Transparent	Graphene is one atom thick and light can pass through it.
Good conductor of heat and electricity	Delocalised electrons can conduct the charge and heat.

[4 marks – 1 per correct row]

- (b) Graphene is one atom thick, so scientists consider graphene to be a two-dimensional substance [1]. Graphite has many layers of carbon atoms and is three-dimensional [1]. [2 marks]

[Total: 35 marks]