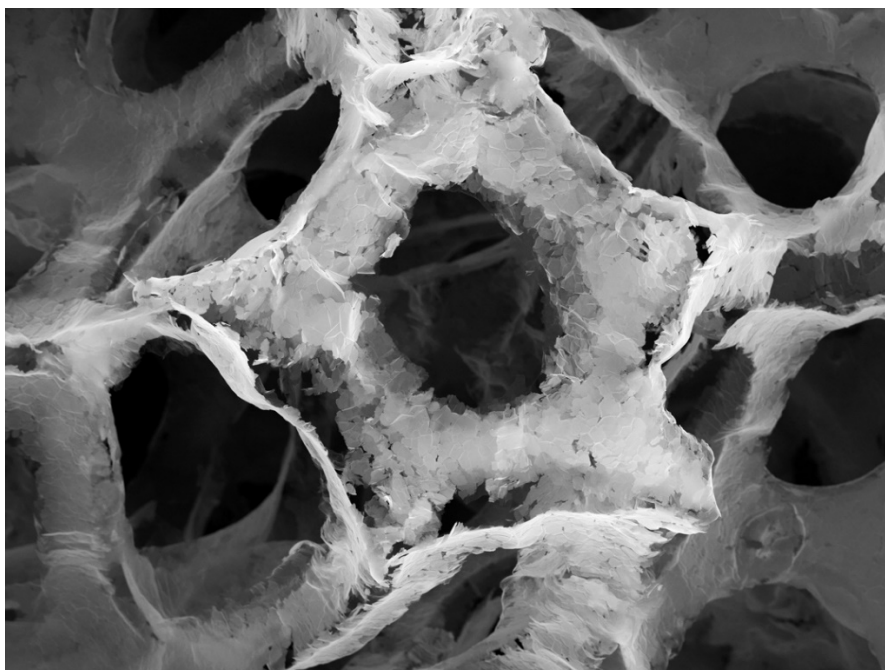


Structure and bonding of carbon

Scientists experimented for many years to remove a single layer of carbon atoms from graphite. They predicted that it would have very useful properties. After many expensive experiments, they eventually succeeded using common sticky tape to remove a layer of carbon atoms from a lump of graphite. This single layer was named graphene.

- 1 This is an electron microscope image of graphene.



Source: © Shutterstock

- (a) What do each of the following represent in the image?

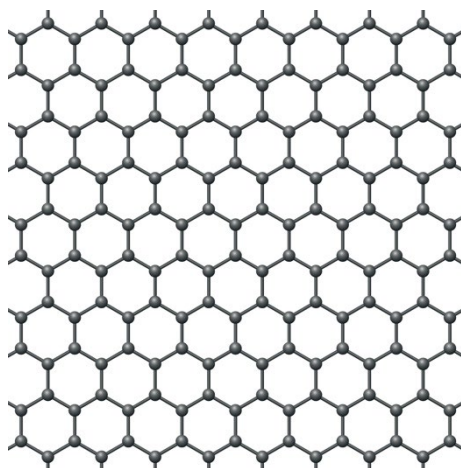
- i. The lighter hexagonal shapes

- ii. The darker spaces

- (b) Explain why it was easy to remove a layer of carbon atoms from graphite.

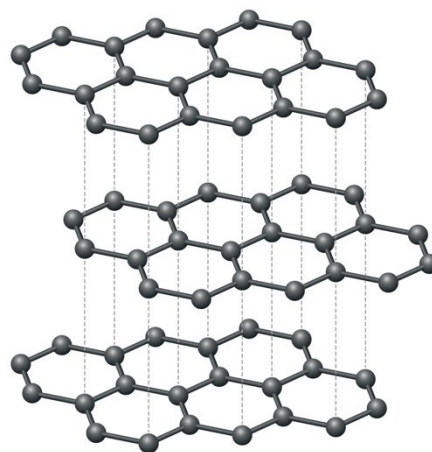
Diagram A shows the structure of graphene and diagram B shows the structure of graphite.

Diagram A



Source: © Shutterstock

Diagram B



Source: © Shutterstock

- (c) Explain why graphene is usually represented by a 2D diagram, while graphite is represented by a 3D diagram.

- (d) Sheets of graphene are 0.345 nm thick.
What is the thickness of a sheet of graphene in metres?

Hint: remember, $1 \text{ nm} = 10^{-9} \text{ m}$

- (e) A sample of graphite is three layers thick. The distance between the layers is 3.40 nm. Calculate the thickness of the sample of graphite. Give your answer in nanometres (nm).

- 2 In the 1980s scientists were investigating carbon atoms in deep space. What they found was so surprising, they thought they had made a mistake. They had discovered Buckminsterfullerene, C_{60} .

(a) Name the type of structure in:

i. diamond

ii. graphite

iii. Buckminsterfullerene

- (b) The molecular formula of Buckminsterfullerene is C_{60} . Calculate its relative formula mass.

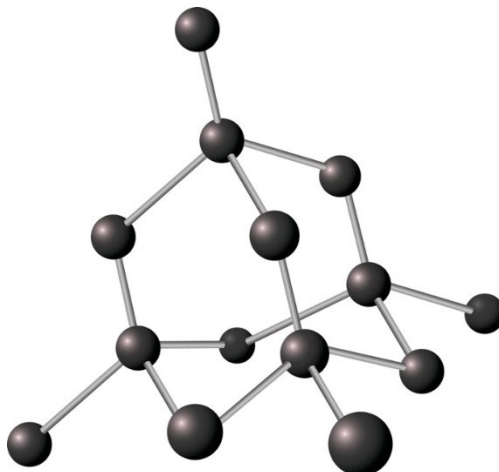
A_r carbon = 12

- (c) What is the mass of one mole of C_{60} molecules?

- (d) How many molecules are present in one mole of C_{60} molecules?

- (e) The diameter of a C_{60} molecule is 1.1 nm. The diameter of a Premier League football is 0.22 m. How many times larger is the diameter of the football than a C_{60} molecule?

- 3 Scientists think the first diamonds were discovered in caves in India nearly 4000 years ago. They were valued for their hardness, strength and brilliance. This is a representation of the structure of diamond.



Source: © Shutterstock

- (a) Explain why diamonds are hard. Refer to bonding and structure.

- (b) Jewellers weigh diamonds in carats. One carat = 0.200 g.
Calculate the mass in grams of a 2.5-carat diamond.

- (c) Calculate the number of moles of carbon atoms in a 2.5 carat diamond.
 A_r carbon = 12

- (d) Calculate the number of carbon atoms in a 2.5 carat diamond.
Hint: Avogadro constant = 6.02×10^{23}



Which question(s) did you get wrong? Why?

What will you do next time you're asked a similar question?