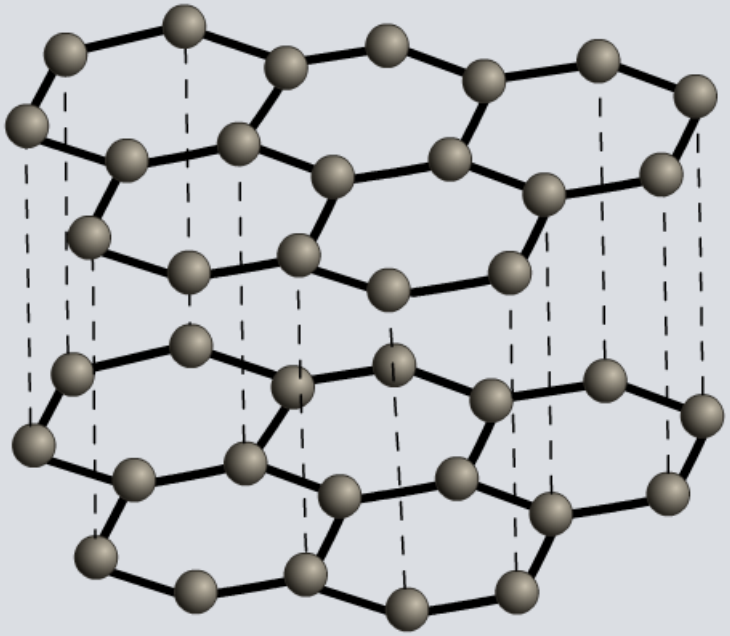
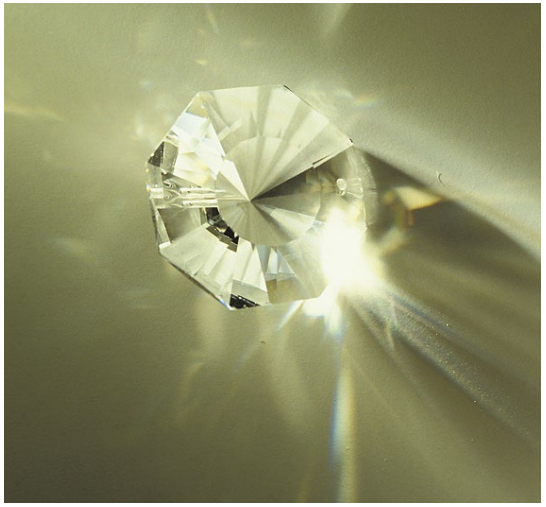
Giant Covalent Structures



What are giant covalent structures?

In some substances, such as sand, diamond and graphite, millions of atoms are joined together by covalent bonds.



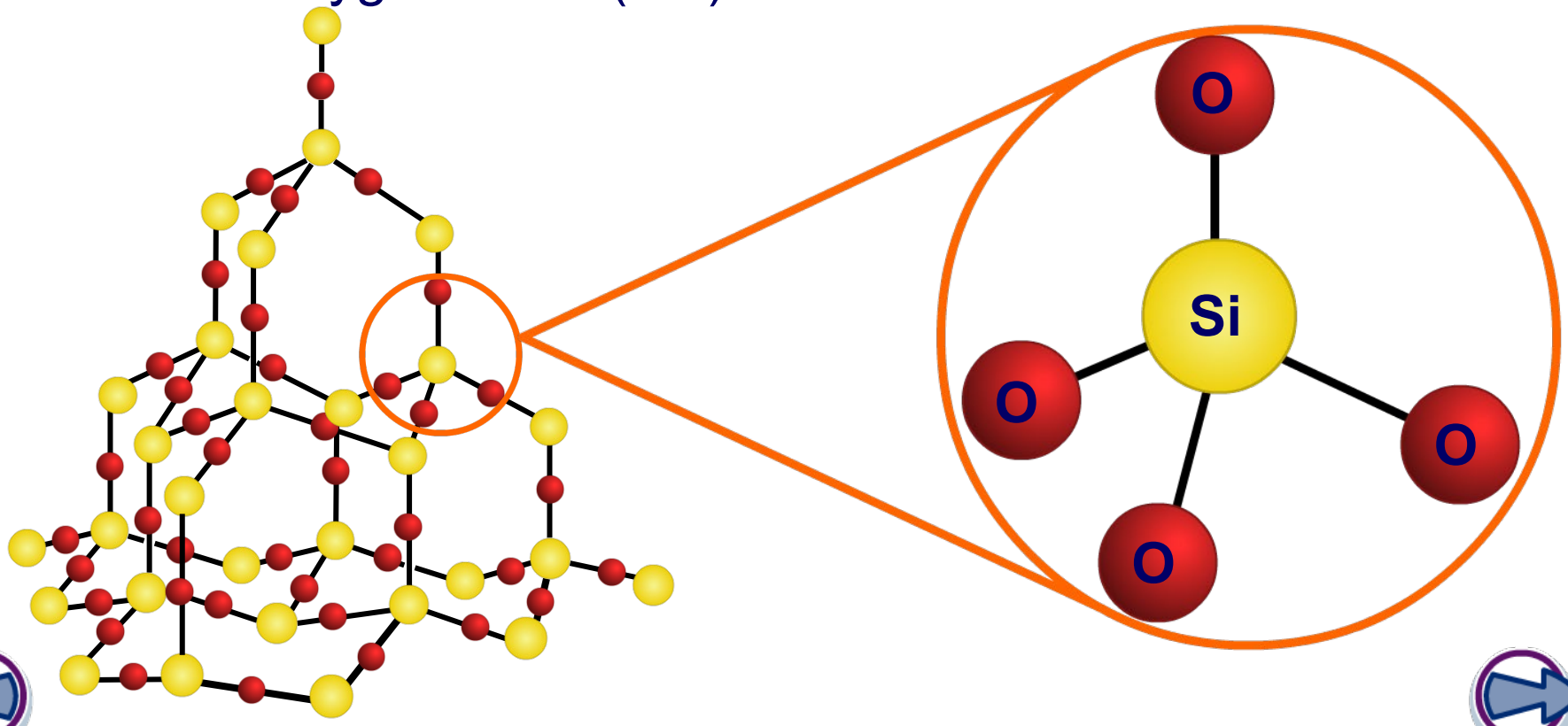
The covalent bonds in these substances do not form molecules, but vast networks of atoms called **giant covalent structures**.

All the bonds are covalent, so giant covalent structures have very high melting and boiling points, and are usually hard.

What is the structure of sand?

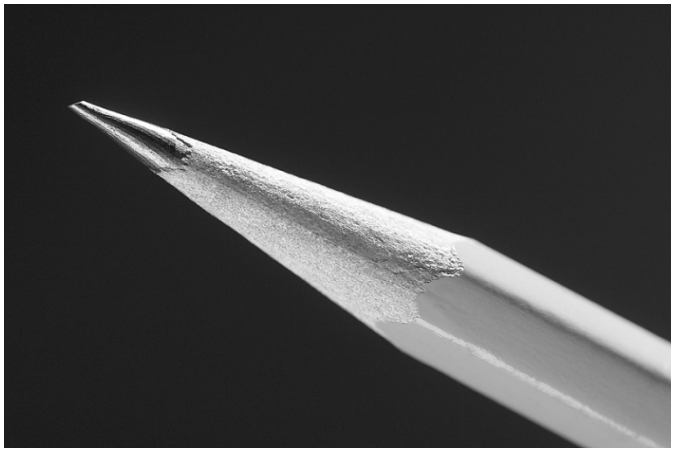
Sand is mostly made of the mineral quartz, which is silicon dioxide. It has a giant covalent structure made up of silicon and oxygen atoms.

Each silicon atom (2.8.4) is bonded to four oxygen atoms, and each oxygen atom (2.6) is bonded to two silicon atoms.



What are the allotropes of carbon?

Diamond and graphite appear to be very different substances, but what do they have in common?



Both diamond and graphite are made up of carbon atoms.

Different forms of the same element are called **allotropes**.

These allotropes of carbon have different properties because the atoms are bonded in different arrangements, which create different giant structures.

How does structure affect properties?

How do the different structures of diamond and graphite influence their properties?

What is the structure of diamond?

Diamond is a rare form of carbon.

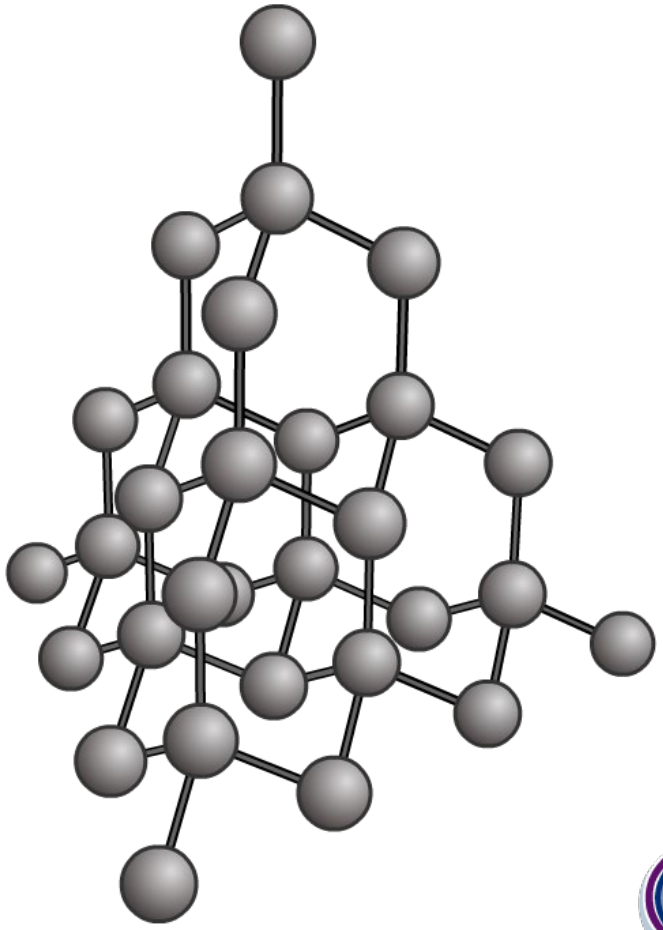
Click "**play**" to find out more about its structure.

What are the properties of diamond?

In diamond, all the electrons in the outer shell of each carbon atom (2.4) are involved in forming covalent bonds.

This affects the properties of this allotrope of carbon:

- Diamond is very **hard** – the hardest natural substance.
- Diamond has a **very high melting and boiling point** – a lot of energy is needed to break the covalent bonds.
- Diamond **cannot conduct electricity** – there are no free electrons or ions to carry a charge.



What is the structure of graphite?

Graphite is a much more common form of carbon than diamond.

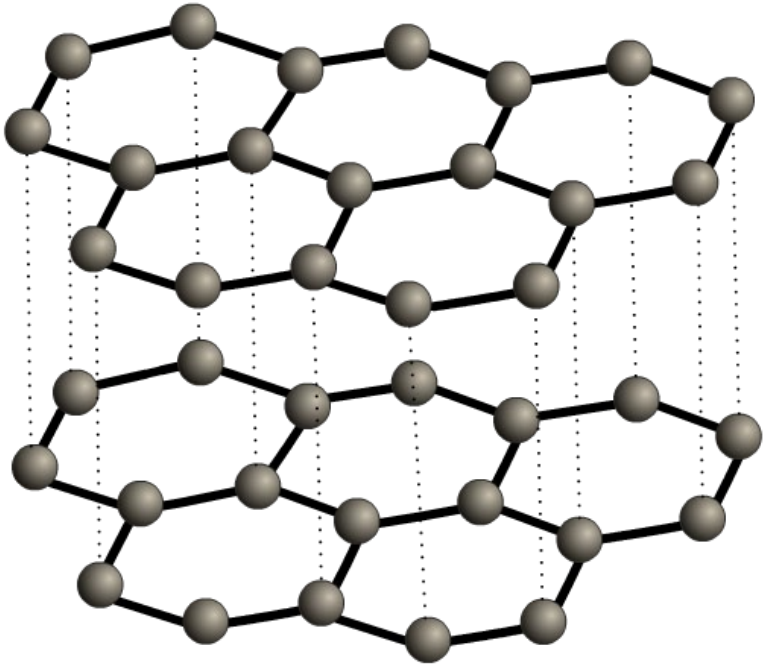
Click "**play**" to find out more about its structure.

What are the properties of graphite?

In graphite, only three of the four electrons in the outer shell of each carbon atom (2.4) are involved in covalent bonds.

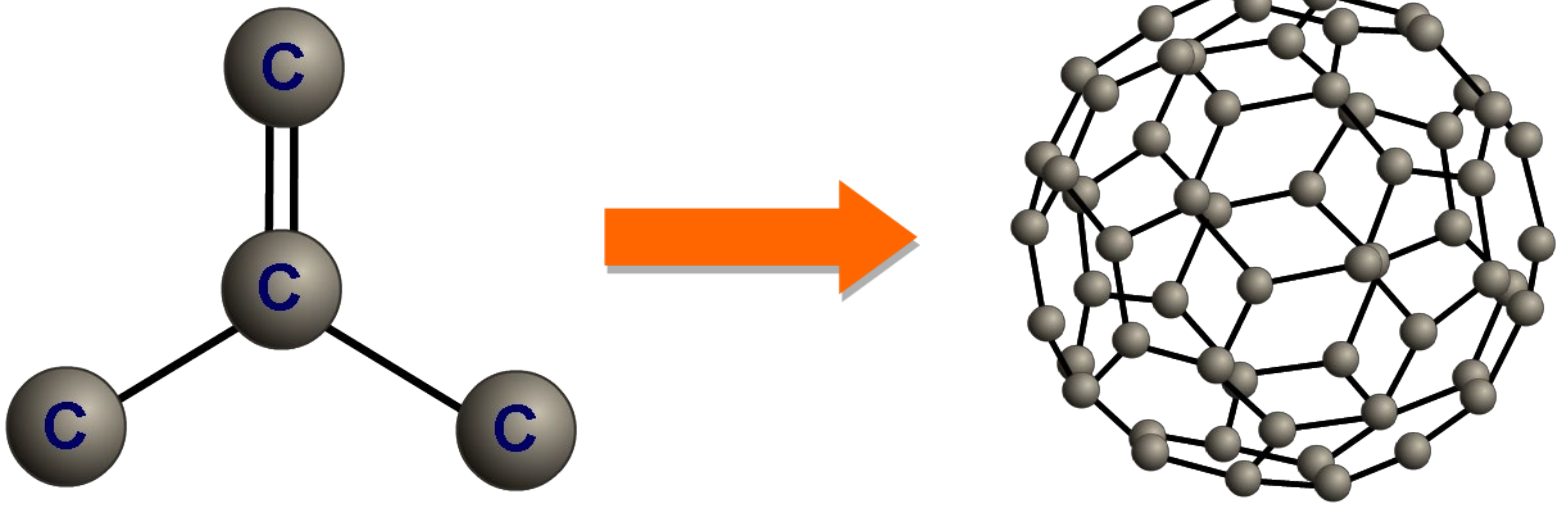
This affects the properties of this allotrope of carbon:

- **Graphite is soft and slippery** – layers can easily slide over each other because the weak forces of attraction are easily broken. This is why graphite is used as a lubricant.
- **Graphite conducts electricity** – the only nonmetal to do so. The free electron from each carbon means that each layer has delocalized electrons, which can carry charge.



Are there other allotropes of carbon?

A third class of carbon compounds have been discovered in recent years. These are called **fullerenes**.
Buckminsterfullerene is one type of fullerene. It contains 60 carbon atoms, each of which is bonded to three others by two single bonds and one double bond.



The atoms in this allotrope of carbon form a sphere, like the shape of a soccer ball. The molecules can be called ‘bucky balls’. They are large but are not classified as giant structures.

Complete the sentences

What are the missing words about covalent bonding?

1. Giant covalent structures are vast networks of ? bonded atoms.

2. Giant covalent structures such as ? and sand have very ? melting and boiling points are usually ?.

3. Diamond, graphite and buckminsterfullerene are all allotropes of ?.

4a. Giant covalent structures generally ?

?

C solve