

Covalent Bonding in Diamonds

Aims

In this worksheet you will develop your skills of reading for information. You will learn more about the properties and uses of diamond, which has a giant covalent structure. You will practise answering questions that involve some of the key words and scientific terms.

Learning outcomes

After completing this worksheet, you should be able to:

- Recall some of the properties of diamond
- Explain why diamond has these properties.

Task

Read the following passage about diamond and then answer the questions.

Diamond

Diamond is an allotrope of carbon. Allotropes are different forms of the same element that exist in the same state. Other allotropes of carbon include graphite and fullerenes.

Diamonds can be specially cut so that they reflect nearly all the light that falls on to them. This makes diamonds appear to sparkle and high quality diamonds are used in jewellery.

Pure diamonds, with a perfect structure, are completely colourless. However, tiny levels of chemical impurity or small defects in the way the atoms are arranged in the diamond can produce diamonds that have different colours. Diamonds that contain traces of nitrogen have a yellow or orange colour, while a trace of boron makes a diamond grey or black. Diamonds that are exposed to natural radiation have a green colour at their surface. Rare pink and red diamonds are formed by small defects in the way the electrons are arranged in the structure. These defects are thought to be caused as the diamond travels to the Earth's surface.

Diamond is the hardest naturally occurring substance and has a high melting point. These properties can be useful in cutting tools such as diamond knives and diamond tipped drill bits that can be used to cut through hard rock and yet still stay sharp.

Diamonds have a giant covalent structure in which each carbon atom is bonded to four other carbon atoms by strong covalent bonds. These bonds require lots of energy to break and so diamonds are hard and have a high melting point. Diamonds are good thermal conductors. A piece of diamond can conduct thermal energy about six times better than a piece of copper. Diamonds conduct heat because they contain strong covalent bonds that transmit the motion of one carbon atom to the next very effectively. Diamonds do not conduct electricity because they do not have any delocalised electrons or ions which can carry charge.

Diamonds do not contain ions which might form bonds with water molecules, so like other giant covalent structures, diamond is insoluble in water.

Questions

1 Define the term 'allotrope'.
..... (1
mark)

2 Name two allotropes of diamond.
..... (2
marks)

3 Explain why diamonds appear to sparkle.
.....
..... (1
mark)

4 Suggest why some diamonds have a yellow colour.
.....
..... (1
rk)

5 Suggest why some diamonds have a green coloured surface.
.....
.....
(1mark)

6 Explain why diamonds are used to make drill bits.
.....
..... (2
marks)

7 Name the type of bonding and the type of structure in diamond.
.....
..... (2
marks)

8 Explain why diamonds conduct heat.
.....

..... (1
mark)

9 Explain why diamonds do not conduct electricity.

.....
..... (1
mark)

10 Discuss why diamonds are insoluble in water.

.....
..... (1
mark)