SCH4U1

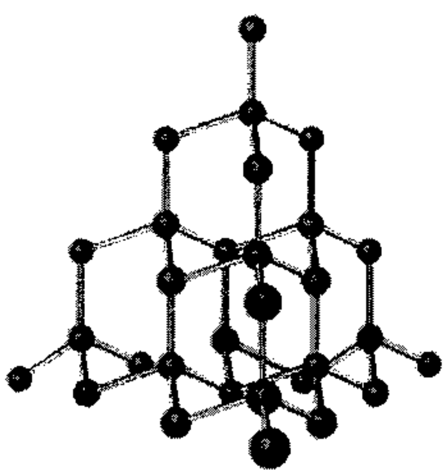
Covalent Network Solids

Network solids consist of atoms covalently and polar-covalently bonded to each other in a continuous pattern, forming a crystal. Network solids do not contain molecules since bonding is continuous. The number of covalent bonds makes them very hard and brittle. Network solids do not conduct since the valence electrons are involved in bonding.

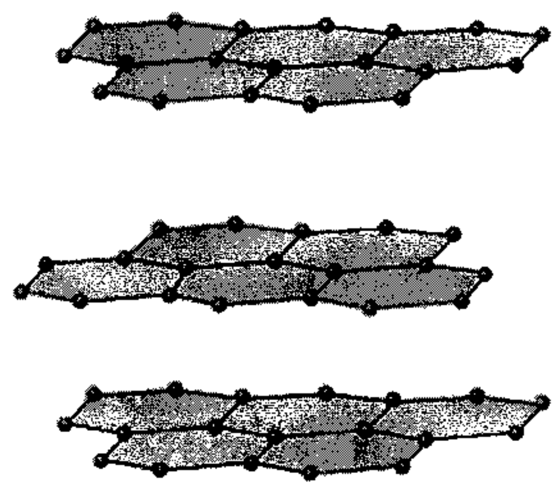
Properties of Network Solids:

- high melting point, boiling point
- hard and brittle
- non-conductive
- not soluble in water

Examples:



(a) Diamond



(b) Graphite

Network Solid Questions

Refer to p. 270-272 of *Chemsitry 12* and the readings to answer these questions..

1. Diamond and graphite are said to be allotropes of carbon. What is an allotrope?

2. a) What type of network crystal is diamond?
   b) Name another element and two compounds which are solids of this type.

3. What type of bonds hold adjacent carbon atoms together in a diamond?

4. a) What type of network solid is graphite?
   b) Name another substance that is a solid of this type.

5. Describe the arrangement of atoms in a) diamond and b) graphite.

6. What is the combination of bonding orbitals (orbital hybridization) for each carbon atom in a) diamond and b) graphite?

7. Explain why diamond:
   i) has a very high melting point
   ii) is extremely hard
   iii) has a low electrical conductivity

8. Explain why graphite:
   i) is both a good and a poor conductor
   ii) is a good lubricant
   iii) has a high melting point

Two Network Solids Containing Silicon. Silicon, immediately below carbon in the Periodic Table, shows both similarities and differences with carbon in the properties of the elements and compounds.

There is a compound, properly called silicon carbide but more often known as *carborundum,* which contains equal numbers of carbon and silicon atoms. Carborundum is used to make grindstones and grinding wheels because it is very hard, though not as hard as diamond. The clue to its hardness is that the silicon and carbon atoms are arranged alternately in a network just like that of diamond. To be more specific, every carbon atom is bonded to four silicon atoms as nearest neighbours, and (you guessed it!) every silicon atom is bonded to four carbon atoms. The atoms of silicon are larger than those of carbon; therefore, the greater interatomic distances do not permit as firm sharing of the valence electrons, and the bonds are slightly weaker than in diamond. For this reason, presumably, carborundum is not quite as hard as diamond (and it is considerably less expensive).

The formula for carborundum is written SiC. You cannot tell from the formula whether this compound is made up of diatomic molecules, or is a network solid containing equal numbers of the two kinds of atoms. From the high melting point, and lack of volatility or solubility, you might guess that carborundum is the latter.

One of the most common and abundant minerals is *quartz,* which consists almost entirely of silicon dioxide, $Si0_2$, often called *silica.* This too is a network solid. Each silicon atom in the mineral is bonded to four oxygen atoms, and each oxygen atom to two silicon atoms. The arrangement in three dimensions is not easy to portray in a diagram, but the linking of atoms (without regard to their positions in space) is conveyed by Fig. 10-4. If you examine a larger array than that shown in this figure you will see that the number of oxygen atoms tends to become twice the number of silicon atoms. Thus the formula $Si0_2$ conveys the relative numbers of atoms, but fails to convey the enormous numbers of these in the network.