

## Chapter 5 Atoms and Bonding ▪ Section 3 Summary

## Covalent Bonds

### Key Concepts

- What holds covalently bonded atoms together?
- What are the properties of molecular compounds?
- How does unequal sharing of electrons affect molecules?

The chemical bond formed when two atoms share electrons is called a **covalent bond**. Covalent bonds usually form between atoms of nonmetals. In contrast, ionic bonds usually form when a metal combines with a nonmetal. Nonmetals can bond with other nonmetals by sharing electrons. By sharing electrons, each atom gets a stable set of electrons. **The force that holds atoms together in a covalent bond is the attraction of each atom's nucleus for the shared pair of electrons.** A **molecule** is a neutral group of atoms joined by covalent bonds. The number of covalent bonds that a nonmetal can form equals the number of electrons that it needs to make a total of eight. Some atoms share two pairs of electrons. This forms a **double bond**. Some atoms can form **triple bonds**. In a triple bond, the atoms share three pairs of electrons.

A **molecular compound** is a compound that is composed of molecules. The molecules contain atoms that are covalently bonded. **Compared to ionic compounds, molecular compounds generally have lower melting points and boiling points. Unlike ionic compounds, molecular compounds do not conduct electric current when melted or dissolved in water.**

Atoms of some elements pull more strongly on shared electrons than atoms of other elements do. As a result, the electrons are shared unequally. **Unequal sharing of electrons causes the bonded atoms to have slight electrical charges.** A covalent bond in which electrons are shared unequally is called a **polar bond**. A covalent bond in which electrons are shared equally is called a **nonpolar bond**.

A molecule is polar if it has a positively charged end and a negatively charged end. However, not all molecules containing polar bonds are polar. For example, in carbon dioxide ( $\text{CO}_2$ ), the two oxygen atoms attract electrons much more strongly than carbon does. The bonds between the oxygen and carbon atoms are polar. However, a carbon dioxide molecule has a straight-line shape. The two oxygen atoms pull with equal strength in opposite directions. The attractions cancel each other out, making the molecule nonpolar.

In contrast, a water molecule, with two polar bonds, is polar. A water molecule has two hydrogen atoms at one end and an oxygen atom at the other end. The oxygen atom attracts electrons more strongly than the hydrogen atoms do. As a result, the oxygen end has a slight negative charge, and the hydrogen end has a slight positive charge.

The properties of polar and nonpolar compounds differ because of differences in attraction between their molecules.

**Atoms and Bonding** ▪ *Reading/Notetaking Guide***Covalent Bonds** (pp. 192–197)

*This section describes how covalently bonded atoms are held together. It explains how the properties of molecular compounds differ from those of ionic compounds. It also describes how unequal sharing of electrons affects molecules.*

**Use Target Reading Skills**

*As you read, fill in the table to compare and contrast the properties of molecular and ionic compounds.*

	Melting Point	Boiling Point	Electrical Conductivity
<b>Molecular compounds</b>			
<b>Ionic compounds</b>		higher	

**How Covalent Bonds Form** (pp. 193–194)

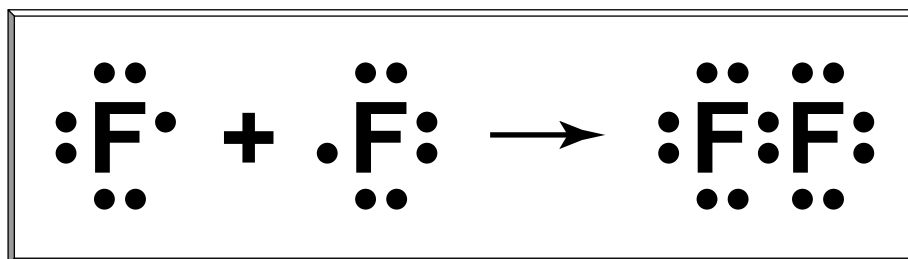
1. What is a covalent bond?

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2. On the dot diagram below, draw a circle around the shared electrons that form a covalent bond between two fluorine atoms.



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**Covalent Bonds** (*continued*)

3. The two bonded fluorine atoms form a neutral particle called a(n) \_\_\_\_\_.
4. When two atoms share two pairs of electrons, a(n) \_\_\_\_\_ is formed.
5. Is the following sentence true or false? Atoms of some elements can share three pairs of electrons. \_\_\_\_\_

**Molecular Compounds** (pp. 194–195)

6. How are atoms arranged in molecular compounds?  
\_\_\_\_\_
7. Circle the letter of each sentence that is true about molecular compounds.
  - a. More heat is needed to separate their molecules than is needed to separate ions.
  - b. They melt at much higher temperatures than do ionic compounds.
  - c. They boil at much higher temperatures than do ionic compounds.
  - d. Most are poor conductors of electricity when dissolved in water.

**Unequal Sharing of Electrons** (pp. 195–197)

8. How do molecules in certain molecular compounds come to have a slight electrical charge?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
9. In a(n) \_\_\_\_\_ covalent bond, electrons are shared unequally.
10. How are electrons shared in a nonpolar covalent bond?  
\_\_\_\_\_
11. How can a molecule be nonpolar overall and still contain polar bonds?  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
12. Is the following sentence true or false? Water molecules are polar.  
\_\_\_\_\_

**Atoms and Bonding** ▪ *Reading/Notetaking Guide*

13. Why do polar and nonpolar molecules have different properties?

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14. Why don't water and vegetable oil mix?

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15. When you do laundry, what causes nonpolar oil or greasy dirt to mix with the polar water?

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