

5.2

Ionic Bonds

Key Concepts

- What are ions, and how do they form bonds?
- How are the formulas and names of ionic compounds written?
- What are the properties of ionic compounds?

An **ion** is an atom or group of atoms that has an electric charge. When an atom loses an electron, it loses a negative charge and becomes a positive ion. When an atom gains an electron, it gains a negative charge and becomes a negative ion. Some ions are made of several atoms. Ions that are made of more than one atom are called **polyatomic ions**. You can think of polyatomic ions as a group of atoms that react as a unit. Like other ions, polyatomic ions have an overall positive or negative charge.

Positive ions and negative ions attract one another because they are oppositely charged. An **ionic bond** is the attraction between two oppositely charged ions. **Ionic bonds form as a result of the attraction between positive and negative ions.** A compound that consists of positive and negative ions is called an **ionic compound**. Sodium chloride is an example of an ionic compound. The sodium ion is positively charged, and the chloride ion is negatively charged.

Compounds can be represented by chemical formulas. A **chemical formula** is a combination of symbols that shows the ratio of elements in a compound. **When ionic compounds form, the ions come together in a way that balances out the charges on the ions.** The chemical formula for the compound reflects this balance. For example, the formula of magnesium chloride is $MgCl_2$. A magnesium ion has a charge of $2+$, and a chloride ion has a charge of $1-$. Therefore, two chloride ions are needed to balance one magnesium ion in the compound. The number "2" in the formula is a subscript. A **subscript** tells you the ratio of elements in the compound. An ionic compound is named according to certain rules. **For an ionic compound, the name of the positive ion comes first, followed by the name of the negative ion.**

All ionic compounds are similar in some ways. Ionic compounds are **hard, brittle crystals that have high melting points.** When dissolved in water or melted, they **conduct electricity.** The ions in ionic compounds form an orderly, three-dimensional arrangement called a **crystal.** Every ion is attracted to the oppositely charged ions above, below, and to all sides of it. The strength of these ionic bonds makes ionic crystals hard and brittle. Because ionic bonds are strong, a lot of energy is needed to break them. As a result, ionic compounds have high melting points and are solids at room temperature. When ionic compounds dissolve in water, the bonds are broken and the ions are free to move. This allows the solution to conduct electricity.

Ionic Bonds (pp. 158–163)

This section explains how an atom becomes electrically charged. It also describes the characteristic properties of bonds formed by the attraction of electrically charged particles.

Use Target Reading Skills

Before you read, preview Figure 9 in your textbook. Then write two questions that you have about the diagram in the graphic organizer below. As you read, answer your questions.

Formation of an Ionic Bond

Q. What is an ionic bond?
A.
Q.
A.

Ions and Ionic Bonds (pp. 159–160)

1. An atom or group of atoms that has an electric charge is called a(n)

_____.

2. What happens to an atom when it loses an electron?

3. What happens to an atom when it gains an electron?

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Ionic Bonds (continued)

4. Ions that are made of more than one atom are called _____.
5. Use the table in the textbook to complete the table below.

Ions and Their Charges		
Name	Charge	Symbol or Formula
Sodium	a.	b.
Magnesium	c.	d.
Chloride	e.	f.
Sulfate	g.	h.

6. What is the charge on a carbonate ion (CO_3^{2-})? Compared to the number of protons, how many electrons does the carbonate ion have? (Hint: You can answer this question without having to count all the particles.)
- _____
- _____

7. What kinds of ions do a sodium atom and a chlorine atom become when a valence electron is transferred from one to the other?
- _____
- _____
- _____

8. What is an ionic bond?
- _____
- _____

9. Give an example from the table above of two ions that can form an ionic bond.
- _____
- _____

Chemical Formulas and Names (p. 161)

10. A(n) _____ is a combination of symbols that shows the ratio of elements in a compound.
11. Is the following sentence true or false? When ionic compounds form, the ions come together in a way that balances out the charges on the ions.

12. In the chemical formula for magnesium chloride ($MgCl_2$), what is the number "2" called, and what does it tell you?

13. Is the following sentence true or false? For an ionic compound, the name of the negative ion comes first. _____
14. When does the end of a name of a negative ion end in *-ide*?

Properties of Ionic Compounds (pp. 162–163)

15. What are three characteristic properties of ionic compounds?
a. _____
b. _____
c. _____
16. An orderly, three-dimensional arrangement formed by ions is called a(n) _____
17. In an ionic compound, which ions are attracted to each other?

Ionic Bonds (continued)

18. Why do ionic compounds have high melting points?

19. At room temperature, ionic bonds are strong enough to cause all ionic compounds to be _____.

20. Why do ionic compounds conduct electricity well when they are dissolved in water?
