

Chapter 5 Atoms and Bonding ▪ Section 2 Summary

Ionic Bonds

Key Concepts

- How do ions 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.

Oppositely charged particles attract. An **ionic bond** is the force of 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**. Ionic compounds are electrically neutral.

The **chemical formula** of an ionic compound tells you the ratio of the ions in the compound. **When ionic compounds form, the ions come together in a way that balances out the charges of the ions. The chemical formula for the compound reflects this balance.** For example, the formula of magnesium chloride is MgCl_2 . The number "2" is a **subscript**. A subscript tells you the ratio of elements in the compound. For MgCl_2 , the ratio of magnesium ions to chloride ions is 1 to 2. If no subscript is written, the number 1 is understood. The formula NaCl tells you that the ratio of sodium ions to chloride ions is 1 to 1.

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.** In an ionic compound, the positive ion is usually a metal. If the negative ion is a single element, the end of its name changes to *-ide*, as in sodium chloride (NaCl). If the negative ion is polyatomic, its name usually ends in *-ate* or *-ite*, as in ammonium nitrate (NH_4NO_3).

In general, ionic compounds are hard, brittle solids with high melting points. When melted or dissolved in water, they conduct electric current. Ionic compounds form solids by building up repeating patterns of ions. A **crystal** is an orderly, three-dimensional arrangement of atoms or ions. In an ionic compound, every ion is attracted to ions of opposite charge that surround it. The strength of these ionic bonds and the attractions among all the ions make many crystals of ionic compounds 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. When ionic crystals dissolve in water, the bonds between ions are broken. As a result, the ions are free to move about, and the solution conducts electricity.

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This section explains how atoms become ions. It describes the electrical charge of an ionic compound and what the chemical formula of an ionic compound tells you.

Use Target Reading Skills

As you read, fill in the table to compare and contrast the properties of sodium chloride with the properties of its component ions.

	Color	State at Room Temperature	Stability
Sodium chloride			
Elements of sodium chloride	sodium: chlorine:	sodium: chlorine:	sodium: unstable chlorine:

Ions (pp. 185–186)

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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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.

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Ionic Bonds (*continued*)

Chemical Formulas and Names (p. 187)

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. 188–189)

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

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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?
