SECTION 2

Oxidation Numbers

OBJECTIVES

- List the rules for assigning oxidation numbers.
- Give the oxidation number for each element in the formula of a chemical compound.
- Name binary molecular compounds using oxidation numbers and the Stock system.

The charges on the ions composing an ionic compound reflect the electron distribution of the compound. *In order to indicate the general distribution of electrons among the bonded atoms in a molecular compound or a polyatomic ion,* **oxidation numbers,** *also called* **oxidation states,** *are assigned to the atoms composing the compound or ion.* Unlike ionic charges, oxidation numbers do not have an exact physical meaning. In fact, in some cases they are quite arbitrary. However, oxidation numbers are useful in naming compounds, in writing formulas, and in balancing chemical equations. And, as will be discussed in Chapter 19, they are helpful in studying certain types of chemical reactions.

Assigning Oxidation Numbers

As a general rule in assigning oxidation numbers, shared electrons are assumed to belong to the more electronegative atom in each bond. More specific rules for determining oxidation numbers are provided by the following guidelines.

1. The atoms in a pure element have an oxidation number of zero. For example, the atoms in pure sodium, Na, oxygen, O_2, phosphorus, P_4, and sulfur, S_8, all have oxidation numbers of zero.
2. The more-electronegative element in a binary molecular compound is assigned the number equal to the negative charge it would have as an anion. The less-electronegative atom is assigned the number equal to the positive charge it would have as a cation.
3. Fluorine has an oxidation number of –1 in all of its compounds because it is the most electronegative element.
4. Oxygen has an oxidation number of –2 in almost all compounds. Exceptions include when it is in peroxides, such as H_2O_2, in which its oxidation number is –1, and when it is in compounds with fluorine, such as OF_2, in which its oxidation number is +2.
5. Hydrogen has an oxidation number of +1 in all compounds containing elements that are more electronegative than it; it has an oxidation number of –1 in compounds with metals.
6. The algebraic sum of the oxidation numbers of all atoms in a neutral compound is equal to zero.
7. The algebraic sum of the oxidation numbers of all atoms in a polyatomic ion is equal to the charge of the ion.
8. Although rules 1 through 7 apply to covalently bonded atoms, oxidation numbers can also be assigned to atoms in ionic compounds.