Oxidation and Reduction

SECTION 1

OBJECTIVES

- Assign oxidation numbers to reactant and product species.
- Define *oxidation* and *reduction.*
- Explain what an oxidation-reduction reaction (redox reaction) is.

Oxidation-reduction reactions involve a transfer of electrons. Oxidation involves the loss of electrons, whereas reduction involves the gain of electrons. Reduction and oxidation half-reactions must occur simultaneously. These processes can be identified through the understanding and use of oxidation numbers (oxidation states).

Oxidation States

Oxidation states were defined in Chapter 7. The oxidation number assigned to an element in a molecule is based on the distribution of electrons in that molecule. The rules by which oxidation numbers are assigned were given in Chapter 7. These rules are summarized in **Table 1.**

TABLE 1 ***Rules for Assigning Oxidation Numbers***

Rule	Example
1. The oxidation number of any uncombined element is 0.	The oxidation number of Na(s) is 0.
2. The oxidation number of a monatomic ion equals the charge on the ion.	The oxidation number of Cl^- is –1.
3. The more electronegative element in a binary compound is assigned the number equal to the charge it would have if it were an ion.	The oxidation number of O in NO is –2.
4. The oxidation number of fluorine in a compound is always –1.	The oxidation number of F in LiF is –1.
5. Oxygen has an oxidation number of –2 unless it is combined with F, in which it is +1 or +2, or it is in a peroxide, in which it is –1.	The oxidation number of O in NO_2 is –2.
6. Hydrogen's oxidation state in most of its compounds is +1 unless it is combined with a metal, in which case it is –1.	The oxidation number of H in LiH is –1.
7. In compounds, Group 1 and 2 elements and aluminum have oxidation numbers of +1, +2, and +3, respectively.	The oxidation number of Ca in $CaCO_3$ is +2.
8. The sum of the oxidation numbers of all atoms in a neutral compound is 0.	The oxidation number of C in $CaCO_3$ is +4.
9. The sum of the oxidation numbers of all atoms in a polyatomic ion equals the charge of the ion.	The oxidation number of P in $H_2PO_4^-$ is +5.