SECTION 3

Current and Resistance

SECTION OBJECTIVES

- **Describe the basic properties of electric current, and solve problems relating current, charge, and time.**
- **Distinguish between the drift speed of a charge carrier and the average speed of the charge carrier between collisions.**
- **Calculate resistance, current, and potential difference by using the definition of *resistance*.**
- **Distinguish between ohmic and non-ohmic materials, and learn what factors affect resistance.**

CURRENT AND CHARGE MOVEMENT

Although many practical applications and devices are based on the principles of static electricity, electricity did not become an integral part of our daily lives until scientists learned to control the movement of electric charge, known as *current.* Electric currents power our lights, radios, television sets, air conditioners, and refrigerators. Currents are also used in automobile engines, travel through miniature components that make up the chips of computers, and perform countless other invaluable tasks.

Electric currents are even part of the human body. This connection between physics and biology was discovered by Luigi Galvani (1737–1798). While conducting electrical experiments near a frog he had recently dissected, Galvani noticed that electrical sparks caused the frog's legs to twitch and even convulse. After further research, Galvani concluded that electricity was present in the frog. Today, we know that electric currents are responsible for transmitting messages between body muscles and the brain. In fact, every function involving the nervous system is initiated by electrical activity.

Current is the rate of charge movement

A current exists whenever there is a net movement of electric charge through a medium. To define *current* more precisely, suppose electrons are moving through a wire, as shown in **Figure 9.** The **electric current** is the rate at which these charges move through the cross section of the wire. If ΔQ is the amount of charge that passes through this area in a time interval, Δt, then the current, I, is the ratio of the amount of charge to the time interval. Note that the direction of current is *opposite* the movement of the negative charges. We will further discuss this detail later in this section.

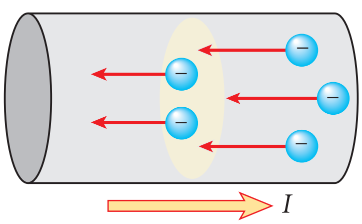

Figure 9
The current in this wire is defined as the rate at which electric charges pass through a cross-sectional area of the wire.

electric current

the rate at which electric charges pass through a given area

ELECTRIC CURRENT

$$I = \frac{\Delta Q}{\Delta t}$$

$$\text{electric current} = \frac{\text{charge passing through a given area}}{\text{time interval}}$$

The SI unit for current is the *ampere*, A. One ampere is equivalent to one coulomb of charge passing through a cross-sectional area in a time interval of one second (1 A = 1 C/s).