Resistors in Series or in Parallel

SECTION 2

SECTION OBJECTIVES

- **Calculate the equivalent resistance for a circuit of resistors in series, and find the current in and potential difference across each resistor in the circuit.**
- **Calculate the equivalent resistance for a circuit of resistors in parallel, and find the current in and potential difference across each resistor in the circuit.**

RESISTORS IN SERIES

In a circuit that consists of a single bulb and a battery, the potential difference across the bulb equals the terminal voltage. The total current in the circuit can be found using the equation $\Delta V = IR$.

What happens when a second bulb is added to such a circuit, as shown in **Figure 9**? When moving through this circuit, charges that pass through one bulb must also move through the second bulb. Because all charges in the circuit must follow the same conducting path, these bulbs are said to be connected in **series.**

series

describes two or more components of a circuit that provide a single path for current

Resistors in series carry the same current

Light-bulb filaments are resistors; thus, **Figure 9(b)** represents the two bulbs in **Figure 9(a)** as resistors. Because charge is conserved, charges cannot build up or disappear at a point. For this reason, the amount of charge that enters one bulb in a given time interval equals the amount of charge that exits that bulb in the same amount of time. Because there is only one path for a charge to follow, the amount of charge entering and exiting the first bulb must equal the amount of charge that enters and exits the second bulb in the same time interval.

Because the current is the amount of charge moving past a point per unit of time, the current in the first bulb must equal the current in the second bulb. This is true for any number of resistors arranged in series. *When many resistors are connected in series, the current in each resistor is the same.*

The total current in a series circuit depends on how many resistors are present and on how much resistance each offers. Thus, to find the total current, first use the individual resistance values to find the total resistance of the circuit, called the *equivalent resistance*. Then the equivalent resistance can be used to find the current.

Figure 9
These two light bulbs are connected in series. Because light-bulb filaments are resistors, **(a)** the two bulbs in this series circuit can be represented by **(b)** two resistors in the schematic diagram shown on the right.