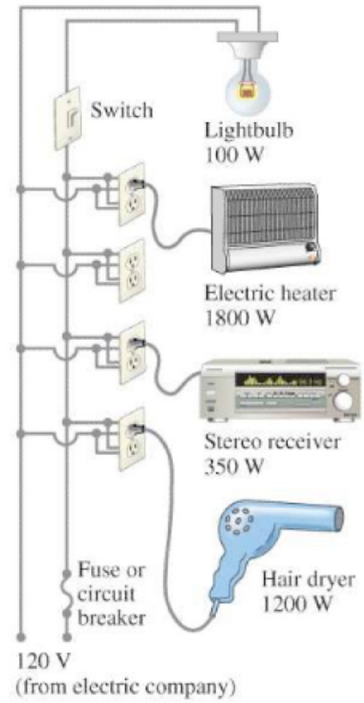


FIGURE 18–20 Connection of household appliances.

Household circuits are designed with the various devices connected so that each receives the standard voltage (usually 120 V in the United States) from the electric company (Fig. 18–20). Circuits with the devices arranged as in Fig. 18–20 are called *parallel circuits*, as we will discuss in the next Chapter. When a fuse blows or circuit breaker opens, it is important to check the total current being drawn on that circuit, which is the sum of the currents in each device.

EXAMPLE 18–11 **Will a fuse blow?** Determine the total current drawn by all the devices in the circuit of Fig. 18–20.

APPROACH Each device has the same 120-V voltage across it. The current each draws from the source is found from $I = P/V$, Eq. 18–5.

SOLUTION The circuit in Fig. 18–20 draws the following currents: the lightbulb draws $I = P/V = 100\,\mathrm{W}/120\,\mathrm{V} = 0.8\,\mathrm{A}$; the heater draws $1800\,\mathrm{W}/120\,\mathrm{V} = 15.0\,\mathrm{A}$; the stereo draws a maximum of $350\,\mathrm{W}/120\,\mathrm{V} = 2.9\,\mathrm{A}$; and the hair dryer draws $1200\,\mathrm{W}/120\,\mathrm{V} = 10.0\,\mathrm{A}$. The total current drawn, if all devices are used at the same time, is

$$0.8\,\mathrm{A} + 15.0\,\mathrm{A} + 2.9\,\mathrm{A} + 10.0\,\mathrm{A} = 28.7\,\mathrm{A}.$$

NOTE The heater draws as much current as 18 100-W lightbulbs. For safety, the heater should probably be on a circuit by itself.

PHYSICS APPLIED
Proper fuses and shorts

If the circuit in Fig. 18–20 is designed for a 20-A fuse, the fuse should blow, and we hope it will, to prevent overloaded wires from getting hot enough to start a fire. Something will have to be turned off to get this circuit below 20 A. (Houses and apartments usually have several circuits, each with its own fuse or circuit breaker; try moving one of the devices to another circuit.) If the circuit is designed with heavier wire and a 30-A fuse, the fuse shouldn't blow—if it does, a short may be the problem. (The most likely place for a short is in the cord of one of the devices.) Proper fuse size is selected according to the wire used to supply the current; a properly rated fuse should *never* be replaced by a higher-rated one. A fuse blowing or a circuit breaker opening is acting like a switch, making an "open circuit." By an open circuit, we mean that there is no longer a complete conducting path, so no current can flow; it is as if $R = \infty$.

PHYSICS APPLIED
Extension cords and possible danger

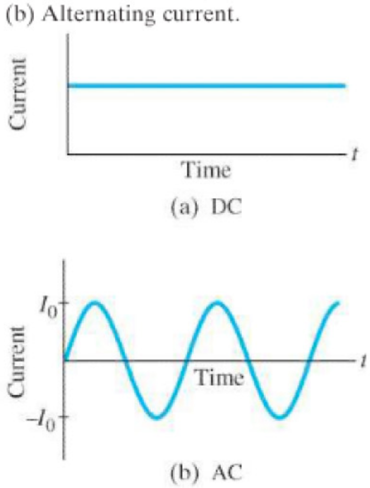
EXERCISE E Your 1800-W portable electric heater is too far from your desk to warm your feet. Its cord is too short, so you plug it into an extension cord rated at 11 A. Why is this dangerous?

18–7 Alternating Current

DC and AC

When a battery is connected to a circuit, the current moves steadily in one direction. This is called a **direct current**, or **dc**. Electric generators at electric power plants, however, produce **alternating current**, or **ac**. (Sometimes capital letters are used, DC and AC.) An alternating current reverses direction many times per second and is commonly sinusoidal, as shown in Fig. 18–21. The electrons in a wire first move in one direction and then in the other. The current supplied to homes and businesses by electric companies is ac throughout virtually the entire world. We will discuss and analyze ac circuits in detail in Chapter 21. But because ac circuits are so common in real life, we will discuss some of their basic aspects here.

FIGURE 18–21 (a) Direct current. (b) Alternating current.



The voltage produced by an ac electric generator is sinusoidal, as we shall see later. The current it produces is thus sinusoidal (Fig. 18–21b). We can write the voltage as a function of time as

$$V = V_0 \sin 2\pi f t = V_0 \sin \omega t.$$

The potential V oscillates between $+V_0$ and $-V_0$, and V_0 is referred to as the **peak voltage**. The frequency f is the number of complete oscillations made per second, and $\omega = 2\pi f$. In most areas of the United States and Canada, f is