13.3 Electric Current

electric current (*I*) a measure of the rate of electron flow past a given point in a circuit; measured in amperes (A)

For any electrical device to operate, there must be a flow of electrons. When designing or troubleshooting a circuit, you need to know how much electric current is flowing through the different loads of the circuit. **Electric current** is the rate of electron flow past a specific point in a circuit. To better understand the concept of electric current, consider a waterfall. Imagine that you are standing near the top of the cliff. If you counted the number of water molecules flowing past the top of the cliff during a given time period, you would get the rate at which the water is flowing past that point. In the same way, electric current is a measure of the rate at which a large number of electrons are flowing past a specific point in a circuit. French physicist André-Marie Ampère (1775–1836) devised a way to measure electric current. The unit for electric current is called the ampere (A), named in honour of Ampère. The symbol for current is *I*.

To learn more about being a physicist,
GO TO NELSON SCIENCE

Measuring Current

ammeter a device used to measure electric current

When an electrical circuit does not work, an electrician, technician, or engineer must troubleshoot the circuit to find the problem. To do this, they must measure the current flowing through the different loads of the circuit. An **ammeter** is the device designed for this purpose (Figure 1(a)). The circuit diagram symbol for an ammeter is shown in Figure 1(b).

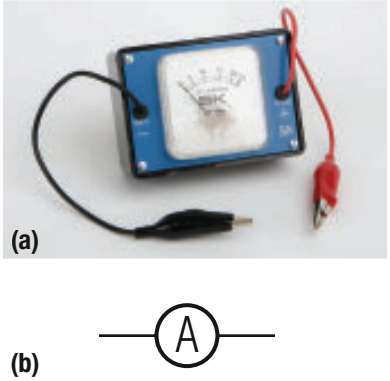

Figure 1 (a) An ammeter (b) The circuit diagram symbol for an ammeter

An ammeter must be connected in series with a load to measure the current flowing through the load. For example, to measure the current through the lamp in Figure 2, you must connect the ammeter in series with the lamp. This ensures that all of the electrons that flow through the lamp will also flow through the ammeter.

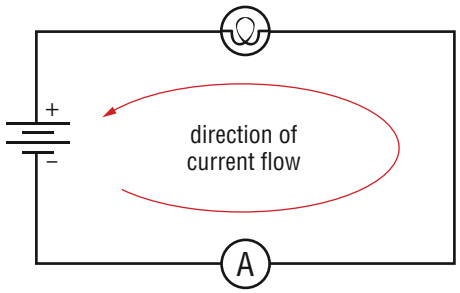

Figure 2 An ammeter must be connected in series with a load to measure the current through the load. Note that the negative side of the battery is connected to the negative side of the ammeter.

Typical electric currents involve the flow of huge numbers of electrons. Consider, for example, when an ammeter indicates that there is a current of 1 A through a circuit. This means that approximately 6.2×10^{18} electrons (over 6 billion billion electrons) are flowing through the ammeter and the rest of the circuit each second!

Safety with Electric Currents

Very large currents can damage electrical devices and cause an electrical fire. That is why every home has a distribution panel with circuit breakers or, in older homes, fuses. The circuit breakers or fuses are connected in series with the circuits leading to the appliances or wall outlets in your home.

If there is too much current through the circuit breaker or fuse, it trips or blows and behaves like an open switch. No current flows through it. This protects electrical devices, such as a washing machine or computer, from becoming damaged by electric currents.

There are two very important safety tips to follow when measuring current:

- Always set the ammeter to the highest current setting. Too low a setting can damage the meter.
- To prevent an electric shock, never touch the tips of the ammeter leads when they are connected to a circuit.

The Human Body and Electrical Shock

The brain coordinates the action of your muscles through electrical signals sent through the nervous system. For example, electrical signals from your brain are stimulating the muscles of your eyes, making them move to scan this page for information. Electrical signals are sent through the nervous system using charged particles called ions rather than electrons.

Even small electrical shocks can be dangerous. An electric current of about 0.001 A passing through the body may give you a tingling sensation. A current of 0.050–0.150 A can cause muscles to contract or convulse out of control. This amount of current is sometimes called the "let-go" threshold because beyond this value you can no longer let go of the object that is shocking you. A current of 1.0–4.3 A passing through the chest will stop your heart. A wall outlet that powers a computer can deliver 15 A. This is why you should never touch a circuit with a current going through it. Remember, current kills!

WRITING TIP

Asking Questions for Critical Analysis

If writing a critical analysis of an article about common household electrical hazards, you might ask questions such as "How might these hazards be prevented?" By conducting research, you might discover that the use of electrical outlet covers can prevent young children from sticking their fingers or a fork into an uncovered electrical socket and receiving a severe electrical shock.

To learn more about safety tips for preventing electric shocks,
GO TO NELSON SCIENCE

IN SUMMARY

- Current is a measure of the rate of electron flow past a given point in a circuit.
- Current is measured in amperes (A) by using a device called an ammeter.
- Ammeters must be connected in series with a load when measuring current.
- Circuit breakers and fuses protect electrical devices from excess current.
- A small amount of electric current can be dangerous to the human body.

CHECK YOUR LEARNING

1. Copy and complete Table 1 in your notebook. K/U

Table 1 Electric Current

Electrical quantity	Electrical quantity symbol	Unit of measurement	Unit of measurement symbol
electric current			

2. List two important things to remember when using an ammeter. K/U

3. A student connected an ammeter as shown in Figure 3. Did the student connect the ammeter correctly? Explain. K/U

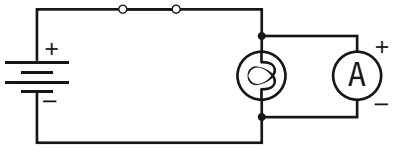

Figure 3

4. Describe why electric currents can be dangerous. K/U