TOPIC 7 Electricity in the Home

Do you know how power reaches your home from an electricity-generating power station? How is the power distributed through your home? How do you pay for the electricity you use?

Transmission of Electricity through the Power Grid

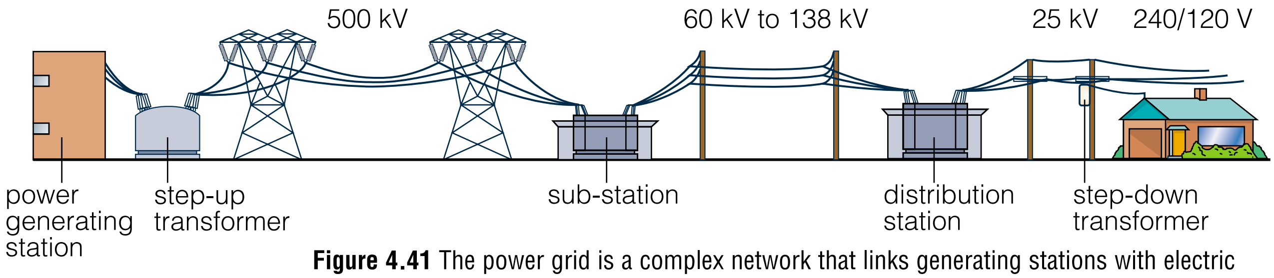


Figure 4.41 The power grid is a complex network that links generating stations with electric energy users such as homes and factories.

Alternating current for use in homes and industry is produced by large electric generators in power stations. **Transformers** are used to "step up" the voltage for efficient transmission over long distances. At the destination, other transformers "step down" the voltage to the 240/120 V used in homes and factories. There is probably a step-down transformer near your home, perched on a power pole, or in a back alley.

Find Out ACTIVITY

Build a Transformer

A transformer is composed of two coils of wire wrapped around an iron core. In this activity, you will build a simple transformer and investigate its operation.

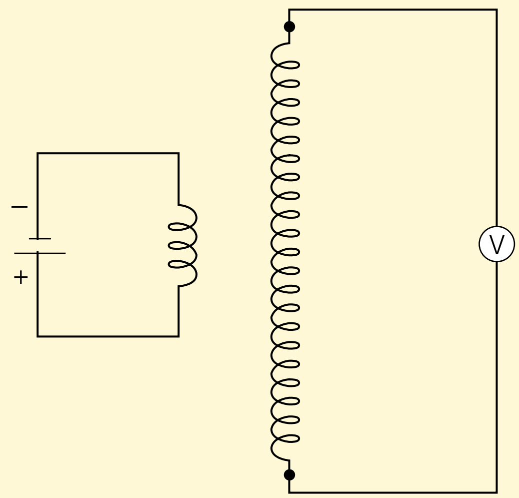
Materials

iron nail, bolt, or rod at least 10 cm long
2 lengths of magnet wire (22 or 24 AWG) about 1.5 m long
1 D-cell in holder
sensitive analog voltmeter
sandpaper (a small square)

Safety Precautions

Procedure Performing and Recording

1. Coil half of one length of wire neatly and tightly around the nail near one end. Leave extra wire free at each end of the coil.
2. Coil most of the other wire near the other end of the nail (leave about 10 cm of wire free at each end). Do not let this coil touch the other one.
3. Sand off the insulating coating from all exposed wire ends.
4. Attach the ends of the first wire coil to the voltmeter.
5. Touch the ends of the second wire coil to the terminals of the D-cell. Observe the voltmeter reading as you connect and disconnect the cell.



What Did You find Out? **Analyzing and Interpreting**

1. What happened to the reading on the voltmeter as you connected and disconnected your transformer to the cell? What happened during the interval that the cell was connected?
2. Was your transformer connected as a step-up transformer or as a step-down transformer? How do you know?
3. Based on your observations, explain why transformers are not used with direct current.

From the Grid into Your Home

Distribution lines connect your home to the power grid through a step-down transformer and a power meter (Figure 4.42). The meter is usually mounted on the outside wall of buildings where the distribution lines enter. It records the total electric energy supplied to electric devices that are operating in the house.

After being metered, electricity then goes to a service panel. At the top of the panel, wires from the meter are connected to the main **circuit breaker**. The main breaker acts as a switch and safety device that can cut off all power coming into the home. If current exceeds a safe level, a bimetallic strip in the breaker heats up, bends, and opens the circuit. Current stops flowing until the breaker cools and you reset it.

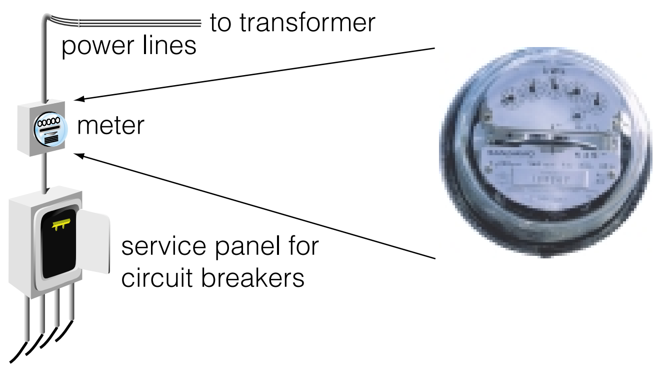


Figure 4.42 The amount of electric energy supplied to your home is measured by a meter and distributed by a service panel.

Older homes often have a **fuse** box instead of a breaker panel. A fuse contains a metallic conductor that melts when excessive current heats it up. This opens the circuit until the fuse is replaced. Fuses are rarely used in modern buildings, but they are common in electric stoves and automobile electrical systems.

Figure 4.43 Circuit breakers (left) and fuses (right) "blow" if current becomes excessive. This fuse stops current greater than 20 A, preventing overheated wires and possible fires.

Figure 4.44 Fourteen gauge electric cable, commonly used for home wiring. Black = hot, white = neutral, bare copper (sometimes green) = ground.

The lower part of a service panel contains additional circuit breakers or fuses for each **branch circuit** in your home. Each branch circuit supplies power to one or more wall plugs or lights connected in parallel by cables in the house walls. As additional loads are plugged into a branch circuit, the current flowing through the connecting cables increases. The small resistance of the cable wires causes them to heat up when enough current flows. Before the wires become hot enough to start a fire, the branch breaker or fuse cuts off current to all loads in that circuit. Because the branch circuits are connected in parallel, however, appliances or devices plugged into other branches will continue to operate.

The breakers, plugs, lights, and switches in each branch circuit are connected by electric cables that contain three wires. There are two "live" wires — a white insulated wire (usually called the **neutral wire**) and a black insulated wire (usually called the **hot wire**). The third wire, the **ground wire**, is either bare copper or covered with green insulation. In North American homes, there is a potential difference of 120V across the black and white wires, in curcuits for lamps and ordinary appliances (220-240V for kitchen ranges). The ground wire reduces shock hazards by safely channelling back into the ground any current that has "leaked" onto metal components in the electric circuit.

Home Wiring

To install or modify wiring in your home, it is usually necessary to get a permit from your city, town or municipal office. Licensed electricians who do the wiring must follow strict regulations and practise extreme caution when changing or repairing circuit components. After major wiring work is complete, an electrical inspector may need to certify that the job meets a set of standards called the **electrical code**.

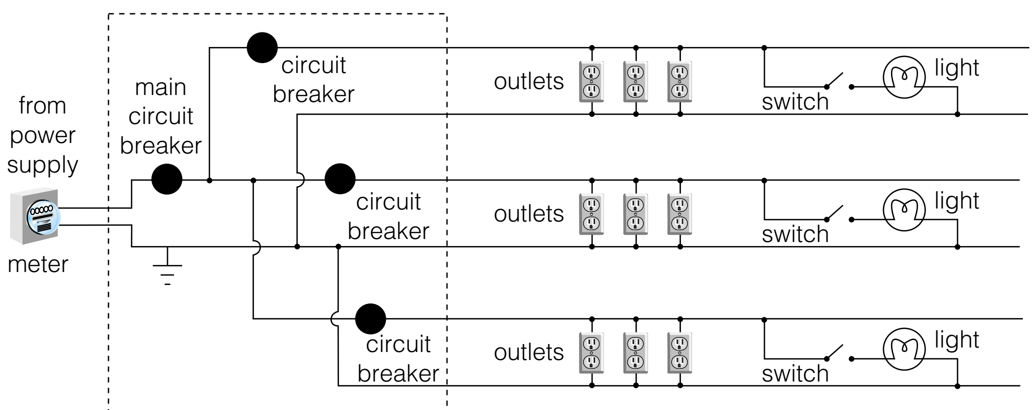


Figure 4.45 A single service panel supplies and controls current to dozens of branch circuits in a typical house. Only three branch circuits are shown in this wiring diagram.

Find Out ACTIVITY

Circuit Training in Your Room

To plan the wiring in a new home, electricians and, in some cases, electrical engineers draw circuit diagrams that show where the different electric fixtures will be placed and how they will be connected. In this activity, you will have the opportunity to draw a circuit diagram of your room.

Materials

pencil
ruler
graph paper

Procedure

1. Measure your bedroom and draw an accurate scale floor plan that includes doors, windows, wall switches, electric outlets, and permanent light fixtures.
2. Find out which electric components in your room are connected together. The light switch, for example, probably does not control the wall outlets. On your plan, draw a possible wiring diagram for your room.
3. Draw a circuit diagram for your room using standard symbols for lights and switches, and a circle with an "X" inside for wall outlets.

What Did You Find Out? Analyzing and Interpreting

1. Where in your circuit compared to the receptacles and the lights would the light switch be located? Explain the reason you chose this location.
2. Describe at least three things you must consider when wiring a bedroom.
3. How is the circuit diagram for your room similar to the diagrams you have previously drawn of simple circuits? How is it different? (Give at least two answers for each question.)

Extension

4. Imagine that you wanted to add an additional receptacle to your room, controlled by the existing light switch. On your circuit diagram, show the additional electric components in a different colour. Explain the reason for each placement.

Career CONNECT

Electricity runs in Craig Terakita's family. For about 25 years, Craig has worked in his family's electrical business. Every day, he wires residences so they will have safe and efficient heating, lighting, and power. He can do it all — from applying for wiring permits and preparing cost and material estimates, to stringing electric cable through walls, installing plugs and switches, and hanging light fixtures. Craig often works eight to ten hours each day, but he enjoys being on the job with other tradespeople, even when projects require working on weekends.

"To do this job, you need a strong math background," Craig says. He spent four years in postsecondary education, taking classes and then apprenticing for between eight and 12 weeks per year. Now, as a master electrician, Craig's training and experience make him very aware of the potential danger of electricity. He treats it with great respect.

Does a career as an electrician interest you? You can learn about requirements and training opportunities from your school guidance counsellor, the library, or the Internet.

Digital Devices

Have you ever peeked at the circuit board inside a calculator or computer? The four basic circuit elements are present there, although they may take unfamiliar forms. Conductors, for example, may be thin traces of copper instead of wires. Some loads, such as resistors and lamps, resemble the components you have been using. What you do not see are the thousands or millions of tiny electronic switches that form the heart of **digital** electronic technology — machines that process numerically coded information.

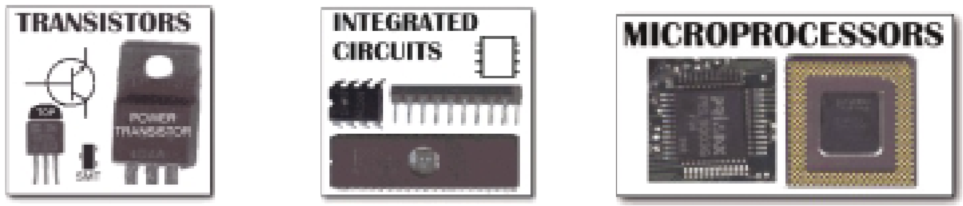


Figure 4.46 Modern digital electronic devices are based on transistors, integrated circuits with several transistors in the same case, and microprocessors (chips), which contain millions of transistors.

Did You Know?

Most digital devices operate on direct current. The power cube transformers (adapters) that allow personal electronic equipment to operate from household power convert 110 V AC to low-voltage DC that replaces energy from batteries.

Switches have only two states: on or off. These states can be used to represent numbers and letters using a **binary code**, a sequence of "on" and "off" signals. In addition, logic circuits containing many switches can process binary information. For example, you can build a logic circuit that will compare two numbers, add them, or find their difference.

The electronic switches in modern digital devices are **transistors**, solid-state components that can be turned on and off by electric signals. In turn, transistors can control other signals. Every digital device you use, from your calculator to your CD player, is designed around components that contain enormous numbers of transistors (Figure 4.46).

Cool Tools

Devices called "surge suppressors" (or "surge protectors") are often used to protect expensive electronic equipment, such as computers, televisions, stereos, home theatre systems, and fax machines. Surges of electric charge, which are momentary increases in the energy (voltage) of the supply to tens of thousands of volts, can occur through household electric wiring and also through telephone lines and coaxial cable. Surges can be caused by lightning, by turning on or off large appliances, or by a local power company transferring large amounts of electricity into or out of the power grid.The suppressor absorbs some of the electric surge and then diverts the rest to the ground.

Measuring Electric Power

In physics, **power** is defined as energy per unit time. Electric power describes the amount of electric energy that is converted into other forms of energy (heat, light, sound, or motion) every second. As well, electric power can also describe the amount of electric energy that is transferred from one place to another in a certain amount of time. The symbol for power is *P*. The mathematical equation that defines power is:

$$\text{Power (in watts)} = \frac{\text{Energy (in joules)}}{\text{Time (in seconds)}}$$

$$P = \frac{E}{t}$$

The units of power are joules per second. One joule per second is also called one watt (W) in honour of James Watt (1736–1819). A 100 W light bulb, for example, converts 100 W of electric energy into light and heat every second. A kilowatt (kW) is 1000 watts.

Electric power is not usually calculated directly by measuring energy and time. It is much more common to measure the voltage and current in a circuit and use these quantities to calculate power.

$$\text{Power (in watts)} = \text{Current (in amps)} \times \text{Voltage (in volts)}$$

$$P = IV$$

This equation can be manipulated to determine the current or the voltage of the circuit.

$$\text{Current} = \frac{\text{Power}}{\text{Voltage}} \qquad I = \frac{P}{V}$$

$$\text{Voltage} = \frac{\text{Power}}{\text{Current}} \qquad V = \frac{P}{I}$$

Word CONNECT

One watt is a relatively small amount of electric power. Electric power production and transmission involves much more power, which is expressed as:

kilowatts (kW) = 1 000 W

megawatts (MW) = 1 000 000 W

gigawatts (GW) = 1 000 000 000 W

Model Problem

A current of 13.6 A passes through an electric baseboard heater when it is connected to a 110 V wall outlet. What is the power of the heater?

Given

$I = 13.6$ A
$V = 110$ V

Required

Power, *P*, in watts (W)

Analysis

Since you know the potential difference and the current, use the equation $P = IV$ to calculate the power.

Solution

$$\begin{aligned} P &= IV \\ &= 13.6 \text{ A} \times 110 \text{ V} \\ &= 1496 \text{ W} \\ &= 1.50 \times 10^3 \text{ W} \end{aligned}$$

Paraphrase

13.6 A of 110 V current passing through an electric heater is a power of 1.50×10^3 W.

Pause & Reflect

Review the units and symbols for the new quantities that you have learned. Add the unit and symbol for power to the table in your Science Log. Include the relationships between watts, joules, and seconds.

Practice Problems

1. What is the power (in watts and kilowatts) of a hair dryer that requires 10 A of current to operate on a 120 V circuit?
2. The maximum current that a 68.5 cm television can withstand is 2 A. If the television is connected to a 120 V circuit, how much power is the television using?
3. A 900 W microwave oven requires 7.5 A of current to run. What is the voltage of the circuit to which the microwave is connected?
4. A flashlight using two 1.5 V D-cells contains a bulb that can withstand up to 0.5 A of current. What would be the maximum power of the bulb?

DidYouKnow?

James Watt (1736–1819), a Scottish engineer, is known for improving the efficiency of the steam engine. To describe the power of steam engines and other devices, he compared them to horses. Watt defined the power of a strong horse as one horsepower. One horsepower equals 746 W. What is the power in watts of a small car with a 100 hp engine?

Paying for Electric Energy

Producing and distributing electric energy is expensive. Power companies pass their costs on to customers according to the amount of energy supplied to each user. To determine this amount, a power company employee records the reading on every customer's electricity meter at regular intervals.

You can read an electric meter yourself. On the meter, each dial represents one digit in a five-digit number. When a dial pointer is between numbers, the lower number is recorded (Figure 4.47). For convenience, most power companies measure electric energy in a customary (non-SI) unit — the kilowatt hour (kWh). One kilowatt hour is the total energy supplied to a 1000 W load during 1 h of operation. For example, a small hair dryer might be rated at 1000 W (1 kW). If it ran for 1 h, the dryer would have transformed 1 kWh of electric energy into thermal energy.

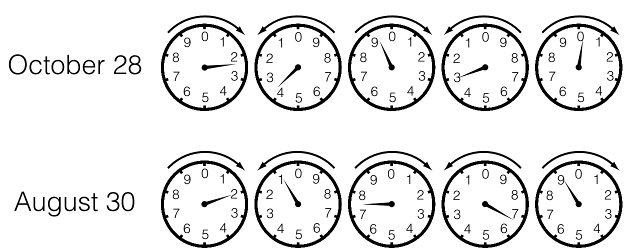


Figure 4.47 The bottom row of meter dials show an August 30 reading of 20 769 units. The top row of dials show an October 28 reading of 23 930 units. The power company would bill this customer for 3161 units of electric energy.

Model Problem

A family uses 3000 kWh of electric energy in a two-month period. If the energy costs 11.0 cents per kilowatt hour, what is the electric bill for the period?

Given

E = 3000 kWh
Unit cost = 11.0 cents per kilowatt hour

Required

Total cost in dollars

Analysis

Convert unit cost from cents to dollars. Then find the total cost by using the following formula.
Total cost (dollars) = Total energy used in kWh × cost in $ per kWh

Solution

Total cost

$$= 3000 \text{ kWh} \times \frac{\$0.11}{\text{kWh}} = \$330.00$$

Paraphrase

The cost of electric energy used in this home over a two-month period was $330.

Practice Problems

1. (a) If a refrigerator requires 700 W of power to function, how many kilowatt hours of power will it require in a 30-day period?
   (b) If electricity costs 11 cents per kilowatt hour, how much would the refrigerator cost to operate in that period?
2. A home-owner finds that she has a total of 42 light bulbs (100 W) in use in her home.
   (a) If all of the bulbs are on for an average of 5 h per day, how many kilowatt hours of electricity will be consumed in a 30-day period?
   (b) At 11 cents per kilowatt hour, how much will operating these lights cost the home-owner during that period?
   (c) How much money would the home-owner save if she switched all of the bulbs to energy-saving 52 W light bulbs?
3. Bob has a stereo that operates at 120 V, using 2.5 A of current.
   (a) How much power does Bob's stereo need to operate? (Hint: Think back to the previous power-calculation Practice Problems.)
   (b) If Bob plays his stereo for an average of 5 h each day, how much electricity will he use in a 30-day period?

DidYouKnow?

The amount of energy a person uses on a low-activity 24 h day is about the same as the energy that a 100 W light bulb uses when it is on for 24 h. People, of course, obtain energy from food.

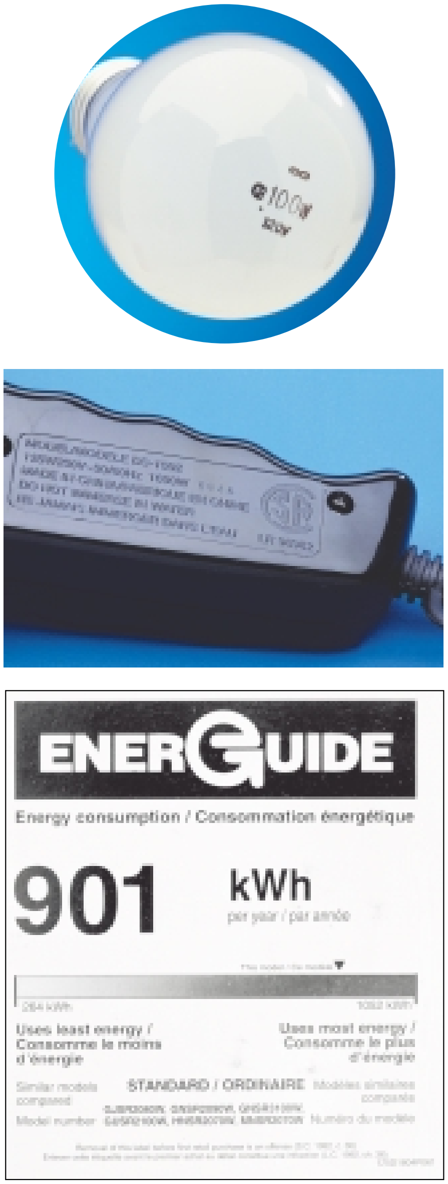


Figure 4.48 A power rating or yearly energy use information is marked on most electric devices.

Power Rating

Many electric appliances, such as hair dryers, electric kettles, and even light bulbs, have a power in watts marked on them. This rating tells you how many joules of energy the device uses in every second of operation. (Remember, 1 W is 1 J/s.)

"EnerGuide" labels, such as the one shown in Figure 4.48, help people to make comparisons of energy use when purchasing large home appliances. Stoves, refrigerators, washers, dryers, air conditioners, and similar appliances sold in Canada carry EnerGuide labels. The large number at the top of the label indicates the approximate amount of energy the appliance will use in one year of typical operation. The coloured bar on the label shows how that particular appliance compares with others on the market. The numbers on the bar give the yearly energy use of the most efficient (left end) and least efficient (right end) appliances of similar type. EnerGuide ratings are assigned after appliances are tested according to standard procedures accepted by the Canadian Standards Association (CSA).

Together, all the appliances in your home require a surprisingly large amount of electrical power. Examine Table 4.9 to find some typical examples. In the next investigation, you will determine how your household uses electric energy.

INTERNET CONNECT

www.mcgrawhill.ca/links/sciencefocus9

Most major power companies offer electric power-consumption calculation tools on their Internet sites to help you find out where your family's power consumption dollars are going. Many power company sites also offer energy conservation suggestions. To find some that you could begin to use, go to the web site above, and click on Web Links to find out where to go next.

Table 4.9 Power Ratings and Energy Use for Appliances

Appliance	Power *P* (W)	Average energy used per year (MJ)	Appliance	Power *P* (W)	Average energy used per year E (MJ)
clothes dryer	4356	3600	CD player	85	500
dishwasher	1200	1300	TV (colour)	200	1600
range and oven	12 200	4200	washing machine	512	400
refrigerator	615	6600	water heater	2475	5000

INVESTIGATION 4-I

SKILLCHECK

Initiating and Planning

Performing and Recording

Analyzing and Interpreting

Communication and Teamwork

You've Got the Power!

Think about how electricity is used in your home. Which appliances are costing you the most to operate? Which cost you the least? What would be the easiest way to reduce your household's electricity bill and perhaps help the environment without major changes in your lifestyle?

What To Do

1. Construct a large data table in which to record the information you collect.
2. At home, list all of the major and minor electric appliances or devices that are used in your home.
3. For each device, try to estimate the average number of hours per day (and then per month) that it is used. Ask members of your household for their input or check a power company website for average values.
4. For each device, record any information you can find that is related to the wattage, voltage, or amperage required by the device. Consult the appliance power-consumption reference sheet supplied by your teacher for wattages you cannot determine. If wattages cannot be found for certain devices, attempt to calculate power use by using data for voltage and current and the equation (watts = volts × amps) you learned earlier. The voltage of a standard receptacle is 120 V.
5. Calculate the number of kilowatt hours of electricity consumed by each device in a month. From these values, determine the total monthly electricity consumption by your household.
6. Use the current rate your household is paying for electric power to calculate the monthly power bill. (You can find the current rate per kilowatt hour from a recent electric bill or by contacting the local power company.)

Analyze

1. Which appliances or devices did you find were costing you the most money in terms of electricity consumption? Which cost the least? Explain why you think this was the case. Give at least two explanations for each of the high- and low-cost devices.
2. Suppose that your goal is to reduce your power bill by $25.00 over a 30-day period.
   (a) At the rate your household is currently paying for electricity, by how many kilowatt hours of power would you need to reduce your consumption to save $25.00 in a 30-day period? Show your detailed calculations.
   (b) Describe in detail what measures you could take to reduce your electricity consumption by the number of kilowatt hours you calculated in question 2 (a).

Electric Devices and Efficiency

If an electric light bulb were perfect, all of the electric energy it took in (input energy) would be converted into light (useful output energy). No real device, however, is a perfectly efficient energy converter. Some input energy is always converted into waste heat.

You can express efficiency as a percentage by using the following mathematical relationship.

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy input}} \times 100\%$$

To find the efficiency of electric devices, it is often necessary to calculate energy inputs or outputs.

To determine the electric energy input of a device, the formula for power $\left(P = \frac{E}{t}\right)$ can be manipulated to solve for energy.

$E = Pt$ or energy (joules) = power (watts) × time (seconds)

Different types of electric lighting provide a good example of differences in efficiency.

Figure 4.49 Replacing traditional light bulbs with more efficient compact fluorescent bulbs (bottom) can significantly reduce energy requirements and operating costs for electric lights.

Incandescent Bulbs

Electric lighting in most homes is largely provided by incandescent light bulbs, which are only about 5% efficient. About 95% of the input electric energy is converted to waste heat as current passes through a thin metal filament coiled inside the bulb.

Halogen Bulbs

Halogen bulbs are filled with a high-pressure gas containing traces of iodine, which helps prevent their filament from evaporating. This allows the bulbs to operate at very high temperatures, so they convert a greater proportion of their input energy into light. Although halogen bulbs are about 15% efficient, they still waste a significant amount of energy as heat and can be a fire hazard. Halogen bulbs last two to six times longer than incandescent bulbs.

Fluorescent Tubes

A fluorescent tube contains a gas such as mercury vapour. When current passes through the vapour, it emits energy that affects a white material on the inside of the glass, causing it to glow. Fluorescent tubes operate at relatively low temperatures, so they waste very little energy as heat. Most fluorescent tubes are about 20% efficient, and they last ten to 13 times longer than incandescent bulbs. Compact fluorescent bulbs are much more expensive than the regular light bulbs which they can replace. Fluorescent bulbs' long lifetime and low power consumption, however, more than repay this initial cost. By using less electricity, compact fluorescent bulbs also reduce the environmental impact of generating their operating power.

Model Problem

A 1000 W electric kettle takes 4.00 min to boil some water. If it takes 1.96×10^5 J (196 000 J) of energy to heat the water, what is the efficiency of the kettle?

Given	**Required**
$P = 1000$ W	Efficiency
$t = 4.00$ min	
Useful energy output $= 1.96 \times 10^5$ J	

Analysis

To find the energy used by the kettle, use the formula $E = Pt$.
To find the efficiency of the kettle use

$$\text{efficiency} = \frac{\text{Useful energy output}}{\text{Total energy input}} \times 100\%$$

Solution

Convert time into seconds.

$$t = 4.00 \text{ min} \times \frac{60 \text{ s}}{\text{min}} = 240 \text{ s}$$

Find the electric energy input to the kettle.

$$\begin{aligned} E &= Pt \\ &= 1000 \text{ W} \times 240 \text{ s} \\ &= 240\ 000 \text{ J} \\ &= 2.40 \times 10^5 \text{ J} \end{aligned}$$

Find the percent efficiency.

$$\text{efficiency} = \frac{\text{Useful energy output}}{\text{Total energy input}} \times 100\%$$

$$\text{efficiency} = \frac{1.96 \times 10^5 \text{ J}}{2.40 \times 10^5 \text{ J}} \times 100\% = 81.7\%$$

Paraphrase

The kettle is about 81.7% efficient.

Practice Problems

1. Find the efficiency of a 23 W fluorescent tube that is used 4.0 h per day and in that time produces 6.624×10^4 J of useful light energy.
2. A 100 W incandescent bulb also produces about 6.624×10^4 J over a 4.0 h period. What is the efficiency of this bulb?
3. Based on your answers to questions 1 and 2, how much money would you save in a 30-day month if you replaced 25 of the 100 W incandescent bulbs with 23 W fluorescent bulbs? Assume that the bulbs operate 4 h daily, and that electricity costs 10¢ per kilowatt hour.

Math CONNECT

Look again at the mathematical relationship that defines efficiency. High efficiency (near 100%) means the useful output energy is almost the same as the input energy. Very little energy is transformed into waste heat. *High* efficiency means *low waste*. What would it mean for a device to have efficiency greater than 100%? Do you think this is possible?

Home Electric Safety

It does not take a very large electric current to do serious damage to a person. Electricity-related injuries often occur when a person's body accidentally becomes a conducting pathway by which electricity can reach the ground. Current flowing through the body — an electric shock — can cause pain, muscle spasms, and even death. In addition to injuring people directly, electrical faults are a common cause of household fires. Fortunately, simple safety measures can help to prevent you from being harmed by electricity.

- Do not overload an outlet or a circuit by plugging in too many electric devices. Overloading can cause the wiring to heat up and could lead to a fire.
- Never work on or clean appliances that are still plugged in. You might touch a "hot" wire and become a path to the ground.
- Replace frayed or worn out electric cords. If a person touches the exposed wires, electric current may flow through the person's body rather than through the load. If the bare wires touch directly (a **short circuit**), a high current flows between them, causing sparks and often starting a fire.

Cool Tools

Emergency medical personnel sometimes use an electric *defibrillator* to apply a controlled electric shock to an accident victim's heart muscle. If the heart has stopped, the shock can cause it to contract and begin beating again. If the heart muscle is contracting in uncontrolled spasms, its normal rhythm can be restored by the shock, which is applied through a paddle-shaped electrode. Some portable defibrillators even "speak" computer-generated instructions to guide inexperienced users.

Figure 4.50 Frayed electrical cords are a serious shock and fire hazard.

- Use receptacle covers on easily accessible outlets to prevent small children from sticking objects into receptacles, causing short circuits or shocks.
- Never use appliances close to a sink or bathtub with water in it or when your hands are wet.

DidYouKnow?

You have probably seen outlets with reset buttons, such as the one in the photograph. These buttons indicate that the outlet is connected to a ground fault circuit interrupter (GFCI). These devices are required in areas such as bathrooms and outdoor locations where water and electricity create a hazard.

A GFCI monitors current flowing into and out of a load. If any electricity is diverted out of the circuit wires, the GFCI immediately cuts off the current. If the problem is caused by electricity leaking from the load and through a person's body to the ground, opening the circuit could prevent a potentially fatal electric shock.

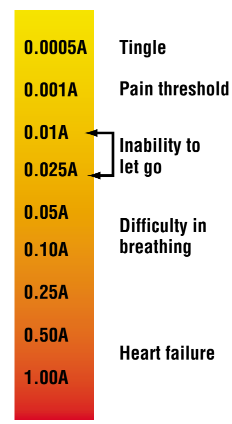
Electric Safety Outdoors

Electric hazards exist outdoors as well as inside your home. Power poles, transformers, substations, and overhead wires can all be dangerous. To protect yourself from a possibly fatal electric shock, you should follow a few simple rules.

- Never allow your body or something you are holding to come into contact with live electric wires. Touching a kite string, ladder, branch, or TV antenna that is in contact with power wires can make you a pathway to the ground, causing electricity to flow through your body.
- Never use ungrounded or frayed two-prong electric cords outdoors.
- Do not operate electric equipment outdoors when it is raining.
- Before digging deeply in your yard, make sure that there are no underground utility cables. A shovel can cut through buried communications wires and disrupt telephone or cable television service. Heavy equipment or power posthole diggers can pierce the insulation of underground power cables, creating a risk of serious shock for the equipment operator as well as causing a power outage. Utility companies will send an employee to your property on request, to locate and mark underground wires and pipes without charge.

Effects of Electric Current

The scale below shows how the effect of electric current on the human body depends on the amount of current that flows into the body.



Off the Wall

Effects of Electric Current

The scale shows how the effect of electric current on the human body depends on the amount of current that flows into the body. The average circuit in a home carries a maximum current of 15 A. Extreme caution must be used when dealing with electricity because of the danger that this level of current poses.

TOPIC 7 Review

1. Describe the purpose and location in the power grid of:
   (a) step-up transformers
   (b) step-down transformers
2. Calculate the cost of using a 300 W television for:
   (a) 6 hours when electricity costs $0.11 per kWh.
   (b) 300 hours when electricity costs $0.16 per kWh.
3. Describe the difference between a circuit breaker and a fuse.
4. Describe three ways in which electric energy could be conserved with respect to home lighting.