CHAPTER 22 REVIEW

Key Terms

22.1

- electric current
- conventional current
- battery
- photovoltaic cell
- electric circuit
- ampere
- resistance
- resistor
- potentiometer
- schematic
- parallel connection
- series connection

22.2

- kilowatt-hour

Summary

22.1 Current and Circuits

- Batteries, generators, and solar cells convert various forms of energy to electric energy.
- In an electric circuit, electric energy is transmitted from a device that produces electric energy to a resistor or other device that converts electric energy into the form needed.
- As a charge moves through resistors in a circuit, its potential energy is reduced. The energy released when the charge moves around the remainder of the circuit equals the work done to give the charge its initial potential energy.
- One ampere is one coulomb per second.
- Electric power is found by multiplying voltage by current.
- The resistance of a device is the ratio of the voltage across it divided by the current through it.
- In a device that obeys Ohm's law, the resistance remains constant as the voltage and current change.
- The current in a circuit can be varied by changing either the voltage or the resistance, or both.
- In a circuit diagram, conventional current is used. This is the direction in which a positive charge would move.

22.2 Using Electric Energy

- The thermal energy produced in a circuit from electric energy is equal to I^2Rt.
- In long-distance transmission, current is reduced without power being reduced by increasing the voltage.
- A kilowatt-hour, kWh, is an energy unit. It is equal to 3.6×10^6 J.

Reviewing Concepts

Section 22.1

1. Describe the energy conversions that occur in each of these devices.
   a. incandescent lightbulb
   b. clothes dryer
   c. digital clock radio
2. Define the unit of electric current in terms of fundamental MKS units.
3. Which wire conducts electricity with the least resistance: one with a large cross-sectional diameter or one with a small cross-sectional diameter?
4. How many electrons flow past a point in a wire each second if the wire has a current of 1 A?

Section 22.2

5. Why do lightbulbs burn out more frequently just as they are switched on rather than while they are operating?
6. A simple circuit consists of a battery, a resistor, and some connecting wires. Draw a circuit schematic of this simple circuit. Show the polarity of the battery and the direction of the conventional current.
7. A simple circuit consists of a resistor, a battery, and connecting wires.
   a. How must an ammeter be connected in a circuit to correctly read the current?
   b. How must a voltmeter be connected to a resistor in order to read the potential difference across it?
8. If a battery is short-circuited by a heavy copper wire being connected from one terminal to the other, the temperature of the copper wire rises.

Why does this happen?

9. Why does a wire become warmer as charges flow through it?
10. What electrical quantities must be kept small to transmit electric energy economically over long distances?

Applying Concepts

11. When a battery is connected to a complete circuit, charges flow in the circuit almost instantaneously. Explain.
12. Explain why a cow that touches an electric fence experiences a mild shock.
13. Why can birds perch on high-voltage lines without being injured?
14. Describe two ways to increase the current in a circuit.
15. You have two lightbulbs that work on a 120-V circuit. One is 50 W, the other is 100 W. Which bulb has a higher resistance? Explain.
16. If the voltage across a circuit is kept constant and the resistance is doubled, what effect does this have on the circuit's current?
17. What is the effect on the current in a circuit if both the voltage and the resistance are doubled? Explain.
18. Sue finds a device that looks like a resistor. When she connects it to a 1.5-V battery, only 45×10^{-6} A is measured, but when a 3.0-V battery is used, 25×10^{-3} A is measured. Does the device obey Ohm's law?
19. If the ammeter in **Figure 22–5** were moved to the bottom of the diagram, would the ammeter have the same reading? Explain.
20. Two wires can be placed across the terminals of a 6.0-V battery. One has a high resistance, and the other has a low resistance. Which wire will produce thermal energy at the faster rate? Why?

Problems

Section 22.1

LEVEL 1

21. The current through a toaster connected to a 120-V source is 8.0 A. What power is dissipated by the toaster?
22. A current of 1.2 A is measured through a lightbulb when it is connected across a 120-V source. What power is dissipated by the bulb?
23. A lamp draws 0.50 A from a 120-V generator.
    a. How much power is delivered?
    b. How much energy does the lamp convert in 5.0 min?
24. A 12-V automobile battery is connected to an electric starter motor. The current through the motor is 210 A.
    a. How many joules of energy does the battery deliver to the motor each second?
    b. What power, in watts, does the motor use?
25. A 4000-W clothes dryer is connected to a 220-V circuit. How much current does the dryer draw?
26. A flashlight bulb is connected across a 3.0-V potential difference. The current through the lamp is 1.5 A.
    a. What is the power rating of the lamp?
    b. How much electric energy does the lamp convert in 11 min?
27. A resistance of 60 Ω has a current of 0.40 A through it when it is connected to the terminals of a battery. What is the voltage of the battery?
28. What voltage is applied to a 4.0-Ω resistor if the current is 1.5 A?
29. What voltage is placed across a motor of 15-Ω operating resistance if there is 8.0 A of current?
30. A voltage of 75 V is placed across a 15-Ω resistor. What is the current through the resistor?
31. A 20.0-Ω resistor is connected to a 30.0-V battery. What is the current through the resistor?
32. A 12-V battery is connected to a device and 24 mA of current is measured. If the device obeys Ohm's law, how much current is present when a 24-V battery is used?
33. A person with dry skin has a resistance from one arm to the other of about 1×10^5 Ω. When skin is wet, resistance drops to about 1.5×10^3 Ω. (refer to **Table 22–1**).
    a. What is the minimum voltage placed across the arms that would produce a current that could be felt by a person with dry skin?
    b. What effect would the same voltage have if the person had wet skin?