31. (II) A 120-V hair dryer has two settings: 850 W and 1250 W. (*a*) At which setting do you expect the resistance to be higher? After making a guess, determine the resistance at (*b*) the lower setting; and (*c*) the higher setting.

32. (II) You buy a 75-W lightbulb in Europe, where electricity is delivered to homes at 240 V. If you use the lightbulb in the United States at 120 V (assume its resistance does not change), how bright will it be relative to 75-W 120-V bulbs? [*Hint*: assume roughly that brightness is proportional to power consumed.]

33. (II) How many kWh of energy does a 550-W toaster use in the morning if it is in operation for a total of 15 min? At a cost of 9.0 cents/kWh, estimate how much this would add to your monthly electric energy bill if you made toast four mornings per week.

34. (II) At $0.095 per kWh, what does it cost to leave a 25-W porch light on day and night for a year?

35. (II) An ordinary flashlight uses two D-cell 1.5-V batteries connected in series as in Fig. 18–4b (Fig. 18–36). The bulb draws 450 mA when turned on. (*a*) Calculate the resistance of the bulb and the power dissipated. (*b*) By what factor would the power increase if four D-cells in series were used with the same bulb? (Neglect heating effects of the filament.) Why shouldn't you try this?

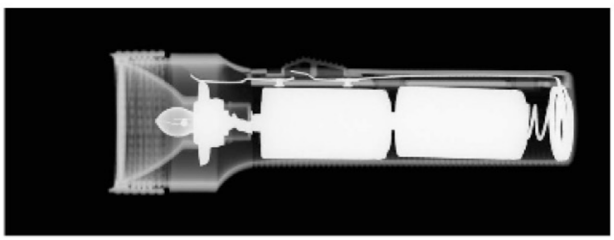

FIGURE 18–36 Problem 35.

36. (II) What is the total amount of energy stored in a 12-V, 85-A·h car battery when it is fully charged?

37. (II) How many 100-W lightbulbs, connected to 120 V as in Fig. 18–20, can be used without blowing a 15-A fuse?

38. (II) An extension cord made of two wires of diameter 0.129 cm (no. 16 copper wire) and of length 2.7 m (9 ft) is connected to an electric heater which draws 15.0 A on a 120-V line. How much power is dissipated in the cord?

39. (II) A power station delivers 620 kW of power at 12,000 V to a factory through wires with total resistance 3.0 Ω. How much less power is wasted if the electricity is delivered at 50,000 V rather than 12,000 V?

40. (III) The current in an electromagnet connected to a 240-V line is 17.5 A. At what rate must cooling water pass over the coils if the water temperature is to rise by no more than 7.50 C°?

41. (III) A small immersion heater can be used in a car to heat a cup of water for coffee or tea. If the heater can heat 120 mL of water from 25°C to 95°C in 8.0 min, (*a*) approximately how much current does it draw from the car's 12-V battery, and (*b*) what is its resistance? Assume the manufacturer's claim of 60% efficiency.

18–7 Alternating Current

42. (I) Calculate the peak current in a 2.2-kΩ resistor connected to a 220-V rms ac source.

43. (I) An ac voltage, whose peak value is 180 V, is across a 330-Ω resistor. What are the rms and peak currents in the resistor?

44. (II) Estimate the resistance of the 120-V_{rms} circuits in your house as seen by the power company, when (*a*) everything electrical is unplugged, and (*b*) there is a lone 75-W lightbulb burning.

45. (II) The peak value of an alternating current in a 1500-W device is 5.4 A. What is the rms voltage across it?

46. (II) An 1800-W arc welder is connected to a 660-V_{rms} ac line. Calculate (*a*) the peak voltage and (*b*) the peak current.

47. (II) (*a*) What is the maximum instantaneous power dissipated by a 3.0-hp pump connected to a 240-V_{rms} ac power source? (*b*) What is the maximum current passing through the pump?

48. (II) A heater coil connected to a 240-V_{rms} ac line has a resistance of 34 Ω. (*a*) What is the average power used? (*b*) What are the maximum and minimum values of the instantaneous power?

* 18–8 Microscopic View of Electric Current

* **49.** (II) A 0.65-mm-diameter copper wire carries a tiny current of 2.3 μA. What is the electron drift speed in the wire?

* **50.** (II) A 5.80-m length of 2.0-mm-diameter wire carries a 750-mA current when 22.0 mV is applied to its ends. If the drift speed is 1.7×10^{-5} m/s, determine (*a*) the resistance R of the wire, (*b*) the resistivity ρ, and (*c*) the number n of free electrons per unit volume.

* **51.** (III) At a point high in the Earth's atmosphere, He^{2+} ions in a concentration of $2.8 \times 10^{12}/\text{m}^3$ are moving due north at a speed of 2.0×10^{6} m/s. Also, a $7.0 \times 10^{11}/\text{m}^3$ concentration of O_2^- ions is moving due south at a speed of 7.2×10^{6} m/s. Determine the magnitude and direction of the net current passing through unit area (A/m^2).

* 18–10 Nerve Conduction

* **52.** (I) What is the magnitude of the electric field across an axon membrane 1.0×10^{-8} m thick if the resting potential is −70 mV?

* **53.** (II) A neuron is stimulated with an electric pulse. The action potential is detected at a point 3.40 cm down the axon 0.0052 s later. When the action potential is detected 7.20 cm from the point of stimulation, the time required is 0.0063 s. What is the speed of the electric pulse along the axon? (Why are two measurements needed instead of only one?)

* **54.** (III) Estimate how much energy is required to transmit one action potential along the axon of Example 18–15. [*Hint*: the energy to transmit one pulse is equivalent to the energy stored by charging the axon capacitance; see Section 17–9]. What minimum average power is required for 10^4 neurons each transmitting 100 pulses per second?

* **55.** (III) During an action potential, Na^+ ions move into the cell at a rate of about $3 \times 10^{-7}\,\text{mol/m}^2\cdot\text{s}$. How much power must be produced by the "active Na^+ pumping" system to produce this flow against a +30-mV potential difference? Assume that the axon is 10 cm long and 20 μm in diameter.