Chapter 20

Problems & Exercises

1.

0.278 mA

3.

0.250 A

5.

1.50ms

7.

(a) $1.67 \mathrm{k}\Omega$

(b) If a 50 times larger resistance existed, keeping the current about the same, the power would be increased by a factor of about 50 (based on the equation $P = I^2R$), causing much more energy to be transferred to the skin, which could cause serious burns. The gel used reduces the resistance, and therefore reduces the power transferred to the skin.

9.

(a) 0.120 C

(b) 7.50×10^{17}electrons

11.

96.3 s

13.

(a) 7.81×10^{14} He^{++} nuclei/s

(b) 4.00×10^{3} s

(c) 7.71×10^{8} s

15.

-1.13×10^{-4}m/s

17.

9.42×10^{13}electrons

18.

0.833 A

20.

7.33×10^{-2} Ω

22.

(a) 0.300 V

(b) 1.50 V

(c) The voltage supplied to whatever appliance is being used is reduced because the total voltage drop from the wall to the final output of the appliance is fixed. Thus, if the voltage drop across the extension cord is large, the voltage drop across the appliance is significantly decreased, so the power output by the appliance can be significantly decreased, reducing the ability of the appliance to work properly.

24.

0.104 Ω

26.

2.8×10^{-2} m

28.

1.10×10^{-3} A

30.

-5C to 45ºC

32.

1.03

34.

0.06%

36.

-17ºC

38.

(a) 4.7 Ω (total)

(b) 3.0% decrease

40.

2.00×10^{12} W

44.

(a) 1.50 W

(b) 7.50 W

46.

$\frac{V^2}{\Omega} = \frac{V^2}{\mathrm{V/A}} = \mathrm{AV} = \left(\frac{C}{s}\right)\left(\frac{J}{C}\right) = \frac{J}{s} = 1\ \mathrm{W}$

48.

$1\ \mathrm{kW}\cdot\mathrm{h}= \left(\frac{1\times10^3\ \mathrm{J}}{1\ \mathrm{s}}\right)(1\ h)\left(\frac{3600\ \mathrm{s}}{1\ \mathrm{h}}\right) = 3.60\times10^6\ \mathrm{J}$

50.

\$438/y

52.

\$6.25

54.

1.58 h

56.

\$3.94 billion/year

58.

25.5 W

60.

(a) 2.00×10^9 J

(b) 769 kg

62.

45.0 s

64.

(a) 343 A

(b) 2.17×10^3 A

(c) 1.10×10^3 A

66.

(a) 1.23×10^3 kg

(b) 2.64×10^3 kg

69.

(a) 2.08×10^5 A

(b) 4.33×10^4 MW

(c) The transmission lines dissipate more power than they are supposed to transmit.

(d) A voltage of 480 V is unreasonably low for a transmission voltage. Long-distance transmission lines are kept at much higher voltages (often hundreds of kilovolts) to reduce power losses.

73.

480 V

75.

2.50 ms

77.

(a) 4.00 kA

(b) 16.0 MW

(c) 16.0%

79.

2.40 kW

81.

(a) 4.0

(b) 0.50

(c) 4.0

83.

(a) 1.39 ms

(b) 4.17 ms

(c) 8.33 ms

85.

(a) 194 kW

(b) 880 A

87.

(a) 0.400 mA, no effect

(b) 26.7 mA, muscular contraction for duration of the shock (can't let go)

89.

$1.20 \times 10^{5}\ \Omega$

91.

(a) 1.00 Ω

(b) 14.4 kW

93.

Temperature increases 860º C. It is very likely to be damaging.

95.

80 beats/minute

97.

$$\frac{3.25\times10^{-3}}{1}\text{j/s} = Power = I^2R = \frac{1}{r^2}\,\frac{(2.50)^2(1.72\times10^{-8})(1.25)}{\pi}\text{jm}^2\text{/s}$$

(a) $r = \sqrt{\frac{(2.50)^2(1.72\times10^{-8})(1.25)}{0.00325\pi}} = \mathbf{3.63\ mm}$

(b) $Power = \frac{(2.50)^2(1.74\times10^{-8})(1.25)}{(3.63\times10^{-3})^2\pi}$j/s, so 3.28 j of energy is expended in 1 s. Since α is specified in the chart to only two significant figures, round to 3.3 j.

(c) Since the energy dissipation is directly proportional to the resistivity, the increase of 0.01% in energy dissipation is when the resistivity increases 1%. Or, $1.01 = 1 + 0.0039\Delta T$. $T = 23^{\circ}$C.