75. Power is generated at 24 kV at a generating plant located 118 km from a town that requires 50 MW of power at 12 kV. Two transmission lines from the plant to the town each have a resistance of 0.10 Ω/km. What should the output voltage of the transformer at the generating plant be for an overall transmission efficiency of 98.5%, assuming a perfect transformer?

76. The primary windings of a transformer which has an 80% efficiency are connected to 110-V ac. The secondary windings are connected across a 2.4-Ω, 75-W lightbulb. (*a*) Calculate the current through the primary windings of the transformer. (*b*) Calculate the ratio of the number of primary windings of the transformer to the number of secondary windings of the transformer.

77. A pair of power transmission lines each have a 0.80-Ω resistance and carry 740 A over 9.0 km. If the rms input voltage is 42 kV, calculate (*a*) the voltage at the other end, (*b*) the power input, (*c*) power loss in the lines, and (*d*) the power output.

78. Two resistanceless rails rest 32 cm apart on a 6.0° ramp. They are joined at the bottom by a 0.60-Ω resistor. At the top a copper bar of mass 0.040 kg (ignore its resistance) is laid across the rails. The whole apparatus is immersed in a vertical 0.55-T field. What is the terminal (steady) velocity of the bar as it slides frictionlessly down the rails?

79. Show that the power loss in transmission lines, P_L, is given by $P_L = (P_T)^2 R_L/V^2$, where P_T is the power transmitted to the user, V is the delivered voltage, and R_L is the resistance of the power lines.

80. A coil with 150 turns, a radius of 5.0 cm, and a resistance of 12 Ω surrounds a solenoid with 230 turns/cm and a radius of 4.5 cm; see Fig. 21–54. The current in the solenoid changes at a constant rate from 0 to 2.0 A in 0.10 s. Calculate the magnitude and direction of the induced current in the coil.

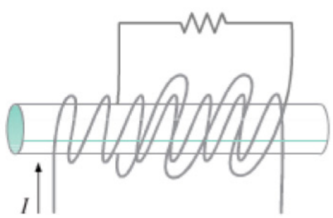

FIGURE 21–54 Problem 80.

81. A certain electronic device needs to be protected against sudden surges in current. In particular, after the power is turned on the current should rise no more than 7.5 mA in the first 120 μs. The device has resistance 150 Ω and is designed to operate at 55 mA. How would you protect this device?

82. A 25-turn 12.5-cm-diameter coil is placed between the pole pieces of an electromagnet. When the magnet is turned on, the flux through the coil changes, inducing an emf. At what rate (in T/s) must the field produced by the magnet change if the emf is to be 120 V?

* **83.** Calculate the peak output voltage of a simple generator whose square armature windings are 6.60 cm on a side; the armature contains 155 loops and rotates in a field of 0.200 T at a rate of 120 rev/s.

* **84.** Typical large values for electric and magnetic fields attained in laboratories are about 1.0×10^4 V/m and 2.0 T. (*a*) Determine the energy density for each field and compare. (*b*) What magnitude electric field would be needed to produce the same energy density as the 2.0-T magnetic field?

* **85.** What is the inductance L of the primary of a transformer whose input is 220 V at 60.0 Hz if the current drawn is 5.8 A? Assume no current in the secondary.

* **86.** A 130-mH coil whose resistance is 18.5 Ω is connected to a capacitor C and a 1360-Hz source voltage. If the current and voltage are to be in phase, what value must C have?

* **87.** An inductance coil draws 2.5-A dc when connected to a 36-V battery. When connected to a 60-Hz 120-V (rms) source, the current drawn is 3.8 A (rms). Determine the inductance and resistance of the coil.

* **88.** A 135-mH inductor with 2.0-Ω resistance is connected in series to a 20-μF capacitor and a 60-Hz, 45-V source. Calculate (*a*) the rms current, and (*b*) the phase angle.

* **89.** The ***Q* factor** of a resonance circuit can be defined as the ratio of the voltage across the capacitor (or inductor) to the voltage across the resistor, at resonance. The larger the Q factor, the sharper the resonance curve will be and the sharper the tuning. (*a*) Show that the Q factor is given by the equation $Q = (1/R)\sqrt{L/C}$. (*b*) At a resonant frequency $f_0 = 1.0$ MHz, what must be the values of L and R to produce a Q factor of 550? Assume that $C = 0.010\ \mu$F.

Answers to Exercises

A: 0.0102 Wb.

B: (*a*) Counterclockwise; (*b*) clockwise; (*c*) zero; (*d*) counterclockwise.

C: Counterclockwise.

D: 10 turns.