8. (II) (*a*) If the resistance of the resistor in Fig. 21–48 is slowly increased, what is the direction of the current induced in the small circular loop inside the larger loop? (*b*) What would it be if the small loop were placed outside the larger one, to the left?

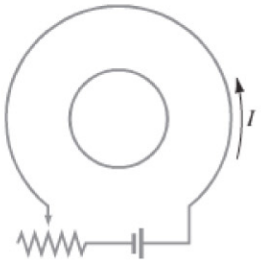

FIGURE 21–48 Problem 8.

9. (II) What is the direction of the induced current in the circular loop due to the current shown in each part of Fig. 21–49?

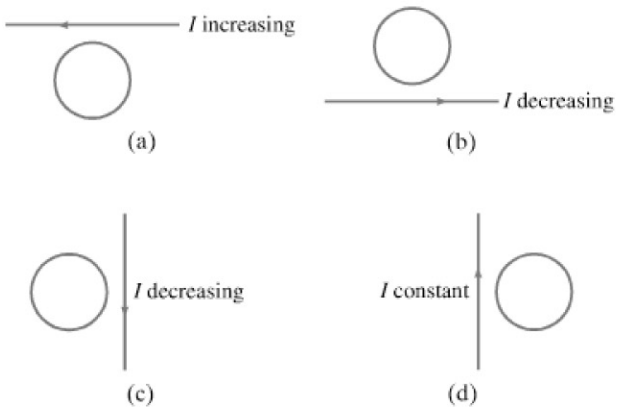

FIGURE 21–49 Problem 9.

10. (II) If the solenoid in Fig. 21–50 is being pulled away from the loop shown, in what direction is the induced current in the loop?

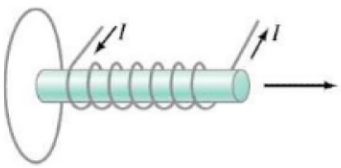

FIGURE 21–50 Problem 10.

11. (II) The magnetic field perpendicular to a circular wire loop 12.0 cm in diameter is changed from +0.52 T to −0.45 T in 180 ms, where + means the field points away from an observer and − toward the observer. (*a*) Calculate the induced emf. (*b*) In what direction does the induced current flow?

12. (II) The moving rod in Fig. 21–12 is 12.0 cm long and is pulled at a speed of 15.0 cm/s. If the magnetic field is 0.800 T, calculate (*a*) the emf developed, and (*b*) the electric field felt by electrons in the rod.

13. (II) A circular loop in the plane of the paper lies in a 0.75-T magnetic field pointing into the paper. If the loop's diameter changes from 20.0 cm to 6.0 cm in 0.50 s, (*a*) what is the direction of the induced current, (*b*) what is the magnitude of the average induced emf, and (*c*) if the coil resistance is 2.5 Ω, what is the average induced current?

14. (II) The moving rod in Fig. 21–12 is 13.2 cm long and generates an emf of 120 mV while moving in a 0.90-T magnetic field. (*a*) What is its speed? (*b*) What is the electric field in the rod?

15. (II) Part of a single rectangular loop of wire with dimensions shown in Fig. 21–51 is situated inside a region of uniform magnetic field of 0.550 T. The total resistance of the loop is 0.230 Ω. Calculate the force required to pull the loop from the field (to the right) at a constant velocity of 3.40 m/s. Neglect gravity.

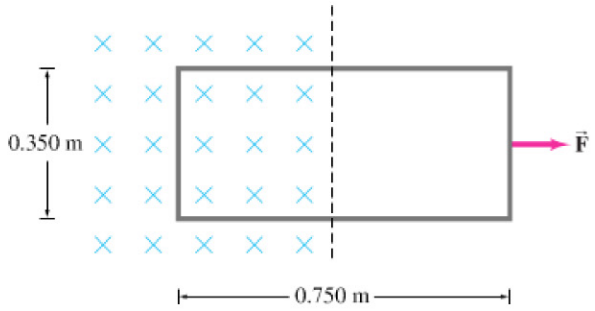

FIGURE 21–51 Problem 15.

16. (II) A 500-turn solenoid, 25 cm long, has a diameter of 2.5 cm. A 10-turn coil is wound tightly around the center of the solenoid. If the current in the solenoid increases uniformly from 0 to 5.0 A in 0.60 s, what will be the induced emf in the short coil during this time?

17. (II) In Fig. 21–12, the rod moves with a speed of 1.6 m/s, is 30.0 cm long, and has a resistance of 2.5 Ω. The magnetic field is 0.35 T, and the resistance of the U-shaped conductor is 25.0 Ω at a given instant. Calculate (*a*) the induced emf, (*b*) the current in the U-shaped conductor, and (*c*) the external force needed to keep the rod's velocity constant at that instant.

18. (III) A 22.0-cm-diameter coil consists of 20 turns of circular copper wire 2.6 mm in diameter. A uniform magnetic field, perpendicular to the plane of the coil, changes at a rate of 8.65×10^{-3} T/s. Determine (*a*) the current in the loop, and (*b*) the rate at which thermal energy is produced.

19. (III) The magnetic field perpendicular to a single 13.2-cm-diameter circular loop of copper wire decreases uniformly from 0.750 T to zero. If the wire is 2.25 mm in diameter, how much charge moves past a point in the coil during this operation?

21–5 Generators

20. (I) A simple generator is used to generate a peak output voltage of 24.0 V. The square armature consists of windings that are 6.0 cm on a side and rotates in a field of 0.420 T at a rate of 60.0 rev/s. How many loops of wire should be wound on the square armature?