Problems Chapter 29

-29 **SSM** In Fig. 29-56, four long straight wires are perpendicular to the page, and their cross sections form a square of edge length \( a = 20 \text{ cm} \). The currents are out of the page in wires 1 and 4 and into the page in wires 2 and 3, and each wire carries 20 A. In unit-vector notation, what is the net magnetic field at the square’s center?

-30 **GO** Two long straight thin wires with current lie against an equally long plastic cylinder, at radius \( R = 20.0 \text{ cm} \) from the cylinder’s central axis.

-37 **GO** In Fig. 29-56, four long straight wires are perpendicular to the page, and their cross sections form a square of edge length \( a = 13.5 \text{ cm} \). Each wire carries 7.50 A, and the currents are out of the page in wires 1 and 4 and into the page in wires 2 and 3. In unit-vector notation, what is the net magnetic force per meter of wire length on wire 4?

-44 Figure 29-67 shows two closed paths wrapped around two conducting loops carrying currents \( i_1 = 6.0 \text{ A} \) and \( i_2 = 3.0 \text{ A} \). What is the value of the integral \( \oint B \cdot ds \) for (a) path 1 and (b) path 2?

-45 **SSM** Each of the eight conductors in Fig. 29-68 carries 2.0 A of current into or out of the page. Two paths are indicated for the line integral \( \oint B \cdot ds \). What is the value of the integral for (a) path 1 and (b) path 2?
27. As seen in Fig. 30-48, a square loop of wire has sides of length 2.0 cm. A magnetic field is directed out of the page; its magnitude is given by $B = 4.0 t^2 y$, where $B$ is in teslas, $t$ is in seconds, and $y$ is in meters. At $t = 2.5$ s, what are the (a) magnitude and (b) direction of the emf induced in the loop?

![Fig. 30-48 Problem 27.](image)

28. In Fig. 30-49, a rectangular loop of wire with length $a = 2.2$ cm, width $b = 0.80$ cm, and resistance $R = 0.40$ m$\Omega$ is placed near an infinitely long wire carrying current $i = 6.9$ A. The loop is then moved away from the wire at constant speed $v = 3.2$ mm/s. When the center of the loop is at distance $r = 1.5b$, what are (a) the magnitude of the magnetic flux through the loop and (b) the current induced in the loop?

![Fig. 30-49 Problem 28.](image)

sec. 30-5 Induction and Energy Transfers

29. In Fig. 30-50, a metal rod is forced to move with constant velocity $\vec{v}$ along two parallel metal rails, connected with a strip of metal at one end. A magnetic field of magnitude $B = 0.350$ T points out of the page. (a) If the rails are separated by $L = 25.0$ cm and the speed of the rod is 55.0 cm/s, what emf is generated? (b) If the rod has a resistance of 18.0 $\Omega$ and the rails and connector have

![Fig. 30-50 Problems 29 and 35.](image)