31. (II) An experiment on the Earth's magnetic field is being carried out 1.00 m from an electric cable. What is the maximum allowable current in the cable if the experiment is to be accurate to ±1.0%?

32. (II) A power line carries a current of 95 A along the tops of 8.5-m-high poles. What is the magnitude of the magnetic field produced by this wire at the ground? How does this compare with the Earth's field of about $\frac{1}{2}$ G?

33. (II) Two long thin parallel wires 13.0 cm apart carry 25-A currents in the same direction. Determine the magnetic field at point P, 12.0 cm from one wire and 5.0 cm from the other (Fig. 20–55).

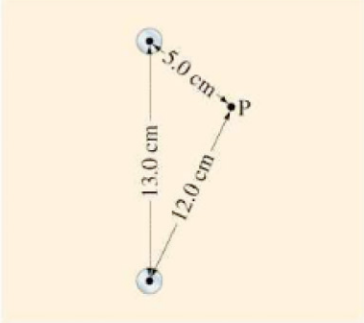

FIGURE 20–55
Problem 33.

34. (II) A horizontal compass is placed 18 cm due south from a straight vertical wire carrying a 35-A current downward. In what direction does the compass needle point at this location? Assume the horizontal component of the Earth's field at this point is 0.45×10^{-4} T and the magnetic declination is 0°.

35. (II) A long horizontal wire carries 22.0 A of current due north. What is the net magnetic field 20.0 cm due west of the wire if the Earth's field there points north but downward, 37° below the horizontal, and has magnitude 5.0×10^{-5} T?

36. (II) A straight stream of protons passes a given point in space at a rate of 1.5×10^{9} protons/s. What magnetic field do they produce 2.0 m from the beam?

37. (II) Determine the magnetic field midway between two long straight wires 2.0 cm apart in terms of the current I in one when the other carries 15 A. Assume these currents are (*a*) in the same direction, and (*b*) in opposite directions.

38. (II) A long pair of wires conducts 25.0 A of dc current to, and from, an instrument. If the insulated wires are of negligible diameter but are 2.8 mm apart, what is the magnetic field 10.00 cm from their midpoint, in their plane (Fig. 20–56)? Compare to the magnetic field of the Earth.

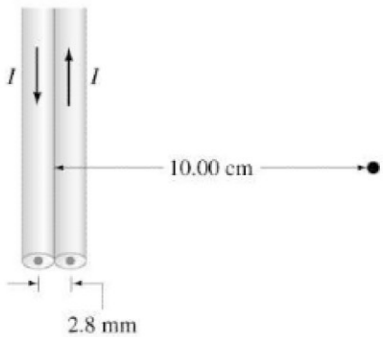

FIGURE 20–56
Problems 38 and 39.

39. (II) A third wire is placed in the plane of the two wires shown in Fig. 20–56, parallel and just to the right. If it carries 25.0 A upward, what force per meter of length does it exert on each of the other two wires? Assume it is 2.8 mm from the nearest wire, center to center.

40. (II) A compass needle points 23° E of N outdoors. However, when it is placed 12.0 cm to the east of a vertical wire inside a building, it points 55° E of N. What are the magnitude and direction of the current in the wire? The Earth's field there is 0.50×10^{-4} T and is horizontal.

41. (II) A rectangular loop of wire lies in the same plane as a straight wire, as shown in Fig. 20–57. There is a current of 2.5 A in both wires. Determine the magnitude and direction of the net force on the loop.

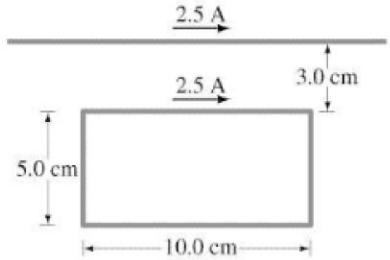

FIGURE 20–57 Problem 41.

42. (II) A long horizontal wire carries a current of 48 A. A second wire, made of 2.5-mm-diameter copper wire and parallel to the first, is kept in suspension magnetically 15 cm below (Fig. 20–58). (*a*) Determine the magnitude and direction of the current in the lower wire. (*b*) Is the lower wire in stable equilibrium? (*c*) Repeat parts (*a*) and (*b*) if the second wire is suspended 15 cm *above* the first due to the latter's field.

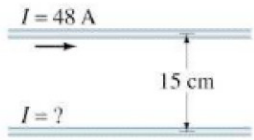

FIGURE 20–58 Problem 42.

43. (II) Two long wires are oriented so that they are perpendicular to each other. At their closest, they are 20.0 cm apart (Fig. 20–59). What is the magnitude of the magnetic field at a point midway between them if the top one carries a current of 20.0 A and the bottom one carries 5.0 A?

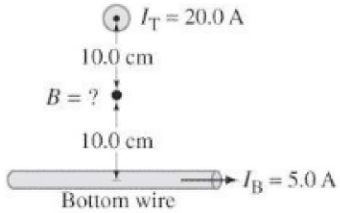

FIGURE 20–59 Problem 43.