C and J Magnetism Q's

Ch 21.

CQ 14. The drawing shows and end-on view of three parallel wires that are perpendicular to the plane of the paper. In two of the wires the current is directed into the paper, while in the remaining wire, the current is directed out of the paper. The two outermost wires are held rigidly in place. Which way will the middle wire move? Explain.

Problems

7. An electron is moving through a magnetic field whose magnitude is 8.70×10^{-4} T. The electron experiences only a magnetic force and has an acceleration of magnitude 3.50×10^{14} m/s^2. At a certain instant, it has a speed of 6.80×10^6 m/s. Determine the angle θ (less than 90°) between the electron's velocity and the magnetic field.

11. An electron moves at a speed of 6.0×10^6 m/s perpendicular to a constant magnetic field. The path is a circle of radius 1.3×10^{-3} m. (a) Draw a sketch showing the magnetic field and the electron's path. (b) What is the magnitude of the field? (c) Find the magnitude of the electron's acceleration.

12. A charged particle enters a uniform magnetic field and follows the circular path shown in the drawing. (a) Is the particle positively or negatively charged? Why? (b) The particle's speed is 140 m/s, the magnitude of the magnetic field is 0.48 T, and the radius of the path is 960 m. Determine the mass of the particle, given that its charge has a magnitude of 8.2×10^{-4} C.

13. A charged particle with a charge-to-mass ratio of $q/m = 5.7 \times 10^8$ C/kg travels on a circular path that is perpendicular to a magnetic field whose magnitude is 0.72 T. How much time does it take for the particle to complete one revolution?

14. The solar wind is a thin, hot gas given off by the sun. Charged particles in this gas enter the magnetic field of the earth and can experience a magnetic force. Suppose a charged particle traveling with a speed of 9.0×10^6 m/s encounters the earth's magnetic field at an altitude where the field has a magnitude of 1.2×10^{-7} T. Assuming that the particle's velocity is perpendicular to the magnetic field, find the radius of the circular path on which the particle would move if it were (a) an electron and (b) a proton.

15. A beam of protons moves in a circle of radius 0.25 m. The protons move perpendicular to a 0.30-T magnetic field. (a) What is the speed of each proton? (b) Determine the magnitude of the centripetal force that acts on each proton.

21. A proton with a speed of 3.5×10^6 m/s is shot into a region between two plates that are separated by a distance of 0.23 m. As the drawing shows, a magnetic field exists between the plates, and it is perpendicular to the velocity of the proton. What must be the magnitude of the magnetic field, so the proton just misses colliding with the opposite plate?

26. A 45-m length of wire is stretched horizontally between two vertical posts. The wire carries a current of 75 A and experiences a magnetic force of 0.15 N. Find the magnitude of the earth's magnetic field at the location of the wire, assuming the field makes an angle of 60.0° with respect to the wire.

27. An electric power line carries a current of 1400 A in a location where the earth's magnetic field is 5.0×10^{-5} T. The line makes an angle of 75° with respect to the field. Determine the magnitude of the magnetic force on a 120-m length of line.

28. A wire carries a current of 0.66 A. This wire makes an angle of 58° with respect to a magnetic field of magnitude 4.7×10^{-5} T. The wire experiences a magnetic force of magnitude 7.1×10^{-5} N. What is the length of the wire?

29. A square coil of wire containing a single turn is placed in a uniform 0.25-T magnetic field, as the drawing shows. Each side has a length of 0.32 m, and the current in the coil is 12 A. Determine the magnitude of the magnetic force on each of the four sides.

30. The triangular loop of wire shown in the drawing carries a current of I = 4.70 A. A uniform magnetic field is directed parallel to side AB of the triangle and has a magnitude of 1.80 T. (a) Find the magnitude and direction of the magnetic force exerted on each side of the triangle. (b) Determine the magnitude of the net force exerted on the triangle.

46. A long straight wire carries a current of 48 A. The magnetic field produced by this current at a certain point is 8.0×10^{-5} T. How far is the point from the wire?

47. In a lightning bolt, 15 C of charge flows in a time of 1.5×10^{-3} s. Assuming that the lightning bolt can be represented as a long, straight line of current, what is the magnitude of the magnetic field at a distance of 25 m from the bolt?

50. A +600 μC charge is moving with a speed of 7.50×10^{4} m/s parallel to a very long, straight wire. The wire is 5.00 cm from the charge and carries a current of 67.0 A in a direction opposite to that of the moving charge. Find the magnitude and direction of the force on the charge.

51. Two rigid rods are oriented parallel to each other and to the ground. The rods carry the same current in the same direction. The length of each rod is 0.85 m, while the mass of each is 0.073 kg. One rod is held in place above the ground, and the other floats beneath it at a distance of 8.2×10^{-3} m. Determine the current in the rods.

54. As background for this problem, review Conceptual Example 9. A rectangular current loop is located near a long, straight wire that carries a current of 12 A (see the drawing). The current in the loop is 25 A. Determine the magnitude of the net magnetic force that acts on the loop.

56. Two long, straight parallel wires A and B are separated by a distance of one meter. They carry currents in opposite directions, and the current in wire A is one-third of that in wire B. On a line drawn perpendicular to the wires, find the point where the net magnetic field is zero. Determine this point relative to wire A.

Conceptual Questions

Ch.32

Knight

2. The metal sphere in FIGURE Q32.2 hangs by a thread. When the north pole of a magnet is brought near, the sphere is strongly attracted to the magnet. Then the magnet is reversed and its south pole is brought near the sphere. How does the sphere respond? Explain.

4. What is the current direction in the wire of FIGURE Q32.4? Explain.

5. What is the current direction in the wire of FIGURE Q32.5? Explain.

6. What is the initial direction of deflection for the charged particles entering magnetic fields shown in FIGURE Q32.6?

7. What is the initial direction of deflection for the charged particles entering the magnetic fields shown in FIGURE Q32.7?

Exercises and Problems

1. Points 1 and 2 in FIGURE EX32.1 are the same distance from the wires as the point where B = 2.0 mT. What are the strength and direction of B at points 1 and 2?
2. What is the magnetic field strength at points 2 to 4 in FIGURE EX32.2? Assume that the wires overlap closely and that points 1 to 4 are equally distant from the wires.
3. A proton moves along the x-axis with v_x = 1.0 x 10^7 m/s. As it passes the origin, what are the strength and direction of the magnetic field at (x,y,z) positions (a) (1 cm, 0 cm, 0 cm), (b) (0 cm, 1 cm, 0 cm), and (c) (0 cm, - 2 cm, 1 cm)?
4. An electron moves along the z-axis with v_z = 2.0 X 10^7 m/s. As it passes the origin, what are the strength and direction of the magnetic field at the (x,y,z) positions (a) (1 cm, 0 cm, 0 cm), (b) (0 cm, 0 cm, 1 cm), and (c) (0 cm, 1 cm, 1 cm)?
5. What is the magnetic field at the position of the dot in FIGURE EX32.5? Give your answer as a vector.
6. What is the magnetic field at the position of the dot in FIGURE EX32.6? Give your answer as a vector.

13. What are the magnetic fields at point a to c in FIGURE EX32.13? Give your answers as vectors.

14. What are the magnetic field strength and direction at points a to c in FIGURE EX32.14?

26. A proton moves in the magnetic field $\vec{B}$ = 0.50$\hat{\imath}$ T with a speed of 1.0 X 10^7 m/s in the directions shown in FIGURE EX32.26. For each, what is magnetic force $\vec{F}$ on the proton? Give your answers in component form.

27. An electron moves in the magnetic field $\vec{B}$ = 0.50$\hat{\imath}$ T with a speed of 1.0 X 10^7 m/s in the directions shown in FIGURE EX32.27. For each, what is magnetic force $\vec{F}$ on the electron? Give your answers in component form.