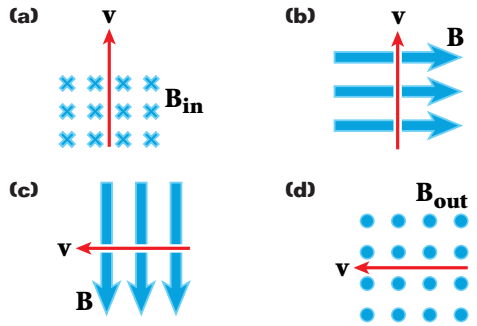
33. A thin 1.00 m long copper rod in a uniform magnetic field has a mass of 50.0 g. When the rod carries a current of 0.245 A, it floats in the magnetic field. What is the field strength of the magnetic field?

MIXED REVIEW

34. A proton moves at 2.50×10^6 m/s horizontally at a right angle to a magnetic field.

- **a.** What is the strength of the magnetic field required to exactly balance the weight of the proton and keep it moving horizontally?
- **b.** Should the direction of the magnetic field be in a horizontal or a vertical plane?

35. Find the direction of the force on a proton moving through each magnetic field in the four figures below.



36. Find the direction of the force on an electron moving through each magnetic field in the four figures in item 35 above.

37. In the four figures in item 35, assume that in each case the velocity vector shown is replaced with a wire carrying a current in the direction of the velocity vector. Find the direction of the magnetic force acting on each wire.

38. A proton moves at a speed of 2.0×10^7 m/s at right angles to a magnetic field with a magnitude of 0.10 T. Find the magnitude of the acceleration of the proton.

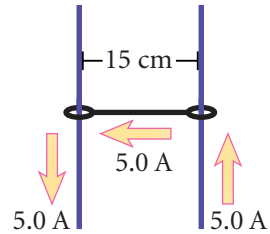
39. A proton moves perpendicularly to a uniform magnetic field, **B,** with a speed of 1.0×10^7 m/s and experiences an acceleration of 2.0×10^{13} m/s^2 in the positive x direction when its velocity is in the positive z direction. Determine the magnitude and direction of the field.

40. A proton travels with a speed of 3.0×10^6 m/s at an angle of 37° west of north. A magnetic field of 0.30 T points to the north. Determine the following:

- **a.** the magnitude of the magnetic force on the proton
- **b.** the direction of the magnetic force on the proton
- **c.** the proton's acceleration as it moves through the magnetic field

(Hint: The magnetic force experienced by the proton in the magnetic field is proportional to the component of the proton's velocity that is perpendicular to the magnetic field.)

41. In the figure below, a 15 cm length of conducting wire that is free to move is held in place between two thin conducting wires. All the wires are in a magnetic field. When a 5.0 A current is in the wire, as shown in the figure, the wire segment moves upward at a constant velocity. Assuming the wire slides without friction on the two vertical conductors and has a mass of 0.15 kg, find the magnitude and direction of the minimum magnetic field that is required to move the wire.



42. A current, $I = 15$ A, is directed along the positive x-axis and perpendicular to a uniform magnetic field. The conductor experiences a magnetic force per unit length of 0.12 N/m in the negative y direction. Calculate the magnitude and direction of the magnetic field in the region through which the current passes.

43. A proton moving perpendicular to a magnetic field of strength 3.5 mT experiences a force due to the field of 4.5×10^{-21} N. Calculate the following:

- **a.** the speed of the proton
- **b.** the kinetic energy of the proton

Recall that a proton has a charge of 1.60×10^{-19} C and a mass of 1.67×10^{-27} kg.