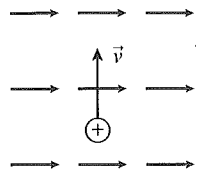
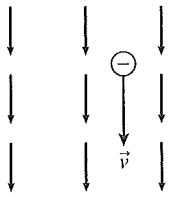
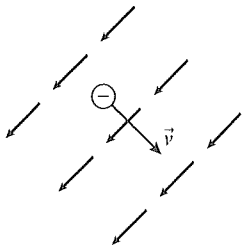
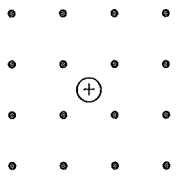
33.7 The Magnetic Force on a Moving Charge

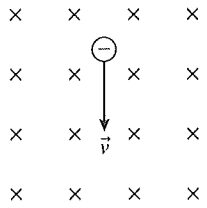
27. For each of the following, draw the magnetic force vector on the charge or, if appropriate, write "$\vec{F}$ into page," "$\vec{F}$ out of page," or "$\vec{F} = \vec{0}$."

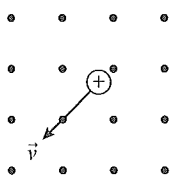
a. 

b. 

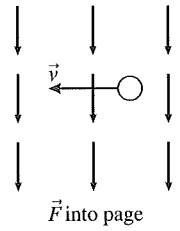
c. 

d. 

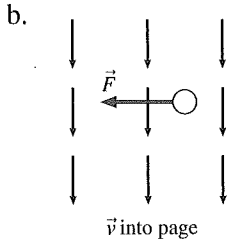
e. 

f. 

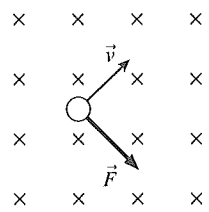
28. For each of the following, determine the sign of the charge (+ or −).

a. 

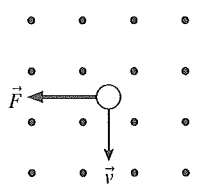
$q =$ _____

b. 

$q =$ _____

c. 

$q =$ _____

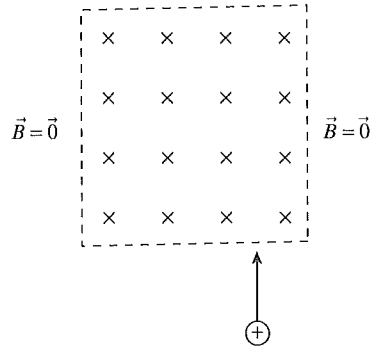
d. 

$q =$ _____

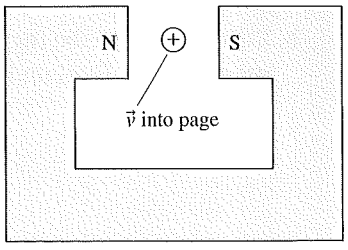
29. The magnetic field is constant magnitude inside the dashed lines and zero outside. Sketch and label the trajectory of the charge for

a. A weak field.

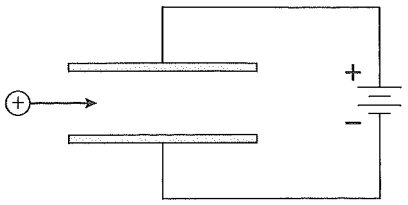
b. A strong field.



30. A positive ion, initially traveling into the page, is shot through the gap in a horseshoe magnet. Is the ion deflected up, down, left, or right? Explain.



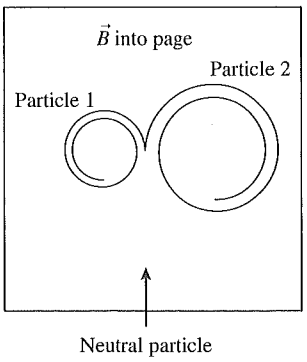
31. A positive ion is shot between the plates of a parallel-plate capacitor.



a. In what direction is the electric force on the ion?

b. Could a magnetic field exert a magnetic force on the ion that is opposite in direction to the electric force? If so, show the magnetic field on the figure.

32. In a high-energy physics experiment, a neutral particle enters a bubble chamber in which a magnetic field points into the page. The neutral particle undergoes a collision inside the bubble chamber, creating two charged particles. The subsequent trajectories of the charged particles are shown.

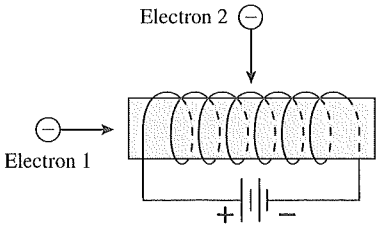


a. What is the sign (+ or −) of particle 1? _____

What is the sign (+ or −) of particle 2? _____

b. Which charged particle leaves the collision with a larger momentum? Explain. (Assume that $|q| = e$ for both particles.)

33. A solenoid is wound as shown and attached to a battery. Two electrons are fired into the solenoid, one from the end and one through a very small hole in the side.

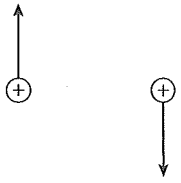


a. In what direction does the magnetic field inside the solenoid point? Show it on the figure.

b. Is electron 1 deflected as it moves through the solenoid? If so, in which direction? If not, why not?

c. Is electron 2 deflected as it moves through the solenoid? If so, in which direction? If not, why not?

34. Two protons are traveling in the directions shown.



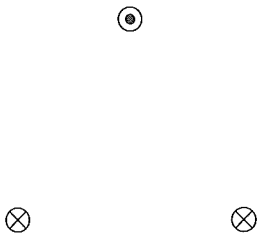
a. Draw and label the electric force on each proton due to the other proton.

b. Draw and label the magnetic force on each proton due to the other proton. Explain how you determined the directions.

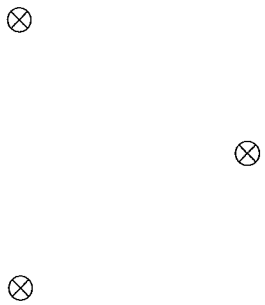
33.8 Magnetic Forces on Current-Carrying Wires

33.9 Forces and Torques on Current Loops

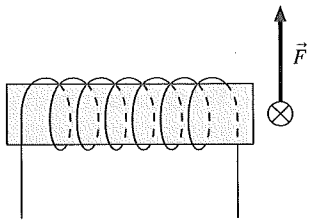
35. Three current-carrying wires are perpendicular to the page. Construct a force vector diagram on the figure to find the net force on the upper wire due to the two lower wires.



36. Three current-carrying wires are perpendicular to the page.
    a. Construct a force vector diagram on each wire to determine the direction of the net force on each wire.
    b. Can three *charges* be placed in a triangular pattern so that their force diagram looks like this? If so, draw it below. If not, why not?

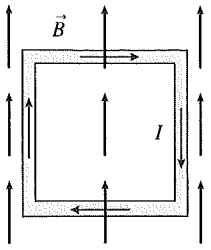


37. A current-carrying wire passes in front of a solenoid that is wound as shown. The wire experiences an upward force. Use arrows to show the direction in which the current enters and leaves the solenoid. Explain your choice.



38. A current loop is placed between two bar magnets. Does the loop move to the right, move to the left, rotate clockwise, rotate counterclockwise, some combination of these, or none of these? Explain.

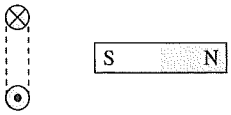
39. A square current loop is placed in a magnetic field as shown.



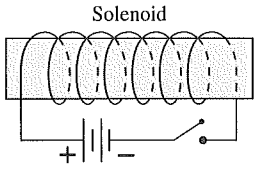
a. Does the loop undergo a displacement? If so, is it up, down, left, or right? If not, why not?

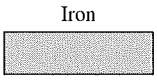
b. Does the loop rotate? If so, which edge rotates out of the page and which edge into the page? If not, why not?

40. The south pole of a bar magnet is brought toward the current loop. Does the bar magnet attract the loop, repel the loop, or have no effect on the loop? Explain.



33.10 Magnetic Properties of Matter





41. A solenoid, wound as shown, is placed next to an unmagnetized piece of iron. Then the switch is closed.

a. Identify on the figure the north and south poles of the solenoid.

b. What is the direction of the solenoid's magnetic field as it passes through the iron?

c. What is the direction of the induced magnetic dipole in the iron?

d. Identify on the figure the north and south poles of the induced magnetic dipole in the iron.

e. When the switch is closed, does the iron move left or right? Does it rotate? Explain.