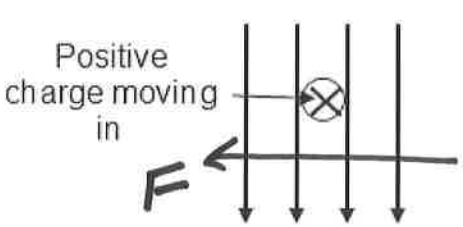
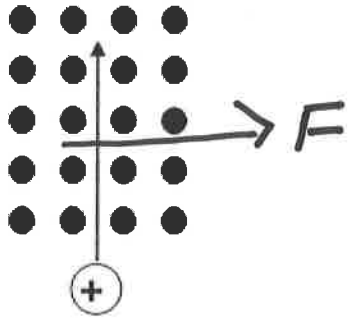
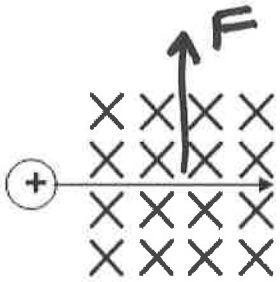
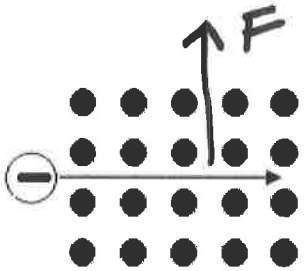
Magnetic Force Direction on a Moving Charge:

1. Determine the direction of the force on a moving charge in the diagrams below.





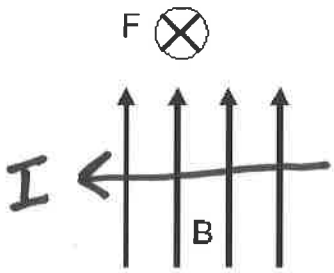


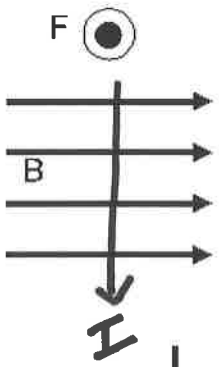


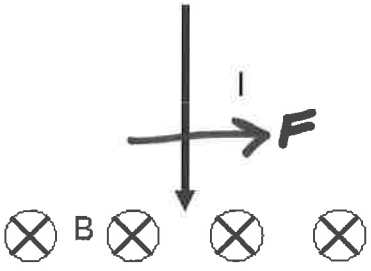
Magnetic Force on a Current Carrying Wire:

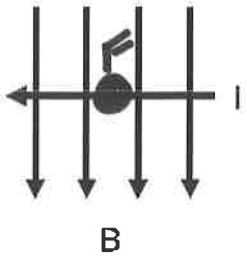
Force Direction on a Wire - Use RHR, positive charge moving + to - :

1. Use the right hand rule to find the direction of the current or the force in the diagrams below:









Magnetic Force on a Moving Charge:

$F = Bqv$

$B =$ Magnetic field strength in Teslas (T)

$q =$ Charge of the object in Coulombs (C)

$v =$ Velocity of the object (m/s)

Magnetic Force on a wire:

From our experience in the lab, we also know that a wire with a current in it also contains moving charges and will experience a force on it if it is placed in a magnetic field. Starting with the equation for a moving charge, derive an equation for the force on a current carrying wire.

$F = BIL$

$B =$ Magnetic field strength in Teslas (T)

$I =$ Current in the wire (A)

$L =$ Length of the wire (L)

Magnetic Force Problems:

For each problem calculate the missing value and draw a diagram of the force, field, and direction of the velocity or current.

1. A positive charge of 0.55 C moves to the right at 100 m/s and enters a magnetic field of 0.80 T directed downward into the page. What is the magnitude and initial direction of the force on the charge?

$F = BqV$

$= .8(.55)(100)$

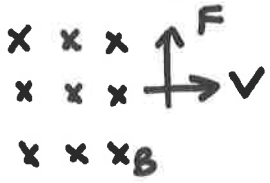
$F = 44\ N$

$V = 100 \rightarrow$

$q = .55$

$B = 0.8 \otimes$

Draw and Label a diagram of the problem



2. A straight wire of 5.0 m long conducts a current of 4.00 A toward the bottom of the page, if the wire experiences a force of 0.02 N to the left. What is the magnitude and direction of the magnetic field?

$F = 0.02N \leftarrow$

$I = 4.0A \downarrow$

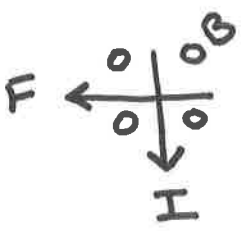
$L = 5.0\ m$

$F = BIL$

$.02 = B(4)(5)$

$B = \frac{.02}{20} = 0.001\ T$

Draw and Label a diagram of the problem



3. A magnetic field of 0.015 T is directed into the page. Find the force on a straight 0.75 m long wire with a 15 amp current. If the force on the wire is directed toward the bottom of the page, what is the direction of the current?

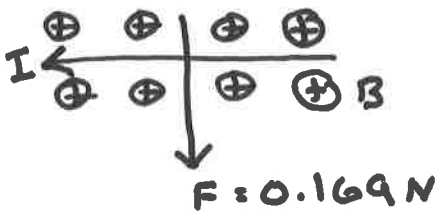
$B = 0.015\ T \otimes$ $F = BIL$

$L = 0.75\ m$ $F = .015(15)(.75)$

$I = 15\ A$ $F = 0.169\ N$

$F = ?$ ↓

Draw and Label a diagram of the problem



$F = 0.169\ N$

4. An electron traveling at 10,000 m/s to the East enters a uniform magnetic field and experiences a force of 9.0×10^{-11} N directed up (out of the page). What is the magnitude and direction of the magnetic field? $q_e = 1.6 \times 10^{-19}$ C

$V = 10{,}000 \rightarrow E$

$F = 9 \times 10^{-11}\ N \bullet$

$q = 1.6 \times 10^{-19}$

Draw and Label a diagram of the problem

$F = B\,q\,V$

$9 \times 10^{-11} = B\,(1.6 \times 10^{-19})\,10{,}000$

$$\frac{9 \times 10^{-11}}{1.6 \times 10^{-15}}$$

$B = 56{,}250\ T$