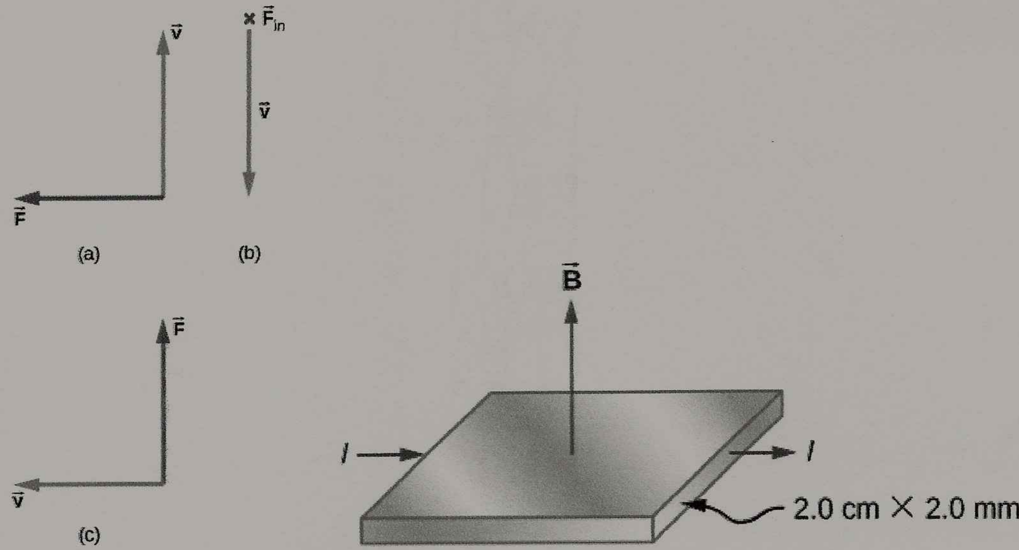

Figure 1: (Left) A current I experiences a force F in a B-field.

2 Chapter 11: Magnetic Forces and Fields

1. Consider Fig. 1 (left). In each of the three cases, determine the direction of the B-field given that F is the Lorentz force.
   - a: In the Page
   - b: Left
   - c: out the Page

2. Consider Fig. 1 (right). **The Hall Effect**. An E-field exists in the vertical direction and a B-field is perpendicular to the direction of charge velocity. (a) Show that if the E-field force on a charge balances the Lorentz force on a charge, that $v = E/B$. (b) If the E-field is constant, $E = \Delta V/\Delta x$. Show that

$$\Delta V = \frac{B\Delta x I}{n q_e A} \tag{1}$$

a) $F = E$
$F = qv \cdot B$
$\cancel{q}E = \cancel{q}vB$
$\frac{E}{B} = \frac{vB}{B}$ $\boxed{v = \frac{E}{B}}$
If charge balances they cancel out

where n is the charge carrier density, q_e is the electron charge, A is the cross-sectional area of the conductor, and I is the current. Plug in $B = 1.33$ T, $\Delta x = 2$ cm, $I = 10$ A, $n = 2 \times 10^{28}$ m^{-3}, $A = 1$ mm^2, and q_e is the charge of an electron.

b) $E = \frac{\Delta V}{\Delta x}$ $\Delta V = E\Delta x$
$E = vB$
$\Delta V = vB\Delta x$
$= I/nq_eA = v$
$V = \frac{I}{nq_eA}(B\Delta x)$ $\boxed{V = \frac{IB\Delta l}{nq_e A}}$

$\frac{(10A)(1.33)(2\cdot10^{-2}cm)}{(2\cdot10^{28}m^{-3})(1.6\cdot10^{-19})(1\cdot10^{-6}m^2)}$ $\frac{.266}{3200}$
$\boxed{8.31\cdot10^{-5}V}$

3. A proton has a magnetic field due to its spin. The field is similar to that created by a circular current loop 0.65×10^{-15} m in radius with a current of 1.05×10^{4} A. Find the maximum torque on a proton in a 2.50-T field. (This is a significant torque on a small particle.)

$\tau = NIAB$
$(1)(1.05\cdot10^4)(\pi)(.65\cdot10^{-15})(2.5) = \boxed{3.48\cdot10^{-26}\ N\cdot m}$

3 Chapter 12: Sources of Magnetic Fields

1. (a) What is the B-field inside a solenoid with 500 turns per meter, carrying a current of 0.3 A? (b) Suppose we insert a piece of metal inside the solenoid, boosting μ_0 by a factor of 5000. What is the new B-field?

b) $(6.28\cdot10^{-3})(500)(.3) = $ b) $\boxed{.942T}$

$B = (\mu_0)(N)(I)$
$(1.26\cdot10^{-6})5000$
a) $(4\pi\cdot10^{-7})(500)(.3)$ a)
$(1.26\cdot10^{-6})(500)(.3) = \boxed{1.88\cdot10^{-4}T}$