Chapter 22 – Problems 1, 3, 5, question 4, 9, 11, 15, 17, 19, 20, 21, 22, 24, 27, 31, 32

1. The force on a wire carrying current I is $F = ILB\sin(\text{theta})$, where theta is the angle of the wire with respect to the magnetic field **B**. Remember that F and B are the magnitudes of the vector force **F** and the vector field **B**. For this problem, the theta is 90 degrees, so that $\sin(90^o) = 1.0$.

   F = (30 A)(0.50 m)(0.50 T) = 7.5 N.

   To find the direction of this force, use your right hand and point your thumb straight westward along the direction of I. then, keeping your thumb pointing westward, simultaneously point your fingers straight downward in the direction of **B**. Since your palm faces southward, that is the direction of the force.

3. This problem uses the same equation as in problem (1). The units of **B**, however are given in gauss (G) instead of Tesla (T), where 1 T = 10,000 G. In each case, if you point your right-hand thumb along the direction of I and your fingers along **B** (to the right of the page), your palm points "into" the page. The force in each case is

   F_1 = (15 A)(0.50 m)(0.0250 T)$\sin(90^o)$ = 0.188 into the page.
   F_2 = (15 A)(0.50 m)(0.0250 T)$\sin(60^o)$ = 0.162 into the page.
   F_1 = (15 A)(0.50 m)(0.0250 T)$\sin(0^o)$ = 0.

5. This problem again uses the equation $F = ILB\sin(\text{theta})$. Note that according to the definition of theta, $B\sin(\text{theta})$ is often stated as $B_{perpendicular}$, which is just the component of B that is perpendicular to the direction of current. For this problem, the current is upward from the earth's surface and the component of **B** that is perpendicular to the current is northward. Thus, point your right thumb upward and your fingers northward. Your palm then faces westward in the direction of the force. The magnitude of the force is

   F = (17 A)(2.0 m)(0.30 x 10^{-4} T) = 1.0 x 10^{-4} N (westward)

   Question 4, (not problem 4).

   The field due to the bar magnet is exactly as shown in Figure 22.4 (b) of the book. Now look at the diagram for the question. The direction of the magnetic field all along the wire is downward and inward toward the center. This means that all along the wire there is a force acting inward and upward. Because of the symmetry, the inward component of force all along the wire cancels out, but the upward component adds. Therefore there is a net upward force.