Physics 112
Homework on Magnetism

Name: _____

Show all your work for each question. Explain your answers (in words) when indicated. Value: 6 points.

1. *[0.5 point]* The "normal" vector to the *yz* plane must point in which direction? Draw a sketch to explain.

2. *[0.5]* A uniform magnetic field points in the negative y direction. A square loop of wire carrying a current is placed at the origin. The normal to the plane of the loop points in the positive z direction. Then:
   A) Is there a net force on the loop? If so, in which direction? Explain.
   B) Is there a net torque on the loop? Explain your answer with a sketch.

3. *[1]* Wire "A" is parallel to the y axis, at x = –3 m; it carries an unchanging current of 4 A flowing toward positive y. Wire "B" is parallel to the y axis, at x = +3 m. When the current in wire "B" is zero, the magnitude of the magnetic field at the origin is "*n*" teslas. When wire "B" carries a 12 A current flowing toward positive y, what is the magnitude of the ***net*** magnetic field at the origin? Explain your answer in detail.

4. *[0.5]* A 5 T magnetic field points everywhere in the y direction. An electric field of magnitude 5 N/C points everywhere in the x direction. A proton is moving ***along the y axis toward positive y*** at 5 m/s. At the moment the proton passes the origin, is the magnitude of the magnetic force on the proton *greater than*, *less than*, or *equal to* the magnitude of the electric force on the proton? Is this force zero or nonzero?

5. *[0.5]* A uniform magnetic field points in the positive y direction. A square loop of wire carrying a current is placed at the origin. The plane of the loop is in the *xz* plane.
   a) Will the loop twist? If so, describe (or sketch) how it will twist.(E.g., around which axis will it rotate?)
   b) Will the loop move away from the origin? If so, which way will it go?

6. *[1]* A loop of wire is placed in a magnetic field, and an ammeter is connected to the loop to measure current flow. Which type of magnetic field will result in the greatest magnitude of current flow in the loop **(**circle one for each):
   a) orientation relative to the plane of the loop [*perpendicular, parallel,* or *at a 45 degree angle*]*?*
   b) initial magnitude [*0 T, 1 T, 100 T,* or *independent of initial value*]?
   c) magnetic field magnitude [*increasing, decreasing,* or *either increasing or decreasing (doesn't matter which)*]*?*
   d) magnetic field magnitude changing at a rate of [*0.1 T per second, 1 T per second, or 10 T per second*]*?* Explain your answer.

7. *[0.5]* A circular conducting loop sits in a magnetic field; the magnetic field is perpendicular to the plane of the loop. The magnetic field is decreasing at 2 T/s, and the current in the loop is 3 A clockwise. If the magnetic field were ***increasing*** at 6 T/s, what would be the magnitude and direction of the current in the loop?

8. *[1]* A proton travels at 1000 meters per second through a magnetic field of magnitude 1.44 T; its velocity is perpendicular to the direction of the field. It passes 0.1 cm away from an electron. At that moment, what is the ratio of the magnetic force on the proton, to the electric force? [Magnetic Force ÷ Electric Force = ?]

9. *[0.5]* Two parallel wires carry currents I_1 and I_2 in the same direction. I_2 is double the value of I_1. ***There are no other currents or magnetic fields anywhere nearby.*** Will the magnitude of the force on the wire carrying current I_1 be *greater than, equal to*, or *less than* the magnitude of the force on the wire carrying current I_2? Explain.