Electromagnetism & Light **Name** :_____

Practice Exam 2

1) [25 points] An electron moves with an initial velocity $\overrightarrow{v}_0$ through a uniform magnetic field $\overrightarrow{B}$.

$$\overrightarrow{v}_0 = 1000(\hat{x} + \hat{y}) \qquad \overrightarrow{B} = 5\hat{x}$$

1. Determine the subsequent spiral motion of the particle. Include the radius of the spiral, the frequency of rotation, linear component of the velocity and the direction of rotation.

2. Determine the magnitude and direction of the constant electric field $\overrightarrow{E}$ whose addition would cause the electron to travel in a straight line.

2) [25 points] A DC power line is strung 10 meters above the ground and aligned with the earth's magnetic field. When we hold a magnetic compass on the ground below the power line we see it points 10 degrees away from the the direction of the earth's magnetic field.

$$B_{earth} = 5.0 \times 10^{-5} T$$

1. Determine the current in power line.

2. Determine the angular deflection of the compass 2 meters below the powerline.

3) [25 points] A massless 3 meter long bar has +1 mC charge "glued" to one side and +1 mC charge glued to the other. We begin to rotate the bar at a frequency of 10 Hz around a pivot point 1 meter from the +1 C end.

1. Determine the current generated by each moving charge.

2. Determine the total magnetic moment of the contraption.

3. Determine the magnetic field at the center of rotation.

4) [25 points] A coaxial cable consists of a tubular inner conductor of radius a surrounded by a tubular outer conductor of radius b. The two carry equal currents but in opposite directions. The current density is distributed uniformly over each conductor.

1. Determine the magnetic field in the three regions: $r < a$, $a < r < b$ and $r > b$.

2. Graph $B(r)$.