Electromagnetism & Light **Name** :_____

Exam 2

Choose four of the five questions

1) [25 points] Starting form the origin 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 equation of motion for the electron's position $\overrightarrow{r}(t)$.

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.

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

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 C charge "glued" to one side and -1 C 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 and the field at the center of rotation.

3. Determine the magnetic potential energy of the rotating contraption.

4) [25 points] A coaxial cable consists of a solid inner conductor of radius a surrounded by a thin 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 $B(r)$.

5 [25 points] For the circuit drawn below determine the following:

1. Determine the equivalent resistance of the circuit.
2. Determine the total current through the circuit.
3. Determine the voltage drop across each resistor.
4. Determine the current through each resistor.
5. Determine the power dissipated in each resistor.