Exam # 3 – Physics 152
Magnetic Forces, Magnetic Fields, and Maxwell's Equations

April 7, 2009

Be sure to include pictures, coordinate systems, etc. where reasonable.

1. (10pts) An electron moves in a uniform magnetic field $\vec{B} = 0.1T\hat{i}$ with an initial velocity $\vec{v}(0) = 1m/s\hat{i} - 1m/s\hat{j}$. What path will the electron follow? In your description be quantitative about how much it can move in each of the x, y, and z directions.

2. (10pts) Electric fields can be created in a number of ways. For both situations listed below of sketch the object causing the electric field and a few electric field vectors to give a sense of how the electric field points at various points in space.

    (a) A stationary electron.

    (b) A solenoid pointing out of the page with a current flowing clockwise that is decreasing in strength with time.

3. (10pts) Magnetic fields can be created in a number of ways. For both situations listed below sketch the object creating the magnetic field and a few magnetic field vectors to give a sense of how the magnetic field points at various locations in space.

    (a) A current through a wire flowing out of the page.

    (b) A capacitor with its positive plate below your page and negative plate above your page that is being charged.

4. (15pts) A solenoid has the following properties: it is $0.20m$ long, has a radius of $0.01m$, and has a turn density of $1x10^5 turns/m$.

   (a) Find the magnetic flux through the inside of the solenoid for a current of $10Amps$.

   (b) How quickly must you ramp down the current (i.e. smoothly shut off the current) to induce an electric field of $10^{-3}V/m$ at the edge of the solenoid. Hint: think of the ramp down time as a Δt.

   (c) What effect will this have on the solenoid?

5. (10pts) There is magnetic field inside a dynamo is constant and yet it is able to create an electric current. Explain why this is being sure to root your explanation in Maxwell's equations.

6. (10pts) A piece of wire is bent in the shape of a semicirle with radius $R = 0.5m$ and has a current of $1.5Amps$ running through it. What is the magentic field (size and direction) at point P?