11/3/2004. **Due:** Wednesday, Nov. 10, 2004 (in class).

Physics 301/571: Electromagnetic Theory I

Read: Griffiths chapters 5.1-5.3

"**G**" refers to Griffiths' book.
Problems with stars are not for credit and will NOT be graded.

Homework 8

Exercise 1

Consider a proton with kinetic energy 10 MeV in a cyclotron with magnetic field 1 T. Calculate the cyclotron frequency and the radius of the orbit.

Exercise 2 (G 5.4)

Suppose that the magnetic field in some region has the form

$$\vec{B} = kz\hat{\mathbf{x}}$$

(where k is a constant). Find the force on a square loop (side a), lying in the yz plane and centered at the origin, if it carries a current I, flowing counterclockwise, when you look down the x axis.

Exercise 3 (G 5.5)

A current I flows down a wire of radius a.

a) If it is uniformly distributed over the surface, what is the surface current density K?

b) If it is distributed in such a way that the volume current density is inversely proportional to the distance from the axis, what is J?

*Exercise 4 (G 5.8 partial)

Find a magnetic field at the center of a square loop (side a), which carries a steady current I.

Exercise 5 (G 5.14)

A thick slab extending from $z = -a$ to $z = +a$ carries a uniform volume current $\vec{J} = J\hat{\mathbf{x}}$. Find the magnetic field, as a function of z both inside and outside the slab.

Exercise 6

Consider the magnetic field $\vec{B}(\vec{r}) = axy\,\hat{\mathbf{x}} + by^2\,\hat{\mathbf{y}}$.

a) What relation must connect the constants a and b?

b) What current density $\vec{J}(\vec{r})$ produces this field? Describe the current distribution in words and pictures.