2/1/2005. **Due:** Tuesday, February 8, 2005 (in class).

Physics 302/572: Electromagnetic Theory II

Read: Griffiths chapter 8.1, 8.2

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

Homework 1

Exercise 1 (G 8.1)

Two long conducting coaxial cylinders of radii a and b respectively are held at potential difference V. They also carry current I down one and back up the other cylinder. Calculate the power (energy per unit time) transported down the cylinders.

Exercise 2

Consider a very long solenoid with radius R and self-inductance L. The solenoid carries the current $I = \alpha t$, where α is some constant.

a) Find electric and magnetic field everywhere in space.

b) Find the total magnetic energy W_m stored in the solenoid as a function of time.

c) Find the Poynting vector everywhere in space.

d) Find the flux Φ_P of Poynting vector through the surface of the solenoid.

e) Check that $\frac{dW_m}{dt} + \Phi_P = 0$.

Exercise 3 (G 8.4)

a) Consider two equal point charges q, separated by a distance $2a$. Construct the plane equidistant from the two charges. By integrating Maxwell's stress tensor over the plane, determine the force of one charge on the other.

b) Do the same for charges that are opposite in sign.

Exercise 4 (G 8.6 partial)

A charged parallel-plate capacitor (with uniform electric field $\vec{E} = E\hat{z}$) is placed in a uniform magnetic field $\vec{B} = B\hat{x}$.

a) Find the electromagnetic momentum in the space between the plates.

b) Now a resistive wire is connected between the plates, along the z axis, so that the capacitor slowly discharges. The current through the wire will experience

a magnetic force; what is the total impulse delivered to the system, during the discharge?

c) Compare the results obtained in a) and b).