10/27/2004. **Due:** Wednesday, Nov. 3, 2004 (in class).

Physics 301/571: Electromagnetic Theory I

Read: Griffiths chapters 4.2-4.4

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

Homework 7

Exercise 1 (G 4.31)

A dielectric cube of side a, centered at the origin, carries a "frozen-in" polarization $\vec{P} = k\vec{r}$, where k is a constant. Find all the bound charges, and check that they add up to zero.

Exercise 2 (G 4.32)

A point charge q is imbedded at the center of a sphere of linear dielectric material (with susceptibility χ_e and radius R). Find the electric field, the polarization, and the bound charge densities, ρ_b and σ_b. What is the total bound charge on the surface? Where is the compensating negative bound charge located?

*Exercise 3 (G 4.33 partial)

At the interface between one linear dielectric and another the electric field lines bend. Show that

$$\tan\theta_{above}/\tan\theta_{below} = \epsilon_{below}/\epsilon_{above},$$

assuming there is no *free* charge at the boundary. Here θ_{above} (θ_{below}) are the angles formed by field lines with the axis orthogonal to the boundary.

Exercise 4

A slab of dielectric with area A and thickness t is placed in a parallel plate capacitor having the plate area A and separation d, with $d > t$. Find the capacitance of this arrangement.

*Exercise 5 (G 4.38)

Derive the **Clausius-Mossotti** formula. See Griffiths, problem 4.38.

Exercise 6

Two identical parallel-plate capacitors, each with capacitance C, are connected in series across a fixed total potential V. Then a slab of dielectric, with dielectric constant ϵ, is inserted into one of the capacitors. Calculate the change of total energy stored in the two capacitors, the work done by the electrostatic force on the slab as it is inserted, and the energy supplied by the voltage source.