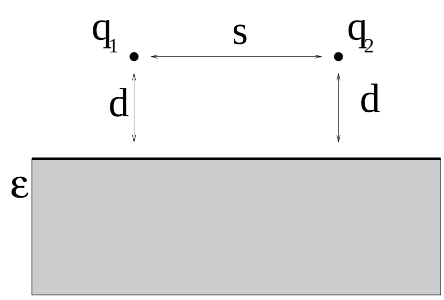
1. What is the surface polarization charge density on a sphere of dielectric constant ϵ and radius a placed in a uniform electric field $E_o\hat{z}$? Use MKS units.

2. For the previous problem, make an **accurate** plot of the displacement field $\vec{D}(\vec{r})$, the electric field $\vec{E}(\vec{r})$, and the polarization field $\vec{P}(\vec{r})$ both inside and outside the sphere. It should look better than the sketch on the bottom of page 17-12 in the notes. A computer-generated plot would be ideal.

Warning! This problem looks easy but is very subtle – be extremely careful in your solution. The whole point is to test your understanding of what contributes to the energy and what does not.

3. Two point charges q_1 and q_2, separated by a distance s, are each located a distance d from a semi-infinite slab of conductor that fills the entire lower half space. Calculate the energy of the system excluding the infinite self-energies of the point charges.



Bonus:

A thin flat conducting circular disk of radius R is located in the xy-plane with its center at the origin and is maintained at potential V with the convention that $V = 0$ infinitely far away. I will tell you that the charge density on the disk is proportional to $(R^2 - s^2)^{-\frac{1}{2}}$ in cylindrical polar coordinates rather than have you derive it.

1. Find the capacitance of the disk and compare this to the capacitance of a sphere of radius R. See also page 19 of Jackson 3rd ed. for Henry Cavendish's measurements.