PHYS 401: Electricity & Magnetism I
Due date: Wednesday, April 14, 2021

Problem set #8

1) Problem 3.47: Dipoles and the average electric field

2) Problem 4.14: Total bound charge

3) Problem 4.16: Cavities in a dielectric

4) Problem 4.36: Snell's law for electric fields

5) Dielectric sphere with free charge

A dielectric sphere (with dielectric constant κ) of radius R is filled with a uniform free charge density ρ_c.

a) Find the polarization $\vec{P}(\vec{r})$.

b) Calculate the total bound charge of the sphere (volume and surface). Explain the result briefly.

6) Conductor and dielectric

Consider a thin grounded conducting shell of radius a surrounded by a concentric spherical dielectric region of radius b with permittivity ε. There is vacuum for $r > b$. The entire system is subject to an applied external electric field $\vec{E} = E_0\hat{z}$. Calculate the potential everywhere (i.e. for $r < a$, $a < r < b$, and $r > b$) using separation of variables.