[Griffiths 4.10] A sphere of radius R carries a polarization

$$\mathbf{P}(\mathbf{r}) = k\mathbf{r},$$

where k is a constant and $\mathbf{r}$is the vector from the center.

1. Calculate the bound charges σ_b and ρ_b.
2. Find the electric field inside and outside the sphere.

[Griffiths 4.25] Consider an interface ($z = 0$) between two linear dielectrics, with permittivity ϵ_1 and ϵ_2 . A point charge q is embeded at $(0, 0, d)$ in dielectric ϵ_1. Find Potential everywhere. (See Example 4.8 in Griffiths). Draw electric field lines for $\epsilon_1 > \epsilon_2$ and $\epsilon_1 < \epsilon_2$.

[–] A sphere of linear dielectric material (radius a, permittivity ϵ_2) is placed in a region of permittivity ϵ_1. In the absence of the sphere, there exists a uniform electric field $\mathbf{E} = E_0\hat{k}$ in the outer dielectric. Find the potential (everywhere), the charge density on the surface of the sphere. Sketch $\mathbf{E}$ lines for $\epsilon_1 > \epsilon_2$ and $\epsilon_1 < \epsilon_2$.

[Griffiths 4.34] A point dipole $\mathbf{p}$ is embeded at the center of a sphere of linear dielectric material (with radius R and dielectric constant ϵ_r). Find the electric potential inside and outside the sphere.

[Griffiths 4.40] the Langevin Formula.

[–] A localized charge distribution described by $\rho(\mathbf{x})$ is kept in an external potential $\Phi(\mathbf{x})$. Show that the electrostatic energy is given by

$$W = q\Phi(0) - \mathbf{p}\cdot\mathbf{E}(0) - \frac{1}{6}\sum_i\sum_j Q_{ij}\frac{\partial E_j}{\partial x_i}(0) + \cdots$$

[Jackson 4.5]

[Jackson 4.6]

[Jackson 4.10]

[Jackson 4.13]