Homework 4 **Due:** Start of class, October 19th

1. Griffiths Problem 3.26 (4th Edition; called 3.25 in the 3rd Edition) **[5pts]**
   Hints: Before you start calculating, look carefully at the general solution of Laplace's equation in cylindrical coordinates with no z-dependence ("circular coordinates") and the surface charge distribution for this problem. Note that at the surface of a conductor, $\frac{\sigma}{\varepsilon_0} = \frac{\partial V}{\partial s}|_{below} - \frac{\partial V}{\partial s}|_{above}$. You can also use this equation to solve for your non-zero coefficients. Also note V is continuous at the conductor surface, which you can evaluate at any azimuthal angle φ.

2. Griffiths Problem 3.27 (4th Edition; called 3.26 in the 3rd Edition) **[5pts]**
   Hints: You're using spherical coordinates, so $d\tau = r^2 \sin\theta \, d\theta d\varphi$. When you integrate for the potential components, the limits of integration are over the charge distribution. You can save time in this problem by doing the dr integral first for the monopole term and the $d\theta$ integral first for the dipole term. For the latter, use u-substitution with $u = \sin\theta$. Also, $\sin^2\theta + \cos^2\theta = 1$ might come in handy for one of your integrals.

3. Griffiths Problem 3.32 (4th Edition; called 3.30 in the 3rd Edition) **[3pts]**
   Hints: $\hat{z} \cdot \hat{r} = \cos\theta$, while $\hat{y} \cdot \hat{r} = \sin\theta \sin\varphi$.

4. Griffiths Problem 4.4 **[3pts]**
   Hints: You have two fields to consider. $\vec{E}_{point}$ from the point-charge polarizes the atom to make it a dipole. $\vec{E}_{dipole}$ is the field resulting in the force between the atom and the charge. Note that we determined $\vec{E}_{dipole}$ in Lecture 15 and, for this scenario, we can see $\theta = \pi$.

5. Griffiths Problem 4.20 **[5pts]**
   Hints: Use Gauss's law for dielectrics. Since ρ_f is uniform, $q_{f,encl} = \rho_f \tau$, where τ is the volume enclosing the charge. Calculate the potential directly, noting that the field's functional form is of course different inside and outside of the sphere.

6. Griffiths Problem 4.22 **[11pts]**
   Hints: Follow the example we did in class of the uniform dielectric sphere in a uniform electric field, which is also covered in Example 4.7 of the book. Write your answer in terms of χ_e.