# Physics 513, Autumn Quarter 2017
# Electrodynamics: Homework Assignment 6
# Due November 9 either 11:00am in class or 10:45am in the instructor's mailbox.

1. A spherical shell is known to have fixed potential $\Phi_0 \cos(\theta)$. Now place a point charge *Q* at the center and find the potential everywhere.

2. A dipole **P** is outside and a distance d from the center of a grounded sphere. You can assume the dipole is directed radially. Find the resulting potential.

3a A certain charge distribution $\rho(r)$ has a finite spatial extent. Show that the dipole moment of this charge distribution is

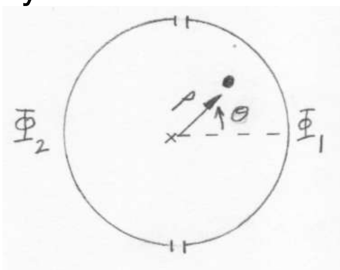
$$\mathbf{P} = -3\varepsilon_0 \iiint \mathbf{E}(\mathbf{r})dv$$

3b. Now suppose the charge in problem 3a is entirely outside some volume *V* of finite spatial extent. Show that the electric field **E**(*p*) at a point *p* within the volume is

$$\mathbf{E}(p) = \frac{1}{V}\iiint \mathbf{E}(\mathbf{r})dv$$

These are classic problems done in numerous texts. Hint: Since the distribution is finite in extent, there is some sphere which contains all the charge. There are several ways to do these: one way is to start by replacing **E**(**r**) with integral expression over charge density. The Smythe solution to I do not believe is logically sensible.

4. 2D electrostatics. A long hollow cylinder conductor of radius *R* is split into two half-cylinders through its axis. One half-cylinder is at potential $\Phi_1$, the other at potential $\Phi_2$. Find the potential within the cylinder. The end-on geometry is




You will likely need an infinite-series solution. There is a claim this series can be summed, but I have not worked it out. I solved this via separation-of-variables into cylindrical coordinates. There is a claim the solution can also be obtained with Green's Function techniques.

[ver 03nov17 17:00]