Physics 842 – Fall 2011
Classical Electrodynamics II

Problem Set #1 – due Tuesday September 13

1. A capacitor consists of two concentric metal spherical shells of radii a and b, with $b > a$. Calculate the capacitance C.

2. Calculate the capacitance per unit length of two concentric cylindrical shells of radii a and b, with $b > a$. Show that your answer is consistent with the answer to Problem 7 at the end of Section 3 in Landau & Lifshitz, for the special case $c = 0$.

3. Two point charges of opposite sign, q_1 and $-q_2$, are at a distance h from each other. Show that one of the equipotential surfaces, $\phi(\vec{r}) = $ constant, is a sphere. Find its radius and location.
   Hint: Like many E&M problems, this one is much easier if you choose a convenient coordinate system. I suggest using spherical coordinates with the center of the hypothetical sphere as the origin. Then find the potential at the two points on the sphere that lie on the line connecting q_1 and $-q_2$. Of course, if you find an easier way to solve this problem, I'll be happy to hear about it!

4. The potential on the surface of a hypothetical spherical surface in free space is given by $\phi(\vec{r}) = \phi(\vartheta, \varphi)$. Find the potential at the point in the middle of the sphere.

Quiz #1

The quiz will be on Thursday, September 15, at the beginning of class, and will last 20 minutes. On the quiz you will be given one of the following problems:

- Problems 1 to 3 on Problem Set #1

- Problems 1 to 4 at the end of Section 2

- Problems 1, 2, and 6 at the end of Section 3