Physics 842 – Fall 2010
Classical Electrodynamics II

Problem Set #2 – due Tuesday September 28

1. A parallel-plate capacitor has dimensions L × W × d, where L is the length, W is the width, and d is the spacing between the plates. A conducting box of dimensions L × W × a, with a < d, slides partway into the capacitor, sticking in a distance x along the length direction L.
   a) Calculate the capacitance as a function of x.
   b) The capacitor is charged, with charge Q on the top plate and –Q on the bottom plate. Calculate the force on the conducting box. (Is the box being pulled in or pushed out by the electric field?)
   c) Now the capacitor is held at fixed potential ϕ by a battery. Calculate the force on the conducting box. (Again, is the box being pulled in or pushed out by the electric field?)

2. Work out problem 6 at the end of Section 3 of Landau & Lifshitz. First, calculate the force acting on the dipole, then integrate the force starting with the dipole an infinite distance away to get the potential energy. Explain why the answer in the book is incorrect by exactly a factor of 2.

3. In problem 1 of section 3, Landau & Lifshitz calculate the potential everywhere in space when a conducting sphere is placed in a uniform electric field. Calculate the change in field energy with the sphere present, compared to with the sphere absent. (Obviously the uniform field has infinite energy when integrated over all space. That is why I am asking you to calculate the energy difference.)

Quiz #2

The quiz on Thursday, September 30, will consist of one of the following problems:

- Problems 1 to 3 on Problem Set #2
- Problems 1 to 3 at the end of Section 5