Problem Set 3
Electrodynamics
Due: Jan. 28, 2005

Problem 1: Find the force per unit length on a wire of diameter a set inside a metallic cylinder of inner radius $R \gg a$ when the wire is offset from the center by a distance d and raised to a potential V_0 with the outer cylinder grounded. (Hint: Find the potential by the image charge method and work from there.)

Problem 2: Find the two dimensional Green's function for the inner region of a metallic pipe with inner radius R. Use this Green's function to determine the potential inside a pipe split lengthwise where half of the cylinder is held at V_0 and the other half is held at $-V_0$. Plot the potential across the center of the pipe (from the center of the half cylinder held at $-V_0$ to the center of the half cylinder held at V_0) and compare it to the one found for the split sphere. (Notebook for the split sphere can be found on the class web site.) For the same voltages and the same radius, which has the larger electric field at the center?

Problem 3: Jackson 2.4 (answers are given – be sure to show your work.) Hint: Look at the first sentence of Jackson 2.6 for an idea where to begin.

Problem 4: Using the Green's function that is derived via image charges, find the potential near a $90°$ metallic corner when one side of the corner is grounded and the other is held at a voltage V_0. Draw the equipotential lines for this problem.

<u>Spring '96 Electrodynamics Qualifying Exam</u>

Do not use *Mathematica* for this problem!

A capacitor composed of two parallel infinite conducting sheets separated by a distance d is connected to a battery. The lower plate (pictured below) is maintained a some potential V_1 and the upper plate is maintained at some potential V_2. A small hemispherical boss of radius $a \ll d$ is introduced on the lower plate. State the boundary conditions for this problem (hint, consider the limit as the distance between the plates becomes large). Find the potential between the plates and the surface charge density on the plates.