10/6/2004. **Due:** Wednesday, Oct. 13, 2004 (in class).

Physics 301/571: Electromagnetic Theory I

Read: Griffiths chapter 2.4-2.5, 3.2

"**G**" refers to Griffiths' book.
Problems with stars are not for credit and will NOT be graded.

Homework 5

Exercise 1

Eight particles of mass m and electric charge $-q$ each are placed in corners of a cube and released. Find the velocity of each charge at infinity. The length of the edge of the cube is a.

Exercise 2 (G 2.35)

A metal sphere of radius R, carrying charge q, is surrounded by a thick concentric metal shell (inner radius a, outer radius b). The shell carries no net charge.

a) Find the surface charge density σ at R, at a, and at b.

b) Find the potential at the center, using infinity as the reference point.

c) Now the outer surface is touched to a grounding wire, which lowers its potential to zero (same as infinity). How do your answers to (a) and (b) change?

Exercise 3 (G 2.38)

A metal sphere of radius R carries a total charge Q. What is the force of repulsion between the "northern" and "southern" hemisphere?

*Exercise 4 (G 2.39)

Find the capacitance per unit length of two coaxial (very long) metal cylindrical tubes, of radii a and b.

Exercise 5

What is the minimal work required to move a point charge q from the center of a thick concentric metal shell (inner radius a, outer radius b) to infinity. Assume that there is a small hole in the shell.

Exercise 6 (2d electron gas)

Two electrons are confined to a two-dimensional xy plane (can freely move along the plane, but have a fixed coordinate $z = 0$). There is an infinite conducting plane (gate) parallel to the xy plane at the distance a from the latter ($z = a$). Find the "effective" force between electrons at distances $r \gg a$. Take into account the "screening" by image charges.