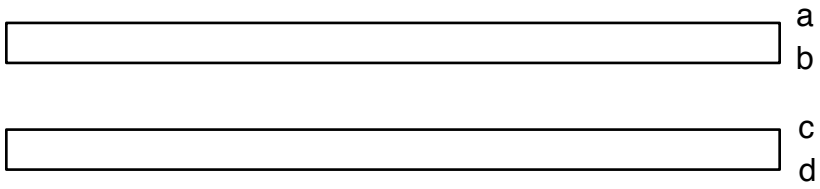
Homework #5; Due Thursday 9/29.

1. Problem 2.38 (the charged solid sphere inside the spherical conducting shell; has three parts, a,b,c.)

2. A) Find the capacitance per unit length of two coaxial cylindrical tubes (both conductors), of radius a and b. (b>a).
B) Assume this capacitor is held at some potential difference V. Find the energy per unit length using two different methods, and show they are the same.

3. Problem 2.60 (the one about moving a charge q from the center of a conducting shell to infinity; calc. the work needed if the shell goes from inner radius a to outer radius b.]

4. Consider a parallel-plate capacitor with UNEQUAL charge magnitudes on the two conducting plates (the usual capacitor equations don't apply here). The top plate has double the surface charge on the lower surface "b" as the upper surface "a" . In other words, the charge density on "a" is σ, the charge density on "b" is 2σ.



A) What is the (net) force on the top plate? (Assume you know the area A.)

B) Find the missing charge density on surface "c". Hint: use Gauss's Law, on a surface that you know must have zero Electric flux.

C) Find the missing charge density on surface "d". Hints: remember the net charge on the upper plate is not necessarily related to the net charge on the lower plate. But the net effect of all the charges must be able to keep the E-field zero where it needs to be zero.

D) Sketch the potential as a function of vertical location. Choose any reference point you wish. Be sure to account for the fact that the conductors have finite thickness; have your graph extend above "a" and below "d"; label a,b,c,d on the diagram.

E) Moving the upper plate against the force calculated in A) will require work. Show that the amount of work done (force dot displacement) is exactly the same as the change in the energy stored in the system as the plate is moved. (Hint: the *total* stored energy is not relevant; just consider where the E-field **changes**, and compute the difference in the energy that corresponds to the change.)