Homework 1
Due September 18, 2009

272:

1.- A water droplet of diameter d carries a negative charge Q such that the electric field at its surface, due to this charge, is E. Now divide this droplet into two of equal size and separate them well, dividing the charge equally between them. Find the electric field at the surface of the two new droplets.

2.- A thin, nonconducting plastic rod is bent into the form of a nearly complete circle of length L radius. There is a gap between the ends of length d where $d \ll L$. A positive charge Q is spread uniformly over the length of the rod. What is the magnitude and direction of the electric field at the center of the circle?

272H (the two previous and the following ones):

3.- Two flat parallel sheet of charge, or density σ_A and σ_B respectively, are separated by a distance s, sheet A lying on the left of sheet B, as we look at the situation edge on. Let $\mathbf{E}_1$ be the electric field on the left of sheet A, $\mathbf{E}_2$ the field between the sheets, and E_3 the field to the right of sheet B. This field is not only that due to the sheets themselves, but includes the effect of other sources that may be present. Assume the other sources are far enough away so that they contribute a uniform field throughout the region we are examining. Now suppose that the two sheets are mechanically connected somehow, so that we could measure the total force on the combination. Find the force per unite area of the combination.

4.- A long coaxial cable carries a uniform volume charge density ρ on the inner radius (radius a), and a uniform surface charge density σ on the outer cylindrical shell (radius b). This surface charge is negative and of just the right magnitude so that the cable as a whole is electrically neutral. Find the electric field in each of the three regions: i) inside the inner cylinder ($r < a$), ii) between the cylinders ($a < r < b$), iii) outside the cable ($r > b$). Plot the magnitude of the electric field $|\mathbf{E}|$ as a function of r.