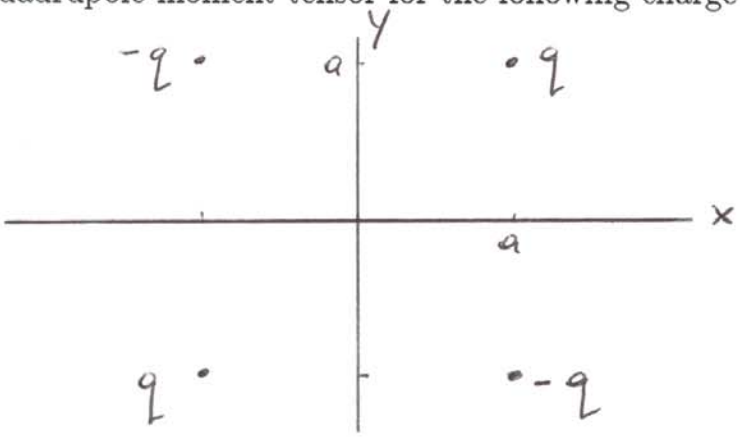
Assignment 6

1a) Show that the quadrupole moment tensor is symmetric.

b) Show that the trace of the quadrupole moment tensor is zero.

2. Evaluate the quadrupole moment tensor for the following charge distribution.



3. Electric quadrupole moments of nuclei are tabulated by dividing the quadrupole moment by the proton charge. Hence they have units of area. The deuteron quadrupole moment is 0.00282 barns where 1 barn $= 10^{-24}$ cm^2. Evaluate the interaction energy of the deuteron quadrupole with an electron located a distance of one Bohr radius away and compare this amount to the Rydberg energy.

4. Consider a conducting sphere having a charge Q and a radius a which is surrounded by a spherical shell containing dielectric material ϵ up to an outer radius b.

a) Find the bound surface charge densities on the inner and outer surfaces of the dielectric.

b) What is the electric potential at the center of the sphere taking the potential to be zero at infinity?

5. What is the capacitance of a parallel plate capacitor having plates of area A, spaced distance s apart and filled with dielectric material ϵ? Ignore edge effects.