Homework 2

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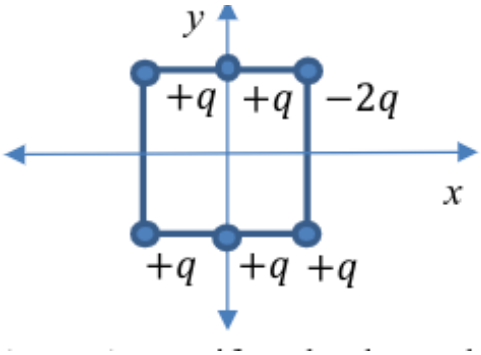
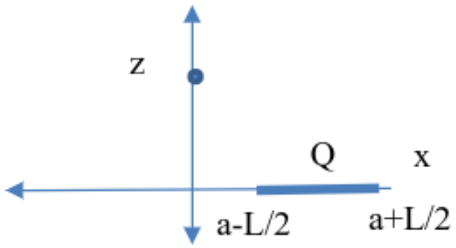
1. Six charges are arranged along the sides and corners of a square with sides of length L as shown. Calculate the magnitude and direction of the electric field at the origin. Use symmetry and superposition to make the calculation simple.



2. A uniformly charged rod of length L and charge q is placed along the x-axis with its center at $x = a$. Find the x-component of the electric field at a point on the z axis. (Hint: use R as the variable of integration.) Check your expression in the following limit: $z = 0$ and $a >> L$.



3. Calculate the electric potential on the z-axis due to a uniformly charged annulus in the xy-plane centered at the origin with inner radius a and outer radius b. Then find the electric field from the gradient of the potential.

4. Consider an infinitely long uniformly-charged solid cylinder of radius a and charge per unit volume ρ surrounded by a coaxial cylindrical shell of radius b and charge per unit area of σ. Take the axis of the cylinders as the z-axis.

   (a) Calculate the electric field everywhere in space

   (b) Also calculate the potential as a function of the distance from the axis, taking the potential to be zero on the z-axis.

5. The electric field for two charged concentric spherical shells is given by

$$\begin{cases} 0, & r < a \\ \hat{\mathbf{r}} A_1/r^2, & a < r < b \\ \hat{\mathbf{r}} A_2/r^2, & r > b \end{cases}$$

   Where $A_1 = 5 \times 10^6 \left[\frac{\mathrm{N\,m^2}}{\mathrm{C}}\right]$, $A_2 = -3 \times 10^6 \left[\frac{\mathrm{N\,m^2}}{\mathrm{C}}\right]$, $a = .25$[m], and $b = .45$[m]. Find the surface charge densities σ_a and σ_b on the two shells.