Electrostatics

1. Three charges are are lined up on the x-axis and fixed in place. The first charge $q_1 = 3q$ is located at $x = -d$, the second charge $q_2 = 2q$ is located at $x = 0$, and the third charge $q_3 = q$ is located at $x = d$. Determine the magnitude of the force on a fourth charge $Q$, also on the x-axis, that is located at $x = 2d$. Assume both $q$ and $Q$ are positive.

2. The same setup as the previous problem, but this time the fourth charge $Q$ is not located on the x-axis, but is instead located at the point $x = 0$, $y = d$. Determine the magnitude of the force on $Q$ in this case.

3. Two positive charges $q_1$ and $q_2$ lie on the x-axis and are separated by a distance $d$. Determine the point on the x-axis where the electric field is zero.

4. Four identical charges $q$ are located at the corners of a rectangle with length $L$ and height $h$. Determine the electrostatic force on the bottom right charge from the other three charges.

5. A thin rod of length $\ell$ and total charge $Q$ has a linear charge density that is directly proportional to the distance from its left end. If the rod is lined up along the x-axis, determine the electric field on the x-axis, a distance $d$ from its right end.

6. A thin, uniformly charged rod with length $\ell$ and total charge $Q$ lies along the x-axis with its center at the origin. What is the electric field a height $h$ above the center of the rod, i.e. at the point $x = 0$, $y = h$?