**Electrostatics**

1. A uniformly charged rod of length $\ell$ and total charge $Q$ is bent into a perfect half circle. What is the electric field at the center of the half circle (the point that would be the center of the whole circle if the other half were filled in)?

2. Determine the electric field at the point a height $h$ above the center of a non-uniformly charged disk of radius $R$ whose total charge is $Q$ and whose surface charge density is inversely proportional to the distance from the disk’s center, i.e. $\sigma \propto 1/r$.

3. A particle of mass $m$ and negative charge $-q$ is placed at the center of a thin, uniformly charged hoop with radius $R$ and total positive charge $+Q$. The particle is then given a slight nudge moving it a small distance $x$ in the direction pointing directly through the circle. The particle then begins to oscillate in and out of the circle. Using the fact that $x$ is much less than the circle’s radius, determine an approximate expression for how long it takes the particle to undergo one full oscillation.

4. An infinitely long, uniformly charged, solid cylinder with radius $R$ and charge density $\rho$ lies centered along the $z$-axis. Determine the electric field a distance $r$ from the $z$-axis. (Note that you must consider both possibilities: $r < R$ and $r > R$.)

5. A solid, nonuniformly charged sphere has total charge $Q$ and a charge density that is directly proportional to the radial distance from its center. Determine the electric field as a function of the distance from the center of the sphere. Sketch a graph of your result.