PHY6938 Proficiency Exam Fall 2002
September 13, 2002
E & M

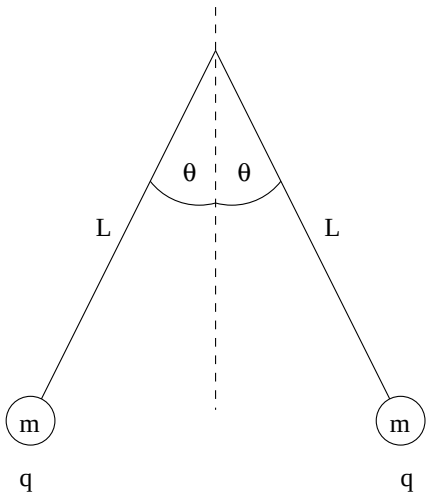
1. A positive charge is uniformly distributed throughout a very long cylindrical volume of radius R. The charge per unit volume is ρ.

(a) Find the electric field $\vec{E}$ everywhere as a function of the distance r from the axis of the cylinder.

(b) Find the electric potential V everywhere as a function of r. Define $V = 0$ at the surface of the cylinder.

(c) Sketch E and V as function of r, from $r = 0$ to $r = 3R$, showing the values of each at $r = 0$, R, and $3R$.

2. Two small spheres of mass m are suspended from a common point by threads of length L. When each sphere carries a charge q, each thread makes an angle θ with the vertical as shown in the figure. Find an expression for the charge q at equilibrium in terms of L, m, g, θ and the Coulomb constant k.



3. A proton traveling with a velocity of $\vec{v} = 1 \times 10^4 \text{m/s}\,\hat{i} + 2 \times 10^4 \text{m/s}\,\hat{j}$ is located at $x = 3\text{m}$, $y = 4\text{m}$ at some time t. Find the magnetic field at time t at the following positions:

(a) $x = 2\text{m}$,$y = 2\text{m}$

(a) $x = 6\text{m}$,$y = 4\text{m}$

(a) $x = 3\text{m}$,$y = 6\text{m}$