DEPARTMENT OF PHYSICS
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PH2140 Mathematics on the Computer Assignment 4 24 August 2015

1. Electrostatic potential of a line charge

Consider a line charge, with density $\lambda(z)$ C/m and length $L = 1$m, placed along the z axis and symmetrically about $z = 0$.

1. Assume $\lambda = \lambda_0 =$ constant. Use the `Integrate` command to evaluate the potential $V(x, y, z)$ everywhere (taking it's zero at infinity), and plot the equi-potential lines in the x-z plane. You may explore and use the `ContourPlot` command for the latter.

2. Assume $\lambda = f(z)$. Use the `NIntegrate` command to evaluate the potential $V(x, y, z)$ everywhere (taking it's zero at infinity), and plot the equi-potential lines in the x-z plane, for the following profiles:

   (a) $f(z) \propto z$.

   (b) $f(z) \propto \exp\left[-(z/a)^2\right]$, where a is a constant and you must plot this case for $a = (1/2)$m and $a = 2$m.

3. Show all the above results on a single plot. Make sure you understand their differences in terms of elementary electrostatics.

2. Simple Pendulum

Consider a simple pendulum of length L in the constant gravitational acceleration g of Earth. Let T be the time period of this pendulum, and $T_0 = 2\pi\sqrt{L/g}$, the time period for small amplitude oscillations.

Plot T/T_0 for this pendulum as a function of the amplitude ϕ_0.