PH632 – Winter 2016
Week 3 Problem Set (short week, short homework)
Due Friday Jan 22 at 5pm

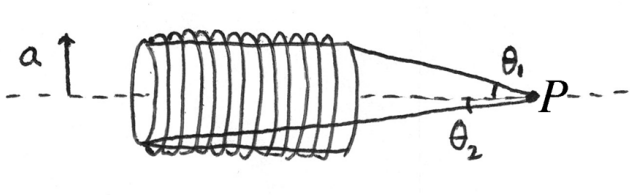
1. Suppose you have two parallel infinitely long line charges λ, a distance d apart, moving along at a constant speed v. The parameters λ, d and v are all measured in the same laboratory reference frame. How great would v have to be in order for the magnetic attraction to balance the electrical repulsion? Work out the actual number in meters/second.

2. The magnetic field a distance z above the center of a circular loop of radius R, which carries a steady current I, is easily calculated from the Biot-Savart law

$$B(z) = \frac{\mu_0 I}{2} \frac{R^2}{(R^2 + z^2)^{3/2}}$$

Use this result to solve the following problems:

a) Find the magnetic field at point P on the axis of a tightly wound solenoid consisting of n turns per unit length wrapped around a cylindrical tube of radius a and carry current I. Express your answer in terms of θ_1 and θ_2 (the easiest way).



b) Calculate the magnetic field at the center of a uniformly charged spherical shell, of radius R and total charge Q, spinning at constant angular velocity ω.