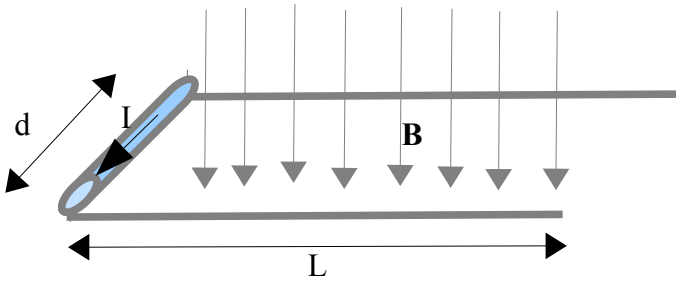
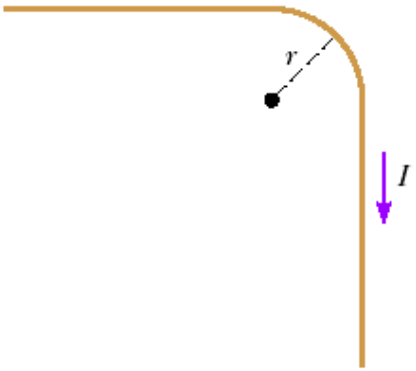
Physics 2201 E&M
Homework #13 – Due Feb. 2, 2016 by 3pm
(hand in to drop box outside 3L24)

1. A long piece of wire with a mass of 0.12 kg and a total length of 3 m is used to make a square coil of several loops with a side of 0.075 m. The coil is hinged along a horizontal side, carries a 3.50-A current, and is placed in a vertical magnetic field with a magnitude of 0.01 T. (a) Determine the angle that the plane of the coil makes with the vertical when the coil is in equilibrium. (b) Find the torque acting on the coil due to the magnetic force at equilibrium.

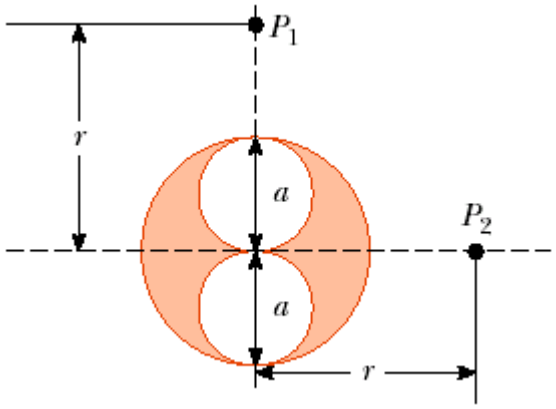
2. A rod of mass m and radius R rests on two parallel rails, as shown in the figure below. The rails are a distance d apart, and have a length L. The rod carries a current I in the direction shown, and rolls along the rails without slipping. A uniform magnetic field B is directed perpendicular to the rod and the rails. If the rod starts from rest, what is the speed of the rod as it leaves the rails? [Note: moment of inertia of rod is $I_R = \frac{1}{2}mR^2$.]



3. A very long straight wire carries current *I*. In the middle of the wire a right-angle bend is made. The bend forms an arc of a circle of radius *r*, as shown in the figure below. Determine the magnetic field at the center of the arc.



4. A long cylindrical conductor of radius a has two cylindrical cavities of diameter a through its entire length, as shown in the figure below. A current I is directed out of the page and is uniform through a cross section of the conductor. Find the magnitude and direction of the magnetic field in terms of μ_0, I, r, and a at (a) point P_1 and (b) point P_2.



5. A cube of edge length $\ell = 22.50$ cm is positioned as shown in the figure below. A uniform magnetic field given by $\mathbf{B} = (\ 0.5\ \hat{\imath} + 3.5\ \hat{\jmath}\ -2.5\ \mathrm{k}\ )$T exists throughout the region. (a) Calculate the magnetic flux through each of the six faces. (b) What is the total magnetic flux through the cube?