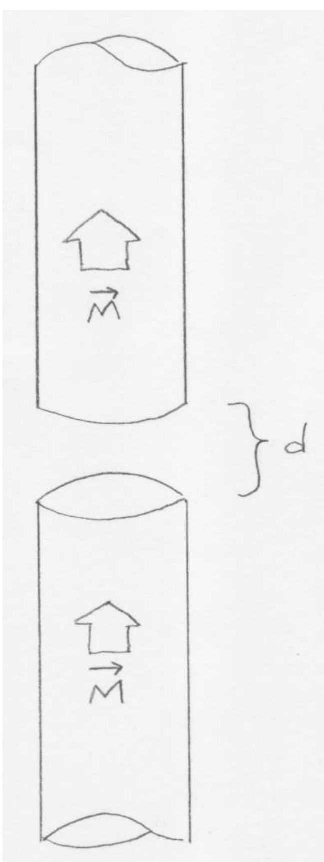
Physics 513, Autumn Quarter 2017
Electrodynamics: Homework Assignment 10
Due Dec. 7, 5:00pm either 11:00am in class or 10:45am in the instructor's mailbox.

1. Two semi-infinite permanent magnets of radii *R* are axially aligned so as to have a gap *d*, as shown.
a. Using magnetization currents, find the magnetic field **B** at the center point of the gap. Express this field in terms of the opening angle, relative to the axis, θ_0 of the edge of the pole face as seen at the field point.
b. Using equivalent "magnetic charge" (the source of magnetic scalar potential, Jackson eqn 5.95), find the magnetic field **B** at the center point of the gap. This is a good application of magnetic scaler potential since there are no true currents.



2. Consider a permeable (with permeability μ) conducting infinitely-long cylinder of radius R. It carries a uniform current **J** in the axial direction. In addition, there is a uniform external field $\mathbf{B_0}$ at right angles to the cylinder's axis. Find the vector potential everywhere. This problem is similar to the dielectric cylinder in an external $\mathbf{E_0}$ field from electrostatics. Some thoughts on the expansion solution: Because of the symmetry and 2D nature of the problem, Laplace's and Poisson's equations for **A** are simple. As usual, have separate solutions inside and outside the cylinder and eventually match boundary conditions to find the expansion coefficients. A subtlety: You should include the particular solution of the vector potential outside a wire $-\mu J \frac{r^2}{4}$ to solutions of Laplace's equation inside the cylinder. To the potential outside the cylinder, you should add the term corresponding the uniform applied field. Also, note the potential at points along the axis is non-singular.

3. A spherical capacitor consists of concentric conducting spheres of inner and outer radii R_i and R_o. The space between the spheres contains a weakly-conducting dielectric of conductivity σ and current is flowing from one conductor to the other. Use the Lorentz condition (Jackson eqn 6.14) to find the magnetic field between the conductors. (In class we discussed other ways to attack this, including finding **A** directly and taking its curl, showing there are no solenoidal currents to source magnetic fields, directly finding the magnetic field from the Biot-Savart law, current conservaton, and noting the curl of **H** vanishes.)

4. Consider a long current-carrying solenoid. Use the principle of virtual work to find the outward pressure on the solenoid.