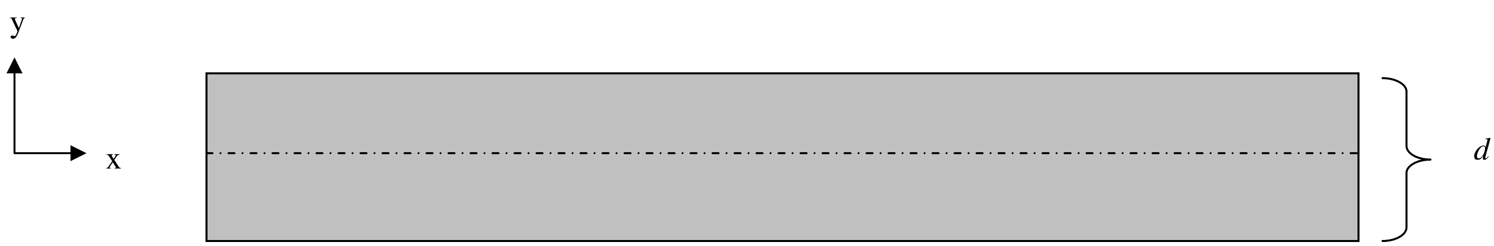
Homework 2:

Remember: In addition to this problem, you also have a "Mastering Physics" assignment Due February 13.

Due outside my office(2104 Physics) by 10:00 Friday, February 13 Write up of the solution to this problem in a coherent fashion.

This homework exploits Ampere's law and symmetry find the magnetic field in a nontrivial situation. Consider a "current slab" of thickness *d* carrying a current density of magnitude *J*. You can envision the slab as being in the x-z plane and carrying current in the z direction as in the figure below which gives a cross-sectional view:



You should envision the current going into the page and take the extent in the x and z direction to be large enough to be well approximated by infinity. The dashed line in the center of the diagram marks the location, y=0.

Symmetry considerations require that the field is oriented in (either the positive or negative) x direction with a magnitude independent of x and z. Thus one can write $\vec{B} = \hat{x}B(y)$. Moreover the symmetry of the problem requires $B(y)=-B(-y)$: the field below is of the same magnitude and opposite direction of the analogous point above. Among other things this implies that $B(0)=0$.

a. By choosing an appropriate loop for Ampere's law, find the strength of the magnetic field inside the slab. That is, find $B(y)$ for $d/2>y> -d/2$. *Hint: A rectangular loop including y=0 is helpful.*

b. By choosing an appropriate loop for Ampere's law, find the strength of the magnetic field outside the slab. That is find $B(y)$ for $y> d/2$ and for $y <-d/2$.