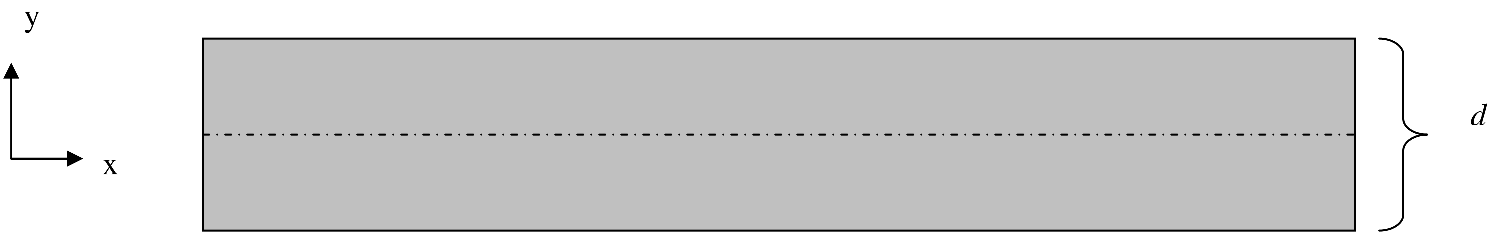
Homework 3:

Due outside my office(2104 Physics) by 10:00 Friday, February 20 Write up of the solution to this problem in a coherent fashion. **Remember: In addition to this problem, you also have a "Mastering Physics" assignment Due February 20.**

This homework exploits Faraday's law and symmetry find theeElectricc field in a nontrivial situation. Consider a "magnetic slab" of thickness *d* with a time-dependent magnet field. You can envision the slab as being in the x-z plane and the magnetic field to be in the z direction as in the figure below which gives a cross-sectional view:



You should envision the magnetic as being in the $\hat{z}$ direction and given by $\vec{B} = B_0 \cos(\omega t)\hat{z}$. You may 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 electric field is oriented in (either the positive or negative) x direction with a magnitude independent of *x* and *z*. Thus one can write $\vec{E} = \hat{x}E(y,t)$. Moreover the symmetry of the problem requires *E(y,t)=-E(-y,t)*: the field below is of the same magnitude and opposite direction of the analogous point above at any given time. Among other things this implies that *E*(0,t)=0.

a. By choosing an appropriate loop for Faradays's law, find the strength of the electric field inside the slab as a function of ti,e. That is, find *E(y,t)* for *d/2>y> -d/2*. *Hint: A rectangular loop including y=0 is helpful.*

b. By choosing an appropriate loop for Faraday's law, find the strength of the Electric field outside the slab. That is find *E(y,t)* for *y> d/2* and for *y <-d/2*.

c. In order for the magnetic field to have this pattern there must be time dependent "current sheets" at y=d/2 and y=-d/2. By symmetry the two must be equal in magnitude and opposite in direction. Use the right-hand rule to determine the direction that these current sheets flow and then use Ampere's law to find the magnitude of the surface current densities of these sheets as a function of time.