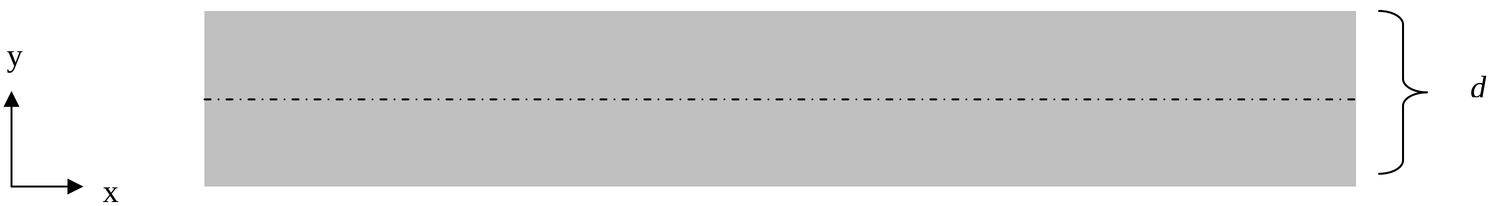
Homework 3:

Remember: In addition to this problem, you also have a "Mastering Physics" assignment Due February 22.

Due at the **beginning** of lecture, Friday, February 22. Write up of the solution to this problem in a coherent fashion.

Last week for homework we used Ampere's law to find the magnetic field from a "current slab". This week we consider an analogous problem for Faraday's law. In particular you should consider a magnetic field in a slab configuration. You can envision a slab of width *d* in the x-z plane with the magnetic field oriented in the z direction (in or out of the page) as in the figure below which gives a cross-sectional view:



You should consider the slab as being sufficiently large in the x and z directions to be treated as though it was infinite. Inside the slab the magnetic field is constant in space; it varies in time sinusoidally. Thus the magnetic field is given by

$$\vec{B} = \hat{k} B_o \sin(\omega t) \quad \text{for} \quad -d/2 < y < d/2 \quad \text{(intside the slab)}$$

$$\vec{B} = 0 \quad \text{for} \quad -d/2 > y \quad \text{and} \quad y > d/2 \quad \text{(outside the slab)}$$

The dashed line in the center of the diagram marks the location of y=0 (the plane dividing the slab in half). The time varying magnetic field induces an electric field. The task of this problem is to find it.

As with the example last week, 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 $\vec{E} = \hat{i}E(y)$. Moreover the symmetry of the problem requires *E(y)=-E(-y)*: the field below is of the same magnitude and opposite direction of the analogous point above. Among other things this implies that *E*(0)=0---i.e that the field is zero on the midplane.

a. By choosing an appropriate loop for Farady's's law, find the strength of the electric field inside the slab. That is, findE*(y)* 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)* for *y> d/2* and for *y <-d/2.*