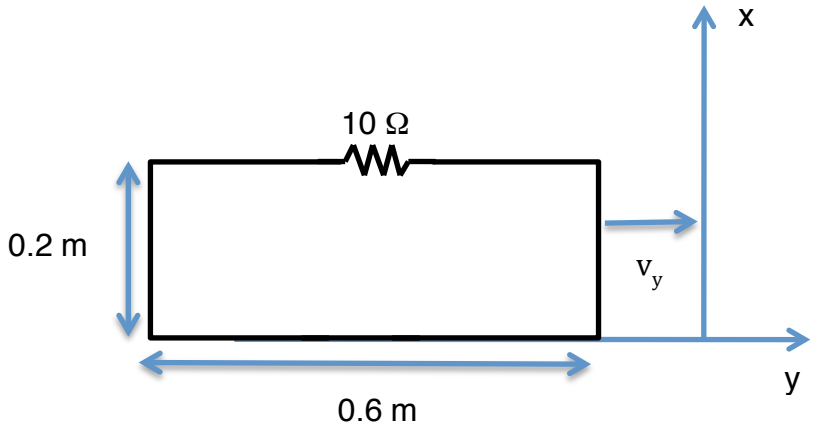
ENEL 476 Assignment #1 Due Wed Feb 7 at 5 pm

Question 1

The loop shown below moves from an area of zero external magnetic flux density (y<0) into an external magnetic flux density (y>0). In the region y>0, the flux density is described by:

$$\mathbf{B}=-0.3\mathbf{a}_z \text{ Wb/m}^2$$

The loop moves with velocity of $2\mathbf{a}_y$ cm/s and the location of the right side of the loop at t=0 is y=0.



a) Find the total magnetic flux (ϕ) passing through the surface of the loop.
b) Find the induced EMF.
c) Find the induced current flowing in the loop and explain how the induced current satisfies Lenz's law.
d) The external flux density in the region y>0 changes to:

$$\mathbf{B}=-0.3\cos(2\pi x10^3 t)\mathbf{a}_z \text{ Wb/m}^2$$

How does the induced EMF change?

Question 2

a) An electric field is given by:

$$\mathbf{E}(y,t)=40\cos(2\pi x10^6 t-\beta y)\mathbf{a}_x \text{ mV/m}$$

The field is in a dielectric material with $\varepsilon_r=2.4$ ($\mu_r=1$, $\sigma=0$). Assume a source-free region.

a) Find the associated displacement current density ($\mathbf{J}_d$).
b) Find the associated magnetic field, $\mathbf{H}(y,t)$.
c) Find β.