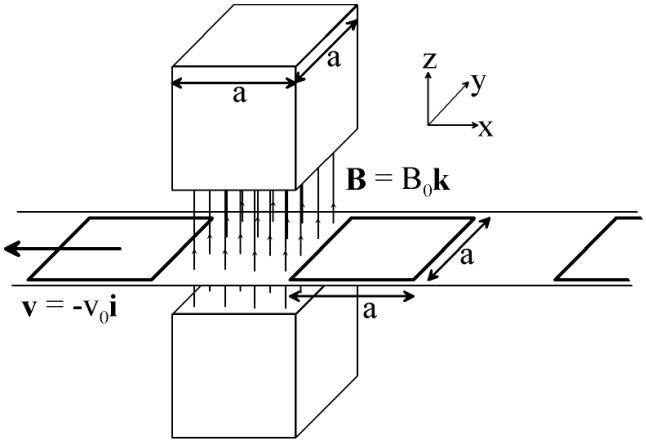
Problem Set 3, Written Problem, Due in class February 19, 2008

Name _____

An insulating strip carries square conducting loops (side length a) through a region of magnetic field created by a permanent magnet. The magnetic field $\vec{B} = B_0\hat{k}$ is confined to a square region of side length a. The strip has a velocity $\vec{v} = -v_0\hat{i}$ where $v_0 > 0$. Each loop has a resistance R.



At time t=0 a loop is just entering the magnetic field.

A) Make a plot of the magnetic flux Φ_m through the loop (on the y-axis) as a function of time t (on the x-axis). Label the x-axis and y-axis so that the values of **both** Φ_m and t can be identified at the following times: when the loop just enters the field (t=0), when the loop is all the way into the region of field, and when the loop has just left the field.

cont'd

B) Make a plot of the EMF $\mathcal{E}$ around the loop (on the y-axis) as a function of time t (on the x-axis). Label the x-axis and y-axis so that the values of $\mathcal{E}$ and t can be identified at the following times: when the loop just enters the field (t=0), when the loop is all the way into the region of field, and when the loop has just left the field. If $\mathcal{E}$ is clockwise looking down on the loop, make it positive on the graph, if $\mathcal{E}$ is counterclockwise, make it negative on the graph.

C) What is the maximum current induced in the loop?

D) What is the magnitude of the dipole moment $|\vec{\imath}|$ of the loop when the current is maximum?

E) What force $\vec{F}$ must be applied to the strip to keep it moving through the magnetic field? (Remember: $\vec{F}$ is a vector! Give magnitude and direction).