In this problem you will model the effects of eddy currents. The model consists of a rectangular loop with width $L$, containing a resistor of resistance $R$, and a slide wire with mass $m$ as shown in the figure at the left. A uniform magnetic field $B$ is directed perpendicular to the plane of the loop into the plane of the figure. The slide wire is given an initial speed of $v_0$ (at time $t = 0$) and then released. There is no friction between the slide wire and the loop, and the resistance of the slide wire and the wire of the loop can be neglected in comparison with the resistance $R$. Answer the following questions. You must show all your work to receive full credit. You may want to work on a separate sheet and staple it to this one.

(i) What is the magnitude of the EMF in the circuit when the slide wire has a speed $v$?

$$|\mathcal{E}| = \text{___________}$$

(ii) When the slide wire has a speed $v$, what is the current in the loop? Indicate its direction on the figure.

$$i = \text{___________}$$

(iii) When the slide wire has a speed $v$, what is the magnetic force on it? Be sure to indicate the sign of the force. Take positive in the same direction as $\vec{v}$ and negative in the opposite direction.

$$F = \text{___________}$$

(iv) Write Newton’s second law for the motion of the slide wire, using $dv/dt$ for the acceleration and solve the differential equation. (Hint: we’ve solved differential equations like this several times in lecture!)

$$v(t) = \text{___________}$$

(v) Extra Credit! Show that the total distance traveled by the slide wire is the finite value $\Delta x = v_0 m R / (B^2 L^2)$. 