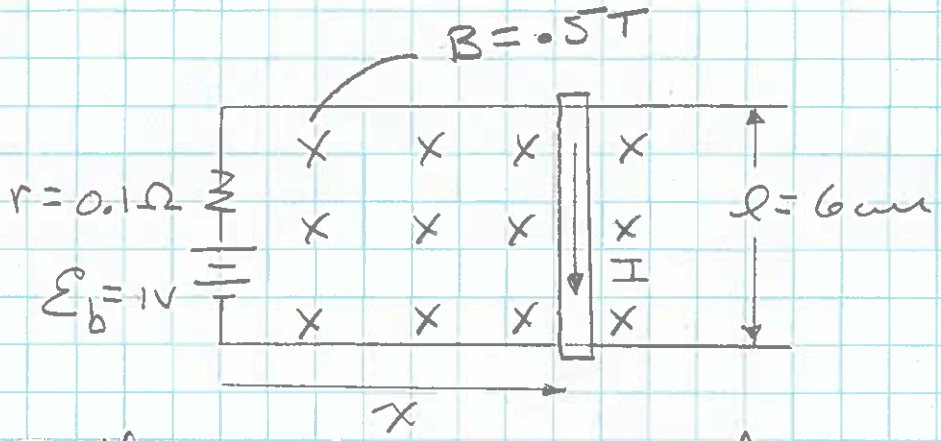



a.) Battery produces a current: $I = \frac{\mathcal{E}_b}{r}$

which is ccw, so there's a force on the bar

$$\vec{F}_{mag} = I\vec{\ell} \times \vec{B} = (I\ell B, \text{right})$$

Now, as bar moves to the right, there's an induced EMF in the loop:

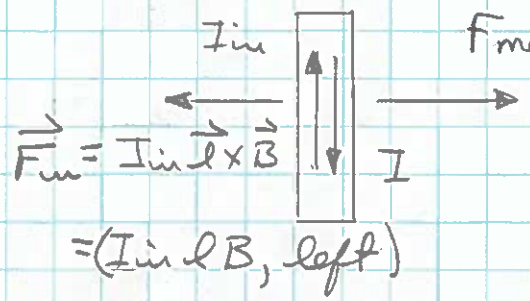
$$\mathcal{E}_{in} = \left| \frac{d\Phi_m}{dt} \right| = \frac{d}{dt}(B\ell \cdot x) = B\ell v$$

and $I_{in} = \frac{\mathcal{E}_{in}}{r} = \frac{B\ell v}{r}$

Flux is increasing $\Rightarrow \vec{B}_{in}$ is out

so $I_{in}$ is ccw (up through the bar)

FBD




$\Sigma F_x = F_{mag} - F_{in} = ma_x = 0$ at terminal vel.

$$I\ell B - I_{in}\ell B = 0$$

$$\frac{\mathcal{E}_b}{r} - \frac{B\ell v}{r} = 0 \Rightarrow v_{term} = \frac{\mathcal{E}_b}{B\ell}$$

b.) $v_{term} = 33.3\ m/s$