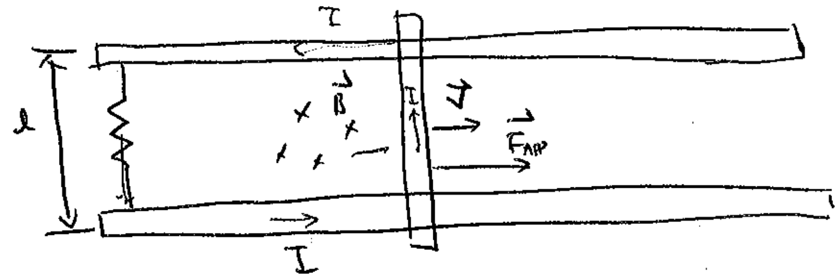
MONDAY 3/30/09

Consider following situations



$\vec{F}_D$ ←

$$\boxed{\Delta V = Blv} \rightarrow \mathcal{E} = Blv \text{ FROM } \mathcal{E} = -\frac{d\Phi_B}{dt} = -vlB$$

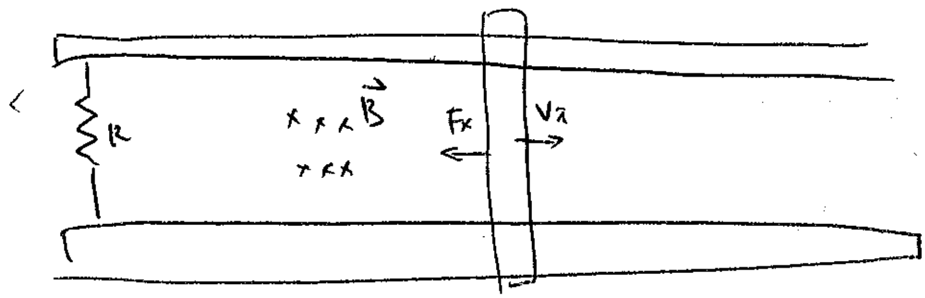
$$\boxed{I = \frac{Blv}{R}}$$

$$F_{APP}\, v = P \Rightarrow P = (IlB)v$$

$$= (lBv)\frac{Blv}{R}$$

$$= \frac{B^2 l^2 v^2}{R} = \frac{\mathcal{E}^2}{R}$$

MAGNETIC FORCE ACTING ON A SLIDING BAR



$$\vec{F}_x = ma = m\frac{dv}{dt} = -I\ell B$$

$$I = \frac{B\ell v}{R} \qquad = -\frac{B^2\ell^2 v}{R}$$

$$m\frac{dv}{dt} = -\frac{B^2\ell^2 v}{R}$$

$$\frac{dv}{v} = -\left(\frac{B^2\ell^2}{mR}\right)dt$$

$$\int_{V_i}^{V_f}\frac{dv}{v} = -\frac{B^2\ell^2}{mR}\int_0^t dt$$

$$\ln\left(\frac{v}{V_i}\right) = -\left(\frac{B^2\ell^2}{mR}\right)t$$

$$v = V_i\, e^{-t/\tau} \qquad \tau = \frac{mR}{B^2\ell^2}$$

c) METHOD

$$P_{RESISTOR} = I^2 R$$

$$= - P_{BAR}$$

$$I = \frac{B\ell v}{R}$$

$$P = \frac{dE}{dt} =$$

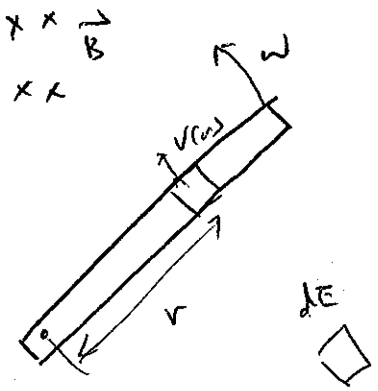
$$I^2 = \frac{B^2 \ell^2 v^2}{R^2}$$

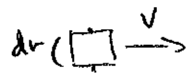
$$-\frac{d}{dt}\left(\frac{1}{2} m v^2\right) = \frac{B^2 \ell^2 v^2}{R}$$

$$-mv\frac{dv}{dt} = \frac{B^2 \ell^2 v^2}{R}$$

$$\frac{dv}{v} = -\left(\frac{B^2 \ell^2}{mR}\right) dt$$

MOTIONAL EMF ON A ROTATING BAR





$qvB = qE$

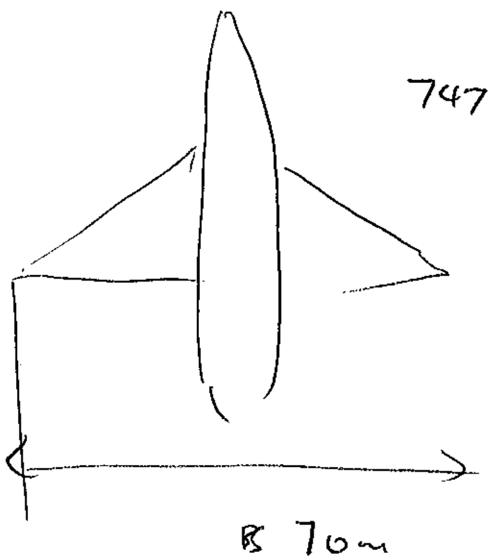
$qvB\,dr = d\mathcal{E}$

$$d\mathcal{E} = Bv\,dr$$

$$d\mathcal{E} = \int Bv\,dr$$

$$\mathcal{E} = B\int_0^{l} v\,dr$$

$$= B\int_0^{l} \omega r\,dr = \boxed{\frac{1}{2}B\omega l^2}$$



535 mph
893 km/hr
≈250 m/s

B = ~ 0.5 GAUSS

$v = 250\ m/s$

$B = 0.5 \times 10^{-4}\ T$

$\ell = 70\ m$

$\mathcal{E} = 70 \times 250 \times 0.5 \times 10^{-4}\ V$

$= 8750 \times 10^{-4}$

$\boxed{= 0.875\ V}$ MEASURABLE