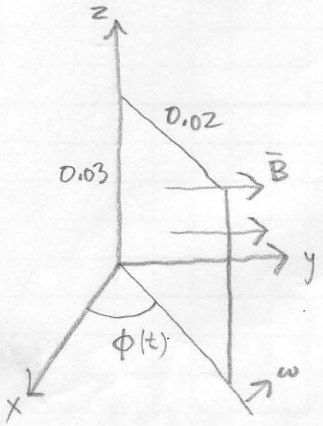
6.7 A rectangular loop conducting rotates at 6000 rpm in a uniform magnetic field

$$\bar{B} = \hat{y}\, 50 \times 10^{-3} \quad (T)$$

Determine the current induced in the loop if $R_i = 0.5\ \Omega$.



$$6000 \frac{\text{rev}}{\text{min}} \cdot \frac{1}{60\ \text{sec}} = 100\ \text{Hz}$$

$$V_{emf}^{tv} = -\frac{d\Phi}{dt} = -\frac{d}{dt}\int_s \bar{B}\cdot d\bar{s}$$

$$= -\frac{d}{dt}\int_{0.0}^{0.02} \hat{y}\, 0.05 \cos\phi(t) \cdot \hat{y}\, 0.03\, dx$$

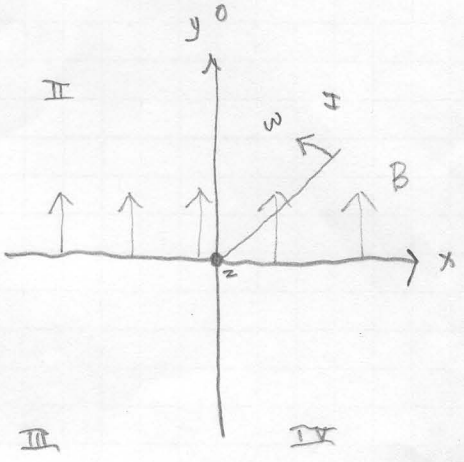
$$= -\frac{d}{dt}\left[0.05 \cdot 0.02 \cdot 0.03 \cos\phi(t)\right]$$

$$= -\frac{d}{dt}\, 30\times10^{-6} \cos\phi(t)$$

$$= 30\times10^{-6} \cdot 200\pi \sin 200\pi t \quad (V)$$

$$I_{ind} = \frac{V_{emf}}{R_i} = \frac{0.006}{0.5}\pi \sin 200\pi t$$

$$= 12\pi \sin 200\pi t \quad (mA) \qquad \approx 37.7 \sin(200\pi t)\ mA$$



zero current at $y = 0$ plane

I CW @ $x = 0$

II ACW

III ACW

IV CW