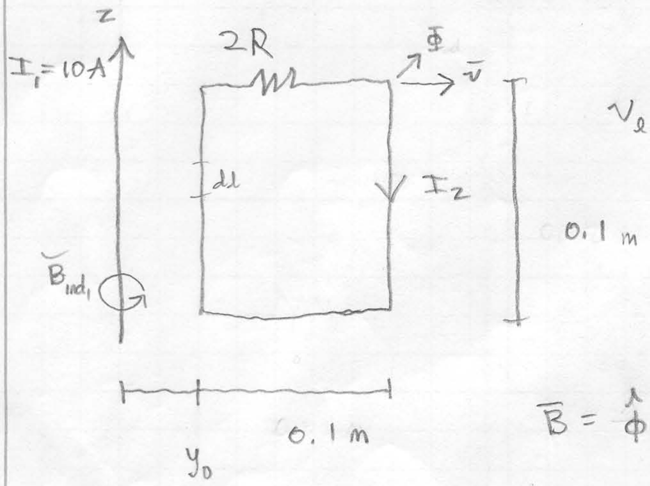
6.11 The loop shown is moving away from a current carrying wire at $\bar{v} = \hat{y}\,7.5$ m/s. If $R = 10\,\Omega$ and I_2 direction is defined below. Determine I_2 as a function of y_0.

Assume internal Resistance is negligble.



$$V_{emf} = \cancel{V_{emf}^{tr}}^{\,0} + V_{emf}^{m}$$

$$= \oint_C (\bar{u} \times \bar{B}) \cdot d\bar{l}$$

$$\bar{B} = \hat{\phi}\, \mu \frac{I_1}{2\pi r} \ \frac{Wb}{m^2} \qquad \bar{v} = \hat{y}\,7.5 \ \frac{m}{s}$$

Note: $dl \cdot \hat{z} = 1$, $dl \cdot \hat{r} = 0$

$$\hat{u} \times \bar{B} = \hat{r} \times \hat{\phi} = \hat{z}$$

$$= \hat{z}\, \mu \frac{I_1 |v|}{2\pi r}$$

$d\bar{l} = \hat{z}\, dz$ cyl. coor.

$$V_{emf} = \int_0^{0.2} \hat{z}\, \mu \frac{I_1 v}{2\pi r}\Bigg|_{r=y_0} \cdot \hat{z}\, dz + \int_{0.2}^{0} \hat{z}\, \mu \frac{I_1 v}{2\pi r}\Bigg|_{r=y_0+0.1} \cdot \hat{z}\, dz$$

$$= \frac{\mu v I_1}{2\pi}\left[\int_0^{0.2} \frac{1}{y_0}\, dz - \int_{0.2}^{0} \frac{dz}{y_0 + 0.1}\right]$$

$$= \frac{\mu v I_1}{2\pi}\, 0.2 \left(\frac{1}{y_0} + \frac{1}{y_0 + 0.1}\right) \quad (V)$$

$$I_2 = \frac{V_{emf}^{m}}{2R} = \frac{4\pi \times 10^{-7} \cdot 7.5 \cdot 10 \cdot 0.2}{2\pi}\left[\frac{1}{y_0} + \frac{1}{y_0 + 0.1}\right] \quad (A)$$