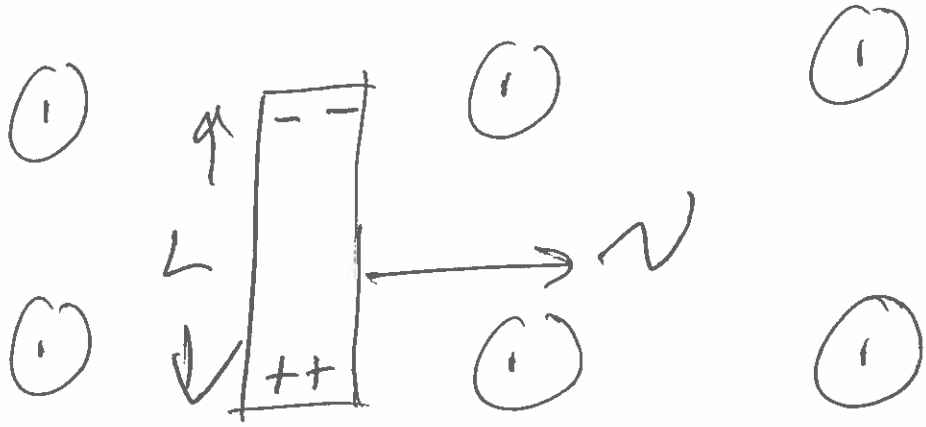


$$\vec{F}_B = q\vec{v} \times \vec{B}$$

+ charges ↓ − charges ↑

$$F_E = F_B$$

$$QE = QvB$$

$$E = \frac{\text{voltage}}{\text{distance}} = \frac{\mathcal{E}}{L}$$

$\mathcal{E}$ - emf

$$Q\frac{\mathcal{E}}{L} = QvB$$

$$\Rightarrow \boxed{\mathcal{E}_{induced} = vBL}$$

eg $L = 65.0\,m$ Wings of 747

$v = 260\,m/s$ Cruising speed

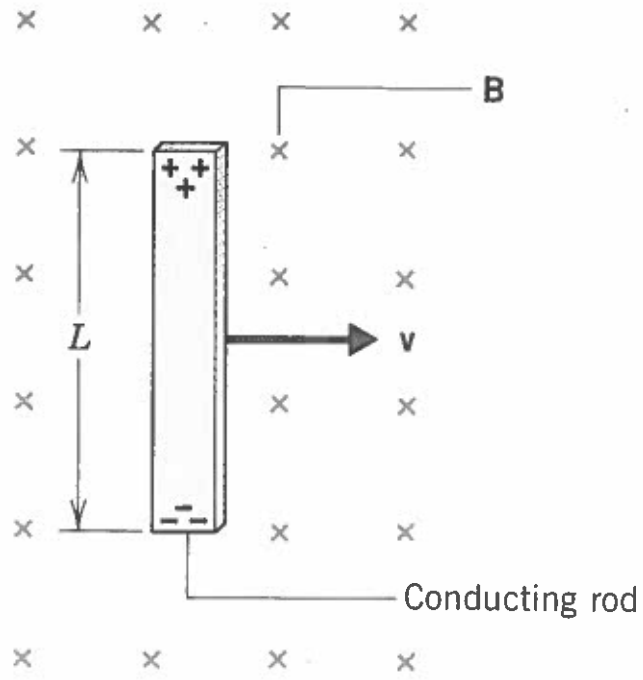
$B_{vert} = 10^{-6}\,T$ $\hat{down}$

$$\mathcal{E} = vBL = \left(260\frac{m}{s}\right)\left(10^{-6}\,T\right)(65.0\,m)$$

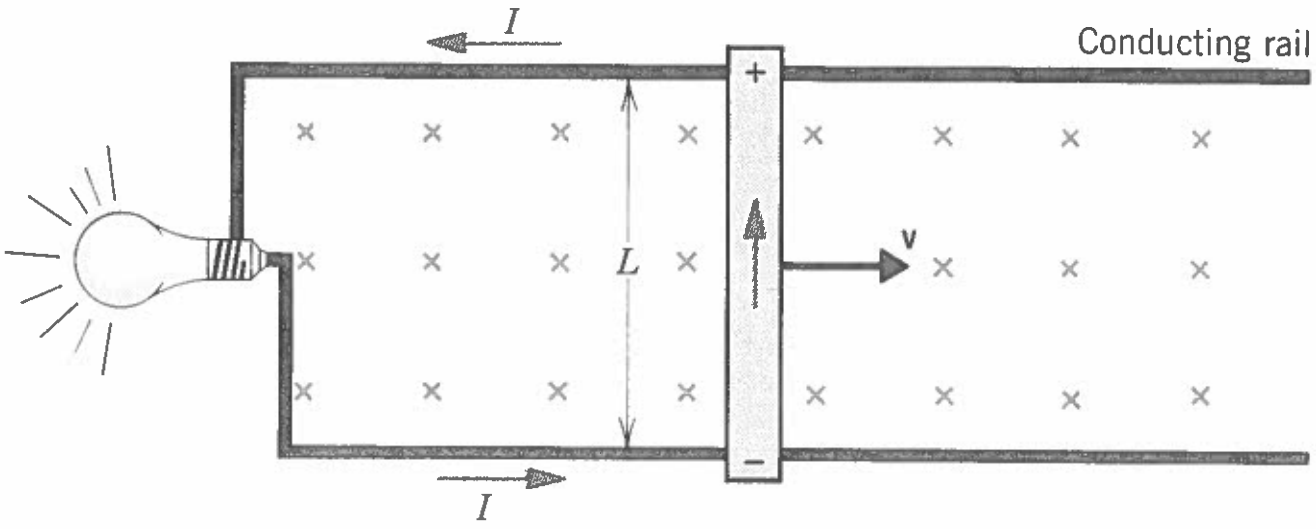
$$\mathcal{E} = 0.169 = 169\,mV$$

flying North $\vec{v} \times \vec{B}$ ↑ N × down

+ end $\hat{West}$!



(a)



(b)

FIGURE 22.4 a, b 162

If $L = 1.0\ m$ $\quad B = 100\ T$ (X)

What $v = ?$ $\Rightarrow$ $\mathcal{E} = 25.0\ V$?

$$\mathcal{E} = BLv$$

$$v = \frac{\mathcal{E}}{BL} = \frac{(25.0\ V)}{(100\ T)(1.0\ m)} = \underline{0.250\ \frac{m}{s}}$$

$R_{Bulb} = 100\ \Omega$ $\Rightarrow$ $i = ?$

$$i = \frac{\mathcal{E}}{R} = \frac{(25.0\ V)}{100\ \Omega} = \underline{0.250\ A}$$

How much Power is dissipated?

$$P = i^2 R = (.250\ A)^2 (100\ \Omega)$$

$$\underline{P = 6.25\ W}$$

$\vec{F}_B = i\vec{L} \times \vec{B}$ $\qquad$ $\uparrow i$ (X)

$\leftarrow \vec{F}_B$

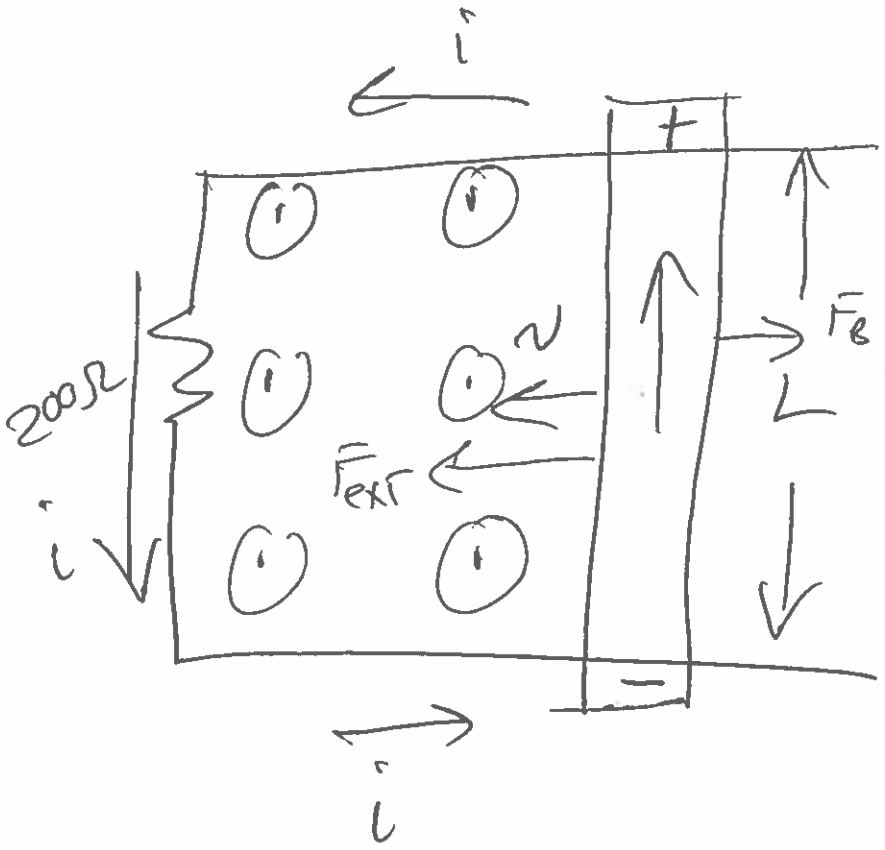
$$\bar{F}_{ext} = \bar{F}_B = ILB$$

$$\bar{F}_{ext} = (1.25A)(1.0m)(100T)$$

$$\underline{F_{ext} = 25.0\ N}$$

$$P_{ext} = \bar{F}v = (25.0\ N)(1.250\ m/s)$$

$$\underline{P_{ext} = 6.25\ W}$$



B = 1.50 T

v = 0.50 M/s

$$\mathcal{E} = BLv = (1.50\,T)(.50\,m)(.50\,m/s)$$

$$\mathcal{E} = 37.5\,V$$

$$i = \frac{\mathcal{E}}{R} = \frac{37.5\,V}{200\,\Omega} = \underline{0.188\,A}$$

$$F_{ext} = F_B = iLB = (0.188\,A)(0.50\,m)(1.50\,T)$$

$$\underline{F_{ext} = 14.1\,N}$$

$$P_{200\Omega} = (0.188\,A)^2(200\,\Omega) = \underline{7.07\,W}$$

$$P_{ext} = (14.1\,N)(0.50\,m/s) = \underline{7.07\,W}$$

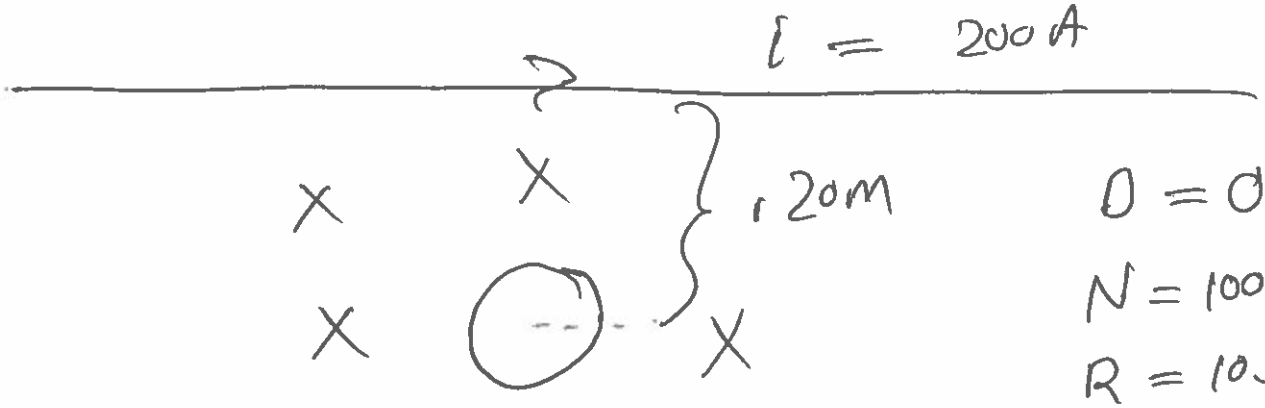
Faraday's Law of electromagnetic Induction

$$\mathcal{E} = -N \frac{\Delta \Phi_B}{\Delta t}$$

N = # of turns of wire

$\Phi_B = \vec{B} \cdot \vec{A}$

– Sign Lenz's Law ⇒ induced magnetic field opposes the change in magnetic flux.



$D = 0.10\,m$

$N = 100$ turns

$R = 10\,\Omega$

i_{wire} → 200 A → 100 A in 10 sec

$$i_{coil} = \frac{\mathcal{E}}{R} = \frac{N \frac{\Delta \Phi_B}{\Delta t}}{R}$$