Faraday's Law

Induced Voltage $\mathcal{E} = -\dfrac{d\Phi_B}{dt} = \dfrac{-N\, d\Phi_B}{dt}$

Φ_B → Magnetic Flux

N → Number of loops in wire

$\dfrac{d\Phi_B}{dt}$ → Change in magnetic flux

$$\Phi_B = \frac{-d[B \cdot A \cos\theta]}{dt}$$

θ → angle b/w magnetic field and normal to surface

A → Area of loop / wire

$N = 30$

$\theta = 0$

$r = 4 \times 10^{-2}$ m

$R = 1\ \Omega$

$B = 0.01t + 0.04t^2$

$t = 5$

$$\mathcal{E} = -30\pi(4\times10^{-2})^2 \cos(0)\frac{dB}{dt}$$

$$= -30\pi(4\times10^{-2})^2 \times (0.01 + 0.08t)$$

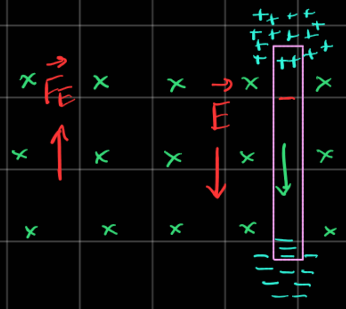
$$\mathcal{E} = \frac{-d(BA\cos\theta)}{dt}$$

$$= -8\times10^{-4}\frac{dB}{dt}$$

$$= -8\times10^{-4} \times 2 \ldots$$

$$= -16\times10^{-4}\ V$$

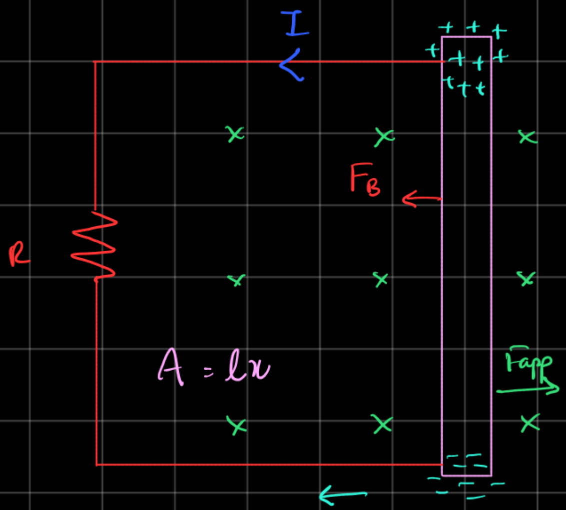
$$I = \frac{\varepsilon}{R} = \frac{-16\times10^{-4}}{2} = -8\times10^{-4}\ A$$



$$F_e = F_B \Rightarrow qE = qvB$$

$$E = vB$$

$$E = \frac{\Delta V}{l} \Rightarrow \Delta V = El \Rightarrow El = vBl$$



$$I = \frac{\Delta V}{R} = \frac{vBl}{R}$$

$$\varepsilon = -\frac{d\Phi_B}{dt}$$

motional EMF

$$= -\frac{d[BA\cos\theta]}{dt}$$

$$= -B\frac{dA}{dt}$$

$$= -Bl\frac{dx}{dt}$$

$$\boxed{= -Blv}$$

$$P = \frac{\varepsilon^2}{R} = F_{app}\,v$$

$$F_{app} = F_B = IlB$$

$$\varepsilon = -N\frac{d\Phi_B}{dt} = -NBA\frac{d[\cos\theta]}{dt} = -NBA\frac{d[\cos\omega t]}{dt}$$

$$= NBA\omega\sin(\omega t)$$

$$\omega = rad/sec = \theta/t$$

$$\theta = \omega t$$

$E_{max} = NBA\omega$

$24 = NBA\ 900$

$NBA = \frac{24}{900}$

$\varepsilon = \frac{24}{9\cancel{0}\cancel{0}} \times 5\cancel{0}\cancel{0}$

$= \frac{120}{9}$

$= 13.33\ V$