Physics 201 — Day 14

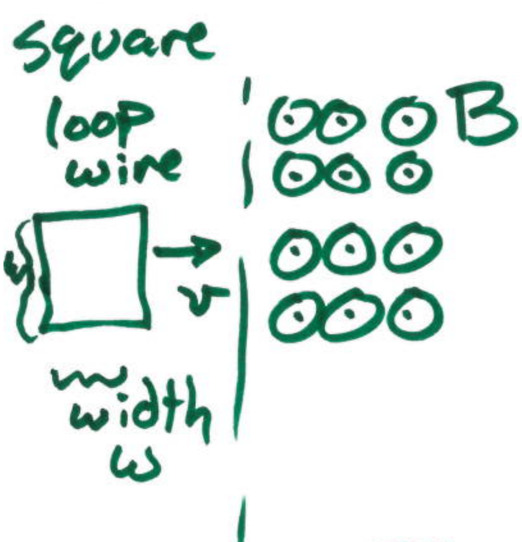
Faraday's Law + Lenz's Law

$$V = -\frac{d}{dt}\oint \vec{B}\cdot\vec{da}$$

must change something:

B, area, θ between them.

last time, area.



$$V = \frac{d}{dt}\int \vec{B}\cdot\vec{da}$$

$$V = B\frac{d}{dt}\underbrace{\int da_{IN}}$$

$$A_{IN} = x_{IN}\cdot \overset{y}{\widetilde{w}}$$

$$x_{IN} = x_0 + vt$$

What is V in loop while entering field at speed v?

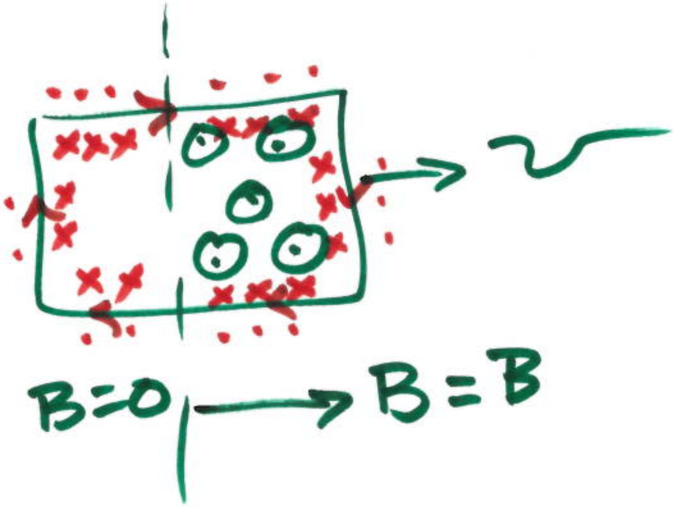
which way does I go?

$$V = Bw\frac{d}{dt}(x_0 + vt)$$

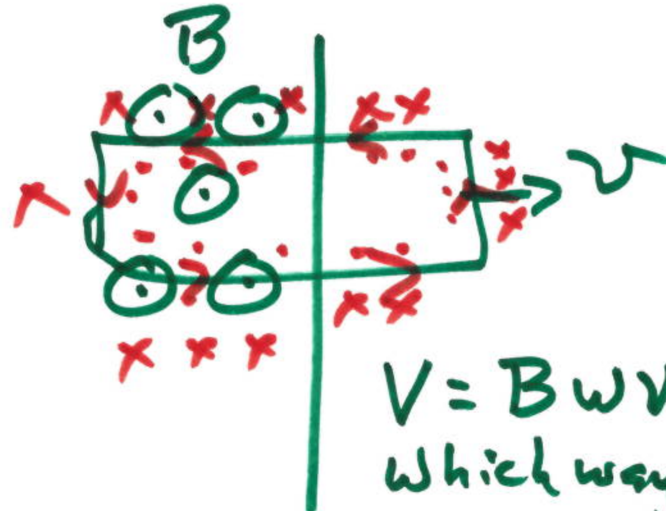
$$\boxed{V = Bwv}$$

Lenz' Law:

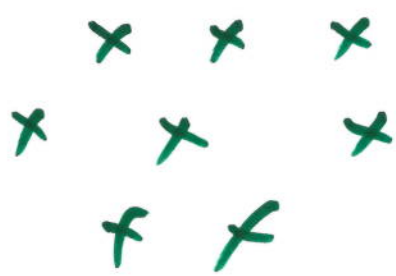
The current induced generates a $\vec{B}$ field which opposes the change in flux.

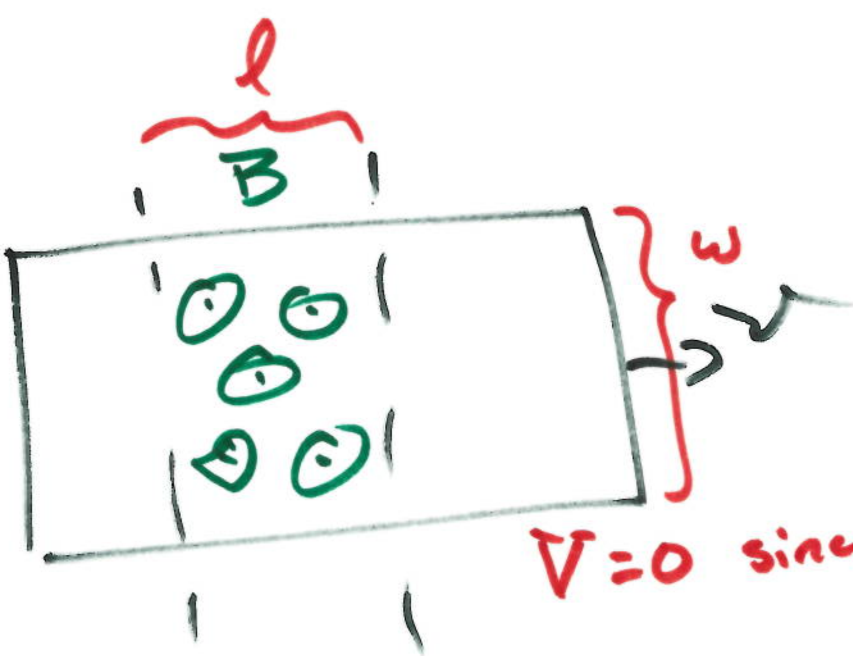


later on:



$V = Bwv$
which way?

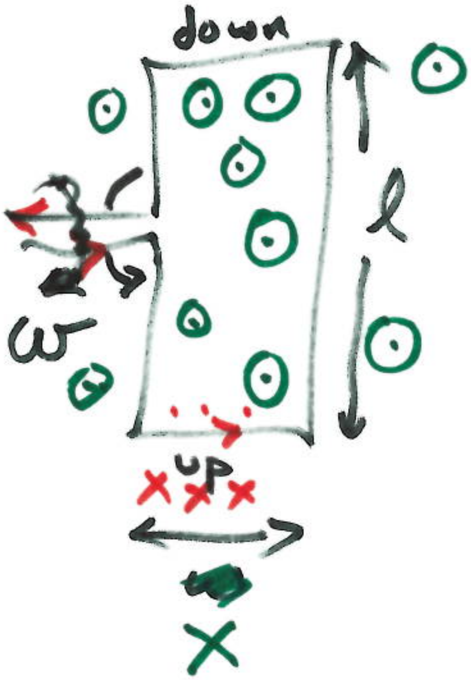




$V = 0$ since $\frac{d}{dt} B \overbrace{A_{IN}}^{w \cdot l} = 0$

Changing θ: the angle between $\vec{B}$ and $\vec{da}$:

$\vec{B}$ = const.



$$V = -\frac{d}{dt}\int \vec{B}\cdot\vec{da}$$

$$= \frac{d}{dt}\int B\,da\,\cancel{\sin}\cos(\underbrace{\omega t}_{\theta = \omega t})$$

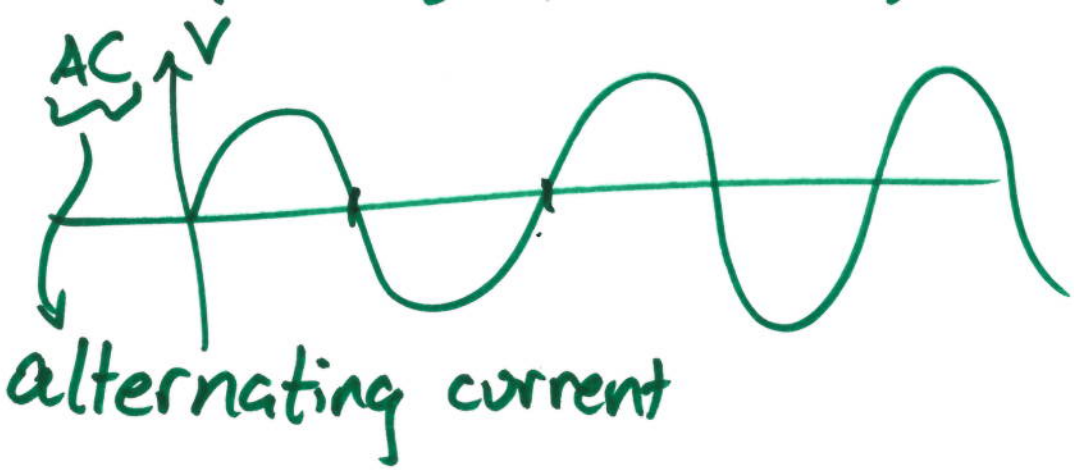
or: $\omega = \frac{d\theta}{dt}$

$$= \frac{d}{dt} B\cos(\omega t)\underbrace{\int da}_{\ell \cdot x}$$

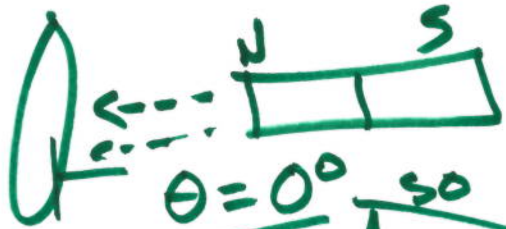
$\vec{B}\cdot\vec{da} = B\,da_{\perp}$

$$= B\ell x \frac{d}{dt}\cos(\omega t)$$

$$V = B\ell x \sin(\omega t)\,\omega$$



Option III could change B with t holding area, angle constant



$$B = B_0 + \alpha t$$

$\theta = 0°$ so loop $\perp$ page

loop area A

$$V = \frac{d}{dt}\int \vec{B}\cdot d\vec{a}$$

$$V = \frac{d}{dt} B(t) A \underbrace{\cos 0°}_{1} = A \underbrace{\frac{dB}{dt}}_{\alpha}$$

$$V = A\alpha$$

$\vec{B}$ increasing ($\alpha > 0$)