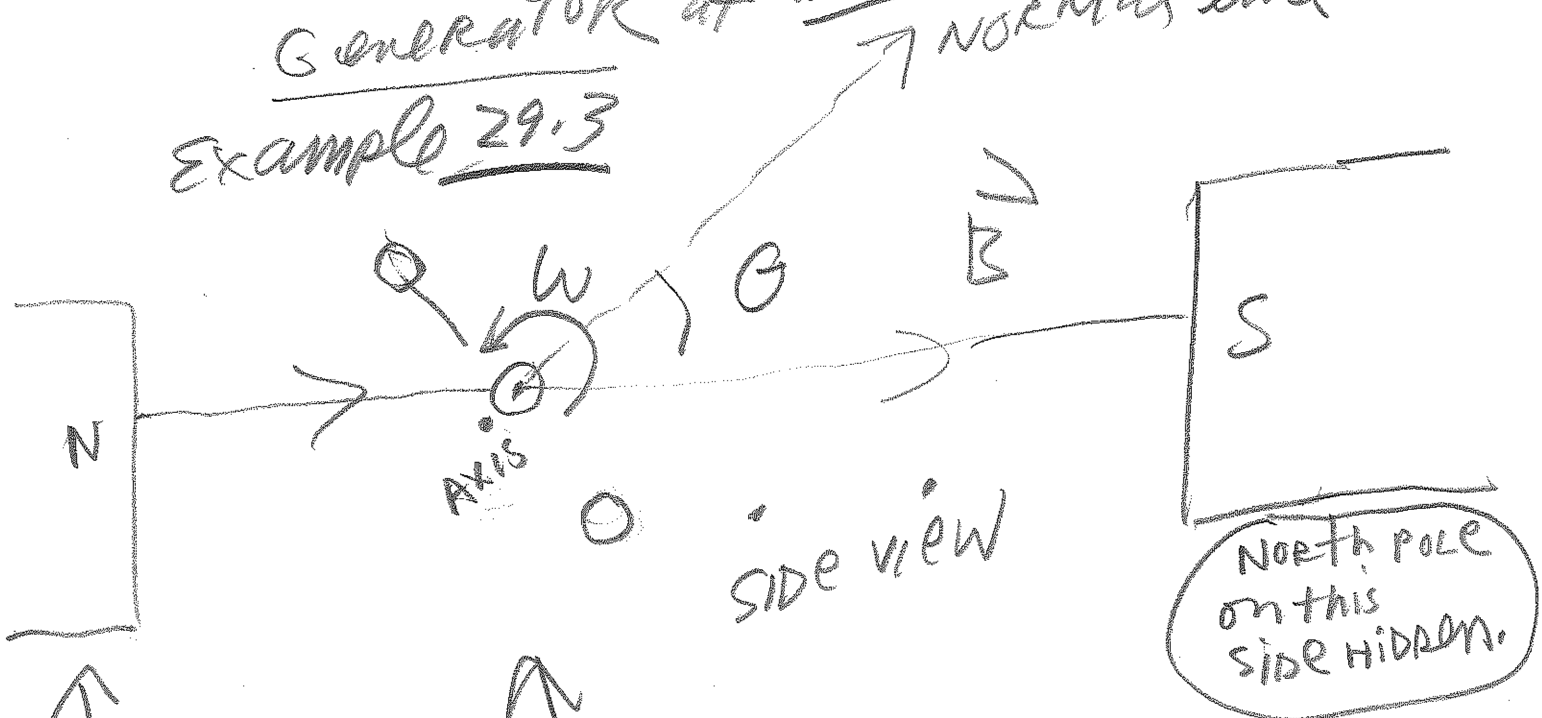
CH 29 — 4-28-14 4B

*AC Generators, induced electric fields (HARD DRIVES, HYBRID CAR wheels, airplane Engine crankshafts, ...)

*Generator at HYDROELECTRIC DAM:

Example 29.3



South on this pole side not shown.

ROTATING LOOP: $\Phi_B = BA\cos\theta$

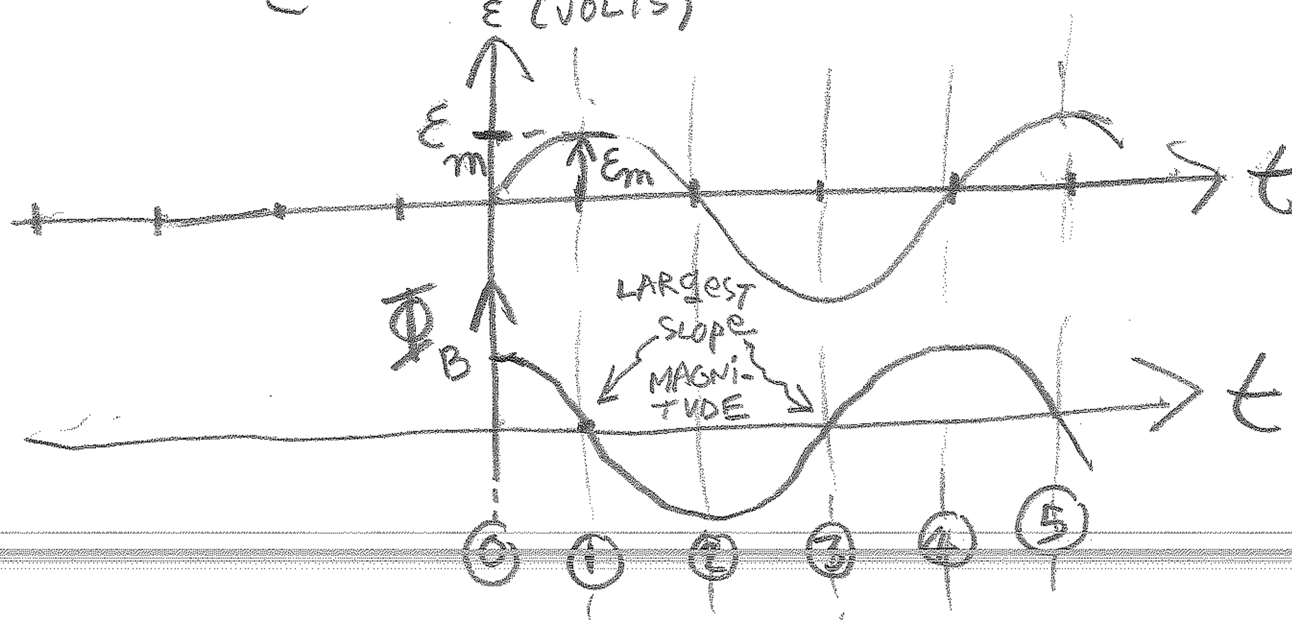
$\Phi_B = BA\cos\omega t$

$$\mathcal{E} = -\frac{d\Phi_B}{dt}$$

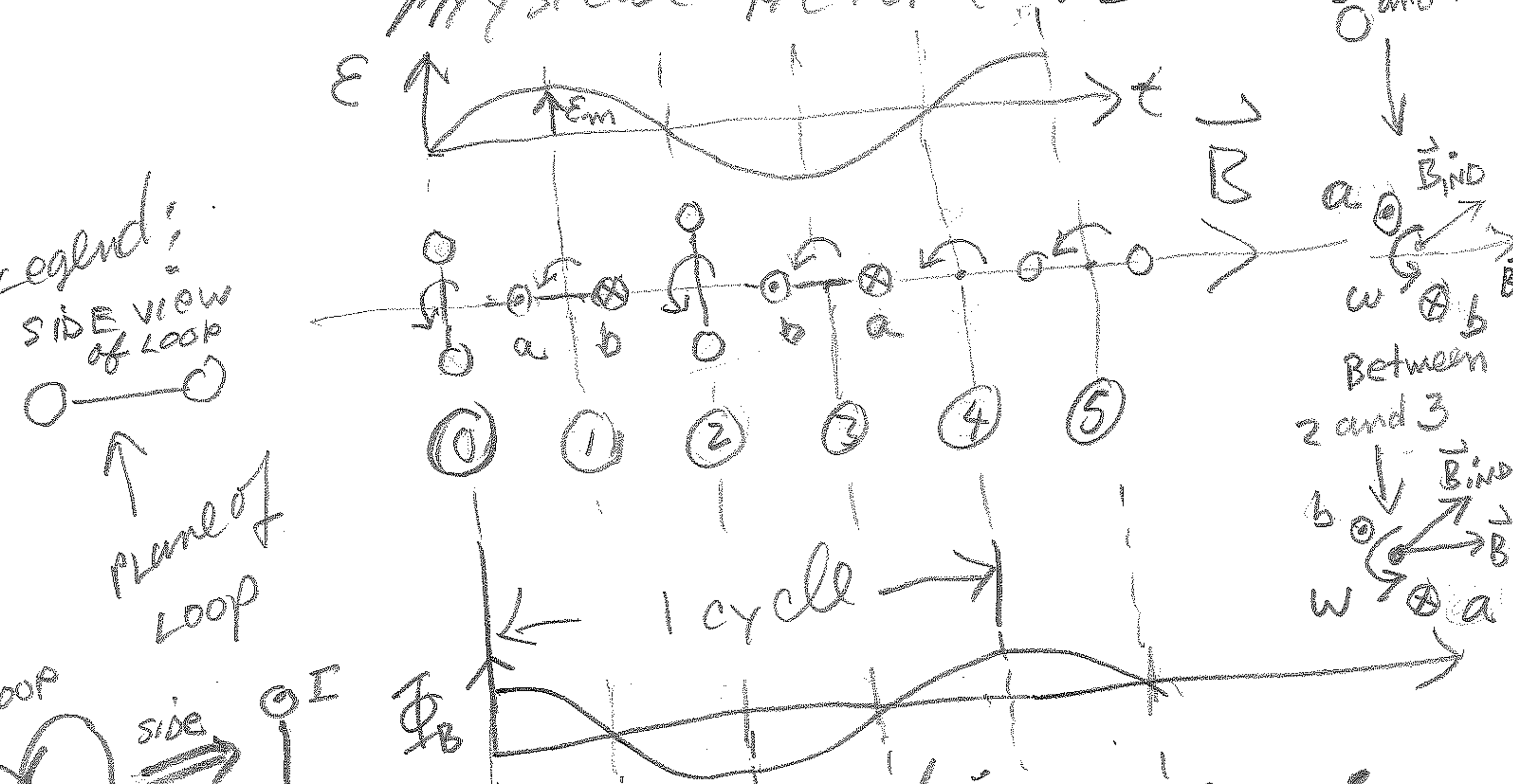
– indicates opposition to change in magnetic flux; $\mathcal{E}$ acts to oppose change in flux.

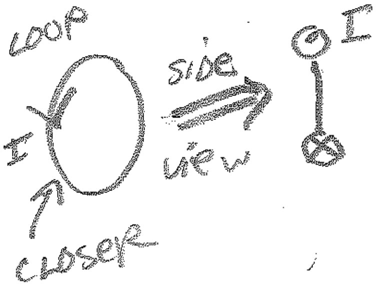
$$\mathcal{E} = -\frac{d(BA\cos\omega t)}{dt}$$

$$\mathcal{E} = \omega BA\sin\omega t = \mathcal{E}_m \sin\omega t$$



Physical picture of loop



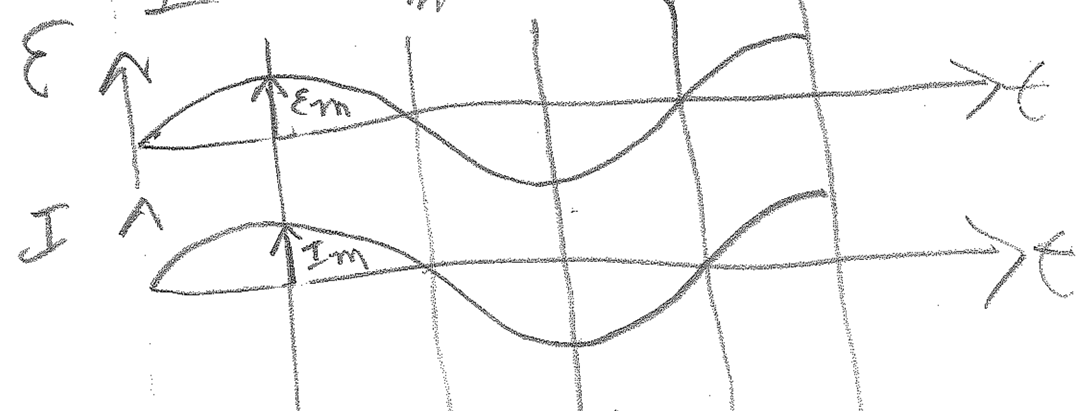


NOTE: current in wire loop is

$$I = \frac{\varepsilon}{R} = \frac{\varepsilon_m}{R}\sin\omega t,$$

R = resistance of loop

$$I = I_m \sin\omega t$$



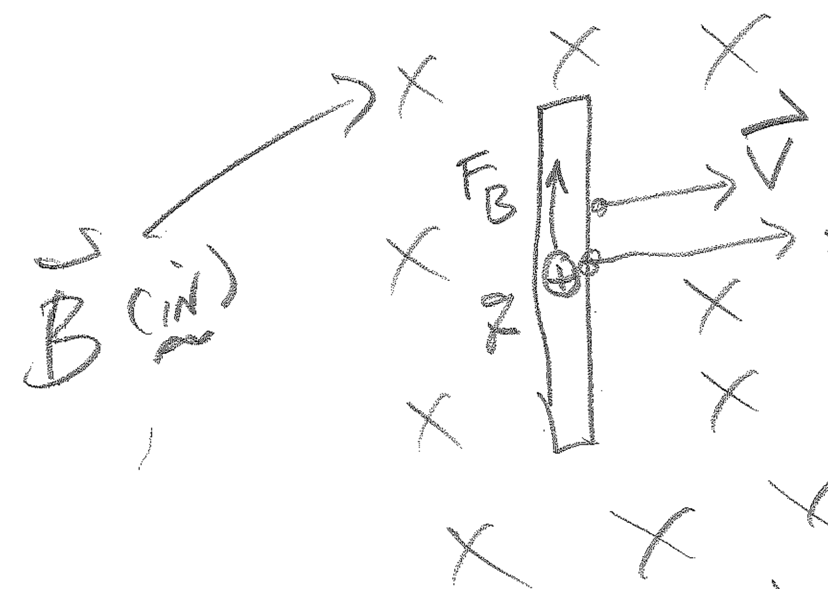
AC current with changing direction in loop*

* see discussion on commutators

Section 29.4

Motional EMF's

suppose you pull on a conducting piece of metal in a magnetic field

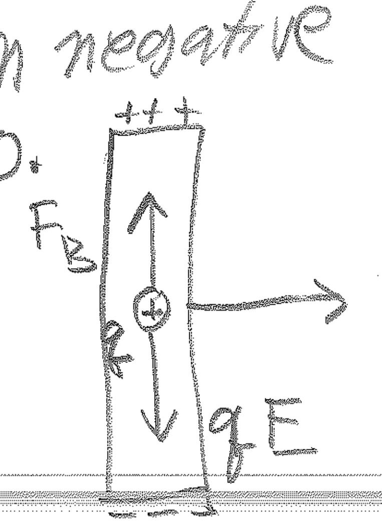


$F_B = qVB\sin 90$

$\boxed{F_B = qVB}$

$V = |\vec{V}|$

as charges (q) move up, top becomes +ve, bottom negative until $q\vec{E} + \vec{F}_B = 0$.

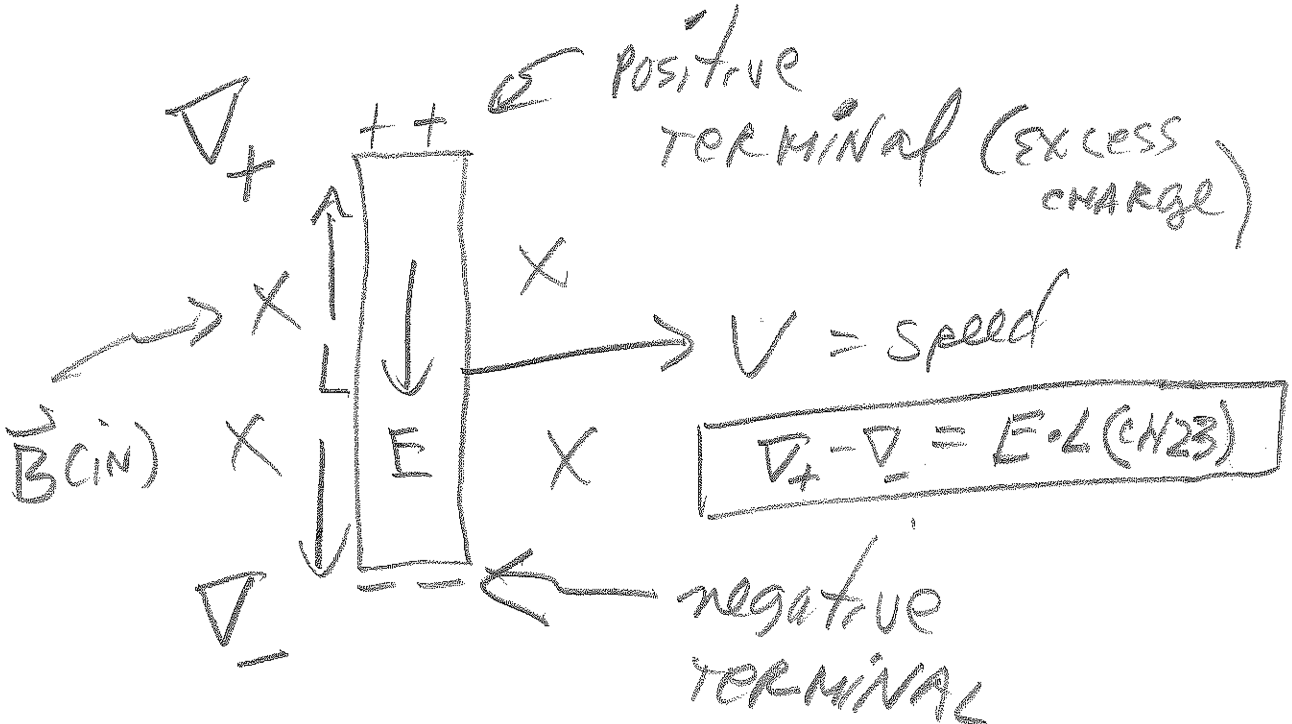


THUS, $\vec{F}_{net} = 0$.

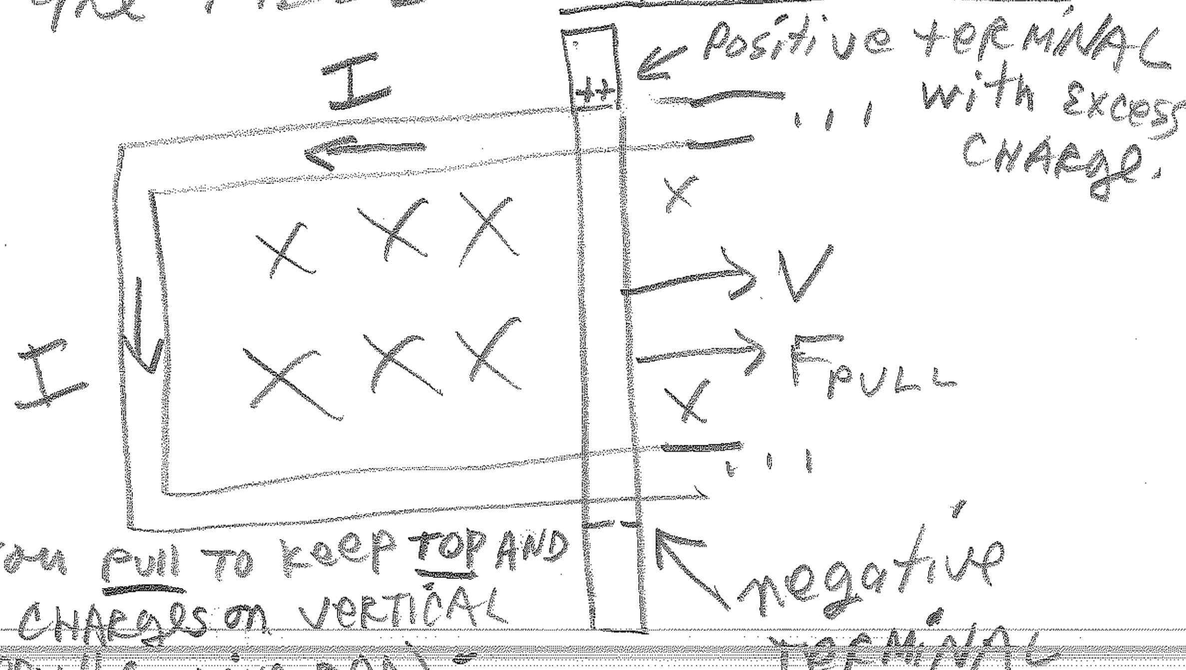
so $qE = qVB$

$E = VB$

ROD ACTS like a battery:

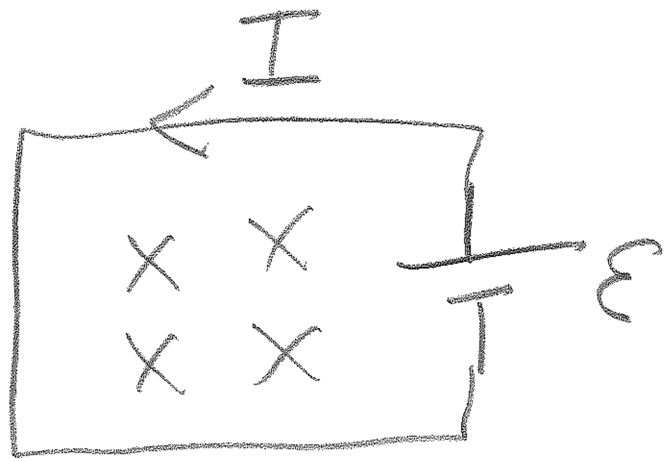


NOW PUT THIS "BATTERY" on a stationary U-SHAPED conductor in the FIELD to complete a circuit



NOTE: you pull to keep top and bottom excess charges on vertical "battery" (moving ROD)

Equivalent picture:

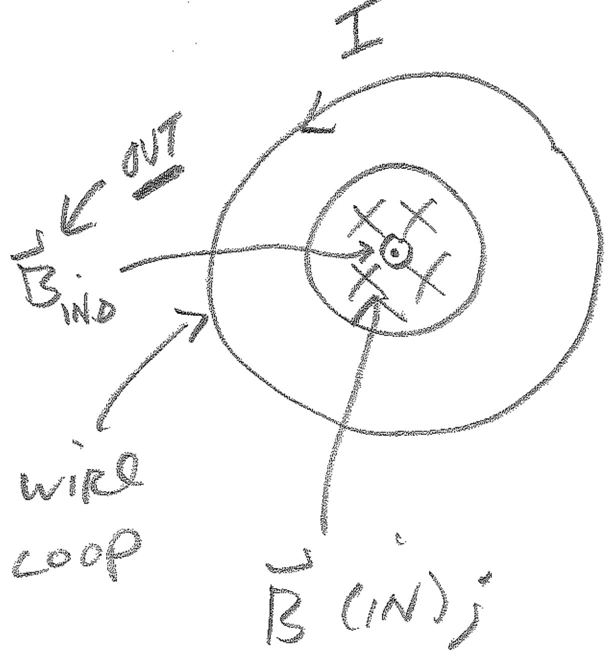


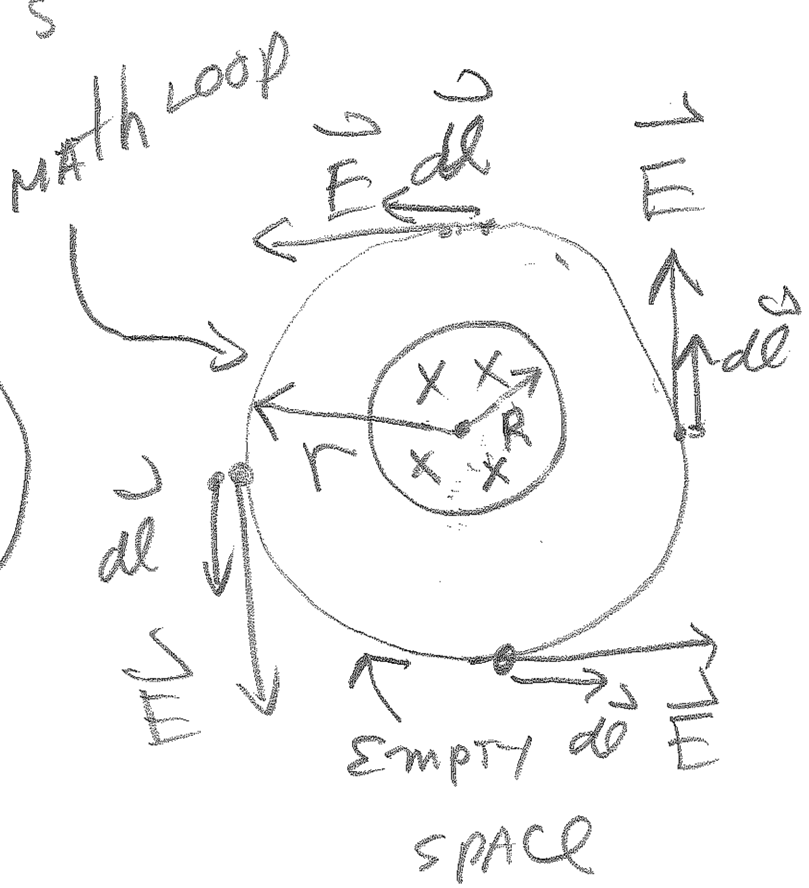
$\mathcal{E} = E \cdot L = B \cdot v \cdot L$

same result as

lecture 4-23-14 !

Sec. 29.5

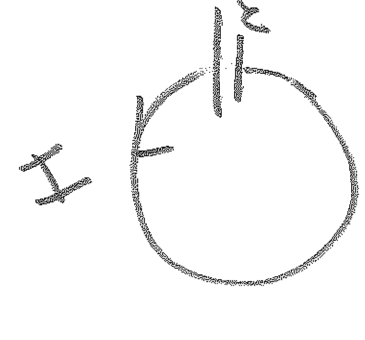




$|\vec{B}|$ increases

$\Uparrow$

$$|\mathcal{E}| = A\left|\frac{dB}{dt}\right|$$



$$|\mathcal{E}| = A\left|\frac{dB}{dt}\right|$$

and $|\mathcal{E}| = \oint_{loop} \vec{E}\cdot\vec{dl}$

$$\oint \vec{E}\cdot\vec{dl} = \oint E\,dl\cos 0$$

$$= E\oint dl = E(2\pi r).$$

$$A\left|\frac{dB}{dt}\right| = E(2\pi r)$$

$$\pi R^2\cdot\left|\frac{dB}{dt}\right| = E(2\pi r)$$

$$E = \frac{R^2}{2r}\left|\frac{dB}{dt}\right| \propto \frac{1}{r}$$

$(r \geq R)$ $E \propto \left|\frac{dB}{dt}\right|$

"curl" result

$\vec{B} = 0,\ r > R$

Quiz 29: #71.

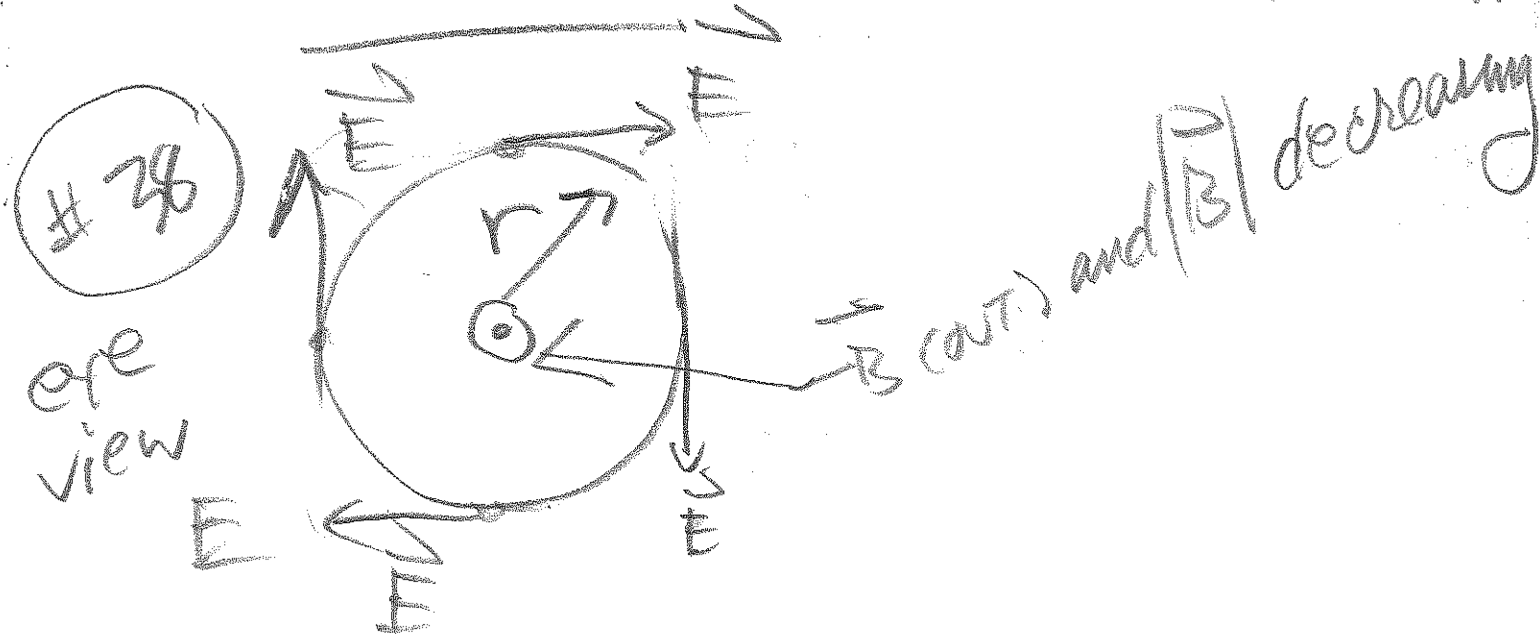
side view

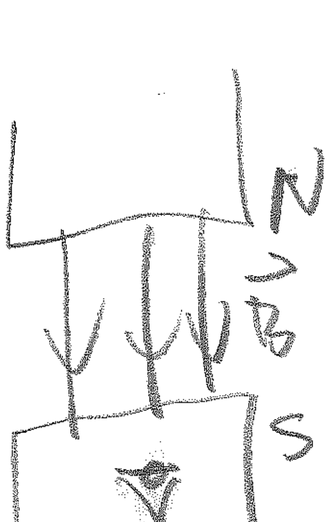
$$E(2\pi r) = \pi r^2 \cdot \left|\frac{dB}{dt}\right| \Rightarrow E = \frac{r}{2}\left|\frac{dB}{dt}\right|$$

$(r \leq R)$

PostLec.29 CH29 masteringphysics.com

#28





$$E(2\pi r) = \pi r^2 \left|\frac{dB}{dt}\right|$$

$$E = \frac{r}{2}\left|\frac{dB}{dt}\right|$$