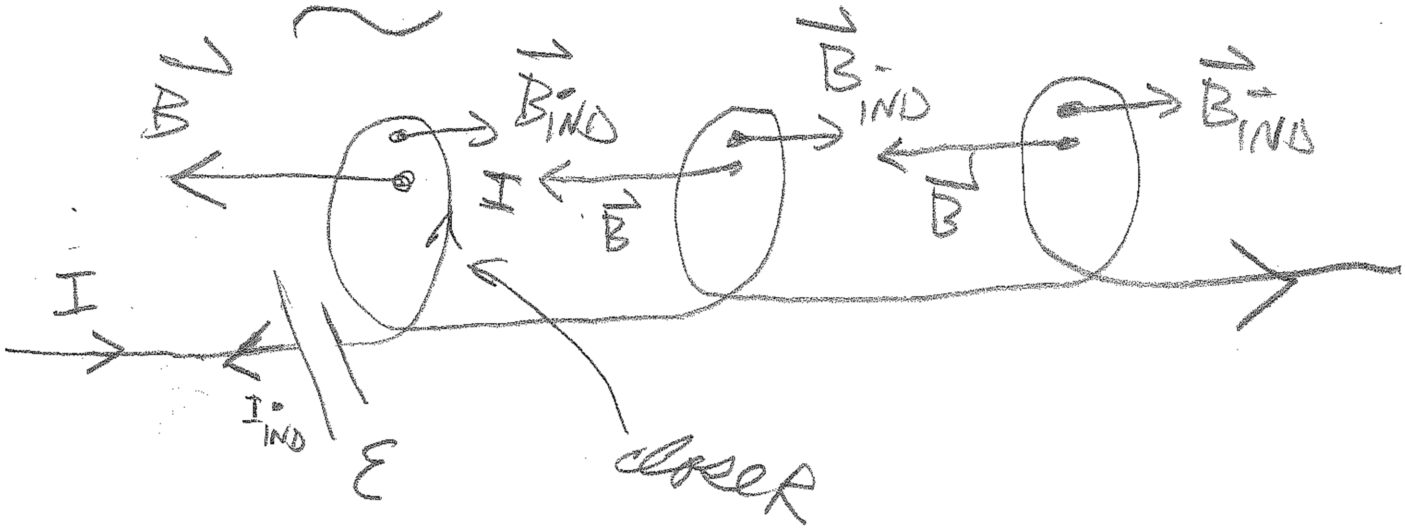
4-30-14

CH 30

Sec. 30.2



$$|\vec{B}| = B \cong \mu_0 \cdot n \cdot I$$

IF I increases, $|\vec{B}|$ increases.

$\vec{B}_{IND}$ opposes increase in $\vec{B}$.

$\mathcal{E}$ causes I_{IND} associated with $\vec{B}_{IND}$. Net effect on next page.

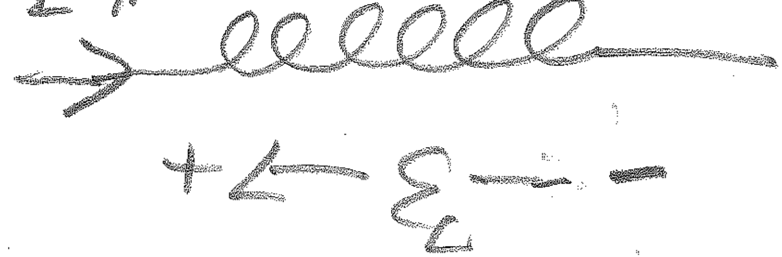
4-30-14 (2

Sec 30.2

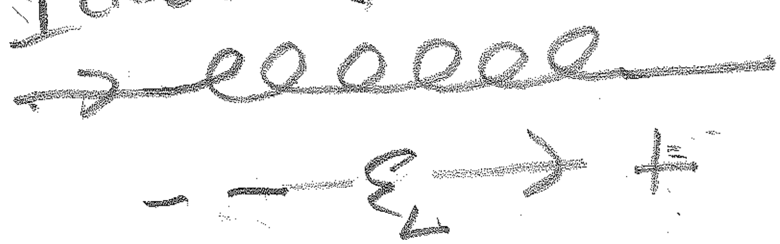
WEB-Based Narrative: fig 30.6,

p996: SELF-inductance

I increases



I decreases



$$\mathcal{E}_L = N\cdot\left|\frac{d\Phi_B}{dt}\right| = L\cdot\left|\frac{dI}{dt}\right|$$

$$L = \frac{N\Phi_B}{I}$$

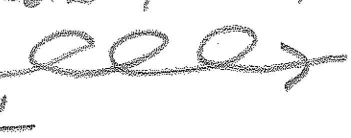
= inductance of solenoid.

Energy

Sec 30.3 see EQN 30.9,

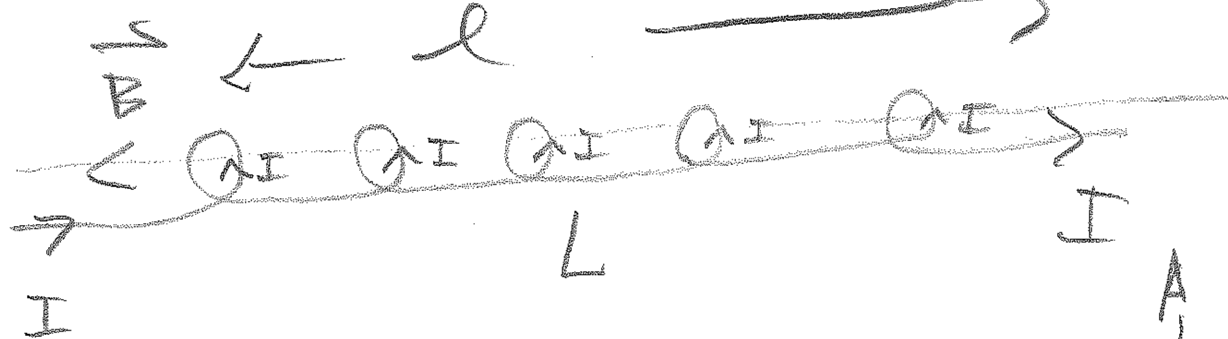
p999 $\Rightarrow U = \frac{1}{2}LI^2$

coil system



Insert: sec 30-3

Energy in system: ENERGY IN SPACE within coil.



$$U_B = \frac{1}{2} L I^2$$

$U_B = u_B \cdot \text{volume}$, u_B = ENERGY density $\left(\frac{J}{m^3}\right)$

$$\frac{1}{2} L I^2 = u_B \cdot A \cdot \ell$$

see # 15, Quiz 30 (CH 30)

$$L = \frac{\mu_0 A N^2}{\ell}$$

ALSO USE: $B = \mu_0 \frac{N}{\ell} \cdot I$

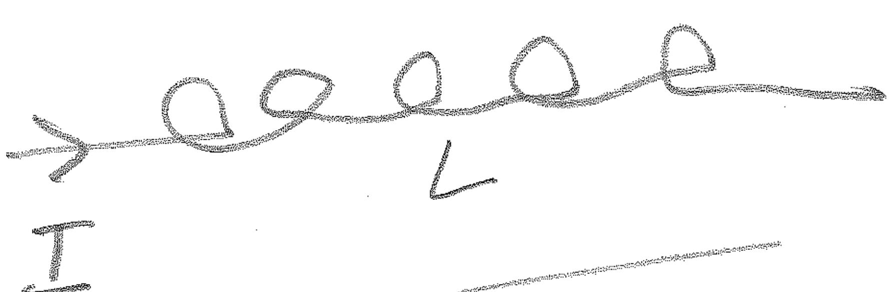
$$\rightarrow I = \frac{B \cdot \ell}{\mu_0 \cdot N} \Rightarrow u_B = \boxed{\frac{B^2}{2\mu_0} \left(\frac{J}{m^3}\right)}$$

see 30-3 :

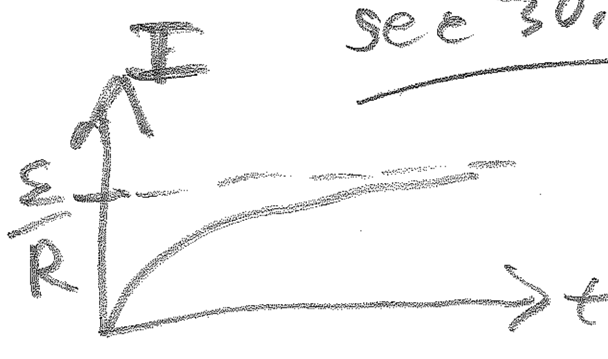
Note: $dU = L\,i\,di$

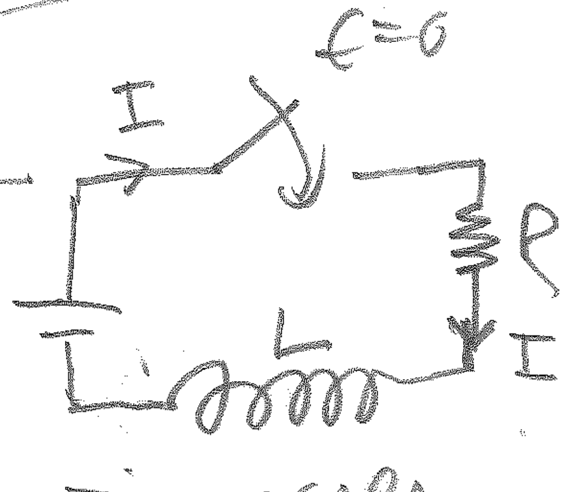
$$U = \int_0^{I_f} L\,i\,di$$

$$U = \frac{1}{2} L i^2 \Big|_0^{I} = \frac{1}{2} L I^2$$



see 30.4





Increases

Sec 30.4

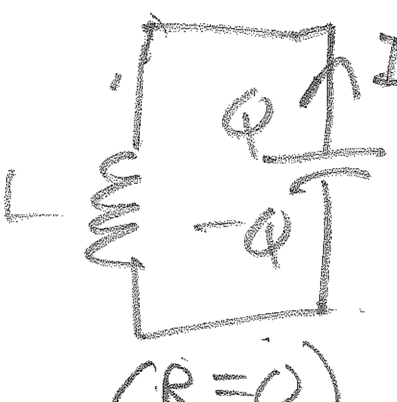
$$I = \frac{\mathcal{E}}{R}\left(1 - e^{-t/\tau}\right)$$

$$\tau = L/R$$

BACKTRACK: Sec 30.3

note: We derive L.

Sec. 30-5: L-C circuits.



(R=0)

$$\frac{1}{2}LI^2 + \frac{Q^2}{2C} = \frac{Q_{MAX}^2}{2C}$$

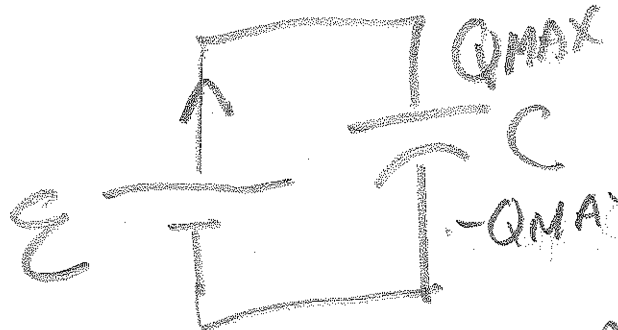
$$Q = Q_{MAX}\cos(\omega t + \phi)$$

$$\omega = \frac{1}{\sqrt{LC}}$$

<u>Question</u> from floor:
where does I come from?

<u>Example</u>:

<u>step</u> (A) charge up a capacitor to <u>max</u> charge <u>Q_{MAX}</u>



<u>step</u> (B): <u>dis</u>-connect capacitor C from battery

<u>step</u> (C): <u>connect</u> C to L.

step C.

Increases

sec 30.5

decreases initially.

$$I = -\frac{dQ}{dt}$$

Q decreasing

$\frac{dI}{dt} > 0$ initially

$$|\varepsilon_L| = \frac{Q}{C}$$

$$|\varepsilon_L| = L\frac{dI}{dt} = -L\frac{d^2Q}{dt^2}$$

$$\sum_{loop} \Delta V = 0 = \frac{Q}{C} - L\frac{dI}{dt}$$

$$\Rightarrow \quad L\frac{dI}{dt} = \frac{Q}{C}$$

$$-L\frac{d^2Q}{dt^2} = \frac{Q}{C} \rightarrow L\frac{d^2Q}{dt^2} = -\frac{Q}{C}$$

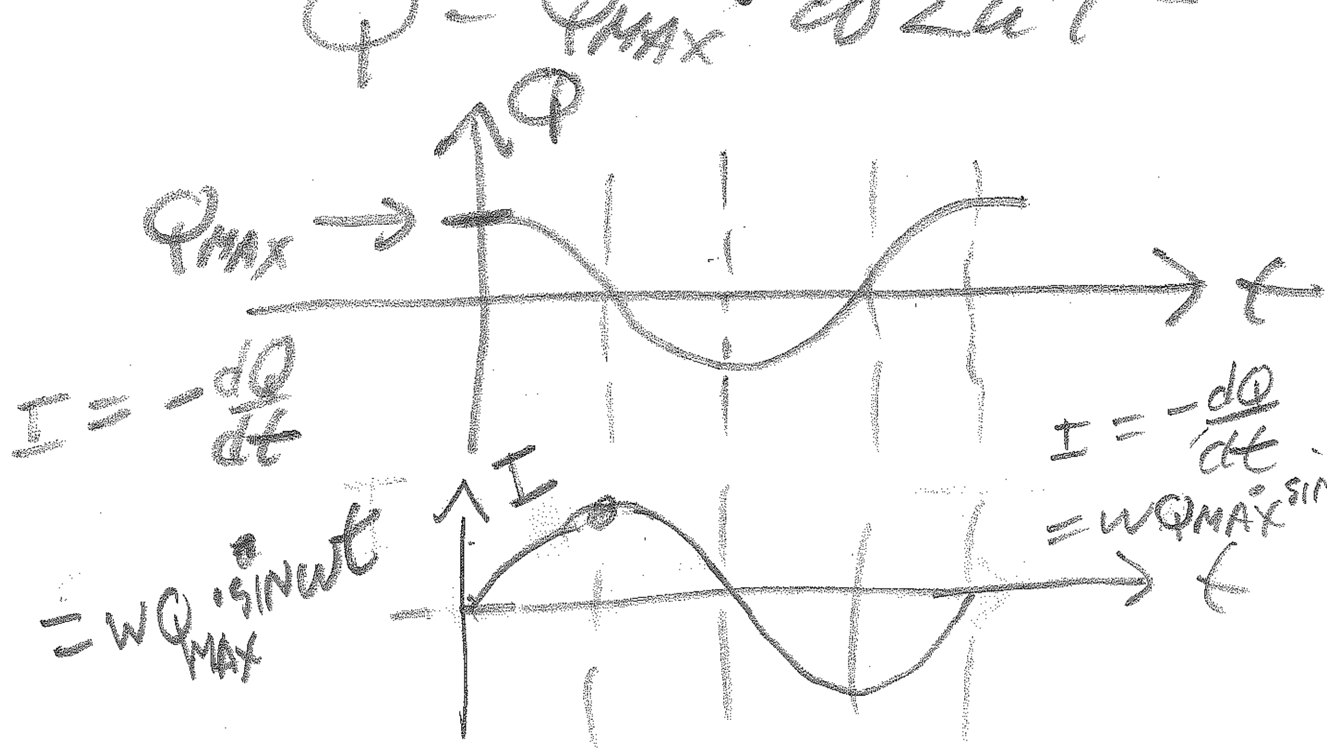
solution: $Q = Q_{MAX} \cos(\omega t + \phi)$

$$\omega = \frac{1}{\sqrt{LC}}$$

In this case: $\phi = 0$
since $I = 0$ at
$t = 0$.

see 30.5

$Q = Q_{MAX} \cdot \cos \omega t$



4-30-19

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ch30 $\frac{1}{2}LI^2 + \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}\frac{Q_{MAX}^2}{C}$

FOR ALL time:

p411 $\underbrace{\frac{1}{2}mV^2 + \frac{1}{2}kx^2 = \frac{1}{2}kA^2}_{\text{4A-analogy}}$