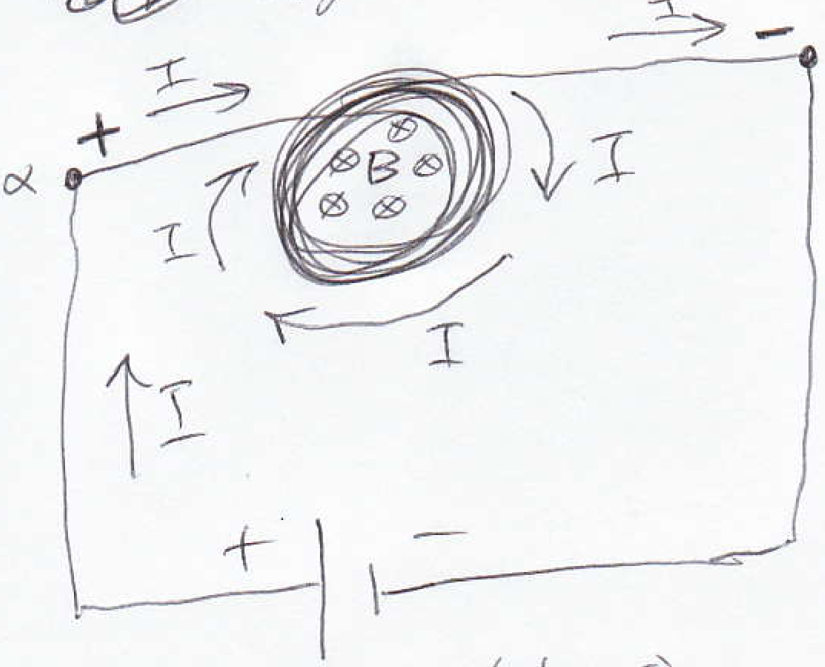
Right-hand rule & self-inductance:



when $dI/dt > 0$

$\vec{B}$ caused by I points ⊗ (in) by right-hand rule.

Suppose $\frac{dI}{dt} > 0$.

Then the induced $\vec{E}$ satisfies

$$\oint \vec{E}_{ind} \cdot d\vec{l} = -N \frac{d\Phi_B}{dt}.$$

(N = # loops)

Let the area vector $\vec{A}$ point in ⊗. By the right-hand rule, the direction of the loop integral is clockwise ~~and so~~ through the coil, ~~goes from α, through~~ ~~through the coil,~~ ~~so it goes from α, then~~ ~~then to β,~~ so $\frac{dI}{dt} > 0$

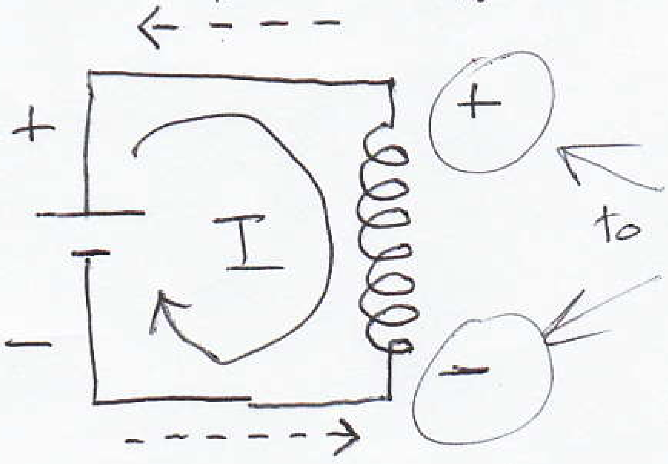
$$\Rightarrow \frac{d\Phi_B}{dt} = A\mu_0 \frac{N}{l_0}\frac{dI}{dt} > 0 \Rightarrow \vec{E}\cdot d\vec{l} < 0$$

l_0 length of coil:

$\Rightarrow \vec{E}$ points counterclockwise

$$\Rightarrow V_{\alpha\beta} = \int_\beta^\alpha -\vec{E}\cdot d\vec{l} > 0 \Rightarrow \boxed{V_\alpha > V_\beta}$$

induced opposing current direction

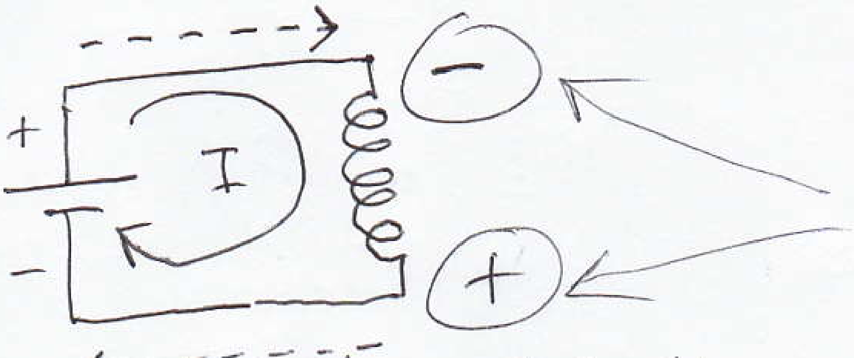


Coil opposes increasing current by - - - - induced to oppose the current <u>outside</u> the coil

when $dI/dt > 0$ ↗

Applying Lenz's law to current outside the coil.

when $dI/dt < 0$ ↘



induced current direction

Coil opposes decreasing current by - - - - induced to increase the current <u>outside</u> the coil.

Len'z law matches experiments:

- when we close a switch on an LR circuit with battery, current gently rises instead of "jumping". (Steep increase opposed.)
- when we open a switch on an LR circuit with battery, current gently falls instead of "jumping down". (Steep drop opposed.)