

Inductance (L) {Self field coupling}

$$\phi_{\text{solenoid (total)}} = N (AB) = N (A [\mu_0 n I])$$

$\begin{matrix} \uparrow & \uparrow \\ \# \text{ loops} & \phi / \text{loop} \end{matrix}$

$n = \frac{\# \text{ loops}}{\text{length}} = \frac{N}{l}$

$$\phi = N A \mu_0 \frac{N}{l} I = \underbrace{\left[\mu_0 \frac{N^2 A}{l} \right]}_{[L]} I$$

so $\boxed{\phi = L I}$

$$\boxed{L = \left[\mu_0 \frac{N^2 A}{l} \right]}$$

How L is used \rightarrow AC circuits
or just
time change
in I



$$\mathcal{E} \text{ across } \mathcal{E} = - \frac{\Delta \phi}{\Delta t} = -L \frac{\Delta I}{\Delta t}$$