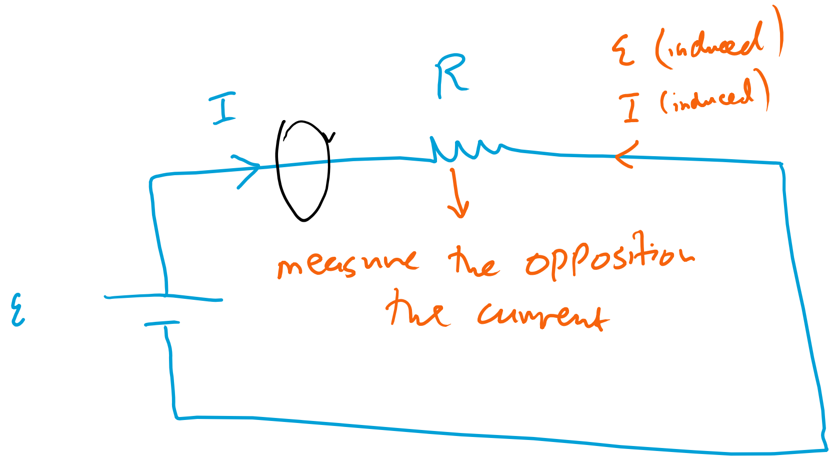


$I_{max} = \frac{\varepsilon}{R}$

self-Inductance

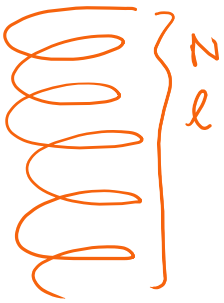
↓

measures the opposition to the CHANGE in the current

$$\varepsilon_L = -N\frac{d\Phi_B}{dt} = -L\frac{dI}{dt} \quad ; \quad L = \frac{-\varepsilon_L}{dI/dt} = \frac{N\Phi_B}{i}$$

L → Inductance (Henry, H)

Solenoid:

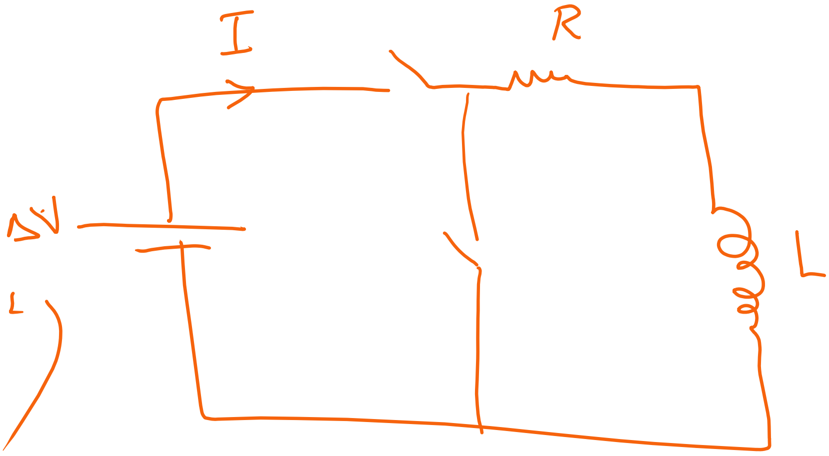


$$L = \mu_0 n^2 V$$

$n \rightarrow \frac{N}{l}$

$V \rightarrow A\,l$ (volume)

RL circuit



$I_{max} = \frac{\Delta V}{R}$

Charging: $i = \frac{\varepsilon}{R}\left(1 - e^{-tR/L}\right)$

$t = 0 \rightarrow i = 0$

$t = \infty \rightarrow i = \varepsilon/R$; $\tau = \frac{L}{R}$ (the time for the current to reach $0.63\, I_{max}$)

$$i = \frac{\varepsilon}{R}\left(1 - e^{-t/\tau}\right)$$

discharging: $i = \varepsilon/R \; e^{-t/\tau}$

$t = 0 \rightarrow i = \varepsilon/R$

$t = \infty \rightarrow i = 0$ fully discharged

Magnetic Potential Energy

$$U_L = \frac{1}{2} L i^2 \qquad U_C = \frac{1}{2} C V^2 = \frac{Q^2}{2C}$$

Solenoid: $U_L = \frac{1}{2} L I^2$

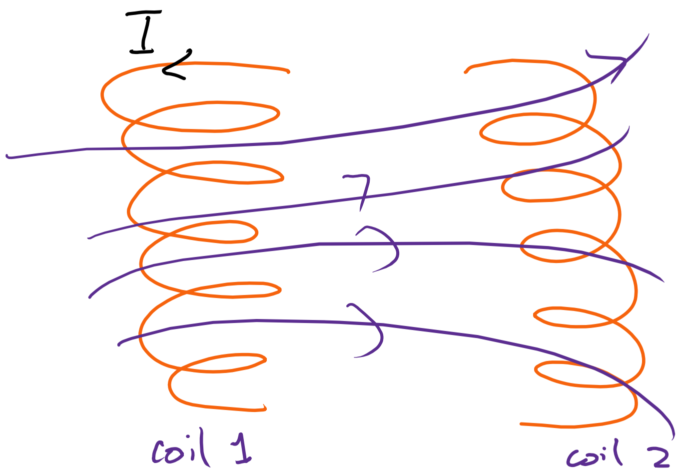
$$B = \mu_0 n I \qquad = \frac{1}{2}\left[\mu_0 \overset{N/\ell}{n}{}^2 V\right]\left[\frac{B}{\mu_0 n}\right]^2$$

$$B = \mu_0 \frac{N}{\ell} I \qquad U_L = \frac{1}{2}\frac{B^2 V}{\mu_0} \Rightarrow u = \frac{U_L}{V} = \frac{1}{2}\frac{B^2}{\mu_0}$$

energy density $\Rightarrow J/m^3$

Mutual Inductance

$$L = \frac{N\Phi}{i}$$



$$M_{12} = \frac{N_2 \Phi_{12}}{i_1}$$

(H)

$$\mathcal{E}_2 = -M_{12}\frac{di_1}{dt}$$

$$\mathcal{E}_L = -L\frac{dI}{dt}$$

$$M_{21} = \frac{N_1 \Phi_{21}}{i_2}$$

$$\mathcal{E}_1 = -M_{21}\frac{di_2}{dt}$$

$$\boxed{M_{12} = M_{21} = M}$$

$$U_c = \frac{Q_{max}^2}{2C}$$

$$U_T = \frac{q^2}{2C} + \frac{1}{2} L i^2$$

$$= \frac{Q_{max}^2}{2C} = \frac{1}{2} L I_{max}^2$$