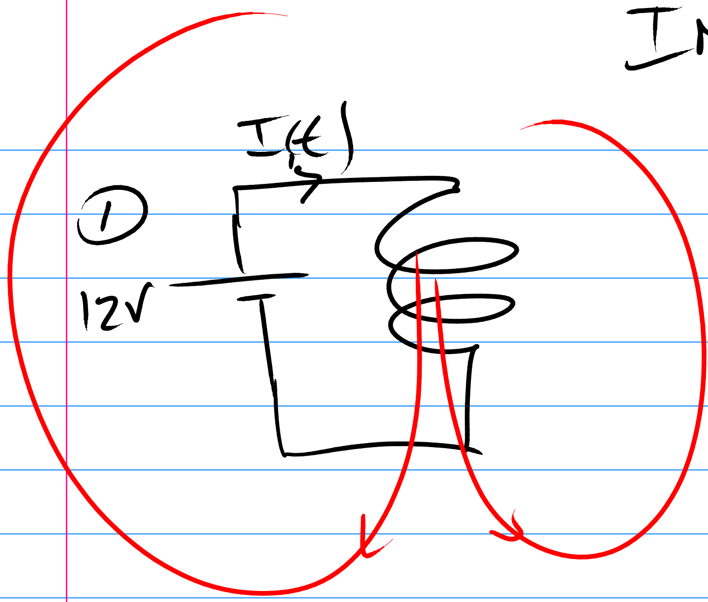
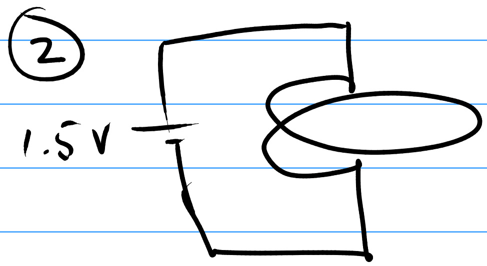
INDUCTANCE



$$\mathcal{E}mf^{\text{due to }(1)}_{\text{in }(2)} = -\frac{d\Phi^{\text{on }(2)}_{\text{from }(1)}}{dt}$$



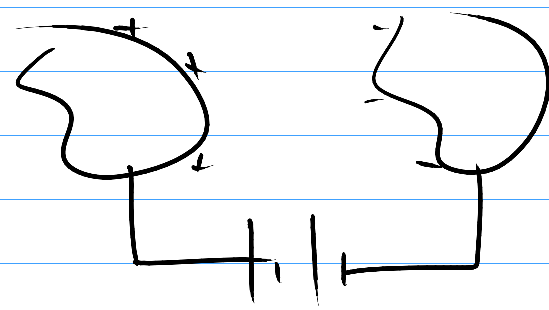
$$\Phi^{\text{on }(2)}_{\text{from }(1)} \propto I_1$$

depends on sep, size, orientation

$$\Phi^{\text{on }(2)}_{\text{from }(1)} = M_{12} I_1$$

Henry

Capacitance



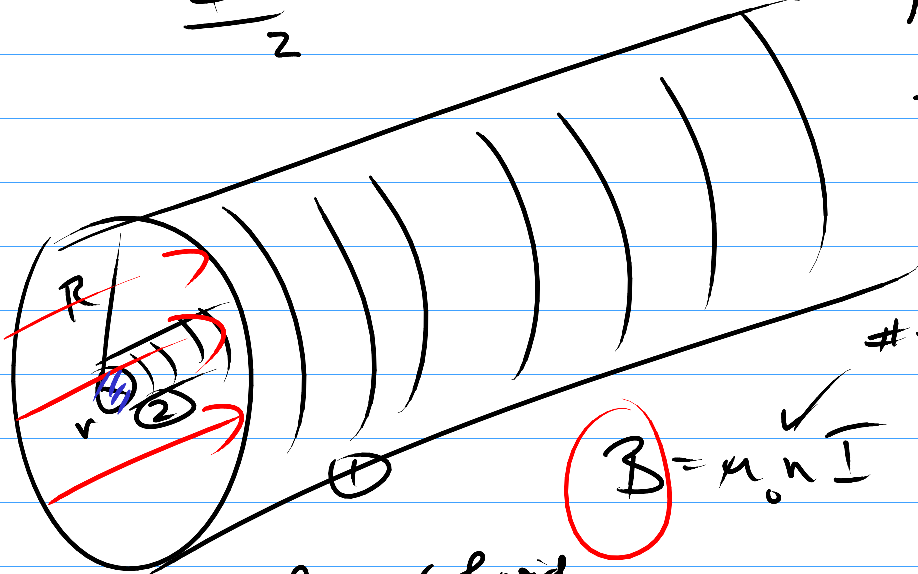
$$C = \frac{Q}{V} \quad \left(\frac{\text{Coul}}{\text{volt}}\right)$$

depends on geometry

$$M_{12} = \frac{\Phi \text{ in one circuit}}{I \text{ Amp in other}}$$

$$\Phi_2^{tot} = M I \qquad \Phi_2^{tot} = N_2 \Phi_{\text{one loop}}$$

N_2: # loops in small sol.



turns/m

$$B = \mu_0 n I$$

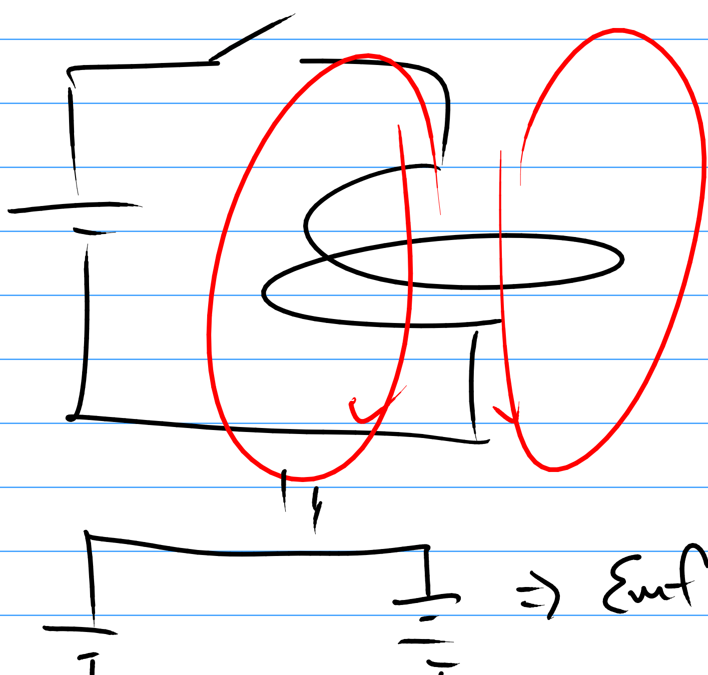
one loop in large solenoid

$$\Phi_B \equiv \int \bar{B}\cdot da = \int \underbrace{\mu_0 n_1 I_1}\, da \cos\phi = \mu_0 n_1 I_1 \pi r^2$$

$$= M I_1$$

$$M_{12} = \mu_0 n_1 \pi r^2$$

Self inductance

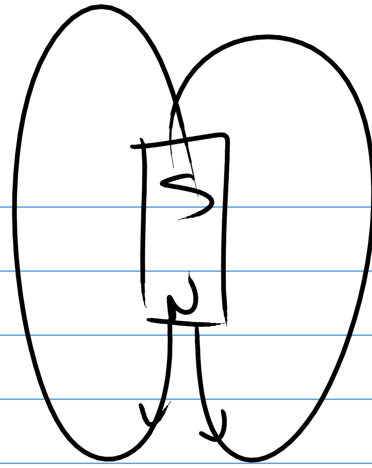


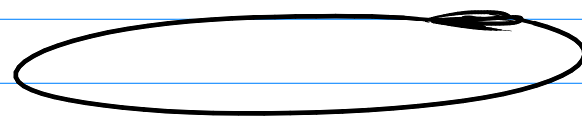
$$\Phi \propto I$$

$$\Phi = L I$$

L: self indu

$$\Rightarrow \mathcal{E}mf = -\frac{d\Phi}{dt} = -\frac{d}{dt}(LI)$$



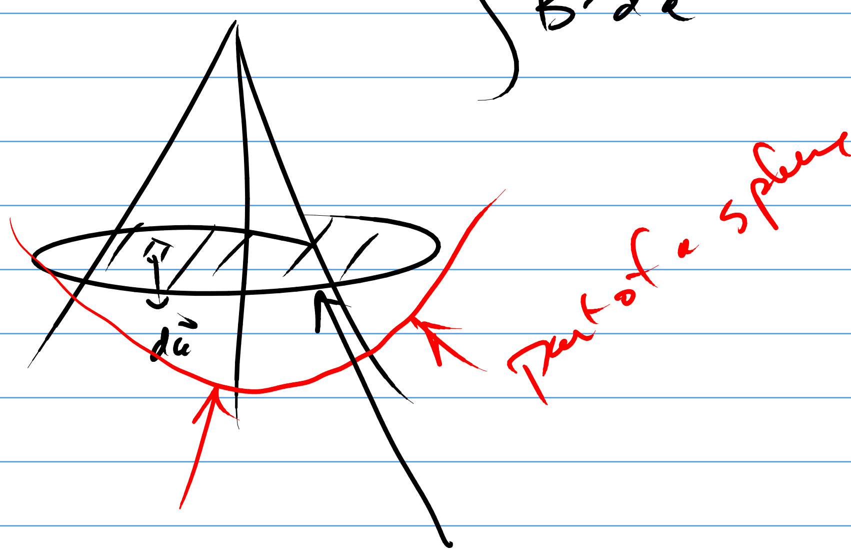


$$\mathcal{E}_{net} = -\frac{d\Phi}{dt} = -\frac{d}{dt}\Phi_{magnet} - \frac{d}{dt}\Phi_{wire}$$

$$\Phi_{wire} = LI \qquad -L\frac{dI_{wire}}{dt}$$

Φ_{magnet} assume small dipole

$$\int \vec{B}\cdot d\vec{a}$$

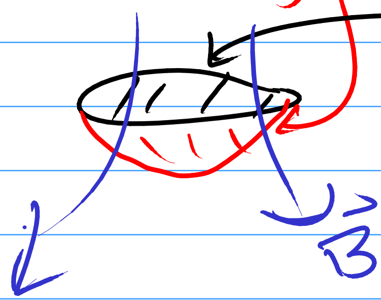


$$\int \vec{B}\cdot da \stackrel{?}{=} \int \vec{B}\cdot da$$

open surface

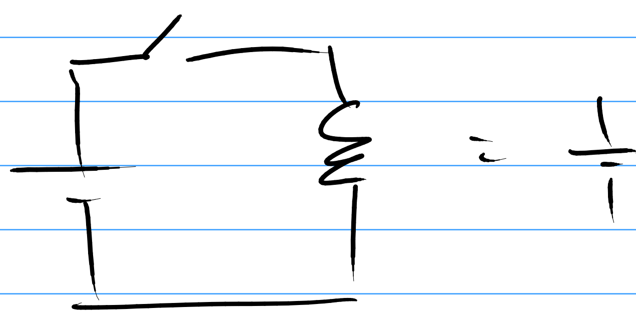
$$\vec{\nabla}\cdot\vec{B} = 0 \Rightarrow \int \vec{\nabla}\cdot\vec{B}\, d\tau = \oint \vec{B}\cdot da$$

$$\oint \vec{B}\cdot d\vec{a} = \int \vec{B}\cdot d\vec{a} + \int \vec{B}\cdot d\vec{a} = 0$$



Closed surface

Energy in inductor



$$\text{Emf} = -\frac{d\Phi}{dt}$$