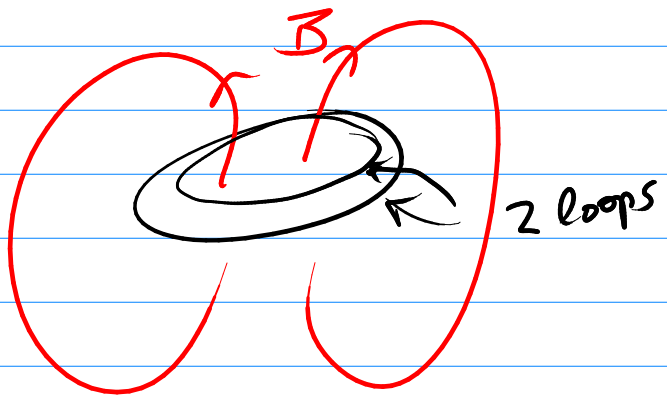
Defn of self inductance

$\Phi \propto I$ $\quad\quad$ $\Phi = LI$

flux thru 1 loop

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



$B \propto N$

↑ # loops

$N \Phi_{\text{one loop}} = \int \vec{B} \cdot d\vec{a} = LI$

↑ $\propto N$

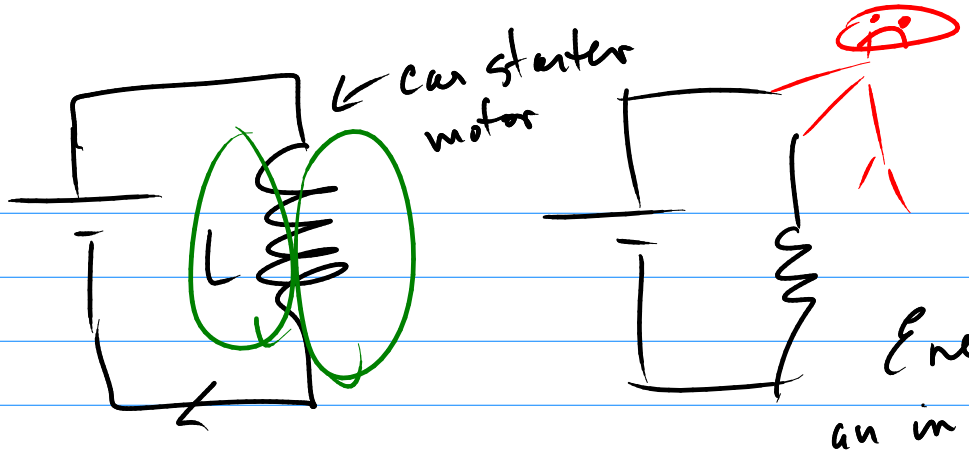
might find $L \approx 10^{-6}$ H

Energy in inductor $= \frac{1}{2} L I^2 \approx 10^{-6}$ J

I ~ 1 Amp

Energy cap $= \frac{1}{2} C V^2 \approx \frac{1}{2} 10^{-6} (10^3)^2$

$\approx$ Joules



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

Energy stored in an inductor can be dangerous

$I = 10$ Amps

$L \approx 1$ H

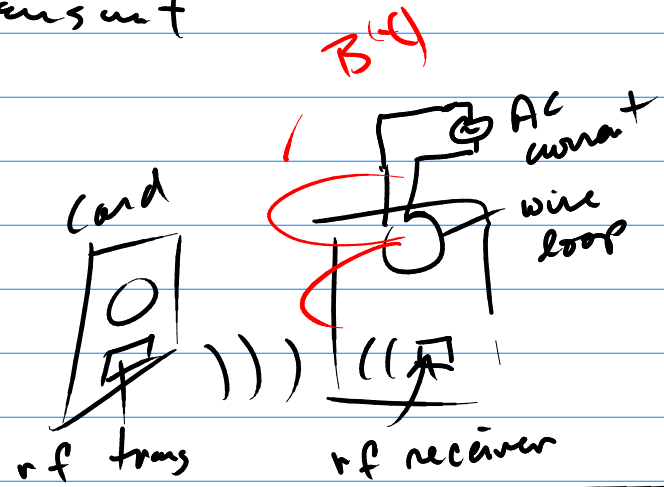
$\frac{1}{2} L I^2 = \frac{1}{2} 100$ J

RF ID device (flaster card)

How does it work?

- code transmitted radio freq ⟵
- need energy to transmit get from Faraday's law

$$\mathcal{E}_{emf} = -\frac{d\Phi}{dt}$$



Maxwell's eqns

$$\nabla \cdot \vec{E} = \rho/\epsilon_0 \qquad \nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$$

$$\nabla \cdot \vec{B} = 0 \qquad \nabla \times \vec{B} = \mu_0 \vec{J}$$

amps law

$$\oint \vec{B} \cdot d\vec{\ell} = \mu_0 I_{enc}$$

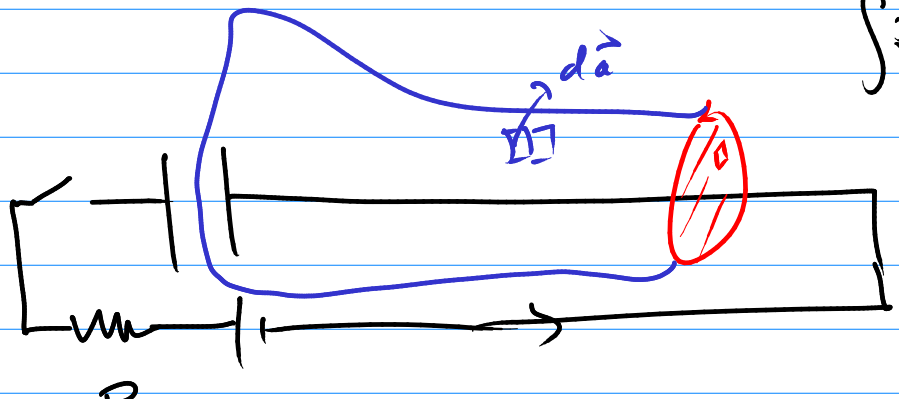
magnetostatics $\nabla \cdot \vec{J} = 0$

$$\int \vec{\nabla} \cdot \vec{J}\, d\tau = \oint \vec{J} \cdot da$$

$$0 \quad \mu_0 I_{enc} \quad 0$$

$$\int \vec{J} \cdot d\vec{a} + \int \vec{J} \cdot d\vec{a} = \oint \vec{J} \cdot da$$

$$\int \vec{J} \cdot d\vec{a} = 0$$



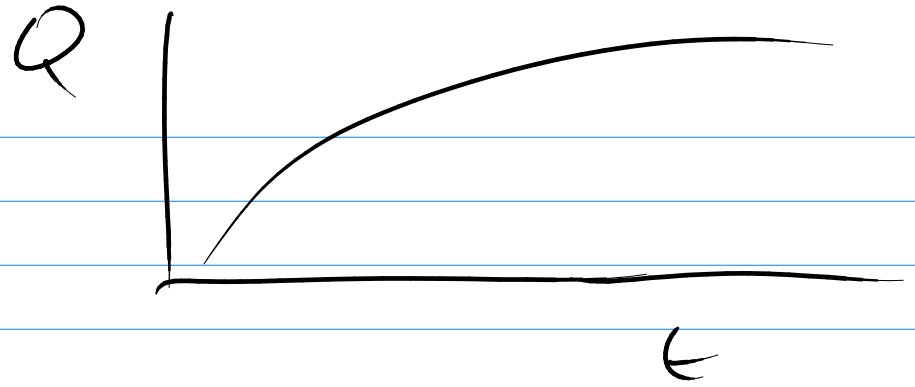
$$\int \mu_0 \vec{J} \cdot d\vec{a}$$

$$\int \vec{\nabla} \times \vec{B} \cdot da = \oint \vec{B} \cdot d\vec{\ell}$$

In general cons of charge

$$\vec{\nabla} \cdot \vec{J} = -\frac{\partial \rho}{\partial t}$$

Let the cap plates $Q(t)$



RC circuit

has $\frac{dQ}{dt} \neq 0$