Faraday's law

$$\mathcal{E}mf = -\frac{d\Phi_B}{dt}$$

$$''$$

$$\oint \vec{E}\cdot d\vec{l} = -\frac{d\Phi_B}{dt}$$

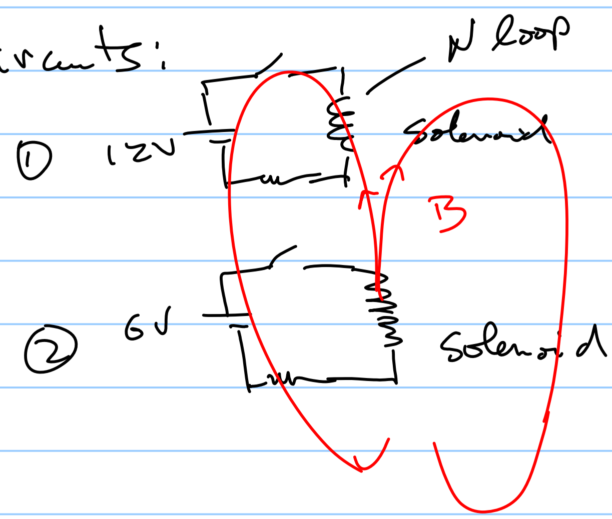
$$''$$

$$\oint \vec{\nabla}\times\vec{E}\cdot d\vec{a}$$

$$\Downarrow$$

$$\vec{\nabla}\times\vec{E} = -\frac{\partial B}{\partial t}$$

Circuits:

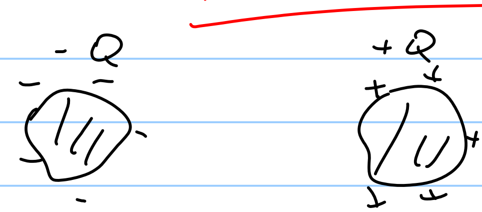


flux in coil ① due to ②

$$\Phi_{12} \propto i_2(t)$$

$$\boxed{\Phi^{tot}_{12} = N_1\Phi_{12} = M_{12}\, i_2}$$

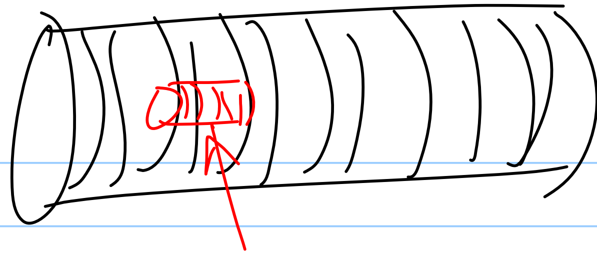
remind you cap



$$\Delta V \propto Q \qquad \Delta V = \frac{1}{C}Q$$

ΣV in circuit 1 $\qquad \mathcal{E}mf = -\frac{d\Phi_B}{dt} = -\frac{d}{dt}\left(M\, i_2(t)\right)$

How do we cal M?



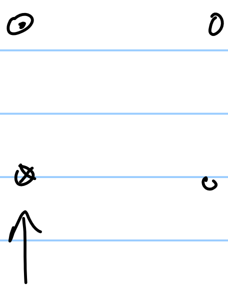
find M we need Φ_B

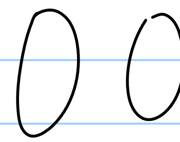
$N\Phi_B = M i_2$

$N B \text{ Area}$

$\propto i_2$

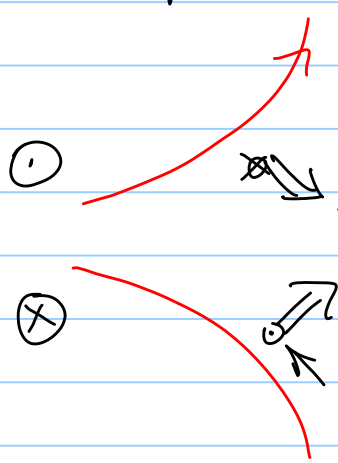
i(t) increasing





wire loops

justify force on second loop



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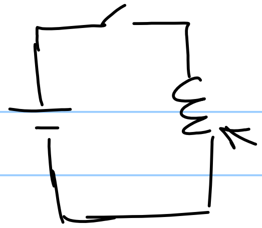
repulsion

Lenz's law: circuit tries to oppose increasing flux

What B do we use in $\int \vec{B} \cdot d\vec{a} = \Phi_B$

B_{tot}



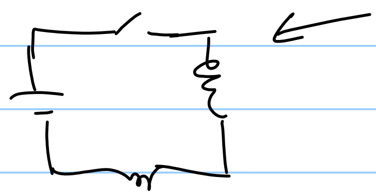
the loop has $\Phi_B \propto i$

in loop itself

$$\Phi_B = L i$$

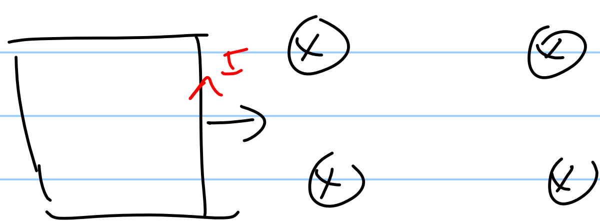
self induction

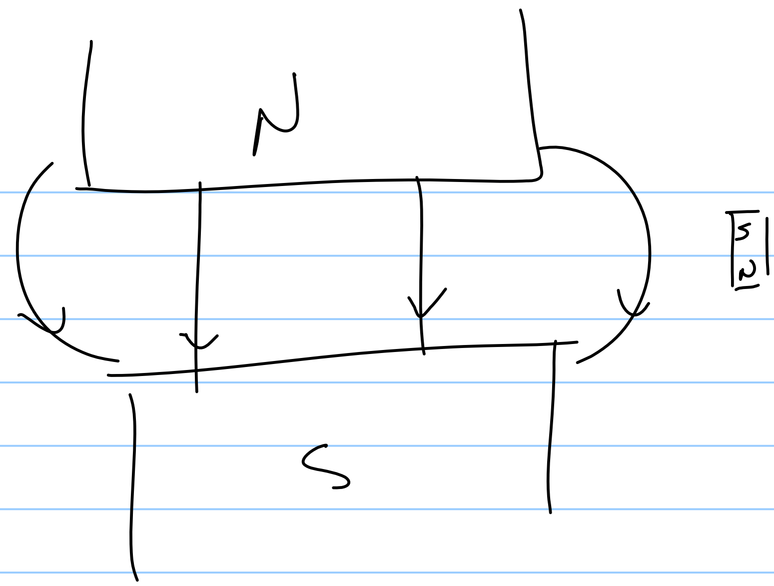
$$\mathcal{E}mf = -\frac{d\Phi}{dt} = -L\frac{di}{dt}$$



$$\mathcal{E}mf_{\text{inductor}} = -\frac{\partial \Phi_{B_{tot}}}{\partial t} = -\frac{\partial \Phi_{B_{\text{other circuit}}}}{\partial t} - \frac{\partial \Phi_{B_{\text{itself}}}}{\partial t}$$

$$\mathcal{E}mf_{\text{inductor}} = -M\frac{di_2}{dt} - L\frac{di_1}{dt}$$

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