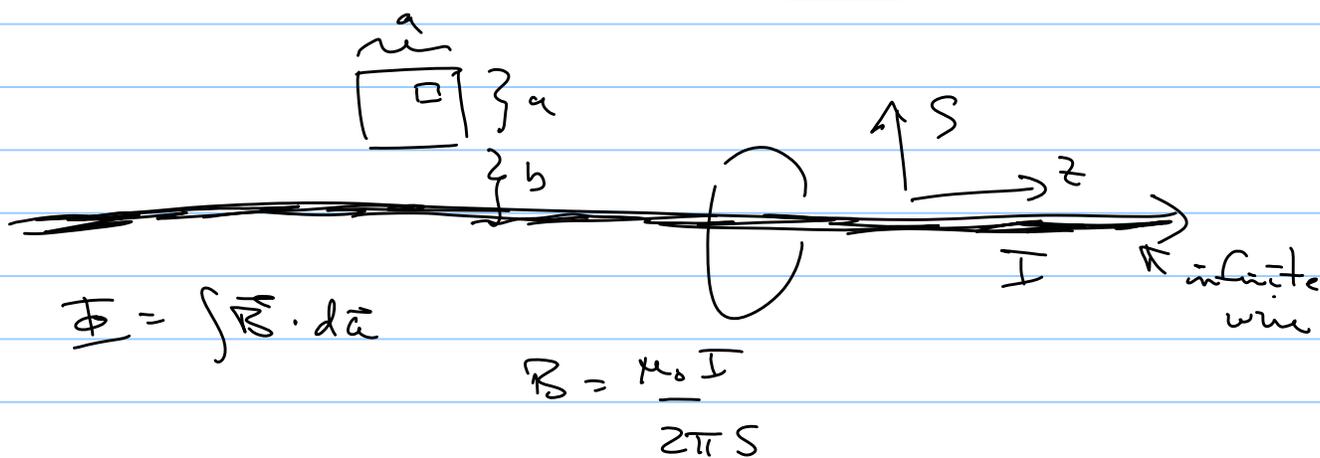


$$\oint \vec{E} \cdot d\vec{l} = - \int \frac{\partial \vec{B}}{\partial t} \cdot d\vec{a}$$

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

$$\int \vec{\nabla} \times \vec{E} \cdot d\vec{a} = - \int \frac{\partial \vec{B}}{\partial t} \cdot d\vec{a}$$

$$\begin{aligned} \Phi_m &= \int \vec{B} \cdot d\vec{a} = \int \vec{\nabla} \times \vec{A} \cdot d\vec{a} && \leftarrow \text{flux thru area} \\ &= \oint \vec{A} \cdot d\vec{l} && \leftarrow \text{path that defines area} \end{aligned}$$



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

$$dA = ds dz$$

$$\int_0^a \int_0^{b+a} \frac{\mu_0 I}{2\pi S} ds dz = \frac{\mu_0 I a}{2\pi} \ln\left(\frac{a+b}{b}\right) = \Phi$$

\leftarrow fixed position

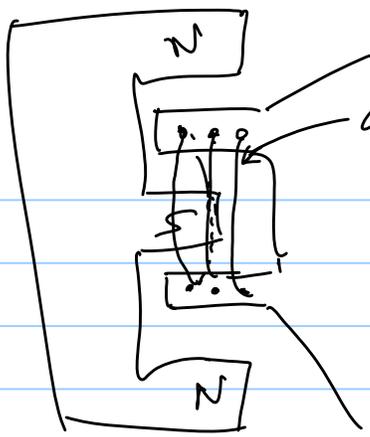
$$\mathcal{E}_{mf} = - \frac{d\Phi_m}{dt} ; \frac{dI(t)}{dt}$$

$$d\vec{B} = \frac{\partial \vec{B}}{\partial t} dt + \frac{\partial \vec{B}}{\partial x} dx + \dots$$

\uparrow fix x, fix y, fix z or take a snapshot in time to calculate Φ_m .

$$\frac{d\Phi}{dt} = \frac{\mu_0 I_0 a}{2\pi} \frac{d}{dt} \ln\left[\frac{a+b(t)}{b(t)}\right]$$

Now if b varies with time the snapshot changes with time by substituting $b \rightarrow b(t)$



current in this wire

$$d\vec{F} = I d\vec{l} \times \vec{B}$$

Energy in B fields

$$\text{Emf} = \int \frac{+v}{-v} \mathcal{E}$$

$$qV - qIR = 0$$



$$W_{\text{in inductor}} = \int L \frac{di}{dt}$$

$$P = \frac{dW}{dt} = i \frac{d\mathcal{E}}{dt}$$

$$\text{Emf} = - \frac{d\Phi_{\text{tot}}}{dt} = \frac{d Li}{dt} = - L \frac{di}{dt}$$

$$\Phi_{\text{tot}} = Li$$

$$\frac{dW}{dt} = L i \frac{di}{dt}$$

$$W = \int L i di = \frac{L i^2}{2}$$