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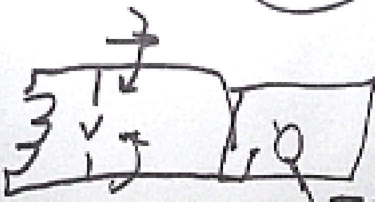
$$L = \frac{\phi_m}{I}$$



$$I = bt$$

$$LI = \phi_m$$

$$L\frac{dI}{dt} = \frac{d\phi_m}{dt} = -\mathcal{E}mf$$

$$Lb = \mathcal{E}mf \qquad L = \frac{\mathcal{E}mf}{b}$$

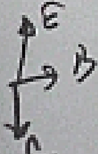
$$\text{Power} = \frac{dU_M}{dt} = -I\mathcal{E}$$

$$\mathcal{E} = -\frac{d\Phi_M}{dt}$$

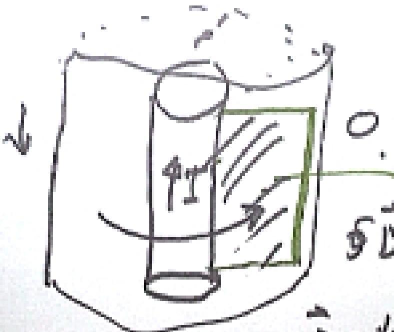
$$\int dU = \int L I \frac{dI}{\cancel{dt}} \Rightarrow U_m = \frac{1}{2} L I^2$$

$$u_M = \frac{B^2}{2\mu_0} \qquad \int u_E \, d^3r = U_m$$

$$u_E = \frac{1}{2}\varepsilon_0 E^2$$



$$U_m \cdot \frac{2}{I^2} = L$$



$$\oint \vec{B}\cdot d\vec{s} = \mu_0 I_c$$

$$\vec{B} = \frac{\mu_0 I}{2\pi s}\hat{\phi}$$

$$\oint B\cdot ds = \frac{\mu_0 I}{\pi a^2}\cdot \pi r^2$$

$$\Phi_{M,1} = \iint \vec{B}\cdot dA$$

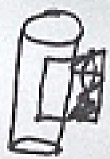
$$\Phi_M = \Sigma \Phi_{M,1} \qquad = \iint \frac{\mu_0 I}{2\pi s}\cdot dz\, \underline{ds}$$

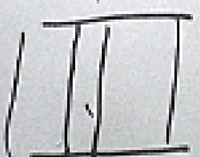
$$\int 2\pi$$

$$U_E = \frac{1}{2\mu_0} B^2 \int s\,ds\,d\phi\,dz$$

$$B = \mu_0 I \Sigma^4$$

$$B = \frac{\mu_0 I}{2\pi s}\frac{s^2}{a^2}$$





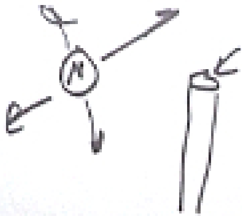
GAUSS: $\oint\!\!\oint \vec{E}\cdot d\vec{A} = \frac{1}{\varepsilon_0}\iiint \rho\, d^3r$

$$\oint\!\!\oint \vec{E}\cdot d\vec{A} = \iiint (\vec{\nabla}\cdot\vec{E})\, d^3r$$

$$\iiint (\vec{\nabla}\cdot\vec{E})\, d^3r = \frac{1}{\varepsilon_0}\iiint \rho\, d^3r$$

$$\Rightarrow \vec{\nabla}\cdot\vec{E} = \frac{\rho}{\varepsilon_0}$$

$$\oiint \vec{B}\cdot d\vec{A} = 0 \Rightarrow \vec{\nabla}\cdot\vec{B} = 0$$



no mag monopoles

Faraday's Law

$$\oint \vec{E}\cdot d\vec{s} = -\frac{\partial}{\partial t}\iint \vec{B}\cdot d\vec{A}$$

$$\oint \vec{E}\cdot d\vec{s} = \iint (\vec{\nabla}\times\vec{E})\cdot d\vec{A}$$

$$\iint (\vec{\nabla}\times\vec{E})\cdot d\vec{A} = -\frac{\partial}{\partial t}\iint \vec{B}\cdot d\vec{A}$$

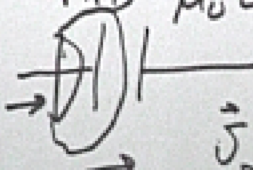
...day's $\vec{\nabla}\times\vec{E} = -\partial\vec{B}$

$$\oint \vec{B}\cdot d\vec{s} = \mu_0 \oiint \vec{J}\cdot d\vec{A}$$

$$\oiint (\vec{\nabla}\times\vec{B})\cdot d\vec{A} = \oint \vec{B}\cdot d\vec{s}$$

$$\oiint (\vec{\nabla}\times\vec{B})\cdot d\vec{A} = \mu_0 \oiint \vec{J}\cdot d\vec{A}$$

$$\vec{\nabla}\times\vec{B} = \mu_0 \vec{J}$$



$$\vec{J}_D = \varepsilon_0 \frac{\partial \vec{E}}{\partial t}$$

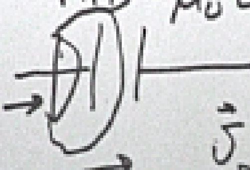
$$\vec{\nabla}\times\vec{B} = \mu_0 \vec{J}_c + \mu_0 \vec{J}_D$$

$$\oint \vec{B}\cdot d\vec{s} = \mu_0 \oiint \vec{J}\cdot d\vec{A}$$

$$\oiint (\vec{\nabla}\times\vec{B})\cdot d\vec{A} = \oint \vec{B}\cdot d\vec{s}$$

$$\oiint (\vec{\nabla}\times\vec{B})\cdot d\vec{A} = \mu_0 \oiint \vec{J}\cdot d\vec{A}$$

$$\vec{\nabla}\times\vec{B} = \mu_0 \vec{J}$$



$$\vec{J}_D = \varepsilon_0 \frac{\partial \vec{E}}{\partial t}$$

$$\vec{\nabla}\times\vec{B} = \mu_0 \vec{J}_c + \mu_0 \vec{J}_D$$

$$\vec{\nabla} \times \vec{B} = \mu_0 \vec{J}$$

$$\vec{\nabla} \cdot (\vec{\nabla} \times \vec{B}) = \mu_0 \vec{\nabla} \cdot \vec{J}$$

$$\vec{J}_D = \varepsilon_0 \frac{\partial \vec{E}}{\partial t}$$

$$\oint \vec{B} \cdot d\vec{S} = \mu_0 \iint \left[\vec{J} + \varepsilon_0 \frac{\partial \vec{E}}{\partial t} \right] \cdot d\vec{A}$$

$$\vec{\nabla} \times \vec{B} = \mu_0 \vec{J}_c + \varepsilon_0 \mu_0 \frac{\partial \vec{E}}{\partial t}$$

$$\vec{F} = q \left(\vec{E} + \vec{v} \times \vec{B} \right)$$

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

$$u_E = \frac{1}{2}\varepsilon_0 \vec{E}^2 \qquad u_m = \frac{\vec{B}^2}{2\mu_0}$$

$$\vec{E}\cdot\vec{E}$$

$$U_E = \frac{1}{2}\varepsilon_0 \oiiint u_E \, d^3r$$

$$U_m = \frac{1}{2\mu_0} \oiiint u_m \, d^3r$$

$$\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$$

$$\text{Power} = \frac{\partial(\vec{F} \cdot \vec{x})}{\partial t} = \vec{F} \cdot \vec{v}$$

$$\vec{F} = q\vec{E}$$

$$\vec{F} = q\vec{E} \cdot \vec{v}$$

$$q = \iiint \rho \, d^3r$$

$$\vec{J} = \rho \vec{v}$$

$$\text{Power} = \frac{dW}{dt} = \oiiint \rho \vec{E}\cdot\vec{v}\, d^3r$$

$$= \oiiint \vec{E}\cdot\vec{J}\, d^3r$$

$$\vec{E}\cdot\left(\vec{\nabla}\times\vec{B} = \mu_0 \vec{J} + \mu_0 \varepsilon_0 \frac{\partial \vec{E}}{\partial t}\right)$$

$$\vec{E}\cdot\vec{J} = \frac{1}{\mu_0}\vec{E}\cdot(\vec{\nabla}\times\vec{B}) - \varepsilon_0 \vec{E}\cdot\frac{\partial \vec{E}}{\partial t}$$

$$\vec{E}\cdot\vec{J} = \frac{1}{\mu_0}\vec{E}\cdot(\vec{\nabla}\times\vec{B}) - \varepsilon_0 \vec{E}\cdot\frac{\partial \vec{E}}{\partial t}$$

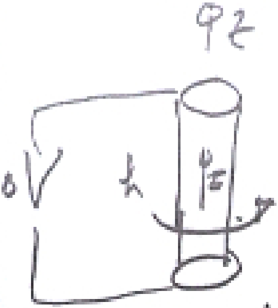
$$\frac{dW}{dt} = \oiiint \Big[\frac{1}{2\mu_0}\frac{\partial B^2}{\partial t} - \frac{\varepsilon_0}{2}\frac{\partial E^2}{\partial t} - \frac{1}{\mu_0}\vec{\nabla}\cdot(\vec{E}\times\vec{B}) \Big] d^3r$$

$$\vec{S} = \frac{1}{\mu_0}\left(\vec{E} \times \vec{B}\right)$$

$$\frac{dW}{dt} = \iiint \left[-\frac{1}{2\mu_0}\frac{\partial B^2}{\partial t} - \frac{1}{2}\epsilon\frac{\partial E^2}{\partial t} - \vec{\nabla}\cdot\vec{S} \right] d^3r$$

$$= \frac{\partial u_{EM}}{\partial t} \Rightarrow \frac{\partial u_E}{\partial t} = -\vec{\nabla}\cdot\vec{S}$$

$$\frac{\partial u_{EM}}{\partial t} = -\oint\!\!\oint \vec{S}\cdot d\vec{A}$$



$$\vec{E} = \frac{V}{h}\hat{z}$$

$$\oint \vec{B} \cdot d\vec{s} = \mu_0 I$$

$$\vec{B} = \frac{\mu_0 I}{2\pi a}\hat{\phi}$$

$$\vec{S} = \frac{1}{\mu_0}\left(\vec{E} \times \vec{B}\right)$$

$$\vec{S} = \frac{\mu_0 I}{2\pi a}\frac{V}{h}\left(\hat{z} \times \hat{\phi}\right)$$

$$\vec{S} = \frac{1}{\mu_0}(\vec{E} \times \vec{B})$$

$$\vec{S} = \frac{\mu_0 I}{2\pi a} \frac{V}{h} (\hat{z} \times \hat{\phi})$$

$$\hat{z} \times \hat{\phi} = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ 0 & 0 & 1 \\ -\sin\phi & \cos\phi & 0 \end{vmatrix}$$

$$= \hat{x}(-\cos\phi) - \hat{y}(\sin\phi)$$

$$= -\hat{s}$$

$$\vec{S} = \frac{1}{\mu_0} \frac{V}{h} \cdot \frac{\mu_0 I}{2\pi a} (-\hat{s})$$

$$= \frac{IV}{h \cdot 2\pi a} (-\hat{s})$$

$= -\hat{s}$

$$\vec{S} = \frac{1}{\mu_0 R}\frac{V}{} \cdot \frac{\mu_0 I}{2\pi a}(-\hat{s})$$

$$= \frac{IV}{R \cdot 2\pi a}(-\hat{s})$$

$$\oiint \vec{S} \cdot d\vec{A} = -\frac{-IV}{2\pi a h}\iint a\, d\phi\, dz$$

$$= IV$$

$$P_{ower} = IV = I^2R = \frac{V^2}{R}$$

$$V = IR$$

$$\vec{S} = \frac{1}{\mu_0 h} \frac{V}{} \cdot \frac{\mu_0 I}{2\pi a} (-\hat{s})$$

$$= \frac{IV}{h \cdot 2\pi a} (-\hat{s})$$

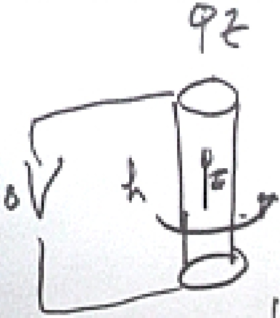
$$\oiint \vec{S} \cdot d\vec{A} = -\frac{IV}{2\pi a h} \iint a \, d\phi \, dz$$

$$= IV$$

$$\text{Power} = IV = I^2 R = \frac{V^2}{R}$$

$$V = IR \qquad \vec{F} = \frac{d\vec{p}}{dt}$$

$$\int \vec{F} \cdot dt = \int d\vec{p}$$



$$\vec{E} = \frac{V}{h}\hat{z}$$

$$\oint \vec{B}\cdot d\vec{s} = \mu_0 I$$

$$\vec{B} = \frac{\mu_0 I}{2\pi a}\hat{\phi}$$

$$\vec{S} = \frac{1}{\mu_0}\left(\vec{E}\times\vec{B}\right)$$

$$\vec{S} = \frac{\mu_0 I}{2\pi a}\frac{V}{h}\left(\hat{z}\times\hat{\phi}\right)$$

$$\hat{z} \times \hat{\phi} = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ 0 & 0 & 1 \\ -\sin\phi & \cos\phi & 0 \end{vmatrix}$$

$$= \hat{x}(-\cos\phi) - \hat{y}(\sin\phi)$$

$$= -\hat{s}$$

$$\vec{S} = \frac{1}{\mu_0 R} V \cdot \frac{\mu_0 I}{2\pi a}(-\hat{s})$$

$$= \frac{IV}{R \cdot 2\pi a}(-\hat{s})$$

$$\oiint \vec{S} \cdot d\vec{A} = \frac{--IV}{2\pi a h} \oint a\,d\phi\,dz$$

$$= IV$$

$$\text{Power} = IV = I^2R = \frac{V^2}{R}$$

$$V = IR$$

$$\bar{F} = \frac{d\bar{P}}{dt}$$

$$\int \hat{F} \cdot dt = \int d\vec{P}$$