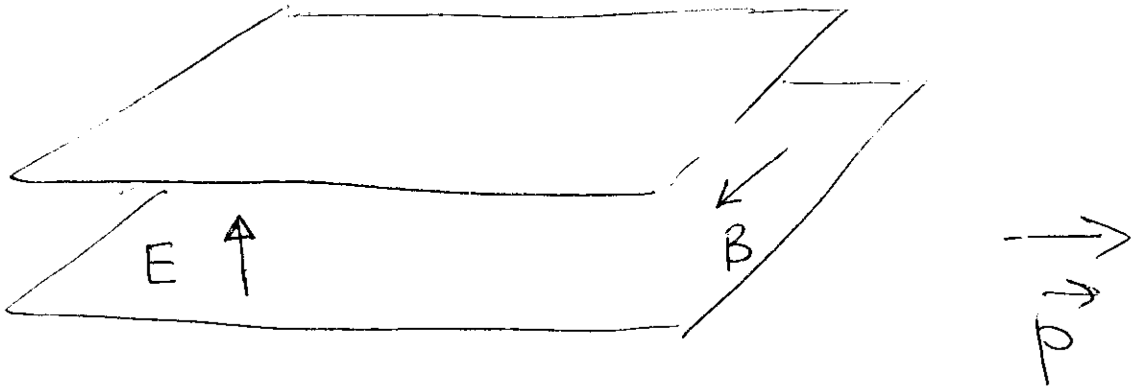
Applications

1. Poynting vector
2. Stress tensor
3. Angular momentum



$$\vec{\mathcal{P}} = \varepsilon_0 \, \vec{E} \times \vec{B}$$

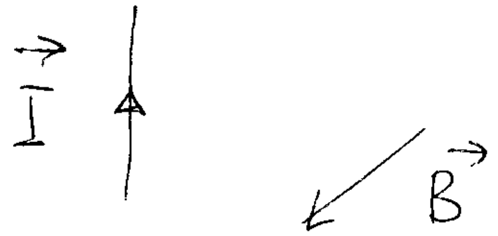
$$|\vec{E}| = \frac{1}{\varepsilon_0} \, \frac{Q}{S}$$

$$\vec{p} = \int \vec{\mathcal{P}} \, d^3 r = \varepsilon_0 \left(\vec{E} \times \vec{B} \right) \underbrace{V}_{Sd}$$

$$= \cancel{\varepsilon_0} \frac{Q}{\cancel{\varepsilon_0} \cancel{S}} \cdot \cancel{S} d \quad \left(\vec{n}_E \times \vec{B} \right)$$

$$= \cancel{\varepsilon_0} \frac{Q d}{\cancel{\varepsilon_0}} \quad \vec{n}_e \times \vec{B} =$$

$$= \underline{Q \, d \quad \vec{n}_e \times \vec{B}}$$



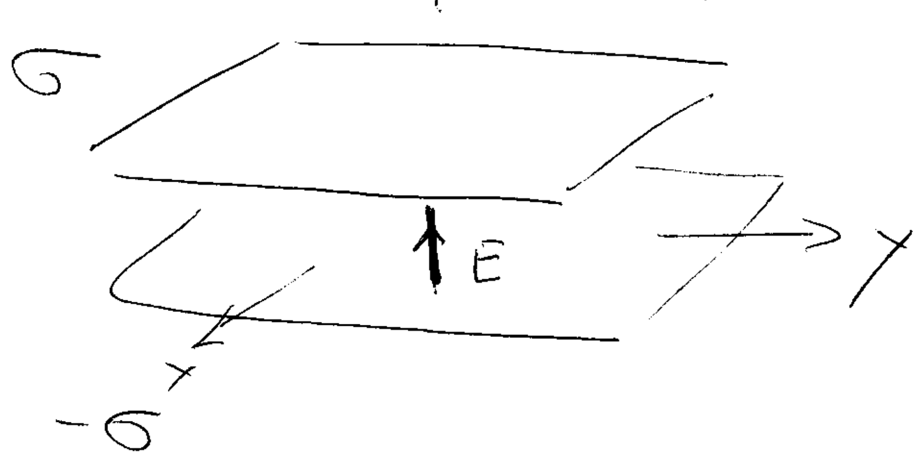
$$\vec{F} = \int \rho\, \vec{v} \times \vec{B}\, d^3r = \int \vec{J} \times \vec{B}\, d^3r$$

$$= \int \vec{I} \times \vec{B}\, dl =$$

$$= \vec{I} \times \vec{B} \cdot d$$

$$\vec{p} = \int \vec{F}\, dt = d \int \vec{I}\, dt \times B$$

$$= \underline{Q\, d\, \vec{n}_{\vec{I}} \times \vec{B}}$$



$$\overleftrightarrow{T} = \varepsilon_0 \begin{pmatrix} -\frac{1}{2}\vec{E}^2 & & \\ & -\frac{1}{2}E^2 & \\ & & \frac{1}{2}\vec{E}^2 \end{pmatrix} =$$

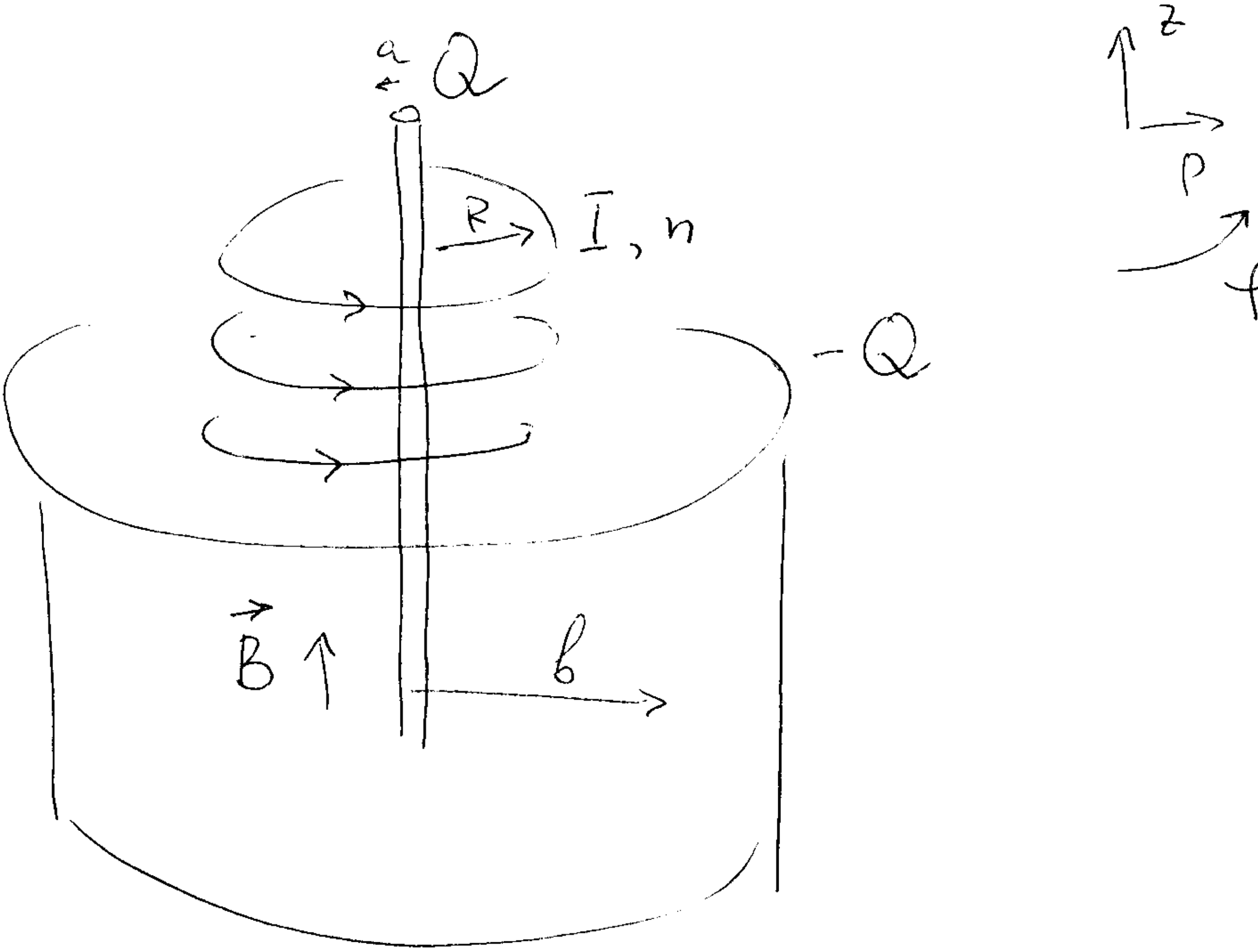
$$= \frac{\varepsilon_0 \vec{E}^2}{2} \begin{pmatrix} -1 & & \\ & -1 & \\ & & 1 \end{pmatrix}$$

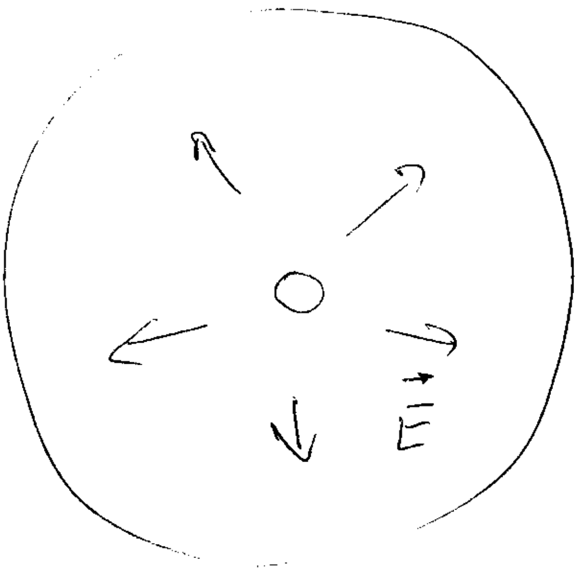
$$\vec{F}_z = \left(\int \overleftrightarrow{T}\, d\vec{S} \right)_z = -\frac{\varepsilon_0 E^2 \cdot S}{2}$$

$$E = \frac{\sigma}{\varepsilon_0}$$

$$W = \frac{\varepsilon_0 E^2}{2} \cdot S d$$

$$F = -\frac{\partial W}{\partial d} = -\frac{\varepsilon_0 E^2}{2} S$$


a
Q
R
I, n
-Q
$\vec{B}$
b
z
ρ
φ


$\vec{E}$

$$\vec{E} = \frac{Q}{2\pi\varepsilon_0 \ell}\,\frac{\vec{n}_\rho}{\rho} \qquad a < \rho < b$$

$$\vec{B} = \mu_0\, n\, I\, \vec{n}_z$$

$$\vec{\wp}_{em} = \varepsilon_0\, \vec{E} \times \vec{B} = -\frac{\mu_0}{2\pi}\,\frac{n I Q}{\ell \rho}\,\vec{n}_\varphi$$

$$\vec{\ell}_{em} \Rightarrow \vec{\rho} \times \vec{\wp}_{em} = -\frac{\mu_0}{2\pi}\,\frac{n I Q}{\ell}\,\vec{n}_z$$

$$\vec{L}_{em} = -\frac{\mu_0}{2\pi}\,\frac{n I Q}{\cancel{\ell}} \cdot \underbrace{V}_{\pi(R^2 - a^2)\cancel{\ell}} \cdot \vec{n}_z =$$

$$= -\frac{\mu_0}{2}\, n I Q\, (R^2 - a^2)\, \vec{n}_z$$