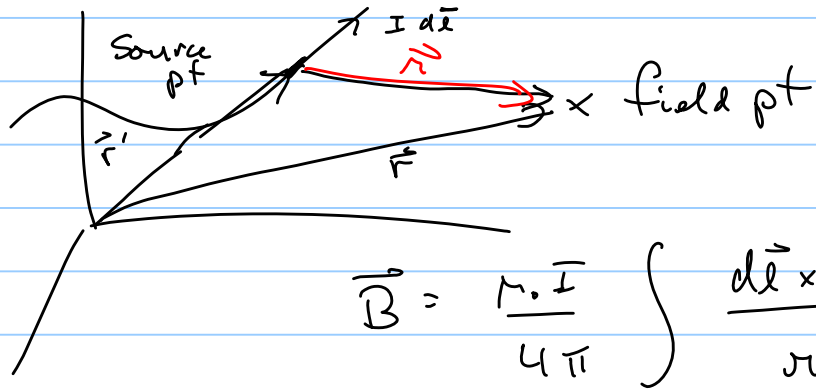
Note Title 3/16/2009

$d\vec{F} = dq\,\vec{v}\times\vec{B}$ $\quad\rightarrow\quad \rho\,d\tau\,\vec{v}\times\vec{B} = \vec{J}\times\vec{B}\,d\tau$

$dq \rightarrow \lambda\,dl,\ \sigma\,da,\ \rho\,d\tau$

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

- Find $\vec{B}$ Biot-Savart

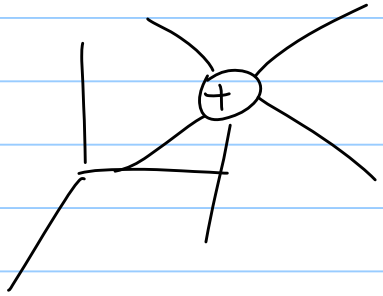


$$\vec{B} = \frac{\mu_0 I}{4\pi}\int \frac{d\vec{l}\times\hat{r}}{r^3}$$

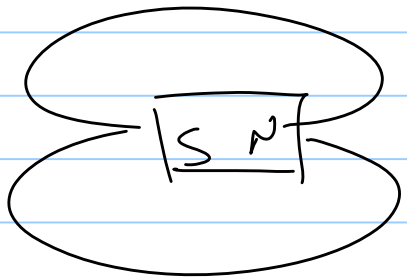
$$\vec{B} = \frac{\mu_0}{4\pi}\int \frac{\vec{J}\times\hat{r}}{r^3}\,d\tau' \qquad \vec{r} = \vec{r} - \vec{r}'$$

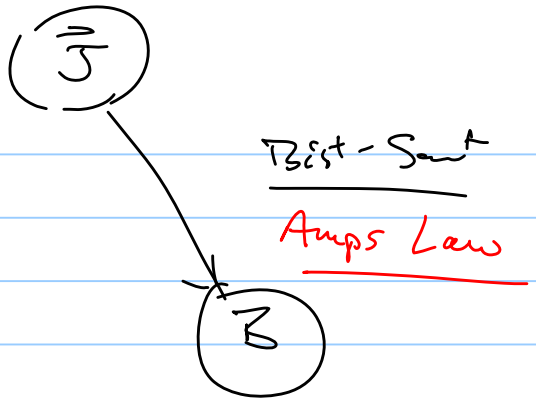
$$\vec{\nabla}\cdot\vec{B} = \frac{\partial}{\partial x}B_x + \frac{\partial}{\partial y}B_y + \frac{\partial}{\partial z}B_z = 0$$

$$\vec{\nabla}\cdot\vec{E} = \rho/\epsilon_0$$



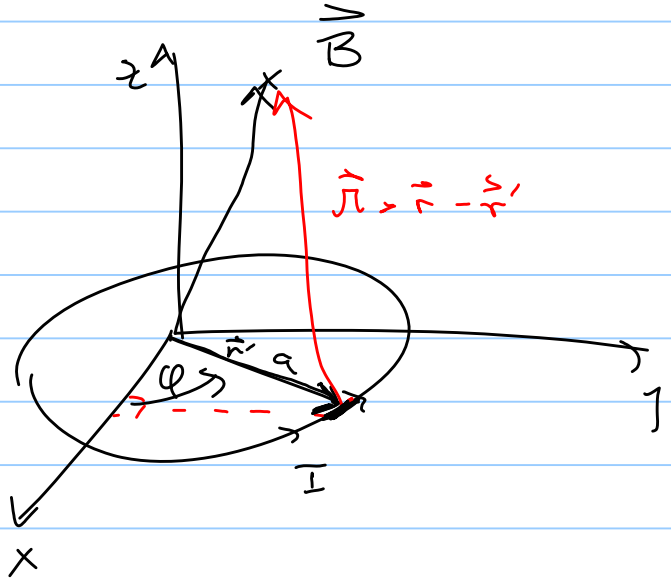
$\cdot\ \vec{\nabla}\cdot\vec{E} = 0$





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

Table of Q # 1



- derive $d\vec{\ell}$

$$d\vec{\ell} = a\, d\varphi\, \hat{\varphi}$$

$$\vec{r}' = a\cos\varphi\,\hat{x} + a\sin\varphi\,\hat{y}$$

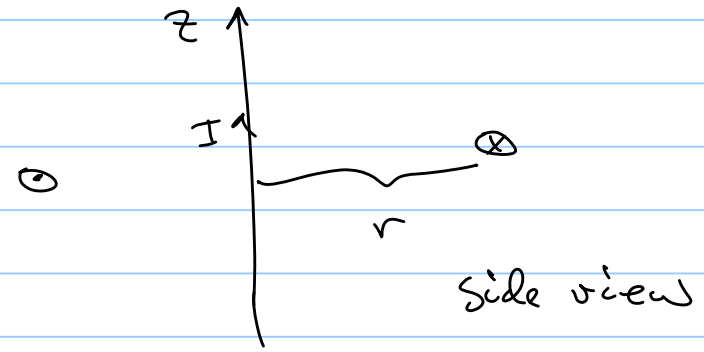
$$d\vec{\ell} = -a\sin\varphi\, d\varphi\,\hat{x} + a\cos\varphi\, d\varphi\,\hat{y} = d\vec{r}'$$

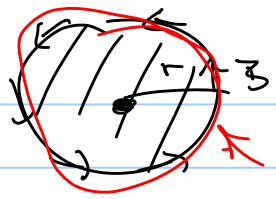
$$\vec{r} = x\,\hat{x} + y\,\hat{y} + z\,\hat{z}$$

$$\vec{r}' =$$

$$\vec{B} = \int_0^{2\pi} \frac{\mu_0}{4\pi} \frac{I\, d\vec{\ell} \times \vec{r}}{r^3}$$

Ex:





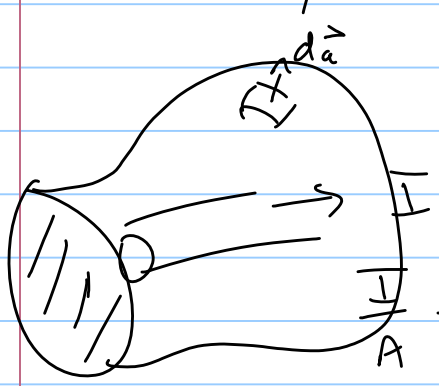
$$\int \underbrace{\nabla \times \vec{B}}_{\mu_0 \vec{J}} \cdot d\vec{a} = \oint \vec{B} \cdot d\vec{\ell}$$

$$\oint |\vec{B}||d\vec{\ell}| \cos\phi$$

$\vec{J}$ ← $\rho \vec{v}$ ($\frac{coul}{m^3} \frac{m}{s}$) → $\frac{coul}{m^2 \cdot s}$ or $\frac{Amps}{m^2}$

$$RHS = \int \mu_0 \vec{J} \cdot d\vec{a} = \mu_0 I_{encl}$$

$$B \underbrace{\oint d\ell}_{2\pi r} = B 2\pi r$$

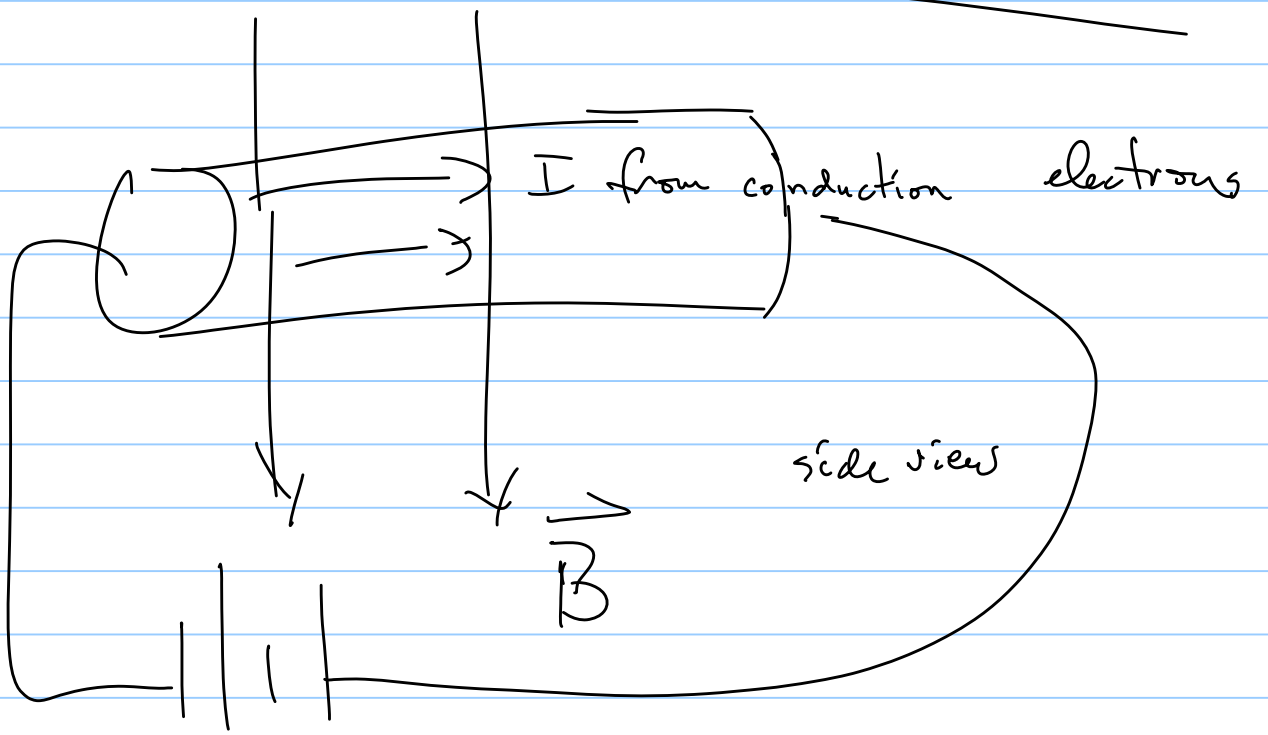


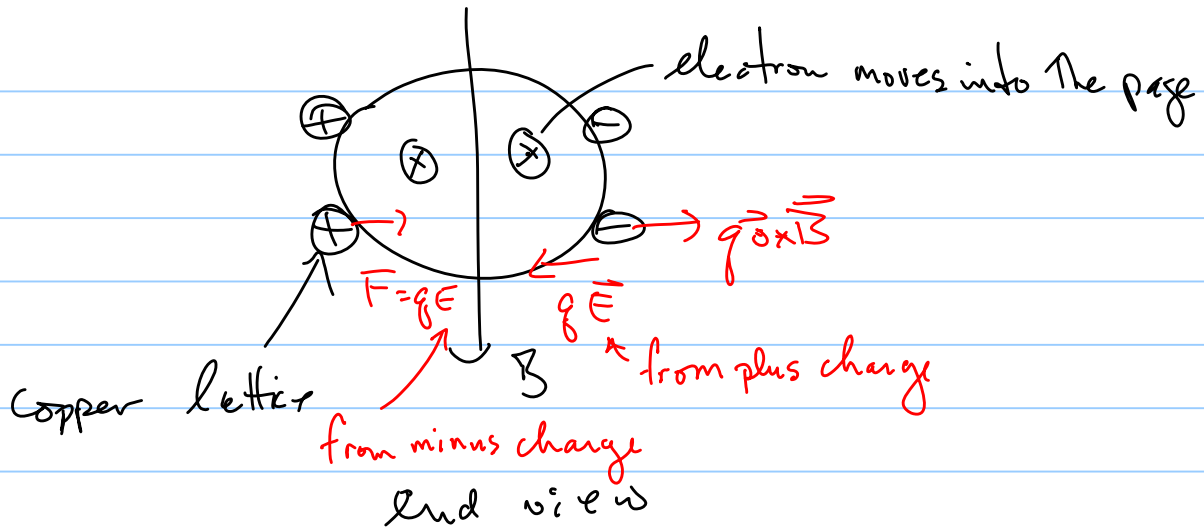
$$\oint d\vec{\ell} = \emptyset$$

$$\frac{Amps}{m^2} \qquad \vec{J}\ \underbrace{area}_{m^2} = I$$

$$\mu_0 I = 2\pi r B \qquad B = \frac{\mu_0 I}{2\pi r} \propto \frac{1}{r}$$

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




electron moves into the page
$q\vec{v}\times\vec{B}$
$\vec{F}=q\vec{E}$
$q\vec{E}$
from plus charge
Copper lattice
B
from minus charge
end view