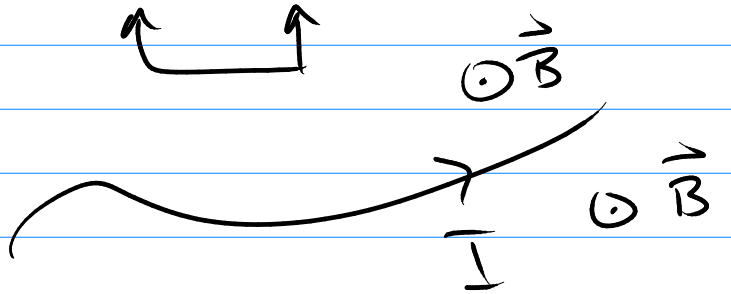
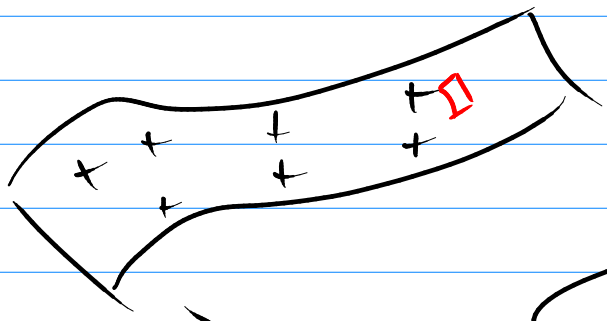
$$\vec{F} = q\vec{v} \times \vec{B}$$

$$d\vec{F} = dq\,\vec{v} \times \vec{B}$$

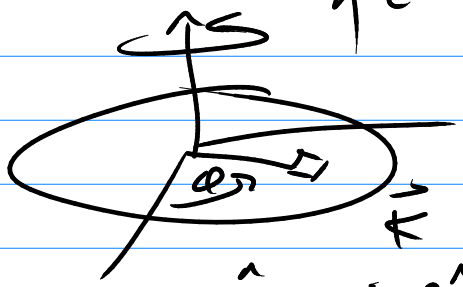
$$= \lambda\, d\ell\, \vec{v} \times \vec{B} = \vec{I} \times \vec{B}\, d\ell$$

($dq = \lambda\, d\ell$, $\lambda \vec{v} = \vec{I}$)





sheet of charge



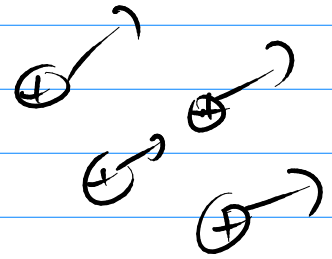
$$d\vec{F} = dq\,\vec{v} \times \vec{B}$$

$$\sigma\, da\, \vec{v} \times \vec{B} = \vec{K} \times \vec{B}\, da$$

$\vec{K}$ $\quad \frac{\text{Coul}}{\text{m}^2} \frac{\text{m}}{\text{s}} \rightarrow \frac{\text{Coul}}{\text{m}\cdot\text{s}}$

$\hat{\varphi} = -\sin\varphi\,\hat{x} + \cos\varphi\,\hat{y}$

3-D

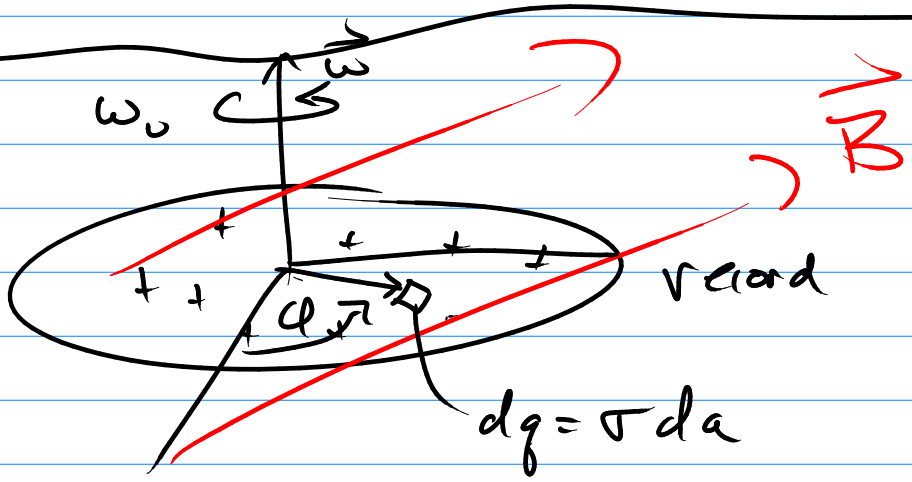


$$d\vec{F} = dq\,\vec{v} \times \vec{B}$$

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

$\vec{J}$

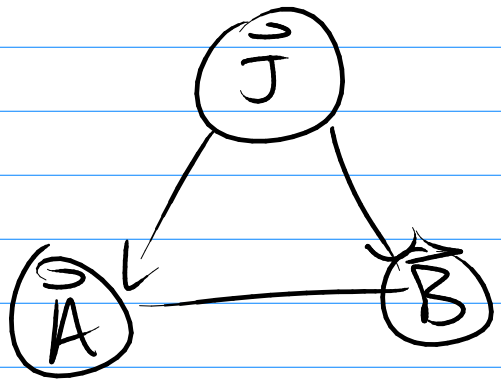
Ex:



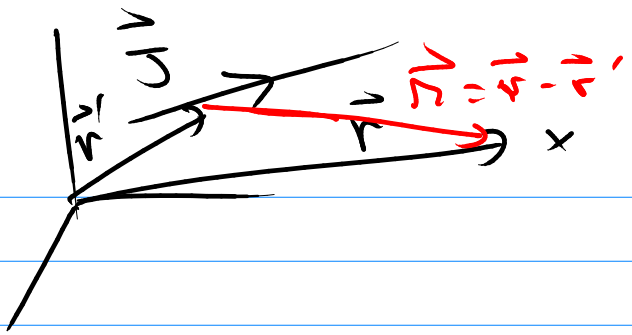
$$\vec{K} = \sigma\vec{v} = \sigma\,\vec{\omega} \times \vec{r} = \sigma\,\omega r \underbrace{\sin(90^\circ)}_{1}\,\hat{\varphi}$$

$$= \sigma\omega r\left(-\sin\varphi\,\hat{x} + \cos\varphi\,\hat{y}\right)$$

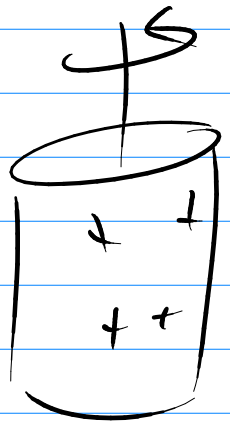
$$d\vec{F} = \vec{K} \times \vec{B}\, da = \sigma\omega r \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ -\sin\varphi & \cos\varphi & 0 \\ B_x & B_y & B_z \end{vmatrix} r\,d\varphi\,dr$$



Biot Savart



$$\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi} \int \frac{I\, d\vec{\ell} \times \vec{\pi}}{\pi^3}$$



$$\vec{B} = \frac{\mu_0}{4\pi} \int \frac{\vec{J} \times \vec{\pi}}{\pi^3} d\tau'$$