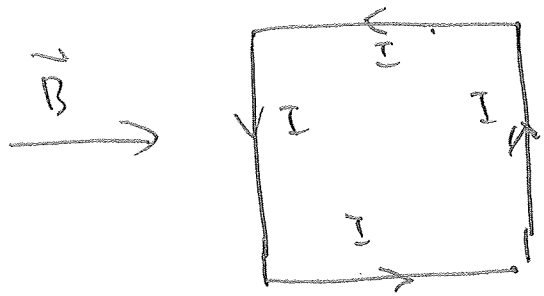
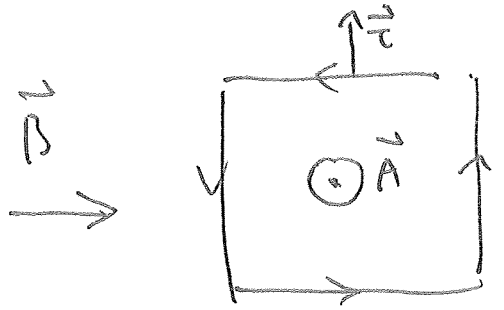
$$\vec{F} = I \vec{L} \times \vec{B}$$



$|\vec{\tau}| = I A B$

AREA OF THE LOOP



$|\vec{A}|$ = AREA

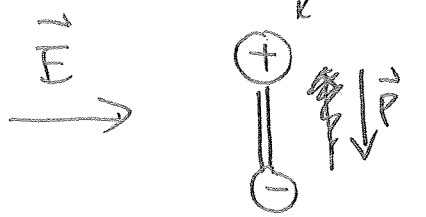
$\vec{\tau} = I \vec{A} \times \vec{B}$

$I \vec{A} = \vec{\mu}$

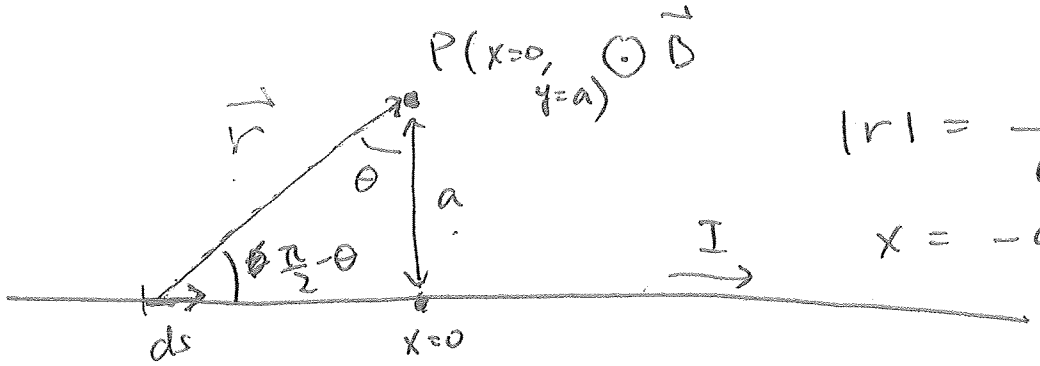
$\vec{\tau} = \vec{\mu} \times \vec{B}$

↑ MAGNETIC DIPOLE

ELECTRIC DIPOLE



$\vec{p} \times \vec{E} = \vec{\tau}$



$$|r| = \frac{a}{\cos\theta}$$

$$x = -a\tan\theta$$

$$d\vec{B} = \frac{\mu_0 I}{4\pi}\frac{d\vec{s}\times\hat{r}}{r^2} \qquad d\vec{s} = dx\,\hat{x}$$

$$d\vec{s}\times\hat{r} = dx\,(\hat{x}\times\hat{r})$$

$$= dx\cdot\hat{z}\sin\left(\frac{\pi}{2}-\theta\right)$$

$$= \hat{z}\,dx\cos\theta$$

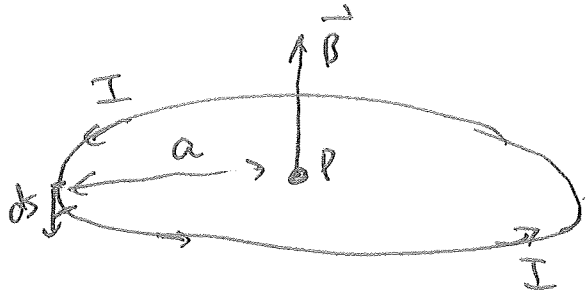
$$d\vec{B} = \frac{\mu_0 I}{4\pi}\frac{dx\cos\theta}{r^2}\hat{z}$$

$$x = -a\tan\theta$$

$$dx = -a\sec^2\theta\,d\theta = -\frac{a\,d\theta}{\cos^2\theta}$$

$$\vec{B} = \int d\vec{B} = \int_{\pi/2}^{-\pi/2}\frac{\mu_0 I}{4\pi a}(-\cos\theta)\,d\theta\,\hat{z}$$

$$= \frac{\mu_0 I}{2\pi a}\hat{z}$$



$$d\vec{B} = \frac{\mu_0 I}{4\pi} \frac{d\vec{s} \times \hat{r}}{r^2}$$

$$d\vec{B} = \frac{\mu_0 I}{4\pi} \frac{|d\vec{s}|\,|1|}{a^2} \quad \text{POINTS UP}$$

TOP VIEW

$$\vec{B} = \int d\vec{B} = \int \frac{\mu_0 I}{4\pi} \frac{|d\vec{s}|}{a^2}$$

$$= \frac{\mu_0 I}{4\pi a^2} \underbrace{\int |d\vec{s}|}_{2\pi a}$$

$$= \frac{\mu_0 I}{4\pi a^2} 2\pi a$$

$$\vec{B} = \frac{\mu_0 I}{2a} \quad \text{POINTS UP}$$