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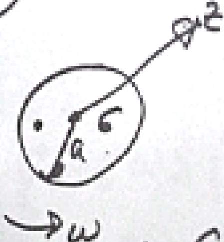


$$\vec{B} = \frac{\mu_0}{4\pi}\int_{I} \frac{\vec{K} \times \vec{r}_{ip}}{|\vec{r}_{ip}|^3}\, dA'$$

$$\vec{K} = \sigma \vec{\underline{V}}$$

$\bar{s} = x_i \hat{x} + y_i \hat{y}$

$$\underline{\bar{V}_t = \bar{\omega}_q \times \bar{s}} = (\omega \hat{z}) \times (s(\cos\phi \hat{x} + \sin\phi \hat{y}))$$

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

$$= \omega s\left(\hat{x}(-\sin\phi) + \hat{y}(-\cos\phi)\right)$$

$$= \omega s\,\hat{\phi}$$

$$\vec{K} = -\sigma\omega s\left(\sin\phi\,\hat{x} + \cos\phi\,\hat{y}\right)$$

$$\vec{r}_i = x_i\hat{x} + y_i\hat{y} \; : \; \vec{r}_p = z_p\hat{z}$$

$$\vec{r}_{ip} = -s\cos\phi\,\hat{x} - s\sin\phi\,\hat{y} + z_p\hat{z}$$

$$\vec{K} \times \bar{r}_{i\to p} = +\sigma\omega s \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ \sin\phi & \cos\phi & 0 \\ s\cos\phi & s\sin\phi & -z_p \end{vmatrix}$$

$$\hat{z}$$

$$= \sigma\omega s \left(s\sin^2\phi + s\cos^2\phi \right)\hat{z}$$

$$= \sigma\omega s^2 \hat{z}$$

$$\vec{B} = \frac{\mu_0}{4\pi} \iint \frac{(\sigma\omega s^2)}{[s^2+z_p^2]^{3/2}} \, s \, ds \, d\phi$$

$$= \frac{\mu_0}{2} \omega\sigma \int_{s=0}^{a} \frac{s^3}{[s^2+z_p^2]^{3/2}} \, ds$$

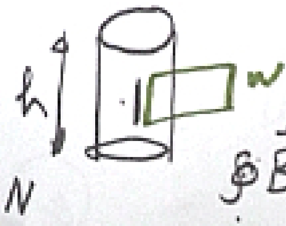
$$\left.\frac{2z_p^2+s^2}{\sqrt{s^2+z_p^2}}\right|_{s=0}^{s=a}$$

$$= \frac{2z_p^2+a^2}{\sqrt{a^2+z_p^2}} - \frac{2z_p^2}{\underbrace{\sqrt{z_p^2}}_{2z_p}}$$

Keep $z_p > 0$

look at $z_p >> a$

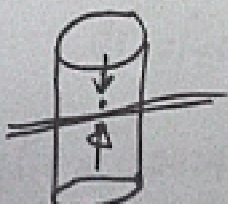
$$\hookrightarrow \frac{2z_p^2}{\sqrt{z_p^2}} - \frac{2z_p^2}{\sqrt{z_p^2}} \to 0$$



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

$$Bw = \mu_0 n \cdot w I$$

$$B = \mu_0 n I$$



$$B_{end} = \frac{1}{2} B_{center}$$

$$= \frac{1}{2}\mu_0 n I$$

$$B = \frac{\mu_0 I}{4\pi} \int_I \frac{d\vec{L}_i \times \hat{r}_{ip}}{|\hat{r}_{ip}|^3}$$

$$\vec{r}_i = a\cos\phi_i \hat{x} + a\sin\phi_i \hat{y}$$
$$+ C\phi \hat{z}$$

$C \ (+, -)$

$$d\hat{r}_i = \left[-a\sin\phi_i \cdot \hat{x} + a\cos\phi_i \cdot \hat{y} + C\hat{z}\right] d\phi_i$$

$$\vec{r}_{ip} = -a\cos\phi_i \hat{x} - a\sin\phi_i \cdot \hat{y} + (z_p - C\phi)\hat{z}$$

$$d\vec{L}_i \times \vec{r}_{ip} = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ -a\sin\phi & a\cos\phi & c \\ -a\cos\phi & -a\sin\phi & (z_p - c) \end{vmatrix}$$

$$\vec{B} = \hat{z}\,\frac{\mu_0 I}{4\pi} \int_{\phi=0}^{2N\pi} \frac{a^2\,d\phi}{\left[a^2 + (z_p - c\phi)^2\right]^{3/2}}$$

$$\left. \frac{c\phi - z}{c\sqrt{a^2 + (z - c\phi)^2}^{\,2}} \right|_{\phi=0}^{\phi=2N\pi}$$

$$\vec{B} = \hat{z}\,\frac{2\mu_0 I N}{\sqrt{a^2+(N\pi c^2)}}$$

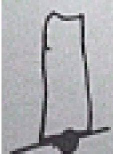
$$@\ z_p = N\pi c$$

$$(z - 2N\pi c)^2$$

$$\vec{B} = \hat{z}\left(\frac{2\mu_0 I N}{\sqrt{(N\pi c)^2}}\right)$$

$$2N\pi c = W \Rightarrow \pi c = \frac{W}{2N}$$

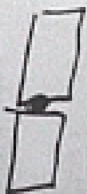
$$\vec{B} = \hat{z}\,\mu_0 n I$$



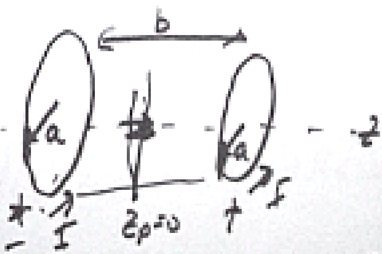
$$z_p = 0$$

$$\vec{B} = \hat{z}\,\frac{\mu_0 I}{4\pi}\left(\frac{2N\pi c}{\sqrt{a^2+(2N\pi c)^2}}\right)$$

$$\rightarrow \vec{B} \simeq \frac{1}{2}\left[\hat{z}\right]\left[\frac{\mu_0 I}{2\pi c}\right] \rightarrow$$



$B_{end} \simeq \frac{1}{2} B_{center}$



$$\vec{B} = \frac{\mu_0 I}{4\pi} \int_I \frac{d\vec{L}_i \times \vec{r}_{ip}}{|\vec{r}_{ip}|^3}$$

$$\vec{r}_p = z_p \hat{z}$$

$$\vec{r}_{i_-} = a\cos\phi\,\hat{x} + a\sin\phi\,\hat{y} - \frac{b}{2}\hat{z}$$

$$\vec{r}_{i_+} = a\cos\phi\,\hat{x} + a\sin\phi\,\hat{y} + \frac{b}{2}\hat{z}$$

$$d\vec{L}_i = -a\sin\phi\,\hat{x} + a\cos\phi\,\hat{y}$$

$$d\vec{L}_{i+} = -a\sin\phi\,\hat{x} + a\cos\phi\,\hat{y}$$

$$\int (-a\sin\phi\,\hat{x} + a\cos\phi\,\hat{y}) \times (-a\cos\phi\,\hat{x} + -a\sin\phi\,\hat{y} + \frac{b}{2}\hat{z})$$

$$a\,d\phi$$

$$a\begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ -a\sin\phi & a\cos\phi & 0 \\ -a\cos\phi & -a\sin\phi & \frac{b}{2} \end{vmatrix}$$

$$a\left(a\sin^2\phi + \underset{a}{b}\cos^2\phi\right)\hat{z}\; 2$$

$$\vec{B} = \frac{\mu_0 I}{4\pi}(a\cdot 2\pi)2\,\frac{a^2}{\left(a^2+\left(\frac{b}{2}\right)^2\right)^{3/2}}$$