$$\boxed{d\vec{B}_A = 4{,}4 \cdot 10^{-7}\,\hat{k}\ \ (T)}$$

$dB_A = 4{,}4 \cdot 10^{-7}$

direção = eixo z

sentido = +z

b) $d\vec{B}_B = ?$

$$\vec{r}_B = 14{,}0 \cdot 10^{-2}\,\hat{i} + 5{,}0 \cdot 10^{-2}\,\hat{j}$$

$$d\vec{B}_B = \frac{10^{-7} \cdot 10{,}0 \cdot 1{,}10 \cdot 10^{-3}\,\hat{i} \wedge (14{,}0\,\hat{i} + 5{,}0\,\hat{j}) \cdot 10^{-2}}{\left(\sqrt{(14{,}0^2 + 5{,}0^2)(10^{-2})^2}\right)^3}$$

$$\boxed{d\vec{B}_B = 1{,}7 \cdot 10^{-8}\,\hat{k}}\ (T)$$

$dB_B = 1{,}7 \cdot 10^{-8}$

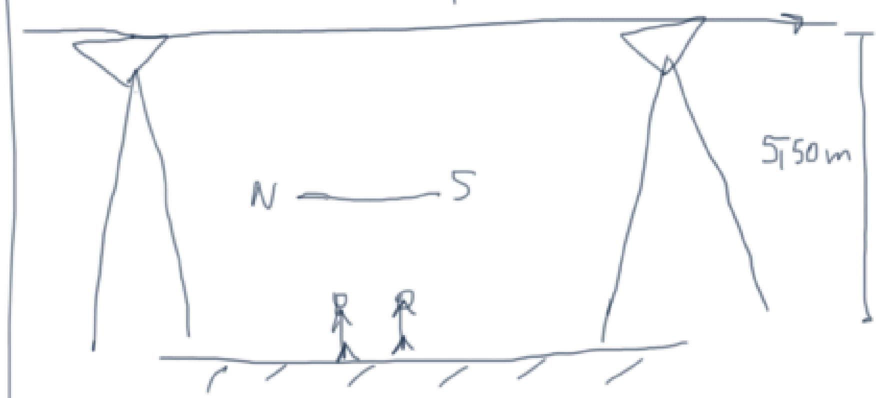
direção = z

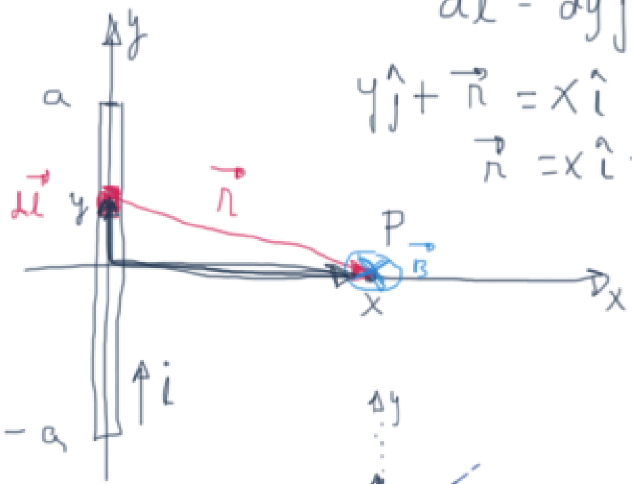
sentido = +z

c) $d\vec{B}_C = 0$.

pois $d\vec{l} \parallel \vec{r}_C$

Ex. 28.20, p. 272

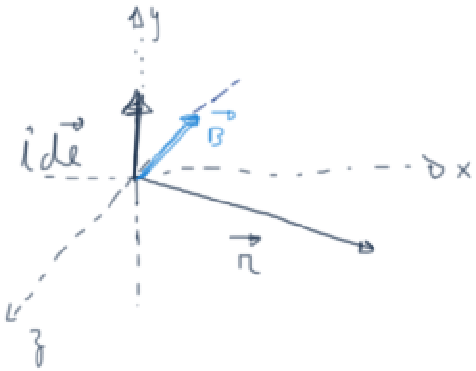




$d\vec{l} = dy\,\hat{j}$

$y\hat{j} + \vec{r} = x\hat{i}$

$\vec{r} = x\hat{i} - y\hat{j}$



$$\vec{B} = \int d\vec{B} = \int_{-a}^{a} \frac{\mu_0}{4\pi}\,\frac{i\,\overbrace{(dy\,\hat{j})}^{d\vec{l}} \wedge \overbrace{(x\hat{i} - y\hat{j})}^{\vec{r}}}{\underbrace{\left(\sqrt{x^2+y^2}\right)^3}_{r}}$$

$$\vec{B} = \frac{\mu_0 i}{4\pi}(-\hat{k}) \int_{-a}^{a} \frac{x\,dy}{\left(\sqrt{x^2+y^2}\right)^3}$$

$$\vec B = \frac{\mu_0 i x}{4\pi}(-\hat k)\int_{-a}^{a} \frac{1}{(\sqrt{x^2+y^2})^3}\,dy$$

$$\int \frac{1}{(\sqrt{x^2+y^2})^3}\,dy = \frac{y}{x^2\sqrt{x^2+y^2}} + k$$

↓ dica

$$\int \frac{1}{\left(x\sqrt{1+\left(\frac{y}{x}\right)^2}\right)^3}\,dy$$

$\boxed{\frac{y}{x} = tg\,u}$ $\left\{ \begin{array}{l} y = x\,tg\,u \\ \frac{dy}{du} = x\sec^2 u \end{array}\right.$ $\boxed{dy = x\sec^2 u\,du}$

$$\int \frac{x\sec^2 u}{x^3(\sqrt{\underbrace{1+tg^2 u}_{\sec^2 u}})^3}\,du$$

$$\to \frac{1}{x^2}\int \frac{\sec^2 u\,du}{\sec^3 u} \ldots$$

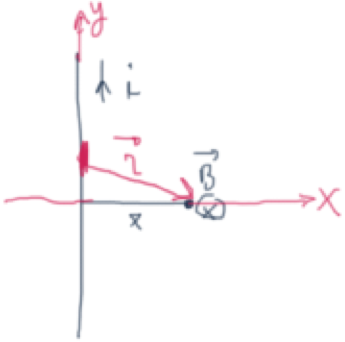
$$\vec B = \frac{\mu_0 i x}{4\pi}\frac{1}{x^2}\left[\frac{y}{\sqrt{x^2+y^2}}\right]_{-a}^{a}(-\hat k)$$

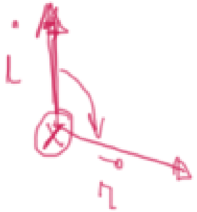
$$\vec B = \frac{\mu_0 i}{4\pi x}\left(\frac{a}{\sqrt{x^2+a^2}}+\frac{a}{\sqrt{x^2+a^2}}\right)(-\hat k)$$

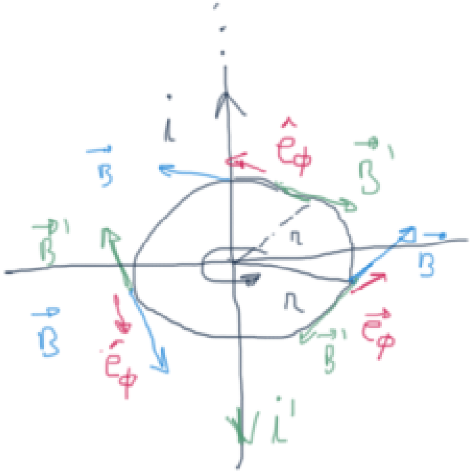
$$\boxed{\vec B = \frac{\mu_0 i}{4\pi x}\frac{2a}{\sqrt{x^2+a^2}}(-\hat k)}$$

$$a >> x \to \sqrt{x^2+a^2} \simeq \sqrt{a^2} = a$$

$$\vec B \cong \frac{\mu_0 i}{2\pi x}(-\hat k)$$



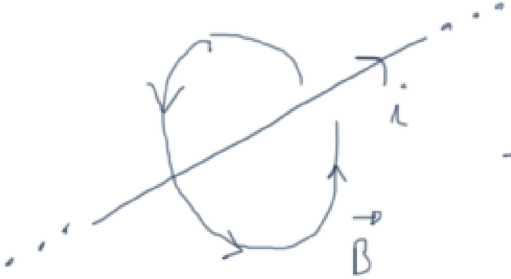


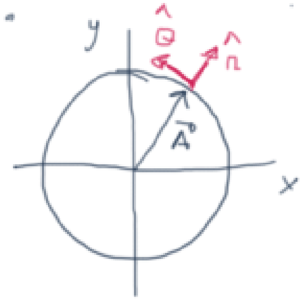


Em geral, $\vec B = \frac{\mu_0 i}{2\pi r}\hat e_\varphi$

↓ em polares

$\hat\theta$



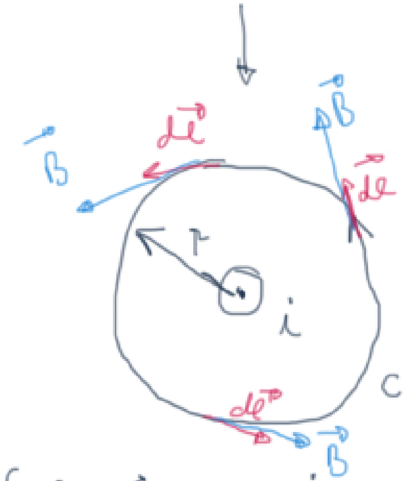


$(r,\theta,\varphi) \to \hat e_r, \hat e_\theta, \hat e_\varphi$

$x, y, z \to \hat e_x, \hat e_y, \hat e_z$

$(r,\varphi,z) \to \hat e_r, \hat e_\varphi, \hat e_z$

Outro jeito: Lei de Ampère



$$\oint_C \underbrace{\vec{B}\cdot d\vec{l}}_{B\,dl} = \mu_0 i_{int} = \mu_0 i$$

$$\oint_C B\,dl = \mu_0 i$$

$$B \underbrace{\oint_C dl}_{2\pi r} = \mu_0 i$$

$$\boxed{B = \frac{\mu_0 i}{2\pi r}}$$

Voltando ao problema...

$$B = \frac{\overset{10^{-7}}{\mu_0} \cdot 800 \cdot 2}{2 \cdot 2\pi \cdot 5{,}50}$$

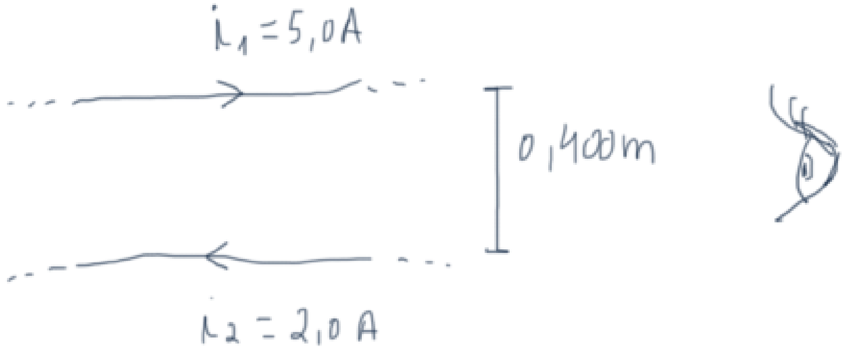
$$\boxed{B = 2{,}91 \cdot 10^{-5}\,T}$$

$$B = 0{,}291 \overset{G}{10^{-4}\,T} =$$

$$= 0{,}291\ G$$

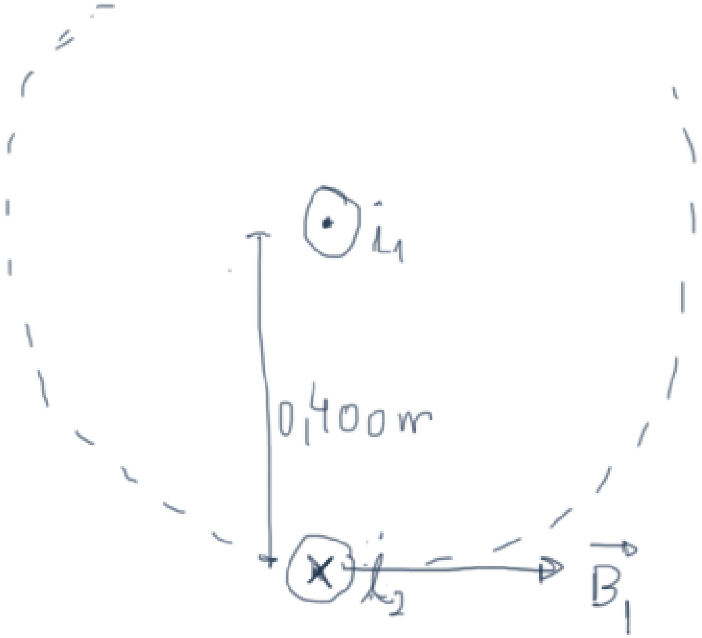
$$B_{Terra} = 0{,}5\ G$$

EX 20.25, p. 273



a) $L = 1{,}20\,m$

$F = ?$



$$\boxed{\vec{F}_m = i\,\vec{L} \wedge \vec{B}}$$

$$F_m = i\,L\,B\,\cancel{\operatorname{sen}\theta}^{\,1}$$

$$F_m = i_2 \cdot L \cdot \left(\frac{\mu_0\, i_1}{2\pi r}\right)$$

$$\vec{F}_m = \int_{\text{fio}} i\, d\vec{l} \wedge \vec{B}$$

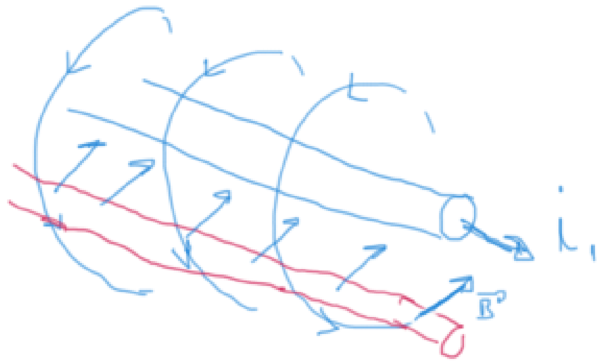
$$= i\int -\vec{B} \wedge d\vec{l} = -i\,\vec{B} \wedge \int d\vec{l} = -i\,\vec{B} \wedge \vec{L} = i\,\vec{L} \wedge \vec{B}$$

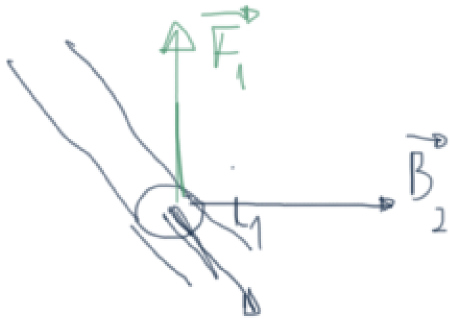
$$\boxed{\frac{F_{\substack{\text{entre}\\ \text{fios}}}}{L} = \frac{\mu_0\, i_1\, i_2}{2\pi r}}$$

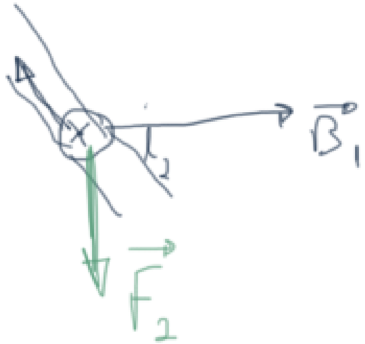
$$F_{\substack{\text{entre}\\ \text{fios}}} = L \cdot \frac{\overbrace{\mu_0}^{10^{-7}}\, i_1\, i_2\, 2}{\underbrace{2 \cdot 2\pi}\, r}$$

$$= \frac{1{,}20 \cdot 10^{-7} \cdot 5{,}0 \cdot 2{,}0 \cdot 2}{0{,}400}$$

$$\boxed{F_{\substack{\text{entre}\\ \text{fios}}} = 2{,}4 \cdot 10^{-5}\ \text{N}}$$

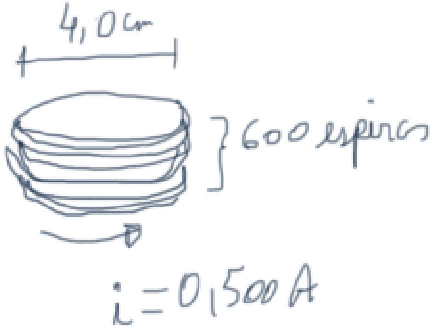




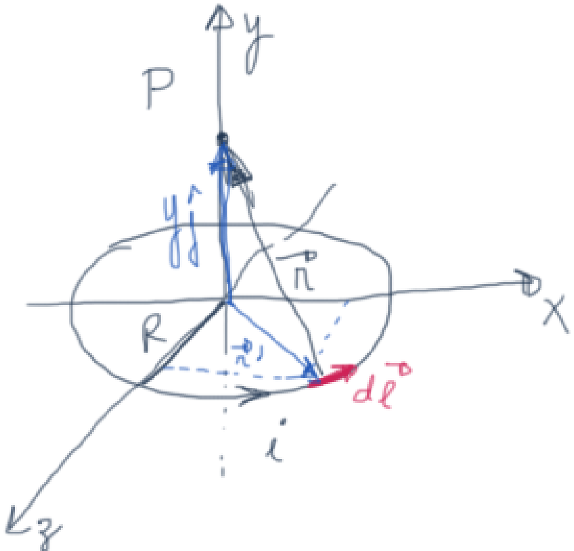


Resp: $F_{\substack{\text{entre}\\ \text{fios}}}$ é uma força de repulsão.

EX. 28.33, p. 274



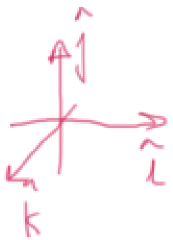
Campo $\vec{B}$ de UMA espira



$$d\vec{B} = \frac{\mu_0 i}{4\pi} \frac{d\vec{\ell} \wedge \vec{r}}{r^3}$$

$$d\vec{\ell} = dx\,\hat{i} + dz\,\hat{k}$$

$$\vec{r}' + \vec{r} = y\hat{j} \rightarrow \vec{r} = y\hat{j} - \vec{r}'$$



$$\vec{r} = y\hat{j} - (x\hat{i} + z\hat{k})$$

$$r = \sqrt{x^2 + y^2 + z^2}$$

R^2

$$r = \sqrt{y^2 + R^2}$$

$$d\vec{\ell} \wedge \vec{r} = (dx\,\hat{i} + dz\,\hat{k}) \wedge (-x\hat{i} + y\hat{j} - z\hat{k})$$

$$= 0 + dx \cdot y\, \hat{i} \wedge \hat{j} - dx \cdot z \cdot \hat{i} \wedge \hat{k}$$

$$- dz \cdot x \cdot \hat{k} \wedge \hat{i} + dz \cdot y\, \hat{k} \wedge \hat{j} + 0$$

$$= y\,dx\,\hat{k} - z\,dx(-\hat{j}) - x\,dz\,\hat{j} + y\,dz(-\hat{i})$$

$$= dx(y\hat{k} + z\hat{j}) + dz(-x\hat{j} - y\hat{i})$$

Vamos continuar na próxima aula...