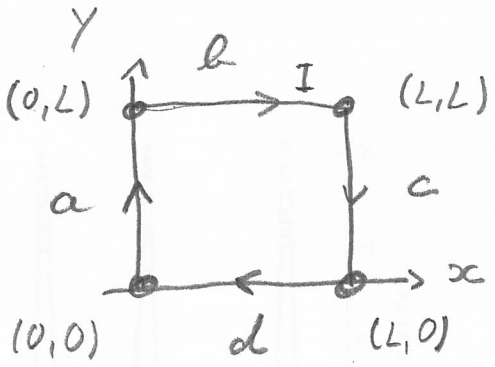
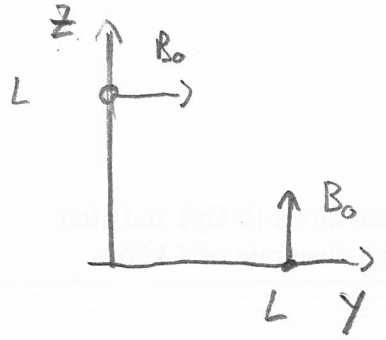
FORÇA SOBRE UMA ESPIRA DE CORRENTE EM UM CAMPO MAGNÉTICO NÃO UNIFORME

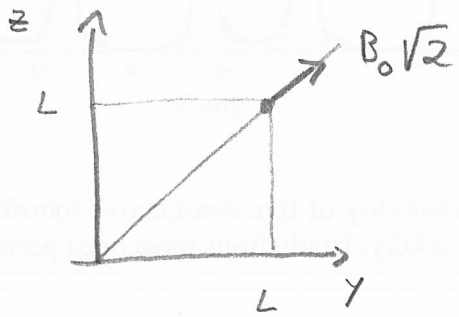
PROBLEMA 27.81

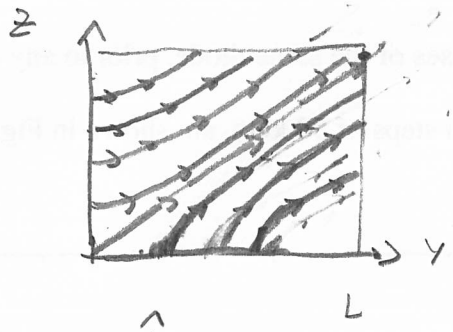
$$\underline{B} = B_0 \frac{z}{L} \hat{j} + B_0 \frac{y}{L} \hat{k}$$



ⓐ







ⓑ $\underline{dF} = I\, \underline{dl} \wedge \underline{B}$

LATO a

$\underline{dl_a} = dy\, \hat{j}$ $(x=0)$

$$\underline{dF_a} = I dy\, \hat{j} \wedge \left(B_0 \frac{z}{L} \hat{j} + B_0 \frac{y}{L} \hat{k} \right) = I B_0 \frac{y}{L} dy\, \hat{j} \wedge \hat{k} = I B_0 \frac{y}{L} dy\, \hat{i}$$

$$\underline{F_a} = \hat{i} \int_0^L I B_0 \frac{y}{L} dy = \hat{i}\, \frac{1}{2} I B_0 \frac{y^2}{L} \Big|_0^L = \frac{1}{2} I B_0 L\, \hat{i}$$

LATO b

$$\underline{d\ell}_b = dx\,\hat{\imath} \qquad (y=L)$$

$$\underline{dF}_b = I\,dx\,\hat{\imath} \wedge \left(B_0 \frac{z}{L}\hat{\jmath} + B_0\hat{k}\right) = IB_0\frac{z}{L}dx\,\hat{\imath}\wedge\hat{\jmath} + IB_0\,dx\,\hat{\imath}\wedge\hat{k}$$

$$\underline{F}_b = \hat{k}\int_0^L IB_0\frac{z}{L}dx - \hat{\jmath}\int_0^L IB_0\,dx = IB_0 z\,\hat{k} - IB_0 L\,\hat{\jmath}$$

LATO c

$$\underline{d\ell}_c = -dy\,\hat{\jmath} \qquad (x=L)$$

$$\underline{dF}_c = -I\,dy\,\hat{\jmath}\wedge\left(B_0\frac{z}{L}\hat{\jmath} + B_0\frac{y}{L}\hat{k}\right) = -IB_0\frac{y}{L}dy\,\hat{\jmath}\wedge\hat{k} =$$

$$= -IB_0\frac{y}{L}dy\,\hat{\imath}$$

$$\underline{F}_c = -\hat{\imath}\int_0^L IB_0\frac{y}{L}dy = -\hat{\imath}\,\frac{1}{2}IB_0\frac{y^2}{L}\Big|_0^L = -\frac{1}{2}IB_0 L\,\hat{\imath}$$

LATO d

$$\underline{d\ell}_d = -dx\,\hat{\imath} \qquad (y=0)$$

$$\underline{dF}_d = -I\,dx\,\hat{\imath}\wedge B_0\frac{z}{L}\hat{\jmath} = -IB_0\frac{z}{L}dx\,\hat{\imath}\wedge\hat{\jmath} = -IB_0\frac{z}{L}dx\,\hat{k}$$

$$\underline{F}_d = -\hat{k}\int_0^L IB_0\frac{z}{L}dx = -\hat{k}\,\frac{1}{2}IB_0\frac{z^2}{L}\Big|_0^L = -\frac{1}{2}IB_0 L\,\hat{k}$$

PROBLEMA 27.81

(d)

A FORÇA RESULTANTE É

$$\underline{F} = \frac{1}{2} I B_0 L \hat{i} + I B_0 z \hat{k} - I B_0 L \hat{j}$$

$$-\frac{1}{2} I B_0 L \hat{i} - I B_0 z \hat{k}$$

$$\underline{F} = -I B_0 L \hat{j}$$

$$\boxed{\underline{F} = \underline{\mu} \cdot \nabla \underline{B}}$$ FORMULA GERAL

$$\boxed{\underline{\mu} = -I L^2 \underline{k}}$$ MOMENTO DE DIPOLO MAGNÉTICO DA ESPIRA

$$\underline{F} = -I L^2 \frac{\partial}{\partial z} \underline{B} = -I L^2 \frac{B_0}{L} \hat{j} = -I B_0 L \hat{j}$$