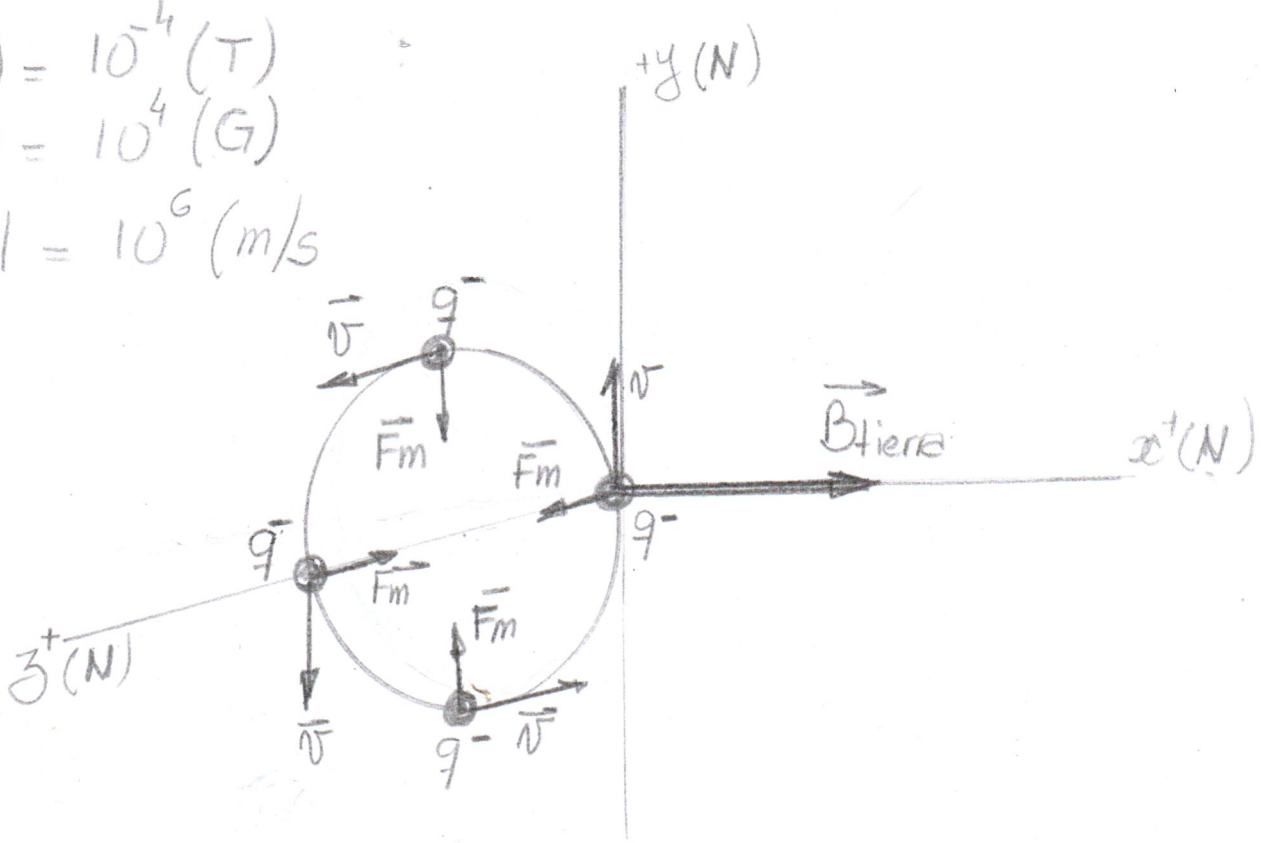
25.2 $\|\vec{B}\| = 0{,}157\ (G) = 1{,}57 \cdot 10^{-5}\ (T)$

$1\ (G) = 10^{-4}\ (T)$

$1\ (T) = 10^{4}\ (G)$

$\|\vec{v}\| = 10^{6}\ (m/s$




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

$\|\vec{F}\| = |q_e| \|\vec{v}\| \|\vec{B}\| \cdot \operatorname{sen} 90$

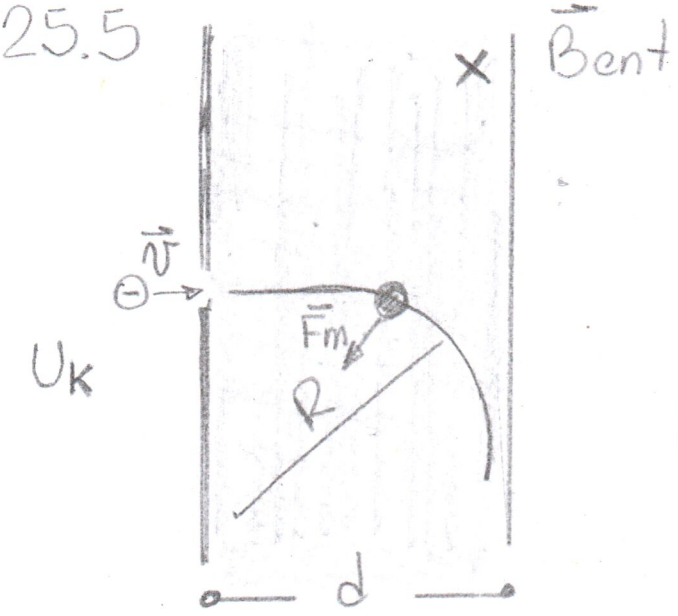
$\|\vec{F}\| = 1{,}6\ 10^{-19} \cdot 10^{6} \cdot 1{,}57\ 10^{-5} = 2{,}512\ 10^{-18}\ (N)$

$\vec{F} = (0\hat{i} + 0\hat{j} + 2{,}512 \cdot 10^{-18}\hat{k})\ (N)$

b) $\vec{F} = m_e\vec{a}$ $\qquad \|\vec{F}\| = m_e\|\vec{a}\|$

$$\|\vec{a}_e\| = \frac{\|\vec{F}\|}{m_e} = \frac{2{,}512\ 10^{-18}}{9{,}11\ 10^{-31}} = 2{,}757\ 10^{12}\ (m/s)$$

25.5




$R < d$

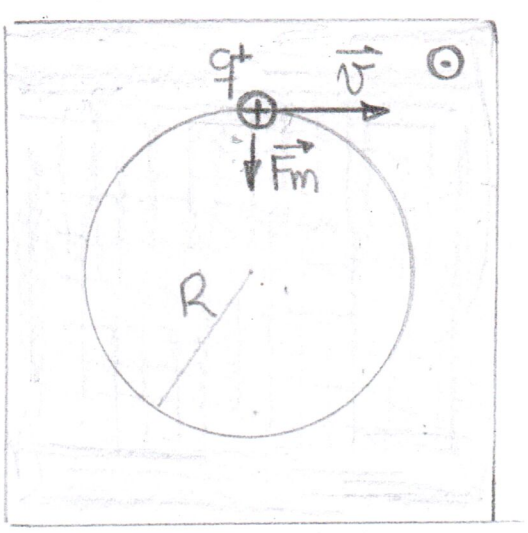
$$U_K = \frac{1}{2} m_e v^2 = \frac{1}{2} m_e 2ad$$

$$\frac{U_K}{d} = m_e \cdot a$$

$$\|\vec{F}_m\| = |q| \cdot \|\vec{v}\| \cdot \|\vec{B}\| = m_e \cdot a = \frac{U_K}{d}$$

$$\|\vec{B}\| = \frac{m_e \cdot a}{|q| \cdot \|\vec{v}\|} = \frac{U_K}{d \cdot |q| \cdot \|\vec{v}\|}$$

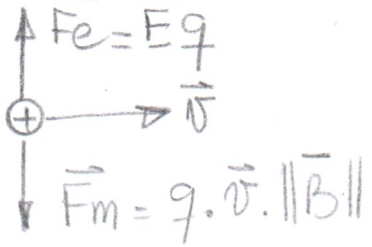
25.6




$$|q| \cdot \|\vec{B}\| \cdot \|\vec{v}\| = m_p \cdot \frac{\|\vec{v}\|^2}{R}$$

a) $$\|\vec{B}\| = \frac{m_p \|\vec{v}\|}{|q| R} = 0{,}26\,(T)$$

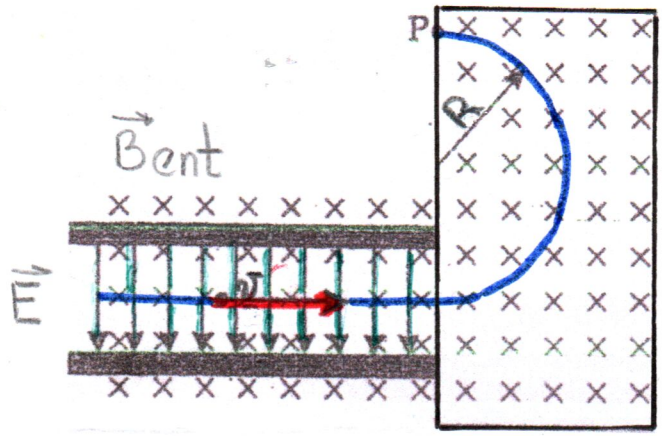
b)




$$q\|\vec{E}\| = q\|\vec{v}\|\|\vec{B}\|$$

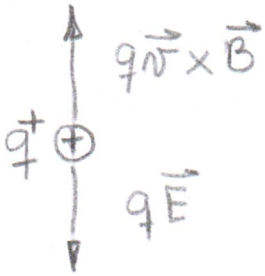
$$\|\vec{E}\| = \|\vec{v}\|\|\vec{B}\|$$

26.1




$\|\vec{B}\| = 0{,}93\,(T)$

$\|\vec{E}\| = 950\,(V/m)$



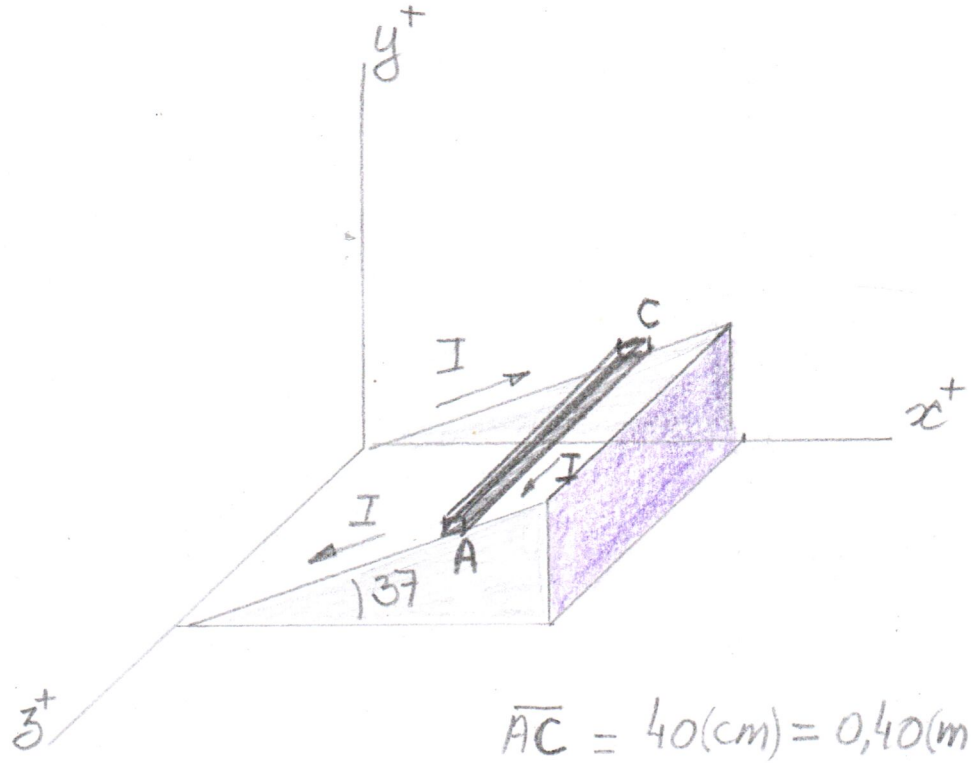

$$\cancel{|q|}\,\|\vec{v}\|\,\|\vec{B}\| = \cancel{|q|}\,\|\vec{E}\|$$

$$\|\vec{v}\| = \frac{\|\vec{E}\|}{\|\vec{B}\|} = \frac{950}{0{,}93} = 1021{,}5\ (m/s)$$

$$R = \frac{m\,.\,\|\vec{v}\|}{|q|\,\|\vec{B}\|} = \frac{2{,}18\ 10^{-25}\,.\ 1021{,}51}{1{,}602\ 10^{-19}\ \ 0{,}93}$$

$$= 1{,}495\ mm = 0{,}001495\ m$$

27.3

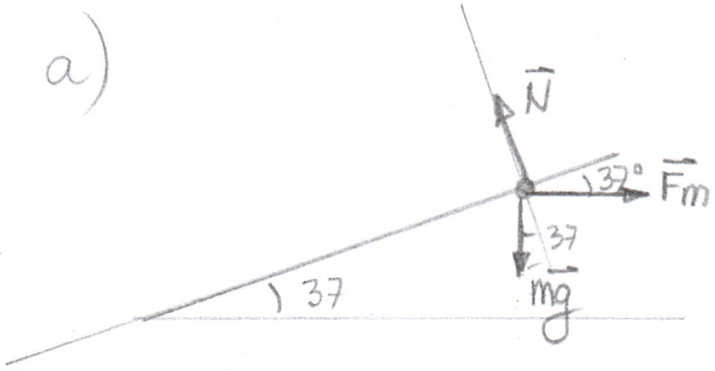



$\overline{AC} = 40(cm) = 0,40(m)$

$m = 50(g) = 0,05(kg)$

$\vec{B} = (0\hat{i} - 0,2\hat{j} + 0\hat{k})\,(T)$

a)

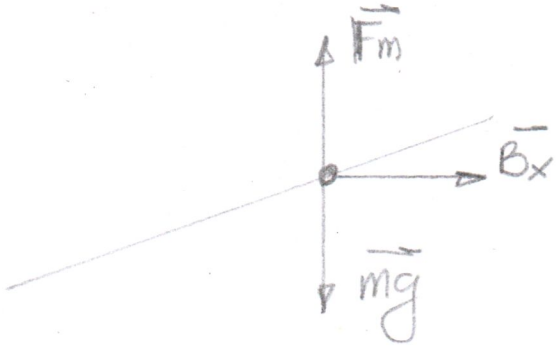



$\sum F_x : \; mg\,sen37 = I\,\ell\,\|B\|\cos 37$

$I = \dfrac{mg\,sen37}{\ell\,\|B\|\cos 37} = \dfrac{0,05.10\,tg37}{0,4.0,2} =$

$I = 4,71\,(A)$

b)

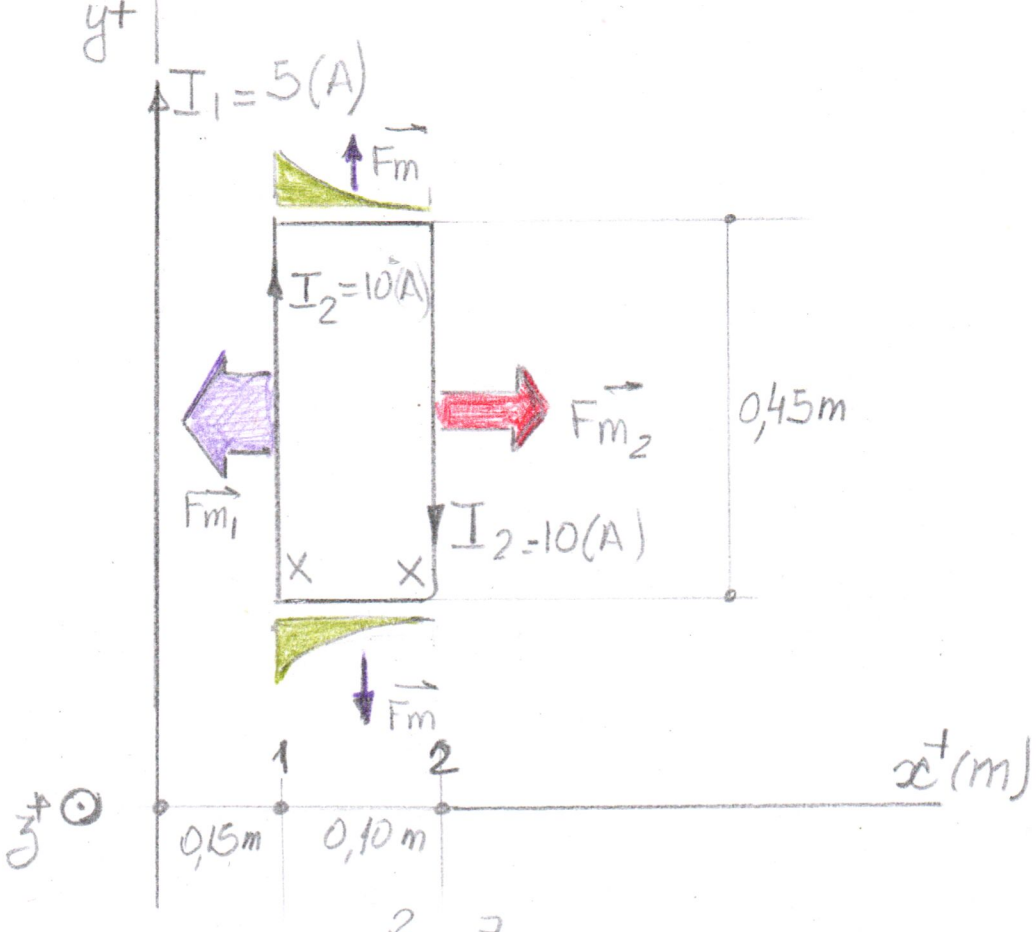



$I\,\ell\,\|\vec{B}_x\| = mg$

$\|\vec{B}_x\| = \dfrac{mg}{I\,\ell} = \dfrac{0,05.10}{4,71.0,4}$

$\|\vec{B}_x\| = 0,265\,(T)$

27.7




$$\|\vec{B}_1\|_1 = \frac{\mu_0 I_1}{2\pi a_1} = \frac{4\pi 10^{-7} \cdot 5}{2\pi \, 0{,}15} = 6{,}67\ (\mu T)$$

$$\vec{B}_1 = (0\hat{i} + 0\hat{j} - 6{,}67\hat{k})\ (\mu T)$$

$$\|\vec{F}m\|_1 = I_2 \|\vec{\ell}\| \|\vec{B}_1\| = 10 \cdot 0{,}45 \cdot 6{,}67\, 10^{-6} = 30\ (\mu N)$$

$$\|\vec{B}_2\|_2 = \frac{\mu_0 I_2}{2\pi a_2} = \frac{4\pi 10^{-7} \cdot 5}{2\pi \, 0{,}25} = 4\ (\mu T)$$

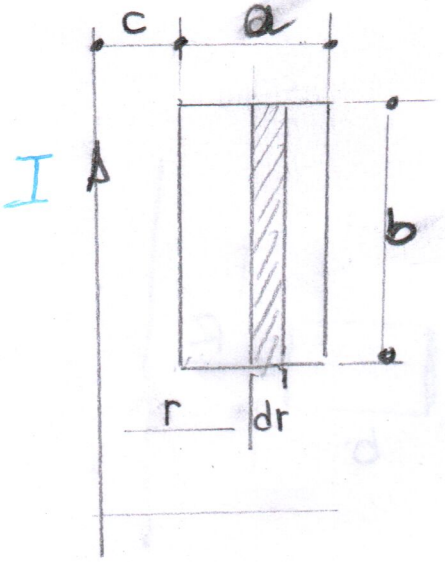
$$\vec{B}_2 = (0\hat{i} + 0\hat{j} - 4\hat{k})\ (\mu T)$$

$$\|\vec{F}m_2\|_2 = I_2 \|\vec{\ell}\| \|\vec{B}_2\| = 10 \cdot 0{,}45 \cdot 4\, 10^{-6} = 18\ (\mu N)$$

$$\vec{F}_R = \vec{F}m_1 + \vec{F}m_2 \qquad \|\vec{F}_R\| = \|\vec{F}m_1\| - \|\vec{F}m_2\|$$

$$\|\vec{F}_R\| = (30 - 18)\, 10^{-6} = 12\, 10^{-6}\ (N)$$

$$\vec{F}_R = (-12\hat{i} + 0\hat{j} + 0\hat{k})\, 10^{-6}\ (N)$$




$$B = \frac{\mu_0 I}{2\pi r}$$

$$\Phi_m = \int B\,dA = \int \frac{\mu_0 I}{2\pi r}\,dA$$

$$dA = b.dr$$

$$\Phi_m = \frac{\mu_0 I b}{2\pi} \int_c^{c+a} \frac{dr}{r}$$

$$= \frac{\mu_0 I b}{2\pi} . \ln r \Big|_c^{c+a}$$

$$= \frac{\mu_0 I b}{2\pi} \left( \ln(c+a) - \ln c \right)$$

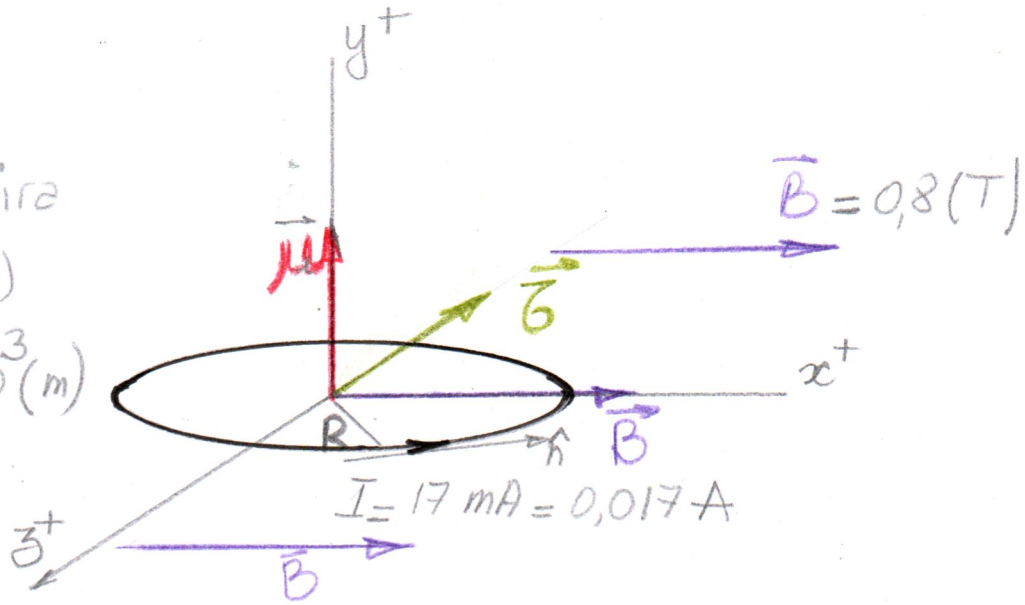
$$= \frac{\mu_0 I b}{2\pi} \ln \frac{c+a}{c}$$

28.1

N = 1 espira

$P_m = 2(m)$

$R = 3{,}18\,10^{-3}(m)$




$$\vec{\mu} = N\,I\,\vec{A} = N\,I\,\|\vec{A}\|\,\hat{n}$$

$$\|\vec{\mu}\| = 1 \cdot 0{,}017 \cdot \pi\,(3{,}18\,10^{-3})^2 = 5{,}4\,10^{-7}\,(A\,m^2)$$

$$\vec{\mu} = (0\,\hat{i} + 5{,}4 \cdot 10^{-7}\,\hat{j} + 0\,\hat{k})\,(A\,m^2)$$

$$\vec{B} = (0{,}8\,\hat{i} + 0\hat{j} + 0\,\hat{k})\,(T)$$

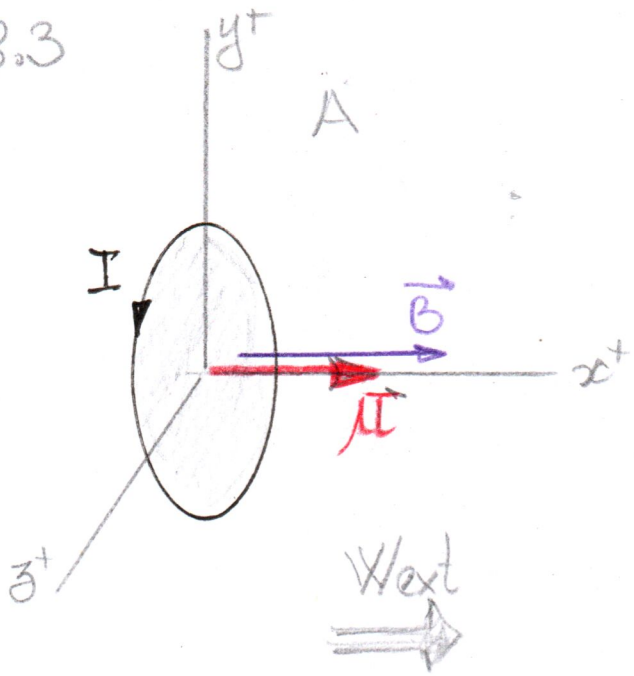
$$\vec{\sigma} = \vec{\mu} \times \vec{B}$$

$$\|\vec{\sigma}\| = \|\vec{\mu}\|\,\|\vec{B}\|\,\cancel{sen\,90} = 5{,}4\,10^{-7} \cdot 0{,}8 = 4{,}32 \cdot 10^{-7}\,(N\,m)$$

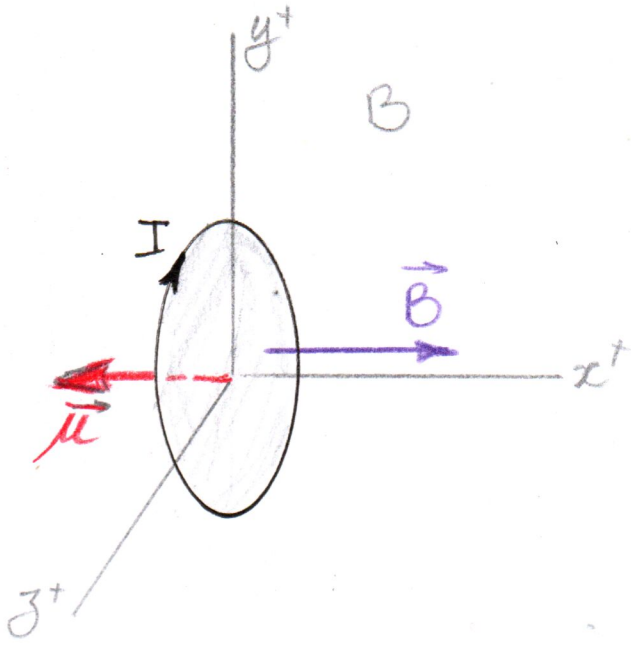
$$\vec{\sigma} = (0\hat{i} + 0\hat{j} - 4{,}32\,10^{-7}\,\hat{k})\,(N\,m)$$

$$\vec{\mu} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 5{,}4\,10^{-7} & 0 \\ 0{,}8 & 0 & 0 \end{vmatrix}$$

28.3




Wext ⟹




$R = 2,5\,(cm) = 0,025\,(m)$
$N = 100$ espiras
$I = 100\,(mA) = 0,1\,(A)$

$\vec{B} = (1,5\hat{i} + 0\hat{j} + 0\hat{k})\,(T)$

$\vec{\tau} = \vec{\mu} \times \vec{B}$ $\qquad U_p = -\vec{\mu} \cdot \vec{B}$

$\|\vec{\mu}\| = N\,I\,A = 100 \cdot 0,1 \cdot \pi \cdot 0,025^2 = 0,0196\,(Am^2)$

Posición A $\qquad U_{P_A} = -\|\vec{\mu}\|\|\vec{B}\|\cos 0° =$

$U_{P_A} = -0,0295\,(J)$

Posición B $\qquad U_{P_B} = -\|\vec{\mu}\|\|\vec{B}\|\cos 180 = 0,0295$ (J)

$W_{ext} = \Delta U_p = U_{P_B} - U_{P_A} = 0,0295 - (-0,095)$

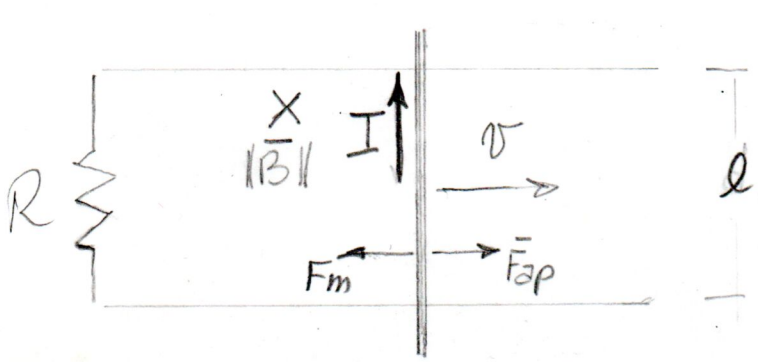
$= +0,0589\,(J)$

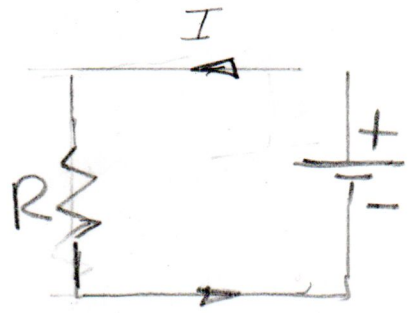
29.1 $\|\bar{F}\| = I \ell \|\bar{B}\| \operatorname{sen}\theta$

$\mathcal{E} = -\|B\| \ell v$

$R = 0{,}5\ (\Omega)$ $\quad v = 0{,}8\ (m/s)$

$\|\bar{B}\| = 0{,}4\ (T)$ $\quad \ell = 10\ (cm) = 0{,}10\ (m)$




$\mathcal{E} = -0{,}4 \cdot 0{,}10 \cdot 0{,}8 = 0{,}032\ (V)$

$I = \dfrac{\mathcal{E}}{R} = \dfrac{0{,}032}{0{,}5} = 0{,}064\ (A)$

$\|\bar{F}\| = I \ell \|\bar{B}\| \operatorname{sen} 90 = 0{,}064 \cdot 0{,}10 \cdot 0{,}4 =$

$= 0{,}00256\ (N)$

$\|\bar{F}\| = -\dfrac{\|\bar{B}\| \ell \cdot v}{R} \cdot \ell \cdot \|\bar{B}\| = -\dfrac{\|\bar{B}\|^2 \ell^2 v}{R}$

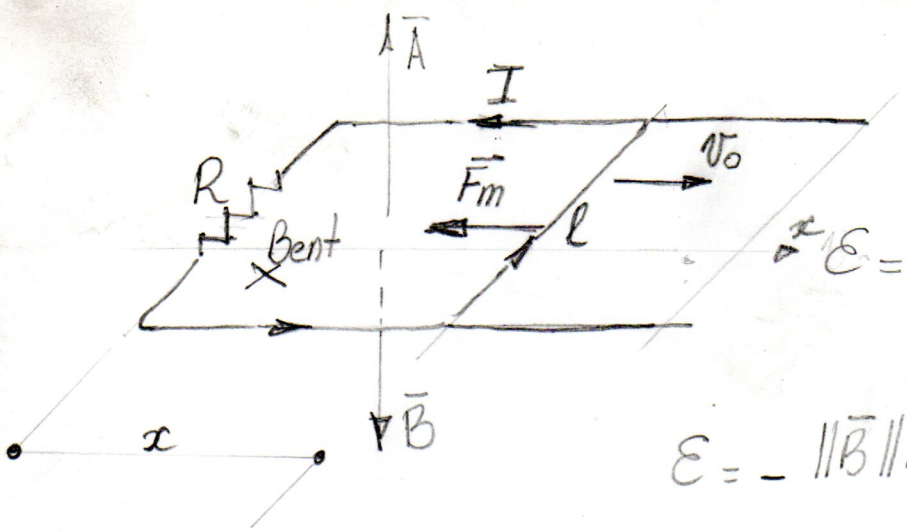
$= -\dfrac{0{,}4^2 \cdot 0{,}10^2 \cdot 0{,}8}{0{,}5} = 0{,}00256\ (N)$

$$Pot = P = \|\vec{F}_{ap}\| \cdot v = \|\vec{F}_m\| \cdot v = I\ell \cdot \|B\| \cdot v =$$

$$= \underbrace{\|\vec{B}\| \ell v} \cdot I = \mathcal{E} \cdot I$$

$$= \|\vec{B}\| \ell v \cdot \frac{\|\vec{B}\| \ell v}{R} = \frac{\|B\|^2 \ell^2 v^2}{R}$$

Esta potencia es igual a la rapidez con la cual la Energía se disipa en la resistencia: $I^2R = I\mathcal{E}$ siendo $\mathcal{E}$ la fem inducida. Es un claro ejemplo de la conservación de la energía mecánica en energía eléctrica y finalmente en energía térmica (calentamiento Joule)




$$\mathcal{E} = -\frac{d\Phi}{dt} = -\frac{\|B\|\,\ell\,dx}{dt}$$

$$\mathcal{E} = -\|\vec{B}\|\cdot\ell\cdot\frac{dx}{dt} = -\|\vec{B}\|\cdot\ell\cdot v$$

$$I = \frac{|\mathcal{E}|}{R} = \frac{\|B\|\cdot\ell\cdot v}{R}$$

$$F_x = ma = m\frac{dv}{dt} = -I\ell\|\vec{B}\| = -\frac{\|\vec{B}\|\ell v}{R}\cdot\ell\|\vec{B}\|$$

$$m\frac{dv}{dt} = -\frac{\|\vec{B}\|^2\ell^2 v}{R}$$

$$\frac{dv}{v} = -\frac{\|\vec{B}\|^2\ell^2}{mR}\cdot dt$$

$$\int_v^v \frac{dv}{v} = -\frac{\|\vec{B}\|^2\ell^2}{mR}\cdot\int_0^t dt =$$

$$\ln\frac{v}{v_0} = -\frac{\|\vec{B}\|^2\ell^2}{mR}\cdot t = \frac{-t}{\frac{mR}{\|\vec{B}\|^2\ell^2}} = -\frac{t}{\tau}$$

$$\frac{v}{v_0} = e^{-t/\tau} \rightarrow v = v_0 e^{-t/\tau}$$

$$I = \frac{\|\vec{B}\|\cdot\ell\cdot v}{R} = \frac{\|\vec{B}\|\ell v_0}{R}e^{-t/\tau}$$

$$\mathcal{E} = -\|\vec{B}\|\cdot\ell\cdot v_0 e^{-t/\tau}$$