(1) 36 → Campo magnético

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

(1)
a) $\uparrow \hat{j}$

b) $\hat{k}$

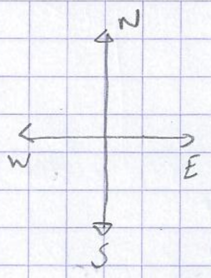
c) sem deflexão

d) $-\hat{k}$

(2) $B = 50\,\mu T$ $\uparrow$

$E = 130\ V/m$ $\otimes$

$v = 6 \times 10^{6}\ m/s$ $\rightarrow$



$m_e = 9{,}109 \times 10^{-31}\ kg$

$q_e = -1{,}6022 \times 10^{-19}\ C$

Gravitacional: $F_g = mg$

$= 9{,}109 \times 10^{-31} \times (-9{,}8) = -8{,}93 \times 10^{-30}\ N$ para baixo

Elétrica: $F_e = qE = (-1{,}6022 \times 10^{-19}) \cdot (-130) = +2{,}1 \times 10^{-17}\ N$ para cima

Magnética: $F_B = |qv| \times |B| \operatorname{sen} 90^\circ = 1{,}6022 \times 10^{-19} \times 6 \times 10^{6} \times 50 \times 10^{-6} =$

$= 4{,}8 \times 10^{-17}\ N$ para baixo $(-\hat{j})$

(confirmado)

3) $\vec{B} = 1{,}4\hat{i} + 2{,}1\hat{j}$

$\vec{v} = 3{,}7 \times 10^{5}\ \hat{j}\ m/s$

$$\vec{F_B} = -1{,}6022 \times 10^{-19}\,(0;\ 3{,}7 \times 10^{5};\ 0) \times (1{,}4;\ 2{,}1;\ 0)$$

$$= (0;\ -5{,}9 \times 10^{-14};\ 0) \times (1{,}4;\ 2{,}1;\ 0)$$

$$\vec{v} \times \vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & -5{,}9 \times 10^{-14} & 0 \\ 1{,}4 & 2{,}1 & 0 \end{vmatrix}$$

$$= 8{,}3 \times 10^{-14}\ \hat{k}\ N$$

$$= 0\hat{i} + 0\hat{j} + 8{,}3 \times 10^{-14}\hat{k}$$

4) $\vec{E} = (3\hat{i} + 5\hat{j} - 2\hat{k})\, 10^4$ V/m

$\vec{B} = ?$

$Q = 10^{-10}$ C

$\vec{v} = 10^3 \hat{i}$ m/s

$\vec{F} = (3\hat{i} + 2\hat{j}) \times 10^{-6}$ N

$$\sum \vec{F} = m\vec{a}$$

$$\vec{F_e} = q\vec{E} = 3\times10^{-6}\,\hat{i} + 5\times10^{-6}\,\hat{j} - 2\times10^{-6}\,\hat{k}$$

$$\vec{F_B} = q\vec{v} \times \vec{B} = 10^{-7}\hat{i} \times \vec{B} = 10^{-7} b_z \hat{j} + 10^{-7} b_y \hat{k}$$

$$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 10^{-7} & 0 & 0 \\ b_x & b_y & b_z \end{vmatrix}$$

$$= 0\hat{i} + 10^{-7} b_z \hat{j} + 10^{-7} b_y \hat{k}$$

$$\vec{F}_{res} = 3\times10^{-6}\,\hat{i} + \left(5\times10^{-6} + 10^{-7} b_z\right)\hat{j} + \left(-2\times10^{-6} + 10^{-7} b_y\right)\hat{k}$$

$$\begin{cases} 3\times10^{-6} = 3\times10^{-6} \ \checkmark \\ 5\times10^{-6} + 10^{-7} b_z = 2\times10^{-6} \\ -2\times10^{-6} + 10^{-7} b_y = 0 \end{cases} \Leftrightarrow$$

$$\Leftrightarrow \begin{cases} b_x = ? \\ b_z = -30 \\ b_y = 20 \end{cases}$$

$$\vec{B} = B_x \hat{i} + 20\hat{j} - 30\hat{k} \quad (T)$$

5) $l = 2{,}8$ cm | $\theta = 60°$: $F = ILB \sin 60° = 4{,}73$ N

$I = 5$ A | $\theta = 90°$: $F = ILB \sin 90° = 5{,}46$ N

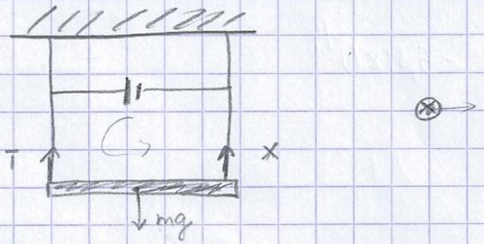
$|\vec{B}| = 0{,}39$ T | $\theta = 120°$: $F = ILB \sin(120°) = 4{,}73$ N

6) $\lambda = 40$ g/m $\Rightarrow m = 40l$

$I = ?$

[redacted]

$B = 3{,}6$ T ⊗



$F_B = mg \Leftrightarrow ILB \sin 90° = mg$

$$\Leftrightarrow I = \frac{mg}{Bl} \Leftrightarrow I = \frac{40\times10^{-3} \times l \times 9{,}8}{3{,}6 \times l} = 0{,}109 \text{ A}$$

2

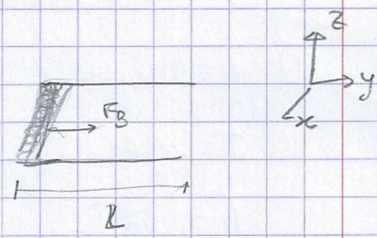
7) m
R

d, L

I

$$\begin{vmatrix} i & j & k \\ Id & 0 & 0 \\ 0 & 0 & -B \end{vmatrix}$$

$$\vec{F_B} = I\, d \times B$$
$$= I\, d\hat{\imath} \times (-B\hat{k})$$
$$= 0\hat{\imath} - IdB\hat{j} + 0\hat{k}$$
$$= -IdB\hat{j} \quad (\text{o campo é neg})$$



$$(E_c + E_{rot})_i + \Delta E = (E_c + E_{rot})_f$$

Como não tem atrito → escorrega não tem rotação e $E_{rot} = 0$

$$\Delta E = E_c$$

$$F_B \times L \times \cos 0^\circ = \frac{1}{2} m v^2$$

$$IdB \times L \times 1 = \frac{1}{2} m v^2$$

$$2IdBL = mv^2$$

$$v = \sqrt{\frac{2IdBL}{m}}$$

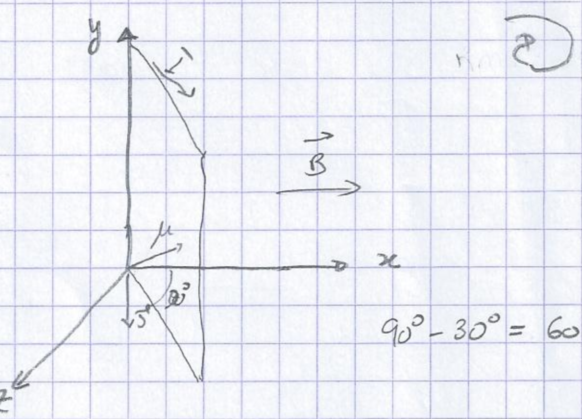
8) $N = 100$ espirais

$a = 40\,cm$
$b = 30\,cm$

$I = 1{,}2\,A$

$\theta = 30^\circ$

$B = 0{,}8\,T$



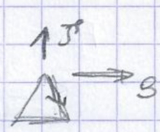
$90^\circ - 30^\circ = 60^\circ$

$$\boxed{\tau = NBAI \operatorname{sen}\theta}$$

$$\tau = 100 \times 0{,}8 \times (0{,}4 \times 0{,}3) \times 1{,}2 \times \operatorname{sen} 60^\circ = 9{,}98\ N.m$$

(comprimindo!)

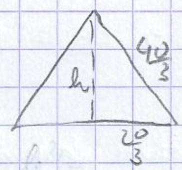
9) $L = 40\,cm$



$I = 20\,A$ $\qquad \vec{J} = IA \times B$

$B = 0{,}52\,T$ $\qquad J = IAB \operatorname{sen} 90^\circ = IAB$

a) $l = \frac{40}{3}$



$A = \frac{b \times h}{2} = \frac{\frac{40}{3} \times \frac{20}{\sqrt{3}}}{2} = 76{,}98\,cm^2$

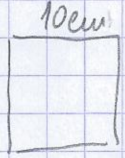
$\downarrow$

$7{,}7 \times 10^{-3}\,m^2$

$h^2 = \left(\frac{40}{3}\right)^2 - \left(\frac{20}{3}\right)^2 \Leftrightarrow h = \sqrt{\frac{400}{3}} = \frac{20}{\sqrt{3}}$

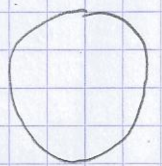
logo, $\quad J = 20 \times 7{,}7 \times 10^{-3} \times 0{,}52 = 0{,}08\,Nm$

b)



$J = 20 \times 0{,}1^2 \times 0{,}52 = 0{,}104\,Nm$

c)



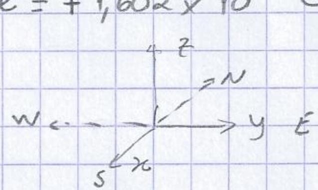
$P = 2\pi R \quad \Rightarrow 0{,}40 = 2\pi R \Leftrightarrow R = \frac{0{,}20}{\pi}$

$A = \pi R^2 = \pi \times \frac{0{,}20^2}{\pi^2} = \frac{0{,}20^2}{\pi} \simeq 1{,}27 \times 10^{-2}\,m^2$

$\vec{J} = 20 \times 1{,}27 \times 10^{-2} \times 0{,}52 = 0{,}132\,Nm$

10) $B = 50\,\mu T$ $\quad \downarrow\downarrow\downarrow$ $\qquad e = +1{,}602 \times 10^{-19}\,C$

$\vec{v} = 6{,}2 \times 10^6\,m/s$ $\quad \longleftarrow$



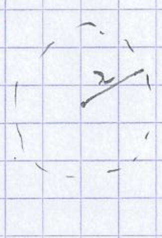
a) $\vec{F} = q\vec{v} \times \vec{B}$

$\vec{F} = (0\hat{i} + 9{,}93 \times 10^{-13}\hat{j} + 0\hat{k}) \times (0\hat{i} + 0\hat{j} - 50 \times 10^{-6}\hat{k})$

$\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & -9{,}93 & 0 \\ 0 & 0 & -50 \end{vmatrix} = +4{,}97 \times 10^{-17}\,\hat{i}\ N$

$|\vec{F}| = 4{,}97 \times 10^{-17}$ $\qquad$ direção Sul

b)



$F = \frac{mv^2}{r} \Leftrightarrow r = \frac{1{,}6726 \times 10^{-27} \times (6{,}2 \times 10^6)^2}{4{,}97 \times 10^{-17}} = 1{,}29 \times 10^3\,m$

ou $\quad r = \frac{mv}{qB} = \frac{1{,}6726 \times 10^{-27} \times 6{,}2 \times 10^6}{1{,}602 \times 10^{-19} \times 50 \times 10^{-6}} = 1{,}29 \times 10^3\,m$

③

11) $m = 3{,}2 \times 10^{-26}$ kg

$q = 1{,}6022 \times 10^{-19}$ C

$q_i = 0$

$\Delta V = 833$ V

$B = 0{,}92$ T

$r = ?$

$\vec{v} \perp \vec{B} \Rightarrow$

$\Rightarrow |\vec{F}| = qvB \sin 90°$

$\Leftrightarrow F = qvB$

mas $F = m \dfrac{v^2}{r}$

$qvB = \dfrac{mv^2}{r}$

$r = \dfrac{mv^2}{qvB} \Leftrightarrow r = \dfrac{mv}{qB}$

Quanto a v:

$E_c = E_p$ Energia cinética ganha = E. potencial perdida

$\frac{1}{2} m v^2 = q \Delta V$

$\frac{1}{2} \times 3{,}2 \times 10^{-26} \times v^2 = 1{,}6022 \times 10^{-19} \times 833$

$\Leftrightarrow v = 9{,}13 \times 10^4$ m/s

e,

$$r = \frac{3{,}2 \times 10^{-26} \times 9{,}13 \times 10^4}{1{,}6022 \times 10^{-19} \times 0{,}92} = 1{,}98 \times 10^{-2} \text{ m}$$

12) m_1

$q_1 = 1{,}6022 \times 10^{-19}$ C

$\vec{B} \perp \vec{v} \Rightarrow \theta = 90°$

R

m'

$q' = 2 \times 1{,}6022 \times 10^{-19}$

$\Delta V = \Delta V'$

$R' = 2R$

$\dfrac{m'}{m} = ?$

$E_c = E_p$

$\frac{1}{2} m v^2 = q \Delta V \Rightarrow v = \sqrt{\dfrac{2q\Delta V}{m}}$

$q' = 2q$ $\qquad v' = \sqrt{\dfrac{4q\Delta V}{m'}}$

mas,

$r = \dfrac{mv}{qB}$ e $r' = \dfrac{m'v}{qB}$

$\Leftrightarrow m = \dfrac{qBR}{v}$ e $m' = \dfrac{2qB2R}{v'}$

$$\frac{m}{m'} = \frac{\frac{qBR}{v}}{\frac{4qBR}{v'}} = \frac{v'}{4v} = \frac{1}{4}\sqrt{\frac{4q\Delta V}{m'} \times \frac{m}{2q\Delta V}}$$

$$\Leftrightarrow \frac{m}{m'} = \frac{1}{4}\sqrt{\frac{2m}{m'}} \Leftrightarrow \frac{m^2}{m'^2} = \frac{1}{16} \times 2\frac{m}{m'} \Leftrightarrow$$

$$\Leftrightarrow \frac{m}{m'} = \frac{1}{8} \; //$$

13) $\vec{E} = E\hat{k}$

$\vec{B} = B \cdot \hat{j}$

$B = 0{,}015\,T$

$\Delta E = 750\,eV = 750 \times 1{,}602 \times 10^{-19} = 1{,}2 \times 10^{-16}\,J$

Para no ser deflectido

$F_e = F_B$

$qE = qvB$

$E_c = \frac{1}{2} m v^2$

$v = \sqrt{\frac{2E_c}{m}} = \sqrt{\frac{2 \times 1{,}2 \times 10^{-16}}{9{,}11 \times 10^{-31}}} = 1{,}62 \times 10^7\,m/s$

$E = 1{,}62 \times 10^7 \times 0{,}015$

$E = 2{,}43 \times 10^5\,V/m$

14) $E = 250\,V/m$

$B = 0{,}035\,T$

$q = 1{,}602 \times 10^{-19}\,e$

$m = 2{,}18 \times 10^{-26}\,kg$

$F_e = F_B$

$qE = qv_iB$

$v_i = 7{,}14 \times 10^3\,m/s$

$r = \frac{mv}{qB\,sen\,\theta}$ $\quad \vec{v} \perp \vec{B}$

$r = \frac{2{,}18 \times 10^{-26} \times 7{,}14 \times 10^3}{1{,}602 \times 10^{-19} \times 0{,}035} = 2{,}78 \times 10^{-2}\,m$

15) $\Delta E = 34\,MeV = 34 \times 10^6 \times 1{,}602 \times 10^{-19} = 5{,}45 \times 10^{-12}\,J$

$B = 5{,}2\,T$

$\Delta E = \frac{1}{2} m v^2$

$5{,}45 \times 10^{-12} = \frac{1}{2} \times 1{,}6726 \times 10^{-27} \times v^2$

$v = 8{,}07 \times 10^7\,m/s$

logo, $r = \frac{mv}{qB} = \frac{1{,}6726 \times 10^{-27} \times 8{,}07 \times 10^7}{1{,}6022 \times 10^{-19} \times 5{,}2} = 0{,}162\,m$

④ 16) $B = 0{,}45\,T$ $\quad m = 1{,}6726 \times 10^{-27}$ kg

$r = 1{,}2$ m

a) $r = \frac{mv}{qB} \Leftrightarrow v = \frac{1{,}2 \times 1{,}6022\times10^{-19} \times 0{,}45}{1{,}6726 \times 10^{-27}} = 5{,}17\times10^{7}$ m/s

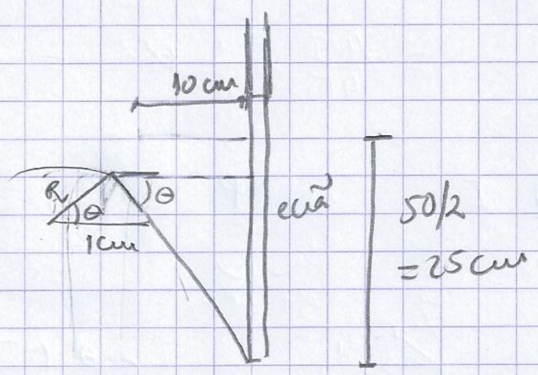
$\omega = \frac{v}{r} \Leftrightarrow 2\pi f = \frac{v}{r} \Leftrightarrow f = \frac{5{,}17\times10^{7}}{1{,}2 \times 2\pi}$

$\Leftrightarrow f = 6{,}86\times10^{6}$ Hz

b) Feixe $\quad v = 5{,}17\times10^{7}$ m/s

17) $\Delta V = 50$ kV

$L = 1$ cm



$tg\theta = \frac{25}{10} \Leftrightarrow \theta = 68{,}2^{0}$

$R = \frac{1\times10^{-2}}{sen\,68{,}2^{0}} = 1{,}08\times10^{-2}$ m $\qquad r = \frac{mv}{qB}$

mas $\quad E_e = E_p$

$\frac{1}{2} mv^2 = q\Delta V$

$\frac{1}{2} \times 9{,}11\times10^{-31} \times v^2 = 1{,}6022\times10^{-19} \times 50\times10^{3}$

$v = 1{,}33\times10^{8}$ m/s

e,

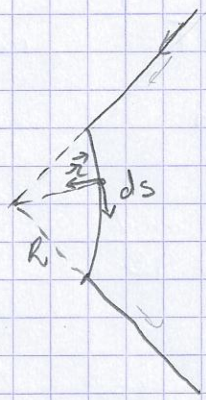
$\frac{mv}{qB} = 1{,}08\times10^{-2}$

$B = \frac{9{,}11\times10^{-31} \times 1{,}33\times10^{8}}{1{,}6022\times10^{-19} \times 1{,}08\times10^{-2}}$

$B = 7\times10^{-2}$ T

(18) I, R, α

$$B = \frac{\mu_0 I}{4\pi} \int \frac{ds \times \hat{r}}{r^2}$$



$$|ds \times \hat{r}| = |ds||1| \operatorname{sen} 90° = ds$$

$$B = \frac{\mu_0 I}{4\pi} \int \frac{1}{r^2} ds \qquad r = R \text{ constante}$$

$$B = \frac{\mu_0 I}{4\pi} \times \frac{1}{R^2} \int ds$$

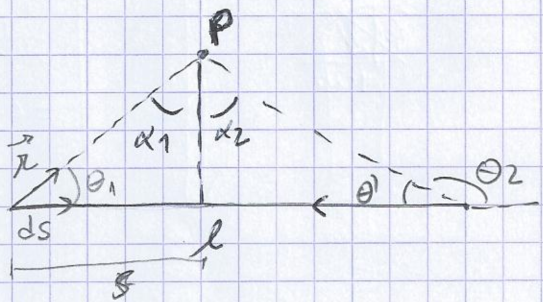
$$= \frac{\mu_0 I}{4\pi} \times \frac{1}{R^2} s$$

$$= \frac{\mu_0 I}{4\pi} \times \frac{1}{R^2} \alpha R = \frac{\mu_0 I \alpha}{4\pi R} \quad \otimes$$

$$P_{\odot} = 2\pi R$$

$$s = \frac{\alpha}{\cancel{2\pi}} \cancel{2\pi} R = \alpha R$$

(19) I



$$\theta_2 = 180° - \theta'$$

$$\cos(\theta_2) = \cos(180° - \theta') = -\cos\theta'$$

$$= -\operatorname{sen} \alpha_2$$

a)

$$dB = \frac{\mu_0 I}{4\pi} \times \frac{ds \times \vec{r}}{r^2} \qquad |ds \times \vec{r}| = |ds||r| \operatorname{sen}\theta$$

$$dB = \frac{\mu_0 I}{4\pi} \frac{ds \operatorname{sen}\theta}{r^2} \qquad \cos\theta = \frac{s}{r} \Leftrightarrow r = \frac{s}{\cos\theta}$$

$$= \frac{\mu_0 I}{4\pi} \frac{\operatorname{sen}\theta}{s^2} \times \cos^2\theta \, ds \qquad \frac{s}{h} = \operatorname{cotg}\theta \Rightarrow s = h \operatorname{cotg}\theta$$

$$ds = \frac{h}{\operatorname{sen}^2\theta} d\theta$$

$$= \frac{\mu_0 I}{4\pi} \frac{\operatorname{sen}\theta \times \cancel{\cos^2\theta}}{h^2 \operatorname{cotg}^2\theta} \times \frac{h}{\operatorname{sen}^2\theta} d\theta$$

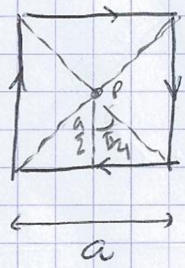
$$\frac{\operatorname{sen}\theta \, \cancel{\cos^2\theta}}{\frac{\cancel{\cos^2\theta}}{\cancel{\operatorname{sen}^2\theta}}} \times \frac{1}{\cancel{\operatorname{sen}^2\theta}}$$

$$\Leftrightarrow B = \frac{\mu_0 I}{4\pi} \int_{\theta_1}^{\theta_2} \frac{1}{h} \operatorname{sen}\theta \, d\theta$$

$$B \quad \frac{\mu_0 I}{4\pi} \frac{1}{h} \Big[-\cos\theta \Big]_{\theta_1}^{\theta_2}$$

$$B = \frac{\mu_0 I}{4\pi} \frac{1}{h} (\cos\theta_1 - \cos\theta_2) = \frac{\mu_0 I}{4\pi h} (\operatorname{sen}\alpha_1 + \operatorname{sen}\alpha_2)$$

(5) b) $\alpha_1 \simeq \alpha_2 \simeq 90^\circ$? $B_0 = \frac{\mu_0 I}{4\pi h} \times 2 = \frac{\mu_0 I}{2\pi h}$

20) 

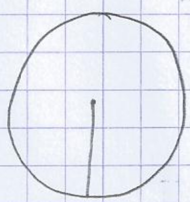
a) 4 triângulos

$$B = \cancel{4} \times \frac{\mu_0 I}{\cancel{4}\pi} \times \frac{2}{a}\left(\sin\frac{\pi}{4} + \sin\frac{\pi}{4}\right)$$

$$B = \frac{\mu_0 I}{\pi} \times \frac{2}{a} \times \left(\frac{\sqrt{2}}{2} + \frac{\sqrt{2}}{2}\right)$$

$$B = \frac{\mu_0 I \, 2\sqrt{2}}{\pi a}$$

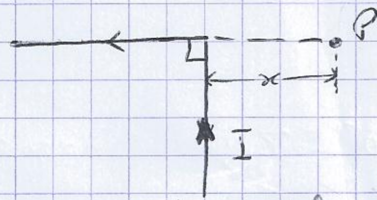
$ds = 2\pi \, dR$

b) 

$4a = 2\pi R$

Do loop: $B = \frac{\mu_0 I}{2R}$

$$\Rightarrow B = \frac{\mu_0 I \, 2\pi}{2\pi R} = \frac{\mu_0 I \pi}{4a}$$

21) 

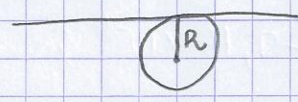
Sabe-se que (19b))

$$B_0 = \frac{\mu_0 I}{2\pi x}$$

Na parte horizontal do fio temos um sinal de paralelismo logo o campo é zero.

Temos assim apenas metade do comprimento do fio.

logo: $B = \frac{1}{2} B_0 = \frac{\mu_0 I}{4\pi x}$

22) R, I O fio: $B = \frac{\mu_0 I}{2\pi \times d}$ com $d = R$ 

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

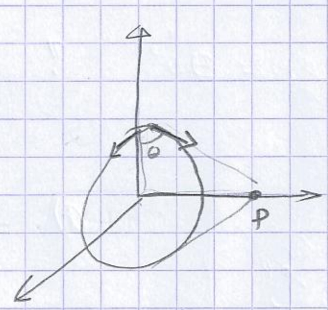
do loop: $B = \frac{\mu_0 I}{2R}$ logo $B = \frac{\mu_0 I}{2\pi R} + \frac{\mu_0 I \pi}{2\pi R} = \frac{\mu_0 I}{2\pi R}(1+\pi)$

23) R

I

$$dB = \frac{\mu_0 I}{4\pi} \times \frac{|ds \times \hat{r}|}{r^2}$$

$$= \frac{\mu_0 I}{4\pi} \times \frac{\cos\theta}{R^2 + x^2} \, ds$$



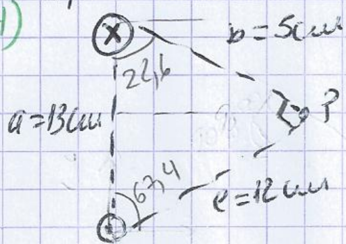
$r^2 = R^2 + x^2$

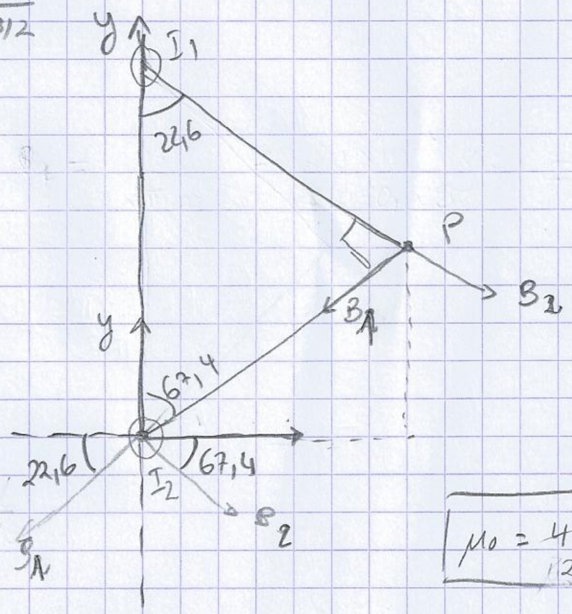
$\cos\theta = \frac{R}{r} = \frac{R}{\sqrt{R^2 + x^2}}$

$$B = \frac{\mu_0 I}{4\pi} \times \frac{R}{(R^2 + x^2)^{3/2}} \times 2\pi R$$

$$B = \frac{\mu_0 I}{2} \times \frac{R^2}{(R^2 + x^2)^{3/2}}$$

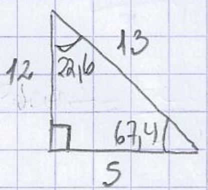
24)





Nota:

$13^2 = 12^2 + 5^2$



$\boxed{\mu_0 = 4\pi \times 10^{-7} \; Tm/A}$

$B_1 = \frac{\mu_0 I}{2\pi d} = 1,2 \times 10^{-5}$ T $d = 0,05$ m

$\theta_1 = \cos^{-1}\left(\frac{12}{13}\right)$

$B_2 = \frac{\mu_0 I}{2\pi d} = 5 \times 10^{-6}$ T $d = 0,12$ m

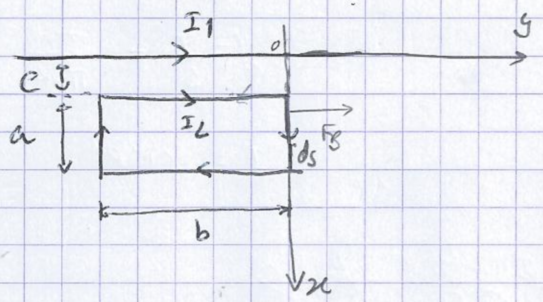
$$\vec{B} = 1,2 \times 10^{-5}\left(-\hat{i}\cos(22,6) - \hat{j}\,\mathrm{sen}(22,6)\right) + 5 \times 10^{-6}\left(\hat{i}\cos(67,4) - \hat{j}\,\mathrm{sen}(67,4)\right)$$

$$= -9,16 \times 10^{-6}\,\hat{i} - 9,23 \times 10^{-6} \quad T$$

$$|\vec{B}| = \sqrt{B_x^2 + B_y^2} = 1,3 \times 10^{-5} \quad T$$

(6)

25)



no fio:

$$\vec{B} = \frac{\mu_0 I_1}{2\pi x}$$

$$df_B = I_2 ds \times B$$

$$df_B = \frac{\mu_0 I_1 I_2}{2\pi x} \times 1 \; dx$$

$$F_B = \frac{\mu_0 I_1 I_2}{2\pi} \Big[\ln x \Big]_c^{c+a} \quad \ldots$$

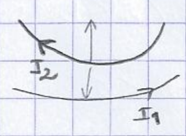
26) $d = 1mm$

$R = 10cm$

$I_1 = 14A$

$I_2 = 14A$

a) $F = \frac{\mu_0 I^2 l}{2\pi a}$ $\qquad l = 2\pi \times 0,10$



$$= \frac{4\pi \times 10^{-7} \times 14^2 \times (2\pi \times 0,10)}{2 \times \pi \times 1 \times 10^{-3}}$$

$$= 2,46 \times 10^{-2} \text{ N} \quad (\text{para cima})$$

b) $m_1 = 21g$

i) $F = F_B$

$ma = 2,46 \times 10^{-2}$

$a = 1,17 \; m/s^2$ (cima)

ii) $ma = -F_B + F_g$

$21 \times 10^{-3} \times a = -2,46 \times 10^{-2} + 21 \times 10^{-3} \times 9,8$

$a = 8,63 \; m/s^2$

27) r

$\vec{J}$

$-2\vec{J}$

$$J = \frac{I}{S} = \frac{I}{\pi r^2}$$

$$I = J \pi R^2$$

$$B_y = \frac{\mu_0 I_1}{2\pi \frac{a\sqrt{2}}{2}} - \frac{\mu_0 I_2}{2\pi \frac{a\sqrt{2}}{2}}$$

$$I = \frac{\pi r^2 J}{2\pi r}$$

$$= \frac{\mu_0 J \pi R^2}{2\pi \frac{a\sqrt{2}}{2}} + \frac{\mu_0 2\pi R^2}{4 \frac{a\sqrt{2}}{2}}$$

$$= 3 \frac{\mu_0 J R^2}{2 \frac{a\sqrt{2}}{2}} = \frac{6 \mu_0 J R^2}{a\sqrt{2}}$$

$$\frac{6 \mu_0 J R^2}{a\sqrt{2}} \operatorname{sen} 45^\circ = \frac{6 \mu_0 \frac{I}{\pi R^2} R^2}{a\sqrt{2}} \times \frac{\sqrt{2}}{2}$$

$$= 3 \frac{\mu_0 I}{\pi a}$$

28) $a < r < b$ $\quad B = \frac{\mu_0 I}{2\pi r}$

$r < a$

$$\frac{I'}{I} = \frac{\pi r^2}{\pi a^2} \; ; \quad B = \frac{\mu_0 \frac{\pi r^2}{\pi a^2} I}{2\pi r} = \frac{\mu_0 r I}{2\pi a^2}$$

$b < r < c$

$$B = \frac{\mu_0 I'}{2\pi r} = \frac{\mu_0 \frac{\pi (c^2 - r^2)}{\pi (c^2 - b^2)} I}{2\pi r}$$

$$\frac{I'}{I} = \frac{\pi (c^2 - r^2)}{\pi (c^2 - b^2)}$$

$$= \frac{\mu_0 I}{2\pi r} \frac{(c^2 - r^2)}{c^2 - b^2}$$

(7)

29) 100

$R = 0{,}5\,cm$

$I = 2A$

a) $B = \frac{\mu_0 I_0 r}{2\pi R^2}$

Num fio acham os 99

$$B = \frac{4\pi \times 10^{-7} \times 99 \times 2 \times 0{,}2 \times 10^{-2}}{2\pi\,(0{,}500 \times 10^{-2})^2} =$$

$$= 3{,}17 \times 10^{-3}\ T$$

logo $\frac{F_B}{l} = IB\,\text{sen}\,\theta \qquad \theta = 90°$

$$\frac{F_B}{l} = 2 \times 3{,}17 \times 10^{-3} = 6{,}34 \times 10^{-3}\ N/m$$

b) Fora ...

30) R
I

$\vec{J} = b r . \hat{z}$

a) $\oint B . dl = \mu_0 I$

$\oint B . dl = \mu_0 \int J\, dA$

$B\, 2\pi r = \mu_0 \int_0^r (br)(2\pi r)\, dr$

$A = \pi r^2$
$dA = 2\pi r\, dr$

$$B \times \cancel{2\pi} r = \mu_0 \times b \times \cancel{2\pi} \int_0^r r^2\, dr$$

$$B = \frac{\mu_0 \times b}{r} \left[\frac{r^3}{3} \right]_0^r$$

$$B = \frac{\mu_0 \times b \times r^2}{3}$$

b)

$$B \times \cancel{2}\cancel{\pi} r = \mu_0 \int_0^R br(2\pi r)\, dr \iff B \cancel{\pi} = \mu_0 \left[b \frac{r^3}{3} \right]_0^R$$

$$\iff B = \frac{\mu_0 b R^3}{3r}$$

31) Solenóide

$r = 2cm$

$l = 80m$

$d = 1mm$

$\Delta V = 20V$

$2\pi r$

nº de espiras:

$P_{\odot} = 2\pi \times 0,02 = 0,126\ m$

$80 : 0,04\pi = 636$ espiras

Comprimento do solenóide

$636 : 2 = 318$

$318 \times 1 \times 10^{-3} = 0,318\ m$

$\boxed{B = \mu_0 (1 + \chi) H}$

$H = nI$

$R = \rho \frac{L}{A} = 1,7 \times 10^{-4} \times \frac{80}{\pi \times (0,5 \times 10^{-3})^2} = 17316\ \Omega \Rightarrow I = 1,16 \times 10^{-3}\ A$

logo $H = nI = \frac{636}{0,318} \times 1,16 \times 10^{-3} = 2,32$

?

l

$B = 4\pi \times 10^{-7} (1 - 9,8 \times 10^{-6})\, 2,32 = 2,92 \times 10^{-6}\ T$

32) $d = 4,5cm$

$l = 22,5cm$

$d_e = 0,4mm$

$B = 1W$

$\Delta V = 12V$

$P = IV$

a) $B = \mu_0 (1 + \chi) H$

nº de espiras:

$H = nI = 2500 \times 0,5 = 1250$