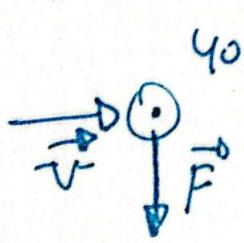
1.-

$E_c = 4'0 \cdot 10^{-15}\ J$

$\vec{F} = q(\vec{v} \wedge \vec{B})$



$q_p = 1'6 \cdot 10^{-19} C$

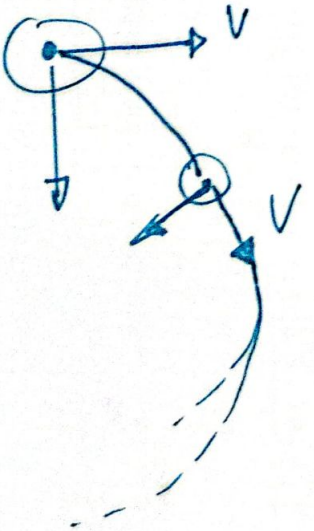
$m_p = 1'67 \cdot 10^{-27} kg$

$E_c = \frac{1}{2} m v^2 \Rightarrow v = \left(\frac{2E_c}{m}\right)^{1/2}$

$v = \left(\frac{2 \cdot 4'0 \cdot 10^{-15} J}{1'67 \cdot 10^{-27} kg}\right)^{1/2} = 2'189 \cdot 10^6 \frac{m}{s}$

$|\vec{F}| = q\ 2'19 \cdot 10^6 \frac{m}{s} \cdot 40 \cdot 10^{-3} T = 1'405 \cdot 10^{-14} N.$

$q \downarrow 1'6 \cdot 10^{-19} C$



$|\vec{F_m}| = |F_c|$

$|\vec{F_M}| = m \frac{v^2}{r}$

$r = \frac{m v^2}{|\vec{F_m}|} = \frac{1'67 \cdot 10^{-27} kg \cdot 2'19 \cdot 10^6 m}{1'405 \cdot 10^{-14} N}$

$r = 0'570 m.$

2. -

$m = 8\,ng$

$q = -2\,\mu C$

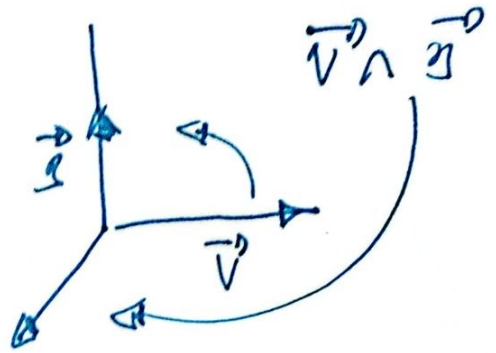
$\vec{B} = 3\,\vec{j}\ T$

$v = 6\,10^2\,\vec{i}\ m/s$

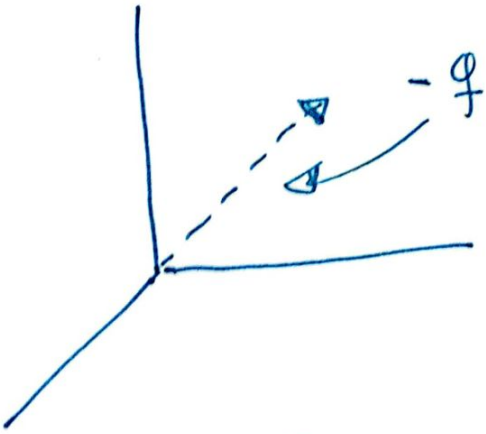
$v = \omega r$

$\omega = \frac{v}{r}$

$\vec{F} = q\,(\vec{v} \wedge \vec{B})$



$-q\,(\vec{v} \wedge \vec{B})$



$F_m = -\vec{k}$

$F_e = +\vec{k} \Rightarrow \vec{F_e} = q\vec{E}$, ; $\vec{E} = -$

$F_m = F_i$

$|q|\,|\vec{v}|\,|\vec{B}| = m\frac{v^2}{r}$

$r = \frac{m v^2}{q \cdot v \eta} = \frac{m v}{q \cdot \eta}$

$$r = \frac{m \cdot v}{q \cdot B} \; ; \quad r = \frac{8 \cdot 10^{-9} kg \cdot 6\, m/s}{2 \cdot 10^{-6} C \cdot 3T} = 8 \cdot 10^{-3} m.$$

$$\omega = \frac{6\, m/s}{8 \cdot 10^{-3} m} = 7 \cdot 10^{3} \frac{rad}{s}$$

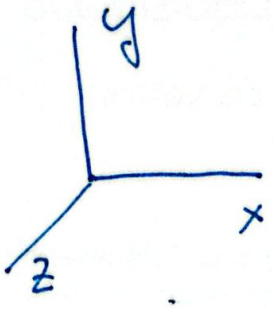
$$|F_e| = |F_m|$$

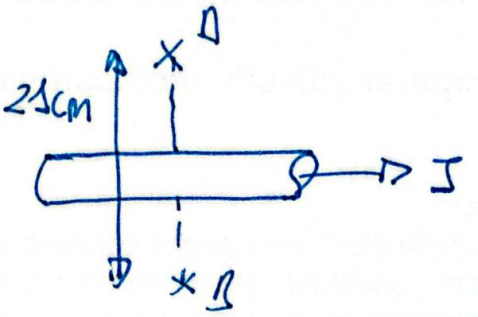
$$|q|\,|\vec{E}| = |q|\,|\vec{v}|\,|\vec{B}|$$

$$|\vec{E}| = 6 \frac{m}{s} \, 3T = 18\, N/C$$

$$\vec{E} = -18\, \vec{k}\, \frac{N}{C}$$

3.-





$$B = \frac{\mu I}{2\pi a} \quad \begin{cases} |\vec{B}_A| = \frac{\mu I}{2\pi a_A} \\ |\vec{B}_B| = \frac{\mu I}{2\pi a_B} \end{cases}$$

dividindo uma entre a outra

fazendo que de un número maior que 1

$$\frac{|\vec{B}_B|}{|\vec{B}_A|} = \frac{\frac{\mu I}{2\pi a_B}}{\frac{\mu I}{2\pi a_A}} \Rightarrow \frac{|\vec{B}_B|}{|\vec{B}_A|} = \frac{a_A}{a_B}$$

$$\frac{8 \cdot 10^{-5} T}{6 \cdot 10^{-5} T} = \frac{a_A}{a_B} \Rightarrow a_A = \frac{8}{6} a_B \Rightarrow a_A = 1'33\, a_B$$

$$a_A + a_B = 21\ cm.$$

$$1'33\, a_B + a_B \Rightarrow a_B = \frac{21\ cm.}{2'33}$$

$$a_B = 9\ cm.$$

$$a_A = 12\ cm.$$

4.-

$\Delta V = 1'0 \cdot 10^3 V$

$B = 0'2\ T$

a) v do electron ; b) r?

qV energia potencial electrostática que se transforma en energía cinética

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

$$v = \left(\frac{2qV}{m}\right)^{1/2} = \left(\frac{2 \cdot 1'6 \cdot 10^{-19} C \ 1'0 10^3 V}{9'1 \cdot 10^{-31} kg}\right)^{1/2}$$

(q positivo)

$$v = 1'88 \cdot 10^7\ m/s$$

b)

$F_{magnetica} = F_{inercia}$

$\vec{F} = q(\vec{v} \wedge \vec{B})$; $|\vec{F}| = q|\vec{v}||\vec{B}|$

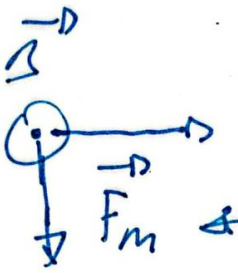
($\vec{v}$ y $\vec{B}$ perpendiculares)

$$qvB = \frac{mv^2}{r} \Rightarrow r = \frac{mv}{qB}$$

$$r = \frac{9'1\,10^{-31} kg \cdot 1'88 \cdot 10^7 m/s}{1'6 \cdot 10^{-19} C \cdot 0'2\ T} = 5'34\ 10^{-2} m.$$

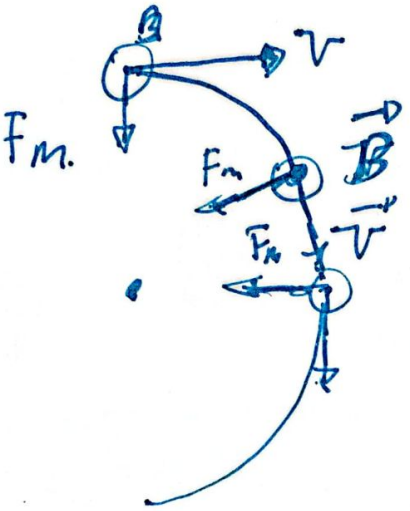
c)

$\vec{v}$ e $\vec{B}$ perpendiculares

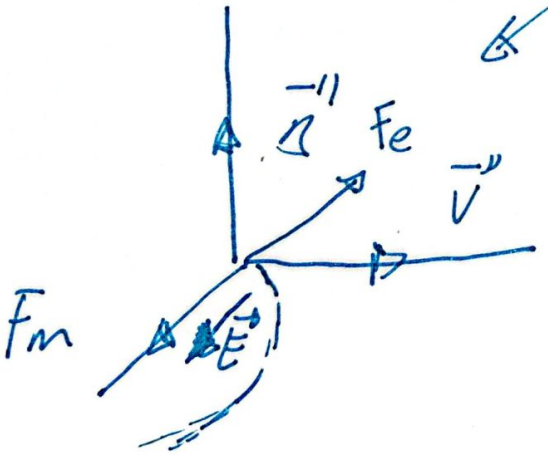


$\vec{F} = q(\vec{v} \wedge \vec{B})$

$\vec{F}_m$ = fuerza magnética.



La trayectoria es una circunferencia.



F_e que se opone a F_m.

$\vec{F}_e = q \cdot \vec{E}$

↓

electrón (negativo)

$\vec{E}$ en sentido opuesto a F_e

no mismo sentido del campo magnético

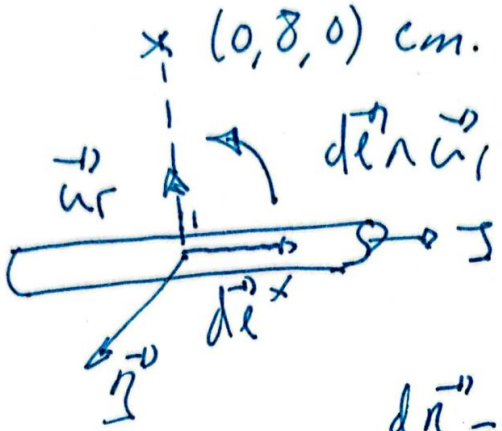
$$|\vec{E}| = \frac{|\vec{F}_e|}{|q|} = \frac{|\vec{F}_m|}{|q|} = \frac{|q||\vec{v}||\vec{B}|}{|q|} = 1'88\,10^7 \text{ m/s} \cdot 0'2\text{T}$$

$$= 3'76\,10^6 \frac{N}{C}$$

$$I_A = \frac{B_A \, 2\pi \, a_A}{\mu_0} = \frac{6 \cdot 10^{-5} \, T \, 2\pi \, 5 \cdot 10^{-2} \, m}{4\pi \, 10^{-7} \, \frac{T \cdot m}{A}} = 3\,6\,A$$

$$I_B = \frac{B_B \, 2\pi \, a_B}{4\pi \cdot 10^{-7} \, \frac{T \cdot m}{A}} = \frac{8 \cdot 10^{-5} \, T \cdot 2\pi \cdot 9 \cdot 10^{-2} \, m}{4\pi \cdot 10^{-7} \, \frac{T \cdot m}{A}} = 3\,6\,A.$$

6)



$$d\vec{B} = \frac{\mu I}{4\pi} \frac{d\vec{l} \wedge \vec{u}_r}{r^2}$$

$$\vec{B} = \frac{\mu I}{2\pi a} = \frac{4\pi 10^{-7} \, T.m.A^{-1} \, 3\,6\,A}{2\pi \, 8 \cdot 10^{-2} \, m.}$$

$$\vec{B} = 9 \cdot 10^{-5} \, T \, \vec{k}$$

5.-

$r = 20\,cm = 0'2\,m$

$B = 0'4\,T$

DATOS

$q_p = 1'6 \cdot 10^{-19}\,C$

$m_p = 1'67 \cdot 10^{-27}\,kg$

a) v del protón

b) T

c) $|\vec{E}|$ para anular F_m.

a) $F_m = F_i \;;\; |q|\,|\vec{v}|\,|\vec{B}| = m\frac{v^2}{r}$

$90^0 = \text{sen}\,90^0 = 1$

$$v = \frac{q \cdot B \cdot r}{m} = \frac{1'6 \cdot 10^{-19}\,C \cdot 0'4\,T \cdot 0'2\,m}{1'67 \cdot 10^{-27}\,kg} = 7'66 \cdot 10^6\,m/s$$

b) $T?\;;\; v = \omega \cdot r \Rightarrow v = \frac{2\pi}{T} \cdot r$

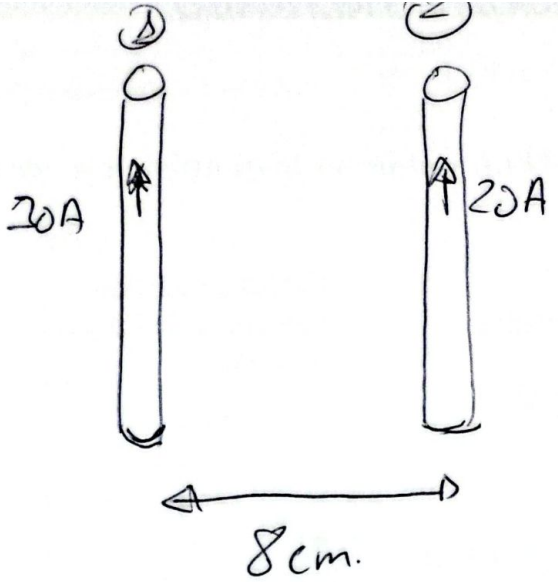
$$T = \frac{2\pi}{v} \cdot r = \frac{2\pi}{7'66 \cdot 10^6\,m/s} \cdot 0'2\,m = 1'64 \cdot 10^{-7}\,s$$

c) $|\vec{F}_m| = |q|\,|\vec{v}|\,|\vec{B}|$ | $|q|\,|\vec{E}| = |q|\,|\vec{v}|\,|\vec{B}|$

$|\vec{F}_e| = q \cdot |\vec{E}|$

$$|\vec{E}| = |\vec{v}|\,|\vec{B}| = 7'66 \cdot 10^6\,\frac{m}{s} \cdot 0'4\,T = 3'064 \cdot 10^6\,\frac{N}{C}$$

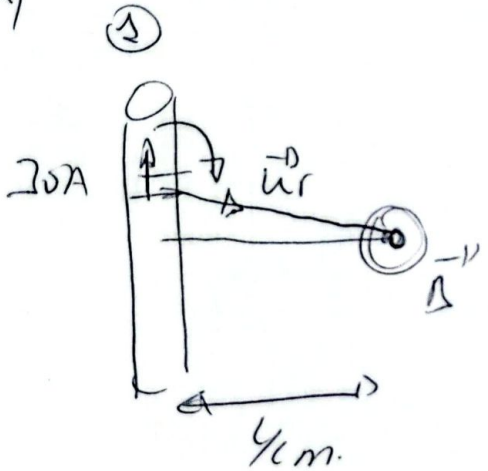
6.-



a) $\vec{B}$ no medio b) $\vec{B}$? a 3cm de 2. e F/l.

c) fm conservativa. ?

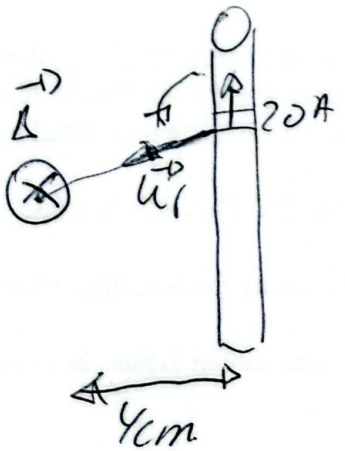
a)



$B = \frac{\mu \cdot I}{2\pi a}$; $a = 4cm.$

cara o interior do plano do papel

$|\vec{B_1}| = \frac{4\pi \cdot 10^{-7} T \cdot m \cdot A^{-1} \cdot 20A}{2\pi \cdot 0'04m.} = 1 \cdot 10^{-5} T$



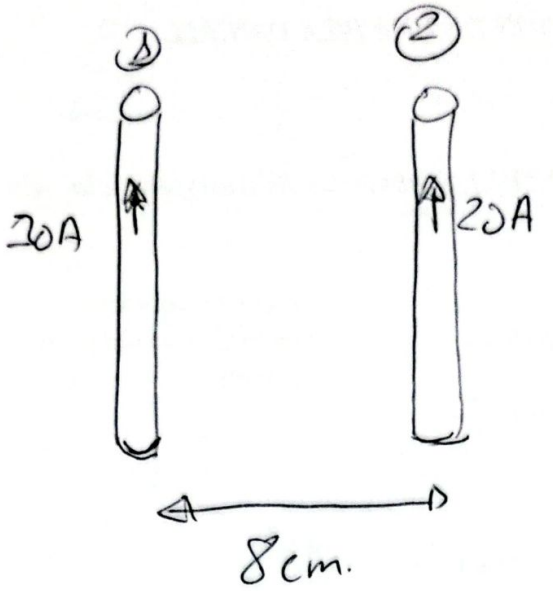
$|\vec{B_2}| = \frac{4\pi \cdot 10^{-7} T \cdot m A^{-1} \cdot 20A}{2\pi \cdot 0'004m} = 1 \cdot 10^{-4} T$

cara o exterior do plano do papel.

$|\vec{B_1}| - |\vec{B_2}| = 5 \cdot 10^{-5} T$

CARA O INTERIOR DO PLANO DO PAPEL

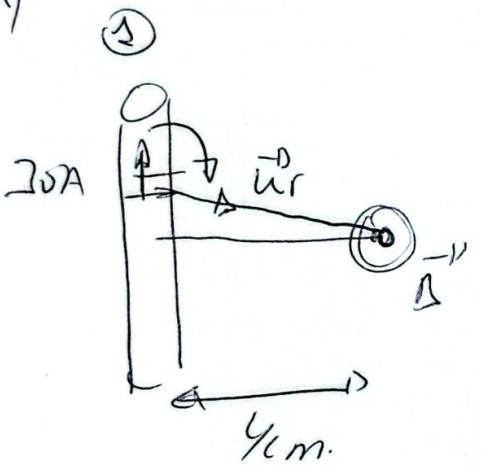
6.-



a) $\vec{B}$ no medio b) $\vec{B}$? a 3cm de 2. e F/l.

c) Fm conservativa. ?

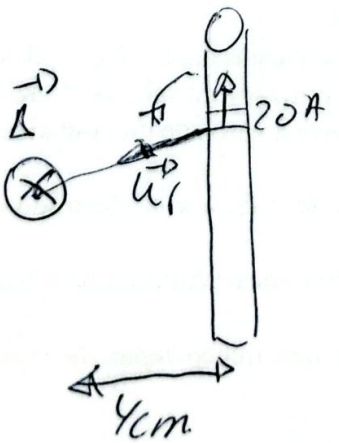
a)



$B = \frac{\mu \cdot I}{2\pi a}$; $a = 4cm.$

cara o interior do plano do papel

$|\vec{B}_1| = \frac{4\pi \cdot 10^{-7} T.m.A^{-1} \cdot 30A}{2\pi \cdot 0'04m.} = 15 \cdot 10^{-5} T$



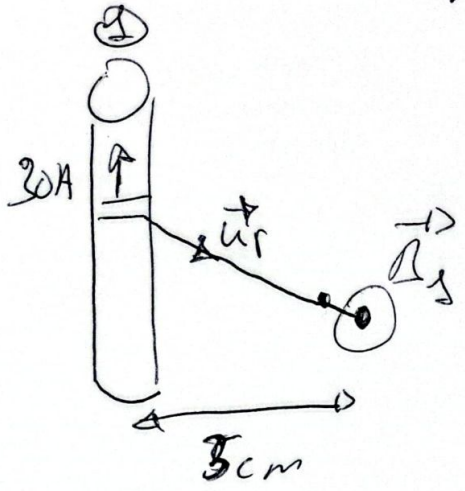
$|\vec{B}_2| = \frac{4\pi \cdot 10^{-7} T.mA^{-1} \cdot 20A}{2\pi \cdot 0'004m} = 1 \cdot 10^{-4} T$

cara o exterior do plano do papel.

$|\vec{B}_1| - |\vec{B}_2| = 5 \cdot 10^{-5} T$

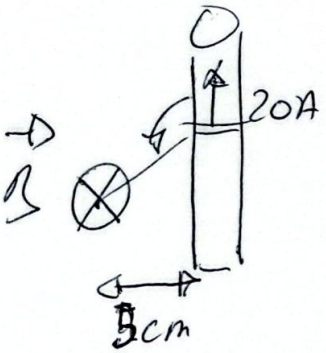
CARA O INTERIOR DO PLANO DO PAPEL

b) Calculamos o campo magnético a 3cm do condutor da esquerda.



$$|\vec{B}_1| = \frac{\mu \cdot I}{2\pi a} = \frac{4\pi 10^{-7}\, T.m.A^{-1} \cdot 30A}{2\pi \cdot 0'03 m}$$

$$|\vec{B}_1| = 2\,10^{-4} T$$

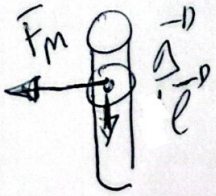


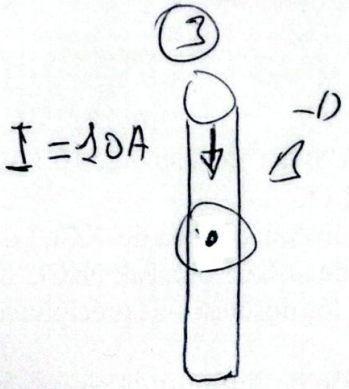
$$|\vec{B}_2| = \frac{\mu \cdot I}{2\pi a} = \frac{4\pi 10^{-7}\, T.m A^{-1} \cdot 20A}{2\pi \cdot 0'05 m}$$

$$|\vec{B}_2| = 8\,10^{-5} T$$

$$|\vec{B}_2| - |\vec{B}_1| = 5'2\,10^{-4} T$$

cara o exterior do plano do papel.





$$\vec{F} = I(\vec{l} \wedge \vec{B})$$

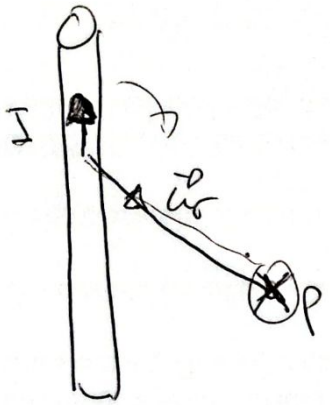
perpendiculares.

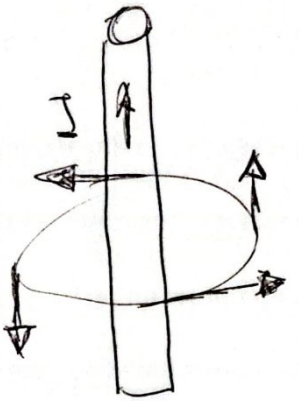
$$|\vec{F}| = I\,|\vec{l}|\,|\vec{B}|$$

$$F/l = I \cdot |\vec{B}|$$

$$F/l = I\,B = 30A \cdot 5'2\,10^{-5} T = 5'2 \cdot 10^{-3} \frac{N}{m}$$

7.-

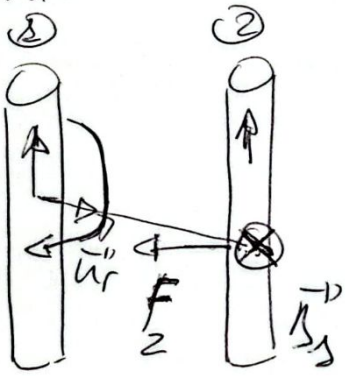




$I_1 = 2I_2$ atraense → mesmo sentido ?
→ sentido contrario ?

distancia 50cm

O mesmo sentido



$$d\vec{B} = \frac{\mu \cdot I}{4\pi} \frac{d\vec{l} \wedge \vec{u}_r}{r^2}$$

$$\vec{F} = I(\vec{l} \wedge \vec{B})$$

deben ter o mesmo sentido

$$\frac{|\vec{F}|}{l} = IB \quad ; \quad |\vec{B}| = \frac{\mu \cdot I}{2\pi a}$$

A forza é a mesma sobre os dous condutores

$$|\vec{B}_1| = \frac{\mu I_1}{2\pi a} \; ; \; \frac{|\vec{F}_2|}{\ell} = I_2 |\vec{B}_1| \; ; \; \frac{|\vec{F}_2|}{\ell} = \frac{I_2 \mu \cdot I_1}{2\pi a}$$

$$|\vec{B}_2| = \frac{\mu \cdot I_2}{2\pi a} \; ; \; \frac{|\vec{F}_1|}{\ell} = I_1 |\vec{B}_2| \; ; \; \frac{|\vec{F}_1|}{\ell} = I_1 \frac{\mu \cdot I_2}{2\pi a}$$

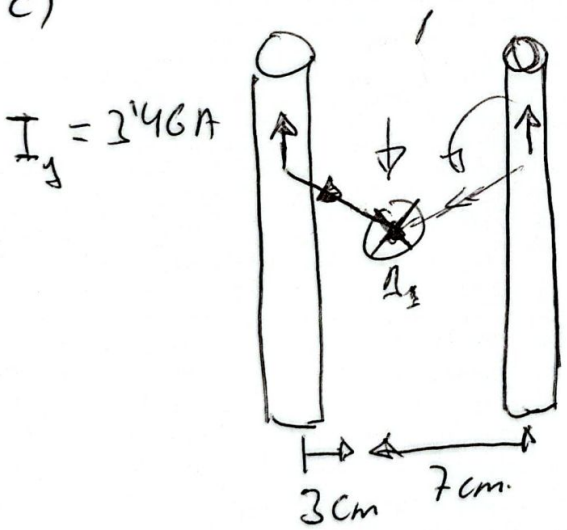
$$\frac{|\vec{F}|}{\ell} = \frac{I_1 \mu \cdot I_2}{2\pi a} \Rightarrow \frac{F}{\ell} = \frac{2 I_1^2 \mu}{2\pi a}$$

$$I_1^2 = \frac{2\pi a \cdot (F/\ell)}{2\mu}$$

$$I_1^2 = \frac{\pi \; 0'1 m \cdot 4'8 \cdot 10^{-5} N/m}{4\pi \cdot 10^{-7} N \cdot A^{-2}} = 0'12 \cdot 10^2 A^2$$

$$I_1 = 3'46 A \Rightarrow I_2 = 2 \times 3'46 A = 6'93 A$$

c)



$$|\vec{B}_1| = \frac{\mu I_1}{2\pi \, 0'03 m}$$

$$|\vec{B}_2| = \frac{\mu \cdot I_2}{2\pi \cdot 0'07 m}$$

$$|\vec{B}_1| = \frac{4\pi \cdot 10^{-7} N A^{-2} \cdot 3'46 A}{2\pi \cdot 0'03 m} = 23'1 \cdot 10^{-6} T$$

$$|\vec{B}_2| = \frac{4\pi \cdot 10^{-7} N \cdot A^{-2} \; 6'93 A}{2\pi \; 0'07 m} = 19'8 \cdot 10^{-6} T$$

$$|\vec{B}_T| = 3'3 \; 10^{-6} T$$

14.-

protón $\Delta V = 5.000\,V$ penetra perpendicularmente num campo magnético de $0'32\,T$

a) v_p (velocidade do protón) ?

b) r da órbita, frecuencia ?

DATOS
$m_p = 1'67.10^{-27}\,kg$
$q_p = 1'6.10^{-19}\,C$

a enerxía cinética coa que penetra é

$$q\Delta V = 5.10^2\,V \cdot 1'6\,10^{-19}\,C = 8.10^{-16}\,J$$

$$E_c = \frac{1}{2} m v^2 \Rightarrow v = \left(\frac{2E_c}{m}\right)^{1/2}$$

$$v = \left(\frac{2.8.10^{-16}\,J}{1'67.10^{-27}\,kg}\right)^{1/2} = 9'79.10^3 \frac{m}{s}\left(9'79.10^5 \frac{m}{s}\right)$$

b) $|q|\,|\vec{v}|\,|\vec{B}| = m\frac{v^2}{r}$

$$r = \frac{mv}{q.B} = \frac{1'67.10^{-27}\,kg\ 9'79.10^5\,m/s}{1'6.10^{-19}\,C.\ 0'32\,T}$$

$$r = 0'0319\,m.$$

$$v = w.r \Rightarrow v = 2\pi.f.r \Rightarrow f = \frac{v}{2\pi r}$$

$$f = \frac{9'79\,10^5\,m/s}{2\pi\ 0'0319\,m} = 4'88.10^6\ \frac{volts}{s}.$$

15.-

Protón con $E_c = 10^{-15}\,J$, en campo magnético $B = 2\,T$

a) r, radio de la trayectoria ?

b) número de vueltas por minuto

DATOS: $m_p = 1'67 \cdot 10^{-27}\,kg$; $q_p = 1'6 \cdot 10^{-19}\,C$

a) $m\frac{v^2}{r} = |q||\vec{v}||\vec{B}|$; $E_c = \frac{1}{2}mv^2 \Rightarrow v = \left(\frac{2E_c}{m}\right)^{1/2}$

$m\frac{v}{r} = q \cdot B \Rightarrow r = \frac{mv}{q \cdot B}$

$r = \frac{m}{q \cdot B}\left(\frac{2E_c}{m}\right)^{1/2} \Rightarrow r = \frac{(2mE_c)^{1/2}}{q \cdot B}$

$$r = \frac{(2 \cdot 1'67 \cdot 10^{-27}\,kg \cdot 1 \cdot 10^{-15}\,J)^{1/2}}{1'6 \cdot 10^{-19}\,C \cdot 2\,T} = 5'711 \cdot 10^{-3}\,m.$$

b) $v = \omega \cdot r \Rightarrow v = 2\pi \cdot f \cdot r \Rightarrow f = \frac{v}{2\pi r}$

$f = \frac{(2E_c/m)^{1/2}}{2\pi r}$; $f = \left(\frac{E_c}{2m}\right)^{1/2}\frac{1}{\pi r}$

$$f = \frac{(1 \cdot 10^{-15}\,J / 2 \cdot 1'67 \cdot 10^{-27}\,kg)^{1/2}}{\pi \cdot 5'711 \cdot 10^{-3}\,m.} = 3'05 \cdot 10^{7}\ \frac{\text{vueltas}}{\text{segundo}}$$

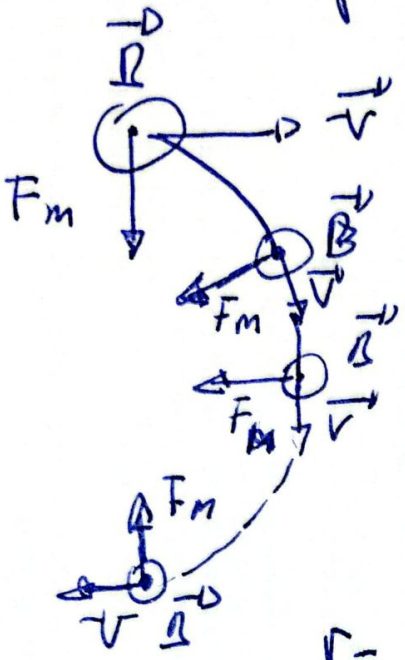
$$3'05 \cdot 10^{7}\ \frac{\text{vueltas}}{s} \cdot \frac{60\,s}{1\,min} = 1'83 \cdot 10^{9}\ \frac{\text{vueltas}}{\text{minuto}}$$

16.- $v = 1000 \frac{m}{s}$; $v = 1.10^3 \frac{m}{s}$; $B = 5\,T$

DATOS: $m_p = 1'67\,10^{-27}\,Kg$; $q_p = 1'6.10^{-19}\,C$

a) r?

b) $\vec{E}$



$\vec{F} = q(\vec{v} \wedge \vec{\Omega})$

igualando os modulos

$qv.\Omega = m\frac{v^2}{r}$ ($F_i = F_m$)

$r = \frac{mv}{q.B}$

$r = \frac{1'67.10^{-27}\,Kg.\ 1.10^3\,m/s}{1'6.10^{-19}\,C\ .\ 5\,T} = 2'09\,10^{-6}\,m.$

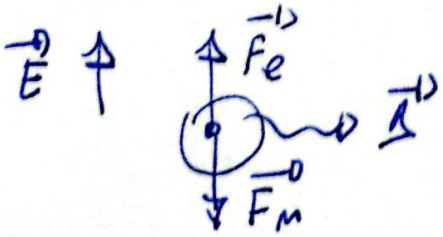
o campo eléctrico que anule o efecto do campo magnético

$|\vec{F_e}| = |\vec{F_m}|$. o sentido tem que ser oposto

$|\vec{F_e}| = |\vec{F_m}| = q(|\vec{v}|.|\vec{\Omega}|) = 1'6.10^{-19}\,C.1.10^3 \frac{m}{s}.5\,T$

$|\vec{F_e}| = |\vec{F_m}| = 8.10^{-16}\,N$; $8.10^{-16}\,N$

$|\vec{E}| = \frac{|\vec{F_e}|}{q} = \frac{8.10^{-16}\,N}{1'6.10^{-19}\,C} = 5000\,N/C$



17.- $\Delta V = 2.10^6 V$

v no sentido positivo do eixe X

$|\vec{B}| = 0'2T$; $|\vec{B}'| = 0'2\,T$ sentido positivo do eixe Y

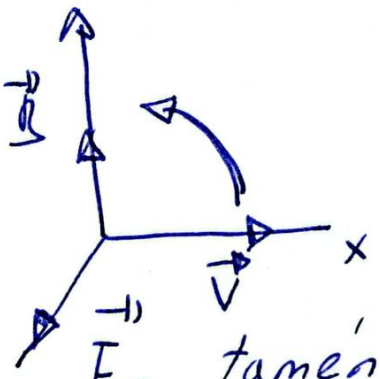
a) r ?

b) f ?

DATOS:

$m_p = 1'67.10^{-27} Kg$

$q_p = 1'6.10^{-19} C$



$\vec{F}_m = q(\vec{v} \wedge \vec{B})$

F_m tamén e o signo de $\vec{v} \wedge \vec{B}$

$m\frac{v^2}{r} = |q|\,|\vec{v}|.|\vec{B}| : \; m\frac{v^2}{r} = q v.B \Rightarrow r = \frac{m v}{q.B}$

$r = \frac{1'67.10^{-27} Kg.\ 2.10^6 v.\ q_e}{q_p.\ 0'2\,T}$

$E_c = \frac{1}{2} m v^2$; $E_c = q\Delta V \Rightarrow \frac{1}{2} m v^2 = q.\Delta V$

$v = \left(\frac{2q\Delta V}{m}\right)^{1/2} \Rightarrow v = \left(\frac{2.1'6.10^{-19} C.\ 2.10^6 V}{1'67.10^{-27} Kg}\right)^{1/2} =$

$v = 1'96.10^7 m/s$ ($v = 1'46.10^7 m/s$

a) $r = \frac{m v}{q.B} = \frac{1'67.10^{-27} Kg.\ 1'96.10^7 m/s}{1'6.10^{-19} C.\ 0'2T} = 1'02\ m.$

b) $v = w.r \Rightarrow v = 2\pi.f.r \Rightarrow f = \frac{v}{2\pi r} \Rightarrow$

$f = \frac{1'46.10^7 m/s.}{2.\pi.1'02 m} = 3'06.10^6$ volts/s