Folha 3

1) $q = 1{,}6022 \times 10^{-19}\ C$ $\quad v = 30{,}761722\ Km\ s^{-1}$ $\quad B = 80{,}000\ mT$

a. $|F_m| = |q| \times v \times B = (1{,}6022 \times 10^{-19})(30{,}761722 \cancel{\times 10^{3}})(80{,}000 \cancel{\times 10^{-3}}) = 3{,}9429 \times 10^{-16}\ N$

b. $x = 1{,}6254\ m$ $\quad R = \dfrac{x}{2} = 0{,}8127\ m$ $\quad m = ?$ $\quad 1\ uma = 1{,}6605 \times 10^{-27}\ Kg$

$$F = m\frac{v^2}{R} \Leftrightarrow m = \frac{RF}{v^2} \rightarrow m = \frac{0{,}8127 \times 3{,}9429 \times 10^{-16}}{(30{,}761722 \times 10^{3})^2} \approx 3{,}3863 \times 10^{-25}\ Kg$$

$1\ u.m.a \longrightarrow 1{,}6605 \times 10^{-27}\ Kg$

$$m = \frac{3{,}3863 \times 10^{-25}}{1{,}6605 \times 10^{-27}} \approx 203{,}93\ u.m.a$$

2) $v = 8{,}0 \times 10^{6}\ m\,s^{-1}$ $\quad B = 0{,}025\ T$ $\quad \theta = 60°$ (eixo xx)

$m = 9{,}1 \times 10^{-31}\ Kg$ $\quad q = 1{,}6 \times 10^{-19}\ C$

a. $|F_m| = |q| \times v \times \vec{B}\ sen\ \theta = (1{,}6 \times 10^{-19})(8{,}0 \times 10^{6}) \times 0{,}025\ sen\ 60° \approx 2{,}77 \times 10^{-14}\ N$

b. Segundo a regra da mão direita, a direcção da força magnética é segundo o eixo dos zz, no sentido negativo (para baixo).

c. $$F = ma \Rightarrow a = \frac{F}{m} = \frac{2{,}77 \times 10^{-14}}{9{,}1 \times 10^{-31}} \approx 3{,}04 \times 10^{16}\ m\,s^{-2}$$

3) $f = 12\ MHz = 12 \times 10^{6}\ Hz$ $\quad R = 53\ cm = 53 \times 10^{-2}\ m$ $\quad m = 3{,}34 \times 10^{-27}\ Kg$

a. $\omega = 2\pi f \approx 75{,}4 \times 10^{6}\ rad\,s^{-1}$ $\quad v = \omega R \approx 39{,}96 \times 10^{6}\ m\,s^{-1}$

$$F_m = F_c \Rightarrow \frac{m v^2}{R} = q v B \Rightarrow B = \frac{3{,}34 \times 10^{-27} \times 39{,}96 \times 10^{6}}{53 \times 10^{-2} \times 1{,}6022 \times 10^{-19}} \approx 1{,}6\ T$$

b. $$\omega = \frac{v}{R} \Rightarrow v = \omega R = 2\pi f R = 2\pi \times 12 \times 10^{6} \times 53 \times 10^{-2} \approx 4{,}0 \times 10^{7}\ m\,s^{-1}$$

4) $B = 2{,}0 \times 10^{-5}\ T$ $\quad I = 1{,}0\ A$ $\quad d = 1{,}0 \times 10^{-2}\ m \rightarrow R = \dfrac{d}{2}$

$$B_{máx} = \frac{\mu_0}{4\pi}\frac{2I}{R} = \frac{4\cancel{\pi} \times 10^{-7} \times 1{,}0}{2\cancel{\pi} \times 0{,}5 \times 10^{-2}} \approx 4{,}0 \times 10^{-5}\ T$$

5) $l = 2,4\,m$ $\quad d = 9,5 \times 10^{-2}\,m$ $\quad exp = 2,0 \times 10^{-3}\,m$ $\quad B = 1,5\,T$ $\quad I = ?$

$$B = \mu_0\, n\, I \Rightarrow I = \frac{B}{\mu_0\, n}$$

1 espira : $I = \dfrac{1,5}{4\pi \times 10^{-7} \times 1} \approx 1,2 \times 10^{6}\,A$

6) $r = 0,1\,m$ $\quad R = 2,0\,\Omega$ $\quad B/t = 0,10\,T\,s^{-1}$ $\quad I = ?$ $\quad \theta = \dfrac{\pi}{2}$

$$R = \frac{V}{I} \qquad B = \frac{\mu_0\, I}{2\, R} \Rightarrow I = \frac{2\,R\,B}{\mu_0} = \frac{2 \times 0,1 \times 0,10}{4\pi \times 10^{-7}} \approx [illegible]\,kA$$

7) $l = 25,0 \times 10^{-2}\,m$ $\quad B = 1,2\,T$ $\quad \mathcal{E}_{ind} = 3\,V$

$$\mathcal{E}_{ind} = v\,B\,l \Rightarrow v = \frac{3}{1,2 \times 25,0 \times 10^{-2}} = 10\,m\,s^{-1}$$

8) $r = 11,0 \times 10^{-2}\,m$ $\quad R = 10\,\Omega$ $\quad B = 0,63\,T$ $\quad \omega = 250\,rad\,s^{-1}$ $\quad \theta = \omega t$

Lei de Faraday : $\mathcal{E}_{ind} = -\dfrac{d}{dt}\, B\, A \cos(\theta) = \omega\, B A \,\text{sen}\,(\omega t)$

$$\mathcal{E}_{ind} = 250 \times 0,63 \times \pi \times (11,0 \times 10^{-2})^2\, \text{sen}\,(250t) \approx (6\, \text{sen}\,(250t))\ V$$

$$I = \frac{\mathcal{E}_{ind}}{R} = \frac{6\,\text{sen}\,(250t)}{10} = (0,6\, \text{sen}\,(250t))\ A$$

9) $\vec{B} = (2,0 \times 10^{-2}\, \vec{e_y})\ T$ $\qquad \vec{v} = (3,0 \times 10^{5}\, \vec{e_x})\ m\,s^{-1}$

a. $\vec{F_m} = q\, \vec{v} \times \vec{B} = (1,6022 \times 10^{-19})\,(3,0 \times 10^{5}\, \vec{e_x})\,(2,0 \times 10^{-2}\, \vec{e_y}) \approx (9,6 \times 10^{-16}\, \vec{e_z})\ N$ $\qquad [\vec{e_x} \times \vec{e_y} = \vec{e_z}]$

b. $\vec{F_m} = \vec{F_c} \Rightarrow 9,6 \times 10^{-16} = m_p \dfrac{v^2}{R} \Rightarrow R = \dfrac{1,673 \times 10^{-27} \times (3,0 \times 10^{5})^2}{(9,6 \times 10^{-16})} \approx 0,16\,m$

c. $v = \dfrac{\Delta x}{\Delta t} \Rightarrow \Delta t = \dfrac{\Delta x}{v} = \dfrac{\frac{1}{2}(2\pi r)}{v} = \dfrac{\pi \times 0,16}{3,0 \times 10^{5}} \approx 1,68 \times 10^{-6}\,s$

d. $E_c = \dfrac{1}{2} m_p v^2 = \dfrac{1}{2} \times (1,673 \times 10^{-27}) \times (3,0 \times 10^{5})^2 \approx 7,5 \times 10^{-19}\,J$

e. $W = \vec{F_m} \cdot \vec{d} \cos\left(\dfrac{\pi}{2}\right) = 0\,J$, pois $\vec{F_m} \perp \vec{s}$

10) $q = +3,0 \times 10^{-11}\,C$ $\quad \vec{v} = (2,0 \times 10^{6}\, \vec{e_y})\ m\,s^{-1}$ $\quad \vec{B} = (2,0 \times 10^{-2}\, \vec{e_x})\ T$ $\quad \vec{E} = (4,0 \times 10^{3}\, \vec{e_z})\ V/m$

a. $F_{em} = q\,(\vec{E} + \vec{v}\,\vec{B}) = 3,0 \times 10^{-11}\,(4,0 \times 10^{3}\, \vec{e_z} + (2,0 \times 10^{6}\, \vec{e_y})(2,0 \times 10^{-2}\, \vec{e_x}))$

$$= 1,2 \times 10^{-7}\, \vec{e_z} + 1,2 \times 10^{-6}\,(\cos \pi\, \vec{e_z}) = (-1,08 \times 10^{-6}\, \vec{e_z})\ N$$

b. A força magnética é a responsável pela alteração da trajetória

Para não haver desvio na sua partícula, o produto vetorial $\vec{v}\,\vec{B}$ tem de ser 0. Logo, teria de ser qualquer velocidade colinear com o vetor $\vec{B}$ (mesmo sentido ou sentidos opostos), pois sen 0 = sen π = 0.

c. $\vec{F}_{em} = q\vec{E} + \vec{F}_m = q\vec{E}$

Se a partícula não sofre desvio na sua trajetória, então o seu movimento tem de ser retilíneo uniforme

11) $V_p = 8,5 \times 10^3$ V $\quad V_s = 120$ V

a. $\frac{V_P}{V_s} = \frac{N_P}{N_s} \Rightarrow \frac{N_P}{N_s} = \frac{8,5 \times 10^3}{120} \approx 71$

b. $P = 78 \times 10^3$ W $\quad P_p = P_s = 78 \times 10^3$ W

$i_p = \frac{P_P}{V_p} = \frac{78 \times 10^3}{8,5 \times 10^3} \approx 9,18$ A $\qquad i_s = \frac{P_s}{V_s} = \frac{78 \times 10^3}{120} = 650$ A

c. $R_p = \frac{V_P}{i_p} = \frac{8,5 \times 10^3}{9,18} \approx 925,9\ \Omega \qquad R_s = \frac{V_s}{i_s} = \frac{120}{650} \approx 0,18\ \Omega$

12) $V_s = 230$ V $\quad R_s = 4,4\ \Omega \quad I_p = 2$ A

a. $I_s = \frac{V_s}{R_s} = \frac{230}{4,4} \approx 52,27$ A

$\frac{N_p}{N_s} = \frac{I_s}{I_p} = \frac{52,27}{2} \approx 26$

b. calculado em a) $\rightarrow I_s = \frac{V_s}{R_s} = \frac{230}{4,4} \approx 52,27$ A

13) $m = 2,0 \times 10^{-8}$ Kg $\quad \vec{B} = (-4,0 \times 10^{-2}\,\vec{e}_z)$ T $\quad \vec{v} = (50\,\vec{e}_y)\ \text{m s}^{-1} \quad R = -\frac{2,5 \times 10^{-2}}{2} = -12,5 \times 10^{-3}$ m

a. $F_m = F_c \Rightarrow q\,v\,B = \frac{m v^2}{R} \Rightarrow q = \frac{(2,0 \times 10^{-8}) \times 50}{(-12,5 \times 10^{-3})(-4,0 \times 10^{-2})} = 2,0 \times 10^{-3}$ C

$q > 0$, pois $B < 0$ e $R < 0$

b. $s = \frac{2\pi|R|}{2} = \pi \times 12,5 \times 10^{-3} \approx 39,27 \times 10^{-3}$ m

$v = \frac{s}{\Delta t} \Rightarrow \Delta t = \frac{s}{v} = \frac{39,27 \times 10^{-3}}{50} \approx 7,9 \times 10^{-4}$ s

14) $m = 0,3$ Kg $\quad q = 3$ C $\quad \vec{E} = (-\hat{i} - 3\hat{j})\ \text{N C}^{-1} \quad \vec{B} = (\hat{i} - 2\hat{j} + 3\hat{k})$ T

a. $v = (3\hat{i})\ \text{m s}^{-1}$

$\vec{F}_m = q\,\vec{v}\,\vec{B} = 3\begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & 0 & 0 \\ 1 & -2 & 3 \end{vmatrix} = 3[(0 - 6\hat{k} + 0) - (0 + 0 - 9\hat{j})] = (-27\hat{j} - 18\hat{k})$ N

b. $\vec{F_{em}} = q\vec{E} + \vec{F_m} = 3(-\vec{i} - 3\vec{j}) + (-27\vec{j} - 18\vec{k}) = (-3\vec{i} - 36\vec{j} - 18\vec{k})$ N

c. $\vec{g} = (-10\vec{k})\ ms^{-2}$

2ª Lei de Newton:

$$\vec{F_T} = m\vec{a} \Rightarrow \vec{a} = \frac{\vec{F_T}}{m} = \frac{\vec{F_{em}} + m\vec{g}}{m} = \frac{-3\vec{i} - 36\vec{j} - 18\vec{k} + 0{,}3 \times (-10\vec{k})}{0{,}3} = (-10\vec{i} - 120\vec{j} - 70\vec{k})\ ms^{-2}$$

15) $m = 2{,}0 \times 10^{-12}$ kg $\quad q = (+)\ 4{,}4 \times 10^{-6}$ C $\quad d = 3 \times 10^{-3}$ m

a. $v = (2{,}0 \times 10^{6}\ \vec{e_y})\ ms^{-1}$

$$R^2 + R^2 = d^2 \Rightarrow R = \sqrt{\frac{d^2}{2}} = \sqrt{\frac{(3\times10^{-3})^2}{2}} \simeq 2{,}12 \times 10^{-3}\ m$$

$$F_m = F_c \Rightarrow qvB = m\frac{v^2}{R} \Rightarrow B = \frac{(2{,}0\times10^{-12})(2{,}0\times10^{6}\vec{e_y})}{(4{,}4\times10^{-6})(2{,}12\times10^{-3}\vec{e_x})}\ (428{,}82\ \vec{e_z})\ T$$

Direção eixo zz
sentido positivo

b. $\vec{E} = (-3 \times 10^{8}\ \vec{e_y})$ V/m

$$\vec{F_{em}} = q\vec{E} + \vec{F_m} = (4{,}4\times10^{-6})(-3\times10^{8}\vec{e_y}) + (4{,}4\times10^{-6})(2{,}0\times10^{6}\vec{e_y})(428{,}82\ \vec{e_z})$$
$$\simeq -1320\ \vec{e_y} + 3773{,}62 \cos\pi\ \vec{e_x} = (-1320\ \vec{e_y} - 3773{,}62\ \vec{e_x})\ N$$

c. $F_R = F_{em} \Rightarrow ma = |(-1320\ \vec{e_y} - 3773{,}62\ \vec{e_x})|$

$$|\vec{F_{em}}| = \sqrt{(-1320)^2 + (-3773{,}62)^2} \simeq 3997{,}8\ N$$

$$ma = 3997{,}8 \Rightarrow a = \frac{3997{,}8}{2{,}0\times10^{-12}} \simeq 2{,}0 \times 10^{15}\ ms^{-2}$$