Série 6 – Campo magnético

①

$v = 8 \times 10^6 \, m/s$

$B = 2,5 \, T$

$\theta = 60°$

$q = 1,6 \times 10^{-19} \, C$

$m_{protão} = 1,67 \times 10^{-27} \, Kg$

$a = ?$

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

$$F = q v B \operatorname{sen} \theta$$

$$F = 1,6 \times 10^{-19} \times 8 \times 10^{6} \times 2,5 \operatorname{sen} 60°$$

$$F = 2,8 \times 10^{-12} \, N$$

2ª lei de Newton $\vec{F} = m \vec{a}$

$$a = \frac{F}{m_p}$$

$$a = \frac{2,8 \times 10^{-12}}{1,67 \times 10^{-27}}$$

$$\boxed{a = 1,66 \times 10^{15} \, m/s^2}$$

②

$\lambda = 0,04 \, Kg/m$

↓

massa por unidade de comprimento de barra $\left(\lambda = \frac{m}{\ell}\right)$

$\Delta V = 0$

$B = 3,6 \, T$

$I = ?$

$F = P$

$B I \ell = m g$

$$I = \frac{m g}{B \ell} \Rightarrow I = \frac{\lambda g}{B}$$

$$I = \frac{\lambda g}{B} \qquad g = 10\ m/s^2$$

$$I = \frac{0,04 \times 10}{3,6}$$

$$\boxed{I = 0,11\ A}$$

(3)

$$B = 1,7\ mT = 1,7 \times 10^{-3}\ T$$

$$I = 20\ A$$

$$\mu_0 = 1,26 \times 10^{-6}\ Tm/A$$

$R = ?$

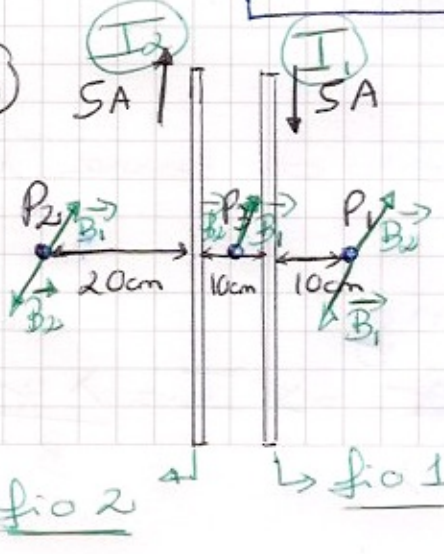
$$B = \frac{\mu_0 I}{2\pi R}$$

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

$$R = \frac{1,26 \times 10^{-6} \times 20}{2\pi \times 1,7 \times 10^{-3}}$$

$$\boxed{R = 2,36 \times 10^{-3}\ m = 2,36\ mm}$$

(4)



$\vec{B}$ nos pontos P_1, P_2 e P_3?

Ponto P_1

$$\vec{B} = \vec{B_1} + \vec{B_2}$$

$$\vec{B_1} = \frac{\mu_0 I_1}{2\pi R_1}(\vec{\mu_z})$$

$$\vec{B_1} = \frac{\mu_0 \times 5}{2\pi \times 0,1}(\vec{\mu_z})$$

$$\vec{B_2} = \frac{\mu_0 I_2}{2\pi R_2}(-\vec{\mu_z})$$

$$\vec{B_2} = \frac{\mu_0 \times 5}{2\pi \times 0,2}(-\vec{\mu_z})$$

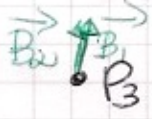
$\mu_0 = 4\pi \times 10^{-7}\ Tm/A$

$$\vec{B} = \vec{B_1} + \vec{B_2}$$

$$\vec{B} = \frac{4\pi \times 10^{-7} \times 5}{2\pi}\left(\frac{1}{0,1} - \frac{1}{0,2}\right)$$

$$\vec{B} = 5 \times 10^{-6}\ T(\vec{\mu_z})$$

Ponto P_3



$$\vec{B} = \vec{B_1} + \vec{B_2}$$

$$\vec{B_1} = \frac{\mu_0 \times 5}{2\pi \times 0,05}(-\vec{\mu_z})$$

$$\vec{B_2} = \frac{\mu_0 \times 5}{2\pi \times 0,05}(-\vec{\mu_z})$$

$$\vec{B_1} = \vec{B_2} \Rightarrow \vec{B} = \vec{B_1} + \vec{B_2} \Rightarrow \vec{B} = 2\vec{B_1}$$

$$\vec{B} = 2\vec{B_1} = \frac{2 \times 4\pi \times 10^{-7} \times 5}{2\pi \times 0{,}05}\left(-\vec{\mu_z}\right)$$

$$\vec{B} = 4 \times 10^{-5}\ T\left(-\vec{\mu_z}\right)$$

Ponto P_2

$$\vec{B} = \vec{B_1} + \vec{B_2}$$

$$\vec{B_1} = \frac{\mu_0 \times 5}{2\pi \times 0{,}3}\left(-\vec{\mu_z}\right)$$

$$\vec{B_2} = \frac{\mu_0 \times 5}{2\pi \times 0{,}2}\left(\vec{\mu_z}\right)$$

$$\vec{B} = \vec{B_1} + \vec{B_2}$$

$$\vec{B} = \frac{4\pi \times 10^{-7} \times 5}{2\pi}\left(\frac{1}{0{,}2} - \frac{1}{0{,}3}\right)$$

$$\vec{B} = 1{,}67 \times 10^{-6}\ T\left(\vec{\mu_z}\right)$$

(5)

$L = 20\ cm = 0{,}2\ m$

$N = 500$

$I = 2A$

$B = ?$

$$B = \mu_0 \frac{N}{L} I$$ Lei de Ampere

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

$$B = 0{,}0063\ T$$

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

$|\vec{B}| = 0{,}093\ T$

$q = 1{,}60 \times 10^{-19}\ C$

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

$F_m = F_e$ logo $qvB = qE$ então $v = \frac{E}{B}$

como

$$qvB = \frac{mv^2}{R} \quad \text{então} \quad R = \frac{mv}{qB} = \frac{m(E/B)}{qB}$$

logo

$$\boxed{R = \frac{mE}{qB^2}}$$

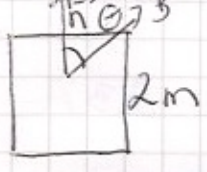
$$R = \frac{2{,}18 \times 10^{-26} \times 950}{1{,}60 \times 10^{-19} \times (0{,}093)^2}$$

$$\boxed{R = 0{,}015\ m}$$

(7)

$B = 0{,}3\ T$

$\theta = 50^\circ$



$$\Phi_B = BA\cos\theta$$

$$A = 2 \times 2 = 4\ m^2$$

$$\Phi_B = 0{,}3 \times 4 \cos 50^\circ$$

$$\boxed{\Phi_B = 7{,}71 \times 10^{-1}\ Tm^2}$$

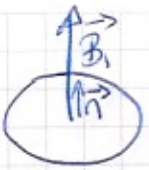
(8)

$R = 0,3\ m$

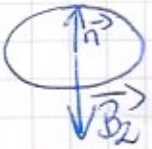
$\vec{B_1} = 0,3\ T$

$\vec{B_2} = 0,2\ T$

$\Delta t = 1,5\ s$



$\theta_i = 0°$



$\theta_f = 180°$

θ - ângulo entre $\vec{B}$ e $\vec{n}$

$$A = \pi R^2$$

$$A = \pi \times (0,3)^2 = 0,28\ m^2$$

$$|\varepsilon| = \frac{|\Delta \phi_B|}{\Delta t}$$

$$|\varepsilon| = \frac{|\Delta (B \cos\theta)| \times A}{\Delta t}$$

$$|\varepsilon| = \frac{|0,2 \times \cos 180° - 0,3 \times \cos 0°| \times 0,28}{1,5}$$

$$|\varepsilon| = 9,4 \times 10^{-2}\ V = 94\ mV$$

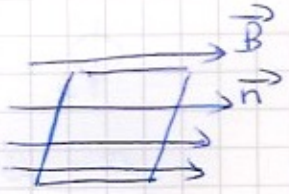
(9)

$\ell = 5\ cm = 5 \times 10^{-2}\ m$

$B = 5\ T$

$\Delta B = 2\ T$

$\Delta t = 5\ s$



$\vec{B} \parallel \vec{n}$

$\phi_B = BA$

$A = \ell^2$

$A = (5 \times 10^{-2})^2 =$

$A = 2,5 \times 10^{-3}\ m^2$

$\Delta \phi_B = \Delta B A$

$$\varepsilon = -\frac{\Delta \phi_B}{\Delta t}$$

$$\boxed{\varepsilon = -\frac{\Delta B A}{\Delta t}}$$

$$\varepsilon = -\frac{2 \times 2,5 \times 10^{-3}}{5}$$

$$\boxed{\varepsilon = -1 \times 10^{-3}\ V}$$

(10) $B = 2{,}5\ T$

$R = 6\ \Omega$

$\ell = 1{,}2\ m$

$I = 0{,}5\ A$

$v = ?$

$$|\mathcal{E}| = \frac{\Delta\Phi_B}{\Delta t} = B\ell v$$

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

$$v = \frac{RI}{B\ell}$$

$$v = \frac{6 \times 0{,}5}{2{,}5 \times 1{,}2}$$

$$\boxed{v = 1\ m/s}$$

(11)

$B_0 = 1{,}1 \times 10^{-3}\ T$

$f = 60\ Hz$

$d = 8\ \mu m = 8 \times 10^{-6}\ m$

$\mathcal{E} = ?$

Neste problema, temos uma espira (célula) estacionária num campo magnético oscilante.

Então

$$\mathcal{E} = \mathcal{E}_{máx} \operatorname{sen} \omega t$$

$$\mathcal{E}_{máx} = NBA\omega$$

1 espira $\Rightarrow N = 1$

$\omega = 2\pi f \quad \omega = 2\pi \times 60 = 120\pi\ rad/s$

$A = \pi R^2 = \frac{\pi d^2}{4}$ Então, $\mathcal{E}_{máx} = NBA\omega$

$$\mathcal{E}_{máx} = 1{,}1 \times 10^{-3} \times \frac{\pi \times (8 \times 10^{-6})^2}{4} \times 120\pi$$

$$\boxed{\mathcal{E}_{máx} = 1{,}9 \times 10^{-11}\ V}$$

(12) $N = 5$

$\Delta t = 10\,s$

$\mathcal{E} = 5\,V$

$A = 50\,cm^2 = 50 \times 10^{-4}\,m^2$

$\Delta B = ?$

$$|\mathcal{E}| = N\frac{\Delta\phi}{\Delta t}$$

$$|\mathcal{E}| = N\frac{\Delta B\, A}{\Delta t}$$

$$5 = \frac{5 \times \Delta B \times 50 \times 10^{-4}}{10}$$

$$\boxed{\Delta B = 2 \times 10^{3}\,T}$$

(13) $V_{eff} = 230\,V$

$R = 50\,\Omega$

a) $V_{máx} = ?$

$$V_{eff} = \frac{V_{máx}}{\sqrt{2}}$$

$$V_{máx} = 230 \times \sqrt{2}$$

$$\boxed{V_{máx} = 325\,V}$$

b) Potência dissipada?

$$P = V_{eff} I_{eff} = \frac{V_{eff}^2}{R}$$

$$P = \frac{230^2}{50}$$

$$\boxed{P = 1058\,W}$$

(14) $P = 75\ W$

$V_{máx} = 170\ V$

$R = ?$

$$P = \frac{V_{eff}^2}{R} \quad e \quad V_{eff} = \frac{V_{máx}}{\sqrt{2}}$$

$$P = \frac{V_{máx}^2}{2R} \Rightarrow R = \frac{V_{máx}^2}{2P}$$

$$R = \frac{170^2}{2 \times 75}$$

$$\boxed{R = 193\ \Omega}$$

(15) $N_1 = 350$

$N_2 = 2000$

$V_1 = 325 \cos(\omega t)\ V$ → $V_{1máx}$

$V_{2\,eff} = ?$

$$V_{1\,eff} = \frac{V_{1máx}}{\sqrt{2}}$$

$$V_{1\,eff} = \frac{325}{\sqrt{2}} = 229{,}8\ V$$

Nos transformadores, considerando que não há perdas, a potência do enrolamento primário é igual à do secundário e logo

$$\frac{V_1}{V_2} = \frac{N_1}{N_2} \qquad \frac{229{,}8}{V_2} = \frac{350}{2000}$$

$$\boxed{V_2 = 1313\ V}$$

(16) $V_1 = 3600\,V$

$V_2 = 120\,V$

$P_{OUTPUT} = 1000\,kW = 1000 \times 10^3\,W$ — 90% eficiencia

a) $P_1 = ?$

$P_{OUTPUT} = 0{,}9\ P_{input}$

90% eficiencia

Então, se $P_{OUTPUT} = 1000 \times 10^3\,W$

$$P_{input} = \frac{P_{output}}{0{,}90}$$

$$P_{input} = \frac{1000 \times 10^3}{0{,}90}$$

$$\boxed{P_{input} = 1{,}1 \times 10^6\,W} = P_1$$

b) $I_1 = ?$

$$I_1 = \frac{P_1}{V_1} \qquad \boxed{P_1 = P_{input}}$$

$$I_1 = \frac{1{,}1 \times 10^6}{3600} = \boxed{3{,}1 \times 10^2\,A}$$

c) $I_2 = ?$

$$I_2 = \frac{P_2}{V_2} \qquad \boxed{P_2 = P_{OUTPUT}}$$

$$I_2 = \frac{1000 \times 10^3}{120} = \boxed{8{,}3 \times 10^3\,A}$$