Ficha TP 6

1)

$I = 125\ \mu A = 125 \times 10^{-6}$ $\qquad I = \frac{\Delta Q}{\Delta T}$

$\Delta t = 23\ s$

$\Rightarrow \Delta Q = I \times \Delta t = 125 \times 10^{-6} \times 23$

$= 2,875 \times 10^{-3}\ C$

$Q = n e \Rightarrow n = \frac{Q}{e} = \frac{2,875 \times 10^{-3}}{1,6 \times 10^{-19}} \simeq 1,8 \times 10^{16}$ photoes

2)

$P = 10\ W$

$V = 220$

$\Delta t = 12\ h$

$= 12 \times 60 \times 60\ s$

$I = \frac{\Delta Q}{\Delta t} \Rightarrow \Delta Q = I \times \Delta t$

$P = V I$

$\Leftrightarrow I = \frac{P}{V} = \frac{10}{220}$

$\therefore \Delta Q = \frac{1}{22} \times 12 \times 60 \times 60$

$\approx 1963\ C$

3)

$J = 440\ A/cm^2 = 440 \times 10^{-4}\ A/m^2$

$J = \frac{I}{\Delta A} = \frac{\Delta Q}{\Delta t\, \Delta A}$

$I = 0,5\ A$

$A = \pi r^2$

$440 \times 10^{-4} = \frac{0,5}{\pi r^2}$

$\Leftrightarrow r^2 \approx 3,62 \times 10^{-8} \Rightarrow r = 1,9 \times 10^{-4}$

$d = 2r = 3,8 \times 10^{-4}\ m = 0,38\ mm$

4)

$R = 50\ \Omega$ a $20°C$ $\alpha = 3,92 \times 10^{-3}\ °C^{-1}$

$R = 76,8\ \Omega$

$R(T) = 76,8$

$\Leftrightarrow 76,8 = 50\left(1 + 3,92 \times 10^{-3}(T-20)\right)$

$\Leftrightarrow 1 + 3,92 \times 10^{-3}(T-20) = \frac{76,8}{50}$

$\Leftrightarrow T - 20 = \frac{\left(\frac{76,8}{50} - 1\right)}{3,92 \times 10^{-3}}$

$\Leftrightarrow T = \frac{\left(\frac{76,8}{50} - 1\right)}{3,92 \times 10^{-3}} + 20 \approx \underline{\underline{156,7\ °C}}$

5)

$V = 75,0\ mV = 75 \times 10^{-3}\ V$ $I = 0,200\ mA = 0,2 \times 10^{-3}\ A$

$P = VI = 75 \times 10^{-3} \times 0,2 \times 10^{-3}$
$= 15 \times 10^{-6}\ W$
$= \underline{\underline{15\ \mu W}}$

6)

$d = 1,0\ mm$
$L = 2,0\ m$
$R = 50\ m\Omega$

$R = \rho \frac{L}{A}$ $A = \pi r^2$
$= \pi \left(\frac{d}{2}\right)^2$

$\rho = \frac{R \times A}{L} = \frac{50 \times 10^{-3}}{2} \times \pi \left(\frac{1 \times 10^{-3}}{2}\right)^2$

$\approx 1,96 \times 10^{-8}\ \Omega\, m$

$\sigma = \frac{1}{\rho} = 5,09 \times 10^{7}\ \Omega^{-1} m^{-1}$

7)

$L = 15\ m$ $\quad d = 2\ mm = 2\times10^{-3}\ m$

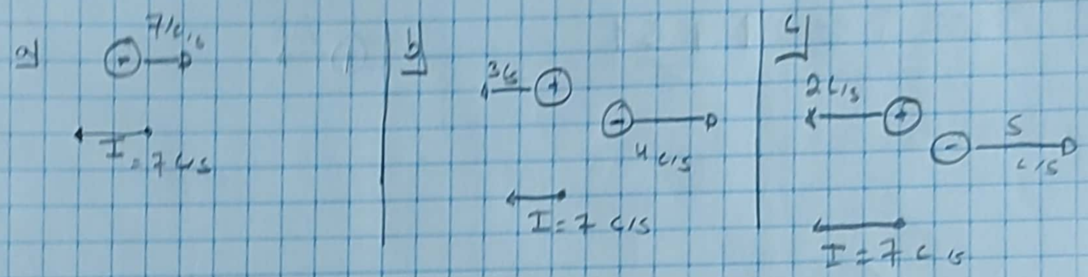
$I = 20\ A$ $\quad \sigma = 5{,}8\times10^{7}\ \Omega^{-1}\ m^{-1}$

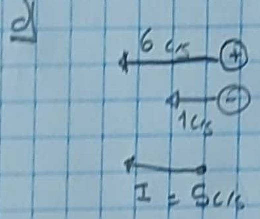
$$\rho = \frac{R\times A}{L} \Rightarrow \sigma = \frac{L}{R\times A}$$

$$\Rightarrow R = \frac{15}{5{,}8\times10^{7}\times\pi\times\left(\frac{2\times10^{-3}}{2}\right)^2} \approx 8{,}2\times10^{-2}\ \Omega$$

- $V = R\times I = 20\times 8{,}2\times10^{-2} = 1{,}65\ V$

Q1)





$A = B = C < D$

Q10)

a) $I = \frac{\Delta Q}{\Delta t}$ → Conservação da carga $I_A = I_B = I_C$

b) $J = \frac{I}{A}$, sabemos que o $I_A = I_B = I_C$ e $A_A > A_C > A_B$, pelo que $J_A < J_C < J_B$.

c) $J = \sigma \vec{E} \Rightarrow \vec{E} = \frac{J}{\sigma}$ → constante e

como $J_A < J_C < J_B$, então

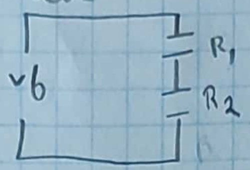
$E_A < E_C < E_B$.

Ficha 7 (3) (67)

Q5|

$R_1 > R_2$

(A) série

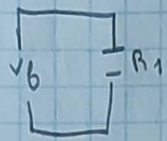


$Vb - IR_1 - IR_2 = 0$

$\Leftrightarrow Vb = I(R_1 + R_2)$

$\Leftrightarrow I = \frac{Vb}{(R_1+R_2)}$

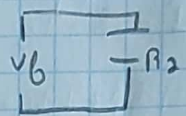
(B)



$Vb = R_1 I$

$\Rightarrow I = \frac{Vb}{R_1}$

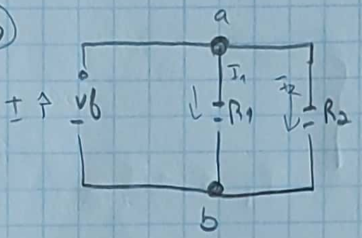
(C)



$Vb = R_2 I$

$\Rightarrow I = \frac{Vb}{R_2}$

(D)



$I = I_1 + I_2$

$$\begin{cases} \cdot\ Vb - R_1 I_1 = 0 \\ \cdot\ Vb - R_2 I_2 = 0 \end{cases}$$

$$\Rightarrow \begin{cases} I_1 = \frac{Vb}{R_1} \\ I_2 = \frac{Vb}{R_2} \end{cases}$$

$$I = \frac{Vb}{R_1} + \frac{Vb}{R_2}$$

$$= Vb\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$

$I(\text{paralelo}) > I_{R_2} > I_{R_1} > I(\text{série})$

P 30) $R_1 = R_2 = 6\ \Omega$ $\quad V_f = 12\ V$

a)

$$\begin{cases} I = I_1 + I_2 \\ -R_1 I_1 + V_f = 0 \\ -R_2 I_2 + V_f = 0 \end{cases} \longrightarrow R_1 I_1 = V_1$$

logo

$$V_f = R_1 I_1 = V_1$$

$$\underline{\underline{V_1 = 12V}}$$

b)

$$\begin{cases} V_f - R_3 I_3 - R_1 I_1 = 0 \\ V_f - R_3 I_3 - R_2 I_2 = 0 \\ -R_1 I_1 - R_2 I_2 = 0 \end{cases} \quad I_3 = I_1 + I_2$$

$$\Leftrightarrow \begin{cases} V_f - R_1 (I_3 - I_1) = 0 \\ V_f - R_2 (I_3 - I_2) = 0 \\ R (I_1 + I_2) = 0 \end{cases} \Leftrightarrow \Big\{$$

? ?

P27 $R_1 = 100\ \Omega \quad R_2 = 50 \quad \mathcal{E}_1 = 6\ V$

$\mathcal{E}_2 = 5\ V \quad \mathcal{E}_3 = 4\ V$

Lei dos nós:

- $I_3 + I_1 = I_2$
- $I_2 = I_1 + I_3$

- Caminho 1 $\quad \mathcal{E}_2\ R_1$

$+\mathcal{E}_2 - R_1 I_1 = 0 \Leftrightarrow \mathcal{E}_2 = R_1 I_1 \Leftrightarrow I_1 = 0{,}05\ A$

- Caminho 2 $\quad \mathcal{E}_1, \mathcal{E}_2, \mathcal{E}_3, R_2$

$\mathcal{E}_2 + \mathcal{E}_3 - \mathcal{E}_1 - R_2 I_2 = 0 \Rightarrow I_2 = \dfrac{-\mathcal{E}_1 + \mathcal{E}_2 + \mathcal{E}_3}{R_2}$

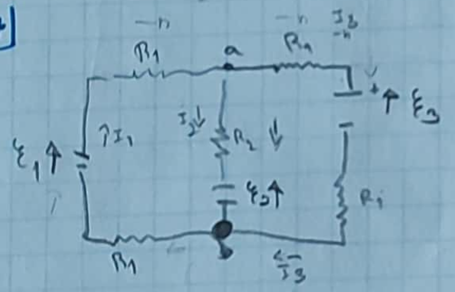
$= 0{,}06\ A$

- $V_{AB} = -\mathcal{E}_2 - \mathcal{E}_3 = -9V$ ✓

ou

$V_{AB} = -\mathcal{E}_1 - R_2 I_2 = -9V$ ✓

P37



$\begin{cases} I_1 = I_2 + I_3 \\ I_2 + I_3 = I_1 \end{cases}$

$R_1 = 1 \quad R_2 = 2$

$\mathcal{E}_1 = 2 \quad \mathcal{E}_2 = \mathcal{E}_3 = 4$

$R_2 = 2R_1$

- M_1: esquerda

$-R_1 I_1 + \mathcal{E}_1 - R_1 I_1 - R_2 I_2 - \mathcal{E}_2 = 0$

$\mathcal{E}_1 - \mathcal{E}_2 = 2R_1 I_1 + R_2 I_2 \Rightarrow \mathcal{E}_1 - \mathcal{E}_2 = 2R_1 I_1 + 2R_1 I_2$

$\Rightarrow \mathcal{E}_1 - \mathcal{E}_2 = 2R_1 (I_1 + I_2)$

- M_2: direita

$\mathcal{E}_2 + R_2 I_2 - R_1 I_3 - \mathcal{E}_3 - R_1 I_3 = 0$

$\Rightarrow \mathcal{E}_2 - \mathcal{E}_3 + R_2 I_2 - 2R_1 I_3 = 0$

$\Leftrightarrow \mathcal{E}_2 - \mathcal{E}_3 = 2R_1 I_3 - R_2 I_2$

$\Leftrightarrow \mathcal{E}_2 - \mathcal{E}_3 = 2R_1 I_3 - 2R_1 I_2 = 2R_1 (I_3 - I_2)$

$$\begin{cases} I_1 = I_2 + I_3 \\ \varepsilon_1 - \varepsilon_2 = 2R_1(I_1 + I_2) \\ +\varepsilon_2 - \varepsilon_3 = 2R_1(I_3 - I_2) \end{cases}$$

$$\begin{cases} --- \\ -2 = 2(I_1 + I_2) \\ 0 = 2R_1(I_3 - I_2) \end{cases} \Rightarrow \begin{cases} I_1 = I_2 + I_3 \\ -1 = I_1 + I_2 \\ I_3 = I_2 \end{cases}$$

$$\Leftrightarrow \begin{cases} I_1 = 2I_2 \\ -1 = 2I_2 + I_2 \\ I_3 = I_2 \end{cases} \Leftrightarrow \begin{cases} I_2 = \frac{1}{3} \\ I_2 = I_3 \end{cases}$$

$I_2 = I_3 = 0,33 \qquad I_1 \simeq 0,66$

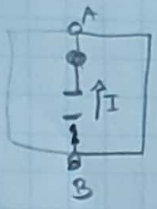
B "Do cima" para baixo"

D "Do baixo" para cima"

$$V_A - V_B = \varepsilon_2 - R_2 I_2 = \underline{\underline{3,34}}$$

5

P5| $\mathcal{E} = 12\,V$ $\quad R_i = 0{,}040\,\Omega$ $\quad I = 50\,A$



$$V_{AB} = \mathcal{E} + RI$$
$$= 12 + 0{,}040 \times 50$$
$$= 14\,V$$

b| $P_{dissipada} = V_{ßm} I = I \times IR = 50^2 \times 0{,}040$
$$= \underline{\underline{100}}\,W$$

c| $P_{fornecida} = \mathcal{E} I = 12 \times 50 = \underline{\underline{600}}\,W$

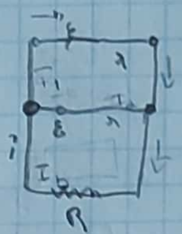
d| Depois de usada

- $V_{Bateria} = \mathcal{E} - RI = 10\,V$

- $P_{dissipado} = VI = \underline{\underline{100}}\,W$

42| $\mathcal{E} = 12{,}0\,V$ $\quad r = 0{,}200\,\Omega$ $\quad R = 2{,}00\,\Omega$
$= 0{,}4$

a|



$$\begin{cases} I_b = I_1 + I_2 \\ -RI + \mathcal{E} - rI_2 = 0 \\ -RI + \mathcal{E} - rI_1 = 0 \end{cases} \quad I_2 = I_1$$
$$\mathcal{E} - rI_1 - \mathcal{E} + rI_2 = 0$$

Não sei fazer calculos

b| $-RI + \mathcal{E} - rI + \mathcal{E} - rI = 0$

$\Leftrightarrow -2ri\,I + 2\mathcal{E} - 2rI = 0$

$\Leftrightarrow 2\mathcal{E} = 4rI$

$\Leftrightarrow I = \dfrac{2\mathcal{E}}{4r} = \dfrac{\mathcal{E}}{2r} = \underline{\underline{30}}\,A$

c| Em série.

$R = \frac{r}{2}$ $I = I_1 + I_2$

?

$$\begin{cases} -RI + \mathcal{E} - rI_1 = 0 \\ -RI + \mathcal{E} - rI_2 = 0 \\ +\mathcal{E} - rI_1 + rI_2 - \mathcal{E} = 0 \end{cases}$$

Não sei fazer cálculos

e)

$-RI + 2\mathcal{E} - 2rI = 0$

$\Leftrightarrow 2\mathcal{E} = I(2r + R)$

$\Leftrightarrow I = \frac{2\mathcal{E}}{2r + \frac{R}{2}} = 48A$

b) Maior om

53)

$R_V = 300\,\Omega$ $R_A = 3{,}00\,\Omega$

$R_0 = 100\,\Omega$ $\mathcal{E} = 12V$ $R = \frac{V}{i}$

• Se $R = 85\,\Omega$

$$\begin{cases} \text{Malha central: } -Ri - R_A i - R_0 I_0 + \mathcal{E}_0 = 0 \Rightarrow \mathcal{E} = R_0 I_0 + (R + R_A)i \\ \text{Malha sup: } -Ri - R_A i + R_V I_1 = 0 \Leftrightarrow i(R + R_A) = R I_1 \\ I_0 = i + I_1 \end{cases}$$

• $-R I_1 - R_0 I_0 + \mathcal{E}_0 = 0$

$\Leftrightarrow \mathcal{E}_0 = R I_1 + R_0 I_0$

Ver Melho ??

• $i(R + R_A) = R_V I_1$

$\Leftrightarrow i = \frac{300}{3 + 85} I_1 \Rightarrow i = 3{,}40 I_1$

$\mathcal{E} = R_0 I_0 + (R + R_A)i$

$I_0 = i + I_1 = i + \frac{1}{3{,}40} i = 1{,}30 i$

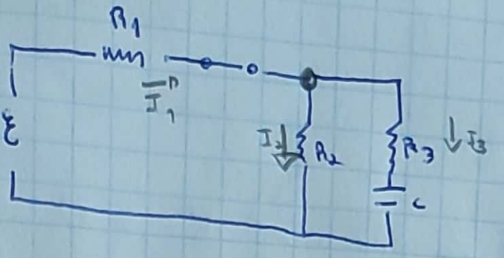
$\Leftrightarrow 12 = 100 \times 1{,}30 i + (88) i$

$\Leftrightarrow i = 0{,}055$

b) $I_1 = 0{,}187$

$V = V_{AB} = + Ri + R_A i = 4{,}84V$

65)



$\mathcal{E} = 1,2\ kV = 1,2 \times 10^{3}\ V$

$C = 6,5\ \mu F = 6,5 \times 10^{-6}\ F$

$R_1 = R_2 = R_3 = 0,73\ M\Omega = 0,73 \times 10^{6}\ \Omega$

<u>Nó</u> $I_1 = I_2 + I_3$

<u>M esq</u>

$+\mathcal{E} - R_1 I_1 - R_2 I_2 = 0 \Rightarrow \mathcal{E} - R(I_1 + I_2) = 0$

<u>M dir</u>

$-R_3 I_3 + R_2 I_2 = 0 \Rightarrow \Rightarrow R(I_2 - I_3) = 0$

$\Rightarrow I_2 = I_3$

<u>M centro</u>

$\mathcal{E} - R_1 I_1 - R_3 I_3 = 0 \Rightarrow \mathcal{E} - R(I_1 + I_3) = 0$

$\Rightarrow \mathcal{E} = R(I_1 + I_3) = 0$

$$\begin{cases} \mathcal{E} - R_1 I_1 - R_1 (I_1 - I_3) = 0 \\ \mathcal{E} - R_1 I_1 - R_1 I_3 = 0 \end{cases}$$

$$\begin{cases} \mathcal{E} - R_1 (I_1 + I_1 - I_3) = 0 \\ \mathcal{E} = R_1 (I_1 + I_3) \cancel{= 0} \end{cases}$$

$R_1(I_1 + I_3) - R_1(I_1 + I_1 - I_3) = 0$

$\Leftrightarrow R_1(I_1 - 2I_1 + 2I_3) = 0$

$\Leftrightarrow \boxed{+I_1 = 2I_3}$

- $\mathcal{E} = R(I_1 + I_3)$

$\Leftrightarrow \frac{\mathcal{E}}{R} = 2I_3 + I_3$

$\Leftrightarrow I_3 = 0,55\ mA = I_2$

$I_1 = 2 \times I_3 = 1,1\ mA$

cont. ex ex 81

$t \to \infty$, condensador carregado

$V_c \neq 0$ e V_c Max $\Rightarrow I_3 = 0$

Nó

$I_1 = I_2 + I_3 \Rightarrow I_1 = I_2$

$$\text{c Max} \begin{cases} M_{esq}: & \mathcal{E} - R_1 I_1 - R_2 I_2 = 0 \\ M_{dir} & R_2 I_2 - V_c = 0 \end{cases}$$

$$\mathcal{E} = R(I_1 + I_1)$$

$$\Leftrightarrow I_1 = I_2 = \frac{\mathcal{E}}{2R} = 0{,}82\ mA$$

$$V_c = R_2 I_2 \approx \underline{600}$$

• Quando I_3 existe e $0 < V_c < 00$

Mas quando $R_2 I_2 - R_3 I_3 - V_c = 0$

$$R_2 I_2 = \underbrace{R_3 I_3 (+)}_{\text{diminui}} + \underbrace{V_c (T)}_{\text{aumenta}}$$

$t = 0$

$$R_2 I_2 = 400$$

S3) a) $R^s = \frac{-(R + RA)\, I}{i} = 88{,}8$

se RA diminui, $R^s \approx R$

$R = \frac{VR}{i} = \frac{V_{uy}}{i}$ $\quad R^s = \frac{V_{AB}}{i} = \frac{V_{uy} + V_{RA}}{i}$

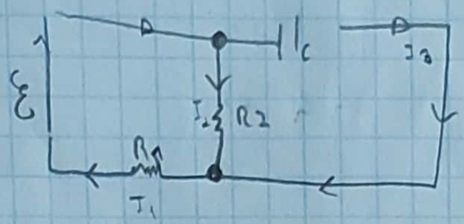
para $R = R^s$ então $V_{RA} = 0$

$$\boxed{V_A = R_A I}$$

$\hookrightarrow$ logo RA diminui.

67 $R_1 = 10,0 K\Omega$ $R_2 = 15 k\Omega$ (S)

$C = 0,400 \mu F$ $\mathcal{E} = 20,0 V$



$I = \frac{V_F}{R}$

t = 0 C está carregado

$I(t) = I_{max} e^{-\frac{t}{RC}}$

• t = 0 $I_2 = 0$ $I_3 = I_1$

$\mathcal{E} - R_1 I - R_2 I = 0$

$(=) I = \frac{\mathcal{E}}{R_1 + R_2} = \frac{20}{25 \times 10^3} = 8 \times 10^{-4}$

$= 0,8 \text{ mA}$

$V = I \times R$

$\Rightarrow V_{max} = I \cdot R_2 = 8 \times 10^{-4} \times 15 \times 10^3 = 12 V$

$I(4ms) =$

??

goes brhhh

39 a   Q7

1

Ficha 8

Q3

a) Não, o vetor força não é perpendicular ao vetor velocidade.

b) Sim, tanto o vetor velocidade como o vetor campo magnético são perpendiculares ao vetor força.

c) Não, o vetor força não é perpendicular ao vetor campo magnético.

Q8

$|\vec{E}| = 1{,}50\ k\ V/m = 1\ 500\ V/m$

$|\vec{B}| = 0{,}400T$

$\vec{F_R} = \vec{F_e} + \vec{F_B}$ $\vec{F_R} = 0$

$|\vec{F_e}| = |\vec{F_B}|$

$\Leftrightarrow |\vec{q}|\,|\vec{E}| = |\vec{q}|\,|\vec{v}|\,|\vec{B}|\ \text{sen}\ \alpha$

$\Leftrightarrow |\vec{v}| = \dfrac{|\vec{E}|}{|\vec{B}|\ \text{sen}\ \alpha}$

como são perpendiculares $\alpha = 90°$

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

$\Leftrightarrow |\vec{v}| = \dfrac{1\ 500}{0{,}400\ T}\ V/m = 3{,}750 \times 10^3\ m/s$

Q7

a) A carga é negativa.

b) Igual

c) $F_m = \vec{F_L} \Rightarrow q\,v\,B\ \text{sen}\,90 = m\dfrac{v^2}{R}$

$\Rightarrow v = \dfrac{R\,q\,B}{m}$, $x = vt$, $\pi R = vT$

d) $\Rightarrow T = \dfrac{\pi m}{qB}$ Igual

$R = \dfrac{m\ 0{,}5\ v_{ant}}{q\,B} = 0{,}5\ R_{inicial}$

Tempo igual, Raio menor.   igual ao Ø

P17)

$E_c = 1{,}20\ keV$ $\qquad r = 25{,}0\ cm = 25\times10^{-2}\ m$

$= 1{,}92\times10^{-16}\ J$ $\qquad m = 9{,}1\times10^{-31}\ kg$

$E_c = \frac{1}{2} m v^2 \Rightarrow v^2 = 4{,}22\times10^{14}$

$\Rightarrow v = \pm\sqrt{4{,}22\times10^{14}} = 2{,}05\times10^{7}\ m/s$

b)

$\vec{F}_r = 0 = \vec{F}_m + \vec{F}_c$

$|\vec{F}_m| = |\vec{F}_c|$ $\qquad q = 1{,}6\times10^{-19}$

$\Leftrightarrow q\ v\ B\ \operatorname{sen}\alpha^{90} = m\frac{v^2}{R}$

$\Leftrightarrow B = \frac{m\ v^{\cancel{2}}}{R\ q\ \cancel{v}}$

$\Leftrightarrow B = 4{,}66\times10^{-4}\ T$

c)

$d = v\ t$

$2\pi r = v t$

$\Leftrightarrow t = \frac{2\pi r}{v} = 7{,}66\times10^{-8}$

$F = 1{,}31\times10^{7}\ Hz$

d)

$t = 7{,}66\times10^{-8}\ s$

P24)

$|\vec{B}| = 4{,}00\ mT$ $\qquad |\vec{F}_m| = 3{,}20\times10^{-15}\ N$

$|\vec{F}_m| = q\ v\ B\ \operatorname{sen}\alpha$ $\qquad \alpha = 90°$

$\Leftrightarrow 3{,}20\times10^{-15} = 1{,}6\times10^{-19}\times v\times4\times10^{-3}$

$\Leftrightarrow v = 5\times10^{6}\ m/s$

b) $|\vec{F}_m| = |\vec{F}_c| \Rightarrow 3{,}20\times10^{-15} = m\frac{v^2}{R} \Rightarrow R = 7{,}11\times10^{-3}$

$d = vT$

$\Leftrightarrow 2\pi r = vT \Leftrightarrow T = \frac{2\pi r}{v} \simeq 8{,}93\times10^{-9}\ s$

P39

$m = 13{,}0\,g$ $\quad L = 62{,}0\,cm = 62\times10^{-2}\,m$

$|\vec{B}| = 0{,}440\,T$

? $\vec{F_R} = 0$ $\quad |\vec{F_m}| = |\vec{P}|$

$\Leftrightarrow |I|\,|\vec{L}|\,|\vec{B}|\ \text{sen}\,\alpha = m\,g$

$\Leftrightarrow I\,L\,B = mg$

$\Leftrightarrow I = 0{,}46\,A$

b) Anti horário.

P44

$m = 24{,}1\,mg = 24{,}1\times10^{-3}\,g$

$d = 2{,}56\,cm = 2{,}56\times10^{-2}\,m$

$|\vec{B}| = 56{,}3\,mT = 56{,}3\times10^{-3}\,T$

$t = 0 \quad i = 9{,}13\,mA = 9{,}13\times10^{-3}\,A$

$t = 61{,}1\,ms = 61{,}1\times10^{-3}\,s \quad v = ?$

$|\vec{F_m}| = I\vec{L}\vec{B}$

$= I\,|\vec{L}|\,|\vec{B}|\ \text{sen}\,90$

$= I\,L\,B = 1{,}32\times10^{-5}$

$|\vec{F_m}| = m\,a$

$\Leftrightarrow a = 5{,}48\times10^{-4}\,m^2/s$

$v(t) = a\,t$

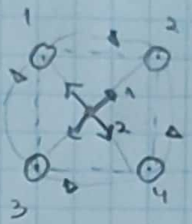
$\Rightarrow v(61{,}1\times10^{-3}) \simeq 3{,}35\times10^{-5}\,m/s$

? $\Rightarrow$ b) Direita para a esquerda.

Ficha 9 Q 8 Q 11

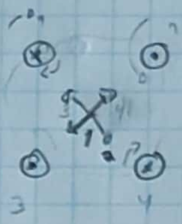
1)

a)



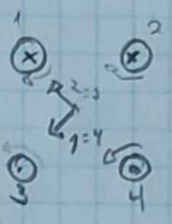
$|B| = 0$

B)

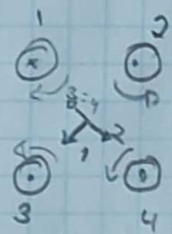


$|B| = 0$

C)

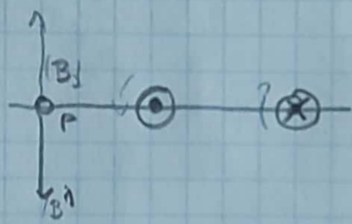


D)



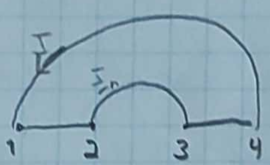
$|B|_C > |B|_D > |B|_B = |B|_A$

Q a)



• Deve ser para dentro do papel e $i_2 > i_1$ pois o fio 2 encontra-se a uma distância maior do ponto P.

P6) $R_2 = 7,80 \times 10^{-2}$ m
$R_1 = 3,15 \times 10^{-2}$ m $\theta = 180$ $i = 0,281$ A



$|B_{1 \to 2}| = |B_{3 \to 4}| = 0$

$$|B|_{2 \to 3} = \frac{1}{2} \frac{\mu_0 I}{2\pi r_1} = \frac{1}{4} \times \frac{\mu_0 I}{\pi r_1} = \frac{10^{-7}}{r_1} I = 8,92 \times 10^{-7}$$

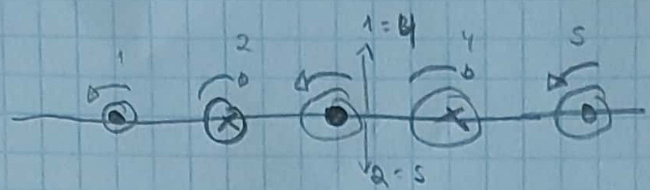
$$|B|_{1 \to 4} = \frac{1}{2 \cdot 2\pi} \times \frac{\mu_0 I}{r_2} = 3,60 \times 10^{-7}$$

$$|B| = 1,25 \times 10^{-6}$$

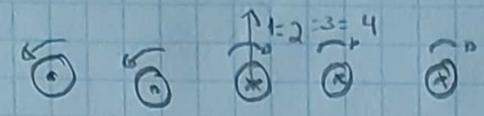
b) Dentro da folha.

6

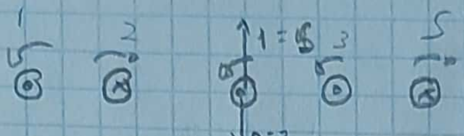
a)



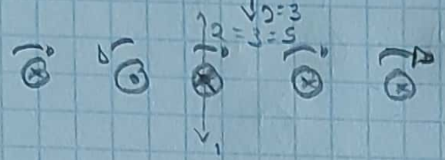
b)



c)



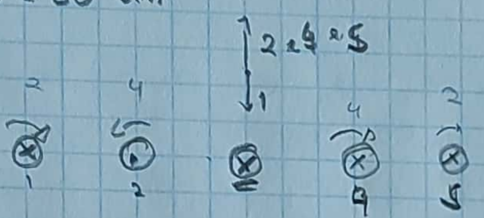
d)



$|F|_b > |F|_d > |F|_c > |F|_a$

37)

$d = 50$ cm



$i_1 = 2$
$i_3 = 0{,}250$
$i_4 = 4$
$i_5 = 2$
$i_2 = 4$

$F = I_3 \cdot |\vec{L}_3| \times |B| \times \operatorname{sen}(I_3 L_3, B)$

$|B_1| = \frac{\mu_0 I_1}{2\pi \times 2d} = \frac{\mu_0 I_1}{4\pi d} = 4 \times 10^{-7}$

$|B_2| = \frac{\mu_0 I_2}{2\pi d} = 1{,}6 \times 10^{-6}$

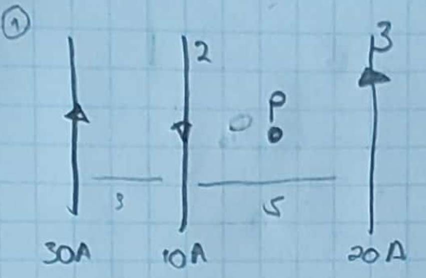
$|B_4| = \frac{\mu_0 I_3}{2\pi d} = 1{,}6 \times 10^{-6}$

$|B_5| = \frac{\mu_0 I_4}{2\pi \times 2d} = 4 \times 10^{-7}$

$|\vec{B}_p| = |B_2| + |B_4| = 2 \times 1{,}6 \times 10^{-6} = 3{,}2 \times 10^{-6}$

$|F| = 0{,}250 \times 3{,}2 \times 10^{-6} = \underline{8 \times 10^{-7}}$

Extra 1



$I_1 = 30\ A$
$I_2 = 10\ A$
$I_3 = 20\ A$

No ponto B

1 → ⊗   2 → ⊙   3 → ⊙

$$|\vec{B}_1| = \frac{\mu_0 I_1}{2\pi r} = \frac{\mu_0 \times 30}{2\pi \times 5{,}5 \times 10^{-2}} = 1{,}1 \times 10^{-4} \quad (-k)$$

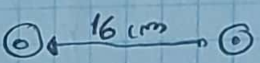
$$|\vec{B}_2| = \frac{\mu_0 I_2}{2\pi r} = \frac{\mu_0 \times 10}{2\pi \times 2{,}5 \times 10^{-2}} = 8 \times 10^{-5} \quad (+k)$$

$$|\vec{B}_3| = \frac{\mu_0 I_3}{2\pi r} = \frac{\mu_0 \times 20}{2\pi \times 2{,}5 \times 10^{-2}} = 1{,}6 \times 10^{-4} \quad (+k)$$

$$|\vec{B}| = 1{,}3 \times 10^{-4}\ T$$

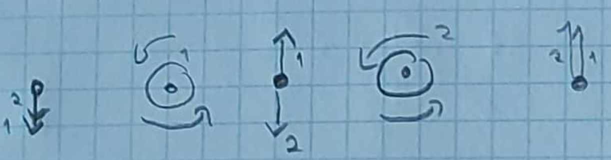
Extra 2

$I_1 = 3{,}61$ e $I_2 = 3I_1$



a) será entre os 2 fios. *

b) Não.



(*) $|B_1| = |B_2|$

$$\Leftrightarrow \frac{\cancel{\mu_0} I_1}{2\pi a} = \frac{\cancel{\mu_0} I_2}{2\pi (d - a)}$$

$$\Leftrightarrow \frac{I_2}{I_1} = \frac{d - a}{a}$$

$$\Leftrightarrow \frac{3 I_1}{I_1} a = d - a \Leftrightarrow 3a + a = d$$

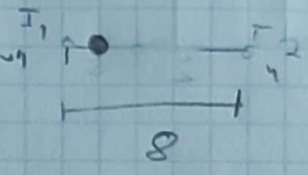
$$\rightarrow \Leftrightarrow a = \frac{16}{4}$$

$$\Leftrightarrow a = 4\ cm$$

Extra 3

a) $d = -3$ cm $\quad |\vec{B}| = 0 \quad I_2 = 6$ A

$|B_1| = |B_2|$



$\Leftrightarrow \frac{\cancel{\mu_0} I_1}{\cancel{2\pi}\, 1\times10^{-2}} = \frac{\cancel{\mu_0} I_2}{\cancel{2\pi}\times 7\times10^{-2}}$

$\Leftrightarrow I_1 = \frac{6\times1\times10^{-2}}{7\times10^{-2}} = \frac{6}{7} \approx \underline{\underline{0,86 \text{ A}}}$

b) $|F_{1-2}| = I_2 \times I_1 \times \frac{\mu_0}{2\pi\times8\times10^{-2}} L = 1,29\times10^{-5} L$

$|F_{2-1}| = I_1 \times I_2 \frac{\mu_0}{2\pi\times8\times10^{-2}} L = 1,29\times10^{-5} L$

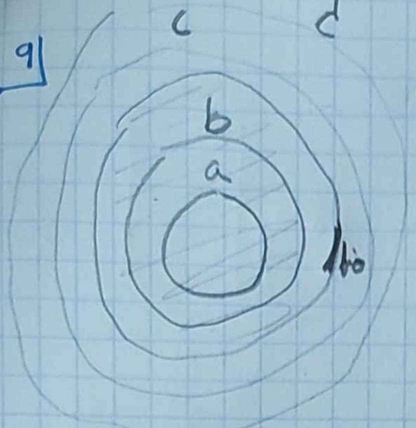
$\frac{|F_1|}{l} = \frac{|F_2|}{l} = 1,29\times10^{-5}$ N

Q8)

a)

9

③



$$\oint B \cdot d\ell = \mu_0 I_{mc}$$

$I_{md} = I$
$I_{mc} = I$ } o fio encontra-se dentro

$J = \text{constante} = \frac{I}{A_{rea}}$

$$\frac{I}{\pi r^2} = \frac{I^S}{\pi a^2} \Rightarrow I^S = I \frac{\cancel{\pi} a^2}{\cancel{\pi} r^2}$$

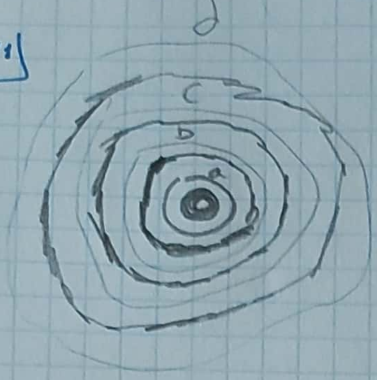
$r_b > r_a \Rightarrow r_b^2 > r_a^2$

logo

$I_{m_b} > I_{mc\,a}$

R: $I_{mc\,d} = I_{mc\,c} > I_{m_b} > I_{mc\,a}$

Q11



4 A ⊙

9A ⊗

5 A ⊙

3A ⊗

$\oint |\vec{B}|\,|\vec{s}|$ × cos

$= \oint |\vec{B}|\,|\vec{ds}|$

$= \oint \frac{\mu_0 I}{2\pi} |ds| = \frac{\mu_0 I}{2\pi} \times A$

ⓐ 4

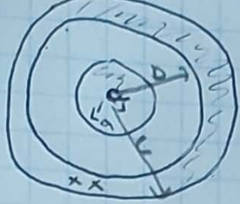
ⓑ $9 - 4 = 5$

ⓒ $9 - 4 - 5 = 0$

D $9 + 3 - 4 + 5 = 3$

$\boxed{B > a > d > c}$

Extra



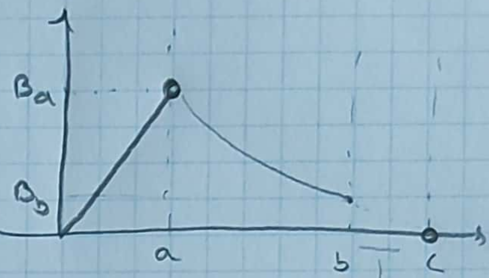
$$\oint \vec{B} \cdot \vec{dl} = \mu_0 \, I_{enc} \qquad |B_p| = \frac{\mu_0 I}{2\pi r}$$

$$\Leftrightarrow \oint |B||dl| \cos(0) = \mu_0 I_{enc}$$

$$\Leftrightarrow B \oint dl = \mu_0 I_{enc}$$

$$\Leftrightarrow B \, 2\pi r = \mu_0 I_{enc}$$

$$\Leftrightarrow \boxed{B = \frac{\mu_0 I_{enc}}{2\pi r}}$$



entre b e c, a dependência é não se sabe representar corretamente

$\boxed{r < a}$

$$I - \pi a^2$$
$$I_{enc}? - \pi r^2$$

$$I_{enc} = \frac{I \times \cancel{\pi} r^2}{\cancel{\pi} a^2}$$

$$B \, 2\pi \cancel{r} = \frac{\mu_0 I \times \cancel{\pi} r^{\cancel{2}}}{\cancel{\pi} a^2}$$

$$\Leftrightarrow B = \frac{\mu_0 I}{a^2 \times 2\pi} \times r$$

→ constante

$\boxed{b < r < c}$

$$B \, 2\pi r = \mu_0 I_{enc}$$

$$\circ \; I_{en} = I_{fio} + I^s$$

$$J = \frac{I_0}{A_{fio}} = \frac{I_0}{\pi(c^2 - b^2)}$$

$$\Leftrightarrow I_0^s = \frac{r^2 - b^2}{c^2 - b^2} \times I_{fio}$$

$\boxed{r = a}$

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

$\boxed{a < r < b}$

$$B \, 2\pi r = \mu_0 I$$

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

constante

$$B \, 2\pi r = \mu_0 I_{enc}$$

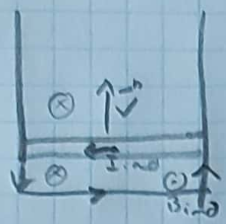
$$\Leftrightarrow B = \frac{\mu_0}{2\pi r} \frac{((r^2 - b^2) + I_0 \ldots)}{(c^2 - b^2)}$$

$$= \frac{\mu_0}{2\pi r} \times I \left(1 - \frac{r^2 - b^2}{c^2 - b^2}\right)$$

$$\begin{cases} r = b = 2a \Rightarrow B = \frac{\mu_0 I}{2\pi r} \\ r = c \Rightarrow B = \frac{\mu_0}{\ldots} I (1 - 1) = 0 \end{cases}$$

Ficha 10 (1)

(2)



a) Para baixo.

b) Sentido contihorário

c)

$$\mathcal{E} = \frac{d \int B \, dA}{dT}$$

$$= B \times \frac{d(A)}{dt}$$

$$= B \times \frac{dA}{dt}$$

como $A_1 > A_2$ então $\mathcal{E}_1 > \mathcal{E}_2$

5) $n = 120$ $r = 1,8 \text{ cm} = 1,8 \times 10^{-2}$ m

$R = 5,3\,\Omega$

solenoide $= 220$ espiras / cm

$r = \frac{3,2}{2} \times 10^{-2}$ m $= 1,2 \times 10^{2}$

$I = 1,5A \to 0$

$\Delta t = 25$ ms

$$\left| B_{\substack{\text{interior} \\ \text{solenoide}}} \right| = \mu_0 \, n \, I_{\text{solenoide}}$$

$$\left| B_{\substack{\text{int} \\ \text{solenoide} \\ f}} \right| = 0$$

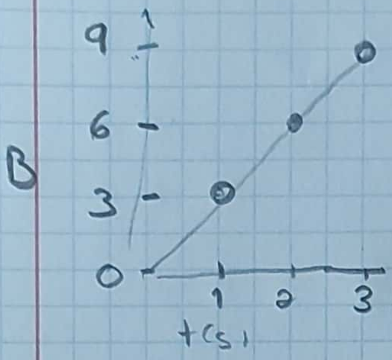
$$\left| B_{\substack{\text{int solenoide} \\ i}} \right| = \mu_0 \times 220 \times 1,6 \times 10^{-2} \times 10^{3} \times 1,5$$

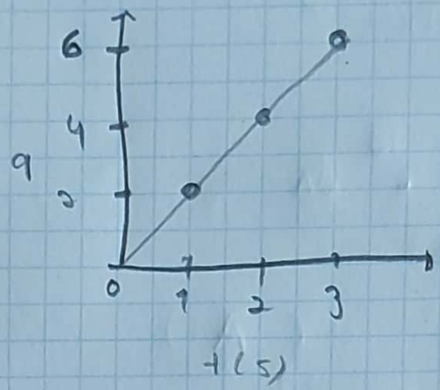
$$= 6,64 \times 10^{-3}$$

10) $B_s = 9{,}0\ mT$ $t_s = 3{,}0\ s$

$A = 8{,}0 \times 10^{-4}\ m^2$

$q_s = 6{,}0\ mC$ $t_s = 3{,}0\ s$





$V = R\,I$ $I = \frac{q}{t} = \frac{6}{3} = 2$

$B(t) = 3t$

$$|\mathcal{E}_{ind}| = \frac{d(\int B \cdot dA)}{dt} = \frac{d(A \times B)}{dt}$$

$$= \frac{d(3t)}{dt} A$$

$$= 3 \times 8{,}0 \times 10^{-4}$$

$$|\mathcal{E}_{ind}| = R\,I$$

$$\Rightarrow R = \frac{3 \times 8{,}0 \times 10^{-4}}{2} = 1{,}2 \times 10^{-3}\ m$$

P17

Bobina $n = 100$ espiras

$A = 50 \times 10^{-2} \times 30 \times 10^{-2} = 1500 \times 10^{-4}$

$= 0,15 \ m^2$

$B = 3,50 \ T$

Gira 1000 revoluções / min

$$|\varepsilon_{ind}| = \frac{d \Phi_m}{dt}$$

11) $A = 4\ m^2$ $A = 2\ m^2$

↳ dentro do campo

$\varepsilon = 20\ V$

$B = 0{,}0420 - 0{,}870t$

$$|\varepsilon|_{ind} = -\frac{d\left(\int \vec{B}^n \cdot \vec{dA}^0\right)}{dt}$$

$$= -\frac{d\left(\int |B| \times |dA| \times \cos 0\right)}{dt}$$

$$= -\frac{d\,(B \times A)}{dt} = A \times \frac{dB}{dt}$$

$$= -\frac{d\,(0{,}0420 - 0{,}870t)}{dT} \times A$$

$$= -A \times (-0{,}870)$$

$$= 2 \times 0{,}870 = 1{,}74$$

$V = \varepsilon + \varepsilon_{ind}$

$= 20 + 1{,}74 = 21{,}74\ V$

B) Antihorário

Extra 1

$l = 1{,}0\,m \qquad a = 50 \times 10^{-2}\, m$

$|\vec{B}| = 0{,}8\,T \qquad \Delta t = 0{,}1\, s$

$\Delta \phi m = \phi f - \phi i$

$\phi i = \int |B| \times ds \times \underbrace{\cos(90)}_{0} = 0$

$\phi f = \int |B| \times ds \times \cos(0) =$

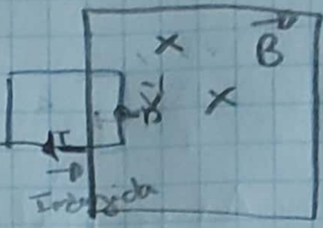
$= B \times A = 0{,}8 \times 50 \times 10^{-2} \times 1$

$= 0{,}4$

$\Delta \phi = 0{,}4\, T$

$|\varepsilon\, ind| = \frac{\Delta \phi}{\Delta T} = \frac{0{,}4}{0{,}1} = 4\, V$

Extra 2



Anti-horário

b) Travar

c) $I = 0$ Força não afetará a velocidade

$F = 0$

P33) $L = 10 \times 10^{-2}$ m $\quad v = 5$ m/s

$B = 1,2$ T

$x = vt$

$$|\mathcal{E}| = \frac{d\,(\int B\, dA)}{dt}$$

$$= \frac{d\,(BA)}{dt} = \frac{d\,(B \times (L\, vt))}{dt}$$

$$= B\,L\,v = 0,6\,V$$

b) horário

c) $R = 0,4\,\Omega$

$$R = \frac{V}{I} \qquad I = \frac{V}{R} = 1,5\,A$$

d) $B\,I\,L = F_{ext}$

$\Rightarrow F_{ext} = 0,18\,N$