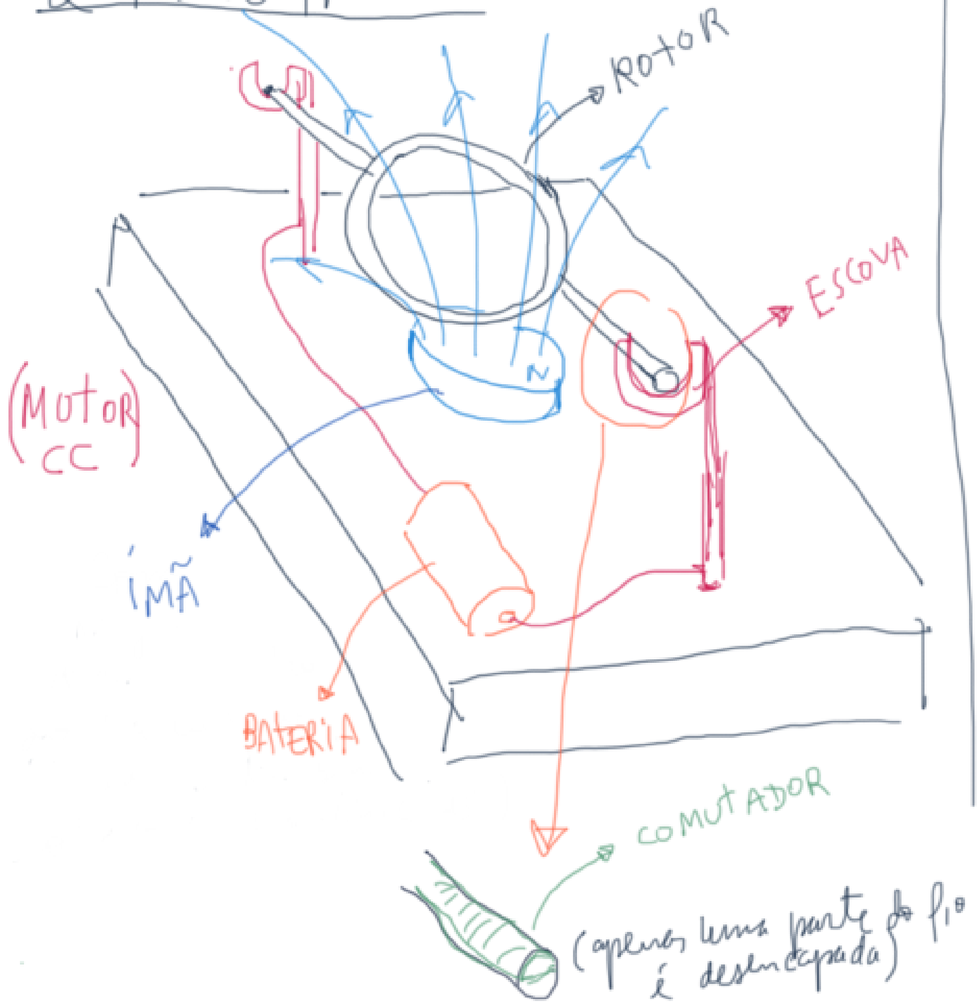
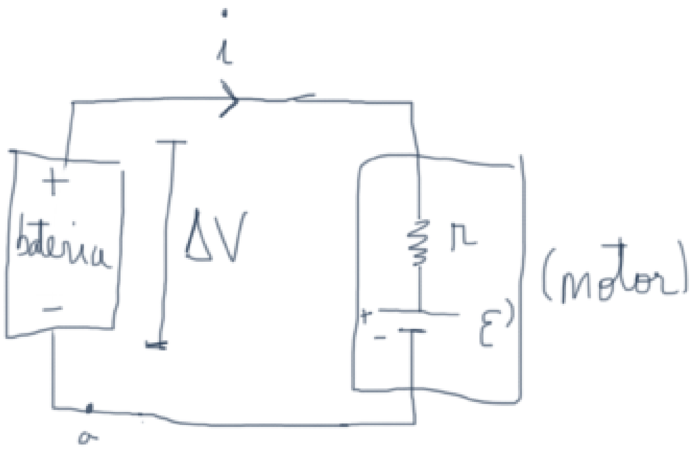
Continuação exercício
motor elétrico simples

27.48, p.236





ε' = f.e.m. induzida = 105 V

$r = 3{,}2\ \Omega$

$\Delta V = 120\text{V}$

a) $i = ?$

Começando em a:

$+\Delta V - ri - \varepsilon' = 0$

$\Delta V - \varepsilon' = ri$

$$\boxed{i = \frac{\Delta V - \varepsilon'}{r}} = \frac{120 - 105}{3{,}2} = 4{,}7\text{A}$$

b) $\boxed{P_{bateria}} = \Delta V \cdot i$

$= 120 \cdot 4{,}7$

$= \boxed{564\text{ W}}$

c) $\boxed{P_{motor}} = P_{bateria} - P_r$

$= 564 - 3{,}2 \cdot 4{,}7^2$

$= \boxed{493\text{ W}}$

$= \varepsilon' \cdot i$

Curiosidades

e = eficiência $= \frac{P_{motor}}{P_{bateria}} = \frac{493}{564} = 87\%$

$\varepsilon' \propto \omega \rightarrow$ se $\omega = 0 \rightarrow \varepsilon' = 0 \rightarrow$

$i = \frac{\Delta V}{r} = \frac{120}{3{,}2} = 38\text{ A}!$

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

Fontes de Campo Magnético

1) $\vec{B}$ de uma carga em movimento com $\vec{v}$

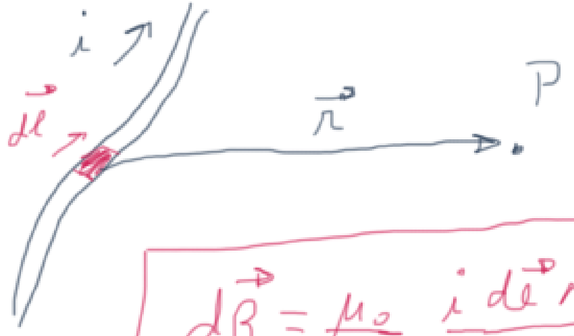
$$\vec{B} = \frac{\mu_0}{4\pi} \frac{q\,\vec{v} \wedge \hat{r}}{r^2} = \frac{\mu_0}{4\pi} \frac{q\,\vec{v} \wedge \vec{r}}{r^3}$$

$10^{-7}\ \frac{T \cdot m}{A}$

$\frac{1}{4\pi\varepsilon_0} = 9 \cdot 10^9\ \frac{N\,m^2}{C^2}$

$F = k \frac{|q_1 q_2|}{r^2}$

2) $\vec{B}$ de um elemento de corrente



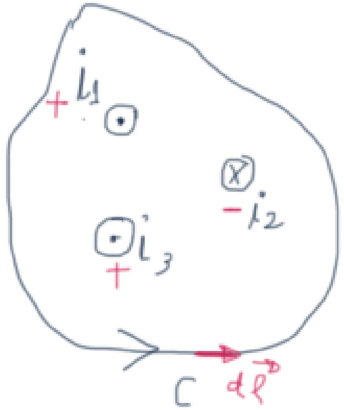
$$d\vec{B} = \frac{\mu_0}{4\pi} \frac{i\,d\vec{\ell} \wedge \hat{r}}{r^2}$$

ou

$$d\vec{B} = \frac{\mu_0}{4\pi} \frac{i\,d\vec{\ell} \wedge \vec{r}}{r^3}$$

(Lei de Biot-Savart)

3) Lei de Ampère



$$\oint_C \vec{B} \cdot d\vec{\ell} = \mu_0\, i_{int}$$

$+i_1 - i_2 + i_3$

De acordo com a regra da mão direita e o sentido do caminho C, $i_1 > 0$, $i_2 < 0$, $i_3 > 0$ e $i_{int} = i_1 - i_2 + i_3$.

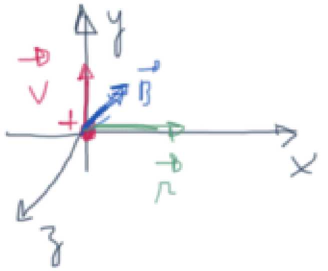
4) Origem atômica do magnetismo → domínios magnéticos → classificação dos materiais:

(Seção 28.8)

A) Ferromagnéticos (Ex: Ferro)
B) Paramagnéticos (Ex: Alumínio)
C) Diamagnéticos (Ex: Cobre)

Ex. 28.1, p. 270

$q = +6{,}0\,\mu C$



$\vec{v} = 8{,}0 \cdot 10^{6}\,\hat{j}$ (m/s)

$\vec{B} = ?$

a) $\vec{r} = 0{,}500\,\hat{i} + 0\,\hat{j} + 0\,\hat{k}$

$$\vec{B} = \frac{\mu_0}{4\pi}\,\frac{q\,\vec{v}\wedge\vec{r}}{r^3} =$$

$$= \frac{10^{-7} \cdot 6{,}0 \cdot 10^{-6} \cdot 8{,}0 \cdot 10^{6}\,\hat{j} \wedge (0{,}500\,\hat{i})}{(0{,}500)^{3}}$$

$$= 1{,}9 \cdot 10^{-5}\,(-\hat{k}) \quad (T)$$

b) $\vec{r} = -0{,}500\,\hat{j}$

$$\vec{B} = \frac{10^{-7} \cdot 6{,}0 \cdot 10^{-6} \cdot 8{,}0 \cdot 10^{6}\,\hat{j} \wedge (-0{,}500\,\hat{j})}{(0{,}500)^{3}}$$

$$\vec{B} = 0$$

c) $\vec{r} = 0{,}500\,\hat{k}$

$$\vec{B} = \frac{10^{-7} \cdot 6{,}0 \cdot 10^{-6} \cdot 8{,}0 \cdot 10^{6}\,\hat{j} \wedge (0{,}500\,\hat{k})}{(0{,}500)^{3}}$$

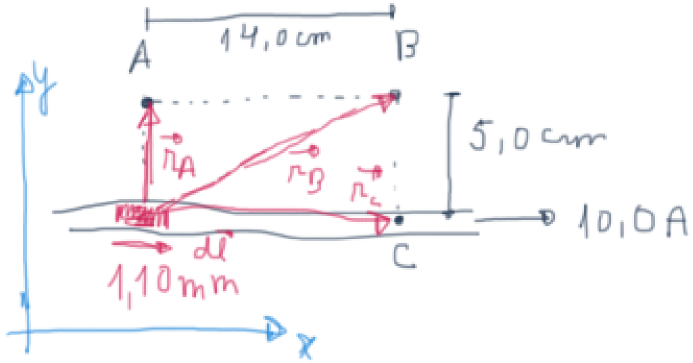
$$\vec{B} = 1{,}9 \cdot 10^{-5}\,\hat{i} \quad (T)$$

d) $\vec{r} = -0{,}500\,\hat{j} + 0{,}500\,\hat{k}$

$$\vec{B} = \frac{10^{-7} \cdot 6{,}0 \cdot 10^{-6} \cdot 8{,}0 \cdot 10^{6}\,\hat{j} \wedge (-0{,}500\,\hat{j} + 0{,}500\,\hat{k})}{\left(\sqrt{(-0{,}500)^2 + (0{,}500)^2}\right)^{3}}$$

$$\vec{B} = 6{,}8 \cdot 10^{-6}\,\hat{i}$$

Ex. 28.9, p. 271



a) $d\vec{B}_A = \frac{\mu_0}{4\pi}\,\frac{i\,d\vec{l}\wedge\vec{r}}{r^3}$ (Lei de Biot-Savart)

$d\vec{l} = 1{,}10 \cdot 10^{-3}\,\hat{i}$

$\vec{r}_A = 5{,}0 \cdot 10^{-2}\,\hat{j}$

$$d\vec{B}_A = \frac{10^{-7} \cdot 10{,}0 \cdot 1{,}10 \cdot 10^{-3}\,\hat{i} \wedge 5{,}0 \cdot 10^{-2}\,\hat{j}}{(5{,}0 \cdot 10^{-2})^{3}}$$

$$d\vec{B}_A = 4{,}4 \cdot 10^{-7}\,\hat{k}\ (T)$$

$dB_A = 4{,}4 \cdot 10^{-7}$

direção = eixo z

sentido = +z

b) $d\vec{B}_B = ?$

$$\vec{r}_B = 14{,}0\cdot 10^{-2}\,\hat{i} + 5{,}0\cdot 10^{-2}\,\hat{j}$$

$$d\vec{B}_B = \frac{10^{-7}\cdot 10{,}0\cdot 1{,}10\cdot 10^{-3}\,\hat{i}\wedge(14{,}0\hat{i}+5{,}0\hat{j})\cdot 10^{-2}}{\left(\sqrt{(14{,}0^2+5{,}0^2)(10^{-2})^2}\right)^3}$$

$$d\vec{B}_B = 1{,}7\cdot 10^{-8}\,\hat{k}\ (T)$$

$dB_B = 1{,}7\cdot 10^{-8}$

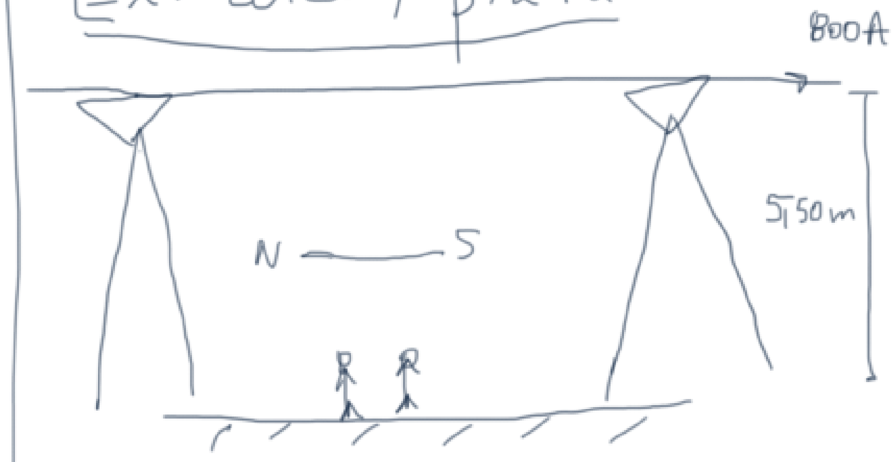
direção = z

sentido = +z

c) $d\vec{B}_C = 0$.

pois $d\vec{l} \parallel \vec{r}_C$

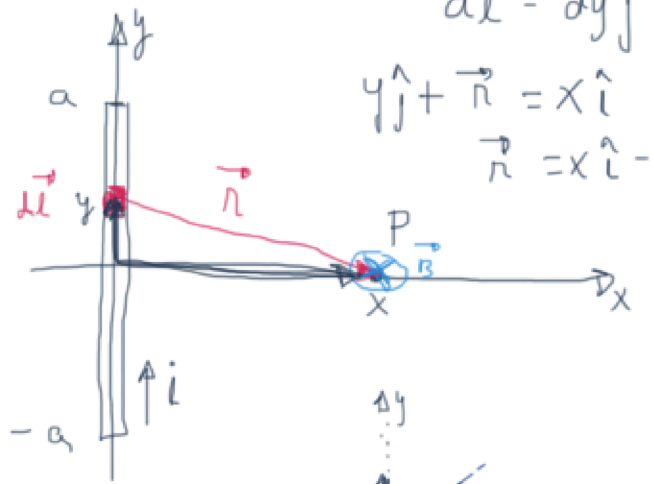
Ex. 28.20, p.272

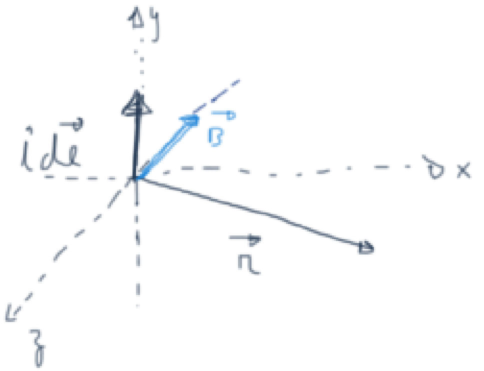


$d\vec{l} = dy\,\hat{j}$

$y\hat{j} + \vec{r} = x\hat{i}$

$\vec{r} = x\hat{i} - y\hat{j}$





$$\vec{B} = \int d\vec{B} = \int_{-a}^{a} \frac{\mu_0}{4\pi}\,\frac{i\,(dy\,\hat{j})\wedge(x\hat{i}-y\hat{j})}{\left(\sqrt{x^2+y^2}\right)^3}$$