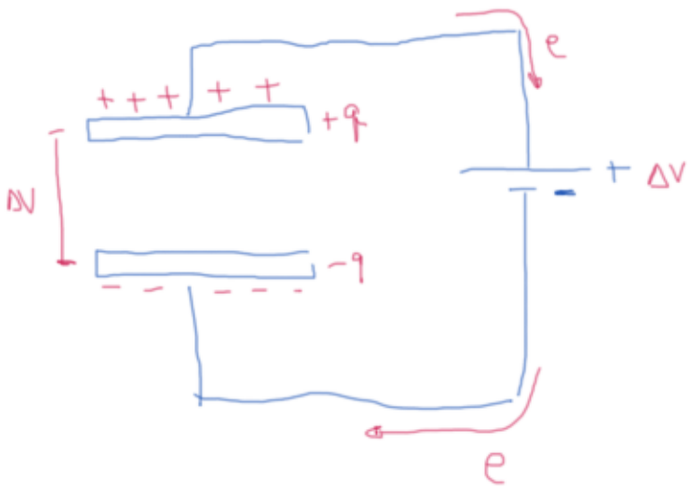
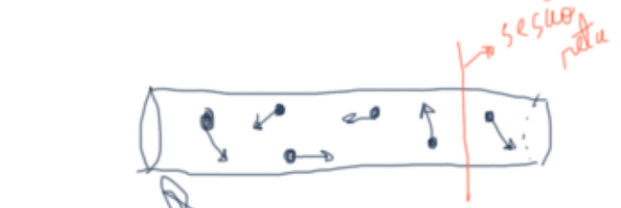
Eletrodinâmica

Corrente elétrica





movimento caótico

$\langle v \rangle \sim 10^6 \frac{m}{s}$!

"movimento 'ordenado' dos portadores de carga em um condutor"

$$q = \int_{t_0}^{t} i \, dt$$

def: $$i = \frac{dq}{dt}$$

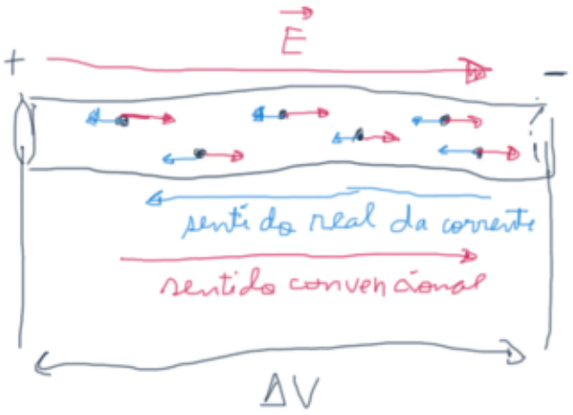
$[i] = \frac{C}{s} = A$ (ampère)

Se i = constante,

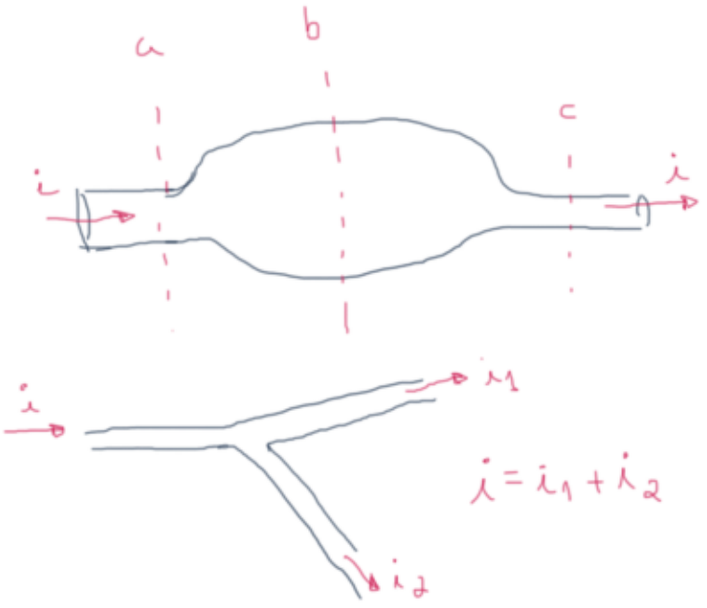
$$i = \frac{q}{\Delta t}$$

Velocidade de deriva

$v_d = ?$



$\vec{F} = -e\vec{E}$



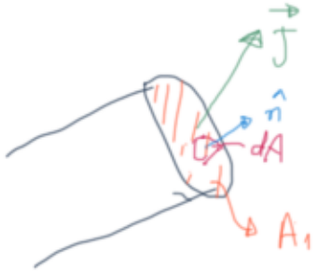
$i = i_1 + i_2$

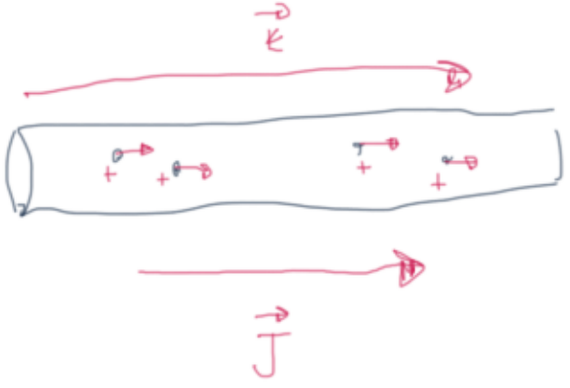
Densidade de corrente J

$$J = \frac{i}{A} \qquad [J] = \frac{A}{m^2}$$

$\vec{J}$ = constante

def: $i = \int_{A_1} \vec{J} \cdot d\vec{A}$, $d\vec{A} = dA \cdot \hat{n}$





$$\vec{J} = \sigma \vec{E}, \quad \sigma = \text{condutividade}$$

$$\vec{E} = \rho \vec{J}, \quad \rho = \text{resistividade}$$

$$\sigma = \frac{1}{\rho}$$

Velocidade de deriva (v_d)

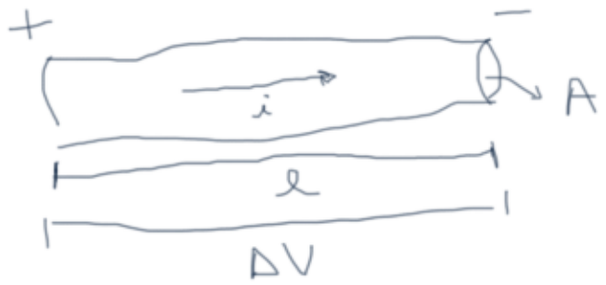
$$J = n \cdot q \cdot v_d$$

q → carga de cada portador

n → nº de portadores de carga / unidade de volume

Fio metálico: $J = n \cdot e \cdot v_d$

Resistência Elétrica



def: $R = \frac{\Delta V}{i}$, $[R] = \frac{V}{A} = \Omega$ (Ohm)

Resistência elétrica

$\Delta V = E \cdot \ell$

$E = \rho J$

$J = \frac{i}{A}$

$R = \frac{E \cdot \ell}{i} = \frac{\rho J \ell}{i} =$

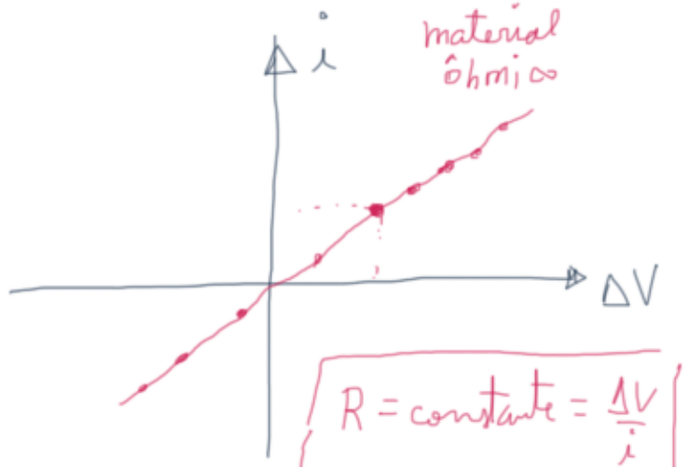
$= \rho \frac{i \ell}{i A}$

$R = \rho \frac{\ell}{A}$ ("2ª Lei de Ohm")

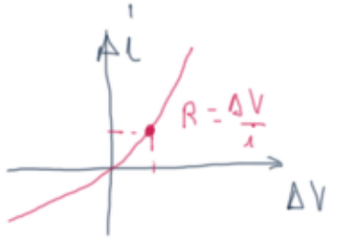
$\rho = \frac{A R}{\ell} \rightarrow [\rho] = \Omega \cdot m$

1ª Lei de Ohm

Varia $\Delta V \rightarrow$ mede i



1ª Lei de Ohm



Ex. 25.1, p. 160

$i = 3,6\ A$

$\Delta t = 3,0\ h = 3,0 \cdot 3600\ s$

$i = \frac{q}{\Delta t} \rightarrow q = i \cdot \Delta t$

$q = 3,6 \cdot 3,0 \cdot 3600$

$\boxed{q = 3,9 \cdot 10^{4}\ C}$

Ex. 25.2, p. 160

$D = 2,6\ mm \rightarrow A = \frac{\pi D^2}{4} = 5,3 \cdot 10^{-6}\ m^2$

$q = 420\ C$

$\Delta t = 80\ min = 80 \cdot 60\ s$

a) $i = \frac{q}{\Delta t} = \frac{420}{80 \cdot 60} \Rightarrow \boxed{i = 0,088\ A}$

ou

$\boxed{i = 88\ mA}$

b) $n = 5,8 \cdot 10^{28}\ \frac{\text{électrons libres}}{m^3}$

$J = n \cdot e \cdot V_d \rightarrow V_d = \frac{J}{n \cdot e}$

$J = \frac{i}{A}$ ← $V_d = \frac{i}{n \cdot e \cdot A}$

$V_d = \frac{0,088}{5,8 \cdot 10^{28} \cdot 1,6 \cdot 10^{-19} \cdot 5,3 \cdot 10^{-6}}$

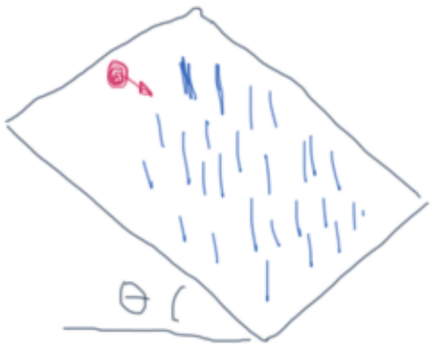
$\boxed{V_d = 1,8 \cdot 10^{-6}\ \frac{m}{s}}$

$V_d = 1,8 \cdot 10^{-4}\ \frac{cm}{s}$ / $s = \frac{1}{3600}\ h$

$\boxed{V_d = 0,65\ \frac{cm}{h}}$

ou

$\boxed{V_d = 6,5\ \frac{mm}{h}}$



25.4, p. 160

$D = 1{,}02\ mm$

$J = 1{,}50 \cdot 10^6\ \frac{A}{m^2}$

a) $J = \frac{i}{A} \rightarrow i = J \cdot A$

$A = \frac{\pi D^2}{4} = 8{,}17 \cdot 10^{-7}\ m^2$

$i = 1{,}50 \cdot 10^6 \cdot 8{,}17 \cdot 10^{-7}$

$\boxed{i = 1{,}23\ A}$

b) $V_d = \frac{J}{n \cdot e}$

Ex. 25.3 et Ex. 25.5

$n_{Cu} = 8{,}5 \cdot 10^{28}\ \frac{\text{électrons libres}}{m^3}$

$V_d = \frac{1{,}50 \cdot 10^6}{8{,}5 \cdot 10^{28} \cdot 1{,}6 \cdot 10^{-19}}$

$\boxed{V_d = 1{,}1 \cdot 10^{-4}\ \frac{m}{s}}$

ou

$\boxed{V_d = 0{,}11\ \frac{mm}{s}}$

25.7 | p. 160

$$i(t) = 55 - 0{,}65t^2 \quad (SI)$$

a) $t_0 = 0\,s$ e $t_1 = 8\,s$

$$i = \frac{dq}{dt} \rightarrow q = \int_{t_0}^{t_1} i\,dt$$

$$q = \int_0^8 (55 - 0{,}65t^2)\,dt =$$

$$= \left[55t - \frac{0{,}65t^3}{3}\right]_0^8$$

$$= 55 \cdot 8 - \frac{0{,}65 \cdot 8^3}{3}$$

$$= 3{,}3 \cdot 10^2\,C$$

b) $i_m = \frac{q}{\Delta t} = \frac{3{,}3 \cdot 10^2}{8 - 0}$

$$\boxed{i_m = 41\,A}$$

$$F = e\,E$$

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

$$\boxed{V_d = a \cdot \tau}$$