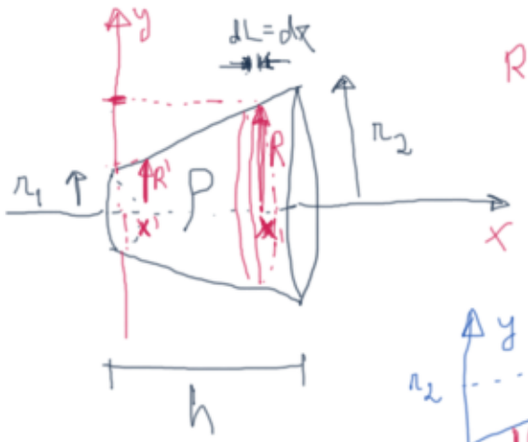
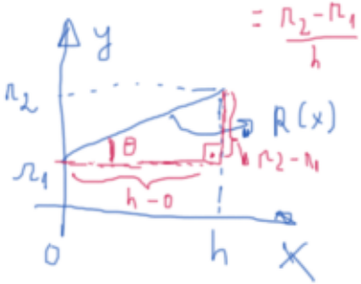
25.63, p. 164





$m = tg\theta = \frac{n_2 - n_1}{h}$

a) $R = ?$

$R = \rho \cdot \frac{L}{A}$

$R(x) = \underbrace{\frac{n_2 - n_1}{h}}_{A} \cdot x + n_1$

$R(x) = Ax + n_1$

$$\boxed{dR = \rho \frac{dL}{A}}$$

$$\int_0^R dR' = \int_{\text{Comprimento}} \rho \frac{dL}{A}$$

$$= \int_0^h \rho \frac{dx}{\pi [R(x)]^2}$$

$$R = \frac{\rho}{\pi} \int_{x=0}^{x=h} \frac{1}{(Ax + n_1)^2} dx$$

$u = Ax + n_1$

$\frac{du}{dx} = A \rightarrow du = A\,dx \rightarrow \frac{1}{A} du = dx$

$x = 0 \rightarrow u = n_1$

$x = h \rightarrow u = A \cdot h + n_1 = \frac{n_2 - n_1}{h} \cdot h + n_1$

$u = n_2$

$$R = \frac{\rho}{A\pi} \int_{n_1}^{n_2} \frac{1}{u^2} du =$$

$$= \frac{\rho}{A\pi} \int_{n_1}^{n_2} u^{-2} du$$

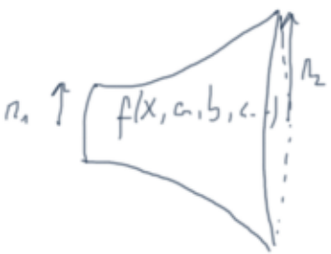
$$\int x^n dx = \frac{x^{n+1}}{n+1} + k$$

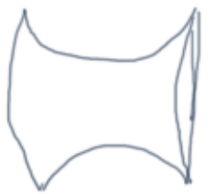
$$= \frac{\rho}{\pi A} \left[-\frac{1}{u} \right]_{n_1}^{n_2} = \frac{\rho h}{\pi (n_2 - n_1)} \left(\frac{1}{n_1} - \frac{1}{n_2} \right) =$$

$$= \frac{\rho h}{\pi (n_2 - n_1)} \cdot \frac{n_2 - n_1}{n_1 n_2} \rightarrow \boxed{R = \frac{\rho h}{\pi n_1 n_2}}$$

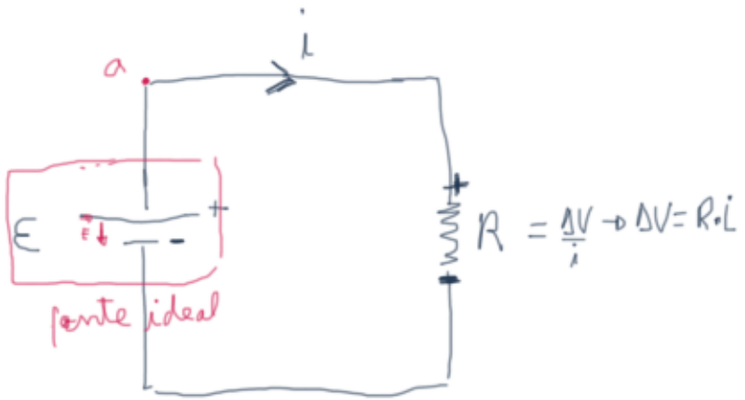
b) $n_1 = n_2 = n$ 

$R = \frac{\rho h}{\pi n^2} = \rho \cdot \frac{h}{A} \rightarrow$ cilindro

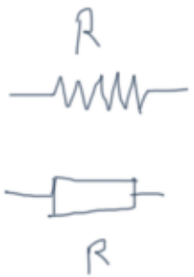




Circuitos Elétricos



$R = \frac{\Delta V}{i} \rightarrow \Delta V = R \cdot i$



ENERGIA

$$P = \Delta V \cdot i = \frac{\text{Energia}}{\Delta t}$$

potência

Na bateria ideal: $P = \varepsilon \cdot i$

No resistor: $P = Ri^2 = \frac{\Delta V^2}{R}$

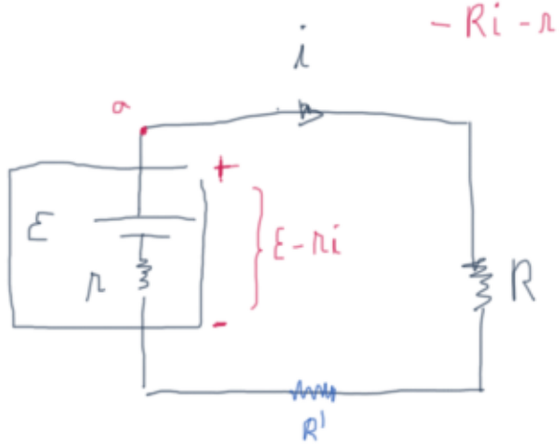
Corrente elétrica

A) Balanço energético:

$P_{bateria} = P_{resistor}$

$\varepsilon \cdot i = Ri^2 \rightarrow i = \frac{\varepsilon}{R}$

(bateria ideal)



$-Ri - ri + \varepsilon = 0$

outra forma

$P_{bateria} = P_{resistor}$

$(\varepsilon - r \cdot i)\, i = Ri^2$

$\varepsilon - ri = Ri$

$$i = \frac{\varepsilon}{R + r + R'}$$

(bateria real)

B) Balanço de Tensões

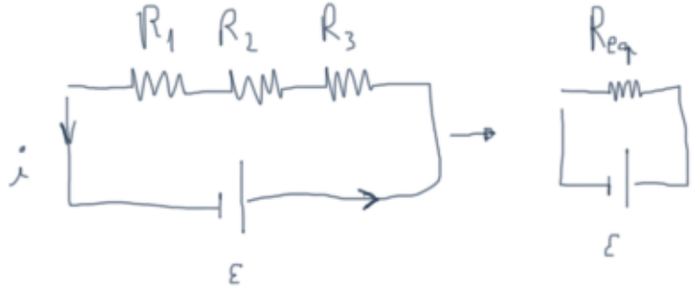
$$V_A - V_B = \oint_A^B \vec{E} \cdot d\vec{l} = \int_A^C \dots + \int_C^D \dots + \int_D^B = 0$$

Para o circuito ideal:

$-Ri + \varepsilon = 0 \rightarrow i = \frac{\varepsilon}{R}$

Associação de Resistores

Série



$$\varepsilon = \underbrace{\Delta V_1}_{R_1 \cdot i} + \underbrace{\Delta V_2}_{R_2 \cdot i} + \underbrace{\Delta V_3}_{R_3 \cdot i}$$

$$\varepsilon = (R_1 + R_2 + R_3) \cdot i$$

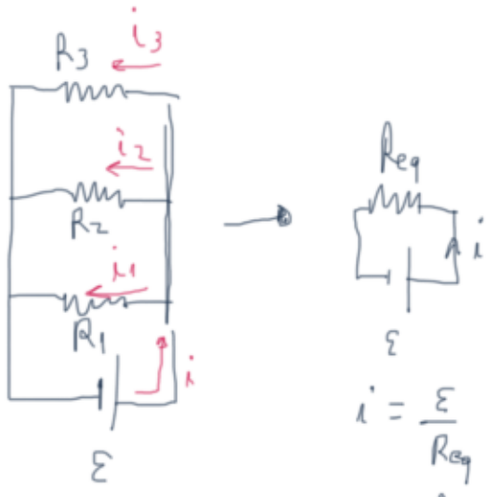
$$\varepsilon = R_{eq} \cdot i$$

$$R_{eq} = R_1 + R_2 + R_3$$

$$\boxed{R_{eq} = \sum_{j=1}^{j=N} R_j}$$

$$R = \frac{\Delta V}{i}$$

Paralelo



$$i' = \frac{\varepsilon}{R_{eq}}$$

$$i = i_1 + i_2 + i_3$$

$$= \frac{\varepsilon}{R_1} + \frac{\varepsilon}{R_2} + \frac{\varepsilon}{R_3}$$

$$= \varepsilon \left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \right)$$

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$\boxed{\frac{1}{R_{eq}} = \sum_{1}^{N} \frac{1}{R_j}}$$

25.31, p. 161

$L = 100\ km$

$A = \frac{\pi d^2}{4}$

a) $\Delta V = ?$

$\Delta V = E L$

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

$\rho_{Cu} = 1{,}72 \cdot 10^{-8}\ \Omega \cdot m$

$$\boxed{\Delta V = \rho \frac{i}{A} \cdot L}$$

$$= \frac{1{,}72 \cdot 10^{-8} \cdot 125 \cdot 100 \cdot 10^3}{\frac{\pi (10{,}0 \cdot 10^{-2})^2}{4}} = \boxed{27{,}4\ V}$$

b) $P = \Delta V . i$

$P = 27{,}4 . 125$

$\boxed{P = 3{,}42 . 10^3 \text{ W}}$

ou

$\boxed{P = 3{,}42 \text{ kW}}$

$\boxed{E_{1h} = P . \Delta t}$

$= 3{,}42 . 10^3 . 3600$

$\boxed{= 1{,}23 . 10^7 \text{ J}}$

$E_{1h} = 3{,}42 \text{ kW} . 1\text{h}$

$\boxed{E_{1h} = 3{,}42 \text{ kWh}}$