Ap#5: Corrente electrica continua e resistencia electrica

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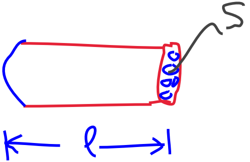
① R, ρ, σ



$R \sim \rho$;

$R \sim \ell$

$R \sim \frac{1}{S}$

$$\boxed{\rho_T = \rho_{T_0}(1 + \alpha \Delta T)}$$

$$\boxed{R_T = R_{T_0}(1 + \alpha \Delta T)}$$

$$\boxed{R = \rho \frac{\ell}{S} \; ; \; [\Omega]}$$

$$\boxed{\rho = \frac{RS}{\ell} \; ; \; \left[\frac{\Omega\, m^2}{m}\right]} \; ; \; \boxed{\sigma = \rho^{-1}}$$

$$\boxed{R = \frac{1}{\sigma}\frac{\ell}{S}}$$

Condutores
- óhmicos – $I = \frac{1}{R} V$
- não óhmicos

$I = R^{-1} V$ — lei de Ohm (integral)

$\vec{j} = \sigma \vec{E}$ — " " " (diferencial)

$$j = \frac{I}{S} \quad [A\, m^{-2}] \qquad j = \frac{di}{dS}$$

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$J = 400\,A\,cm^{-2}$

$d\,/_{I=0.5A}$?

$J = \frac{I}{S} \Rightarrow J = \frac{I}{\frac{1}{4}\pi d^2}$

$d = \left(\frac{4I}{\pi J}\right)^{1/2} \rightarrow d = 0.14\,cm$

$(1m)^2 = (10^2 cm)^2 \Longrightarrow 1m^2 = 10^4 cm^2 \rightarrow 1cm^2 = 10^{-4} m^2$

$J = 4 \times 10^6\,A\,m^{-2}$

$i_i = 0A$; $i_f = 5A$; $\Delta t = 10s$

$$\boxed{I = \frac{Q}{\Delta t}}$$

a) $Q - ?$

b) $W|_{R=10\Omega}$ — ?

$dq = I\,dt$

$\int dq = \int I\,dt$

$\frac{\Delta I}{\Delta t} = \frac{5-0}{10-0} = \frac{1}{2}\ A/s \hookrightarrow \boxed{I = 0.5t}$

$$\int_0^Q dq = \int_0^{10} 0.5t\,dt \Rightarrow \underline{Q = 25C}$$

$W = P\Delta t$.

$P = VI \Rightarrow P = RI^2$

$$\underline{W} = RI^2\Delta t = 10 \times 5^2 \times 10 = \underline{2500J}$$

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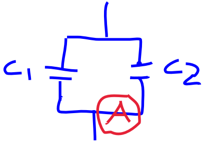

$\hookrightarrow i - ?$

$S_1 = S_2$

$\varepsilon_1 = \varepsilon_2$

$d_1 = d_0 + v_0 t \wedge d_2 = d_0 - v_0 t$

$i = \frac{dQ}{dt}$, $\underline{Q = q_1 + q_2}$

$V_1 = V_2 = V$, $\underline{Q = C V}$

$$Q = (C_1 + C_2) V \Rightarrow Q = \underbrace{\varepsilon_0 S V}_{\eta} \left[\frac{1}{d_0 + v_0 t} + \frac{1}{d_0 - v_0 t} \right]$$

$$Q = \eta \left[(d_0 + v_0 t)^{-1} + (d_0 - v_0 t)^{-1} \right]$$

$$i = \frac{dQ}{dt} = \eta \left[-v_0 (d_0 + v_0 t)^{-2} + v_0 (d_0 - v_0 t)^{-2} \right]$$

5 $R_T = R_{T_0}\left[1+\alpha(T-T_0)\right]$

$R_{T_0} = 50\,\Omega$

$T_0 = 20^{\circ}C$

$\alpha = 3.9\times10^{-3}/^{\circ}C$

$R_T = 58\,\Omega$

$T - ? \Rightarrow T = 62,1^{\circ}C$

6 $I = 4+2t^2$ [A] , $[t] = s$

$t_0 = 0\,s$

$t_1 = 10\,s$

$\bar{I} = \langle I \rangle$ - ? | $\bar{I}_{rms}$?

Imaginemos que temos uma funcao (f(x)) continua e pretendemod deteerminar o seu valor medio num intervalo x=[a,b]. Como se faz?

$$\langle f(x)\rangle = \frac{1}{b-a}\int_a^b f(x)\,dx$$

$$f(x)_{rms} = \frac{1}{b-a}\int_a^b [f(x)]^2\,dx$$

$$\langle I \rangle = \frac{1}{10-0}\int_0^{10}(4+2t^2)\,dt = \frac{1}{10}\left(40+\frac{2}{3}\times 1000\right) =$$

$$I_{rms} = \frac{1}{10-0}\int_0^{10}\left[4+2t^2\right]^2 dt$$

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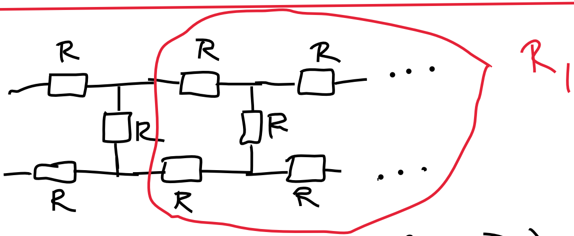
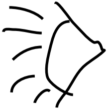
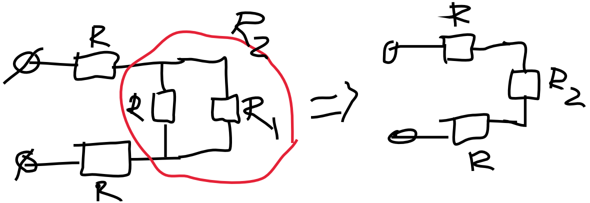


$$R_{eq} = (1+\sqrt{3})R \sim ?$$





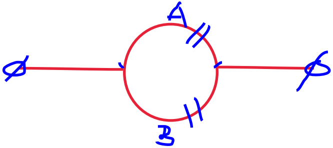
$$R_{eq} = 2R + R_2 \Rightarrow R_{eq} = 2R + \frac{RR_1}{R+R_1}$$

$$\boxed{R_{eq} \approx R_1}$$

$$\hookrightarrow R_1 = 2R + \frac{RR_1}{R+R_1}$$

$$2R(R+R_1) + RR_1 = (R+R_1)R_1$$

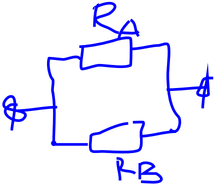
$$\boxed{R_1^2 - 2RR_1 - 2R^2 = 0} \Rightarrow \underline{R_1 = (1+\sqrt{3})R}$$



$R = 10\Omega$

$$\frac{R_A}{R_B}\Big|_{R_{eq} = 1.0\Omega} = \ ?$$

$\Longrightarrow$



$$R_{eq} = \frac{R_A R_B}{R_A + R_B}$$

$R = 10\Omega \rightarrow R = R_A + R_B$

$R_A = 5 \pm \sqrt{15}$; $R_A = \rho \dfrac{\ell_A}{S}$

$$\frac{R_A}{R_B} = \frac{\ell_A}{\ell_B} = \frac{5 - \sqrt{15}}{5 + \sqrt{15}}$$