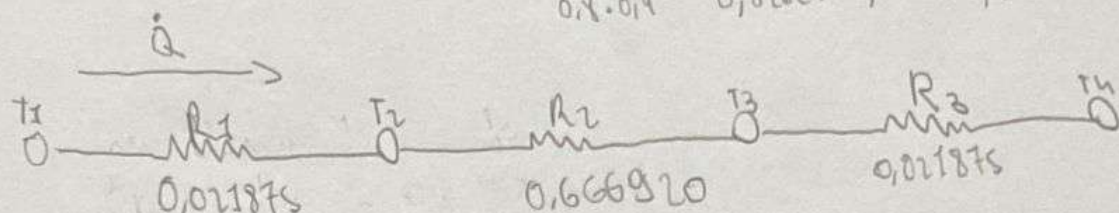


Fenômenos de Transporte \Rightarrow Exercício Semanal

3.1) a) $R = \frac{L}{k \cdot A} [K/W] \Rightarrow L_v = 7 \text{ mm}, k_g = 0,8 \text{ W/m} \cdot \text{K}; L_a = 7 \text{ mm}, k_g = 0,02629 \text{ W/m}$

$$A = 0,2 \cdot 0,2 = 0,04 \text{ m}^2 \Rightarrow R_{\text{tot}} = \frac{7 \cdot 10^{-3}}{0,8 \cdot 0,04} + \frac{7 \cdot 10^{-3}}{0,02629 \cdot 0,04} + \frac{7 \cdot 10^{-3}}{0,1 \cdot 0,04} \approx 0,71 \text{ K/W}$$



b) $\dot{Q} = \frac{\Delta T}{R} = \frac{20}{0,71} \approx 28,1 \text{ W}$

3.2) $\dot{Q}_{\text{orig}} = \dot{Q}_{\text{comp}} \Rightarrow \frac{k_{\text{orig}}}{L_{\text{orig}}} = 0,75 \frac{k_{\text{comp}}}{L_{\text{comp}}} \Rightarrow L_{\text{orig}} = \frac{0,75 \cdot 0,1}{0,75 \cdot 0,25} = 0,40 \text{ m}$

3.3) $L_1 = 0,02 \text{ m}; k_1 = 1,3, k_2 = 0,35 \quad \dot{q}_{\text{max}} = 1830 \text{ W/m}^2$

$T_x = 130^\circ; T_0 = 30^\circ \quad \Delta T = 100 \text{ K}$

$\Rightarrow \dot{q} = \frac{\Delta T}{R_1}; R = \frac{L}{k} \Rightarrow R_1 = \frac{0,02}{1,3} = 0,01538 \text{ K m/W}$

$R_2 = \frac{L_2}{0,35} \Rightarrow R_{\text{t}} = R_1 + R_2 \Rightarrow \dot{q} = \frac{100}{0,01538 + \frac{L_2}{0,35}} \leq 1830 \Rightarrow \frac{100}{1830} \leq 0,01538 + \frac{L_2}{0,35}$

$\Rightarrow 0,05464 \leq 0,01538 + \frac{L_2}{0,35} \Rightarrow L_2 \geq 0,03926 \cdot 0,35 \Rightarrow L_2 \approx 1,37 \text{ cm}$

$$3.4) R_A = \frac{0,015}{175} = 8,571 \cdot 10^{-5}; R_B = \frac{0,075}{30 \cdot 0,5} = 0,005$$

$$R_C = \frac{0,075}{40 \cdot 0,5} = 0,00375; R_D = \frac{0,05}{80 \cdot 0,25} = 0,00075; R_E = \frac{0,05}{100 \cdot 0,75} = 6,667 \cdot 10^{-4}$$

$$R_{BC} = \left(\frac{1}{R_B} + \frac{1}{R_C} \right)^{-1} = 0,001429; R_{DE} = 0,0005263$$

$$R_{eq} = R_A + R_{BC} + R_{DE} = 0,002812 \quad \dot{Q} = \frac{\Delta T}{R_{eq}} = 1,09 \cdot 10^5 \text{ W}$$

$$3.5) a) k_{cu} = 385 \text{ W/mK}; d_e = 0,03; d_i = 0,015 \text{ m}; L = 5 \text{ m}; r_1 = 0,0075 \text{ m}; r_2 = 0,015$$

$$\Delta T = 33 \text{ K}$$

$$Q = \frac{2\pi L \cdot k_{cu} \Delta T}{\ln(r_2/r_1)} = \frac{2\pi \cdot 5 \cdot 385 \cdot 33}{\ln\left(\frac{0,015}{0,0075}\right)} = 5,76 \cdot 10^5 \text{ W}$$

$$b) r_3 = 0,025 \text{ m} \Rightarrow R_{cu} = \frac{\ln(r_2/r_1)}{2\pi k_{cu} L}; R_{ins} = \frac{\ln(r_3/r_1)}{2\pi k_{ins} L}$$

$$\dot{Q} = \frac{\Delta T}{R_{cu} + R_{ins}} \Rightarrow Q = 81 \text{ W}$$