


4.10-2.

(W/K)

$T_{\text{surround}}=477.4\text{K}$



$T_{\text{bread}}=373\text{ K}$

$\epsilon_{\text{bread}} = 0.85$

size=114.3×114.3×330mm

)

Stefan-Boltzmann

$$q_{s \rightarrow b} = \epsilon \cdot \sigma \cdot A_b T_s^4$$

$$q_{b \rightarrow s} = \epsilon \cdot \sigma \cdot A_b T_b^4$$

$$q_{\text{net}} = q_{s \rightarrow b} - q_{b \rightarrow s}$$

$$= \epsilon \cdot \sigma \cdot A_b \cdot (T_s^4 - T_b^4)$$

$$\epsilon = 0.85$$

$$\sigma = 5.676 \times 10^{-8} \frac{\text{W}}{\text{m}^2 \text{K}^4}$$

$$A_b = 2 \times 0.1143^2 + 3 \times 0.1143 \times 0.33 = 0.1393 \text{m}^2 \quad (\quad)$$

$$T_s = 477.4\text{K}$$

$$T_b = 373\text{K}$$

$$q_{\text{net}} = 219.0\text{W}$$

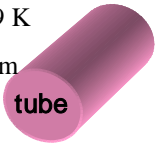
4.10-3

$T_{\text{tube}}=374.9\text{ K}$

$D=0.1683\text{ m}$

$\epsilon_{\text{tube}} = 0.79$

$L=0.305\text{m}$



$T_{\text{sur}}=297.1\text{ K}$

a)

$$\begin{aligned}
 q_{\text{radiation}} &= \varepsilon \cdot \sigma \cdot A \cdot (T_{\text{tube}}^4 - T_{\text{sur}}^4) \\
 &= 0.79 \cdot 5.676 \times 10^{-8} \frac{\text{W}}{\text{m}^2 \text{K}^4} \cdot (\pi DL) \cdot (374.9^4 - 297.1^4) \text{K}^4 \\
 &= 86.5 \text{W}
 \end{aligned}$$

b) < 4.7-2>

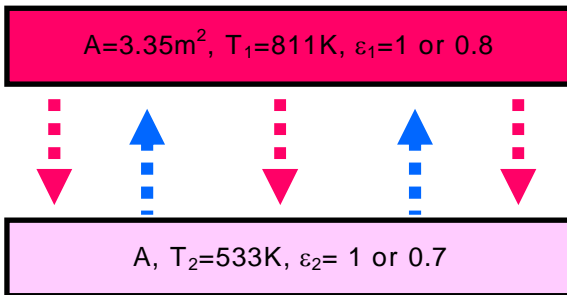
$$h_{\text{convection}} = 1.32 \left(\frac{\Delta T}{D} \right)^{0.25} = 1.32 \left(\frac{374.9 \text{K} - 297.1 \text{K}}{0.1683 \text{m}} \right)^{0.25} = 6.12 \frac{\text{W}}{\text{m}^2 \text{K}}$$

$$q_{\text{convection}} = h_{\text{convection}} \cdot A \cdot (T_{\text{tube}} - T_{\text{sur}}) = 6.12 \frac{\text{W}}{\text{m}^2 \text{K}} \cdot (\pi DL) \text{m}^2 \cdot (374.9 - 297.1) \text{K} = 76.79 \text{W}$$

c) 가

$$q_{\text{total}} = q_r + q_c = 86.5 \text{W} + 76.8 \text{W} = 163.3 \text{W}$$

4.11-4



a) 가
가

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$$\begin{aligned}
 q_{\text{net}} &= \varepsilon_1 \varepsilon_2 \sigma A \cdot \frac{T_1^4 - T_2^4}{1 - (1 - \varepsilon_1)(1 - \varepsilon_2)} \\
 , \varepsilon_1=1, \varepsilon_2=1 & \quad , \quad q_{\text{net}} = \sigma A \cdot (T_1^4 - T_2^4) \\
 q_{\text{net}} &= \sigma A \cdot (T_1^4 - T_2^4) = 66.91 \text{kW}
 \end{aligned}$$

b) **ε₁=0.8, ε₂=0.7**

$$q_{\text{net}} = \varepsilon_1 \varepsilon_2 \sigma A \cdot \frac{T_1^4 - T_2^4}{1 - (1 - \varepsilon_1)(1 - \varepsilon_2)} = 39.86 \text{kW}$$