Solutions

2.1

- $T_s = 353.15$ K, $T_{sur} = 293.15$ K.
- $q'' = \varepsilon\sigma(T_s^4 - T_{sur}^4) = 0.9 \times 5.67 \times 10^{-8}(353.15^4 - 293.15^4) = \mathbf{416.8}$ W/m^2.

2.2

- $h_r = \varepsilon\sigma(T_s^2 + T_{sur}^2)(T_s + T_{sur}) = \mathbf{6.95}$ W/(m^2 · K); check $6.95 \times 60 = 417$.
- Comparable with $h_c \approx 10$: ignoring radiation would miss about 40% of the loss.

3.1

- (a) $q = \sigma(T_1^4 - T_2^4)/(1/\varepsilon_1 + 1/\varepsilon_2 - 1) = 5.67 \times 10^{-8}(500^4 - 300^4)/1.857 = \mathbf{1660.9}$ W/m^2.
- (b) The shield adds $2/0.1 - 1 = 19$, so the denominator is $1.857 + 19 = 20.857$.
- $q = 5.67 \times 10^{-8} \times 5.44 \times 10^{10}/20.857 = \mathbf{147.9}$ W/m^2, **8.9**% of (a).
- (c) Hot side to shield: $q = \sigma(500^4 - T_s^4)/(1/0.7 + 1/0.1 - 1)$.
- $T_s^4 = 500^4 - 147.9 \times 10.43/(5.67 \times 10^{-8})$, so $T_s = \mathbf{433}$ K, nearer the hot plate because the network is symmetric in T^4, not in T.

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