Heat Transfer: Assignment 8

The due date for submitting this assignment has passed.
As per our records, you have not submitted this assignment.

1) A long, 1 mm diameter wire passes an electrical current dissipating 3150 W/m and reaches a surface temperature of 126°C when submerged in water at 1 atm. What is the bing heat transfer coefficient?

Water
(Use: 1 atm; $T_w = 100^{\circ}C, \rho_w = 1 / \gamma_w = 957.9 \text{ kg/m}^3, \rho_f = 1 / \gamma_f = 1.0955 \text{ kg/m}^3, \sigma_f = 4217 J/kg \cdot K, \mu_t = 5 \times 10^{-5} N \cdot s/m^2, \rho T = 1.76, h_{bg} = 2251$

- $39.6 \text{ kW/m}^2 \cdot K$
- $346 \text{ W/m}^3 \cdot K$
- $28.6 \text{ kW/m}^2 \cdot K$
- $40.6 \text{ W/m}^3$

No, the answer is incorrect.
Score: 0

Accepted Answers:
- $39.6 \text{ kW/m}^2 \cdot K$

2) A long, 1 mm diameter wire passes an electrical current dissipating 3150 W/m and reaches a surface temperature of 126°C when submerged in water at 1 atm. Estimate the value of the correlation coefficient $C_{ij}$.

Water
(Use: 1 atm; $T_w = 100^{\circ}C, \rho_w = 1 / \gamma_w = 957.9 \text{ kg/m}^3, \rho_f = 1 / \gamma_f = 1.0955 \text{ kg/m}^3, \sigma_f = 4217 J/kg \cdot K, \mu_t = 5 \times 10^{-5} N \cdot s/m^2, \rho T = 1.76, h_{bg} = 225$

- $17.45$
- $17.74$
- $0.174$
- $0.017$

No, the answer is incorrect.
Score: 0

Accepted Answers:
- $0.017$

3) The bottom of a copper pan, 150 mm in diameter, is maintained at $115^\circ C$ by the heating element of an electric range. Determine the evaporation rate.

Water
(Use: 1 atm; $T_w = 100^{\circ}C, \rho_w = 1 / \gamma_w = 957.9 \text{ kg/m}^3, \rho_f = 1 / \gamma_f = 1.0955 \text{ kg/m}^3, \sigma_f = 4217 J/kg \cdot K, \mu_t = 5 \times 10^{-5} N \cdot s/m^2, \rho T = 1.76, h_{bg} = 2257 kJ/kg \cdot s = 58.9$

For polished copper, correlation coefficient $C_{ij} = 0.013, m = 1$

- $1.3 \times 10^{07} \text{ kg/h}$
- $13.025 \text{ kg/h}$
- $92.19 \text{ kg/h}$
- $2.25 \times 10^{07} \text{ kg/h}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
- $13.025 \text{ kg/h}$

4) The bottom of a copper pan, 150 mm in diameter, is maintained at $115^\circ C$ by the heating element of an electric range. Determine the ratio of the surface heat flux to the critical heat flux.

Water
(Use: 1 atm; $T_w = 100^{\circ}C, \rho_w = 1 / \gamma_w = 957.9 \text{ kg/m}^3, \rho_f = 1 / \gamma_f = 1.0955 \text{ kg/m}^3, \sigma_f = 4217 J/kg \cdot K, \mu_t = 5 \times 10^{-5} N \cdot s/m^2, \rho T = 1.76, h_{bg} = 2257 kJ/kg \cdot s = 58.9$

For polished copper, correlation coefficient $C_{ij} = 0.013, m = 1$

- $6.36$
- $1$
- $0.37$
- $2.5$

No, the answer is incorrect.
Score: 0

Accepted Answers:
- $6.36$

5) A nickel-coated heater element with a thickness of 15 mm and a thermal conductivity of 50 W/m.K is exposed to saturated water at atmospheric pressure. A thermocouple is attached to the back surface, which is well insulated. Measurements at a particular operating condition yield an electrical power dissipation in the heater element of 0.955 x 10^7 W/m and a temperature of $T_w = 266^\circ C$.

- $0.37$

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Select the two correct answers (\( \frac{1}{4} \) point each)

**For the given fluid-surface combination**

- Saturated ethylene glycol
- \( b \): What fraction is the power requirement of the maximum power associated with the critical heat flux?

a. Estimate the heating power requirement and the rate of evaporation.

b. Is there natural convection and when \( T_1 > T_2 \) and when \( T_1 < T_2 \)?

c. There is no natural convection

**In the above figure a quiescent fluid is trapped between two plates at temperatures \( T_1 \) and \( T_2 \) and the corresponding densities of the fluid are \( \rho_1 \) and \( \rho_2 \), then choose the correct statements from the following.

a. In the absence of gravity and when \( T_1 > T_2 \), there is no natural convection

b. In the presence of gravity and when \( T_1 < T_2 \), there is no natural convection

c. All of the above

**No, the answer is incorrect.**

**Score:** 0

**Accepted Answers:**
- 0.63 \( \times 10^5 \) W/m²
- 110°C

b. There is no natural convection in the presence of gravity.

**No, the answer is incorrect.**

**Score:** 0

**Accepted Answers:**
- All of the above

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Saturated ethylene glycol at 1 atm is heated by a horizontal chromium-plated surface which has a diameter of 201 mm and is maintained at 480 K.

a. Estimate the heating power requirement and the rate of evaporation.

b. Is what fraction is the power requirement of the maximum power associated with the critical heat flux?

- 4.79 K and pressure of 1 atm, \( T_{sat} = 470 \) K, \( h_{fg} = 812 \) kJ/kg, \( P_h = 1131 \) kJ/kg, \( \sigma = 32.7 \times 10^{-5} \) N/m², \( r_p = 0.16 \times 10^{-5} \) N/m², \( c_{fg} = 480 \) J/kg K, \( P_f = 0.74 \) kJ, \( \alpha = 0.15 \) W/m² K.

For the given fluid-surface combination \( C_{fg} = 0.01 \) and \( c = 1.0 \).

Select the two correct answers (first four options are for part a and second four options are for part b)

- 0.00 \( \times 10^{-3} \) kg/s
- 21.79 \( \times 10^3 \) kg/s
- 0.217 kg/s
- 603.3 \( \times 10^3 \) kg/s
- 8.68
- 0.028
- 1.48
- 0.65

**No, the answer is incorrect.**

**Score:** 0

**Accepted Answers:**
- 0.60 \( \times 10^{-3} \) kg/s
- 0.028