Solutions

2.1

- $Re_L = VL/\nu = 5 \times 0.2/(1.6 \times 10^{-5}) = \mathbf{62\,500}$.
- Below 5×10^5, so laminar over the whole plate.

2.2

- $Nu = 0.664 Re_L^{1/2} Pr^{1/3} = 0.664 \times 250 \times 0.892 = \mathbf{148.1}$.
- $h = Nu\,k/L = 148.1 \times 0.0265/0.2 = \mathbf{19.6}$ W/(m^2 · K).

2.3

- $q = hA\,\Delta T = 19.6 \times (0.2 \times 0.3) \times 40 = \mathbf{47.1}$ W.

3.1

- $Re = VD/\nu = 1.5 \times 0.025/(0.658 \times 10^{-6}) = \mathbf{56\,990}$.
- Turbulent ($Re > 10^4$), $Pr = 4.32$ inside 0.6 to 160, fluid heated: Dittus–Boelter with $Pr^{0.4}$ applies.
- $Nu = 0.023 Re^{0.8} Pr^{0.4} = \mathbf{263.4}$.
- $h = Nu\,k/D = 263.4 \times 0.631/0.025 = \mathbf{6647}$ W/(m^2 · K).
- $q' = h\pi D\,\Delta T = 6647 \times \pi \times 0.025 \times 20 = \mathbf{10.44}$ kW/m.
- About 340 times the air value: water's conductivity and the thin turbulent wall layer make liquid-side resistances small.

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