

**9.81** If the wetted area of an 80-m ship is  $1500 \text{ m}^2$ , approximately how great is the surface drag when the ship is traveling at a speed of  $10 \text{ m/s}$ ? What is the thickness of the boundary layer at the stern? Assume  $T = 10^\circ\text{C}$ .

**9.81 Information and assumptions**

From Table ~~A.1~~<sup>B.2</sup>  $\nu = 1.4 \times 10^{-6} \text{ m}^2/\text{s}$   
provided in problem statement

**Find**

surface drag and thickness of boundary layer at stern.

**Solution**

$$\begin{aligned} \text{Re}_L &= U_0 L / \nu = 10 \times 80 / (1.4 \times 10^{-6}) \\ \text{Re}_L &= 5.7 \times 10^8 \end{aligned}$$

From Fig. 9-15  $C_f = 0.00173$ . Then

$$F_D = C_f A \rho U_0^2 / 2 = 0.00173 \times 1,500 \times 1,026 \times 10^2 / 2 = \underline{\underline{133 \text{ kN}}}$$

$$\delta/x = \frac{0.16}{\text{Re}_x^{1/7}}$$

$$\delta/x = 0.0089$$

$$\delta = 80 \times 0.0089 = \underline{\underline{0.712 \text{ m}}}$$