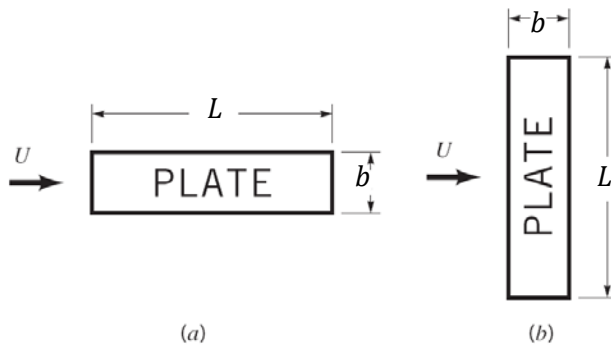


NAME \_\_\_\_\_

Fluids-ID \_\_\_\_\_

Quiz 15. A thin flat plate 55 by 110 cm is immersed in a 6-m/s stream of SAE 10 oil at 20°C. Compute the boundary layer thickness  $\delta$  at the end of the plate and the total friction drag  $D_f$  if the stream is parallel to (a) the long side and (b) the short side. Transition to turbulent flow may occur at  $Re = 5 \times 10^5$ . ( $\rho = 891 \text{ kg/m}^3$ ,  $\mu = 0.29 \text{ kg/m}\cdot\text{s}$ )



Boundary layer thickness:

$$\frac{\delta}{x} = \begin{cases} \frac{5}{\sqrt{Re_x}} & \text{(laminar)} \\ \frac{0.37}{Re_x^{1/5}} & \text{(turbulent)} \end{cases}$$

Friction drag coefficient:

$$C_f = \frac{D_f}{\frac{1}{2}\rho U^2 A} = \begin{cases} \frac{1.328}{\sqrt{Re_\ell}} & \text{(laminar)} \\ \frac{0.072}{Re_\ell^{1/5}} & \text{(turbulent)} \end{cases}$$