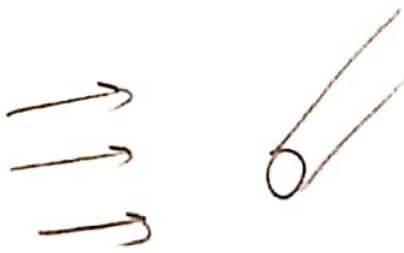


Quiz - 8



$$V_{\infty} = 1 \text{ b [m/s]}$$

$$T_{\infty} = 3 \text{ ab [K]}$$

$$T_s = 4 \text{ ab [K]}$$

$$D = 0. \text{ ab [m]}$$

$$L = 1. \text{ ab [m]}$$

$$Pr = 0.7 \text{ b}$$

$$\nu = 1. \text{ ab} \times 10^{-5} \text{ [m}^2/\text{s]}$$

$$k = 0.02 \text{ b [W/mK]}$$

$$\text{set } a=2 \quad b=1$$

$$Re_D = \frac{V_{\infty} \cdot D}{\nu} = \frac{(1 \text{ m/s}) \cdot (0.21 \text{ m})}{1.21 \times 10^{-5} \text{ m}^2/\text{s}} = 190909$$

Since $Pr \geq 0.7 \Rightarrow \bar{Nu}_D = C Re_D^m Pr^{1/3}$ (this correlation can be used)
 $C = 0.027$, $m = 0.805$ for $Re_D = 190909$ (from table pg. 75 in slides)

$$\bar{Nu}_D = 0.027 \cdot (190909)^{0.805} \cdot (0.71)^{1/3} = 429.38$$

$$\bar{h} = \bar{Nu}_D \cdot \frac{k}{D} = 429.38 \cdot \frac{0.021 \text{ W/mK}}{0.21 \text{ m}} = 42.938 \text{ W/m}^2\text{K}$$

$$q = \bar{h} \cdot A \cdot (T_s - T_{\infty}) \quad \text{where } A = \pi \frac{D^2}{4} + 2\pi \frac{D}{2} \cdot L = 0.8329 \text{ m}^2$$

$$q = (42.938 \text{ W/m}^2\text{K}) \cdot (0.8329 \text{ m}^2) \cdot (421 \text{ K} - 321 \text{ K})$$

$$q = 3576.3 \text{ W}$$

(Note that in the calculation of \bar{Nu}_D Churchill and Bernstein equation can also be used.)