Quiz - 8

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

$T_\infty = 3ab\ [K]$

$T_s = 4ab\ [K]$

$D = 0.ab\ [m]$

$L = 1.ab\ [m]$

$Pr = 0,7b$

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

$k = 0,02b\ [W/mK]$

set $a=2$ $b=1$

$$Re_D = \frac{V_\infty . D}{\nu} = \frac{(11 m/s).(0,21 m)}{1.21 \times 10^{-5} m^2/s} = 190909$$

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)

$$\bar{Nu}_D = 0,027 . (190909)^{0,805} . (0,71)^{1/3} = 429.38$$

$$\bar{h} = \bar{Nu} . \frac{k}{D} = 429.38 . \frac{0,021\ W/mK}{0,21 m} = 42.938\ W/m^2K$$

$$q = \bar{h} . A . (T_s - T_\infty) \quad \text{where } A = \pi \frac{D^2}{4} + 2\pi \frac{D}{2} . L = 0,8329\ m^2$$

$$q = (42.938\ W/m^2K) . (0,8329 m^2) (421 K - 321 K)$$

$q = 3576,3\ W$

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