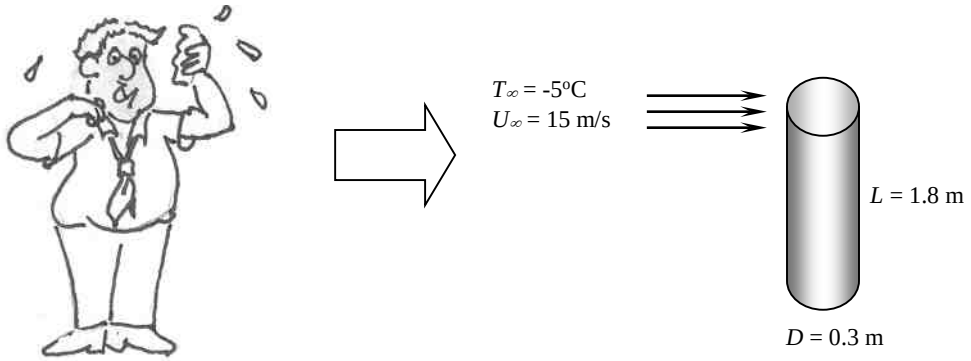
Example

Assume that a person can be approximated as a cylinder of 0.3-m diameter and 1.8 m height with a surface temperature of 25°C. Calculate the body heat loss while this person is subjected to a 15 m/s wind whose temperature is –5°C.



$\dot{Q} = \underbrace{hA}_{\text{LOCAL OR AVERAGE?}}(T_s - T_\infty)$

$$T_f = \frac{T_s + T_\infty}{2} = 10°C$$

- $\rho\,(P_{ATM}) = 1.246$ kg/m³ $\qquad Pr = 0.7336$
- $\mu = 1.778 \times 10^{-5}$ kg/m·s
- $k = 0.02439$ W/m-K

REYNOLDS #

$$Re = \frac{\rho V_\infty D}{\mu} = \frac{(1.246)(15)(0.3)}{(1.778\times10^{-5})} \frac{kg}{m^3}\cdot\frac{m}{s}\cdot m\cdot\frac{m\cdot s}{kg} = 315,354$$

$$Nu = \frac{hD}{k} = 0.3 + \frac{0.62\,Re^{1/2}\,Pr^{1/3}}{[1+(0.4/Pr^{2/3})]^{1/4}}\left[1+\left(\frac{Re}{282,000}\right)^{5/8}\right]^{4/5}$$

$= 495$

– OR TRY –

$Nu = 0.027\,Re^{0.805}\,Pr^{1/3} = 650$

NOTE DIFFERENCE!

$h = \frac{Nu\,k}{D} = 40.26 \frac{W}{m^2 K}$

$h = 52.9$ W/m²-K

$\dot{Q} = 2049$ W

$\dot{Q} = 2690$ W