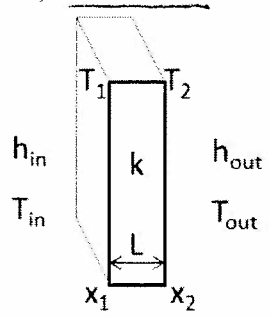
Name (2 points): Dawson
April 4, 2016
ChBE 3200
Quiz 7

Q1 (4 points): For 1D heat transfer in the x-direction, **determine the temperature outside the wall (T_{out}).**
$q'' = q/A = 80$ W/m^2, $h_{in} = 15$ W/m^{2}K, $h_{OUT} = 50$ W/m^{2}K, $k = 1.5$ W/m K, $L = 0.1$ m, Tin = 270 K.

$q = \frac{\Delta T}{\Sigma R}$ $\quad T_{in} = 270\,K$ $\quad T_1, T_2, T_{out} = ?$



$\Sigma R = \frac{1}{h_i A} + \frac{1}{h_o A} + \frac{L}{kA} = \frac{1}{A}\left(\frac{1}{h_i} + \frac{1}{h_o} + \frac{L}{k}\right)$

$\Sigma R = \frac{1}{15A} + \frac{1}{50A} + \frac{0.1}{1.5A} = \frac{0.153}{A}$

$q = \frac{\Delta T}{0.153} A$

$\frac{q}{A} = \frac{\Delta T}{0.153} = \frac{T_{in} - T_{out}}{0.153} = 80$

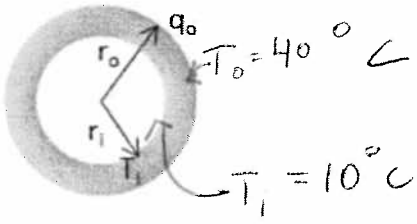
$T_{in} - T_{out} = 12.3$

$T_{out} = T_{in} - 12.3$

$\boxed{T_{out} = 256\,K}$

Q2 (4 points): Assume steady state heat transfer from walls of tube with inner radius ri, outer radius ro, and length L. **Determine the (A) resistance to heat transfer and (B) rate of heat transfer.**
$k = 12$ W/mK, $r_i = 1$ cm, $r_o = 3$ cm, $L = 1$m, $T_i = 10°$ C, $T_o = 40°$ C.

$q = \frac{\Delta T}{\Sigma R}$ $\quad$ Cyl $\quad R = \frac{\ln r_o/r_i}{2\pi L k}$



$\boxed{R = \frac{\ln(3/1)}{2\pi(12)\frac{W}{K\,m}} = 0.0146\,\frac{K}{W}}$

$q = \frac{(10-40)\,K}{0.0146\,K}\,W = -2055\,W$

HT inward $\quad \boxed{q = -2055\,W}$