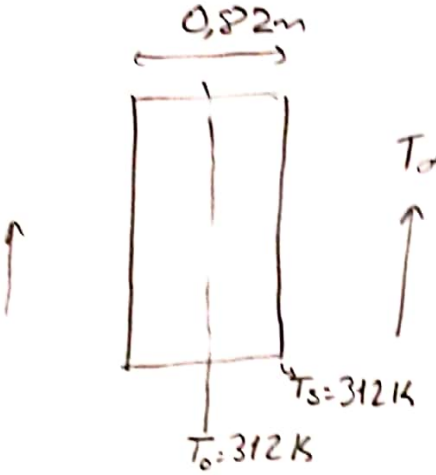
AE-331 Quiz-5

a = 1, b = 2



$k = 52\ kW/mK$

$h = 32\ kW/m^2K$

$\rho_w = 2212\ kg/m^3$

$C_{p_w} = 1.2\ kJ/kgK$

$t = (20h).(60d).(60s) = 72000\ s$

$$Bi = \frac{h.L}{k} = \frac{(32\ kW/m^2K).\left(\frac{0,82m}{2}\right)}{(52\ kW/mK)} = 0,25$$

$\rightarrow C_1 = 1.0382$

$\rightarrow \zeta_1 = 0.4801$ from table 5.1

$$Fo = \frac{\alpha.t}{L^2} \rightarrow \alpha = \frac{k}{\rho.C_p} = \frac{(52\ kW/mK)}{(2212\ kg/m^3).(1,2\ kJ/kgK)}$$

$$\alpha = 0,02$$

$$Fo = \frac{0,02.(72000s)}{\left(\frac{0,82m}{2}\right)} = 8566$$

$\frac{1}{e^{1973.6}} \approx 0$

$$\theta_o^* = C_1.\exp(-\zeta_1^2.Fo) = 1.0382.\exp(-(0,4801)^2.8566)$$

$\theta_o^* = 0$ $\boxed{T_o = T_\infty}$ b. ✓

$\theta^* = \theta_o^*.\cos(\zeta_1.x^*) = 0$ $\boxed{T(x) = T_\infty}$ a. ✓

($\theta_o^* \rightarrow 0$)

after 20 hours temperatures are equal to gas temperature

therefore there is no heat flux at time $t = 72000\ s$

$\boxed{q'' = 0 \quad t = 72000s}$ c. ✓