2. Known:

$L_A = 30\,cm$

$L_B = 10\,cm$

$T_\infty = 20°C$

$T_w = 115°C$

$T_i = 100°C$

Properties:

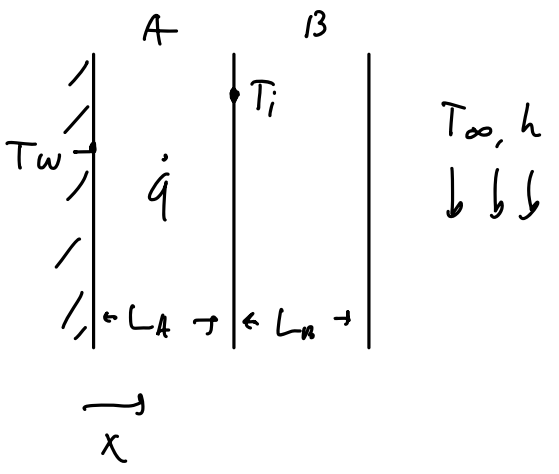
$\dot{q}$ unknown

k_A unknown

$k_B = 30\ W/mK$

$h_B = 500\ W/m^2K$

Schematic:



Find:

a) T_s of wall B

b) $\dot{q}$ at steady state

c) k_A of wall A

d) Plot temp profile

Assumptions:

perfect insulation

no contact resistance

no radiation

Analysis:

a) $\dot{q}''_{in} = \dot{q}_{out} \rightarrow \dot{q}''_{cond} = \dot{q}''_{conv}$

$$\frac{k_B}{L_B}(T_i - T_s) = h(T_s - T_\infty)$$

$$\frac{30}{0.1}(100 - T_s) = 500(T_s - 20)$$

$$\boxed{T_s = 50°C}$$

b) $\frac{\partial^2 T}{\partial x^2} = -\frac{\dot{q}}{k_A}$ with $\left.\frac{\partial T}{\partial x}\right|_{x=0} = 0$

$$q(x) = -k_A \frac{\partial T}{\partial x} = \dot{q}x$$

$$q(L_A) = \dot{q}L_A = \dot{q}_{in}$$

$$h(50-20) = \dot{q}L_A$$

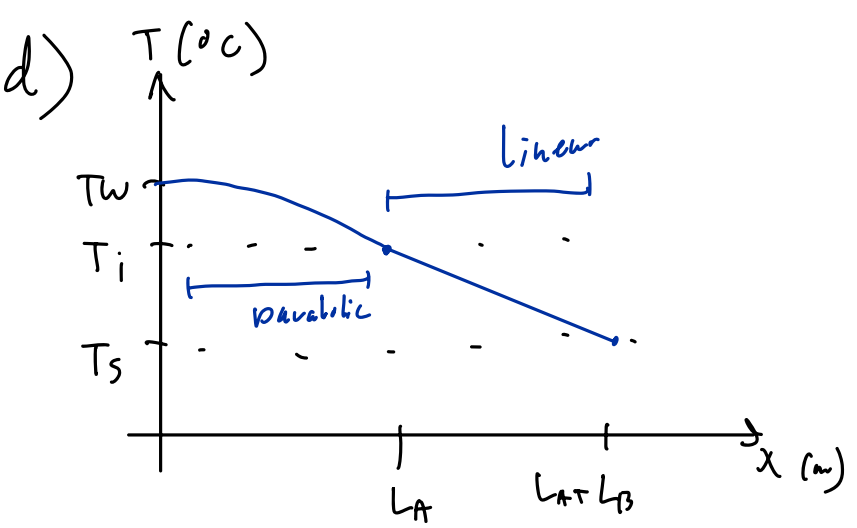
$$\boxed{\dot{q} = 5e4\ W/m^3}$$

c) $T_A(x) = T_w - \frac{\dot{q}}{2k_A} x^2$

$$T_i = T_w - \frac{\dot{q}}{2k_A} L_A^2$$

$$k_A = \frac{\dot{q} L_A^2}{2(T_w - T_i)} = \frac{5e4\ (0.04)}{2(15)} = \boxed{150\ W/mK}$$

d)



These results all make sense in the context of the problem