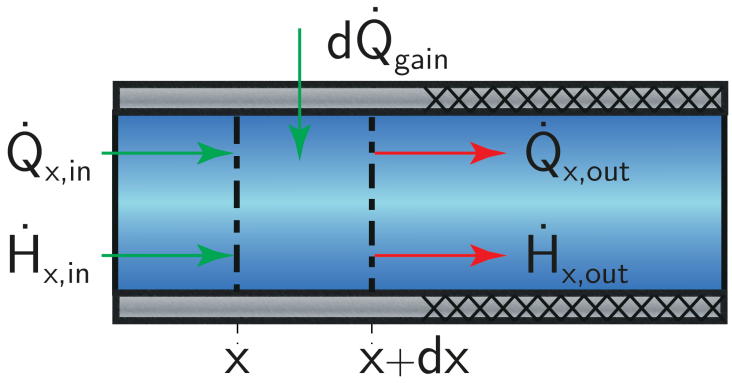
Boundary Conditions - Conv. - IE 4

Through a very long pipe with diameter D flows a fluid. The first half of the pipe is being heated with a constant rate $\dot{q}''$. The second half of the pipe is fully adiabatic.

Give the correct boundary and coupling conditions to solve the given differential equation for deriving the temperature profile in the flow direction of the first segment of the pipe $T_{\mathrm{I}}(x)$.



Given the differential equation:

$$0 = \frac{\lambda \pi D^2}{4} \frac{\partial^2 T}{\partial x^2} - \frac{u \rho c \pi D^2}{4} \frac{\partial T}{\partial x} + \dot{q}'' \pi D$$

In order to solve the differential equation, two boundary conditions are required. This can be seen from the fact that the variable T has been differentiated twice with respect to x.

Boundary conditions:

$$T_{\mathrm{I}}(x = 0) \;=\; T_1$$

The boundary condition above describes that the temperature of the fluid equals T_1 at the entrance of the pipe, as can be seen from the figure.

$$T_{\mathrm{I}}(x = L/2) \;=\; T_{\mathrm{II}}(x = L/2)$$

The boundary condition above describes that the temperature of the fluid at $x = L/2$ should be equal for both segments.