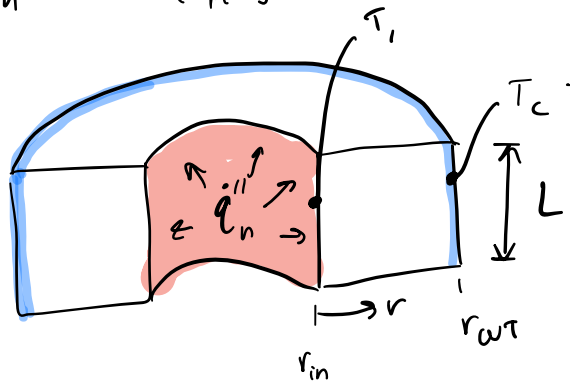
$\dot{q}''_h = 10 \left[\frac{kW}{m^2}\right]$



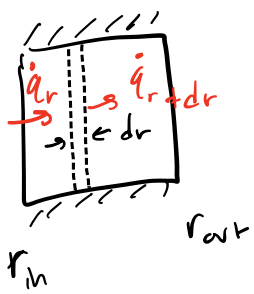
$r_{in} = 0.1$ [m]

$r_{out} = 0.2$ [m]

ASSUME: WELL-INSULATED

$\dot{q}, \frac{dU}{dt} = 0$

a)



b) IN + GEN = OUT + STORED (GEN = 0, STORED = 0)

$\hookrightarrow \dot{q}_r = \dot{q}_{r+dr}$

$\dot{q}_{r+dr} = \dot{q}_r + \frac{d\dot{q}_r}{dr} dr$

ODE: $\frac{d\dot{q}_r}{dr} = 0$

c) $\dot{q}_r = -kA_c \frac{dT}{dr}$ $\qquad A_c = 2\pi r L$

$\frac{d\dot{q}_r}{dr} = -k \frac{d}{dr}\left(A_c \cdot \frac{dT}{dr}\right)$

$$\frac{d\dot{q}_r}{dr} = 0 = \frac{d}{dr}\left(-k\,2\pi L\, r \frac{dT}{dr}\right)$$

$$\rightarrow \int 0\,dr = \int \frac{d}{dr}\left(r\frac{dT}{dr}\right)dr$$

$$C_1 = r\frac{dT}{dr} \qquad \frac{dT}{dr} = \frac{C_1}{r}$$

$$\int \frac{C_1}{r}dr = \int \frac{dT}{dr}dr$$

$$\boxed{C_1 \ln(r) + C_2 = T}$$

d) BC1: $T(r = r_{out}) = T_c$

BC2: $\dot{q}(r = r_{in}) = \dot{q}''_h \cdot 2\pi r_{in} L$

e) $T(r = r_{out}) = T_c = 298.15\,K = C_1 \ln(0.2) + C_2$

$\dot{q}(r = r_{in}) = \dot{q}''_h \cdot 2\pi (0.1m)(1m) = 6283\,W$

$\dot{q}_r = -k A_c \frac{dT}{dr}$