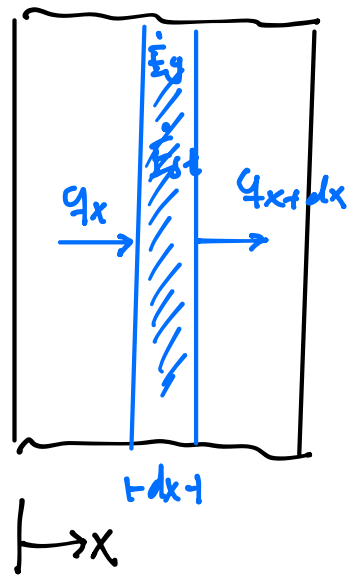


$T(x,t)$

$$q_x - q_{x+dx} + \dot{E}_g = \dot{E}_{st}$$

$$q_{x+dx} = q_x + \frac{dq_x}{dx}dx + \dots$$

$$-\frac{dq_x}{dx}dx + \dot{E}_g = \dot{E}_{st}$$

$$-\frac{\partial}{\partial x}\left(-kA\frac{dT}{dx}\right)dx + \dot{q}\,A\,dx = \frac{\partial}{\partial t}\left(\rho A dx C_p T\right)$$

$$\div (A\,dx)$$

$$\frac{\partial}{\partial x}\left(k\frac{\partial T}{\partial x}\right) + \dot{q} = \frac{\partial}{\partial t}(\rho C_p T) \qquad \underbrace{\left(\frac{k}{\rho C_p}\right)}_{\alpha}\frac{\partial^2 T}{\partial x^2} + \frac{\dot{q}}{\rho C_p} = \frac{\partial T}{\partial t}$$

- Estacionario $\frac{\partial}{\partial t} = 0$
- prop. ctes k, ρ, C_p
- sin generación $\dot{q} = 0$

$$k\frac{d^2T}{dx^2} = 0 \qquad \frac{d^2T}{dx^2} = 0 \qquad d\left(\frac{dT}{dx}\right) = 0\,dx$$

$$\int \frac{d^2T}{dx^2}dx = 0 \qquad \frac{dT}{dx} + C_1 = 0 \Rightarrow \frac{dT}{dx} = cte$$

$$q_x = -kA\frac{dT}{dx} = cte$$

$$q_x = -kA(-C_1)$$

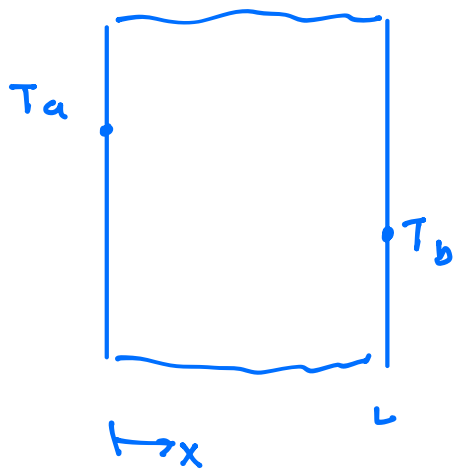
$$q_x = kAC_1$$

$$C_1 = \frac{q_x}{kA}$$

$$\int \left(\frac{dT}{dx} + C_1 \right) dx \int 0\, dx$$

$$T + C_1 x + C_2 = 0 \Rightarrow T = -C_1 x - C_2$$

$$T = -\frac{q_x}{kA} - C_2$$



$x=0 \quad T(0)=T_a$

$x=L \quad T(L)=T_b$

$$T_a + C_1(0) + C_2 = 0$$

$$T_b + C_1(L) + C_2 = 0$$

$$C_1 = \frac{T_a - T_b}{L} \qquad C_2 = -T_a$$

$$\begin{cases} T(x) = \dfrac{T_b - T_a}{L} x + T_a \\ q(x) = kA\left(\dfrac{T_a - T_b}{L}\right) \end{cases}$$

$$k\frac{d^2T}{dx^2} + \dot{q} = 0$$

$$\frac{d^2T}{dx^2} = -\frac{\dot{q}}{k}$$

$$\int d\left(\frac{dT}{dx}\right) = \int -\frac{\dot{q}}{k}\,dx$$

$$\frac{dT}{dx} = -\frac{\dot{q}}{k}x + C_1$$

$$\int dT = \int \left(-\frac{\dot{q}}{k}x + C_1\right)dx$$

$$T = -\frac{\dot{q}}{2k}x^2 + C_1 x + C_2$$

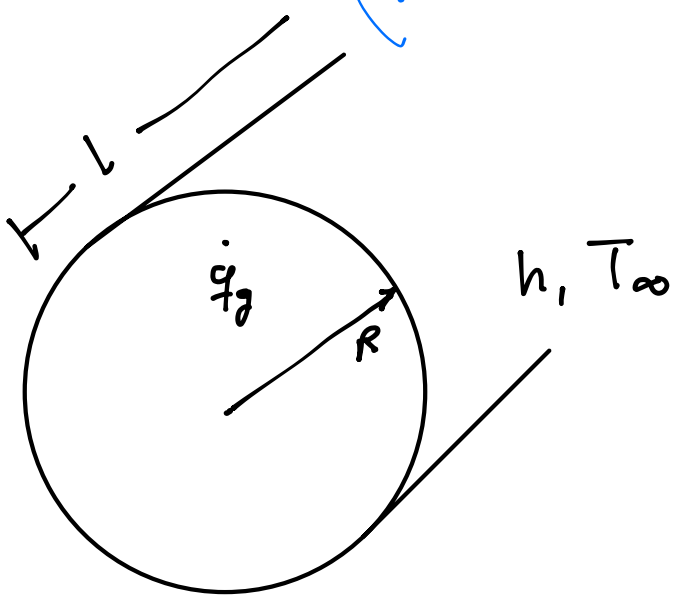
$$q_x = -kA\frac{dT}{dx} = -kA\left(-\frac{\dot{q}}{k}x + C_1\right)$$

$$T_a = C_2$$

$$T_b = -\frac{\dot{q}}{2k} L^2 + C_1 L + C_2$$

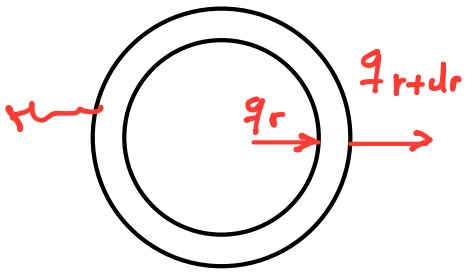
$$T(x) = -\frac{\dot{q}}{2k} x^2 + \left(\frac{L^2 \dot{q} - 2T_a k + 2T_b k}{2Lk} \right) x + T_a$$

$$q(x) = -kA \frac{dT}{dx} = -kA \left(-\frac{\dot{q}}{k} x + \left(\frac{L^2 \dot{q} - 2T_a k + 2T_b k}{2Lk} \right) \right)$$



$T(r)$

$\frac{\partial}{\partial \theta} = 0$



$$\dot{q}_r - \dot{q}_{r+dr} + \dot{q}_g (2\pi r dr L) = 0$$

$$q_{r+dr} = q_r + \frac{dq_r}{dr} dr + \cdots$$

$$-\frac{d\dot{q}_r}{dr}\,dr + \dot{q}_y(2\pi r\,dr\,L) = 0$$

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

$\div$ dvol.

$$\frac{1}{r}\frac{d}{dr}\left(K r\frac{dT}{dr}\right) + \dot{q}_y = 0 \qquad K = cte.$$

$$\frac{d}{dr}\left(r\frac{dT}{dr}\right) = -\frac{r\dot{q}_y}{K}$$

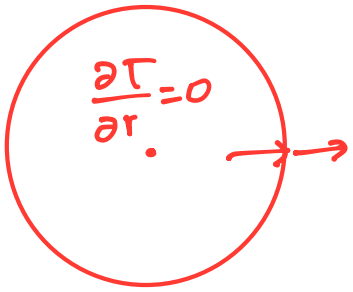
$$\int \frac{d}{dr}\left(r\frac{dT}{dr}\right)dr = -\int \frac{r\dot{q}_y}{K}\,dr$$

$$r\frac{dT}{dr} = -\frac{r^2\dot{q}_y}{2K} + C_1$$

$$\frac{dT}{dr} = -\frac{r\dot{q}_y}{2K} + \frac{C_1}{r}$$

$$\int \frac{dT}{dr}\,dr = \int\left(-\frac{r\dot{q}_y}{2K} + \frac{C_1}{r}\right)dr$$

$$T = -\frac{r^2\dot{q}_y}{4K} + C_1\ln r + C_2$$



$r=0 \quad \frac{\partial T}{\partial r}=0$

$r=R \quad q''_{cond}=q''_{conv}$

$$-k\frac{dT}{dr}=-h(T-T_\infty)$$

$$\frac{dT}{dr}=\frac{h}{k}(T-T_\infty)$$

$r=0$

$$\frac{dT}{dr}=-\frac{r\dot{q}_y}{2k}+\frac{C_1}{r}$$

$$\frac{dT}{dr}=-\frac{r\dot{q}_y}{2k}+C_1 \qquad C_1=0$$

$r=R$

$$-\frac{R\dot{q}_y}{2k}=\frac{h}{k}\left(-\frac{R^2\dot{q}_y}{4k}+C_2\right)$$

$$C_2=-\frac{R\dot{q}_y}{2h}+\frac{R^2\dot{q}_y}{4k}$$

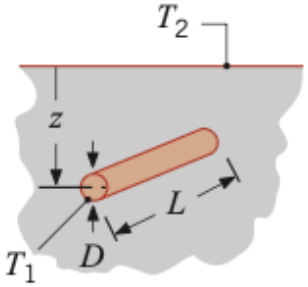
$$T=-\frac{r^2\dot{q}_y}{4k}-\frac{R\dot{q}_y}{2h}+\frac{R^2\dot{q}_y}{4k}$$

$$T=\frac{\dot{q}}{4k}\left(R^2-r^2\right)-\frac{R\dot{q}_y}{2h}$$

$$k\nabla^2 T + \dot{q} = 0$$

$$k\left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2}\right) + \dot{q}_y = 0 \qquad T(x, y)$$

$$q_{TOT} = S\,k\,(T_1 - T_2)$$



	$L \gg D$	$\dfrac{2\pi L}{\cosh^{-1}(2z/D)}$
-	$L \gg D$ $z > 3D/2$	$\dfrac{2\pi L}{\ln(4z/D)}$

$z = 50$ cms

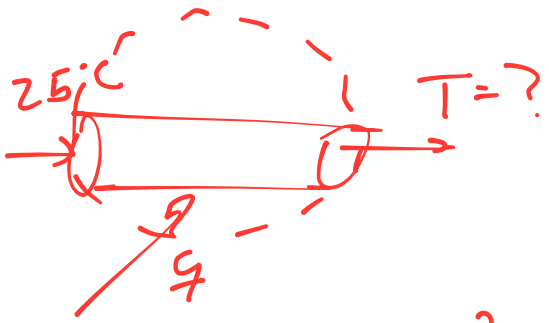
$L = 2$ mts.

$T_1 = 25\,^{\circ}C$

$T_2 = 80\,^{\circ}C$

$\dot{m} = 0.01\ \frac{kJ}{s}$

$D = 1''$



$$\dot{q} = \dot{m} C_p (T - 25) \quad (T = ?)$$