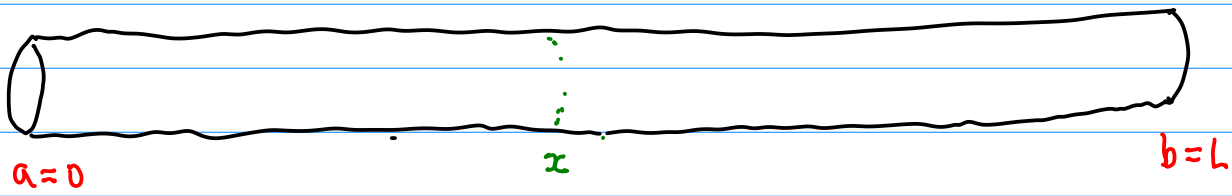
heat capacity · density · temperature · position in the rod. or material · time · conductivity · internal production of heat energy in the rod.

$$c(x)\,\rho(x)\,\frac{\partial}{\partial t}u(x,t) = \frac{\partial}{\partial x}\left(K_0(x)\,\frac{\partial u}{\partial x}\right) + Q(x,t)$$



Initial condition

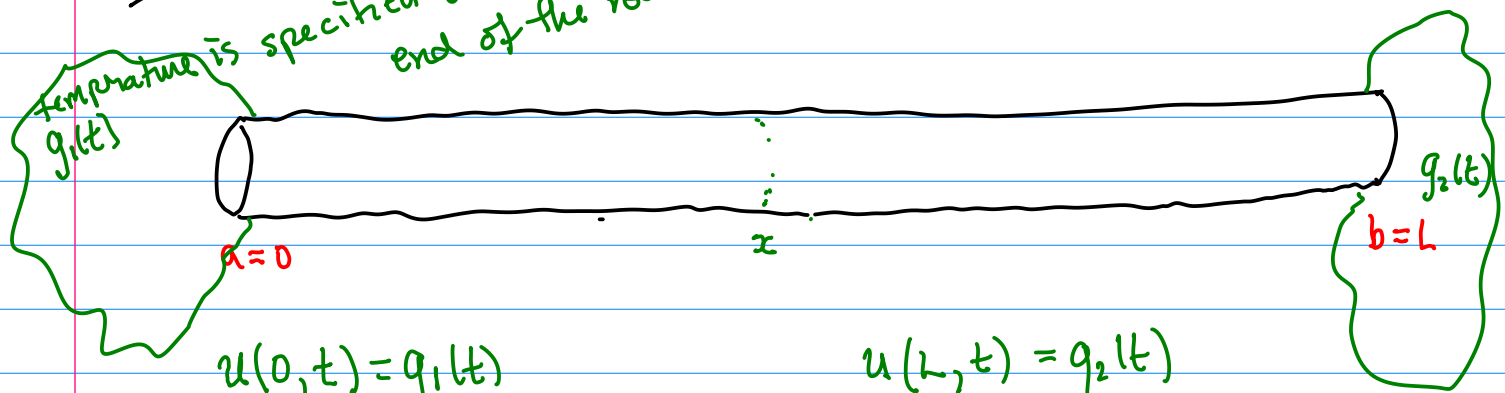
Note the equation is first order in time. To predict the future need to integrate in time once. Mathematically, that means there is one constant of integration needed to find the answer. That's the initial distribution of temperature in the rod.

$$u(x,0) = f(x) \quad \text{for} \quad x \in [0,L].$$

Boundary conditions What flux of energy goes in and out through the ends of the rod?

Heat bath

temperature is specified at each end of the rod



$u(0,t) = g_1(t)$ — temperature at the left

$u(L,t) = g_2(t)$ — temperature at the right

for $t > 0$

Insulating boundary conditions

Boundary conditions based on Newton's law of cooling

for next time...