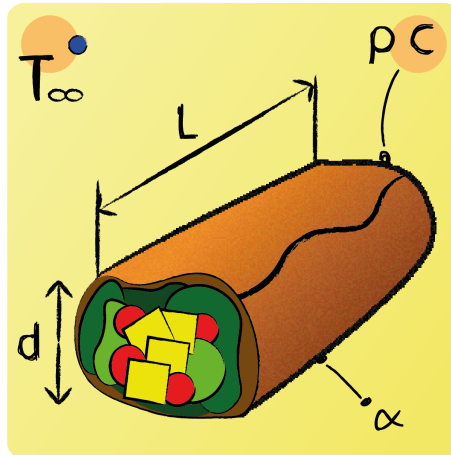


## Lecture 15 Question 5

A perfectly cylindrical kebab roll cools down. The initial temperature is  $T_0$ , the optimal serving temperature is  $T_s$ . Determine the time  $t$  that it takes to reach  $T_s$



Energy balance around the kebab roll:

$$\frac{dU}{dt} = \dot{Q}_{\text{conv}}$$

$$\rho c \frac{\pi d^2}{4} \frac{dT}{dt} = -\alpha \pi d (T - T_{\infty})$$

$$\frac{dT}{T - T_{\infty}} = \frac{4\alpha}{\rho c d} dt$$

$$\ln \left( \frac{T_s - T_{\infty}}{T_0 - T_{\infty}} \right) = -\frac{4\alpha}{\rho c d} t$$

$$t = \frac{\rho c d}{4\alpha} \cdot \ln \left( \frac{T_0 - T_{\infty}}{T_s - T_{\infty}} \right)$$