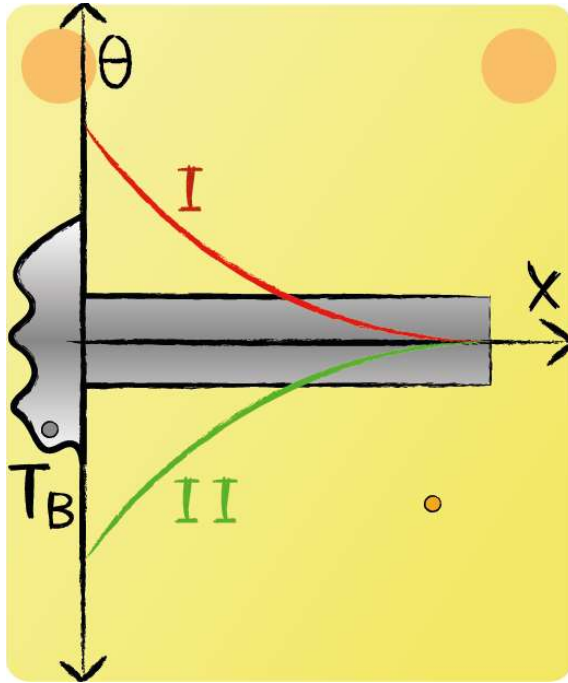# Lecture 11 - Question 6

In the figure there is a fin with a base temperature T_B and a surrounding fluid with temperature T_A. Consider the following temperature profiles for a fin. Fill in the correct answers.

Profile I applies when $T_B > T_A$ and describes **heating** of the surrounding fluid.

Profile II applies when $T_B < T_A$ and describes **cooling** of the surrounding fluid.

Profile I as well as II will **never equal** $\theta = 0$ at x=L in practice.

θ will be positive when $T_B > T_A$ and negative when $T_B < T_A$. Where a positive value for θ will describe heating of the fluid, because heat is transferred from the fin to the fluid. So will a negative value for θ describe heat transfer to the fin and thus cooling of the fluid.

Even with $\dot{Q}_{head} = 0$ the temperature at the tip is always above the ambient temperature and θ will only approach zero.

With the given boundary conditions: $\theta(0) = \theta_B$ and $\frac{d\theta}{dx}\big|_{x=L} = 0$

$$\rightarrow \theta(x) = \theta_B \cdot \left(\frac{e^{m(L-x)} + e^{-m(L-x)}}{e^{mL} + e^{-mL}} \right)$$

and thus

$$\theta(L) = \theta_B \cdot \left(\frac{e^0 + e^0}{e^{mL} + e^{-mL}} \right) = \theta_B \cdot \left(\frac{2}{e^{mL} + e^{-mL}} \right) \neq 0$$