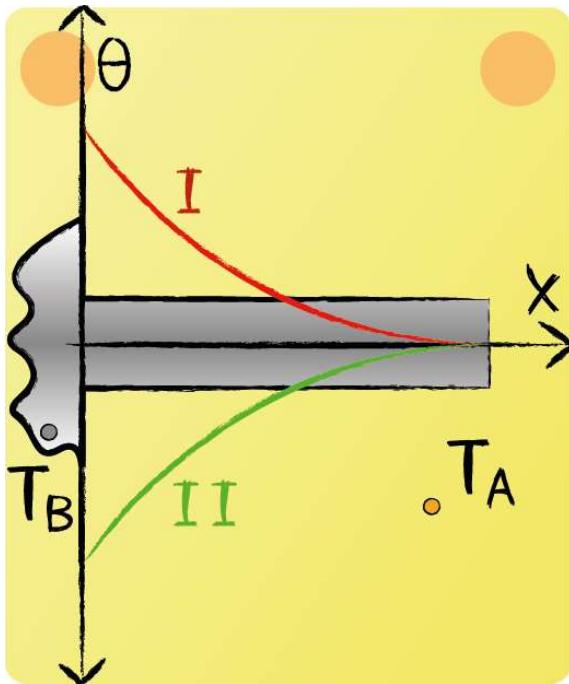


## Lecture 11 - Question 6



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 can **only approach**  $\theta = 0$  at  $x=L$  in practice.

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

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

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

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

and thus

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

