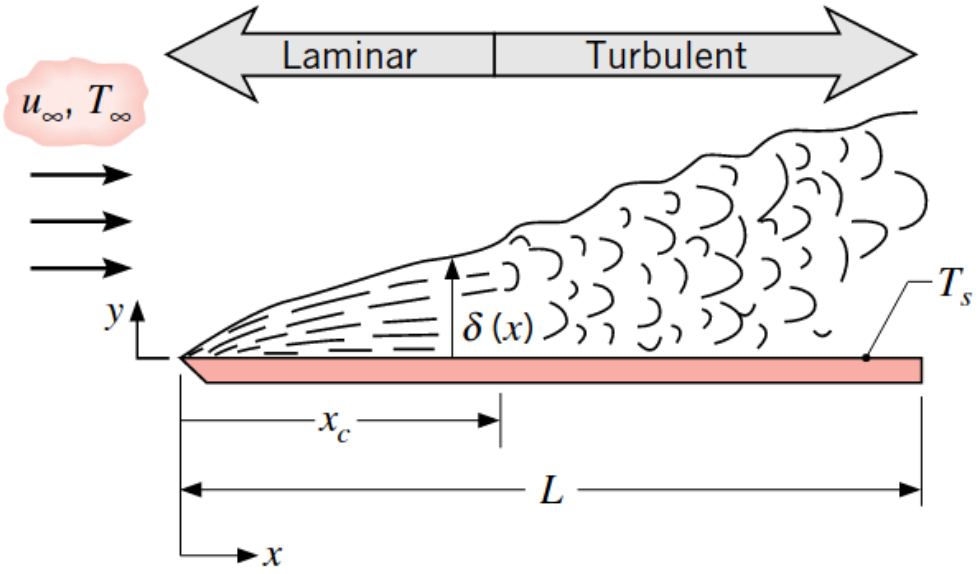
HW4, PP1



First we calculate the Reynolds number to determine whether the flow is laminar or turbulent. The boundary layer is laminar at the beginning of the plate and evolves in the direction of the plate. Hence, the characteristic length that describes the nature of the flow is the length of the plate. There is some critical length after which the boundary layer becomes turbulent.

$Re = UL/\nu$

The critical Reynolds number for this case is around $Re_c = 5.5 * 10^5$

The rate of heat transfer is determined by the Newton's law of cooling. To obtain the convective heat transfer coefficient, we need to calculate the mean Nusselt number from a correlation that suits this case. The correlation for a laminar flow is

$Nu = 0.644\, Re^{(1/2)}\, Pr^{(1/3)}$

And for turbulent flow

$Nu = 0.0296\, Re^{(4/5)}\, Pr^{(1/3)}$

The correct answer is of the order of $q' = q/W = 200\, W/m$