# Heat Transfer Questions & Answers

### Question by Student 201427115

*Professor, I have a question about insulation. At the surface insulated, heat transfer is zero. But in assignment 1 problem #1, even the wall has insulation layer, it has heat transfer inside the insulation part. What's the difference between two? Thank you.*

If an insulation layer is specified without a thermal conductivity, then assume its conductivity is zero (and hence there is no conduction heat transfer). If the insulation layer has a given thermal conductivity, then the heat transfer through the insulation layer will not be zero. 1 point bonus.

### Question by Student 201327132

*Dear Professor. Today, We learned about Thermal layer. I have a question*

$$\frac{\mu}{\rho c}\left(\frac{\partial u}{\partial y}\right)^2 = \frac{\mu}{\rho c}\frac{(u_\infty - 0)^2}{\delta_t^2}$$

*I think that we can't use* $(u_\infty - 0)$*. Because Boundary layer is longer than Thermal layer. So If we use* $\delta$*,* $(u_\infty - 0)$ *is reasonable. But, If we use* $\delta_t$*, The velocity at the point have some difference with* $u_\infty$*. Is it because assume very small difference? Thank you.*

Here we were doing an order of magnitude analysis. As long as $\delta$ and $\delta_t$ are within the same order of magnitude (and as will be shown later, they are), the analysis is correct. 1 point bonus.

### Question by Student 201427115

*Professor, I have a question in assignment #5. In question #2, to find heat transfer, I needed to multiply area per unit depth. Here, heat transfer(*$q_{out}$*) occurs in the casing of the journal bearing. Because we assumed no heat transfer into the journal. So I multiplied by* $\pi D_o$*. But to get right answer I should multiply* $\pi D_i$*. Why does it use* $D_i$*?*

In the question, it says the journal bearing has a diameter of 75 mm. It's not mentioned whether this is the diameter of the shaft or of the casing. This doesn't really matter here because the difference in diameter is quite small. I chose the diameter of the casing ($D_\text{o}$) to be 75 mm. 1 point bonus.

**Question by Student 201527110**

*Professor, I have a question about the "Eckert Number." I found that some of the books had defined the Eckert number as the rate of difference of temperatures as following below*

$$Ec = 2\frac{T_0 - T_\infty}{T_w - T_\infty}$$

*However, in the Table what you offered, the Eckert number had defined as the rate of kinetic energy to Thermo energy difference as following below*

$$Ec = \frac{u_\infty^2}{C_p \mid T_\infty - T_w|}$$

*I wonder they have different meaning (Defined for other reasons) or just have different forms?*

What is $T_0$ in your second definition of Ec? We need to know how $T_0$ is defined. Write down the definition for $T_0$ and try to to express it as a function of $u_\infty$.

**Question by Student 201527110**

*Ok I see. I found that $T_0$, stagnation temperature can be defined as*

$$T_0 = T_\infty + \frac{u_\infty^2}{2C_p}$$

*and then we substitute it in the other with the table one, then both Eckert number have same form. I appreciate for your help.*

Great! 1 point bonus for bringing this up.

**Question by Student 201327139**

*Professor, I wonder about 'Summary of eqs for flow over flat plate' table. When flow regime is Laminar, local, we have another 2 restriction, same condition of $Re_x < 5 * 10^5, 0.6 < P_r < 50$ and '$T_w = const$' / '$q_w = const$'. What's the difference of two condition? What should I use between two condition? Thank you.*

Well, you should use the $\mathrm{Nu}_x$ expression that says $T_\mathrm{w}$ is constant when the wall temperature over the entire plate is a constant. And you should use the $\mathrm{Nu}_x$ expression that says $q''$ is constant when the heat flux at any location on the flat plate is constant. 0.5 point bonus.