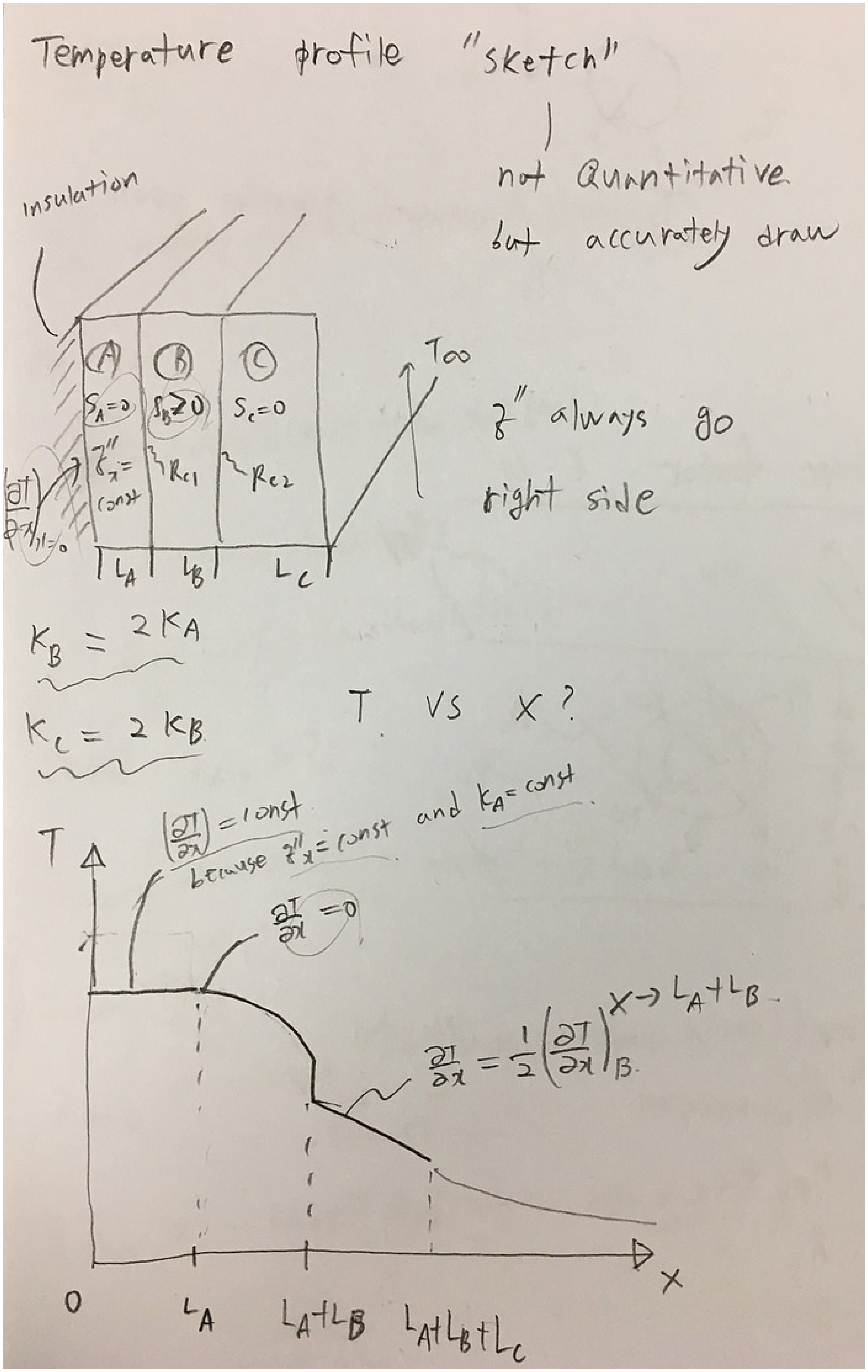
Heat Transfer Questions & Answers

Question by Student 201427132

Dear professor, i ask you that i understand in right way.
Previous question :



I rewrite my previous question about "Temperature profile sketch".
I am curious that why $\frac{dT}{dx}$ on graph is decreasing between section L_A and section $L_A + L_B$ although there is heat generation between section L_A and section $L_A + L_B$.
I guess if there is heat generation, temperature goes up. But in the graph, it doesn't. Why this happened?

There is one assumption that heat always go to right side.
06.15.17
Well yes, but I think the answer to this is fairly obvious.. So, I am asking you to think about it a little. You ask why temperature goes down and not up. But if the temperature goes up, where will the heat go? Answer left or right.

I understand temperature should go down, the reason that if temperature goes up, heat would go left side, and it results temperature goes up in section L_A, So it does not make sense.
As a result, temperature should go down.
Am i understand in right way?

Yes that's fine! You answered your own question.. I can give you 0.5 point bonus boost.

Question by Student 201327132

$q''_x = -k\frac{\partial T}{\partial x}$ = const. and $k = k_0(1+\beta T)$. So $q''_x = -k_0(1+\beta T)\frac{\partial T}{\partial x}$. If $\beta > 0$ and $k_0 + \beta T$ is higher, $-\frac{\partial T}{\partial x}$ (slope) should become lower. Because $q''_x = -k_0(1+\beta T)\frac{\partial T}{\partial x}$ should be constant. $T_2 > T_1$ in the graph. So, graph should drawn half parabola to the negative direction along x. I think today's question is just advert phase.

Hm, it's in the right direction, but not as clear as I would like. Maybe a schematic would help. I'll give you 1 point bonus for the effort.

Question by Student 201527110

Professor, I wonder the difference of conductivties between that of gas and solid. The definiton of conductivity is $K \equiv \frac{m5R\sqrt{3RT}}{\sigma 4\sqrt{2}}$ and is it valid only for gases? If that definition is also valid for both gas and solid, why solid doesn't exactly proporsional to $\sqrt{T}$?

This is valid for gases assuming negligible intermolecular collisions and assuming that all the particules going towards the interface have the same average energy independently of speed. For liquids, the expression will be different because of intermolecular attraction forces. For solids, the expression for k will be totally different and depend on how the phonons propagate (different from solid to solid). 1 point bonus boost.

Question by Student 201427104

Professor. I tried to sort out the problem that you asked us to explain yesterday. The solution of the given problem is the same as that of the $T_1 > T_2$ graph. Assume q''_x = const and $\beta > 0$. q''_x = const = $-k\frac{\partial T}{\partial x}$ and $k = k_0(1+\beta T)\frac{\partial T}{\partial x}$.

Therefore $q''_x = -k_0(1+\beta T)\frac{\partial T}{\partial x}$*. In other words* $q''_x = k_0(1+\beta T)(-\frac{\partial T}{\partial x})$*. That is, since* $q''_x = const$*,* $(-\frac{\partial T}{\partial x})$ *must be small if* $k_0(1+\beta T)$ *is large. The reverse is also true. So* $(-\frac{\partial T}{\partial x})$ *is low for* T_2*, and* $(-\frac{\partial T}{\partial x})$ *is high for* T_1*. Therefore, the shape of the graph is a symmetrical shape of the graph when* $T_1 > T_2$*. It is convex shape.*

This is a better explanation but builds on the one of the previous student: 0.5 point bonus boost. I deleted the second question from your post — please ask only 1 question per post.

Question by Student 201427111

In the last lesson, I thought about the problem that professor aksed me to explain why. As the professor explained about T profile in wall that $q''_x = constant = -k\frac{\partial T}{\partial x}$*,* $k = (k_0 + k_0\beta T)$*. So* $q''_x = constant = (k_0 + k_0\beta T)(-\frac{\partial T}{\partial x})$*. And if* $\beta > 0$ *because of* $T_1 > T_2$ *when* T_1*,* $(k_0 + k_0\beta T)$ *is high and* $(-\frac{\partial T}{\partial x})$ *is low. similarly when* T_2 *,* $(k_0 + k_0\beta T)$ *is low and* $(-\frac{\partial T}{\partial x})$ *is high. As a result slope is decrease in positive direction along x. that is convex up shape In the same case if* $T_2 > T_1$ *when* T_2*,* $(k_0 + k_0\beta T)$ *is high and* $(-\frac{\partial T}{\partial x})$ *is low when* T_1 *,* $(k_0 + k_0\beta T)$ *is low and* $(-\frac{\partial T}{\partial x})$ *is high. As a result slope is increase in negative direction along x. that is convex up shape.*

This is a repetition of the explanations given by the previous students. No bonus.

Question by Student 201327128

Dear professor, I would like to answer about your question(this monday).

First solution to this problem

in case, $T_1 > T_2 \rightarrow q_x'' > 0,\ q_x'' = const$

$T_1 < T_2$ and if $B>0 \rightarrow q_x'' = -\frac{k_0}{L}(T_2-T_1)\left(1+\frac{B}{2}(T_2+T_1)\right)$

$-\frac{k_0}{L}(T_2-T_1)<0,\quad 1+\frac{B}{2}(T_2+T_1)>0$

so $q_x''<0$ and $q_x'' = const = -(k_0+Bk_0T)\frac{\partial T}{\partial x}$

and $-(k_0+Bk_0T)<0$

Therefore $\frac{\partial T}{\partial x}>0$. and $-q_x''>0$,

$-q_x'' = -(const) = (k_0+Bk_0T)\frac{\partial T}{\partial x}$

so (k_0+Bk_0T) is higher then $\frac{\partial T}{\partial x}$ become lower

(k_0+Bk_0T) is lower then $\frac{\partial T}{\partial x}$ become higher

another solution to this problem

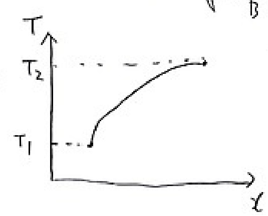
$-q_x'' = -(const) = A$ then $A = \frac{\partial T}{\partial x} k_0(1+BT) \rightarrow \int A\,dx = \int k_0(1+BT)\,dT$

$\rightarrow Ax = \frac{k_0}{2B}(1+BT)^2 + C$

$\rightarrow \sqrt{\frac{(Ax-C)2B}{k_0}} = 1+BT$ (Because $(1+BT)>0$)

Therefore $T = \sqrt{\frac{(Ax-C)2}{Bk_0}} - \frac{1}{B} = \sqrt{\frac{2(-q_x''x-C)}{Bk_0}} - \frac{1}{B}$ and $T_1<T<T_2$

graph



I'm sorry, I'm not good at writing with a formula on the computer. So I attached a image.

You need to typeset your post using LaTeX. Only attach images for figures/schematics. Also, other students have provided good explanations already — we need to move on now.