

Heat Transfer Questions & Answers

This is a good question. “Convective” heat transfer is just an handy way of dealing with the complex conduction heat transfer that occurs within matter in movement. So in this course, we say that convective heat transfer is the heat transfer that occurs at the interface between a solid and a fluid and we use the parameter h to deal with this situation: this is an engineer “trick” that makes it easier to solve engineering problems. But fundamentally in physics, there are only two types of heat transfer: conduction and radiation.

For the second question, please ask it below and delete it from your 1st post. Only 1 question per post is allowed.

I'll give you 2 points bonus boost for your question.

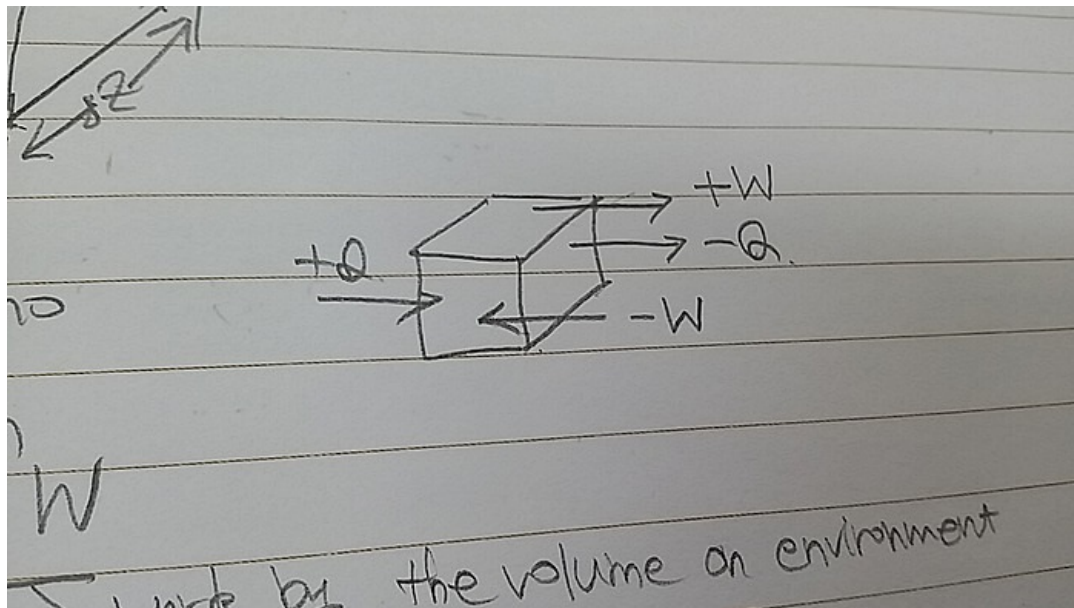
Question by Student 201427564

Hello. I have a question about ur 2nd lecture. Actually its the range of thermo. Anyway, i learned that work 'by the volume' on environment is positive in thermo class. But u wrote negative. Am i wrong? Please answer and have a good day. Thx.

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Hi, I'll answer your question after you type it better. Please use standard English spelling: “u” should be “you”, “i” should be “I”, etc. Also, Place your figure inline so that it appears within your question instead of being an attachment. This will make it easier for everyone to read your question.

Question by Student 201427564



I'm sorry. Hello again. I have a question about your 2nd lecture. Actually it is the range of Thermodynamics. Anyway, I learned that work 'by the volume' on environment is positive in Thermodynamics class. But you wrote negative. Am I wrong? Please answer and have a good day. Thank you.

Your question is incomplete: you have to outline in your post the first law that the professor used in his course. Make a correction by clicking on EDIT just right of your question and add the outline of the first law using L^AT_EX (write the precise mathematical terms he used). There are many ways the first law can be written.. I will answer your question once you do this.

Question by Student 201427115

hello professor, I think there is something wrong at our assignment. At problem 2, you wrote the answer is 9.6°C . But there is some problem to 9.6°C become answer. Two coefficients of temperature of the plate have different units.

$$\sigma = 5.67 \times 10^{-8} [\text{W}/\text{m}^2 \text{K}^4]$$

Its temperature unit is K.

$$h = 12 [\text{W}/\text{m}^2 \text{C}]$$

its temperature unit is $^{\circ}\text{C}$. so it can't be calculated directly. I attached my solution. So please answer me. Thank you for reading my question.

This is a very good question, and I am glad you are asking it. When using the relationship for radiation heat transfer (i.e. $q'' = \sigma T^4$), you must use units of absolute temperature like Kelvin or Rankine. But, when using the relationship for convective heat transfer (i.e. $q'' = h(T_s - T_{\infty})$) or conduction heat transfer (i.e. $q''_x = -k \partial T / \partial x$), you can use either units of Kelvin or of Celcius. This is because convective and conduction heat transfer depend on a simple difference of temperatures, and the difference in Kelvin is exactly equal to the difference in Celcius. Thus, you can change the unit Kelvin to Celcius as you wish. But, you can't do this for radiation thus because the radiative heat transfer can not be expressed as a simple difference of temperatures: it corresponds to a difference of T^4 , and a difference of K^4 is not equal to a difference of $^{\circ}\text{C}^4$.

I'll give you 1.5 points bonus boost for your question. I would have given more if your L^AT_EX typesetting would have been better. You should write " $\text{W}/\text{m}^2 \text{C}$ " not " $\text{W}/\text{m}^2 \text{C}$ ". To learn L^AT_EX quickly, just right click on any mathematical expression on my website. Then select "Show Math As" and then "T_EX command".

Also, don't attach your solutions to your post (I deleted them). It's too time consuming for me to go through your solutions. Your question by itself was fine.

Question by Student 201027112

Hello professeur, I have a question about derivation of integral form of heat equation. Following the steps, it starts from differential form of heat equation.

$$\frac{\partial}{\partial t}(\rho c T) = -\frac{\partial}{\partial x} q_x'' - \frac{\partial}{\partial y} q_y'' - \frac{\partial}{\partial z} q_z'' + S$$

And multiply by $dV = dx dy dz$ and integrating both sides. I can understand up to this step.

$$\int_V \frac{\partial}{\partial t}(\rho c T) dV = - \int_z \int_y \partial q_x'' dy dz - \int_z \int_x \partial q_y'' dx dz - \int_y \int_x \partial q_z'' dx dy + \int_V S dV$$

But I've little confused from next step.

$$\frac{\partial}{\partial t} \int_V (\rho c T) dV = - \int_S \vec{q}'' \cdot \hat{n} dS + \int_V S dV$$

I understand that this step is expressing each directions of heat fluxes (x, y, z direction) to single vector form. But suddenly partial operator in front of each heat flux is gone. I've wondered this point.

$$\frac{\partial}{\partial t} \int_V (\rho c T) dV = q_{in} - q_{out} + \int_V S dV$$

Equation above is conclusion of integral form of heat equation. But for derivation of q_{in} and q_{out} , maybe partial operator should remain. Then partial operator and integral operator can be eliminated. I think the step that I wondered should be below.

$$\frac{\partial}{\partial t} \int_V (\rho c T) dV = - \int_S \partial \vec{q}'' \cdot \hat{n} dS + \int_V S dV$$

Am I wrong or I miswrote in your lecture? If I'm wrong, where am I missed something in process of derivation? I'll wait your answer. Thank you. :)

This is a good point. The problem is in the second equation (maybe you made a mistake when writing down what I wrote, or maybe I made a mistake on the blackboard — this happens sometimes):

$$\int_V \frac{\partial}{\partial t}(\rho c T) dV = - \int_z \int_y \partial q_x'' dy dz - \int_z \int_x \partial q_y'' dx dz - \int_y \int_x \partial q_z'' dx dy + \int_V S dV$$

There is an integral missing. This equation should be:

$$\begin{aligned} \int_V \frac{\partial}{\partial t}(\rho c T) dV = & - \int_z \int_y \int_{x=0}^{x=L} \partial q_x'' dy dz - \int_z \int_x \int_{y=0}^{y=H} \partial q_y'' dx dz - \int_y \int_x \\ & \int_{z=0}^{z=D} \partial q_z'' dx dy + \int_V S dV \end{aligned}$$

Notice the missing integrals in front of the heat fluxes, and note that L, H, D are the length, height, and depth of the domain we are integrating. The integrals of the heat fluxes can be easily done and this will yield:

$$\int_{x=0}^{x=L} \partial q_x'' = q_{x=L}'' - q_{x=0}''$$

and similarly for the other dimensions. I'll give you a 2 point bonus boost for your question.

Question by Student 201427130

When I solve assignment #1, question #3. I find something strange. when I solve that, i define $q_{\text{rad.in}}$ and $q_{\text{rad.out}}$. I only know energy moving occur that high temperture move to low temperture. But $q_{\text{rad.out}}$. it is moved to high temperture to low temperture. $q_{\text{rad.out}}$ is energy that T_1 to T_2 . But T_1 is colder than T_2 . why we define that energy moving?

Please typeset your question correctly using L^AT_EX, and I will answer it afterwards: T_1 should be T_1 , $q_{\text{[radiation in]}}$ should be $q_{\text{rad.in}}$, etc. This will make your question easier to read for me and for the class, and I can then answer it using the same notation as you used. Besides, L^AT_EX skills can be an asset on a resume (L^AT_EX is not only used on my website: it's commonly used to typeset mathematics within google docs, wikipedia, scholarpedia, scholarly publications and books, etc).

Question by Student 201427130

I'm sorry for my mistake for not use latex. So I ask it again sir. When I solve assignment #1, question #3. I find something strange. when I solve that, i define $q_{\text{rad.in}}$ and $q_{\text{rad.out}}$. I only know energy moving occur that high temperture move to low temperture. But $q_{\text{rad.out}}$. it is moved to high temperture to low temperture. $q_{\text{rad.out}}$ is energy that T_1 to T_2 . But T_1 is colder than T_2 . why we define that energy moving?