*weekly_submission_**02***

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> Summary about the convection heat transfer.

Convection is one of the three mechanism of heat transfer. It's the transfer of heat from one place to another by the movement of fluids (liquid and gases). There are two types of convection:

- natural (or free) convection: in this case the fluid motion is generated only by density differences in the fluid occurring due to temperature gradients;
- forced convection: in this case, the fluid is forced to flow over a surface or in a tube by external means.

Rate of convective heat transfer depends on three elements: the temperature difference, the velocity of liquid and gases and the kind of liquid and gases.

The basic relationship for heat transfer by convection is:

$$\dot{Q} = hA(T_s - T_\infty)$$

where $\dot{Q}$ is the heat transferred per unit time, A is the area of the object, h is the heat transfer coefficient, T_s is the object's surface temperature and T_∞ is the fluid temperature.
The convective heat transfer coefficient is dependent upon the physical properties of the fluid and the physical situation.

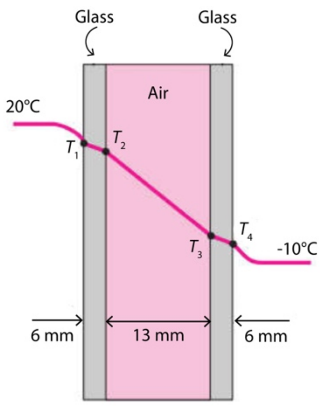
> Explain why increasing the thickness of a single pane glass does not increase the total resistance.

The thermal resistance of the glass is a very small value compared to the thermal resistance of the air between the two glasses. Increasing the thickness of a single glass can increase the thermal resistance but in a very insignificant way. To have a significant effect you should have a glass a few meters thick, but this is a "stupid" option when you can use a double glass.

> Write an explanation about what mistakes you made in the class that resulted in wrong answers.

My mistake was to have converted badly from m to mm the thickness of the glass in the first exercise.

> Consider a 0,8 $\boldsymbol{m}$ high and 1,5 $\boldsymbol{m}$ wide double pane window consisting of two mm thick layers of glass ($\boldsymbol{k} = \mathbf{0,78}\ \frac{W}{m^2{}^\circ C}$) separated by 13 $\boldsymbol{mm}$ wide stagnant air space ($\boldsymbol{k} = \mathbf{0,026}\ \frac{W}{m^2{}^\circ C}$).
Determine the steady rate of heat transfer through this double pane window and the temperature of its inner surface. (Take the convection heat transfer coefficient on the inner and outer surface of the window to be $\boldsymbol{h_1} = \mathbf{10}\ \frac{W}{m^2{}^\circ C}$ and $\boldsymbol{h_2} = \mathbf{40}\ \frac{W}{m^2{}^\circ C}$, which include the effects of radiation).



Area of the surface:

$$A_{glass} = 0{,}8 * 1{,}5 = 1{,}2\ m^2$$

The thermal resistance of the <u>convection</u> between inner surface and the air:

$$R_{conv,1} = \frac{1}{h_1 A} = \frac{1}{10 * 1{,}2} = 0{,}0833\ \frac{°C}{W}$$

The thermal resistance of the <u>convection</u> between outer surface and the air:

$$R_{conv,2} = \frac{1}{h_2 A} = \frac{1}{40 * 1{,}2} = 0{,}0208\ \frac{°C}{W}$$

The thermal resistance of the <u>conduction</u> of a 6 mm thick of glass:

$$R_{glass} = \frac{L_{glass}}{k_{glass} A} = \frac{0{,}006}{0{,}78 * 1{,}2} = 0{,}0064\ \frac{°C}{W}$$

The thermal resistance of the <u>conduction</u> of a 13 mm wide stagnant air space:

$$R_{air} = \frac{L_{air}}{k_{air}A} = \frac{0{,}013}{0{,}026 * 1{,}2} = 0{,}4167\ \frac{°C}{W}$$

Total thermal resistance of the window:

$$R_{tot} = R_{conv,1} + R_{glass,1} + R_{air} + R_{glass,2} + R_{conv,2} = 0{,}0833 + 0{,}0064 + 0{,}4167 + 0{,}0064 + 0{,}0208 = 0{,}5333\ \frac{°C}{W}$$

Steady rate of heat transfer through this double pane window:

$$\dot{Q} = \frac{\Delta T}{R_{tot}} = \frac{20 - (-10)}{0{,}5333} = 56{,}2535\ w$$

The temperature of the inner surface of the window:

$$\dot{Q} = \frac{T_{\infty,1} - T_1}{R_{conv,1}}$$

$$T_1 = T_{\infty,1} - (\dot{Q} * R_{conv,1}) = 20 - (56{,}2535 * 0{,}0833) = 15{,}31\ °C$$

> Explain why we have an optimal range for the air-gap's distance.

In this situation we have an optimal range for the air-gap's distance because it is able to guarantee a very high resistance of the conduction. The air-gap's distance divided by the area of the glass and the value of thermal conductivity k (which is very low) generates a high value of R.