1 write a summary (in your own words !, (in your own words !!!) about the convective heat transfer (half a page)

Convective heat transfer refers to the phenomenon of heat transfer between a fluid and a solid surface as it flows through the solid. When the fluid flows as a laminar flow, the heat transfer in a direction perpendicular to the flow of the fluid is mainly carried out in the form of heat conduction. Convective heat transfer is different from thermal convection, both heat convection and heat conduction. For example: aluminum fins for household air conditioner heat exchangers have both heat conduction and convective heat transfer with air.
Convection is divided into natural convection and forced convection due to different causes of fluid motion. If the motion is caused by the difference in local density due to the temperature difference inside the fluid, it is called natural convection. If the fluid moves due to the action of a water pump, fan or other external force, it is called forced convection. But in fact, while heat convection, there is heat conduction between the various parts of the fluid, forming a complex heat transfer process. This is actually a heat transfer process that combines two basic heat transfer modes, convective heat transfer and heat transfer.

explain why increasing the thickness of a single pane glass does not increase the total resistance

Since the thermal conductivity K of the glass is relatively large, the thermal resistance R of the glass is relatively small. Compared with thermal resistance of convection it is insignificant, so just increasing the thickness of a single pane glass does not increase the total thermal resistance.

2 write an explanation about what mistakes you made in the class that resulted in wrong answers !!

The wrong idea is about the direction of indoor and outdoor convection in the natural state. When cold air meets the wall, on the one hand, cold air flows from bottom to top along the wall, and on the other hand, the air entering the room conducts heat convection and flows from top to bottom. The wall temperature is lower than the indoor temperature. The wall naturally absorbs the indoor energy. The outdoor temperature is lower than the wall. The cold air outside the wall absorbs the energy of the wall.

3 solve the same probelm as that of double pane window with with the air-gap thickness of 13 mm and glass thickness of 6 mm, commment on your results and explain why we have an optimal range for the air-gap's distance !

$$A = 0.8 \times 1.5 = 1.2\text{㎡}$$

$$R_{g1} = R_{g2} = \frac{L_g}{(K_g \times A)} = \frac{0.006}{0.78 \times 1.2} = 0.0064℃/W$$

$$R_{conv1} = \frac{1}{h_1 A} = \frac{1}{10 \times 1.2} = 0.0833℃/W$$

$$R_{conv2} = \frac{1}{h_2 A} = \frac{1}{40 \times 1.2} = 0.0208℃/W$$

$$R_{airGap} = \frac{L_{airGap}}{(K_{airGap} \times A)} = \frac{0.013}{0.026 \times 1.2} = 0.4167℃/W$$

$$R_{total} = R_{conv1} + R_{conv2} + 2R_g + R_{airGap}$$

$$= 0.0833 + 0.0208 + 2 \times 0.0064 + 0.4167$$

$$= 0.5336℃/W$$

$$\dot{Q} = \frac{\Delta T}{R_{total}} = \frac{30}{0.5336} = 56.22W$$

$$\dot{Q} = \frac{T_{\infty 1} - T_{s1}}{R_{conv1}} \rightarrow 56.22 = \frac{20 - T_{s1}}{0.0833}$$

$$T_{S1} = 15.32℃$$

In the case where the glass material and the sealing structure are the same, the larger the gas spacer layer, the larger the thermal resistance.However, after the thickness of the gas layer reaches a certain level, the growth rate of the thermal resistance is small. Because when the thickness of the gas layer is increased to a certain extent, the gas will have a certain convection under the effect of the temperature difference between the glass, such reducing the effect of thickening of the gas layer. For glass thickness of 6 mm , the thickness of the air-gap exceeding 13 mm does not produce a significant energy saving effect.