WEEK 2 _assignment

1 write a summary (in your own words!, (in your own words !!!) about the convective heat transfer (half a page) and explain why increasing the thickness of a single pane glass does not increase the total resistance

(1) Convection heat transfer:

- When fluids move from one place to another place, the heat of fluid start to transfer, this phenomenon is called convection heat transfer. Mainly due to the movement of particle position, the temperature tends to be uniform and the density of fluid tends to be uniform. Although convection is the main form of heat transfer in liquids and gases, it is often accompanied by heat conduction.
- Convection heat transfer is divide into natural convection and forced convection:

a. Natural convection: If convection is only coursed by the temperature difference which is responsible for the density difference in the different part of fluids, it is called natural convection.

b. Forced convection: If convection is coursed by some external forces like pump, fan or stirring, it is called forced convection.

- Newton's law of cooling:

Convection heat transfer is usually described by Newton' law of cooling, which is, the rate of heat loss of a body is proportional to the difference in temperatures between the body and its surroundings while under the effects of a breeze. The formula is:

$$\dot{Q}_{conv} = hA_s(T_s - T_\infty) \qquad (W)$$

$$R_{conv} = \frac{1}{hA_s} \qquad (℃/W)$$

$\dot{Q}_{conv}$: The rate of convection heat transfer

A_s : The area of object

T_s : The temperature in the surface of object

T_∞ : The temperature of fluids

R_{conv} : The resistance to convection

h : Heat transfer coefficient. (The convective heat transfer coefficient is dependent upon the physical properties of the fluid and the physical situation.)

(2) explain why increasing the thickness of a single pane glass does not increase the total resistance.

$R_1 = \frac{1}{h_1 A}$, $R_{\text{GLASS}} = \frac{\text{L}}{\text{k}A}$, $R_2 = \frac{1}{h_2 A}$

$$R_{\text{total}} = R_1 + R_{GLASS} + R_2 = \frac{1}{\text{h}_1 A} + \frac{L}{\text{k}A} + \frac{1}{\text{h}_2 A} = \frac{1}{A}(\frac{1}{\text{h}_1} + \frac{L}{k} + \frac{1}{h_2})$$

Because the value of R_{GLASS} is very small than other two values, so increasing " L " will have little influence on the value of total resistance.

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

I have no mistake.

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

（1）

$$A = 0.8 \times 1.5 = 1.2\text{m}^2$$

$$R_1 = \frac{1}{\text{h}_1 A} = \frac{1}{10 \times 1.2} = 0.0833℃/W$$

$$R_{GLASS} = \frac{L_{GLASS}}{K_{GLASS} A} = \frac{0.006}{0.78 \times 1.2} = 0.0064℃/W$$

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

$$R_2 = \frac{1}{\text{h}_2 A} = \frac{1}{40 \times 1.2} = 0.0208℃/W$$

$$R_{TOTAL} = R_1 + R_2 + 2R_{GLASS} + R_{AIR} = 0.5336℃/W$$

$$\dot{Q} = \frac{\Delta T}{R_{TOTAL}} = \frac{20 - (-10)}{0.5336} = 56.22W$$

$$\dot{Q} = \frac{20 - T_1}{R_1} \rightarrow 56.22 = \frac{20 - T_1}{0.0833} \rightarrow T_1 = 15.32℃$$

（2）explain why we have an optimal range for the air-gap's distance

The air-gap’s distance have an influence on the value of total resistance exactly. Under the same conditions, if we increase the air-gap, the thermal resistance in air will be increased. But when the air-gap expand to some extent, the rate of the total resistance will decrease. Because convection will take place in the air space due to the different temperature between two glass so that the convection process can offset the increasing of thermal resistance brought by expanding air-gap. So before reaching the value of air-gap’s distance which lead to a convection, we can have an optimal range about it.