WEEK ASSIGNMENT 2

QUESTIONS:

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

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

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

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

ANSWERS:

1.

a) Convective heat transfer (convection) is happening by moving two fluids (liquid and gas, gas and gas etc) or fluid and a solid (gas and solid) from one place to another.

   Convection happens when there are temperature differences between fluids or between fluid and a solid (depends on combination that is moving from one place to another).

   First type of convection is free convection that happens if in the contact is absent external force.

   Second type of convection is forced convection and it happens if in the contact is due to external force.

   In both of those convections the heat is transferred from hotter to the cooler part.

b) Thermal resistance of glass is smaller then thermal resistance between glass and air based on that total thermal resistance will remain same even if the glass thermal resistance will be increased.

2.

At the mentioned class I was not able to attend because of meeting for residence permit which took place in Comune in Milano. I got materials from the lectures and I were successful in solving problems following material and notes from colleague without any big doubts.

3.

The area of the surface:

$$A = \ 0.8 * 1.5 = 1.2$$

The thermal resistance of the conduction of a 6-mm-thick layers of glass:

$$R_{g_1} = R_{g_2} = \frac{L_g}{(K_g \times A)} = \frac{0.006}{0.78 * 1.2} = 0.0064\ °C/W$$

The thermal resistance of the conduction of air gap:

$$R_{airGap} = \frac{L_{airGap}}{(K_{airGap} \times A)} = \frac{0.013}{0.026 * 1.2} = 0.4166\ °C/W$$

The thermal resistance of the convection between inner air and the glass:

$$R_{conv_1} = \frac{1}{\mathrm{h}_1 \times A} = (\frac{1}{10 * 1.2}) = 0.0833\ °C/W$$

The thermal resistance of the convection between oughter air and the glass:

$$R_{conv_2} = \frac{1}{\mathrm{h}_2 \times A} = (\frac{1}{40 * 1.2}) = 0.0208\ °C/W$$

Total thermal resistance of the window:

$$R_{total} = R_{conv_1} + R_{conv_2} + 2 \times R_g + R_{airGap}$$
$$= 0.0833 + 0.0208 + 2 * 0.0064 + 0.4166 = 0.5335\ °C/W$$

Heat transfer through this double–pane window is:

$$\dot{Q} = \frac{\Delta T}{R_{Total}} = \frac{30}{0.5335} = 56.23\ W$$

The temperature of the inner surface of the window is:

$$\dot{Q} = \frac{T_{inf_1} - T_{s_1}}{R_{conv_1}} \rightarrow 56.23\ \text{W} = \frac{20 - T_{s_1}}{0.0833} \rightarrow T_{S_1} = 15.31°C$$

Trapped air helps reduce heat loss, it keeps warm air on the inside.