Week 2

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 resistane

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, commment on your results and explain why we have an optimal range for the air-gap's distance !

1. Convection is the heat transfer between fluid and solid. A real world example would be the kettle we have in our kitchens. With the use of electricity, a coil inside of the kettle is heated and this heat is transferred to the water inside of the kettle that eventually reaches a boiling point in a short amount of time. Newton's law of cooling can also be explained through the phenomenon of convection. Newton's theory states that the rate of change of an object's temperature is directly proportional to the difference in its temperature and its surrounding temperature.

   Convection can be summarized in the following formula:

   $$\dot{Q} = hA_s(Ts - T_\infty)$$

   When calculating for the total resistance, The resistance of glass is notably less than the resistance of convection therefore increasing the thickness of the glass will have little effect on resistance but will have a significant increase in the cost of the project. Therefore it is useless to increase thickness. Rather the correct solution would be to create an airgap between 2 pieces of glass sheets.

2. No mistakes

3. $L_{airgap} = 13mm$ $L_{glass} = 6mm$

   A=0.8m*1.5m = 1.2m^2

   $$k_{glass} = 0.78\frac{W}{m^{2\circ}\text{C}}$$

$$k_{airgap} = 0.026 \frac{W}{m^{2}\text{°C}}$$

$$h_1 = 10 \frac{W}{m^{2}\text{°C}}$$

$$h_2 = 40 \frac{W}{m^{2}\text{°C}}$$

$$R_{g1} = R_{g2} = \frac{L}{k_{glass} A} = \frac{0.006m}{0.78 \frac{W}{m^{2}\text{°C}} \times 1.2m} = 0.00641 \frac{\text{°C}}{W}$$

$$R_{airgap} = \frac{L_{gap}}{k_{airgap} \times A} = \frac{0.013m}{0.026 \frac{W}{m^{2}\text{°C}} \times 1.2m} = 0.4167 \frac{\text{°C}}{W}$$

$$R_{conv1} = \frac{1}{h_1 A} = \frac{1}{10 \frac{W}{m^{2}\text{°C}} \times 1.2m^{2}} = 0.0833 \, {}^{\text{°C}}/_{W}$$

$$R_{conv2} = \frac{1}{h_2 A} = \frac{1}{40 \frac{W}{m^{2}\text{°C}} \times 1.2m^{2}} = 0.0208 \, {}^{\text{°C}}/_{W}$$

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

$$R_{total} = 0.0833 + 0.0208 + (2 \times 0.00641) + 0.4167 = 0.5336 \, {}^{\text{°C}}/_{W}$$

If we compare the example we did in class vs. the current example we can extrapolate that increasing the air gap thickness from 10mm to 13mm had a significant effect on increasing Rtotal from 0.4332 ${}^{\text{°C}}/_{W}$ to 0.5336 ${}^{\text{°C}}/_{W}$ respectively. Although in these two examples the thickness of the glass also differs by 2mm, the difference in Rg creates little effect.