WEEK 2 SUBMISSION

QUESTION 1:
Write a summary about the convective heat transfer and explain why increasing the thickness of a single pane glass does not increase the total resistance.

ANSWER 1:
Convective heat transfer is one of the three ways to transfer heat. Basically, the convective heat transfer happens due to the temperature difference in the air which leads to air convection, so the heat is transferred within the process. This phenomenon usually happens in the fluids, but also happens within the fluid and solidity, of which often combined with heat conduction during the heat transfer.

When it happens between the fluid like air and solidity like wall, the temperature of the air will be divided into two parts: one is the area where the air touches the wall and a short range besides, the other is the area outside that range. For the first area, the temperature changes drastically due to the heat transfer between the wall and the air, and the temperature in the second area is generally remains the same. The air will rise up if the temperature is higher and will goes down if the temperature is lower than the part which is in a certain distance away from the wall.

The increasing thickness of a single pane glass does not increase the total resistance is because the thermal conductivity of the glass is quite low when comparing with the air. As a result, increasing the thickness of glass will not reduce much heat that transferred through the glass.

QUESTION 2:
Write an explanation about what mistakes you made in the class that resulted in wrong answers.

ANSWER 2:
I made a mistake when I was calculating the R_{wall}. I mistakenly remembered the equation as $R_{wall} = 1/kA$ rather than $R_{wall} = L/kA$, so result in a wrong answer.

QUESTION 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.

ANSWER 3:
If I follow the data which was given to us during the class, that:
The glass is 0.8m * 1.5m = 1.2 m^2

k_{glass} = 0.78 W/m℃
k_{air} = 0.026 W/㎡℃
h_1 = 10 W/㎡℃
h_2 = 40 W/㎡℃
Then we calculate them one by one:
$R_{conv1} = 1/ h_1A = 1/10*1.2 \approx 0.0833$ ℃/W
$R_{glass1} = L_{glass}/ k_{glass}A = 0.006/0.78*1.2 \approx 0.0064$℃/W
$R_{air} = L_{air}/ k_{air}A = 0.013/0.26*1.2 \approx 0.4167$℃/W
$R_{glass1} = L_{glass}/ k_{glass}A = 0.006/0.78*1.2 \approx 0.0064$℃/W
$R_{conv2} = 1/ h_2A = 1/40*1.2 \approx 0.0208$ ℃/W

The total thermal resistance is:
$R_{total} = R_{conv1} + R_{glass1} + R_{air} + R_{glass2} + R_{conv2}$ = 0.0833 +0.0064 +0.4167 +0.0064 +0.0208 = 0.5333℃/W
The heat that transfer through the window is:
$.Q = \Delta T/ R_{total} = 30/0.5333 \approx 56.2535$W

This range between the two glass panes which is around 12mm is an ideal distance because if the space is smaller than 12mm, the air will not work sufficiently to stop much heat transfer; and if the space is larger than 12mm, the space is large enough for the air to circulate due to the heat transfer, which will reduce the ability of the window's temperature isolation.