Weekly submissions: week 2

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1. **Summary about the convective heat transfer**

Convective heat transfer is the transfer of heat from one place to another with difference of temperature, by the movement of fluids, like liquids or gas. It's the most important way of heat transfer for fluids, and the heat is usually transfer from the hotter to the colder place.
There are two typologies of convection:

1. *Free convection* --> when two fluids come into contact without any forces from the outside, and they have different temperatures, the heat is moved from the hotter to colder one.
2. *Forced convection* --> when two fluids come into contact due to an outside force, such as fans creating an artificially induced convection current, the heat is moved from the hotter to the colder one.

Both of these types of convection, either natural or forced, can be *internal* or *external* because they are independent of each other. Internal flow occurs when a fluid is enclosed by a solid boundary, instead an external flow happen when a fluid is extends indefinitely without facing a solid surface.

Question 1: explain why increasing the thickness of a single pane glass does not increase the total resistance
The thermal resistance of glass is rather small compared to the thermal resistance of the convention between glass and air. Increasing the thickness of a single glass can increase the thermal resistance of the glass, but does not significantly increase the total thermal resistance.

2. **Explanation of mistakes made in the class**
During operation, the thickness of the solid wall was neglected when calculating the thermal resistance of the wall. It is sufficient to apply the formula while neglecting the factors that influence the thermal resistance of a solid object.

$$Rwall = \frac{\mathrm{L}}{kA}$$

3. **Question 2**
Consider a 0.8 m high and 1.5 m wide double pane window consisting of two 6 mm thik layers of glass (k=0.78 W/m°C) separeted by a 13 mm wide stagnant air space (k=0.026 W/m°C).
Determine the steady rate of heat transfer through this double pane window and the temperature of its inner surface. (Take the convection heat transfer coefficients on the inner ad outer surfaces of the window to be h1= 10 W/mq°C and h2= 40 W/mq°C which includes the effects of radiation).

The area of the surface:
Aglass= 0.8 x 1.5 = 1.2 mq

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

$$Rconv1 = \frac{1}{h1A} = \frac{1}{10\ x\ 1.2} = 0.083\,°\frac{C}{W}$$

The thermal resistance of the convection between outer surface and the air:

$$Rconv2 = \frac{1}{h2A} = \frac{1}{40\ x\ 1.2} = 0.0208\,°\frac{C}{W}$$

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

$$Rgrass = \frac{\mathrm{L\ glass}}{kglass\ x\ A} = \frac{0.006}{0.78\ x\ 1.2} = 0.0064\,°\frac{C}{W}$$

The thermal resistance of the conduction of a 13 mm wide air space:

$$Rair = \frac{\mathrm{Lair}}{kair\ x\ A} = \frac{0.013}{0.026\ x\ 1.2} = 0.4167\,°\frac{C}{W}$$

Total thermal resistance of the window:

$$Rtot = Rconv1 + Rconv2 + Rglass1 + Rglass2 + Rair = 0.5333\,°\frac{C}{W}$$

Heat transfer through double pane window:

$$\dot{Q} = \frac{\mathrm{T1-T2}}{Rtot} = \frac{20° - (-10)}{0.5333} = 56.254\ W$$

$$\dot{Q} = \frac{\mathrm{T1-t1}}{Rconv1}$$

Temperature of inner surface of the window is:

$$t1 = T1 - \dot{Q}\ x\ Rconv1 = 20°C - 562535\ x\ 0.0833 = 15.3°C$$