2nd *WEEK'S* SUBMISSION

1. SUMMARY OF THE LESSON ON CONCECTIVE HEAT TRANSFER

First, it is important to remember that convection can be of two types: **natural** or **forced**.

In a building, natural convective movements are generated both inside and outside and are due to the temperature differences to which the air is subjected.

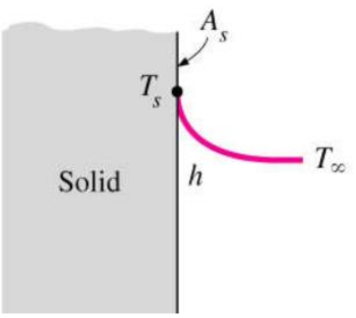
Internally, the air in a room meets colder wall surfaces and for this reason generates convective motions downwards.

Externally, the air comes into contact with warmer surfaces and for this reason generates convective motions upwards.

We can summarize that the rate of convective heat transfer depends on:

- **difference of temperature**
- **the speed of the air in touch with the wall**
- **kind of gas**

From these conditions we can formulate the **Newton's law of cooling**:

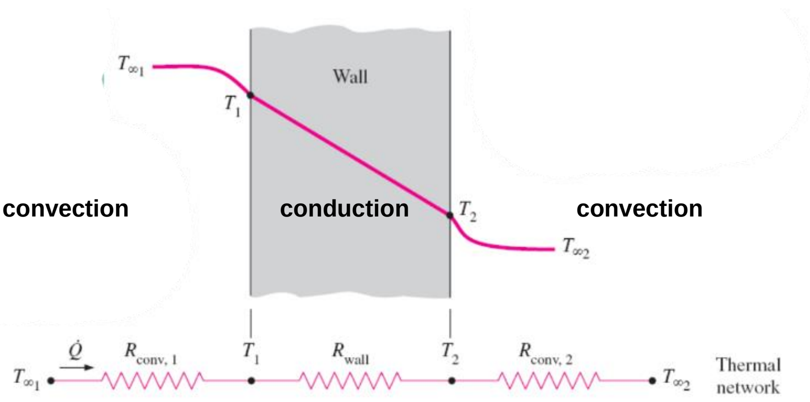


$$\dot{Q} = \frac{Ts - T\infty}{Rconv} \; (W) \quad (1)$$

$$R_{conv} = \frac{1}{hAs} \; (°C/W) \quad (2)$$

Ts = temperature of the surface
T∞= temperature not affected by the wall
h= convective heat transfert coefficient (depends on how fast the air is moving)
From the second formula we can understand that faster is the air less is the resistance.

In the heat transfer of heat from a wall there are both conduction and convection.



So if we want to determine the overall heat transfer, we have to remember to add all the resistance:

$$\dot{Q} = \frac{Ts - T\infty}{Rtotal}$$

R total =R conv 1 + R wall + R conv 2

$$R\ total = \frac{1}{hAs} + \frac{L}{KA} + \frac{1}{hAs}$$

3. WHY INCREASING THE THICKNESS OF A SINGLE PANE GLASS DOES NOT INCREASE THE TOTAL RESISTANCE?

Because if we change the thickness of the glass the value of resistance is too small compared with the resistance of convection, so the total thermal resistance will not be affected by as so small change.

4. EXPLANATION ABOUT WHAT MISTAKES YOU MADE IN CLASS

In the first exercise made in class I have forgot to convert the 8 mm in 0,008 m.

The area and K were expressed in meters so we have to convert also the thickness of the glass.

5. CONSIDER A 0,8 m HIGHT AND 1,5 m WHIDE DOUBLE PLANE WINDOW CONSISTING OF TWO 6 mm THICK LAYERS OF GLASS (K=0,78 W/m°C) SEPARATE BY A 13 mm WHIDE AIR SPACE (K=0,026 W/m°C). DETERMINE THE STEADY RATE OF HEAT TRANSFER THROUGH THIS DOUBLE PLANE WINDOW AND THE TEMPERATURE OF THIS INNER SOURFACE.

CONSIDER $h_{1=}$ 10 W/m^2°C AND $h_{2=}$ 40 W/m^2°C

Area:

A= 0,8 m x 1,5 m= 1,2 m^2

First resistance between air and glass:

$$R\ conv1 = \frac{1}{h1\ x\ A} = \frac{1}{10\frac{W}{m2°C}\ x\ 1{,}2m2} = 0{,}083\ °\frac{C}{W}$$

Second resistance between glass 1:

$$Rglass1 = \frac{L}{Kglass\ x\ A} = \frac{0{,}06\ m}{0{,}78\frac{W}{m2°C}\ x\ 1{,}2m2} = 0{,}0064\ °\frac{C}{W}$$

Second resistance through the inner air:

$$R\ air = \frac{L}{Kair\ x\ A} = \frac{0{,}06\ m}{0{,}026\frac{W}{m2°C}\ x\ 1{,}2m2} = 0{,}4167\ °\frac{C}{W}$$

Second resistance between glass 2:

Rglass2 = $\frac{L}{Kglass\ x\ A} = \frac{0{,}06\ m}{0{,}78\frac{W}{m2°C}\ x\ 1{,}2\text{m2}} = 0{,}0064\ °\frac{C}{W}$

Second resistance between glass and air:

R conv2 =$\frac{1}{h2\ x\ A} = \frac{1}{40\frac{W}{m2°C}\ x\ 1{,}2\text{m2}} = 0{,}0208\ °\frac{C}{W}$

Total thermal resistance:

R total =R conv 1 + R glass1 + R air + R glass 2 + R conv 2

R total = $0{,}083\ °\frac{C}{W} + 0{,}0064°\frac{C}{W} + 0{,}4167°\frac{C}{W} + 0{,}0064°\frac{C}{W} + 0{,}0208°\frac{C}{W} = 0{,}5333\ °\frac{C}{W}$

Overall heat transfer:

$\dot{Q} = \frac{Ts - T\infty}{Rtotal} = \frac{20°C-(-10°C)}{0{,}5333°\frac{C}{W}} = 56{,}2535\ W$

Temperature of the inner surface of the window:

$T_1 = \text{T}\infty 1 - \dot{Q}\ \text{x R conv1} = 20°\text{C} - 56{,}2535\ \text{x}\ 0{,}0833\ °\text{C/W} = 15{,}3°\text{C}$

6. WHY WE HAVE AN OPTIMAL RANGE FOR THE AIR GAP'S DISTANCE?

Because if the two planes of glass were too far the convective motions inside the chamber would be favoured losing the performance.