First name: …… Last name: ……..

# Homework n°01

## Exercise

The bottom of a pan is made of a **4-mm-thick aluminium layer**. In order to increase the rate of heat transfer through the bottom of the pan, someone proposes a design for the bottom that consists of a **3-mm-thick copper layer sandwiched between two 2-mm-thick aluminium layers**.

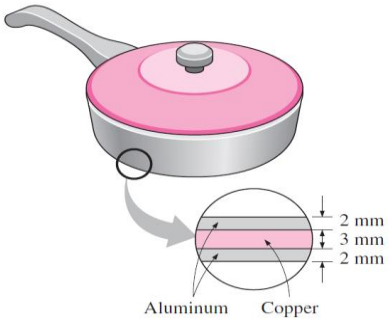

**Figure 01**

Will the new design **conduct** heat better? Explain.

Given:

$k_{copper}$ = 398 W/m.K

$k_{aluminium}$ = 237 W/m.K

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## Calculate the Thermal Resistance of the Original Design (Aluminum Only)

The formula for thermal resistance is: R=k/L

R = 0.004 / 237 ≈ 0.00001688 K/W

So, the thermal resistance of the original design is: $R_{original}$ = 0.00001688 K/W

## Calculate the Thermal Resistance of the New Design (Aluminum/Copper/Aluminum)

The total thermal resistance is the sum of the resistances of each layer:

$$R_{new} = R_{aluminum,\,top} + R_{copper} + R_{aluminum,\,bottom}$$

$$R_{aluminum,\,total} = 2 \times 0.00000844 \approx 0.00001688\,K/W$$

$$R_{copper} = \frac{L}{k} = \frac{0.003}{398} \approx 0.00000754\,K/W$$

$$R_{new} = R_{aluminum,\,total} + R_{copper}$$

$$R_{new} = 0.00001688 + 0.00000754 \approx 0.00002442\,K/W$$

The new design introduces the thermal resistance of the copper layer in addition to the thermal resistance of the aluminium which has the same value for both designs. Therefore, **the new design will be a poorer conductor of heat.**