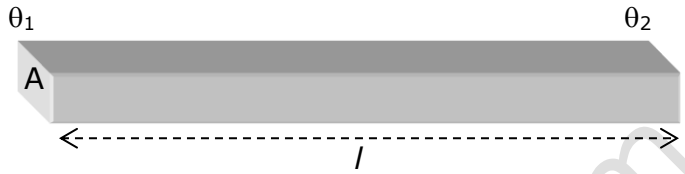
Q- A glass windowpane has an area of 3.00m^2 and a thickness of 0.600cm. If the temperature difference between its faces is 25.0 degrees Celsius, what is the rate of energy transfer by conduction through the window? (coefficient of conductivity for glass to be taken as 0.8 W/(m.K)



When the two ends of a rod are maintained at a temperature difference and the heat is conducting only along the length, no heat is lost from the side faces, in steady state the rate of heat flow through the rod dQ/dt is directly proportional to the temperature difference, directly proportional to the area of cross section and inversely proportional to the length of the rod. Hence combining all we have

$$\frac{dQ}{dt} \propto \frac{A(\theta_1 - \theta_2)}{l}$$

Or $$\frac{dQ}{dt} = K\frac{A(\theta_1 - \theta_2)}{l}$$

Here K is the constant of proportionality depending on the conducting property of the material of rod and is called coefficient of conductivity of the material.

In differential form the equation can be written as

$$\frac{dQ}{dt} = -KA * \frac{d\theta}{dx}$$

Here $d\theta/dx$ is called the temperature gradient of the rod at that point.

According to the question

Area of the panel	A = 3.00 m^2
Thickness of glass	l = 0.600cm. = 6*10^{-3} m
Temperature difference	θ_1-θ_2 = 25.0 degrees Celsius,
Conductivity for glass	K = 0.8 W/(m.K)

Substituting the values in the equation the rate of heat conduction is given by

$$\frac{dQ}{dt} = K\frac{A(\theta_1 - \theta_2)}{l}$$

Or $$\frac{dQ}{dt} = \frac{0.8 * 3.00 * 25}{6 * 10^{-3}} = 10000W = 10KW$$