

## **PROBLEMS**

9.1 The concrete roof of a house of thickness 20 cm has an area 200 m<sup>2</sup>. The temperature inside the house is 15<sup>0</sup> C and outside is 35<sup>0</sup> C. find the rate at which thermal energy conducted through the roof. The value of k for concrete is 0.65 Wm<sup>-1</sup>K<sup>-1</sup>.

#### Given Data

Thickness of the roof = 
$$L = 20 \text{ cm} = 0.2 \text{ m}$$

Area of the 
$$roof = A = 200 \text{ m}^2$$

Temperature outside the house = 
$$T_1 = 35^{\circ}$$
 C =  $(35 + 273)$  K = 308 K

Temperature inside the house = 
$$T_2 = 15^0 \text{ C} = (15 + 273) \text{ K} = 288 \text{ K}$$

Coefficient of thermal conductivity = 
$$k = 0.65 \text{ Wm}^{-1}\text{K}^{-1}$$

# Required

Rate of conduction of energy through the roof = Q/t = ?

### Solution

As we know that

Rate of flow of heat = 
$$\frac{Q}{t} = \frac{kA(T_1 - T_2)}{L_t}$$

By putting the values, we have

Rate of flow of heat = 
$$\frac{Q}{t} = \frac{0.65 \times 200 \times (308 - 288)}{0.2}$$

Rate of flow of heat = 
$$\frac{Q}{t} = \frac{130 \times 20}{0.2}$$

Rate of flow of heat = 
$$\frac{Q}{t} = \frac{2600}{0.2}$$

Rate of flow of heat = 
$$\frac{Q}{t}$$
 = 13000 Js<sup>-1</sup>

#### Result

Rate of conduction of energy through the roof =  $Q/t = 13000 \text{ Js}^{-1}$ 

9.2 How much heat is lost in an hour through a glass window measuring 2.0 m by 2.5 m when inside temperature is 25° C and that of outside is 5° C, the thickness of glass is 0.8 cm and the value of k for glass is 0.8 Wm<sup>-1</sup>k<sup>-1</sup>?

#### Given Data

Area of the window =  $A = 2.0 \text{ m} \times 2.5 \text{ m} = 5.0 \text{ m}^2$ 

Thickness of the glass = 0.8 cm = 0.0008 m

Temperature inside the window =  $T_1 = 25^{\circ}$  C

Temperature outside the window =  $T_2 = 5^{\circ}$  C

Coefficient of thermal conductivity =  $k = 0.8 \text{ Wm}^{-1}\text{K}^{-1}$ 

## Required

Heat lost through the glass = Q = ?

## Solution

As know that

$$Q = \frac{kA(T_1 - T_2)t}{L}$$

By putting the values, we have

$$Q = \frac{0.8 \times 5 \times (298 - 278) \times 3600}{0.008}$$

$$Q = \frac{4 \times 20 \times 3600}{0.008}$$

$$Q = \frac{288000}{0.008}$$

$$Q = 36000000 J$$

$$Q = 3.6 \times 10^7 \text{ J}$$

## Result

Heat lost through the glass =  $Q = 3.6 \times 10^7 \text{ J}$ 

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