UNIT 9

TRANSFER OF HEAT

PROBLEMS

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

Given Data

Thickness of the roof = L = 20 cm = 0.2 m

Area of the roof = A = 200 m^2

Temperature outside the house = $T_1 = 35^0$ C = (35 + 273) K = 308 K

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

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

Required

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

Solution

As we know that

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

By putting the values, we have

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

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

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

$$\text{Rate of flow of heat} = \frac{Q}{t} = 13000\ Js^{-1}$$

Result

Rate of conduction of energy through the roof = Q/t = 13000 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 25^0 C and that of outside is 5^0 C, the thickness of glass is 0.8 cm and the value of k for glass is 0.8 $Wm^{-1}k^{-1}$?

Given Data

Area of the window = A = 2.0 m x 2.5 m = 5.0 m^2

Thickness of the glass = 0.8 cm = 0.0008 m

Temperature inside the window = T_1 = 25° C

Temperature outside the window = T_2 = 5° C

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

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

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

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

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

$$Q = 36000000 \text{ J}$$

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

Result

Heat lost through the glass = Q = 3.6 x 10^7 J