An ice box has a total area of $A = 0.950 m^2$ wall thickness $d = 2.50 cm = 0.025\ m$ the box contain ice water and can beverages at $T_1 = 0'C$. How much ice melts in $t = 1\ day = 24\ h = 86400\ s$ if the ice box is kept in the trunk of the car at $T_2 = 35.0'C$?

Solution

The rate of heat transfer:

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

$$\frac{Q}{t} = \frac{(0.010)(0.950)(35 - 0)}{0.025} = 13.3\ W.$$

The heat for melting the ice:

$$Q = mL.$$

$$m = \frac{Q}{L} = \frac{\left(\frac{Q}{t}\right)t}{L} = \frac{(13.3)(86400)}{334 \cdot 10^3} = 3.44\ kg.$$

Answer: $3.44\ kg$.