261.

Problem 26.38 (RHK)

Suppose the same amount of heat energy, say, 260 J *is transferred by conduction from a heat reservoir at temperature of* 400 K *to another reservoir, the temperature of which is* (a) 100 K, (b) 200 K, (c) 300 K, *and* (d) 360 K. *We have to calculate the changes in entropy and find the trend.*

Solution:

Temperature at the hot reservoir $T_H = 400$ K.

Let the temperature of the cold reservoir to which heat is transferred by conduction from the hot reservoir be T_L K.

The amount of heat transferred by conduction from the hot reservoir to the cold reservoir $Q = 260$ J.

Therefore, the change in entropy of the two reservoirs will be

$$\Delta S\left(T_L\right) = -\frac{Q}{T_H} + \frac{Q}{T_L} = Q\left(\frac{T_H - T_L}{T_H T_L}\right)$$

$$= \frac{260 \times \left(400 - T_L\right)}{400 \times T_L} \text{ J K}^{-1}.$$

We next compute $\Delta S\left(T_L\right)$ for

$T_L = 100$ K, 200 K, 300K, and 360 K.

We find

$\Delta S\left(100\text{ K}\right) = 1.95\text{ J K}^{-1}$,

$\Delta S\left(200\text{ K}\right) = 0.65\text{ J K}^{-1}$,

$\Delta S\left(300\text{ K}\right) = 0.216\text{ J K}^{-1}$,

and

$\Delta S\left(360\text{ K}\right) = 0.072\text{ J K}^{-1}$.

We note that the change in entropy of the two reservoirs decreases with decrease in difference in their temperatures.