

260.

Problem 26.39 (RHK)

A brass rod is in thermal contact with a heat reservoir at 130°C at one end and a heat reservoir at 24.0°C at the other end. We have to compute (a) the total change in entropy arising from the process of conduction of 1200 J of heat through the rod; (b) and answer whether there is any change in the entropy of the rod.

Solution:

(a) and (b)

When heat is conducted through a brass rod, there is no change in the entropy of the rod as the thermodynamic state of the rod does not change during the process of heat conduction. Change in entropy arises because of heat exchanges taking place at the reservoirs at the ends of the rod.

Heat loss at the reservoir at temperature of 130°C (403 K) is 1200 J . And the heat gained by the reservoir at 24.0°C (297 K) is also 1200 J .



The change in entropy of the system comprising of the two reservoirs and the brass rod will be

$$\Delta S = -\frac{Q}{T_H} + \frac{Q}{T_L} = Q \left(\frac{T_H - T_L}{T_H T_L} \right) = 1200 \times \left(\frac{403 - 297}{403 \times 297} \right) \text{ J K}^{-1} \\ = 1.06 \text{ J K}^{-1}.$$

