

10. This problem is similar to Sample Problem 21-2. The only difference is that we need to find the mass m of each of the blocks. Since the two blocks are identical the final temperature T_f is the average of the initial temperatures:

$$T_f = \frac{1}{2}(T_i + T_f) = \frac{1}{2}(305.5 \text{ K} + 294.5 \text{ K}) = 300.0 \text{ K} .$$

Thus from $Q = mc\Delta T$ we find the mass m :

$$m = \frac{Q}{c\Delta T} = \frac{215 \text{ J}}{(386 \text{ J/kg}\cdot\text{K})(300.0 \text{ K} - 294.5 \text{ K})} = 0.101 \text{ kg} .$$

(a)

$$\Delta S_L = mc \ln\left(\frac{T_f}{T_{iL}}\right) = (0.101 \text{ kg})(386 \text{ J/kg}\cdot\text{K}) \ln\left(\frac{300.0 \text{ K}}{305.5 \text{ K}}\right) = -0.710 \text{ J/K} .$$

- (b) Since the temperature of the reservoir is virtually the same as that of the block, which gives up the same amount of heat as the reservoir absorbs, the change in entropy $\Delta S'_L$ of the reservoir connected to the left block is the opposite of that of the left block: $\Delta S'_L = -\Delta S_L = +0.710 \text{ J/K}$.

- (c) The entropy change for block R is

$$\Delta S_R = mc \ln\left(\frac{T_f}{T_{iR}}\right) = (0.101 \text{ kg})(386 \text{ J/kg}\cdot\text{K}) \ln\left(\frac{300.0 \text{ K}}{294.5 \text{ K}}\right) = +0.723 \text{ J/K} .$$

- (d) Similar to the case in part (b) above, the change in entropy $\Delta S'_R$ of the reservoir connected to the right block is given by $\Delta S'_R = -\Delta S_R = -0.723 \text{ J/K}$.
- (e) The change in entropy for the two-block system is $\Delta S_L + \Delta S_R = -0.710 \text{ J/K} + 0.723 \text{ J/K} = +0.013 \text{ J/K}$.
- (f) The entropy change for the entire system is given by $\Delta S = \Delta S_L + \Delta S'_L + \Delta S_R + \Delta S'_R = \Delta S_L - \Delta S_L + \Delta S_R - \Delta S_R = 0$, which is expected of a reversible process.