BoxSand Thermodynamics Entropy & 2nd Law Quantitative Problems

Thermodynamics.Entropy-2nd-Law.**QP.BS.1:** Heat Q flows spontaneously from a reservoir at 299 K into a reservoir that has a lower temperature T. Because of the spontaneous flow, forty percent of Q is rendered unavailable for work when a Carnot engine operates between the reservoir at temperature T and a reservoir at 263 K. Find the temperature.

Thermodynamics.Entropy-2nd-Law.**QP.BS.2:** A process occurs in which the entropy of a system increases by 135 J/K. During the process, the energy that becomes unavailable for doing work is zero. (a) is the process reversible or irreversible? Give your reasoning. (b) Determine the change in the entropy of the surroundings.

Thermodynamics.Entropy-2nd-Law.**QP.BS.3:** (a) Find the equilibrium temperature that results when two kilograms of liquid water at 350 K is added to three kilograms of liquid water at 274 K in a perfectly insulated container. (b) When heat is added to or removed from a solid or liquid of mass m and specific heat capacity c, the change in entropy can be shown to be $\mathbf{\Delta S = mc \ln(T_f/T_i)}$ where $\mathbf{T_i}$ and $\mathbf{T_f}$ are the initial and final Kelvin temperatures. Use this equation to calculate the entropy change for each amount of water. Then combine the two entropy changes algebraically to obtain the total entropy change of the universe. Note that the process is irreversible, so the total entropy change of the universe is greater than zero. (c) Assuming that the coldest reservoir at hand has a temperature of 265 K, determine the amount of energy that becomes unavailable for doing work because of the irreversible process.