The 2nd and 3rd law of thermodynamics

P21. Calculate the change of entropy for the surroundings when 1.00 mol of $H_2O(l)$ is formed from its elements under standard conditions at 298.15 K. $\Delta_{form}H^{\ominus}(H_2O, l) = -285.8\ \text{kJ mol}^{-1}$. Provide a general statement on how the entropy of the surroundings changes in exothermic and endothermic processes. *[958.6 J/K. In exothermic processes (like this one), the entropy for the surroundings increases, in endothermic processes, it decreases.]*

P22. Calculate the change of entropy for 1.00 mol perfect gas (ΔS), its surroundings ($\Delta S'$), and ΔS_{tot}, when the volume of the gas is doubled in an

a) isotherm reversible, or *[$\Delta S = 5.76$ J/K, $\Delta S' = -5.76$ J/K, $\Delta S_{tot} = 0$ J/K]*

b) adiabatic reversible expansion. *[$\Delta S = \Delta S' = \Delta S_{tot} = 0$ J/K]*

P23. In a container, there is 4.00 mol nitrogen gas, in another container, there is 1.00 mol oxygen. The pressure and temperature are the same in the two containers. The containers are connected with a thin tube. How does the entropy change when the two gases are mixed? (There is no chemical reaction happening, and both gases are perfect gases.) *[$\Delta S = 20.8$ J/K]*

P24. 2.00 mol of CO_2 is heated at atmospheric pressure from 0 ºC to 1000 ºC. Calculate the change in entropy for CO_2. The molar heat capacity of CO_2 at constant pressure is $C_{p,m} = (28.8 + 3.59\times10^{-2}\,T - 1.04\times10^{-5}\,T^2)\ \text{J mol}^{-1}\ \text{K}^{-1}$. *[$\Delta S = 144.4$ J/K]*

P25. Calculate ΔS_{tot} when 100 g of 300 ºC iron is placed into 1000 g of 15 ºC water. The iron-water system is isolated from its surroundings. Specific heat values for iron and water are as follows: $0.460\ \text{J g}^{-1}\ \text{K}^{-1}$ and $4.184\ \text{J g}^{-1}\ \text{K}^{-1}$. *[$\Delta S = 13.7$ J/K]*

P26. Calculate the Carnot efficiency for a ruddy steam engine working with 100 ºC steam and 60 ºC condensate. Do the same calculation for a modern steam turbine operating with 300 ºC steam and 80 ºC condensate. *[10.7%, 38.4%]*