Ch En 3853
Chemical Engineering Thermodynamics
Homework Assignment #2

Must be turned in via Canvas (as single PDF file) *by 11:59 pm on Sunday, Sep 5h, 2021*

Unless otherwise specified, all textbook problems referenced are from the course textbook: Elliott & Lira, "Introductory Chemical Engineering Thermodynamics", 2^{nd} Ed.

Important Note for All Homeworks: For full credit, submitted homework solutions must adhere to the Homework Guidelines. Also, it is the responsibility of each student to check that the solution uploaded to Canvas is the correct file.

Problem 1 –(15 pts) What is the minimum power necessary to separate 100 mol/s O_2 from the atmosphere at 300 K and 1 bar? Assume that the ideal gas model applies. (A ≈600kW)

Problem 2 –(30 pts) Rework Example 4.8 using the following modifications: Assume the liquid is n-pentane, and that it is heated to a final temperature that is above its boiling point. Thus, the modified problem statement is as follows:

Example 4.8 (modified). Entropy generation in a temperature gradient

A 500 mL glass of liquid n-Pentane at 283 K is removed from a refrigerator that is located outside on a very hot day in Phoenix. The n-pentane slowly equilibrates to the ambient temperature, which is 110 °F. The process occurs at 1 bar. Calculate the entropy change of the n-pentane, $\Delta S_{n\text{-}C5}$, the entropy change of the surroundings, ΔS_{surr}, and the entropy change of the universe, ΔS_{univ}. Neglect the heat capacity of the container. The normal boiling point for n-pentane is 309.2 K, liquid density is 626 kg/m^3, and Heat of Vaporization can be taken as 25.79 KJ/mol. Assume constant Cp values ca be used, with a liquid Cp value of 169 J/mol-K, and a vapor Cp value of 126 J/mol-K.

($\Delta S_{n\text{-}C5} \approx 440 J/K$ $\Delta S_{surr} \approx -435$J/K $\Delta S_{univ} \approx 5$J/K)

Problem 3 – (30 pts) Textbook problem #4.7

4.7. An isolated chamber with rigid walls is divided into two equal compartments, one containing gas at 600 K and 1 MPa and the other evacuated. The partition between the two compartments ruptures. Compute the final T, P, and ΔS for the following:

a. An ideal gas with $C_P/R = 7/2$ (ΔS≈5.8J/(mol K), T≈ 600K, P≈0.5MPa)
b. Steam. (ΔS≈5.7J/(mol K), T≈ 320°C, P≈0.5MPa)

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Problem 4 – (25 pts) Example 6.4 (modified)

A gas is being compressed from ambient conditions (298K 1atm) to a high pressure and temperature (400K 10atm). Assume the ideal gas equation of state.

(1) Devise a model equation for computing ΔS(T,P).
(2) Calculate ΔS for this process. (A$\approx -10J/(molK)$