Ch En 3853
Chemical Engineering Thermodynamics
Homework Assignment #4

Must be turned in via Canvas (as single PDF file) by 11:59 pm on Sunday, Sept. 19, 2021

Unless otherwise specified, all problems referenced are from the course textbook:
Elliott & Lira, "Introductory Chemical Engineering Thermodynamics", 2nd 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 – Rework Example 8.4 using different values for State 1 and State 2, as noted in the revised problem statement below: Propane gas undergoes a change of state from an initial condition of 9 bar and 117°C to 35 bar and 220°C. Compute the change in enthalpy and entropy using the Peng-Robinson EOS. (A: $\Delta H \approx 9400 J/mol; \Delta S \approx 11 J/mol$)

Problem 2– In the Linde liquefaction example discussed in class and described in Example 8.9, the amount of methane liquefied for the conditions specified is 6.4%. Propane is a slightly heavier hydrocarbon and is commercially important for the manufacture of chemicals such as polypropylene. If the methane feedstock was switched to a pure propane feedstock, and all operating conditions (temperatures and pressures) were maintained the same as described in Example 8.9, what fraction of the propane entering the heat exchanger would be liquefied in this process? You can use the Peng- Robinson EOS for this problem. (A: $\approx 50\%$)

Problem 3– Text #8.16

8.16. Using the Peng-Robinson equation, estimate the change in entropy (J/mole- K) for raising butane from a saturated liquid at 271 K and 1 bar to a vapor at 386.98 K and 20 bar. What fraction of this total change is given by the departure function at 271 K? (A≈ 97%)What fraction of this change is given by the departure function at 386.98 K? (A≈ 7%)

Problem 4– Make a graph that compares vapor pressures calculated using the Peng-Robinson EOS to the experimental vapor pressures (calculated by the Antoine constants) for the species listed below at temperatures of 300 K, 350 K, 400 K, 450 K and 500 K. Use individual points (symbols only, no connecting lines) for experimental values (Antoine results), and connecting lines (with no symbols) for the PR-EOS predictions.

a) isopentane

b) toluene

c) methylcyclohexane

d) 1-butanol

e) Water