Ch En 3853
Chemical Engineering Thermodynamics
Homework Assignment #1

Must be submitted via Canvas (single PDF file) by 11:59 pm on Sunday, August 29, 2021

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 (20 pts)

Steam undergoes a state change from 650°C and 2.5 MPa to 200°C and 0.4 MPa. Determine ΔH and ΔU using the following:

a. Steam table data. (A:$\Delta U \approx$-730 kJ/kg, $\Delta H \approx$-940kJ/kg)

b. Ideal gas assumptions. (Be sure to use the ideal gas heat capacity for water. Assume Cp is a constant for the temperature range, see back flap of textbook for value of Cp) (A:$\Delta U \approx$-630 kJ/kg, $\Delta H \approx$-840kJ/kg)

Problem 2 (20 pts)

25 grams of Benzene ($\rho^L = 0.88$ g/cm^3) is placed in a variable volume piston. What are the molar enthalpy and total enthalpy of the pure system when 50% and 75% have been evaporated at: (*i*) 30°C, (*ii*) 50°C? Use liquid at 25°C as a reference state. (all properties can be found from textbook Appendix E.1, Appendix E.2, Appendix E.9 and back flap) (A: for 30°C, 50% evaporated, total enthalpy ≈ 6kJ)

Problem 3 (30 pts) – Textbook #2.20

Steam at 550 kPa and 200°C is throttled through a valve at a flow rate of 15 kg/min to a pressure of 200 kPa. What is the temperature of the steam in the outlet state, and what is the change in specific internal energy across the value, (Uout – Uin)? (A: T≈ 190 °C; ΔU≈ 0)

Problem 4 (30 pts)

Using information from Appendix E, what is the heat of reaction for the following combustion reaction:

$$C_2H_6(g) + \frac{7}{2}O_2 \rightarrow 2CO_2 + 3H_2O(l)$$
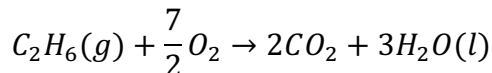
a) at 298.15 K and 1 bar (A: ≈ -1600 kJ/mol)

b) at 400 K and 1 bar (A: ≈-1500 kJ/mol)