17 January 2019
To: ChE 312 Class
From: Professors Koretsky and Goulas
Subject: Homework #3

Below is the third homework assignment of the quarter. Please conform to the format described in the class syllabus. This assignment is due on 24 January 2019 at 1 pm on Gradescope and at the start of the studio section for which you are registered. If you have any questions, feel free to see us or one of the other instructors during office hours or by appointment.

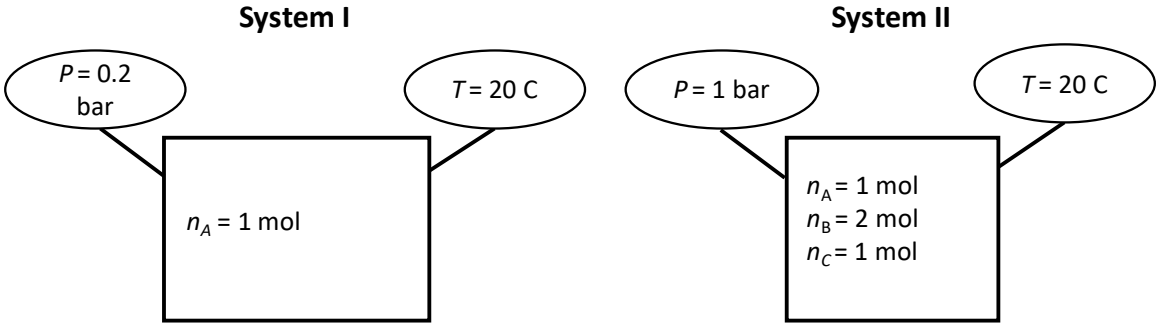
1. Text 6.20

2. A rigid container contains 10 mol of pure species 1 at 1 bar and 200 K. Under those conditions, species 1 is in vapor-liquid equilibrium and contains 20% vapor by mass. You wish to increase the pressure to 5 bar by heating it. After heating, there are also both liquid and vapor phases present in equilibrium. You may treat the vapor as an ideal gas. You may also neglect the volume of the liquid relative to the vapor. The enthalpy of vaporization at 200 K, and heat capacities in the vapor and liquid for species 1 are given by:

$$\Delta h_{vap,200\ \mathrm{K}} = 14\ \frac{\mathrm{kJ}}{\mathrm{mol}};\ c_P^v = 25\ \left[\frac{\mathrm{J}}{\mathrm{mol\ K}}\right];\ \text{and}\ c_P^l = 25\ \left[\frac{\mathrm{J}}{\mathrm{mol\ K}}\right]$$

   Answer the following:
   A. Draw a schematic of the process labeling state 1 and state 2. Include all the information you know about the process in your schematic.
   B. Estimate the number of moles of 1 that changes phase. State any assumptions that you make
   C. Solve for the total amount of heat that is transferred. State any assumptions that you make.

3. Consider the two systems shown below. System I contains 1 mol of pure vapor species A at 20 ^{o}C and 0.2 bar. System II contains a vapor mixture of 1 mol species A, 2 mol species B, and 1 mol species C at 20 ^{o}C and 1 bar. You may assume ideal gas behavior in both systems. Pay attention to the nomenclature we have been using in this class when answering. **Explain your reasoning.**



Answer the following questions:

How does h_A for system I compare to h_A for system II? Explain

____ $h_A^I < h_A^{II}$

____ $h_A^I = h_A^{II}$

____ $h_A^I > h_A^{II}$

How does the h_A for system I compare to $\bar{H}_A$ for system II? Explain

____ $h_A^I < \bar{H}_A^{II}$

____ $h_A^I = \bar{H}_A^{II}$

____ $h_A^I > \bar{H}_A^{II}$

How does s_A for system I compare to s_A for system II? Explain

____ $s_A^I < s_A^{II}$

____ $s_A^I = s_A^{II}$

____ $s_A^I > s_A^{II}$

How does the s_A for system I compare to $\bar{S}_A$ for system II? Explain

____ $s_A^I < \bar{S}_A^{II}$

____ $s_A^I = \bar{S}_A^{II}$

____ $s_A^I > \bar{S}_A^{II}$

How does g_A for system I compare to g_A for system II? Explain

____ $g_A^I < g_A^{II}$

____ $g_A^I = g_A^{II}$

____ $g_A^I > g_A^{II}$

How does the g_A for system I compare to $\bar{G}_A$ for system II? Explain

____ $g_A^I < \bar{G}_A^{II}$

____ $g_A^I = \bar{G}_A^{II}$

____ $g_A^I > \bar{G}_A^{II}$

4. Text 6.47

5. Text 6.57