February 1, 2002

CH 342 S02, Homework 4

due Wednesday, February 6, 2002

Problems marked with a $\star$ must be done using a computer (spreadsheet or symbolic math package).

Gibb's Phase Rule

1. A system initially contains solid carbon, liquid water, and gaseous oxygen and nitrogen. Assume no reaction occurs.

   a) What is the maximum number of equilibrium phases that would be found in this system?

   b) If temperature and pressure were specified, what is the maximum number of phases that would be found together in equilibrium.

   Extra Credit: Make a list of the possible phases that could be formed from all constituents in the above system. Determine which of those typically exist at room temperature and pressure. How many phases remain? Does this number agree or disagree with the number determined using Gibb's phase rule? Why or why not?

2. Consider the previous system with chemical reactions to form gaseous carbon monoxide and carbon dioxide. Answer the above two questions in this case.

   Extra Credit: Make a list of the possible phases that could be formed from all constituents in the above system. Determine which of those typically exist at room temperature and pressure. How many phases remain? Does this number agree or disagree with the number determined using Gibb's phase rule? Why or why not?

Binary P-z Diagrams

3. E 8.1b

4. $\star$ Plot the P-z diagram for the above system. Show the liquid and vapor composition as solid lines. Prepare the plot as a function of 1,3 dimethylbenzene mole fraction from 17 kPa to 21 kPa pressure.

5. E 8.3b

Binary T-z Diagrams

6. E 8.5b

   Extra Credit: Determine the number of theoretical stages that would be needed to distill a mixture of $x_A = 0.20$ to a state with $x_A = 0.98$ or better.

7. E 8.9a

Binary T-x Diagrams

8. E 8.16b

9. P 8.6