University of Kentucky
Chemical & Materials Engineering Department

CME 550: Chemical Reactor Design
Homework 2

Due at *beginning* of class on Friday, September 9, 2005
Partial credit will be given in ½-point increments.

1) [1 pt] Levenspiel (OL) Chapter 2 problem 2.17 (the start of the question is at the bottom of p. 35)

2) [2 pt] The equation for reforming of ethanol to produce hydrogen can be expressed as:

$$C_2H_5OH_{(g)} + 2\,H_2O_{(g)} + \frac{1}{2}O_{2(g)} \longrightarrow 2\,CO_{2(g)} + 5\,H_{2(g)}$$

   a. Calculate the equilibrium coefficient for this reaction at 298 K (you will need a table of Gibbs energies of formation, such as Table C.4 from Smith, Van Ness & Abbott).

   b. If a stoichiometric feed of ethanol vapor, water vapor and oxygen is to be used to produce hydrogen, what is the maximum fraction of ethanol that will react at 298 K?

3) [3 pt] Toluene (T) can react through bimolecular reactions to produce one of three forms of xylene (ortho-xylene, OX; meta-xylene, MX; or para-xylene, PX) and benzene. The values of ΔG^0 (below) were determined at 700 K. What is the equilibrium composition (including all xylene isomers) at 700 K and 1.0 atm pressure? Suggest one way to design a process to produce mainly PX from toluene, and little OX and MX?

2 T = OX + B	ΔG^0 = 14.85 kJ/mol
2 T = MX + B	ΔG^0 = 10.42 kJ/mol
2 T = PX + B	ΔG^0 = 15.06 kJ/mol

4) [2 pt] OL 2.18

5) [2 pt] OL 2.20