ChE 212 Chemical Process Calculations University of Rhode Island
Professor Greenfield Fall 2008

Homework 13
due November 25 or December 2, 2008 (TBA, based on Thursday class)

If you find yourself without enough information, make and justify a reasonable approximation. Please answer all (requested) parts of a question! (This is good practice for an exam setting.)

1. Felder and Rousseau, problem 9.7ab (heat of reaction and Hess's Law)

2. *(A similar version of this problem was on an old final.)*
   A liquid-phase feed mixture of propylene, benzene, and cumene is separated using two consecutive distillation columns. Propylene and benzene emerge as vapor-phase overhead products of the first column. The bottoms product, a mixture of benzene and cumene, is fed to the second column and continues outside the scope of this problem

   Both columns operate at 2 bar total pressure, and because the piping is sealed any liquid or vapor in either column contains only propylene, benzene, and/or cumene.

   One column design leads to the following flow rates and temperatures for the **first column**:

species	Liquid Feed	Overhead	Bottoms
propylene	4. mol/h	4.0 mol/h	—
benzene	28. mol/h	$\dot{n}_1$ mol/h	$\dot{n}_2$ mol/h
cumene	10. mol/h	—	10. mol/h
temperature	75 °C	50 °C	125 °C

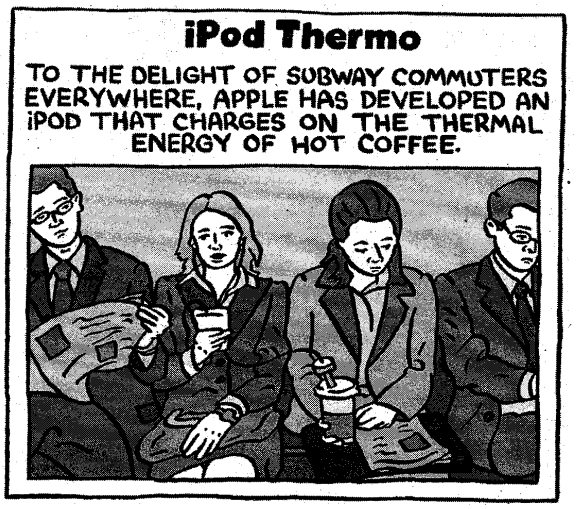
   Benzene outlet flow rates aren't provided, but you are told that 96.4% of the inlet benzene emerges from the column with the cumene.

   Calculate the net heat flow into or out of this column. If you need it, assume that the heat of vaporization of propylene is also independent of temperature. Assume that all overhead products are vapors and that all bottoms products are liquids under the listed conditions. Be clear about where $\hat{H}$=0.

   In solving the problem, remember to label the flowsheet. Also remember that a strategy from early in the course is to list the equations that you will solve, indicating which unknown will be found from each.

Do meet with your team members to discuss the second set of project questions!
Also, problems continue on reverse!!

3. Consider this scenario (*also from an old final*):



Too good to be true? Perhaps. Your want-to-be venture capitalist friends ask you to investigate before they invest their life savings. They provide you with secret plans listing technical details.

These plans suggest that a special mug is required, which heats the coffee so it provides saturated steam into the new ipod$^{\mathrm{TM}}$ charger as vapor at 1.5 bar absolute pressure. The steam then exits the charger as saturated vapor at 1 atm absolute pressure. The charger simultaneously gives off heat at a rate of 2 W and does work on the ipod at a rate of 5 W (to do the charging).

Calculate the flow rate of steam required, assuming everything in the charging process occurs at steady state.