ChE 272 Introduction to Chemical Engineering Calculations University of Rhode Island
Professor Greenfield Spring 2007

Homework 3
due February 15, 2007

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

1. Chapra and Canale, problem 6.1
2. Chapra and Canale, problem 8.9. Solve using Newton-Raphson.
3. The class handout described the adiabatic temperature rise for ethane, when combustion proceeds to completion in the presence of 15% excess air. Use the secant method to solve for the temperature.
4. You may recall from CHE 212 (or see Felder and Rousseau, chapter 6) that the *bubble point temperature* equals the temperature at which a liquid mixture gives off the first bubble. This temperature equals the temperature that satisfies the equation

   $$P = \sum_i x_i P_i^{\mathrm{sat}}(T)$$

   in which x_i equals the mole fraction of species i and $P_i^{\mathrm{sat}}(T)$ equals the saturation pressure (also called vapor pressure), which is typically calculated using the Antoine equation.

   Calulate the bubble point temperature for a mixture of n-octane (mole fraction 0.60) and n-decane (mole fraction 0.40) at a total pressure of 2 atm.

   You have to show your work to receive full credit. Then use a prepackaged solver in excel or Matlab to check your work.

Late homework 3 papers will be penalized using the function

$$(1-p) = \frac{1}{kc_0 t + 1}$$

This function is the solution to a second-order chemical rate equation,

$$-\frac{dc}{dt} = kc^2$$

where c is the concentration, k is the rate constant, and the extent of reaction p is defined as $c = c_0(1-p)$. p begins at zero and goes to 1 as the reaction completes. The term kc_0 = 0.07/day. Here, the left side $(1-p)$ corresponds to the number of possible points that can be earned, and t refers to the number of days that the homework is late.