ABE370 Test 2

Name:

Instructions:

1. Put your name on every sheet of paper you hand in for grading, including this sheet.
2. Please attach your 1 page of notes to your solution.
3. Please clearly indicate the corresponding question/part numbers for your solutions. If partial credit is desired, please clearly show methodology used to solve problems. If the solutions are not clearly explained, no partial credit will be given.
4. Provide the answers in the units requested.

Problem 1 (20 points)

The performance equations for each reactor are:

$\tau_m = (C_o - C_m)/k$ $\qquad$ $\tau_p = (C_o - C_p)/k$

$\kappa\tau_m = (C_o - C_m)$ $\qquad$ $k\tau_p = (C_o - C_p)$

$\kappa\tau_m/C_0 = (C_o - C_m)/C_0 = X_m$ $\qquad$ $k\tau_p/C_0 = (C_o - C_p)/C_o = X_p$

So,

$\tau_m = C_0X_m/k$ $\qquad$ $\tau_p = C_0X_p/k$

$\tau_m/\tau_p = [C_0X_m/k]/[C_0X_p/k] = X_m/X_p$

If q and V are the same for both reactors, then $\tau_m = \tau_p$ so $\tau_m/\tau_p = 1$ and $X_m = X_p$
Therefore, neither reactor has a better conversion than the other.

Problem 2 (50 points)

Problem 2 solution

$km := 0.$ $vm := 3$ $Co := 18$

$$tau1 := \frac{80}{30} \qquad tau1 = 2.667$$

$$tau2 := \frac{75}{30} \qquad tau2 = 2.5$$

$$tau := \frac{Co - C}{-r} \qquad tau := \frac{(Co - C)\cdot(Km + C)}{VmC}$$

Solving for C,

$$C(t, Cx) := \frac{(Cx - t\cdot vm - km) + \sqrt{(km - Cx + t\cdot vm)^2 + 4\cdot Cx\cdot km}}{2}$$

$C1 := C(tau1, Co)$ $\quad C1 = 10.368$ $\quad X1 := \frac{Co - C1}{Co}$ $\quad X1 = 0.424$

$C2 := C(tau2, C1)$ $\quad C2 = 3.75$ $\quad X2 := \frac{Co - C2}{Co}$ $\quad X2 = 0.792$

Problem 3 (30 points)

$k := 0.17$ $\quad V := 240$ $\quad q := 180$ $\quad Co := 70$ $\quad tau := \frac{V}{q}$ $\quad tau = 1.333$

$$C(Cin) := \frac{-1 + \sqrt{1 + 4 \cdot k \cdot tau \cdot Cin}}{2k \cdot tau}$$

Part A. 3 reactors in series

reactor 1 $\quad C1 := C(Co) \quad C1 = 15.159$

reactor 2 $\quad C2 := C(C1) \quad C2 = 6.145$

reactor 3 $\quad C3 := C(C2) \quad C3 = 3.395$

$$X3 := 1 - \frac{C3}{Co} \qquad X3 = 0.952$$

Part B. 3ktCo=50.12 (see red arrow below)

Follow curve to N=3, read down to 1-X=0.048 so X=0.952, which agrees with part A.