Name.....Student ID number.....

PRINCE OF SONGKLA UNIVERSITY

FACULTY OF ENGINEERING

Midterm Examination Semester I — Academic year: 2004

Date : Saturday 31, 2004 — Time : 9.00-12.00 am

Subject : 231-321 Chemical Engineering Kinetics and Reactor Design I — Room: R201

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Read instruction carefully before working on your exam

- All documents (i.e., text book, lecture note, home work and old exam) and calculator are allowed
- Exam paper consists of 5 problems with a total points of 100
- Do all problems in provided paper only
- Please put you name and your student ID number on every page
- The exam paper is not allowed to leave an exam room
- Please do not borrow any item from other person while taking an exam. Student are allowed to use pencil to work on the exam .

Problem No.	Total Points	Student achieved Point
1	15	
2	15	
3	25	
4	20	
5	25	
Total	100	

Exam paper contains 9 pages. Please check all pages before start to work on your exam

Good luck and do your best

Charun Bunyakan, Ph.D.

July 27, 2004.

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1. (15 points)

Liquid phase reaction

$$A + 2B \longrightarrow R + S$$

Given a dilute aqueous phase feed, C_{A0} = 100 mol/dm^3, C_{B0} = 200 mol/dm^3 to a CSTR. If C_A = 20 mol/dm^3 at the reactor exit, What is C_B, X_A and X_B there?

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2. (15 points)

For a gas reaction at 400 K, the rate is reported as

$$-r_A = -\frac{dP_A}{dt} = 0.0012P_A^2 \qquad \text{atm/s}$$

(a) What is the unit of the rate constant?

(b) Rewrite the rate law in term of concentration (C_A) and determine the value and unit of the rate constant.

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3. (25 points)

Liquid phase reaction

$$A \longrightarrow R$$

$$-r_A = 0.3C_A^{0.5} \quad \frac{mol}{dm^3 hr}$$

$$C_{A0} = 1.0 \frac{mol}{dm^3}$$

(a) Determine the conversion after 1 hr in a batch reactor

(b) Determine the conversion in 1000 dm^3 CSTR if F_{A0} = 5 mol/min

(c) Determine the volume of PFR to obtain the same conversion as in part (b) and

F_{A0} = 5 mol/min

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4 (20 points)

Liquid phase elementary reaction

$$2A + B \longrightarrow 2C + D$$

is to be carried out isothermally at 100 °C in CSTR. The rate constant at this temperature is 0.02 $(dm^3/mol)^2 s^{-1}$. Feed contained C_{A0} = 5 mol/dm^3, C_{B0} = 2 mol/dm^3 was fed to reactor at the total volumetric flow rate of 5 dm^3/s.

(a) Express C_A, C_B, C_C and C_D as function of X_A

(b) Determine the volume of CSTR to achieve X_A of 0.6

(c) Can we determine the C_B at X_A=0.9? If not, give the reason and determine what is the maximum conversion of A that we can possibly be obtained.

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5. (25 points)

The kinetics data for the decomposition of gas A are given below.

$$4A(g) \longrightarrow B(g) + 6C(g)$$

at 500°C: $-r_A = 10(hr^{-1})C_A$

at 800°C: $-r_A = 14(hr^{-1})C_A$

Determine the size of PFR operating at 650 °C and 11.4 atm for 75% conversion of 10 mol/hr of feed contained 75%A and 25% inert gas.