

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

Room: R201

and Reactor Design I

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	

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

Good luck and do your best

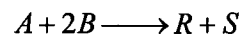
Charun Bunyakan, Ph.D.

July 27, 2004.

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1. (15 points)

Liquid phase reaction



Given a dilute aqueous phase feed, $C_{A0} = 100 \text{ mol/dm}^3$, $C_{B0} = 200 \text{ mol/dm}^3$ to a CSTR.

If $C_A = 20 \text{ mol/dm}^3$ 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

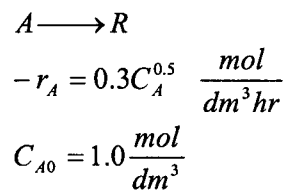
$$-r_A = -\frac{dP_A}{dt} = 0.0012P_A^2 \quad \text{atm/s}$$

- (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

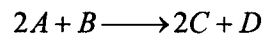


- (a) Determine the conversion after 1 hr in a batch reactor
- (b) Determine the conversion in 1000 dm³ CSTR if $F_{A0} = 5$ mol/min
- (c) Determine the volume of PFR to obtain the same conversion as in part (b) and $F_{A0} = 5$ mol/min

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4 (20 points)

Liquid phase elementary reaction



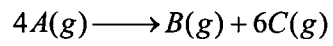
is to be carried out isothermally at 100 °C in CSTR. The rate constant at this temperature is 0.02 (dm³/mol)²s⁻¹. Feed contained C_{A0} = 5 mol/dm³, C_{B0} = 2 mol/dm³ was fed to reactor at the total volumetric flow rate of 5 dm³/s.

- (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.



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.