Name: _____ Student ID _____

Prince of Songkla University
Faculty of Engineering

Final Exam: Semester I **Academic Year: 2011 – 2012**
Date: October 3, 2011 **Time: 1:30 – 2:30 PM**
Subject: 230-301 – Basic Chemical Engineering I **Room: Robot**

Part I: Energy Balance

Instructions: There are a total of 2 problems. You have 60 minutes to work on them. The points for each problem are not distributed evenly. Place your name and the student ID number on every page. This is a CLOSED BOOK exam. Students are allowed to use only a pen or pencil, a calculator, and a pocket or talking dictionary. No notes are allowed in the exam. No exams are allowed to leave the room.

Points Distribution (For Grader Only)		
Problem	Points Value	Score
1	25	
2	25	
Total	50	

Exam prepared by
Ram Yamsaengsung
September 25, 2011

PLEASE CHECK TO MAKE SURE THAT
YOU HAVE 5 PAGES OF THE EXAM BEFORE BEGINNING

GOOD LUCK!!!

Name: _____ **Student ID** _____

Prince of Songkla University
Faculty of Engineering

Final Exam: Semester I **Academic Year: 2010 – 2011**
Date: October 4, 2010 **Time: 1:30 – 4:30 PM**
Subject: 230-301 – Basic Chemical Engineering I **Room: Robot**

---

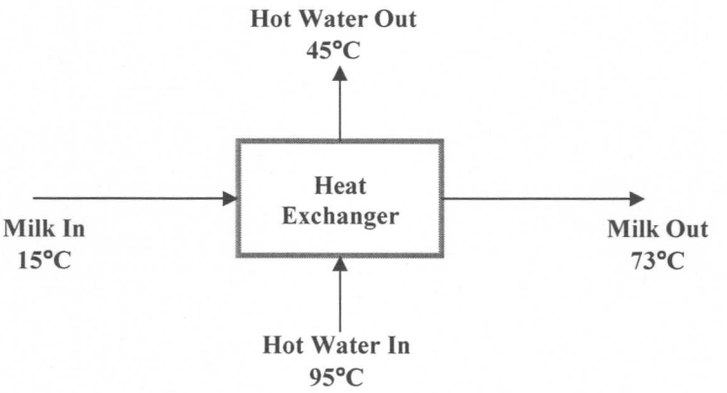
1. Carbon Monoxide is burned with 150% excess air resulting in flue gas consisting of CO_2, N_2 and O_2. If the CO flow rate is 50 m^3/min. at 60°C and 150.5 kPa, determine the following: **(25 points)**

   (a) Draw a diagram of the process and label all given information. **(5 points)**
   (b) Calculate the kg mol of CO entering the combustion chamber. **(5 points)**
   (c) Calculate the amount of O_2 entering the combustion chamber. **(5 points)**
   (d) The m^3 of air required at 25°C and 100.0 kPa used per m^3 of CO burned. **(5 points)**
   (e) The composition of the exiting gas in mol %. **(5 points)**

2. In a pasteurization process, hot water is used to raise the temperature of the milk from 15°C to 73°C. If 2,000 kg/hr of fresh milk is fed into the heat exchanger, determine the following: **(25 Points Total)**

   (a) Determine the amount of heat gained by milk in kJ/hr. **(10 points)**
   (b) Determine the amount of hot water (in **kg/hr**) required if it enters the heat exchanger at 95°C and leaves at 45°C. **(15 points)**

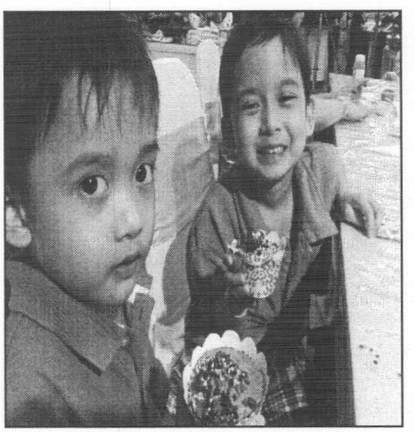
   The Cp of the milk is 3.98 kJ/kg °C and the Cp of water is 4.17 kJ/kg °C.
   Hint: Use Enthalpy Balance.



BONUS: Which university did I receive my Bachelor's Degree from? **(3 Points)**

(a) Prince of Songkla University
(b) Thammasart University
(c) Chulalongkorn University
(c) The University of Texas at Austin
(d) The University of Michigan at Ann Arbor

Constants: R = 8.314 (kPa-m^3/kg mol-K)



Equations:

$$PV = nRT$$

$$P_i = \left(\frac{n_i}{n_{tot}}\right) P_{tot}$$

$$\Delta H = m_{hot} C_{p,hot} \Delta T_{hot} = -m_{cold} C_{p,cold} \Delta T_{cold}$$

$$\Delta H = n \int_{T1}^{T2} C_p dT = n(h_2 - h_1)$$

$$\Delta H_i = n_i \left[\int_{25}^{Ti} C_{pi} dT + \Delta \hat{H}^0_{fi} + \Delta \hat{H}_{phase\ change} \right]$$

Congratulations! End of Part I!

- Part 2 -

Faculty of Engineering

Prince of Songkla University

Final Examination Paper: Semester I **Academic year:** 2011

Date: October 3, 2011 **Time:** 14.30-16.30

Subject: 230-301 Basic Chemical Engineering I (Chemical Engineering Kinetics and Reactor Design I) **Room:** Robot

---

คำสั่ง

- ❖ ให้ตอบคำถามลงในข้อสอบ
- ❖ ห้ามนำข้อสอบบางส่วนหรือทั้งหมดออกจากห้องสอบ
- ❖ ห้ามหยิบยืมเอกสารใดๆ และพูดคุยกับนักศึกษาอื่นขณะทำข้อสอบ

อนุญาต

- ❖ ให้นำเครื่องคิดเลข หนังสือ และเอกสารเข้าห้องสอบได้
- ❖ ให้นักศึกษาเขียนชื่อและรหัสลงในข้อสอบที่จัดให้ครบทุกแผ่น

สำหรับนักศึกษา

ชื่อ .....ตอน .....รหัสนักศึกษา .....

ข้อ	1	2	3	4	รวม
คะแนนเต็ม	15	20	20	25	80
ทำได้					

ทุจริตในการสอบ โทษขั้นต่ำคือปรับตกในวิชานั้น

และพักการเรียน 1 ภาคการศึกษา

ข้อสอบมีทั้งหมด 4 ข้อ 8 หน้า (รวมปก) โปรดดูความเรียบร้อยก่อนลงมือทำ

ดร. สุรัสวดี กังสนันท์

ผู้ออกข้อสอบ

ชื่อนักศึกษา.....รหัสนักศึกษา.....

1. (15 points) Set up a stoichiometric tables using A as a basis of calculation in the following elementary **liquid-phase** reaction.

$$2A + B \rightarrow C + 3D$$

The reaction is carried out in the isothermal batch reactor. The reactor is initially fed with equal molar in A and B. Please use the stoichiometric tables to express the concentrations of A, B, C, and D as a function of conversion (Ci = f(X)).

Solution

Chemical reaction using A as a basis of calculation =

Elementary Rate Law =

Stoichiometric Table:

Symbol	Initial	Change	Remaining
	N_{T0}		N_T =

δ =

N_T =

C_A =

C_B =

C_C =

C_D =

ชื่อนักศึกษา.....รหัสนักศึกษา.....

2. (20 points) Set up a stoichiometric tables using A as a basis of calculation in the following **gas-phase** reaction.

$$A + \frac{1}{2}B \rightarrow \mathrm{C}$$

The reaction is carried out in isothermal, isobaric, variable-volume gas-phase flow reactor. The feed consists of A and B with y_{A0}= 0.25. Please use the stoichiometric tables to express the concentration as a function of conversion by combining Ci = f(X) with the appropriate rate law to obtain $-r_A$ = f(X).

2.1) What is the rate of formation of A?

2.2) What is the rate of disappearance of B?

2.3) What is the rate of formation of C?

Answer for General Data

Symbol	Initial	Change	Remaining
A			
B			
C			
	F_{T0}		$F_T = F_{T0} + \delta F_{A0} X$

y_{A0} =

δ =

ε =

$\nu =$

$C_A =$

$C_B =$

$C_C =$

$-r_A =$

ชื่อนักศึกษา.....รหัสนักศึกษา.....

2.1) What is the rate of formation of A?

2.2) What is the rate of disappearance of B?

2.3) What is the rate of formation of C?

ชื่อนักศึกษา.....รหัสนักศึกษา.....

3. (20 points) For **gas–phase** reaction,

$$A \rightarrow \mathrm{B}$$

Pure A is placed in a **constant volume batch reactor** at 60 atm and 227 ^{o}C. The reaction is carried out in a batch reactor with $-r_A = kC^2_A$. Calculate the time to consume 50% of A in the reactor.

Additional information: k = 0.01 dm^3/mol-min at 400 K and E = 15000 J/mol

Solution

Evaluating the Initial concentration of A

$C_{A0} =$

$C_A =$

Evaluating the value of k at 500K =

1. Mole balance equation

ชื่อนักศึกษา.....รหัสนักศึกษา.....

2. Rate law:

3. Combine

4. Evaluate