Name: _____ Student ID _____
Nickname: _____ Group: _____

Prince of Songkla University
Faculty of Engineering

Exam: Mid-Term, Semester I
Date: August 2, 2007
Subject: 230-391
Basic Chemical Engineering I

Academic Year: 2007 – 2008
Time: 1:30 – 4:30 PM
Room: A201

ทุจริตในการสอบโทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

Instructions: There are a total of 5 problems and 9 pages (not including this page). Place your name and the student ID number on every page. Students are allowed to use only a pen or pencil and a calculator. They can also bring in 1 sheet of A4 front side only, a Conversions Table, and a Dictionary. No exams are allowed to leave the room.

Points Distribution (For Grader Only)		
Problem	**Points Value**	**Score**
1	20	
2	20	
3	20	
4	20	
5	20	
Total	100	

Exam prepared by
Ram Yamsaengsung
July 24, 2007

PLEASE CHECK TO MAKE SURE THAT
YOU HAVE ALL 9 PAGES OF THE EXAM BEFORE BEGINNING
(not including the cover sheet).
GOOD LUCK!

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1. Convert the following to the given units: **(20 Points)**

   (a) 350 W/(m^2 K) to Btu/(hr ft^2 °F) (5 points)

   (b) 4.875 cal/(gmol K) to (psia)(ft^3)/(lb-mol °R) (5 points)

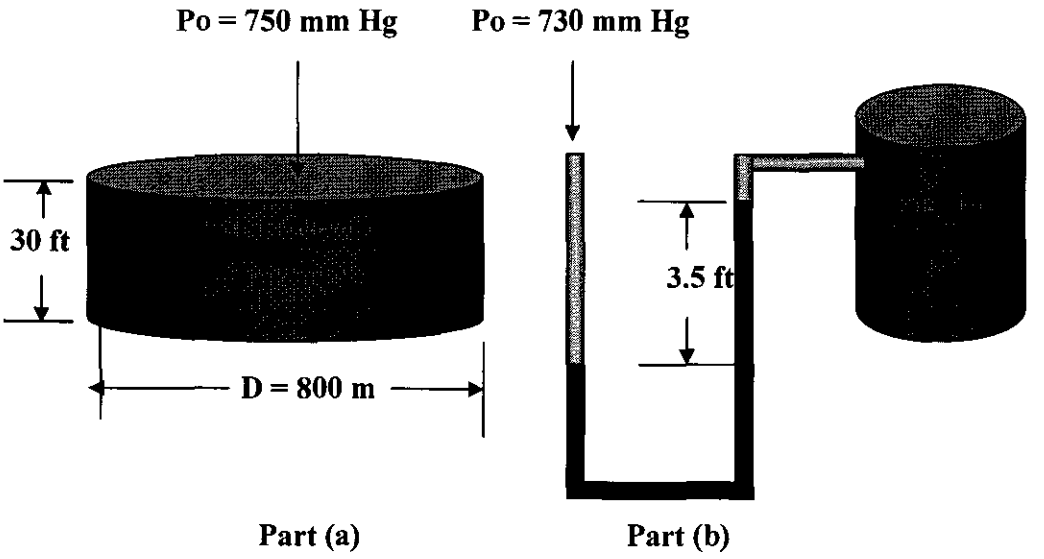
   (c) 0.95 Btu/[(hr)(ft^2)(°F/ft)] to kJ/[(day)(m^2)(°C/cm)] (5 points)

   (d) A bucket contains 55 lb of water. If the specific heat (C_p) of H_2O is 4.17 kJ/(kg °C), what is its enthalpy change (ΔH) if the temperature is increased from 35°C to 98°C. Give the answer in Btu. (5 points)

$$\Delta H = mC_p(T_2 - T_1)$$

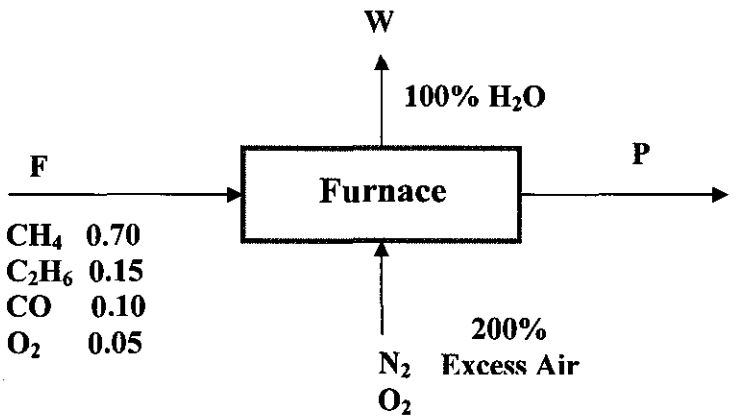
2. From the figures below, answer the following questions. **(20 Points)**

   (a) What is the total force exerted on the bottom of reservoir in Newton? (10 points) (Hint: Determine the total pressure at the bottom of the reservoir in Pa units.)
   (b) What is the pressure inside the storage tank in psig if water is used as the fluid inside the manometer? (10 points)



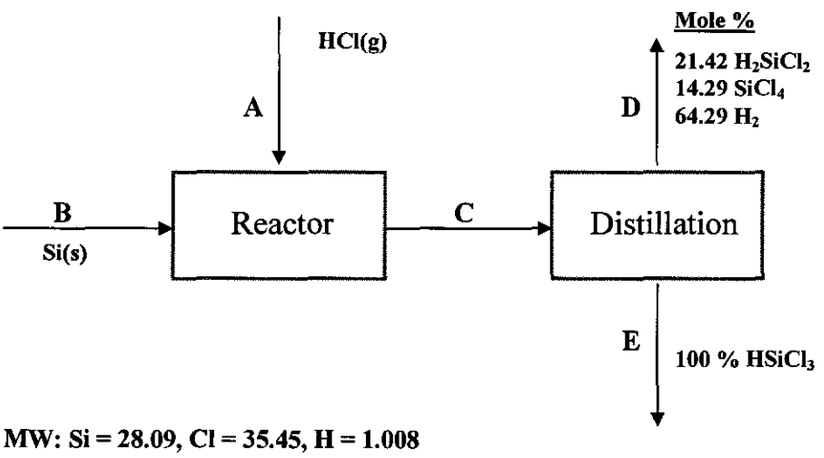
Part (a) **Part (b)**

3. A mixture of 70% CH_4, 15% C_2H_6, 10% CO and 5% O_2 is burned in a furnace with 200% excess air. If no CO, CH_4, and C_2H_6 leave the furnace, determine the following information: **(20 points)**



(a) The moles of air entering the furnace (10 points)
(b) The moles of water produced (5 points)
(c) The Orsat Analysis of the flue gas (5 points)

4. Metallurgical-grade silicon is purified to electronic grade for use in the semiconductor industry by chemically separating it form its impurities. The Si metal reacts in varying degrees with hydrogen chloride gas at 300°C to form several polychlorinated silanes. Trichlorosilane is liquid at room temperature and is easily separated by fractional distillation from the other gases. If 100 kg of silicon is reacted as shown below, how much trichlorosilane is produced ($HSiCl_3$)? (Hint: There are 3 chemical reactions.) **(20 points)**

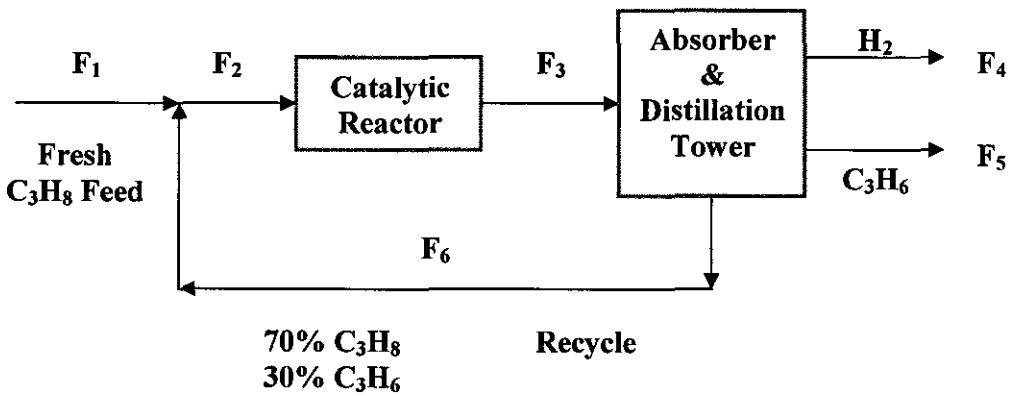


MW: Si = 28.09, Cl = 35.45, H = 1.008

5. The process shown in the figure below is the dehydrogenation of propane (C_3H_8) to propylene (C_3H_6) according to the reaction.

$$C_3H_8 \rightarrow C_3H_6 + H_2$$

The conversion of propane to propylene based on the total propane feed into the reactor at F_2 is 70%. The product flow rate F_5 is 100 kg mol/hr. Calculate all the six flow rates F_1 to F_6 in kg mol/hr. **(20 points)**



Constants:

$g = 32.2\ ft/s^2 = 9.81\ m/s^2$	$1 lb_m = 0.454\ kg$
$g_c = 32.174\ ft\text{-}lb_m/(lb_f\text{-}s^2)$	$1\ ft = 0.3048\ m$
$1\ cp = 1 \times 10^{-2}\ g/(cm\text{-}s)$	$1\ m^3 = 264.172\ gal$
$1\ psia = 1\ lb_f/in^2 = 6.89476\ kPa$	$1\ Pa = 1\ N/m^2 = 1\ kg/(m\text{-}s^2)$
$1\Delta K = 1.8\Delta°R$	$1\Delta°C = 1.8\Delta°F$
$\rho_{H2O} = 62.4\ lb_m/ft^3 = 1\ g/cm^3$	$1\ J/s = 1\ W\ (Watt)$

Equations:

Pressure = Force/Area

Static Pressure: $P = \rho gh + Po$

Area of Circle = $\pi D^2/4$