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

Prince of Songkla University
Faculty of Engineering

Exam: Mid-Term, Semester I **Academic Year: 2006 – 2007**
Date: August 3, 2006 **Time: 1:30 – 4:30 PM**
Subject: 230-391 **Room: A203**
Basic Chemical Engineering I

ทุจริตในการสอบโทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

Instructions: There are a total of 5 problems and 8 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	15	
2	20	
3	20	
4	20	
5	25	
Total	100	

Exam prepared by
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July 25, 2006

PLEASE CHECK TO MAKE SURE THAT
YOU HAVE ALL 8 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: **(15 Points)**

   (a) 400 Btu/(hr ft^2 °F) to W/(m^2 K) (5 points)

   (b) 35.15 (L)(atm)/(gmol K) to (psia)(ft^3)/(lb-mol °R) (5 points)

   (c) A bucket contains 20 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 30°C to 95°C. Give the answer in Btu. (5 points)

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

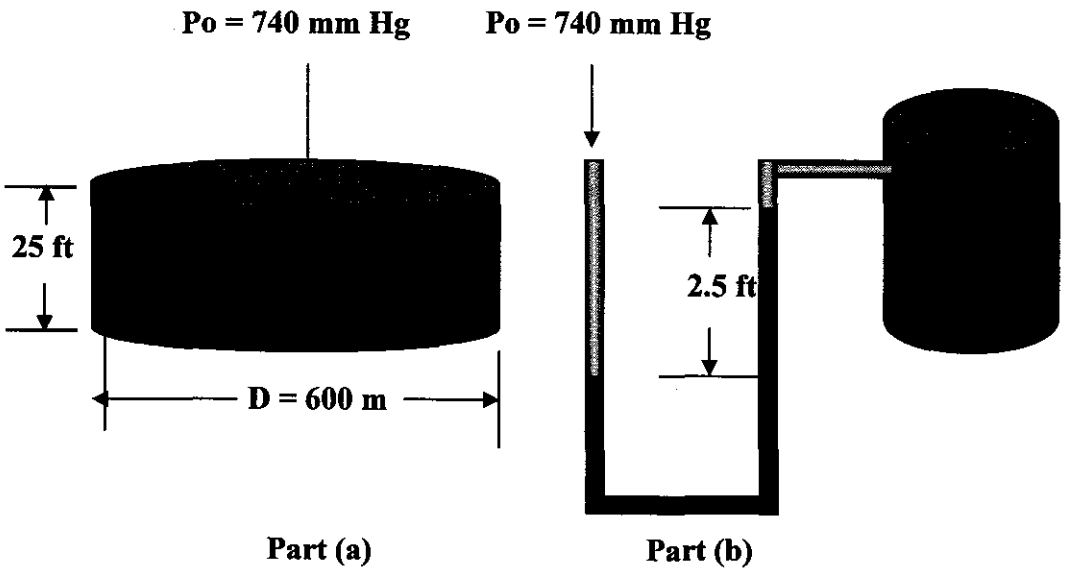
Constants:

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

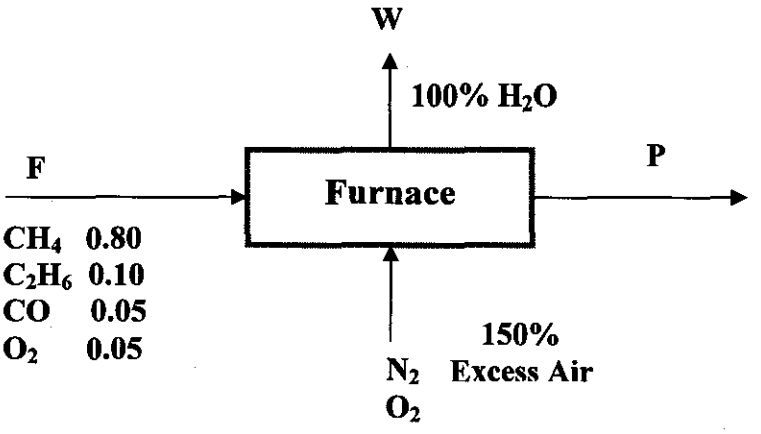
Equations: Pressure = Force/Area
Static Pressure: $P = \rho gh + Po$

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)

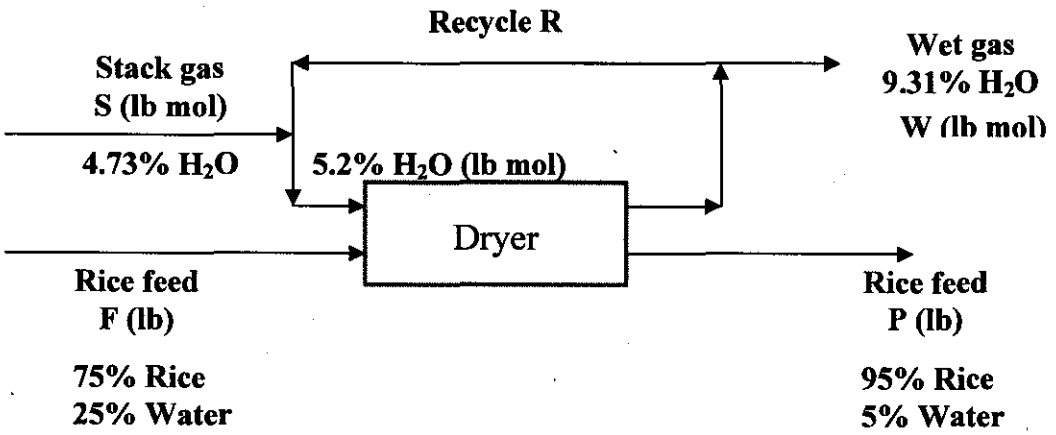


3. A mixture of 80% CH_4, 10% C_2H_6, 5% CO and 5% O_2 is burned in a furnace with 150% excess air. If no CO, CH_4, and C_2H_6 leave the furnace, determine the following information:
(20 points)



(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. To save energy, stack gas from a furnace is used to dry rice. The flow sheet and known data are shown below. What is the amount of recycle gas (in lb mol) per 100 lb of P if the concentration of water in the gas stream entering the dryer is 5.2%? (Hint: Do a mass balance for Rice and Water. Then, do mole balances for water and gas.) **(20 points)**



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 60%. The product flow rate F_5 is 50 kg mol/hr. Calculate all the six flow rates F_1 to F_6 in kg mol/hr. **(25 points)**