

Name: \_\_\_\_\_ Student ID \_\_\_\_\_  
Nickname: \_\_\_\_\_ Group: \_\_\_\_\_

**Prince of Songkla University**  
**Faculty of Engineering**

Exam: Mid-Term, Semester I  
Date: July 27, 2009  
Subject: 230-301  
Basic Chemical Engineering I

Academic Year: 2009 – 2010  
Time: 1:30 – 4:30 PM  
Room: A203

ทฤษฎีในการสอบโทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทฤษฎี 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                                     | 25           |       |
| 2                                     | 20           |       |
| 3                                     | 15           |       |
| 4                                     | 20           |       |
| 5                                     | 20           |       |
| Total                                 | 100          |       |

Exam prepared by  
Ram Yamsaengsung  
July 22, 2009

**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. Conversions of Units: (25 Points)

1.1 Convert

(a)  $0.55 \text{ g}/(\text{min})(\text{in}^3)$  to  $\text{lb}_m/(\text{hr})(\text{ft}^3)$  (5 points)

(b)  $1.35 \text{ Btu}/[(\text{hr})(\text{ft}^2)(^\circ\text{F}/\text{ft})]$  to  $\text{kJ}/[(\text{day})(\text{m}^2)(^\circ\text{C}/\text{cm})]$  (5 points)

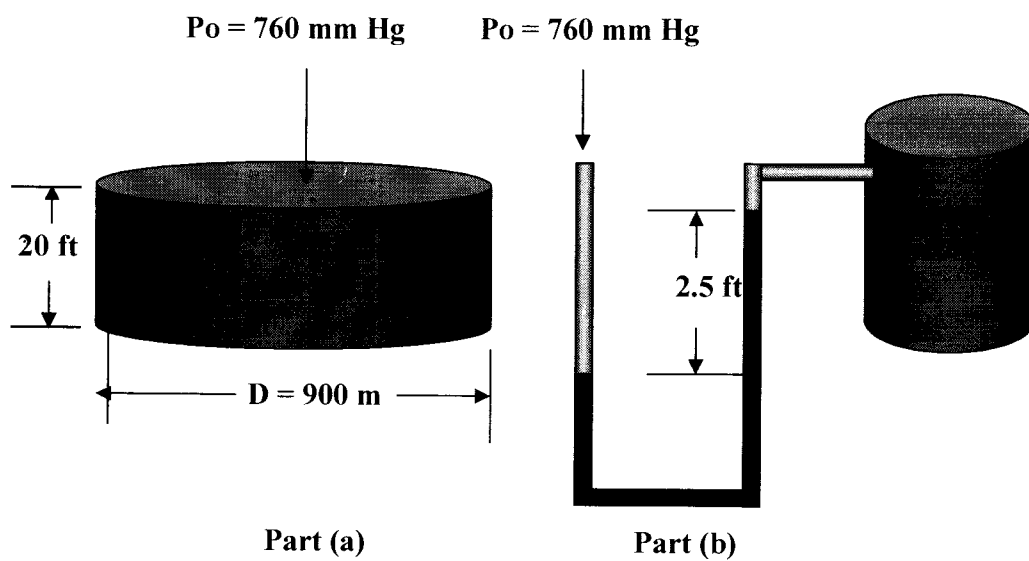
1.2 Water is flowing through a 2.5-inch diameter pipe with a velocity of 3 m/s.

(a) What is the kinetic energy of the water in  $(\text{ft})(\text{lb}_f)/\text{lb}$ ? (5 points)

(b) What is the flow rate in gal/min? (10 points)

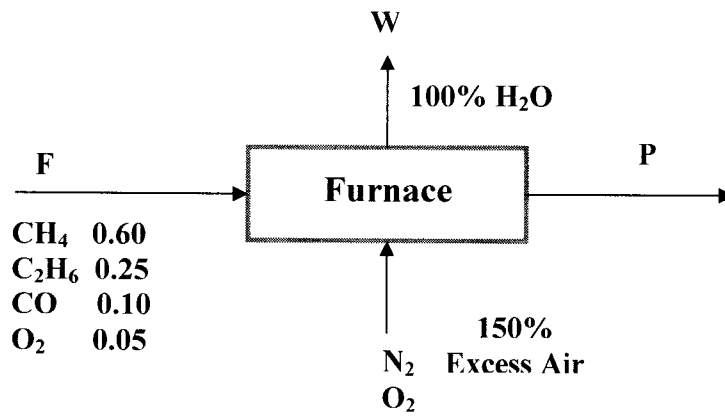
2. From the figures below, answer the following questions. (20 Points)

- (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)



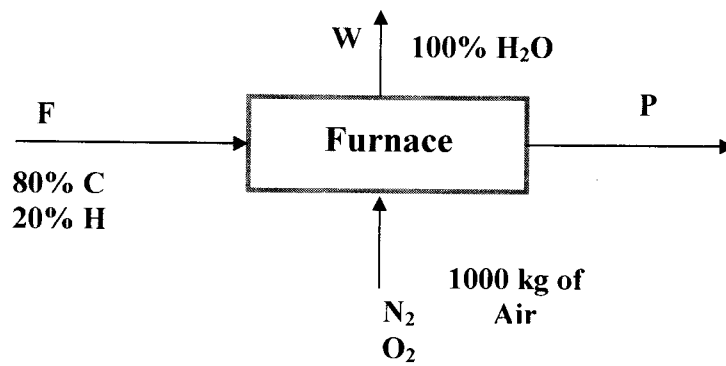
3. To prepare a solution of 65% sulfuric acid, a dilute waste acid containing 35%  $\text{H}_2\text{SO}_4$  is fortified with a purchased acid containing 95%  $\text{H}_2\text{SO}_4$ . How many kilograms of the purchased acid must be bought for each 100 kg of dilute acid? **(15 Points)**

4. A mixture of 60% CH<sub>4</sub>, 25% C<sub>2</sub>H<sub>6</sub>, 10% CO and 5% O<sub>2</sub> is burned in a furnace with 200% excess air. If no CO, CH<sub>4</sub>, and C<sub>2</sub>H<sub>6</sub> 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)

5. Fifty kilograms of coal (analysis 80% C and 20% H ignoring the ash) are burned with 1000 kg of air, yielding a gas having an Orsat analysis in which the ratio of  $\text{CO}_2$  to CO is 3 to 2. (20 points)

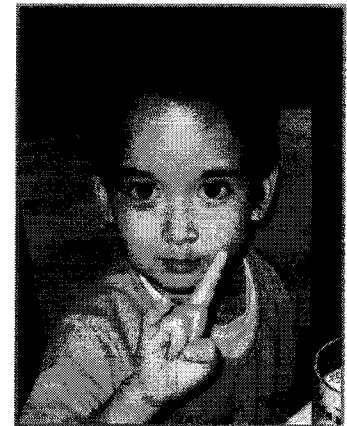


- (a) What is the percent excess air? (10 points)  
(b) What is the Orsat analysis of the flue gas? (10 points)

**BONUS:** What is the name of the restaurant that N'Bright is sitting in below?  
(5 Points)



**CONGRATULATIONS!  
END OF EXAM!**



**Constants:**

|  |   |
|--|---|
| $g = 32.2 \text{ ft/s}^2 = 9.81 \text{ m/s}^2$                                 | $1 \text{ lb}_m = 0.454 \text{ kg}$                                       |
| $g_c = 32.174 \text{ ft}\cdot\text{lb}_m / (\text{lb}_f\cdot\text{s}^2)$       | $1 \text{ ft} = 0.3048 \text{ m}$   |
| $1 \text{ Btu} = 1.055 \times 10^3 \text{ J}$                                  | $1 \text{ m}^3 = 264.172 \text{ gal}$                                     |
| $1 \text{ psia} = 1 \text{ lb}_f/\text{in}^2 = 6.89476 \text{ kPa}$            | $1 \text{ Pa} = 1 \text{ N/m}^2 = 1 \text{ kg}/(\text{m}\cdot\text{s}^2)$ |
| $1 \Delta\text{K} = 1.8 \Delta^\circ\text{R}$                                  | $1 \Delta^\circ\text{C} = 1.8 \Delta^\circ\text{F}$                       |
| $\rho_{\text{H}_2\text{O}} = 62.4 \text{ lb}_m/\text{ft}^3 = 1 \text{ g/cm}^3$ | $1 \text{ J/s} = 1 \text{ W (Watt)}$                                      |

**Equations:**

Pressure = Force/Area  
 Static Pressure:  $P = \rho gh + P_o$   
 Area of Circle =  $\pi D^2/4$