

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

**Prince of Songkla University  
Faculty of Engineering**

Exam: Mid-Term, Semester I  
Date: July 30, 2012  
Subject: 230-301  
Basic Chemical Engineering I

Academic Year: 2012 – 2013  
Time: 1:30 – 4:30 PM  
Room: A401

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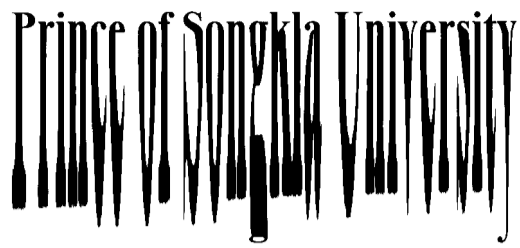
ทฤษฎีในการสอบโทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทฤษฎี และพักการเรียน 1 ภาคการศึกษา

**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. No notes are allowed. No exams are allowed to leave the room.

Points Distribution (For Grader Only)		
Problem	Points Value	Score
1	20	
2	20	
3	15	
4	25	
5	20	
Total	100	

Exam prepared by  
Ram Yamsaengsung  
July 23, 2012

**PLEASE CHECK TO MAKE SURE THAT  
YOU HAVE ALL 10 PAGES OF THE EXAM BEFORE BEGINNING  
(not including the cover sheet).  
GOOD LUCK!**



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**1. Conversions of Units: (20 Points)**

**1.1 Convert**

(a)  $0.24 \text{ g}/(\text{min})(\text{in}^3)$  to  $\text{lb}_m/(\text{hr})(\text{ft}^3)$  (4 points)

(b)  $5.35 \text{ g}/(\text{s})(\text{in}^3)$  to  $\text{lb}_m/(\text{day})(\text{ft}^3)$  (4 points)

(c)  $12.32 \text{ Btu}/[(\text{hr})(\text{ft}^2)(^\circ\text{F}/\text{ft})]$  to  $\text{kJ}/[(\text{min})(\text{m}^2)(^\circ\text{C}/\text{cm})]$  (4 points)

(d) 50 lb of  $\text{C}_2\text{H}_6\text{O}$  to g mol (4 points)

(e)  $-36^\circ\text{F}$  to K (4 points)

2. Application of Units Conversions (20 points)

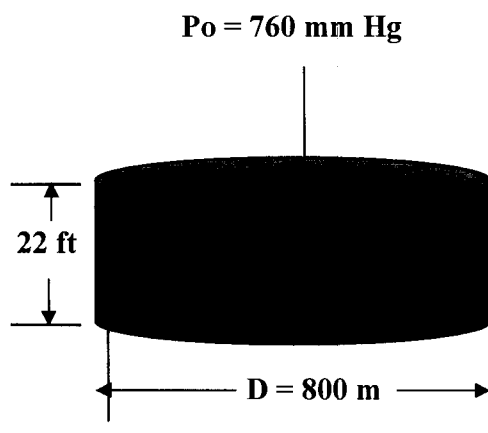
2.1 Water is flowing through a 2.5-inch diameter pipe with a velocity of 8 m/s.

(a) What is the flow rate in gal/min? (5 points)

(b) How long will it take to fill-up a storage tank that has a capacity of 20,000 L? (5 points)

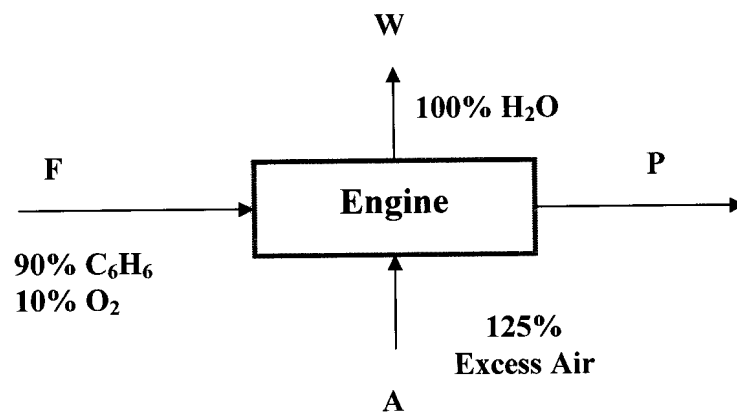
2.2 What is the total force exerted on the bottom of reservoir in Newton? (10 points)

(Hint: Determine the total pressure at the bottom of the reservoir in Pa units.)

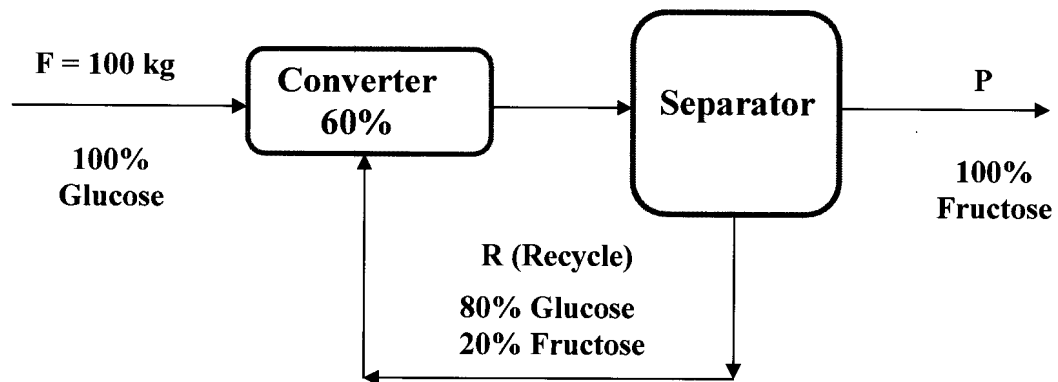


3. Apples contain 90% water when fresh and is sold for 30 Baht/kg. The apples are vacuum dried to produce a product containing 3% water. If the cost of removing the water is 100 Baht/10 kg of water removed. **(15 points)**
- (a) How much water is removed per 100 kg of dried apples? **(10 points)**
- (b) What should be the selling price of the vacuum dried apples to maintain the same profit margin? **(5 points)**

4. Benzene is initially mixed with oxygen to obtain a gas containing 90%  $C_6H_6$  and 10%  $O_2$  that is then burned in an engine with 125% excess air. Eighty-five percent of benzene goes to  $CO_2$ , 10% goes to  $CO$ , and 5% remains unburned. Calculate the composition of the exhaust gas on a dry basis. (25 points)



5. *d*-Glucose and *d*-Fructose have the same chemical formula ( $C_6H_{12}O_6$ ) but different properties. Glucose is converted to fructose as shown below, but only 60% is converted on one pass through the converter vessel so that unconverted material is recycled. Calculate the flow of the recycle stream per kg of 100% glucose fed to the converter (F). Ignore the solvent water used to carry the glucose and fructose. (20 Points)  
**Hint: Balance around Separator where there is no chemical reaction.**  
**You must determine input into Separator coming from Converter.**



**BONUS: Where was this picture taken? (5 points)**

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**CONGRATULATIONS!  
END OF EXAM!**



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**Constants:**

$g = 32.2 \text{ ft/s}^2 = 9.81 \text{ m/s}^2$	$1 \text{ lb}_m = 0.454 \text{ kg}$
$g_c = 32.174 \text{ ft}\cdot\text{lb}_m / (\text{lb}_f\cdot\text{s}^2)$	$1 \text{ ft} = 0.3048 \text{ m} = 12 \text{ in.}$
$1 \text{ Btu} = 1.055 \times 10^3 \text{ J}$	$1 \text{ m}^3 = 264.172 \text{ gal} = 1000 \text{ L}$
$1 \text{ psia} = 1 \text{ lb}_f/\text{in}^2 = 6.89476 \text{ kPa}$	$1 \text{ Pa} = 1 \text{ N/m}^2 = 1 \text{ kg}/(\text{m}\cdot\text{s}^2)$
$1 \Delta\text{K} = 1.8 \Delta^\circ\text{R}$	$1 \Delta^\circ\text{C} = 1.8 \Delta^\circ\text{F}$
$\rho_{\text{H}_2\text{O}} = 62.4 \text{ lb}_m/\text{ft}^3 = 1 \text{ g/cm}^3$	$1 \text{ in.} = 2.54 \text{ cm}$
$1 \text{ J/s} = 1 \text{ W (Watt)}$	

**Equations:**

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