

ชื่อ.....รหัส.....

PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Midterm Examination : Semester I

Academic year : 2011

Date : 6 August, 2011

Time : 09.00 – 12.00 AM

Subject : 231-201 Material and Energy Balances

Room : S201

รายละเอียดการทำข้อสอบ

1. ห้ามนำข้อสอบบางส่วนหรือทั้งหมดออกจากห้องสอบ
2. สามารถนำหนังสือ Dictionary หรือเอกสารใดๆ เข้าห้องสอบได้
3. นำเครื่องคิดเลขไม่จำกัดรุ่นเข้าห้องสอบได้
4. ห้ามหยิบยืมเอกสารใดๆ และพูดคุยกับนักศึกษาอื่นขณะทำข้อสอบ
5. ข้อสอบมีทั้งหมด 5 ข้อ มีจำนวนทั้งหมด 6 หน้า
6. อนุญาตให้ทำข้อสอบด้านหลังกระดาษคำตอบแต่ละข้อได้
7. กรอกชื่อและรหัสนักศึกษาด้านหน้าข้อสอบและกรอกรหัสนักศึกษาทุกหน้าของกระดาษ

ข้อที่	คะแนนเต็ม	คะแนนที่ได้
1	20	
2	25	
3	30	
4	30	
5	25	
รวม	130	

อ.จันทิมา ชั่งศิริพร

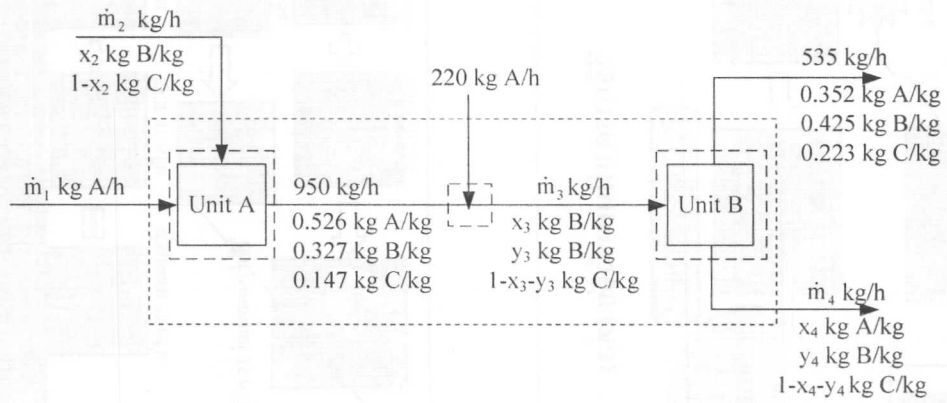
ผู้ออกข้อสอบ

1. Mixture of Ethanol-water 400 kg containing 70 wt% ethanol (EtOH) and 30% water and quantity of 60 wt% ethanol-40% water are blended to produce 1000 kg of mixture containing 80 wt% ethanol. Pure ethanol (100%) is added in the mixture to control for final concentration and quantity of the product. (20 คะแนน)

- 1) Draw and label a flowchart of the mixing process.
- 2) Calculate quantity of all unknown in the flowchart.
- 3) Calculate flow rate of all streams if the process is scaled up to produce the final product mixture at 2500 kg/h



2. Following is a labeled flowchart for a steady-state two-unit process, with boundaries shown to denote subsystems about which balances can be taken. Determine all unknown process variables in the flowchart. (25 คะแนน)



3. Ethane is chlorinated in a continuous reactor: $C_2H_6 + Cl_2 \rightarrow C_2H_5Cl + HCl$.

Some of the product monochloroethane is further chlorinated in an undesired side reaction:



- 1) Take a basis of 100 mol/h Cl_2 fed. Assume that the feed contains ethane, chlorine, and 50 mol/h nitrogen and that all of the chlorine is consumed.
- 2) The reactor is designed at 25% conversion of ethane and a selectivity of 20 mol C_2H_5Cl /mol $C_2H_4Cl_2$

Calculate 1) Draw and label a flowchart the process

- 2) The feed ratio (mol Cl_2 /mol C_2H_6)
- 3) The fractional yield of monochloroethane
- 4) Show the extent of these reactions

4. One hundred mol/h of propane (C_3H_8) and 3000 mol/h of air are fed into combustion reactor. Propane burns in the reaction $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ as assuming that only 75% of the propane reacts. (30 คะแนน)

Draw the flowchart and calculate: (Note: air contains N_2 79 mole % and O_2 21 mole %)

- 1) What is the theoretical air flow rate for this combustion?
- 2) What is the percent excess of air by this burning reaction?
- 3) What is extent of the combustion reaction?
- 4) What is the molar composition of the stack gas (combustion gas) on a dry basis?

5. Liquid acetone (C_3H_6O) is fed at 150 kg/h into an evaporator, where it evaporates into a N_2 stream. The gas leaving the heater is compressed to a total press. $P_{abs} = 5.4$ atm at a temperature of $325^\circ C$. The partial pressure of acetone in this stream is $p_a = 600$ mmHg. Atmospheric pressure is 760 mm Hg. (25 คะแนน)

- 1) What is the molar composition of the stream leaving the compressor?
- 2) What is the volumetric flow rate of the N_2 entering the evaporator if this stream has STP condition.

