

ชื่อ.....รหัส.....

PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Midterm Examination : Semester I

Academic year : 2012

Date : 4 August, 2012

Time : 09.00 – 12.00 AM

Subject : 231-201 Material and Energy Balances

Room : S203

รายละเอียดการทำข้อสอบ

1. ห้ามนำข้อสอบบางส่วนหรือทั้งหมดออกจากห้องสอบ
2. นำหนังสือหรือเอกสารเข้าห้องสอบได้
3. ห้ามหยิบยืมเอกสารใดๆ และพูดคุยกับนักศึกษาอื่นขณะทำข้อสอบ
4. ข้อสอบมีทั้งหมด 6 ข้อ มีจำนวนทั้งหมด 7 หน้า
5. อนุญาตให้ทำข้อสอบด้านหลังกระดาษคำตอบแต่ละข้อได้
6. กรอกชื่อและรหัสนักศึกษาด้านหน้าข้อสอบและกรอกรหัสนักศึกษาทุกหน้าของกระดาษ

ข้อที่	คะแนนเต็ม	คะแนนที่ได้
1	10	
2	20	
3	20	
4	20	
5	25	
6	25	
รวม	120	

อ.จันทิมา ชั่งศิริพร
ผู้ออกข้อสอบ

รหัส.....

1. An aqueous feed solution of sulfuric acid (H_2SO_4) containing 20.0% H_2SO_4 by mass is fed to mixer at a flow rate of 20 kg/h. It is desired to produce 32.0% H_2SO_4 solution by mixing with a stream of 40.0% H_2SO_4 .

a) Basis and draw the diagram of this process.

b) Calculate the ratios (kg feed solution/kg mixing stream).

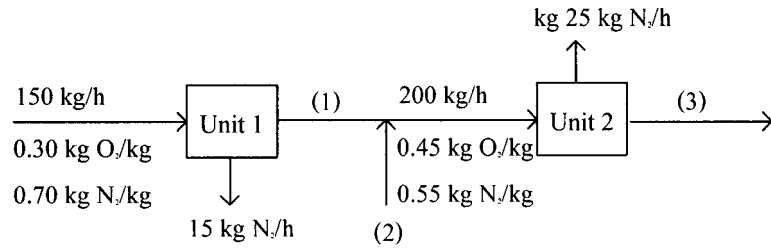
(10 คะแนน)

2. A stream of humid air containing 10% water vapor enters to a condenser in which 85% (by mole) of the water vapor in the air is condensed. The flow rate of the condensate (the liquid leaving the condenser) is measured and found to be 35 L/h. Dry air may be taken to contain 21 mole % oxygen, with the balance nitrogen. (Note: Outlet gas is not dry air.) (20 คะแนน)

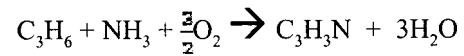
- a) Draw the flowchart of this process and basis for calculation.
- b) Calculate the molar flow rate and mole fractions in the outlet gas stream.
- c) Scale up to a produce air 5000 lb-mol/h, and draw flowcharts for the scaled processes.

3. A labeled flowchart of a continuous steady state two-unit process is shown below. Each stream contains N_2 and O_2 , in different proportions. Three streams whose flow rates and/or compositions are not known as labeled (1), (2), and (3). (20 คะแนน)

Calculate the streams whose flow rates and/or compositions are not known.



4. Acrylonitrile is continuously produced from the reaction of propylene, ammonia, and oxygen:



The feed contains 30.0 mole% propylene, 25.0% ammonia, 30.0% oxygen, and balance N_2 . (20 คะแนน)

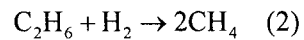
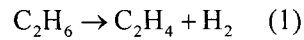
Determine: a) Draw the process diagram of this reactor?

b) Which reactant is limiting?

c) The percentage by which each of the other reactants is in excess?

d) The molar amounts of all product gas if a fractional conversion of 55.0% the limiting reactant is achieved by using extent of reaction?

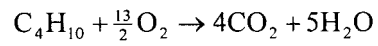
5. Chemical reaction to produce ethylene (C_2H_4) from ethane (C_2H_6) can be shown as following:



The reactions occur by feed C_2H_6 , H_2 , and N_2 at flow rate of 150 mol/h. The feed contains 80.0 mole% C_2H_6 , 15.0 mole% H_2 and balance N_2 . Fractional conversion of C_2H_6 is 0.65 and C_2H_4 (main product) is produced 55 mol/h. (25 คะแนน)

- Draw the process diagram of this reactor?
- What is the percentage yield of C_2H_4 in this reaction?
- Flow rate of each gas in the product stream?
- What is selectivity of C_2H_4 to CH_4 production?

6. Fuel of C_4H_{10} is continuously fed to burn at flow rate of 100 mol/h to combustion chamber:



- What is the theoretical O_2 flow rate if complete combustion occurs in the reactor?
- What is the theoretical air flow rate assuming that 55% of the C_4H_{10} reacts to form CO_2 ?
- If 150% excess air is supplied, what is the flow rate of air entering the reactor?
- The molar amounts of all product flue gas using extent of reaction?

Note: c) using the condition of b) and d) using the condition of c) (25 คะแนน)