

Name ..... Code .....

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FACULTY OF ENGINEERING  
PRINCE OF SONGKLA UNIVERSITY

Final Examination Paper : Semester II

Academic year: 2007

Date : February 29, 2008

Time: 13.30-16.30

Subject: 230-392 Basic Chemical Engineering II

Room: A 401

ทฤษฎีในการสอบโทษขั้นต่ำ คือ ปรับตกในรายวิชาที่ทฤษฎีและพักรเรียน 1 ภาคการศึกษา

-There are a total 5 questions.

-The exam is open book.

-Place your name and the student ID number  
on every page.

-Students are allowed to use a pen or pencil  
and a calculator.

-No exams are allowed to leave the room.

Question	Points Value	Score
1	15	
2	15	
3	25	
4	30	
5	20	
Total	105	

**PLEASE CHECK TO MAKE SURE THAT**

**YOU HAVE ALL 9 PAGES OF THE EXAM BEFORE BEGINNING.**

(Including the cover sheet)

GOOD LUCK

Dr. Supawan Tirawanichakul

February 22, 2008

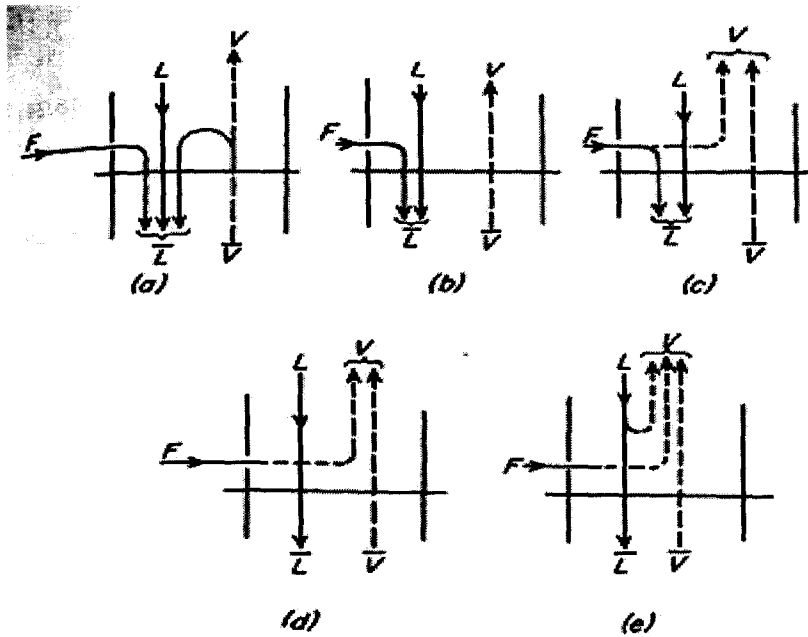
Name ..... Code ..... 2

1. (15 points) Estimate the diffusivity of carbon monoxide gas in gas mixture of oxygen: mole fraction = 0.10, nitrogen: mole fraction = 0.70, hydrogen: mole fraction = 0.05 and carbon monoxide: mole fraction = 0.15 at 298 K and 1.5 atm.

2. (15 points)

From the figure below, if  $F = 100$  moles,  $L = 60$  moles, and  $V = 80$  moles, answer the following questions.

- (a) Indicate the types of feed into the column and what is the approximate value of  $q$  for each of the feed?
- (b) For case (b), what is the value of  $\bar{L}$  and  $\bar{V}$ .
- (c) For case (c), if  $f$  equals 0.65, what is the value of  $\bar{L}$  and  $\bar{V}$ .



3. (25 points)

A mixture of 50 mole percent benzene and 50 mole percent toluene is subjected to flash distillation at a pressure of 1 atm. The vapor-liquid equilibrium curve and boiling-point diagram are shown in Figs. 1 and 2.

- (a) What is the composition of the liquid and vapor leaving the separator if  $f$ , the fractional vaporization is 0, 0.3, 0.5, 0.7 and 1?
- (b) What is the temperature in the separator?
- (c) Would the number of moles in the vapor phase increase or decrease if you increase the mole fraction of benzene? Explain

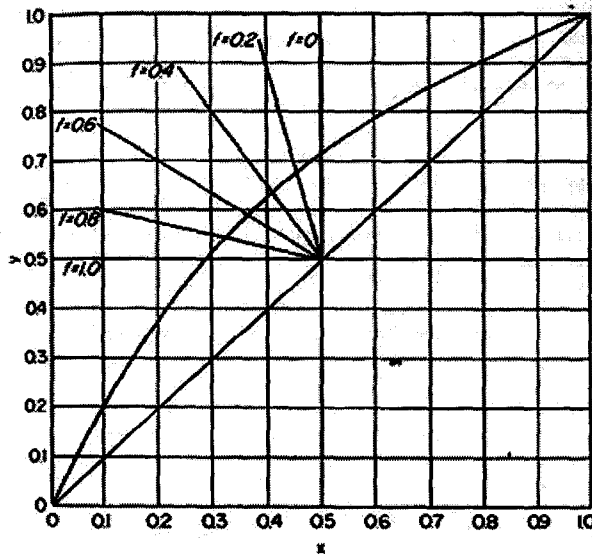


Figure 1 Equilibrium curve, system benzene-toluene

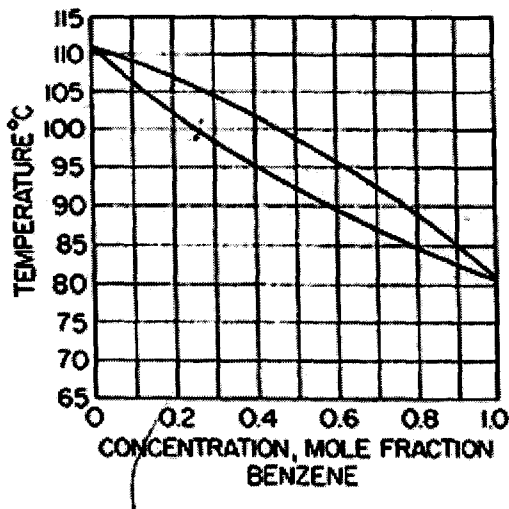


FIGURE 18.3 Boiling-point diagram (system benzene-toluene at 1 atm).

Figure 2 Boiling-point Diagram (system benzene-toluene)

4. (30 points) Oil is to be extracted from meal by means of n-hexane using a continuous countercurrent extractor. The unit is to treat 1000 kg of meal (based on completely exhausted solid) per hour. The untreated meal contains 500 kg of oil and 30 kg of hexane. The fresh solvent mixture contains 7 kg of oil and 400 kg of hexane. The exhausted solids are to contain 70 kg of unextracted oil. Experiments carried out under conditions identical with those of the projected battery show that the solution retained depends on the concentration of the solution, as shown in Table 1.

Find

- the concentration of the strong solution, or extract;
- the concentration of the solution adhering to the extracted solids
- the mass of solution leaving with the extracted meal;
- the mass of extract; (e) estimate the number of stages required.

All quantities are given on an hourly basis.

Table 1

Concentration kg oil/ kg solution	Solution retained kg / kg solid
0.0	0.500
0.1	0.505
0.2	0.515
0.3	0.530
0.4	0.550
0.5	0.571
0.6	0.595
0.7	0.620
0.8	0.646

5. (20 points) A filter cake 60 cm squared and 5 cm thick, supported on a screen, was dry at dry-bulb temperature of 55°C and at wet-bulb temperature of 25°C. The air cross flows the cake at a velocity of 1.3 m/s. The dry density of the cake is 1950 kg/m<sup>3</sup>. The equilibrium-moisture content is negligible. Find

- (a) the drying rate during the constant-rate period
- (b) drying time for this material to be dried from an initial moisture content of 25 percent (dry basis) to a final moisture content of 14 percent?