

**ChE 265 Midterm**  
February 10, 1997

1. Correct any errors in the following equations and statements, and tell me the names of the balance equations they correspond to (15 points):

a)  $IN + \text{generation} = OUT + \text{consumption} - \text{accumulation}$   
equation: \_\_\_\_\_

b)  $\sum_{i=1}^n x_i = 1.0$  where  $n = \text{the number of components}$ . This equation applies to inlet streams. equation: \_\_\_\_\_.

c)  $\sum_{i=1}^n x_i F_i = \sum x_i F_i + \beta_i \xi$  where  $i$  designates component  $i$ .  
equation: \_\_\_\_\_

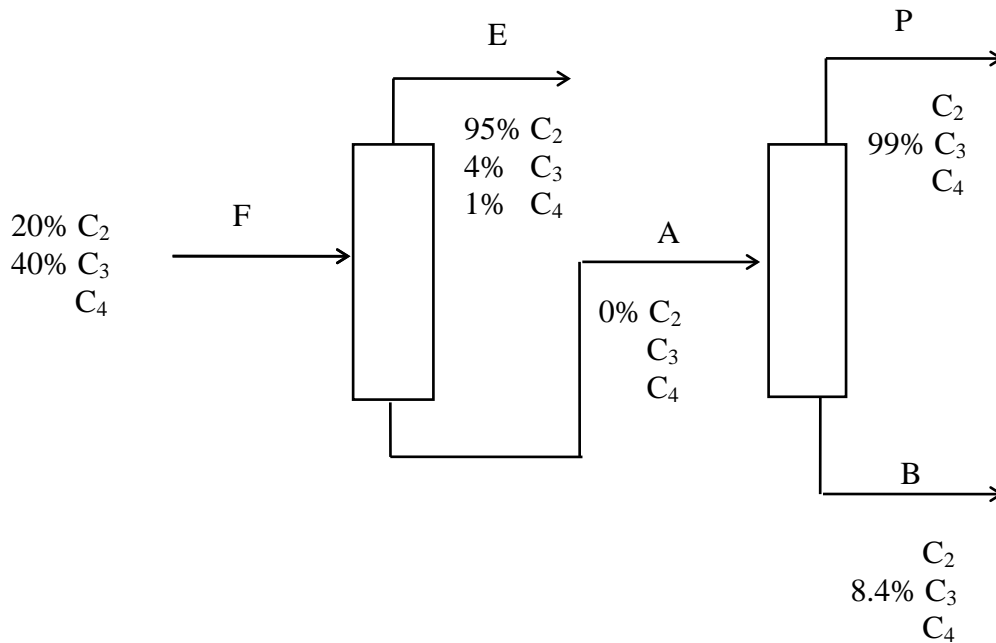
2. (10 points) Circle the correct statement(s). The basis

- a) is an arbitrary choice only if no reaction takes place.
- b) may be chosen based on information given in the problem statement.
- c) chosen may be used to scale the results up or down.
- d) may be in kg/hr, moles/day, or any other amount/time units.

3. (10 points) Circle the correct statement(s). The system boundaries determine

- a) which streams flow in and out of the system
- b) the components present in the system
- c) the difficulty of the problem
- d) the numerical answers

4. (65 points)



a) (35 points) In a distillation train, a liquid hydrocarbon containing 20 mole % ethane (C<sub>2</sub>H<sub>6</sub> or C<sub>2</sub> for short), 40 mole % propane (C<sub>3</sub>H<sub>8</sub> or C<sub>3</sub> for short), and 40 mole % butane (C<sub>4</sub>H<sub>10</sub> or C<sub>4</sub> for short), is to be separated into three essentially pure components as shown above. Using a basis of 100 moles of stream F, complete the material balance (all flowrates and compositions). Indicate clearly your system(s), equations, and assumptions.

b) (30 points) In another part of the plant stream E is to be burned to generate steam. - what are the reactions?

- if the extent of the ethane reaction is 18 mols, the butane and propane reactions go to completion, and oxygen is fed in 100% excess for all reactions, how much oxygen is fed? How much ethane burns?

- if pure O<sub>2</sub> is fed, what is the composition and flowrate of the exit gas?