

**Chemical Engineering 201
Fall 2000**

Midterm # 2

Name _____

Problem # 1 _____

Problem # 2 _____

Problem # 3 _____

Problem # 1 (30 points):

The catalytic dehydrogenation of propane to form propylene is carried out in a continuous packed-bed reactor. One thousand kilograms per hour of pure propane is preheated to a temperature of 670°C before it passes into the reactor. The reactor effluent gas, which includes propane, propylene, methane, and hydrogen, is cooled from 800°C to 110°C and fed to an absorption tower, where the propane and propylene are dissolved in oil. The oil then goes to a stripping column that uses nitrogen, releasing the dissolved gases. Propylene is then separated from the other species in a distillation column. The nitrogen entering the distillation column is removed in a third product stream from the column and recycled back to the stripper. The propane stream is recycled back to join the feed to the reactor preheater. The product stream from the distillation column contains 98% propylene, and the recycle stream is 97% propane. The stripped oil is recycled to the absorption tower. Sketch and label this problem statement.

Problem # 2 (30 points):

Wet sugar that is one-fifth water by mass is sent through an evaporator in which 85% of the entering water is evaporated. How much water (kg) is vaporized per kilogram of wet sugar leaving the evaporator?

b) (5 points) If 1000 tons/day of wet sugar is fed to the evaporator, how much wet sugar will come out (tons/day)?

Problem # 3 (35 points):

500 kg/hr are coming out of a reactor where the stream has 30 wt% ethylene, 40 wt % water, and 30 wt% oxygen. This stream is sent to a separator where all of the ethylene is removed from the water and oxygen stream. The ethylene stream also contains 10 wt% oxygen, but no water. The oxygen/water stream is sent to another separator where 90% of the water is condensed, but none of the oxygen is. How much water leaves the condenser as a vapor with the oxygen stream? What is the mass fraction of oxygen in the vapor stream leaving the condenser?