1. A stream containing components A and B is fed to a separator operating at 1.5 atm. The $T_x$-$y$ diagram at this pressure for solution of A and B is given in Figure 1. Of the B entering through the feed (F), 90% exits through the liquid stream (L). The composition of A in the vapor stream (V) is 80 mol%. (see Figure 2 for flowsheet).

   a) (10 pts) At what temperature was the separator operating at?
   b) (35 pts) Determine the composition of the feed.

![Txy Diagram at P=1.5 atm](image)

Figure 1.
2. (40 pts) A feed composed of 50 mol % Benzene and 50 mol % Ethylbenzene is fed to a flash tank. The flow rate of the vapor stream (V) is 2000 liters/sec. The tank is kept at 80°C and 0.5 atm. Assuming that Raoult's law applies and that the vapor stream (V) behaves as an ideal gas, determine the molar flow rate of the feed. (see Figure 2 for flowsheet.)

3. (15 pts) Humid air (air + H₂O) having S% relative saturation at a temperature T₁ enters a drier at a rate nₐ (moles/sec). It then picks up water from a bed of wet material and exits at a temperature T₂ with a Q% relative saturation. The pressure of all the streams and the drier unit can be assumed to be constant at P (atm). Show that the rate of water removed, nₖₙ (mol H₂O/sec), from the drier by the incoming air is given by

\[ n_W = n_A \left( \frac{Q P_{H_2O}^s(T_1) - S P_{H_2O}^s(T_2)}{100P - Q P_{H_2O}^s(T_2)} \right) \]

4. (Bonus: 10 pts) Obtain the bubble point temperature for a liquid mixture of 20 mol% Benzene and 80 mol% Toluene at 2 atm. (Hint: it should be between 125°C and 130°C)