

Open Book ONLY

Name: \_\_\_\_\_

*Instructions: Read each problem carefully before attempting to work. Show your work. Use your time wisely. Clearly indicate final answers. Accuracy of graphical solutions will be considered. Identify all important points and lines clearly.*

(100%) A distillation column is being designed to separate a mixture of n-hexane and n-octane. Vapor-liquid equilibrium data is presented for this system at 1.0 atm is presented in the table. A Hxy diagram is also provided. "Blank" graph paper (xy) is supplied for your use.

**DO NOT USE THE Hxy DIAGRAM TO DEVELOP YOUR xy DIAGRAM. USE THE xyT DATA PROVIDED FOR THAT PURPOSE. USE THE Hxy DIAGRAM TO GET ENTHALPY DATA AND TO SHOW COMPOSITION AND TEMPERATURE VALUES AS REQUESTED.**

The following operating parameters are known:

- The feed to the column is 500 lb-mol/h of liquid subcooled below its bubble-point by 50 °F.
- The feed to the column is 30 mass% n-hexane and 70 mass% n-octane.
- The column is designed to recover 95% of the n-hexane in the feed in the top product. The purity of the top product is 95% n-hexane.
- The column has a partial condenser and a total reboiler.
- The column operates at 50% over the minimum reflux ratio.
- The reflux is saturated liquid.
- The feed is on stage 3 (numbering from the top).

x	y	T
0	0	259
0.1	0.31	240
0.2	0.55	224
0.4	0.80	199
0.6	0.92	180
0.8	0.98	165
0.9	0.99	160
1	1	157

Questions about the overall performance of the column.

1. What is the amount and composition of the top product (mole fraction).
2. What is the amount and composition of the bottom product (mole fraction).

Questions relating to the feed.

3. What is the feed temperature? **Indicate  $T_F$  values on diagram Hxy diagram.**
4. What is the feed quality, q?
5. How much rising vapor (lb-mol/h) is condensed when contacting the subcooled liquid feed?

Questions about the condenser operation.

6. What is the composition (mole fraction) of the reflux liquid? **Indicate  $x_o$  on the xy diagram.**
7. What is the temperature of the refluxed liquid? **Indicate  $T_o$  value on Hxy diagram.**
8. What is the relative volatility of n-hexane relative to n-octane (at condenser conditions)?
9. What is the condenser duty (Btu/h)? **Indicate H values used on the Hxy diagram.**

Questions about the reboiler operation.

10. What is the boilup ratio,  $\bar{V}/B$ ?
11. What is the temperature of the bottom product? **Indicate  $T_B$  value on Hxy diagram.**

Questions about the column.

12. How many stages are in the column?