

A mixture of 30 mol% toluene and 70% ethylbenzene is to be separated in a distillation column. The feed enters as a saturated liquid at a rate of 500 kmol/hr. The distillate is to exit at 99 mole% toluene and the residue at 1 mole% toluene. The column is to be designed for a reflux ratio of 1.2 times the minimum.

- a) Use a McCabe-Thiele diagram to estimate the number of ideal stages needed.
- b) For an overall efficiency of 75%, how many actual stages are needed?
- c) Size the condenser and reboiler for this column. Assume saturated steam is available 150 psig and cooling water comes in at 30 °C and is returned at 45 °C. Report the following:
 - i) the heat duty of the condenser and reboiler in GJ/hr
 - ii) the heat transfer area of the condenser and reboiler in m²
- d) Estimate the diameter of the top tray (in m and ft) assuming the vapor is at 75% of the flooding velocity and the active area is 80% of the column cross sectional area. Assume a 2 ft tray spacing.