

Name Student ID

1. (20 points) A wetted – wall column is use to study the stripping of trichloroethylene (TCE) to air at a constant temperature 293 K and total system pressure of 1 atm. The column inner diameter is 4 cm and the height is 2 m. The volumetric flowrate of air is $2 \times 10^{-3} \text{ m}^3/\text{s}$, and the diffusivity of TCE to air at 293 K and 1 atm is $8.08 \times 10^{-6} \text{ m}^2/\text{s}$. **Determine mass transfer coefficient, k_c in m/s.**

Name Student ID

2. (15 points) A water stream with 10% mole of A flows countercurrent to an air stream (0.2% mole A). At gas - liquid interface, liquid mole fraction of A is 0.045. Find overall mass transfer coefficient in liquid phase, K_x if the mass transfer coefficients, k_y and k_x for this process are 1 and $0.008 \text{ kmol/m}^2 \cdot \text{h} \cdot \text{mole fraction}$ respectively. It is noted that equilibrium data for component A can be approximated by $y_A = -0.8434x_A^2 + 0.1721x_A$.

Name Student ID

3. (10 points) Predict the diffusion coefficient in cm^2/s of nitrobenzene in water at 20°C . If 1.203 kg of nitrobenzene has volume of 1000 cm^3 , and 1 mole of nitrobenzene has weight of 123.1 g.

4. (5 points) It is found that a saturated solution of sodium chloride in water boils under atmospheric pressure at 109°C. Under an absolute pressure of 25.4 kPa, water boils at 65.6°C and saturated sodium chloride at 73.3°C. From these, draw a Duhring plot for saturated salt solution as shown in the figure below. Find the boiling temperature of saturated salt solution under a total pressure of 33.3 kPa.

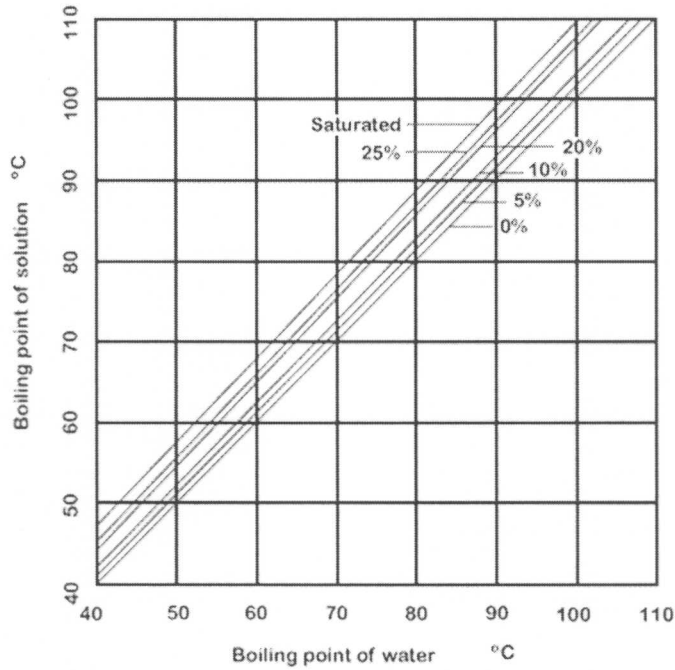


Figure: Duhring plot for boiling point of sodium chloride solutions

Name Student ID

5. (30 points) A single effect evaporator is required to concentrate a solution from 10% solids to 30% solids at the rate of 250 kg of feed per hour. If the pressure in the evaporator is 77 kPa absolute and if steam is available at 200 kPa gauge (also consider temperature change of steam). Calculate the quantity of steam required per hour if the overall heat transfer coefficient is $1700 \text{ J/m}^2 \cdot \text{s} \cdot ^\circ\text{C}$ (negligible heat of dilution).

Assume that the temperature of the feed is 18°C and the specific heat of feed solution is same as for water as $4.186 \times 10^3 \text{ J/kg} \cdot ^\circ\text{C}$, and the latent heat of vaporization of the solution is the same as that for water under the same conditions.