ChEn 3603 Homework #9

You can do the stage calculation by hand if you want to; my solutions will do this all using python.

Problem 1 (15 pts)

SHR 6.7 (Absorption of CO_2 from air). Note that you need to report x and y ultimately, not X and Y.

Problem 2 (10 pts)

Given the data in problem 1 and the same desired recovery of CO_2,

1. (2 pts) Determine the minimum value of L'/V' to achieve the desired separation.
2. (6 pts) If the solvent flow rate is twice the minimum, how many theoretical stages are required?
3. (2 pts) If each stage has an efficiency of 40%, how many actual trays are required?

Problem 3 (10 pts)

SHR 6.8 (Absorption of acetone from air).

For part (c), report mole fraction rather than concentration.

Problem 4 (12 pts)

SHR 6.32 (SHR 6.25 in third edition) – Absorption of SO_2 in a packed tower.

An SO_2–air mixture is scrubbed with water in a packed tower at 20 ° C 20°C and 1 atm. Solute-free water enters the top at 1,000 lb/h and is well distributed over the packing. The liquor leaving contains 0.6 lb SO_2 per 100 lb of solute-free water. The partial pressure of SO_2 in the gas leaving is 23 torr. The *mole* ratio of water to air is 25. The necessary equilibrium data are tabulated below.

Solubility of SO2 in H2O at 20°C

$\frac{\text{lb } SO_2}{100 \text{ lb } H_2O}$	p_{SO_2} (torr)
0.02	0.5
0.05	1.2
0.10	3.2
0.15	5.8
0.20	8.5
0.30	14.1
0.50	26.0
0.70	39.0
1.0	59

1. (4 pts) What percent (on a mole basis) of the SO_2 in the entering gases is absorbed in the tower?

2. (10 pts) During operation, it was found that rate coefficients k_p and k_p remained substantially constant throughout the tower at

$$k_L = 1.3\,\text{ft/hr},$$
$$k_p = 0.195\,\text{lbmol/h}\cdot\text{ft}^2\cdot\text{atm}$$

At a point in the tower where the liquid concentration is 0.001 lbmol SO_2 per lbmol of water, what is the liquid concentration at the gas–liquid interface (in lbmol/ft^3) and SO_2 vapor partial pressure at the interface (in atm)? The solution density is 1 g/cm^3.