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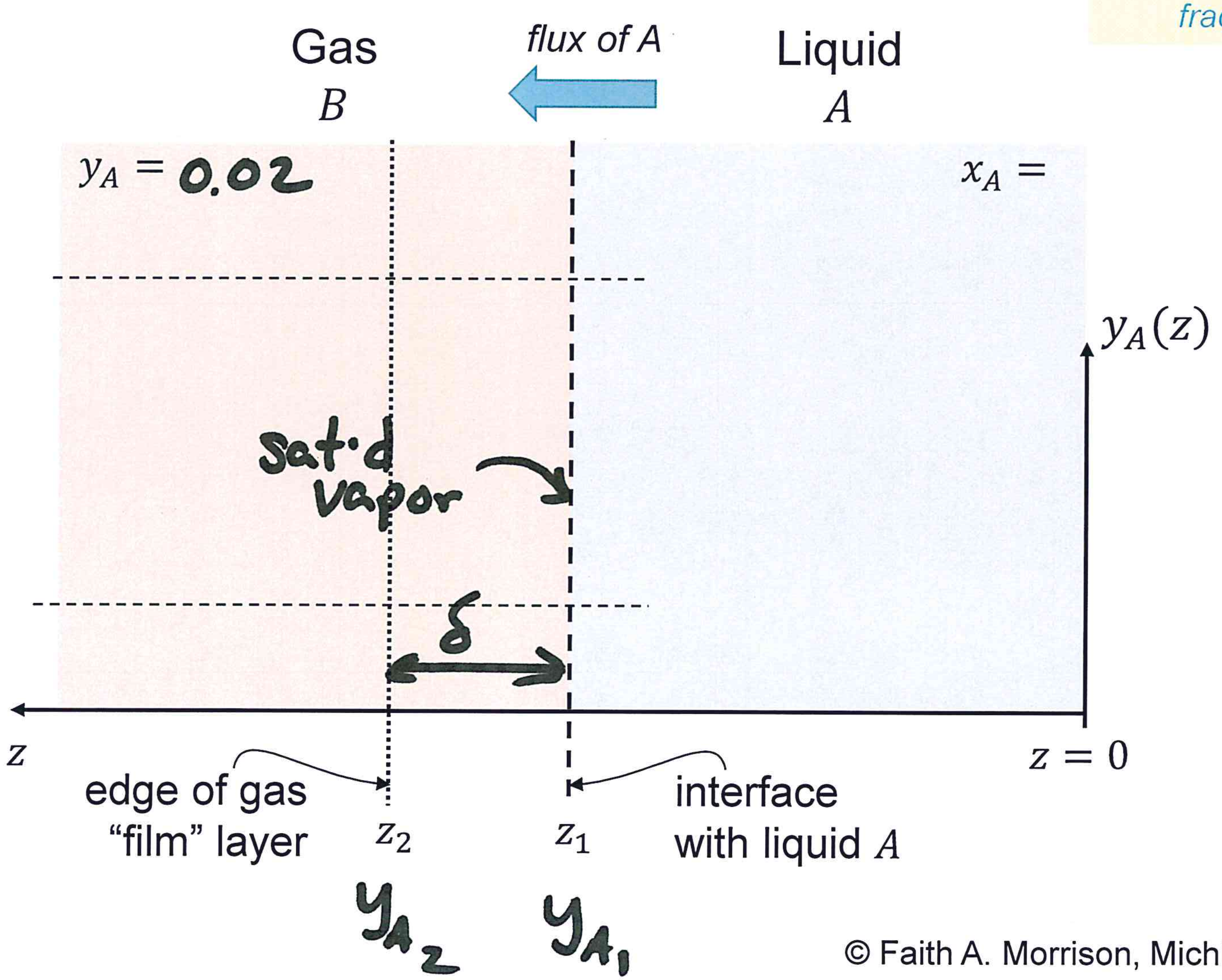
Example: The film model of 1D steady diffusion yields a composition distribution and an expression for the flux. What is the mass-transfer coefficient in the film model?

(we use x for liquid and y for gas mole fractions)



From Example 1:

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$$N_{Az} = \frac{c \overset{\text{need } D_{AB}}{D_{AB}}}{\underbrace{(z_2 - z_1)}_{\delta}} \ln\left(\frac{1 - y_{A2}}{1 - y_{A1}}\right)$$

Linear driving force model:

$$N_{Az} = \underset{\uparrow \text{ need } k_y}{k_y} (y_{A1} - y_{A2})$$

Both approaches are right. (if their assumptions are met)

If we equate these two expressions, we see how the two approaches are related.

$$N_{Az} = k_y(y_{A1} - y_{A2})$$

$$= \frac{cD_{AB}}{\delta} \ln\left(\frac{1-y_{A2}}{1-y_{A1}}\right)$$

since they are mole fractions $\begin{cases} 1 - y_{A1} = y_{B1} \\ 1 - y_{A2} = y_{B2} \end{cases}$

NOTE

$$y_{A1} - y_{A2} = 1 - y_{B1} - (1 - y_{B2})$$

$$= 1 - y_{B1} - 1 + y_{B2}$$

$$= y_{B2} - y_{B1}$$

Substituting above + solving for k_y:

$$k_y = \frac{c\,D_{AB}}{\delta}\underbrace{\left(\frac{\ln \frac{y_{B2}}{y_{B1}}}{y_{B2}-y_{B1}}\right)}_{1/y_{B\,lm}}$$

a "log mean" concentration driving force

$$\boxed{k_y = \left(\frac{c\,D_{AB}}{\delta\, y_{B\,lm}}\right)}$$

- $k_y \propto D_{AB}^{1}$
- we don't know δ, however