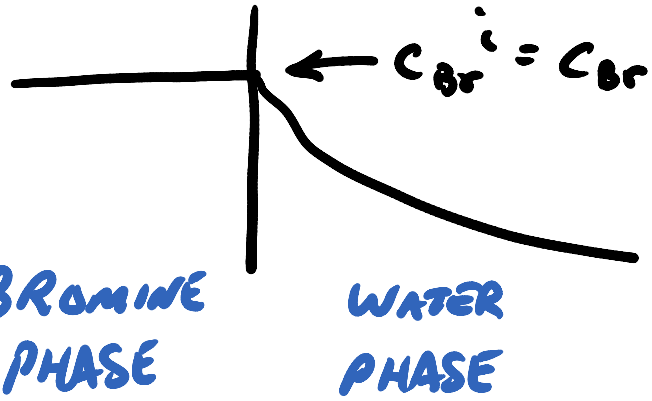
# INTERLUDE PROBLEM #1

$$k_L a = 3.82 \times 10^{-3}\ s^{-1}$$

## BROMINE MATERIAL BALANCE ON WATER PHASE




... BECAUSE IT IS PURE BROMINE, THERE IS NO CONC. GRADIENT IN BROMINE PHASE.

$$\text{ACC} = \text{IN} - \text{OUT} + \text{GEN}^{0}$$

$$\frac{d}{dt}\left(V C_{Br}^{l}\right) = \bar{\Phi}_{Br} A$$

$$V \frac{dc_{Br}^{l}}{dt} = A \overbrace{k_L \left( c_{Br}^{i} - c_{Br}^{l} \right)}^{\Phi_{Br}}$$

$$\frac{dc_{Br}^{l}}{dt} = k_L \frac{A}{V} \left( c_{Br}^{*} - c_{Br}^{l} \right)$$

$$\int_0^{c_{Br}^{f}} \frac{dc_{Br}^{l}}{c_{Br}^{*} - c_{Br}^{l}} = k_L \frac{A}{V} \int_0^{t} dt$$

$$\ln \left[ \frac{c_{Br}^{*} - c_{Br}^{l}}{c_{Br}^{*} - 0} \right] = -k_L \frac{A}{V} t$$

$c_{Br}^{l}$ VERSUS $t$

NOTE: IF WE HAVE DATA OF $C_{Br}^{l}$ VERSUS $t$, THEN WE CAN CALCULATE $k_L$:

$$\ln\left[C_{Br}^{*} - C_{Br}^{l}\right] - \ln\left[C_{Br}^{*} - 0\right] = -k_L \frac{A}{V} t$$

$$\ln\left[C_{Br}^{*} - C_{Br}^{l}\right] = -\frac{k_L A}{V} t + \ln\left[C_{Br}^{*}\right]$$

$$Y = m x + B$$

PLOT OF $\ln\left[C_{Br}^{*} - C_{Br}^{l}\right]$ VS. $t$

WILL HAVE SLOPE OF $-\frac{k_L A}{V}$

← CROSS-SECTIONAL AREA FOR MASS TRANSPORT

← VOLUME OF LIQUID (WATER) PHASE.

... BACK TO PROBLEM ...

$$\ln\left[\frac{C_{Br}^{*} - C_{Br}^{l}}{C_{Br}^{*}}\right] = -k_L \frac{A}{V} t$$

"$k_L a$"

$$\ln\left[1 - \frac{C_{Br}^{l}}{C_{Br}^{*}}\right] = -k_L a\, t$$

OR $$t = -\frac{1}{k_L a} \ln\left[1 - \frac{C_{Br}^{l}}{C_{Br}^{*}}\right]$$

HOW LONG FOR $C_{Br^-}^{l}$ TO REACH $\frac{C_{Br^-}^{*}}{2}$ ?

$$C_{Br^-}^{l} = \frac{C_{Br^-}^{*}}{2}$$

$$\frac{C_{Br^-}^{l}}{C_{Br^-}^{*}} = 0.5$$

$$t = -\frac{1}{3.82 \times 10^{-3} s^{-1}} \ln\left[1 - 0.5\right]$$

$$t = 181 \text{ s}$$