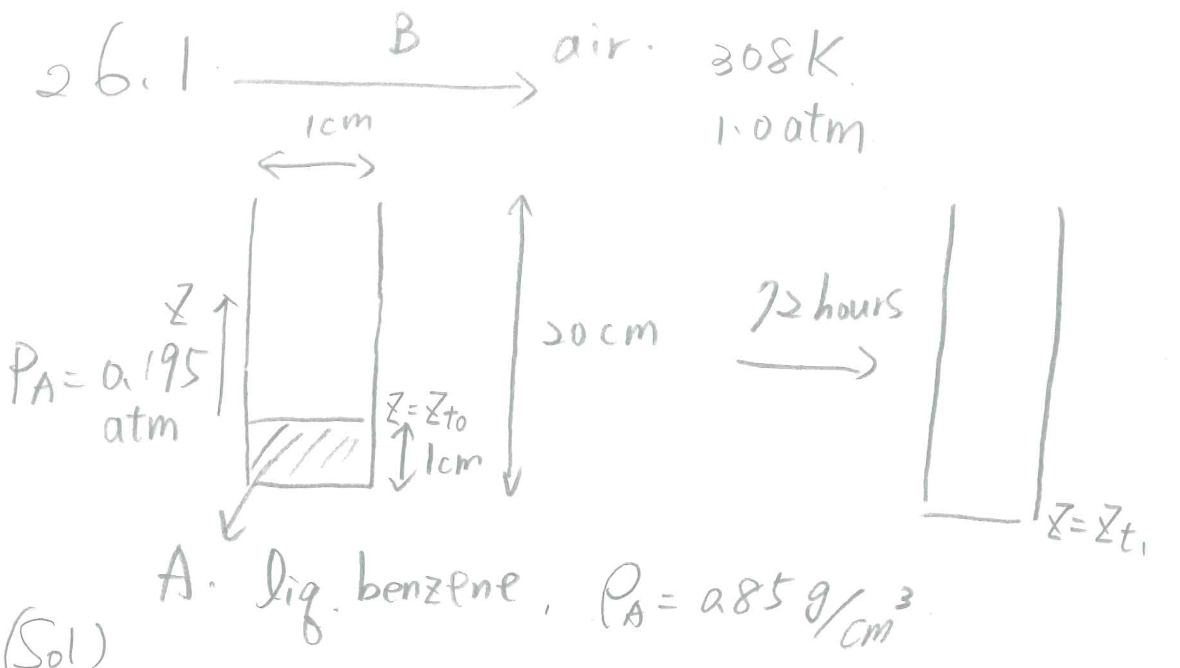
26.1



Find $D_{AB} = ?$
(A ↓ benzene, B ↓ air)

(Sol)

For 1D pseudo-steady-state

Differential eq'n of mass transfer

$$\vec{\nabla}\vec{N}_A + \frac{\partial C_A}{\partial t} - R_A = 0$$

($\frac{\partial C_A}{\partial t} \to 0$: pseudo-s.s., $R_A \to 0$: no reaction)

$$\Rightarrow \frac{\partial N_{A,x}}{\partial x} + \frac{\partial N_{A,y}}{\partial y} + \frac{\partial N_{A,z}}{\partial z} = 0$$

($\frac{\partial N_{A,x}}{\partial x} \to 0$, $\frac{\partial N_{A,y}}{\partial y} \to 0$: for z direction only)

$$\Rightarrow \frac{\partial N_{A,z}}{\partial z} = 0. \quad N_{A,z} \text{ is not a function of } z$$

Fick's eq'n

$$N_{A,z} = -CD_{AB}\frac{\partial y_A}{\partial z} + y_A(N_{A,z} + N_{B,z})$$

B has a negligible solubility in Liq. A $\Rightarrow N_{B,z} = 0$

$$\Rightarrow N_{A,z} = \frac{-CD_{AB}}{1-y_A}\frac{\partial y_A}{\partial z}$$

$$\Rightarrow N_{A\cdot z} = \frac{C D_{AB} (y_{A1} - y_{A2})}{z_t \, y_{B\,lm}}$$

From mass balance of Liq. A

$$A \cdot N_{A\cdot z} = \frac{\rho_{A.L}}{MW_A} A \frac{dz_t}{dt}$$

$$\Rightarrow N_{A\cdot z} = \frac{\rho_{A.L}}{M.W_A} \frac{dz_t}{dt} = \frac{C D_{AB} (y_{A1} - y_{A2})}{z_t \, y_{B\cdot lm}}$$

$$\Rightarrow \int_0^t t = \frac{\rho_{A.L}}{MW_A} \frac{y_{B\cdot lm}}{C D_{AB} (y_{A1} - y_{A2})} z_t \, dz_t$$

$$\Rightarrow t = \frac{\rho_{A.L}}{MW_A} \frac{y_{B\cdot lm}}{C D_{AB} (y_{A1} - y_{A2})} \frac{1}{2} (z_{t1}^2 - z_{t0}^2)$$

$t = 12$ hours

ρ_{AL} : $0.858 \, g/cm^3$

$MW_A = 78 \, g/mol$

$$\begin{cases} y_{A1} = \frac{0.195}{1} \\ y_{A2} = 0 \end{cases}$$

$y_{B1} = 1 - \frac{0.195}{1}$

$y_{B2} = 1$

$P = CRT$, $P = 1atm$, $T = 308K$. $\Rightarrow$ get C

$z_{t1} = 20$. $z_{t0} = 19cm$

$\Rightarrow$ get "D_{AB}"