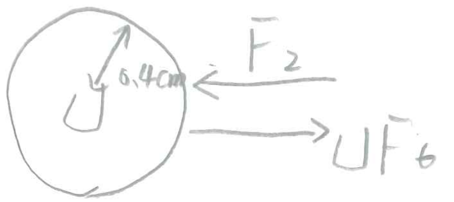
26.19



$$U_{(s)} + 3F_{2(g)} \rightarrow UF_{6(g)}$$

A B

$D_{AB} = 0.273\ cm^2/s$

Sol) Differential eq'n of mass transfer

0 S.S. ∴ No reaction in diffusion domain

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

$$\Rightarrow \vec{\nabla}\cdot\vec{N}_A = 0$$

for spherical coordinates, in r direction only

$$\frac{1}{r^2}\frac{\partial(r^2 N_{A,r})}{\partial r} + \cancel{\frac{1}{r\sin\theta}\frac{\partial(N_{A,\theta}\sin\theta)}{\partial\theta}} + \cancel{\frac{1}{r\sin\theta}\frac{\partial N_{A\phi}}{\partial\phi}} = 0$$

$$\Rightarrow \frac{\partial(r^2 N_{A,r})}{\partial r} = 0$$

$\Rightarrow r^2 N_{A,r}$ is not a function of r.

Fick's eq'n :

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

$$\because N_{B,r} = -\frac{1}{3}N_{A,r}$$

$$\Rightarrow \left(1 + \frac{2}{3}y_A\right)N_{A,r} = -CD_{AB}\frac{\partial y_A}{\partial r}$$

$$\Rightarrow N_{A \cdot r} = -CD_{AB}\left(\frac{1}{1+\frac{2}{3}y_A}\right)\frac{dy_A}{dr}$$

$$\Rightarrow r^2 N_{A \cdot r}\int_R^{\infty}\frac{1}{r^2}\,dr = -CD_{AB}\int_0^1\left(\frac{1}{1+\frac{2}{3}y_A}\right)dy_A$$

$$\Rightarrow r^2 N_{A \cdot r}\left(-\frac{1}{r}\right)\Big|_R^{\infty} = -CD_{AB}\,\frac{3}{2}\ln\left(1+\frac{2}{3}y_A\right)\Big|_0^1$$

$$\Rightarrow R^2 N_{A \cdot R}\,\frac{1}{R} = -CD_{AB}\,\frac{3}{2}\ln(1.67)$$

$$\Rightarrow \underbrace{4\pi R^2 N_{A \cdot R}}_{W_{F_2}} = 4\pi R\cdot\left(-CD_{AB}\,\frac{3}{2}\ln(1.67)\right)$$

$$\because W_{F_2} = -3\,W_{UF_6} \Rightarrow W_{UF_6} = -\frac{1}{3}W_{F_2}$$

$$\Rightarrow W_{UF_6} = -\frac{1}{3}\cdot 4\pi R\left(-CD_{AB}\,\frac{3}{2}\ln(1.67)\right)$$

$$= 2\pi R\,C\,D_{AB}\ln(1.67)$$

$R \rightarrow 0.4\ \text{cm}$

$C = \frac{P}{RT} = \frac{1.013\times 10^5\ \text{Pa}}{8.314\ \frac{\text{Pa}\cdot\text{m}^3}{\text{mol}\cdot\text{K}}\cdot 1000\ \text{K}}$

$D_{AB} \rightarrow 0.273\ \text{cm}^2/\text{s}$

$\Rightarrow$ get W_{UF_6}