29.16 (1)

| air ← N_A water | 290K. 1.013×10^5 Pa.

$P_{AG}=4\times10^3$ Pa. $C_{A,L}=4$ kg mol/m³. $H=1400\ \frac{Pa}{kg\,mol/m^3}$

$K_G=2.46\times10^{-8}$ kg mol/m²·s·Pa, $0.6\frac{1}{K_G}=\frac{1}{k_G}$

Find k_G. k_L. p_{ai}, K_L

(Sol)

(a) $$\frac{1}{K_G}=\frac{1}{k_G}+\frac{H}{k_L}$$

$$0.6\frac{1}{K_G}=\frac{1}{k_G}\Rightarrow k_G=\frac{K_G}{0.6}=\frac{2.46\times10^{-8}}{0.6}=4.1\times10^{-8}\ \frac{kg\,mol}{m^2\cdot s\cdot Pa}$$

(b) $$0.4\frac{1}{K_G}=\frac{H}{k_L}\Rightarrow k_L=\frac{H\cdot K_G}{0.4}=\frac{1400\ \frac{Pa}{kg\cdot mol/m^3}\cdot 2.46\times10^{-8}\ \frac{kg\,mol}{m^2\cdot s\cdot Pa}}{0.4}$$

$$=8.61\times10^{-5}\ m/s$$ #

(c) $$N_A=K_G(P_{AG}-P^*)=k_G(P_{AG}-P_{Ai})$$

$$=2.46\times10^{-8}(4\times10^3-1400\times4)\ \frac{kg\,mol}{m^2\cdot s}$$

$$=4.1\times10^{-8}(4\times10^3-P_{Ai})\ \frac{kg\,mol}{m^2\cdot s}$$ #

$$\Rightarrow -\frac{3.94\times10^{-5}}{4.1\times10^{-8}} = (4000 - P_{Ai})$$

$$\Rightarrow P_{Ai} = 4000 + 961 = 4961 \text{ Pa} \quad \#$$

(d) $$\frac{1}{K_L} = \frac{1}{Hk_G} + \frac{1}{k_L}$$

$$= \frac{1}{1400\times4.1\times10^{-8}} + \frac{1}{8.61\times10^{-5}}$$

$$= \frac{1}{5.75\times10^{-5}} + \frac{1}{8.61\times10^{-5}}$$

$$= 1.74\times10^{4} + 1.16\times10^{4}$$

$$= 2.9\times10^{4} \ (s/m)$$

$$\Rightarrow K_L = \frac{1}{2.9\times10^{4}} = 3.45\times10^{-5} \ m/s \quad \#$$