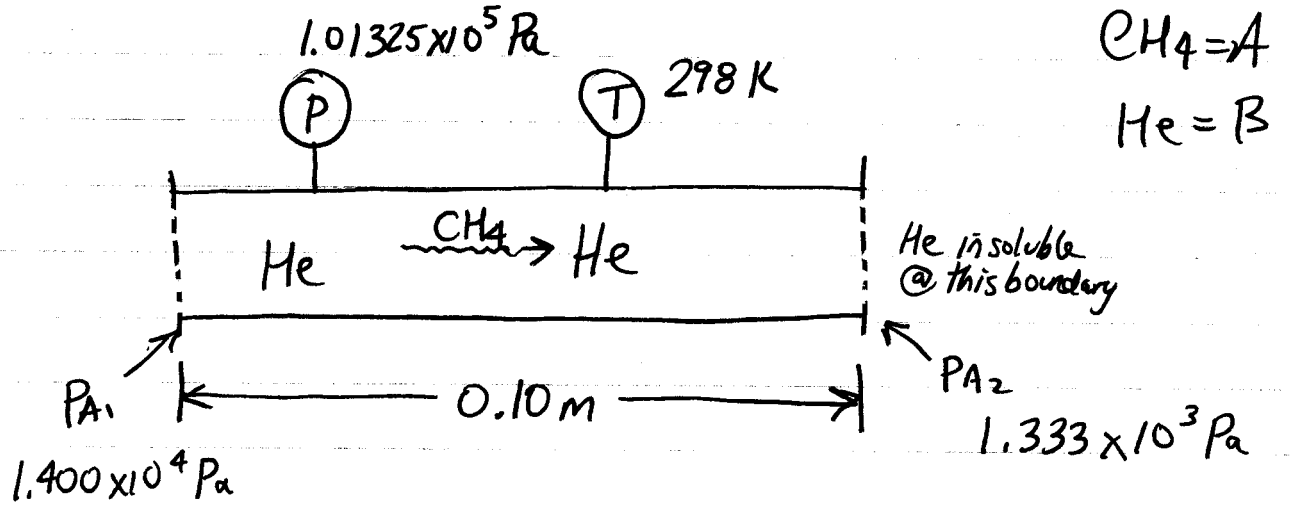
Diffusion of Methane through Nondiffusing Helium



He is non-diffusing or stagnant at a boundary by problem definition

$D_{AB} = 0.675 \times 10^{-4} \frac{m^2}{s}$ (Table 6.21 - Handout)

?? $J = [kgmol/m^2.s]$ @ steady state

$$J_A = N_A = \frac{D_{AB} P}{RT(z_2 - z_1) P_{BM}} (P_{A1} - P_{A2})$$

$$R = 8.314 \ m^3 Pa / mol\ K$$

$$P_{BM} = \frac{P_{A1} - P_{A2}}{\ln\left[\frac{(P - P_{A2})}{(P - P_{A1})}\right]}$$

(use this method more exact soln)

All in Pa units

$$P_{BM} = \frac{1.40 \times 10^4 - 1.333 \times 10^3}{\ln\left[\frac{1.01325 \times 10^5 - 1.333 \times 10^3}{1.01325 \times 10^5 - 1.400 \times 10^4}\right]} = 9.3516 \times 10^4 \ Pa$$

$$J_A = \frac{\left(0.675 \times 10^{-4} \frac{m^2}{s}\right)\left(1.01325 \times 10^5 \ Pa\right)}{\left(8.314 \frac{m^3 Pa}{mol\ K}\right)(298\ K)(0.10\ m)(9.3516 \times 10^4 Pa)} \times$$

$$\times \left(1.40 \times 10^4 - 1.333 \times 10^3\right) Pa$$

$$J_A = \left(3.739 \times 10^{-3} \frac{mol}{m^2 s}\right)\left(\frac{kg}{1000 g}\right) = \boxed{3.739 \times 10^{-6} \frac{kmol}{m^2 s}}$$