New Problems Chapter 18

18.1-3. ***Equilmolar Counter-diffusion.*** Two bulbs are attached by a small 0.01m diameter tube and filled with helium and Hydrogen gas. In bulb A, the mol fraction of Helium is y = 0.8. In bulb B, the mol fraction of Helium is y = 0.33. If the pressure and temperature of the system are constant at 1atm and 273K, and the distance between the bulbs is 0.95m, determine the molar flux of Helium $\left(\frac{mole}{m^2 \cdot hr}\right)$, using a diffusivity of D = 0.641cm2/s. Also, determine the molar and mass average velocities at bulb B.

18.1-4. ***Equilmolar Counter-diffusion.*** Air and Hydrogen gas are contained in a tube with two bulbs on the end. The total pressure is 1 atm at 0 °C. In bulb one, the partial pressure of Hydrogen is 0.95 atm and in bulb two, the partial pressure of hydrogen is 0.8 atm. Calculate flux of hydrogen in $\left(\frac{mole}{m^2 \cdot hr}\right)$ and $\left(\frac{gm}{m^2 \cdot hr}\right)$. The tube is 10cm in length.

18.2-11. ***Finding D_{AB} for a gas using the Chapman and Enskog equation.*** Calculate the given diffusion coefficients in cm2/s of the following gases.

a) Ethylene in air at 50°C and 1 atm

b) Ethylene in air at 70°C and 100 atm

c) Methylene chloride in He at 25°C and 2 atm

d) Cyanogen in hydrogen (H2) at 75°and 1 atm

18.2-12. ***Finding D_{AB} for a gas using the Fuller equation.*** Estimate the diffusivity in cm2/s of Acetaldehyde in Carbon Dioxide at 200°C and 1 atm.

18.2-13. ***Finding D_{AB} for a gas using the Fuller equation.*** Estimate the diffusivity in cm2/s of Phosgene in Air given the following conditions.

a) 10°C and 1 atm

b) 70°C and 1 atm

c) 10°C and 100 atm

18.2-14. ***Finding D_{AB} for a liquid using the Wilke - Chang equation.*** Estimate the diffusivity in cm2/s of Ethanol in water at 25°C and 1 atm.

18.2-15. ***Finding D_{AB} for a liquid using the Wilke - Chang equation.*** Estimate the diffusivity in cm2/s of butyric acid in methanol at 50°C and 1 atm.

18.2-16. ***Finding D_{AB} for a liquid with a large molecular weight in water.*** Estimate the diffusivity in cm2/s of Cytochrome C in water at 20°C and 1 atm using the following methods.

a) Stokes-Einstein equation – assume Cytochrome C is spherical in shape with a MW = 12000 Da, and $\hat{V} = 0.71\frac{cm^3}{gm}$

b) Polson equation

18.2-17. ***Simple single film mass transfer problem.*** Oxygen bubbles are dissolving in water at a rate of $2.20\times10^{-3}\,\frac{mole}{m^2\cdot s}$ if the bulk concentration of oxygen in the water is essentially zero, what is the solubility (mole/m3) of the oxygen in the water if the system's mass transfer coefficient is $k_c = 1.0\times10^{-2}\,\frac{m}{s}$.

18.2-18. ***Simple single film mass transfer problem.*** What is the flux of compound A $\left(\frac{kg}{m^2\cdot s}\right)$ dissolving in air if its molecular weight is 200 and its solubility is 0.2 mole/m3? The mass transfer coefficient of compound A dissolving in air is approximately $k_c = 1.0\times10^{-3}\,\frac{m}{s}$ and the bulk concentration of compound A in the air is essentially zero.