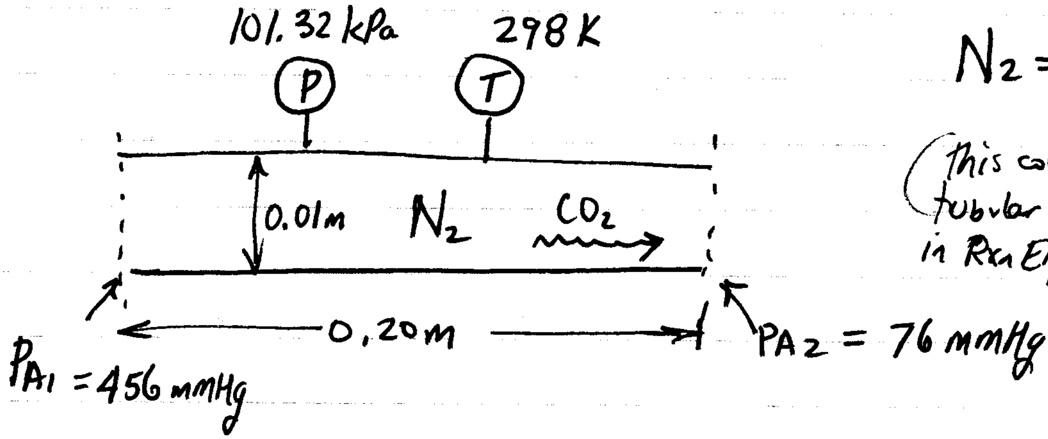
Diffusion of CO_2 in a Binary Gas Mixture

$CO_2 = A$

$N_2 = B$

(this could be a tubular reactor like in Rxn Eng. course)



Assume all pressures are absolute units unless otherwise given as gauge

$J_A = N_A$ Flux CO_2 in cgs + SI units

Equimolar Counterdiffusion

So $J_A = -J_B$; CO_2 diffuses to 'right' ; N_2 to 'left'

$$D_{AB} = D_{BA} = 0.167 \times 10^{-4} \frac{m^2}{s} = 0.167 \frac{cm^2}{s}$$ (Table 6.2-1 Handout)

$$J_A = -D_{AB}\frac{dc_A}{dz} = \frac{D_{AB}(C_{A1}-C_{A2})}{z_1-z_2}$$

in pressure units (for gases)

$$J_A = \frac{D_{AB}(p_{A1}-p_{A2})}{RT(z_2-z_1)}$$

(SI)

$$J_A = \frac{\left(0.167\times10^{-4}\,\frac{m^2}{s}\right)(456-76)\,mmHg\left(\frac{1.01325\times10^5\,Pa}{760\,mmHg}\right)}{\left(8.314\,\frac{m^3\,Pa}{mol\,K}\right)(298K)(0.20m)}$$

$$J_A = 1.7074\times10^{-3}\,\frac{mol}{m^2 s} = 1.7074\times10^{-6}\,\frac{kg\,mol\;CO_2}{m^2 s}$$

direction →

(cgs)

$$\left(1.7074\times10^{-3}\,\frac{mol}{m^2 s}\right)\left(\frac{m}{100\,cm}\right)^2 = 1.7074\times10^{-7}\,\frac{mol\;CO_2}{cm^2\cdot s}$$

direction →