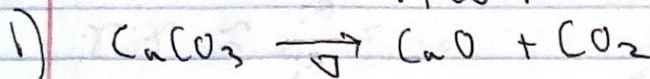


HW 12



@ $T = 298 \text{ K}$: ~~DATA~~

WATER

$$\Delta G^\circ = -394.38 - 604.03 + 1128.79 = 130.38 \frac{\text{kJ}}{\text{mol}}$$

$$\Delta H^\circ = -393.51 - 635.09 + 1206.92 = 178.32 \frac{\text{kJ}}{\text{mol}}$$

$$K_{a,R} = \exp\left(\frac{-130380}{8.314 \cdot 298}\right) = 1.44 \times 10^{-23}$$

$$K_a = K_{a,R} \exp\left(\frac{-\Delta H^\circ}{R} \left(\frac{1}{T} - \frac{1}{T_R}\right)\right) = \frac{a_2 a_3}{a_1}$$

$$a_1, a_2 = 1 \quad \therefore K_a = a_3 = \gamma_3 \frac{P}{P_0} \rightarrow P = 1$$

$$\therefore \gamma_3 = a_3 \rightarrow \gamma_3 = 1 = a_3 = K_a$$

$$\rightarrow K_a = 1 = 1.436 \times 10^{-23} \cdot \exp\left(\frac{-178320}{8.314} \left(\frac{1}{T} - \frac{1}{298}\right)\right)$$

$$\rightarrow T = 1110 \text{ K}$$

2.)
a.) $\kappa_a = \frac{a_3 a_4}{a_1 a_2}$, $a_i = \frac{\hat{e}_i}{\hat{e}_0} \approx \chi_i \gamma_i$
 $\gamma_i \approx 1 \therefore a_i \approx \chi_i$

excl: $\epsilon = 0.695$

69.5% Converted

$\chi_1 = 0.153$

$\chi_3 = 0.347 = \chi_4$

$\chi_2 = 0.153$

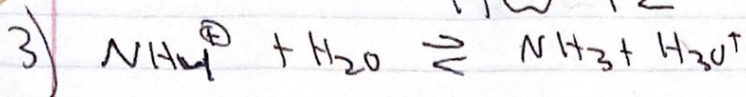
b) Repeat a $\rightarrow 3.1 \rightarrow \epsilon = 0.921 \rightarrow 92.1\%$

$\chi_1 = 0.520$

$\chi_3 = \chi_4 = 0.230$

$\chi_2 = 0.020$

HW 12



$\text{pK}_{a,B} = 4.750$, $\text{pK}_{a,A} = 9.245$

$$\text{K}_{a,A} = 9.245 = \frac{a_3 a_4}{a_1 a_2} = \frac{[\text{NH}_3][\text{H}_3\text{O}^+]}{[\text{NH}_4^+]}$$

$$C_A = 0.15 = [\text{NH}_3] + [\text{NH}_4^+] \rightarrow [\text{NH}_4^+] = C_A - [\text{NH}_3]$$

$$\rightarrow \text{K}_{a,A} = \frac{[\text{NH}_3][\text{H}_3\text{O}^+]}{C_A - [\text{NH}_3]} \rightarrow [\text{NH}_3] = \frac{C_A \text{K}_{a,A}}{\text{K}_{a,A} + [\text{H}^+]}$$

@ $\text{pH} = 7 \rightarrow [\text{H}^+] = 10^{-7} \rightarrow \frac{[\text{NH}_3]}{C_A} = \frac{10^{-9.245}}{10^{-9.245} + 10^{-7}}$

$= 5.66 \times 10^{-3} \rightarrow 0.566\% \text{ undissociated } \text{NH}_3$

$\rightarrow 99.4\% \text{ dissociated } \text{NH}_3$

@ $\text{pH} = 1 \quad \frac{[\text{NH}_3]}{C_A} = 5.69 \times 10^{-9}\% \text{ undissociated}$

$\frac{[\text{NH}_4^+]}{C_A} = 99.9\%$