CHE3173-01 EXAM III Dec. 6, 1983

Solution

I.

$\log_{10} P = 7.944 - 3000/T$

for solids at moderate pressures $a_i = 1$

$\therefore \quad K_a = f_{H_2O} = P_{H_2O}$ since $\phi_{H_2O} = 1$

$K_a = 10^{(7.944 - 3000/T)}$

$\ln K_a = 2.3026 (7.944 - 3000/T)$

$\Delta G = -RT \ln K_a$

$\Delta G = -RT [2.3026 (7.944 - 3000/T)]$

$\boxed{\Delta G = -RT(18.29 - 6907.8/T)} \quad -RT[18.29 - 6907.8/T]$

$K_a = 10^x$

$\ln K_a = \ln(10)^x$

$\ln K_a = x \ln 10$

II. a) Since $P \to I$ only two are independent

$+ \quad I \to N$

$P \to N$

b) $K_{a1} = \frac{y_I}{y_P} = 7.676 \Rightarrow y_I = 7.676\, y_P$

$K_{a2} = \frac{y_N}{y_P} = 2.165 \Rightarrow y_N = 2.165 y_P$

$y_I + y_N + y_P = 1$

$7.676 y_P + 2.165 y_P + y_P = 1$

$y_P = 0.092$

$y_N = 0.200$

$y_I = 0.708$

c) $K_{a3} = \frac{y_N}{y_I} = \frac{1}{3.545} = .28$

III. $H_2O \rightarrow H_2 + \frac{1}{2}O_2$

at 25°C

2500°K = 4040°F

$\Delta H_{R,25} = +57798$

$\Delta G_{R,25} = +54635$

$\Delta G = \Delta H - T\Delta S$

$\Delta S_{R,25} = +10.608$

Better use $C_p = a + bT + \dots$

$\Delta H_{R,2500} = +57798 + (7.7)(2500 - 298) + (\frac{1}{2})(8.5)(2500 - 298) - 10.7(2500 - 298)$

$\Delta H_{R,2500} = 60550$

$\Delta S_{R,2500} = 10.608 + [7.7 + \frac{1}{2}(8.5) - 10.7] \ln \frac{2500}{298.16}$

$\Delta S_{R,2500} = 13.27$

$\Delta G_{R,2500} = 60905 - (2500)(13.27)$

$\Delta G_{R,2500} = 27760 = -RT \ln K_A$

$K_A = 3.74 \times 10^{-3}$