UPPSALA UNIVERSITET

IAU Symposium No. 210
Modelling of Stellar Atmospheres
17 - 21 June 2002
Uppsala, Sweden

At 5000 K: Compare w/ JANAF

$$K(H_2^+) = \frac{K(H)\ K(H^+)}{K(H_2^+)} = \frac{6.442 \times 7.45 \times 10^{-11}}{2.477 \times 10^{-12}}$$

$$= 193.6$$

since 1 more product than reactant, we change to SI units

$$\rightarrow 193.6 \times P_{standard} = 1.94 \times 10^{7}\ N/m^2\ (Pa)$$

$$= 1.94 \times 10^{8}\ dyne/cm^2$$

compare with Stancil, 1994, JQRST 51, 655 → 1.98×10^{8} dyne/cm²

$$K(H_2) = \frac{K(H)\ K(H)}{K(H_2^*)} = \frac{6.442^2}{1} = 41.49$$

$$\rightarrow 4.15 \times 10^{6}\ N/m^2\ (Pa)$$

$$\rightarrow 4.15 \times 10^{7}\ dyne/cm^2$$

Compare with my calculated value → ~ 3.95×10^{6} Pa

Sauval & Tatum value: $\theta = 1.008$, ($\log \theta = 3.46 \times 10^{-3}$)

$$\log K = 11.1759 - 0.8735 \times 3.46 \times 10^{-3} - 0.7470 \times O(-6) - \theta\ldots$$

$$\sim 11.1759 - 1.008 \times 4.4781$$

$$\sim 6.66$$

$$K \sim 4.57 \times 10^{6}$$

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At 5000K

$$K(NO^+) = \frac{\overset{-1.48}{K(N)}\ \overset{-10.153}{K(O^+)}}{\underset{-7.306}{K(NO^+)}} = \frac{3.31\times10^{-2} \times 7.03\times10^{-4}}{4.94\times10^{-8}}$$

$$= \frac{2.327 \times 10^{-12}}{4.94\times10^{-8}}$$

$$= 4.71\times10^{-5}$$

$\rightarrow$ = 4.71 Pa

= 47.1 dyne/cm^2

Data from Tarafdar 1977 $\rightarrow$ log K = 1.6682

$\rightarrow$ K = 46.58 dyne/cm^2

My value K = 23.00 Pa!

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we want $K^d(H_2^+) = \dfrac{P_H P_{H^+}}{P_{H_2^+}}$

they give (JANAF) $K^J(H_2^+) = \dfrac{K^f(H_2^+)}{\text{reference state}} =$

easier example

eg. say we want OH, $O + H \rightleftharpoons OH$

in terms of reference elements would be

$$\frac{1}{2} O_2 + \frac{1}{2} H_2 \rightleftharpoons OH.$$

we want $K_d = \dfrac{P_O P_H}{P_{OH}}$

we have $K_f(O) = \dfrac{P_O}{\sqrt{P_{O_2}}}$ ← at ref state $\quad \frac{1}{2} O_2 \rightleftharpoons O$

$K_f(H) = \dfrac{P_H}{\sqrt{P_{H_2}}} \quad \frac{1}{2} H_2 \rightleftharpoons H$

$K_f(OH) = \dfrac{P_{OH}}{\sqrt{P_{H_2}}\sqrt{P_{O_2}}}$

so $K_d = \dfrac{K(O)\,K(H)}{K(OH)} = \dfrac{P_O}{\cancel{\sqrt{P_{O_2}}}} \cdot \dfrac{P_H}{\cancel{\sqrt{P_{H_2}}}} \cdot \dfrac{\cancel{\sqrt{P_{H_2}}\sqrt{P_{O_2}}}}{P_{OH}}$!