PARTITION FUNCTIONS

μB

$-\mu B$

$$Z = e^{-\mu B/\beta} + e^{+\mu B/\beta}$$

DEGENERACY

μB 6

$-\mu B$ 4

$$Z = 6e^{-\mu B/\beta} + 4e^{+\mu B/\beta}$$

DIATOMIC MOLECULES LIKE CO (ROTATIONAL ENERGY)

$E(j) = j(j+1)\varepsilon$ $\qquad E(j) = \frac{\hbar^2}{2I} j(j+1)$

DEGENERACY $2j+1$

$$Z = \sum_j (2j+1)\, e^{-j(j+1)\varepsilon/\beta}$$

$$= \int_0^\infty (2j+1)\, e^{-j(j+1)\varepsilon/\beta}\, dj$$

$$= -\frac{1}{\varepsilon/\beta}\, e^{-j(j+1)\varepsilon/\beta}\Big]_0^\infty = \frac{1}{\varepsilon/\beta} = \frac{kT}{\varepsilon}$$

$$Z = \frac{kT}{\varepsilon} = \frac{1}{\varepsilon\mu}$$

$$\bar{E} = -\frac{1}{Z}\frac{\partial Z}{\partial \mu} = -\frac{1}{Z}\left(-\frac{1}{\varepsilon\mu^2}\right) = \frac{\varepsilon/\mu}{\varepsilon\mu^2}$$

FOR O_2 $\quad Z' = \frac{Z}{2} \rightarrow \bar{\varepsilon} = \frac{1}{2}kT \qquad = \underline{kT}$

VIBRATION?

$$E = n\hbar\omega$$

$$Z = \sum_n e^{-n\hbar\omega\beta} \quad \text{IN}$$

SINCE $\quad \sum_{n=0}^{\infty} a^n = \frac{1}{1-a} \quad$ IF $|a| \ll 1$

$\hbar\omega\beta \gg 1$ I.E. AT $\hbar\omega \gg kT$ THEN

$$Z \cong \frac{1}{1 - e^{-\beta\hbar\omega}} \quad \text{OR} \quad \text{IF} \quad \frac{\hbar\omega}{kT} = \frac{\Theta_V}{T}$$

Θ_V : VIBRATIONAL TEMP

$$= \frac{1}{1 - e^{-\frac{\Theta_V}{T}}}$$

IF $\quad T \ll \Theta_V \quad Z = 1$

IF $\quad T \gg \Theta_V$

$$e^{-\Theta/T} \sim 1 - \frac{\Theta_J}{T}$$

$$z = \frac{kT}{\hbar\omega} = \frac{1}{\hbar\omega/kT} N_2 \qquad \omega = 2\times10^{14}\ /s$$

$$\Theta_V = 1570\,K$$

AT ROOM TEMP $\sim$ FROZEN

$$\chi_T = -\frac{1}{z}\frac{\partial z}{\partial P} =$$

IDEAL GAS

$$Z = \frac{1}{N!}\left(\frac{V Z_{INT}}{V_Q}\right)^N$$

$$\Downarrow$$

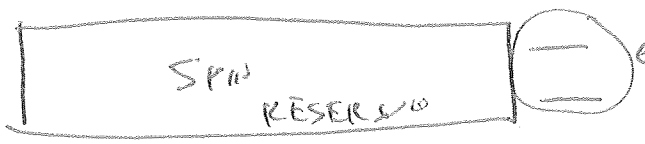
$$F = -kT \ln Z = -NkT\left[\ln V - \ln N - \ln V_Q + 1\right] + F_{INT}$$

$$S = -\left(\frac{\partial F}{\partial T}\right)$$

$$\mu = \left(\frac{\partial F}{\partial N}\right)_{T,V} = -kT \ln\left(\frac{V Z_{INT}}{N V_Q}\right) \qquad \text{IF } Z_{INT} = 1$$

$$\text{OR} \quad \boxed{\mu = -kT \ln\left(\frac{V}{N V_Q}\right)}$$

QUANTUM STATISTICS



CONSIDERED PROBABILITIES OF EACH STATE

PARTITION FUNCTION

ALLOW IN EXCHANGE

GIBBS FACTOR

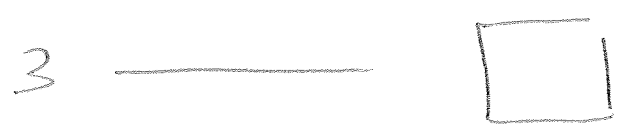
$$e^{-[E(s)-\mu N(s)]/kT}$$

$$\sum_{(s)} e^{-[E(s)-\mu N(s)]/kT}$$

$\mathcal{Z}$ = GRAND PARTITION FUNCTION

$$= \sum_{s} e^{-[E(s)-\mu N(s)]/kT}$$


0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HEMOGL

$\mu_{GAS} = 0$

$\varepsilon = 0$

$\mu_{GAS} = \mu$

$\varepsilon = \varepsilon = -0.7eV$

$(\mu - \varepsilon)\beta$

$\therefore Z = 1 + e$

$\mu_{O_2} = -0.6eV$

$\varepsilon = -0.7eV$

$\frac{0.1}{0.025}$

$Z = 1 + e^{(0.1eV)\beta} = 1 + e^{4} = 55$

$P_{ossi} = \frac{55}{1+55} \cong 100\%$

0

$\varepsilon = 0$

$\mu = 0.6eV$

$\varepsilon = -0.7eV$

$\mu' = -0.72eV$

$\varepsilon = -0.55eV$

$Z = 1 + 54 + 181$

$P = \frac{54}{1+54+81} = 23\%$