| | |
|---|---|
| P.f micro | $\Omega = \sum_{\text{microstates } s} 1$ |
| Entropy micro | $S = k_B \log \Omega$ |
| Temperature | $\frac{1}{T} = \frac{\partial S}{\partial E}\Big\vert_{V,N}$ |
| Diff. Form | $\mathrm{d}E = T\mathrm{d}S - P\mathrm{d}V + \mu\mathrm{d}N$ |
| Diff. Form | $\mathrm{d}F = -S\mathrm{d}T - P\mathrm{d}V + \mu\mathrm{d}N$ |
| Perfect gas | |
| Entropy | $S = k_B N \left(\log\left(\frac{V}{N}\left(\frac{4\pi mE}{3Nh^2}\right)^{3/2}\right) + \frac{5}{2}\right)$ |
| Energy | $E = \frac{3}{2}Nk_BT$ |
| Calorific Capacity | $C_V = \frac{3}{2}Nk_B$ |
| Pressure | $\frac{N}{V}k_BT$ |
| Chemical potential | $\mu = k_BT\log\left(N\lambda^3\right)$ |
| De Broglie Wavelength | $\lambda = \sqrt{\frac{h^2}{2\pi mk_BT}}$ |
| Canonical Partition Function | $Z = \frac{1}{N!}\int \mathrm{d}\Gamma e^{-\beta\mathcal{H}(\Gamma)}$ |
| Energy | $E = -\frac{\partial}{\partial\beta}\log Z$ |
| Free energy | $F = E - TS$ and $F = -k_BT\log Z$ |
| Calorific Capacity | $\langle(E-\bar{E})^2\rangle = k_BT^2C_V$ |
| Grand Canonical Partition Function | $\Theta = \sum_{\text{microstates } s} e^{-\beta(E_s-\mu N_s)} = \sum_N e^{\beta\mu N}Z_N$ |
| Grand Potential | $\Omega = -k_BT\log\Theta$ |
| Free energy | $\Omega = F - \mu N$ |
| Gibbs Duhem | $\Omega F - \mu N = -pV$ |
| Free enthalpy | $G = F + PV = \mu N$ so $\mu = \frac{G}{N}$ |
| Diff. Enthalpy | $\mathrm{d}G = N\mathrm{d}\mu + \mu\mathrm{d}N$ |
| **Useful Gibbs Duhem** | $N\mathrm{d}\mu = -S\mathrm{d}T + V\mathrm{d}P$ |
| Quantum Grand Can. P.F. | $\ln\Theta = -\tau\sum_k \ln\left(1-\tau e^{\beta(\mu-\varepsilon_k)}\right)$, $\tau = 1$ bosons, $\tau = -1$ fermions |