

P.f micro	$\Omega = \sum_{\text{microstates } s} 1$
Entropy micro	$S = k_B \log \Omega$
Temperature	$\frac{1}{T} = \left. \frac{\partial S}{\partial E} \right _{V,N}$
Diff. Form	$dE = TdS - PdV + \mu dN$
Diff. Form	$dF = -SdT - PdV + \mu dN$
Perfect gas	
Entropy	$S = k_B N \left(\log \left(\frac{V}{N} \left(\frac{4\pi m E}{3N h^2} \right)^{3/2} \right) + \frac{5}{2} \right)$
Energy	$E = \frac{3}{2} N k_B T$
Calorific Capacity	$C_V = \frac{3}{2} N k_B$
Pressure	$\frac{N}{V} k_B T$
Chemical potential	$\mu = k_B T \log(N \lambda^3)$
De Broglie Wavelength	$\lambda = \sqrt{\frac{h^2}{2\pi m k_B T}}$
Canonical Partition Function	$Z = \frac{1}{N!} \int d\Gamma e^{-\beta \mathcal{H}(\Gamma)}$
Energy	$E = -\frac{\partial}{\partial \beta} \log Z$
Free energy	$F = E - TS$ and $F = -k_B T \log Z$
Calorific Capacity	$\langle (E - \bar{E})^2 \rangle = k_B T^2 C_V$
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	$\Omega = -k_B T \log \Theta$
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	$dG = N d\mu + \mu dN$
Useful Gibbs Duhem	$N d\mu = -S dT + V dP$
Quantum Grand Can. P.F.	$\ln \Theta = -\tau \sum_k \ln(1 - \tau e^{\beta(\mu - \varepsilon_k)}), \tau = 1 \text{ bosons}, \tau = -1 \text{ fermions}$