FORMULARI

$$\Gamma(E)=\int_{H\le E}\mathrm{d}\boldsymbol{q}\mathrm{d}\boldsymbol{p},\quad \Omega(E)=\frac{\partial\Gamma(E)}{\partial E}$$

$$\mathrm{d}U=T\mathrm{d}S-P\mathrm{d}V+\sum_i\mu_i\mathrm{d}N_i,\qquad \left(\frac{\partial U}{\partial V}\right)_T=T\left(\frac{\partial P}{\partial T}\right)_V-P,\qquad C_P-C_V=\frac{TV\alpha^2}{\kappa_T},$$

$$T\mathrm{d}S=C_V\mathrm{d}T+\frac{T\alpha}{\kappa_T}\mathrm{d}V,\qquad T\mathrm{d}S=C_P\mathrm{d}T-T\alpha V\mathrm{d}P,\qquad T\mathrm{d}S=\frac{C_V\kappa_T}{\alpha}\mathrm{d}P+\frac{C_p}{\alpha V}\mathrm{d}V$$

$$U=TS-PV+\sum_i\mu_iN_i,\qquad F=U-TS,\qquad H=U+PV,\qquad G=U-TS+PV,\qquad \Phi=-PV$$

$$\mathrm{d}H=T\mathrm{d}S+V\mathrm{d}P+\mu\mathrm{d}N,\ \mathrm{d}F=-P\mathrm{d}V-S\mathrm{d}T+\mu\mathrm{d}N,\ \ \mathrm{d}G=-S\mathrm{d}T+V\mathrm{d}P+\mu\mathrm{d}N$$

$$\mathrm{d}\Phi=-P\mathrm{d}V-S\mathrm{d}T-N\mathrm{d}\mu,$$

$$-\left(\frac{\partial P}{\partial S}\right)_V=\left(\frac{\partial T}{\partial V}\right)_S,\qquad \left(\frac{\partial V}{\partial S}\right)_P=\left(\frac{\partial T}{\partial P}\right)_S,\qquad \alpha=\beta P\kappa_T,\qquad \left(\frac{\partial P}{\partial T}\right)_V=\left(\frac{\partial S}{\partial V}\right)_T,\qquad \left(\frac{\partial V}{\partial T}\right)_P=-\left(\frac{\partial S}{\partial P}\right)_T,$$

Conjunt microcanònic: $S=k_B\ln\Omega,\quad \dfrac{1}{T}=k_B\left(\dfrac{\partial\ln\Omega}{\partial U}\right)_{V,N},\quad \dfrac{P}{T}=k_B\left(\dfrac{\partial\ln\Omega}{\partial V}\right)_{U,N},\quad \dfrac{\mu}{T}=-k_B\left(\dfrac{\partial\ln\Omega}{\partial N}\right)_{V,U}$

Conjunt canònic: $F=-k_BT\ln Z,\quad U=\langle E\rangle=-\dfrac{\partial\ln Z}{\partial\beta},\quad \left\langle(\Delta E)^2\right\rangle=\dfrac{\partial^2\ln Z}{\partial\beta^2}=k_BT^2C_V,\quad P=k_BT\dfrac{\partial\ln Z}{\partial V},$

$$Z=\frac{1}{h^fN!}\int e^{-\beta H}\mathrm{d}\boldsymbol{q}\mathrm{d}\boldsymbol{p},\quad \left\langle E^2\right\rangle=\frac{1}{Z}\frac{\partial^2Z}{\partial\beta^2},\quad \rho(\boldsymbol{q},\boldsymbol{p})=\frac{e^{-\beta H(\boldsymbol{q},\boldsymbol{p})}}{\int e^{-\beta H(\boldsymbol{q},\boldsymbol{p})}\mathrm{d}\boldsymbol{q}\mathrm{d}\boldsymbol{p}},\quad S=-k_B\sum_s\rho_s\ln\rho_s$$

$$\rho_s=\frac{e^{-\beta E_s}}{Z},\quad Z=\int g(\varepsilon)e^{-\beta\varepsilon}d\varepsilon,\qquad Z=\sum_s e^{-\beta E_s},\quad Z=\sum_{E_R}g(E_R)e^{-\beta E_R},\qquad \left\langle x_i\frac{\partial H}{\partial x_j}\right\rangle=k_BT\delta_{ij}$$

Conjunt macrocanònic: $Q(T,V,\mu)=\displaystyle\sum_{N=0}^{\infty}z^NZ(T,V,N),\qquad \Phi=-\frac{1}{\beta}\ln Q,\quad U=\langle E\rangle=-\left(\frac{\partial\ln Q}{\partial\beta}\right)_{\beta\mu},$

$$\langle N\rangle=\frac{\partial\ln Q}{\partial(\beta\mu)}=z\frac{\partial\ln Q}{\partial z},\qquad \left\langle(\Delta N)^2\right\rangle=\frac{N^2}{V}k_BT\kappa_T,\quad z=e^{\beta\mu},\quad S=-\left(\frac{\partial\Phi}{\partial T}\right)_{V,\mu}\quad N=-\left(\frac{\partial\Phi}{\partial\mu}\right)_{T,V}$$

$$\left(\frac{\mathrm{d}p}{\mathrm{d}T}\right)_{cc}=\frac{s^{(1)}-s^{(2)}}{v^{(1)}-v^{(2)}}=\frac{l}{T\Delta v},$$

$$Pv=RT\left[1+\tilde{B}_2(T)P+\tilde{B}_3(T)P^2+...\right],\quad Pv=RT\left[1+B_2(T)\frac{1}{v}+B_3(T)\frac{1}{v^2}+...\right],$$

$$\tilde{B}_2(T)=\frac{B_2(T)}{RT},\quad \tilde{B}_3(T)=\frac{B_3-B_2^2}{R^2T^2},\ \ln Z=\ln Z^{id}-\frac{N^2B_2(T)}{V}$$

$$B_2(T)=2\pi\int_0^\infty r^2\left[1-e^{-\beta\phi(r)}\right]\mathrm{d}r,\quad \mu_J=-\frac{1}{c_v}\left[T\left(\frac{\partial P}{\partial T}\right)_v-P\right],\qquad \mu_{JK}=\frac{1}{c_p}\left[T\left(\frac{\partial v}{\partial T}\right)_p-v\right],$$

Sistemes magnètics: Hamiltonià: $H=-\mathcal{H}M,\ M=N\mu_0\displaystyle\sum_i\sigma_i,\ \chi=\left(\frac{\partial M}{\partial\mathcal{H}}\right)_T$

Camp inclòs: $\mathrm{d}U=T\mathrm{d}S-\mu_0M\mathrm{d}\mathcal{H},\ F=U-TS\ \mathrm{d}F=-S\mathrm{d}T-\mu_0M\mathrm{d}\mathcal{H},$ Camp no inclòs: $\mathrm{d}U=T\mathrm{d}S+\mu_0\mathcal{H}\mathrm{d}M$

$$\int_0^\infty x^ne^{-ax}dx=\frac{\Gamma(n+1)}{a^{n+1}},\qquad \int_{-\infty}^{\infty}e^{-ax^2}dx=\sqrt{\pi/a},\qquad \frac{1}{1-x}=\sum_{n=0}^{\infty}x^n,\qquad e^x=\sum_{n=0}^{\infty}\frac{x^n}{n!}$$