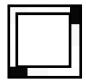
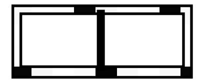
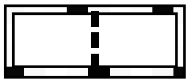
| | MICROCANONICAL | CANONICAL | GRAND CANONICAL |
|---|---|---|---|
| |  |  |  |
| ENSEMBLE: | MICROCANONICAL | CANONICAL | GRAND CANONICAL |
| CONSTRAINTS: | ISOLATED | ENERGY EXCHANGE | ENERGY AND PARTICLE EXCHANGE |
| SPECIFY: | U,V,N | $\tau$,V,N | $\tau$,V,$\mu$ |
| CALCULATE: | g(U,V,N) (from quantum mechanics)<br>$\sigma=\log(g)$<br>$1/\tau=(\partial\sigma/\partial U)_{V,N}$ | $Z=\sum_s e^{-\varepsilon_s/\tau}$<br>$F=-\tau\log Z$<br>$\sigma=-(\partial F/\partial\tau)_{V,N}$  $P=-(\partial F/\partial V)_{\tau,N}$<br>$U=F+\tau\sigma$ | $\mathcal{Z}=\sum_N e^{\left(\frac{N\mu}{\tau}\right)}\sum_s e^{\left(\frac{-\varepsilon_s(N)}{\tau}\right)}$<br>$\Omega=F-\mu N=-\tau\log\mathcal{Z}$<br>$\sigma=-(\partial\Omega/\partial\tau)_{V,\mu}$  $P=-(\partial\Omega/\partial V)_{\tau,N}$<br>$N=-(\partial\Omega/\partial\mu)_{V,\tau}$<br>$F=\Omega+\mu N$<br>$U=\Omega+\mu N+\tau\sigma$ |
| PROBABILITY: | $P_s=1/g$ | $P_s=\frac{e^{-\varepsilon_s/\tau}}{Z}$ | $P_s=\frac{e^{\left(\frac{N\mu-\varepsilon_s(N)}{\tau}\right)}}{\mathcal{Z}}$ |
| APPLICATIONS: | Fundamentals, deriving other ensembles, physical insight, two-level systems. | Systems where Z can be evaluated: two or multi-level,harmonic oscillator, one particle in a box, photons,... | Treating an *individual* quantum state (orbital) as an open system; calculate f=<N> for each state, where<br>$f(\varepsilon)=\frac{1}{e^{(\varepsilon-\mu)/\tau}\pm 1}$<br>then summing over all states to get total N.  Classical, Bose (-), and Fermi (+) gases... |