$$= \int d^{3N} q \int d^{3N} p$$

$H(q,p)\ \Sigma \ldots \quad H(q_i, p_i)$

$$= \underbrace{V^N}_{\text{volumen real}} \int_{H(p_1) \leq E} d^{3N} p$$

La integral restante es una esfera 3N dimensional de radio

$$\sqrt{2mE}$$

$$\sum \frac{p_i^2}{2m} \leq E$$

$$x^2 + y^2 + z^2 = R^2$$

$$p \leq \sqrt{2mE} \qquad R = \sqrt{}$$

$$V_N(R) = \frac{R^N (\pi)^{\frac{N}{2}}}{\frac{N}{2}\Gamma\left(\frac{N}{2}\right)} \leftarrow V_M = R^M C_M$$

$N \to 3N$

$$\omega(E,V,N) = \frac{V^N (2mE)^{3N/2} \pi^{3N/2}}{\frac{3N}{2}\Gamma\left[\frac{3N}{2}\right]}$$

$$\Omega = \frac{\partial \omega}{\partial E}\frac{1}{V_0} = \frac{1}{V_0}\frac{\partial}{\partial E}(\ldots) = \frac{1}{V_0}\,\frac{V^N \pi^{3N/2}\, 2m^{3N/2}\, E^{\frac{3N}{2}-1}}{\Gamma\left[\frac{3N}{2}\right]}$$

$$S(E,V,N) = k \ln(\Omega)$$

$N >> 1$ $\quad E^{\frac{3N}{2}-1} \approx E^{\frac{3N}{2}}$ $\quad$ y el $\ln(\Gamma(n)) \approx n\ln(n) - n$

se aproxima

$$S(E,V,N) = N k \left\{ \frac{3}{2} + \ln\left[\frac{V}{V'}\left(\frac{4\pi m E}{3N}\right)^{3/2}\right] \right\}$$

La funcion no considera el lado iguales, es decir que los moleculas (N) sean iguales entre si.

$$S = k_b \ln\left(\frac{1}{\nabla_\phi} \frac{V^N \pi^{3N/2} \, 2m^{3N/2} \, E^{3N/2}}{\Gamma\left[\frac{3N}{2}\right]}\right)$$

$$= k N \ln\left(V (2m\pi)^{3/2} E^{3/2}\right) - k \ln\left(\nabla_\phi \, \Gamma\left(\frac{3N}{2}\right)\right)$$

$$\ln \Gamma(n) \approx n \ln n - n \qquad - k\left(\ln \nabla_\phi + \ln \Gamma\left(\frac{3N}{2}\right)\right)$$

$$= k N \ln\left(V (2m\pi)^{3/2} E^{3/2}\right) - k\left(\ln \nabla_\phi + \frac{3N}{2} \ln\left(\frac{3N}{2}\right) - \frac{3N}{2}\right)$$

$$k N \left(\ln\left(V (2m\pi)^{3/2}\right) - \right.$$

$$k N \left(\ln V + \frac{3}{2} \ln(2\pi E)\right) - k\left(\ln \nabla_\phi + \frac{3N}{2} \ln\left(\frac{3N}{2}\right) - \frac{3N}{2}\right)$$

$$k N \left(\ln(V) + \frac{3}{2} \ln\left(\frac{2\pi E(2)}{3N}\right)\right) - k\left(\ln \nabla_\phi - \frac{3N}{2}\right)$$

$$k N \left(\ln(V) + \frac{3}{2} \ln\left(\frac{2\pi E(2)}{3N}\right) + \frac{3}{2}\right) - k \ln \nabla_\phi$$

$$k N \left(\ln\left(V \left(\frac{2\pi E(2)}{3N}\right)^{3/2}\right) + \frac{3}{2}\right) + N k \ln\left(\nabla^{\frac{1}{N}}\right) \qquad \nabla' = \nabla^{1/N}$$

$$\nabla_\phi^{-N}$$

$$\boxed{= k N \left(\ln\left(\frac{1}{\nabla'} \left(\frac{4\pi E}{3N}\right)^{3/2}\right) + 3/2\right)}$$

$$S = k \ln(\Omega_1)$$

$$S = k \ln\left(\frac{\Gamma(E)}{\Gamma_\phi}\frac{1}{N!}\right) = k \ln\left(\frac{1}{\Gamma_\phi}\frac{V^N \pi^{3N/2} 2m^{3N/2} E^{\frac{3N}{2}}}{\Gamma\left(\frac{3N}{2}\right)}\frac{1}{N!}\right)$$

$$-k \ln(\Gamma_\phi) + kN \ln\left(V(\pi 2mE)^{3/2}\right) - k\left(\frac{3N}{2}\ln\left(\frac{3N}{2}\right) - \frac{3N}{2}\right) - k \ln(N!)$$

$$-k\left(\ln \Gamma_\phi - N\ln\left(V(\pi 2mE)^{3/2}\right) + \frac{3N}{2}\left(\ln\left(\frac{3N}{2}\right) - 1\right) + \underbrace{\ln(N!)}_{+(N\ln N - N)}\right)$$

$$-kN\left[-\ln\left(V(\pi 2mE)^{3/2}\right) + \ln\left(\left(\frac{3N}{2}\right)^{3/2}\right) - \frac{3}{2} + \left(\ln(N) - 1\right)\right]$$

$$+N\ln(N) - N$$

$$\boxed{+kN\left[+\frac{5}{2} + \ln\left(\frac{V}{\Gamma'}\left(\frac{4\pi m E}{3N}\right)^{3/2}\frac{1}{N}\right)\right]}$$

(5) $S = K_B \ln \Omega$ $\quad \Omega$

cuando $\Omega = \dfrac{\nabla(E)}{\nabla \phi}$

⑥ $dU = T\,dS - P\,dV + \mu\,dN$

$S = K_B \ln(\Omega)$

$$S = KN\left[\frac{5}{2} + \ln\left(\frac{V}{V'}\left(\frac{4\pi\, mE}{3N}\right)^{3/2}\frac{1}{N}\right)\right]$$

$N \gg 2$

$$\frac{\partial S}{\partial E} = \frac{KN\,\frac{3}{2}E^{1/2}}{E^{3/2}} = \frac{3}{2}K_B N E^{-1} = \boxed{\frac{3K_BN}{2E}}$$

$$\frac{\partial S}{\partial V} = \frac{K_BN\left[\cancel{\left(\frac{4\pi\, mE}{3N}\right)^{3/2}}\frac{1}{N}\frac{1}{V_\phi}\right]}{(\%\ldots)\,V} = \frac{K_BN}{V}$$

$$dS = \frac{dU}{T} + \frac{P\,dV}{T} - \frac{\mu}{T}dN$$

$$\frac{3K_BN}{2E} = \frac{1}{T} \qquad \frac{K_BN}{V} = \frac{P}{T}$$

$$\boxed{E = \frac{3}{2}K_BNT} \qquad \boxed{PV = K_BNT}$$