[2008: 2.1]

AOS

? $U=0$

$F=-TS$

$f=-\frac{\partial F}{\partial x}$?

$$x = a(N_{\rightarrow}-N_{\leftarrow}) = 2N_{\rightarrow}-N$$

$$\Omega(x) = \frac{N!}{N_{\rightarrow}!\,(N-N_{\rightarrow}!)} = \frac{N!}{\left[\frac{1}{2}\left(N+\frac{x}{a}\right)\right]!\,\left[\frac{1}{2}\left(N-\frac{x}{a}\right)\right]!}$$

$$\frac{S(x)}{k_B} = \ln\Omega = N\ln N - N_{\rightarrow}\ln N_{\rightarrow} - (N-N_{\rightarrow})!\ln(N-N_{\rightarrow})$$

$$= N\ln N - \frac{1}{2}\left(N+\frac{x}{a}\right)\ln\left(\frac{N+\frac{x}{a}}{2}\right) + \frac{1}{2}\left(N-\frac{x}{a}\right)\ln\left(\frac{N-\frac{x}{a}}{2}\right)$$

$$dU = TdS - fdx = 0$$

שיווי משקל

$$\downarrow$$

$$\frac{dS}{dx} = \frac{f}{T} \rightarrow f = T\frac{dS}{dx}$$

$$\rightarrow f = -T\left[\frac{1}{2a}\ln\left[\frac{1}{2}\left(N+\frac{x}{a}\right)\right] + 1 - \frac{1}{2a}\ln\left(\frac{1}{2}\left(N-\frac{x}{a}\right)\right) - 1\right]$$

$$\boxed{f(x) = \frac{-T}{2a}\ln\left(\frac{N+\frac{x}{a}}{N-\frac{x}{a}}\right)}$$

$$N+\frac{x}{a} > N-\frac{x}{a} \longrightarrow \ln(\;) \geq 0$$

$$\rightarrow f \propto -T < 0$$

כשהטמפ' עולה, הכוח יותר מכווץ.

$$f(x) = \frac{-kT}{2a}\ln\left(\frac{1+\frac{x}{Na}}{1-\frac{x}{Na}}\right) \approx \frac{-kT}{2a}\left[\frac{x}{Na}+\frac{x}{Na}\right]$$

כמו קפיץ (for $\frac{x}{Na} \ll 1$)

$$= \frac{-kT}{Na^2}x$$

$$f \propto -x$$

חוק הוק!