

3.39)

$$S = Nk \left[ \ln \left( \frac{A}{N} \frac{2\pi m U}{Nh^2} \right) + 2 \right]$$

$$\frac{1}{T} = \left( \frac{\partial S}{\partial U} \right)_{N,A} = Nk \cdot \frac{1}{U} \Rightarrow U = NkT \text{ as expected.}$$

$$P = T \left( \frac{\partial S}{\partial A} \right)_{N,U} = T \cdot \frac{Nk}{A} \Rightarrow PA = NkT = nRT \text{ (Ideal gas Law).}$$

$$\begin{aligned} \mu &\equiv -T \left( \frac{\partial S}{\partial N} \right)_{U,A} = -T \cdot \left[ Nk \left( -\frac{2}{N} \right) + \frac{S}{N} \right] \\ &= -T \cdot k \ln \left( \frac{A}{N} \frac{2\pi m U}{Nh^2} \right) \end{aligned}$$

[Not too different from when  $A \rightarrow V$ ]