

6-45)

$$\begin{aligned} (a) \quad S &\equiv -\left(\frac{\partial F}{\partial T}\right)_{N,V} = -\partial_T \left\{ -NkT \left[\ln \left(\frac{V}{NV_0} \right) + 1 \right] + F_{int} \right\} \\ &= Nk \left[\ln \left(\frac{V}{NV_0} \right) + 1 \right] + NkT \partial_T \ln \left(\frac{2\pi mkT}{h} \right)^{3/2} - \partial_T F_{int} \\ &= Nk \left[\ln \left(\frac{V}{NV_0} \right) + \frac{5}{2} \right] - \partial_T F_{int} . \end{aligned}$$

$$\begin{aligned} (b) \quad \mu &\equiv \left(\frac{\partial F}{\partial N}\right)_{T,V} = \partial_N \left\{ -NkT \left(\ln \left(\frac{V}{NV_0} \right) + 1 \right) + F_{int} \right\} \\ &= -kT \left(\ln \left(\frac{V}{NV_0} \right) + 1 \right) + kT + \partial_N F_{int} \end{aligned}$$

$$\text{But } F_{int} = -NkT \ln Z_{int} .$$

$$\begin{aligned} \text{Thus, } \mu &= -kT \ln \left(\frac{V}{NV_0} \right) - kT \ln Z_{int} \\ &= -kT \ln \left(\frac{V Z_{int}}{NV_0} \right) . \end{aligned}$$