

Problem #13 Spring 2002

$$Z = \frac{1}{N!} \left(\frac{V}{(2\pi\hbar^2/mkT)^{3/2}} \right)^N \left(e^{-\beta E} + e^{-\beta(E+\Delta)} \right)^N$$

or

$$Z = \frac{1}{N!} \left(\frac{V}{(2\pi\hbar^2/mkT)^{3/2}} \right)^N \left(e^{+\beta\Delta/2} + e^{-\beta\Delta/2} \right)^N$$

or

$$Z = \frac{1}{N!} \left(\frac{V}{(2\pi\hbar^2/mkT)^{3/2}} \right)^N \left(1 + e^{-\beta\Delta} \right)^N$$

$$F = -kT \ln Z, \quad F = \bar{E} - TS$$

$$S = k(\ln Z + \beta \bar{E})$$

$$\mu = \left(\frac{\partial F}{\partial N} \right) = -kT \frac{\partial \ln Z}{\partial N}$$

$$\bar{E} = - \frac{\partial}{\partial \beta} \ln Z$$

$$P = \frac{1}{\beta} \frac{\partial}{\partial V} \ln Z$$

$$C_P = \left(\frac{\partial \bar{E}}{\partial T} \right)_P$$