Formulae for Exam #2

$$k = 1.381 \cdot 10^{-23}\ \text{J/K} = 8.617 \cdot 10^{-5}\ \text{eV/K}$$

$$h = 6.626 \cdot 10^{-34}\ \text{Js} = 4.136 \cdot 10^{-15}\ \text{eVs}$$

$$N_\text{A} = 6.022 \cdot 10^{23}$$

$$\Delta U = Q + W_\text{on} \qquad \text{where} \qquad W_\text{on} = -\int p\text{d}V$$

$$pV = NkT \qquad pV^\gamma = \text{const., where } \gamma = (f+2)/f$$

$$U = \tfrac{f}{2}NkT \qquad \tfrac{1}{2}kT \text{ for each quadratic degree of freedom}$$

$$\Omega = \left(\begin{array}{c} q+N-1 \\ q \end{array} \right) \qquad \Omega = \left(\begin{array}{c} N \\ n \end{array} \right) = \tfrac{N!}{n!(N-n)!}$$

$$\ln N! \approx N \ln N - N \qquad \ln(1+x) \approx x$$

$$S = k \ln \Omega$$

$$S = Nk \left[\ln \left(\tfrac{V}{N} \left(\tfrac{4\pi m U}{3Nh^2} \right)^{3/2} \right) + \tfrac{5}{2} \right]$$

$$C_V = T \left(\tfrac{\partial S}{\partial T} \right)_{V,N} \qquad C_p = T \left(\tfrac{\partial S}{\partial T} \right)_{p,N} \qquad C_V = \left(\tfrac{\partial U}{\partial T} \right)_{V,N} \qquad \Delta S = \int \tfrac{C\text{d}T}{T}$$

$$dU = TdS - pdV + \mu dN$$

$$H = U + pV \qquad F = U - TS \qquad G = U - TS + pV$$

$$S = k \ln \Omega$$

$$p = \tfrac{NkT}{(V - bN)} - a\tfrac{N^2}{V^2}$$

$$\epsilon = \tfrac{W}{Q_\text{h}} = \tfrac{W_\text{by}}{Q_\text{h}} \qquad \text{COP} = \tfrac{Q_\text{c}}{W}$$

$$G = \mu N$$

$$\tfrac{\text{d}p}{\text{d}T} = \tfrac{\Delta S}{\Delta V} = \tfrac{L}{T\Delta V}$$

$$\tanh(x) = \tfrac{\text{e}^x - \text{e}^{-x}}{\text{e}^x + \text{e}^{-x}} \qquad \tfrac{\text{d}\tanh(x)}{\text{d}x} = \tfrac{1}{\cosh^2(x)}$$