PHYSICS 140A MIDTERM 1 FALL QUARTER 2010
PROF. HIRSCH OCTOBER 15

Formulas:

First law $\Delta U = Q + W$; $C_V = \frac{\partial U}{\partial T})_V$; $H = U + PV$; $C_P = \frac{\partial H}{\partial T})_P$

$k = 1.381 \times 10^{-23} J/K$, $N_A = 6.02 \times 10^{23}$, $R = 8.31 \text{J/(mol}^{\text{o}}K)$

Ideal gas : $PV = NkT$ $U = N\frac{f}{2}kT$ $W = -P\Delta V$, $W = -\int PdV$; $C_P = C_V + Nk$

adiabatic process: $PV^{\gamma} = const.$, $\gamma = (f+2)/f$

$S = k\ln\Omega$; $\frac{1}{T} = \frac{\partial S}{\partial U})_V$; $dS = \frac{Q}{T} = \frac{C_V dT}{T}$ (constant volume)

Ideal gas (monoatomic) : $\Omega_{\text{N}} = C_N V^N U^{3N/2}/N!$

Stirling's approximation : $n! = n^n e^{-n}\sqrt{2\pi n}$

Einstein solid : $\Omega(N,q) = \frac{(q+N-1)!}{q!(N-1)!}$ $\sim (\frac{eq}{N})^N$ for q >> N

Two - state system : $\Omega = \frac{N!}{N_{\uparrow}!N_{\downarrow}!}$

Paramagnetism : $\text{M} = \text{N}\mu \tanh(\mu\text{B/kT})$, $U = -MB$, $M = \mu(N_{\uparrow} - N_{\downarrow})$