SUMMARY Exam I

- Ideal Gas : $pV = NkT = \nu RT$
- Equipartition Thm : $U_{therm} = N\frac{f}{2}kT$, microsc. picture
- 1st Law of Th. : $\Delta U = Q + W$

  $W = -\int p\,dV$ isotherm, adiab., pV diag. (be able to derive W)
- heat capacities : $C = \frac{Q}{\Delta T}$ $C_V = \left(\frac{\partial U}{\partial T}\right)_V$ $C_p = \left(\frac{\partial H}{\partial T}\right)_p$
- [heat conduction , diffusion, ~~heat conduction~~]
- multiplicities : 2-State System, Einstein Solid, Ideal Gas

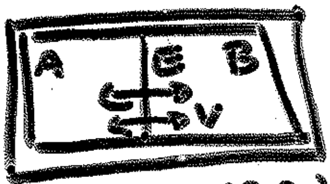
  $\Omega_{tot} = \Omega_A \Omega_B$, Stirling, $\ln(1+x) \approx x$

  width
- entropy $S = k \ln \Omega$

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

  ΔS
- 2nd Law of Thermodynamics

SUMMARY Exam 2



$$\frac{1}{T}=\left(\frac{\partial S}{\partial U}\right)_{V,N} \quad p=T\left(\frac{\partial S}{\partial V}\right)_{U,N} \quad \mu=-T\left(\frac{\partial S}{\partial N}\right)_{U,V}$$

$$\Omega \rightarrow S \rightarrow S(U) \rightarrow T \rightarrow U(T) \rightarrow C_v$$

Einstein Solid, paramagn., polymer, 2 ideal gas

$$\Delta S=\int \frac{Q}{T}=\int \frac{C_{v,p}\,dT}{T}$$

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

Legendre Transf., F min. etc., Maxwell relations, reading of ΔG etc. table for chem. reactions

heat engine $\varepsilon = \frac{W}{Q_h}$ refridg. COP $= \frac{Q_c}{W}$

extensive & intensive variables $G=\mu N$

phase transitions

- G min. $\rightarrow$ ph. tr.

- Claus. Clapeyron $\frac{dp}{dT}=\frac{\Delta S}{\Delta V}=\frac{L}{T\Delta V}$
- van der Waals model, p_c etc.
- phase separation for nonideal mixture
- phase sep. for miscible mixture

SUMMARY EXAM 3

BOLTZMANN STATISTICS

derive $P_{\text{Boltzmann St.}}$ $P_{\text{Gibbs St.}} = \dfrac{e^{-E/kT}}{Z}$

Averages I II III IV V

$$\overline{X} = \frac{1}{Z}\sum_s X(s)\, e^{-E(s)/kT}$$

$$\overline{E} = -\frac{1}{Z}\frac{\partial Z}{\partial \beta}$$

- Fluctuation Dissipation Thm.
- Equipartition Thm proof
- Ising Model

Maxwell Distribution derive $D(v)$, $\bar{v}$ etc.

$$F = -kT\ln Z \longrightarrow S, p, \mu$$

$$Z = Z_1 \cdot \ldots \cdot Z_N \left(\frac{1}{N!}\right)$$

GIBBS STATISTICS

$$P(s) = \frac{1}{Z} e^{-(E(s)-\mu N(s))/kT}$$ derive

Quantum Statistics $\bar{n}_{FD}$, $\bar{n}_{BE}$

degenerate fermi gas $\lambda_n, p_n, E_n \Rightarrow \ldots U_{tot}$

blackbody radiation — " —