Study Guide for Second Midterm Test, Phys 404, Spring 2007

ver. 0.9

Homework problems

Heat engines, Carnot cycles, refrigerators, efficiency, coefficient of performance

pV diagrams, inc. Otto and Diesel cycles

Change in internal energy, change in temperature, heat, work, during "simple" processes: isobaric ($\Delta p = 0$), isochoric ($\Delta V = 0 = W$), isothermal ($\Delta U = \Delta T = 0$), adiabatic ($Q = 0$).
Along an isobar, $W_{by} = p(V_f - V_i)$; along an isotherm $W_{by} = Nk_BT \ln(V_f/V_i)$
Along an adiabat pV^{γ} is constant, as is (using the ideal gas law) $TV^{\gamma-1}$. Note $\gamma = (f+2)/f$

Helmholtz and Gibbs free energies F = U – TS G = U + pV -TS

Electrolysis, fuel cells, batteries

Thermodynamic identities: dF = –S dT – p dV +μ dN dG = –S dT + V dp +μ dN & uses

Gibbs free energy and chemical potential, eqs. 5.37, 5.39/5.40

Phase diagrams and using Gibbs free energy to get them

Clausius-Clapeyron relation, and what it means

van der Waals model and equation, Maxwell construction, “law of corresponding states”: using reduced variables

Mixtures: eq. 5.61 for ideal mixtures; diagrams of G vs. x for ideal mixing, no mixing, realistic mixing

Figs. 5.27, 5.29, 5.30, 5.31, 5.33, 5.35, and what they mean/how to use them

Dilute solutes: osmotic pressure, shifts in boiling and freezing points

Chemical equilibrium and law of mass action, eqs. 5.106-5.108 & generalizations