Chemistry 480A
Study Guide for Exam 2

1. You should know from memory:
   The combined first and second laws in differential form (closed system)
   The criteria for equilibrium at constant U and V, at constant T and V, and at constant T and p
   The equation for entropy of mixing
   The definitions of Helmholtz free energy and Gibbs free energy (A and G)
   The third law of thermodynamics
   The formula for entropy of mixing for ideal solutions
   The Gibbs-Helmholtz equation
   The expressions for chemical potential for ideal and nonideal gases and solutions
   The differential form of the combined first and second laws for an open system
   The integrated form of the combined first and second laws for an open system
   The definitions of activity and activity coefficient
   The Clapeyron and Clausius-Clapeyron equations
   The definition of an ideal solution
   Raoult's law
   Henry's law
   The definition of partial molar volume and other partial molar quantities

2. You should know how to:
   Calculate $\Delta S$ for various processes at constant $p$, constant $V$, or constant $T$ (reversible or irreversible) and for chemical reactions
   Calculate $\Delta G^\circ$ and $\Delta A^\circ$ for chemical reactions at 25°C, and $\Delta G^\circ$ for reactions at other temperatures
   Derive Maxwell's relations from $dG$, $dA$, $dU$, or $dH$
   Derive the equations for $\left(\frac{\partial U}{\partial V}\right)_T$ and $\left(\frac{\partial H}{\partial p}\right)_T$
   Derive the expression for the adiabatic compressibility, $\kappa_S$
   Calculate absolute entropies from heat capacity data and heats of phase transitions
   Calculate $G$ and $\Delta G^\circ$ at pressures other than 1 atmosphere
   Calculate the fugacity of a nonideal gas given the equation of state
   Write expressions for $H$, $A$, and $G$ from the integrated form for $U$
   Sketch and/or analyze a one-component phase diagram ($p$ as a function of $T$)
   Use the Clapeyron and Clausius-Clapeyron equations to calculate various properties of materials
   Calculate the vapor pressure of a substance under an applied external pressure
   Calculate the partial molar volume given appropriate volume and composition data
   Derive expressions for $\Delta S_{mix}$, $\Delta H_{mix}$ and etc. for ideal solutions
   Find vapor pressures of, and vapor compositions above, ideal liquid solutions

3. You should understand:
   What $\Delta A$ and $\Delta G$ measure
   What entropy measures
   The meaning and utility of activity and activity coefficient
   The implications of the Gibbs-Duhem equation
   Vapor pressure
   The triple point, critical point, vapor pressure curve, sublimation curve, and melting curve