Review Sheet for Exam I

Exam 1 will cover sections 1.1 – 3.4 of LMS. You will be provided with relevant equations and physical constants (see Equation Sheet for Exam 1) and a periodic table. You should expect the exam to take about 2 hours and you will need a scientific calculator. There will be a mixture of long answer questions and shorter questions such as multiple choice and true/false. Below is a list of topics for review; however, this is just a guide for studying. Anything that was discussed in class or in the textbook could be on the exam. Pay special attention to homework assignments, in class examples, and the end of chapter problems.

Know the distinction between system and surroundings and know the difference between closed, open and isolated systems.
Know the definition of equilibrium.
Know the Zeroth, First, and Second Laws of thermodynamics. Know both conceptual and mathematical definitions of the laws, where appropriate.
Know the instruments used for measuring pressure.
Know Boyle’s, Charles’s and Avogadro’s Laws and the Ideal Gas Law.
Understand how Charles’s Law leads to the concept of an absolute temperature scale.
Know what an equation of state is and know the definition of a state function.
Know the three main points of the kinetic-molecular theory of gases and be able to rationalize the gas laws in terms of them.
Understand the concept of partial pressure.
Know what effusion is.
Qualitatively understand how the distribution of molecular speeds in a sample changes with temperature and molar mass.
Understand the compression factor and what it is used for.
Know what the critical point is and what a supercritical fluid is. Know some of the useful properties of supercritical fluids.
Understand what makes real gases deviate from ideality and know the physical significance of the a and b constants in the van der Waals equation and of the B(T) and C(T) constants in the virial equation.
Know the Law of Corresponding States and recognize the usefulness of writing the van der Waals equation in terms of reduced quantities.
Know what the Boyle temperature is and its significance.
Understand how a process can be performed reversibly and why most thermodynamic calculations are performed for reversible changes. Know how w changes when a reversible process is made irreversible.
Know the definitions of work and heat and be able to calculate the work done and heat transferred during a change of state of the system.
Understand the difference between exact and inexact differentials.
Know what internal energy and enthalpy are and be able to calculate \( \Delta U \) and \( \Delta H \) for changes of state of a system. Know the definition of enthalpy.
Know the definition of heat capacity and be able to calculate \( \Delta H_m \) and \( q_P \) from \( C_{P,m} \) and \( \Delta U_m \) and \( q_V \) from \( C_{V,m} \).
Understand how to calculate the extent of reaction ($\xi$) and why it can be useful.  
Know the definition of the standard state of a substance.  Know and be able to use Hess’s Law, both with given reactions and with tabulated enthalpies of formation.  Know the definition of the enthalpy of formation of a substance.  
Be able to use bond enthalpies to estimate $\Delta H$ for a reaction.  Know two reasons why this process is only an estimate and not an exact calculation.  
Know how $\Delta H$ is measured experimentally.  Know how to calculate $\Delta H$ from $\Delta U$ for a constant volume process (bomb calorimetry).  
Understand how to calculate $\Delta H$ for a process at a second temperature if the enthalpy change at a first temperature and a heat capacity are already known.  Be able to do this both for constant heat capacity and when the heat capacity is a function of temperature.  
Know the definitions of an adiabatic change and an isothermal change.  Know that $q = 0$ for an adiabatic process and that both $\Delta U$ and $\Delta H$ are zero for isothermal processes in ideal gases.  
Know the definition of the heat capacity ratio ($\gamma$) and know that for adiabatic processes there are relationships involving $T$, $V$, and $P$ that can be used to calculate final values from initial values and vice-versa.  You will be given these equations on the exam.  
Know that for real gases $\Delta U$ is not equal to zero for isothermal processes.  Know the definition of the Joule-Thomson coefficient and what it is used for.  
Know the main steps of the Carnot cycle and be able to calculate $q$, $w$, $\Delta U$ and $\Delta H$ for each step (for an ideal gas).  
Know how real engines differ from Carnot engines.  Understand why $\Delta U$ and $\Delta H$ are zero for the overall cycle but $q$ and $w$ are not.  Recognize that these ideas apply to any thermodynamic cycle.  
Know the definition of entropy (mathematical and in words) and recognize that it is a state function even though it is calculated from $dq$ which is not a state function.  
Know how $q$ and $w$ differ for irreversible processes, compared to reversible ones.  
Be able to interpret entropy in terms of statistical or molecular concepts.  
Be able to calculate entropy changes for different processes.  Recognize the mathematical link between entropy and heat capacity via enthalpy and be able to make use of this link in your calculations.