Exam 1 Study Guide (Chapters 1-2)

Chapter 1

- Know what thermal equilibrium means and how it relates to temperature
- The ideal gas law ($PV = NkT$) and how to use it
  Example Problems:
  - 1.9, 1.10, 1.11, 1.16
- Know how to use the equipartition theorem ($U = \frac{1}{2}NfkT$)
  Example Problems:
  - 1.23,1.24
- The first law: $\Delta U = Q + W$. Positive sign corresponds to energy entering the object.
- Be able to calculate ΔU, Q ,W, etc for compression/expansion of an ideal gas (both adiabatic and isothermal)
  Example Problems:
  - 1.36,1.37
- Heat capacities: definition ($C_V = \left(\frac{\partial U}{\partial T}\right)_V$, $C_P = \left(\frac{\partial U}{\partial T}\right)_P + P\left(\frac{\partial V}{\partial T}\right)_P$)
  - Know how to measure capacities given Q and ΔT and how to use the heat capacity to predict ΔT (1.41, 1.42)

Chapter 2

- You should thoroughly understand the concept of a microstate and macrostate and what the difference is. (Would you be able to explain this concept to somebody else?)
- I don't care that you memorize the multiplicity of an Einstein solid, but be sure you know the context (what do N and q refer to?)
  Example Problems:
  - 1.5-1.7
- Be familiar with computing the microstates and macrostates of interacting systems (i.e. two interacting Einstein solids)
- Be able to describe the 2nd law in terms of macrostate multiplicity
- Know how to find the probability of a given macrostate ($\Omega_{state}/\Omega_{all}$)
  Example Problems:
  - 1.8
- Be familiar with the main results of section 2.4. You won't be asked to derive them, but you should know what they mean. This includes: the multiplicity of the Einstein solid in the high temperature limit, and the result that for very large N ($N \sim 10^{20}$) the multiplicity curve is so sharply peaked that any fluctuations within the peak are utterly unobservable (for all intents and purposes, a system at equilibrium is in the most likely macrostate)
- You won't be asked to derive the multiplicity of the mono-atomic ideal gas, but you should know what it means and how to use it (what is the relative probability of a macrostate with a given volume, energy, etc). Example: 1.27

- Definition of entropy: $S = k \ln \Omega$. Be able to find ΔS for common processes such as expansion, mixing, etc. Be able to express changes in entropy in terms of ratio of microstates before and after a process.
- Be familiar with the 2nd law in its most common form: $\Delta S_{total} \geq 0$
- Know what defines a reversible vs an irreversible process, and the relationship to entropy.