PHY215: Thermodyamics Study Guide

Be able to explain:

1. When is thermodynamics a useful tool?
2. The "0^{th}" law of thermodynamics.
3. The concepts of equilibrium, internal energy, work, temperature, heat, entropy, volume and pressure. Which of these are "state functions", which are not?
4. Mechanisms of heat transfer: conduction, convection, and radiation.
5. Equipartition and Boltzmann's constant – and the relationship to the ideal gas law.
6. The ideal gas law.
7. Reversible and irreversible processes.
8. The 1^{st} law of thermodynamics: $dQ=dU+dW=dU+pdV$
9. The Carnot cycle.
10. Efficiency of a heat engine; performance factor of a refrigerator.
11. The Clausius Theorem: $\Sigma(\Delta Q_i/T_i)\leq 0$.
12. The 2^{nd} law of thermodynamics: $dQ= TdS$, $\Delta S_{universe}>0$.
13. What does *statistical* mean in "statistical mechanics".
14. Entropy and its relation to microstates vs. macrostates, disorder, information, and to the reversibility of a process.
15. Adiabatic free expansion, and why this results in an entropy increase despite the absence of heat flow.
16. Identify the contributions of Joule, Carnot, Kelvin, Clausius, Maxwell, and Boltzmann.

Be able to calculate:

1. Use specific heats and the (latent) heat of transformation during a phase change to relate energy transfer to change in temperature and the flow of heat.
2. Calculate heat flow by conduction and radiation.
3. Use equipartition to estimate the kinetic energy of an atom in a gas.
4. Apply the ideal gas law to understand isothermal and adiabatic processes.
5. Calculate the work done, heat transferred, and internal energy and entropy changes during a process specified in the (P,V) plane.
6. Compute the work done and efficiency of a heat engine cycle.
7. Compute the performance factor of a refrigeration cycle.
8. The entropy change of a system at constant temperature given the heat flow into that system.
9. The entropy of an ideal gas as a function of T, V, and n.
10. Dimensional analysis: what typical length and energy scales are associated with the microscopic physics of everyday life (e.g. gases at STP).