MORE NOTES FOR THE FINAL EXAM

Below is a listing of types of questions and more specific guidelines for the final exam. The list is not necessarily literal, i.e., question 1.16 is not guaranteed to show up on the exam, but something like it might. Similarly, because a question does not appear on this list is not a gurantee it will not be covered, but these are what I regard as the most important points of the course. On the final, be prepared for questions like :

1.16
1.17
1.19 (a good example of using scaling to determine an answer)
1.22 (done for homework)
1.33
1.34 (and other questions in which you are given a PV diagram and are asked to find ΔU, Q, and W
1.38 (a good example of a prose response in which you reference, but do not rely on equations)
1.40
2.3 and 2.4; if I ask you to do any calculations, the numbers involved will be small enough that you can determine an answer by hand; these questions help you work through the basics of probability theory

2.5-2.7; understanding how energy is distributed among possible states is central to the course; do as many of these examples as you can

Expect to be facile enough with Stirling's approximation that you could set up problems like 2.16, although I would not ask you to determine a numerical value on the exam.

Know how to set up random walk problems and use Stirling's approx as appropriate to analyze them (see 2.25)

You should know how to derive Sackur-Tetrode, but via the techniques developed in Ch. 6, not those in Ch. 2. You will not need to know anything about the geometry of hyperspheres.

2.40 is another good example of a question where you provide an explanation; equations may be cited, but they are not the central focus of the answer

2.42 is interesting and could be part of a leitmotif of questions in which stellar astrophysics is used to illustrate various principles of thermodynamics

Material in Chapter 3 is central to understanding both macroscopic thermodynamics (as in Ch. 5) and also statistical mechanics in Ch. 6.

3.5-3.7 are excellent examples to work through.
3.13 is a wonderful demonstration of the second law
3.15 shows how thermodynamics applies to stars
3.16 shows the connection between entropy and information loss

We have explored paramagnetism thoroughly in both Chs 3 and 6; you should be able to do these derivations and use the thermodynamic identity to draw further conclusions about the state of a system.

Review the problems you did for homework from sections 3.4 and 3.5

Make sure that you understand how entropy is related to number of microstates, and how entropy, equilibrium and number of microstates are related.

In ch. 4, know how to describe the PV diagram for a heat engine cycle, how to compute W, Q_h, Q_C and use these parameters to determine expressions for the efficiency of the engine. Read the description of the Diesel engine (pp. 132-133) and derive the efficiency of the engine in terms of the cutoff ratio and the compression ration.

In Ch. 5, be able to distinguish between F and G, be able to derive various forms of the thermodynamic identity, and be able to take partial derivatives to derive more Maxwell relations.

Ch. 6 is central to the course; know how to find partition functions and mean values of thermodynamic properties. Know that $\overline{x}$ = Σ x(s) P(s) = (1/Z) Σ X(s) $e^{-\beta E_s}$

Be able to prove the equipartition function for quadratic forms of energy using partition functions.

Know how to find the partition function for any form of energy, such as an anharmonic oscillator. For classical systems (with a large number of closely spaced states), this may involve converting the summation to an integral and remembering how to integrate Gaussian like functions.

Know how to find the partition function of a composite system, remembering to distinguish between systems of identical and non-identical particles.

Be able to derive Sackur-Tetrode by using partition functions, a la 6.45.

In chapter 7, we will not be able to spend any meaningful amount of time on degeneracy pressure, so I will not rush through that in class. The exam will cover sections 7.1 and 7.2.