Phys 350 Thermodynamics
Study Guide for Part I

Part I covers the Preface, **Chapter 1, Appendix A** with expanded lecture notes and handouts, and **Temperature and Introduction to Thermodynamics** from the links provided on the Phys 350 web site http://www.unidata.ucar.edu/staff/blynds/tmp.html

The emphasis in this course is to understand the basic concepts and laws of thermodynamics and to be able to relate them to a variety of problems. The examples worked out in the book and in class as well as the home work problems you did should greatly enhance your ability to solve problems analytically. The best foundation for being able to solve problems is to have a clear understanding of the basic concepts and laws. The plug and chug approach of using formulas without understanding what they mean is dangerous.

This study guide is not exhaustive. Its aim is to point out important topics that you should have in your lecture notes and handouts so you could review them.

Temperature and Introduction to Thermodynamics

Be able to:

1. State the difference between the macroscopic and microscopic approach to the study of thermal physics.

2. State the difference between thermodynamics and statistical mechanics.

3. Give a few (at least) three definitions of temperature based on the macroscopic as well microscopic perspective.

4. Covert from °F to °C and vice versa , from Kelvin to Celsius and vice versa.

5. Explain how 0K (absolute zero) is arrived at.

6. Distinguish between thermal and diffusive equilibrium.

7. State the assumptions made to arrive at the ideal gas law $PV = nRT$.

8. State how the van der Waals equation modifies the ideal gas law.

9. State the equipartition of energy theorem.

10. Calculate the kinetic energy and the molar specific heats at constant volume and pressure for monoatomic, diatomic, some polyatomic gases, and solids with the help of the equipartition of energy theorem.

11. Calculate the v_{rms} speed for gases at about room temperature.

12. Derive the Dulong-Petit rule (C=3R) using the equipartition of energy theorem and use to calculate molar specific heat as well as the mass specific heat for some metals such as Al (c=2.2 cal/g.K).

13. State the contributions of the following scientist related to heat:
(You may use the web site: http://history.hyperjeff.net/statmech.html)

Toricelli	Watt	Avogadro	Carnot	Clapeyron	Mayer
Rumford	Joule	Thomson	Clausius	Maxwell	Boltzman
Kirchhoff	Gibbs	van der Waals		Wien	

14. Define heat using both the macroscopic and microscopic view

15. Starting from dw = F•ds show that dw = -pdv for a gas that is being compressed by,e.g., a poston.

16. State the 0^{th} law of thermodynamics.

17. State the three means of heat transfer and use them to explain how a thermos bottle works.

18. Explain why the breeze at the beach during a hot summer day is from sea to land and land to sea during a cool night.

19. Derive the expressions for work starting from dw = -pdv for isochoric, isobaric, isothermal and adiabatic processes.

20. State the 1^{st} law of thermodynamics in words and mathematically.

21. Write the 1^{st} law of thermodynamics for isochoric, isobaric, isothermal and adiabatic processes.

22. Define enthalpy in words and mathematically.

23. Calculate the change in enthalpy for some simple chemical reaction such as the combustion of hydrocarbons, carbohydrates, etc., using the data in pages 404 &405

Appendix A: Quantum Theory

Be able to :

24. State how classical phys failed to explain:
    a. The black body radiation curve at short wavelenghts
    b. The photoelectric effect.
    c. Atomic spectra
    d. electron diffraction

25. State how quantum theory succeeds in explaining:
    a. The black body radiation curve at short wave lengths
    b. The photoelectric effect.
    c. Atomic spectra
    d. electron diffraction

26. State the contributions related to quantum theory by:

Planck	Einstein	De Borglie	Bohr	Davidsson and Germer
Schrödinger	Heisenberg	Dirac		

27. Indicate how one obtains Wiens's Law and Stefasn-Boltzman Law from Plancks expression for black body radiations. (Read the handout from PHYS 301).

28. To explain what the symbols K, h, f, φ stand for in the photoelectric equation $K = hf - \varphi$

29. State Heisenberg's uncertainty principle mathematically and in words using change in momentum and displacement as well as change in energy and time.

30. Describe the Bohr Model for the hydrogen atom using statements and a rough sketch.

31. State the two postulates and two laws (from classical physics) that Bohr used to derive formula

32. Explain the difference between the approaches used by Blamer and Bohr to arrive at the formula $1/\lambda = R_H\,(1/2^2 - 1/n^2)$. Why did Bohr get a Noble Prize and not Blamer?

33. Calculate the wave lengths for the hydrogen visible spectra using the Bohr Model. (Use $R_H = (13.6\ \text{eV})/hc$; hc - 1240 eV.nm)

34. Derive the formula for the energy levels for a particle in an infinite rectangular well in 1D, 2D and 3D using standing waves and de Broglie relation as well as from the solutions of the Schrödinger Equation.

35. State mathematically and/or in words the meaning of the terms:
    Normalization condition, tunneling, barrier penetration, boundary condition

HW1
1.1, 1.3, 1.4
1.7, 1.8, 1.9, 1.14
HW2
1.18, 1.22
1.23, 1.24, 1.2
1.3. Heat Work
1.4. $\Delta U = Q + W$
1.28, 29