Physics 3180 (Thermal Physics) Name: ________________________
spring 2016

Problem Set 1

(due Wednesday, January 20, 4:00 pm)

Note: The problems for this course will vary greatly in length, style, and difficulty. Some will be of the familiar "short calculation" type that you saw in introductory physics, where the answer consists of a number (usually expressed to about three significant figures). But you'll also find plenty of other types: thought questions that require verbal answers; rough estimations where one sig. fig. is plenty; and derivations whose answer is not a number but a formula. This diversity of problem styles reflects the diversity of types of thinking that physics requires.

In all cases, be sure to write up your problem solutions with sufficient clarity for a student at your level to follow every step. This almost always means including plenty of English in your solutions, to explain your assumptions and calculational tricks. You needn't be formal or verbose—just clear.

The grading of your homework will reflect the importance of logical presentation and clear explanations. A correct answer following an indecipherable solution will receive little or no credit. On the other hand, a well-presented solution that contains a minor arithmetic error may receive full credit. I will assign an overall score of 0 to 3 points (with possible fractional points) to each problem set, with the longer problems weighing more heavily into the score.

Please staple this cover sheet to your solutions and be sure to sign the statement on the reverse side.

1. The TV weatherman says that tomorrow will be twice as hot as today. What's wrong with this statement? (Hint: Think about the different possible temperature scales.)
2. Problem 1.12, page 8. This is a "rough estimate" problem, in which you needn't calculate anything to better than 10% accuracy.
3. How many moles of water are in a cup? (Be sure to say what you mean by a cup.)
4. Problem 1.16, page 8. Be sure to allow plenty of time for this rather lengthy problem.
5. Run the Interactive Molecular Dynamics simulation (physics.weber.edu/schroeder/md/). After playing with it for a while, and reading all the instructions (especially the part about units), set it up as follows: Set the number of atoms (N) to approximately 100 and the volume (V, actually an area in two dimensions) to approximately 5000. Add or remove energy until the temperature (T) remains stable at approximately 1.0. Then record the pressure (P) and compute the ratio PV/NkT (be careful with units!). What is this ratio for an ideal gas, and how does your result compare? Repeat (using the same N and V) for $T \approx 0.5$ and $T \approx 0.3$, being sure to remove enough energy for the system to equilibrate at these temperatures. Describe the way in which this system's behavior differs from that of an ideal gas, and explain the reason for this difference, noting the visual appearance of the system at each temperature.
6. Calculate the rms speed of an oxygen molecule at room temperature.
7. Problem 1.28, page 20. (Be sure to read the previous page for a review of the information needed to solve this problem.)

(Continued on reverse)

8. A mole of air in a closed container is initially at 300 K. Suppose that you now add 10 J of heat to the air, without doing any work on it. After you are finished, what is the total thermal energy of the air? What is its final temperature?
9. Problem 1.32, page 23.
10. Problem 1.33, page 23.

Affirmation of Academic Honesty

By signing below I hereby affirm that the attached work is my own, and that in preparing this work I have not obtained any unauthorized assistance or otherwise violated the policies of this course or of the Weber State University Student Code. In my solutions I have explicitly acknowledged all sources of substantive assistance that I received.

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Signature and date