Problem Set 1: The Language of Thermodynamics, Ideal Gases Due Aug 28, 2008

Please note that your answers will be collected at the **beginning** of class on Thursday. Problem sets will not be accepted after the first five minutes of class.
You are strongly encouraged to work with other students in the class on this and all other problem sets for the course. Please list (on the first page of your answers) the other people in the group that you have worked with. Clearly indicate who was responsible for creating the final version of the problem set you hand in. Your study group should contain at most four people. Only one set of answers is required for each group. You should make a copy of your answers so that you can refer to them during the discussion.

1. Common types of systems are open, closed, isolated and adiabatic.
   (a) Define the term "system".
   (b) Define the term "surroundings".
   (c) Define each of the 4 common types of systems by describing whether heat, work and mass can exchange between the system and the surroundings.
   (d) Provide an example for each of the 4 common types of systems.
   (e) What type of a system is a bacterial cell?

2. In general, how can you change an extensive property into an intensive property? Give a concrete example to support your proposal.

3. Problem 2.5 (p. 32):
   Starting with the ideal gas equation, show how you can calculate the molar mass of a gas from a knowledge of its density.

4. Problem 2.16 (p. 33):
   Nitrogen forms several gaseous oxides. One of them has a density of 1.27 g/L measured at 764 mm Hg and 150°C. Write the formula of the compound.
   (Hint: use your answer for question 3.)

5. If an ideal gas has a volume of 2.8 liters at 21°C and 1 atm pressure, what is the volume of the same gas at 50°C and 1 atm pressure?

6. The following graph shows four different states for an ideal gas, where P is the pressure and δ is the density of the gas. Is the temperature of state 1 less than or greater than the temperature of state 2. Why?