These questions are from a previous exam. They serve only to give you an idea of the sort of questions you might expect on Exam 1 in Chemistry 126. Please note, however, that each year different sorts of problems are introduced, and I make no guarantee that any problems of any particular sort will be included on this year's exam.

(15) 1. Just lay out the calculation in terms of products and sums of fractions. There is no need to actually do any arithmetic. What is the probability of...

a) ...the top three cards in a standard 52-card deck all being aces?
b) ...neither of the top two cards in a standard 52-card deck being an ace or a king?
c) ...at least one of the top two cards in a standard 52-card deck being an ace or a king?

(15) 2. Briefly explain **why...**
a) ...we can focus on the most probable distribution and not worry about the others.
b) ...as units of energy are added to a system, the temperature rises.
c) ...energy in real chemical systems is quantized.

(20) 3. Consider the energy level diagram "A" on the right.

a) Describe in your own words what the numbers mean.
b) How much energy is in this system? (Please lay out the calculation with actual numbers. Again, no need to actually do the arithmetic.)
c) How would you calculate the number of microstates associated with this distribution? (Just lay out the calculation with the appropriate numbers.)
d) Do you think this distribution is the most probable distribution? Why or why not?

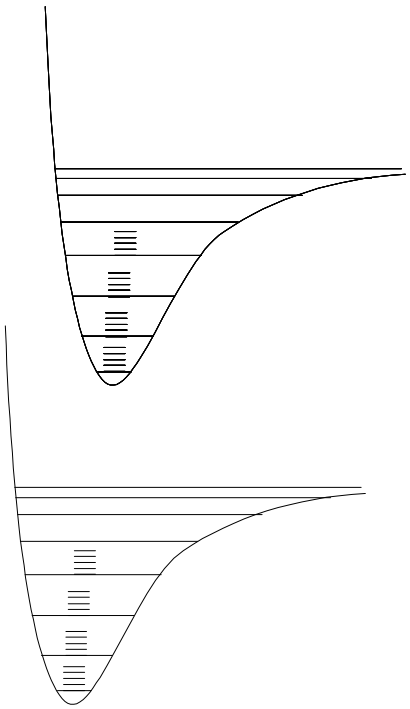
(10) 4. Briefly describe two properties of a Boltzmann distribution.

(10) 5. Fill in the blanks with the appropriate word, ***electronic***, ***rotational***, ***translational***, or ***vibrational***. In some cases, more than one answer is correct. Any correct answer will be given credit.

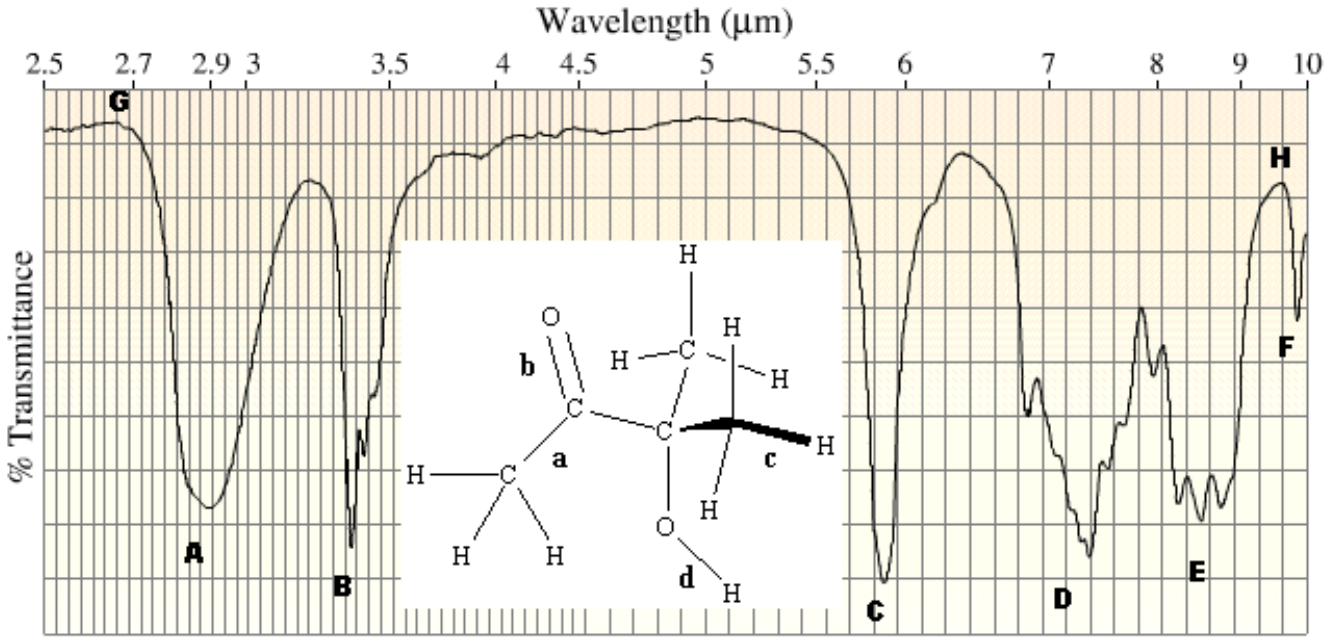
_____ energy levels are about 10 times more closely spaced than electronic energy levels. Consideration of reduced mass is important for calculations of _____ energy. _____ energy levels do not exist for molecules in the solid phase. The mass term in the _____ energy equation is much smaller than the mass term for any other type of energy. _____ excitation is the predominant means by which bonds are broken in ordinary chemical reactions that result from heating a substance.

(5) 6. Sketch a picture of a hydrogen atom orbital that has a two conical nodes.

(5) 7. On the diagram shown on the right, indicate with a vertical arrow an absorption that might involve I_2 in its ground state becoming both electronically and vibrationally excited, but not rotationally excited.



(15) 8. Shown below is molecule and its infrared spectrum. Several bonds in the molecule and areas of the spectrum are labeled.



Circle ONE in each case:

A B C D E F G H	The lowest-energy absorption.
C E	Of **C** and **E**, the absorption most likely to be associated with bond **b** (C=O).
A B C D E F G H	The absorption most likely associated with bond **d** (O–H).
a b c d	The bond most likely associated with absorption **B**.
a b c d	The bond most likely associated with absorption **C**.

In a sentence or two, explain what type of energy absorption we are looking at, and explain why the absorptions are so broad rather than being nice sharp lines.