In all the calculations, where the speed of light, c, is required, assume it to be 2.9979 x 10^{10} cm s^{-1}

1.   In a certain experiment, the rotational constant B for $^{12}C^{16}O$ was determined to be 1.929 cm^{-1}. Using this value for B, calculate the bond length in CO. Another researcher repeats the experiment and reports a B value of 3.858 cm^{-1} for CO. Can you pass a judgement on who is more likely to be correct and if any of the values of B is clearly indicated to be incorrect?

2.   The B value for HF is 20.56 cm^{-1}.

a) For this molecule calculate the populations, relative to that in J=0, for the J levels upto 10 and plot a histrogram showing the population. What is the J level where the population is the highest? Does this J value with the highest population, agree with the calculation of the most probably J that you calculate from the equation derived in class. Assume the temperature to be 300 K.

b) Repeat the above calculation for the temperatures 50 K and 600 K. This will help you understand the effect of temperature.

3.   The B value for HI is 6.43 cm^{-1}.

c) For this molecule calculate the populations, relative to that in J=0, in the J levels upto 10 and plot a histrogram showing the population. What is the J level where the population is the highest? Does this J value with the highest population, agree with the calculation of the most probably J that you calculate from the equation derived in class. Assume the temperature to be 300 K.

d) Repeat the above calculation for the temperatures 50 K and 600 K. This will help you understand the effect of temperature.

(Comparing the results of problem 2 and 3 will help you understand the distribution of population in various levels as a function of B values.)