

Problem W20:

The equilibrium separation of the two atoms in the CO molecule is 0.113 nm.

- (a) Find the excitation energies of the $\ell = 1$ and $\ell = 2$ rotational states.
- (b) Find the ratio of the number of molecules in the $\ell = 1$ and $\ell = 2$ levels to the number in the $\ell = 0$ level at $T = 290\text{K}$. [The number of degenerate states at any level is $2\ell+1$.]

Problem W21:

In the LiF molecule the $\ell = 0$ to $\ell = 1$ absorption line occurs at a wavelength of 3.69 mm. Find the bond length for this molecule. Use 7u and 19u for the atomic masses of Li and F.

Problem W22:

The $\nu = 1$ to $\nu = 0$ vibrational transition in the NO molecule has a frequency of 5.63×10^{13} Hz.

- (a) Find the effective force constant for this molecule.
- (b) Calculate the amplitude of the vibrational motion in the ground state. Remember that the vibrational energy in this state is $\frac{1}{2}\hbar\omega$.