Spectroscopy

Exercises Chapter 2A

1. The rotational energy levels of a diatomic molecule are in a first approximation given by those of the rigid rotor:

$$E_{rot}(J) = \frac{\hbar^2}{2\mu r_e^2} J(J+1)$$

where μ is the reduced mass and r_e the equilibrium distance.

Calculate the energy levels for $J=0$ to 4 for $^{12}C^{16}O$ and $^{13}C^{16}O$ knowing that the equilibrium distance r_e is equal to 1.12819 Å. Express the energy both in Joule and in cm^{-1}.

2. Given that the vibrational wavenumbers of the molecules HCl, SO and PN are 2991, 1149 and 1337 cm^{-1} calculate, assuming that the vibrational motion can be described by an harmonic oscillator, their force constants and comment on the comparative bond strengths.