June 28, 2022

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7-1: At low resolution, the infrared spectrum of $^{12}C^{16}O$ reveals a strong band at $2150cm^{-1}$. At higher resolution, the band resolves into two sets of peaks, one on either side of 2143.26 cm^-1. The peaks nearest to the center of the band are separated by 7.655 cm^-1 , Using the harmonic oscillator and rigid rotor approximation, determine the fundamental frequency of CO, the force constant of CO bond, the CO rotational constant, and the CO band bond length.

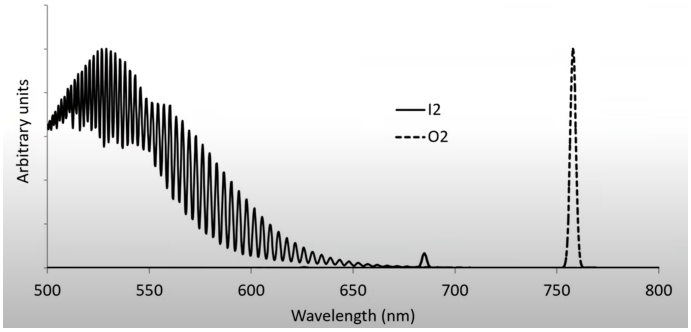
$$\Delta\tilde{E}_{\Delta J=+1} = \tilde{v} + 2\tilde{B}(J+1)$$
$$= \tilde{v} + 2\tilde{B}_1 + (3\tilde{B}_1 - \tilde{B}_0)J + (\tilde{B}_1 - \tilde{B}_0)J^2$$

$$\Delta\tilde{E}_{\Delta J=-1} = \tilde{v} - 2\tilde{B}$$
$$= \tilde{v} - (\tilde{B}_1 + \tilde{B}_0)J + (\tilde{B}_1 - \tilde{B}_0)$$

$$\text{Fundamental Frequency: } v = \frac{1}{2\pi}\sqrt{\frac{k}{\mu}}$$

$$\text{Reduced Mass: } \mu = \frac{m_1 m_2}{m_1 + m_2}$$

7-2: gas phase UV-visible spectra of certain I2 and O2 transition are shown below. State which molecule exhibits a greater bond length change and support your answer



I2 transition exhibits the greater bond length change. The bond length change in this question is determined by the number and shape of peaks. Oxygen has only one sharp peak, which implies that the bond length change is minimal. On the other hand, the continuous dense peaks of iodine demonstrate that the change in bond length is much higher.