5.80 Small-Molecule Spectroscopy and Dynamics
Fall 2008

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Problem Set #4
Some problems [indicated] were taken from various chapters of Molecules and Radiation by J. I. Steinfeld, Harper & Row, 1974

1. [Steinfeld, Ch. 7, #1]
2. [Steinfeld, Ch. 8, # 2]
3. [Steinfeld, Ch. 8, # 4]
4. [Steinfeld, Ch. 8, # 6]
5. [Steinfeld, Ch. 8, # 8]
6. $^{16}$O$^{12}$C$^{32}$S is a linear molecule. The bond lengths are
   \[ r_{CO} = 1.16\text{Å} \]
   \[ r_{CS} = 1.56\text{Å} \]
   and the observed fundamental vibrational frequencies are
   \[ \nu_1 = 858.9 \text{ cm}^{-1} \text{ stretch} \]
   \[ \nu_2 = 520.4 \text{ cm}^{-1} \text{ bend} \]
   \[ \nu_3 = 2062.2 \text{ cm}^{-1} \text{ stretch}. \]
   (a) Obtain $k_{CS}$, $k_{CO}$, and $k_0[r_{CO}r_{CS}]^{-1}$ in dynes/cm.
   (b) What are the amplitudes for C-O and C-S stretch in the $\nu_1$ fundamental level?
   (c) What are the vibrational frequencies for $^{18}$O$^{12}$C$^{32}$S?
7. [Steinfeld, Ch. 9, #1]