

CCB 421/521: Homework 2

Due in class on Monday, Feb. 13.

(3-34) Prove Eq. (3-85).

(3-43) Prove the commutation relation seen in Eq. (3-88). You may start from the fact (proved in class) that $[\hat{x}, \hat{p}_x] = i\hbar$.

(3-48) Assume that HCl and DCl ($H=^1H$, $D=^2H$, and $Cl=^{35}Cl$) can be treated as harmonic oscillators and that both have the same force constant ($4.8 \times 10^2 \text{ N m}^{-1}$). Calculate the fundamental vibrational frequency of each molecule.

(3-52) Using the data from (3-48), calculate the energy (expressed in cm^{-1}) of radiation absorbed when HCl in its ground state is excited to its first excited vibrational state. Repeat for DCl. Compare to the experimental values cited of 2886 and 2070 cm^{-1} , respectively.