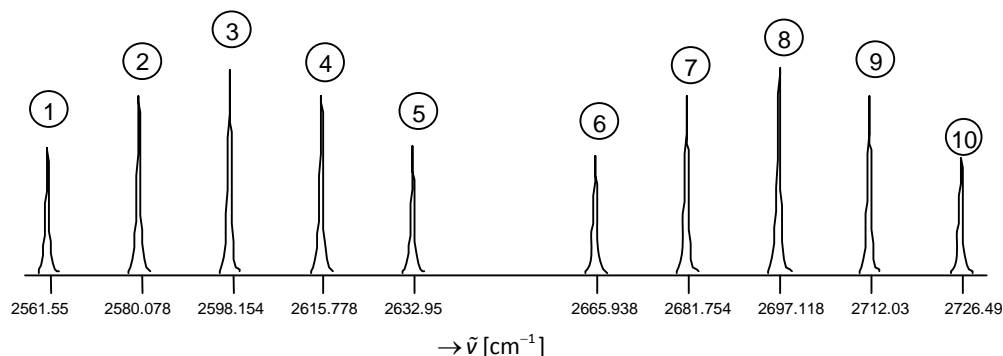


Spectroscopy

Exercises Chapter 4B

1. Shown below is an approximate infrared absorption spectrum of the diatomic molecule HBr.



- Draw an energy level diagram for HBr which includes the first 2 vibrational levels and the first 4 rotational levels of each vibrational level. Label the energy levels by all the appropriate quantum numbers.
 - Indicate on your figure which levels are involved in the transitions labeled 3-8 in the HBr spectrum. Do this by drawing arrows between the pairs of levels involved and label each arrow by the number corresponding to the spectrum of HBr given above. Label each transition in your figure by the proper spectroscopic notation.
 - From the information contained in the spectrum above, estimate a value for $\tilde{\nu}_0$, B_0 , B_1 , B_e , α and r_e . You can assume that the centrifugal distortion is small enough to neglect.
2. The dissociation energy of an anharmonic oscillator can be estimated from the following expression:

$$D_e \cong \frac{\omega_e^2}{4\omega_e x_e}$$

- Derive the expression above.
- From the following separations of vibrational levels in CO, obtain values for ω_e , $\omega_e x_e$, and D_e .

Transition	band origin (cm^{-1})
$v=1 \leftarrow 0$	2138
$v=2 \leftarrow 1$	2115
$v=3 \leftarrow 2$	2091
$v=4 \leftarrow 3$	2063
$v=5 \leftarrow 4$	2038
$v=6 \leftarrow 5$	2011