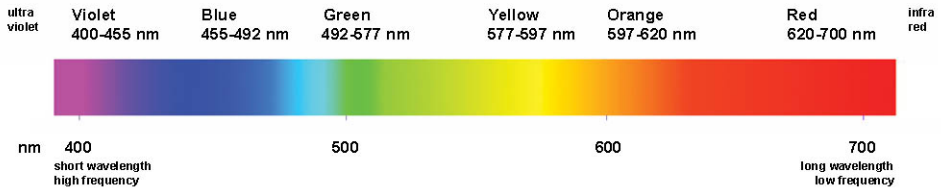
Hao Wu 9/24/2013
Email: haowu@berkeley.edu Office Hour: Tu 5:30-6:30pm Location: Bixby Common

Chem 4A Scholars Worksheet 7

Wavefunction, Particle in a Box, Harmonic Oscillator and Others

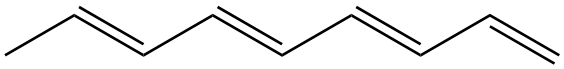
Useful equations:

$$\lambda == \frac{hc}{E} \quad h = 6.63\times10^{-34}\ J\ s \quad m_e = 9.10\times10^{-31}\ kg \quad \omega = \sqrt{\frac{k}{m}} \quad E = \frac{h}{2\pi}\omega\left(n+\frac{1}{2}\right) \quad E = \frac{n^2h^2}{8mL^2}$$



Questions:

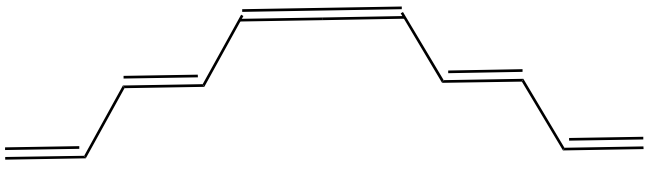
1. *Conjugated alkene chain can be described by particle in a box system. Look at the following graph. Length of C-C bond: 147pm, C=C bond: 134pm. Consider the folling molecule:*



   a. *What is the energy of the ground level?*

   b. *What is the color of the molecule?*

   c. *What about the following molecule?*

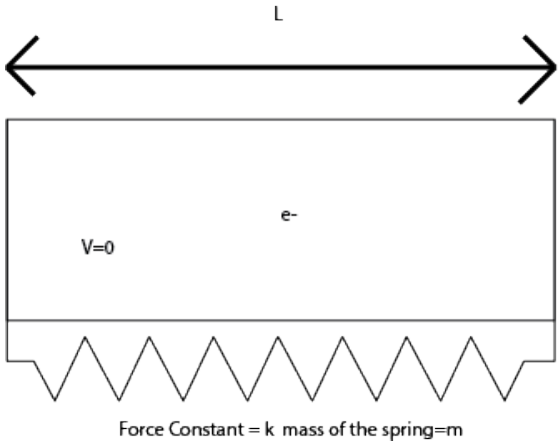


2. *For an electron located in a 3d particle in a box, whose length is 10 nm, draw and label the first four energy levels, note the degeneracy. What is the lowest excitation energy when there are 5 electrons in the box?(ignore electron repulsion)*

3. *It is known that the vibration frequency of N_2 is 2395 cm^{-1},*
   a. *Calculate the force constant for the nitrogen triple bond.*

   b. *What is the zero point energy of this molecule?*

4. *Consider the following imaginary system: one electron sit in a zero potential box of zero potential, the box is elastic and is held by a spring. What is the ground state energy of this particular system?*



5. *What if you replace the electron with a proton?*