Spectrum of harmonic oscillator:

Checkpoint: An experimenter keeps the potential energy applied by the laser constant and measures the absorption frequency for lithium, rubidium. → K

$m_{Li} < m_{Rb}$

$\hbar\omega$ { $\omega = \sqrt{\frac{K}{m}}$ $\quad hf_{Li} = \hbar\sqrt{\frac{K}{m_{Li}}}$ $\quad f_{Li} < f_{Rb}$

Homework 9: Energy Eigenstates

1) $E_n - E_{n-1} \Rightarrow \lambda_{photon} = 2260\,nm$ $\quad n-1 \to n+2 \to \lambda_{photon} = 3192\,nm$

1. $0.54\,eV$: $E_{n\to n-1}$ photon $\quad 2.\ E_{n-1\to n+2}$ Photon $= 0.388\,eV$

3. $E_n - E_{n-1} = \frac{\hbar^2 n^2\pi^2}{2mL^2} - \frac{\hbar^2(n-1)^2\pi^2}{2mL^2} = 0.54\,eV$ $\quad \frac{\hbar^2\pi^2}{2mL^2}(n^2 - n^2 + 2n - 1) = 0.54$

$2n - 1 = 1.4369\times10^{18} L^2 \to n = 7.18455\times10^{17} L^2 + 0.5$

$E_{n-2} - E_{n-1} = \frac{\hbar^2\pi^2}{2mL^2}((n-2)^2 - (n-1)^2) = 0.388$

$-n^2 + 2n - 1 + (n^2 - 4n + 4) = 1.0324\times10^{18} L^2$

$-2n + 3 =$

$n = -5.1622\times10^{17} L^2 + 1.5$

$L = 2.22\,nm$, $n = 4$

4. $L = 2.22\,nm$

5. Longest λ the well can absorb?

$E_2 - E_1 = \frac{hc}{\lambda} \to \lambda \approx 5343\,nm$

2) $M_{Oz} = 5.3372\times10^{-26}\,kg$ $\quad n=5 \to n=2$ $\quad \lambda_{photon} = 2.109\,microns = 2.109\times10^{-6}\,m$

1. $E_{photon} = \frac{1240\,eV\,nm}{\lambda} = \frac{1240\,eV\,nm}{2109\,nm} \approx 0.5886\,eV$

2. $n=5$ $\quad E_n = (n+\frac{1}{2})\hbar\omega$ $\quad E_5 - E_2 = (\frac{11}{2})\hbar\omega - (\frac{5}{2})\hbar\omega$

$\lambda_{longest\ emitted} = ?$ $\quad = 3\hbar\omega = 0.5886\,eV$ $\quad E_5 - E_4 = \hbar\omega$

$\omega = \frac{0.588}{3\hbar}$ $\quad \lambda_{long} = 6.32\,mic$

3. $\lambda_{shortest}$ $\quad E_5 - E_0 = 5\hbar\omega = \frac{hc}{\lambda} = \frac{0.588\cdot5}{3}$ $\quad \lambda = 1.265\,mic$ shortest

4. $\omega = \sqrt{\frac{K}{m}}$ $\quad m\omega^2 = K$ $\quad K \approx 4714\,N/m$

$\omega^2 = \frac{K}{m}$