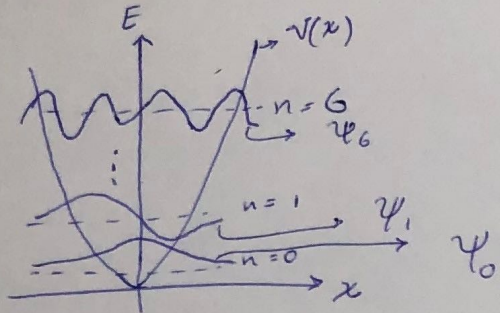


L8: review

bond in molecules as spring $\text{H}-\text{O}$

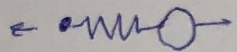


more wiggles \Rightarrow
larger $\frac{\partial^2}{\partial x^2} \Rightarrow$
larger kinetic E .

wider \Rightarrow larger potential E

Energy is discrete: $E_n = h\nu(n + \frac{1}{2})$; $n=0,1,2,\dots$

Transition between states by putting energy (e.g. heat, light = photon) into molecule:

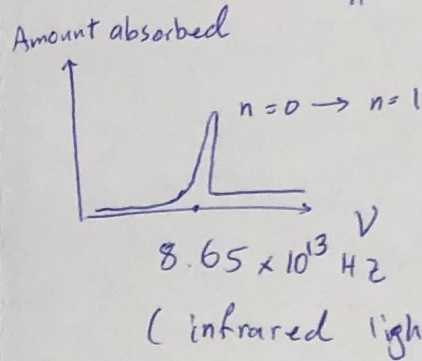


$E_1 = h\nu(1 + \frac{1}{2})$
 $E_0 = h\nu(0 + \frac{1}{2})$
 $E_1 - E_0 = \Delta E = h\nu$
 planck's law

* note that the photon needs to have exactly the energy that is equal to the difference between E_0 and E_1 . This is a major difference between QM and CM. Energy discreteness is what allows spectroscopy.

we can determine the force constant of the

tiny spring $\text{H}-\text{Cl}$ hands-off.



The peak at $8.65 \times 10^{13} \text{ Hz}$ is unique to HCl. Hence, the spectrum is a fingerprint that helps identify the molecule on the

Surface of Mars without collecting the sample by hand.

$$\nu = \frac{1}{2\pi} \sqrt{\frac{k}{m}} \Rightarrow k = m(2\pi\nu)^2 = 490 \frac{\text{N}}{\text{m}}$$

m
 \downarrow
 $m_{\text{H}} = 1.66 \times 10^{-27} \text{ kg}$ (bigger m , smaller $\Delta E = h\nu$)

by measuring the absorption frequency of light we can calculate the force constant of the "spring" without a need to pull the bond!

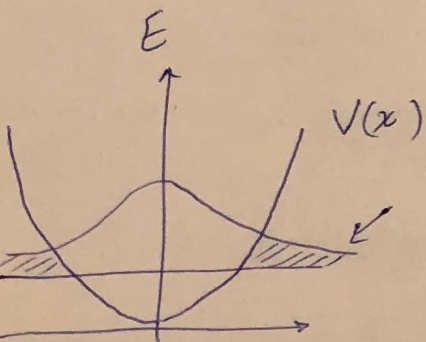
Every molecule has a unique spectrum and can be identified remotely, even light years away!

HWK 02.3 : calculate $(\Delta P^2)(\Delta x^2) = \frac{\hbar^2}{4}$
to prove $\Delta x \cdot \Delta P = \frac{\hbar}{2}$

using $\bar{A} = \int \psi^*(x) \hat{A}(x) \psi(x) dx$,

and ~~scribble~~ ~~scribble~~ ~~scribble~~ $\hat{P}^2 = -\frac{\hbar^2}{2m} \frac{\partial^2}{\partial x^2}$

HWK 0.2.4 : "classically forbidden region"



$E < V(x) \Rightarrow K < 0!$

but $\bar{K} = \int_{-\infty}^{\infty} \psi^* \frac{-\hbar^2}{2m} \frac{\partial^2}{\partial x^2} \psi dx$

> 0