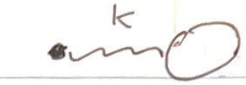
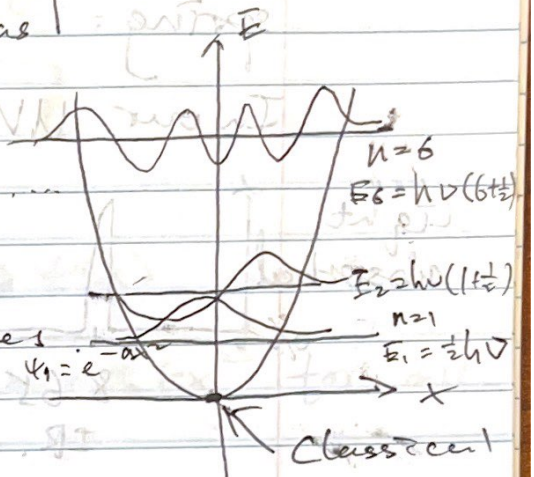
$\nu = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$



Last Time: bond as string

① The Schrödinger differential equation $H\Psi_n = E_n\Psi_n$ has multiple solutions Ψ_n that we can count with the "quantum number" $n = 0, 1, 2, \ldots$

$F = -kx \quad V(x) = \frac{1}{2}kx^2$



② Only certain volumn of the energy are Eigenvalues

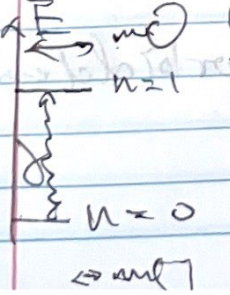
$E_n = h\nu\left(n+\frac{1}{2}\right)$.

③ If Ψ has more wiggles $\Rightarrow$ curvature $= \frac{\partial^2\Psi_n}{\partial x^2}$ is larger $\Rightarrow p^2$ larger $\Rightarrow$ Kinetic E is larger. Function get wider, higher possibility at large $V(x)$.

Today: Transitions and energy levels

Do a transition between two energy levels ($n=0 \to n=1$) by putting heat or light into the molecule. photons.

Like a reaction $M(n=0) + 1\cdot h\nu \to M(n=1) + 0\cdot\gamma$



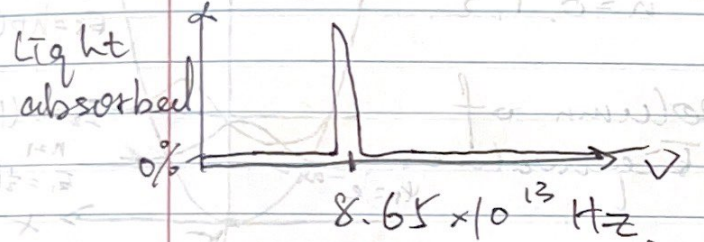
$E_1 - E_0 = \Delta E = h\nu$

$= E_\gamma = h\nu$

Plank's law.

We can use absorption of light (photons) to determine the force constant of a spring: $\overset{k}{\sim\!\sim\!\sim}$ "heads off"

In our UV-Vis



They are saved by the quantized energy "level" of QM". So absorption occurs only at certain frequency.

Plank's Law: $\nu \Rightarrow E = h\nu$

$$\nu = \frac{1}{2\pi}\sqrt{\frac{k}{m}} \quad k \approx 1.66\times10^{-27}\ \text{kg}$$

for H(H-Cl)

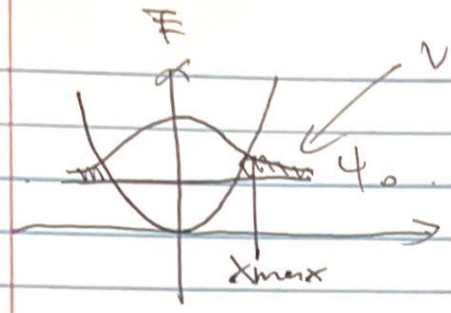
$$= 490\ \frac{N}{m}$$

Every molecule has a unique spectrum or "fingerprint" ⇒ with photon, molecules can be identified remotely.

HWk Q2.3. calculate Δx^2, Δp^2 for ψ_0 of the spring

$$\Rightarrow \Delta x^2 \Delta p^2 = \left(\frac{\hbar}{2}\right)^2 \Rightarrow \Delta x \Delta p = \frac{\hbar}{2}$$

HWk Q2.4 "Classically forbidden region"



$$2\int_{x_{max}}^{\infty} dx\, |\psi_0(x)|^2 \quad P.$$

$$\bar{A} = \int_{-\infty}^{\infty} dx\, \psi^*(x)\, \hat{A}\, \psi(x)$$

$$\bar{K} = \int_{-\infty}^{\infty} dx\, \psi^*(x) \left[-\frac{\hbar^2}{2m}\frac{\partial^2}{\partial x^2}\right] \psi(x)$$

Thought Prob: Can $V(x) = \frac{1}{2}kx^2$ for all x, really?