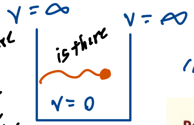
Introduction to Quantum mechanics

Joe Hoshina

- Topic: Infinite potential well
  why we start w/ it.

particle not there



Object have tendency to go from high to low potential

"creating walls w/ high V to trap in electron in between"

square shape infinite potential well

"mass attached to a spring oscillating back and forth"

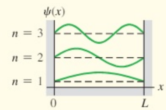
Particle in a box: The energy levels for a particle of mass m in a box (an infinitely deep square potential well) with width L are given by Eq. (40.31). The corresponding normalized stationary-state wave functions of the particle are given by Eq. (40.35). (See Examples 40.3 and 40.4.)

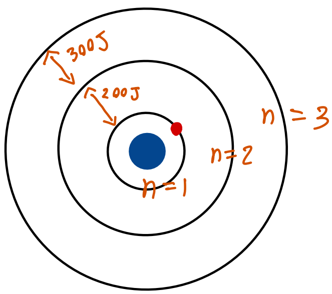
$$E_n = \frac{p_n^2}{2m} = \frac{n^2h^2}{8mL^2} = \frac{n^2\pi^2\hbar^2}{2mL^2} \quad (40.31)$$

$(n = 1, 2, 3, \dots)$

$$\psi_n(x) = \sqrt{\frac{2}{L}}\sin\frac{n\pi x}{L} \quad (40.35)$$

$(n = 1, 2, 3, \dots)$





"Atom w/ nucleus @ its center"

"Electron orbits around the rings"

"for e to move to next orbit x amount of energy is required"

Lets say we provide energy to the electron 20J. we'd assume for it to move 1/10th out. No we need exactly 200J or more for the electron to move.

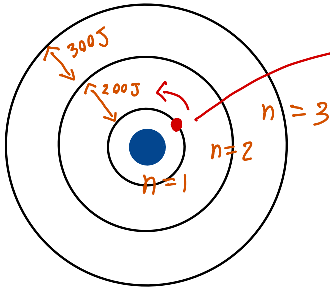
Electrons prefer to absorb certain amount of energy for transitions and are forbidden to be somewhere in the middle no matter what. This means during the transition the electron teleports to the next orbit.

"Spring motion"

- Why is it mentioned when learning about a particle in a box?

Reasons such as molecular vibrations, etc.

Lets instead relate it to electron orbit.



circular motion

$E = \frac{1}{2} m v^2$

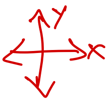
$\Rightarrow$ represent as angular velocity

$\Rightarrow E = \frac{1}{2} m w^2 r^2$

$w = \sqrt{\frac{k}{m}}$ we learned this back when we were introduced to oscillations.

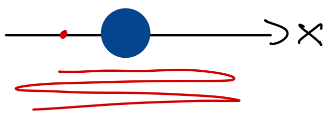
$\Rightarrow E = \frac{1}{2} k r^2$

Notice if I was to define this orbit to be on the xy plane



and we were to view it from the side.

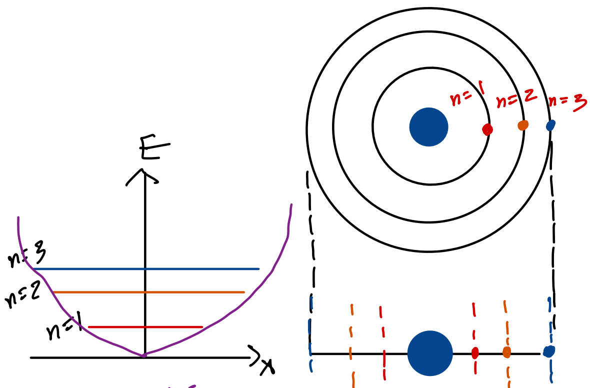
We get:



electron will be bouncing back n forth

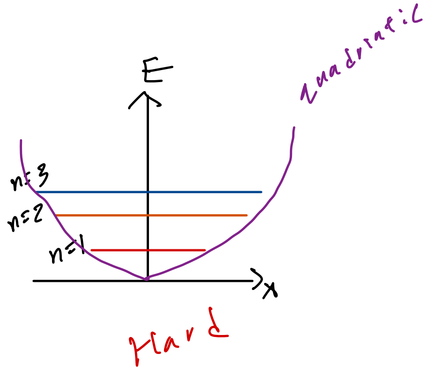
$\underbrace{\frac{1}{2} k r^2 \rightarrow \frac{1}{2} k x^2}$

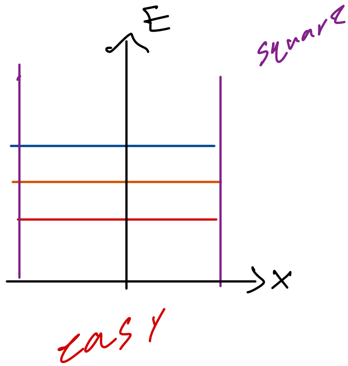
just like the spring motion expression



looks to make a quadriatic function

makes sense since $E(x) = \frac{1}{2} k x^2$


quadratic
E
n=3
n=2
n=1
x
Hard


square
E
x
easy