

S.E. w/ forces

In the absence of forces:

$$-\frac{\hbar^2}{2m} \frac{\partial^2 \psi(x,t)}{\partial x^2} = i\hbar \frac{\partial \psi(x,t)}{\partial t}$$

$$(KE) \psi(x,t) = (E) \psi(x,t)$$

$K = E$

What if we add forces? (do this by adding ^{change in} potential energy U)

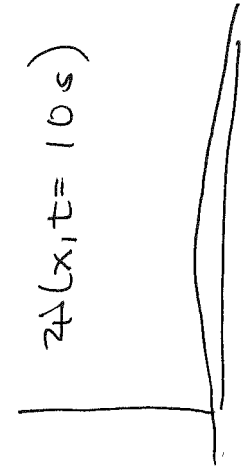
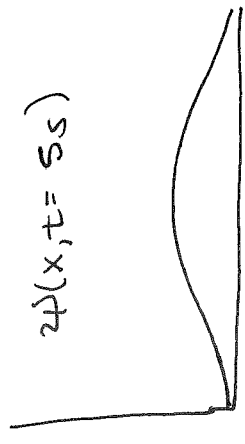
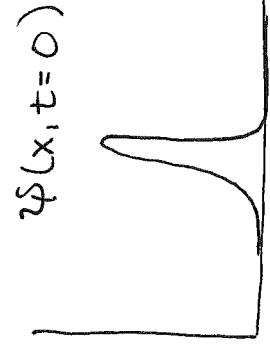
~~$$-\frac{\hbar^2}{2m} \frac{\partial^2 \psi}{\partial x^2} + U(x) \psi(x) = i\hbar \frac{\partial \psi(x,t)}{\partial t}$$~~

$$(KE) \psi(x,t) + U \psi(x,t) = E \psi(x,t)$$

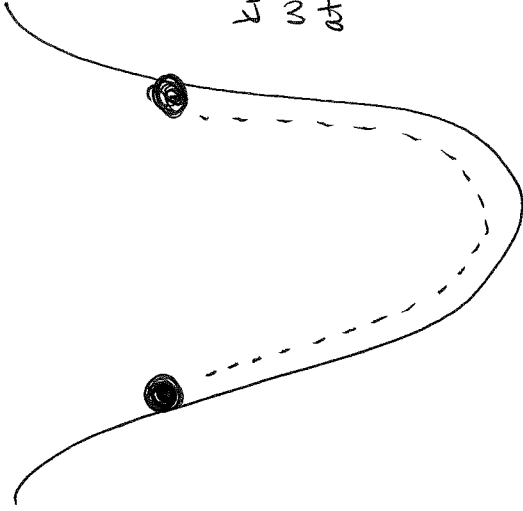
$K + U = E$

And that's it! w/ these equations, we can find out anything we want to know about the probability of where we find particle:

1. solve S.E.
2. apply boundary conditions
3. get specific function $\psi(x,t)$



Particle in a Box



know exactly
where ball is
at all times

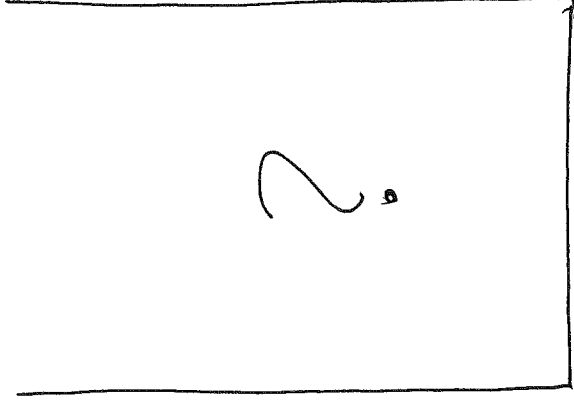
Classical

ball rolling up + down hill

ball stays between two hills:

1. doesn't have enough energy to roll over hill
2. doesn't have enough energy to roll through hill

hill represents an energy barrier
(something that confines the ball)



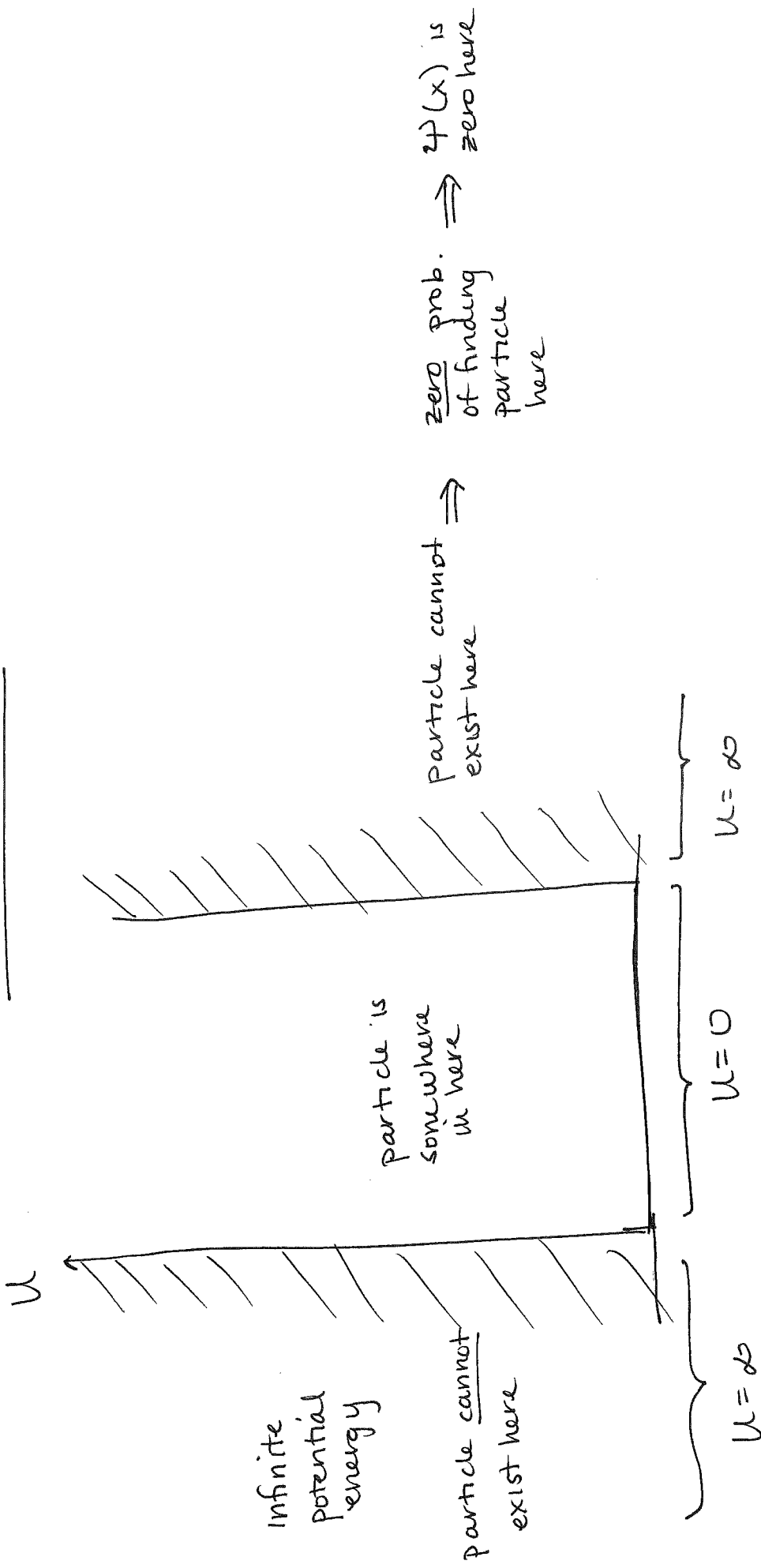
where is
quantum
particle?

Quantum particle in a box

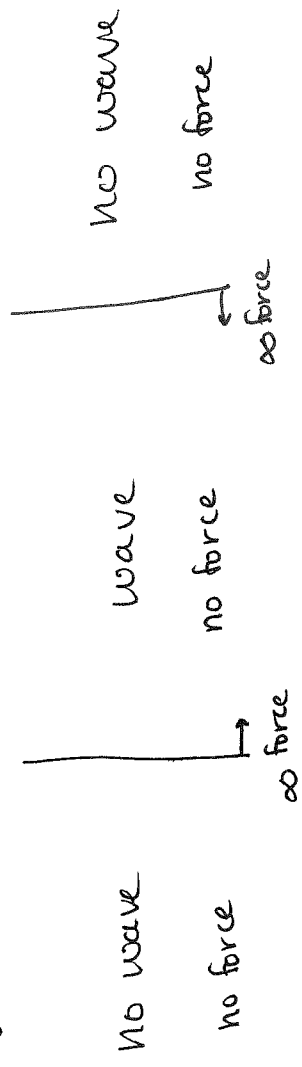
1. particle doesn't have enough energy to jump out of the box
2. particle doesn't have enough energy to pass through walls

box represents energy barrier
(can build box out of lasers, etc)

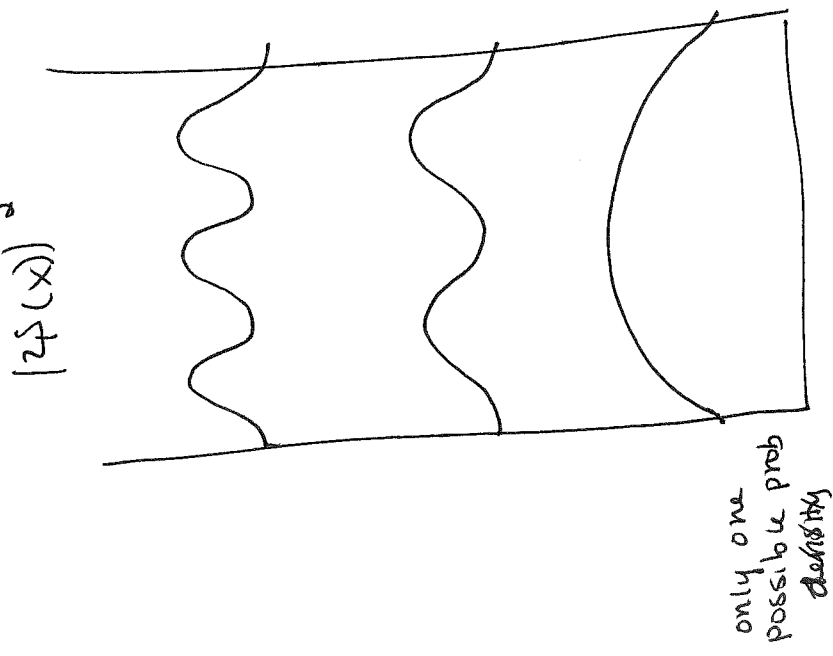
Infinite 1D Box



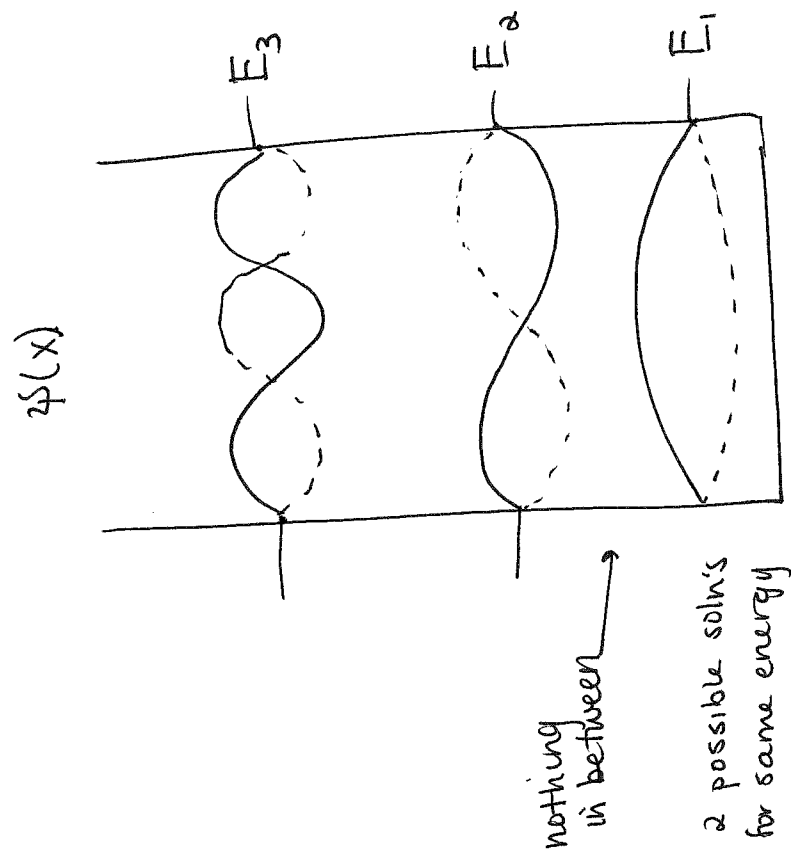
What does this remind you of? \Rightarrow waves on string



1D Box



only one possible probability density



nothing in between

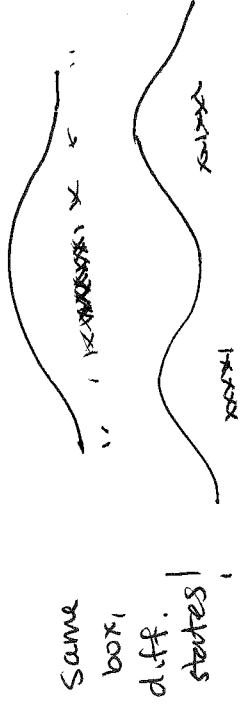
2 possible solns for same energy

get certain (discrete) energy states

1. no energies between E_1 and E_2
2. no partial bumps

energies of particle are quantized

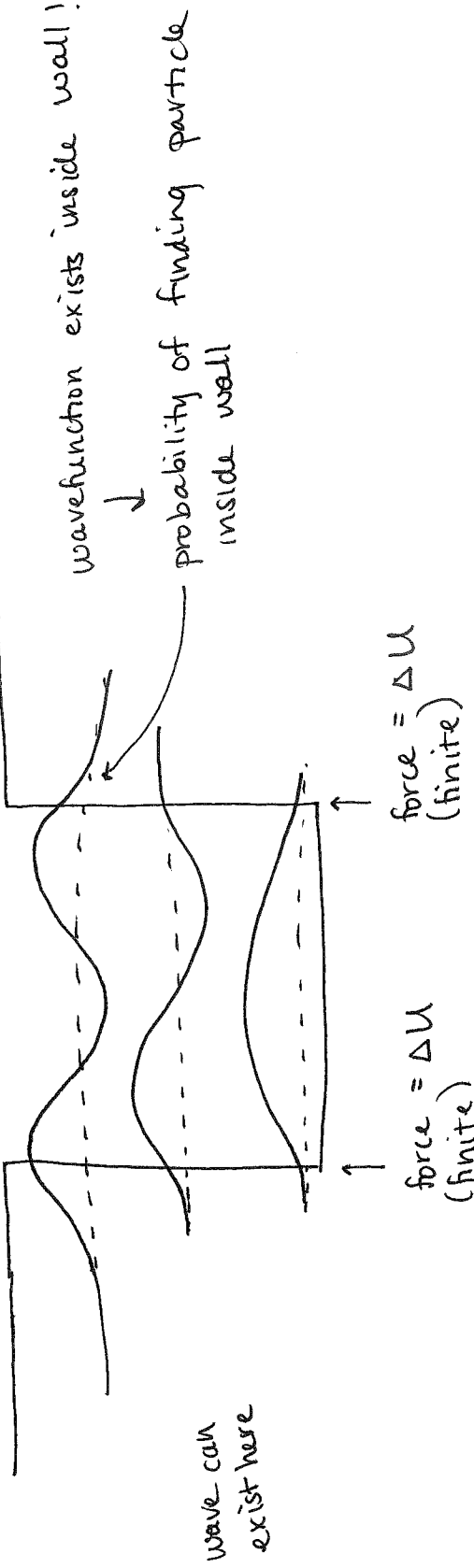
If we take many measurements, most of time we find



Finite 1D Box

What happens when the walls (potential energy) are not infinite?

infinitely thick wall (not infinitely high)



force (ΔU) is bigger than the energy, so we expect the particle to stay in box

What happens if wall is not infinitely thick?

