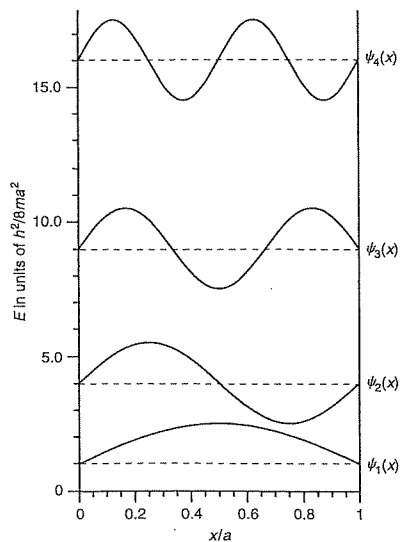


# Quantum Physics & Quantum Mechanics in 1D Particle-in-a-box

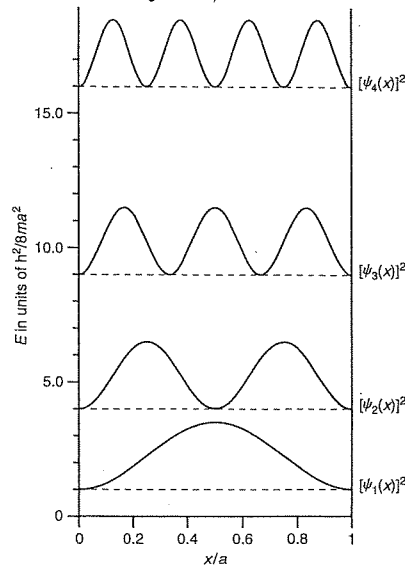
$$\text{TISE gives } \psi_n(x) = \begin{cases} \sqrt{\frac{2}{a}} \sin \frac{n\pi x}{a}, & 0 < x < a \\ 0, & x \leq 0 \text{ \& } x \geq a \end{cases}$$

$$\text{and } E_n = \frac{n^2 \pi^2 \hbar^2}{2ma^2} \quad n=1, 2, 3, \dots$$

a few  $\psi_n(x)$



a few  $|\psi_n(x)|^2$



Things to inspect and learn

- Quantum Confinement Effect

- Wriggling wavefunction has higher kinetic energy

This simple problem actually takes you deep into QM, if you understand it carefully.

▪ Why no allowed energy below  $E_1$ ? "Think like a computer"

▪ What are bound states?

▪  $\Psi_n(x)$ 's are orthogonal! What's orthogonality?  
How about "orthonormal" functions?

▪ Symmetric  $U(x)$  restricts how  $|\psi(x)|^2$  looks like

▪ Expanding any function  $\Phi(x)$  using energy eigenfunctions?

▪ Putting the box somewhere else, does it matter?