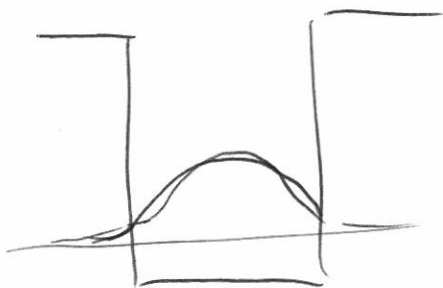


Last time: Detailed solution to the finite square well.



First exercise: Quick estimate of the lowest eigen energy.

Task: Check that the pWET is giving a physically reasonable result for lowest energy state.

Soln: In the well $U(x) = 0$ and $\psi(x) = A \cos kx$

Eigenvalue eqn is $\frac{\hbar^2}{2m} \frac{d^2\psi}{dx^2} = E\psi$

$k = \frac{\pi}{a}$

$$\Rightarrow E = \frac{\hbar^2 k^2}{2m}$$

$$= \frac{\hbar^2 \pi^2}{2ma^2}$$

~~$$= \frac{10^{-34} \pi^2}{2 \cdot 10^{-30} \cdot (10^{-9})^2}$$~~

$$= \frac{(10^{-34})^2 \cdot 10}{2 \cdot 10^{-30} \cdot (10^{-9})^2} = \frac{10^{-68} \cdot 5}{10^{-30} \cdot 10^{-18}}$$

$$= \frac{5 \cdot 10^{-50}}{10^{-48} \cdot 10^{-30}} = 5 \cdot 10^{-20} \text{ J}$$

ie. Zero potential energy, plus this much kinetic ~~potential~~ energy.

(2)

$$\frac{0.5 \times 10^{-19}}{1.6 \times 10^{-19}} = 0.3 \text{ eV}$$

WHERE WE ARE NOW:

- We know what a wavefn represents

i.e. Wave function is [•]continuum limit of a wave vector.

- We know (in principle) how to find energy eigenfunctions and eigenvalues.

i.e. Solve the eigenvalue eqn and find possible values for the unspecified constant "E".

OTHER COMMON QUANTITIES WE MIGHT WANT TO KNOW:

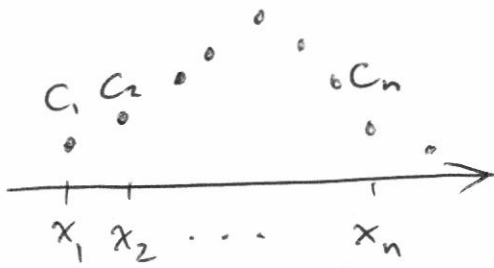
- Expectation values
- Projections (for example, probability that E_i is measured)
- Spread in measured values.

(3)

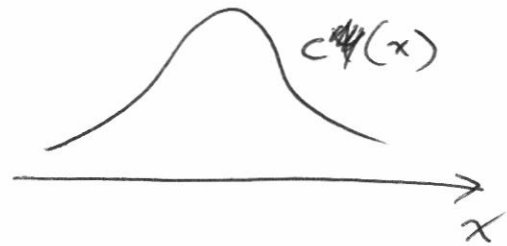
These calculations are a natural extension of your previous work with vectors,

Functions are the continuous limit of vectors

vector (list of #s)



function



Dot product between two vectors

$$[v_1^* \ v_2^* \ \dots \ v_N^*] \begin{bmatrix} c_1 \\ c_2 \\ \vdots \\ c_N \end{bmatrix} = \sum_{i=1}^N v_i^* c_i$$

"Dot product" between two functions

$$\int_{-\infty}^{\infty} v^*(x) c(x) dx$$

Both ~~are~~ operations are called

$$\langle v | c \rangle$$

④

Practice translating "bra-ket" notation into wave function integrals.

$$\langle \psi | H | \psi \rangle = ?$$

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

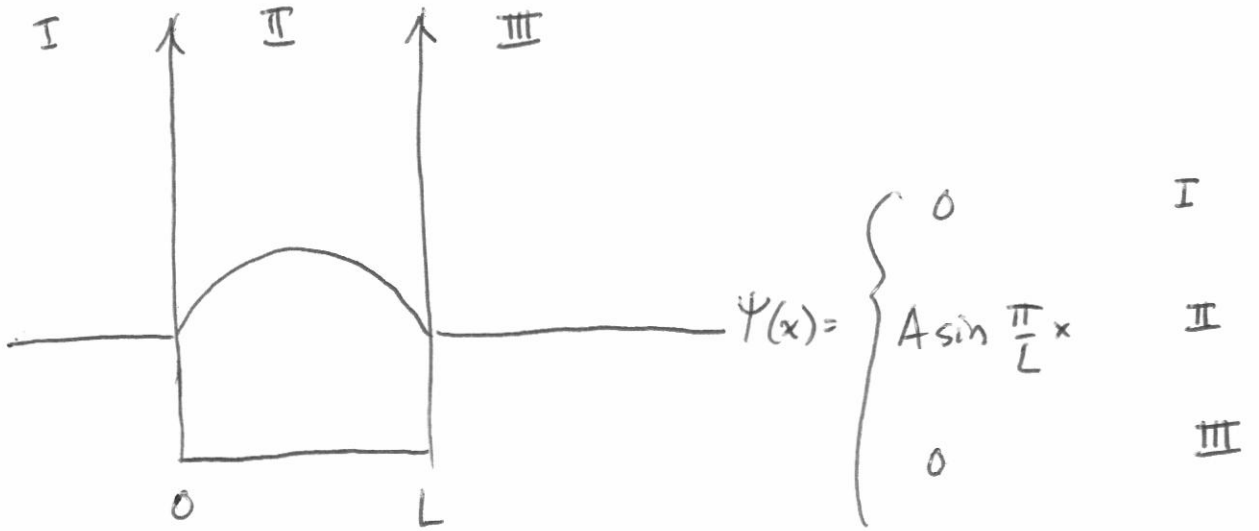
↑
differential
operator

$$\langle \psi | \psi \rangle = ?$$

$$= \int_{-\infty}^{\infty} \psi^*(x) \psi(x) dx$$

$$= \int_{-\infty}^{\infty} |\psi(x)|^2 dx$$

5



Find the normalization constant A .

Answer $A = \sqrt{\frac{2}{L}}$