Print view of 'Midterm2Review'

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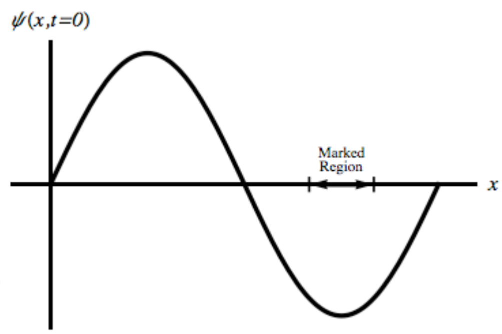
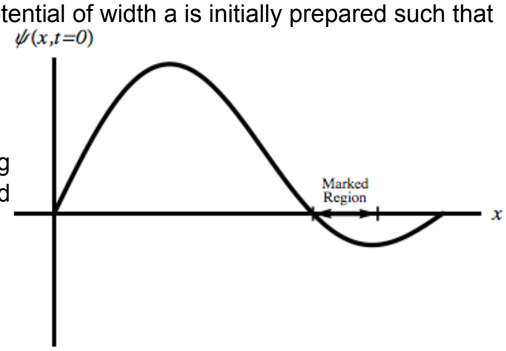
Q1: Suppose a system consists of a particle in an infinite square well potential of width a. The wave function for the system at time t = 0 is shown at right. This state satisfies the eigenvalue equation $\hat{H}\psi = E_2\psi$, where $\mathrm{E}_2 = \frac{2\pi^2\hbar^2}{ma^2}$. Consider the marked region along the x-axis. Rank from greatest to least the probabilities of finding the particle within the marked region at the following five times: $\mathrm{t}_0 = 0$, $\mathrm{t}_1 = \frac{\pi\hbar}{2E_2}$, $\mathrm{t}_2 = \frac{\pi\hbar}{E_2}$, $\mathrm{t}_3 = \frac{3\pi\hbar}{E_2}$, and $t_4 = \lim_{t\to\infty} t$. Use $\mathrm{P}_0,\ P_1,\ P_2,\ P_3,\ \text{and}\ P_4$ as symbols for your probabilities. Explain your ranking.



Q2: Another system consisting of a particle in an infinite square well potential of width a is initially prepared such that its wave function at time t = 0 is $\Psi(x,t=0) = \sqrt{\frac{1}{2}}\left(\psi_1(x) + \psi_2(x)\right)$ as shown at right. ψ_1 and ψ_2 satisfy the eigenvalue equation $\hat{H}\psi_n = E_n\psi_n$. Here $\mathrm{E}_n = \frac{n^2\pi^2\hbar^2}{2ma^2}$. Consider the marked region along the x-axis. Rank the probabilities of finding the particle within the marked region at the following five times: $\mathrm{t}_0 = 0$, $\mathrm{t}_1 = \frac{2\hbar\pi}{E_2}$, $\mathrm{t}_2 = \frac{4\hbar\pi}{E_2}$, $\mathrm{t}_3 = \frac{6\hbar\pi}{E_2}$, and $\mathrm{t}_4 = \frac{8\hbar\pi}{E_2}$. Use $\mathrm{P}_0,\ P_1,\ P_2,\ P_3,\ \text{and}\ P_4$ as symbols for your probabilities. Explain your ranking.



Assume that a quantum mechanical system is prepared so that its initial state is given by:

$$\Psi_i = \Psi(x,0) = i\sqrt{\tfrac{1}{3}}\psi_1 - \sqrt{\tfrac{2}{3}}\psi_2$$

where ψ_1 and ψ_2 are two states which satisfy the time independent Schrödinger equation:

$$\hat{H}\psi_1 = E_1\psi_1$$

and

$$\hat{H}\psi_2 = E_2\psi_2$$

Q3:
a) Consider an energy measurement made on this system. Are there times (before any measurement is made) when the probability of measuring E_2 is zero and the probability of measuring E_1 is one?

- Select one...
- Definitely yes

- It depends (specify below)
- No, there is no such time

b) If so, give the first such time. If not, explain why not.
