Assignment 2

The due date for submitting this assignment has passed. As per our records you have not submitted this assignment.

1) For a potential barrier of height $U_0$ and finite width $b$, the position space wave function $\psi(x)$ will be oscillatory for any $x$ if and only if energy $E$ of the particle is

- greater than $U_0$
- zero
- less than $U_0$
- negative

No, the answer is incorrect.
Score: 0
Accepted Answers: greater than $U_0$

2) $\psi(x,t)$ is a solution of a free particle in one dimension with $\psi(x,0) = Ae^{-x^2/\alpha^2}$. The probability amplitude in the momentum space at $t = 0$ is

- $\frac{A}{\sqrt{\pi}} e^{-p^2/\alpha^2} \hbar^2$
- $\frac{A}{\sqrt{\pi}} e^{-p^2/2\hbar^2}$
- $\frac{A}{\sqrt{\pi}} e^{-p^2/4\hbar^2}$
- $\frac{A}{\sqrt{\pi}} e^{-p^2/4\hbar^2}$

No, the answer is incorrect.
Score: 0
Accepted Answers: $\frac{A}{\sqrt{\pi}} e^{-p^2/2\hbar^2}$

3) A particle is initially in the ground state of a box of length $a$. If the wall at $x = 0$ is slowly moved to $x = 2a$, the wavefunction $\psi(x = 3a/2)$ of the particle in the new well will be

- 0
- $\sqrt{\frac{a}{2}}$
- $\sqrt{\frac{a}{2}}$
- $\sqrt{\frac{a}{2}}$

Score: 0
Accepted Answers: $\sqrt{\frac{a}{2}}$
4) Consider two states $|\Psi_1\rangle = 2|\phi_1\rangle + |\phi_2\rangle - a|\phi_3\rangle + 4|\phi_4\rangle$ and $|\Psi_2\rangle = 3|\phi_1\rangle - i|\phi_2\rangle + 5|\phi_3\rangle - |\phi_4\rangle$, where $|\phi_1\rangle, |\phi_2\rangle, |\phi_3\rangle, |\phi_4\rangle$ are orthonormal kets and $a$ is a constant. The value of $a$ so that $|\Psi_1\rangle$ and $|\Psi_2\rangle$ are orthogonal is

No, the answer is incorrect.
Score: 0
Accepted Answers:

5) A superposed wavefunction at $t = 0$ is $\psi(x, 0) = A x (L - x)$ for the particle in a box of length $L$. The probability of measurement of the second excited state energy ($E_{n=3}$) for the superposed state is

No, the answer is incorrect.
Score: 0
Accepted Answers:

6) For a potential barrier of height $V$ and finite width $a$, we expect the transmission coefficient of the particle of energy $E < V$ to be

No, the answer is incorrect.
Score: 0
Accepted Answers:

7) Consider a potential barrier of height $V_0$ of finite width $b$. Suppose we shrink the width ($b \rightarrow 0$) as well as raise the height of the barrier ($V_0 \rightarrow \infty$) such that $V_0b$ is finite. We would expect

No, the answer is incorrect.
Score: 0
Accepted Answers:

8) For a particle in a one-dimensional potential $V(x) = \frac{1}{2} k x^2 + \beta x^4$ where $\beta$ is a dimensionful positive constant, the normalised energy eigen functions are given as $a \psi(x) + b \psi(-x)$. The allowed values of $a$ and $b$ will be

<table>
<thead>
<tr>
<th>$a$</th>
<th>$b$</th>
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<tbody>
<tr>
<td>$\frac{1}{2}$</td>
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For the wave function \( \psi(x) = \frac{N}{x^2 + \alpha^2} \), in the region \(-\infty \leq x \leq \infty\), the normalization \( N \) will be

- \( \frac{1}{\sqrt{2}} \)
- \( \frac{1}{\sqrt{3}} \sqrt{2} \)
- \( \frac{1}{\sqrt{3}} \sqrt{3} \)
- \( \frac{1}{\sqrt{3}} \sqrt{4} \)

No, the answer is incorrect.
Score: 0
Accepted Answers:
\( \frac{1}{\sqrt{3}} \sqrt{3} \)

Consider a particle of mass \( m \) confined in a 1-dimensional infinite potential well:

- \( V = V_0 \) for \( 0 \leq x \leq L \)
- \( V = \infty \) otherwise

Assuming the stationary state solution \( \phi_n(x) = \sqrt{\frac{2}{L}} \sin\left(\frac{n\pi x}{L}\right) \), the expectation value of position and momentum operator turns out to be

- \( L/2 \) and 0 respectively
- 0 and \( L/2 \) respectively
- \( L \) and 0 respectively

No, the answer is incorrect.
Score: 0
Accepted Answers:
\( L/2 \) and 0 respectively