Assessment 4

The due date for submitting this assignment has passed. Due on 2016-03-18, 23:59 IST.

Submitted assignment

1) The degeneracy of the energy level \( E = \frac{\hbar^2}{8mL^2} \) for a particle in a two dimensional square box is 1 point

- 1
- 2
- 3
- 4

No, the answer is incorrect.
Score: 0
Accepted Answers: 4

2) The correct energy level expression for a particle in a two dimensional potential-free rectangular box with sides \( L_1 \) and \( L_2 \) is

- \( E_{n_1n_2} = \frac{\hbar^2}{8mL^2} (n_1^2 + n_2^2); L = \frac{1}{2} (L_1 + L_2) \)
- \( E_{n_1n_2} = \frac{\hbar^2}{8mL_2} (n_1^2 + n_2^2) \)
- \( E_{n_1n_2} = \frac{\hbar^2}{8mL_1} (n_1^2 + n_2^2) \)
- \( E_{n_1n_2} = \frac{\hbar^2}{8mL_1L_2} (n_1^2 + n_2^2) \)

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

3) The probability that a particle in a two dimensional square box of length \( L \) be found in the area enclosed by \( x=0 \) and \( L/2 \) and \( y=0 \) and \( L \) is 1 point

- 1/4
- 1/2
- 1/8
- 1

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4) A rectangular box has sides $L_1$ and $L_4$ designated as $x$ and $y$ directions respectively. The total energy of the particle is $\frac{h^2}{8\pi^2 m L^2}$. The degeneracy of the state is

- 1
- 2
- 3
- 4

No, the answer is incorrect.
Score: 0
Accepted Answers: 1/2

5) The number of nodal lines for a particle in a two dimensional box with the energy $E_{n_1n_2}(i.e., \psi_{n_1n_2}(x,y)=0)$ is

- $n_1$
- $n_2$
- $n_1 + n_2$
- $n_1 + n_2 - 2$

No, the answer is incorrect.
Score: 0
Accepted Answers: $n_1 + n_2 - 2$

6) For a particle of mass $m$ in a three dimensional cubic box of side $L$, the energy level expression requires specification of three quantum $n_1$, $n_2$, and $n_3$. Also the expression for the quantized energy is $E_{n_1n_2n_3} = \frac{h^2}{8\pi^2 m L^2} (n_1^2 + n_2^2 + n_3^2)$. The lowest energy is thus $\frac{3h^2}{8\pi^2 m L^2}$. The number of distinct quantum states available for $E \leq \frac{6h^2}{8\pi^2 m L^2}$ is

- 1
- 2
- 3
- 4

No, the answer is incorrect.
Score: 0
Accepted Answers: 4

7) The thermal de Broglie wavelength associated with a particle of mass $m$ is given by $\sqrt{\frac{h^2}{2mE_{kin}}}$. At thermal energy corresponding room temperature for an electron ($k_B T \approx 4 \times 10^{-17} J$) whose mass is about $9.31 \times 10^{-31} kg$, the wavelength is of the order of

- An Angstrom ($10^{-10} m$)
- A micrometer
- A millimeter
- A meter

No, the answer is incorrect.
Score: 0
Accepted Answers: An Angstrom ($10^{-10} m$)
8) Assume one hydrogen molecule to be present in a cubic three dimensional box of side 1 micron at a temperature of 300K. Its thermal energy is $\frac{3}{2} k_B T$ . The approximate value for the quantum number $n = \sqrt{n_1^2 + n_2^2 + n_3^2}$ is found to be (mass of the hydrogen molecule is $3.4 \times 10^{-27}$ kg, $k_B = 1.38 \times 10^{-23}$ J.K$^{-1}$)

- 25000
- 2500
- 250
- 25

No, the answer is incorrect.
Score: 0
Accepted Answers:
25000

9) An arbitrary state of a particle in a two dimensional square box of length L is given by

$$\psi(x, y) = c xy(L - x)(L - y)$$

The normalization constant c is given by (dimensional argument is helpful)

- $\frac{30}{L^2}$
- $\frac{30}{L^4}$
- $\frac{30}{L^{32}}$
- $\frac{30}{L^{22}}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{30}{L^{32}}$

10) A wave function of a particle in a two dimensional box is given as

$$\psi(x, y) = c(L - x)(L - y)$$

This wave function is not acceptable as correct because

- It can not be normalized.
- The normalization constant is zero.
- The wave function does not go to zero inside the box.
- The wave function does not satisfy the boundary conditions.

No, the answer is incorrect.
Score: 0
Accepted Answers:
The wave function does not satisfy the boundary conditions.