Assessment 4

The due date for submitting this assignment has passed. Due on 2017-02-26, 23:59 IST.

Submitted assignment

Chemistry I Introduction to Quantum Chemistry and Molecular Spectroscopy
Week 2: Tutorial 4 by K. Mangala Sunder
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Assume speed of light to be $3 \times 10^8 \text{ m.s}^{-1}$; Planck’s constant $h = 6.626 \times 10^{-34} \text{ J.s}$

1) The number of nodes (points where the wavefunction becomes zero) $1 \text{ point}$ for a particle in a one dimensional box with energy $E_n$ is

- $n$
- $n - 1$
- $n + 1$
- zero

No, the answer is incorrect.
Score: 0
Accepted Answers:
$n - 1$

2) The number of nodal lines (lines on which the wave function goes to zero) $1 \text{ point}$ for a particle in a 2 d square box, for which the energy $E_{n_1n_2}$ is specified by two quantum numbers $n_1$ and $n_2$ is

- Zero
- $n_1 + n_2$
- $n_1 + n_2 - 1$
- $n_1 + n_2 - 2$

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

3)
The degeneracy of the energy level \( E = \frac{65h^2}{8mL^2} \) for a particle in a two dimensional square box is

- 1
- 2
- 3
- 4

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

4) The total number of quantum states for a particle in a one dimensional box for \( E \leq \frac{50h^2}{8mL^2} \) is 7 \( \{n = 1, 2, 3, \ldots \} \). For the same energy, the number of quantum states available for the same particle in a two dimensional square box is

- 20
- 33
- 30
- 36

No, the answer is incorrect.
Score: 0
Accepted Answers: 33

5) If the particle moves in a one dimensional box under a constant positive potential \( V \), the energy of the particle is given by

- \( \frac{\hbar^2 n^2}{8mL^2} \)
- \( \frac{\hbar^2 n^2}{8mL^2} + V \)
- \( \frac{\hbar^2 n^2}{8mL^2} - V \)
- \( (\frac{\hbar^2}{8mL^2} + V)n^2 \)

No, the answer is incorrect.
Score: 0
Accepted Answers: \( \frac{\hbar^2 n^2}{8mL^2} + V \)

6) The average value, or the expectation value for the operator \( xp_y - yp_x \) for a particle in a two dimensional square box of length \( L \) is

- 0
- \( \frac{L^2}{2} \)
- 2L
- \( \frac{L^2}{4} \)

No, the answer is incorrect.
Score: 0
Accepted Answers:
7) The probability that a particle in a two dimensional square box of length $L$ be found in the area enclosed by $x = 0$ and $\frac{L}{4}$ and $y = 0$ and $\frac{L}{4}$ is

- $\frac{1}{4}$
- $\frac{1}{2}$
- $\frac{1}{8}$
- Depends on the quantum numbers for both directions

No, the answer is incorrect.
Score: 0
Accepted Answers:
Depends on the quantum numbers for both directions

8) For a particle in a two dimensional rectangular box with sides $L_1$ and $L_2$, the energy level expression for a state with quantum numbers $n_1$ and $n_2$ respectively, is given as

- $\frac{\hbar^2}{8mL_1L_2} (n_1^2 + n_2^2)$
- $\frac{\hbar^2}{8m} \left( \frac{n_1^2}{L_1^2} + \frac{n_2^2}{L_2^2} \right)$
- $\frac{\hbar^2}{8m} \left( \frac{L_1^2}{n_1^2} + \frac{L_2^2}{n_2^2} \right)$
- $\frac{\hbar^2}{8mL_1^2L_2^2} (n_1^2 + n_2^2)$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{\hbar^2}{8m} \left( \frac{n_1^2}{L_1^2} + \frac{n_2^2}{L_2^2} \right)$

9) Two wave functions for a particle in a two dimensional square box are given below.
The quantum number pairs (along x and y directions, respectively) are

- (33) and (22)
- (22) and (22)
- (13) and (22)
- (13) and (23)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(13) and (22)

The squares of two wave functions for a particle in a two dimensional square box are given below. The quantum number pairs (along x and y directions, respectively) are

- (21) and (23)
- (22) and (23)
- (21) and (33)
- (22) and (33)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(21) and (23)