Unit 3 - Week 1 - Introduction

Assignment - 1

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

Due on 2019-08-14, 23:59 IST.

1) Let a ball of mass 1g confined to a one-dimensional box of length 0.1m moves with a velocity of 0.01 m/s. If we calculate its quantum number n and the separation of consecutive energy levels (ΔE), we find: 1 point

- $n = 3 \times 10^{27}, \Delta E = 3.3 \times 10^{-35} J$
- $n = 3 \times 10^{-35}, \Delta E = 3.3 \times 10^{27} J$
- $n = 3, \Delta E = 3.3$
- $n = 3 \times 10^{27}, \Delta E = 0.3 \times 10^{27} J$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$n = 3 \times 10^{27}, \Delta E = 3.3 \times 10^{-35} J$

2) For a helium atom in a one dimensional box of length 1 nm , the value of the quantum numbers of the energy level corresponding to the energy of 450 K (Assuming $E=K_B T$) is: 1 point

- 19
- 27
- 33
- 47

No, the answer is incorrect.
Score: 0
Accepted Answers:
27

3) For a particle in one dimensional box, the spacing between successive energy levels : 1 point

- increase as energy (E) increase
- decrease as energy (E) increase
- remains constant with energy (E)
- does not follow a particular pattern

No, the answer is incorrect.
Score: 0
Accepted Answers:
increase as energy (E) increase

4) 1 point

For two Hermitian operators, A and B, if there exist two unitary operators: e^{iA} and $\frac{1+iB}{1-iB}$, then the two Hermitian operators, A and B, are related to each other as follows:

- $A = \tan\left(\frac{B}{2}\right)$
- $B = 1 + \cos^2\left(\frac{A}{2}\right)$
- $B = \tan\left(\frac{A}{2}\right)$
- $A = B^2$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$B = \tan\left(\frac{A}{2}\right)$

5) 1 point

We measure $|\psi\rangle = \alpha|0\rangle + \beta|1\rangle$ in the $|v\rangle, |v^{\perp}\rangle$ basis, where $|v\rangle = \frac{1}{\sqrt{2}}|0\rangle + \frac{1}{\sqrt{2}}|1\rangle$. What is the probability of measuring $|v\rangle$?

- $\frac{\alpha+\beta}{2}$
- $\frac{\alpha^2}{2} + \frac{\beta^2}{2}$
- $\frac{\alpha+\beta}{\sqrt{2}}$
- $\frac{(\alpha+\beta)^2}{2}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\frac{(\alpha+\beta)^2}{2}$

6) 1 point

Considering a harmonic oscillator model for H_2 and HD, and assuming the same force constants for both the molecules, the lowest energy state for H_2 is (tick the correct choice):

- Lower than that of HD
- Higher than that of HD
- Equal to that of HD
- Not related to that of HD

No, the answer is incorrect.
Score: 0
Accepted Answers:
Higher than that of HD

7) How many variables do the Schrodinger wave functions of He atom depends on ? 1 point

- 2
- 9
- 6
- 3

No, the answer is incorrect.
Score: 0
Accepted Answers:
9

8) 1 point

The electronic Hamiltonian for He atom in *atomic units* is:

- $H = -\frac{1}{2}\nabla^2 - \frac{1}{r}$
- $H = -\frac{1}{2}\left(\nabla_1^2 + \nabla_2^2\right) - \frac{2}{r_1} - \frac{2}{r_2} + \frac{1}{r_{12}}$
- $H = -\frac{1}{2}\left(\nabla_1^2 + \nabla_2^2\right) + \frac{2}{r_1} + \frac{2}{r_2} - \frac{1}{r_{12}}$
- $H = -\frac{1}{2}\left(\nabla_1^2 + \nabla_2^2\right) - \frac{2}{r_1} - \frac{2}{r_2}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$H = -\frac{1}{2}\left(\nabla_1^2 + \nabla_2^2\right) - \frac{2}{r_1} - \frac{2}{r_2} + \frac{1}{r_{12}}$

9) A node in an orbital represents 1 point

- an anti-bonding orbital
- barrier to electron motion at nuclear location
- a point or a plane wherein the wave function changes sign
- a plane of symmetry

No, the answer is incorrect.
Score: 0
Accepted Answers:
a point or a plane wherein the wave function changes sign

10) 1 point

Consider an excited state of He^+ ion having energy of -13.6 eV. If the z-component of orbital angular momentum of its electron in this state is $-\hbar$, logically the state is:

- $2p_{+1}$ state
- 2s state
- $2p_z$ state
- $2p_{-1}$ state

No, the answer is incorrect.
Score: 0
Accepted Answers:
$2p_{-1}$ state