Assignment 9

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

Due on 2018-10-17, 23:59 IST.

1) The Lagrange function for the minimization of energy of a system in the normalized quantum mechanical state $|\psi\rangle$ is

$$L = \langle \psi | H | \psi \rangle - E$$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$L = \langle \psi | H | \psi \rangle - E \langle \langle \psi | \psi \rangle - 1 \rangle$$

2) The first order correction to the energy of a Hamiltonian $H_0 + H_1$ with an eigenvalue $E_0$ and eigenvector $\psi_0$ for $H_0$, due to the perturbation term $H_1$ is

$$\langle \psi_0 | H_1 | \psi_0 \rangle$$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\langle \psi_0 | H_1 + H_0 | \psi_0 \rangle$$

$$\langle \psi_0 | H_1 | \psi_0 \rangle$$
the wavefunction corrected from zero order to

- first order
- second order
- third order
- fourth order

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

4) The perturbation Hamiltonian due to a potential energy term $V_0 x$ ($V_0$ is a constant) for a 1 point particle in a one dimensional box has the first order correction to the ground state energy of the particle given by

- $V_0$
- $V_0 L$
- $V_0 L^2$
- $\frac{V_0 L}{2}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
- $\frac{V_0 L}{2}$

5) The first order correction to the harmonic oscillator wavefunction in the ground state, due to 1 point a potential term is given by $V_0 x^3$ (where $V_0$ is a constant and 'x' the oscillator displacement coordinate)

- $V_0$
- $V_0^2$
- 0
- $\frac{V_0 L}{2}$

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

6) The second order correction to the ground state non-degenerate energy level due to a 1 point perturbation is

- Always negative
- Always zero
- Always positive
Can be positive or negative, but not zero.

No, the answer is incorrect.
Score: 0

Accepted Answers:
Always negative

7) For system with only two quantum states, a zero order Hamiltonian has 1 point
eigenvalues $E_1^{(0)}$ and $E_2^{(0)}$ and eigenvectors $\psi_1^{(0)}$ and $\psi_2^{(0)}$. The perturbing Hamiltonian matrix element is $\langle \psi_1^{(0)} | V | \psi_2^{(0)} \rangle$. The second correction $E_1^{(2)}$ to $E_1^{(0)}$ is given by the formula

$$
\langle \psi_1^{(0)} | V | \psi_2^{(0)} \rangle
$$

$$
\left| \langle \psi_1^{(0)} | V | \psi_2^{(0)} \rangle \right|^2
$$

$$
\left| \frac{\langle \psi_1^{(0)} | V | \psi_2^{(0)} \rangle}{E_2^{(0)}} \right|^2
$$

No, the answer is incorrect.
Score: 0

Accepted Answers:

8) For the system in Problem 7, the sum of second order corrections to $E_1^{(0)}$ and $E_2^{(0)}$ is 1 point

$$
2 \frac{\left| \langle \psi_1^{(0)} | V | \psi_2^{(0)} \rangle \right|^2}{E_1^{(0)} - E_2^{(0)}}
$$

$$
\left| \frac{\langle \psi_1^{(0)} | V | \psi_2^{(0)} \rangle}{E_2^{(0)}} \right|^2 + \left| \frac{\langle \psi_1^{(0)} | V | \psi_2^{(0)} \rangle}{E_1^{(0)}} \right|^2
$$

0

$$
\left| \frac{\langle \psi_1^{(0)} | V | \psi_2^{(0)} \rangle}{E_1^{(0)}} \right|^2 - \left| \frac{\langle \psi_1^{(0)} | V | \psi_2^{(0)} \rangle}{E_2^{(0)}} \right|^2
$$

No, the answer is incorrect.
Score: 0

Accepted Answers:

0

9) For the system in problem 7, the first order correction to the wave function $\psi_1^{(0)}$ is 1 point

$$
\frac{\langle \psi_1^{(0)} | V | \psi_2^{(0)} \rangle}{E_1^{(0)} - E_2^{(0)}} | \psi_1^{(0)} \rangle
$$
To calculate $n$th order correction ($n>3$) to the ground state zero order energy level $E^{(0)}_1$ one needs to know

- $n$th order correction to the ground state wave function $\psi^{(0)}_1$
- $(n-1)$th order correction to the ground state wave function $\psi^{(0)}_1$
- Second order correction to the ground state wave function $\psi^{(0)}_1$ is sufficient.
- First order correction to the ground state wave function $\psi^{(0)}_1$ is sufficient.

No, the answer is incorrect.
Score: 0

Accepted Answers:

$(n-1)$th order correction to the ground state wave function $\psi^{(0)}_1$