Unit 6 - Week 4 - NMR Quantum Computing

Course outline

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Assignment 4

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

Due on 2019-08-28, 23:59 IST.

1) When one solves the Schrödinger equation for a particle in a one-dimensional box, quantization of energy levels results when one imposes the criteria that the wavefunctions: *1 point*

- be normalized
- have n-1 nodes, where n is an integer
- be zero at the walls
- be mutually orthogonal

No, the answer is incorrect.
Score: 0

Accepted Answers:
be zero at the walls

2) Which of the following statements is/are true concerning tunneling? *1 point*

- The particle-in-a-box exhibits tunneling but the harmonic oscillator does not.
- The harmonic oscillator exhibits tunneling but the particle-in-a-box does not.
- Both the harmonic oscillator and the particle-in-a-box exhibit tunneling.
- In the harmonic oscillator, the probability of tunneling increases as quantum number increases.

No, the answer is incorrect.
Score: 0

Accepted Answers:
The harmonic oscillator exhibits tunneling but the particle-in-a-box does not.

3) According to quantum mechanics, in any single, ideal measurement of the observable property associated with operator Â, what values can be observed? *1 point*

- any value that is consistent with the uncertainty principle
- any value that is finite and satisfies the boundary conditions of the system
- the average of two or more eigenvalues of operator Â
- only one of the eigenvalues of operator Â

No, the answer is incorrect.
Score: 0

Accepted Answers:
only one of the eigenvalues of operator Â

4) Born-Oppenheimer approximation(BO) and the Frank-Condon principle (FC) correspond to the potential energy levels of ground and excited states and rely on the fact that *1 point*

- the nuclear mass is extremely large compared to the electronic mass
- Born Oppenheimer (BO) is for molecules, while FC is for atoms
- both are gross approximations and mostly fail
- BO is on a much faster time scale as compared to the FC principle

No, the answer is incorrect.
Score: 0

Accepted Answers:
the nuclear mass is extremely large compared to the electronic mass

5) NMR quantum computation works with ensembles where it is hard to produce pure states so, instead, pseudo pure states are used, each of which is defined as: *1 point*

- A system where every level has a different population
- A system with alternate spins
- A system where all but one level has equal populations
- A system where all spins are in the same direction

No, the answer is incorrect.
Score: 0

Accepted Answers:
A system where all but one level has equal populations

6) Which of the following is the major cause for the liquid NMR quantum computer to be not practically viable as the quantum computer of the future? *1 point*

- signal loss and is not scalable
- need a very low temperature
- small ensembles only
- efficient preparation process

No, the answer is incorrect.
Score: 0

Accepted Answers:
signal loss and is not scalable

7) Consider the projection operator: $\hat{P} = |j\rangle\langle j|$ such that the states form an orthonormal basis $\langle j|k\rangle = \delta_{jk}$. Given that $|\psi\rangle = \sum_k a_k |k\rangle$, which of the following relations is correct? *1 point*

- $\hat{P}_k = a_k|k\rangle$
- $\hat{P}_k^2 = \hat{P}_k$
- $\sum_k \hat{P}_k = 1$
- $\hat{P}_j^2 = \hat{P}_j\delta_{jk}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
$\hat{P}_j^2 = \hat{P}_j\delta_{jk}$

8) An electron is confined in the ground state in a one dimensional box of width 1 angstrom having an energy of 76 eV. The average force on the walls of the box when the electron is in the ground state is : *1 point*

- 7.6 N
- 2.44×10^{-7} N
- 0.38 N
- 0.38×10^{-7} N

No, the answer is incorrect.
Score: 0

Accepted Answers:
2.44×10^{-7} N

9) The amplitude of the zero-point oscillation for a pendulum of length $l = 1$ m and mass $m = 1$ kg can be calculated to be 4.1×10^{-18} m. Which of the following statements represent the above result in terms of the nature of the Quantum phenomena? *1 point*

- Quantum phenomena is wave like
- Quantum phenomena is particle like
- Quantum phenomena is often negligible in the macroscopic world
- Quantum phenomena is mathematically incorrect

No, the answer is incorrect.
Score: 0

Accepted Answers:
Quantum phenomena is often negligible in the macroscopic world

10) For a N -bit quantum computer, an ideal signal scale as: *1 point*

- $N \times 2^{-N}$
- exp(N)
- N^3
- N

No, the answer is incorrect.
Score: 0

Accepted Answers:
$N \times 2^{-N}$