JENPAS UG 2025 Quantum Theory Sample Questions with Solutions PDF

Check out the list of some important sample solved questions on Quantum Theory for the for JENPAS UG 2025 exam:

Question 1: What is the physical significance of the quantum number 'n'?

Answer: The principal quantum number 'n' determines the energy level or shell of an electron in an atom. It can take positive integer values (n = 1,2,3...). Larger 'n' indicates higher energy and larger orbital radius.

Explanation: Energy levels in an atom are quantised, and 'n' indexes these discrete energy levels obtained from solving the Schrödinger equation.

Question 2: State the Pauli Exclusion Principle.

Answer: No two electrons in an atom can have the same set of all four quantum numbers (n, l, m, s). Hence, each electron has a unique quantum state.

Explanation: This principle explains the arrangement of electrons in various orbitals and underlies the structure of the periodic table.

Question 3: Define the Heisenberg Uncertainty Principle.

Answer: It states that it is impossible to simultaneously measure the exact position (x) and momentum (p) of a particle with perfect accuracy. Mathematically, $\Delta x \Delta p \geq 2/\hbar$.

Explanation: This underlines the fundamental limit of measurement in quantum mechanics.

Question 4: What is the significance of the wavefunction ψ in Quantum Mechanics?

Answer: The square of the wavefunction $|\psi|^2$ gives the probability density of finding a particle at a particular position.

Explanation: The wavefunction does not represent the particle itself but the probability distribution of its location.

Question 5: Which of the following sets of quantum numbers is not allowed: (n=2, l=2, m=0, s=+1/2)?

Answer: Not allowed. Because for n=2, l can be 0 or 1 only. l=2 is invalid.

Explanation: Quantum number rules: $0 \leq l \leq n-1$.

Question 6: What is the described behaviour of an electron according to Bohr's model?

Answer: The electron moves in fixed orbits around the nucleus with quantized angular momentum, $L=n\hbar$.

Explanation: This model introduced quantized energy levels to explain the hydrogen atom spectra.

Question 7: Write down the time-independent Schrödinger equation.

Answer: $H\psi = E\psi$
Where H is the Hamiltonian operator, E the energy eigenvalue, and ψ the wavefunction.

Explanation: Fundamental equation for non-relativistic quantum systems.

Question 8: Explain the concept of quantum tunnelling.

Answer: Quantum tunnelling allows a particle to pass through a potential barrier higher than its energy, forbidden in classical mechanics.

Explanation: It has real-world applications, such as in semiconductors and nuclear fusion.

Question 9: Find the spin quantum number of an electron.

Answer: Spin quantum number s can be ± ½ .

Explanation: It indicates the intrinsic angular momentum of the electron.

Question 10: Define orbital quantum number l.

Answer: It determines the shape of the orbital, with integral values between 0 and n−1.

Explanation: Values correspond to s, p, d, f orbitals.