

Quantum Mechanics

Quiz-II

16th November 2020 || Time 40 Mins

- You must upload your solutions by 3:45 pm.
- If (and only if) you face difficulty in uploading, mail them to subhadip.mitra@iiit.ac.in with a cc to arvind.bhaskar@research.iiit.ac.in. The subject of the mail should be “QM:Quiz <Your roll number> <Your name>”.
- If you face difficulty with your connection, you must alert us before 3:30 pm by either calling me at +91-988-574-8328 or Arvind at +91-892-075-0635 or sending an SMS to any of our numbers.
- You don't have to write a lot, but try to put some details to show that you understand what you are writing.

1. Suppose a particle with charge q and mass m is oscillating under $V(x) = \frac{1}{2}m\omega^2 x^2$. Suddenly a tiny electric field E in the +ve x direction is turned on. Find the first and second order corrections to the n^{th} state.
2. Write down the wave function of a three-fermion system $\psi(x_A, x_B, x_C)$ trapped in an infinite square well (one-dim.) where the first one is in the state ψ_5 , the second one is in ψ_6 , and the third one is in ψ_7 .
3. What is the Fermi energy for noninteracting spin-3/2 (i.e., $s = 3/2$) fermions in a two dimensional infinite square well. Let Γ be the number density (number/area) of these fermions.
4. Use the variational principle to show that the first-order non-degenerate perturbation theory never underestimates the ground state energy.
5. Electrons are fermions, yet they can form covalent bonds. How?