(1) (a) A particle is confined to a one-dimensional regime. If the spatial part of the wave function of the particle is $\psi(x) = Asin(5\pi x)$ and the energy of the particle is 1 ev, calculate the ground and the first excited state energy and the wave functions. (b) What is the momentum of the particle in the ground state. (c) Is the momentum well defined?? (d) If the probability of finding the particle in the ground state is twice the probability of finding it in the first excited state, write down the total wave function of the particle. You do not need to calculate the overall normalization constant.

(2) Consider a particle of energy 5 ev, that hits a barrier of height 10 ev, and width 1 cm. Assuming the mass of the particle to be unity, write down the wave function of the particle in each regime and calculate the reflection and transmission coefficient of the particle. How would your answer change, if the energy of the particle is 15 ev??

(3) Consider a H-atom in the first excited state that is spherically symmetric. (a) What is the energy and the wave functions of the particle. (b) Calculate the distance from the center, where
the particle is most likely to be found.

(4) Consider two noninteracting particles in one-dimensional harmonic oscillator potential. What is the total ground state wave function of the system if
(a) one particle is electron and other is proton
(b) Both the particles are electrons
(c) Both the particles are neutrons
(d) Both the particles are photons

(5) True or False
(a) A possible ground state wave function of a two-dimensional simple harmonic oscillator is \( Ae^{-(x^2+y^2)} \).
(b) A possible ground state wave function of a particle in a two-dimensional box is \( Acos(3x) + Bcos(5x) \).
(c) H-atom in the first excited state is always most likely to be found at Bohr orbits.
(d) Solutions of the Schroedinger equation can be real.