1. Calculate the coefficient B in the wave function of the step potential by using the continuity of the logarithmic derivative at the boundary point $x = 0$. Does the continuity of the logarithmic derivative determine the coefficient C also?

2. A particle has energy E and scatters from a one-dimensional potential step of height $V_0 < E$.
   a) Show that the probability density oscillates in the region I, but is a constant in the region II (use the same region numbering as in the lectures).
   b) What is the wave length of the oscillations?

3. Show that the eigenstates of the free particle Hamiltonian do not need to be symmetric or antisymmetric functions, but also a mixed symmetry state is an eigenfunction of that Hamiltonian.
   Why can we not apply the proven statement: *If the potential in one dimensional Schrödinger equation is symmetric and the eigenstate is non-degenerate, then the eigenstate is either a symmetric or an antisymmetric function.*

4. Show that a one-dimensional finite potential well always has at least one bound state.
   One version of the proof is based on the intermediate value theorem.

5. An electron is in the ground state of a one-dimensional potential well. The depth of the potential well is 2 eV and the width 1 Å. What is the binding energy of the electron?