1. Let us consider a step potential and use the same notation as in the lecture notes. Calculate the coefficient B appearing in the wave function 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 with energy E scatters from a one-dimensional potential step of height $V_0 < E$.
   a) Show that the probability density oscillates in region I, but is a constant in region II (use the same region numbering as in the lectures).
   b) What is the wave length of the oscillations?

3. Show that the free particle Hamiltonian has eigenfunctions which are neither symmetric nor antisymmetric. Does this somehow contradict the proven statement: *If the potential in a one-dimensional Schrödinger equation is symmetric and an eigenvalue is non-degenerate, then the corresponding eigenfunction is either symmetric or antisymmetric.*

4. Show that a one-dimensional finite potential well always has at least one bound state.
   Hint: 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?