PHYS 454
HANDOUT 6 – *Continuous spectrum in square wells*

1. The wave function of an electron that executes an one-dimensional motion along x has, at a certain moment, the form

$$\psi = e^{2ix}$$

where x is measured in $\overset{o}{A}$. A) What is the wavelength of this electron? B) What is the electron's velocity?

2. In a region just before a potential step the solution of the Schrödinger equation is written as:

$$\psi_{\mathrm{A}} = 5e^{4ix} + 3e^{-4ix}.$$

What is the percentage of particles, which is reflected?

3. Two particles with energies $E_1 = 2eV$ and $E_2 = 4eV$ are directed towards a potential step of height $V_0 = 1eV$. Which of them has the largest reflection probability?

4. A proton and an electron of the same energy $E = 2\mathrm{MeV}$ are headed towards a potential step of height $V_0 = 1\mathrm{MeV}$. Which of them has the largest reflection probability?

5. A beam of particles of energy $E = 9$ eV is directed towards a potential step and 25% of its particles are reflected. What is the "height" V_0 of this potential?

6. Consider the potential of the following form:

$$V(x) = \begin{cases} 0 & x < 0 \\ -V_0 & x \geq 0 \end{cases}$$

a) A particle with mass m comes from the left with a kinetic energy $E>0$. What is the reflection probability if $E = V_0 / 3$?

b) When a free neutron enters a nucleus, it experiences a sudden drop in potential energy, from $V=0$ outside to around -12 MeV. Supposes a neutron, emitted with kinetic energy 4 MeV by a fission event, strikes such a nucleus. What is the probability it will be absorbed, thereby initiating another fission?

7. Calculate the transmission and the reflection coefficients of a particle having total energy E, at the potential barrier given by:

$$V(x) = \begin{cases} 0 & x < 0 \\ V_0 & 0 < x < a \\ 0 & x \geq a \end{cases}$$

For the cases $E > V_0$ and $0 < E < V_0$.