Recitation #7
Quantum 521

1. Consider scattering off of a step-up potential with $E < V_0$. We found the reflected wave amplitude to be

$$B = \frac{k - iq}{k + iq}$$

where $\hbar k = \sqrt{2mE}$ and $\hbar q = \sqrt{2m(V_0 - E)}$

a) Show that $B = e^{i\phi}$, a pure phase. Write the wave functions before ψ_- and after ψ_+ the step (at $x = 0$) in terms of ϕ.

b) Find the mean (1/e) penetration depth (in nm) into the barrier for an electron with $E = V_0/2$, $V_0 = 8$ eV. (Numbers are simple so you do not need a calculator).

c) Find ϕ and $\psi_\pm$ in the limit $E \ll V_0$. (Be careful evaluating the $\tan^{-1}$)

2. Neutron absorption can be modeled as a collision with a step down potential.

$V(x) = 0 \quad x < 0$
$V(x) = -V_0 \quad x > 0$

Calculate the neutron absorption probability as the probability for transmission through the barrier. Take E = 4 MeV and V_0 = 12 MeV.

3. Consider the square double well potential shown in the figure. Sketch the ground state and first excited state wave functions for the two cases $b \approx a$ and $b \gg a$. Based on the curvature of the wave function, argue that the symmetric state is the ground state.

$$\mathrm{KE} = \frac{-\hbar^2}{2\mathrm{m}} \langle \frac{\mathrm{d}^2}{\mathrm{dx}^2} \rangle$$

Sketch the corresponing energies E_1, E_2 as functions of b on the same graph.

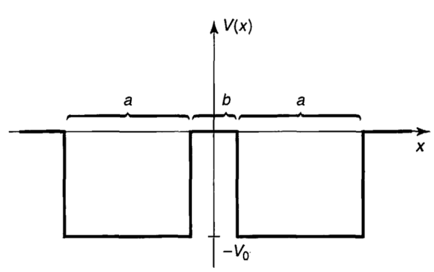

Figure 1: square double well potential (from Griffiths)