QUANTUM MECHANICS III

PHYS 518

Problem Set # 3

Distributed: Oct. 18, 2013

Due: Oct. 25, 2013

1. Scattering: The barrier shown in the inset consists of three potentials of height $V = 5$ eV and width $D = 2\mathring{A}$, separated by $L = 6\mathring{A}$. Compute (reproduce) the transmission spectrum for $0 < E < 10$ eV.

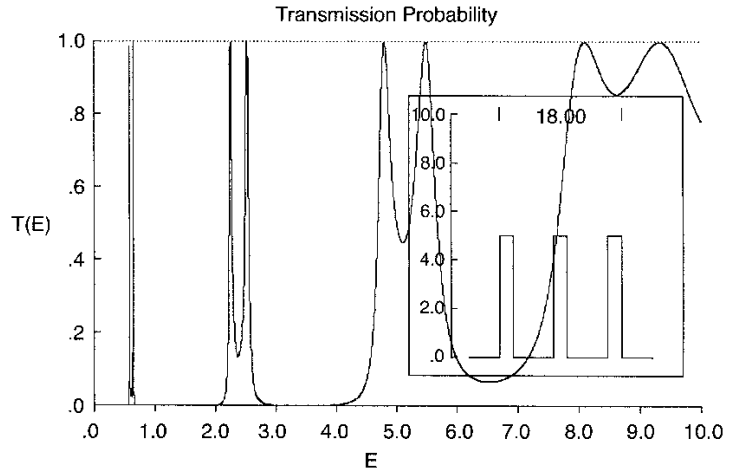

Figure 1: Transmission probability spectrum for three identical barriers with $V = 5$ eV, $D = 2\mathring{A}$, and $L = 6\mathring{A}$. Each peak is a doublet.

2. Binding: Two potential wells have a depth of $V = 5$ eV and a width of $6\mathring{A}$. They are separated by a barrier of width $2\mathring{A}$. The barrier and the

asymptotic potentials on the left and right are the same: you can choose this value to make your life simple (peek at Problem #4). Compute the energies at which there are bound states. Provide a rough sketch of what each bound state eigenfunction looks like (no need for computations if you know what's going on).

3. Periodic Potential and Energy Bands/Gaps: An "atomic potential" has a central region of width $6\mathring{A}$ at $V = 0$ eV and is surrounded by regions of width $1\mathring{A}$ on the left and right at $V = 5$ eV. Compute the edges of the energy bands in the range $0 < E < 20$ eV. (Yes, there are allowed bands and forbidden gaps in the scattering region above $E = 5$ eV.)

4. Comparison: Compare the locations of the transmission peaks (Problem #1) with the locations of the bound state energies (Problem #2) and the allowed energy bands (Problem #3). Write a paragraph expressing your amazement (or explaining to me why these results are so obvious this Problem Set was a waste of your time).