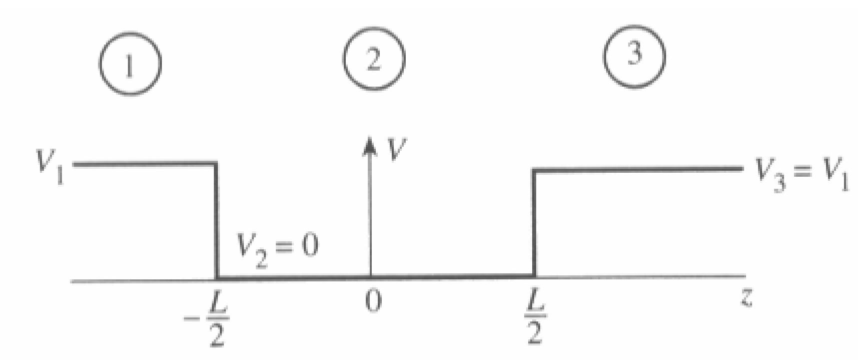
ECE 3080 Homework 2

1.) An electron is contained in a FINITE potential well as shown below. As discussed in class, the finite potential barriers result in the electron wave function penetrating in to the barriers a small distance. Use the Schrödinger equation to solve for the allowable energy values inside the well for a.) Electron wave function solution for electron energy, $E>V_1$ and b.) Use a well width, L=5 angstroms and potential, V1=1.6e-18 Joules (10 eV), to find the Electron energy, $E<V_1$.

Hints for part a: Very similar to what was done in class. There is no need to find all the coefficients.

Hints for part b: Assume a symmetric solution in region 2 of the General form: Ψ=Acos(kz) (actually there are also asymmetric solutions of the form, Ψ=Asin(kz), but we will ignore those in this homework). Use the normalization condition to show that the wave function must be finite at +/- infinity, thus eliminating two coefficients from the total number of general solution coefficients. Then use the continuity of the wave function and continuity of it's derivative as it passes through a boundary to solve for the remaining coefficients. Your final answer will be a transcendental equation in energy (what you are asked to find) and may be solved numerically or graphically for a series of allowable energy values.



2.) Describe the effect of band curvature on the effective mass.
3.) Describe the effect of band slope on the particle velocity.
4.) What is the effect of confining a particle in a localized region as opposed to allowing it to travel throughout free space? Explain by drawing an E-k relationship for both cases.
5.) How is a direct bandgap material different from an indirect bandgap material.
6.) If a state is above the fermi energy, is it likely to be empty or filled?
7.) Briefly describe the various ways a quantum particle can be reflected or transmitted at a potential barrier.