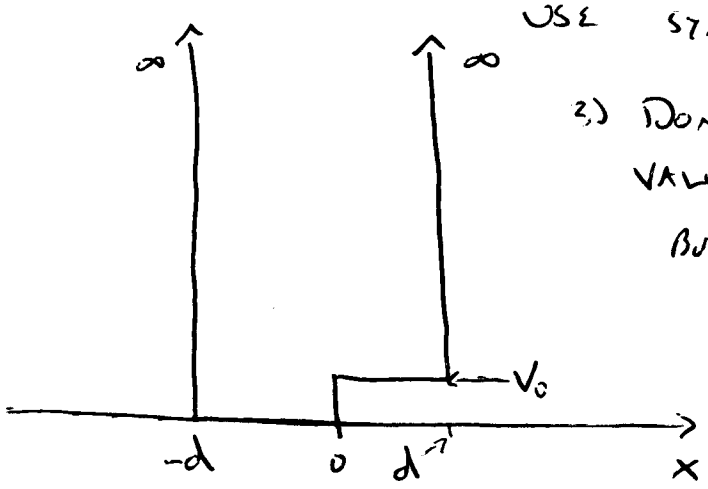
Homework #2

1) A) Find the first two eigen energies and wavefunctions for the following quantum structure

Notes: 1) Assume $E_1 > V_0$

2) System is <u>NOT</u> symmetric, can't use symmetry arguments!

3) Don't bother finding exact values for norm. coefficients, but explain how you would find these...



Solve symbolically, then use

$d = 1$ nm

$m = 1 \times 10^{-31}$ kg

$V_0 = 200$meV

to find solutions.

B) Find ψ_1, ψ_2, E_1, E_2 for $V_0 = 0$, How do these solutions compare to your solutions in (A)?

2) MOST QUANTUM SYSTEMS ARE NOT 1-D.

IMAGINE YOU HAVE A "QUANTUM BOX"

OF SIZE L_x, L_y, L_z, WITH INFINITE POTENTIAL WALLS.

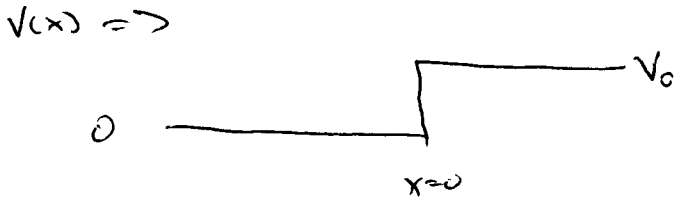
A) FIND THE GENERAL SOLUTIONS TO THIS QUANTUM STRUCTURE.

☆ ASSUME YOU CAN WRITE $\psi(x,y,z) = \psi_x(x)\psi_y(y)\psi_z(z)$

B) IF $L_x = 10\,nm \quad L_y = 35\,nm \quad L_z = 20\,nm$

FIND THE FIRST 5 EIGENENERGIES (5 LOWEST E's)

3) IMAGINE YOU HAVE THE FOLLOWING POTENTIAL:



THE ψ for a free electron is

$\sim e^{ikx}$ -> moving left to right

$\sim e^{-ikx}$ -> moving right to left

ASSUME THAT ψ for $x<0$ HAS COMPONENTS MOVING BOTH TO THE LEFT & RIGHT, BUT ψ for $x>0$ HAS ONLY COMPONENT MOVING LEFT TO RIGT.

FIND ψ's FOR $E < V_0$, $E > V_0$