Quantum Mechanics II

Homework Assignment 1

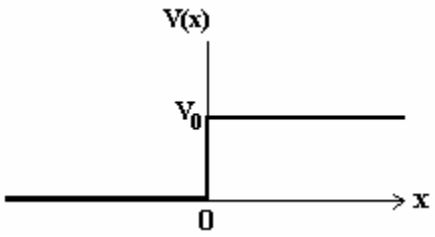
1. Suppose you have bra- and ket- vectors. (They are not necessarily physically plausible.) $\langle a| = (110)$, and $|b\rangle = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}$.

- **a.** Calculate $\langle a|b\rangle$ and $|a\rangle\langle b|$. Then discuss the quantum mechanical interpretation of each result.
- **b.** In part a., you symbolically interpret the meaning of $\langle a|b\rangle$ and $|a\rangle\langle b|$. However, as mentioned above, they do not express actual quantum mechanics. Why is that? Answer the following question: if the braket vectors are from some physical (measurable) system, what should the results in part a. be?

2. You have a following equation: $A\vec{u} = \lambda\vec{u}$. This is called the eigen equation. One obvious solution is $\vec{u} = \vec{0}$. However, the aim of this equation is to find the non-trivial solution, which means $\vec{u} \neq \vec{0}$.

- **a.** When $A = \begin{pmatrix} 1 & 1 \\ -3 & 5 \end{pmatrix}$, find λ and $\vec{u} = \begin{pmatrix} x \\ y \end{pmatrix}$.
- **b.** Compare the above equation with Schrödinger equation, and then interpret A, λ, and $\vec{u}$ in terms of quantum mechanics.

3. Think about the following potential. The incident beam is directed from right to left side in the figure. When $E > V_0$,



- **a.** Set up the Schrödinger equation for each region.
- **b.** Find the wave function for each region.
- **c.** Solve for energy value for each region in terms of momentum.
- **d.** Conceptually summarize how to solve a Schrödinger equation.