PHYS 3701 - Assignment #5
Due Wednesday March 18, 2015

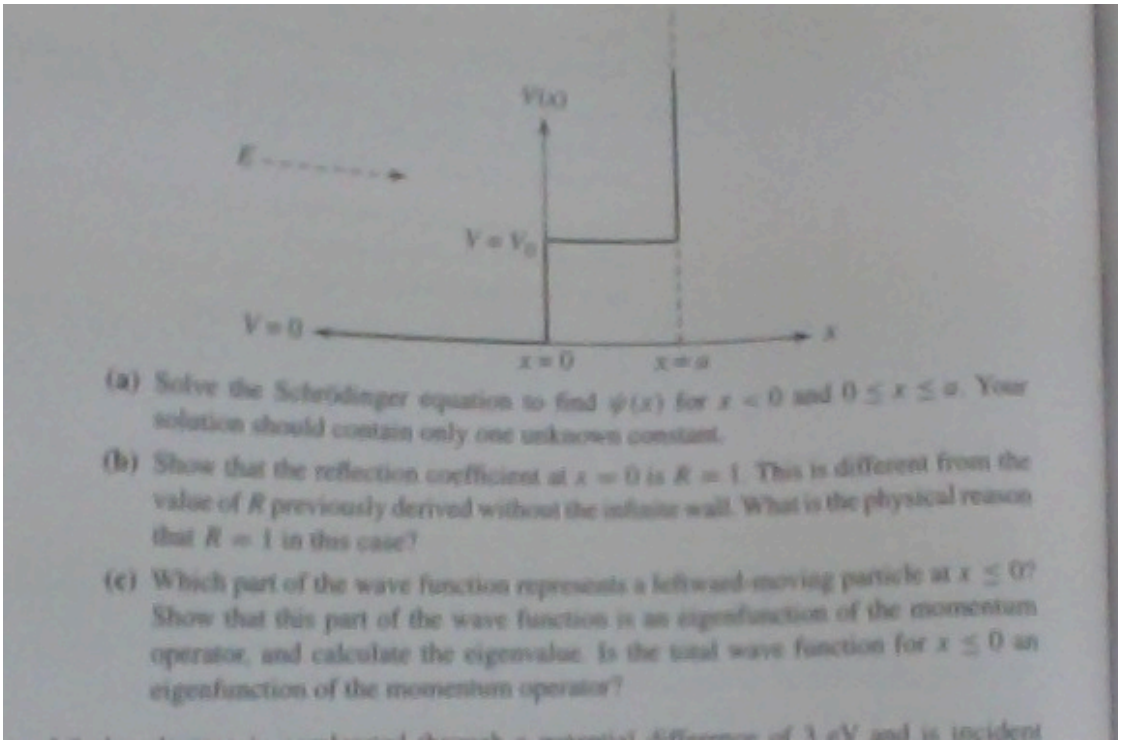
1. a) Determine the momentum-space wavefunction for the ground state of the quantum harmonic oscillator.

   b) Determine the momentum-space wavefunction for the n^{th} energy eigenstate of the infinite square well.

   c) Determine $|\Phi(p,t)|^2$ for both cases.

2. Consider the wave function $\psi(x,0) = \dfrac{A}{x^2 + a^2}$ with constants A and a.
   a) Normalize the wavefunction.
   b) Determine $\Phi(p,0)$.
   c) Check the Heisenberg uncertainty principle for this state.

3. Scherrer Chapter 4 question #5



(a) Solve the Schrödinger equation to find $\psi(x)$ for $x < 0$ and $0 \le x \le a$. Your solution should contain only one unknown constant.

(b) Show that the reflection coefficient at $x = 0$ is $R = 1$. This is different from the value of R previously derived without the infinite wall. What is the physical reason that $R = 1$ in this case?

(c) Which part of the wave function represents a leftward-moving particle at $x \le 0$? Show that this part of the wave function is an eigenfunction of the momentum operator, and calculate the eigenvalue. Is the total wave function for $x \le 0$ an eigenfunction of the momentum operator?