PH 451: Capstone in Quantum Mechanics Homework 1 Due 1/12/11

1) (McIntyre 2.17) A spin-1 particle is in the state

$$|\psi\rangle \doteq \frac{1}{\sqrt{30}} \begin{pmatrix} 1\\ 2\\ 5i \end{pmatrix}$$

- a) What are the possible results of a measurement of the spin component S_z , and with what probabilities would they occur? Calculate the expectation value of the spin component S_z .
- b) Calculate the expectation value of the spin component S_x . Suggestion: Use matrix mechanics to evaluate the expectation value.
- 2) (McIntyre 5.11) A particle is in the ground state of an infinite square well. The potential wall at x = L suddenly moves to x = 3L such that the well is now three times its original size. Find the probabilities that the particle is measured to have the ground state energy or the first excited state energy of the new well.
- 3) (McIntyre 8.7) Calculate the probability that the electron is measured to be in the classically forbidden region for the n=2 states of hydrogen. Discuss the differences between the results for the $\ell = 0$ and $\ell = 1$ states.