# Quantum Mechanics Fall 2003- Test One In Class

**Problem 1** You are given the state of a system $|\psi>$ over a basis $\{|1>, |2> , |3>, |4>\}$. You are given the Hamiltonian $\hat{H}$ and the operator $\hat{A}$ in that basis. Describe everything you could calculate from this information.

**Problem 2** As precisely as possible, state what an uncertainty principle means. How do the commutation properties the operators representing the physical quantities affect uncertainty?

**Problem 3** Consider a 2 state system spanned by the vectors $\{|1>, |2>\}$. The hamiltonian of the system (in this basis is),

$$\hat{H} = \hbar\omega \begin{pmatrix} 2 & -i \\ i & 2 \end{pmatrix}$$

$$\hat{A} = \begin{pmatrix} 2a & 0 \\ 0 & 3a \end{pmatrix}$$

The system is in state $|\psi(0)>= |2>$ at time $t = 0$.

**(a)** Calculate $|\psi(t)>$

**(b)** If the energy of the system is measured what are the possible outcomes for this state vector and with what probabilities? Report values at all time.

**(c)** If $\hat{A}$ is measured, what are the possible outcomes with what probabilities as a function of time?

**(d)** At time $t = 0$, calculate the uncertainty in an observation of the energy.

**(e)** Calculate the expectation value of $\hat{A}$ as a function of time.