QUANTUM PHYSICS I

PROBLEM SET 6

due December 5th, before class

THREE-LEVEL SYSTEM

The goal of this problem is to generalize what we did in class with the two-level system (as a model of covalent bonding) to a three-level system. Consider the hamiltonian $\hat{H} = E_0(|a\rangle\langle a| + |b\rangle\langle b| + |c\rangle\langle c|) + T(|a\rangle\langle b| + |b\rangle\langle a| + |b\rangle\langle c| + |c\rangle\langle b| + |c\rangle\langle a| + |a\rangle\langle c|)$, where $\{|a\rangle, |b\rangle, |c\rangle\}$ form an orthonormal basis.

1. Find the three energy eigenvalues. Sketch the value of the eigenvalues as a function of T (for fixed E_0).
2. Find the three energy eigenstates.
3. Suppose the system is, at the initial time $t = 0$ on the state $|t = 0\rangle = |a\rangle$. What is the probability of finding it on position b at some time t later.
4. Suppose that, at time t, the "position" is measured and we find the system to be at "position" b. What is the state of the system immediately after the measurement. Then, suppose the energy is measured immediately after t. What is the probability of finding the system in the ground state ? Now we make a third measurement and measure the position again. What is the probability of finding the position a ? This phenomenon is called *regeneration*, can you see why ?