

PHYS 331 Homework 12

9 December 2011

Problem 1. (10 points) Problem 5.2.

Comment: Here you apply the results of problem 5.1 (which we discussed in class) to particular cases. You should see that our simplification in chapter 4 didn't affect the numerical values for the hydrogen atom too much. In other cases you see it is very important to include both particles.

Problem 2. (10 points) Problem 5.5.

Comment: As usual as we study new systems in quantum mechanics we reuse what we have learned. In this case we write down a two particle Hamiltonian and solve it for various energy states.

Problem 3. (10 points) Problem 5.6.

Comment: Here you calculate the effect of the "exchange force" in the specific case of the infinite square well.

Problem 4. (5 points) Problem 5.33.

Comment: Here you explore the implications of statistics of different types of particles. The number of allowed states for different types of particles can be very different and has important physical implications.

Problem 5. (10 points) Problem 5.22.

Comment: Here you get practice constructing wave functions from three particle states. This is important in particle physics. Protons and neutrons, for example, are fermions constructed from three other fermions (quarks). Thus symmetry plays a role in the spin configurations, *etc.* that are allowed for the quarks.

Problem 6. (10 points) Problem 5.23.

Comment: Here we again work with a known system (harmonic oscillator) to explore the configurations allowed for three particles in thermal equilibrium with a fixed total energy. The study of many particles is where statistical mechanics takes over and we stop thinking about explicitly building the complete state from individual particle state.

Problem 7. (10 points) Problem 5.32.

Comment: Particles being distinguishable, identical bosons, or identical fermions has very important consequences for the allowed states of multiparticle systems and leads to observable effects. Here we see how it affects one expectation value for the simple case of a harmonic oscillator.