Homework Assignment #2
PS405
Atomic & Nuclear Physics

Due: Wed. September 7, 2016

September 3, 2016

1. It is possible to construct an eigenfunction that satisfies the time-independent Schrodinger equation, and yet has the acceptable property that its probability density does not change by a relabeling of the particles. In fact, there are two ways of doing this. Consider the following two linear combinations:

   Symmetric $\psi_S = A(\psi_a(1)\psi_b(2) + \psi_b(1)\psi_a(2))$ and

   Antisymmetric $\psi_A = A(\psi_a(1)\psi_b(2) - \psi_b(1)\psi_a(2))$

   Show that the normalization constant A for ψ_S and ψ_A is $\frac{1}{\sqrt{2}}$.

   Note: You should not have to do any integration if you use the "bra"-"ket" notation, and assume that the single-particle wave functions are ortho-normal.

2. There are two identical non-interacting particles confined in an infinitely-deep one-dimensional potential well of length L. One particle is in the *n=2* state and the other particle is in the *n=1* state.

   Calculate their mean separation as defined by the following: $\langle |x_1 - x_2| \rangle$

a. If the total wave function for the two-particle system is described by ψ_S .
Symmetric

$\langle |x_1 - x_2| \rangle_S =$ __________ L

b. If the total wave function for the two-particle system is described by ψ_A .
Antisymmetric

$\langle |x_1 - x_2| \rangle_A =$ __________ L

c. If the total wave function for the two-particle system is described by ψ_D .
Distinguishable

$\langle |x_1 - x_2| \rangle_D =$ __________ L