PHY3063 Spring 2017

HOMEWORK H

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Due: April 13, 2017

HW 1: A particle is confined to a three dimensional box that has $L_1, L_2 = 2L_1, L_3 = 3L_1$. Give the sets of quantum numbers $(n_1, n2, n_3)$ that correspond to the lowest 3 energy levels. Are there any degenerate levels?

HW 2: Harris 7-24.

HW 3: For $\ell = 2$ of a hydrogen atom (a) What is the minimum value of $L_t^2 = L_x^2 + L_y^2$? (b) What is the maximum value of L_t^2? (c) What is L_t^2 for $\ell = 2, m = 1$? (d) What is the minimum value of n that this state can have?

HW 4: If $n = 3$ for a hydrogen atom, (a) What are the possible values of ℓ? (b) Considering the the fact that there are two quantum states for each quantum state because of electron spin, find the total number of electron states with $n = 3$.

HW 5: A hydrogen atom is in $6f$ state. What are the values of n and ℓ? Compute the energy and $|\vec{L}|$.

HW 6: Harris 7-40.

HW 7: The radial probability distribution function for the hydrogen ground state state can be written $P(r) = Cr^2e^{-2r/a_o}$ where C is a constant and a_o is the Bohr radius. Where is the maximum of $P(r)$?.

HW 8: Five identical non-interacting particles are placed in an infinite square well with L. Compare the lowest total energy for the case of fermions and bosons assuming they all have mass m.

HW 9: Harris 8-25.
If you calculate the speed (u) by simply calculating the angular momentum ($\hbar$) of a point mass circulating, it will produce an outrageous speed. Therefore $\frac{p}{m} = \gamma_u u$ with a very large γ.

HW 10: Harris 8-34.

HW 11: Harris 8-11.
For a wavefunction $\psi(x_1, x_2) = Ae^{-bx_1^2/2}Bx_2e^{-bx_2^2/2}$, the normalization condition will produce $|A|^2|B|^2 \int_{-\infty}^{+\infty} e^{-bx_1^2}dx_1 \int_{-\infty}^{+\infty} x_2e^{-bx_2^2}dx_2 = 1$.