Assignment - 9
Course: PHYS 304 - Introduction to Quantum Mechanics Instructor: Dr. Ke Zou

Problem 1
Review Example in 4.1 in the 3rd edition of Griffiths (infinte spherical well) and then:

a) What is the key difference in how the angular part of the solutions to the general Schrödinger Equation are obtained in this case, versus the hydrogen atom case?

(b) What is the key difference in how the radial part of the solutions to the general Schrödinger Equation are obtained in this case, versus the Hydrogen atom case?

(c) What are two major distinguishing characteristics of the spectra for the infinite spherical well (Fig. 4.3) and the Hydrogen atom (Fig. 4.6)?

Problem 2
Griffiths 4.12. Work out the radial wave functions R_{30}, R_{31} and R_{32}, using the recursion formula (Equation 4.76). Don't bother to normalize then.

Problem 3
Griffiths 4.15

(a) Find $\langle r \rangle$ and $\langle r^2 \rangle$ for an electron in the ground state of hydrogen. Express your answers in terms of the Bohr radius.

(b) Find $\langle x \rangle$ and $\langle x^2 \rangle$ for an electron in the ground state of hydrogen. *Hint: This requires no new integration-note that $r^2 = x^2 + y^2 + z^2$, and exploit the symmetry of the ground state.*

(c) Find $\langle x^2 \rangle$ in the state $n = 2, \ell = 1, m = 1$. *Hint this state is not symmetrical in x, y, z. Use $x = r \sin\theta \cos\phi$.*

Problem 4
Griffiths 4.17 Calculate $\langle z\hat{H}z \rangle$, in the ground state of hydrogen. *Hint: This takes two pages and six integrals, or four lines and no integrals, depending on how you set it up. To do it the quick way, start by noting that $[z, [H, z]] = 2zHz - Hz^2 - z^2H$*