Physics 237 Due: April 8, 2022
Homework Set # 9 12.00 pm

Write the following text on the front cover of your homework assignment and sign it. If the text is missing, 20 points will be subtracted from your homework grade.

Honor Pledge for Graded Assignments
"I affirm that I have not given or received any unauthorized help on this assignment, and that this work is my own."

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Signature _____

1. Chapter 10, Problem 5 (page 372).
2. Chapter 10, Problem 11 (page 373).
3. Chapter 10, Problem 15 (page 373).
4. Chapter 10, Problem 16 (page 373).
5. Chapter 10, Problem 17 (page 373).

6. **20 points extra credit:** In Chapter 9 we discussed the effect of Coulomb repulsion on the energy levels of the Helium atom. Use Mathematica to calculate the Coulomb repulsion between the electrons in the Helium atom for the following two configurations (see Figure 9.7):

   a. The ground state of Helium ($n = 1,\ \ell = 0\ ,\ n = 1,\ \ell = 0$)

   b. The first excited state of Helium ($n = 1,\ \ell = 0\ ,\ n = 2,\ \ell = 0$)

   To carry out this calculation, use the following procedure:

   1. Obtained the wavefunctions for each electron from Table 7.2.
   2. Construct the appropriate total wavefunction of the state with the proper spatial symmetry.
   3. The position of electron 1 is specified by 3 spatial coordinates; the position of electron 2 is specified by 3 other spatial coordinates. The distance between the two electrons, Δr, depends on these 6 spatial coordinates.
   4. To calculate the Coulomb repulsion, determine the expectation value of $1/\Delta r$. Note: this requires and integration of over the 6 spatial coordinates.

   In order to receive the extra credit, you should create a Mathematica Notebook, showing on the relevant calculations, and submit it electronically to Prof. Wolfs at wolfs@pas.rochester.edu. The name of the file should be hw09p06XXYYYYYYYY.nb where XX are your initials and YYYYYYYY is your student id number. The subject of the email should start with hw09p06XXYYYYYYYY.