Physics 115C Second Problem Set

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1. (a) Use the spreadsheet available on the course web page (`power.xls`) to evaluate the first three bound state energies with $\ell = 0$, (E_1, E_2, E_3), for power law potentials:

    i. $s = 4$.
    ii. $s = 1/2$
    iii. $s = -1/2$

   (b) Plot $R = (E_3 - E_2)/(E_2 - E_1)$ versus s, and include the analytic values for $s = 2$, $s = -1$, and the limit of $s \to \infty$.

2. Sometimes in physics the attractive potential $V(\rho) = -e^{-\alpha\rho}/\rho$ arises, for example due to the weak interaction. Here, we use the 'power law' length scale from page 10 of the notes for $s = -1$ to make the Schrodinger equation dimensionless.

   If α is large enough, there is not even one bound state for this potential. Use the spreadsheet (`power.xls`) to determine the largest α that has a bound state. Assume that $\ell = 0$.

3. Prove the relationship 13.3.16 on page 365 of your text, but generalize it for the Bohr atom with arbitrary n. You will want to read the part of section 13.3 from page 361 through 366, which will not be covered in class.