Physics 137B Homework 4

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February 25, 2024

Question 1: Expectation of the Hydrogen atom

(a) Treating $\lambda = e$, derive the expression $\langle 1/r \rangle_{nl}$.

(b) Treating $\lambda = l$, derive the expression $\langle 1/r \rangle_{nl}$.

Solution:
For this question, we will need to use the Feynman-Hellman Theorem

$$\boxed{\frac{\partial_n E(\lambda)}{\partial \lambda}\bigg|_{\lambda=0} = \langle \psi_n(\lambda) | \frac{\partial \hat{H}}{\partial \lambda} | \psi_n(\lambda) \rangle \bigg|_{\lambda=0}}$$

and the radial
