Physics 852 **Problem Set 2** **Spring 2023**

NOTE: All problem numbers from Sakurai correspond to the 3^{rd} Edition.

1. Sakurai 5.1

2. Sakurai 5.7

3. For the same Hamiltonian with the perturbation of Sakurai 5.7(b), calculate the second order correction to the ground state energy and compare to the exact solution that you found in Sakurai 5.7(c).

4. Sakurai 5.16

   Hint: Assume $R \ll a_0$. You will first need to find $V(r)$ for the uniformly charged sphere, both for $r < R$ and $r \geq R$. Then let $H = H_0 + H'$, with $H_0 = \vec{p}^2/(2m) + V_c(r)$ and $H' = V(r) - V_c(r)$, where $V_c(r) = -e^2/r$ is the coulomb potential for a point-like proton.