This problem will be collected in class on Nov. 23.

Suppose we choose to describe an atom in lowest order using a potential $U(r)$ other than the HF potential.

1. Show that the correction to the first-order energy from the single-particle part of the potential (V_1) for a one electron atom in a state v is
$$E_v^{(1)} = \Delta_{vv},$$
where $\Delta = V_{\rm HF} - U$.

2. Show that the following additional terms appear in the second-order valence energy:
$$E_v^{(2)} = -\sum_{na} \frac{\Delta_{na}\tilde{g}_{avnv} + \tilde{g}_{avnv}\Delta_{an}}{\epsilon_n - \epsilon_a} - \sum_{i\neq v} \frac{\Delta_{vi}\Delta_{iv}}{\epsilon_i - \epsilon_v}.$$
Here, i runs over a and n.