1. In the simplest treatment of helium, we used a trial function of the form

$$\phi(1,2) = 1s(1)1s(2) \frac{1}{\sqrt{2}} [\alpha(1)\beta(2) - \beta(1)\alpha(2)]$$

By varying the 1s function in all ways consistent with the form

$$1s(r, \theta, \phi) = [c_0 + c_1 r + c_2 r^2 + c_3 r^3 + \ldots] \exp\left[-\frac{z_{eff}r}{a}\right]$$

We found that the variational integral predicted a ground state energy of -77.9 eV, while the ground state energy is experimentally measured to be -78.99 eV.

a) Describe why the uncertainty is big for this variational approach. What phenomenon is neglected in this treatment?

b) Describe, in as much detail as possible, an approach that can be used to overcome this problem.

2. textbook 8.1, 8.4, 8.6, 8.7, 8.8, 8.14

3. textbook 9.11, 9.12, 9.15