

Corrections to problem 3.3: Noted in red below.

- (e) Write down also the correct two-electron wave functions for two of the multiplet-split final L-S states of the ion corresponding to the singlet and triplet spin states possible, specifying the space and spin parts fully. Here, you can use the model of the He atom that is described in any quantum mechanics/quantum chemistry textbook, and for final states, you can use specifically:  $\Psi_0(L=0, M_L=0; S=0, M_S=0)$  and  $\Psi_1(L=0, M_L=0; S=1, M_S=0)$ . Assume again that the 1s and 2s orbitals are identical between these two states for simplicity. Now calculate  $\langle \Psi_0 | \hat{H} | \Psi_0 \rangle$  and  $\langle \Psi_1 | \hat{H} | \Psi_1 \rangle$  with the Hamiltonian of **part (d)**, and thus show finally that the energy difference  $E_1 - E_0$  so obtained is in complete agreement with the Van Vleck Theorem. Again, you need not evaluate specifically any angular or radial integrals here, as many terms will just cancel out in the energy difference.