

## Homework 4 – PHYS626

### Reading Material:

Handout Ch 1 – Electron Wavefunctions

5.1 Hydrogen Atom

6.1 Helium Atom

6.2 Multi-electron Atoms

6.3 Alkali Atoms, Quantum Defect

6.4 Theory Models – Give a Quick Read Only

6.5 Assigned Again – Electron Configurations

- 1) Produce Table 6.7 from text for two electrons, one in a p and one in a d orbit.
- 2) What is the relation between the shielding constant  $S$  and the quantum defect  $\delta_{nl}$  of a Rydberg state  $(n,l)$  with large  $n$  and maximum angular momentum  $l=n-1$  in an alkali atom ? HINT: Think of the Coulomb potential energy seen by the outer Rydberg electron compared to the energy of the electron according to the quantum defect.
- 3) Determine  $\langle(x_1-x_2)^2\rangle$  for two electrons in a Harmonic Oscillator potential with single occupancy states and in a singlet spin state.
- 4) Determine the spatial wave function for three electrons whose spin wave functions are all aligned in the same direction. Use single occupancy states denoted by  $|1\rangle$ ,  $|2\rangle$ , and  $|3\rangle$  to compose the multielectron wave function.
- 5) Evaluate the expectation values for  $\langle r \rangle$  and  $\langle z \rangle$  for the 1s and 2p states in hydrogen.