

Practice exam 4

(10 points) Write the Hamiltonian in atomic units for the He atom.

(10 points) What is a spin orbital?

(20 points) The term symbols for a nd^2 electron configuration are 1S , 1D , 1G , 3P , and 3F . Calculate the values of J associated with each of these term symbols. Which term symbol (including J) represents the ground state? What is the degeneracy of the ground state?

(10 points) Normalize the two H_2 symmetry orbitals

$$\Psi_+ = 1s_a + 1s_b \quad \text{and} \quad \Psi_- = 1s_a - 1s_b$$

(15 points) Write the electron configuration for N_2 , N_2^+ , & N_2^- and predict the relative bond lengths and bond energies.

(10 points) Describe the spatial characteristics of the $\sigma_g 2p_z$ and the $\sigma_u 2p_z$ molecular orbitals for a homonuclear diatomic molecule.

(25 points) Construct the sp^2 hybrids on B that point toward the H atoms in BH_3 and are orthogonal.