Chemistry 881 Examination 4
November 9, 2001

Student Name _____

1. (15 points) What are the possible term symbols for a p^2 electron configuration.

2. (10 points) Given that the electron configuration of a zirconium atom is $[Kr]4d^2 5s^2$, determine the ground state term symbol for Zr. What is its degeneracy? Don't forget J.

3. (10 points) Sketch the plot of the bonding, Ψ_+ and antibonding, Ψ_- molecular orbitals for H_2^+ along the inter-nuclear line. Be sure to label any nodes.

4. (10 points) Normalize the two H_2 symmetry orbitals

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

5. (10 points) Write the electron configuration for $O_2, O_2^+, \& O_2^-$ and predict the relative bond lengths and bond energies.

6. (10 points) Describe the spatial characteristics of the $\pi_g 2p_z$ and the $\pi_u 2p_z$ molecular orbitals for a homonuclear diatomic molecule.

7. (10 points) Explain how photoelectron spectroscopy can be used to determine the energy of the occupied molecular orbitals of a molecule.

8. (25 points) The HCH angle in the ground state of CH_2 is 132 degrees. Construct two equivalent hybrid orbitals from the 2s and 2p orbitals of the carbon atom that point towards the H atoms and are orthogonal to one another.