

The Richard Stockton College of New Jersey  
*Chemistry Program, School of Natural Sciences and Mathematics*  
*PO Box 195, Pomona, NJ*

CHEM 3420: Physical Chemistry II — Spring 2009

## Homework 6

Due in Class: Friday, March 13, 2009 (or earlier)

- (a) The molecular ion  $\text{HeH}^+$  has an equilibrium bond length of  $0.774 \text{ \AA}$ . Draw a molecular orbital energy diagram for this ion, indicating the occupied molecular orbitals. Is  $\text{HeH}^+$  paramagnetic? When the  $\text{HeH}^+$  ion dissociates, is a lower energy state reached by forming  $\text{He} + \text{H}^+$  or  $\text{He}^+ + \text{H}$ ?

(b) If the lowest energy molecular orbital has the form  $C_1\psi_{1s}^{\text{H}} + C_2\psi_{1s}^{\text{He}}$ , do you expect  $C_2$  to be larger or smaller than  $C_1$ ?
- The molecule  $\text{H}_2$  has a higher ionization energy than the atom H itself, but the molecule  $\text{F}_2$  has a lower ionization energy than the atom F. Explain this using atomic and molecular orbital theory.
- Arrange the following in terms of decreasing bond energy and bond length:  $\text{O}_2^+$ ,  $\text{O}_2$ ,  $\text{O}_2^-$  and  $\text{O}_2^{-2}$ .
- Roughly sketch the photoelectron spectra for Al and S. Give the relative intensities of the peaks.