

## CH301 Worksheet 8—Molecular Orbital Theory Answer Key

For each of the following statements, identify if it is true or false. If it is false, correct it to make it true.

1. The concept of  $\sigma$  and  $\pi$  bonds is developed for both VSEPR and MO theory.

False, the concept of  $\sigma$  and  $\pi$  is developed for both VB and MO theory?

2. There are three homonuclear diatoms from the  $n=2$  row that have a bond order of 0.

False, there are two homonuclear diatoms from the  $n=2$  row that have a bond order of 0 ( $\text{Be}_2$  and  $\text{Ne}_2$ )

3. When constructing the MO energy levels, the number of molecular orbitals is always equal to the number of atomic orbitals and is twice the number of antibonding orbitals.

True

4. Hund, Pauli and Aufbau rules that were developed for electronic configurations of atoms also apply to electronic configurations in MO theory.

True

5. The bond order in MO theory is another way of calculating the number of bonds between two atoms in a Lewis structure.

True

6. Both atomic oxygen and diatomic oxygen are paramagnetic.

True

7. The maximum bond order for a diatomic species is 3 and corresponds to compounds with the largest bond lengths and lowest bond energies.

False, the maximum bond order for a diatomic species in the  $n = 3$  and corresponds to a compound with the shortest bond lengths and highest bond energy.

8. The sequence of diatoms and diatomic ions:  $\text{O}_2^+$ ,  $\text{O}_2$ ,  $\text{O}_2^-$ , decreases in bond order.

True.

9. The sequence of diatoms and diatomic ions, :  $\text{N}_2^+$ ,  $\text{N}_2$ ,  $\text{N}_2^-$ , decreases in bond length.

False, bond length is shortest when bond order is largest and peaks with neutral diatomic nitrogen and decreases to 2.5 for both cation and anion.

10. In order to argue for paramagnetism in  $\text{O}_2$ , you must fill in the correct electronic MO configuration (symmetrical rather than sad face.)

False, both configurations predict  $\text{O}_2$  is paramagnetic. Because the two configurations differ only slightly it is only occasionally that using the incorrect electronic configuration for diatoms in freshman chemistry will give you the wrong answer. Want to bet we will use an example where it makes a difference when it is time for the exam?