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5.111 Principles of Chemical Science  
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## 5.111 Instructions and Logistics for Exam 2

Exam 2 covers lectures #10-17 and associated reading and problem sets 4-5. It may also draw on earlier topics. The exam is closed book and closed notes. You will need to bring your calculator. Please note that bringing calculators with any relevant physical or chemical information is cheating. The one and only exception is that if your calculator includes values for extremely common fundamental physical constants like  $c$  and  $h$  and  $m_e$ , it is acceptable to use them. No constants that are commonly defined in terms of such fundamental constants (for example, the Rydberg constant) are acceptable. It is your responsibility to make sure that no unacceptable information is available on your calculator.

A sheet that includes a list of physical constants, a periodic table without electron configurations and most equations will be supplied. On the exam, **please pay attention to significant figures and units and box your final answer.**

The new equations for which you are responsible include calculating formal charge, and calculating reaction enthalpies from heats of formation and bond enthalpies. In addition, you need to know principles such as, covalent and ionic bonding; Lewis structures; MO theory; hybridization; relationships between  $\Delta G$ ,  $\Delta H$ , and  $\Delta S$ ; and Hess's law. These are examples of principles that you should know, but this is NOT an all-inclusive list.

**You are responsible for knowing the following guidelines for relative MO energies:**

For homonuclear diatomic molecules:

- The relative E ordering is  $\pi_{px}$  and  $\pi_{py} < \sigma_{pz}$  if  $Z < 8$ .
- The relative E ordering is  $\sigma_{pz} < \pi_{px}$  and  $\pi_{py}$  if  $Z =$  or  $> 8$  for any row two elements and other examples we will see in this course (or on the exam).

For heteronuclear diatomic molecules:

- The relative E ordering is  $\pi_{px}$  and  $\pi_{py} < \sigma_{pz}$  if  $Z < 8$  for both atoms.
- You are NOT responsible for predicting the energy level ordering if either one of the atoms has  $Z =$  or  $> 8$ .

For full credit on MO diagrams,

- label increasing energy with an arrow next to the diagram.
- pay attention to whether the question asks for valence electrons or all electrons.
- for any bonding orbital drawn, include the corresponding anti-bonding orbital, even if it is not filled with any electrons.
- Label each atomic orbital (1s, 2s, 2p<sub>x</sub>, 2p<sub>y</sub>, etc.) and each molecular orbital ( $\sigma 2s$ ,  $\pi 2p_x$ ,  $\pi 2p_y$ , etc.) that you draw.
- Fill in the electrons for both the atomic and molecular orbitals.

**As with exam 1, the nature of exam 2 material requires both understanding AND LOTS OF PRACTICE for success.** Please plan your studying accordingly.