Chem 162-04 Winter 2017

Unit 1

Please note that in the event of school closure, our course content will continue following this Unit Syllabus supplemented by required information from Canvas.

Jan-2 Outcomes

1. To know that chemical bonds, the forces that hold atoms together (text definition), are the lowering of energy when atoms come together (additional definition).
2. To describe, differentiate, and give examples of ionic, covalent, and metallic bonds.
3. To use "sharing of electrons" as a descriptive term for covalent bonding.
4. To understand that there are orbitals that best describe the bonds, and to use energy relationships to describe the stability of covalent bonds and the energy required to break them.
5. To use Lewis dot symbols for atoms as a model that shows valence electrons.
6. To create and use Lewis structures to represent simple molecules, applying the "octet rule" for atoms other than Hydrogen.
7. To create and interpret Lewis structures involving multiple bonds and non-bonding pairs.
8. To use the "octet" rule to predict and describe the configuration of main group monatomic ions; to recognize that Lewis dot symbols are not normally used for ionic compounds.
9. To memorize and use Common Bonding Patterns (not in text) as a tool for predicting single bonds, multiple bonds, lone pairs, and Lewis structures.
10. To interpret and apply condensed structural formulas in representing the structure of molecules.
11. To describe the unequal (non-symmetric) distribution of electrons in covalent bonds as "polar", and symbolize the dipolar partial charges that exist.
12. To predict the polarity of covalent bonds from Pauling electronegativity scale.
13. To view the vibrations of atoms through bonds as a way energy is taken up in the infrared region of the electromagnetic spectrum, and apply it to describing the greenhouse effect.

Assignments:
Read §8.1 – 8.4. (Reading quizzes start 1/4)

Recommended exercises (throughout course): From assigned sections, all in-chapter Sample and Practice Exercises, and select chapter-end Questions and Problems.

Jan-3 Laboratory

Half the class will perform "Models of Molecular Structure" (pp. 19 – 25 of lab manual files) and half the class will perform "Synthesis of Salicylic Acid" (pp. 26 - 32). The documents are on Canvas under Files > Laboratory. This assignment will have been made in class on Jan-2; if you are a late-registering student you will perform "Models of Molecular Structure."

Before lab, read pp. 3 - 8 of the Table of Contents and Appendix file. You will be asked to complete a signature form in lab. Also, complete the Prelaboratory Assignment for the experiment you were assigned (p. 25 or 32), and turn it in at the start of lab. Late-registering students can find these documents on my faculty web page, http://faculty.cascadia.edu/dreichgott/. The full Post-laboratory report is due Jan-9.

If you are performing "Synthesis of Salicylic Acid" please read and comply with the clothing requirements specified on p. 4.

Jan-4 Outcomes

1. To know what a resonance structure is, what is does and does not represent, and how resonance hybrids are useful for describing bonding where bonding orbitals are actually delocalized over several atoms.
2. To know and use the rules for assigning formal charges, their limitations, and when they are useful.
3. To recognize and accept exceptions to the octet rule: odd-electron molecules, H, Be and B in covalent compounds, and "expanded octets" of S, P, halogens, and transition metal compounds.
4. To understand that the Lewis model of bonding is convenient but it has several limitations; to think critically about when it should be used and when a more rigorous approach is needed.
5. To know the source of bond length data and its general relationship to bond order.
6. To know and use the predictive value of bond energies and their relationship to bond lengths.
7. To use bond energies to predict enthalpies of reactions.

Assignments:

Read §8.5 – 8.8. (Reading quiz on the bold-print terms and vocabulary terms in the margins of these sections, at the start of class.)

Jan-9 Outcomes

1. To know that the Valence Shell Electron Pair Repulsion Model (VSEPR) uses repulsions between electron pairs to predict and describe where electron pairs and nuclei should be in polyatomic molecules and ions.
2. To differentiate between electron-pair geometry and molecular geometry.
3. To determine and use the Steric Number to predict and electron-pair and molecular geometries around a single nucleus as linear, trigonal planar, tetrahedral, trigonal bipyramidal, and octahedral.
4. To justify how and when molecular geometries differ from electron-pair geometries.
5. To apply these skills to molecules with lone pairs and multiple bonds.
6. To use the dashed-wedge formalism to understand and communicate three-dimensional molecular structure.
7. To use the VSEPR model to predict geometries of chain-molecules and polyatomic ions and recognize exceptions.
8. To know that a bond dipole is a property of a bond between two atoms expressing unequal electron density.
9. To know that a dipole moment is an experimental quantity expressing the overall polarity of a molecule, reflecting the contributions of all bond dipoles and lone pairs.
10. To give examples of chemical properties and systems where polar vs. non-polar character is important.

Assignments:

Read §9.1 – 9.3. (Reading quiz on the bold-print terms and vocabulary terms in the margins of these sections, at the start of class.)

Lab report due at the start of class.

Jan-10 Laboratory

Half the class will perform "Models of Molecular Structure" (pp. 19 – 25 of lab manual files) and half the class will perform "Synthesis of Salicylic Acid" (pp. 26 - 32): you will perform the experiment that you did not do on Jan-3. If you are performing "Synthesis of Salicylic Acid" please read and comply with the clothing requirements specified on p. 4. Report is due on Jan-16.

Prelaboratory assignment (p. 25 or 32) due at the start of lab.

Jan-11 Outcomes

1. To know that the Valence Bond Theory describes orbitals between two adjacent atoms while the Molecular Orbital Theory considers all atoms in a molecule.
2. To know that a "basis orbital" is an atomic orbital used to form a bond, and a "bonding orbital" results.
3. To know that the concept of overlap, used in both theories, pertains to locations and energies atomic orbitals.
4. To know that the Valence Bond Theory is simpler, contains commonly used vocabulary, and works best when describing molecules without delocalization.
5. To understand that hybridization is a legitimate way of changing atomic basis orbitals before bonding, so the proper molecular geometry results.
6. To memorize and describe the geometries of sp, sp^2, sp^3, sp^3d and sp^3d^2 hybrid atomic orbitals and the molecular geometries that their overlap produce.
7. To know that sigma bonds result from the end-to-end overlap of basis orbitals, and the bonding orbital includes (is wrapped around) the bond axis; to know that pi bonds result from the side-to-side overlap of basis orbitals, and do not include (existing above and below) the bond axis.
8. To know that a sigma bond is present in virtually all single bonds, and that multiple bonds are almost always comprised of one sigma bond and one or two pi bonds.
9. To understand how chemists' communication styles refer to hybrid orbitals in molecules as if they were still present.
10. To describe how shape, bonding, and polarity are key directors of molecular recognition.
11. To give examples where bonding electrons are delocalized, the relationship to resonance, and the symbolic styles for communicating its presence.

Assignments:

Read §9.4 – 9.5. (Reading quiz); §9.6 is recommended for those taking Biology or Organic Chemistry, but it is not testable content in Chem 162.

Jan-16 Outcomes

1. To review examples of where a localized bonding model fails, and examples where geometries do not agree with VSEPR and Valence Bond Theories.
2. To know that in the Molecular Orbital Theory, all orbitals of all atoms in a molecule are used to determine bonding. These are usually restricted to valence orbitals, since core orbitals do not overlap.
3. To know the Molecular Orbital Theory uses atomic basis orbitals (not hybrid orbitals) and combines their wavefunctions mathematically to create new bonding and antibonding orbitals.
4. To know that bonding orbitals are lower in energy than their basis orbitals, and electrons have a high probability of being between bonded atoms. To recognize them in pictures and energy level diagrams.
5. To know that antibonding orbitals are higher in energy than their basis orbitals, and have a nodal plane between bonded atoms, and detract from bonding. To recognize them in pictures and energy level diagrams.
6. To use the output of molecular orbital calculations (energy level diagrams and probability maps) and their vocabulary to describe bonding.
7. To know and use the definition of bond order.
8. To use molecular orbital energy level diagrams to predict bond order, unpaired electrons, and reactivity of diatomic molecules of atoms in the first two rows of the Periodic Table.

9. To use the specific example of benzene to compare and contrast Valence Bond and Molecular Orbital descriptions of bonding where delocalization exists.

(Start Chapter 6, Unit 2 content, not on Unit 1 examination)

Assignments:
Read §9.7 and 6.1 – 6.2 (No reading quiz); §6.3 recommended for lab preparation.
Lab report due at the start of class.
Graded Homework, Chapter-end problems from chapters 8 and 9: Ch 8, #8 (explain), 38, 44, 92, 120 (explain), 128(a); Ch 9: #6, 26(a,d), 58, 96

Jan-17 Laboratory

Gas Laws (pp. 33 – 41 of lab manual). Prelaboratory assignment (p. 41) due at start of lab.

Chemical Resource Lab due at start of lab.

Jan-18 Outcomes

Success on an **hour exam**! Content from all the above learning outcomes for Chapter 8 and 9, and pertinent content from lab.

Group Sheet 1