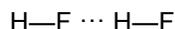


# Checklist for Exam 4

## Chapters 7 and 8 (Covalent bonds and molecular structure)

- I know that bond dissociation energy is the energy required to break a chemical bond. I know that it requires energy to break any covalent bond — and energy is released when a chemical bond is formed.
- Given the chemical formula, I can predict if a compound is ionic or covalent-molecular.
- I know the periodic trend for electronegativity.
- Using only the periodic table, I can predict which of two elements is more electronegative. With this information, I can predict if a bond is polar and if so, I can add the labels “ $\delta^+$ ” and “ $\delta^-$ .” Finally, I also know that the extent of bond polarity increases as the difference in electronegativity between two bonded atom increases.
- I can sketch a Lewis dot structure for any covalent-molecular compound. I realize that under normal conditions, each atom must satisfy the octet rule (except for hydrogen — it wants 2 electrons.) When sketching Lewis dot structures, I shall not create or destroy electrons as that is a big oooooops.
- Once I have an acceptable Lewis dot structure, I can answer questions about the number of single, double and triple bonds.
- Once I have an acceptable Lewis dot structure, I can answer questions about resonance.
- Once I have an acceptable Lewis dot structure, I can answer questions about the formal charge of each atom in a molecule or polyatomic ion. I know that the sum of the formal charges equals the charge on the ion or equals zero for neutral molecules. I also know that structures with formal charges other than 0, or  $\pm 1$  are not good.
- I can use the ABE formulas to predict the shape of the molecule or ion. I know the shape names of all of the ABE formulas as well as the angles for each ABE formula.
- I know that for certain central atoms (A) that have 3<sup>rd</sup> row (or higher) central elements  $n = 3$  or greater, expanding the octet is possible if the bonding groups include fluorine. To a lesser extent, when the B groups are chlorine or even sometimes oxygen, expanding the octet sometimes occurs, but basically, this is something that occurs with fluorine. Central atoms B, C, N, O, and F can never expand their octet.
- I'm aware that some compounds do not satisfy the octet rule. The odd-electron species NO and NO<sub>2</sub> are examples. When drawing their Lewis dot structures, I know to settle on 7 electrons around one of the atoms rather than 9. When rendering the Lewis dot structure into an ABE formula, the unpaired electron counts as a E group. Other molecules such as BF<sub>3</sub> have a central atom that does not obey the octet rule.
- I know that single bonds are  $\sigma$ -bonds, double bonds consist of one  $\sigma$  and one  $\pi$  bond and triple bonds consist of one  $\sigma$  and two  $\pi$  bonds.
- I know that ABE formulas can be related to hybridization. Specifically, for every situation in which there are four structural groups around the A atom (AB<sub>4</sub>, AB<sub>3</sub>E, AB<sub>2</sub>E<sub>2</sub>, and AB<sub>1</sub>E<sub>3</sub>), the hybridization is sp<sup>3</sup>. Further, for every situation in which there are three structural groups around the A atom (AB<sub>3</sub>, AB<sub>2</sub>E, and AB<sub>1</sub>E<sub>2</sub>), the hybridization is sp<sup>2</sup>. And finally, for every situation in which there are two structural groups around the A atom (AB<sub>2</sub> and AB<sub>1</sub>E), the hybridization is sp.
- I recognize and can even sketch each of these hybridizations.

- I can use Lewis dots and the ABE formula in order to predict if a molecule is polar — has a molecular dipole moment — or not. Ionic species have full charges, so we don't fuss about “polar ionics” or “non-polar ionics” – just neutral covalent moleculars are polar or non-polar.
- I can label the  $\delta^+$  and  $\delta^-$  end of a molecule.
- Knowing that a molecule is polar is enough to conclude that molecules are held together by dipole-dipole intermolecular forces.
- “Hydrogen bonding” occurs when hydrogen is covalently bonded to N, O, or F. The hydrogen bond is the intermolecular force between such a bond and another N, O, or F on a neighboring molecule. For example, the H-bond is represented by the dashed line:



- London dispersion forces (LDF) are another important type of intermolecular force. LDF are somewhat proportional to MM and so molecules with large MM have large LDF and these can be considerable. Thus, every substance has LDF forces.
- I know that intermolecular forces explain why and when solids melt and liquids boil, for example. In order to boil a liquid, enough energy has to be added to overcome all of the intermolecular forces.

## Chapter 9. Thermochemistry: Chemical energy

- I have memorized the definition of the standard state (25 °C and 1 atm). If solutions are involved, standard state is 1 molar.
- I know that values for  $\Delta H$  are intensive properties (kJ/mol eqn). Given a balanced chemical equation and enthalpy change for a chemical reaction, I know how to calculate the enthalpy change per mole or per gram of each reactant and product.
- I can relate  $\Delta H$  to  $q$ , the heat flow. I know that  $q$  is an extensive property so its value depends on how much of a substance was reacted. As such,  $q$  has units of kJ.
- I can write the definition of the standard heat of formation for any compound.
- I can calculate  $\Delta H_{\text{rxn}}$  two ways: If I have  $\Delta H_f^\circ$  values available, that is my first choice! If  $\Delta H_f^\circ$  values are not available, I can use the bond energies given in Section 7. 2 to estimate  $\Delta H_{\text{rxn}}$ .
- I can measure  $\Delta H_{\text{rxn}}$  two ways: using a coffee-cup calorimeter or a bomb calorimeter. I know with the coffee cup, I can calculate  $q_{\text{cal}} = (\text{Specific Heat}) \times \text{mass} \times \Delta T$ . Then, I can relate  $q_{\text{cal}}$  to  $q_{\text{rxn}}$  by the simple equation  $q_{\text{cal}} = -q_{\text{rxn}}$ . I will keep in mind that  $q$  is an extensive value, so I can scale it up or down so that it can be written in terms of the intensive value  $\Delta H$  and reported in kJ/mol \_\_\_\_.
- I can use Hess's law to add together two (or more) reactions in order to estimate  $\Delta H$  for the sum of the two (or more). This involves knowing what to do with  $\Delta H$  when I switch an equation around or multiply or divide the coefficients of the equation
- I can predict the sign for  $\Delta H$  for phase changes. If one has to add energy, the process is endothermic,  $\Delta H > 0$ . If heat is given off, the process is exothermic,  $\Delta H < 0$ .
- I know the definition of combustion and can write a combustion reaction for any hydrocarbon substance.
- I know the definition of lattice energy (Chapter 6) and understand how Hess's law is used to estimate lattice energy for any ionic substance.