

**CH301H – Principles of Chemistry I: Honors**  
Fall 2017, Unique 50135

**Homework, Week 4**

1. The bond lengths of the X-H bonds in  $\text{NH}_3$ ,  $\text{PH}_3$ , and  $\text{SbH}_3$  are 1.02, 1.42, and 1.71 Å, respectively. Estimate the length of the As-H bond in  $\text{AsH}_3$ . Which of these four hydrides has the weakest X-H bond?
2. The bond length of  $\text{F}_2$  is 1.417 Å, not twice the atomic radius of F, which is known to be 0.61 Å. What can account for the unexpected length of the F-F bond?
3. Estimate the percent ionic character of the bond in each of the following diatomic molecules, based on the information given.

	Bond length (Å)	Dipole moment (D)
ClO	1.573	1.239
KI	3.051	10.82
TlCl	2.488	4.543
InCl	2.404	3.79

4. For each of the following molecules, draw and name the appropriate molecular geometry. Describe distortions from that geometry caused by the presence of lone pairs. In each case, the central atom is listed first and the other atoms are directly bonded to it.
  - a)  $\text{ICl}_4^-$
  - b)  $\text{OF}_2$
  - c)  $\text{BrO}_3^-$
  - d)  $\text{CS}_2$
  - e)  $\text{CHO}_2^-$
5. Predict the structure of NNO. This molecule has a small molecular dipole moment. Predict the direction of the dipole moment vector, keeping in mind that it is defined as pointing from the negative end of the molecule to the positive end of the molecule.
6. In words, and using any information in your textbook you wish, describe a general relationship between bond lengths and bond energies in similar molecules.
7. Draw the preferred lone pair placement for octahedral geometries containing up to three lone pairs.
8. The element xenon is by no means chemically inert. It forms a number of stable compounds with electronegative elements such as fluorine and oxygen; these compounds can in turn react with water to form even more complex compounds. Predict the structures of the following xenon compounds:  $\text{XeF}_2$ ,  $\text{XeF}_4$ ,  $\text{XeO}_3$ ,  $\text{XeO}_4$ ,  $\text{H}_4\text{XeO}_6$ , and  $\text{XeOF}_4$ .