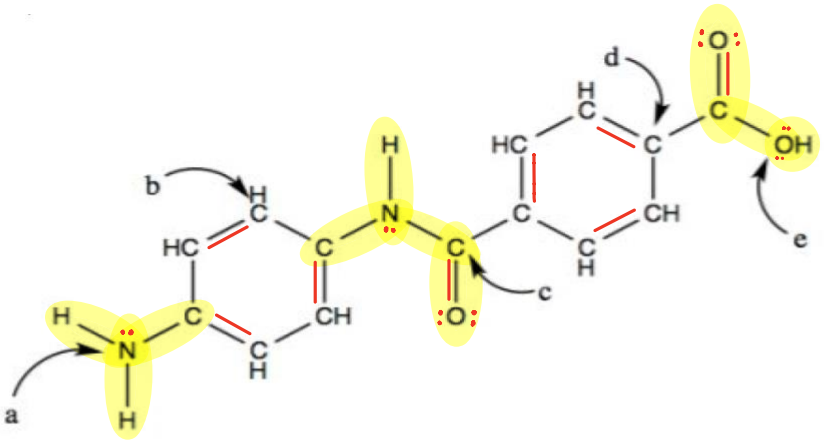
General Chemistry I
PLI Sheet #15
June 25, 2021

Answer key

1.



1a) Complete the structure above by adding bonds and lone pairs. Every atom will have a complete octet and a formal charge of zero. What is the hybridization around the atoms marked a through e?

a: sp^3 b: sp^2 c: sp^2 d: sp^2 e: sp^3

1b) How many σ bonds are in the structure above? How many π bonds?

1c) Circle all of the polar bonds. 32 σ, 8 π

1d) What are the bond angles at a, b, c, d, and e?

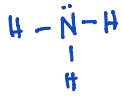
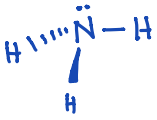
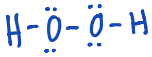
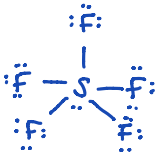
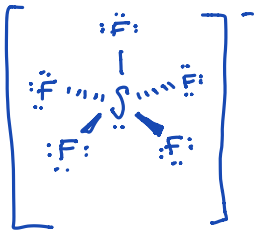
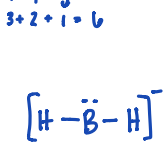
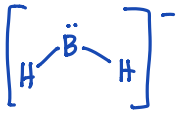
a: $< 109.5°$ b: $120°$ c: $120°$ d: $120°$ e: $< 109.5°$

(tetrahedral, trigonal pyramidal) (trigonal planar ×2) (tetrahedral, bent)

2. Complete the following table:

Regions of high electron density	Electron Pair Geometry	Hybridization	Angle between electron density region	Total hybrid orbitals	P orbitals left over
2	linear	sp	180°	2 sp orbitals	2
3	trigonal planar	sp^2	120°	3 sp^2 orbitals	1
4	tetrahedral	sp^3	109.5°	4 sp^3 orbitals	0

3. **Fill out the following table!**

Name & Lewis Structure	3D Structure	Electron Pair Geometry	Molecular Geometry	Hybridization	Polarity
Ammonia 		tetrahedral	trigonal pyramidal	sp^3	polar
H_2O_2 		~~tetrahedral~~ tetrahedral	~~Bent~~ Bent	sp^3, sp^3	polar
SF_5^- 		octahedral	square pyramidal	sp^3d^2	polar
BH_2^- 		trigonal planar	Bent	sp^2	non polar
HCN 		linear	linear	sp	polar

4. **Balance the following reaction, then using bond dissociation enthalpies from the book, lecture slides or le Google, calculate the bond dissociation enthalpy of the O-F bond. The ΔH_{rxn} -318 kJ/mol.**

$$\_\_\_\_OF_2\,(g) + \_\_\_\_H_2O\,(g) \rightarrow \_\_\_\_O_2(g) + \underline{2}\_\_\_\_HF\,(g)$$

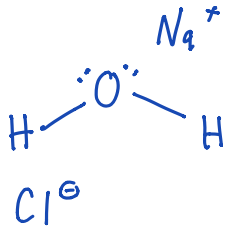
$\Delta H = \sum_{\Delta H} \text{bonds broken} - \sum_{\Delta H} \text{bonds formed}$

$-318\ kJ/mol = (2(O-F) + 2(O-H)) - ((O=O) + 2(H-F))$

$-318\ kJ/mol = (2(O-F) + 2(463\ kJ/mol)) - ((498\ kJ/mol) + 2(565\ kJ/mol))$

$394\ kJ/mol = 2(O-F) \Rightarrow O-F = 192\ kJ/mol$

5. **Draw a likely spatial orientation of a single water molecule with a single molecule of NaCl.**



6. **True or False:**
   a. **The principal quantum number (n) associated with an f orbital must be ≥4** TRUE
   b. **For an electron to go from a lower energy level to a higher energy level, a photon must be absorbed** TRUE
   c. **The freezing of water is an endothermic process** FALSE
   d. **The first ionization energy of Li is less than the second ionization energy of Li** TRUE
   e. **The electronegativity of H is less than that of Mg** FALSE
   f. **Cations are always larger than the neutral atom of the same element.** FALSE

7. **Name three atoms or ions that are described by the following electron configuration:**

   $[Ar]4s^23d^{10}4p^5$

   $Br,\ As^{2-},\ Se^-$