2.7 VESPR and Bond Hybridization
Worksheet

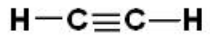
1) Draw Lewis structures, predict the shape, and give the approximate bond angle for each of the following compounds:
   a. Sulfate ion
   b. Water
   c. Carbon dioxide
   d. Ammonia
   e. Nitrate ion
   f. Carbonate ion
   g. Ozone (O_3)
   h. Boron trichloride
   i. Sulfur hexafluoride
   j. Sulfur dichloride
   k. Xenon tetrafluoride
   l. Phosphorus pentafluoride
   m. Nitrogen trifluoride
   n. Phosphorus trifluoride
   o. CH_4
   p. CCl_2F_2
   q. OF_2
   r. ICl_4^-
   s. IOF_5
   t. I_3^-
   u. BrF_3
   v. SOF_4
   w. $XeOF_4$
   x. XeO_2F_2

2) The charge clouds of both methane (CH_4) and ammonia (NH_3) are arranged in a tetrahedral geometry. Explain why the actual bond angles in methane (CH_4) are 109.5°, while the actual bond angles in ammonia (NH_3) are 107.3°.

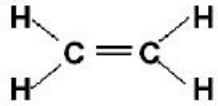
3) Explain why CH_4 has a tetrahedral geometry, while SF_4 has a seesaw shape.

4) In the following structures, identify:
   i. The shape around each carbon atom
   ii. The bond angles emerging from each carbon atom.
   (Hint: Look at each carbon individually. Every atom that is bonded to the carbon you are looking at is considered to be a terminal atom – even other carbons. After finding the shape around the first carbon atom, move to the second carbon and treat it as the central atom.)

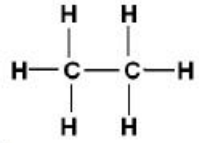
a.



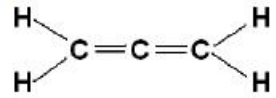
b.



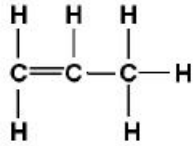
c.



d.



e.



5) Identify the type of hybridization (type of hybrid orbitals) around the central atom in each of the structures listed below. You drew the Lewis diagrams for these molecules in question 1 of this worksheet.
   a. Sulfate ion
   b. Water
   c. Carbon dioxide
   d. Ammonia
   e. Nitrate ion
   f. Carbonate ion
   g. Ozone (O_3)