Organic Chemistry - Exercise 2

Distribution: October 3 2025

Help: October 9 2025

Return until: October 11 2025

1. For each of the following compounds, draw their Lewis structures (please explicitly draw all lone pairs) and give the hybridization of each carbon atom in their structure.
    a. carbon-dioxide (CO_2)
    b. carbon tetrachloride (CCl_4)
    c. dimethyl sulfoxide ($(CH_3)_2S{=}O$)
    d. acetonitrile (CH_3CN)
    e. *N,N*-dimethyl formamide ($H(C{=}O)N(CH_3)_2$)

2. This exercise is about aminoborane $(CH_3)_2B{-}N(CH_3)_2$.
    a. According to VSEPR theory, which hybridization states are expected for boron and nitrogen in this compound?

    b. It is experimentally shown that *both* boron and nitrogen atoms have a trigonal-planar coordination geometry. What are then the *real* hybridization states of these two atoms in this compound and why?

c. After the conclusions in the previous task, draw Valence Bond model of this compound (focus only on B and N atoms).

d. Draw two Lewis resonance structures of this molecule. What is the expected bond order of the B–N bond approximately? What is the expected orientation of the dipole moment if this molecule and why?

3. This exercise is about bond formation in methanol (CH_3OH).

   a. According to VSEPR theory, what are the hybridizations of carbon and oxygen atoms in methanol and why?

b. Draw the MO diagram of methanol by showing the bonding between $H_3C\cdot$ and $\cdot OH$ fragments.

c. Does the bonding molecular orbital look more like the orbital of oxygen or the one of carbon and why?

4. This question is regarding the bond formation in methanimine ($H_2C{=}NH$).
   a. Draw two resonance structures of methanimine indicating all lone pairs.

   b. Draw the MO diagram of methanimine showing the bond formation between $H_2C:$ and :NH fragments.

c. Why does 2p orbital of carbon atom does not interact with $2sp^2$ orbital of nitrogen atom?

d. Why is the energy difference between formed π and π^* orbitals smaller than the energy difference between formed σ and σ^* orbitals?

Reading Suggestions:

Clayden, Greeves, Warren, Wothers, *Oxford University Press*, **2001**.

Organic Chemistry, John McMurry, *Thomson Brooks/Cole*, **2008**.

Chimie Organique, Les Grands Principes, John McMurry, *Dunod Editeur*, **2009**.

Chimie Organique, Paul Arnaud, *Dunod Editeur*, **2009**.