In formic acid, HC(O)OH, the hybridization on the O double-bonded to the C is (use the Lewis structure) ...

1. none
2. sp
3. sp²
4. sp³

Polyatomic MO recipe: Formate, HC(O)O⁻ (delocalized π bonds)

Begin Mahaffy et al., Chapter 11: States of Matter

Behavior of gases: Macroscopic versus microscopic understanding


Polyatomic MO recipe: Formaldehyde, H₂CO

1. Use the Lewis structure to get ...
   • the number of electron pairs
   • make hybrid AO's on each atom; terminal atoms (except H) have same hybrids as central atom
2. Sketch the σ framework and place pairs ...
   • in each bonding σ MO
   • in each nonbonding hybrid AO
3. Sketch the π framework MO's:
   • mark as bonding, nonbonding, and antibonding
   • place remaining pairs (Auf Bau)
   • get the π bond order

H₂CO π framework

1 pair in (localized) π framework

π (bonding) one loop mostly O
π* (antibonding) two loops mostly C

1 pair in π (bonding): bond order 1
Quiz: The difference on AO size in the π bonding orbital is ...

- 25% 1. not physically significant
- 25% 2. because IE_C is larger than IE_o
- 25% 3. because IE_C is smaller than IE_o
- 25% 4. some other reason

H₂CO  π framework

1 pair in (localized)  π framework

Formic acid, HC(O)OH

[TP] In formic acid, HC(O)OH, the hybridization on the O double-bonded to the C is (use the Lewis structure) ...

- 25% 1. none
- 25% 2. sp
- 25% 3. sp²
- 25% 4. sp³
In formic acid, H\(\overset{\cdot}{\text{C}}\)(O)OH, the hybridization on the O single-bonded to the C is (use the Lewis structure) ...

25% 1. none
25% 2. sp
25% 3. sp\(^2\)
25% 4. sp\(^3\)

\section*{π framework}
- mark as bonding, nonbonding, antibonding
- place remaining pairs (Auf Bau)
- get the π bond order

\section*{HC(O)OH σ framework}
- Hybridization of terminal atoms the same as their central atom
- Terminal H never hybridized
- One pair in each hybrid AO σ bonding MO
- One pair in each non-bonded hybrid AO

\section*{HC(O)OH π framework}
1 pair in (localized) π framework

1 pair in π (bonding): bond order 1
Formate, HC(O)O⁻

[TP] Formic acid, HC(O)OH, and its conjugate base formate, HC(O)O⁻, each have 9 pairs of electrons. How many pairs of electrons are in the σ framework of formate?

1. 3 pairs
2. 5 pairs
3. 7 pairs
4. 8 pairs
5. 9 pairs

20%
20%
20%
20%
20%

9 pairs in Lewis structure, 7 pairs in σ framework, and so 2 pairs in (delocalized) π framework.

[TP] How many pairs of electrons are in the π framework of formate?

25% 1. 0 pairs
25% 2. 1 pairs
25% 3. 2 pairs
25% 4. 3 pairs
HC(O)O⁻ π framework

2 pairs in (delocalized) π framework

1 pair in π (bonding) and 1 pair in π* (nonbonding);
bond order 1