

# What Is Orbital Hybridization?

## Worksheet

Orbital hybridization is the blending of atomic orbitals to form new hybrid orbitals of equal energy and shape; the type is determined by the steric number (sigma bonds + lone pairs): 2 sp (linear), 3 sp (trigonal planar), 4 sp (tetrahedral).

## Questions

1. What is the hybridization of the central atom with 4 sigma bonds and 0 lone pairs?  
A) sp  
B) sp  
C) sp  
D) spd
2. What is the steric number of the oxygen in water, HO (2 sigma bonds, 2 lone pairs)?  
A) 2  
B) 3  
C) 4  
D) 6
3. Which hybridization corresponds to a linear molecular geometry?  
A) sp  
B) sp  
C) sp  
D) spd
4. In a C=C double bond, how many sigma bonds does that double bond contribute to the steric number?  
A) 0  
B) 1  
C) 2  
D) 3
5. Determine the hybridization of the central carbon in methane, CH<sub>4</sub>.
6. Determine the hybridization of the central carbon in carbon dioxide, CO<sub>2</sub>.
7. Determine the hybridization of the central nitrogen in ammonia, NH<sub>3</sub>.
8. Define: What is the formula for steric number?
9. Define: What hybridization does steric number 2 give?
10. Define: What hybridization does steric number 3 give?

## Answer Key

1. C)  $sp$  - Steric number =  $4 + 0 = 4$ , which gives  $sp$  hybridization.
2. C) 4 - Steric number = 2 sigma bonds + 2 lone pairs = 4.
3. A)  $sp$  -  $sp$  hybridization (steric number 2) gives a linear shape with 180 bond angles.
4. B) 1 - A double bond is 1 sigma bond plus 1 pi bond; only the sigma bond counts toward the steric number.
5. Carbon forms 4 single (sigma) bonds to hydrogen and has 0 lone pairs. Steric number = 4 (bonds) + 0 (lone pairs) = 4. A steric number of 4 corresponds to  $sp^3$  hybridization - a tetrahedral shape (109.5 bond angles).
6. Carbon forms 2 sigma bonds (one to each oxygen, even though each is a double bond, only one is a sigma bond) and has 0 lone pairs. Steric number = 2 (sigma bonds) + 0 (lone pairs) = 2. A steric number of 2 corresponds to  $sp$  hybridization - a linear shape (180 bond angle).
7. Nitrogen forms 3 sigma bonds to hydrogen and has 1 lone pair. Steric number = 3 (bonds) + 1 (lone pair) = 4. A steric number of 4 corresponds to  $sp^3$  hybridization - the electron geometry is tetrahedral, though the molecular shape is trigonal pyramidal due to the lone pair.
8. Steric number = number of sigma bonds + number of lone pairs on the central atom.
9.  $sp$  hybridization - linear geometry, 180 bond angle (e.g., CO, BeCl<sub>2</sub>).
10.  $sp^2$  hybridization - trigonal planar geometry, 120 bond angles (e.g., BF<sub>3</sub>, ethylene's carbons).

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