

Molecular Bonding and Geometry Theories

What is VSEPR theory?

The best arrangement of a given # of e⁻ domains that minimizes repulsion

What is molecular geometry?

3D spatial arrangement of atoms + their valence e⁻ w/in a molecule or ion

Fill in the tables:

Number of Electron Domains	Electron Domain Geometry	Bonding Domains	Nonbonding Domains	Molecular Geometry	Bond Angle	Hybridization
2	Linear	2	0	Linear	180°	sp

Number of Electron Domains	Electron Domain Geometry	Bonding Domains	Nonbonding Domains	Molecular Geometry	Bond Angle	Hybridization
3	Trigonal Planar	3	0	Trigonal planar	120°	sp^2
3	Trigonal Planar	2	1	Bent	$<120^\circ$	sp^2

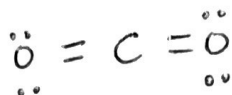
Number of Electron Domains	Electron Domain Geometry	Bonding Domains	Nonbonding Domains	Molecular Geometry	Bond Angle	Hybridization
4	Tetrahedral	4	0	Tetrahedral	109.5°	sp^3
4	Tetrahedral	3	1	Trigonal pyramidal	$<109.5^\circ$ $\sim 107^\circ$	sp^3
4	Tetrahedral	2	2	Bent	$<<109.5^\circ$ $\sim 105^\circ$	sp^3

Write the lewis dot structure and determine the molecular geometry:

Carbon dioxide



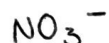
$$4 + 2(6) = 16 e^-$$



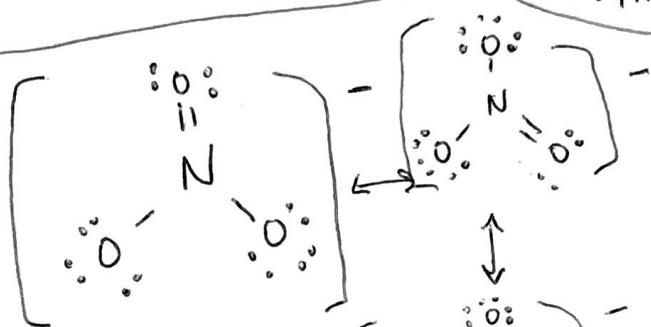
Linear

- Nonpolar molecule
↳ symmetrical

Nitrate



$$5 + 3(6) + 1 = 24 e^-$$



Trigonal Planar
- nonpolar

Sulfur dioxide



$$6 + 2(6) = 18 e^-$$



Bent

Trigonal planar =
e⁻ domain geo.

Polar molecule
- lone pairs

Carbon tetrafluoride



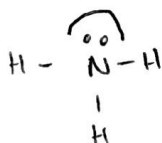
Tetrahedral

- Nonpolar molecule

Ammonia



$$5 + 3(1) = 8 e^-$$



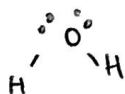
Trigonal pyramidal

Tetrahedral = e⁻ domain geo

Polar molecule

- lone pair on N

Water



Bent

- polar molecule

Look @
formal
charge

What is a sigma bond? σ

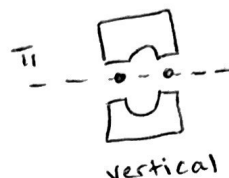
Head-to-head overlap of
atomic orbitals on
intermolecular axis



What is a pi bond? π

Sideways overlap of p orbitals

e^- density above + below
internuclear axis



Internuclear
axis

How many sigma bonds are in a single bond? σ

1 sigma bond

How many sigma and pi bonds are in a double bond?

1 sigma + 1 pi

How many sigma and pi bonds are in a triple bond?

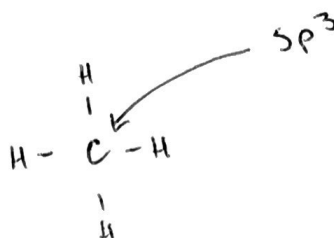
1 sigma + 2 pi

Indicate how many sigma and pi bonds are in each compound. Identify the hybridization of the central atom for each compound:

Methane (CH_4)

4 sigma

↳ 4 single bonds



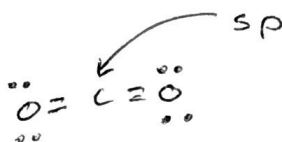
Non polar

109.5°

Carbon dioxide CO_2

2 π bonds

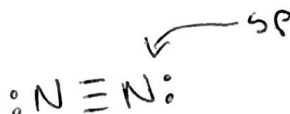
2 σ bonds



Nitrogen Gas N_2

2 π bonds

1 σ bond

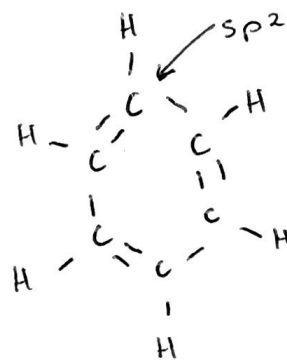


Benzene

3 π bonds

12 σ bonds

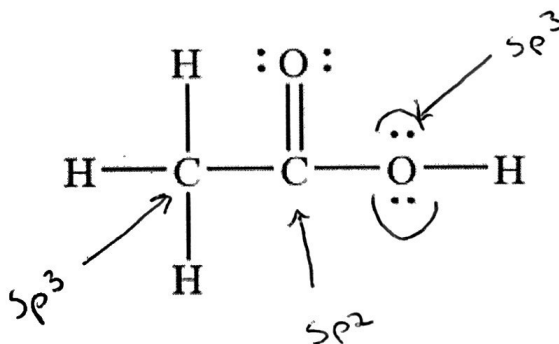
↳ $6 + 3 + 3 = 12$



Acetic Acid (CH_3COOH)

1 π bond

7 σ bonds



Formal charge for SO_2 problem

$$S = 6 - 2 - \frac{1}{2}(6)$$

$$= 0$$

$$= O = 6 - 4 - \frac{1}{2}(4) =$$

$$= 0$$

$$- O = 6 - 6 - \frac{1}{2}(2)$$

$$= -2$$