

Chapter 8 Part 1

Dr. Turner

Hybridization

Number of Electron Pairs	Hybridization	Electron-pair Geometry
2	sp	Linear
3	sp^2	Trigonal planar
4	sp^3	Tetrahedral
5	sp^3d	Trigonal bipyramidal
6	sp^3d^2	Octahedral

Hybridization

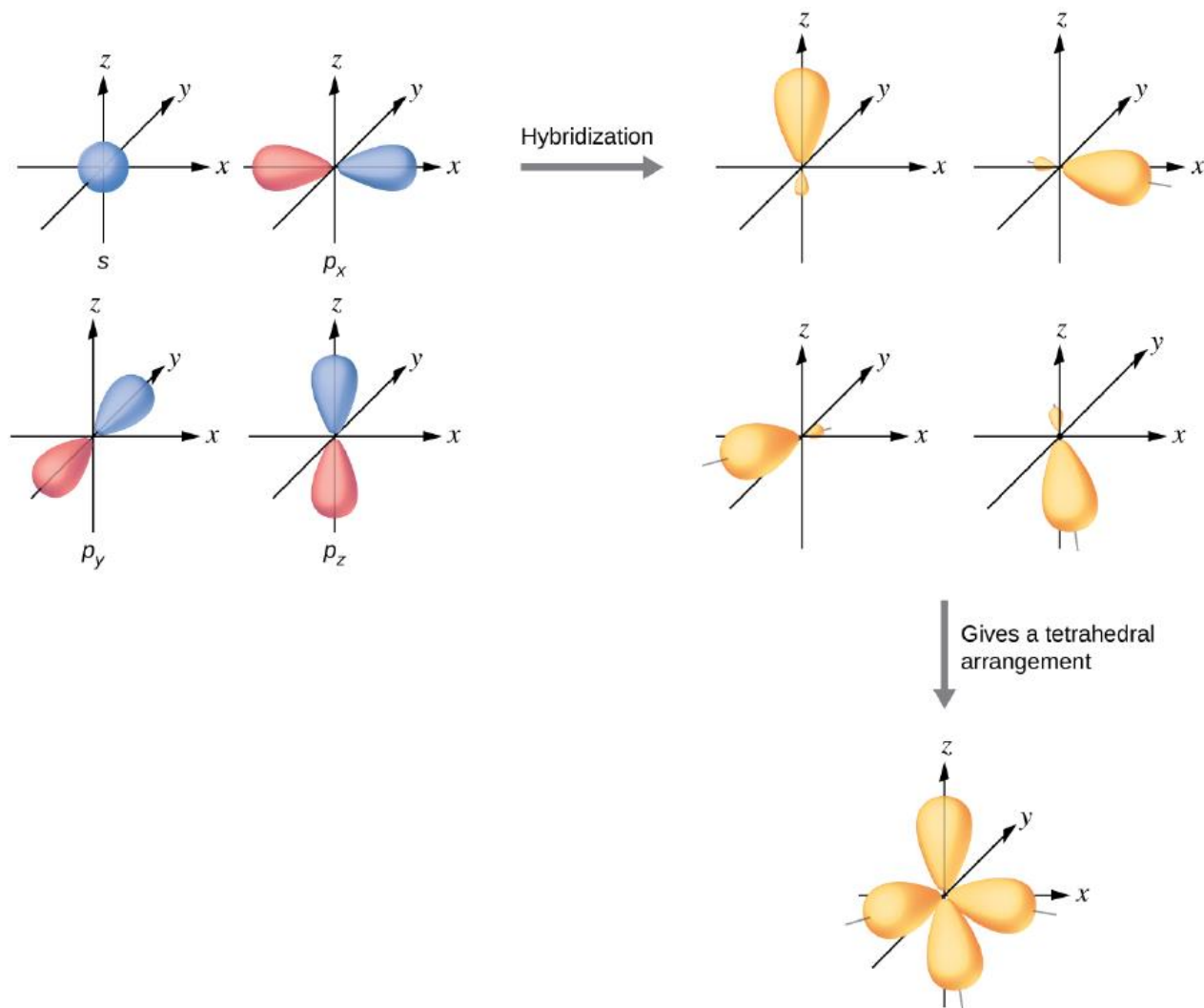
Identify the hybridization on the phosphorus atom in PCl_3

- A. sp^2
- B. sp^3
- C. sp^3d
- D. sp^3d^2



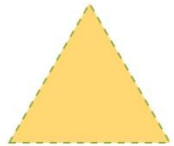
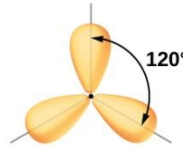
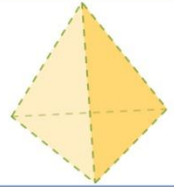
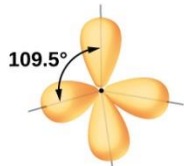

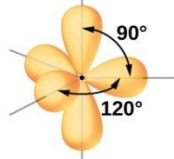
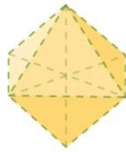
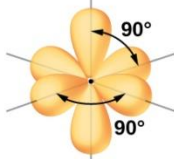
Hybrid Orbitals

- Hybrid orbitals are obtained by taking combinations of atomic orbitals of the isolated atoms
- The number of hybrid orbitals formed always equals the number of orbitals used
- A set of hybrid orbitals always has definite directional characteristics

Hybrid Orbital Formation (Hybridization)



Hybrid Orbitals

Regions of Electron Density	Arrangement		Hybridization	
2		linear	sp	
3		trigonal planar	sp^2	
4		tetrahedral	sp^3	
5		trigonal bipyramidal	sp^3d	
6		octahedral	sp^3d^2	

Introduction to sigma (σ) and pi (π) bonds

- HCN and CO₂

Bond composition

Bond Type	Bond Composition
Single bond	1 σ bond
Double bond	1 σ bond and 1 π bond
Triple bond	1 σ bond and 2 π bonds

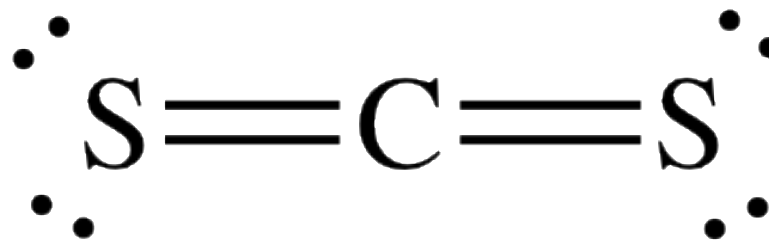
Bond composition

Identify the number of σ and π bonds in the nitrogen-nitrogen bond in N_2 .

Bond Composition

Identify the number of sigma (σ) and pi (π) bonds in the CS₂ molecule.

- A. 1 σ bond; 1 π bond
- B. 0 σ bonds; 2 π bonds
- C. 2 σ bonds; 2 π bonds
- D. 4 σ bonds; 0 π bonds

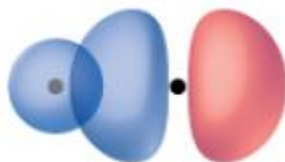


Sigma bonds: another look

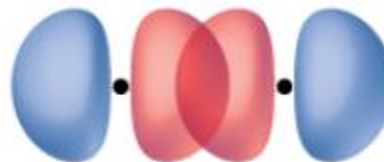
- A sigma (σ) bond has one region of overlap
- A sigma bond has electron density concentrated in the region along the bond axis
- Sigma bonds allow free rotation around bonds



(a)



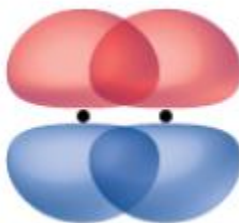
(b)



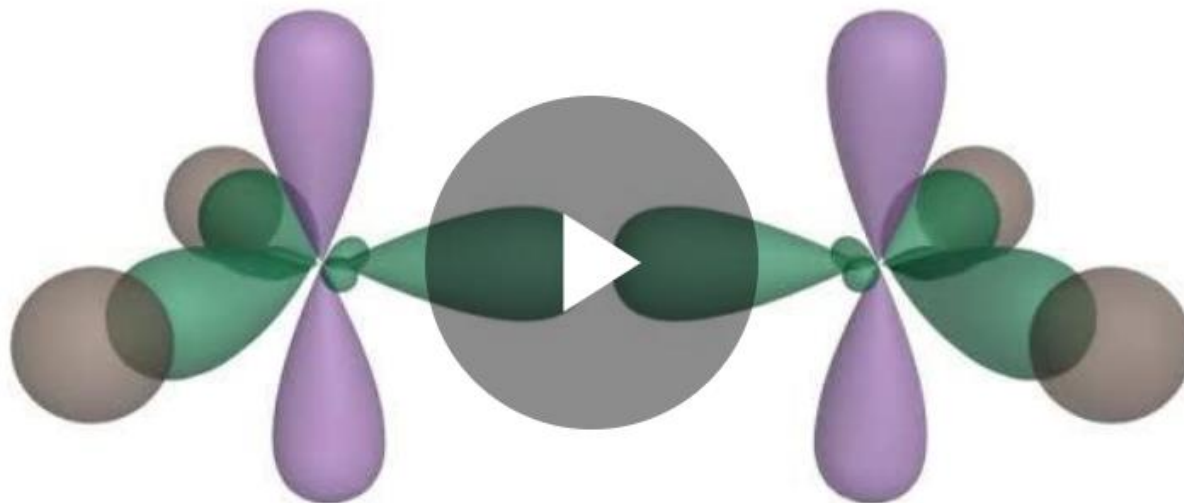
(c)

Pi bonds: another look

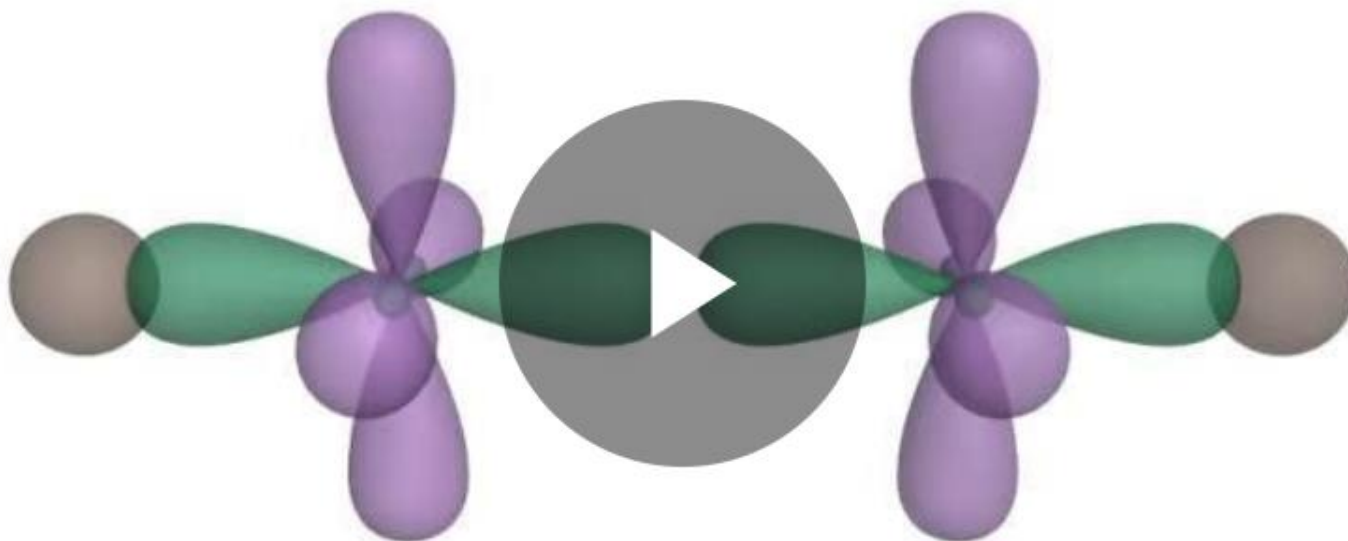
- A pi (π) bond has two regions of overlap
- A pi bond has an electron distribution above and below the bond axis
- Pi bonds prevent free rotation around bonds



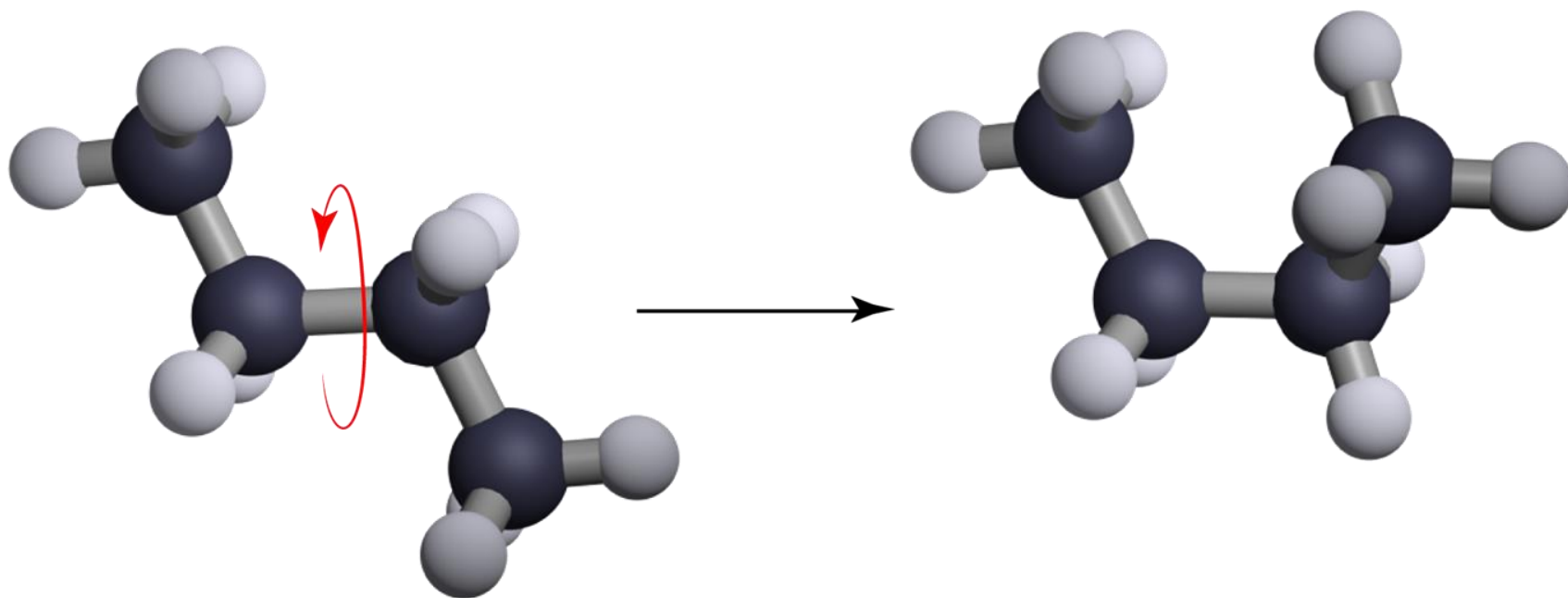
π Bond Animation: Double Bond



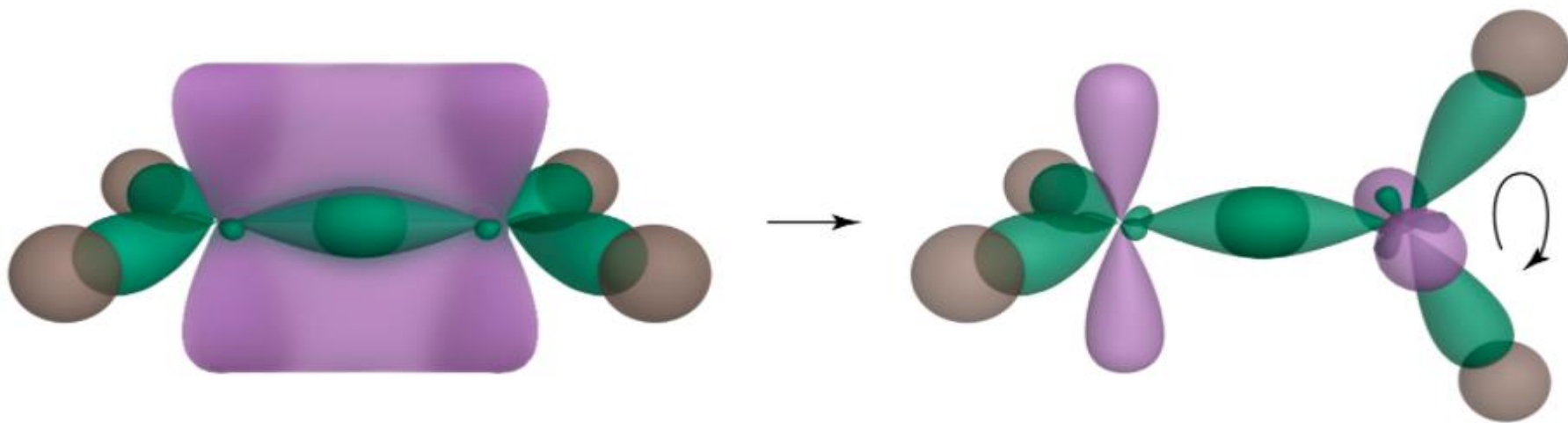
π Bond Animation: Triple Bond



Free Rotation Around Sigma Bonds

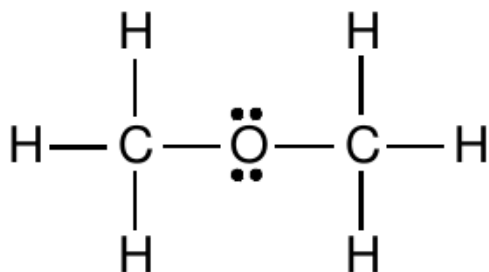


No Rotation Around Pi Bonds

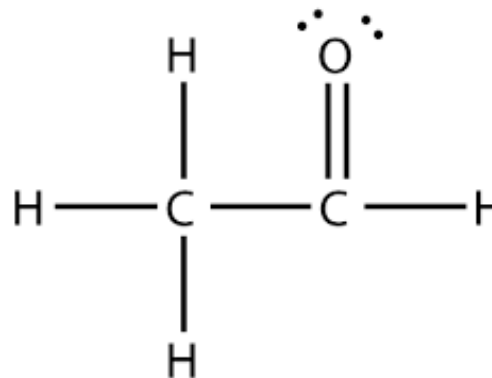


Sigma and pi bonding

Which molecule has free rotation around the carbon-oxygen bond?



dimethyl ether



acetaldehyde

- A. dimethyl ether
- B. acetaldehyde
- C. Both have free rotation around the carbon-oxygen bond.
- D. Neither have free rotation around the carbon-oxygen bond