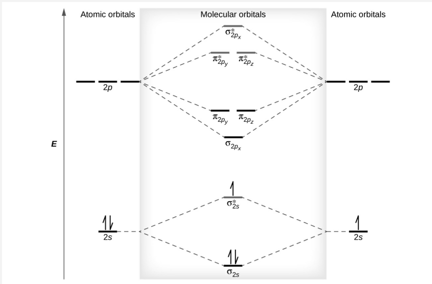
Hybridization and MO Theory Cheat Sheet

by mjb via cheatography.com/128288/cs/25147/

Hybridization

Formal Charge	FC = (group #) - (loan pairs + bonds)
Bond Enthalpy	ΔHrxn = (sum of bonds broken) - (sum of bonds formed)
	Weaker bonds broken provide more exothermic reactions. Weaker product bonds make for a less exothermic reaction.
Bond Order and Length	Shorter bond length = greater bond order
	Single bonds are the longest and the weakest
	Triple bonds are the shortest and the strongest
	Non-integer bond order indicates resonance
Non-polar covalent bonds	ex: Cl-Cl
	small energy difference in electronegativity
Polar Covalent Bonds	ex: H-Cl
	medium energy difference
Ionic Bonds	ex: Li-Cl
	large energy difference (over 1.7)
Average Bond Order	ABO = (# of bonds in the molecule) ÷ (# of resonance structures)

MO Theory



MO diagram for F2, O2, Ne2, and all other molecules

MO Theory

Bond Order	(bonds-antibonds) ÷ 2
Bonds	σ, π
Anti-Bonds	σ, π
Sigma Bond	hybridized \
Pi Bond	unhybridized p orbital \
Loan Pair	Spin Paired \ --> X

VSEPR

Number of Electrons	Electron Geometry	Atoms + Loan Pairs	Molecular Geometry
2	linear	2+0	linear
3	trigonal planar	3+0	trigonal planar
		2+1	bent
4	tetrahedral	4+0	tetrahedral
		3+1	trigonal pyramidal
		2+2	bent
5	trigonal bipyramidal	5+0	trigonal bipyramidal
		4+1	see-saw
		3+2	T-shaped
		2+3	linear
6	octahedral	6+0	octahedral

VSEPR (cont)

5+1	square pyramidal
4+2	square planar

Polarity

Requirements for a Polar Molecule	Bonds must be polar
	The molecule cannot have symmetry
	A bond is polar if one side is more electronegative than the other

MO Theory

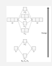


Diagram for B2, C2, and N2

The Born-Haber Cycle

Sublimation	Na (s) + 1/2 Cl2 (g) --> Na (g) + Cl (g)	+107.32 kJ
Cl-Cl bond energy	Na (g) + Cl (g) --> Na (g) + 1/2 Cl2 (g)	+121.68 kJ
ionization energy of sodium	Na (g) + 1/2 Cl2 (g) --> Na+(g) + Cl (g) + e-	+496 kJ
Electron Affinity of Cl	Na+(g) + Cl (g) + e- --> Na+ (g) + Cl- (g)	-349 kJ
Lattice Energy of NaCl	Na+ (g) + Cl- (g) --> NaCl (s)	-786 kJ

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Sigma and Pi Bonds

Valence Bond Theory	When two atoms are in close proximity to one another, they arrange themselves at the lowest possible energy	
Sigma bonds	Formed by end-on overlap of orbitals along the internuclear axis	
	the electron density is highest right between the two atoms	
Pi bonds	Formed by side on overlap of orbitals	
	there is no electron density between the atoms	
	Weaker than sigma bonds	
Valence electron pairs	Electron Geometry	Hybridization
2	linear	sp
3	trigonal planar	sp2
4	tetrahedral	sp3
5	trigonal bipyramidal	sp4
6	octahedral	sp5
Single Bonds	one sigma bond	
Double Bonds	one sigma, one pi bond	
Triple Bonds	one sigma, two pi bonds	

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