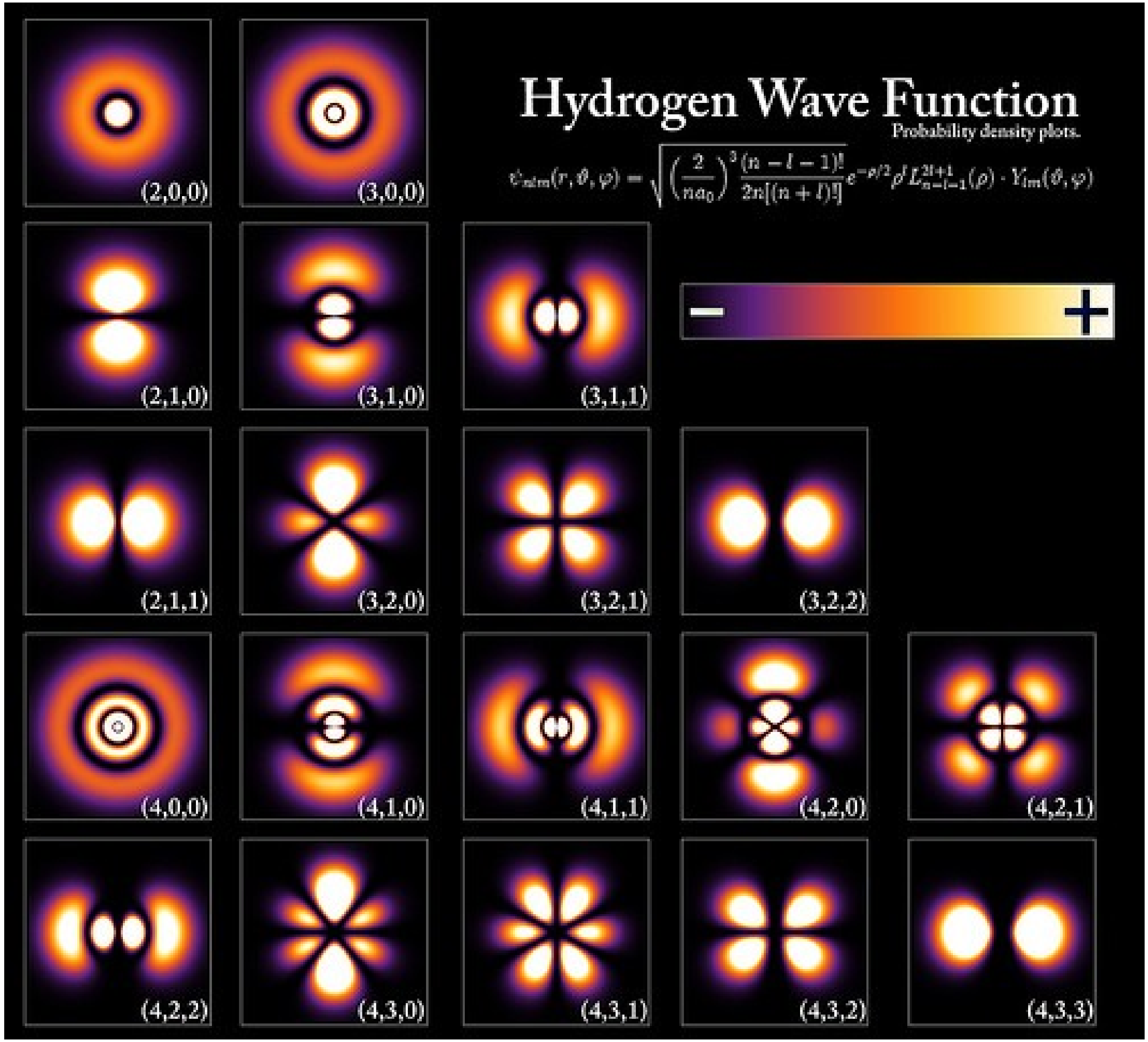
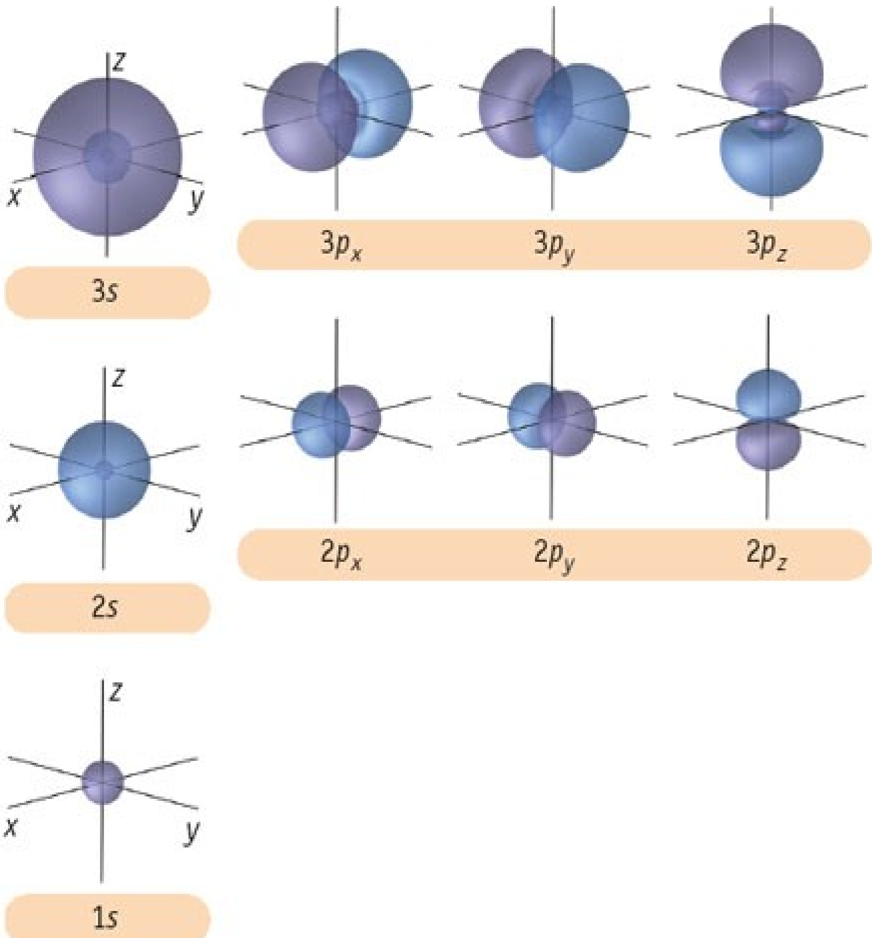
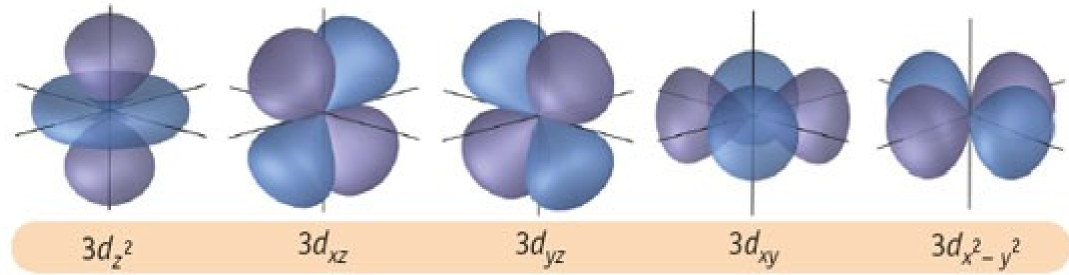


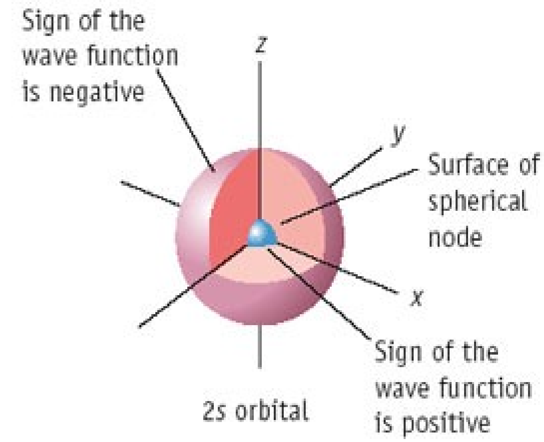
Hydrogen Wave Function
Probability density plots.
$\psi_{nlm}(r,\vartheta,\varphi) = \sqrt{\left(\frac{2}{na_0}\right)^3 \frac{(n-l-1)!}{2n[(n+l)!]}} e^{-\rho/2} \rho^l L_{n-l-1}^{2l+1}(\rho) \cdot Y_{lm}(\vartheta,\varphi)$
−
+
(2,0,0)
(3,0,0)
(2,1,0)
(3,1,0)
(3,1,1)
(2,1,1)
(3,2,0)
(3,2,1)
(3,2,2)
(4,0,0)
(4,1,0)
(4,1,1)
(4,2,0)
(4,2,1)
(4,2,2)
(4,3,0)
(4,3,1)
(4,3,2)
(4,3,3)

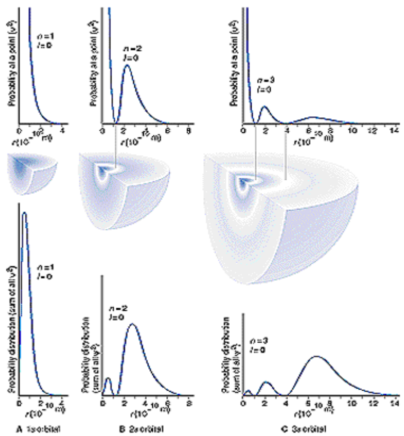


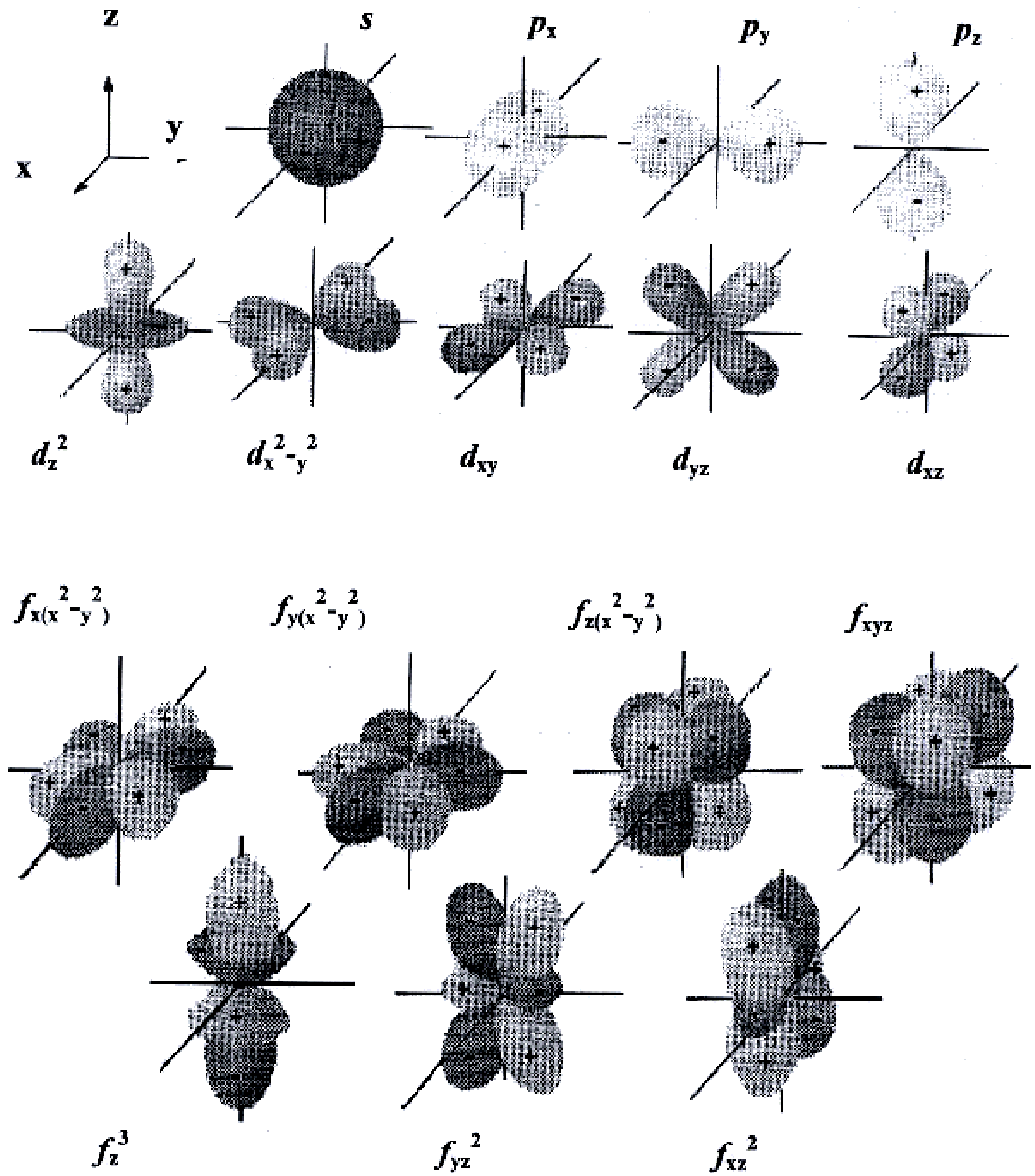


Spherical Nodes

The drawings of the 2*s* and 3*s* orbitals show that they consist of nested spheres because these orbitals (as well as *p* orbitals with $n > 2$ and *d* orbitals with $n > 3$) have spherical nodes. For a 2s orbital the wave function has a positive value close to the nucleus, but it has a negative value at greater distances. That is, the wave function has a zero value, a node, at this point. The node occurs at the same distance from the nucleus regardless of direction so the node occurs on a spherical surface. The number of spherical nodes for any orbital is $n - \ell - 1$.

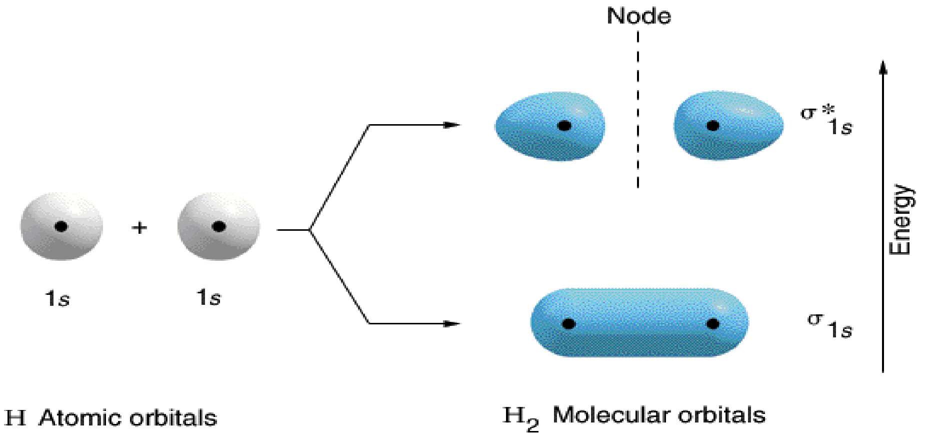




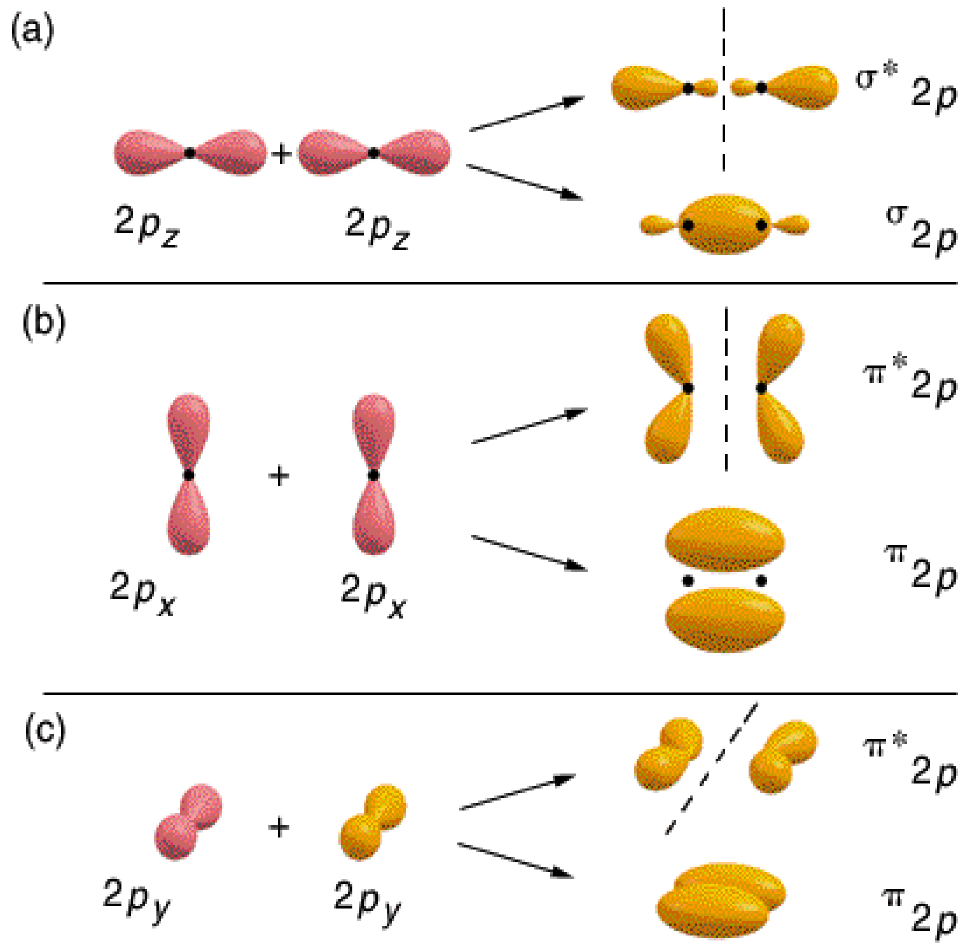


z
y
x
s
p_x
p_y
p_z
d_{z^2}
$d_{x^2-y^2}$
d_{xy}
d_{yz}
d_{xz}
$f_{x(x^2-y^2)}$
$f_{y(x^2-y^2)}$
$f_{z(x^2-y^2)}$
f_{xyz}
f_{z^3}
f_{yz^2}
f_{xz^2}

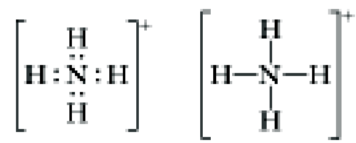
Molekulové orbitaly



Molekulové orbitaly

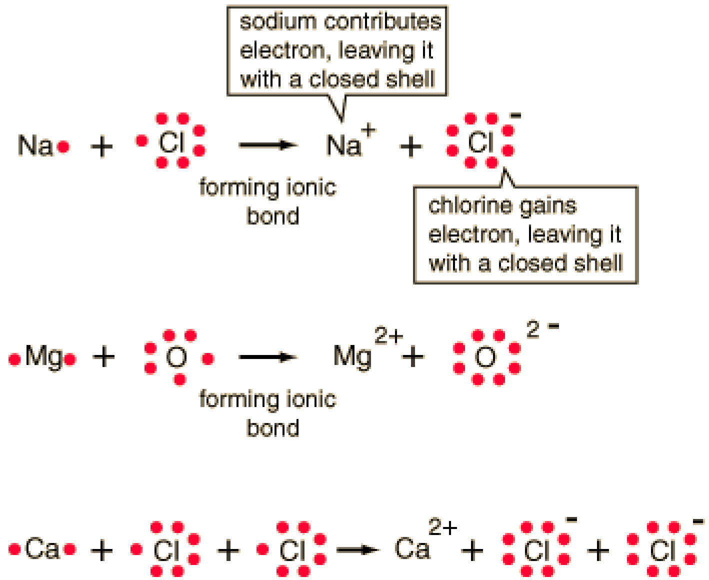


Lewisovy struktury

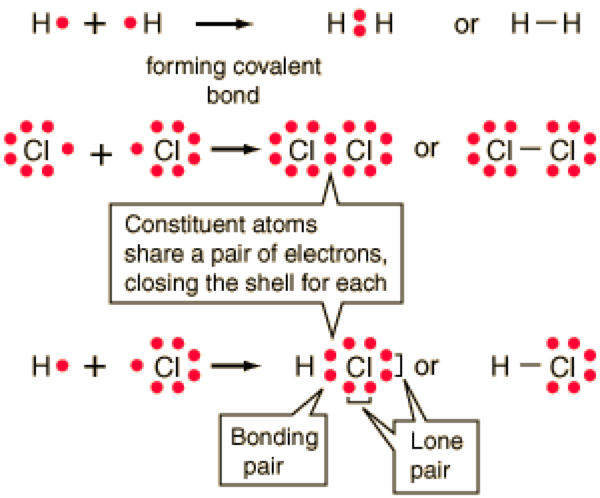


dot formula dash formula

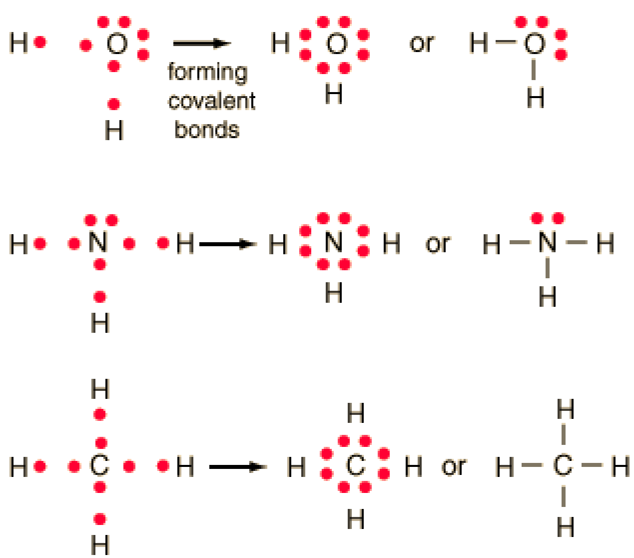
TABLE 7-1	*Lewis Dot Formulas for Representative Elements*							
Group	**IA**	**IIA**	**IIIA**	**IVA**	**VA**	**VIA**	**VIIA**	**VIIIA**
Number of electrons in valence shell	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8 *(except He)***
Period 1	H ·							He :
Period 2	Li ·	Be :	B̈ ·	C̈ ·	· N̈ ·	· Ö :	· F̈ :	: N̈e :
Period 3	Na ·	Mg :	Äl ·	S̈i ·	· P̈ ·	· S̈ :	· C̈l :	:Är :
Period 4	K ·	Ca :	G̈a ·	G̈e ·	· Äs ·	· S̈e :	· B̈r :	: K̈r :
Period 5	Rb ·	Sr :	Ïn ·	S̈n ·	· S̈b ·	· T̈e :	· Ï :	: Ẍe :
Period 6	Cs ·	Ba :	T̈l ·	P̈b ·	· B̈i ·	· P̈o :	· Ät :	: R̈n :
Period 7	Fr ·	Ra :						



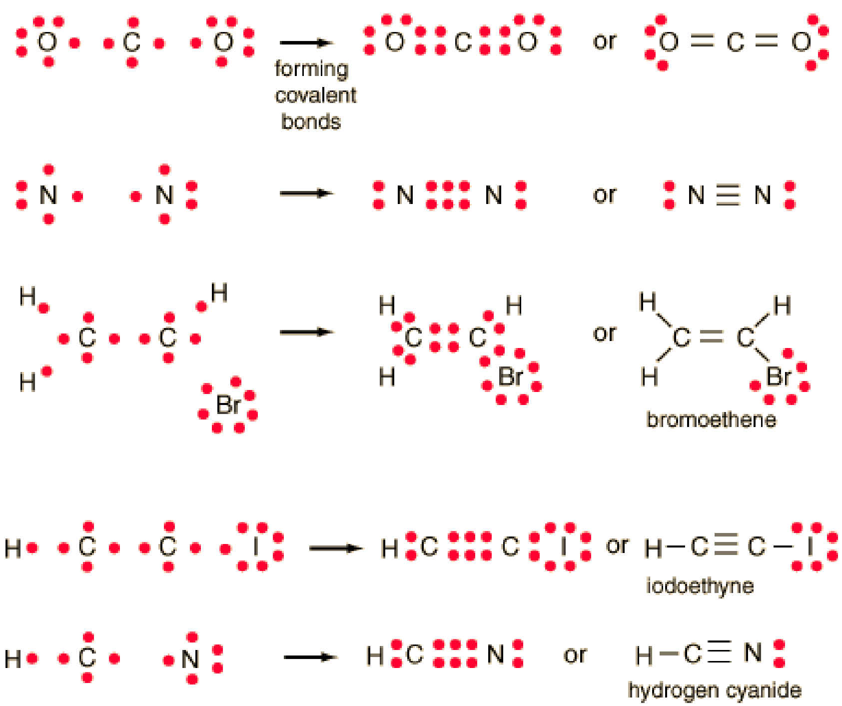
sodium contributes electron, leaving it with a closed shell
Na
Cl
Na
Cl
forming ionic bond
chlorine gains electron, leaving it with a closed shell
Mg
O
Mg
O
forming ionic bond
Ca
Cl
Cl
Ca
Cl
Cl



H
H
H
H
or
H — H
forming covalent bond
Cl
Cl
Cl
Cl
or
Cl — Cl
Constituent atoms share a pair of electrons, closing the shell for each
H
Cl
H
Cl
or
H — Cl
Bonding pair
Lone pair



H
O
H
forming covalent bonds
H
O
H
or
H — O
H
H
N
H
H
H
N
H
H
or
H — N — H
H
H
H
C
H
H
H
C
H
H
or
H — C — H
H
H



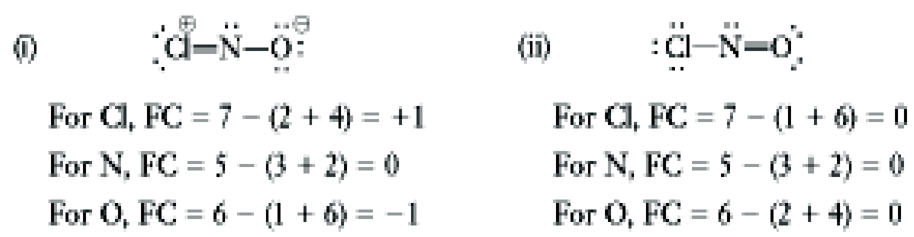
O
C
O
forming covalent bonds
O
C
O
or
O = C = O
N
N
N
N
or
N ≡ N
H
H
C
C
H
Br
H
C
C
H
H
Br
or
H
C = C
H
H
Br
bromoethene
H
C
C
I
H
C
C
I
or
H — C ≡ C — I
iodoethyne
H
C
N
H
C
N
or
H — C ≡ N
hydrogen cyanide

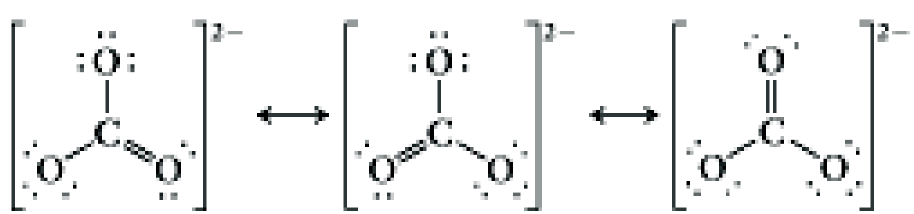
Oktetové pravidlo

Ve většině sloučenin zaujímají prvky stabilní konfiguraci vzácného plynu. Týká se pouze prvků 2. a 3. periody.

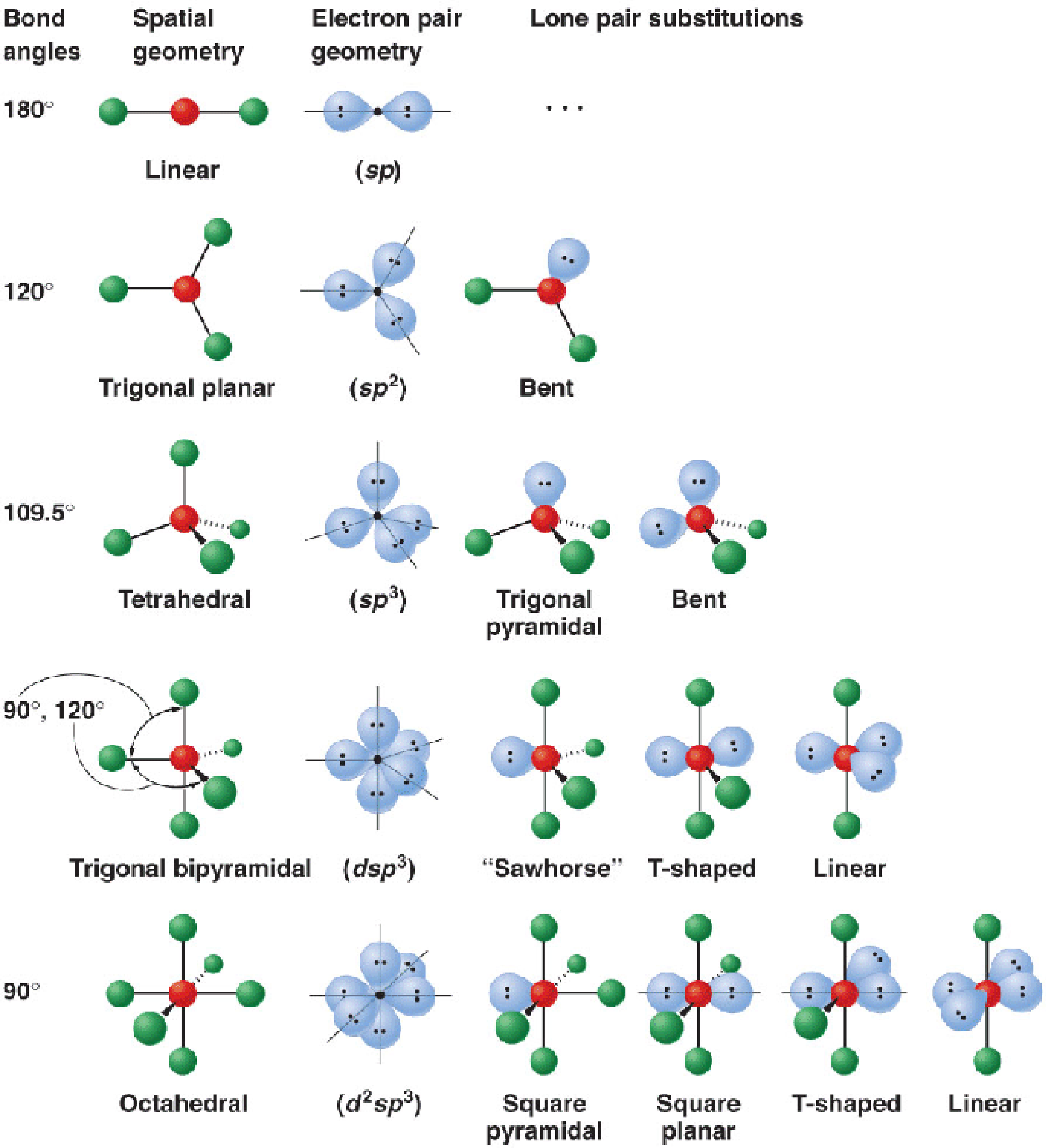
Formální náboj

FC = (č. skupiny) - [(počet vazeb) - (počet nevazeb. el)]

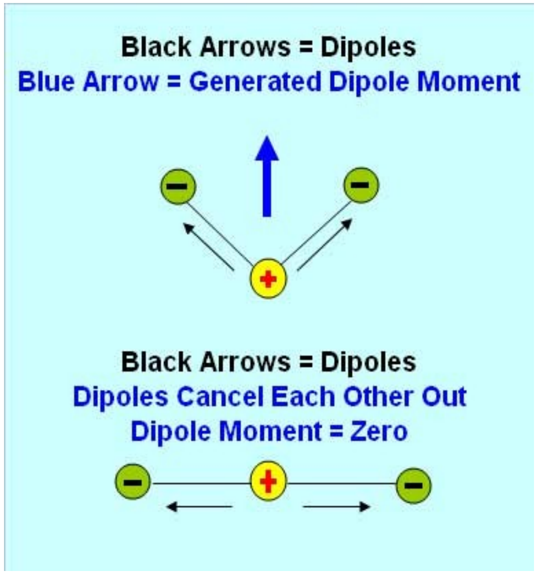




VSEPR

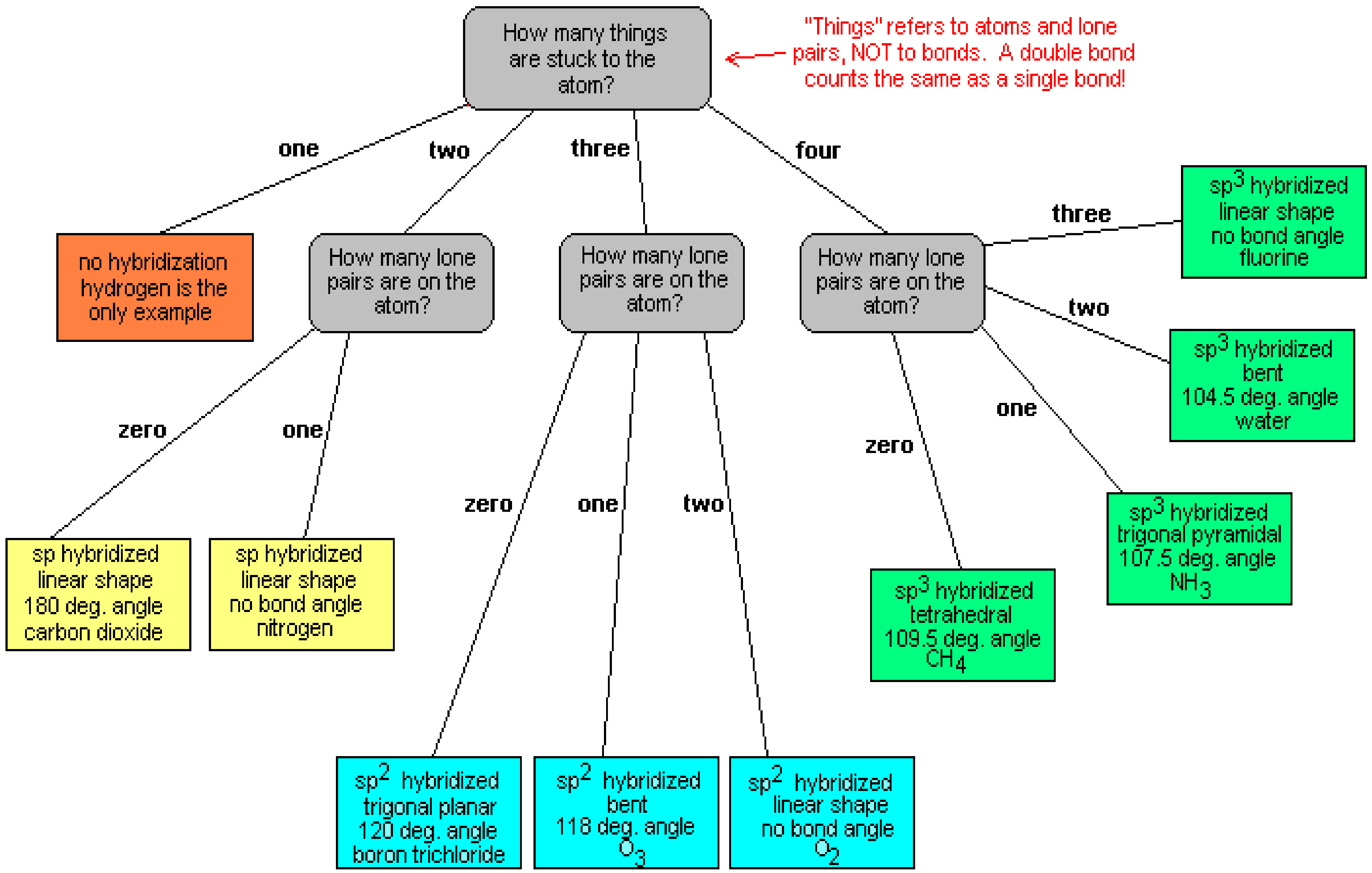


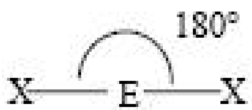
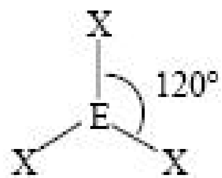
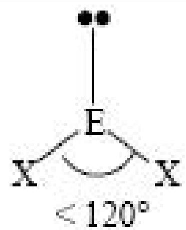
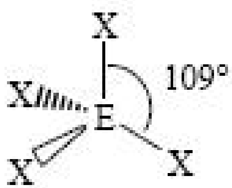
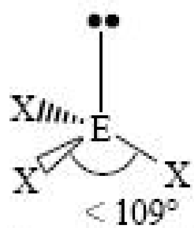
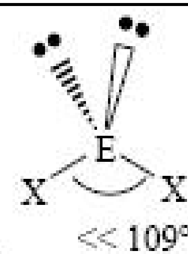
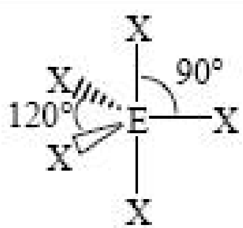
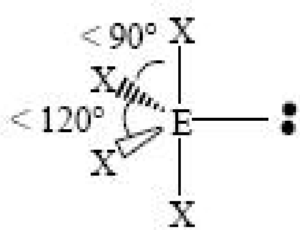
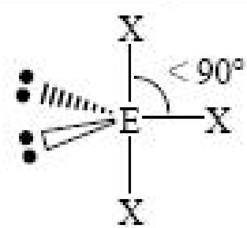
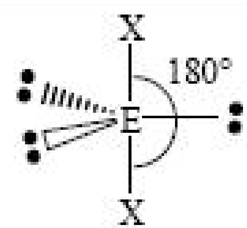
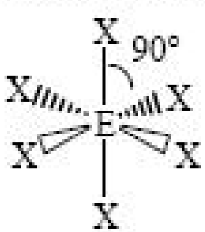
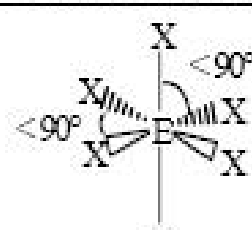
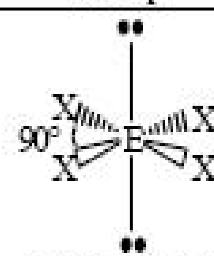
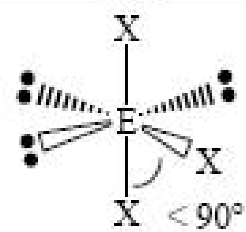
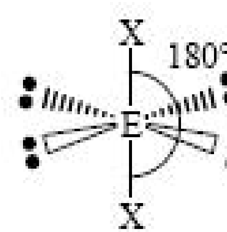
Bond angles
Spatial geometry
Electron pair geometry
Lone pair substitutions
180°
Linear
(sp)
120°
Trigonal planar
(sp2)
Bent
109.5°
Tetrahedral
(sp3)
Trigonal pyramidal
Bent
90°, 120°
Trigonal bipyramidal
(dsp3)
"Sawhorse"
T-shaped
Linear
90°
Octahedral
(d2sp3)
Square pyramidal
Square planar
T-shaped
Linear



Black Arrows = Dipoles
Blue Arrow = Generated Dipole Moment
Black Arrows = Dipoles
Dipoles Cancel Each Other Out
Dipole Moment = Zero

VSEPR

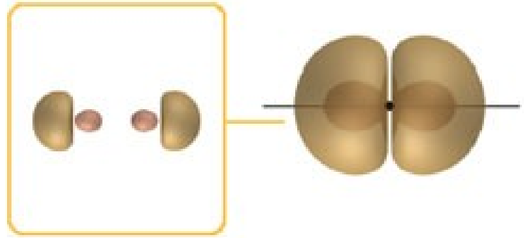
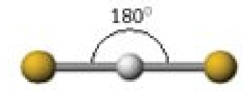
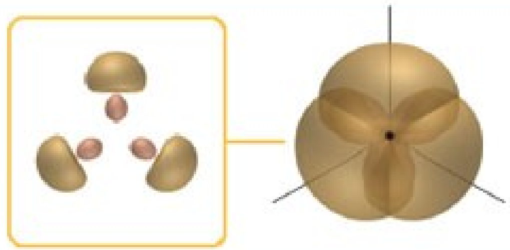
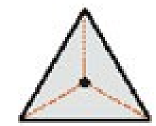
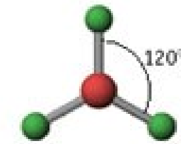
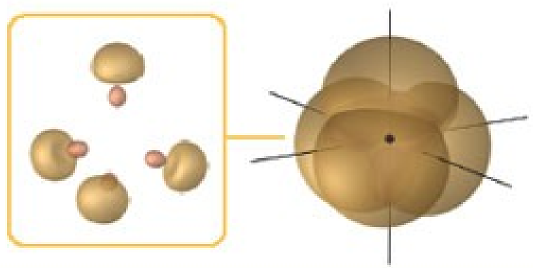
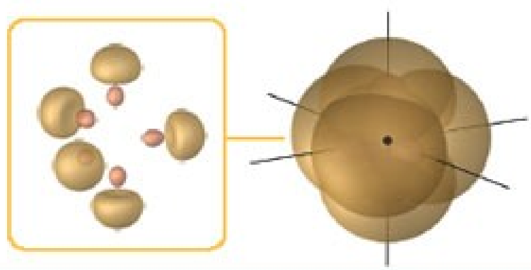
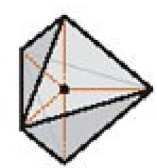
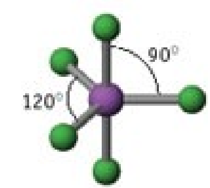
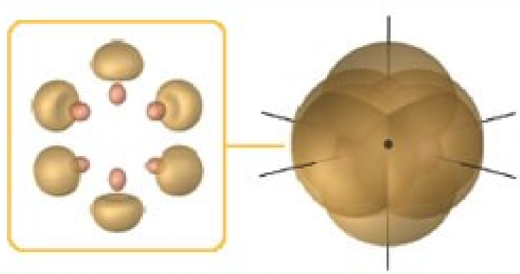
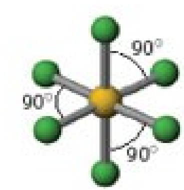

How many things are stuck to the atom?
"Things" refers to atoms and lone pairs, NOT to bonds. A double bond counts the same as a single bond!
one
two
three
four
no hybridization hydrogen is the only example
How many lone pairs are on the atom?
How many lone pairs are on the atom?
How many lone pairs are on the atom?
zero
one
sp hybridized linear shape 180 deg. angle carbon dioxide
sp hybridized linear shape no bond angle nitrogen
zero
one
two
sp^2 hybridized trigonal planar 120 deg. angle boron trichloride
sp^2 hybridized bent 118 deg. angle O_3
sp^2 hybridized linear shape no bond angle O_2
three
sp^3 hybridized linear shape no bond angle fluorine
two
sp^3 hybridized bent 104.5 deg. angle water
one
sp^3 hybridized trigonal pyramidal 107.5 deg. angle NH_3
zero
sp^3 hybridized tetrahedral 109.5 deg. angle CH_4

VSEPR Geometries					
Steric No.	Basic Geometry 0 lone pair	1 lone pair	2 lone pairs	3 lone pairs	4 lone pairs
2	 **Linear**				
3	 **Trigonal Planar**	 **Bent or Angular**			
4	 **Tetrahedral**	 **Trigonal Pyramid**	 **Bent or Angular**		
5	 **Trigonal Bipyramid**	 **Sawhorse or Seesaw**	 **T-shape**	 **Linear**	
6	 **Octahedral**	 **Square Pyramid**	 **Square Planar**	 **T-shape**	 **Linear**

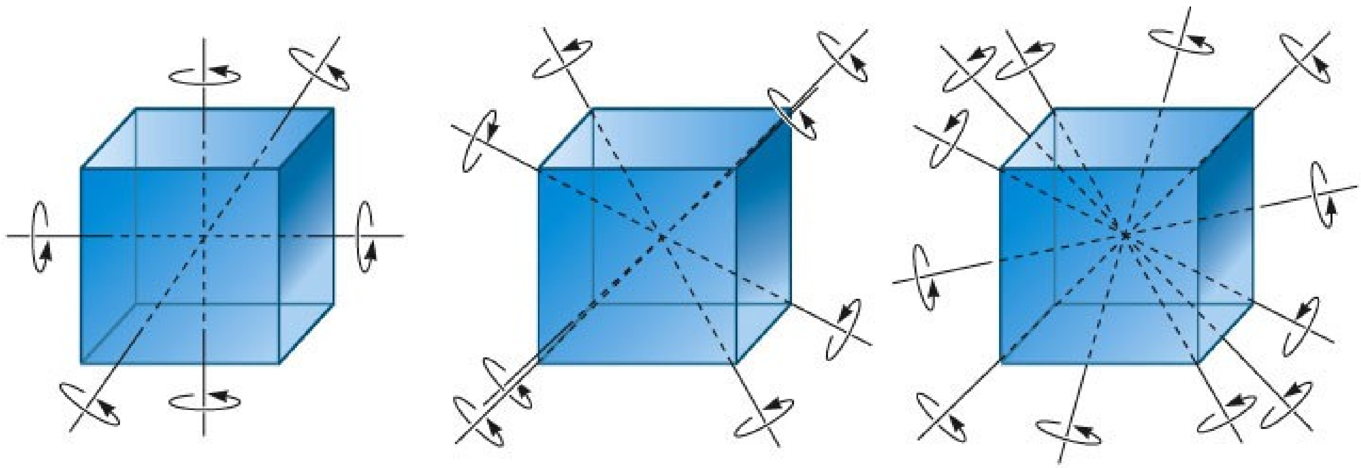
Hybridizace

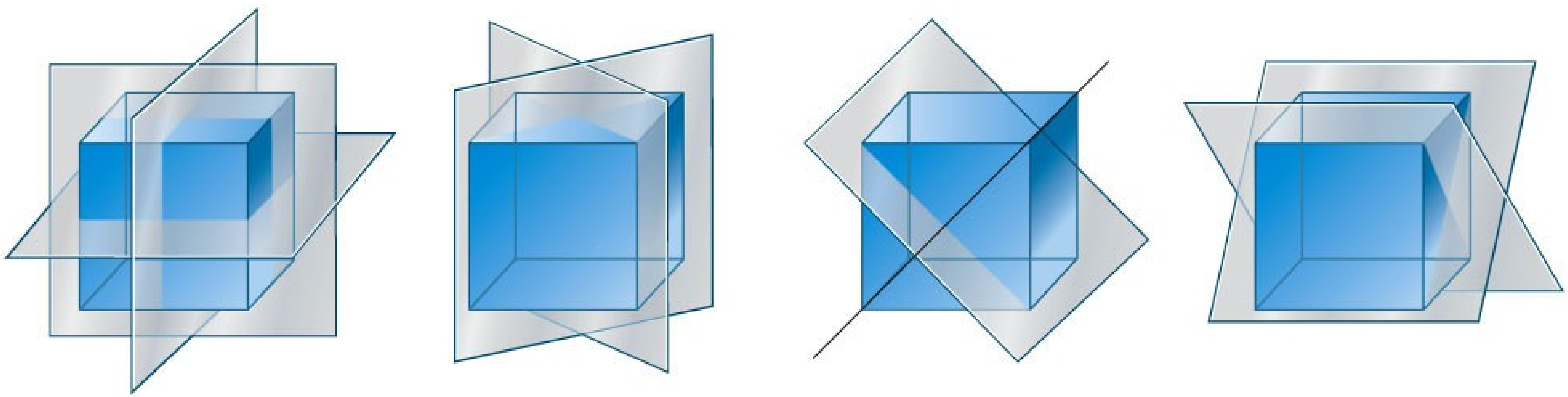
TABLE 8-2 ***Relation Between Electronic Geometries and Hybridization***

Regions of High Electron Density	Electronic Geometry	Atomic Orbitals Mixed from Valence Shell of Central Atom	Hybridization
2	linear	one *s*, one *p*	sp
3	trigonal planar	one *s*, two *p*'s	sp^2
4	tetrahedral	one *s*, three *p*'s	sp^3
5	trigonal bipyramidal	one *s*, three *p*'s, one *d*	sp^3d
6	octahedral	one *s*, three *p*'s, two *d*'s	sp^3d^2

	Arrangement of Hybrid Orbitals	Geometric figure	Example
Two electron pairs *sp*		 Linear	 $BeCl_2$
Three electron pairs sp^2		 Trigonal-planar	 BF_3
Four electron pairs sp^3		 Tetrahedral	 CH_4
Five electron pairs sp^3d		 Trigonal-bipyramidal	 PF_5
Six electron pairs sp^3d^2		 Octahedral	 SF_6

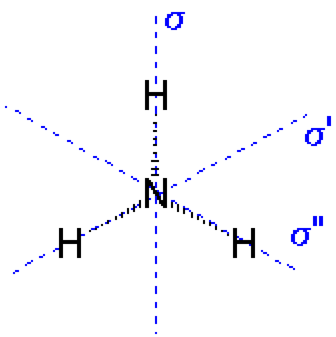
Symetrie



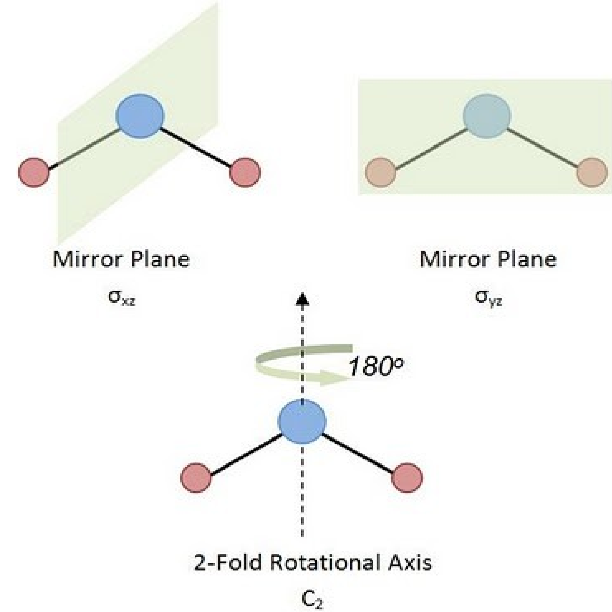


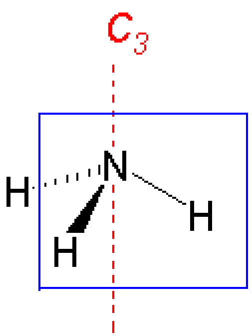
Nine mirror planes

Symetrie



Top view, there is a plane of symmetry along each NH bond as shown by the blue broken lines





Side view, showing the C_3 axis (broken red line) and one of the three planes of symmetry (blue box)