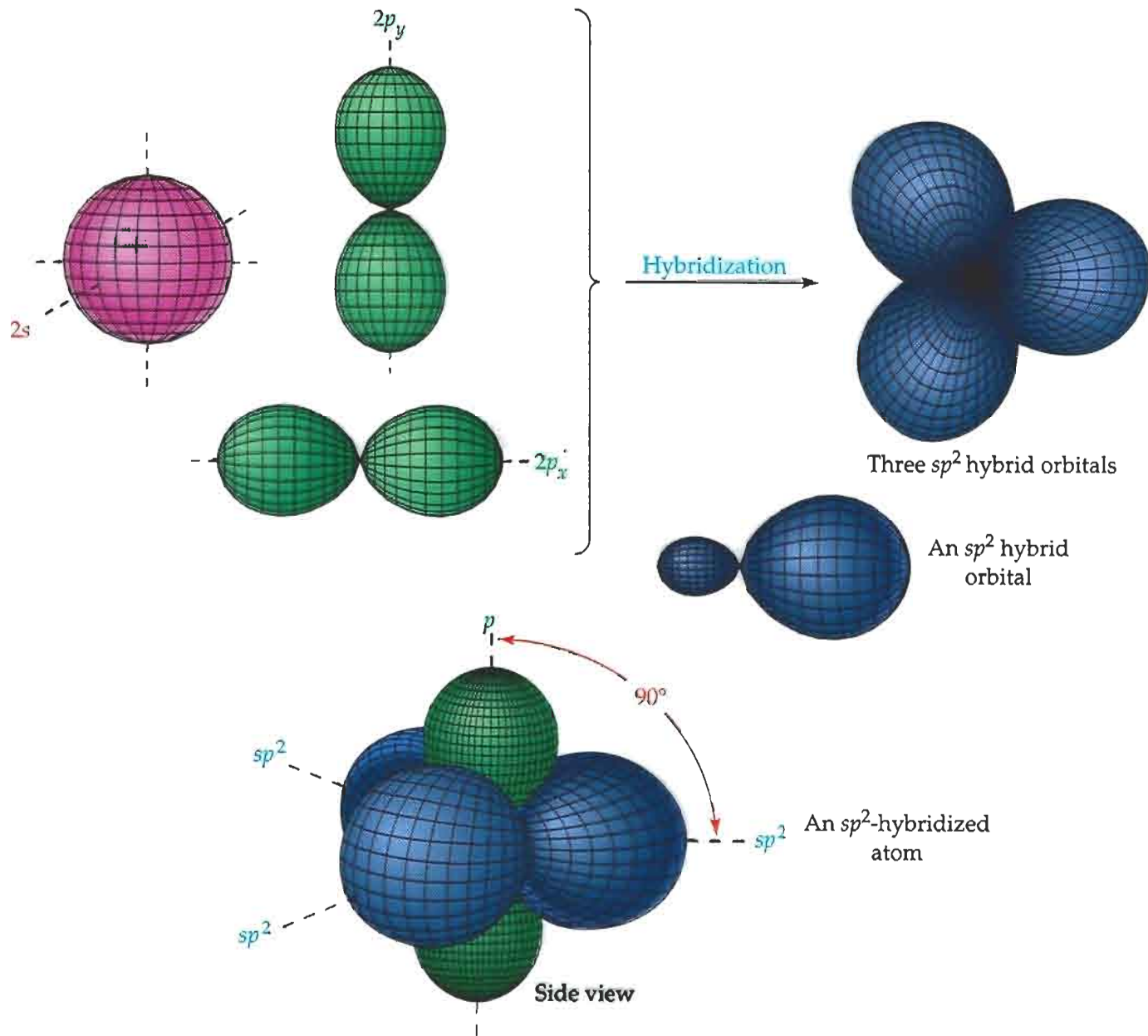
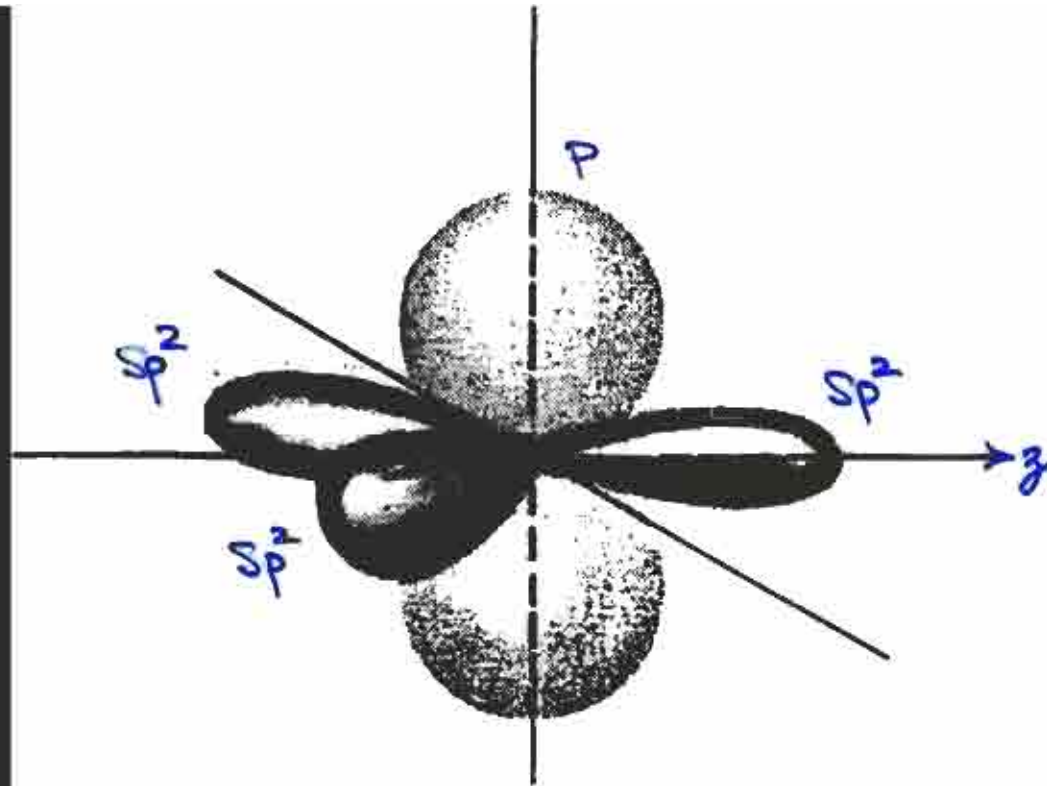


*Welcome to 3.091*

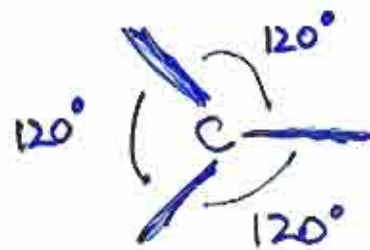
Lecture 11

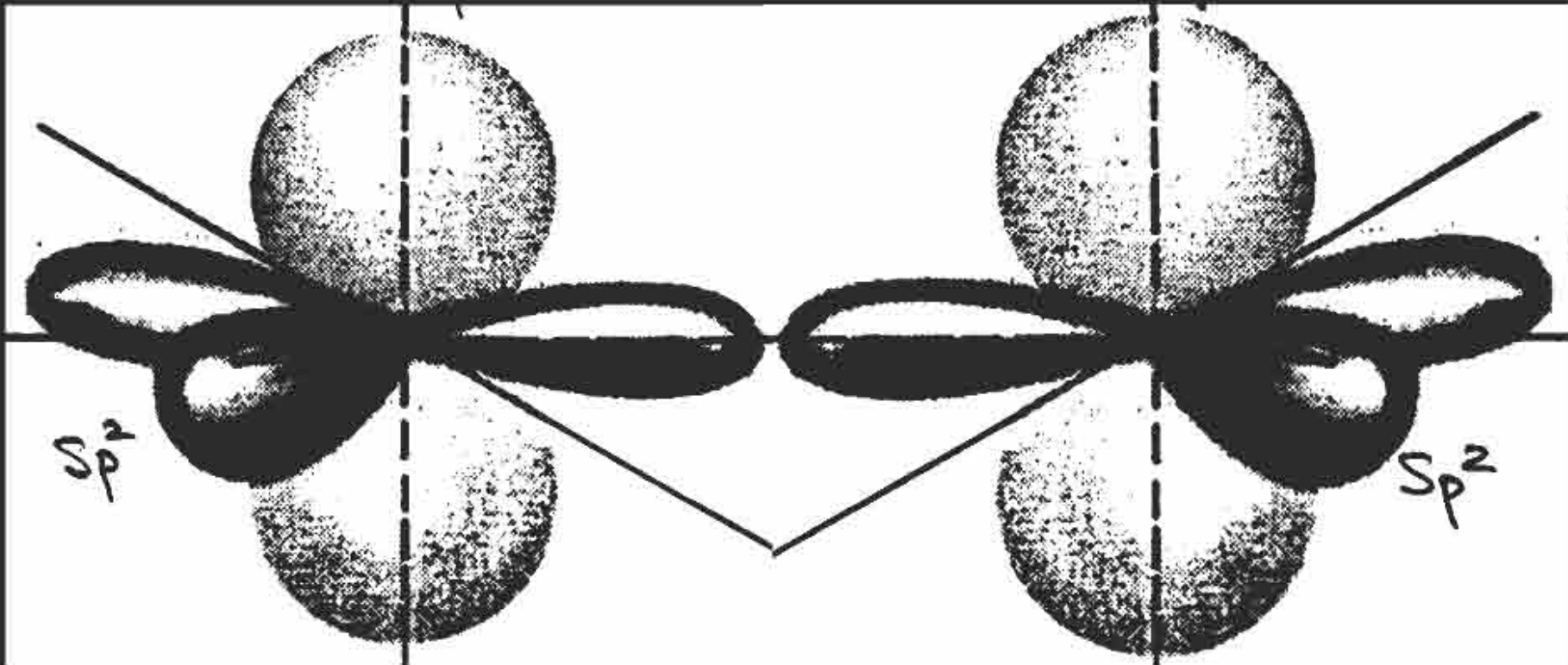
October 4, 2004

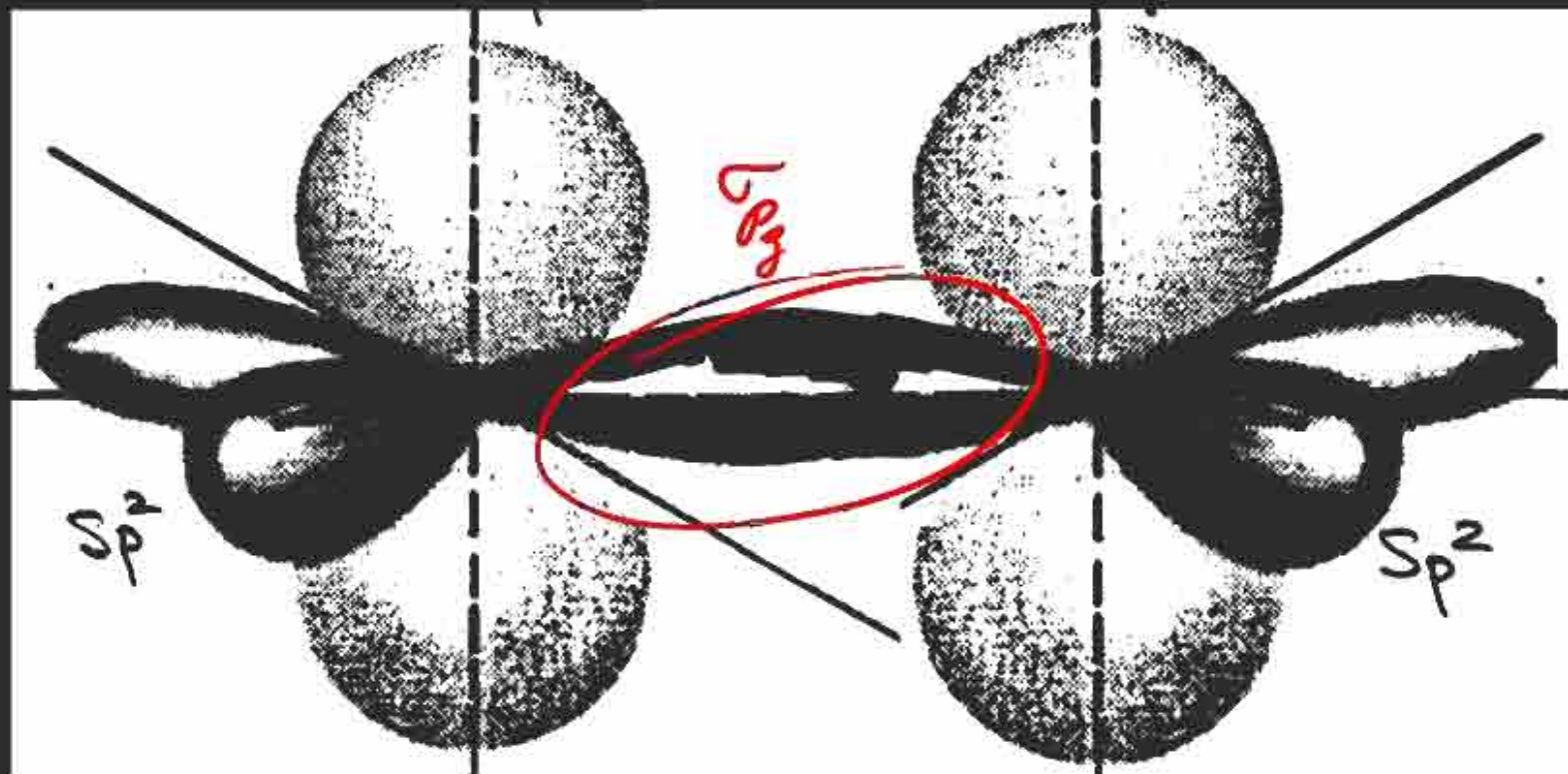




TOP VIEW

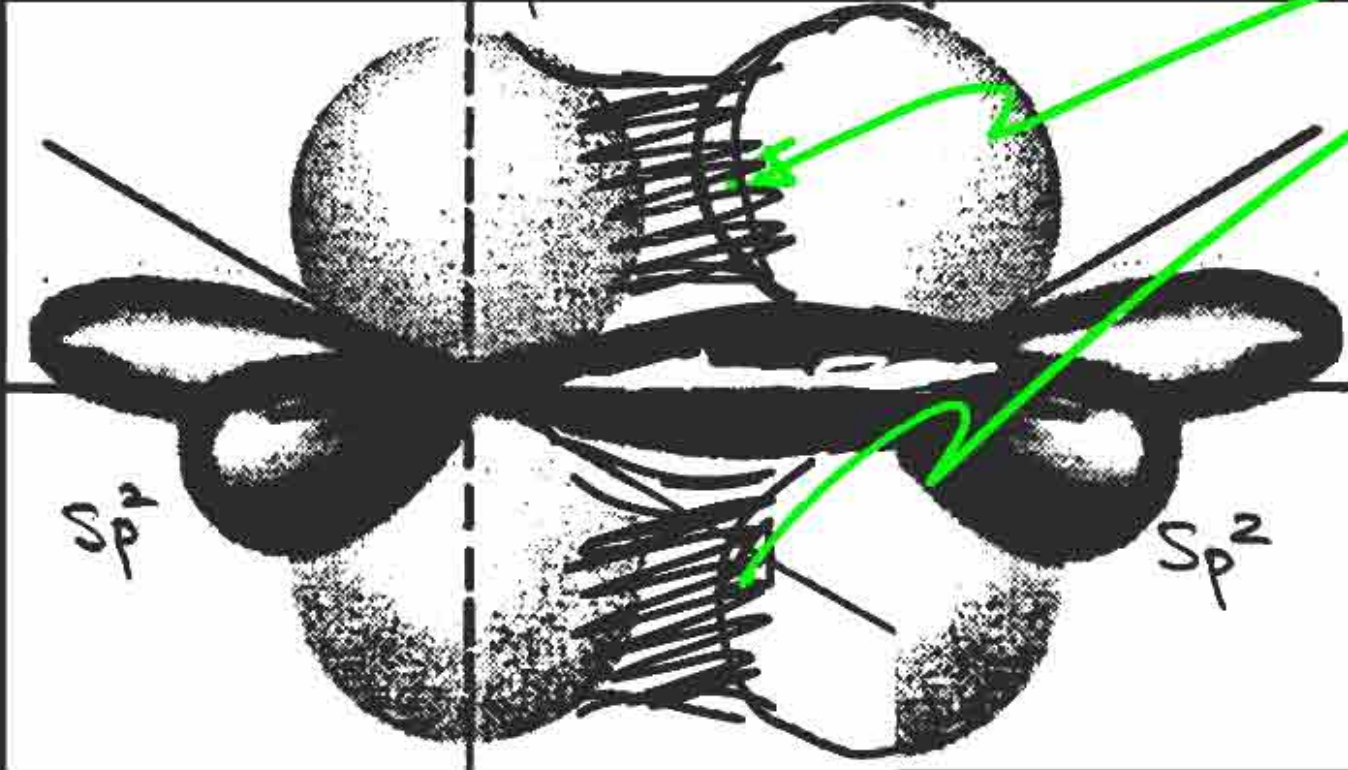






$p_y$

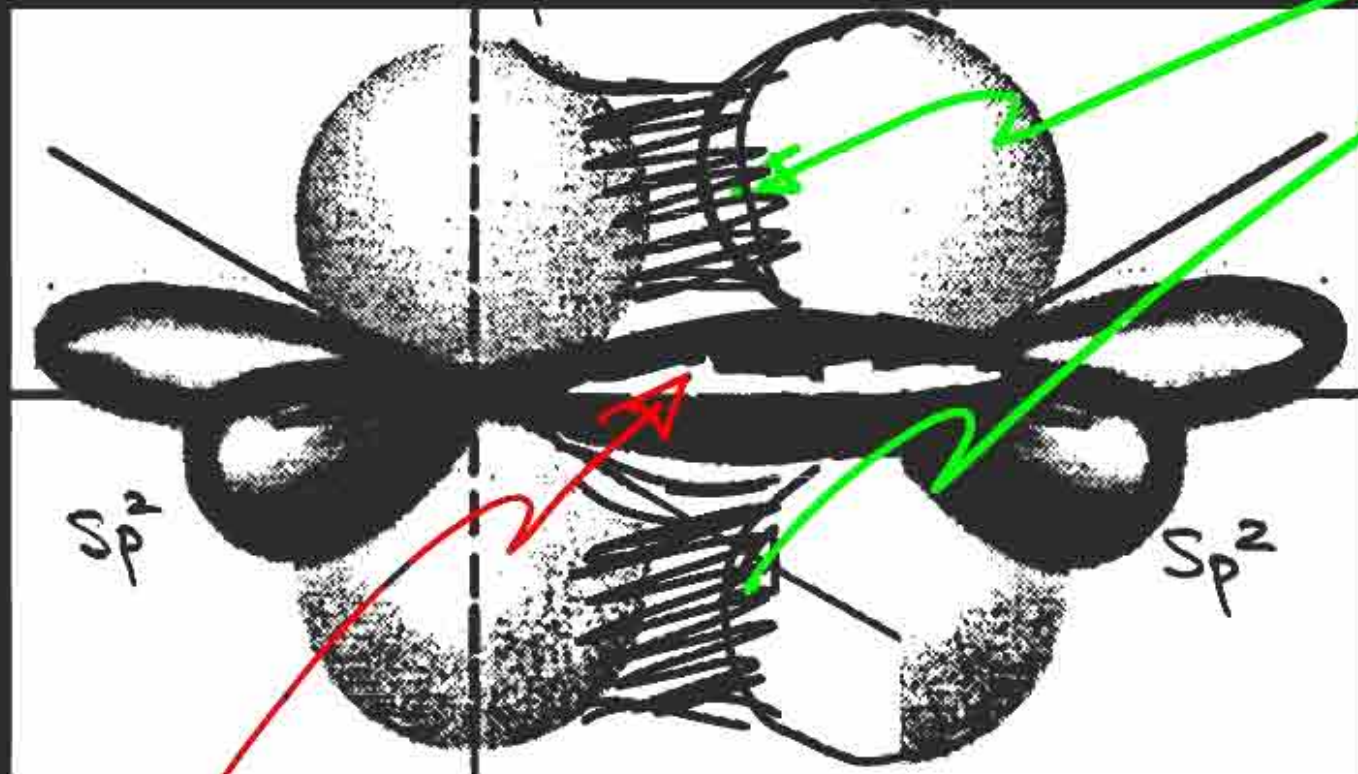
$\pi p_y$



$Sp^2$

$Sp^2$





$p_y$

$\pi p_y$

$sp^2$

$sp^2$

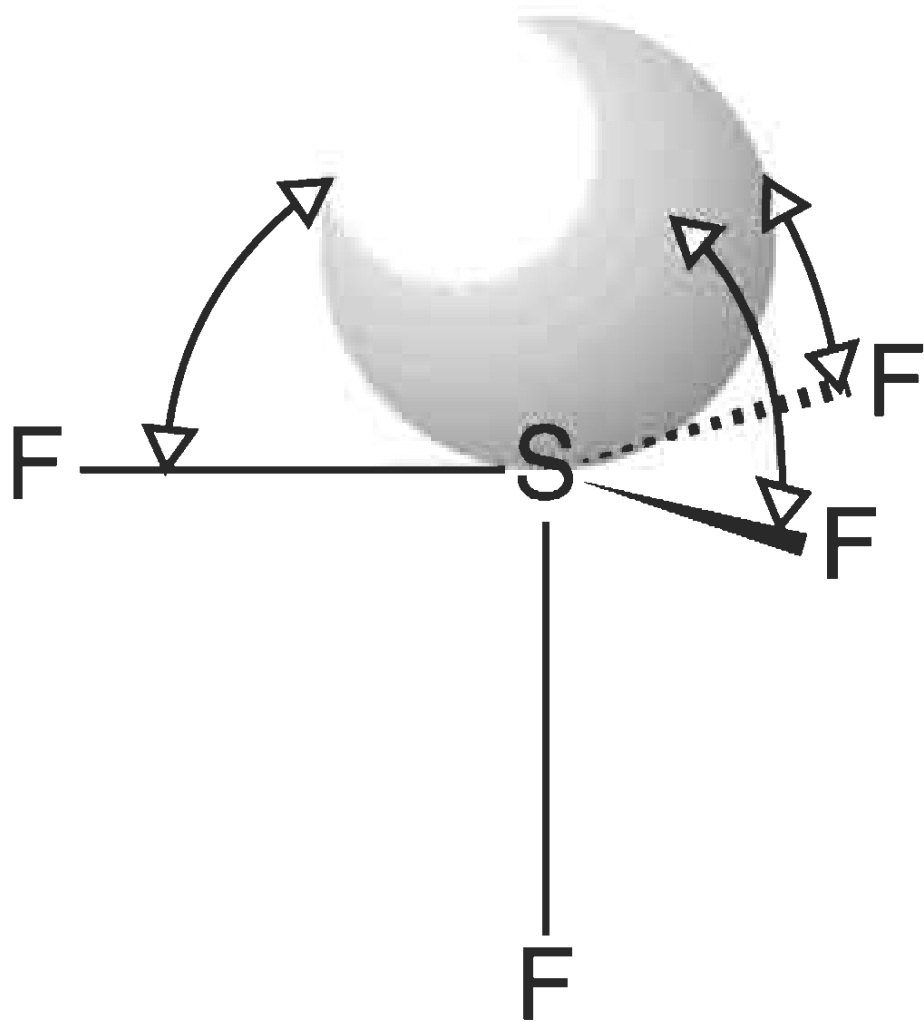
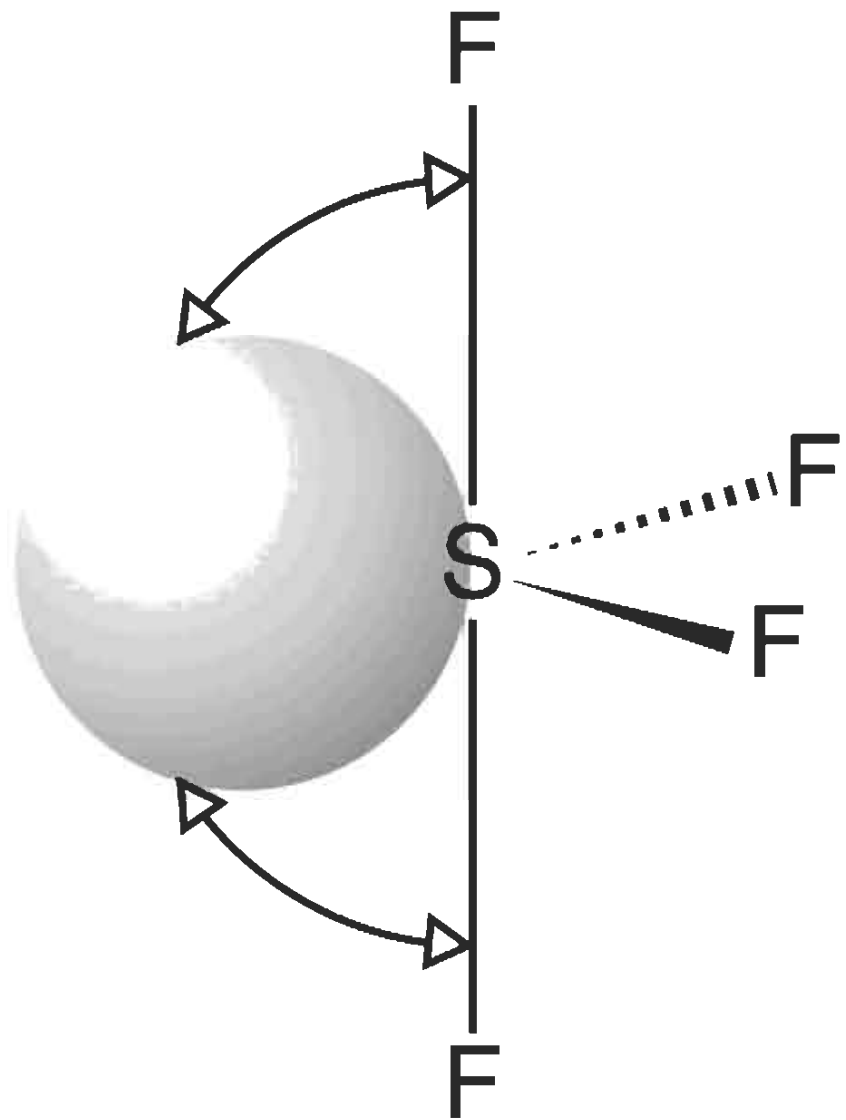
$\sigma p_z$

# Rules for Determining Molecular Shape: Electron Domain Theory

1. write the Lewis structure
  - ⇒ electron distribution
  - ⇒ skeleton
2. classify each electron pair about the central atom as bonding (B) or nonbonding (NB)
3. maximize separation between domains
4. give more space to NB domains and to B domains comprising multiple bonds **EPR**
5. place NB domains at equatorial positions in a trigonal bipyramid







**TABLE 4.3 The Relationship Between the Number of Electron Domains and the Geometry Around an Atom**

<i>Electron Domains</i>	<i>Bonding Domains</i>	<i>Nonbonding Domains</i>	<i>Distribution of Electrons</i>	<i>Molecular Geometry</i>	<i>Examples</i>
2 ( <i>sp</i> )	2	0	Linear	Linear	BeF <sub>2</sub> , CO <sub>2</sub>
	1	1		Linear	CO, NO <sub>2</sub>
3 ( <i>sp</i> <sup>2</sup> )	3	0	Trigonal planar	Trigonal planar	BF <sub>3</sub> , CO <sub>3</sub> <sup>2-</sup>
	2	1		Bent	O <sub>3</sub> , SO <sub>2</sub>
	1	2		Linear	CO <sub>2</sub>
4 ( <i>sp</i> <sup>3</sup> )	4	0	Tetrahedral	Tetrahedral	CH <sub>4</sub> , SO <sub>4</sub> <sup>2-</sup>
	3	1		Trigonal pyramidal	NH <sub>3</sub> , H <sub>3</sub> O <sup>+</sup>
	2	2		Bent	H <sub>2</sub> O, ICl <sub>2</sub> <sup>+</sup>
	1	3		Linear	HF, OH <sup>-</sup>
5 ( <i>sp</i> <sup>3</sup> <i>d</i> )	5	0	Trigonal bipyramidal	Trigonal bipyramidal	PF <sub>5</sub>
	4	1		Seesaw	SF <sub>4</sub> , IF <sub>4</sub> <sup>+</sup>
	3	2		T shaped	ClF <sub>3</sub>
	2	3		Linear	I <sub>3</sub> <sup>-</sup> , XeF <sub>2</sub>
	6	0		Octahedral	SF <sub>6</sub> , PF <sub>6</sub> <sup>-</sup>
6 ( <i>sp</i> <sup>3</sup> <i>d</i> <sup>2</sup> )	5	1	Octahedral	Square pyramidal	BrF <sub>5</sub> , SbCl <sub>5</sub> <sup>2-</sup>
	4	2		Square planar	XeF <sub>4</sub> , ICl <sub>4</sub> <sup>-</sup>

Graphite is the stable form of carbon but metastable diamonds are a girl's best friend!



18  
VIII  
0

13 IIIB IIIA		14 IVB IVA		15 VB VA		16 VIB VIA		17 VIIB VIIA		18 VIII 0	
B		C		N		O		F		Ne	
0.82	22.18	0.77	104.60	0.75	0.3605	0.73	0.2224	0.72	0.255	0.71	0.3347
0.98	480	0.91	716.72 <sup>ES</sup>	0.92/[1.5]	2.79	[1.40]	3.41	[1.35]	3.31	-	1.71
4.68	573.21	5.34	-	17.3	472.79	14.0	249.37	17.1	79.08	16.8	-
1.56/3.03	1.026	1.82/1.76	0.709	2.07/1.10	1.040	2.00/0.802	0.918	2.26/0.557	0.824	2.52/0.3956	1.030
-	0.274	-	1.2-1.5	-	0.0002598	-	0.0002575	-	0.000279	-	0.000493*
Al		Si		P <sup>white, α</sup>		S <sup>α</sup>		Cl		Ar	
1.18	10.669	1.11	46.44	1.06	0.628	1.02	1.72	0.99	3.38	0.98	1.176
1.43	293.72	1.32	439	1.28/[1.9]	12.43	1.27/[1.85]	9.62	[1.80]	10.21	-	6.43
9.99	322.17	12.05	439.32	17.0	314.64	15.5	278.65	18.7	121.75	24.2	-
1.99/6.8	0.897	2.32/5.38	0.705	2.63/3.63	0.769	2.62/2.90	0.710	2.93/2.18	0.479	3.23/1.6411	0.520
2.709	2.37	-	1.49	-	0.00236*	-	0.00270	-	0.000089	-	0.0001772

Figure by MIT OCW.