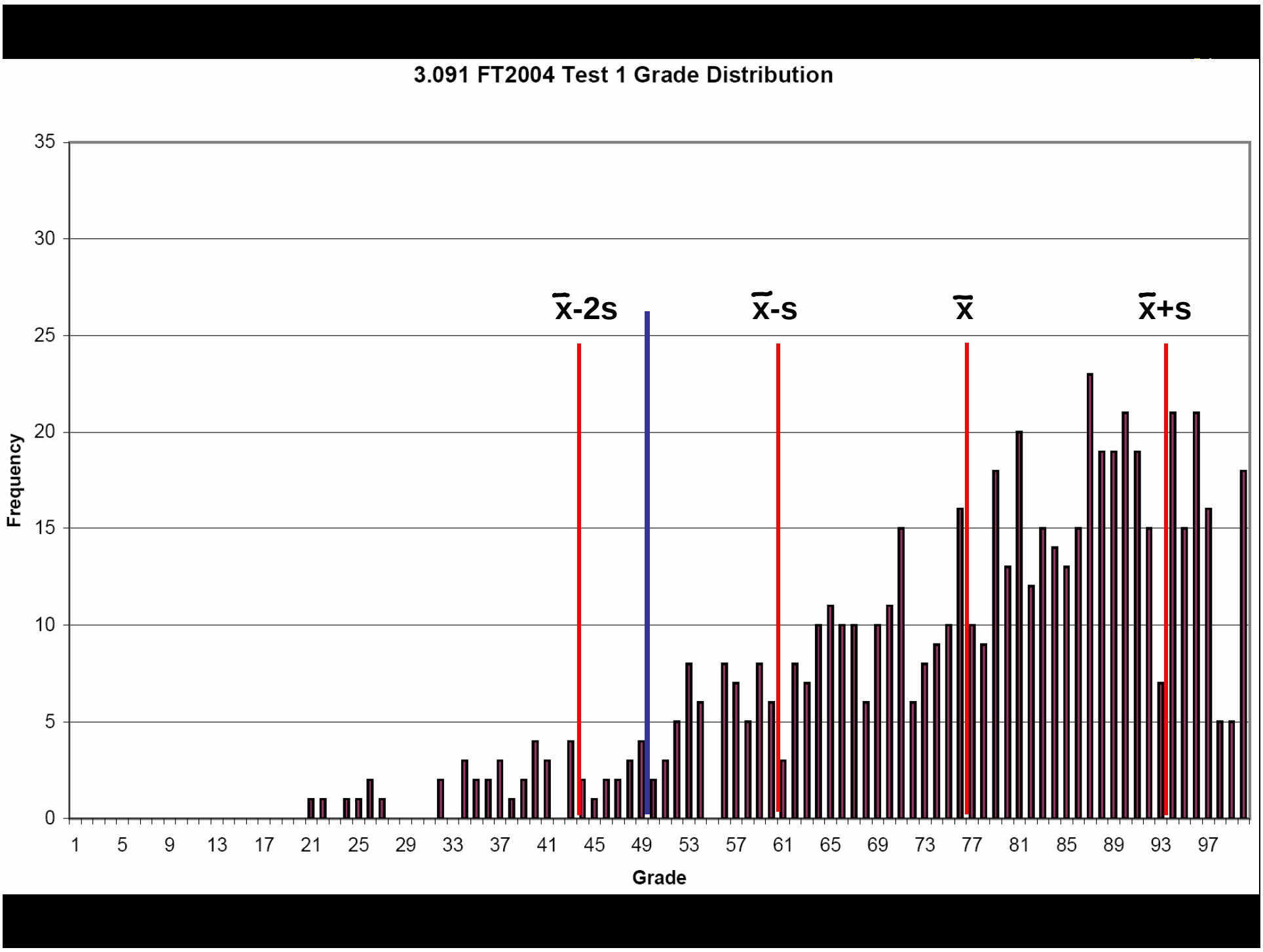
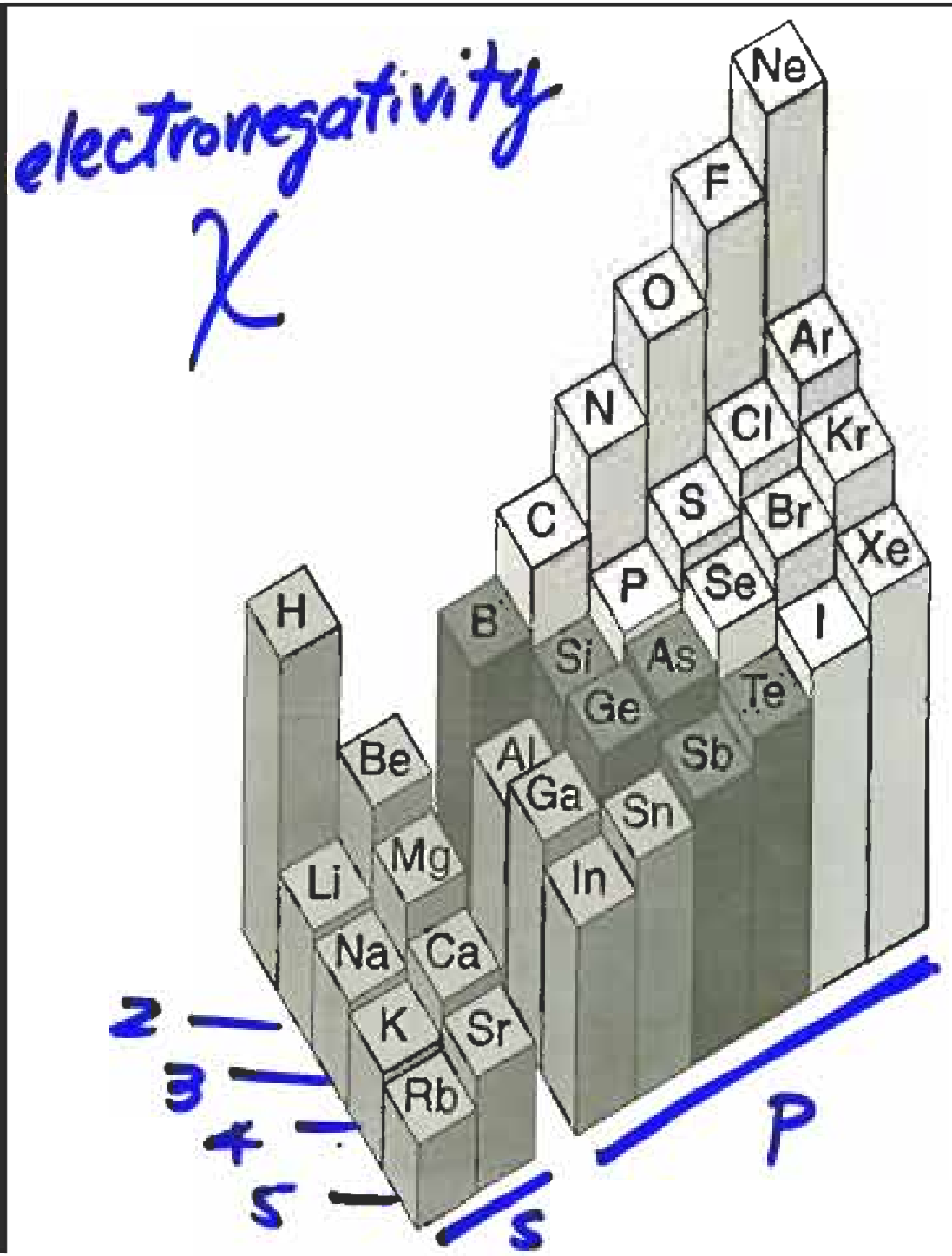
Welcome to 3.091

Lecture 10

October 1, 2004

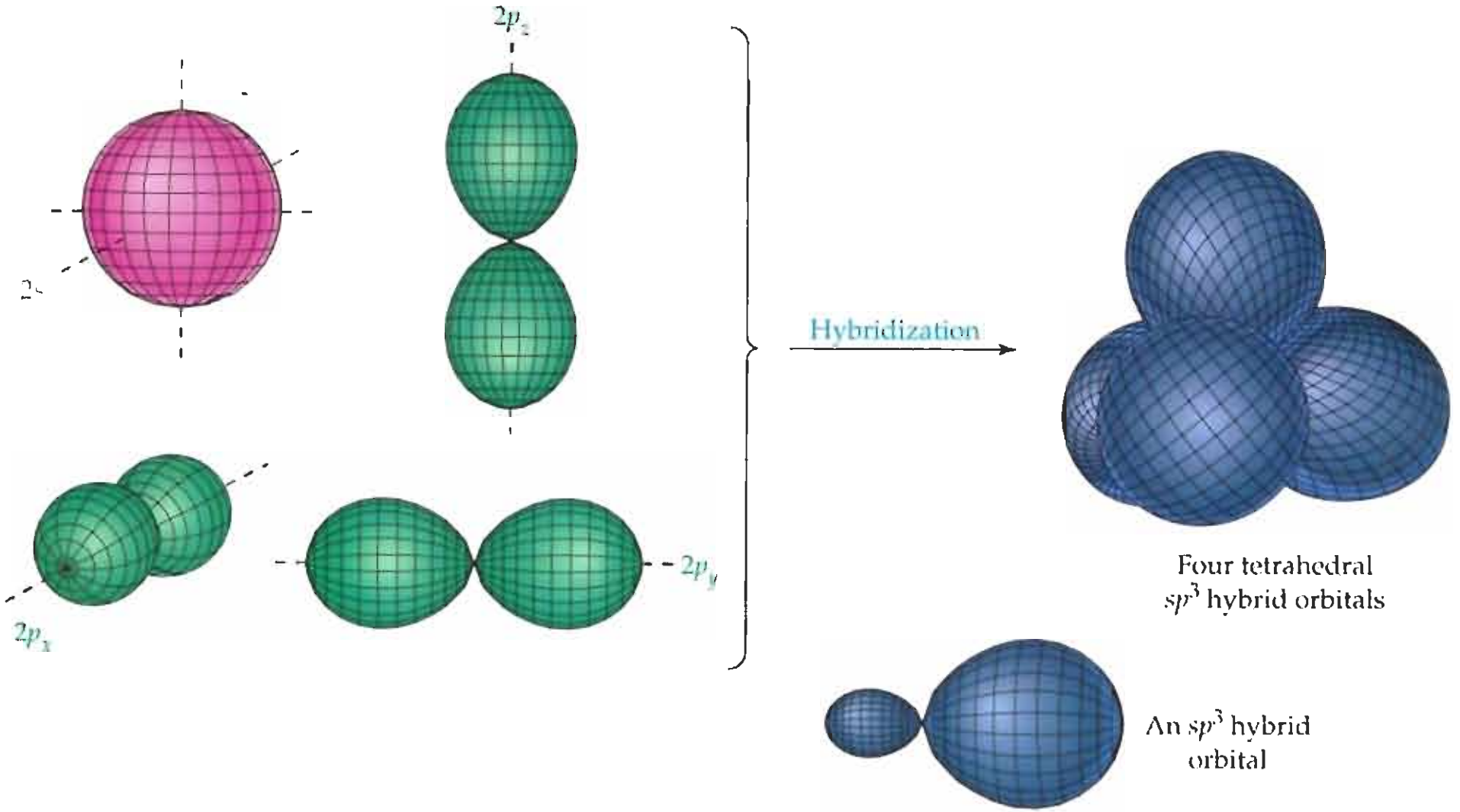

3.091 FT2004 Test 1 Grade Distribution
35
30
25
20
15
10
5
0
Frequency
x̄-2s
x̄-s
x̄
x̄+s
1
5
9
13
17
21
25
29
33
37
41
45
49
53
57
61
65
69
73
77
81
85
89
93
97
Grade

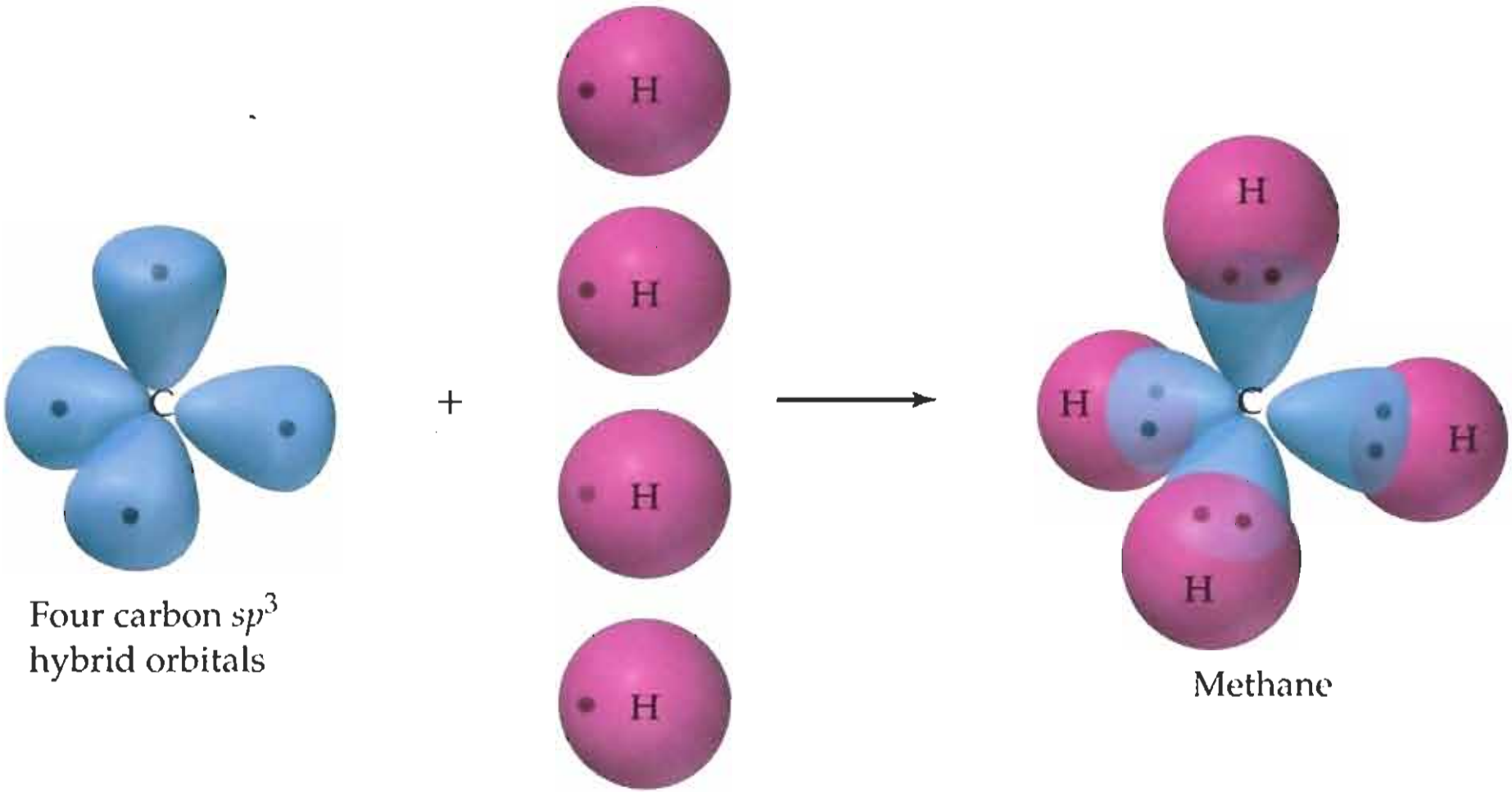

electronegativity
χ
Ne
F
O
Ar
N
Cl
Kr
C
S
Br
Xe
P
Se
I
H
B
Si
As
Te
Ge
Be
Al
Sb
Ga
Sn
Li
Mg
In
Na
Ca
K
Sr
Rb
2
3
4
5
s
p

$$\% \text{ ionic character} = \{1 - \exp(-\tfrac{1}{4}(\Delta X)^2)\} \times 100$$

▼ % Ionic Character of a Single Chemical Bond

Difference in Electronegativity	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.2
%IC (by L. Pauling)	0.2	1.0	2.2	3.9	6.1	8.6	12	15	18	22	26	30	34	39	43	47	51	56	59	63	67	70	73	76	79	82	84	86	88	89	91	92
%IC (by Hannay & Smyth)	1.6	3.3	5.1	7.0	8.9	11	13	15	17	20	22	24	27	29	32	35	37	40	43	46	49	52	55	59	62	65	69	72	76	80	83	87

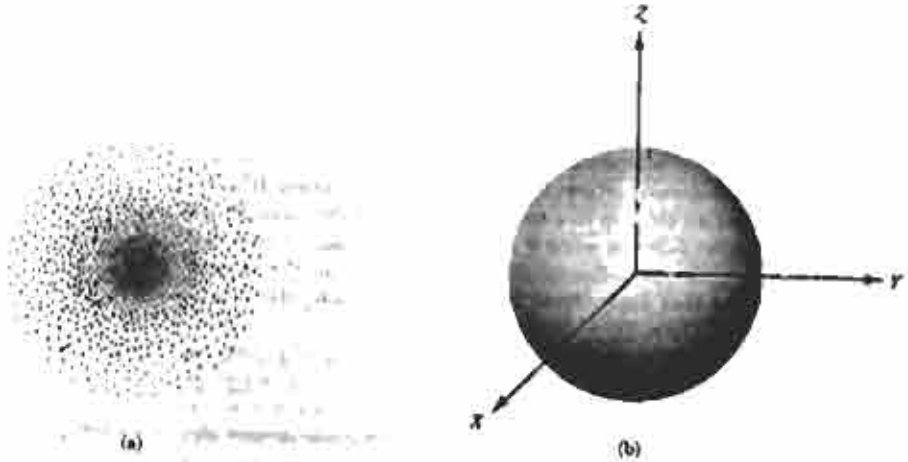

2p_z
2p_x
2p_y
Hybridization
Four tetrahedral
sp³ hybrid orbitals
An sp³ hybrid
orbital



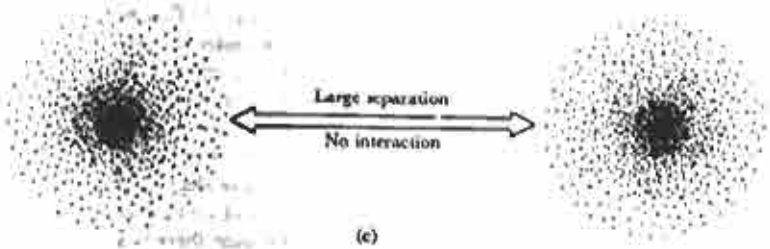
Four carbon sp^3 hybrid orbitals

Four hydrogen 1s atomic orbitals

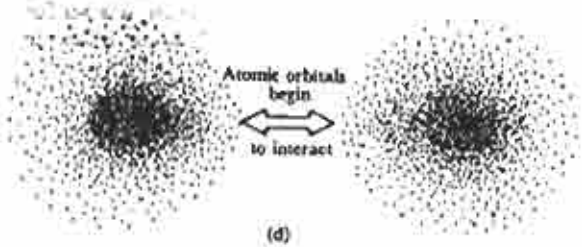
Methane



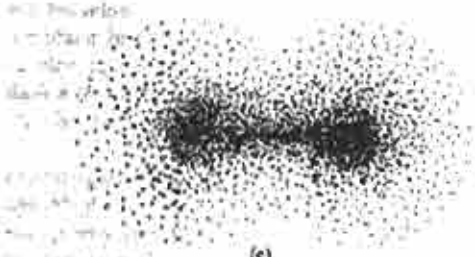
(a) (b)



(c)

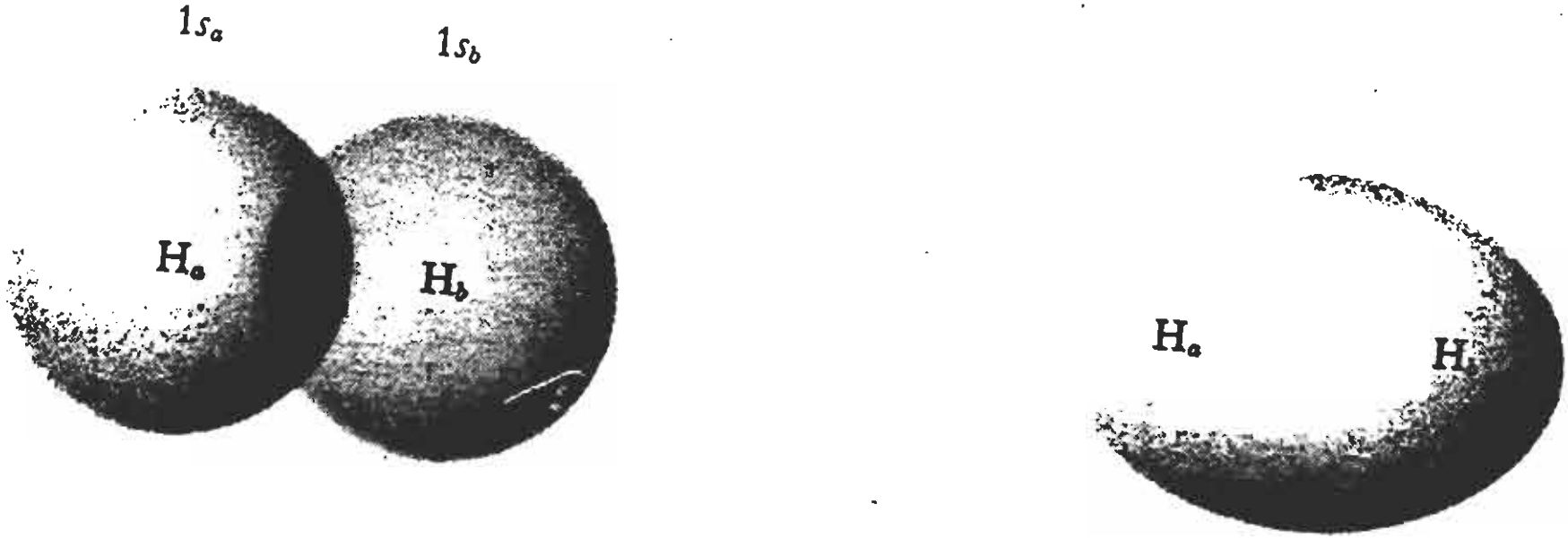


(d)

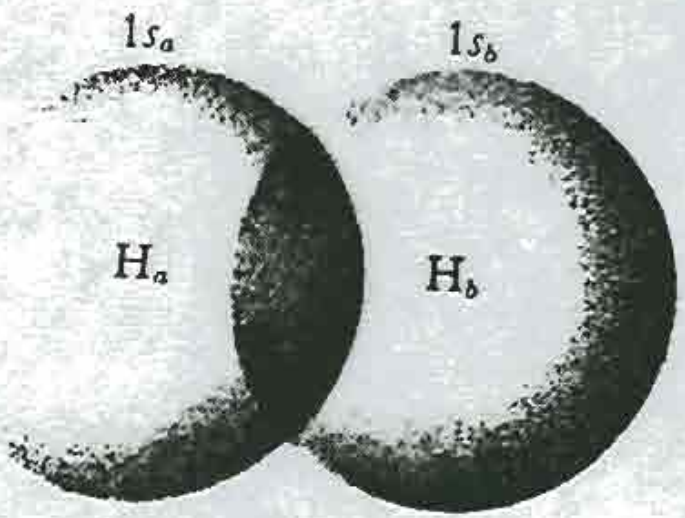


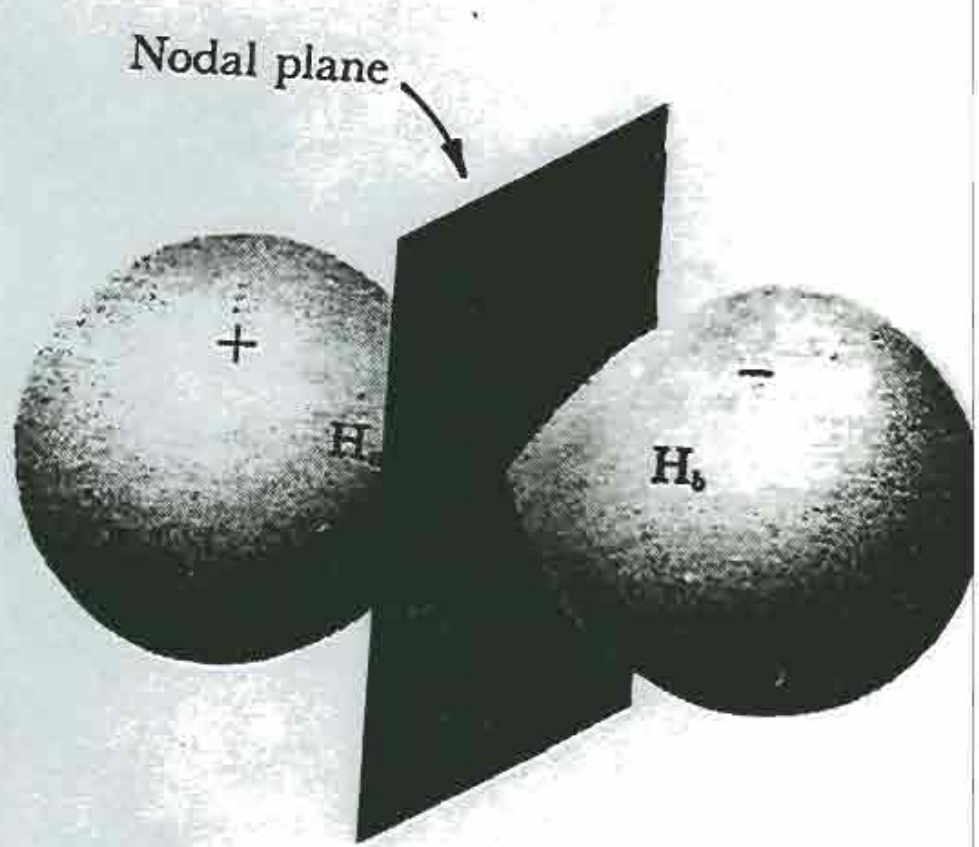
(e)

formation of shared molecular orbitals



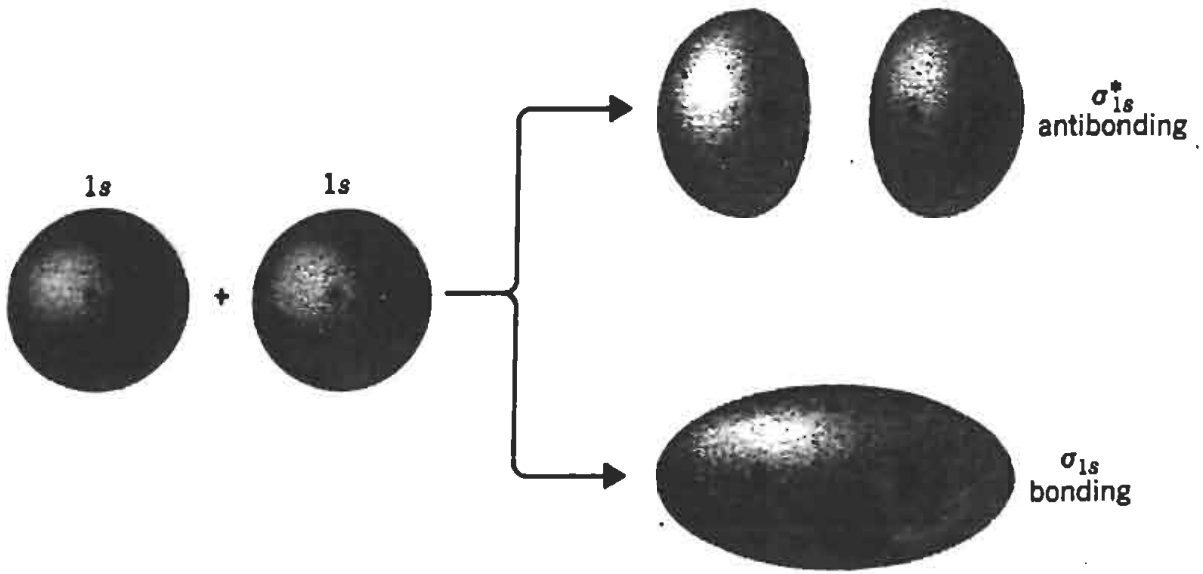
molecular orbital — bonding

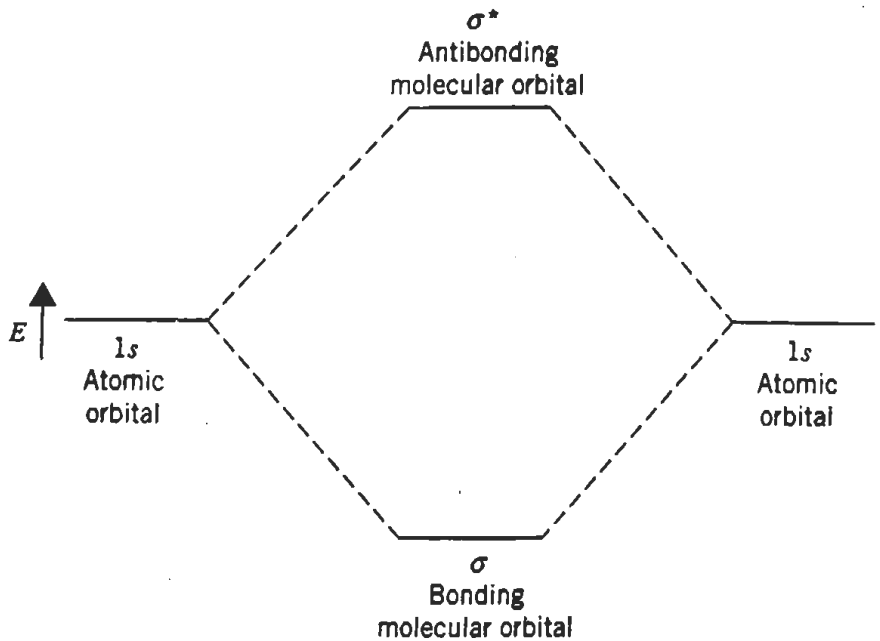


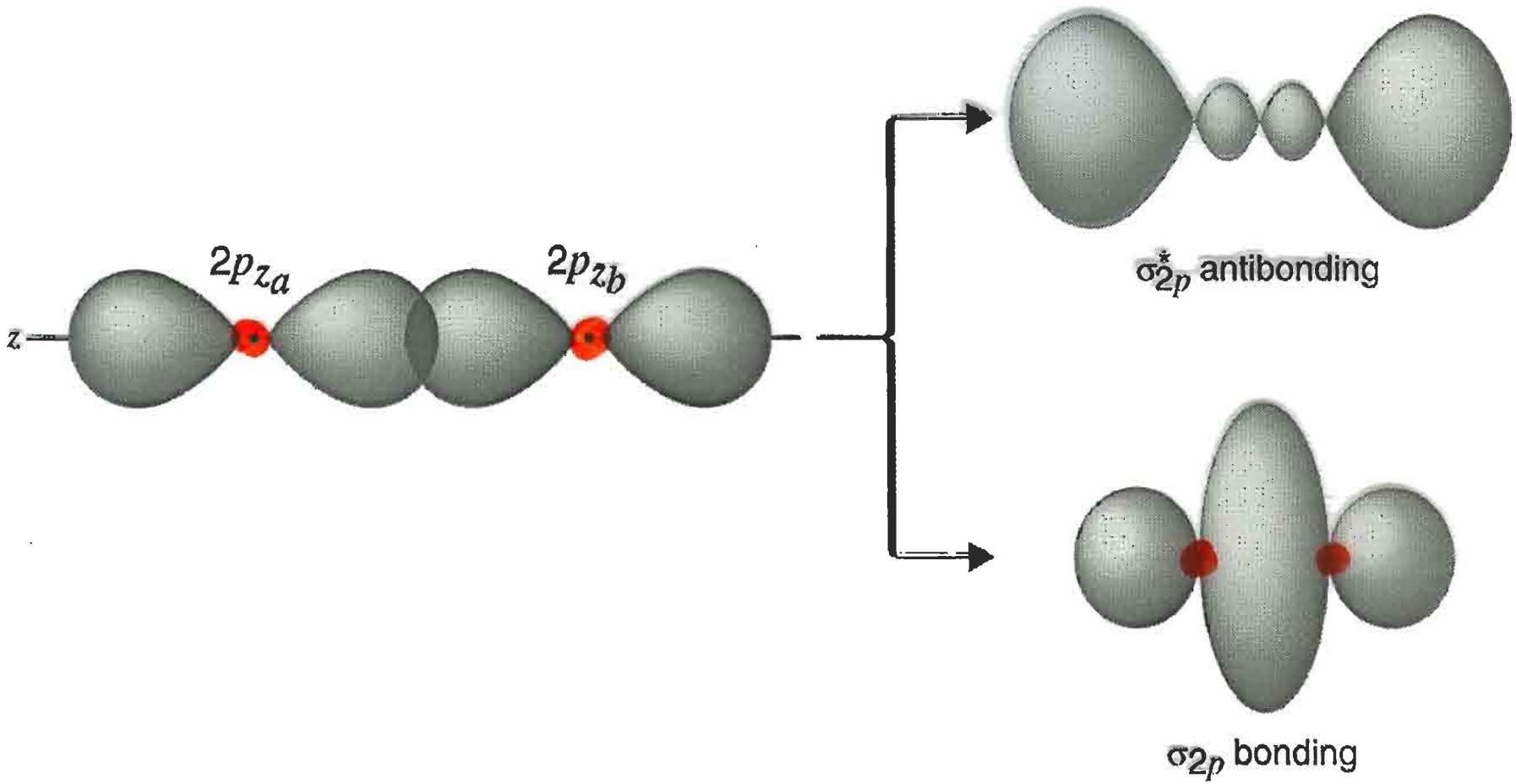


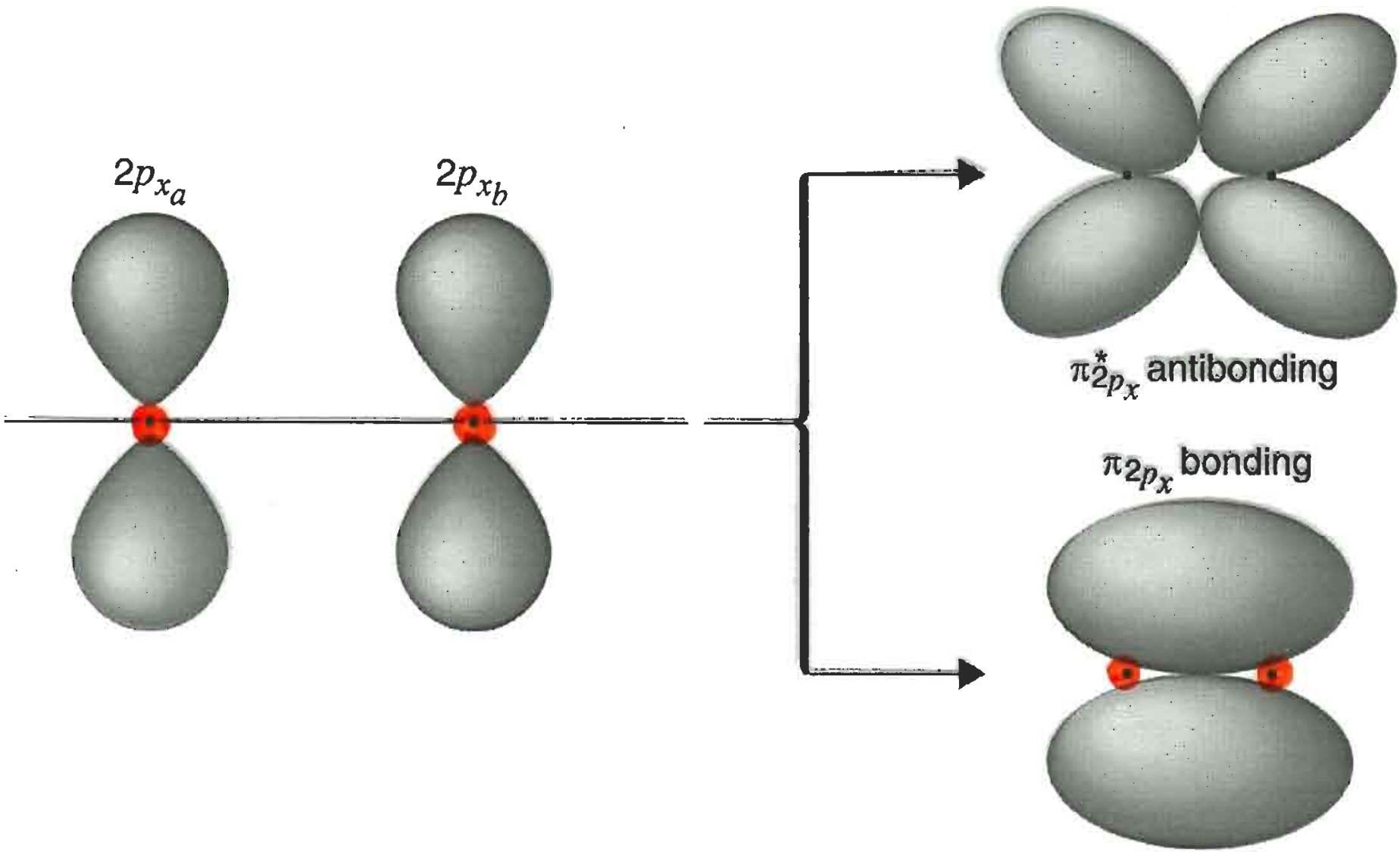
$1s_a - 1s_b =$ MO II

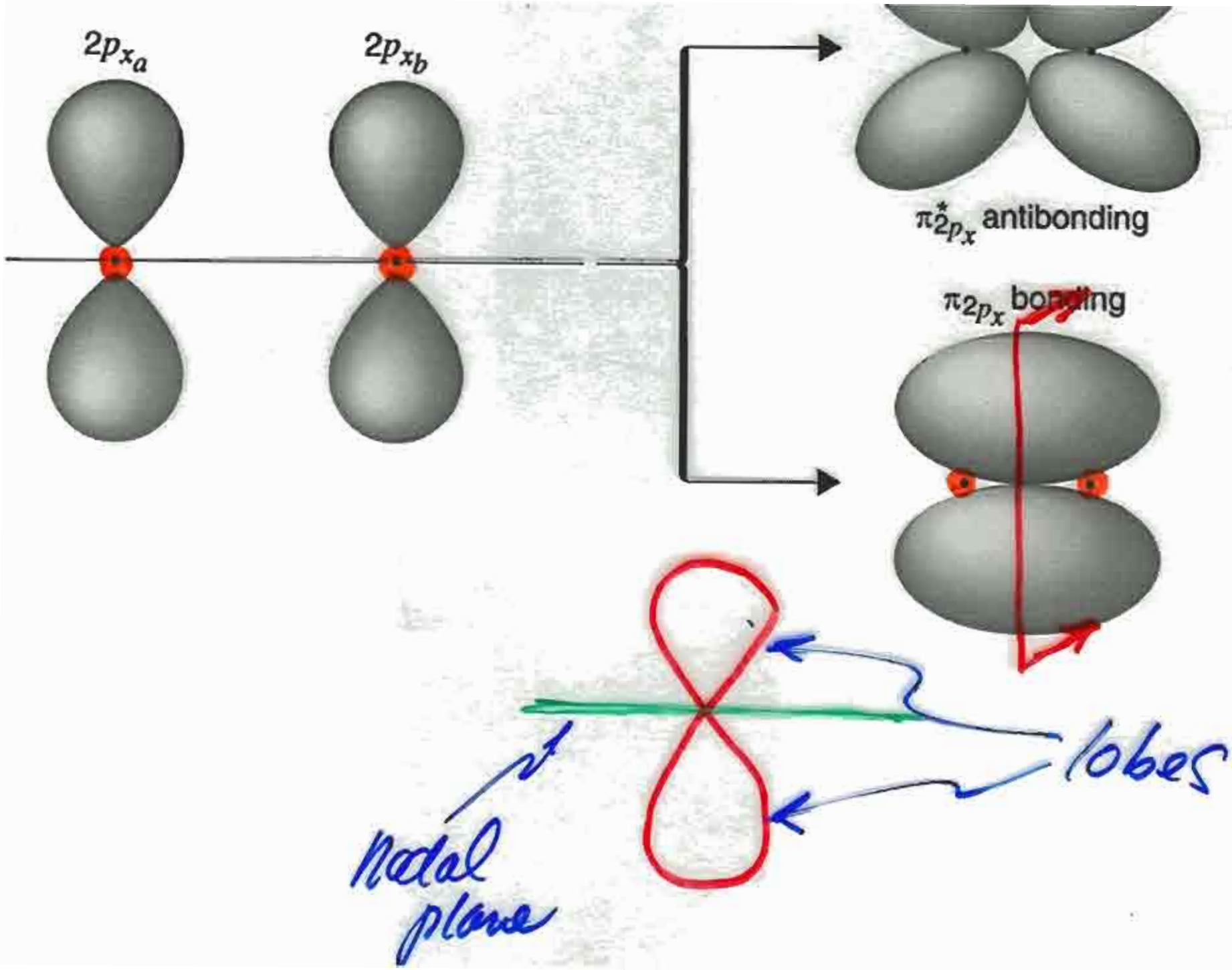
Molecular orbital — anti-bonding.


1s
1s
σ^*_{1s}
antibonding
σ_{1s}
bonding


σ^*
Antibonding
molecular orbital
E
1s
Atomic
orbital
1s
Atomic
orbital
σ
Bonding
molecular orbital


$2p_{za}$
$2p_{zb}$
z
σ^*_{2p} antibonding
σ_{2p} bonding


$2p_{x_a}$
$2p_{x_b}$
$\pi^*_{2p_x}$ antibonding
π_{2p_x} bonding


$2p_{x_a}$
$2p_{x_b}$
$\pi^*_{2p_x}$ antibonding
π_{2p_x} bonding
lobes
nodal plane

Extremes in electronegativity

NaI: $\Delta\chi = 1.73$

CsAu: $\Delta\chi = 1.75$

Cs and Au, both metals, melt to form metallic liquids, *but*…

when the concentration nears 50%

(equal numbers of donors & acceptors)

💣 electron transfer occurs 💣 !

metallic melt turns into molten salt!!

- ☞ clear, colorless liquid
- ☞ big drop in electrical conductivity
- ☞ shift from electronic to ionic conduction
- ☞ cesium auride

Sorcery!