

CH301H Fall 2011 HW 10 key

(1)

1. To save space, I am just going to refer you to Figure 6.16 in your book. We have done several of these in class, and they are also in your class notes.

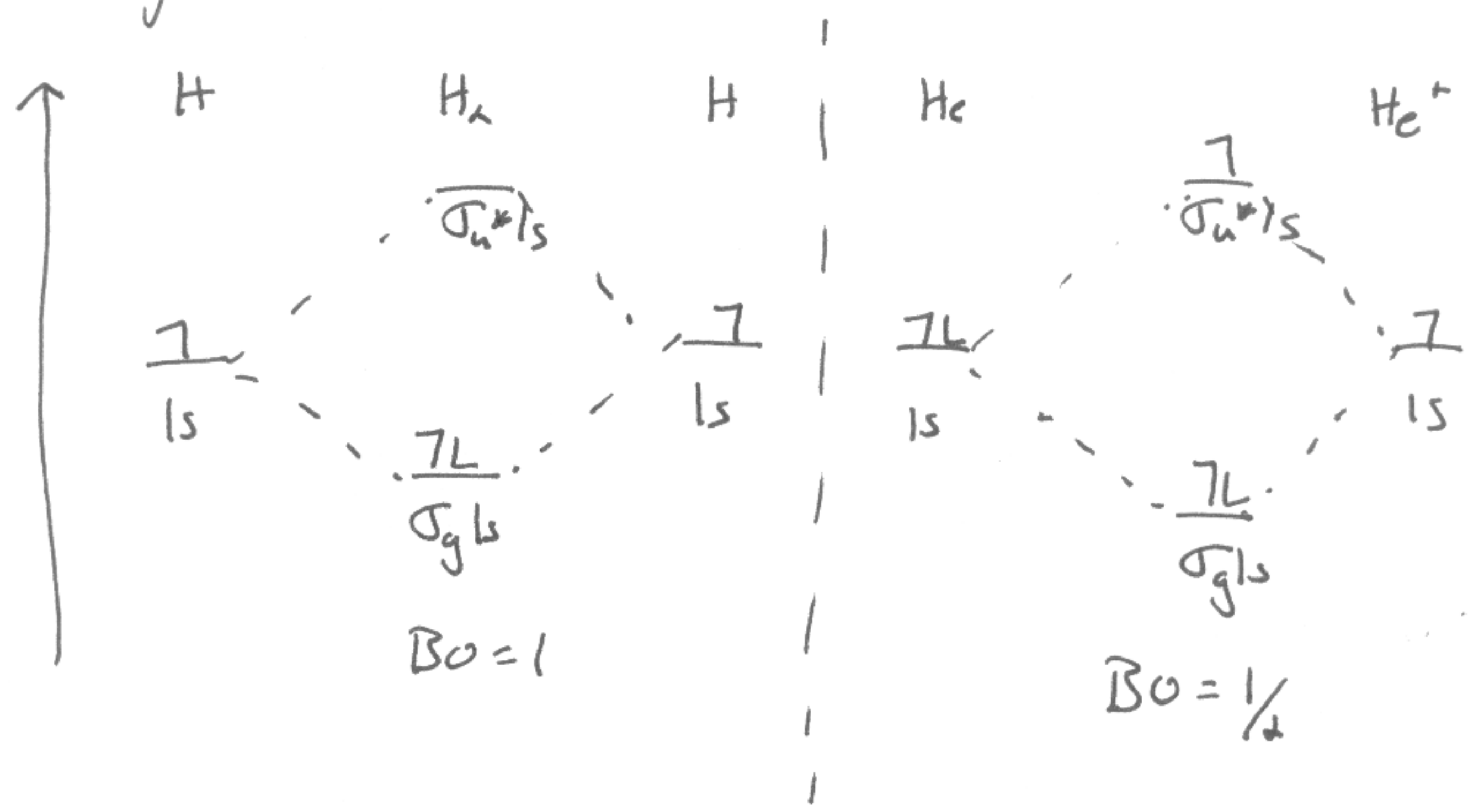
|        |         |         |              |              |                |                       |                       |
|--------|---------|---------|--------------|--------------|----------------|-----------------------|-----------------------|
|        | $Li_2$  | $Be_2$  | $B_2$        | $C_2$        | $N_2$          | $O_2$                 | $F_2$                 |
| BO:    | 1       | 0       | 1            | 2            | 3              | 2                     | 1                     |
| Lewis: | $Li-Li$ | $Be=Be$ | $B \equiv B$ | $C \equiv C$ | $:N \equiv N:$ | $:\ddot{O}=\ddot{O}:$ | $:\ddot{F}-\ddot{F}:$ |
| Ok?:   | yes     | no      | no           | no           | yes            | no                    | yes                   |

-So just in the period 2 homonuclear diatomics - we see that MO diagrams are already more useful than Lewis dot structures in explaining molecules.

2. This question is designed to make you are sure w/ the origin of the shapes in Figure 6.5 in your book. Make sure that you cannot only draw these, but understand where the nodal planes arise from.

3.  $\sigma$  orbital: no nodal plane along the internuclear ( $xz$  or  $yz$ ) axis  
 $\pi$  orbital: nodal plane along the internuclear ( $xz$  or  $yz$ ) axis

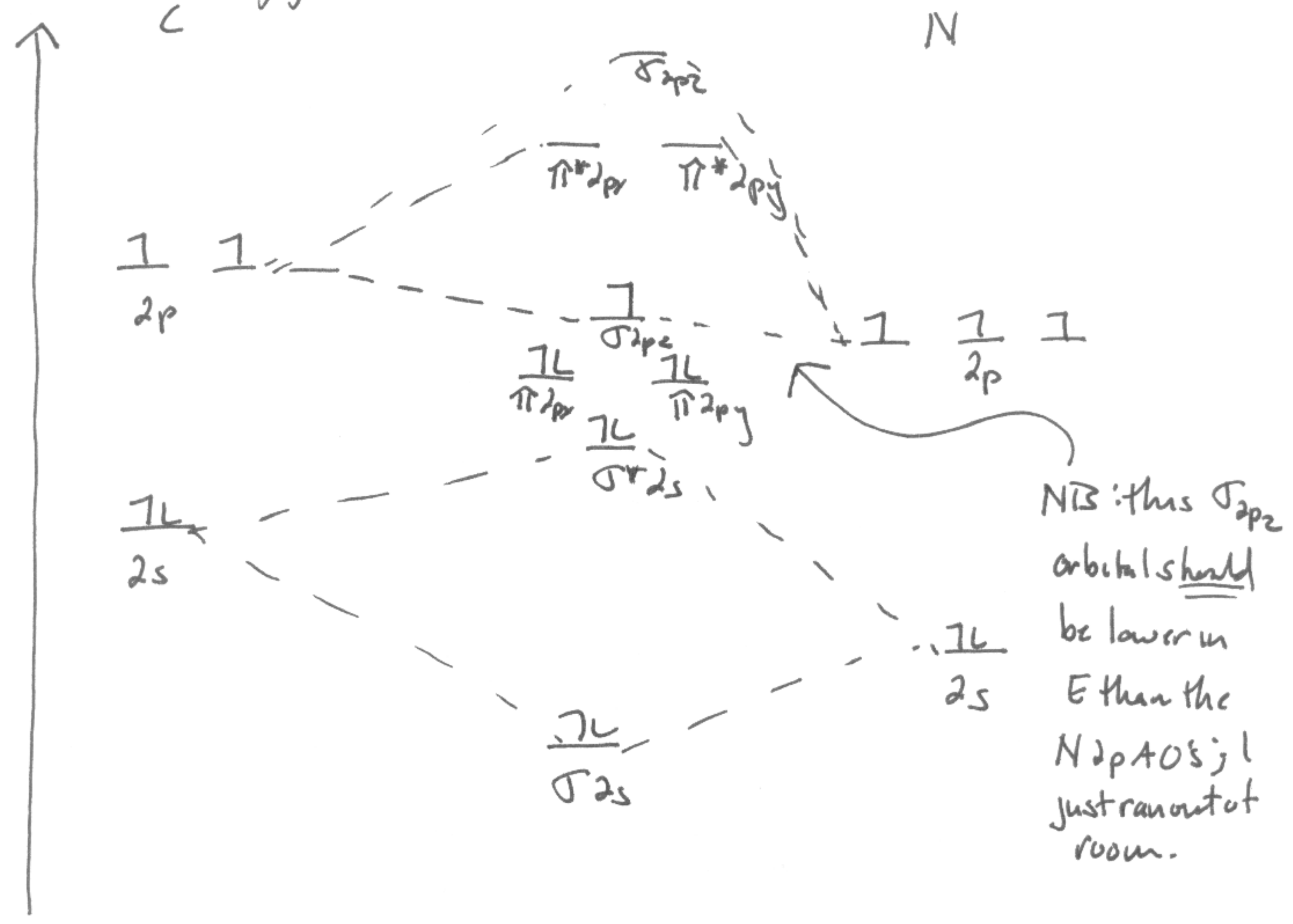
### 4. MO diagrams:



Because  $H_2$  has a larger  $BO$  than  $He_2^+$ , we expect  $H_2$  to have a shorter bond length. This is confirmed by the data in Figure 6.19.

5. CN: N is more electronegative than C, so its AOs are

lower in energy:



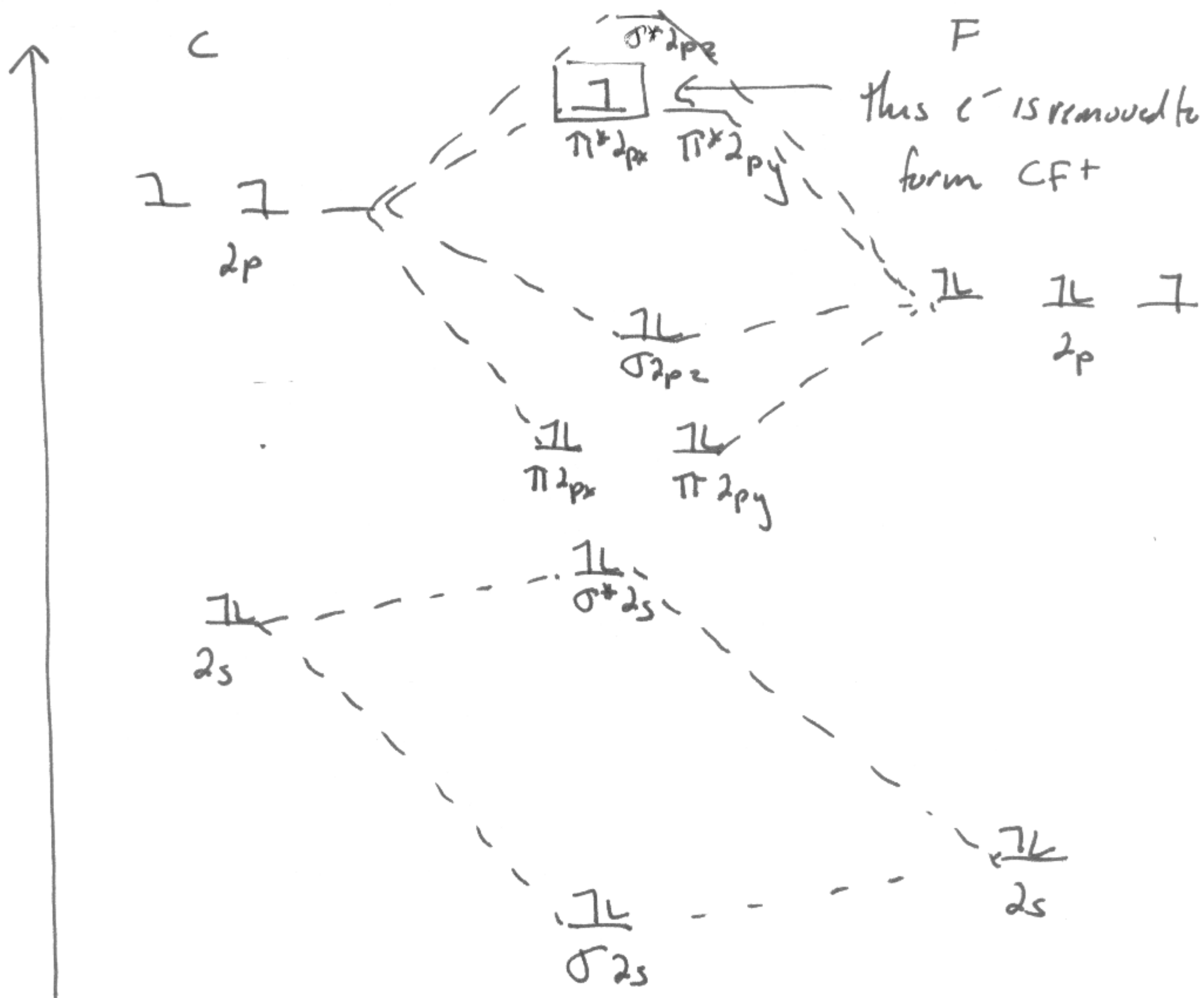
The Lewis dot structure does indeed predict a single  $e^-$  in the molecule; however, it doesn't explain why it is stable.

6. CF:

F is more EN:

CF

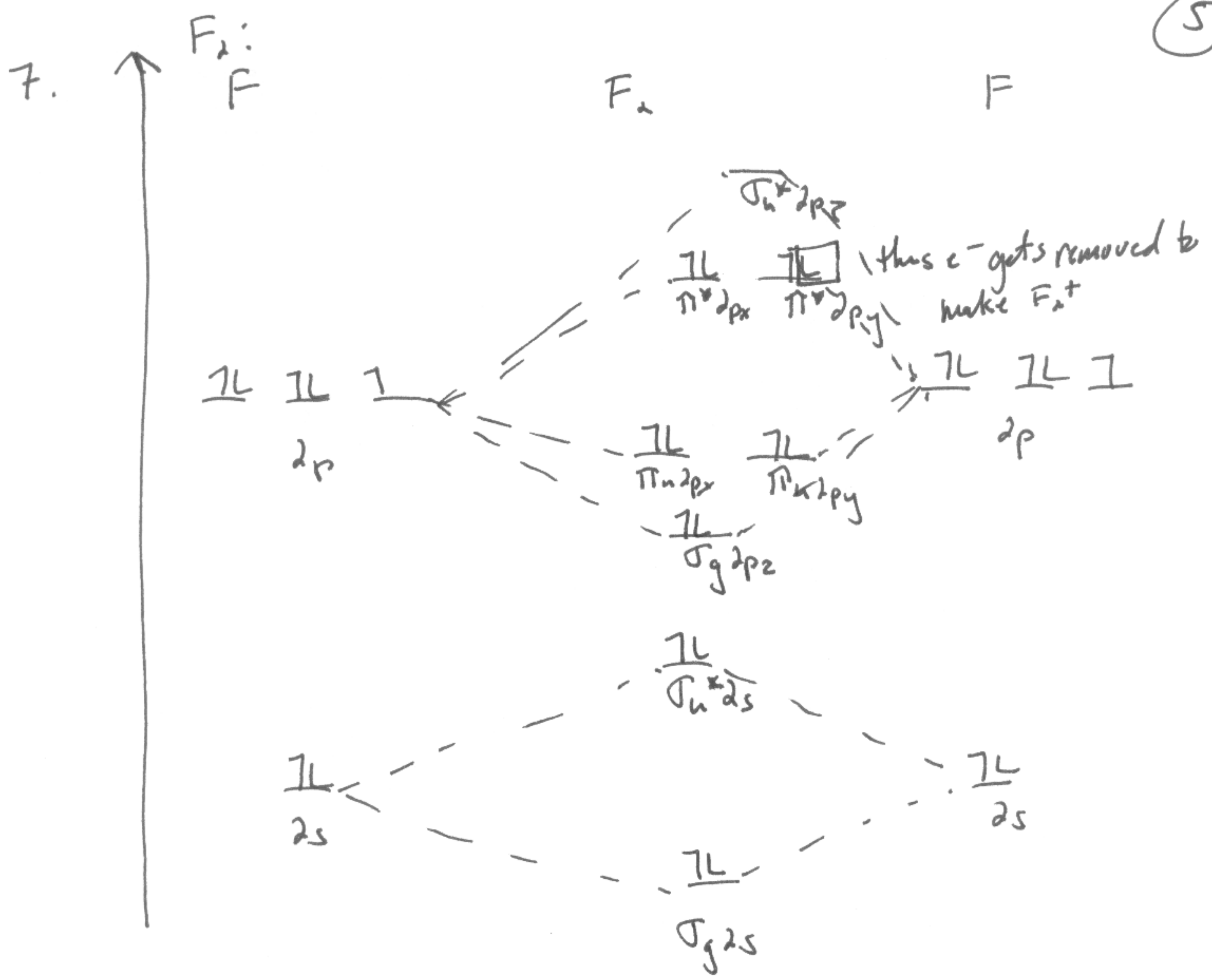
(9)



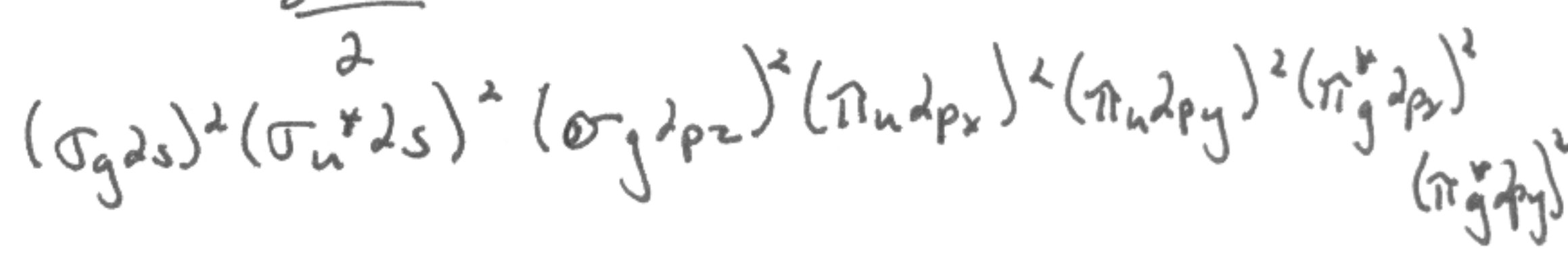
$$CF: BO = \frac{8-3}{2} = \frac{5}{2}$$

$$CF^+: BO = \frac{8-2}{2} = 3$$

So the MO diagram says that ionizing the molecule removes an e- from an antibonding orbital, thus increasing the BO. This will lead to a stronger, shorter bond, shown by the experimental data.



$F_2: BO = \frac{8-6}{2} = 1$



$F_2^+: BO = \frac{8-5}{2} = \frac{3}{2}$

Same e- config except for last orbital

$F_2^+$  will have the greater bond dissociation energy because of its greater BO.