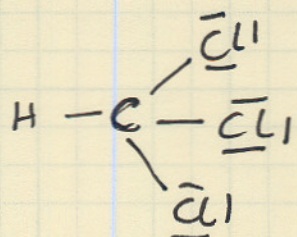


1
INTRODUCTION TO NATURAL SCIENCE
CHEMISTRY HW - WEEK 8 - WINTER QUARTER

Chapter 10

①

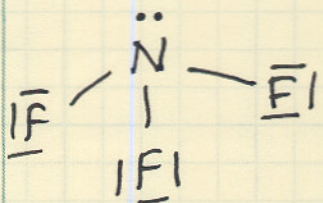


\bar{e} pair geometry = tetrahedral

molecular geometry = tetrahedral

C atom is sp^3 hybridized. Four sp^3 hybrid orbitals of C atom participate in the four σ bonds. H atom has the $1s$ orbital and Cl atoms use $3p$ valence orbitals in overlapping with the sp^3 hybrid orbitals of C to form the 4 σ bonds.

②



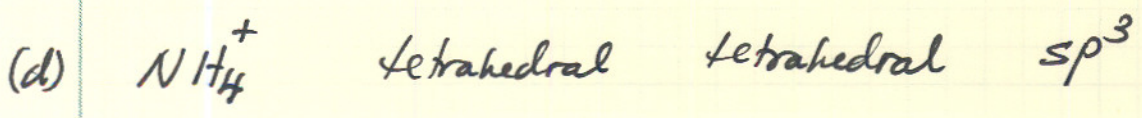
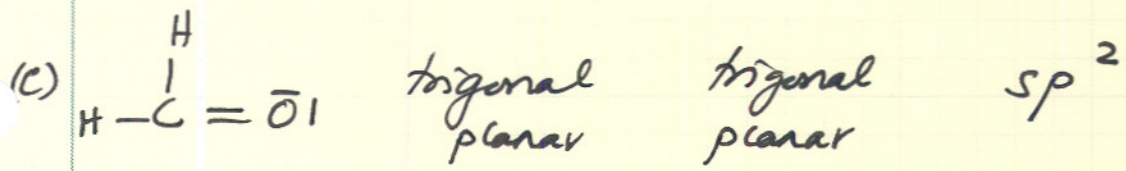
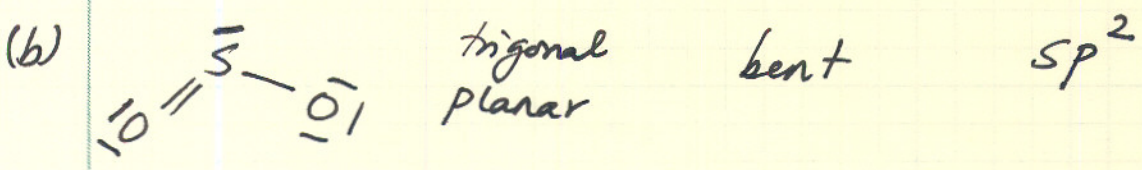
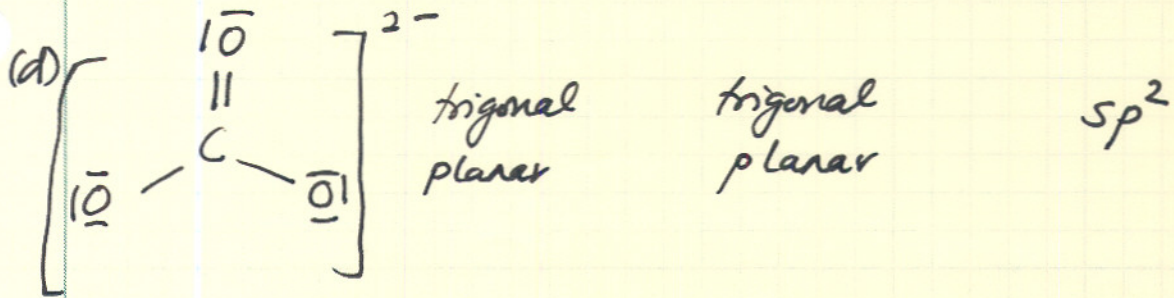
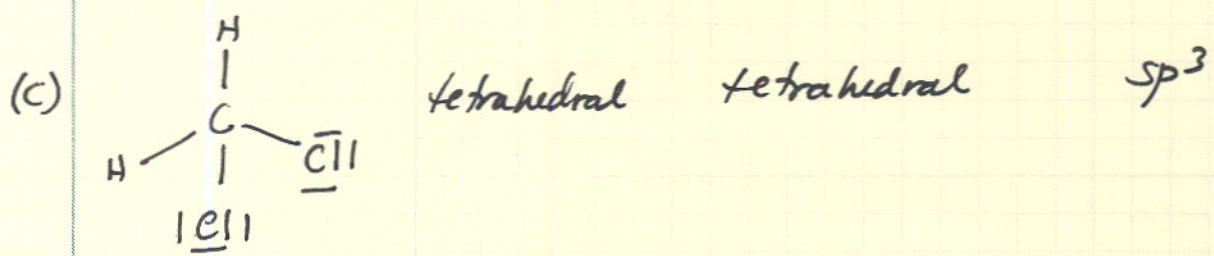
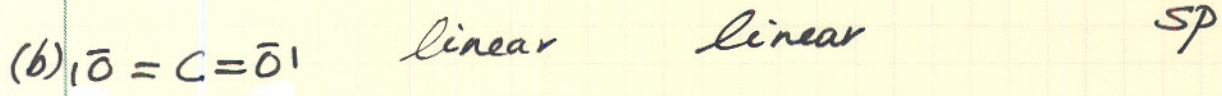
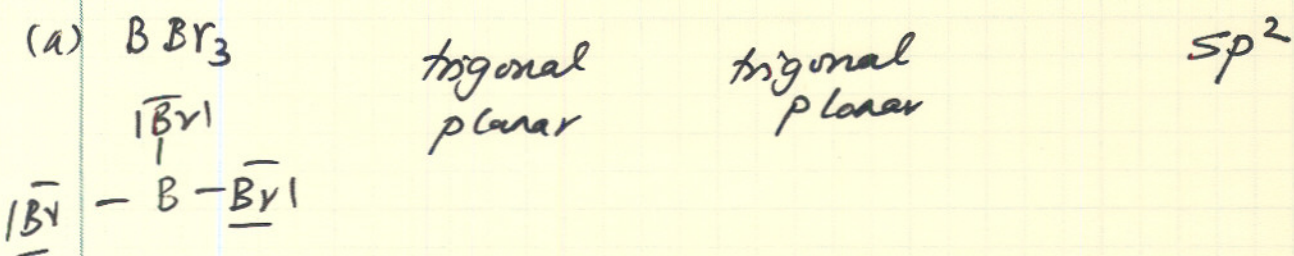
\bar{e} pair geometry = tetrahedral

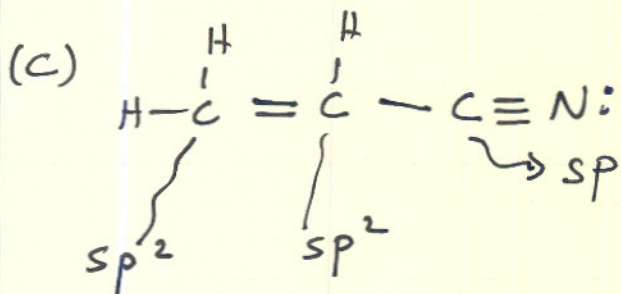
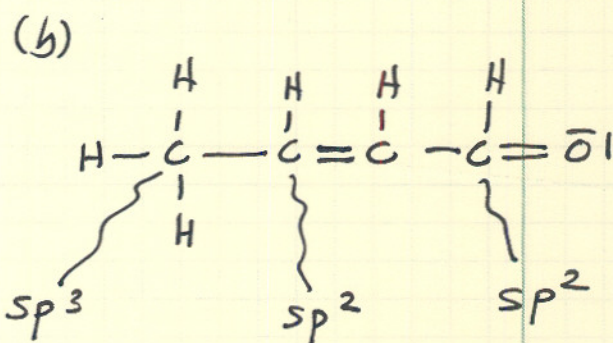
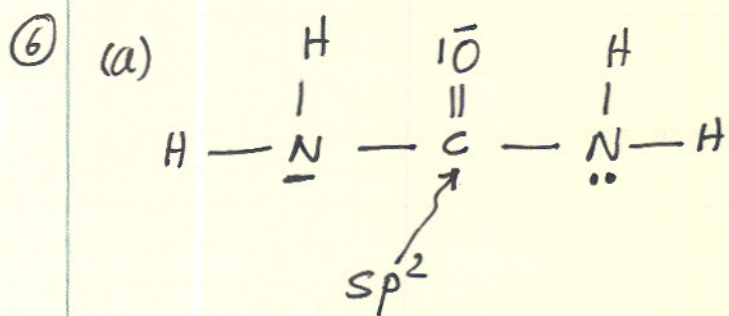
molecular geometry = pyramidal

N atom is sp^3 hybridized

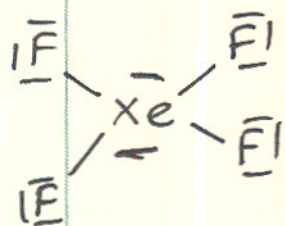
F atoms use $2p$ orbitals to overlap with three sp^3 hybrid orbitals of N to form 3 σ bonds. One sp^3 hybrid orbital contains a lone pair.

(3) molecule e pair geometry molecular geometry hybridization





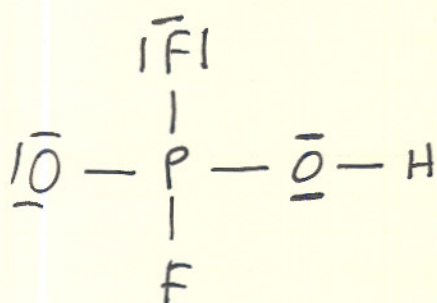
(7) molecule/ion	\bar{e} pair geometry	molecular geometry	hybridization
$\left[\begin{array}{c} \text{F} \\ \\ \text{F} - \text{Si} - \text{F} \\ \quad \\ \text{F} \quad \text{F} \end{array} \right]^{2-}$	Octahedral	octahedral	sp^3d^2
$\begin{array}{c} \text{F} \\ \\ \text{F} - \text{Se} - \text{F} \\ \\ \text{F} \end{array}$	trigonal bipyramidal	see-saw	sp^3d
$\left[\begin{array}{c} \text{I} \\ \\ \text{I} \\ \\ \text{I} \end{array} \right]^-$	trigonal bipyramidal	linear	sp^3d



octahedral

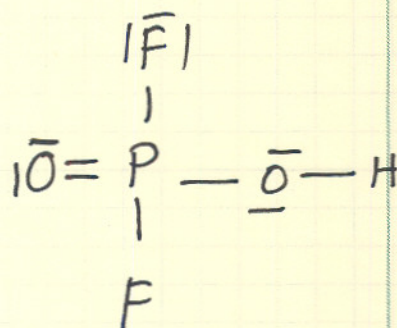
square
planar sp^3d^2

⑨



Str. ①

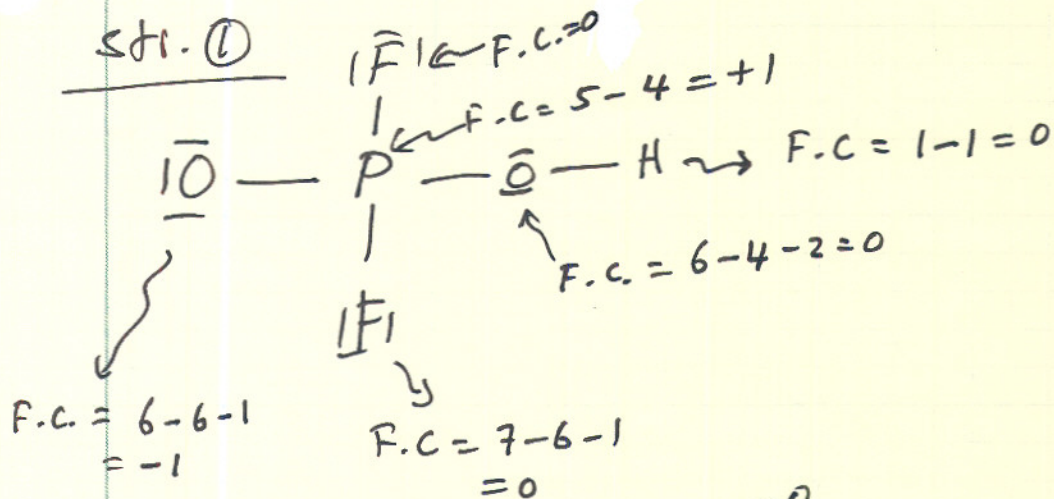
OR



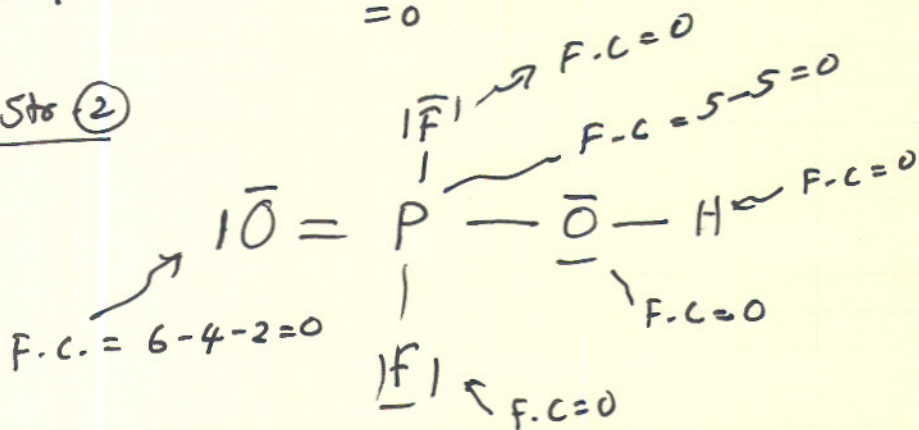
Str ②

Structures ① and ② are possible non-equivalent structures. Use formal charges to determine the correct structure.

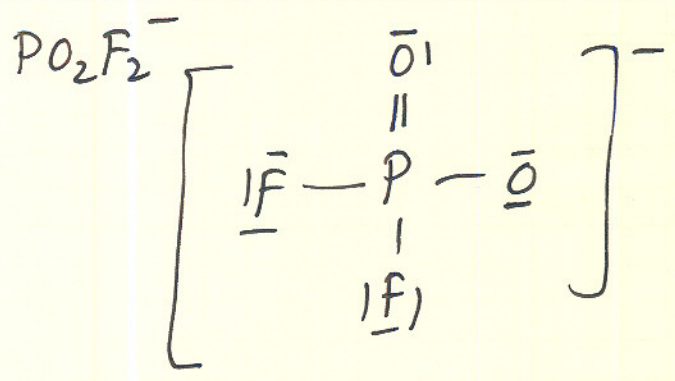
Str. ①



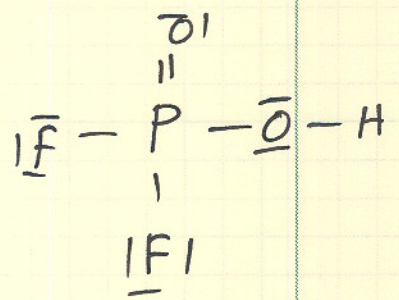
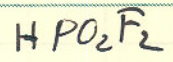
Str ②



← this is the preferred structure.



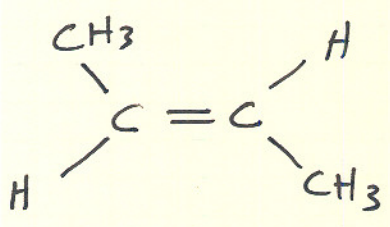
tetrahedral
 sp^3



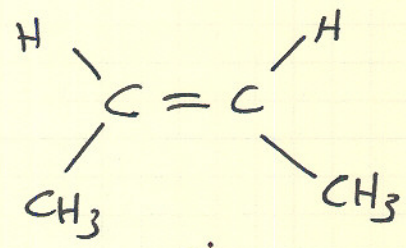
tetrahedral
 sp^3

(13)

(a)

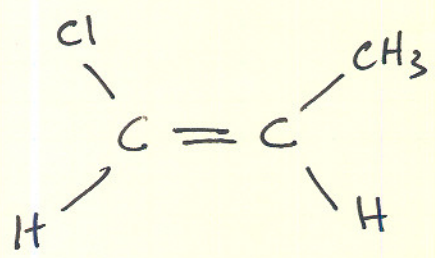


trans

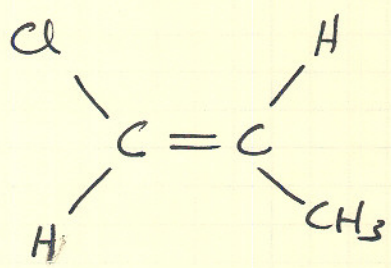


cis

(b)



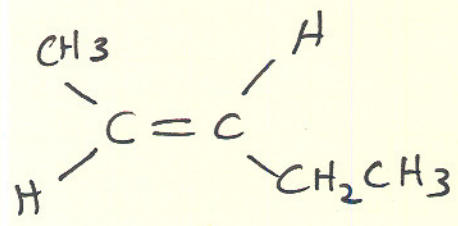
cis



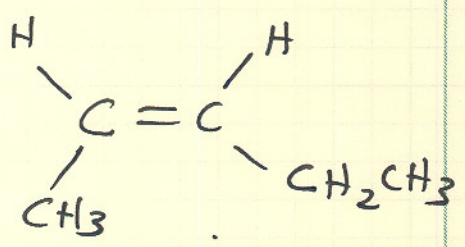
trans

(14)

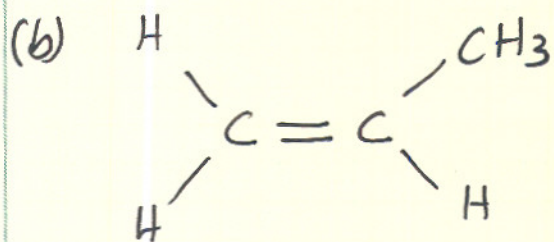
(a)



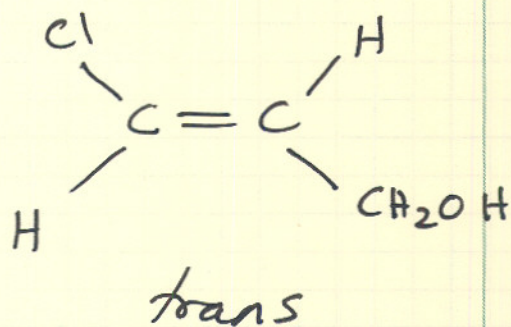
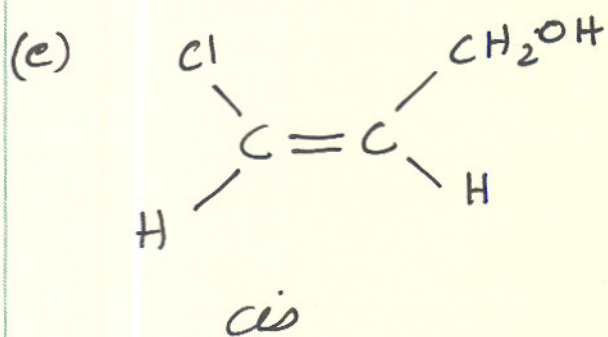
trans



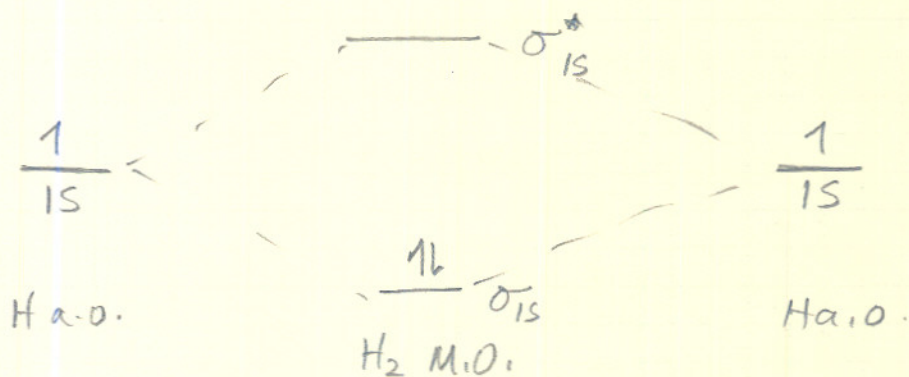
cis



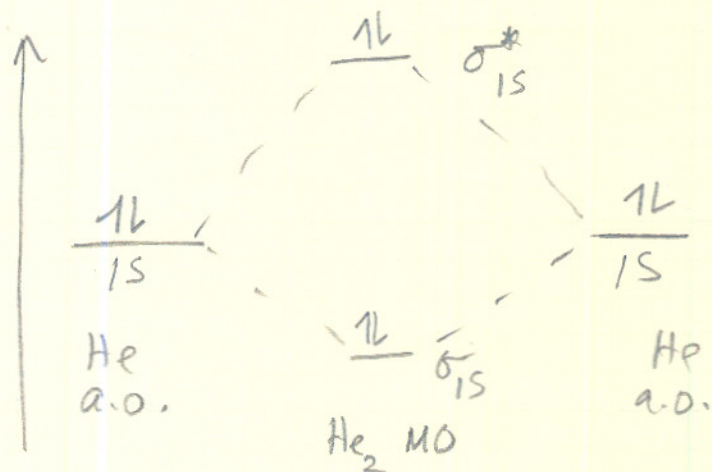
no cis-trans isomerization



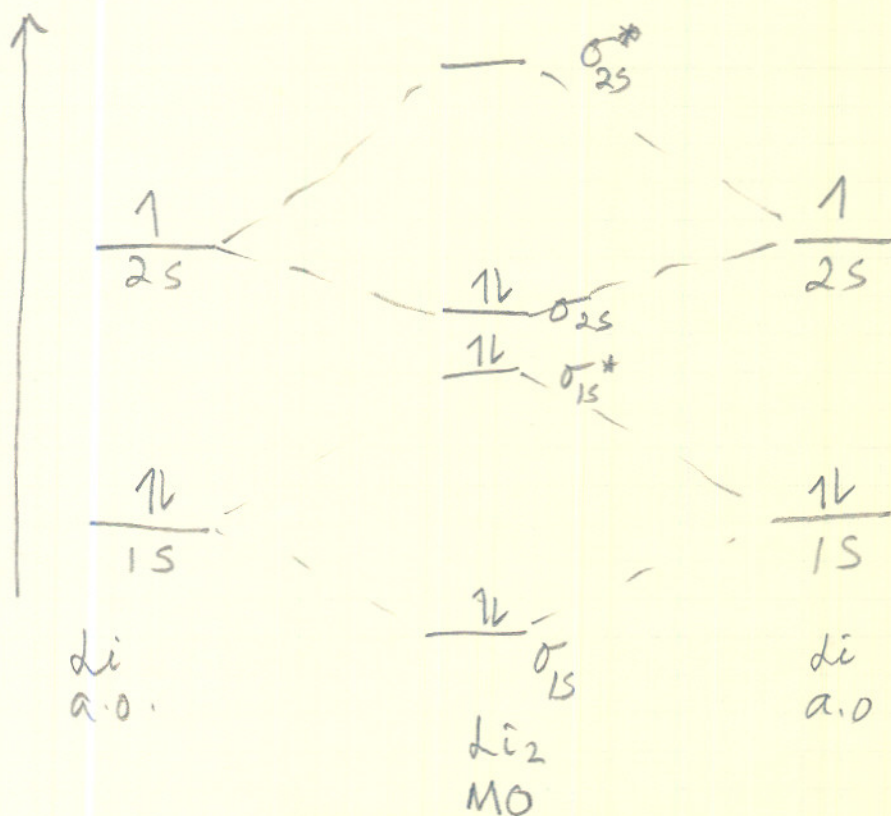
↑ Energy



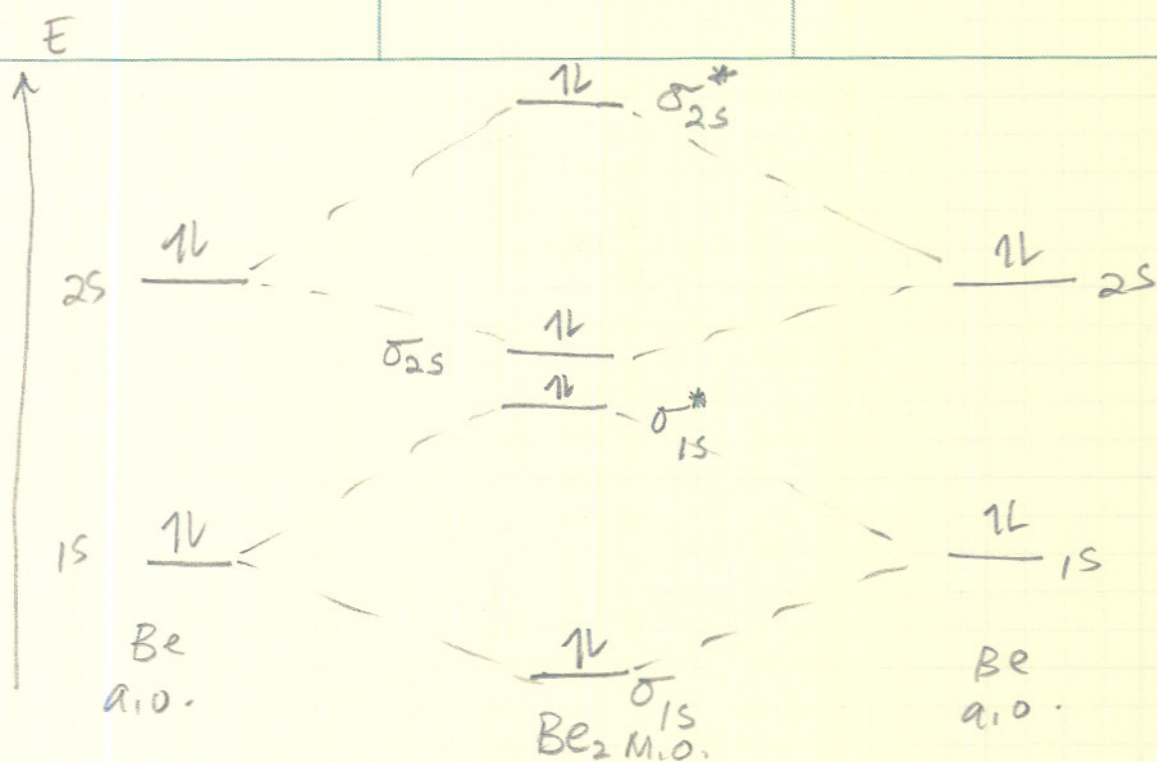
σ_{1s}^2 bond order = $\frac{1}{2}(2-0) = 1$ stable (single bond)
 diamagnetic



$\sigma_{1s}^2 \sigma_{1s}^{*2}$
 bond order = $\frac{1}{2}(2-2) = 0$
 diamagnetic
 unstable



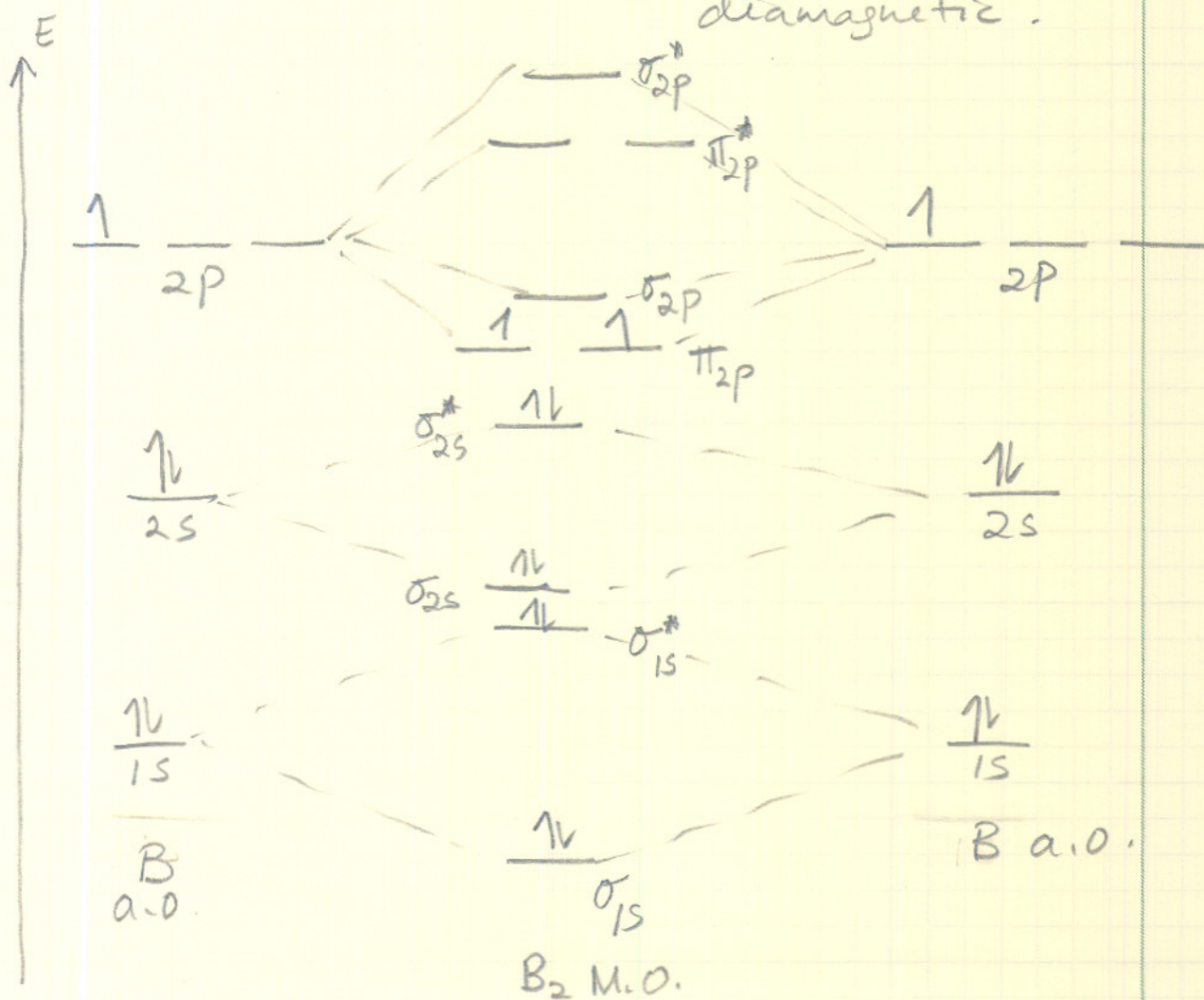
$\sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2$
 bond order = $\frac{1}{2}(4-2) = 1$
 stable
 diamagnetic



$$\sigma_{1s}^2 \quad \sigma_{1s}^{*2} \quad \sigma_{2s}^2 \quad \sigma_{2s}^{*2} \quad \text{bond order} = \frac{1}{2}(4-4) = 0$$

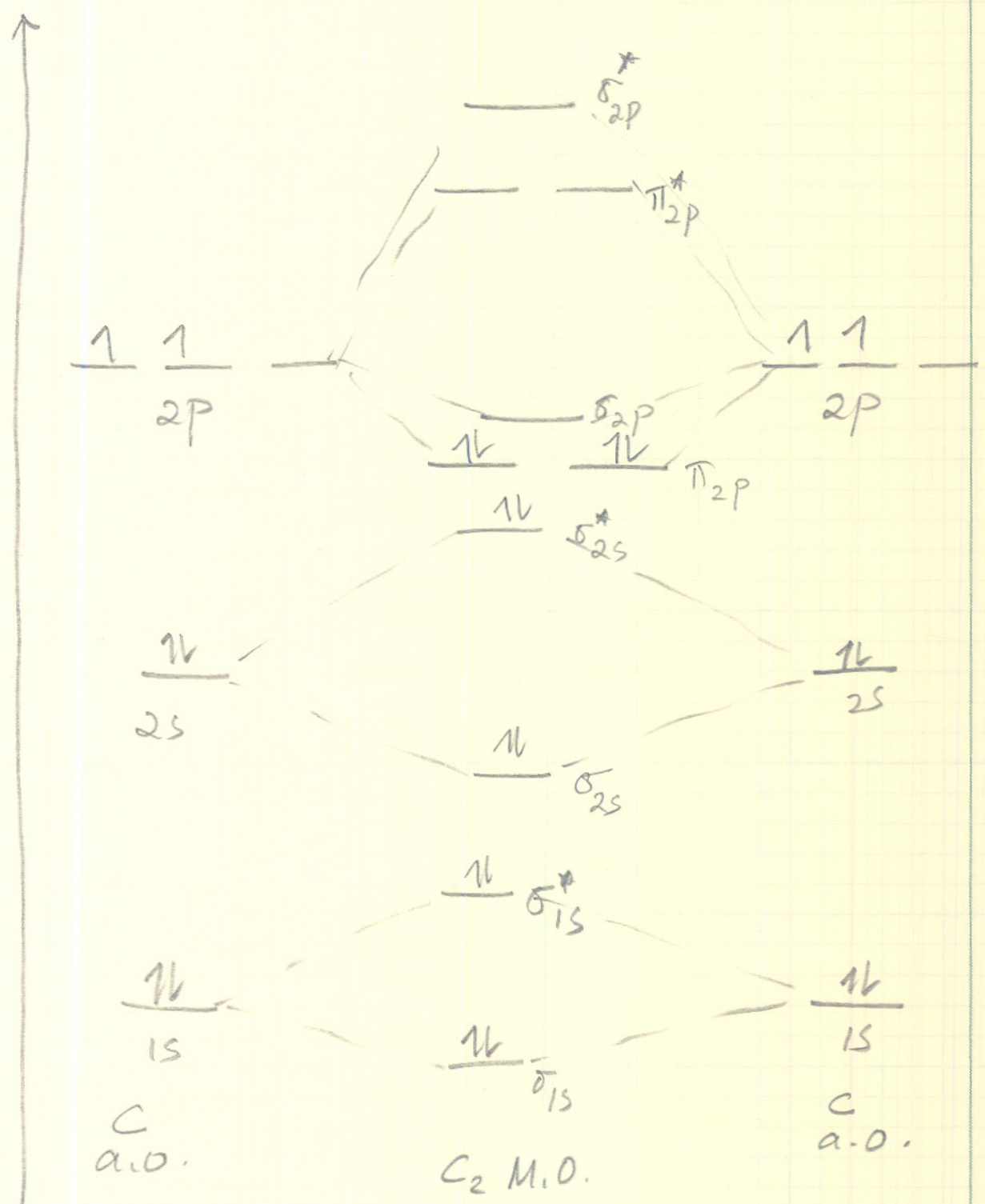
unstable

diamagnetic.



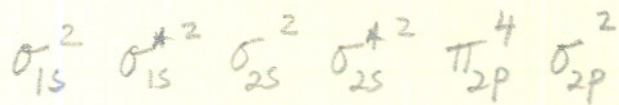
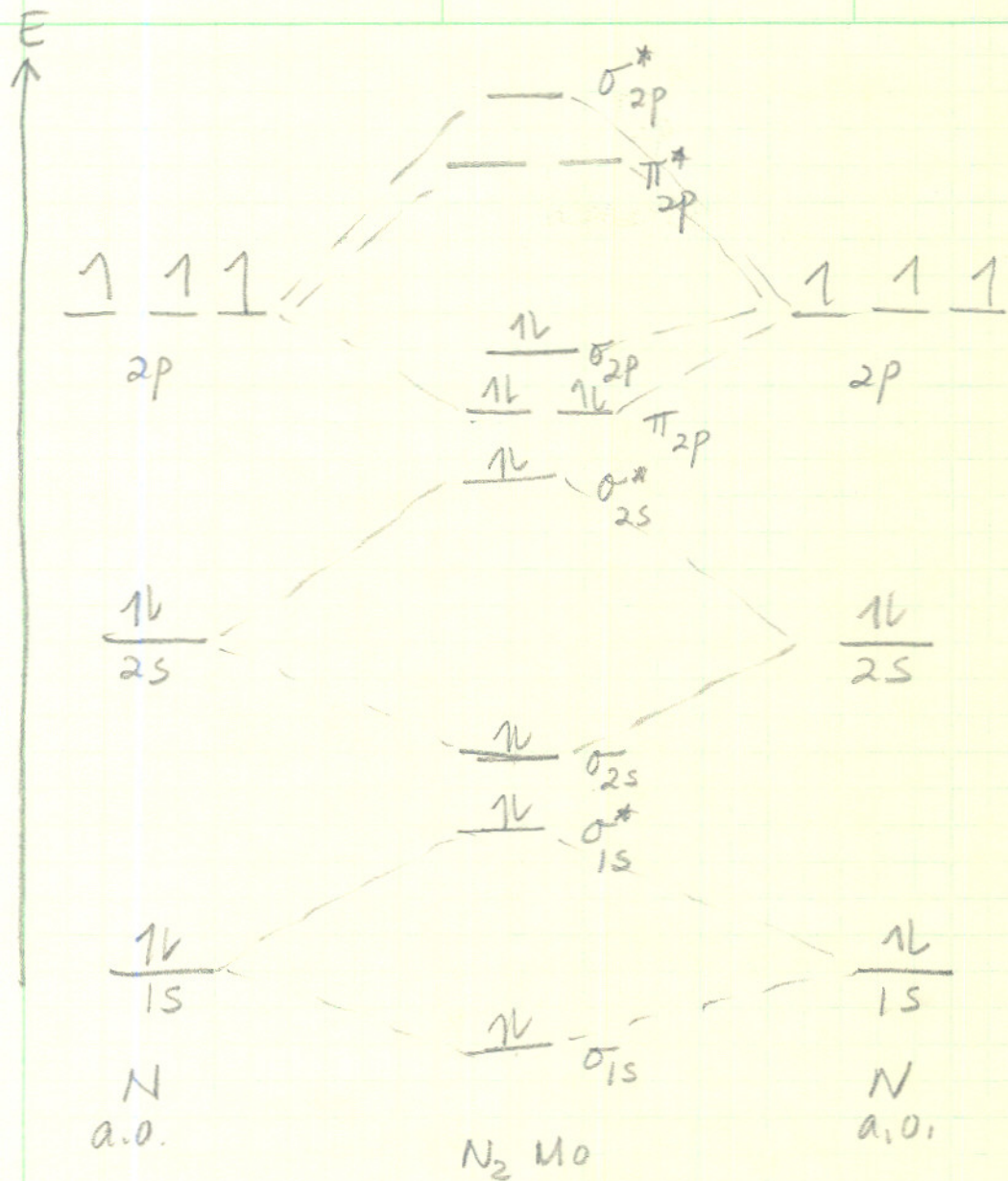
$\sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2 \sigma_{2s}^{*2} \pi_{2p}^2$
 stable paramagnetic

bond order = $\frac{1}{2}(6-4) = 1$



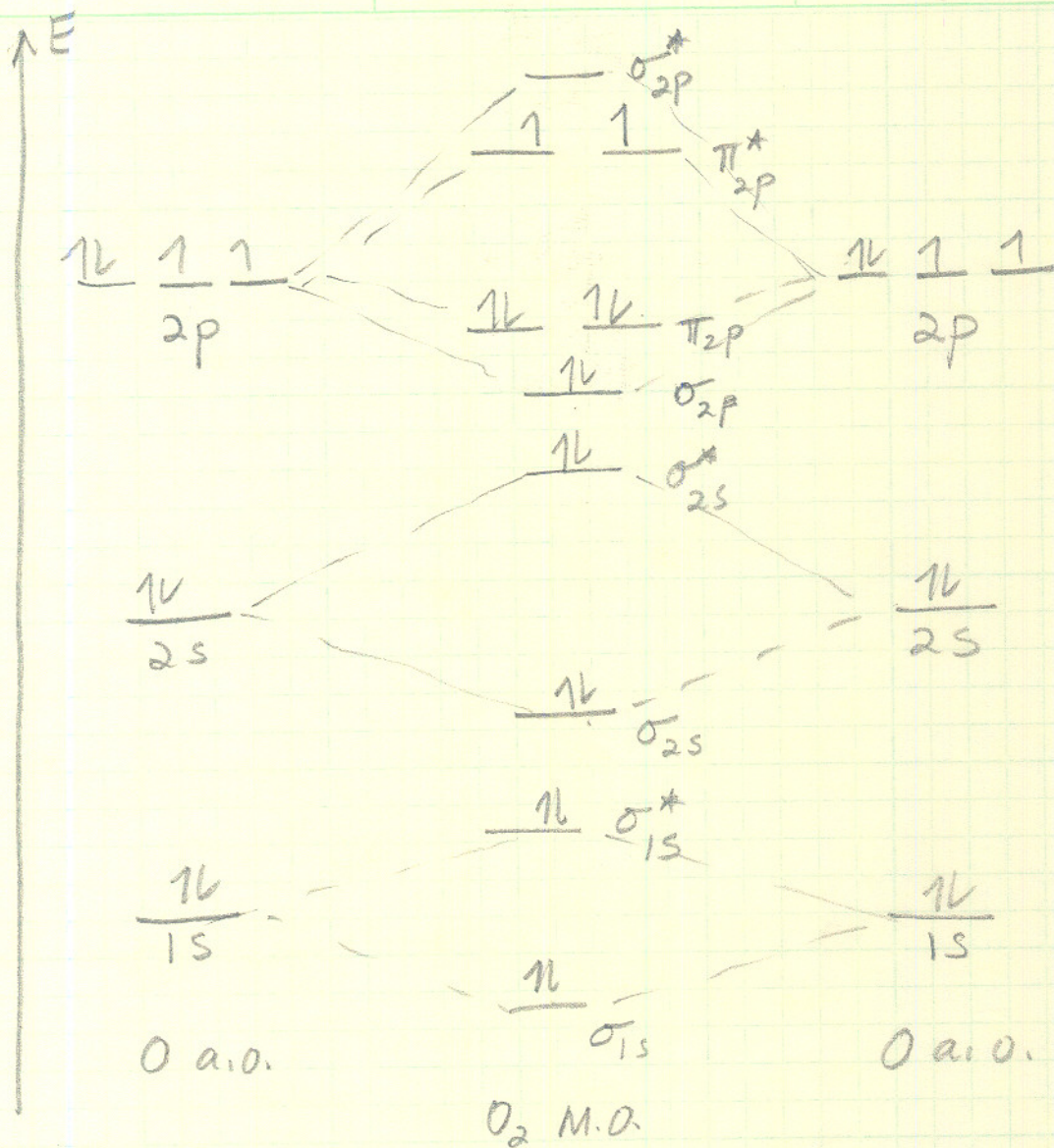
$\sigma_{1s}^2 \sigma_{1s}^{*2} \sigma_{2s}^2 \sigma_{2s}^{*2} \pi_{2p}^4$
 stable diamagnetic

bond order = $\frac{1}{2}(8-4) = 2$



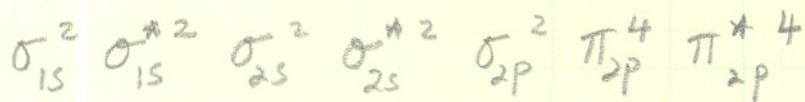
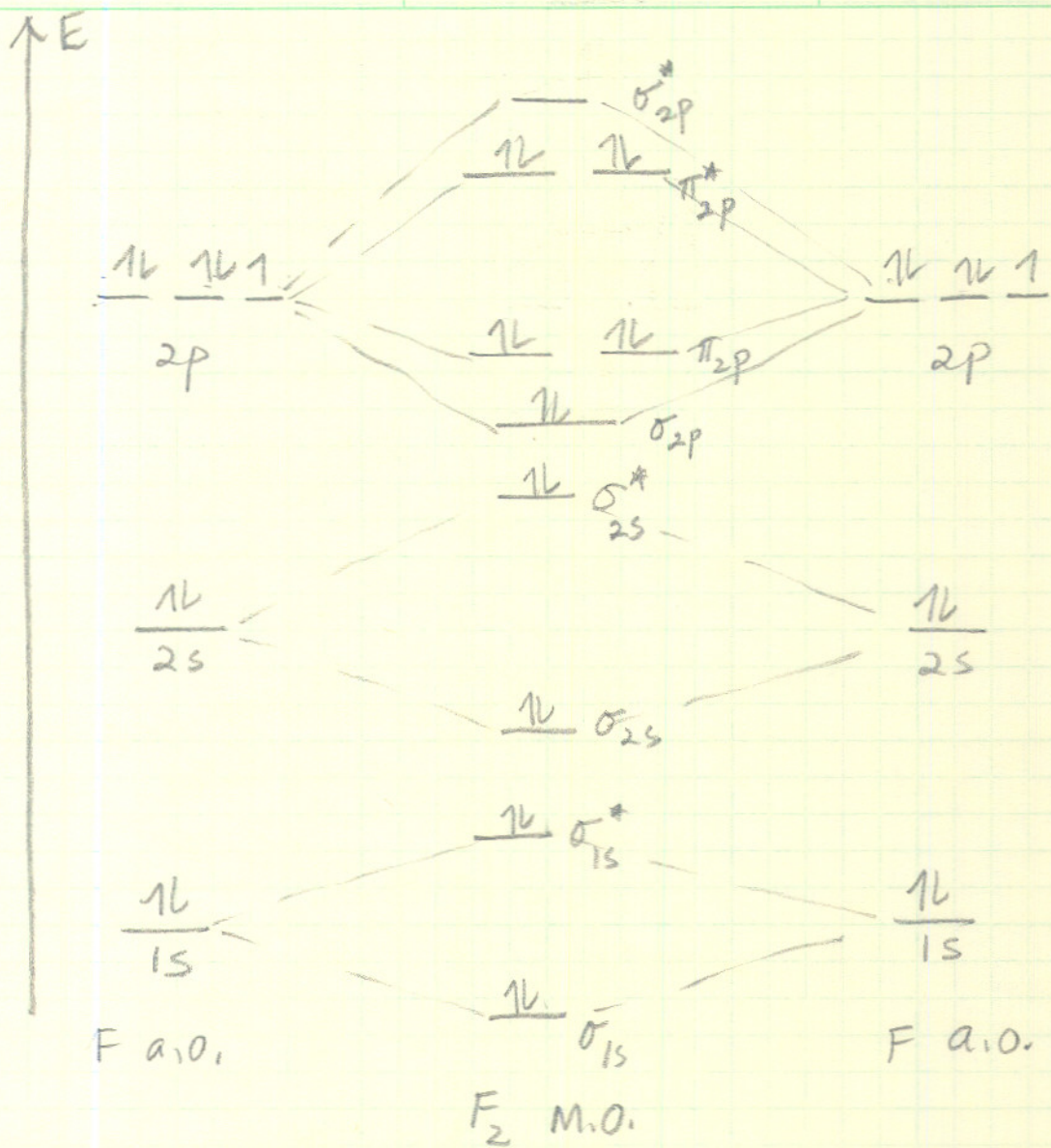
Stable diamagnetic

$$\text{bond order} = \frac{1}{2} (10 - 4) = 3$$



$$\text{bond order} = \frac{1}{2} (10 - 6) = 2 \quad \text{stable}$$

paramagnetic

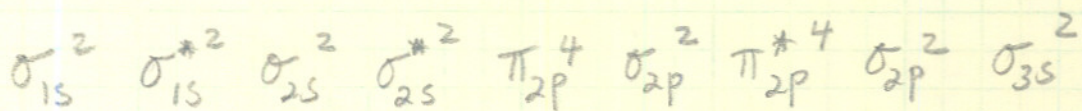
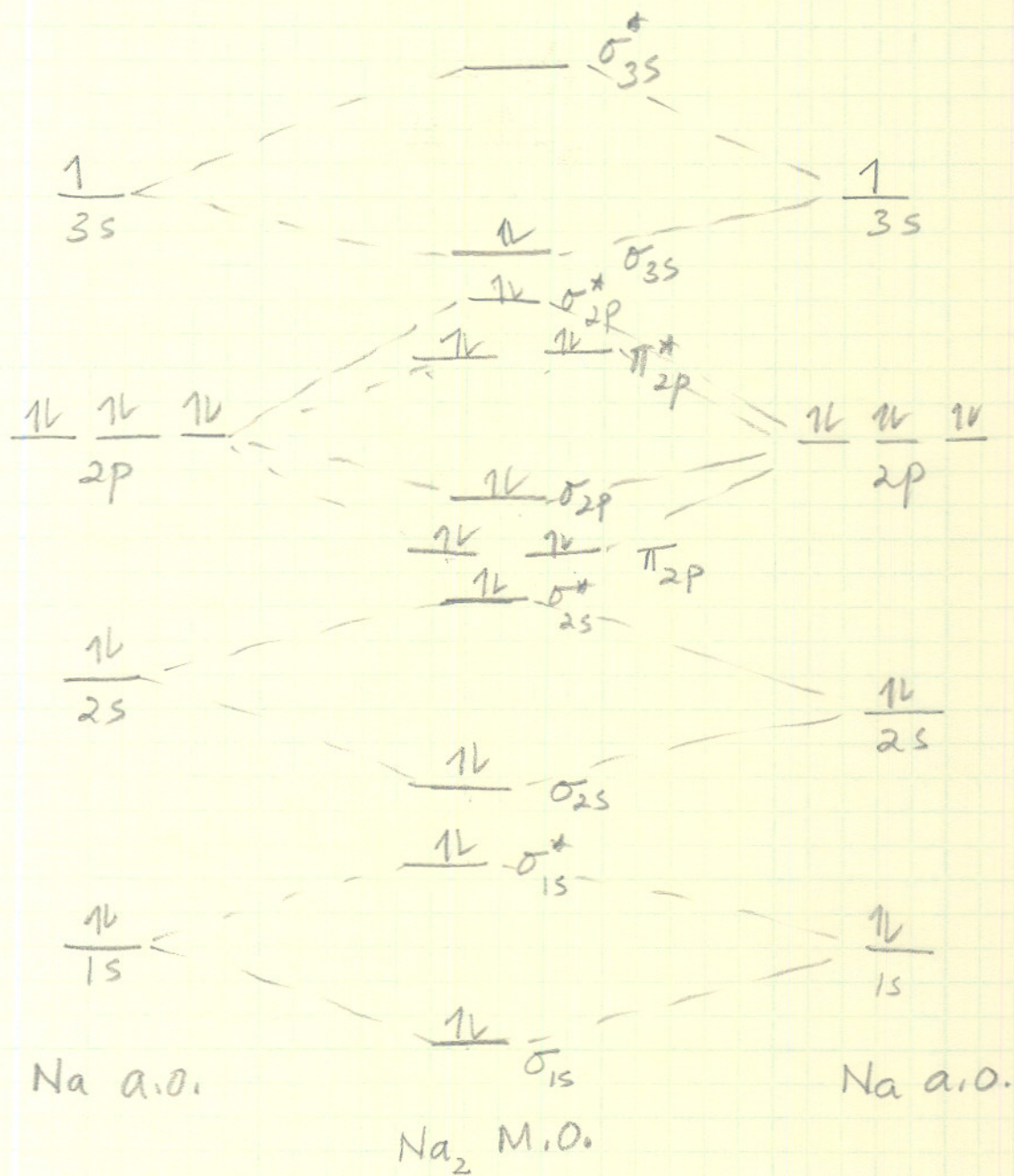


$$\text{bond order} = \frac{1}{2} (10 - 8) = 1 \quad \text{Stable}$$

diamagnetic

d

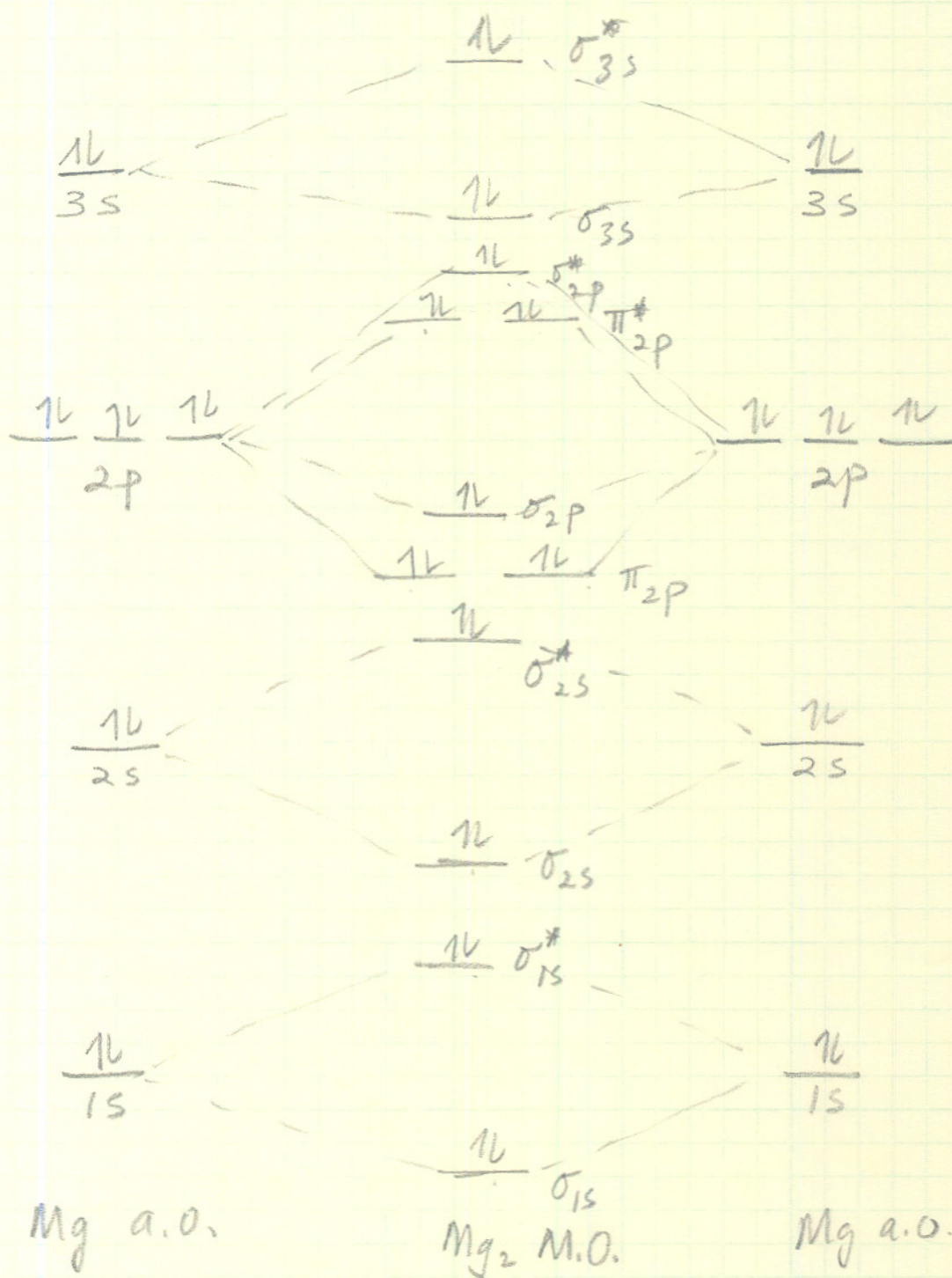
↑ E



$$\text{bond order} = \frac{1}{2} (12 - 10) = 1 \quad \text{stable}$$

diamagnetic.

↑ E



$$\sigma_{1s}^2 \quad \sigma_{1s}^{*2} \quad \sigma_{2s}^2 \quad \sigma_{2s}^{*2} \quad \pi_{2p}^4 \quad \sigma_{2p}^2 \quad \pi_{2p}^{*4} \quad \sigma_{2p}^{*2} \quad \sigma_{3s}^2 \quad \sigma_{3s}^{*2}$$

bond order = $\frac{1}{2} (12 - 12) = 0$ molecule does not exist (unstable)

diamagnetic