Class Assignment 02/18/2020

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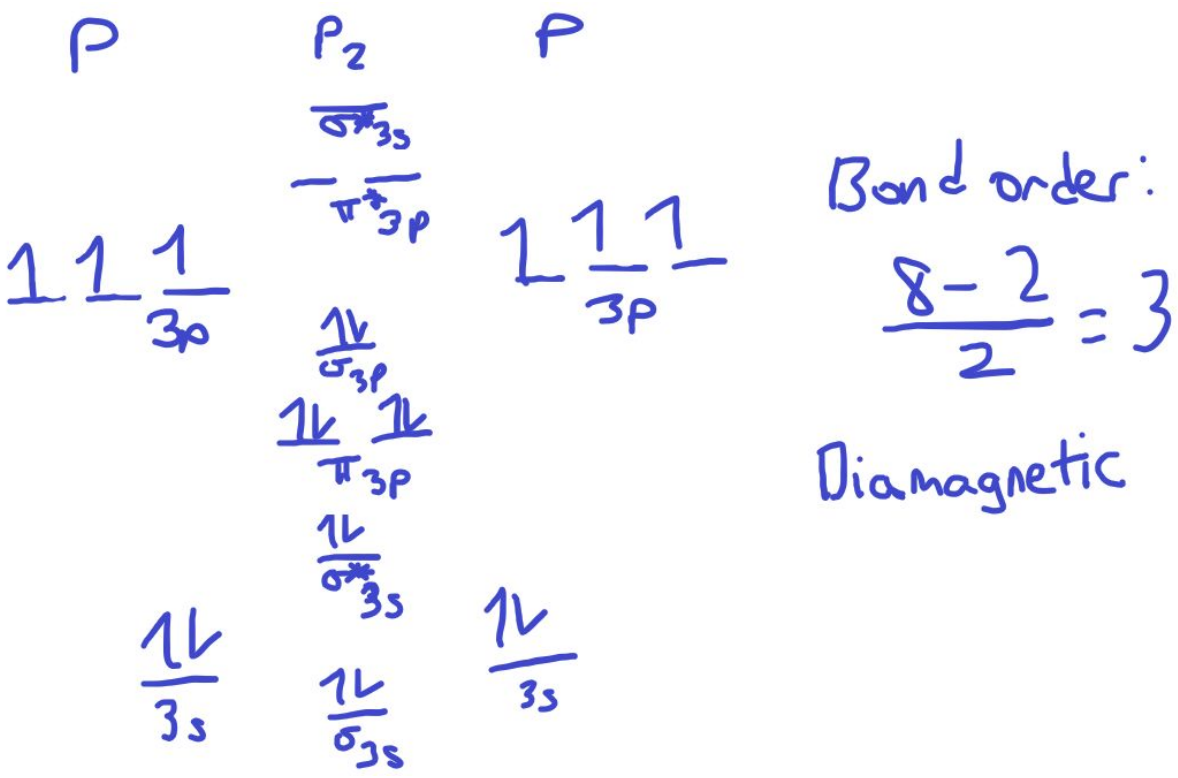
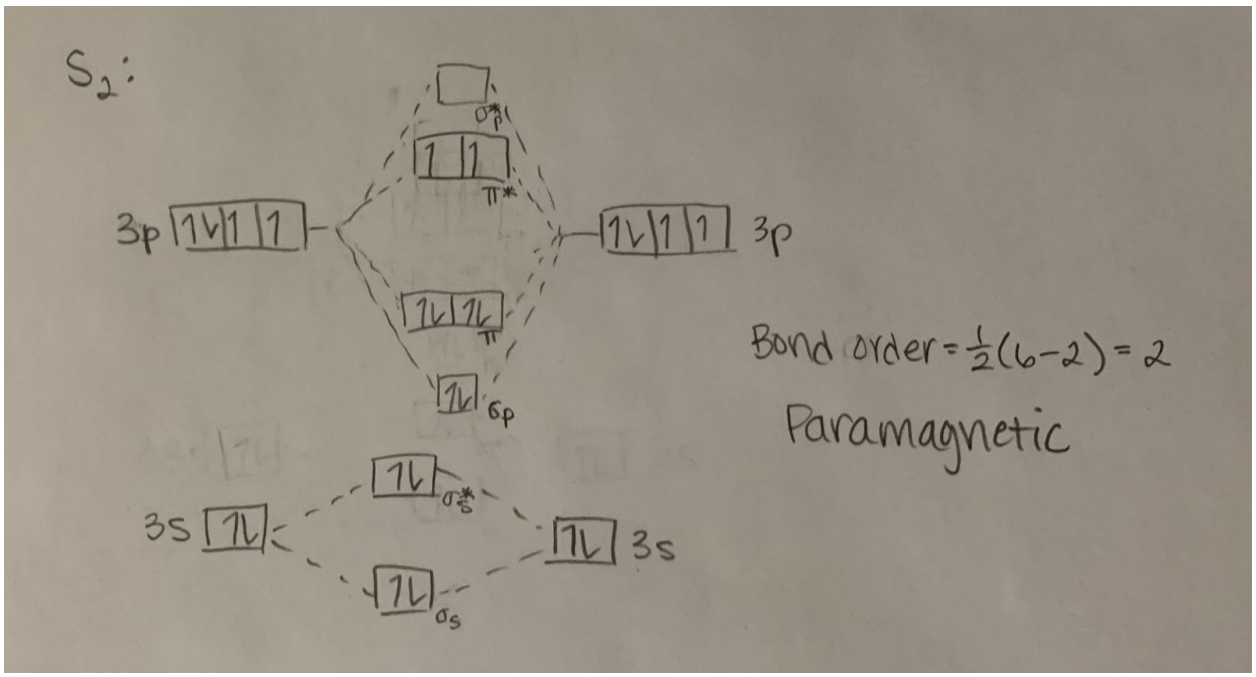
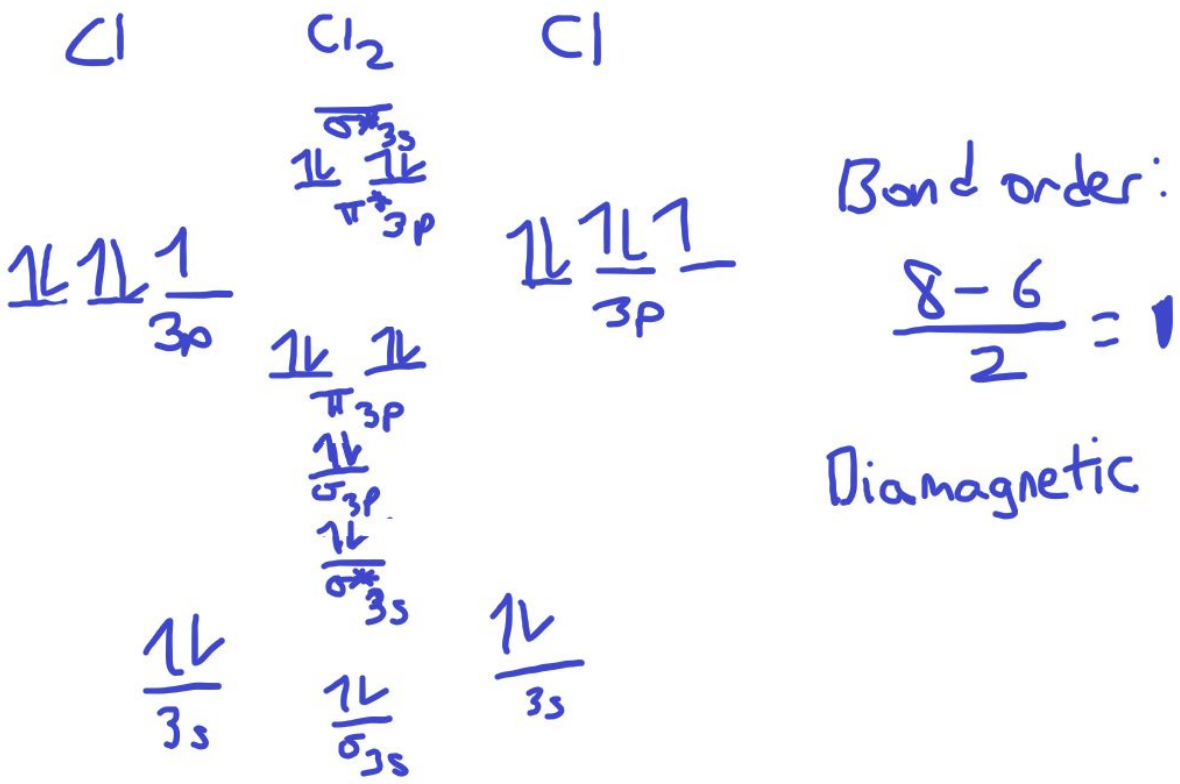
Questions (20 pts):
Q1. (A) Draw the molecular orbital diagrams of the following molecule (B) Determine the bond order, (C) Predict the weakest bond (D) Predict whether molecules are paramagnetic or diamagnetic

a. P2, S2, Cl2

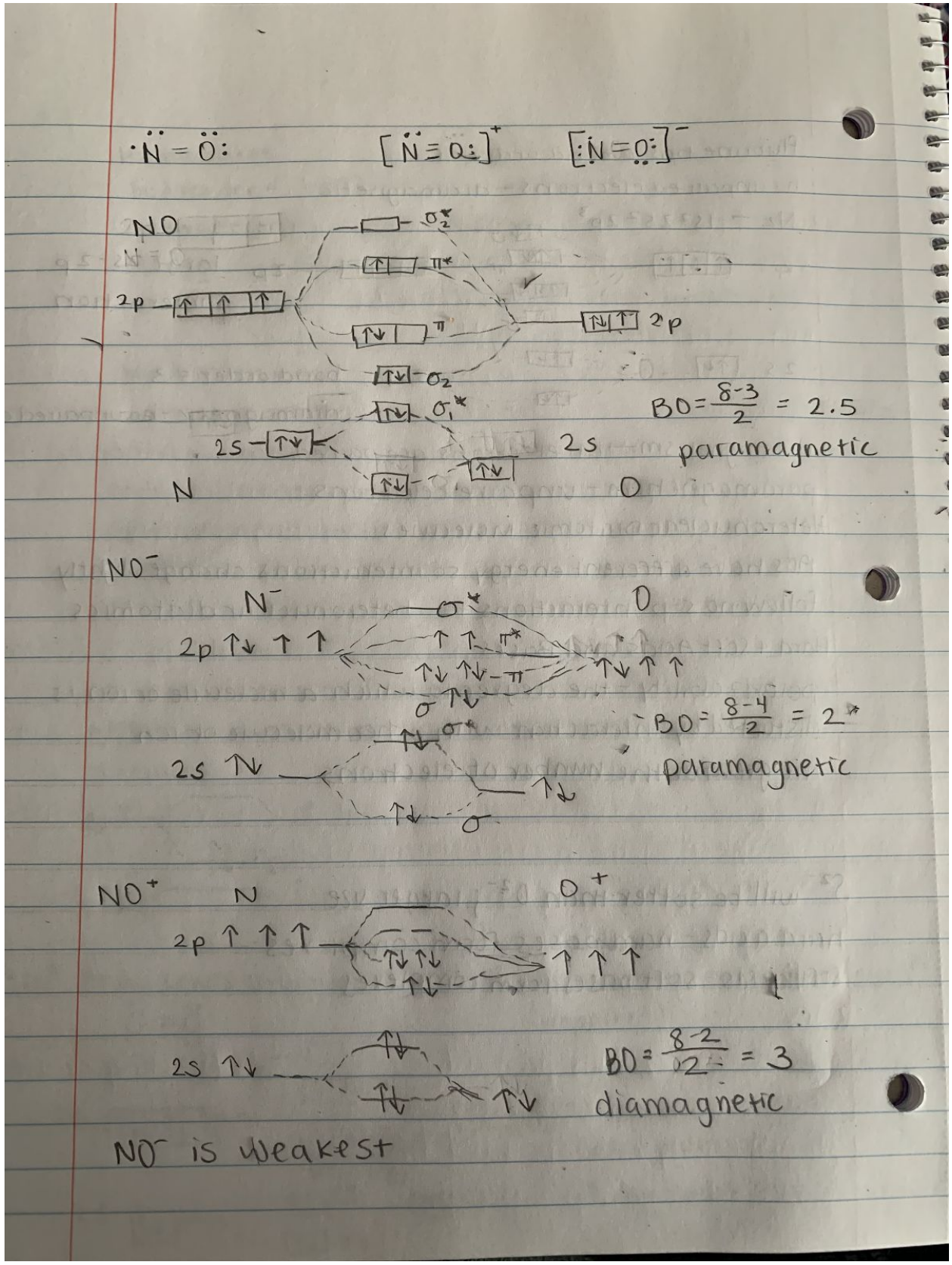






The weakest bond will be the molecule with lowest bond order, which is Cl_2.

b. NO, NO+, NO-


NO
N
O
2p
2s
σ_2^*
π^*
π
σ_2
σ_1^*
$BO = \frac{8-3}{2} = 2.5$
paramagnetic
NO^-
N^-
$BO = \frac{8-4}{2} = 2$
paramagnetic
NO^+
O^+
$BO = \frac{8-2}{2} = 3$
diamagnetic
NO^- is weakest

Q2. Will Fe^{3+} react more favorably with O^{2-} or S^{2-}?

Fe^{+3} is considered a hard acid because it is a cation with a large positive charge. Hard acids are more likely to form complexes with hard bases. Between O^{-2} and S^{-2}, S^{-2} is a larger molecule, making it softer. Thus, **Fe^{+3} will react more favorably with O^{-2}**.

Q3. Predict the solubility in water of each of the following series, and explain the factors involved.

PbCl2, PbBr2, PbI2
PbCl2 will be more water soluble than PbBr2 which is more water soluble than PbI2.

Between Cl^-, Br^-, and I^-, I^- is the largest molecule, making it the softest. Since Pb^{+2} is a relatively soft acid, it will have stronger interactions with the softer base. Thus, the PbI_2 molecule will be harder to dissolve than the $PbCl_2$ molecule.