

1) Give the valence bond description using VB theory for the molecules given below: (36 points)

	Lewis Structure	Electron box Diagram	Draw and Name Geometry of Stereoactive groups of electrons	Type of Hybrid Orbitals
BrF ₅				
C ₂ Cl ₂ (Cl is chlorine)				
HNO ₂ HONO				

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	Lewis Structure	Electron box Diagram	Draw and Name Geometry of Stereoactive groups of electrons	Type of Hybrid Orbitals
TeF ₄				
HCN				
XeF ₄				

2) **Draw** the molecular orbital energy level diagram for CF^- ion. **Label** all energy levels (atomic and molecular). On the diagram show clearly the **relative positions** of the energy levels (atomic and molecular). Show the **distribution of the electrons** among the energy levels. (14 points)

From your diagram above:

a) Calculate the bond order for CF^- ion.
Setup:

Answer _____

b) Predict the magnetic property of CF^- ion.

Answer _____

c) Predict the number of unpaired electrons, if any.

Answer _____

3) a) Write the electron configuration for O_2^+ ion. (13 points)

b) Calculate the bond order for the O_2^+ ion.

Answer: Bond order=_____

c) Write the electronic configuration for F_2^- ion.

d) Calculate the bond order for the F_2^- ion.

Answer: Bond order=_____

e) The oxygen-oxygen bond distance in O_2^+ ion is 1.18 Å. On the basis of bond order from molecular orbital theory, would you expect the bond distance of F_2^- ion to be less than or greater than 1.18 Å?

Answer: The bond distance in F_2^- ion is _____ 1.18 Å. Explain how you have arrived (longer than, shorter than, or equal to)

at the answer.

f) State the magnetic property and the number of unpaired electrons, if any, for O_2^+ and F_2^- ions using MO theory.

Answer: O_2^+ is _____ with _____ unpaired electron(s)
(number)

F_2^- is _____ with _____ unpaired electron(s).
(number)

4) A) Which of the following pairs of atomic orbitals on adjacent nuclei : (5 points)

a) p_y and p_y

b) p_z and p_z

c) p_y and p_x

d) p_z and s

e) p_x and p_x

i) can overlap to form a sigma bond? _____.

ii) can overlap to form a pi bond? _____.

B) Which of the above pairs of atomic orbitals of adjacent nuclei cannot overlap (no bond)?

Answer: _____

5) Why do atoms use hybrid orbitals in bond formation ?

(4 points)

6) Predict the type of **hybrid orbitals** employed for bonding by the central atom and **the bond angle** in each of the following. (**Hint:** You must draw the electron-dot structure.) (28 points)

	Type of Hybrid orbitals	Bond angle
a) COCl_2 (O is the central atom, Cl is chlorine)	a) _____	a) _____
b) SCl_3^-	b) _____	b) _____
c) XeF_3^+	c) _____	c) _____
d) N_3^-	d) _____	d) _____

