

Workbook



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More Aspects of Chemical Bonding

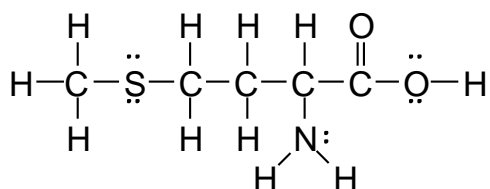
Valence bond VB method

Questions

1) Draw the valence shell orbital diagram (hybridization of pure atomic orbitals, to hybrid atomic orbitals) of the central atom in the following molecules:

- a. CCl_4
- b. COH_2
- c. N_2

2) What are the hybridizations (sp , sp^2 , etc.) of the central atoms in the following molecule:



3) For the following molecules,

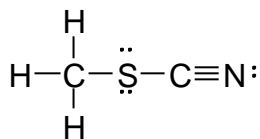
- a. Predict the electron group geometry by VSEPR theory.
- b. Determine the hybridization of the central atoms:
 - a) S_8
 - b) SO_2
 - c) H_2SO_4

4) Determine the hybridization of the following molecules:

- a. PCl_5
- b. COCl_2
- c. SF_6

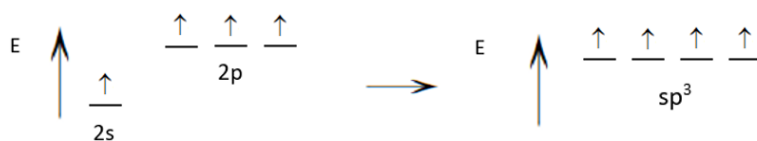
General Chemistry Workbook

- 5) For the following molecule,
- Predict the electron group geometry by VSEPR theory.
 - Determine the hybridization of the central atoms.
 - Identify the orbitals of the central and terminal atoms that are involved, in orbital overlap.

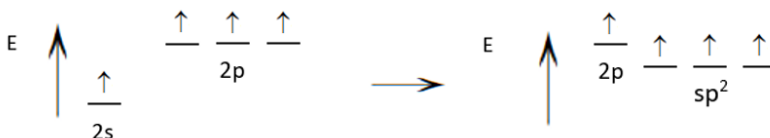


Answer Key

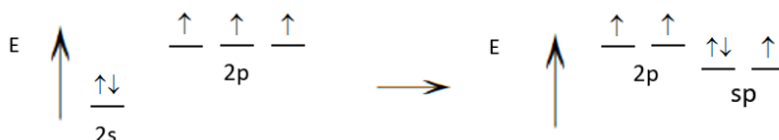
1) a.



b.



c.



2) C₁₋₄: sp³ S: sp³ C₅: sp² O₁: sp³ N: sp³

3) S₈: S: tetrahedral, sp³ SO₂: S: trigonal planar, sp²

H₂SO₄: S: tetrahedral, sp³ O: tetrahedral, sp³

4) a. sp³d b. sp² c. sp³d²

5) C₁: tetrahedral, sp³ S: tetrahedral, sp³ C₂: linear, sp

Orbital overlap: H 1s – C₁ sp³, C₁ sp³ – S sp³, S sp³ – C₂ sp, C₂ sp – N sp

Molecular orbital MO theory

Questions

- 1) Sketch the molecular orbital diagrams for the following species:
 - a. F_2
 - b. C_2^+

- 2)
 - a. Calculate the bond order of O_2 using the molecular orbital diagram.
 - b. Determine the number of unpaired electrons.
 - c. Is the molecule paramagnetic or diamagnetic?

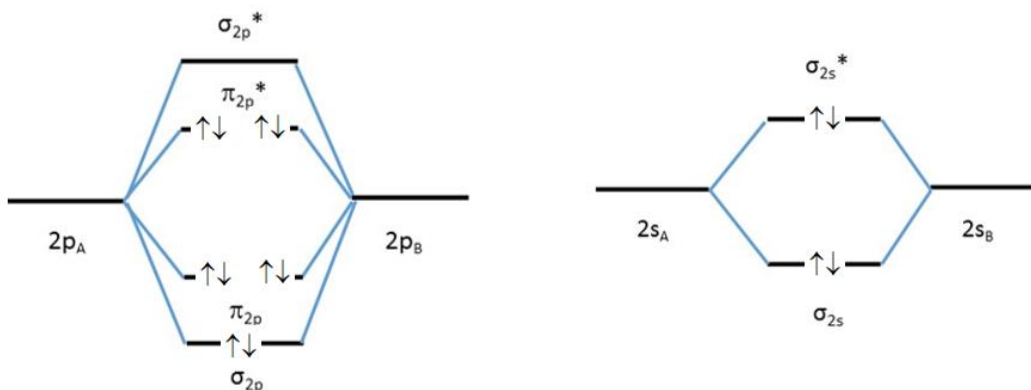
- 3) Calculate the bond order of the following ions and determine if they are stable, using the molecular orbital diagram:
 - a. F_2^{2+}
 - b. C_2^{2-}

- 4) Explain why the oxidation of O_2 decreases the bond distance whereas the oxidation, of N_2 increases the bond distance.

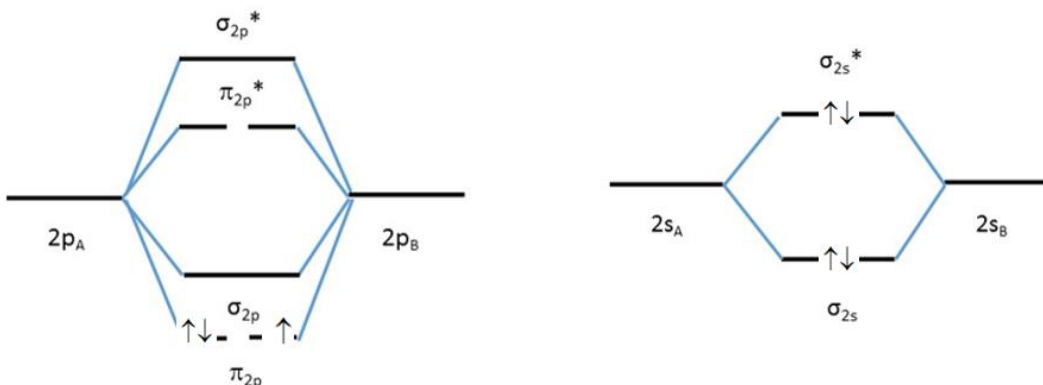
- 5) Sketch a molecular orbital diagram for H_2^- .
Does the extra electron make the H-H bond stronger compared to H_2 ?
Explain your answer.

Answer Key

1) a.



b.



2) a. 2

b. 2

c. paramagnetic

3) a. bond order = 2, stable

b. bond order = 3, stable

4) When O_2 is oxidized, the bond order increases.

When N_2 is oxidized, the bond order decreases.

Bond order and bond distance are inversely proportional.

Therefore, an increase in bond order means a decrease in bond distance and vice versa.

5) Bond order of H_2^- = 0.5. Bond order of H_2 = 1

The extra electron makes the H-H bond weaker

because the bond order decreases,

as a result of the extra electron.

