Chapter 5: Advanced Theories of Bonding

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Notice of ADA Accommodation and Methods

I have an ADA accommodation to do my assignment on paper. This document is a utilization of that accommodation. This assignment will utilize questions from the textbook, *Chemistry: Atoms First, 2e*, to practice the skills and learning objectives for this class.

1 Valence Bond Theory

Q.1: Explain how σ and π bonds are similar and how they are different.

σ bonds are bonds that form in s-orbitals, while π bonds form in p-orbitals.

Q.5: A friend tells you that N_2 has three π bonds due to the overlap of the three *p*-orbitals in each Nitrogen atom. Do you agree?

N_2 would have two π bonds and a σ bond.

2 Hybrid Atomic Orbitals

Q.9: Explain why a Carbon atom cannot form five bonds using sp^3d hybrid orbitals.

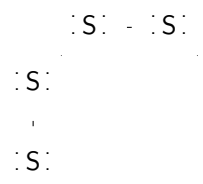
Carbon can only take four more valence shell electrons. sp^3 are what Carbon has since it con only form four bonds.

Q.13: Sulfuric acid is manufactured by the series of reactions:

$$S_8(s) + 8\,O_2(g) \longrightarrow 8\,SO_2(g)$$
$$2\,SO_2(g) + O_2(g) \longrightarrow 2\,SO_3(g)$$
$$SO_3(g) + H_2O(l) \longrightarrow H_2SO_4(l)$$

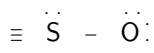
Draw the Lewis Structure, predict the molecular geometry by VSEPR, and determine the hybridization of sulfur for the following:

a. Circular S_8 model

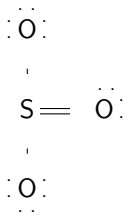


Tetrahedral; Bent, sp^3

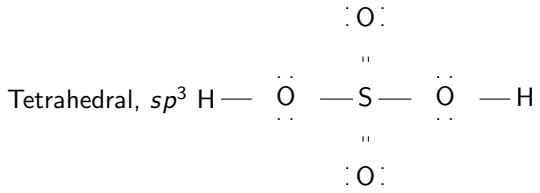
b. SO_2 molecule

Bent, sp^2 

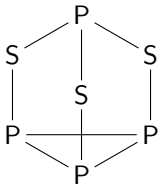
c. SO_3 molecule

Trigonal Planar; sp^2 

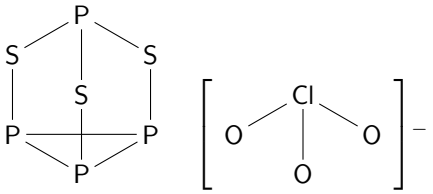
d. H_2SO_4 molecule

Tetrahedral, sp^3 

Q.17: Strike-anywhere matches contain a layer of $KClO_3$ and a layer of P_4S_3. The heat produced by the friction of striking the match causes these two compounds to react vigorously, which sets fire to the wooden stem of the match. $KClO_3$ contains the ClO_3^- ion. P_4S_3 is an unusual molecule with the following skeletal structure:



a. Write the Lewis structures for P_4S_3 and the ClO_3^- ion.



b. Describe the geometry about the P atoms, the S atom, and the Cl atom in these species

P: Trigonal Pyramidal; S: Bent, two lone pairs; Cl: Trigonal Pyramidal

c. Assign a hybridization to the P atoms, the S atom, and tho Cl atom in these species

sp^3 for all

d. Determine the oxidization states and formal charge of the atoms in P_4S_3 and the ClO_3^- ion.

Atom	P	S	Cl	O
Oxidation States	+1	$-1\frac{1}{2}$	+5	-2
Formal Charge	0	0	+2	-1

3 Multiple Bonds

Q.21: The bond energy of a C-C single bond averages 347 kJ mol^{-1}; that of a C≡C triple bond averages 839 kJ mol^{-1}. Explain why the triple bond is not three times as strong as the single bond.

A triple bond is made of of one σ bond and two π bonds. A σ bond is stronger than a π bond.

Q.25: Identify the hybridization of the central atom in each of the following molecules and ions that contain multiple bonds:

ClNO	CS_2	Cl_2CO	Cl_2SO	SO_2F_2	XeO_2F_2	$ClOF_2^+$
sp^2	sp	sp^2	sp^3	sp^3	sp^3d	sp^3

Q.29: Draw the orbital diagram for carbon in CO_2 showing how many carbon atom electrons ore in each orbital.

Orbitals in Carbon Hybridized Carbon in CO_2

These are: (sp: up), (sp: up), (2p: up), (2p: up), but I can't figure out the LaTeXfor it

4 Molecular Orbital Theory

Q.33: Can a molecule with an odd number of electrons ever be diamagnetic? Explain why or why not.

No. An odd number of electrons will always be paramagnetic.

Q.37: Explain why an electron in the bonding molecular orbital in the H_2 molecule has a lower energy than an electron in the 1*s* atomic orbital hydrogen atoms.

The pairing of the two bonding electrons lowers the system's energy compared to a lone atom.

Grading

Points Possible	Points Earned	Score
32		/32