Name: _____ **Date:** _____

Orbital Hybridization Odyssey for 11th Grade

Calculate formal charges and predict molecular geometries using VSEPR theory and hybridization models across complex polyatomic ions and resonance structures.

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1. In the molecule Phosphorus Pentachloride (PCl_5), what is the hybrid orbital set required to accommodate the expanded octet around the central atom?

A. sp^3
B. sp^3d
C. sp^3d^2
D. sp^2

2. The bond angle in a Nitrogen Trifluoride (NF_3) molecule is slightly less than 109.5 degrees due to _____.

A. lone pair-bonding pair repulsion
B. bonding pair-bonding pair repulsion
C. the high electronegativity of Nitrogen
D. the presence of pi bonds

3. The molecule Benzene (C_6H_6) contains localized pi bonds formed by the overlap of hybridized sp^2 orbitals.

A. True
B. False

4. Which of the following polyatomic ions exhibits the highest degree of resonance stabilization where all bond lengths are equivalent?

A. Hydroxide (OH^-)
B. Ammonium (NH_4^+)
C. Carbonate (CO_3^{2-})
D. Sulfate (SO_4^{2-})

5. What is the formal charge on the central Sulfur atom in the Lewis structure of Sulfuric acid (H_2SO_4) that minimizes formal charges?

A. +2
B. +1
C. 0
D. -2

6. In Molecular Orbital (MO) Theory, the combination of two atomic 1s orbitals results in the formation of a low-energy bonding orbital and a high-energy _____ orbital.

A. sigma-star antibonding

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B. pi-star antibonding
C. non-hybridized
D. paramagnetic

7. A molecule with a square planar molecular geometry always possesses a central atom with sp^3d^2 hybridization and two lone pairs.

A. True
B. False

8. The dipole moment of Boron Trifluoride (BF_3) is zero because the _____ arrangement of the polar B-F bonds results in vector cancellation.

A. Trigonal Pyramidal
B. Trigonal Planar
C. Tetrahedral
D. Linear

9. Which of these molecules contains exactly two pi bonds and one sigma bond between the carbon atoms?

A. Ethane (C_2H_6)
B. Ethene (C_2H_4)
C. Ethyne (C_2H_2)
D. Ethanol (C_2H_5OH)

10. The Lattice Energy of Lithium Fluoride (LiF) is lower than that of Magnesium Oxide (MgO) because the product of the ionic charges is smaller.

A. True
B. False