

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## The Resonance of Molecular Geometry: A College Chemistry Challenge

Scholars analyze lattice energy, calculate formal charges, and predict hybridization patterns to explain the stability of complex polyatomic ions and crystal structures.

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**1. Which of the following factors is primarily responsible for the increased lattice energy of Aluminum Nitride (AlN) compared to Magnesium Oxide (MgO)?**

- A. The higher electronegativity of Nitrogen compared to Oxygen
- B. The larger atomic radius of Aluminum compared to Magnesium
- C. The increase in the product of ionic charges ( $Q_1Q_2$ )
- D. The presence of metallic bonding within the crystal lattice

**2. In the polyatomic ion Phosphate ( $PO_4^{3-}$ ), the formal charge on the phosphorus atom when drawn with an expanded octet to minimize formal charges is \_\_\_\_.**

- A. +1
- B. 0
- C. -1
- D. +5

**3. According to Valence Bond Theory, the central iodine atom in the triiodide ion ( $I_3^-$ ) utilizes  $sp^3d$  hybridization to accommodate its lone pairs and bonding pairs.**

- A. True
- B. False

**4. When examining the Molecular Orbital (MO) diagram for Nitrogen ( $N_2$ ), why are the sigma-2p orbitals higher in energy than the pi-2p orbitals?**

- A. Due to significant s-p mixing occurring in lighter diatomic molecules
- B. Because Nitrogen is more electronegative than Oxygen
- C. Because there are no pi-star antibonding orbitals in  $N_2$
- D. Due to the presence of a triple bond increasing nuclear repulsion

**5. The molecular geometry of Xenon Tetrafluoride ( $XeF_4$ ) is best described as \_\_\_\_.**

- A. Tetrahedral
- B. Seesaw
- C. Square Planar
- D. Octahedral

**6. Metallic bonding strength generally decreases across a period from left to right as the number of delocalized electrons increases.**

- A. True
- B. False

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**7. What is the bond order of the Oxygen molecule ion ( $O_2^+$ ) based on Molecular Orbital Theory?**

- A. 2.0
- B. 1.5
- C. 2.5
- D. 3.0

**8. In a polar covalent bond, the vector quantity representing the partial charge separation and distance is known as the \_\_\_\_\_.**

- A. Dielectric constant
- B. Dipole moment
- C. Ionization energy
- D. Electronegativity gradient

**9. The Conductivity of a substance can always be used to definitively distinguish between ionic and covalent solids without further testing.**

- A. True
- B. False

**10. Which molecule exhibits a net dipole moment of zero despite containing polar bonds?**

- A.  $SF_4$
- B.  $NH_3$
- C.  $CCl_4$
- D.  $H_2O$