**Name:** _____ **Date:** _____

## Complex Chemical Connections: College Chemistry Quiz

Analyze molecular orbital theory and lattice energy through 10 advanced problems essential for materials science and pharmaceutical engineering careers.

---

**1. Which transition in the MO diagram of a heteronuclear diatomic molecule like Carbon Monoxide (CO) explains its high affinity for transition metal centers in organometallic catalysis?**

A. Sigma bonding from the 2s orbitals
B. Pi back-bonding into the vacant LUMO
C. Electron donation from the non-bonding HOMO
D. Intermolecular hydrogen bonding

**2. According to the Born-Haber cycle, the stability of an ionic solid is primarily dictated by its _____, which quantifies the energy released when gaseous ions form a crystal lattice.**

A. Ionization Energy
B. Lattice Energy
C. Enthalpy of Atomization
D. Electron Affinity

**3. In Molecular Orbital theory, the paramagnetic nature of Liquid Oxygen is explained by the presence of two unpaired electrons in the pi-star (π*) antibonding orbitals.**

A. True
B. False

**4. Evaluate the following molecules based on Fajan's Rules: Which would demonstrate the highest degree of covalent character despite being classified as an ionic halide?**

A. LiF
B. LiI
C. CsF
D. CsI

**5. The _____ effect describes the phenomenon where the 6s2 electrons in heavy elements like Thallium or Lead remain unshared, leading to oxidation states two units lower than expected.**

A. Photoelectric
B. Jahn-Teller
C. Inert Pair
D. Zeeman

**6. In the context of Band Theory, what distinguishes a p-type semiconductor from an intrinsic semi-conductor?**

A. A full valence band and empty conduction band

**Name: _____ Date: _____**

B. Introduction of acceptor levels near the valence band
C. Introduction of donor levels near the conduction band
D. A zero-energy band gap

**7. The Berry Pseudorotation mechanism explains how phosphorus pentachloride (PCl5) undergoes rapid exchange between axial and equatorial ligands to appear symmetric on an NMR timescale.**

A. True
B. False

**8. When considering the molecular geometry of the Xenon tetrafluoride (XeF4) molecule via VSEPR theory, the presence of two lone pairs results in a _____ geometry.**

A. Tetrahedral
B. Square Planar
C. See-saw
D. Octahedral

**9. Which of the following best describes the 'Bond Order' of the Nitrosyl cation (NO+)?**

A. 1.0
B. 2.0
C. 2.5
D. 3.0

**10. Bent's Rule suggests that more electronegative substituents prefer hybrid orbitals with greater 's' character.**

A. True
B. False