Name: _____ **Date:** _____

Answer Key: Molecular Architecture: A 10th Grade Bonding Blueprint Expedition

Perfect for formative assessment of lattice energy, orbital hybridization, and VSEPR theory as students design stable chemical structures.

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1. Which transition metal complex geometry is most likely to result from d2sp3 hybridization in an octahedral field?

Answer: C) Octahedral

The octahedral geometry is the direct spatial result of d2sp3 hybridization, involving the mixing of two d, one s, and three p orbitals to accommodate six ligand pairs.

2. In the Born-Haber cycle, the energy released when gaseous ions combine to form one mole of an ionic solid is known as _____.

Answer: B) Lattice energy

Lattice energy measures the strength of the electrostatic forces in an ionic crystal; higher lattice energies generally correlate with higher melting points.

3. According to Molecular Orbital Theory, a bond order of zero indicates that the molecule is energetically stable and likely to exist under standard conditions.

Answer: B) False

A bond order of zero means the number of bonding electrons equals the number of antibonding electrons, resulting in no net stability, which explains why molecules like He2 do not form.

4. Analyze the molecule Xenon Tetrafluoride (XeF4). Based on VSEPR theory, what is its electron domain geometry and its molecular shape?

Answer: A) Octahedral / Square Planar

XeF4 has six electron domains (four bonding pairs and two lone pairs), making its domain geometry octahedral. The lone pairs occupy axial positions to minimize repulsion, resulting in a square planar molecular shape.

5. The paradox where certain molecules like Benzene exhibit intermediate bond lengths between single and double bonds is explained by the concept of _____.

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Answer: B) Resonance

Resonance describes the delocalization of electrons within a molecule where a single Lewis structure cannot accurately represent the actual electronic distribution.

6. Which of the following substances would you expect to have the highest boiling point based on its predominant intermolecular forces?

Answer: C) NH3 (Ammonia)

Ammonia (NH3) exhibits hydrogen bonding, a particularly strong type of dipole-dipole interaction occurring when H is bonded to N, O, or F, leading to a significantly higher boiling point than the other listed molecules.

7. Sigma (σ) bonds are formed by the side-to-side overlap of p-orbitals, while pi (π) bonds are formed by head-on orbital overlap.

Answer: B) False

This is reversed: Sigma bonds are formed by head-on overlap along the internuclear axis, whereas Pi bonds result from the side-to-side overlap of p-orbitals.

8. An atom's ability to attract shared electrons in a chemical bond is defined as _____.

Answer: C) Electronegativity

Electronegativity is a chemical property that describes the tendency of an atom to attract a shared pair of electrons towards itself.

9. The 'Sea of Electrons' model in metallic bonding explains why metals are both malleable and ductile.

Answer: A) True

Because the delocalized electrons allow metal nuclei to slide past each other without breaking the 'bond' of the electron sea, metals can be reshaped without shattering.

10. Consider the formal charge on the central atom in the Nitrate ion (NO3-). What is the calculated formal charge for Nitrogen when drawn with one double bond and two single bonds to oxygen?

Answer: B) +1

Nitrogen has 5 valence electrons. In this structure, it has 4 bonds and 0 lone pairs. Formal Charge = Valence - (Bonds + Lone electrons) = 5 - (4 + 0) = +1.