1. Resonance bonding _____.

(A) involves electrons shifting back and forth between two atoms
(B) is represented in a single Lewis dot diagram
(C) involves delocalized electrons
(D) occurs in specific isomers

Hint: Resonance bonding cannot be described by a single Leis dot diagram, because the electrons don't have a defined position. They are delocalized.

Isomers are 2 molecules with the same atoms but arranged in a different way.

Either one can contained delocalized electrons.

2. Which statement is untrue? The formal charge in a Lewis dot diagram _____.

(A) is determined by splitting each bond attached to an atom
(B) depends on how many electrons the atom brought to the Lewis dot diagram
(C) is the most minimal in the most stable atomic configuration
(D) represents the electrical charge on each atom in the molecule

Hint: The formal charge on an atom in a molecule measures the over or under-abundance of electrons around that atom after its chemical bonds are split in half.

3. In a Lewis dot diagram, _____.

(A) the central atom is the most electronegative
(B) unshared electron pairs are omitted
(C) only the valence electrons are depicted
(D) the hybrid subshells are depicted

Hint: In a Lewis dot diagram, the central atom is one most willing to share or give away its electrons.

The dots represent the valence electrons.

Only the valence electrons are displayed.

Each atom should have 8 electrons around it, though this may require moving another electron into the bond to make a double bond.

4. In an SP^3 hybrid orbital _____.

(A) the S and a P orbital are made into 3 new orbitals
(B) the S and three P orbitals are made into four new orbitals
(C) the S and three P orbitals remain where they are but act as one orbital
(D) the S and one P orbital form one new orbital between the remaining two P orbitals

Hint: A single S orbital hybridizing with three P orbitals results moves all four orbitals to a brand new energy level.

5. Valence-shell electron-pair repulsion (VSEPR) explains how unshared electrons cause the intramolecular bonds to _____.

(A) bend away from the unshared electrons
(B) bend toward the unshared electrons
(C) shorten
(D) lengthen

Hint: Unshared, or lone pair, electrons are not shared with another atom and are thus more intensely negative than a pair of electrons being shared with another atom. The extra strength of unshared electrons allows unshared electrons to overpower electrons being shared in an intramolecular bond, and repel the entire intramolecular bond.

6. The angle between SP^3 hybrid bonds is _____.

(A) 104.5^o
(B) 107^o
(C) 109.5^o
(D) 120^o

Hint: Hybrid bonds allow the bonds to be equidistant from each other. Four SP^3 bonds equidistant from each other in 3-dimensional space point toward the four corners of a pyramid, 120 degrees apart from each other.

7. The carbon atoms in graphite bond to each other _____.

(A) in rigid three-dimensional lattices
(B) in long parallel chains with no bonding between chains
(C) in broad flat sheets that slide over one another
(D) as interlocking Bucky balls

Hint: Graphite is greasy because sheets of horizontally-linked carbon atoms are able to slide over one another.

8. Which statement about orbitals is untrue?

(A) the 2p orbital has 4 slots for electrons
(B) the 3s orbital is spherical in shape
(C) there is no p subshell in shell 1
(D) there is no d subshell in shell 2

Hint: Each new shell adds an orbital. Ring 1 has the s orbital, ring 2 the s and p orbitals, ring 3 the s, p, and d orbitals, and ring 4 the s, p, d, and f orbitals.

The s suborbital has a single slot, and each new suborbital adds 2 more slots, so the p suborbital has 3, the d suborbital 5, and the f suborbital 7 slots.

9. Which molecule contains one pair of unshared valence electrons?

(A) water
(B) ammonia
(C) methane
(D) hydrogen bromide

Hint: The oxygen atom in a water molecule has 2 pairs of unshared electrons, which allows it to bend the two hydrogen atoms close together and make water somewhat polar.

The nitrogen atom in ammonia has 5 valence electrons. It shares 3 of them with 3 hydrogen atoms, leaving only 2 electrons as a single pair of unshared electrons.

The carbon in methane shares each of its four valence electrons with a hydrogen atom.

Bromine with 7 valence electrons forms a single ionic bond with hydrogen, leaving 3 pairs of unshared electrons on bromine.

10. How many resonance structures can a phosphate ion (PO_4^{3-}) form?

(A) 1
(B) 2
(C) 3
(D) 4

Hint: Each oxygen atom brings 6 electrons to form a phosphate molecule, so each oxygen atom is the same as every other oxygen atom.

Each oxygen atom therefore looks the same to the phosphorus atom.

The phosphorus atom can double bond to any one of the four oxygen atoms by just moving the electrons around as resonance structures.