**AP Bonding Problems**

1. VSEPR predicts an SbF5 molecule will be which of the following shapes?
   1. tetrahedral
   2. trigonal bipyramidal
   3. square pyramid
   4. trigonal planar
   5. square planar
2. The shortest bond would be present in which of the following substances?
   1. I2
   2. CO
   3. CCl4
   4. O2
   5. SCl2
3. Which of the following does not have one or more π bonds?
   1. H2O
   2. HNO3
   3. O2
   4. N2
   5. NO2–
4. Which of the following is polar?
   1. SF4
   2. XeF4
   3. CF4
   4. SbF5
   5. BF3
5. Resonance structures are needed to describe the bonding in which of the following?
   1. H2O
   2. ClF3
   3. HNO3
   4. CH4
   5. NH3

**For questions 6 and 7, pick the best choice from the following:**

1. ionic bonds
2. hybrid orbitals
3. resonance structures
4. hydrogen bonding
5. van der Waals attractions
6. An explanation of the equivalent bond lengths of the nitrite ion is:
7. Most organic substances have low melting points. This may be because, in most cases, the intermolecular forces are:
8. Which of the following has more than one unshared pair of valence electrons on the central atom?
   1. BrF5
   2. NF3
   3. IF7
   4. ClF3
   5. CF4
9. What is the expected hybridization of the central atom in a molecule of TiCl4? This molecule is tetrahedral.
   1. sp3d2
   2. sp3d
   3. sp
   4. sp2
   5. sp3
10. The species in the following set do not include which of the following geometries?

SiCl4, BrF4–, C2H2, TeF6, NO3–

* 1. square planar
  2. tetrahedral
  3. octahedral
  4. trigonal pyramidal
  5. linear

1. The only substance listed below that contains ionic, σ, and π bonds is:
   1. Na2CO3
   2. HClO2
   3. H2O
   4. CO2
   5. NaCl

**For problems, 12–14 choose a molecule from the following list:**

1. C2
2. F2
3. B2
4. O2
5. Ne2
6. The paramagnetic molecule with a bond order of two.
7. The diamagnetic molecule with no antibonding electrons.
8. The paramagnetic molecule with antibonding electrons.
9. The electron pairs point toward the corners of which geometrical shape for a molecule with sp2 hybrid orbitals?
   1. trigonal planar
   2. octahedron
   3. trigonal bipyramid
   4. trigonal pyramid
   5. tetrahedron
10. Regular tetrahedral molecules or ions include which of the following?
    1. CH4
    2. SF4
    3. NH4+
    4. I, II, and III
    5. I and III only
    6. I only
    7. I and II only
    8. II only
11. Which molecule or ion in the following list has the greatest number of unshared electrons around the central atom?
    1. CF4
    2. ClF3
    3. BF3
    4. NH4+
    5. IF5
12. Which of the following molecules is the least polar?
    1. PH3
    2. CH4
    3. H2O
    4. NO2
    5. HCl
13. What types of hybridization of carbon are in the compound 1,4-butadiene, CH2CHCHCH2?
    1. sp3
    2. sp2
    3. sp
    4. I and II
    5. I, II, and III
    6. I and III
    7. I only
    8. II only
14. Which of the following molecules is the most polar?
    1. C2H2
    2. N2
    3. CH3I
    4. BF3
    5. NH3
15. Which of the following processes involves breaking an ionic bond?
    1. H2(g) + Cl2(g) → 2 HCl(g)
    2. I2(g) → 2 I(g)
    3. Na(s) → Na(g)
    4. 2 C2H6(g) + 7 O2(g) → 4 CO2(g) + 6 H2O(g)
    5. 2 KBr(s) → 2 K(g) + Br2(g)
16. Draw proper Lewis dot structures for the following molecules, including formal charges, partial charges, and resonance as necessary.
    1. Identify the electron geometry and molecular geometry (VSPER) for the molecule.
    2. If resonance is observed, identify the preferred structure if possible.
    3. Identify the hybridization of the central atom(s)
    4. Add a dipole to the structure, if applicable, and identify whether the structure is polar or non-polar.

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| **Formula** | **Lewis Dot** | **EG / MG** | **Resonance?** | **Polar?** |
| CH2F2 |  |  |  |  |
| SO42- |  |  |  |  |
| XeF4 |  |  |  |  |
| CHSOH |  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Formula** | **Lewis Dot** | **EG / MG** | **Resonance?** | **Polar?** |
| SO2 |  |  |  |  |
| NO3- |  |  |  |  |
| POCl2 |  |  |  |  |
| HCN |  |  |  |  |
| CNO- |  |  |  |  |

1. Compare the bond angles of the following molecules by drawing their Lewis structures:

OF2, CF4 , NF3

1. Compare the bond angles of the following molecules by drawing their Lewis structures:

BI3, SO3 , CH2O

1. Use a molecular orbital diagram to predict A) the bond order of F2 gas B) the electrons involved in the bond(s), C) whether Cl2 is paramagnetic or diamagnetic.
2. Draw a diagram that depicts which orbitals are hybridizing and overlapping during the bonding of the molecule HCN.
3. Summarize the effects the bond(s) between C and N have on the HCN molecule above.