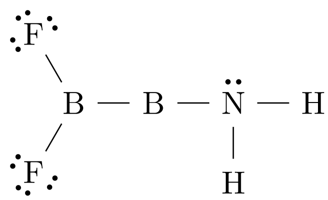
This print-out should have 8 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

LDE Identifying Bonds 001
001 10.0 points

How many polar ionic, polar covalent and non-polar covalent bonds are present in the Lewis structure shown below? Base your answer on simple ΔEN considerations.



1. 0; 3; 3

2. 2; 4; 0

3. 0; 5; 1

4. 2; 3; 1 **correct**

5. 0; 6; 0

Explanation:

Based on the simple rule that $\Delta EN > 1.5$ is ionic, only the two B—F bonds are ionic, for a total of 2. Based on the simple rule that $1.5 > \Delta EN > 0$ is polar covalent, the B—N bond and two N—H bonds are polar covalent, for a total of 3. Lastly, any bond between an atom and another of the same atom is non-polar covalent, so the one B—B bond is non-polar covalent, for a total of 1.

VSEPR Electron Geometry 001
002 10.0 points

In the Lewis structure for dimethylamine (CH_3NHCH_3), what are the bond angles, hybridization and electronic geometry of the nitrogen atom?

1. 109.5°, sp^3, tetrahedral **correct**

2. 109.5°, sp^2, trigonal planar

3. 180°, sp, linear

4. 90°, sp^3, tetrahedral

5. 120°, sp^2, trigonal planar

Explanation:

VSEPR Electron Geometry 002
003 10.0 points

Of the following choices, which has a molecule paired incorrectly with either its bond angle(s), electronic geometry, or hybridization?

1. NH_4^+, 109.5°

2. XeF_2, linear **correct**

3. CO_2, 180°

4. SiH_4, tetrahedral

5. BF_3, sp^2

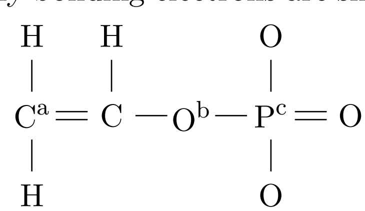
6. SCl_6, sp^3d^2

Explanation:

The xenon atom in XeF_2, has two bonded fluorine atoms and 3 non-bonding pairs of electrons, for a total of 5 regions of high electron density. Its electronic geometry is therefore trigonal bipyramidal, not linear (which would be its molecular geometry).

LDE VSEPR Molecular Geometry 001
004 10.0 points

What are the molecular geometries of the labeled atoms in the Lewis structure below? *Note: only bonding electrons are shown.*



1. trigonal planar; bent; tetrahedral **correct**

2. trigonal planar; linear; trigonal bipyramidal

3. trigonal pyramidal; linear; see-saw

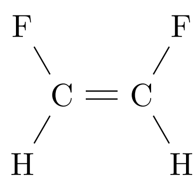
4. bent; trigonal pyramidal; t-shaped

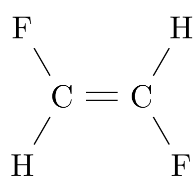
5. bent; tetrahedral; t-shaped

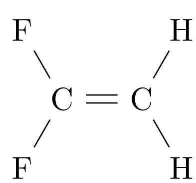
Explanation:
Atom a has three bonded atoms and no non-bonding pairs of electrons and is therefore trigonal planar. Atom b has two bonded atoms and two non-bonding pairs of electrons and is therefore bent. Atom c has four bonded atoms and no non-bonding pairs of electrons and is therefore tetrahedral.

LDE VSEPR Molecular Geometry 002
005 10.0 points

Which of the following molecules is/are polar?

I) 

II) 

III) 

1. II only

2. I, III **correct**

3. I, II

4. II, III

5. I only

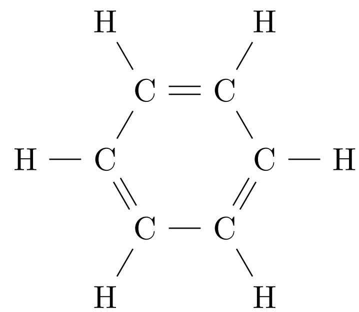
6. III only

7. I, II, III

Explanation:
Molecule II is symmetrical and therefore its individual dipole moments cancel, making it non-polar. Molecules I and III are asymmetrical and therefore polar.

LDE VB Sigma Pi Bonds 001
006 10.0 points

The Lewis structure for benzene (C_6H_6) has how many σ (sigma) and how many π (pi) bonds?



1. 6; 3

2. 12; 3 **correct**

3. 9; 6

4. 12; 0

5. 15; 0

Explanation:

LDE VB Hybridization 001
007 10.0 points

Which of the following statements concerning hybrid orbitals is/are true?

I) Hybrid orbitals are energetically degenerate.

II) Any element can form sp^3d^2 hybrid orbitals.

III) Hybridizing a $2s$ and a $2p$ orbital would produce one sp hybrid orbital.

1. II, III

2. I, II, III

3. III only

4. I only **correct**

5. II only

6. I, III

7. I, II

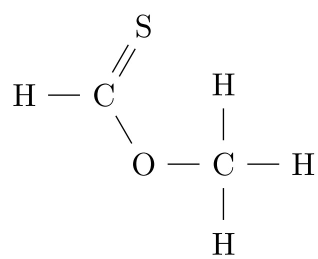
Explanation:

Statement I is true; hybridization was developed as a theoretical framework to explain the energetic degeneracy of bonds in molecules. Statement II is false; hybridization involving d orbitals requires access to empty d orbitals, and thus begins in period 3. Statement III is false; the number of orbitals used to hybridize is always equal to the number of hybridized orbitals, so using a $2s$ and a $2p$ orbital would result in two sp hybrid orbitals.

LDE VB Hybridization 002

008 10.0 points

What orbitals were used to form the π (pi) bond in the thionoester molecule below?



1. $2s, 3p$

2. $2p, 3p$ **correct**

3. $sp^3, 3s$

4. $sp^2, 3s$

5. $sp^3, 3p$

Explanation: