

Molecular Geometry Practice

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- Use VSEPR theory to predict the shapes of the following molecules:
a. BrF_5 b. HCN c. BF_3 d. SO_2 e. SCl_2
- What type of hybridized orbital is used by the central atom of each of the molecules in problem 1?
- Predict the approximate bond angles in the following:
a. GeCl_2 b. IF_4^- c. TeCl_4
- CCl_4 is a perfect tetrahedron, but AsCl_4^- is a distorted tetrahedron. Explain.
- BeCl_2 and TeCl_2 are both covalent molecules, yet BeCl_2 is linear while TeCl_2 is nonlinear (bent). Explain.
- What types of hybridized orbitals can be formed by elements of the third period that cannot be formed by elements in the second period?
- Which molecule should have the larger dipole moment, HBr or HI ?
- Which of the following molecules has a dipole moment?
a. CCl_4 b. H_2S c. CO_2 d. BCl_3 e. Cl_2
- Choose the best answer. For the water molecule:
a. The bonds are polar, and the molecule is nonpolar.
b. The bonds are nonpolar, and the molecule is polar.
c. The bonds are polar, and the molecule is polar.
d. The bonds are nonpolar and the molecule is nonpolar.
- NF_3 has a trigonal pyramidal geometry. How many electron pairs are in the valence shell of the central atom?

True or False:

- In ammonia (NH_3) the N atom has four pairs of valence-shell electrons which orient themselves at the corners of a tetrahedron, but the geometric shape of NH_3 is trigonal pyramidal.
- VSEPR theory predicts that XeF_2 is linear.
- All C atoms in compounds are sp^3 hybridized.
- The reason that C atoms can form four bonds rather than only two is explained by the mixing of orbitals to form hybridized orbitals.
- The triple bond in N_2 results from one N-N σ bond and one N-N π bond.

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Answers

1. a. Square pyramidal b. Linear c. Trigonal Planar d. Bent e. Bent

2. a. sp^3d^2 b. sp c. sp^2 d. sp^2 e. sp^3

3. a. 120° b. 90° c. 90° and 120°
(It's ok if you put slightly less than these angles (<))

4. CCl_4 has four electron pairs about the central C atom, while $AsCl_4^-$ has 5 pairs about the As atom with only 4 Cl atoms attached. The extra pair of unshared electrons in $AsCl_4^-$ prevents it from forming a tetrahedron.

5. There are two electron pairs in the valence shell of Be in $BeCl_2$, but there are four pairs in the valence shell of Te in $TeCl_2$. These four pairs are at the corners of a tetrahedron. When two Cl atoms bond to a Te atom via two of the pairs, the Cl-Te-Cl bond angle is 109.5° .

6. sp^3d and sp^3d^2

7. HBr because of the bond polarity. Br is more electronegative than I is.

8. b only

9. c

10. Four electron pairs.

11. True

12. True

13. False. Carbon can have sp , sp^2 or sp^3 hybridization.

14. True.

15. False. One σ bond and two π bonds.