Molecular Geometry Worksheet Questions and Answers PDF

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Part 1: Building a Foundation

What does VSEPR stand for?

Hint: Think about the principles of electron pair interactions.

- ◯ **Valence Shell Electron Pair Repulsion ✓**
- ◯ Valence Shell Electron Pair Rotation
- ◯ Valence Shell Electron Pair Reaction
- ◯ Valence Shell Electron Pair ResonANCE

> VSEPR stands for Valence Shell Electron Pair Repulsion.

Which of the following are considered electron domains?

Hint: Consider all types of electron pairs and bonds.

- ☐ **Lone pairs ✓**
- ☐ **Single bonds ✓**
- ☐ **Double bonds ✓**
- ☐ **Triple bonds ✓**

> Electron domains include lone pairs, single bonds, double bonds, and triple bonds.

Explain why lone pairs occupy more space than bonding pairs in a molecule.

Hint: Consider the repulsion between electron pairs.

Lone pairs occupy more space because they are localized on one atom and exert greater repulsive forces compared to bonding pairs, which are shared between two atoms.

List the bond angles associated with the following molecular geometries:

Hint: Think about the ideal angles for each geometry.

1. Linear

180°

2. Trigonal Planar

120°

3. Tetrahderal

109.5°

The bond angles are 180° for linear, 120° for trigonal planar, and 109.5° for tetrahedral.

Part 2: Comprehension and Application

Which molecular geometry is associated with a molecule that has three bonding pairs and one lone pair?

Hint: Consider the arrangement of electron pairs around the central atom.

- ◯ Linear
- ◯ Trigonal Planar
- ◯ **Trigonal Pyramidal ✓**
- ◯ Bent

> The molecular geometry is trigonal pyramidal.

Identify the molecular geometries that can result from sp3 hybridization.

Hint: Think about the types of geometries associated with four electron domains.

- ☐ Linear
- ☐ **Tetrahderal ✓**
- ☐ **Trigonal Pyramidal ✓**
- ☐ **Bent ✓**

> The molecular geometries that can result from sp3 hybridization include tetrahedral, trigonal pyramidal, and bent.

Describe how the presence of lone pairs affects the bond angles in a trigonal pyramidal molecule compared to a tetrahedral molecule.

Hint: Consider the repulsion between lone pairs and bonding pairs.

> **In a trigonal pyramidal molecule, the bond angles are slightly less than 109.5° due to the greater repulsion from the lone pair compared to the tetrahedral geometry where all angles are 109.5°.**

Given a molecule with the formula AX3E2, what is the expected molecular geometry?

Hint: Consider the arrangement of bonding and lone pairs.

- ◯ Linear
- ◯ Trigonal Bipyramidal
- ◯ **T-shaped ✓**
- ◯ Octahedral

> The expected molecular geometry is T-shaped.

Predict the molecular geometry and bond angles for a molecule with the formula AX2E2.

Hint: Consider the effects of lone pairs on the geometry.

- ☐ Linear, 180°
- ☐ Bent, <120°
- ☐ **Bent, <109.5° ✓**
- ☐ Trigonal Planar, 120°

> The molecular geometry is bent with bond angles less than 109.5°.

Apply the VSEPR theory to predict the shape of the water molecule and explain your reasoning.

Hint: Consider the number of bonding and lone pairs around the central atom.

> **The water molecule is bent due to two bonding pairs and two lone pairs on the oxygen atom, which repel each other.**

Part 3: Analysis, Evaluation, and Creation

Which of the following molecules has a trigonal planar geometry?

Hint: Think about the arrangement of electron pairs around the central atom.

- ◯ CO2
- ◯ **BF3 ✓**

- ◯ NH3
- ◯ H2O

> The molecule with trigonal planar geometry is BF3.

Analyze the following molecules and identify which have a bent geometry.

Hint: Consider the presence of lone pairs in the molecular structure.

- ☐ **H2O ✓**
- ☐ CO2
- ☐ **SO2 ✓**
- ☐ CH4

> The molecules with bent geometry are H2O and SO2.

Analyze the differences in molecular geometry between NH3 and CH4, focusing on the role of lone pairs.

Hint: Consider how lone pairs affect the shape and angles.

> **NH3 has a trigonal pyramidal shape due to one lone pair, while CH4 has a tetrahedral shape with no lone pairs, resulting in different bond angles.**

Which molecule would likely have the smallest bond angle due to lone pair repulsion?

Hint: Consider the effect of lone pairs on bond angles.

- ◯ CH4
- ◯ NH3
- ◯ **H2O ✓**
- ◯ BF3

> The molecule with the smallest bond angle is H2O due to the presence of two lone pairs.

Evaluate the following statements and select those that correctly describe the impact of lone pairs on molecular geometry.

Hint: Consider how lone pairs influence bond angles and molecular shape.

- [ ] Lone pairs increase bond angles.
- [ ] **Lone pairs decrease bond angles. ✓**
- [ ] Lone pairs have no effect on molecular geometry.
- [ ] **Lone pairs can cause deviations from ideal bond angles. ✓**

> Lone pairs decrease bond angles and can cause deviations from ideal bond angles.

Design a hypothetical molecule with a trigonal bipyramidal geometry. Describe the types of atoms involved, the number of bonding pairs, and any lone pairs present.

Hint: Consider the arrangement of atoms in a trigonal bipyramidal structure.

> **A hypothetical molecule could be XYZ5, with five bonding pairs and no lone pairs, resulting in a trigonal bipyramidal geometry.**