What is VSEPR Theory?

Worksheet

VSEPR theory states that electron pairs (bonding and lone) around a central atom repel each other, arranging to maximize separation and minimize repulsion, giving rise to the molecule's 3D shape.

Questions

1. How many electron pairs surround the carbon in CH@sub{4}?

A) 2
B) 3
C) 4
D) 5

2. What is the molecular geometry of NH@sub{3}?

A) Tetrahedral
B) Trigonal planar
C) Trigonal pyramidal
D) Linear

3. Why is the H-O-H bond angle in water ~104.5@deg, not 109.5@deg?

A) Oxygen is too small
B) Lone pairs repel more strongly than bonding pairs
C) Hydrogen is repelled by itself
D) Water is always bent

4. Which molecule has a linear geometry?

A) CO@sub{2}
B) NH@sub{3}
C) H@sub{2}O
D) CH@sub{4}

5. Predict the shape of CH@sub{4} (methane). Carbon has 4 valence electrons and forms 4 C-H bonds.

6. Predict the shape of NH@sub{3} (ammonia). Nitrogen has 5 valence electrons and forms 3 N-H bonds.

7. Predict the shape of H@sub{2}O (water). Oxygen has 6 valence electrons and forms 2 O-H bonds.

8. Define: What does VSEPR stand for?

9. Define: Why do electron pairs repel?

10. Define: What counts as an 'electron pair' in VSEPR?

Answer Key

1. C) 4 - Carbon forms 4 C-H bonds, giving 4 bonding pairs and 0 lone pairs = 4 total.

2. C) Trigonal pyramidal - 4 electron pairs (3 bonding + 1 lone), but molecular geometry ignores lone pairs @rightarrow pyramidal.

3. B) Lone pairs repel more strongly than bonding pairs - The 2 lone pairs on O repel the 2 bonding pairs more strongly, squeezing the angle below 109.5@deg.

4. A) CO@sub{2} - CO@sub{2} has 2 bonding pairs on C and 0 lone pairs @rightarrow 2 electron pairs @rightarrow linear (180@deg).

5. Central atom: C Electron pairs: 4 bonding pairs, 0 lone pairs Total electron pairs: 4 Geometry: Tetrahedral (109.5@deg bond angles) Shape: All 4 hydrogens point to the vertices of a tetrahedron

6. Central atom: N Electron pairs: 3 bonding pairs, 1 lone pair Total electron pairs: 4 Electron geometry: Tetrahedral; Molecular geometry: Trigonal pyramidal The lone pair occupies space, pushing the 3 hydrogens into a pyramid shape

7. Central atom: O Electron pairs: 2 bonding pairs, 2 lone pairs Total electron pairs: 4 Electron geometry: Tetrahedral; Molecular geometry: Bent The 2 lone pairs repel the 2 bonds, giving a 104.5@deg bond angle

8. Valence Shell Electron Pair Repulsion - a theory that predicts molecular shape from electron repulsion.

9. Negative charges (electrons) naturally repel each other, seeking maximum separation.

10. Both bonding pairs (in covalent bonds) and lone pairs (unshared electrons).