What is the Valence Shell Electron Pair Repulsion Law?

Worksheet

The VSEPR law: valence electron pairs repel each other; the geometry that maximises their separation is the actual molecular shape.

Questions

1. In VSEPR, what is the primary force that determines molecular shape?

A) Attraction between atoms
B) Repulsion of electron pairs
C) Nuclear charge
D) Magnetic interactions

2. A central atom with 5 electron pairs adopts which electron geometry?

A) Tetrahedral
B) Trigonal bipyramidal
C) Octahedral
D) Pentagonal

3. If a molecule has 3 bonding pairs and 2 lone pairs, its molecular geometry is

A) Tetrahedral
B) Trigonal bipyramidal
C) T-shaped
D) Linear

4. Why do lone pairs occupy equatorial positions in a trigonal bipyramidal geometry?

A) They are smaller
B) They repel more strongly and need more space
C) They bond first
D) Randomness

5. Apply VSEPR to CCl@sub{4} (carbon tetrachloride). Carbon is central with 4 chlorine atoms bonded.

6. Apply VSEPR to XeF@sub{2} (xenon difluoride). Xenon is central with 2 fluorine atoms bonded.

7. Apply VSEPR to PCl@sub{3} (phosphorus trichloride).

8. Define: State the VSEPR law.

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

10. Define: Is electron geometry the same as molecular geometry?

Answer Key

1. B) Repulsion of electron pairs - VSEPR is based on electron-pair repulsion maximising separation.

2. B) Trigonal bipyramidal - 5 pairs maximise separation in a trigonal bipyramidal arrangement.

3. C) T-shaped - 5 electron pairs are trigonal bipyramidal; 3 bonding + 2 lone give T-shaped.

4. B) They repel more strongly and need more space - Lone pairs repel more, so they occupy positions furthest from other pairs (equatorial > axial).

5. Valence electrons on C: 4 All form C-Cl bonds Electron pairs: 4 bonding, 0 lone Geometry: Tetrahedral Bond angle: 109.5@deg Result: The 4 Cl atoms arrange symmetrically to minimize repulsion

6. Valence electrons on Xe: 8 2 form Xe-F bonds; 6 remain as 3 lone pairs Electron pairs: 2 bonding, 3 lone Electron geometry: Trigonal bipyramidal Molecular geometry: Linear The 3 lone pairs occupy the equatorial positions; 2 F atoms are axial

7. Valence electrons on P: 5 3 form P-Cl bonds; 2 remain as 1 lone pair Electron pairs: 3 bonding, 1 lone Electron geometry: Tetrahedral Molecular geometry: Trigonal pyramidal The lone pair repels the 3 Cl atoms into a pyramid (107@deg Cl-P-Cl angle)

8. Valence electron pairs repel each other; molecular shape is the arrangement that maximises their separation.

9. Bonding pairs (@sigma and @pi) and lone pairs (non-bonding valence electrons).

10. No; electron geometry includes lone pairs, but molecular geometry counts atoms only.