VSEPR Molecular Geometry — Answer Key

Instructor reference • Worked solutions in red

Explanations use introductory chemistry conventions. Equivalent valid structures or correctly rounded numeric answers may also receive credit.

1. For CO_2, identify electron-group geometry, molecular geometry, central lone-pair count, and approximate bond angle(s).

Central C: 2 regions; 0 lone pair(s); electron geometry linear; molecular geometry linear; angle(s) 180°. Two bonding regions and no central lone pairs.

2. For BF_3, identify electron-group geometry, molecular geometry, central lone-pair count, and approximate bond angle(s).

Central B: 3 regions; 0 lone pair(s); electron geometry trigonal planar; molecular geometry trigonal planar; angle(s) 120°. Three electron regions lie in a plane.

3. For CH_4, identify electron-group geometry, molecular geometry, central lone-pair count, and approximate bond angle(s).

Central C: 4 regions; 0 lone pair(s); electron geometry tetrahedral; molecular geometry tetrahedral; angle(s) 109.5°. Four single bonds around carbon.

4. For NH_3, identify electron-group geometry, molecular geometry, central lone-pair count, and approximate bond angle(s).

Central N: 4 regions; 1 lone pair(s); electron geometry tetrahedral; molecular geometry trigonal pyramidal; angle(s) about 107°. One lone pair compresses the H–N–H angle.

5. For H_2O, identify electron-group geometry, molecular geometry, central lone-pair count, and approximate bond angle(s).

Central O: 4 regions; 2 lone pair(s); electron geometry tetrahedral; molecular geometry bent; angle(s) about 104.5°. Two lone pairs compress the H–O–H angle.

6. For PCl_5, identify electron-group geometry, molecular geometry, central lone-pair count, and approximate bond angle(s).

Central P: 5 regions; 0 lone pair(s); electron geometry trigonal bipyramidal; molecular geometry trigonal bipyramidal; angle(s) 90°, 120°, 180°. Five regions; axial and equatorial positions.

7. For SF_6, identify electron-group geometry, molecular geometry, central lone-pair count, and approximate bond angle(s).

Central S: 6 regions; 0 lone pair(s); electron geometry octahedral; molecular geometry octahedral; angle(s) 90°, 180°. Six bonding groups around sulfur.

8. For SF_4, identify electron-group geometry, molecular geometry, central lone-pair count, and approximate bond angle(s).

Central S: 5 regions; 1 lone pair(s); electron geometry trigonal bipyramidal; molecular geometry seesaw; angle(s) near 90° and 120°. The lone pair occupies an equatorial site.

9. For ClF_3, identify electron-group geometry, molecular geometry, central lone-pair count, and approximate bond angle(s).

Central Cl: 5 regions; 2 lone pair(s); electron geometry trigonal bipyramidal; molecular geometry T-shaped; angle(s) near 90°, 180°. Two equatorial lone pairs.

10. For XeF2, identify electron-group geometry, molecular geometry, central lone-pair count, and approximate bond angle(s).

Central Xe: 5 regions; 3 lone pair(s); electron geometry trigonal bipyramidal; molecular geometry linear; angle(s) 180°. Three equatorial lone pairs leave opposite axial bonds.

11. For BrF5, identify electron-group geometry, molecular geometry, central lone-pair count, and approximate bond angle(s).

Central Br: 6 regions; 1 lone pair(s); electron geometry octahedral; molecular geometry square pyramidal; angle(s) near 90°. One lone pair in an octahedral electron arrangement.

12. For XeF4, identify electron-group geometry, molecular geometry, central lone-pair count, and approximate bond angle(s).

Central Xe: 6 regions; 2 lone pair(s); electron geometry octahedral; molecular geometry square planar; angle(s) 90°, 180°. Two opposite lone pairs.