8.3 BONDING THEORIES

Section Review

Objectives

- Identify the difference between atomic and molecular orbits
- Describe how VSEPR theory helps predict the shapes of molecules
- Identify the ways in which orbital hybridization is useful in describing molecules

Vocabulary

- molecular orbitals
- bonding orbital
- sigma bond
- pi bond
- tetrahedral angle
- VSEPR theory
- hybridization

Part A Completion

Use this completion exercise to check your understanding of the concepts and terms that are introduced in this section. Each blank can be completed with a term, short phrase, or number.

The quantum mechanical model of bonding assumes that atomic orbitals overlap to produce ___1___. A molecular orbit that can be occupied by two electrons of a covalent bond is called a ___2___, whose energy is ___3___ than that of the atomic orbitals from which it formed. When two atomic orbitals combine to form a molecular orbital that is symmetrical around the axis connecting two atomic nuclei, a ___4___ bond is formed. When atomic orbitals overlap side by side, they produce ___5___ bonds.

Electron dot structures fail to reflect the ___6___ shapes of molecules. ___7___ states that because electron pairs repel, molecular shape adjusts so the valence-electron pairs are as far apart as possible. Another way to describe molecules that provides information about both molecular bonding and molecular shape is ___8___.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

Part B True-False

Classify each of these statements as always true, AT; sometimes true, ST; or never true, NT.

_____ **9.** Unshared pairs of electrons affect the shape of molecules.

_____ **10.** Molecular orbitals involve pi bonding.

_____ **11.** A bonding orbital is a molecular orbital whose energy is higher than that of the atomic orbitals from which it is formed.

_____ **12.** With hybridization, several atomic orbitals overlap to form the same total number of equivalent hybrid orbitals.

_____ **13.** Sigma and pi bonds are found in the same molecule.

_____ **14.** The methane molecule has four orbitals with tetrahedral angles of 109.5°.

Part C Matching

Match each description in Column B to the correct term in Column A.

Column A   Column B

_____ **15.** sigma bond   **a.** states that because electron pairs repel, molecules adjust their shapes so that valence-electron pairs are as far apart as possible

_____ **16.** pi bond   **b.** a process in which several atomic orbitals overlap to form the same number of equivalent hybrid orbitals

_____ **17.** VSEPR theory   **c.** a term used to describe the shape of certain molecules such as CO_2

_____ **18.** hybridization   **d.** a bond formed when two atomic orbitals combine to form a molecular orbital that is symmetrical along the axis connecting the two atomic nuclei

_____ **19.** linear molecule   **e.** a bond in which the bonding electrons are most likely to be found in the sausage-shaped regions above and below the nuclei of the bonded atoms

Part D Questions and Problems

Answer the following in the space provided.

20. Indicate the hybrid orbitals used by each carbon atom in the following compound.

$$H_3C - C = C - C \equiv C - CH_3$$
$$\qquad\quad | \quad\ |$$
$$\qquad\quad H \quad H$$