Directed Valence Theory

This theory explains how **valence electrons** in an atom are arranged and **oriented in specific directions** to form chemical bonds. It is closely related to the **valence bond theory (VBT)** and focuses on the geometry and directional nature of bonding.

Key Concepts:

1. **Valence Electrons in Bonding:**
   - **Valence electrons** are the outermost electrons in an atom, which participate in bonding.
   - In covalent bonding, these electrons are shared between atoms.

2. **Directional Nature of Bonds:**
   - Bonds are not random; they form in

2. **Directional Nature of Bonds:**
   - Bonds are not random; they form in specific **directions** to minimize repulsion and maximize overlap between atomic orbitals.
   - For example:
     - **Linear geometry** in molecules like $BeCl_2$.
     - **Tetrahedral geometry** in CH_4 due to sp^3 hybridization.
3. **Hybridization of Atomic Orbitals:**
   - Atomic orbitals (s, p, d) combine to form **hybrid orbitals** that point in

        - **Tetrahedral geometry** in CH_4 due to sp^3 hybridization.

3. **Hybridization of Atomic Orbitals:**
    - Atomic orbitals (s, p, d) combine to form **hybrid orbitals** that point in specific directions.
    - Examples:
        - **sp hybridization**: Linear (180° bond angle).
        - **sp^2 hybridization**: Trigonal pla

(120° bond angle).
        - **sp^3 hybridization**: Tetrahedral (109.5° bond angle).
4. **Bond Strength and Geometry:**
    - Bonds are strongest when orbitals overlap **along the axis** (sigma bonds).
    - **Pi bonds**, formed by side-by-side overlap, are weaker and less directional.
5. **Examples in Main Group Compounds:**
    - **Ammonia (NH_3):** Uses sp^3 hybridization, resulting in a trigonal pyramidal shape.
    - **Water (H_2O):** Bent structure due to sp^3 hybridization and lone pair repulsion.

Importance of Directed Valence Theory:

- Explains molecular shapes and bond angles predicted by **VSEPR (Valence Shell Electron Pair Repulsion) theory**.
- Helps understand how atoms achieve maximum stability through specific bond orientations.