

## Notes on Chemical Bonding

**1. Introduction to Chemical Bonding:** Chemical bonding is the force that holds atoms together in molecules and compounds. It results from the interaction between the electrons of atoms.

### **2. Types of Chemical Bonds:**

- **Ionic Bond:** Formed by the transfer of electrons from a metal to a non-metal. Example: NaCl.
- **Covalent Bond:** Formed by the sharing of electrons between two non-metal atoms. Example: H<sub>2</sub>O.
- **Metallic Bond:** Occurs between metal atoms where electrons are delocalized. Example: Cu, Fe.
- **Hydrogen Bond:** A weak attraction between a hydrogen atom and an electronegative atom like O, N, or F. Example: Water (H<sub>2</sub>O).

**3. Lewis Structures:** Lewis structures represent the valence electrons in a molecule, helping predict bonding and molecular geometry.

**4. VSEPR Theory (Valence Shell Electron Pair Repulsion Theory):** Predicts the 3D shape of molecules based on electron pair repulsions.

- Linear: 180° (CO<sub>2</sub>)
- Trigonal Planar: 120° (BF<sub>3</sub>)
- Tetrahedral: 109.5° (CH<sub>4</sub>)
- Trigonal Bipyramidal: 90° & 120° (PCl<sub>5</sub>)
- Octahedral: 90° (SF<sub>6</sub>)

**5. Hybridization:** Mixing of atomic orbitals to form new hybrid orbitals with specific geometries.

- sp: Linear
- sp<sup>2</sup>: Trigonal Planar
- sp<sup>3</sup>: Tetrahedral
- sp<sup>3</sup>d: Trigonal Bipyramidal
- sp<sup>3</sup>d<sup>2</sup>: Octahedral

### **6. Bond Polarity and Dipole Moment:**

- **Non-Polar Bond:** Equal sharing of electrons (O<sub>2</sub>, N<sub>2</sub>).
- **Polar Bond:** Unequal sharing of electrons (HCl, H<sub>2</sub>O).
- **Dipole Moment:** A measure of bond polarity (higher dipole moment means greater polarity).

**7. Molecular Orbital Theory (MOT):** Explains bonding using molecular orbitals formed by the combination of atomic orbitals.

- Bonding orbital: Lower energy, stabilizing.
- Anti-bonding orbital: Higher energy, destabilizing.
- Bond Order = (Bonding electrons - Anti-bonding electrons) / 2
- Higher bond order means stronger bond.

#### 8. Intermolecular Forces:

- **London Dispersion Forces:** Weak forces due to temporary dipoles.
- **Dipole-Dipole Interactions:** Occur between polar molecules.
- **Hydrogen Bonding:** Stronger than dipole-dipole forces, present in molecules with H-F, H-O, or H-N bonds.

These concepts are fundamental to understanding chemical bonding and molecular structure.