SAWA UNIVERSITY

Bonding and moleculare structure

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First stage

Number of lecture:1

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1.Bonding and molecular structure

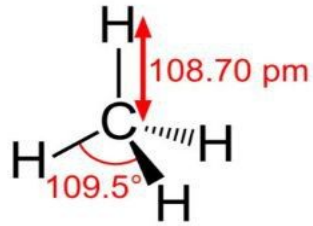
- Chemical bonding refers to the formation of a chemical bond between two or more atoms, molecules, or ions to form a chemical compound. These chemical bonds are what hold the atoms together in the resulting compound.
- The attractive force that holds various constituents (atoms, ions, etc.) together and stabilizes them through the overall loss of energy is known as chemical bonding. Therefore, it can be understood that chemical compounds depend on the strength of the chemical bonds between their constituents; the stronger the bonding between the constituents, the more stable the resulting compound will be.

Types of Chemical Bonding

- **Ionic bonding**: transfer of electrons between atoms for example(nacl,mgo)
- **Covalent bonding(tow types polar and non polar):** It is the bond that arises when two atoms share electrons pairs instead of transferring them. For example, in a water molecule(H_2O), the oxygen atom shares electrons with two hydrogen atoms.(HCl , H2, CH4)
- **Metallic bonding**: occurs when a group of metal atoms shares a cloud of valence electrons.
- **Hydrogen bonding**: is only present in elemental metals. It binds the metal atoms together into tightly-packed configurations.(HF, DNA, C_2H_5OH)
- **Coordinate Bonding:** A type of covalent bond where both electrons in the bond originate from the same atom (e.g., NH_4).

Molecular structure

- The 3D arrangement of atoms in a molecule determines its geometry.
- VSEPR Theory (Valence Shell Electron Pair Repulsion): Predicts the geometry based on the repulsion between electron pairs:
- Linear: 180° bond angle (CO_2)
- Trigonal Planar: 120° (BF_3)
- Tetrahedral: 109.5° (CH4)
- Trigonal, Bipyramidal, and Octahedral for larger molecules.



2. Nomenclature of Alkanes

- Alkanes are saturated hydrocarbons (single bonds only) with the general
- formula CnH2n+2C_nH_{2n+2}CnH2n+2.
- Rules for Naming Alkanes (IUPAC System):
- 1. Identify the longest continuous carbon chain (parent chain) and name it
- based on the number of carbons (e.g., methane, ethane, propane).
- 2. Number the chain such that the substituents get the lowest possible
- numbers.
- 3. Name and number substituents (alkyl groups like methyl, ethyl).

- 4. Assemble the name:
- Prefix: Substituents with numbers (alphabetical order).
- Parent name: Based on the main chain.
- Suffix: “-ane” for alkanes.
- Examples:
- CH_4 → Methane
- CH_3CH_3 → Ethane
- $CH_3CH(CH_3)CH_3$ → 2-Methylpropane

PREPRATION

- 1. Wurtz Reaction:
- Reaction of alkyl halides with sodium in dry ether.
- Example: 2CH3Cl+2Na→C2H6+2NaCl2CH_3Cl + 2Na → C_2H_6 + 2NaCl2CH3Cl+2Na→C2H6+2NaCl
- 2. Hydrogenation of Alkenes:
- Addition of H_2 to an alkene in the presence of a catalyst (e.g., Ni, Pt).
- Example: C2H4+H2→C2H6C_2H_4 + H_2 → C_2H_6C2H4+H2→C2H6
- 3. Reduction of Alkyl Halides:
- With zinc and acid.
- Example: C2H5Br+H2→C2H6+HBrC_2H_5Br + H_2 → C_2H_6 + HBrC2H5Br+H2→C2H6+HBr

Reactions

- 1. Combustion:
- Complete: $CH4+2O2 \rightarrow CO2+2H2O$ $CH_4 + 2O_2 \rightarrow CO_2 +$
- $2H_2O$ $CH4+2O2 \rightarrow CO2+2H2O$
- Incomplete: $CH4+O2 \rightarrow C+2H2O$ $CH_4 + O_2 \rightarrow C +$ $2H_2O$ $CH4+O2 \rightarrow C+2H2O$
- 2. Halogenation:
- Substitution reaction with halogens in the presence of UV light.
- Example: $CH4+Cl2 \rightarrow CH3Cl+HCl$ $CH_4 + Cl_2 \rightarrow CH_3Cl +$
- HCl $CH4+Cl2 \rightarrow CH3Cl+HCl$
- 3. Cracking:

- Breakdown of larger alkanes into smaller molecules, often producing alkenes.

4. Hybridization in Alkenes

- Alkenes are hydrocarbons with at least one carbon-carbon double bond (C=C). The general formula is
- CnH2nC_nH_{2n}CnH2n.
- **Hybridization**:

- The carbon atoms in a double bond exhibit sp^2 hybridization:
- One 2s orbital mixes with two 2p orbitals to form three sp^2 hybrid orbitals.
- These orbitals form σ-bonds in the molecule.
- The unhybridized p orbital forms a π-bond.
- **Geometry:**
- Trigonal planar geometry around the sp^2-hybridized carbon atoms.
- Bond angle ~120°.
- Example:
- Ethene (C_2H_4):

- Each carbon is sp^2 hybridized.
- C=C bond consists of one σ-bond and one π-bond.

Thanks for attention