Introduction to Chemistry, Organic Chemistry and Biochemistry

Homayoun Valafar

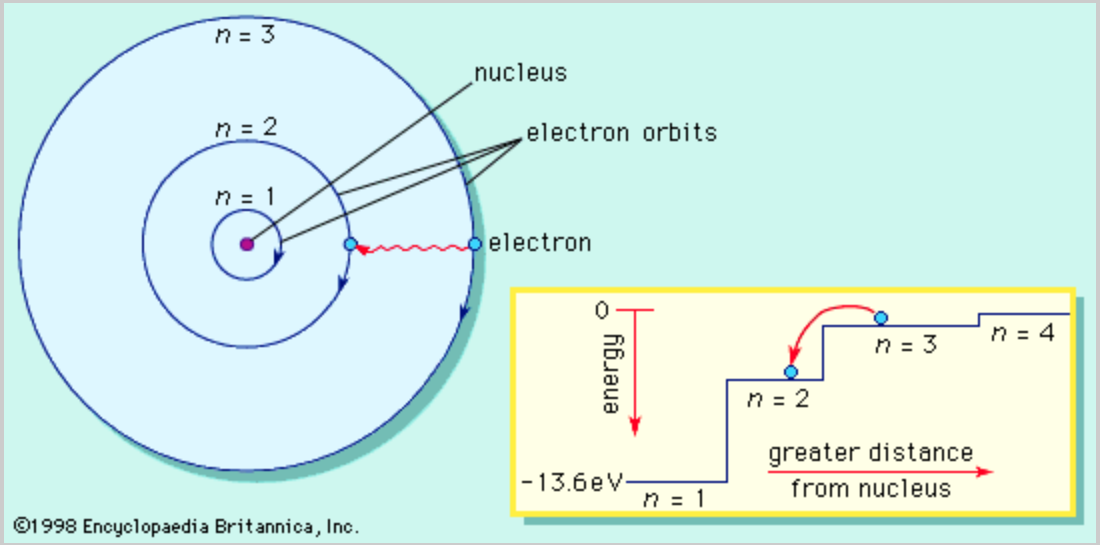
Department of Computer Science and Engineering, USC

Chemical Elements

- Chemistry concerns study of all elements
- Organic chemistry concerns study of biologically relevant elements (primarily small molecules)
- Biochemistry concerns study of biologically relevant molecules (primarily large molecules)
- Link to table of chemical elements.

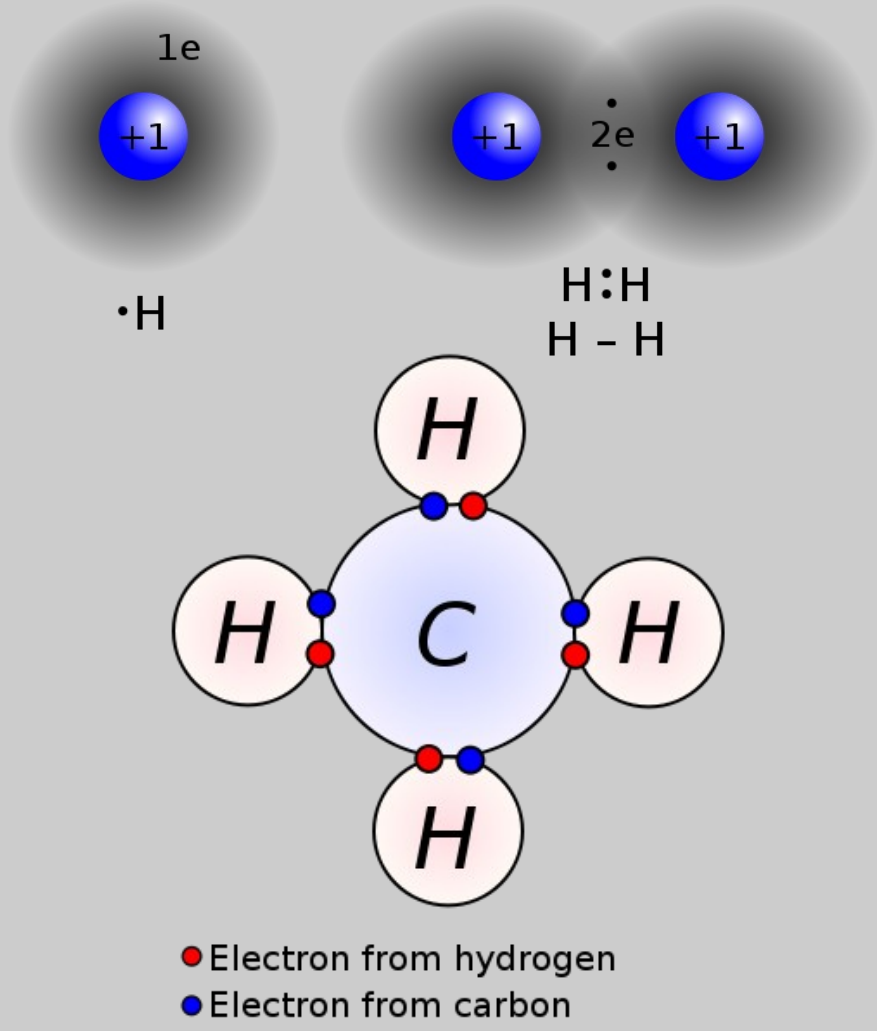
Properties of Atoms

- An atom consists of electrons, protons and neutrons
- Atomic number (Z) – total number of protons
- Number of Neutrons (N)
- Mass number – Z + N
- Atomic weight
- Neils Bohr atomic model:



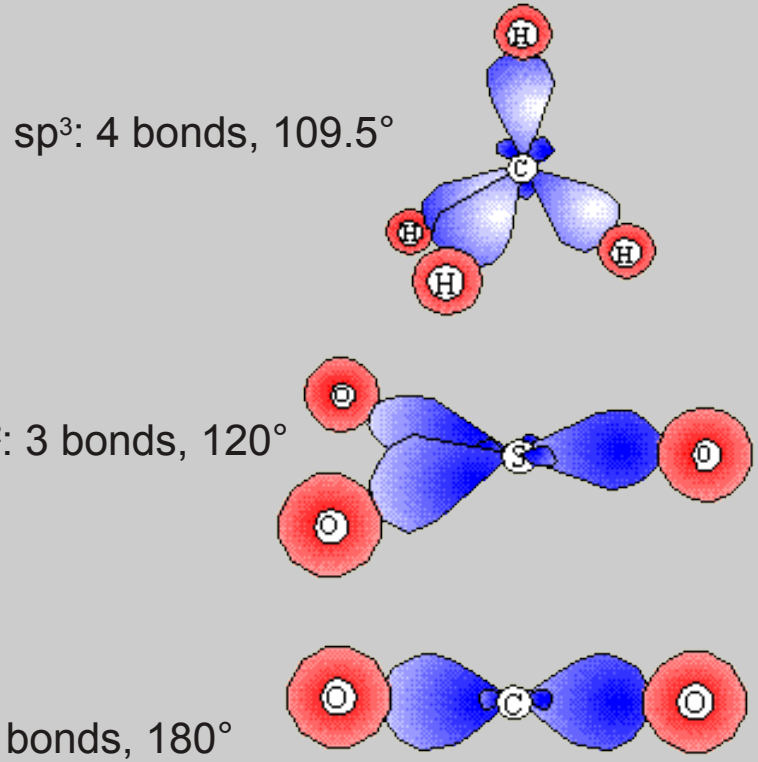
Covalent Bond

- A form of chemical bonding that is characterized by the sharing of pairs of electrons between atoms
- Number of covalent bonds is a property of an atom
- Number of valence electrons determines the number of covalent bonds
- Hydrogen atom: valence of 1
- Carbon atom: valence of 4



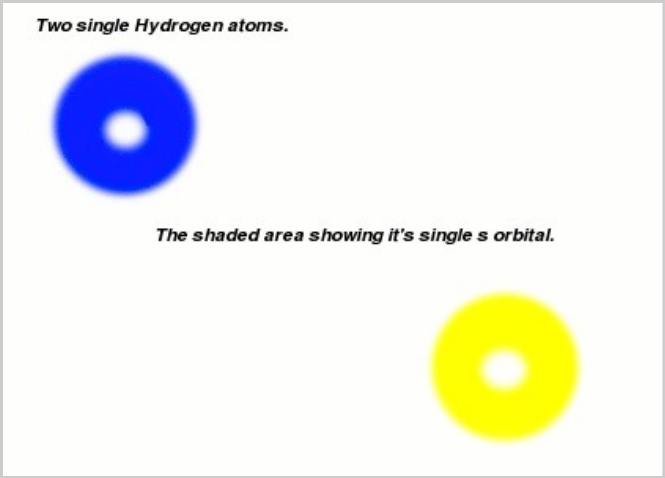
Nature of Chemical Bond

- Chemical bonds have geometric properties.
- Carbon is one of the most important elements present in organic molecules.
  - Carbon forms 4 bonds (no more, no less).
  - Carbon can be sp^3, sp^2 and sp^1 hybridized (click for movie).
  - Carbon bod geometries and properties vary based on hybridization.
  - Properties determined empirically

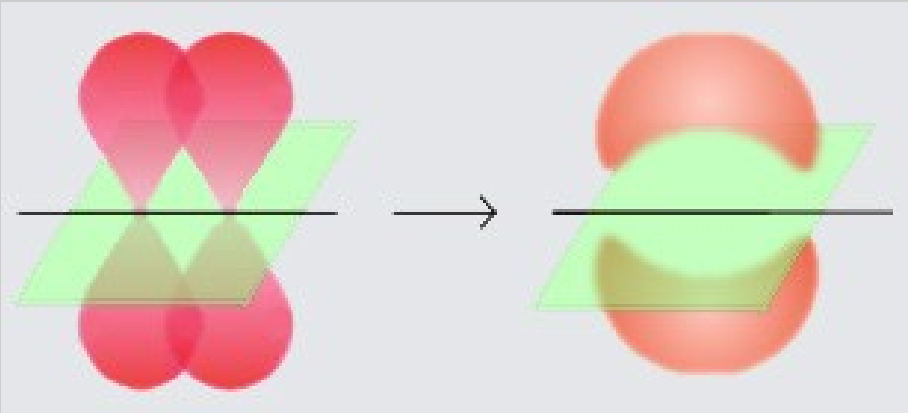


σ and π Bonds

- σ bond: full symmetry around the inter-atomic axis.

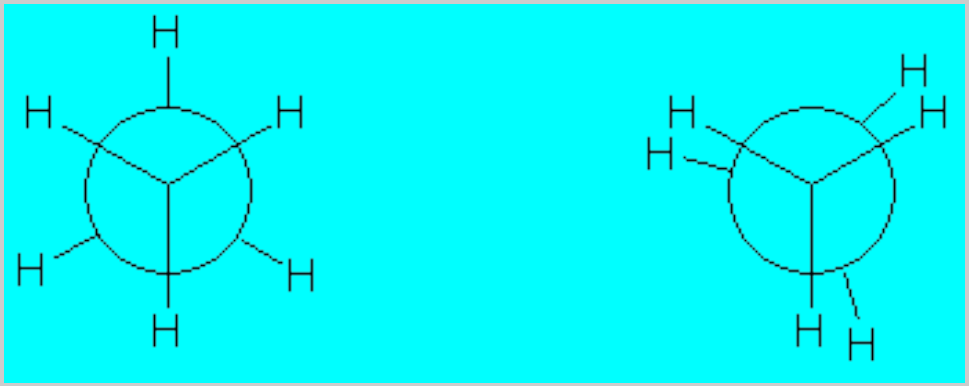


- π bond: when two electron orbitals are in side-ways contact.



Molecular Conformers

- An alternate spatial arrangement of the same molecule (atoms and bonds) is a molecular conformer or rotamer.
- Newman projection is used to portray these conformers.



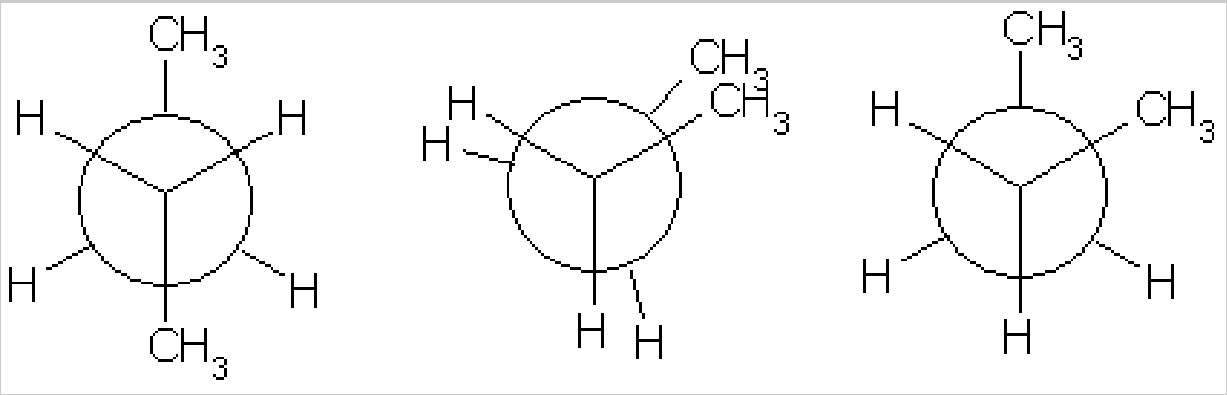
Staggered

Eclipsed

Molecular Conformers of Butane

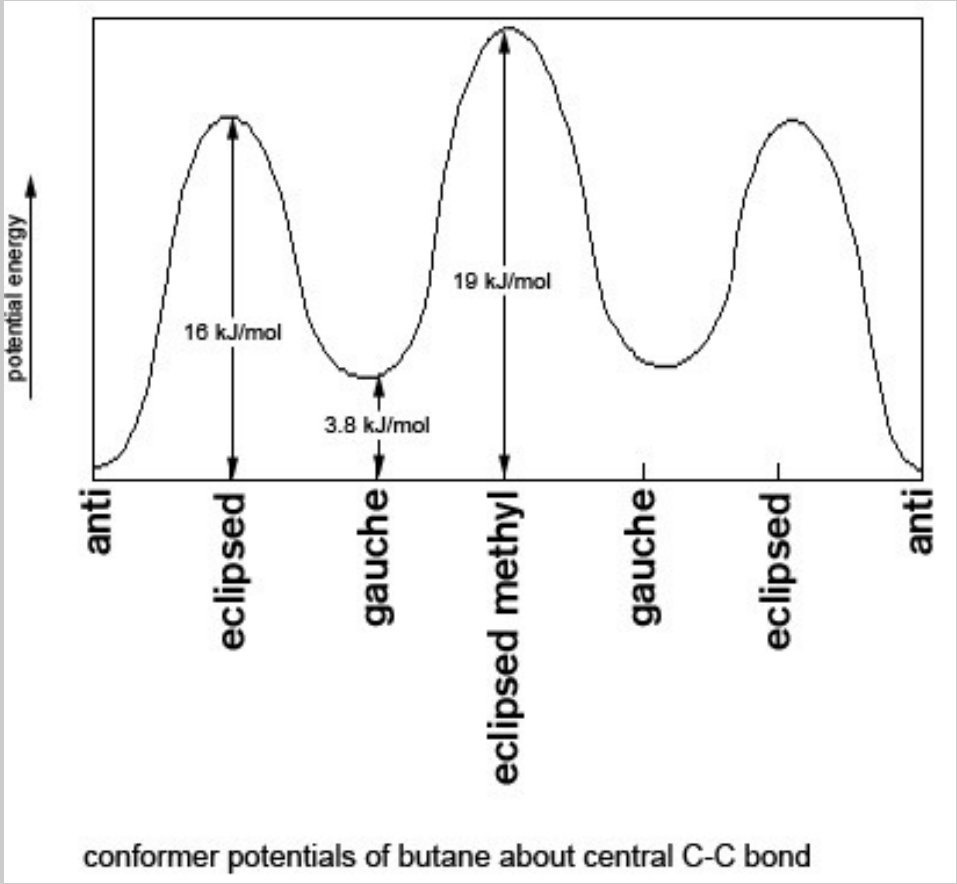
- Conformers of Butane:

CH_3-CH_2-CH_2-CH_3



Anti Eclipsed Gauche

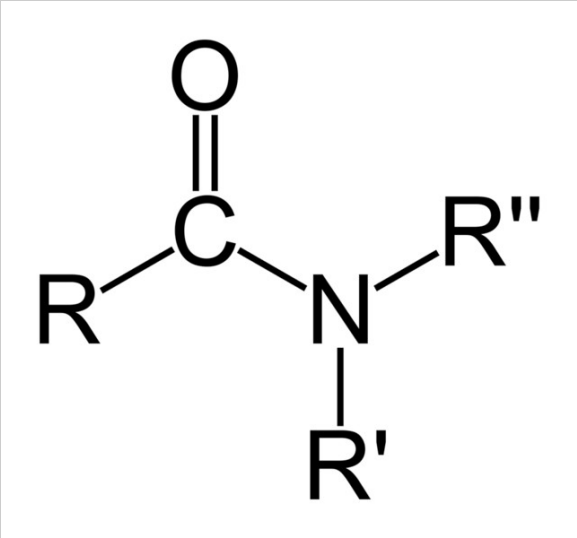
Potential Energy of Butane Conformers

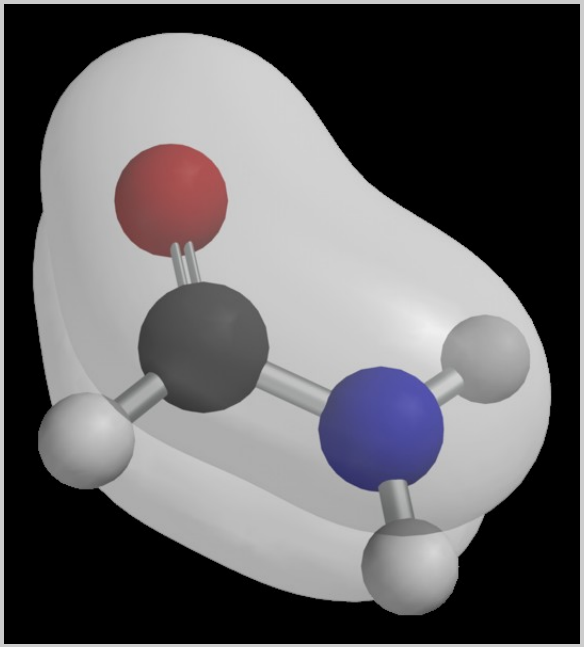


conformer potentials of butane about central C-C bond

Amide Functional Group

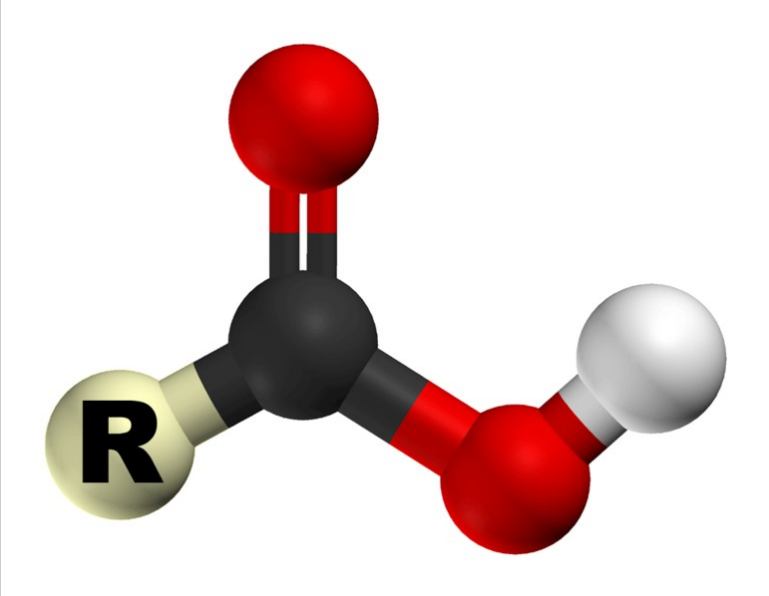
- R-CO-N-R'R"





Carboxylic Acid Functional Group

- R-C-OOH



Resonance Stabilization

- Ozone
- Amides
- Carboxylates