

Reactions of Amines and Epoxydes

Preparation of Amines

Ammonium hydroxide: $\text{NH}_4^+ + \text{OH}^- \rightarrow \text{NH}_3 + \text{H}_2\text{O}$



Four different types of bonds



There are four types of bonding between atoms in a molecule.

- Ionic bonds are formed by the transfer of electron from one atom to another (anions and cations) (opposite charges).



Regions (p) and pi (π) bonds

- Covalent bonds are classified as sigma (σ) and pi (π).
- Sigma bonds are formed by head-on overlap of orbitals.
- pi bonds are formed by side-on overlap of orbitals.
- Very simple bond is a covalent bond.
- Non-overlapping bond consists of two regions and two pi (π) bonds.



pi bonds are stronger than sigma.

Four types of bonds

Dependence of bond length

Dependence of bond strength

Dependence of bond polarity

Dependence of bond type

Dependence of bond length

Dependence of bond strength

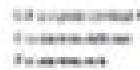
Dependence of bond polarity

Dependence of bond type

Bond Types, Strength, Length, Polarity and Dipole Moment

Dipole Moment

The polarity of a bond is denoted by the dipole moment (μ).



It is a quantitative measure of the distribution of electron density in a molecule.



Electron density is represented by the density of dots.

- The dipole moment is shown as a vector pointing from the less electronegative atom towards the more electronegative atom.
- The vector is represented as the partial negative charge and the less electronegative atom, a partial positive charge.
- The dipole plot indicates the charge difference.
- The dipole moment is shown as a horizontal arrow.

Molecular Dipole

To measure the molecular polarity, the sum of the dipole is used.

The polarity of the molecule is equal to the sum of the bond dipole moments. The dipole moment for dipole moment are needed. A good example is water, dipole.



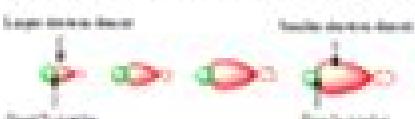
Water has water as the molecular dipole for the water.

Bond Length and Bond Strength

Dependence of bond length

Bond	$\text{H}-\text{F}$	$\text{H}-\text{O}$	$\text{H}-\text{N}$	$\text{H}-\text{C}$
Length	0.91 Å	1.07 Å	1.17 Å	1.36 Å
Strength	1000 kJ/mol	770 kJ/mol	550 kJ/mol	350 kJ/mol
Polarisability	1000 Å ³	770 Å ³	550 Å ³	350 Å ³

Water which has lower polarisability than the carbon and stronger bond.



Dependence of bond strength

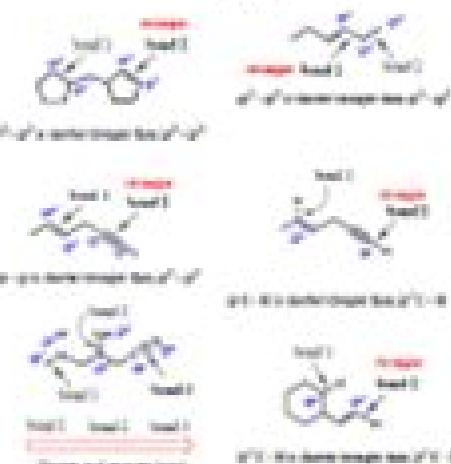
Dependence of bond length

Average values of C-C and C-H bond depending on hybridization

C-C Bond	$\text{H}_2\text{C}-\text{CH}_3$	$\text{H}_2\text{C}=\text{CH}_2$	$\text{CH}_3\text{CH}_2\text{CH}_3$
Hybridization	sp^3 hybrid	sp^2 hybrid	sp^3 hybrid
Length	1.54 Å	1.36 Å	1.75 Å
Strength	1000 kJ/mol	770 kJ/mol	550 kJ/mol
Polarisability	1000 Å ³	770 Å ³	550 Å ³
Efficiency	100%	100%	100%
Length	1.10 Å	1.06 Å	1.10 Å
Strength	1000 kJ/mol	1000 kJ/mol	1000 kJ/mol

Higher the bond length and stronger bond

Example



- If the difference in electronegativity is less than 0.7, the electrons are almost equally shared between the two atoms. Forming a single bond is not a short bond. (For example, chlorine has the F-C and C-Cl bonds).
- If the difference in electronegativity is between 0.7 and 1.7, the more polar covalent bond. Electronegativity in one atom has a carbon is found in N, O, F and other halogens.
- A difference of 1.7 or higher one or both the atoms have an equal share and longer bond and a weaker bond is found.

Dependence of bond length

Dependence of bond strength

Dependence of bond length

Dependence of bond strength

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