Terminology

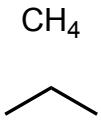
These sheets cover the terminology used to classify organic molecules and the classes of reactions they undergo

Functional Groups: The naming of organic molecules is described through functional groups, a characteristic collection of atoms and bonds that possesses a predictable set of properties and reactivity.

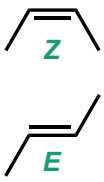
Note: Below, "**R**" is indicating an alkyl or aryl group, unless otherwise noted.

C—C bonds

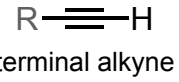
alkane



alkene



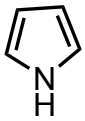
alkyne



terminal alkyne

internal alkyne

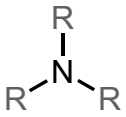
arene



heteroarene

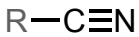
C—N bonds

amine



R can be H

nitrile



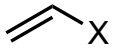
R can be H

C—X bonds

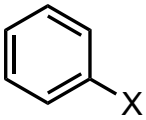
X = F, Cl, Br, I

alkyl halide

vinyl halide

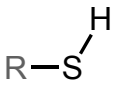


aryl halide

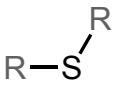


C—S bonds

thiol

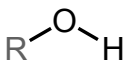


thioether

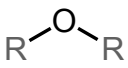


C—O bonds

alcohol



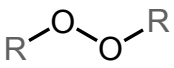
ether



epoxide

R can be H

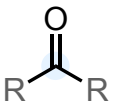
peroxide



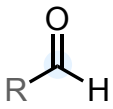
R can be H

C═O bonds

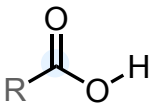
ketone



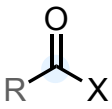
aldehyde



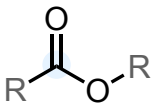
carboxylic acid



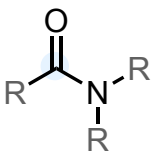
acyl halide



ester



amide

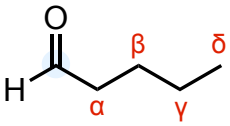


R can be H

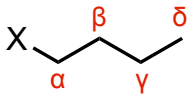
the carbonyl carbon

Naming positions in a molecule (with a functional group)

α *alpha*
β *beta*
γ *gamma*
δ *delta*



Note: carbons are labeled relative to the carbonyl carbon



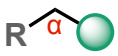
Note: carbons are labeled relative to the halogen (X)

Descriptors for substitution patterns of RX, ROH, & RSH

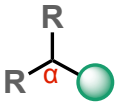
This terminology is typically used to describe the **number of non-hydrogen groups (R) attached to the alpha (α) carbon**

Note: "R" is indicating a non-hydrogen group

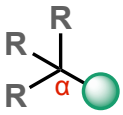
= X, OH, or SH



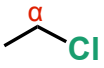
1° primary



2° secondary



3° tertiary

e.g. 

We can describe this as a 1° chloride

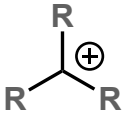
Descriptors for substitution patterns of carbocations

Similar to above, this is analogous terminology to describe the **number of non-hydrogen groups (R) attached to the carbocation carbon**

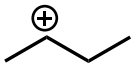
Note: "R" is indicating a non-hydrogen group

1° primary

2° secondary



3° tertiary

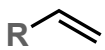
e.g. 

We can describe this as a 2° carbocation

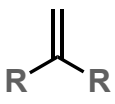
Descriptors for substitution patterns of alkenes

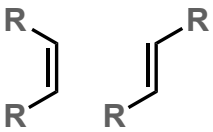
This terminology describes the **number of non-hydrogen groups (R) attached to the two carbons in an alkene**

Note: "R" is indicating a non-hydrogen group

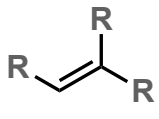


mono-substituted

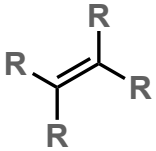




di-substituted



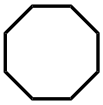
tri-subtituted



tetra-substituted

Alkanes

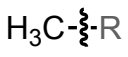
The alkane functional group serves as the "scaffold" upon which organic molecules are constructed. More descriptive terminology to describe alkanes is shown below.

number of C atoms	structure	straight alkane chain name	structure	cycloalkane name
1	CH_4	methane		
2		ethane		
3		propane		cyclopropane
4		butane		cyclobutane
5		pentane		cyclopentane
6		hexane		cyclohexane
7		heptane		cycloheptane
8		octane		cyclooctane

Examples of common alkyl substituent groups and their abbreviations:

one C substituent

methyl (Me)

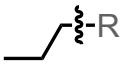


two C substituents

ethyl (Et)

three C substituents

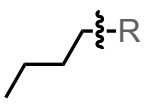
propyl (Pr)



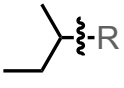
isopropyl (*i*Pr)

four C substituents

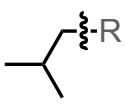
butyl (Bu)



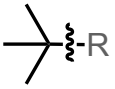
sec-butyl (*sec*-Bu)



isobutyl (*i*Bu)



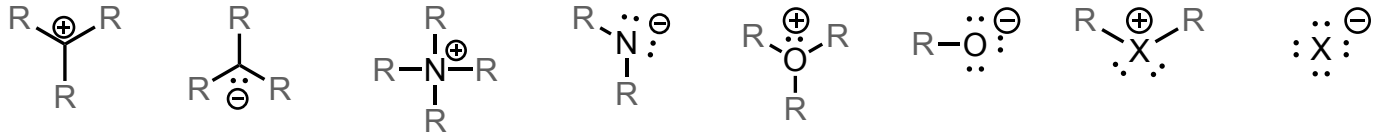
tert-butyl (*t*-Bu)



Charged Species

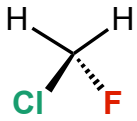
Neutral functional groups can react to form charged species and vice versa. The most common functional groups with non-zero formal charges are listed below.

carbocation **carbanion** **ammonium ion** **amide** **oxonium ion** **alkoxide** **halonium ion** **halide ion**



3-D Representations

The notation of dashes/hashes and wedges are used to better visualize the three dimensional structure of molecules.



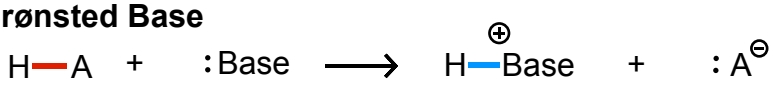
A ***wedge*** represents an atom coming towards the viewer and out of the plane of the paper/screen.

A ***hash*** represents an atom going away from the viewer and into the plane of the paper/screen.

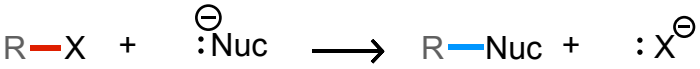
Reaction Classes

The most common reaction classes encountered in the first semester of organic chemistry are listed below. Bonds broken are shown in **red**, while bonds formed are shown in **blue**.

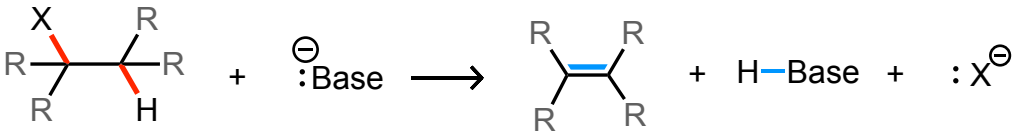
Brønsted Acid - Brønsted Base



Substitution



Beta Elimination



Addition to a Pi Bond