

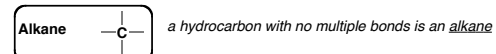
## Summary Sheet - Functional Groups (1)

"Master Organic Chemistry"  
[masterorganicchemistry.com](http://masterorganicchemistry.com)  
 August 2012 Version 1.1

Note - this sheet is not meant to be comprehensive. Your course may provide additional material, or may not cover some of the reactions shown here. Your course instructor is the final authority.

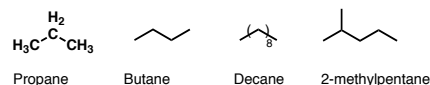
### What Are Functional Groups?

Functional groups are collections of atoms that have a common pattern of chemical reactivity



Suffix: "-ane". As a substituent: "alkyl"

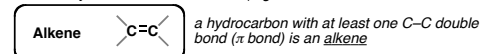
Examples:



Characteristics: nonpolar

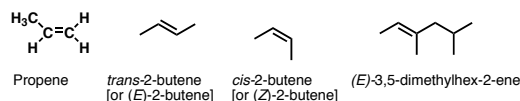
Geometry: tetrahedral ( $sp^3$  hybridized)

Reactivity: **free radical reactions** (e.g. free radical chlorination or bromination)



Suffix: "-ene". As a substituent: "alkenyl"

Examples:

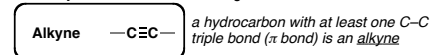


Characteristics: nonpolar. Molecule cannot rotate along double bond.

Geometry: trigonal planar ( $sp^2$  hybridized)

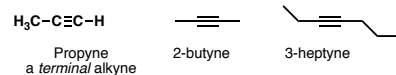
Reactivity: **undergo addition reactions**, as well as **oxidative cleavage**

Stability increases with increasing # of carbons attached



Suffix: "-yne". As a substituent: "alkynyl"

Examples:



Alkynes with a C-H bond are called "terminal" alkynes

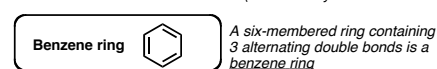
Geometry: linear ( $sp$  hybridized)

Characteristics: non polar

Reactivity: **addition reactions**

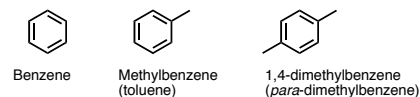
**oxidative cleavage reactions**

**acid-base reactions** (terminal alkynes are unusually acidic)



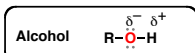
Suffix: "benzene". As a substituent: "phenyl"

Examples:



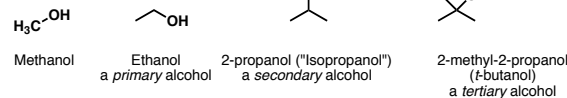
Reactivity: **substitution reactions** (e.g. electrophilic aromatic substitution or nucleophilic aromatic substitution)

Less reactive than normal alkenes due to aromatic stability



Suffix: "-ol". As a substituent: "hydroxy"

Examples:

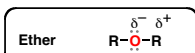


Characteristics: polar (O-H group participates in hydrogen bonding)

Reactivity: **acid-base reactions** (can act as acids or bases)

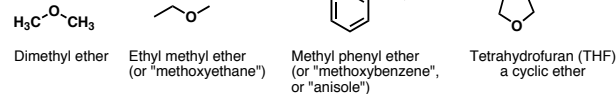
**substitution reactions** (can act as nucleophiles)

**oxidation reactions** (*primary and secondary alcohols (and methanol) can be oxidized to aldehydes, ketones, or carboxylic acids, depending on structure and reagent used*)



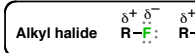
As a substituent: "alkoxy"

Examples:



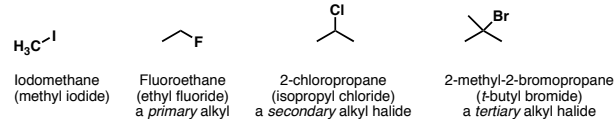
Characteristics: borderline between nonpolar and polar (due to dipole-dipole)

Reactivity: **acid-base reactions** (oxygen can act as a very weak base)



Suffix: "-ane". As a substituent: "haloalkyl"

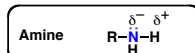
Examples:



Characteristics: generally considered non polar (but more polar than alkanes)

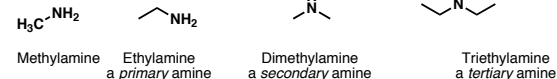
Reactivity: **substitution reactions** (Cl, Br, I can be good leaving groups)

**elimination reactions** (Cl, Br, I can be good leaving groups)



Suffix: "-ine". As a substituent: "amino"

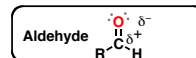
Examples:



Characteristics: polar (N-H group participates in hydrogen bonding, although not as much as a hydroxy group)

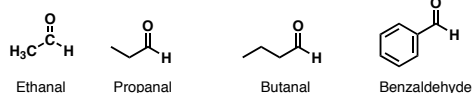
Reactivity: **acid-base reactions** (tend to act as bases)

**substitution reactions** (can act as nucleophiles)



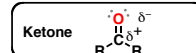
Suffix: "-al" (if attached to ring: carbaldehyde) As a substituent: "oxo"

Examples:



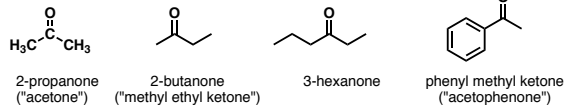
Characteristics: the C=O bond is somewhat polar

Reactivity: **addition reactions** (the carbonyl carbon reacts easily with nucleophiles)



Suffix: "-one". As a substituent: "oxo"

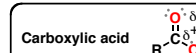
Examples:



Characteristics: the C=O bond is somewhat polar (less so than O-H however)

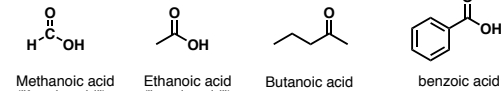
Reactivity: **addition reactions** (the carbonyl carbon reacts easily with nucleophiles)

**acid-base reactions** (carbons adjacent to the ketone can be deprotonated to give enolates)



Suffix: "-oic acid"

Examples:



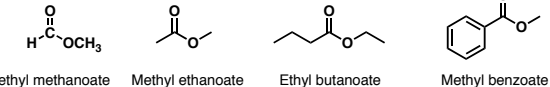
Reactivity: **acid-base reactions** (the O-H is acidic)

**acyl substitution reactions** (can replace OH with other groups under acidic conditions)



Suffix: "-oate"

Examples:



Reactivity: **acyl substitution reactions** (can replace OR with other functional groups under acidic conditions)  
**addition reactions** (the carbonyl carbon reacts easily with nucleophiles)

### Omissions, Mistakes, Suggestions?

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