

## John's Organic Chemistry Cheat Sheet

The product of a non-chemist's decade of collaborating with chemists

(version 21 Jan 2011 – john-bean@virginia.edu)

### Sources:

- Wikipedia encyclopedia of organic chemistry: [http://en.wikipedia.org/wiki/Organic\\_chemistry](http://en.wikipedia.org/wiki/Organic_chemistry)
- Organic Chemistry, textbook by Seyhan Ege
- ChemHeritage glossary (limited list but includes figures in many cases):  
<http://www.chemheritage.org/EducationalServices/pharm/glossary/glossary.htm>
- "ChemCool" chemistry dictionary: <http://www.chemcool.com/dictionary.html>
- Virtual text of organic chemistry: <http://www.cem.msu.edu/~reusch/VirtualText/intro1.htm>
- "About" organic chemistry (includes: chemical structures archive, alkane nomenclature and numbering, and functional groups subpages): <http://chemistry.about.com/od/organicchemistry/>
- "Chemical Forums" chemical structures: <http://www.chemicalforums.com/index.php?page=molecules>
- Clackamas community college chemistry 106 lessons online (includes diagrams of sigma and pi bonds)  
<http://dl.clackamas.cc.or.us/ch106-02/>

### A

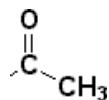
Abstraction

Synonymous with removal

Acyl / Acyl group

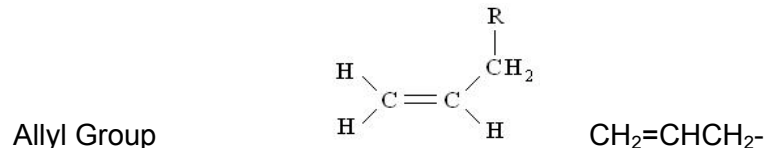
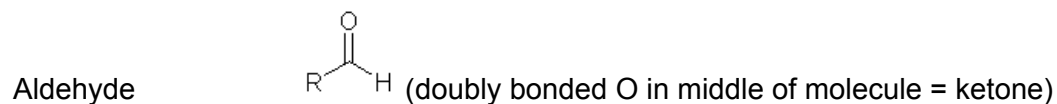
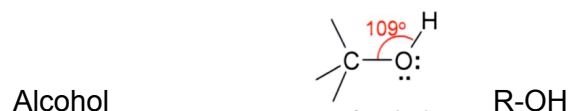


Acetyl/Acetyl group:



Acid                      Specie that can donate a proton (Bronsted-Lowry definition).  
 Specie that can accept a spare electron (Lewis definition).

Activation              Group on ring that makes it easier to introduce a second substituent = activation



Aliphatic              Definition 1: "Acyclic or cyclic, saturated or unsaturated carbon compounds, excluding aromatic compounds"  
 (In other words, NOT aromatic).

Definition 2 (not exactly equivalent!): "Organic molecules joined together in straight or branched chains"

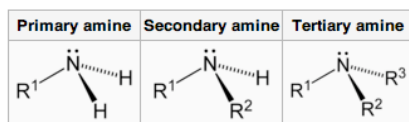
Alkane                    Carbon with tetrahedral bonds (single, covalent) to other carbons, or to hydrogen. C-C bond length ~ 1.54A.  
 Distance between 2<sup>nd</sup> nearest C's (along the spine of the alkane ~2.5A)

Alkene                    An alkene, olefin, or olefine is an unsaturated chemical compound containing at least one carbon to carbon double bond. C=C bond length ~ 1.33A

Alkyne                    A hydrocarbon containing at least one carbon to carbon triple bond. C≡C bond length ~ 1.2A

Alkyl group              Alkane minus one hydrogen/proton (generally attached to something else)

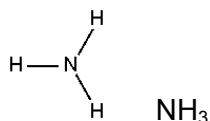




Nitrogen with three bonds plus unbonded electron pair

Amine group

Ammonia



Ammonium ion



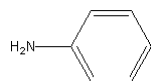
-ane

(suffix) an organic compound with a single bond between carbon atoms

Anode

Electrode that attracts negative ions (anions) and/or repels positive ions (cations)

Aniline

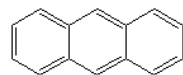


Phenyl ring with one  $\text{NH}_2$  side group:

Anion

Negative ion

Anthracene



Arene

"Monocyclic and polycyclic aromatic hydrocarbons" (synonymous with aromatic)

Aromatic

Containing planar carbon rings with "conjugated" carbon bonds (single bonds alternating with double/triple bonds ("aliphatic" = opposite, no conjugated rings))

Aryl / Aryl Group

Based on aromatic rings

Azide



Azo Compound

Containing  $\text{N}=\text{N}$

## B

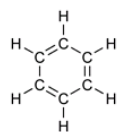
Base

“A solution that has an excess of hydroxide ions (OH<sup>-</sup>) in aqueous solution, removes hydrogen ions (protons) from an acid and combines with them in a chemical reaction.”

Specie that can accept a proton (Bronsted-Lowry definition)

Specie that can donate a pair of electrons (Lewis definition)

Or, a base is a specie that can accept a proton – this requires that it have a lone pair of electrons



Benzene

(benzene minus one hydrogen/proton => "phenyl group")

Butyl

A molecule containing four carbon atoms (butane minus one hydrogen/proton)

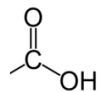
## C

Carbonyl group



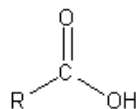
Oxygen doubly bonded to carbon

Carboxyl group



Carbonyl group bonded on one side to hydroxyl group

Carboxylic acid



Cathode

Electrode that attracts positive ions (cations) and/or repels negative ions (anions)

Cation

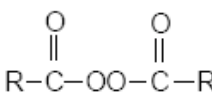
Positive ion

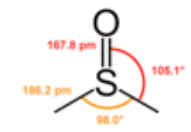
Chiral Chiral molecule = one that cannot be superimposed on its mirror image, (e.g. it may have a left or right "handedness" as screw threads do)

Concerted reaction Chemical reaction in which all bond breaking and bond making occurs in a single simultaneous step

Conjugation C chain with alternation of single bonds with multiple bonds which through their ability to rapidly/continuously switch positions (delocalize) can make the carbon chain/ring electrically conductive

## D

Diacyl peroxide  (used as a Si radical initiator in hydrosilylation)

DMSO  (CH<sub>3</sub>)<sub>2</sub>SO Dimethylsulfoxide


## E

ee Enantiomeric excess =  $(R-S)/(R+S)$  = excess of one enantiomer divided by concentration of both enantiomers (In this context S = left handed (from Latin sinister), R = right handed. This R not to be confused with broader use of R in organic chemistry to denote any possible "appended organic molecule segment")

Electrolyte Plus and minus ions in solution

Enantiomers Mirror image molecules (i.e. complementary molecules of opposite chirality)

-ene (suffix) an organic compound with a double bond between carbon atoms

Enediynes  Molecule with carbon chain containing two triple bonds separated by a double bond



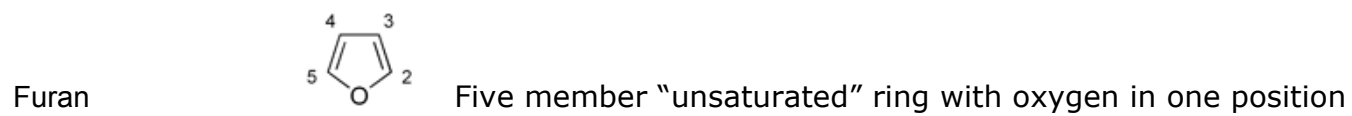
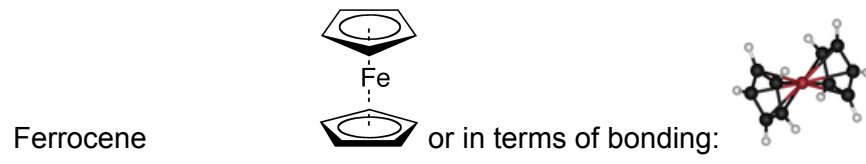
Ethyl / Ethyl group A molecule containing two carbon atoms (ethane minus one hydrogen/proton)

eV 1 eV = 23.0627 kcal/mol

Exogenous "Originating externally. In the context of metalloprotein ligands, exogenous describes ligands added from an external source, such as CO or O<sub>2</sub>."

**F**

Facile substitution Easy substitution



**G**

Grignard Organometallic reagents prepared by deprotonating an organic compound using a strong base Nucleophile or by reaction of organic halides with alkaline metals

## H

Hydroxyl group

-(OH)

Homolytic  
Cleavage

Breaking a bond such that each of the atoms gets one of the electrons

Homolysis

Same as Homolytic Cleavage, above

## K

Ketone



That is, molecule with central carbonyl group. (Doubly bonded O at END of molecule = aldehyde)

kilocalorie

1 kilocalorie =  $2.61144768 \times 10^{22}$  electron volts = 4.184 joule

kcal/mol

1 kcal/mol = 0.04336 eV (thus 1 eV = 23.0627 kcal/mol)

## L

Labile

As in "kinetically labile": Constantly undergoing *change* or something that is *likely* to *undergo* change

Mercaptin

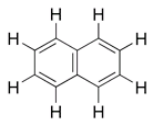
"A traditional term abandoned by IUPAC, synonymous with thiols."

Methyl

A molecule containing one carbon atom

## N

Napthalene



Nitrile group

-(C≡N)

Nucleophile

literally *nucleus lover* = a reagent forms a chemical bond to its reaction partner (the electrophile) by donating both bonding electrons

Nucleophilic: Nucleophile becomes attracted to a full or partial positive charge on an element and displaces the substitution group it is bonded to.

Nucleophilic Attack See Nucleophile

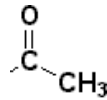
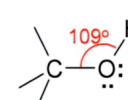
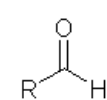
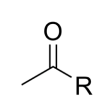
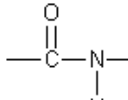
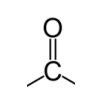
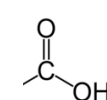
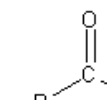
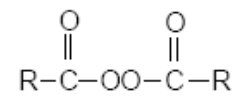
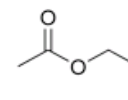
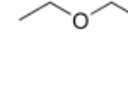
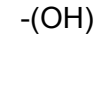
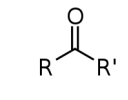
## O

Oxidation Loss of electron

OCP Open circuit potential

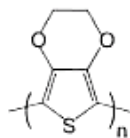
Olefin An alkene, olefin, or olefine is an unsaturated chemical compound containing at least one carbon to carbon double bond

Oxygenated organics:

 Acetyl	 Alcohol	 Aldehyde	 Acyl	 Amide	 Carbonyl	 Carboxyl	 Carboxylic Acid
 Diacyl peroxide	 Ester	 Ether	 Hydroxyl	 Ketone			

## P

PEDOT

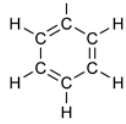


Polyethylene-dioxy-thiophene



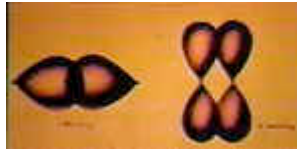
PDMSO

Polydimethylsulfoxide



Phenyl group

(with added hydrogen => benzene ring)

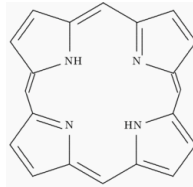


Pi bond

Sigma

Pi

A valence bond formed by side-by-side overlap of p orbitals on two bonded atoms. In most multiple bonds, the first bond is a sigma bond and all of the others are pi bonds



Porphyrin

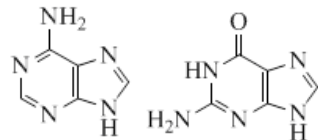
Crazy ring with alternating N's and NH's on inside

Propyl/Propyl group

A molecule containing three carbon atoms (propane minus one hydrogen/proton)

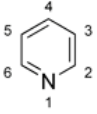
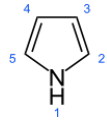
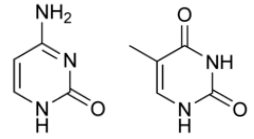
PSS

Polystyrene Sulfonic Acid



Purine

Five member pyrimidine conjugated ring (including two nitrogen's) attached to four member imidazole conjugated ring (also including two nitrogen's), with different possible side groups. Here: adenine and guanine of DNA fame

Pyridine		Six site conjugated ring, 5 Carbons + 1 Nitrogen
Pyrrole		Five site conjugated ring, 4 Carbons + 1 Nitrogen
Pyrimidine		Five member conjugated ring (including two nitrogen's) with different possible side groups. Here: cytosine and thymine of DNA fame

## R

R-	An appended organic molecule segment (~ "plus something else" or "plus X")
Racemic	Opposite of chiral, i.e. containing equal population of alternate enantiomers
Radical	Having an unpaired electron (denoted: <b>C·</b> )
Reduction	Gain of an electron

## S

Salt	Ionic compounds that can be formed by replacing one or more of the hydrogen ions of an acid with another positive ion.
Saturated	Carbon chained together with single bonds (with other carbon bonds being to hydrogen atoms) = carbon chain loaded with maximum number of possible hydrogen atoms (i.e. "saturated")



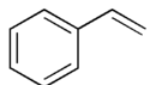
Sigma bond

a sigma bond is a valence bond that is symmetrical around the imaginary line between the bonded atoms. Most single bonds are sigma bonds

Steric hindrance

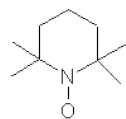
When a chemical reaction is hindered by unacceptable overlap of atoms, electron orbitals, or the formation of unfavorable bond lengths or angles (i.e. outcome of reaction is at least partially dictated by actual fit of atoms)

Styrene



**T**

TEMPO

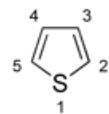


2,2,6,6-Tetramethylpiperidine 1-oxyl (organic radical on O site)

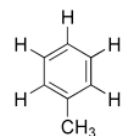
Thiol / Thiol group

-(S-H)

Thiophene



Toluene



THF

Tetrahydrofuran – solvent used in rinsing off organic layers (completely hydrogen saturated version of furan)

**U**

Unsaturated      Opposite of saturated = carbon compound with less than maximum possible number of hydrogen's implying some carbon atoms chained together with double or single bonds.

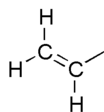
## V

"vide infra"      Latin for "see below"

"vide supra"      Latin for "See earlier" or "look above this page"

Vinyl compound

Containing a vinyl group:



## Y

-yne      (suffix) an organic compound containing a triple bond between carbon atoms

## Z

Zwitterion      A chemical compound that is electrically neutral but carries formal positive and negative charges on different (generally separated) atoms  
*(i.e. what a physicist would just call a polar molecule!)*