Organic Chemistry Notes:

1. Hydrocarbons
   1. Alkanes: n carbons, 2n+2 hydrogens. All carbons have sp3 hybridization, all single bonds.
      1. Nomenclature: Methane, ethane, propane, butane, pentane, hexane, heptane, octane, nonane, decane. From 1-10 carbon atoms.
      2. Isomerization: Can have a carbon chain coming off of the main carbon chain. See nomenclature notes.
      3. Cycloalkanes: what you’d expect. 2 fewer H’s than the usual alkane. Ex: Cyclobutane has four carbons in a ring, each with 2 hydrogens.
      4. Alkyl group: Alkane with one hydrogen removed.
      5. Reactions: Combustion, substitution.
   2. Alkenes:
      1. n carbons, 2n hydrogens. One double bond, which’ll have sp2 hybridization.
      2. Geometric isomers can be formed because the carbons that make the double bond are bonded to 3 things rather than 2, like so:

H H CH3 H

C = C C = C

CH3 CH3 H CH3

The first one is cis-2-butene, second one is trans-2-butene

* + 1. Reactions: Substitution, combustion, polymerization
  1. Alkynes:
     1. 1 triple bond, 2n-2 hydrogens per n carbons, VERY reactive.
  2. Aromatics:
     1. Definition: something involving benzene (6 carbon ring, 3 double and 3 single bonds aka 6 1.5 bonds because benzene has resonance, single hydrogen attached to each carbon). Aromatics are anything that replaces the hydrogens on a benzene ring, probably including benzene itself.
     2. Nomenclature: Say we have 2 chlorines on a benzene ring. Next to each other, they’re ortho-dichloro benzene. Separated by one carbon, meta-dichloro benzene. Separated by 2 carbons, para-dichloro benzene.

1. Hydrocarbon Reactions:
   1. Substitution:

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| --- | --- | --- | --- | --- |
| ethane | + Br2 | -U.V. Light-> | 1-bromo ethane | + HBr |

* 1. Addition: Requires double bond

ethene

+ Br2 --------→

Note that this means adding red Br2 is a good test for a double bond- the red color will fade as the bromine reacts.

1. Alcohols
   1. Substitute an OH for an H. Suffix is –ol, as in methanol, ethanol, propanol, etc.
   2. Nomenclature: If OH is at the end, name is just hydrocarbon’s prefix plus –ol. If it’s in the middle, it’s (number of carbon)- (prefix)ol. Ex: 2-propanol has the OH on the middle carbon.
   3. Can be formed by oxidation: 2CH4 + O2 -> 2CH3(OH)
   4. Or reduction, which means either the usual gain of electrons, formation of a C-H bond, or loss of a C-O or C-X bond where X is a halogen (incidentally, oxidation in O-Chem is the same: loss of electrons, loss of a C-H bond, or gain of a C-O or C-X):

|  |  |  |  |
| --- | --- | --- | --- |
| methanal | +H2 | --> | methanol |

1. Ethers
   1. Oxygen singly bonded to two carbons. Usually has the formula R-O-R’, where R and R’ are carbon chains.
2. Aldehydes
   1. Carbon double bonded to oxygen, which is a carbonyl group (-C=O), at the END of a carbon chain.
   2. Nomenclature: suffix –al
   3. Produced by taking an alcohol with an OH group on the end and oxidizing it. Similarly, aldehydes can be reduced into alcohols.
3. Ketones
   1. Carbonyl group in the MIDDLE of a carbon chain.
   2. Nomenclature: suffix –one. Example: propanone, 2-butanone, etc.
   3. Formed by oxidation of an alcohol with its OH in the middle of the chain.
4. Carboxylic Acids
   1. contain a carboxyl group, carboxyl group,general form, acid group, suffix is –oic acid . Ex: methanoic acid is CHOOH, also known as formic acid
   2. Formation:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ethanol | + O2 | --> | ethanoic acid | + H2O |

* 1. As the length of the carbon chain goes up, organic acids get less polar. They become more soluble in non-polar solvents and less soluble in water. Therefore, longer chain acids are weaker (in water).

1. Esters
   1. Produced by combining a carboxylic acid and an alcohol, like so:

The large blank space should have methyl acetate in it.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ethanoic acid | + | methanol | --> |  | + H2O |

* 1. Methyl acetate: CH3 —C — O — CH3

||

O

That’s an ester. I think some esters are what makes mint minty.

1. Nitrogen Functional Groups
   1. Amines: Replace one or more of the hydrogens in ammonia (NH3) with a carbon chain. One replacement, primary amine. Two, secondary amine. Three, tertiary amine.
   2. Amides: pronounced a-mid for some reason. Carbonyl and amine. R-Carbonyl-NH2. Suffix: -amide.
   3. Amino acids: R-CNH2-COOH
   4. Nitro: R-NO2 Nitro- prefix
   5. Nitrile: -nitrile. C triple bonded to N.

Reaction types by mechanism:

|  |  |  |
| --- | --- | --- |
| **Reaction type** | **Subtype** | **Comment** |
| Addition reactions | electrophilic addition | include such reactions as halogenation, hydrohalogenation and hydration. |
| nucleophilic addition |
| radical addition |
| Elimination reaction |  | include processes such as dehydration and are found to follow an E1, E2 or E1cB reaction mechanism |
| Substitution reactions | nucleophilic aliphatic substitution | with SN1, SN2 and SNi reaction mechanisms |
| nucleophilic aromatic substitution |  |
| nucleophilic acyl substitution |
| electrophilic substitution |
| electrophilic aromatic substitution |
| radical substitution |
| Organic redox reactions |  | are redox reactions specific to organic compounds and are very common. |
| Rearrangement reactions | 1,2-rearrangements |  |
| pericyclic reactions |
| metathesis |