(18) **Today**

Section 3.1
Functional Groups

Section 3.2
Alkanes and Isomers

Section 3.3
Alkyl Groups

Section 3.4
Nomenclature

**Next Class** (19)

Section 3.4
Nomenclature

Section 3.5 - 3.7 Properties and
Conformations of Alkanes

Chap 4 Cycloalkanes

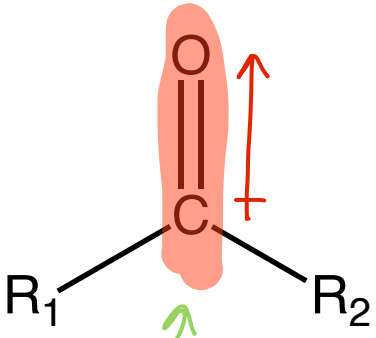
(20) **Second Class from Today**

Chap 4 Cycloalkanes

**Third Class from Today** (21)

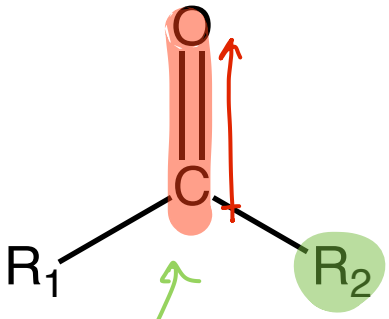
Chap 4 Cycloalkanes

Ketones




$R_1$ or $R_2 \neq H$

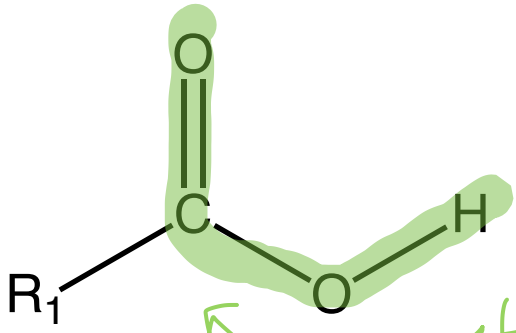
Aldehydes



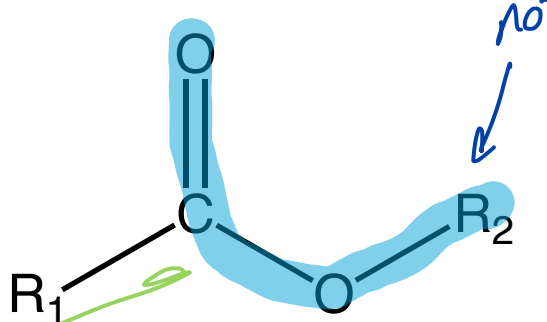

$R_1$ or $R_2 = H$

these C atoms are attractive to ⊖ things even more so than our (C-O-C) singly bond C-O links

## Carboxylic Acids and Esters




$R_1$ = H or $R_1 \neq$ H

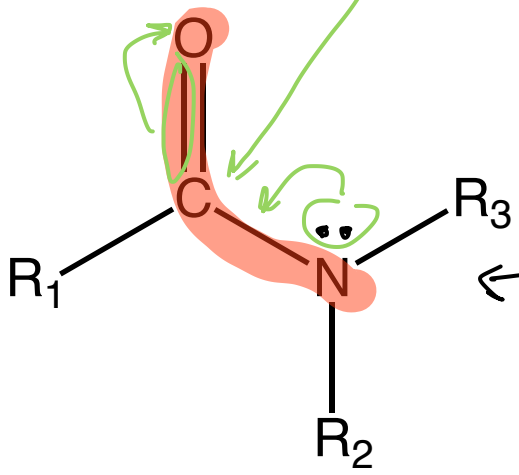


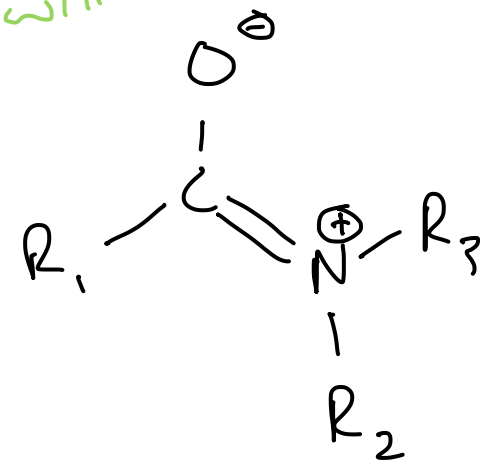

not an H

still very positive

$R_1$ = H or $R_1 \neq$ H but $R_2 \neq$ H

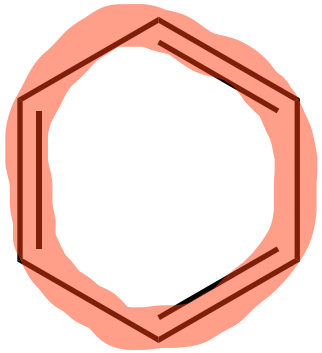
## Amides



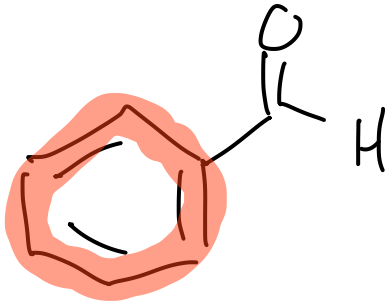

but having O's + N's will add additional reactivity

a peptide bond between two amino acids is an amide functional group

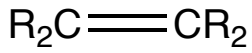


we would do any chemistry with them this semester

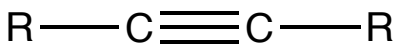
aromatic rings are unusually stable as compared to other C=C



## Grouped to highlight which ones have similar reactivities

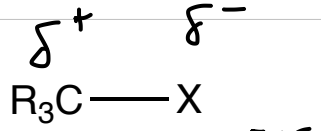


alkenes

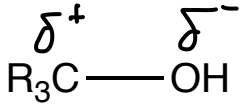


alkynes

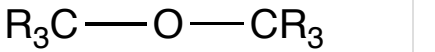
C to C π bonds



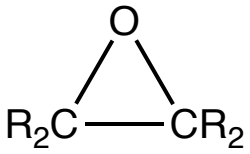
X = Cl, Br, I
Alkyl Halides



alcohols

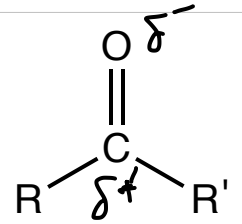


ethers



epoxides

and more…

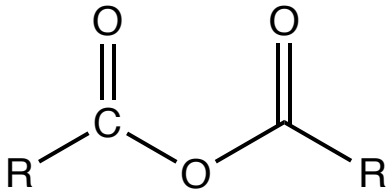


ketones (R, R'≠ H) and
aldehydes (R or R' = H)

$RC(=O)NR_2$
amides

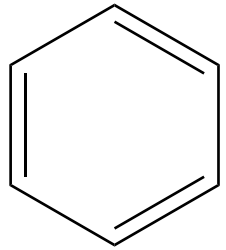
RC(=O)OR
esters (R ≠ H)

RC(=O)OH
carboxylic acids



anhydrides

RC(=O)Cl
acid chlorides



aromatics

and more…

## Nomenclature of Alkanes

hydrocarbons where all C's are $sp^3$ hybridized (all single or σ bonds)

Early names were based on the number of C atoms in the alkane, and the names came from a variety of places — and we're "stuck" with them for the first four

$CH_3OH$ methanol the name is derived from a word coined by French chemists, Jean-Baptiste Dumas and Eugene Peligot, from "methy" (Greek for alcoholic liquid)" + hȳlē (Greek for "forest, wood, timber, material")[2]

$CH_3CH_2OH$ "eth" to distinguish it from méthylène derived from French and German chemists "äthyl" in German[3]

$CH_3CH_2CO_2H$ based on observation that it was the first (shortest chained) carboxylic acid that behaved like a fatty acid
pro (from protos for first) + pion (from pion for fat) => propionic acid[4]

prop

$CH_3CH_2CH_2CO_2H$ isolated from butter => butyric acid[5]

[2] https://en.wikipedia.org/wiki/Methanol#History

[3] https://chemistry.stackexchange.com/questions/142839/why-is-ethane-in-methane, https://gallica.bnf.fr/ark:/12148/bpt6k6569005x/f15.item

[4] https://en.wikipedia.org/wiki/Propionic_acid

[5] https://en.wikipedia.org/wiki/Butyric_acid

Nomenclature of Alkanes: Original Scheme based names on number of C atoms present

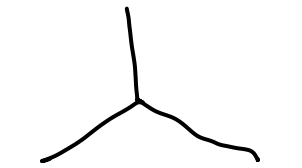


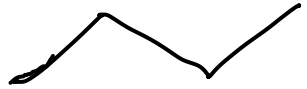
| | |
|---|---|
| methane | $CH_4$ |
| ethane | $C_2H_6$ |
| propane | $C_3H_8$ |
| butane | $C_4H_{10}$ |
| pentane | $C_5H_{12}$ |
| hexane | $C_6H_{14}$ |
| heptane | $C_7H_{16}$ |
| octane | $C_8H_{18}$ |
| nonane | $C_9H_{20}$ |
| decane | $C_{10}H_{22}$ |
| undecane | $C_{11}H_{24}$ |
| dodecane | $C_{12}H_{26}$ |

functional groups can be identified by the ending of the name of the molecule

"ane" for alkane

structural or constitutional isomers

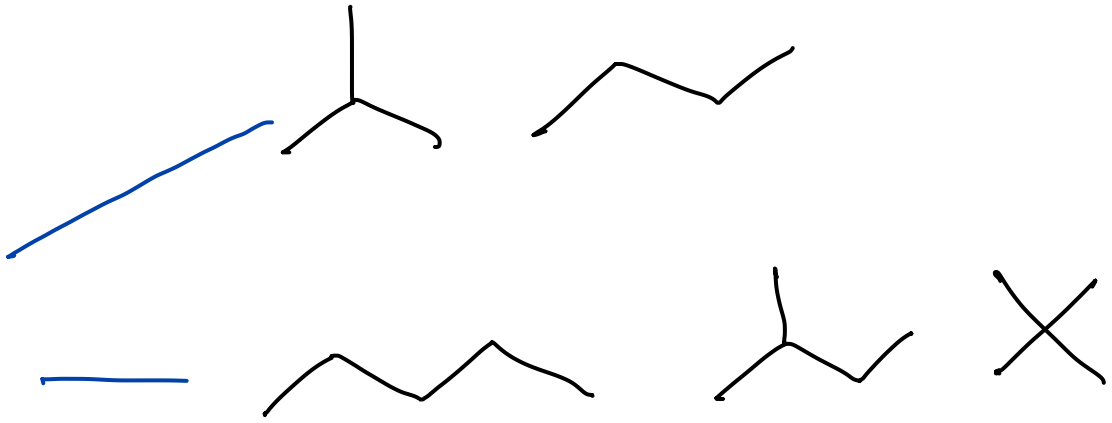




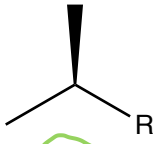
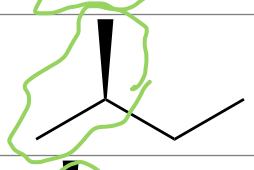
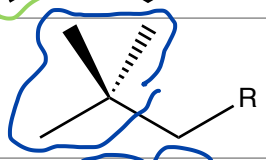
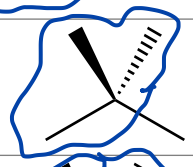
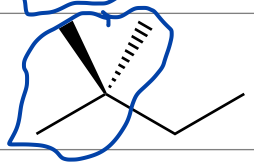
# Nomenclature of Alkanes: Original Scheme based names on number of C atoms present

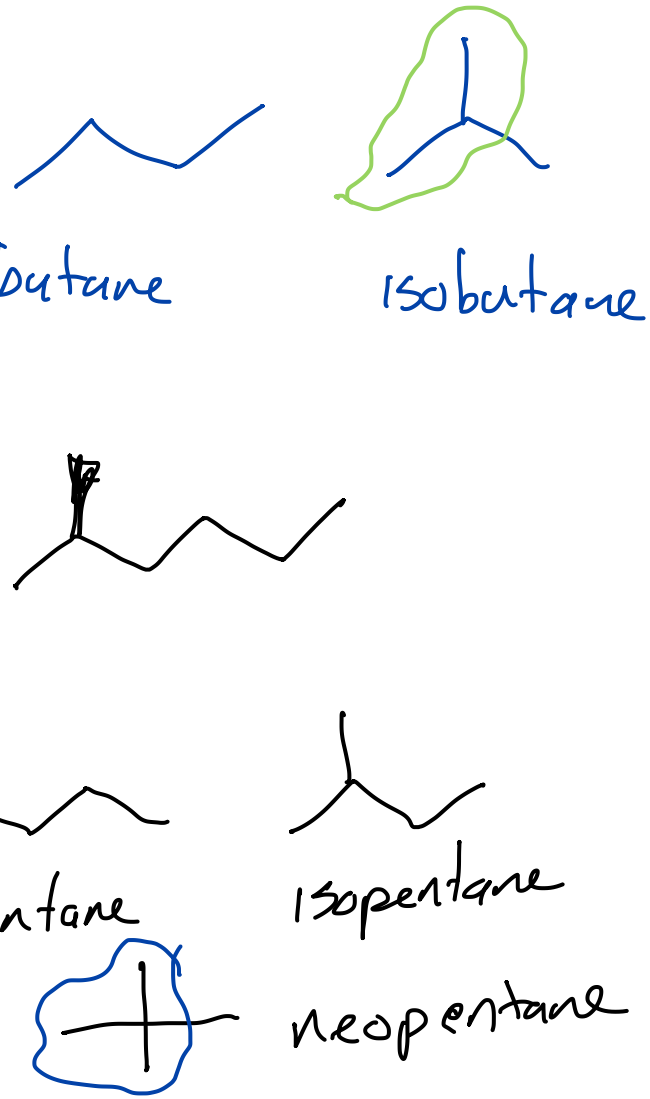


| | | |
|---|---|---|
| methane | $CH_4$ | 1 isomer |
| ethane | $C_2H_6$ | 1 isomer |
| propane | $C_3H_8$ | 1 isomer |
| butane | $C_4H_{10}$ | 2 isomers |
| pentane | $C_5H_{12}$ | 3 isomers |
| hexane | $C_6H_{14}$ | 5 isomers |
| heptane | $C_7H_{16}$ | ... |
| octane | $C_8H_{18}$ | |
| nonane | $C_9H_{20}$ | |
| decane | $C_{10}H_{22}$ | |
| undecane | $C_{11}H_{24}$ | |
| dodecane | $C_{12}H_{26}$ | |



But before getting into the systematic nomenclature of Substituted Alkanes: non-IUPAC names based on total number of C atoms present

| | | |
|---|---|---|
| iso- | |  |
| isobutane | R = $CH_3$ (4 C's) |  |
| isopentane | R = $CH_2CH_3$ (5 C's) |  |
| isohexane | R = $CH_2CH_2CH_3$ (6 C's) |  |
| neo- | |  |
| neopentane | R = H (5 C's) |  |
| neohexane | R = $CH_3$ (6 C's) |  |




Each of these molecules could be used as an adjective to describe a group; for example, the top one where the R is not defined we could say that the defined parts are an isopropyl group. It's three carbons (propane) in the shape of the iso group.

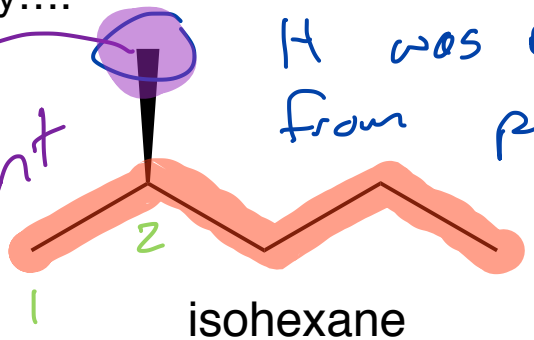
Nonsystematic Nomenclature becomes problematic quickly….

hexane

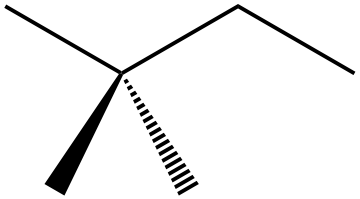
2-methylpentane

here it looks like an H was removed from pentane and a $CH_3$ was put on in its place

substituent



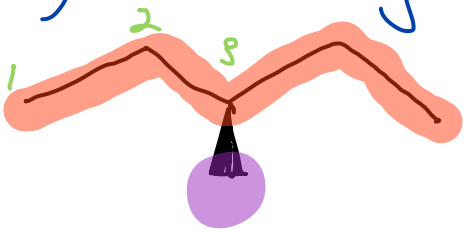

isohexane



neohexane

for alkyl substituents

(#C atoms name) - ane + yl




1 C

methane → methyl

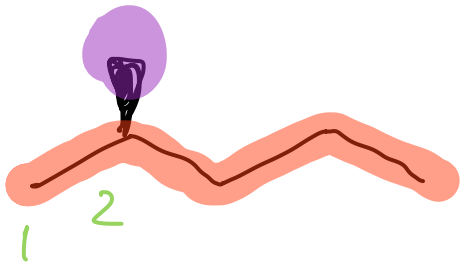
3-methylpentane

Systematic names are built up following rules

2- methyl pentane

(position)-(stuff hanging off longest chain)(longest chain of C atoms)(functional group ending)

#



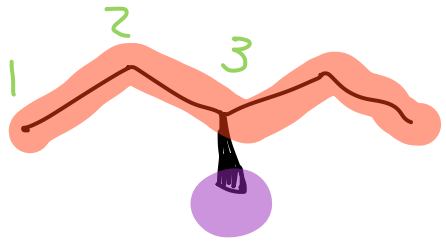

2 - methyl pentane

count to find lowest possible position #

a 1 C

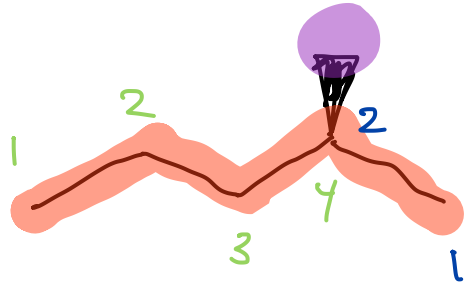
long substituent

longest chain is 5 C's long

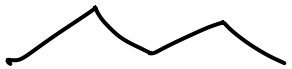



3 - methyl pentane

meth~~ane~~yl




2 - methyl pentane



## Nomenclature of Alkanes: IUPAC Names based on the number of C's in the longest continuous chain of C atoms

Determine longest continuous chain.

- This is the **parent hydrocarbon**
- If compound has two or more chains of the same length, parent hydrocarbon is chain with greatest number of substituents

List the name of substituent(s) before the name of the parent hydrocarbon along with the number of the carbon to which it is attached--Substituents are listed in alphabetical order – neglecting prefixes such as di- tri- tert- etc.

- Find and list all of the substituents
- Names of alkyl substituents are based on the length of the substituent.
- Names for branched substituent such as *sec*-butyl and *tert*-butyl are acceptable, but systematic substituent names are preferable.
    - The numbering system for a branched substituent begins with the carbon attached to the parent hydrocarbon
    - This number together with the substituent name is placed inside parentheses
- Number the substituents
    - in the direction that gives the lower number for the lowest-numbered substituent. (Lowest possible number for all substituents on the parent chain)
    - When both directions yield the same lower number for the lowest numbered substituent, select the direction that yields the lower number for the next lowest numbered substituent
    - If same substituent numbers are obtained in either direction, number in the direction giving lowest number to the first (alphabetically) named substituent

**Form of name:** #-followed by substituent name followed by parent hydrocarbon name

position#-**stuff hanging off longest chain****longest chain of C atoms****functional group ending**