

Introduction to Organic Functional Groups

Constitutional isomers: Klein 4.3

Alkane nomenclature: Klein 4.1-4.2

Functional groups: Klein 2.3

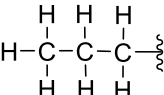
Alkyl halide nomenclature: Klein 7.2

A. Alkanes and Alkyl Groups

=a.k.a.

-General formula for alkanes=

1. Naming alkanes

alkane structure	name	alkyl piece structure	name	no. of C's
CH ₄ =		H ₃ C-		1
CH ₃ -CH ₃ =		H ₃ CCH ₂ -		2
CH ₃ CH ₂ CH ₃		H ₃ CCH ₂ CH ₂ - = 		3
CH ₃ CH ₂ CH ₂ CH ₃		CH ₃ CH ₂ CH ₂ CH ₂ -		4
CH ₃ CH ₂ CH ₂ CH ₂ CH ₃		CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ -		5
CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃		CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ -		6
CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃		CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ -		7
CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃		CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ -		8
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CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃		CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ -		10

Comments:

*mostly Greek prefixes used

Other notable alkyl chains

systematic or official name	common name	no. of C's (Note: including CO ₂ H carbon)
dodecyl	lauryl	
tetradecyl	myristyl	
hexadecyl		16
octadecyl		18
eicosyl	arachidyl	

****KNOW...**

2. Alkane properties=

-they are _____ (water fearing) or _____ in nature; they glob together like

-longer chains have _____ boiling points

-fatty acids=long _____ chains with _____

-fatty acids form _____ in aqueous solutions; fatty acids (triacylglycerols specifically) are an important constituent of _____ and _____ and a great source of energy in cells.

-38 kJ/g for complete oxidation of triacylglycerol (citric acid cycle) vs. 17 kJ/g for carbohydrates and proteins

triacylglycerol (triglycerides)

3. Constitutional isomers

= _____ number and _____ of atoms, but different _____ arrangement

Key -> not all alkyl groups are linear; _____ can occur

-e.g. 4 C constitutional isomers: C₄H₁₀

Side bar: *Depicting organic chemical structures*

formula

condensed

highly condensed

skeletal

****C-C SIGMA BONDS CAN _____ !**

EXAMPLE with hexane (C_6H_{14}):

1. C-C-C-C-C-C

2.

3.

4.

5.

Lots of other examples; see book and assigned questions for more details (not worth more discussion)

-e.g.

# of C's	# of constitutional isomers
C_7H_{16}	
C_8H_{18}	
$C_{10}H_{22}$	
$C_{15}H_{32}$	
$C_{20}H_{42}$	

4. Common names for some common constitutional isomer groups

group	name	skeletal representation
$CH_3-CH(CH_3)-$		
$CH_3-CH(CH_3)-CH_2-$		
$CH_3CH_2CH(CH_3)-$		
$(CH_3)_3C-$		

*add these to the list of groups that you need to know

5. Nomenclature of Alkanes

How to name alkanes....

1st example: $CH_3CH_2CH(CH_3)CH(CH_2CH_3)CH_2CH_3$

*all alkanes have _____ as the suffix

a) Find longest chain and name

*in our example.....

b) Name and number substituents

-number from end that gives lowest number or numbers

-If multiple substituents of the same type, then use the prefixes _____, _____, _____ etc. as necessary.

c) Alphabet wins naming if there is a choice

-lowest number goes to substituent with *first name alphabetically*

-hyphenated prefixes like *sec* and *tert* and di-, tri-, tetra-, penta- etc. are *not* used when alphabetizing

Final name of example:

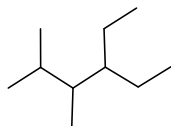
-most organic chemists refer to molecules by their key/critical functional groups, i.e. _____, _____, _____, etc.

This is because the functional groups are the most important part when discussing molecular properties and reactions.

Additional rules...

d) Correct name will use the lowest number for substituents

example



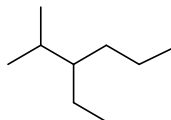
-analysis:

NOT...

NOT...

e) Simplest substituent names preferred over complex

example

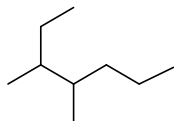


-analysis:

NOT...

NOT...

4th example:



-analysis:

6. Nomenclature of Cycloalkanes

a) count the number of C's in cyclic structure/ring and name using prefix for linear (acyclic) alkanes

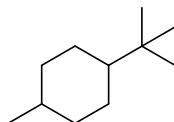
b) use _____ prefix

c) name each substituent on ring

d) if two or more substituents AND same priority (alkyl, halo), lowest numbering first,

e) if numbering same, then number alphabetically

example



example—naming cycloalkyl substituents: draw 3-cyclopropylhexane

7. Other functional groups

*You must recognize all these, but you don't need to know the nomenclature right now.

a) Simple functional groups

(1) alkyl halides: -X, where X=

e.g.

(2) ethers: _____, where R=

e.g.

(3) alcohols:

e.g.

(4) amines:

e.g.

b) C=O functional groups

(1) aldehyde =

e.g.

(2) ketone =

e.g.

(3) carboxylic acid =

e.g.

(4) carboxylic ester = _____, where R and R' are alkyl groups

e.g.

(5) carboxylic amide =

c) Unsaturated hydrocarbon functional groups

-contain _____ bonds

(1) alkene =

e.g.

(2) alkyne =

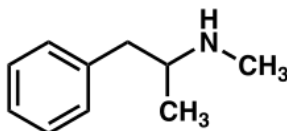
e.g.

(3) benzene/aromatic =

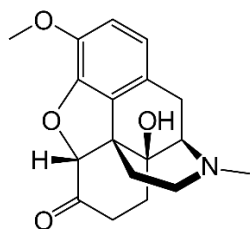
-a.k.a. _____ ring

Practice examples:

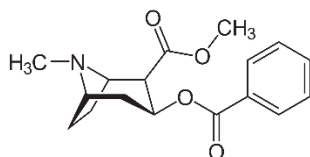
Show a complex structure with many of these functional groups, such as:



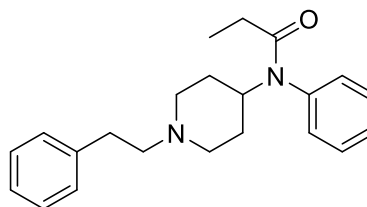
methamphetamine



oxycodone (oxycontin)



cocaine



fentanyl

8. *Special topic: degree of unsaturation

One pi bond or one ring structure = _____ degree of unsaturation

Two pi bonds; two rings; or one ring + one pi bond = _____ degrees of unsaturation

-e.g. $C_{10}H_{20}$ → “normal” saturated alkane would be....

→ $C_{10}H_{20}$ has _____ degree of unsaturation, so you would expect it to have _____ ring or _____ pi bond

Possibilities...

examples to illustrate:

-2-hexene (C_6H_{12}) vs. hexane (C_6H_{14}); loss of two H's =

Possible structures....

-benzene has _____ degrees of unsaturation: C_6H_6 ; normal alkane would be _____

9. *Special designations for types of carbons:*

-defined by # of C's attached to C of interest

(1) 1 C attached = _____ = _____ = _____

(2) 2 C's attached = _____ = _____ = _____

(3) 3 C's attached = _____ = _____ = _____

(4) 4 C's attached = _____ = _____ = _____

Example will illustrate best:

