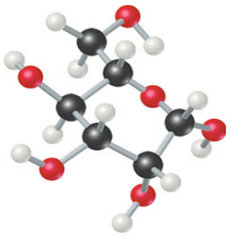
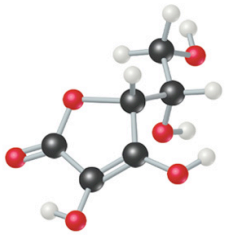
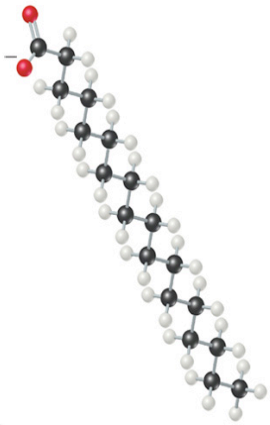
Ch. 22 Organic Chemistry

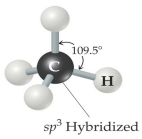

Glucose ($C_6H_{12}O_6$)


Ascorbic acid ($HC_6H_7O_6$)

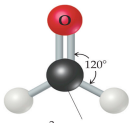

Surfactant ($C_{17}H_{35}COO^-$)

I. The chemistry of _____

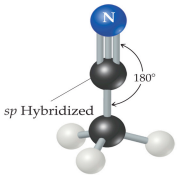
II. Carbon can bond with up to three other atoms _____
1. Because of this, many combinations can occur.



sp^3 Hybridized
(a) Tetrahedral



sp^2 Hybridized
(b) Trigonal planar



(c) Linear

2. Large biomolecules (_____) can be constructed!

III. Properties of hydrocarbons (the most basic of organic molecules)
A. Hydrocarbon: molecules containing just
B. _____
C. _____
D. Carbon backbone: _____
E. Reminder, the larger the molecules, the _____
F. The larger the polar end, the larger the solubility in water

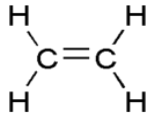
Hydrocarbons

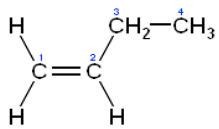
I. Alkanes
A. A hydrocarbon with only _____ bonds.
B. Chemical formula of alkanes _____
C. Known as <u>saturated</u> because they only have single bonds and cannot bond with any more atoms.

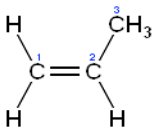
TABLE 22.1 Selected Properties of the First Ten Normal Alkanes

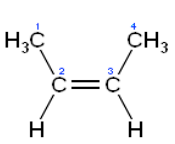
Name	Formula	Molar Mass	Melting Point (°C)	Boiling Point (°C)	Number of Structural Isomers
Methane	CH_4	16	−182	−162	1
Ethane	C_2H_6	30	−183	−89	1
Propane	C_3H_8	44	−187	−42	1
Butane	C_4H_{10}	58	−138	0	2
Pentane	C_5H_{12}	72	−130	36	3
Hexane	C_6H_{14}	86	−95	68	5
Heptane	C_7H_{16}	100	−91	98	9
Octane	C_8H_{18}	114	−57	126	18
Nonane	C_9H_{20}	128	−54	151	35
Decane	$C_{10}H_{22}$	142	−30	174	75

II. Alkenes
A. A hydrocarbon with at least one _____ bond.
B. Given one double bond, the chemical formula of an alkenes is _____
C. Known as _____ because the double bond can be broken to bond with other atoms.

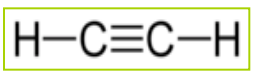


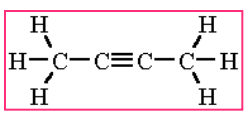


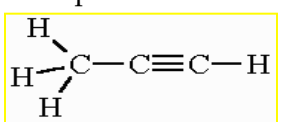




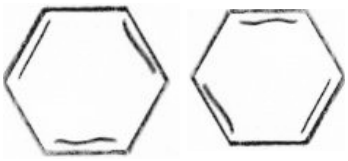
III. Alkynes
A. A hydrocarbon with at least one t_____ bond.
B. Given one triple bond, the chemical formula of an alkenes is _____
C. Known as _____ because the triple bond can be broken to bond with other atoms.

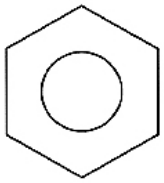






IV. Aromatic hydrocarbons



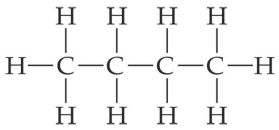


Benzene
C_6H_6

A. These are _____ hydrocarbons.
B. Have distinct scents.
C. The most significant is _____ (_____)
1. Has _____ bonds.
2. Because of _____, a circle is used to represent the bonding.

VI. Ways to express formulas (write down examples!)

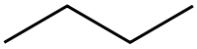
A. Structural formulas:



B. Condensed formulas:

$CH_3CH_2CH_2CH_3$

C. Skeletal formula:



VII. Homologous Series

A. A series of molecules that differ only by a _____
B. Example: methane_____, ethane_____, propane_____.

VIII. Branches

A. Carbons that are bonded but are not part of the backbone (the longest carbon chain) are called _____.
B. Note: with molar mass being equal, the more branched a molecule is, _____
_____

Naming Hydrocarbons

I. Naming alkanes, steps:

A. Find the carbon backbone and count the number the carbons.
B. Write the Greek prefix associated with that number.
1. meth=1, eth=2, prop=3, but=4, pent=5, hex=6, hept=7, oct=8, non=9, dec=10
C. Write the ending, -ane.
D. Examples: C_4H_{10},
$CH_3CH_2CH_2CH_2CH_2CH_3$

II. Naming branches and bonds, steps:

A. Find the carbon backbone and <u>number</u> the carbons. Make sure the branches and bonds have the lowest possible numbers.

B. Start with the branches
1. Write the number of the carbon where the branch is located followed by a dash.
2. Name the branch as you did earlier but replace "-ane" with "-yl"
3. Repeat until all of the branches are named.

4. If there are more than one branch of the same length, combine them and use a prefix (2=di-, 3=tri-, 4=tetra-). Example: 3-methyl, 4-methyl, 6-methyl = 3, 4, 6-trimethyl.

C. Then name the bonds

1. Write the number where the bond STARTS (the lower #)
2. If there are more than one bond, use di-, tri-, tetra-, etc.
3. Write the Greek prefix corresponding with the number of carbons on the carbon backbone.
4. Use the appropriate suffix corresponding to the type of bond (double bond = -ene, triple bond = -yne)

III. Examples:

IV. Drawing the structure from the name, steps:

A. Draw the longest carbon chain using single bonds.
B. Number it from left to right
C. If any, draw in any bonds, starting the bond at the carbon with the lowest number.
D. If any, draw in branches, making sure that they are the right length (remember, the carbon on the backbone is not counted in the length of the branch).
E. Examples:

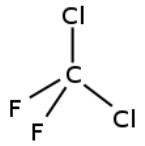
Functional Groups

I. Because of the , many organic molecules bond with other atoms.

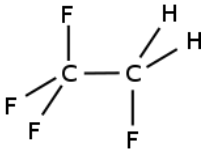
A. These atoms are normally
B. The part of an organic molecule that
These groups are known to react similarly.
C. There are many types of functional groups. (We'll go over eight of them)
D. FYI: R= R'=

II. Simply substituted groups (bonds remain the same)

A.
1.
2. Where
3. To name them,
4. CFC's and HCFC's fall into this category.
5. Examples:

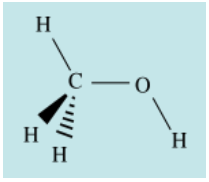


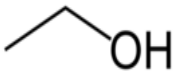
Dichlorodifluoromethane
(CFC-12)



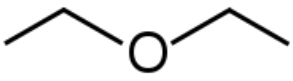
1,1,1,2-Tetrafluoroetha
(HFC-134a)

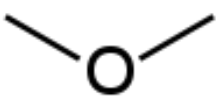
B.
1.
2.
3. Naming:
4.
5. Examples:



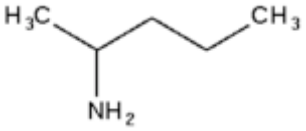


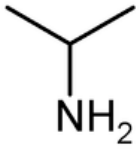
C.
1. of the carbon backbone.
2.
3. Many were used for medicine
4. Naming:





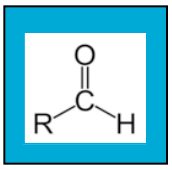
D.

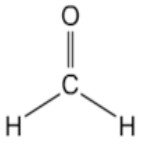




1. Contain
2.
3.
4. Naming:

III. Groups with a carbonyl (C=O) group

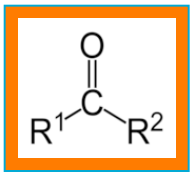


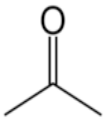


A.

1.
2. Naming:
3. Most common is formaldehyde (methanal) for preserving dead things...like cats...

B.

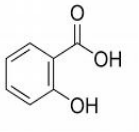


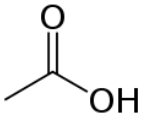


1.
2. Naming:
3. Very strong solvents (nail polish remover, organic labs)
4. Sweet smell

C.

1.
2. They are



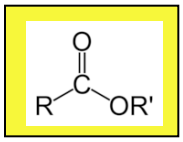


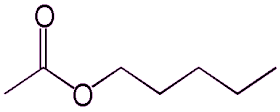
3. Acetic is the most common
4. Naming:

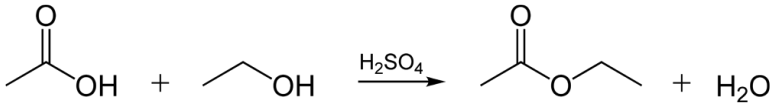
D. Esters

1.
2. Naming: kinda weird...

3. Fruity scents (like bananas, gum, etc.)
4. Made from







Isomers!

I. Isomers: Molecules that have _____.

A. Many organic molecules can be drawn differently.

B. Ex: Draw all the structural isomers of C_5H_{12}

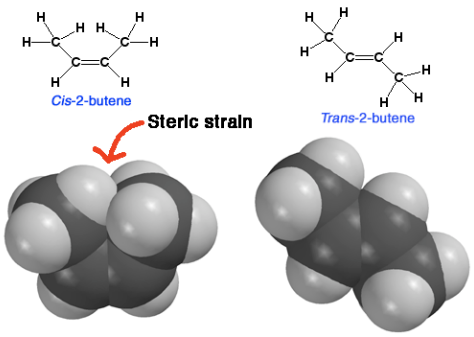
C. Note: single bonds can _____. Therefore, do not be fooled by them. If one atom causes the isomer, flip it to see if it is a true isomer.

II. Isomerism in alkenes.

A. The double bond prevents the carbons from _____.

B. Thus, if different atoms are on same side of the double bond, it is known as a _____.

C. If different atoms are different sides of the double bond, it is known as a _____.



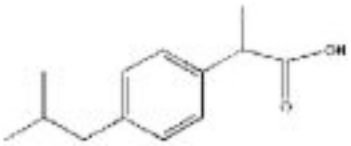
III. Optical isomers:

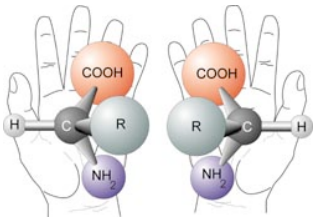
A. Isomers that are _____ of each other.

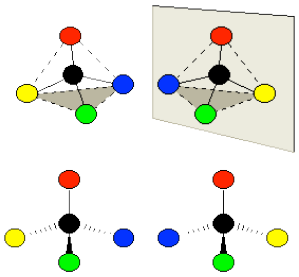
B. There must be three or four different groups for this isomer to exist.

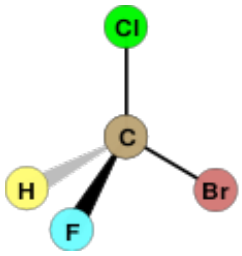
C. It is helpful to think of this in 3D

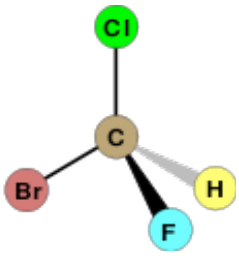
D. Ibuprofen...

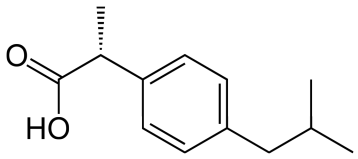


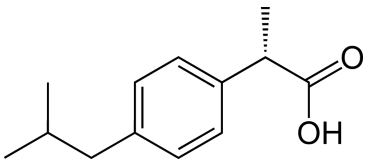


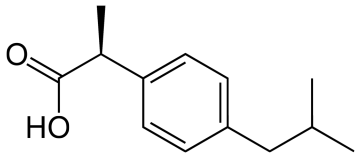












Organic Reactions

I. Because of the many different groups, organic reactants can react in many different ways.

II. Three main ones that you need to know:

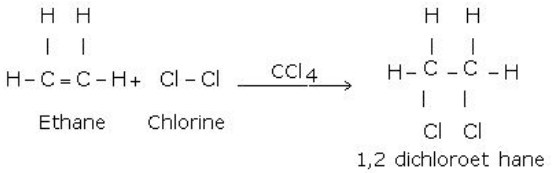
A. _____

1. _____
2. _____
3. If a molecule containing just C's and H's or C's, H's and O's, your products will ALWAYS be _____.

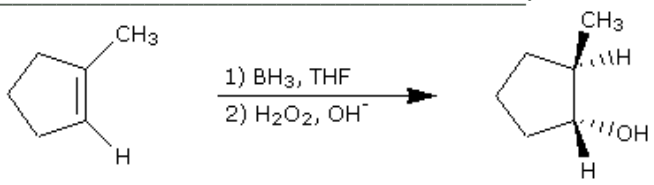
B. _____

1. When an _____ organic molecule reacts with something that breaks the _____ to form a _____with new elements.
2. This is why unsaturated molecules (alkenes, alkynes) are not _____.
3. Applications of addition reactions.

a. _____.



b. _____.



c. _____.

C. _____

1. When an _____ reacts with a carboxylic acid.
2. Also known as _____ reaction because _____ is formed.