Today

4.12 and 4.14 Molecules with more than one chirality center

Sections 5.4
Functional Groups

Sections 5.2 - 5.3, 5.5
Alkene nomenclature and structure, and how alkenes react

Next Class

Sections 5.5 - 5.13
How alkenes react

Kinetics, thermodynamics, reaction coordinate diagrams, and catalysis

Please hand in Reworked test 1.

saturated hydrocarbons don't have "room" for more

Knowing the "degrees of unsaturation" can help a chemist determine the structure of an unknown compound.

H Atoms

unsaturated

CH_4 C_2H_4 vs C_2H_2 vs C_2H_6 C_3H_6 vs C_3H_4 vs C_3H_8

unsaturated

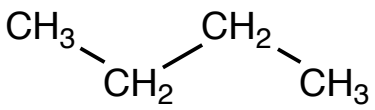
saturated

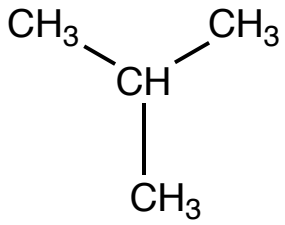
saturated

no C_2 compounds existed with more H atoms bonded to the C

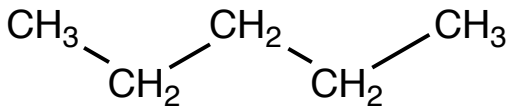
Degrees of Unsaturation: the number of H atoms needed to 'saturate' C atoms

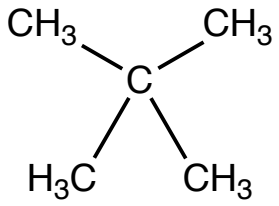
C_4H_{10}

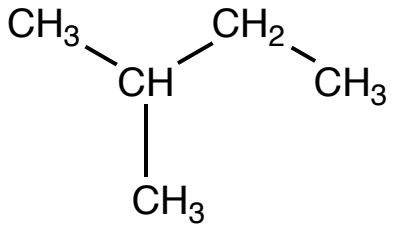




C_5H_{12}





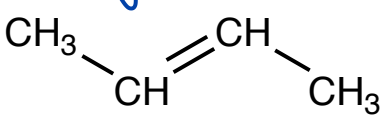


C_4H_{10} C_2H_6 C_3H_8 C_4H_{10} C_5H_{12}

$C_n H_{(2n+2)}$

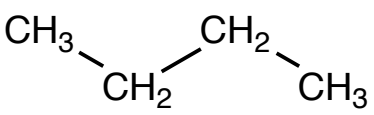
1,4-pentadiene

one degree



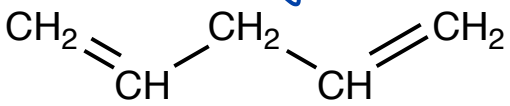
C_4H_8

"missing" 2 H atom



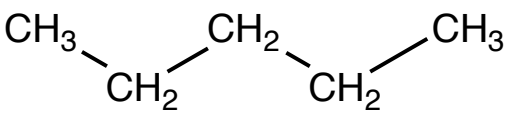
C_4H_{10}

two degrees



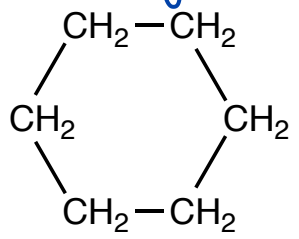
C_5H_8

"missing" 4 H atoms

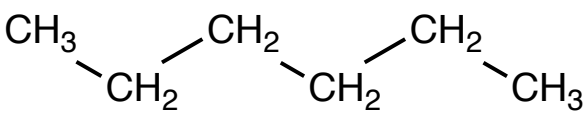


C_5H_{12}

one degree



C_6H_{12}

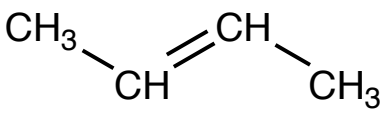


C_6H_{14}

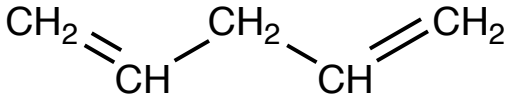
one degree of unsaturation means one π bond or one ring

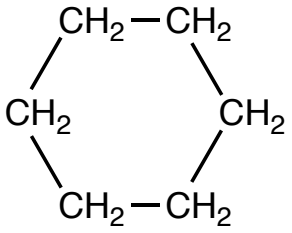
two degrees of unsaturation means two π bond, one π bond and one ring, or two rings

three degrees of unsaturation means three π bonds, etc...

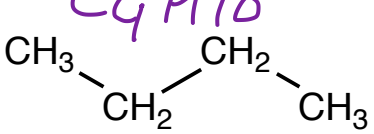


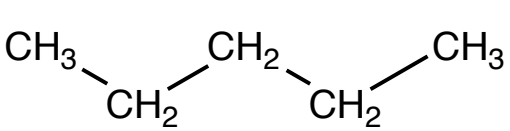
C_4H_8





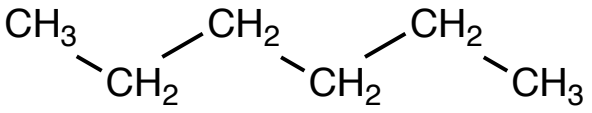
C_4H_{10}





$2 \cdot 4 + 2 = 10 \quad - \quad 10$

$2 \cdot 4 + 2 = 10 \quad - \quad 8$



8

1

$$\frac{\text{("expected" \# of H atoms)} - \text{(actual \# of H atoms)}}{2} = \text{degrees of unsaturation}$$

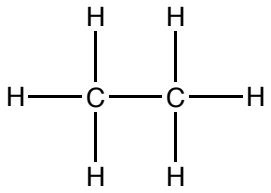
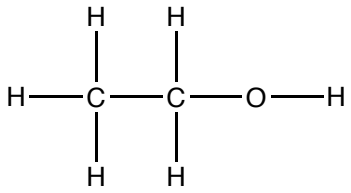
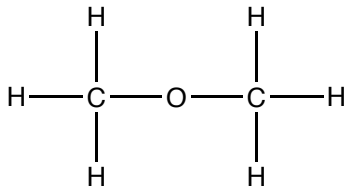
$2n + 2$

where n is the number of C atoms

How do other atoms effect the number of H atoms needed to saturate the C atoms?

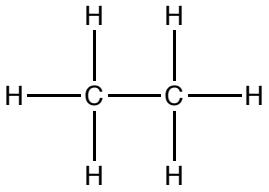
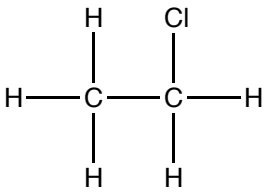
O or S atoms

nothing

Halogens

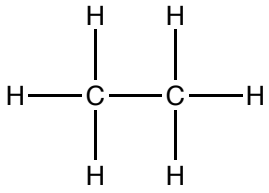
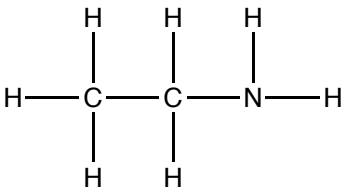
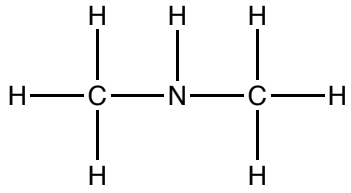
reduce the # of 'expected' H's by 1

N or P atoms

increase the # of expected H's by 1

pnictogen

17 - 9

7 7

$$\frac{\text{("expected" \# of H atoms)} - \text{(actual \# of H atoms)}}{2} = \text{degrees of unsaturation}$$

How do non C atoms effect the number of H atoms needed to saturated the bonding?

O or S atoms Halogens N or P atoms

("expected" # of H atoms) = 2 x (# C atoms) + 2 – (# halogen atoms) + (# of N atoms)

2·3+2 -1

(8 - 1)

degrees of unsaturation in

2·7+2 +1

16

C_3H_7ClO

0 degrees of unsaturation

saturated

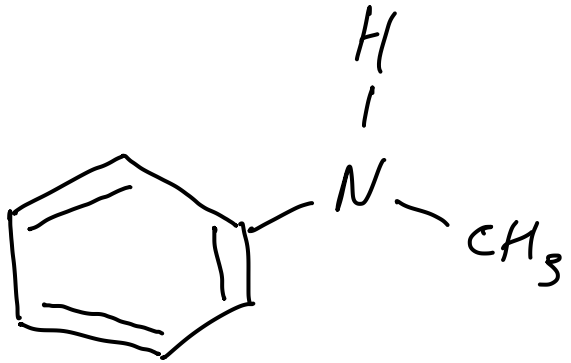
C_7H_9N

+1

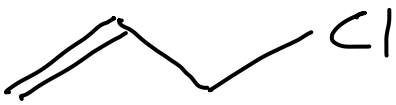
one N means room for 1 more H

4 degrees of unsaturation

4 degrees of unsaturation



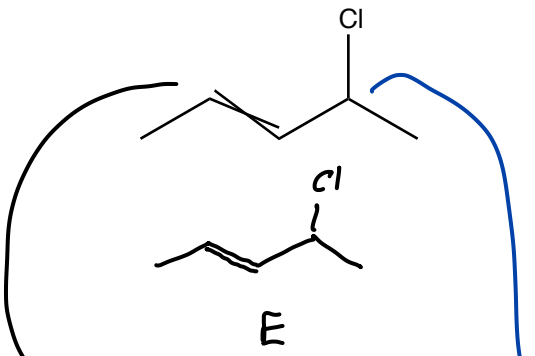
Allyl and Vinyl



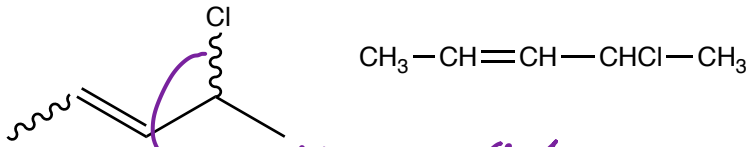
this Cl is in the allylic position

these positions are vinyl positions

Same rules as alkanes and alcohols, except, alkenes are a functional group, so the position of the double bond gets the lowest number and "ane" ending of parent hydrocarbon is changed to "ene".



criss-cross bond means mixture of both Z & E isomers



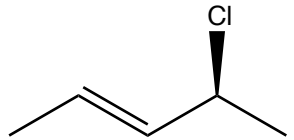
both Z+E

another way of saying R & S

both

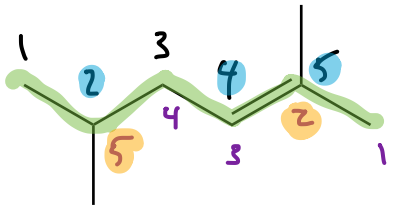
not specifying stereochemistry of this position

both R & S present

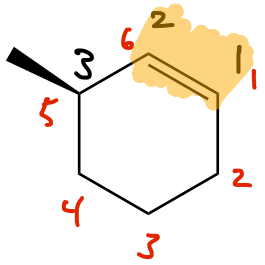


E S

hexane

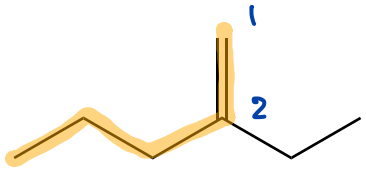


2,5-dimethyl-2-hexene



3-methyl-1-cyclohexene

pentane



2-ethyl-1-pentene

longest chain must contain the db