7.1 Industrial Preparation and Use of Alkenes

7.2 Calculating the Degree of Unsaturation
Calculate degrees of unsaturation 7-1 through 7-3, 7-34, 7-35, 7-67

7.3 Naming Alkenes
Naming and drawing structures 7-4 through 7-7, 7-22, 7-37 through 7-44

7.4 Cis–Trans Isomerism in Alkenes
Naming and drawing cis/trans alkenes 7-8 through 7-10

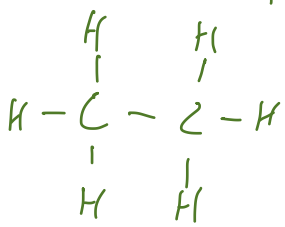
7.5 Alkene Stereochemistry and the E,Z Designation
Assigning priorities 7-11 and 7-12
Determining configuration and drawing alkenes 7-13 and 7-14, 7-23, 7-45 through 7-47, 7-53, 7-63, 7-65

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

CH_4

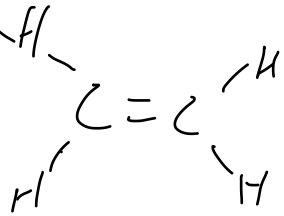
can't fit any more H atoms.... saturated

C_2H_4 vs C_2H_2 vs C_2H_6



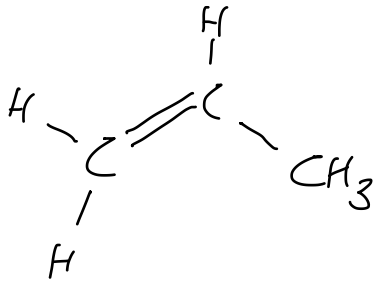
saturated

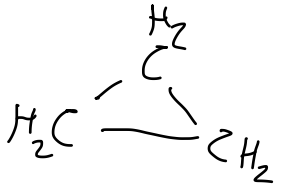
unsaturated room for more H atoms



$H-C\equiv C-H$

C_3H_6 vs C_3H_4 vs C_3H_8

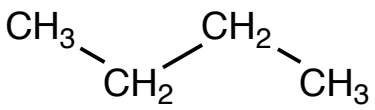


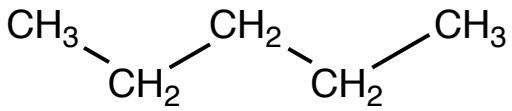


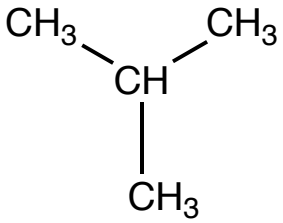
For each 2 H atoms lost, a π bond was added

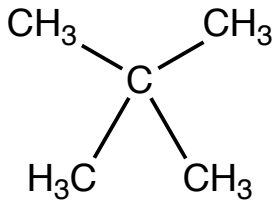
or a ring is added

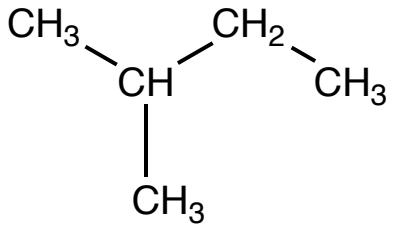
Degrees of Unsaturation: the number of H atoms needed to 'saturate' C atoms









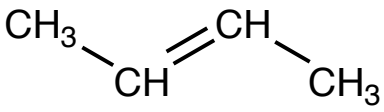


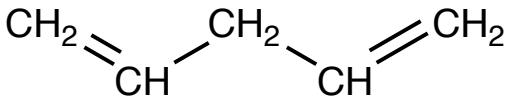
C_4H_{10}

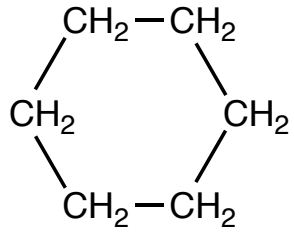
C_5H_{12}

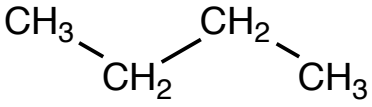
n $\quad$ $2n+2$

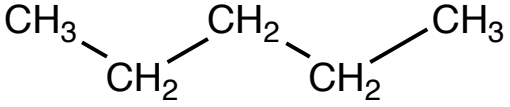
Degrees of Unsaturation

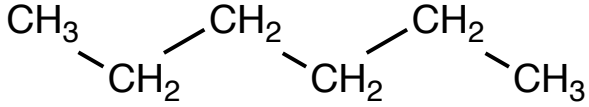










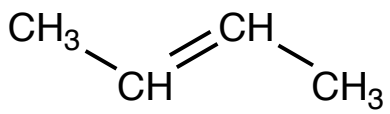


one degree of unsaturation means one π bond or one ring

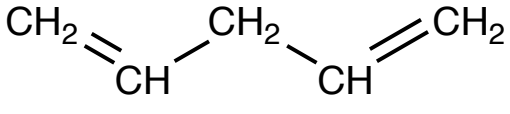
two degrees of unsaturation means two π bond, one π bond and one ring, or two rings

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

Degrees of Unsaturation

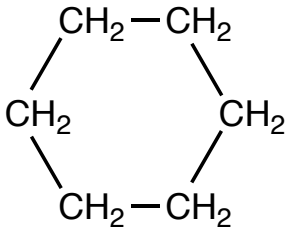


one degree

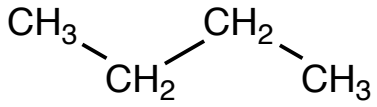


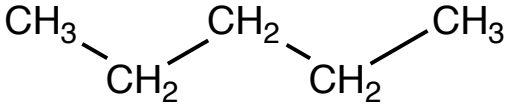
two degrees

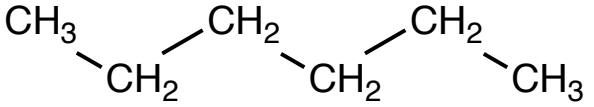
one degree



0 degrees of unsaturation







$2n+2$

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

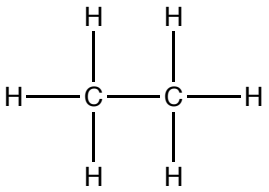
$$\frac{2(4)+2-8}{2} = \frac{10-8}{2} = 1$$

Degrees of Unsaturation: The presence of other atoms

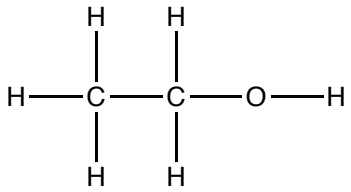
How do other atoms effect the number of H atoms needed to saturate the C atoms?

O or S atoms

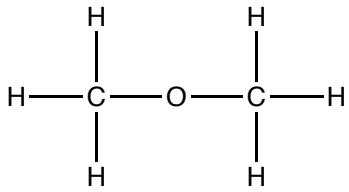
no change in # of H atoms needed



C_2H_6



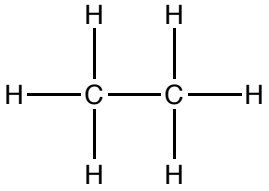
C_2H_6O

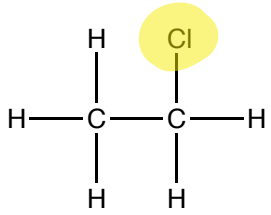


C_2H_6O

Halogens

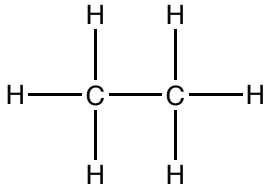
for each halogen added we need to lose an H atom

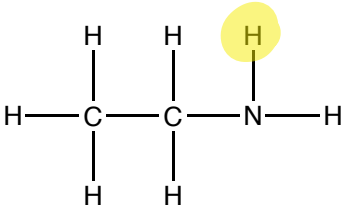


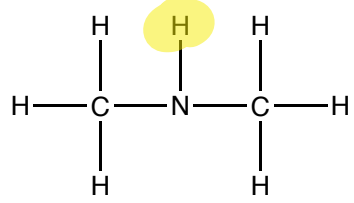


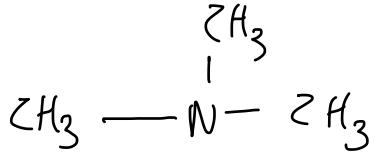
N or P atoms

for each N or P we add an H









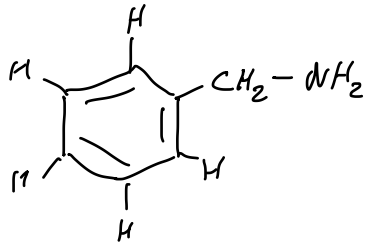
$$\frac{\text{("expected" \# of H atoms)} - \text{(actual \# of H atoms)}}{2} = \text{degrees of unsaturation}$$

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)

degrees of unsaturation in



C_3H_7ClO

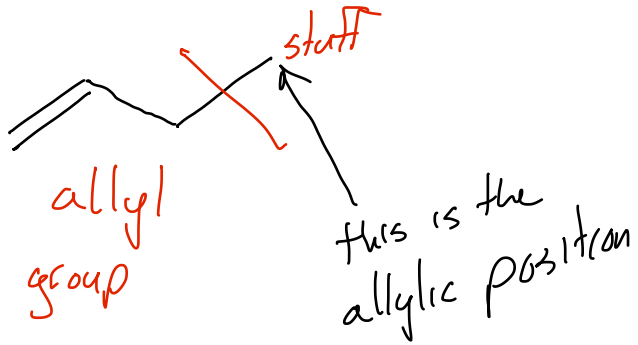
$$\frac{2\times3+2-1-7}{2} = \frac{0}{2}$$

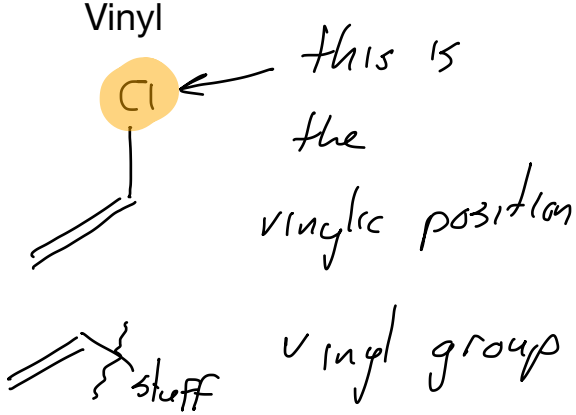
C_7H_9N

$$\frac{(2\times7+2+1)-9}{2} = \frac{8}{2} = 4$$

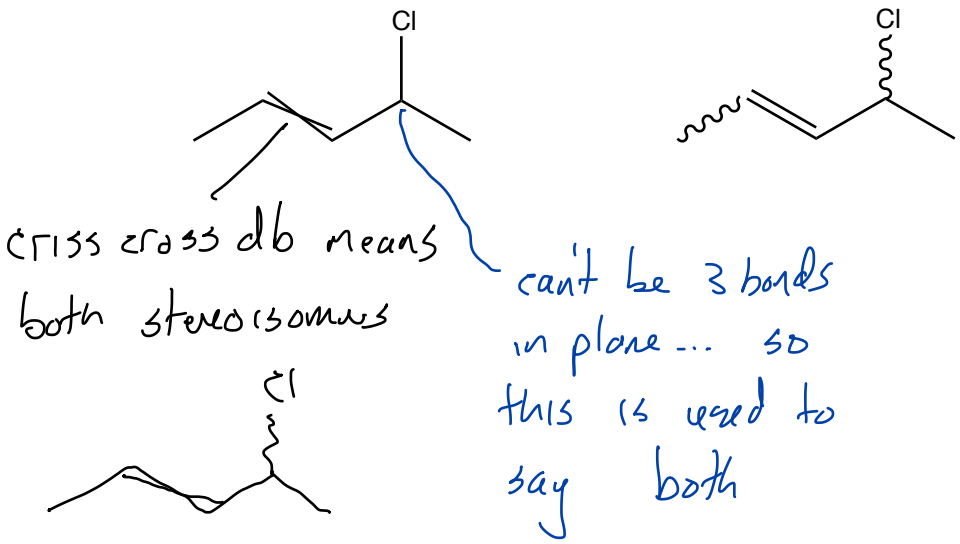
A note on some special names

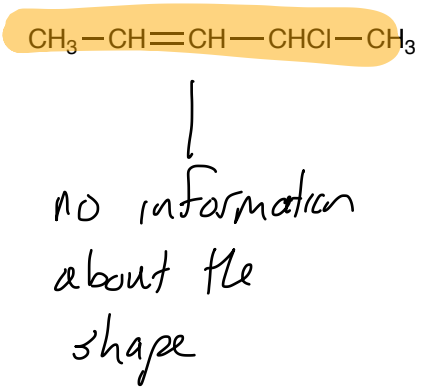
Allyl and Vinyl

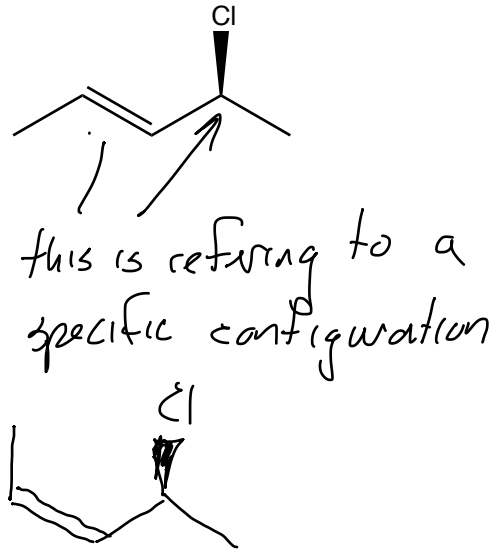




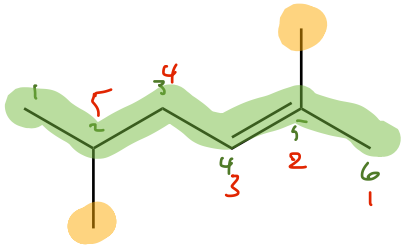
A note on how structures are drawn



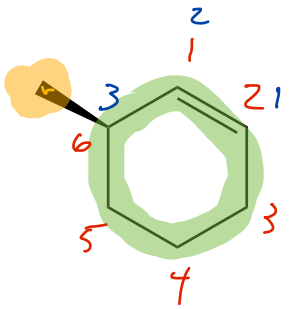




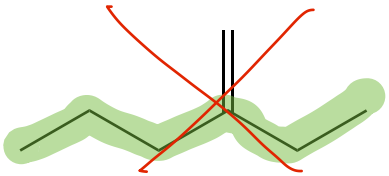
Same rules as alkanes except, alkenes are a functional group, so the position of the double bond gets the lowest number and "ane" ending of parent hydrocarbon is changed to "ene" and the double bond **must** be contained in the longest carbon chain.



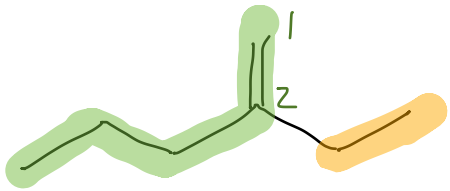
hexane → 2,5-dimethyl-2-hexene



3-methylcyclohexene



chain does not contain db

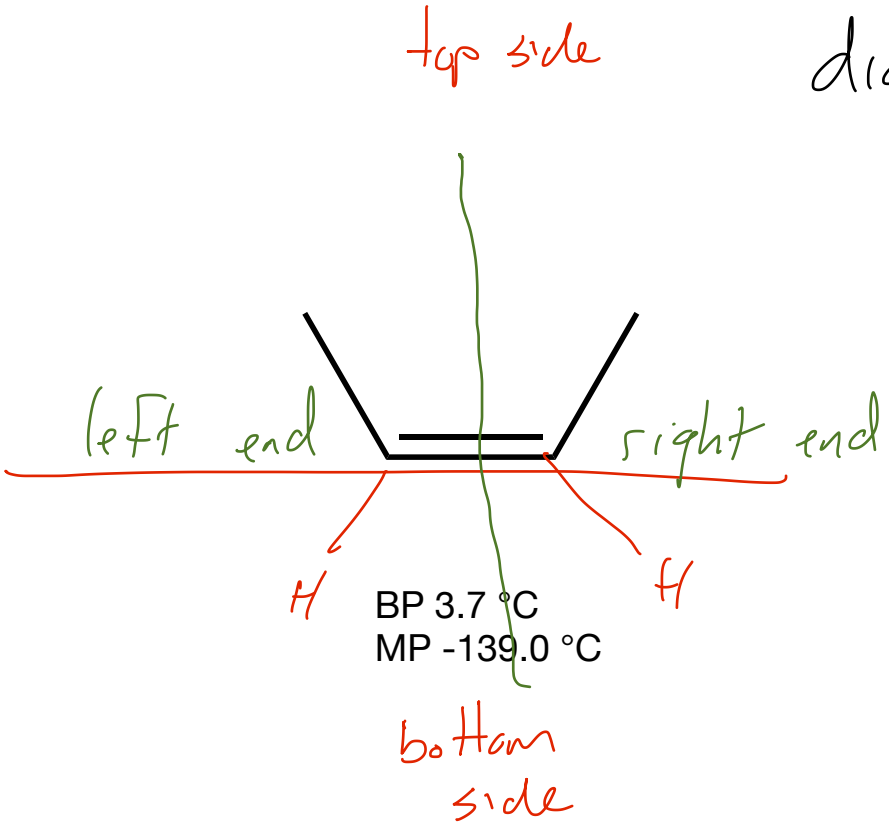


2-ethylpent-1-ene

/

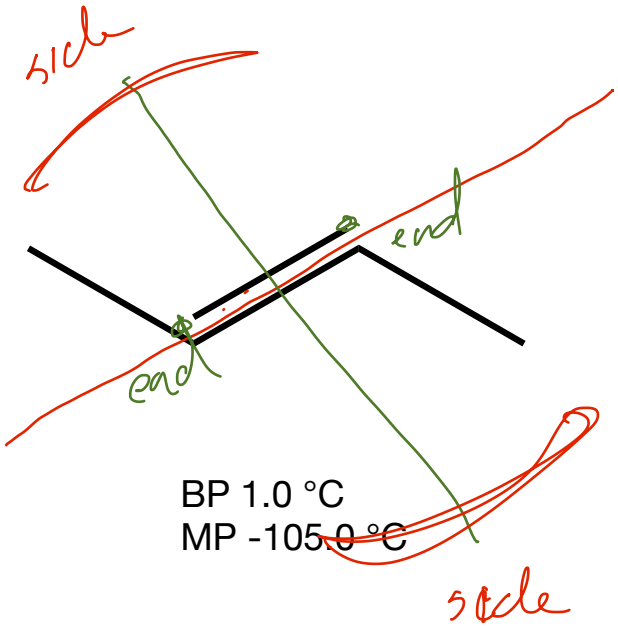
2-ethyl-1-pentene

Convert $CH_3–CH=CH–CH_3$ to a skeletal structure

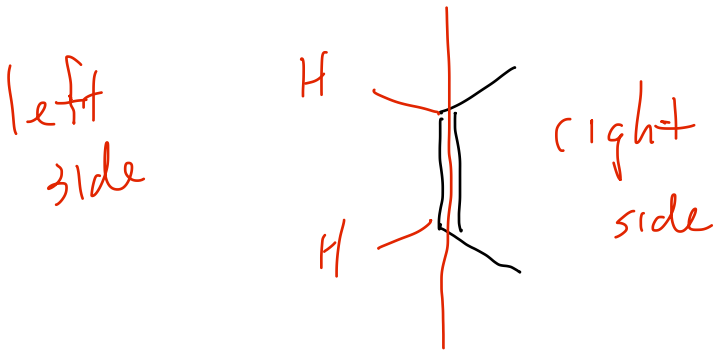


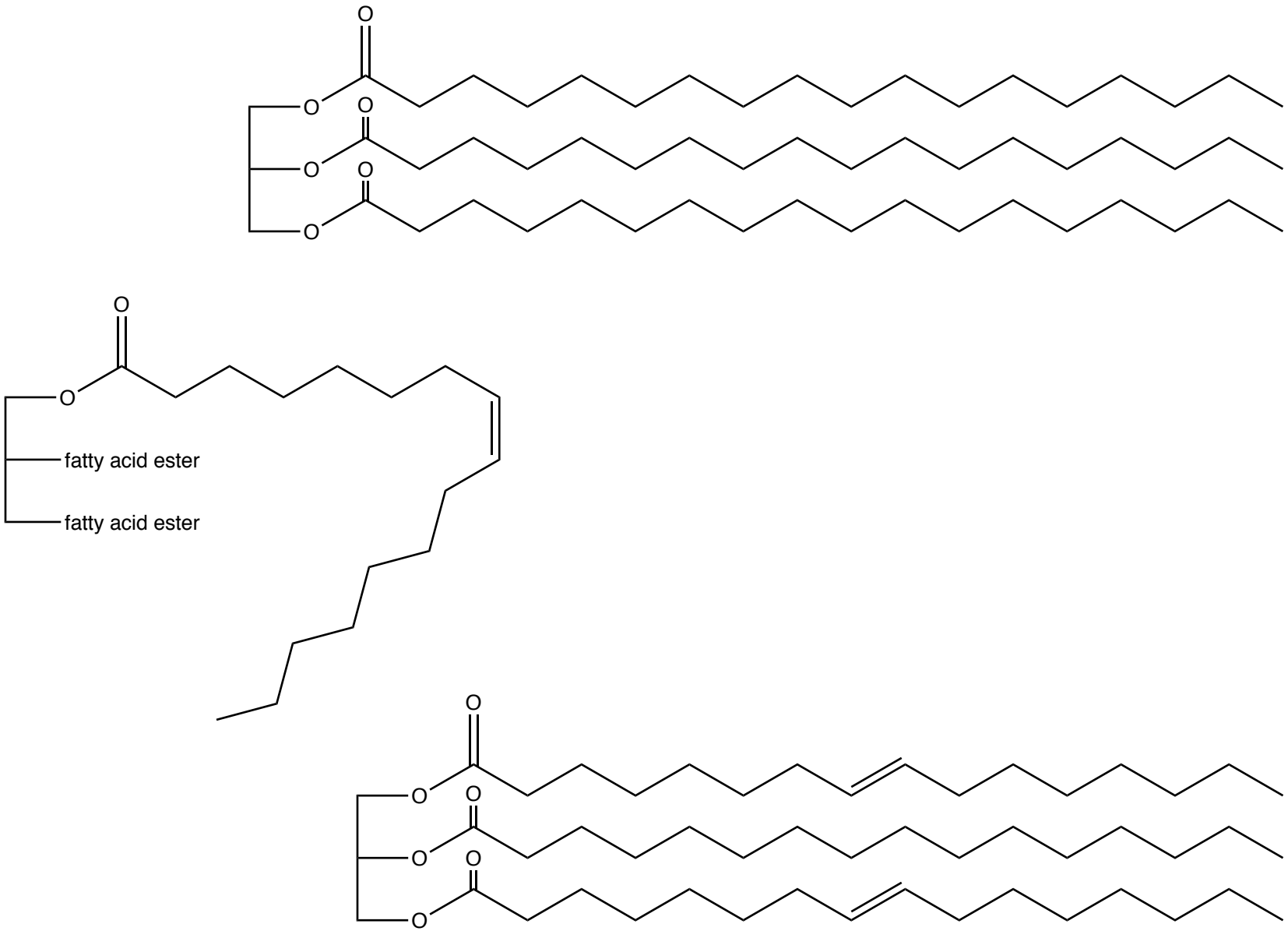
BP 3.7 °C
MP -139.0 °C

diastereomers



BP 1.0 °C
MP -105.0 °C




fatty acid ester
fatty acid ester