

Course 343 Lecturer Sam Gillman  
Day Wednesday Date 9-21-16  
Notes Taken By Nels Gerstner Total # of Pages 4

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Recall: Acid strength  $\rightarrow$   $pK_a$  scale  
Relationship between structure and  $pK_a$ .

Example:

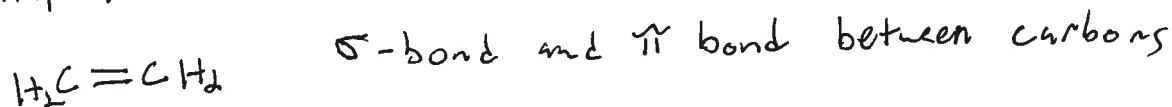


Ch. 4 - Alkenes

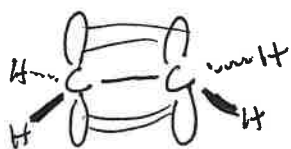
Hydrocarbons, have at least one  $C=C$

Rec. Problems - 2, 3, 6, 10, 13, 16-27, 30-39, 42-44, 47-55,  
57-67

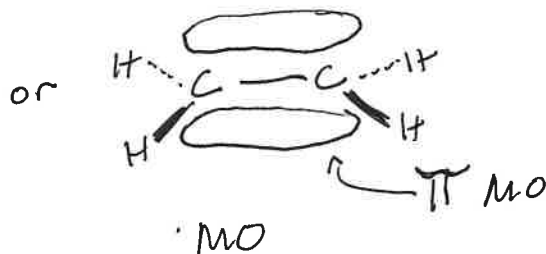
Simplest alkene



"Hybrid drawings"

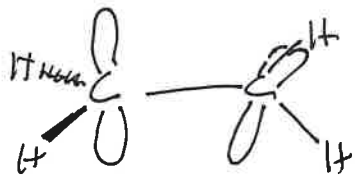


"AOs combining"

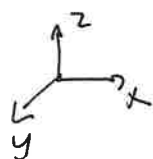


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"twisted" ethylene — unstable!



No  $\pi$  bond, p orbitals are orthogonal (perpendicular) to each other. No overlap because one is oriented in z direction, one is oriented in y direction.



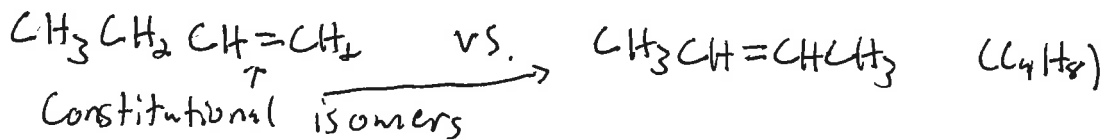
Bond energies

C-C  $\sigma$  bond  $\sim$  90 kcal/mol

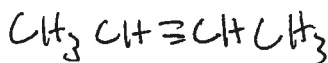
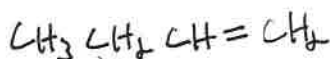
C-C  $\pi$  bond  $\sim$  60 kcal/mol

Because of  $\pi$  bond strength, alkene stereoisomers do not interconvert spontaneously.

Isomer = different molecules w/ same molecular formula.



~~Remember~~  
 Note

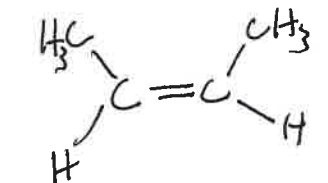


2-butene

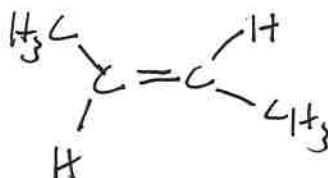
location of double bond — 1-butene  
 how long is chain — tells us double bond

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There are 2 stereoisomers of 2-butene (~~because~~ because there is no spontaneous rotation around C=C  $\pi$  bond).



cis-2-butene



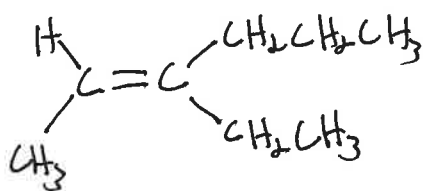
trans-2-butene

stereoisomers, only differs in spatial arrangement of atoms

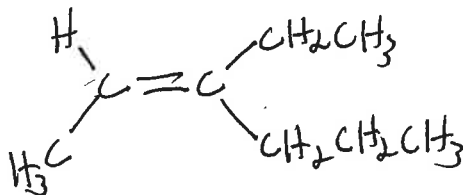
It costs ~60 kcal/mol to interconvert cis and trans-2-butene (loss of  $\pi$  bond @ Transition State)

(compare to rotation about central C-C bond in butane, which is much, much lower<sup>er</sup> in energy.)

More complex alkenes, use E and Z to denote stereoisomers.



vs.



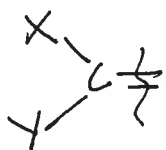
E for Entgegen (opposite)

Z for Zusammen (same)

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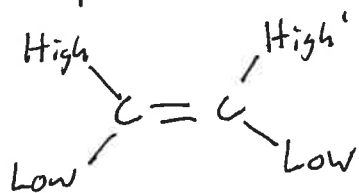
Designation of E vs. Z = "defined skill"

Central concept: Assigning priority to substituents.  
 For ~~an~~ an alkene:

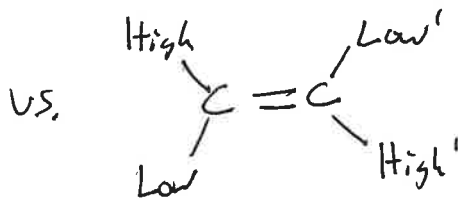


X vs Y - which has higher priority?

2 possibilities

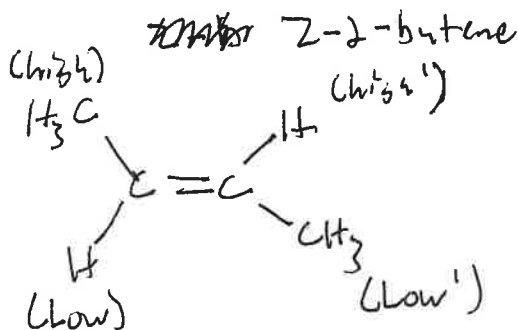
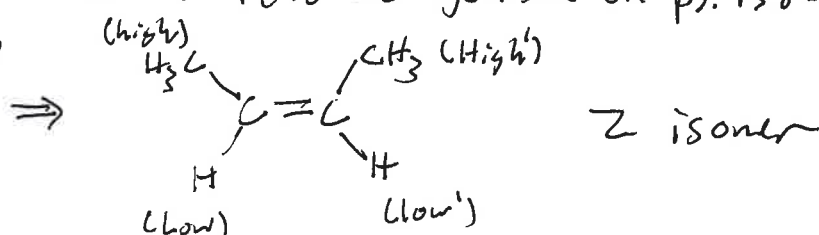
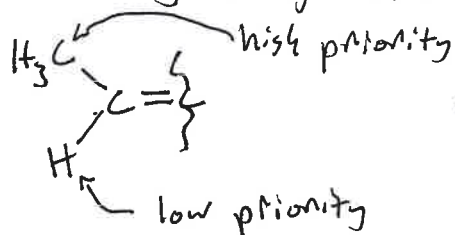


Z isomer



E isomer

Priority assignment rules → read for yourself on ps. 138-143



E isomer

E-2-butene