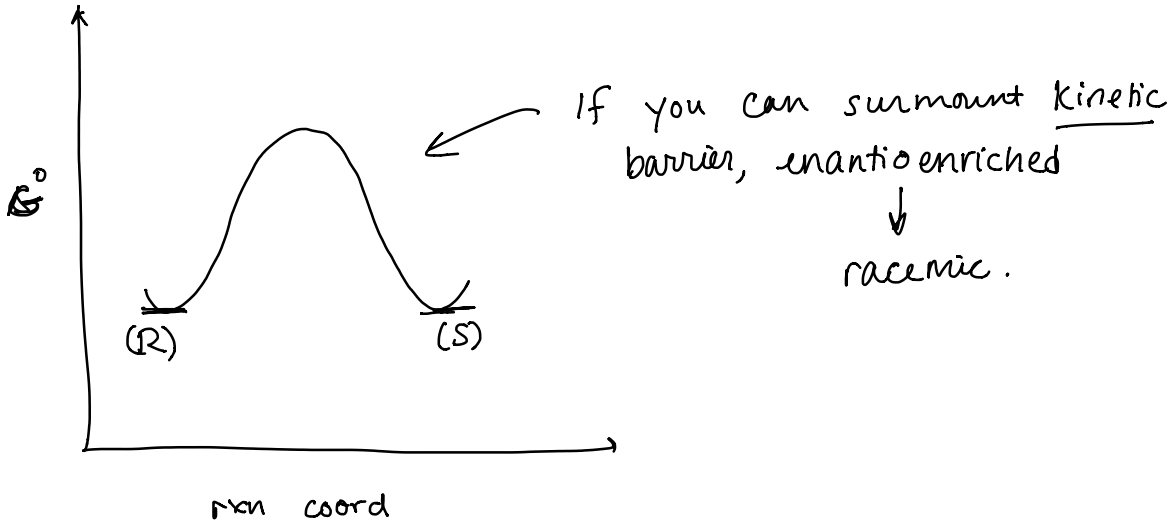
Lecture 8: Conformational Analysis

Announcements:
- Problem Set 2 due now.
- Office hours next week: Mon @ 1:30pm, 208 LDL
  Wed @ 2:30pm, ~~room TBA~~ 208 LDL
- OJC @ 12:30, 219 BRL TODAY

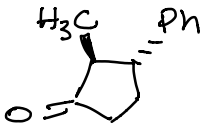
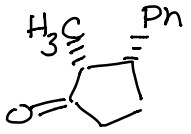
Today:
- Diastereomers
- Conformational Analysis of Acyclic Systems

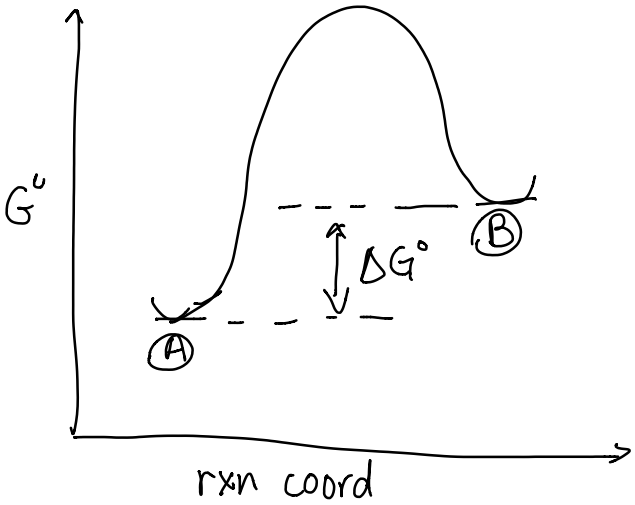
Enantiomers: Same ΔG°



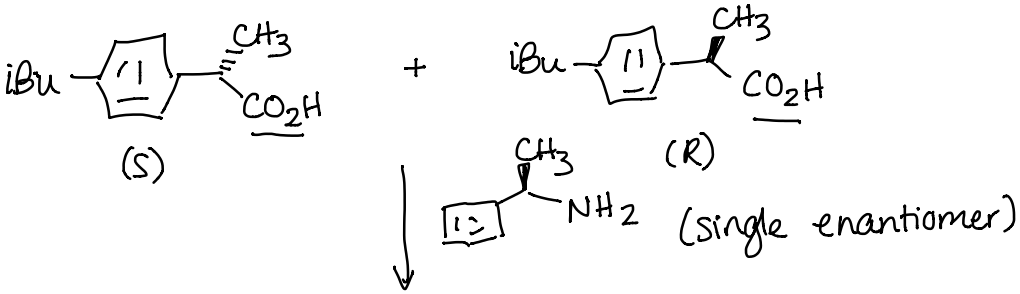
Diastereomers

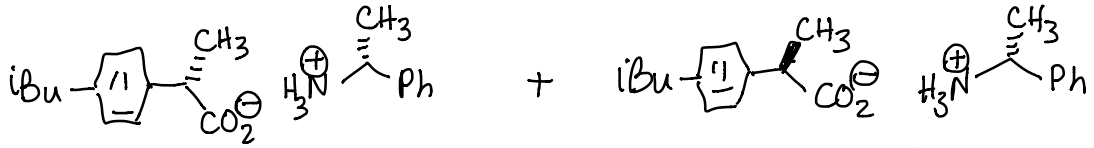
- same connectivity
- different conformations
- not enantiomers
- usually ≥ 2 stereocenters

ex:  vs. 



Classical Resolution (Ibuprofen)





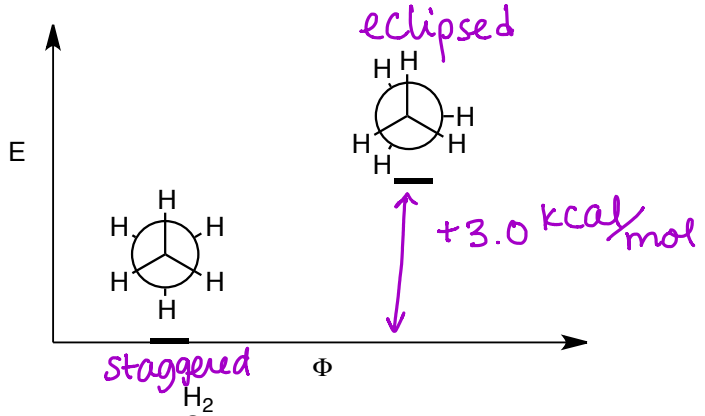
diastereomers → Separate by recrystallization. ☺

Interactions that govern simple systems = interactions that govern complex systems.

How much energy does each interaction cost?

Torsional Energy Profiles

Ethane H_3C-CH_3



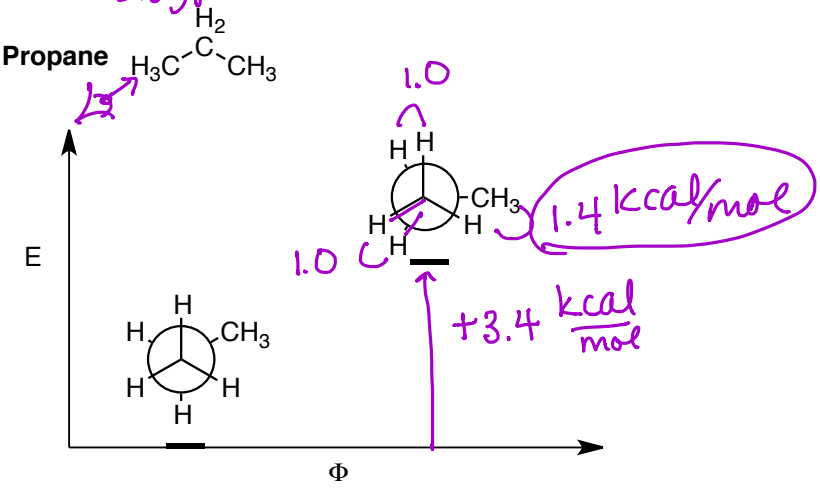
Energy / interaction?

Eclipsed Atoms	δE (kcal/mol)
3 × (H-H)	$\frac{3.0}{3} = +1.0 \frac{kcal}{mol}$

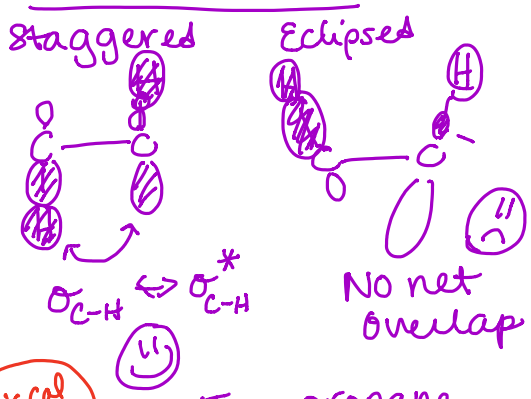
Steric Effect?

Ethane: No overlap of van der Waals radii

Propane $H_3C-CH_2-CH_3$

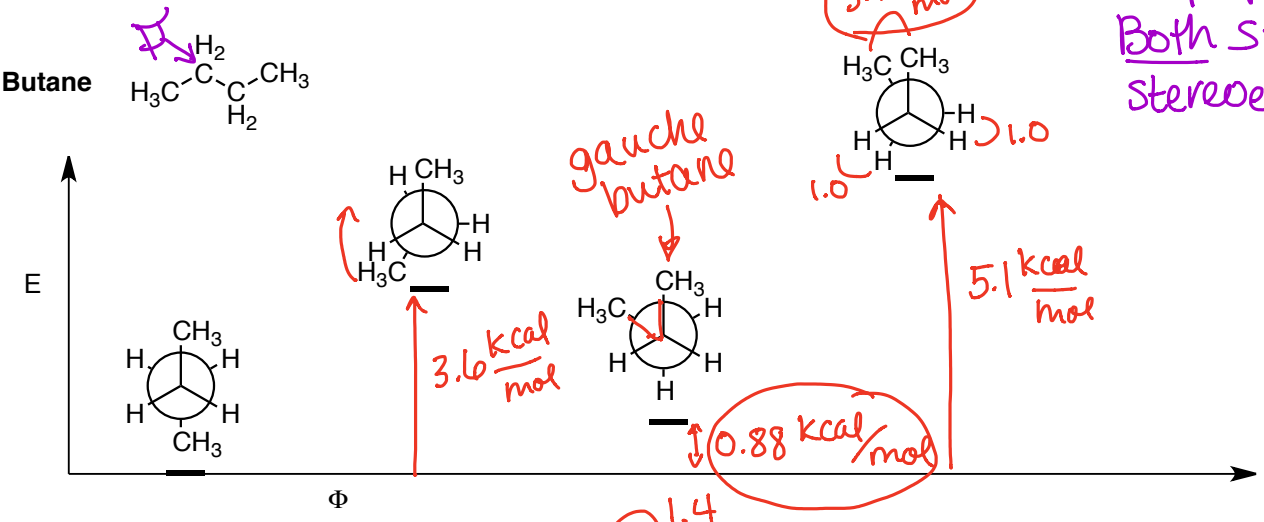


Stereoelectronic?

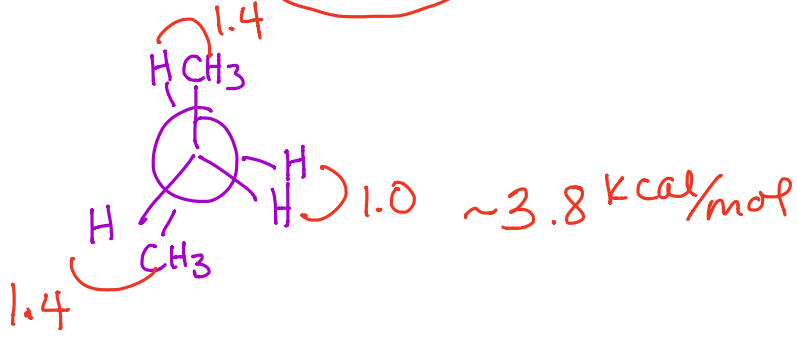


For propane, Both steric & stereoelectronic.

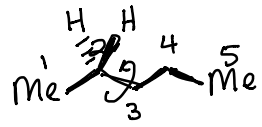
Butane $H_3C-CH_2-CH_2-CH_3$



Back of the envelop:

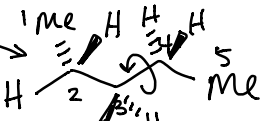


Pentane



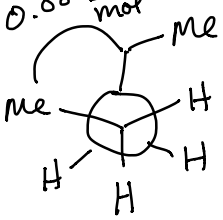
trans, trans

2,3 rotation ⇌



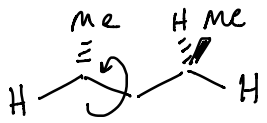
gauche(2,3) – anti(3,4)

~ 0.88 kcal/mol



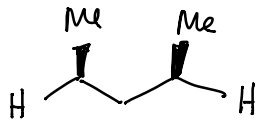
1,3-dimethyl eclipsing

3,4 rotation ⇌



gauche(2,3)-gauche(3,4)

↓↑

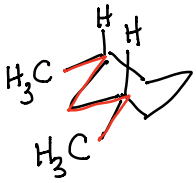


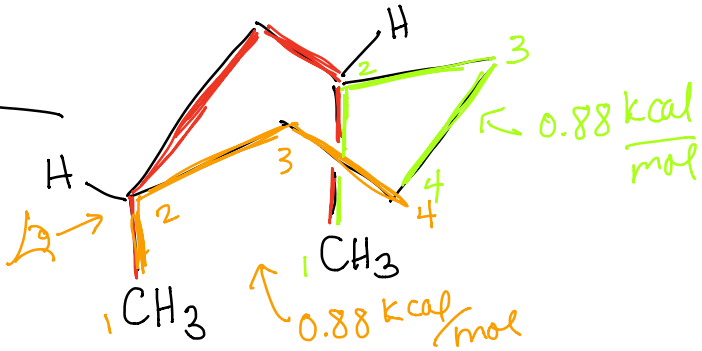
double gauche pentane

← NEW INTERACTION!

syn-pentane

Model System





0.88 kcal/mol

0.88 kcal/mol

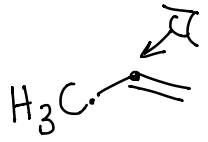
$$\Delta G^\circ = +5.5 \text{ kcal/mol} - 2(0.88 \text{ kcal/mol})$$

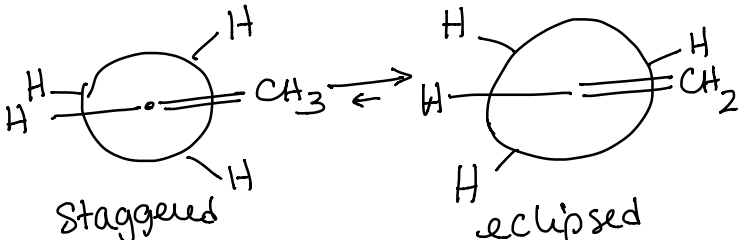
$$+3.7 \text{ kcal/mol} \Rightarrow \text{syn-pentane}$$

Propane vs. Propene

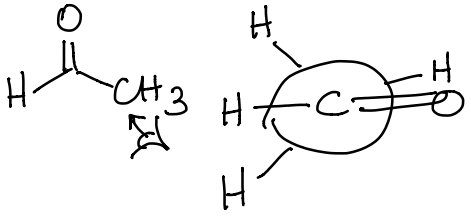
staggered is better

eclipsed is better



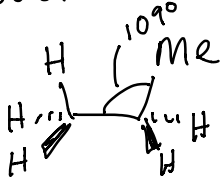


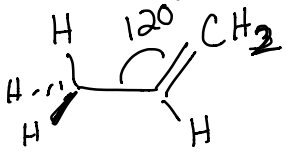
$\Delta E = -2.0 \frac{kcal}{mol}$

Also true for  Lowest energy conformation.

Why?

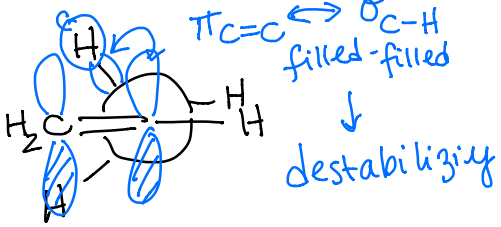
1) It's not as bad as it looks.

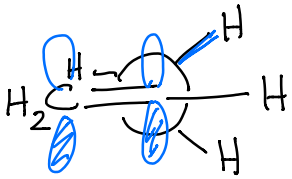




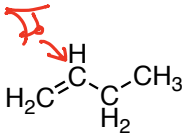
Less steric clash

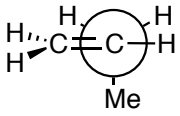
2) New destabilizing effect

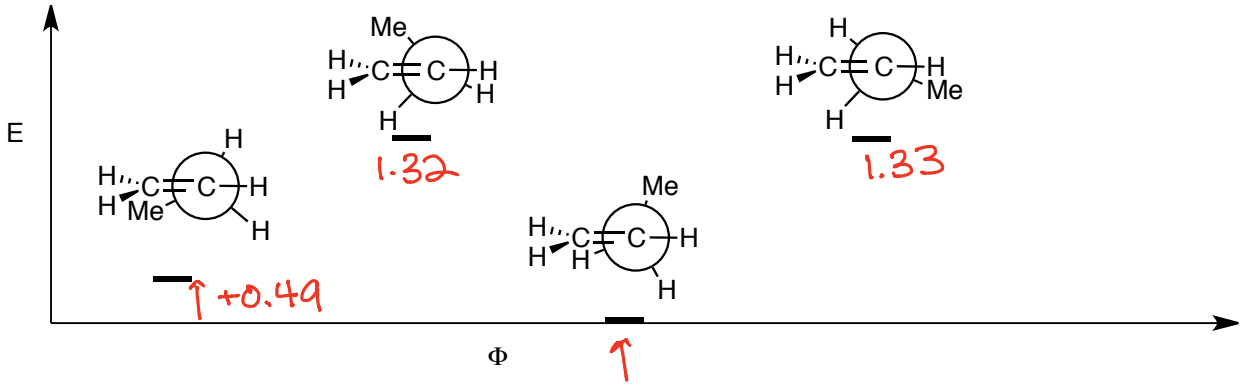




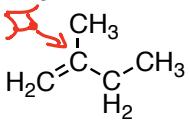
Butene

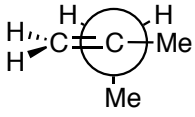


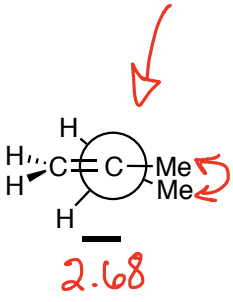


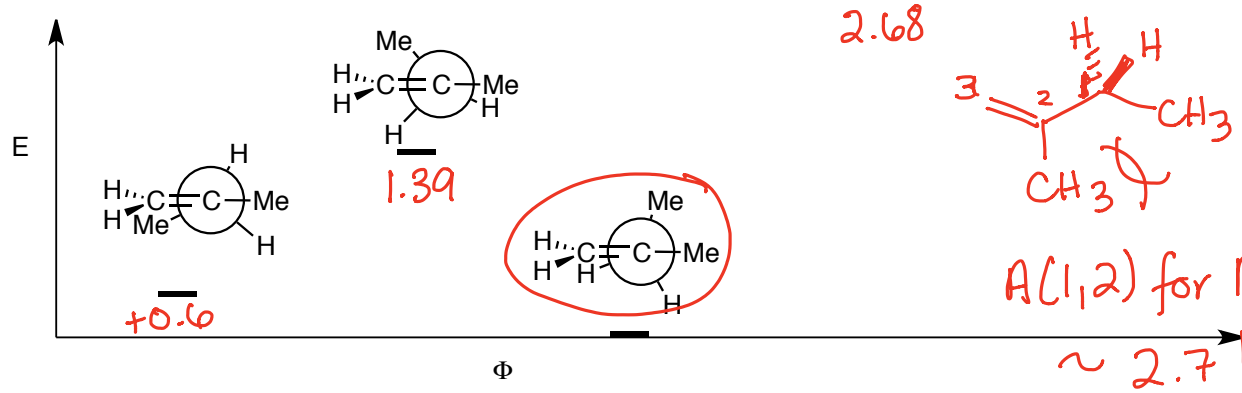


2-Methyl-1-Butene









(*Z*)-2-pentene