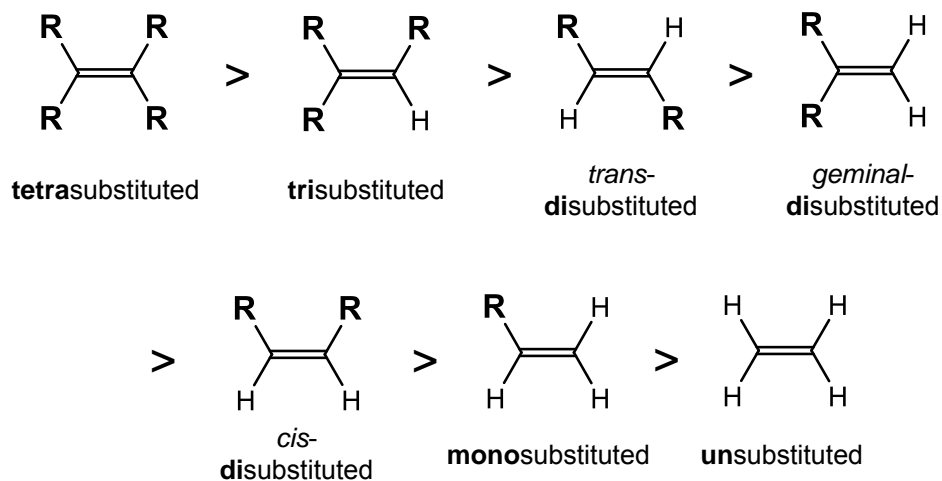


Relative Stability of Alkenes

- More substituted alkenes are more stable.
- Having sterically demanding substituents on opposite sides of an alkene is better than on the same side.

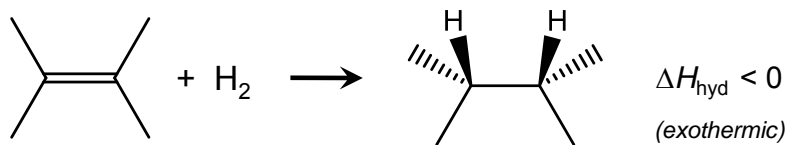
Stability:



Molar Heats of Hydrogenation of Alkenes

Originally, differences in alkene stability were discovered via differences in their hydrogenation enthalpy.

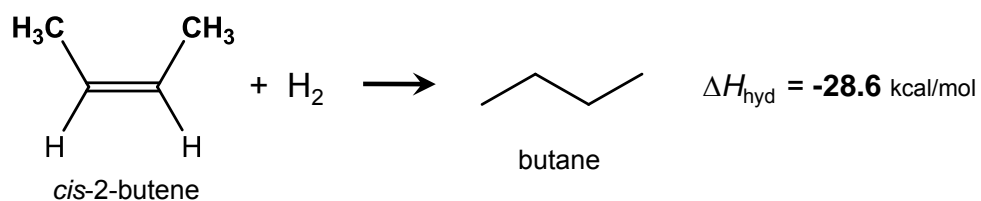
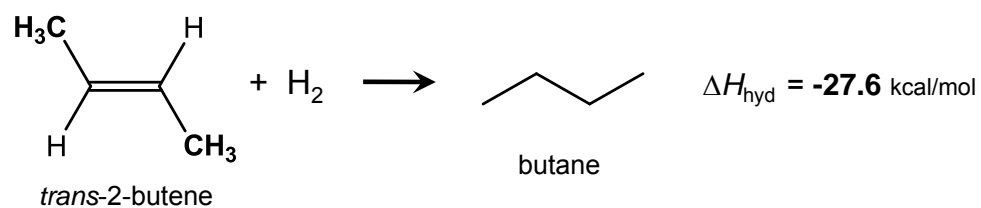
Hydrogenation:



Don't worry about mechanism, etc.

Just using this reaction to think about alkenes.

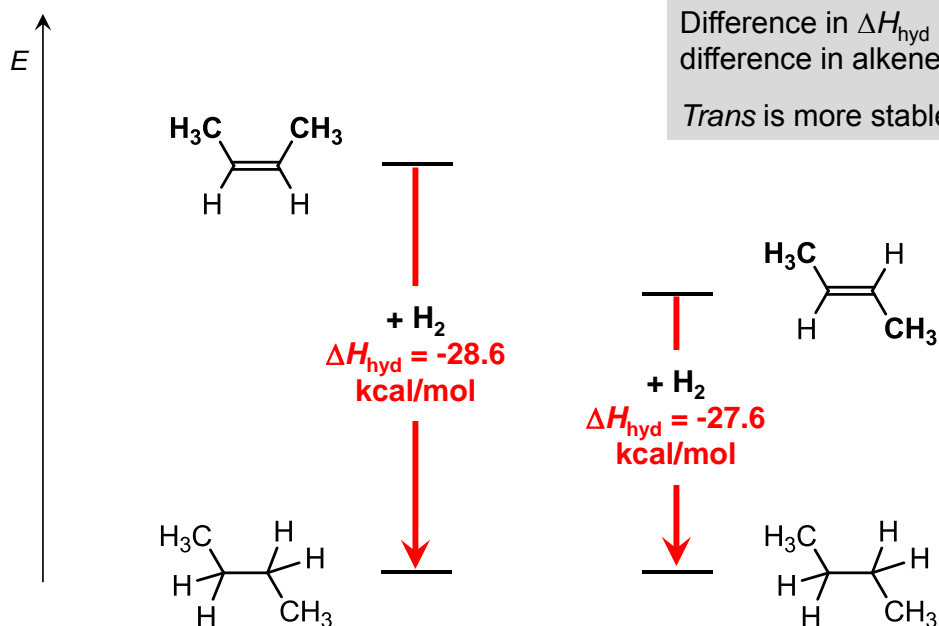
Molar Heats of Hydrogenation of Alkenes



Question: These two reactions both convert C_4H_8 to the same product. But they have different reaction energies. Why?

Answer: Difference in ΔH_{hyd} reflects difference in alkene stability.

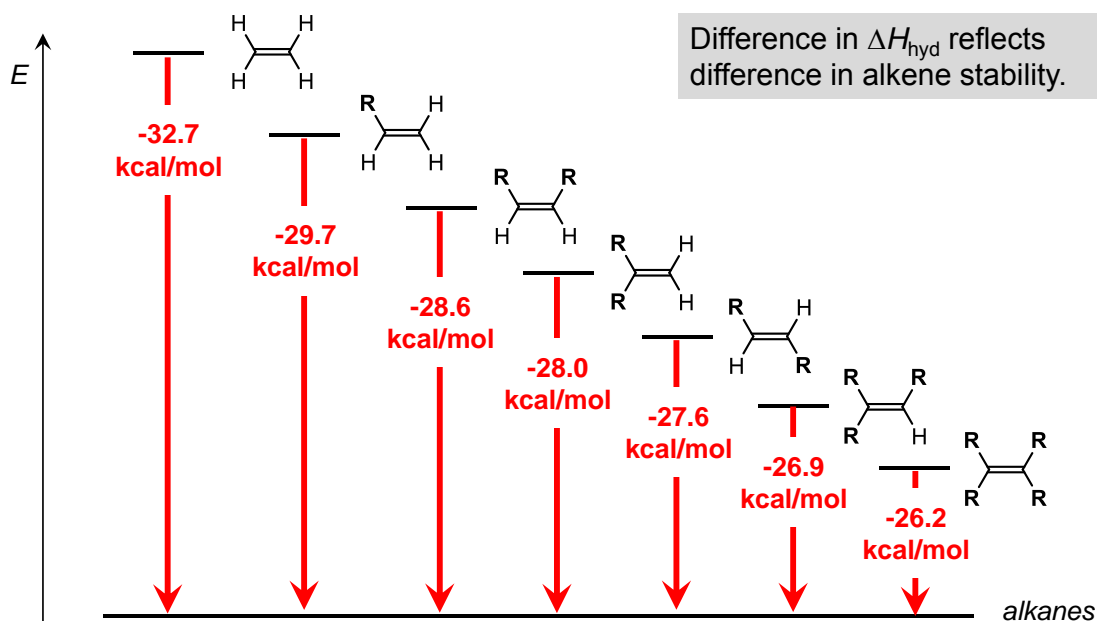
Relative Stability of Alkenes, Based On Molar Heats of Hydrogenation



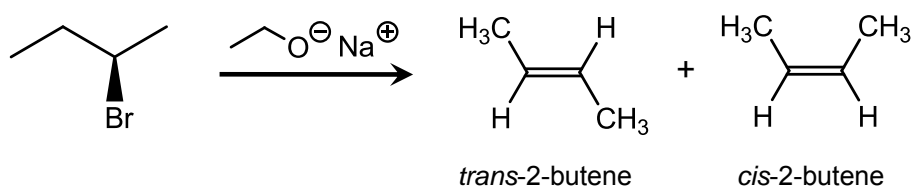
Difference in ΔH_{hyd} reflects difference in alkene stability.

Trans is more stable than *cis*.

Relative Stability of Alkenes, Based On Molar Heats of Hydrogenation

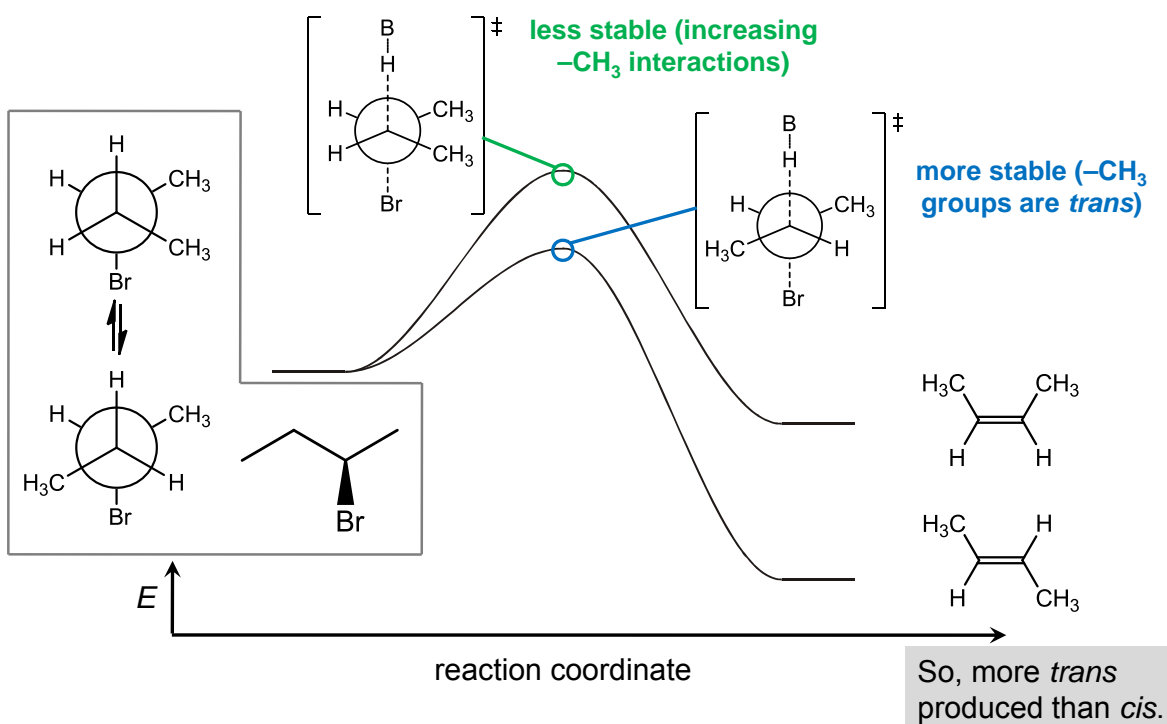


Elimination Reactions Typically Produce the Most Stable Alkene Product



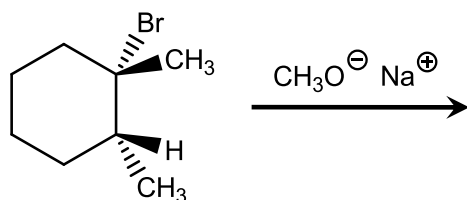
Which product would predominate? Why?

Elimination Reactions Typically Produce the Most Stable Alkene Product



Zaitsev's Rule: Elimination Reactions Produce the Most Substituted Alkene

In-Class Exercise:

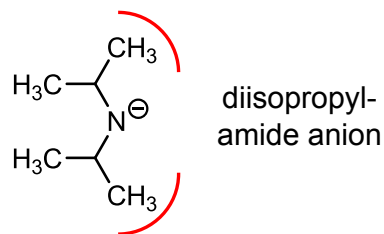
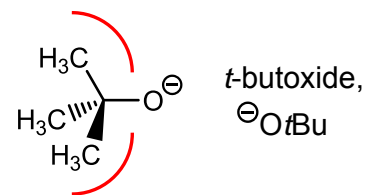
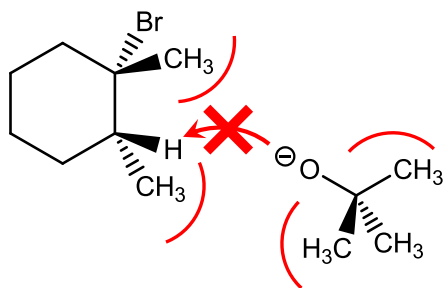


What three products would be generated?
Which would be favored?

Exception to Zaitsev's Rule: Sterically Hindered Bases

If the electron-donating atom in the eliminating base is sterically hindered, the base cannot access 3° or 2° protons as easily.

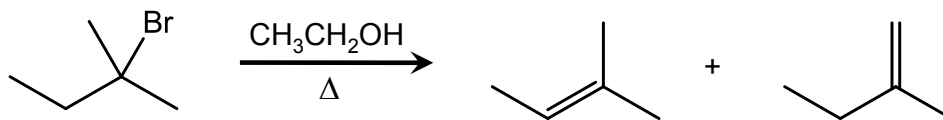
Example:



Result: Elimination here favors least substituted alkene. (Sometimes called "Hofmann selectivity".)

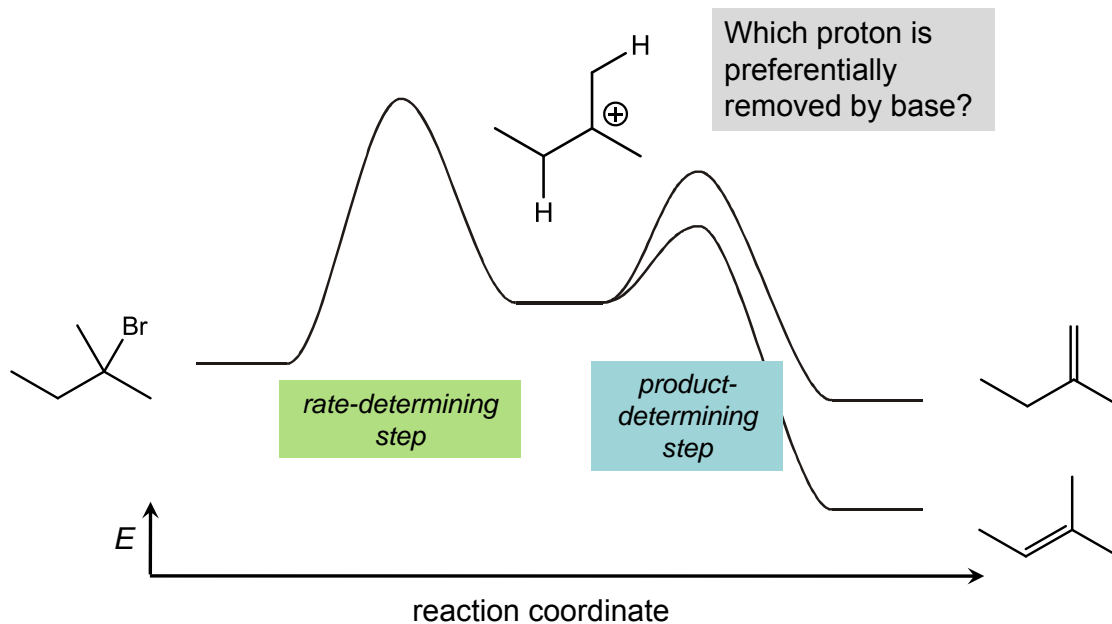
E1 Also Produces the Most Stable, Most Substituted Alkene Product

(Zaitsev's Rule also applies to E1.)



Which product would predominate? Why?

E1 Also Produces the Most Most Stable, Substituted Alkene Product



Predicting Reaction Patterns

S_N2

- Unhindered 1° halides as substrates (2° ok)
- Better nucleophiles than bases:
 I^- , Br^- , $CH_3CO_2^-$, RS^- , HS^- ,
 CN^- , N_3^-

E2

- 2° or 3° halide as substrate
- Better bases than nucleophiles:
 HO^- , RO^- , (esp. $tBuO^-$),
 $RC\equiv C^-$, R_3N , H_3N
- Preferred over S_N2 when product alkene is highly substituted

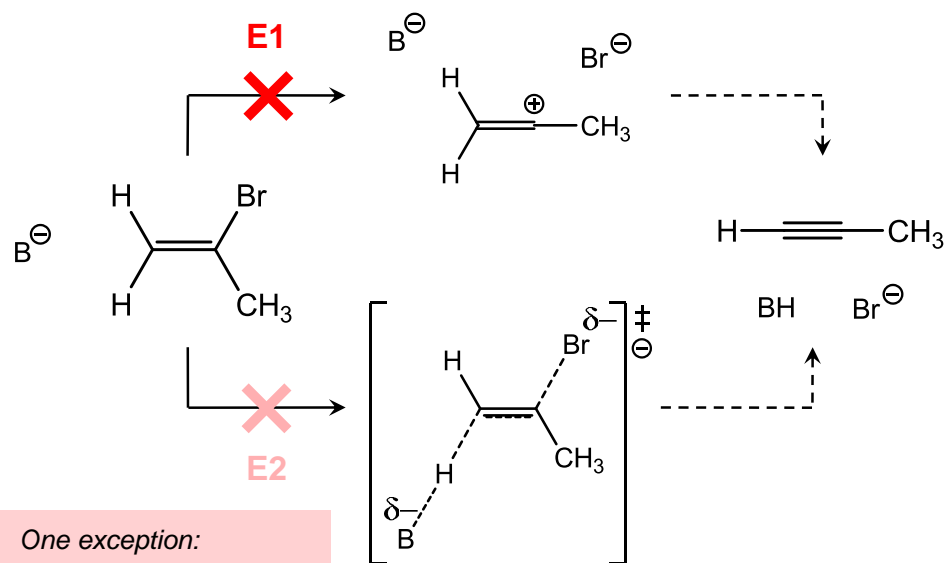
S_N1

- 2° or 3° halide as substrate
- Neutral or acidic conditions, Δ
- Better nucleophiles than bases:
 RSH , H_2S , CH_3COOH

E1

- 2° or 3° halide as substrate
- Neutral or acidic conditions, Δ
- Better bases than nucleophiles:
 H_2O , ROH
- Preferred over S_N1 when product alkene is highly substituted

E1 and E2 at sp^3 -Hybridized Carbon Only



One exception:

