Hello y’all!

Looking for a low-pressure way to get moving and meet new people?

Hooked on Running is here to make that happen! No pressure, no experience, and no one gets left behind.

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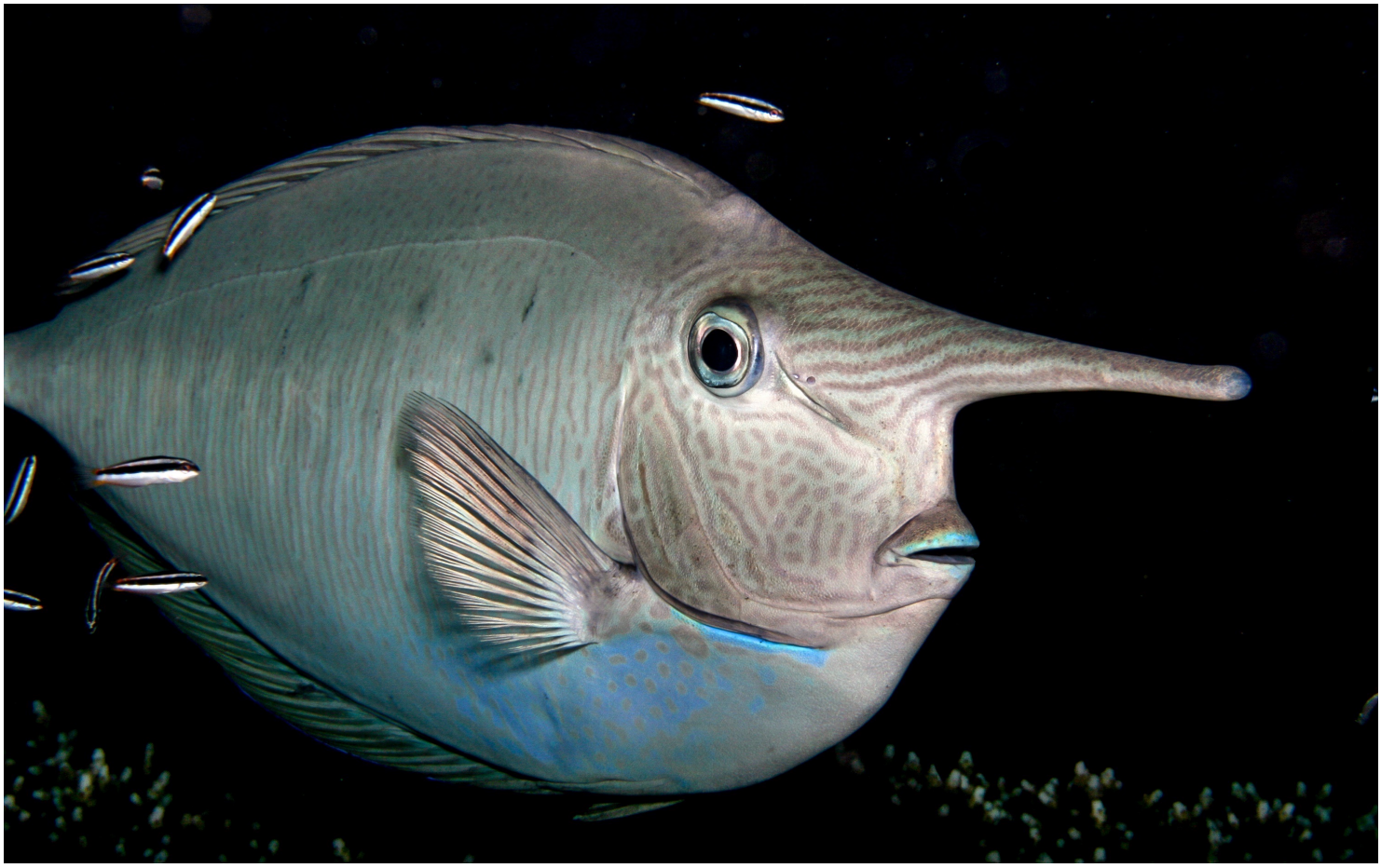
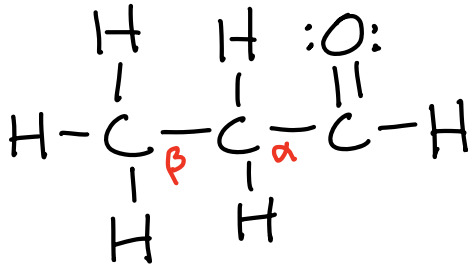
Hooked ON RUNNING

THE RUNNING ORG FOR longhorns

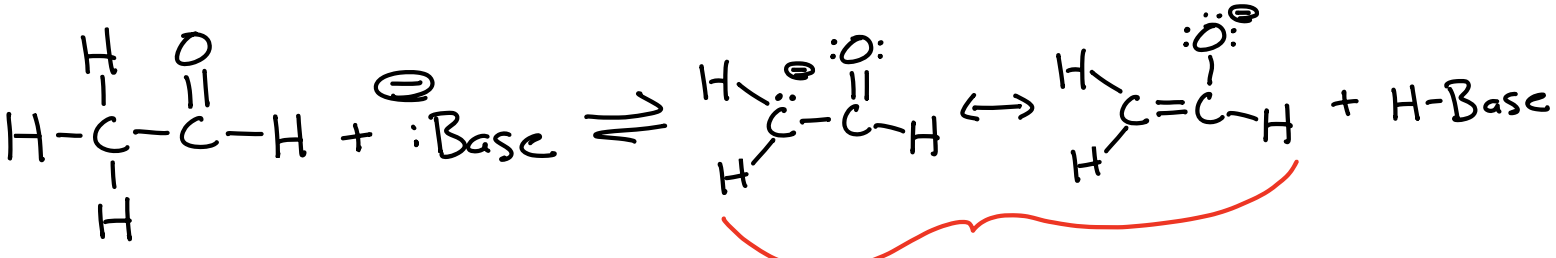




The C atom adjacent to a carbonyl is called the α carbon. The next C atom is called the β carbon.

The H atoms on the α carbon are called α hydrogens

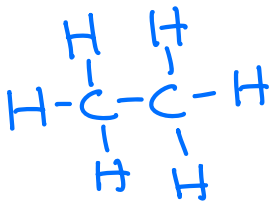
α hydrogens are extremely acidic for a C-H bond



$pK_a = 18$

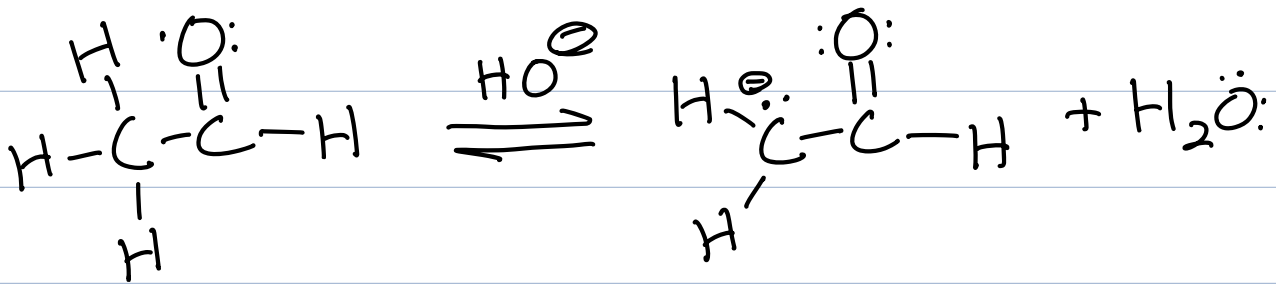
stabilized by delocalization of ⊖ charge and a π-way

Compare:



$pK_a = 51$

Another Movie Rips Off Organic Chemistry



Aldehyde

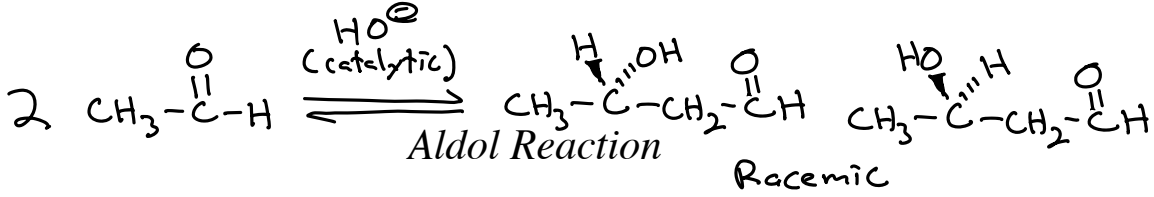
Enolate

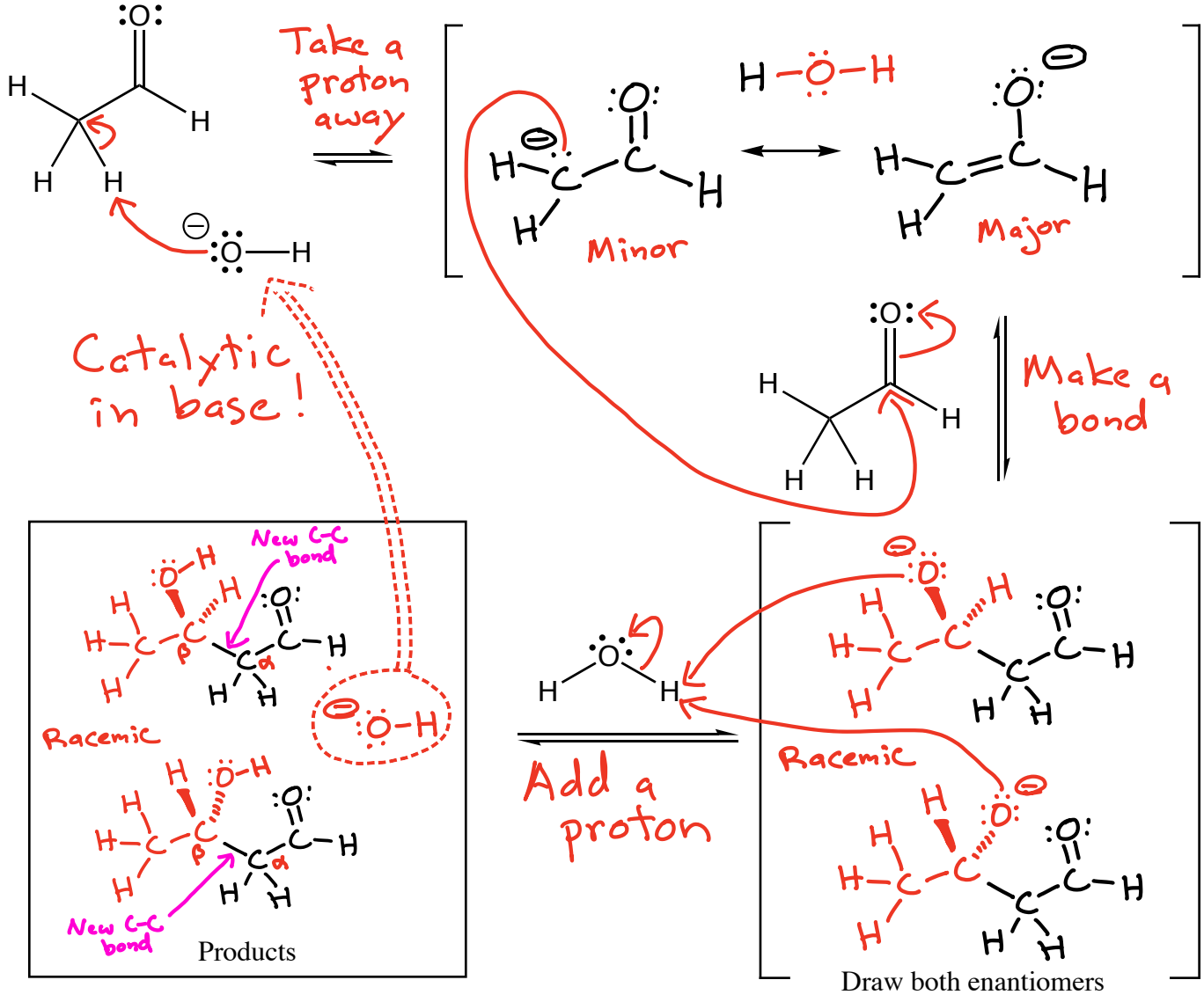
Is Attacked By Enolate

Attacks Aldehyde

Austin Powers

Dr. Evil



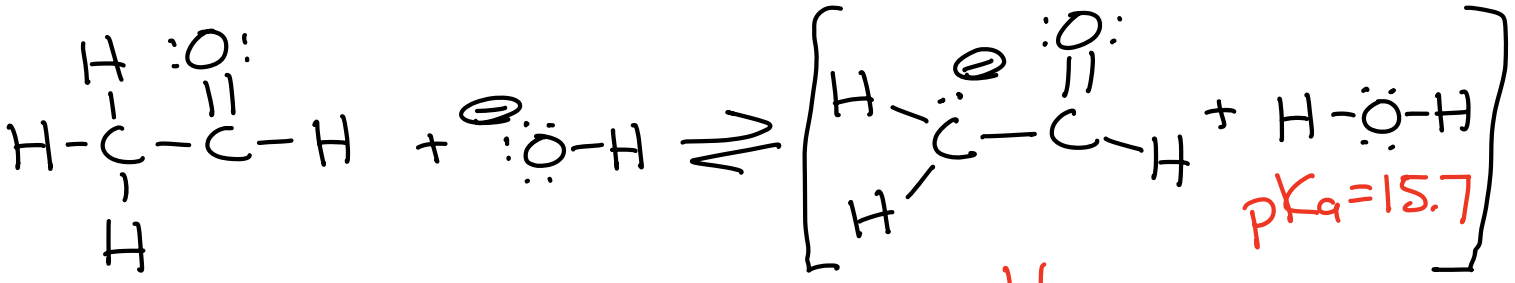


KRE → β-hydroxy aldehyde with a new C-C bond between the aldehyde α and β carbons

Mechanism A

Aldol Reaction Considerations

1) When $HO^{\ominus}$ is used as the base, equilibrium of the first step favors the aldehyde

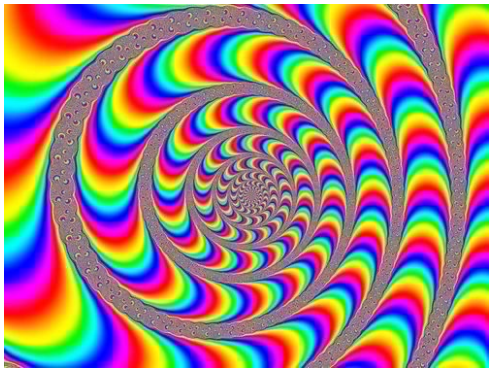


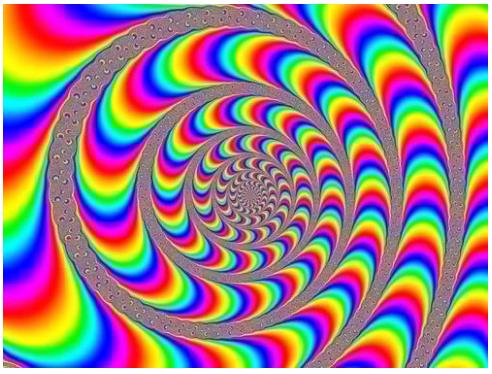
This side favored at equilibrium ⟹ There will be excess aldehyde for the enolate to react with

2) Because there is $HO^{\ominus}$ present at the beginning and end of the reaction there is little driving force (motive) for the aldol reaction → the aldol reaction is reversible

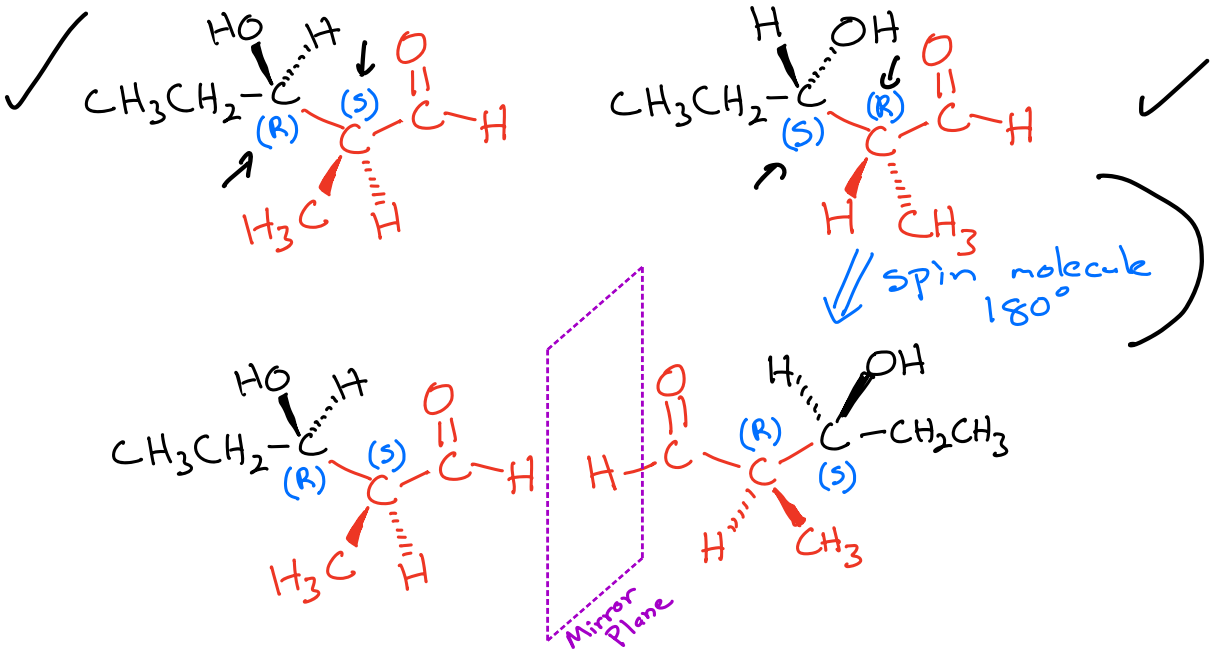
3) The aldol reaction is favorable for aldehydes but NOT for ketones

4) The reaction can make two new chiral centers

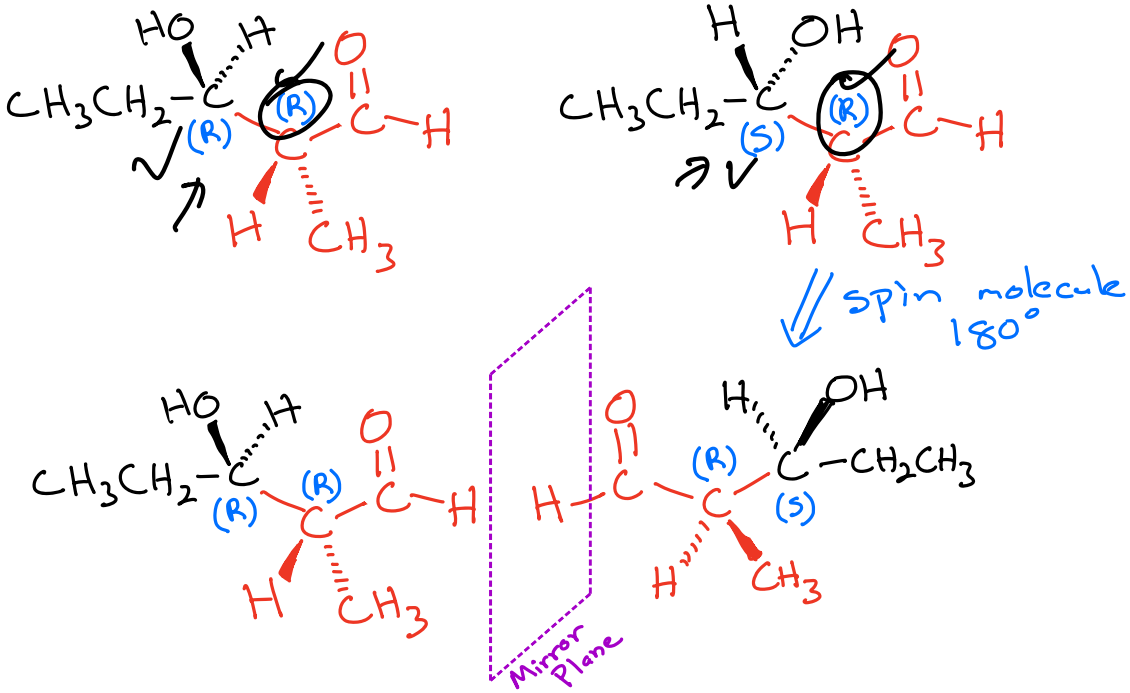




Enantiomers or Diastereomers?

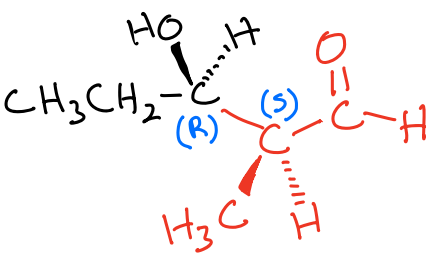


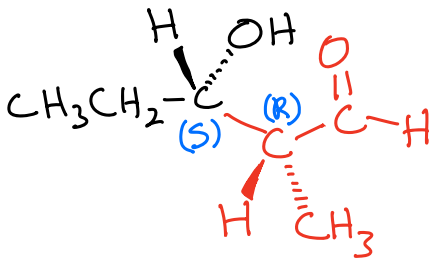
Enantiomers (Section 3.2) Stereoisomers that are nonsuperposable mirror images of each other; refers to a relationship between pairs of objects.



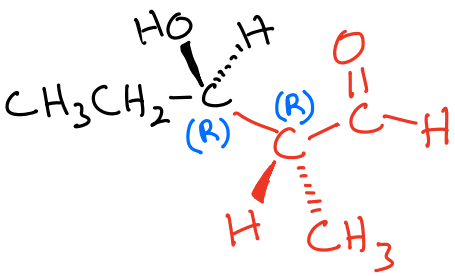
Diastereomers (Section 3.4A) Stereoisomers that are not mirror images of each other; refers to relationships among two or more objects.

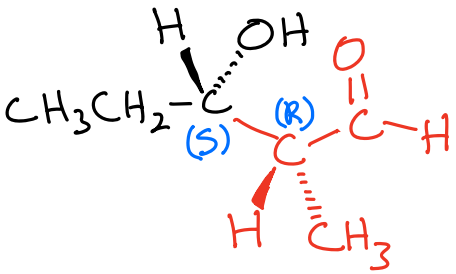
Which pair of molecules could be a racemic mixture?





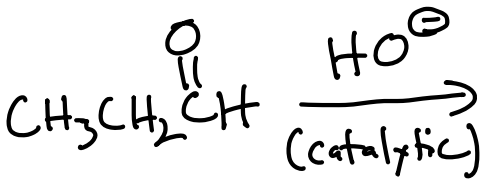
or

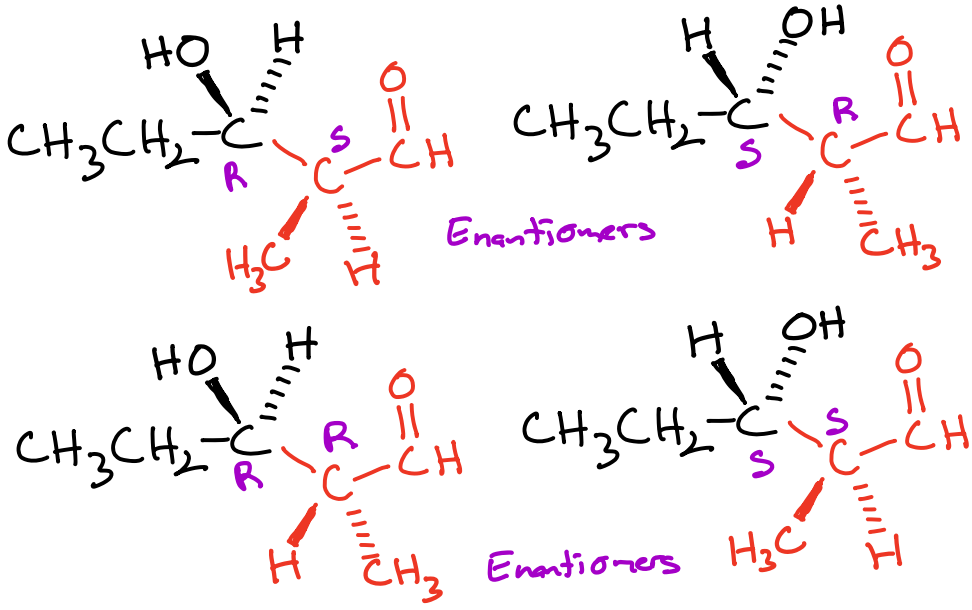




Racemic mixture (Section 3.7C) A mixture of equal amounts of two enantiomers.

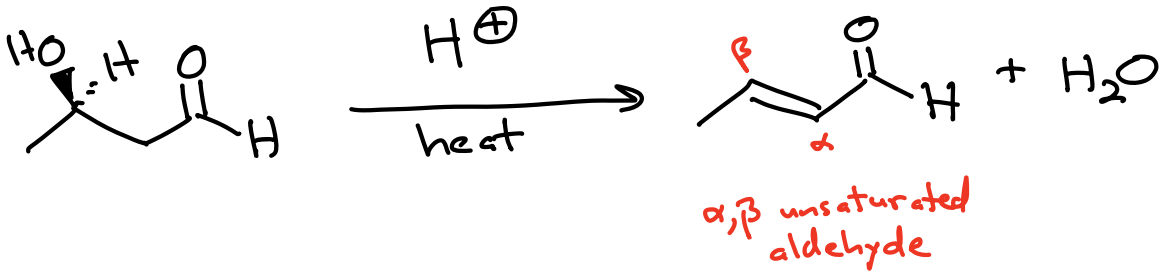
Aldol Reaction: 2 new chiral centers





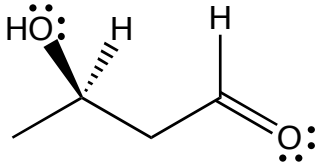
Racemic

In mild acid with some heating, the aldol product will dehydrate to give an α,β-unsaturated aldehyde.



Note: The following mechanism is NOT the simplest you might think of, but it is the one with the lowest energy intermediates (no carbocations, etc.) so this is the correct mechanism

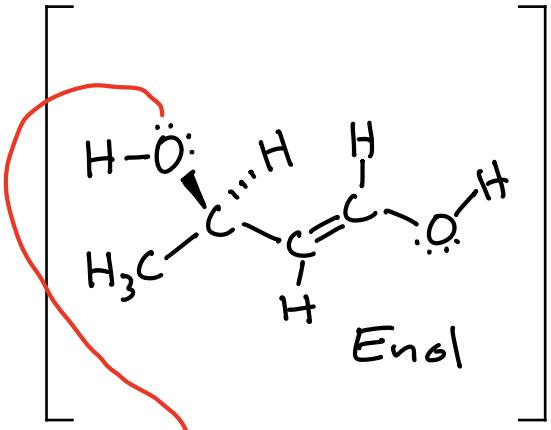
Acid catalyzed dehydration



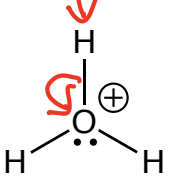
Aldol product

Chemist adds acid and heat

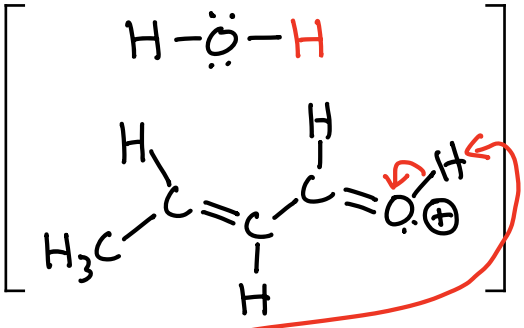
tautomerization



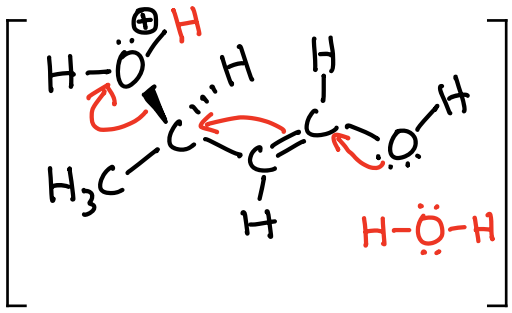
Enol

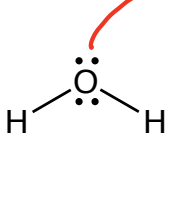


Add a proton



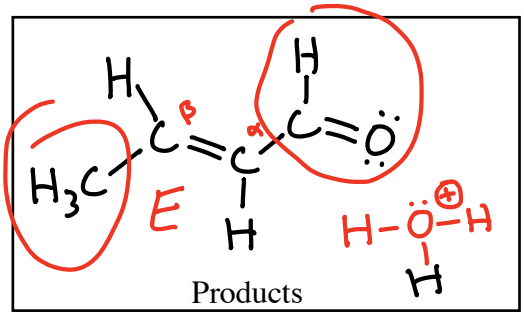
Break a bond





Take a proton away

KRE → α,β-unsaturated aldehyde → the C=C is where the new C-C bond is located

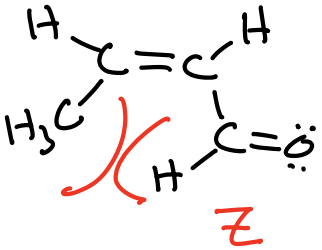


Products

THIS IS UNIQUE TO THIS EXAMPLE

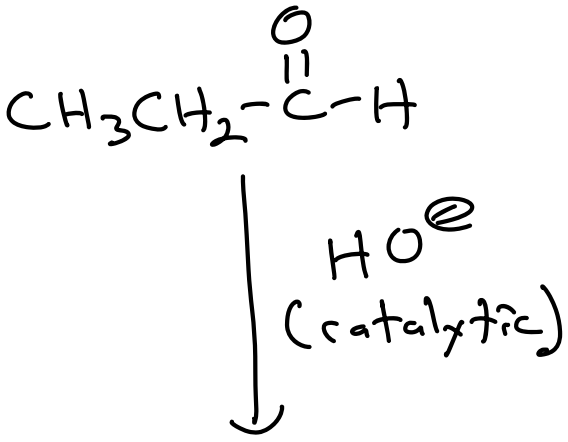
⇓

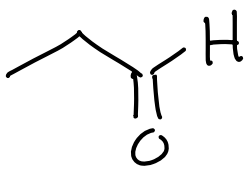
USUALLY BOTH E AND Z ARE FORMED



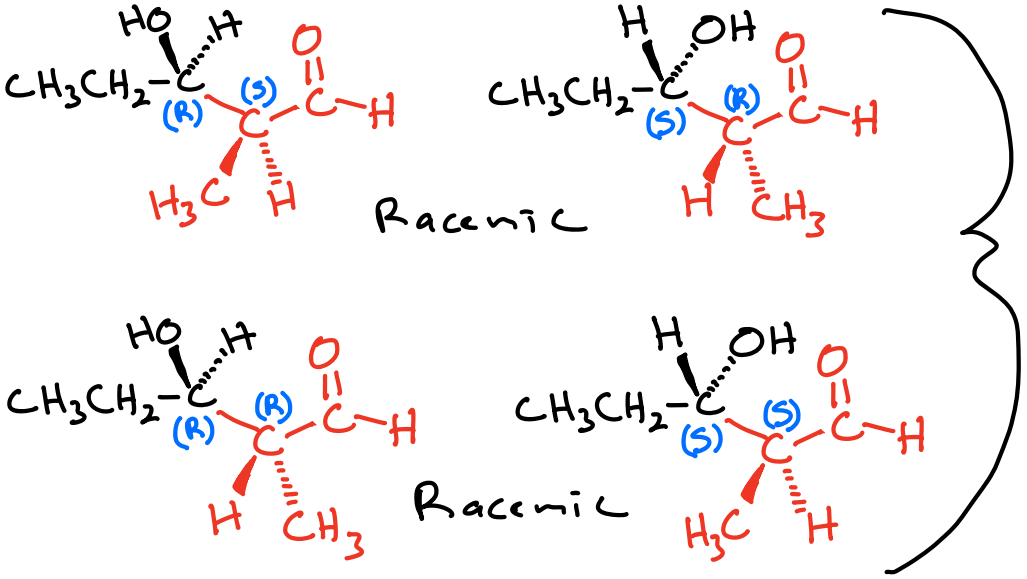
Z

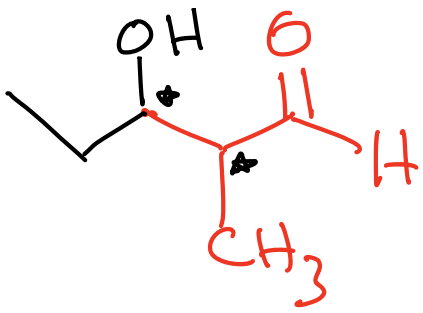
Not much of the Z product is formed because it has significantly more steric strain than E





1) $HO^{\ominus}$ (catalytic)

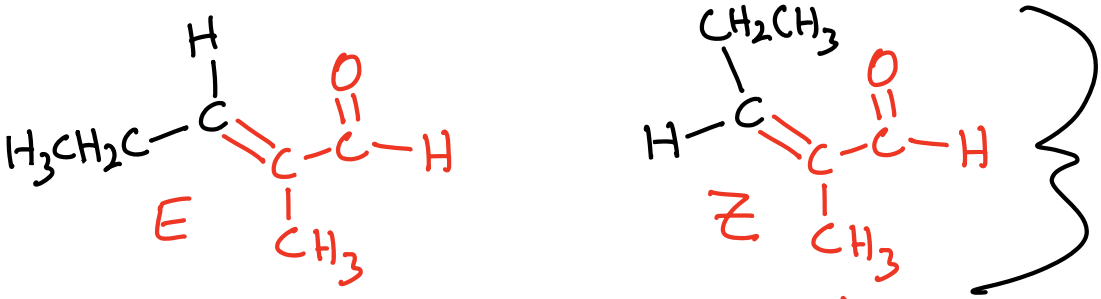




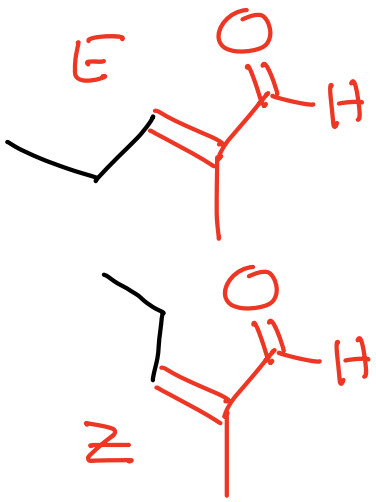
Racemic

2) $H^{\oplus}$ heat

$H^{\oplus}$ heat ← HCl, H_2SO_4 etc. catalytic amount



(Need to draw both)

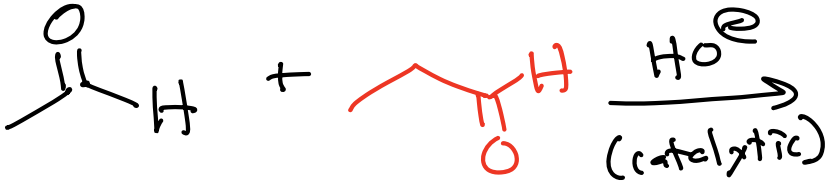


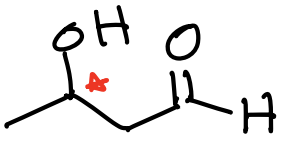
→ The dehydration product is conjugated and therefore stable.

→ The dehydration product can be used in a Michael reaction.

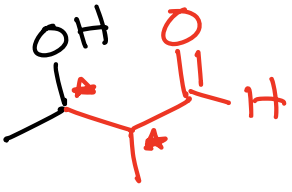
When you run a "mixed" aldol reaction, you generally get far too many reaction products to be useful.

Example

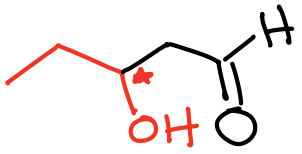




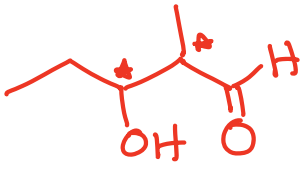
2 stereoisomers



4 stereoisomers



2 stereoisomers



4 stereoisomers

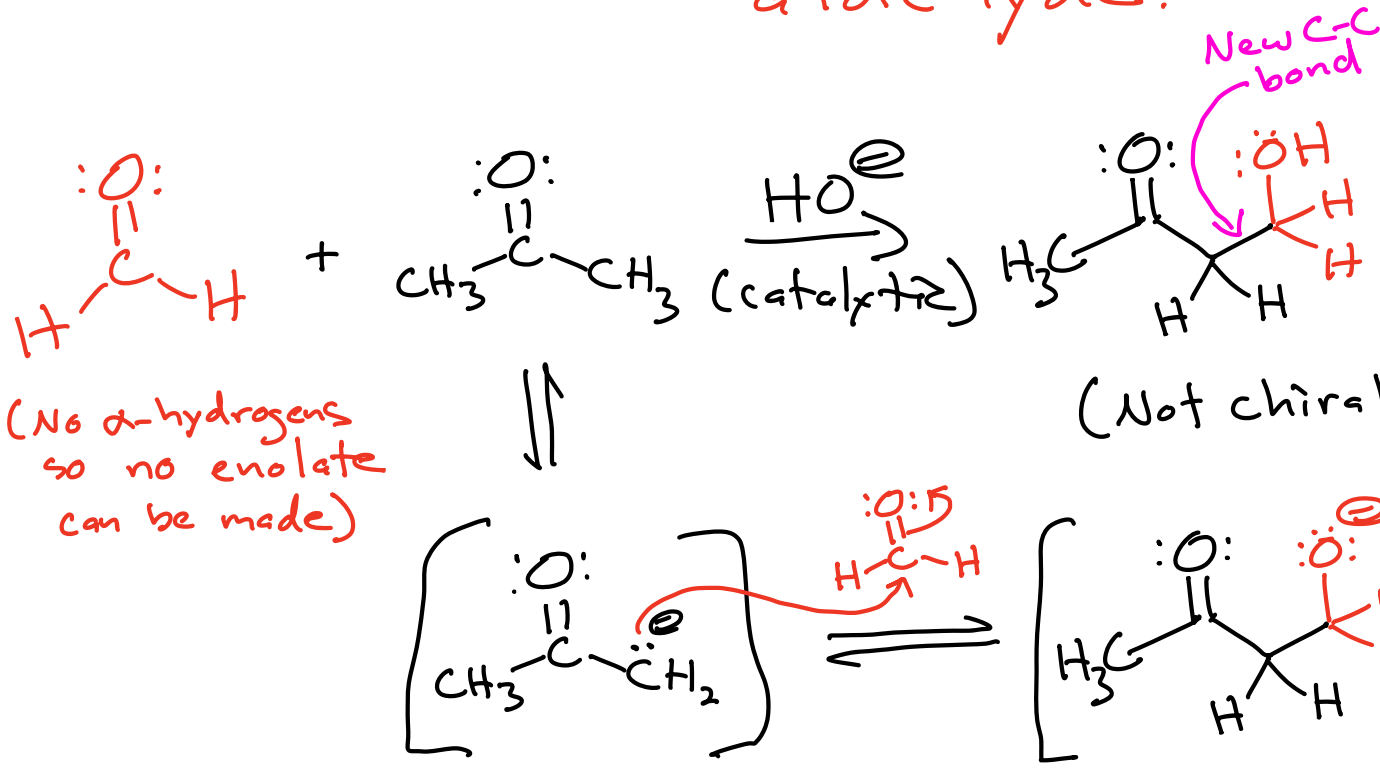
4 Different constitutional isomers!

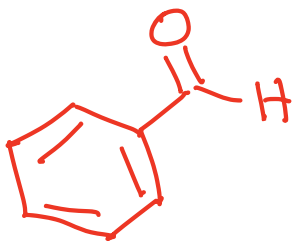
12 Products including stereoisomers!

Key Idea ⇒ By understanding the reaction we can make this process productive:

Strategic Workaround: Use an aldehyde with no α hydrogens and a ketone

The aldehyde cannot make an enolate, while the ketone can but that enolate can only make a stable product with the aldehyde.





Another aldehyde that does NOT have any α hydrogens