Test recap:

\[
\text{Cyclopentadiene} + \text{AlCl}_3 \xrightarrow{\text{CH}_2\text{C}_1} \text{Cyclohexene} + \text{CH}_3
\]

How?

\[\text{H}_3\text{C} - \text{Cl} - \text{AlCl}_3 \quad \text{(forms in situ)} \quad \text{(means in reaction mix)}\]

Avg = 68
A > 80 (Rough ranges)
B > 65
C > 50

Don't forget problem set in back!

Ketone is an electrophile
Enolate of ketone is a nucleophile

If want to go:

\[
\text{Cyclopentanone} + \text{Cs}_2\text{CO}_{3} \xrightarrow{\text{H}_2\text{O}} \text{Cyclopentanone} + \text{H}_2\text{O}
\]

\[
\text{Cyclopentanone} + \text{CH}_3\text{I} \xrightarrow{\text{K}_2\text{CO}_3} \text{Cyclopentanone} + \text{CH}_3\text{I}
\]

\[\text{pK}_a \approx 19 \quad \text{(does not go)}\]

\[\text{Cyclopentanone} + \text{H}_2\text{O} \quad \text{pK}_a \approx 16\]

\[\text{Cyclopentanone} + \text{H}_2\text{O} \quad \text{pK}_a \approx 34\]
New Reaction: Aldol Condensation (Aldol reaction)

\[
\text{2 } \ce{CH-CHO} \xrightarrow{\text{KOH}} \ce{CH-CH(OH)CH=CH2}
\]

Product of Aldol reaction has 1,3 relationship between -OH and =O.

How?

- Dotted circle = electrophile half
- Light demand = nucleophile half

Under basic conditions:

\[
\text{H}^- \text{H} \quad \text{H}^- \text{H} \quad \text{H}^- \text{H}
\]

Normally, -OH poor leaving group, but formation of \(\alpha,\beta\)-unsaturated carbonyl drives to completion & makes -OH an "OK" leaving group.

By control of reaction conditions can pick between dehydration or no dehydration.

See Text figure of reaction.

How to recognize aldol products: 1,3 oxygen relationships!

- New bond. Mentally break.
- See p. 3
New bond

Forward:

Also: \( \alpha, \beta \)-unsaturated carbonyl

Forward direction:

How about 2 different aldehydes/ketones?

Crossed-aldols:

If using an aldehyde w/o enolate ion possible: simplifies

(Will be electrophile half by necessity)

\[ \text{benzaldehyde} + \text{enolate} \xrightarrow{\text{KOH}} \text{product} \]

Gives trans alkene specifically
More recognizing:

\[ \text{bond that was formed} \]

\[ \Rightarrow \]

\[ \text{CH}_3 \]

More!

\[ \text{New bond formed} \]

Nucleophile part
Flows exolate anion

New Topic: Carboxylic acids

- much more acidic than alcohols

\[ \text{Reversal} \]

\[ \Rightarrow \]

\[ \text{Resonance does not help much} \]

\[ \text{Resonance stabilization maximized when both structures are equivalent} \]

derivatives:

\[ \text{Some oxidation state as carboxylic acid} \]

\[ \Rightarrow \]

\[ \text{Ester} \]

\[ \text{(equilibrium)} \]

\[ \Rightarrow \]

\[ \text{OH} \]
C.A.S cont'd: see book figure (ch.10) for acidity discussion
2 of 3 resonance structures good (3rd high energy)

"Hybrid resonance structure": don't write! pretend text never showed 😊

For acetic acid:

\[ \text{acetate ion} \quad \longleftrightarrow \quad \text{acetate ion} \]

Acetic acid:

Vinegar (5% acetic acid in H₂O)

See "old" acidity handout

Brief naming: \[ \text{pentanoic acid} \]
Common name: \[ \text{formic acid (and poison; distill ants to get (yes, five ants!))} \]

\[ \text{benzoic acid} \]

Wed: acidity of C.A.S $\rightarrow$ ester