When acetone reacts with methyl lithium two products are formed. One is the expected addition product with the negative charge on the electronegative oxygen atom. Give the structure of the second product which also has the negative charge on the electronegative oxygen atom.

```
CH₃CH₂COCH₃ + LiCH₃ → CH₃CH₂CH₂O⁻Li⁺ + CH₃COCH₃
```

Possible structures are:

- A
- B
- C
- D
- E
When acetone reacts with methyl lithium two products are formed. One is the expected addition product with the negative charge on the electronegative oxygen atom. Give the structure of the second product which also has the negative charge on the electronegative oxygen atom.
Lithium diisopropylamide (LDA)

Very strong hindered base

$pK_a = 40$

How can you favor the enolate formation?

Use a strong base that will not act as a nucleophile.

$pK_a = 19$

Enolate
Keto \[ K_{eq} = 1.5 \times 10^{-4} \]

Enol

These two compounds are tautomers

Tautomers are isomers that differ only by the location of an ionizable proton.

LDA
Keto $K_{eq} = 1.5 \times 10^{-4}$ Enol

\[
\begin{align*}
\text{C} & \text{C} & \text{C} & \text{C} & \text{O} & \text{H} & \text{H} \\
\text{H} & \text{C} & \text{C} & \text{H} & \text{H} & \text{H} & \text{H} \\
\end{align*}
\]

Keto $K_{eq} = 1.2 \times 10^{-2}$ Enol

\[
\begin{align*}
\text{O} & \text{C} & \text{C} & \text{C} & \text{H} & \text{H} \\
\text{C} & \text{C} & \text{C} & \text{H} & \text{H} & \text{H} \\
\end{align*}
\]

very small

Aldehydes form less enol
Keto  $K_{eq} = 1.5 \times 10^{-4}$  Enol

Acetyl acetone  $K_{eq} = 3.2$

$\text{p}K_a = 19$

$\text{p}K_a = 9$
$K_{eq} = 1.5 \times 10^{-4}$

Keq = 1.5 x 10^{-4}  

**Keto**

\[
\begin{align*}
\text{H}_2\text{C} \quad \text{C} \quad \text{C} \quad \text{H} \\
\text{H} \quad \text{C} \quad \text{H} \quad \text{H}
\end{align*}
\]

**Enol**

\[
\begin{align*}
\text{H} \quad \text{C} \quad \text{C} \quad \text{H} \\
\text{H} \quad \text{C} \quad \text{H} \quad \text{H}
\end{align*}
\]

**pK_a = 19**

Enolate

Two sites of basicity, O and C

Most reactions will take place at C because stronger bonds are the result.
Acid Catalyzed Tautomerization
Many reactions of carbonyl compounds can be catalyzed by both acid or base.
Deuterium exchange

What is the formula of the expected product?

A. $C_6D_1H_9O$  B. $C_6D_2H_8O$  C. $C_6D_4H_6O$
D. $C_6D_6H_4O$  E. $C_6D_8H_2O$  F. $C_6D_{10}O$
Epimerization of (3S,5S)-3,5-dimethylheptan-2-one?

A. i  B. ii  C. i + ii  D. iii  E. iv  F. iii + iv  G. all four
Many reactions of carbonyl compounds can be catalyzed by both acid or base.
Bromine Addition

Net Reaction

Trick Question

Is this reaction catalyzed by OH⁻?

A. Yes
B. No
Net Reaction
The image depicts a chemical reaction involving the conversion of an organic compound into another through the addition of halogen reactants. The net reaction is shown as:

\[ RCH_3COCH_3 + 3X_2 + 3OH^- \rightarrow RCOCH_3 + 3X^- + 3H_2O \]

Where \( X \) can be chlorine, bromine, or iodine. The reaction is commonly known as the Haloform Reaction.

Chloroform (CHCl₃), bromoform (CHBr₃), and iodoform (CHI₃) are the products of this reaction, indicating the conversion of the original compound into halogen-containing derivatives.
1. Hg(OAc)$_2$
2. NaBH$_4$

1. PCC
2. Br$_2$, OH
3. H+$^+$
Name possible four reactions of this enolate involving proton transfer.
Aldehydes in Base

Does not look very stable

Name possible two more possible reactions of this enolate

What are the acid sites in the aldehyde?
Aldehydes in Base

Aldol

Looks more stable

Name possible two more possible reactions of this enolate

What are the acid sites in the aldehyde?
Aldehydes in Base

Aldol

Stop here or depending upon conditions – Stop here

Looks more stable

Enal
Net Reaction

\[
2 \text{RCH}_2\text{CHO} + \text{OH}^- \rightarrow \text{RCH} = \text{CHCHO} + \text{H}_2\text{O}
\]
Enal

Draw the structure of the product

A

B

C

D

E

F