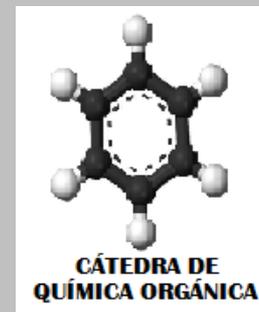
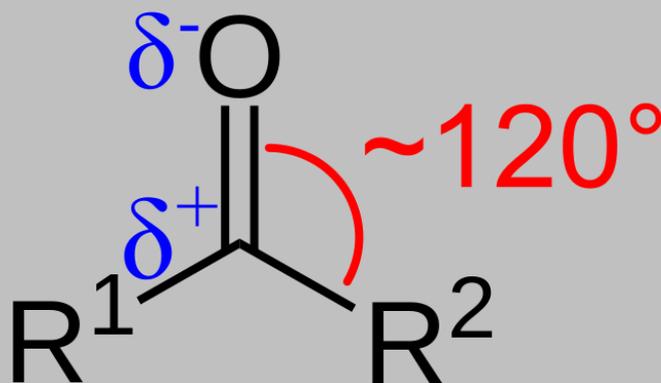




República Bolivariana de Venezuela
Ministerio del Poder Popular para la Educación
U.E. Colegio "Santo Tomás de Villanueva"
Departamento de Ciencias
Cátedra: Química Orgánica
5° Año



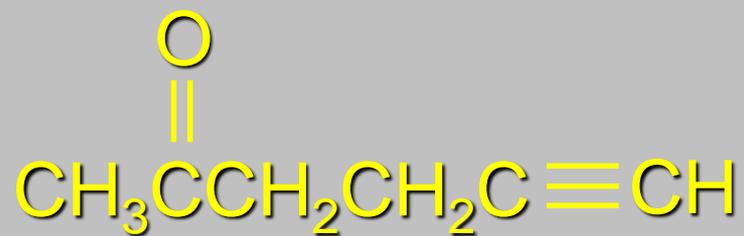
Tema XIV (Parte II): Reacciones del Grupo Carbonilo I (Aldehídos y Cetonas) Grupos protectores, Inducción asimétrica



Prof. Luis E. Aguilar R.

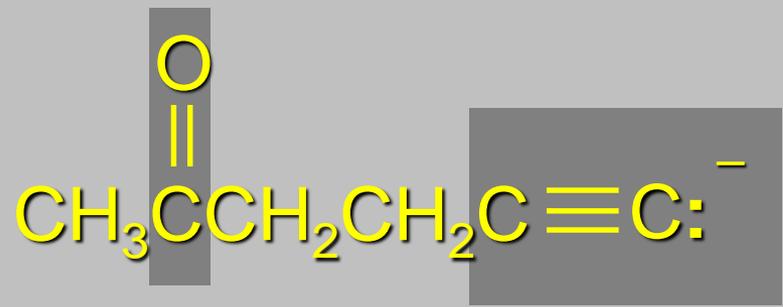
ACETALES COMO GRUPOS PROTECTORES

EJEMPLO



1. NaNH_2
2. CH_3I





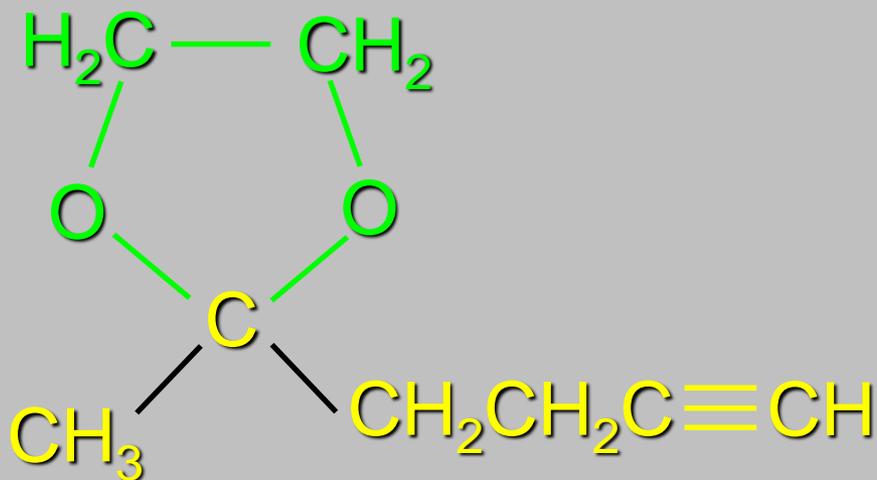
ESTRATEGIA

- 1) proteger C=O
- 2) alquilar
- 3) desproteger C=O

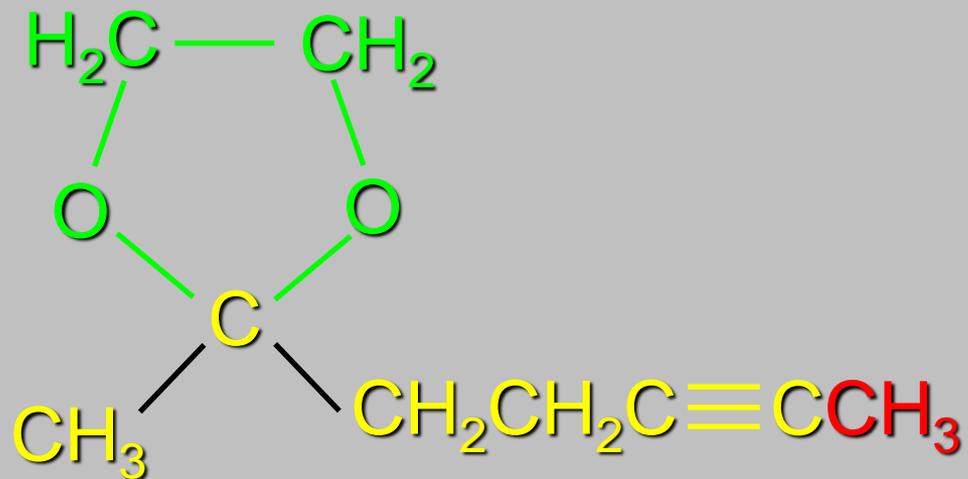
ejemplo: Proteger



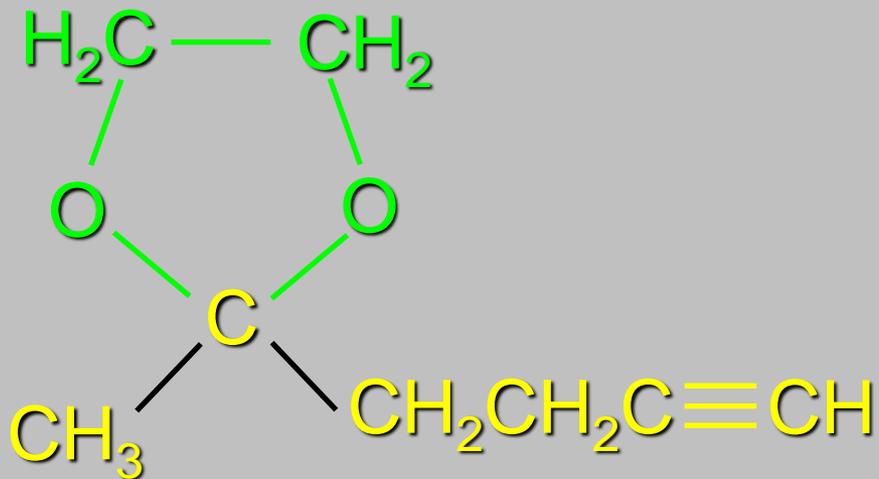
benzene
p-toluenesulfonic acid



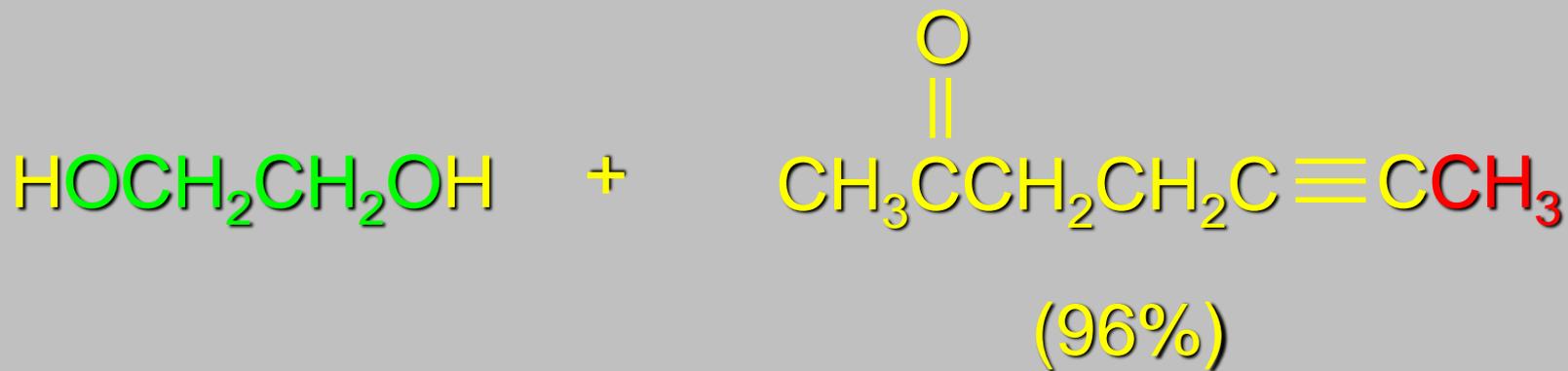
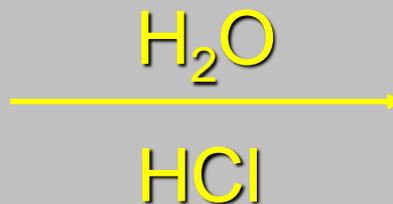
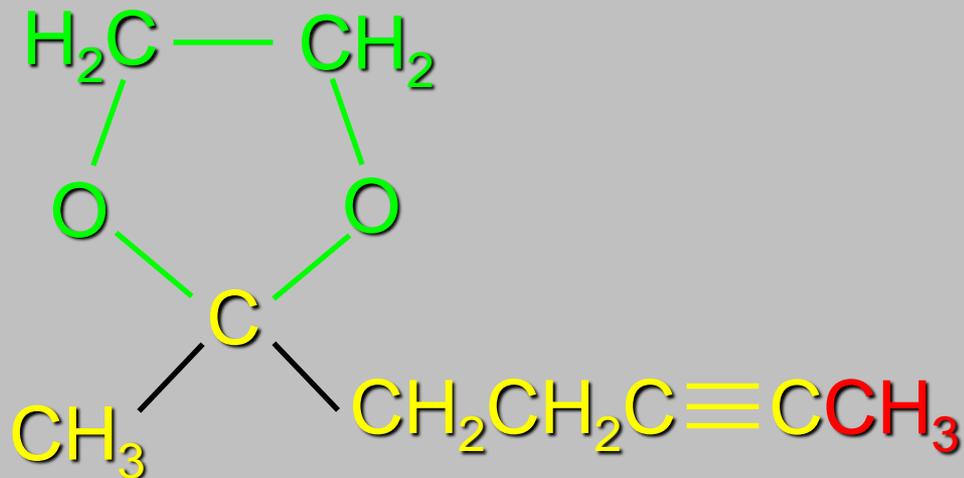
ejemplo: Alquilar

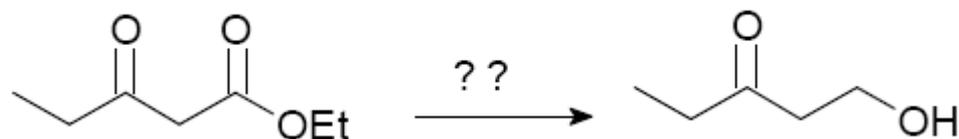


1. NaNH₂
2. CH₃I

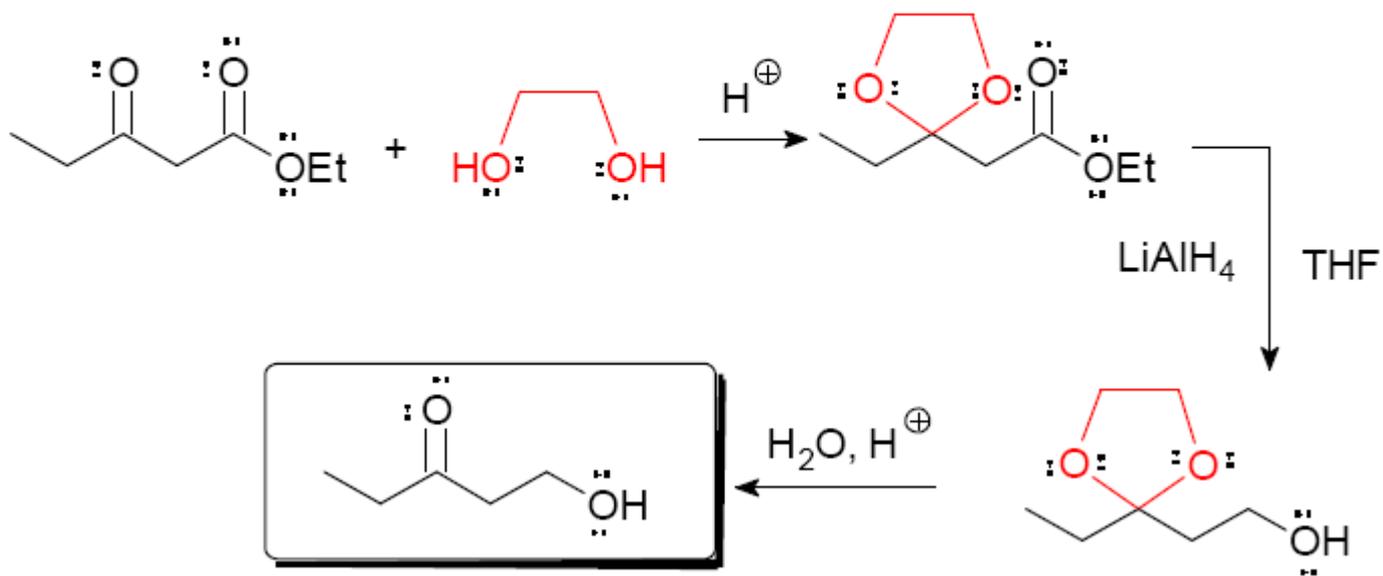


Ejemplo: desproteger

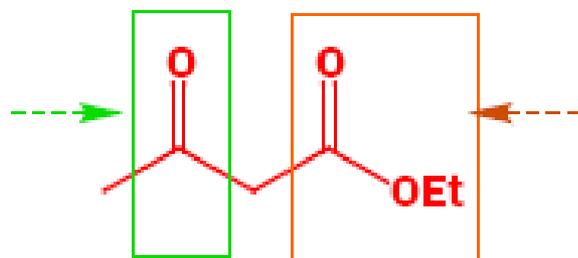




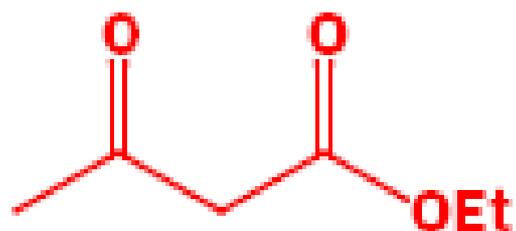
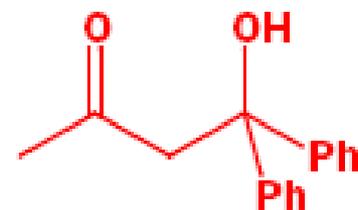
Estrategia de protección/desprotección en la reducción de un éster en presencia de una cetona



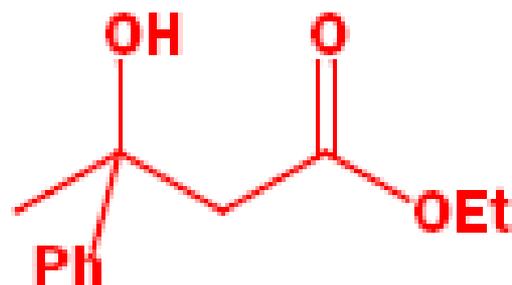
must not
react here



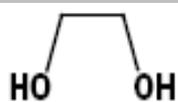
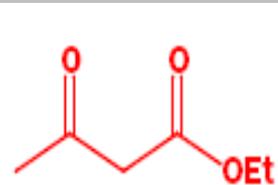
PhMgBr



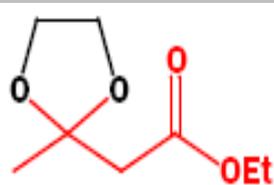
PhMgBr



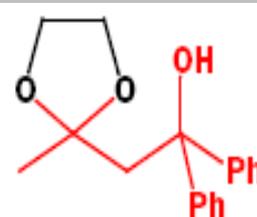
52% yield



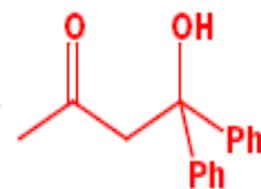
H⁺

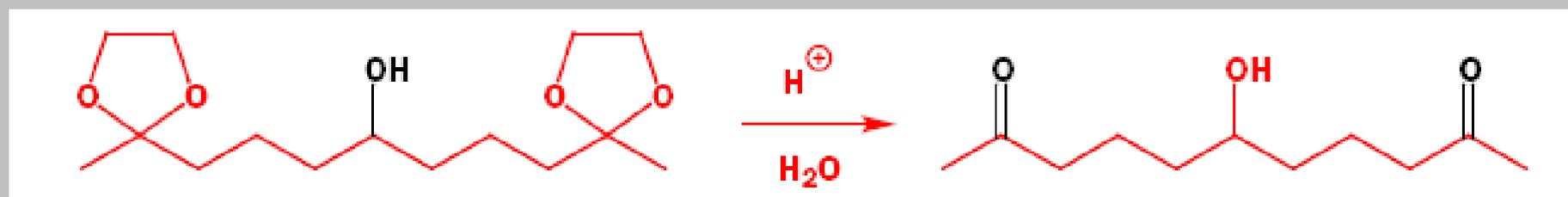
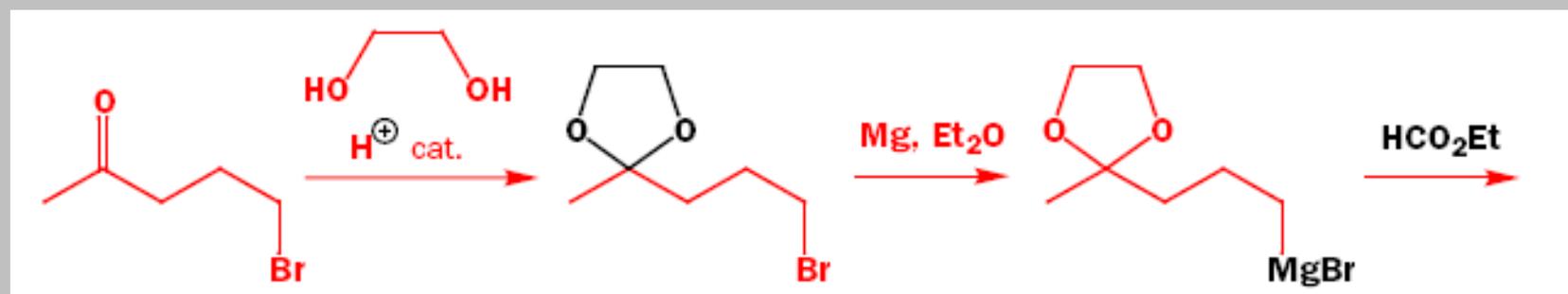
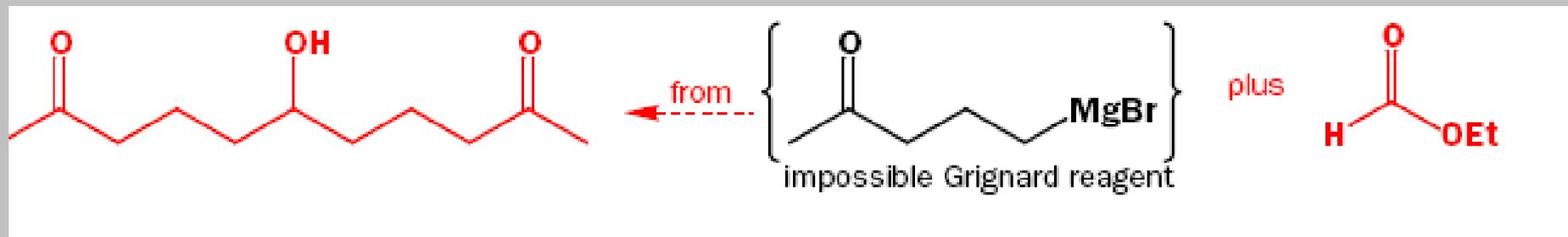


2 × PhMgBr

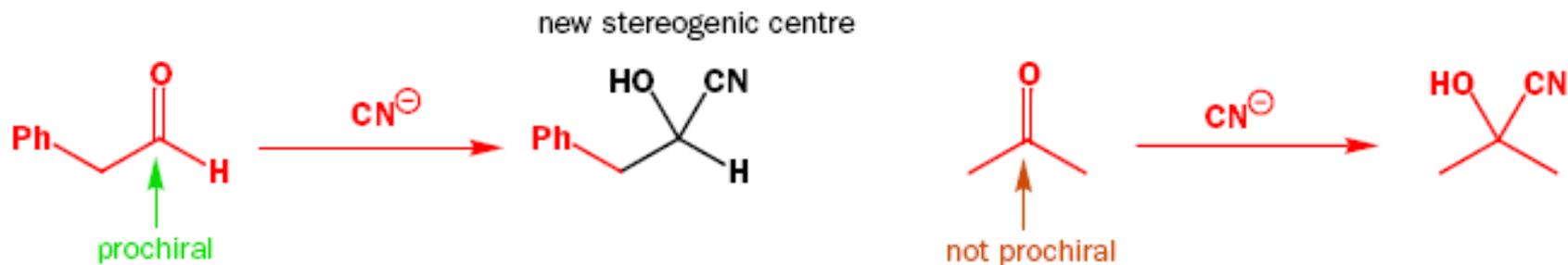
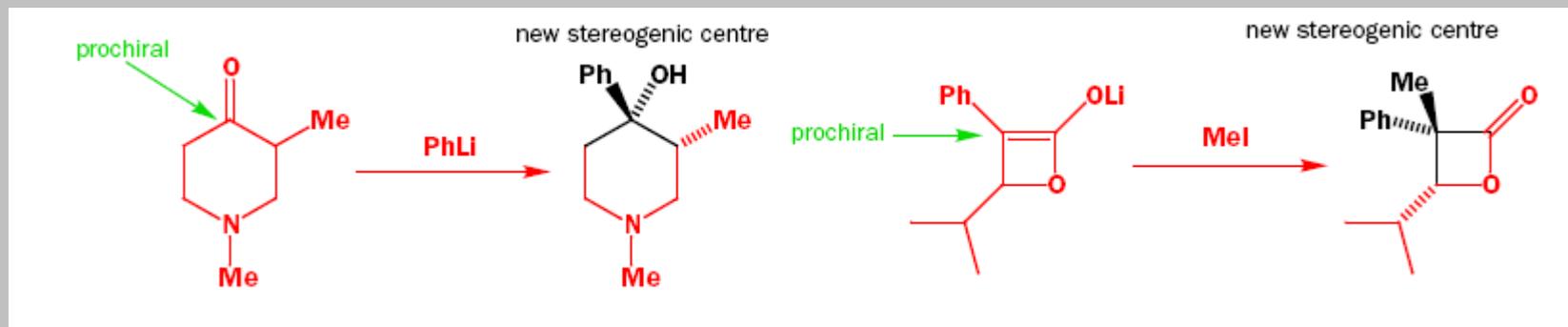


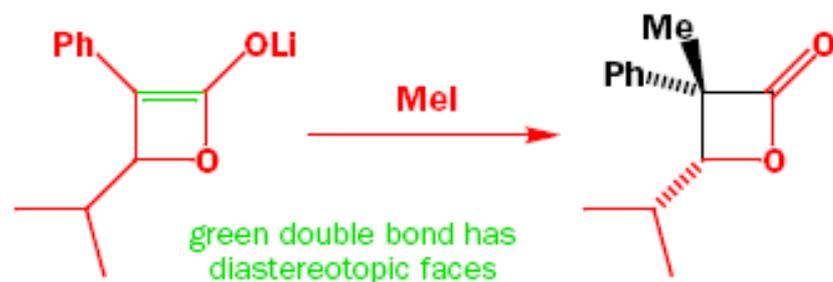
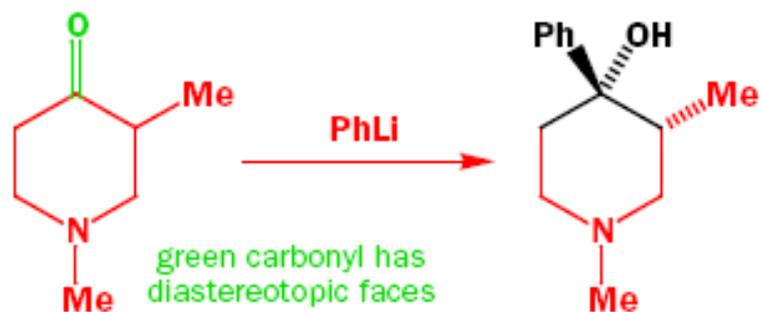
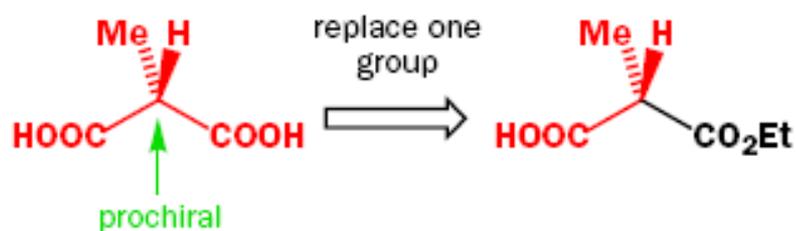
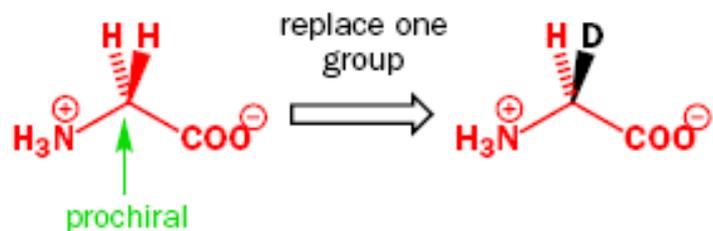
H⁺, H₂O





ESTEREOQUIMICA





yellow carbonyl has enantiotopic faces



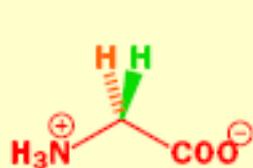
brown carbonyl has homotopic faces



yellow carbonyl has enantiotopic faces



brown carbonyl has homotopic faces



replace green H

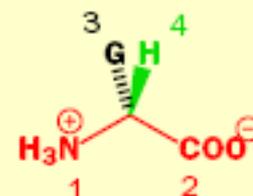


make G higher priority than H

new centre is S
so green proton is *pro-S*

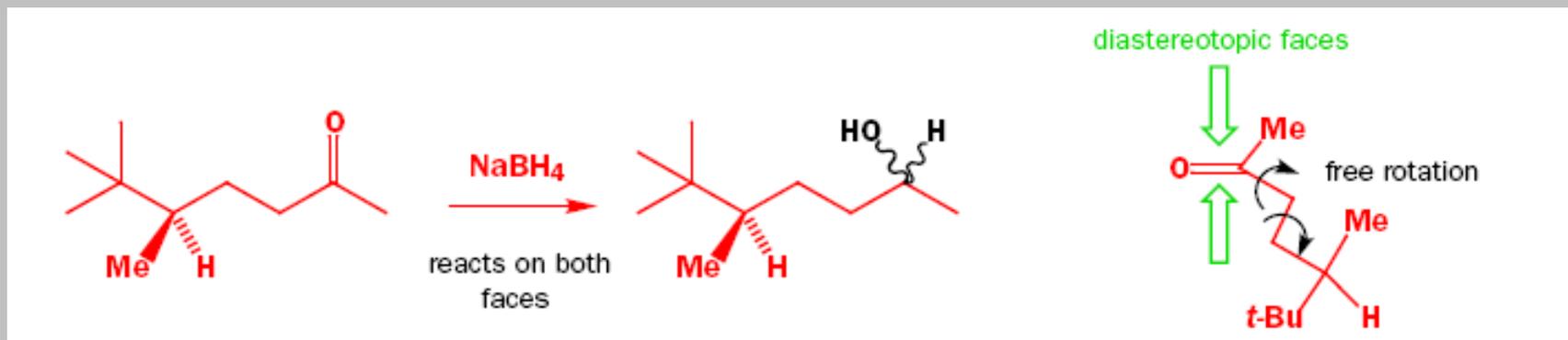
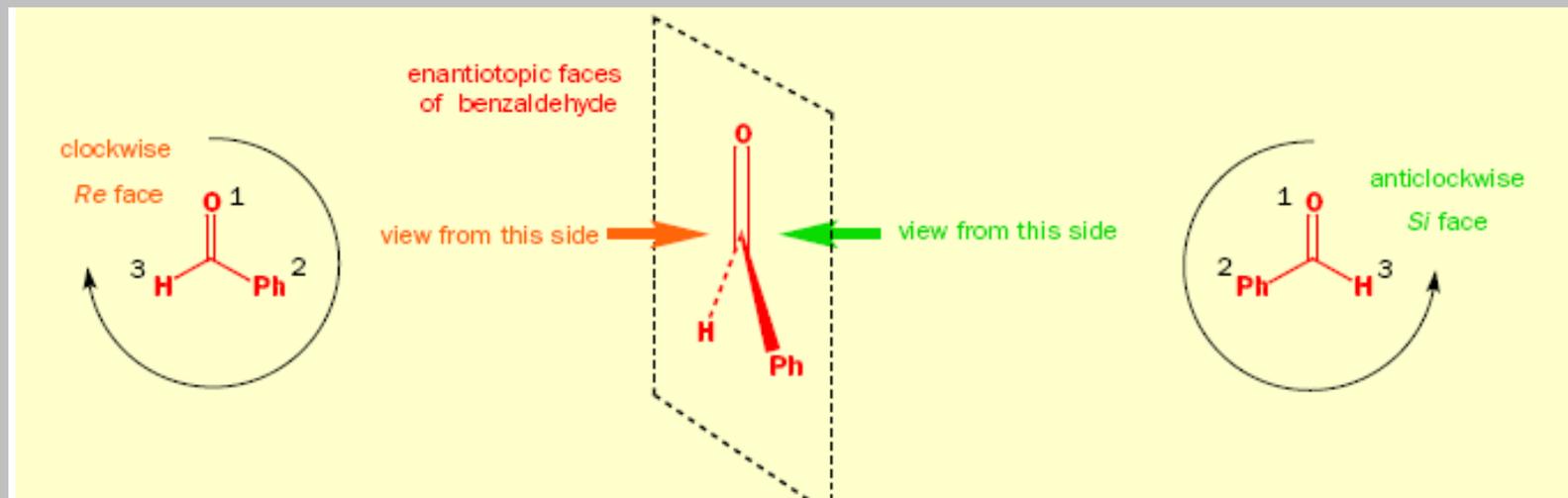


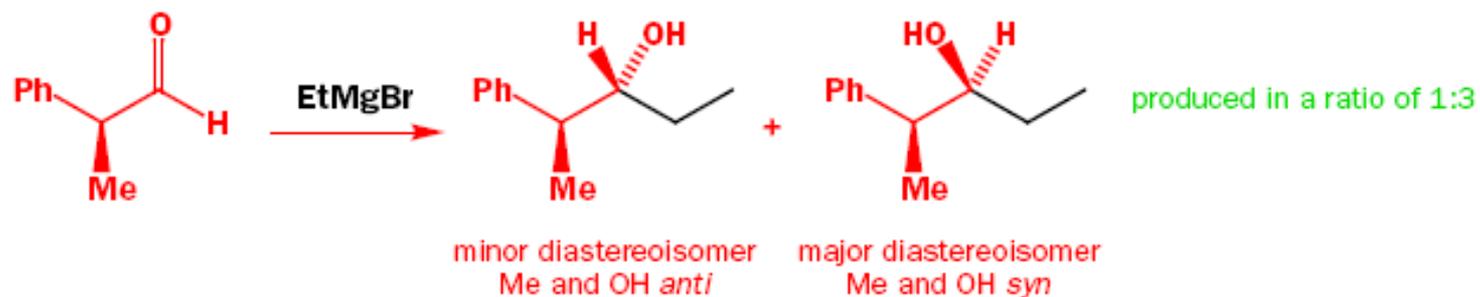
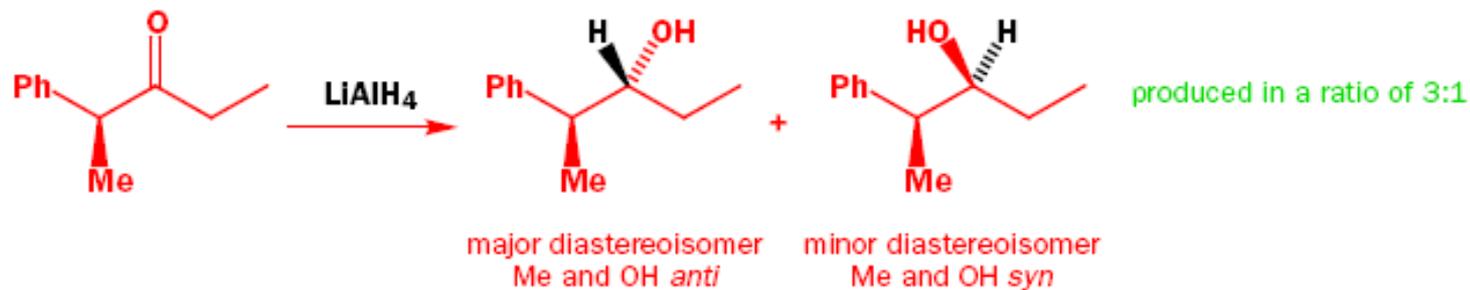
replace orange H



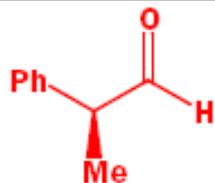
make G higher priority than H

new centre is R
so orange proton is *pro-R*

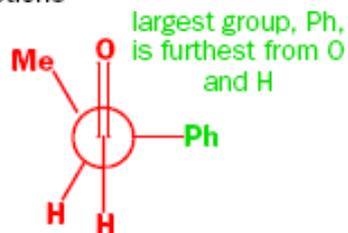




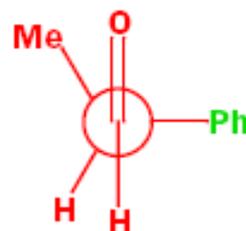
MODELO DE FELKIN-ANN



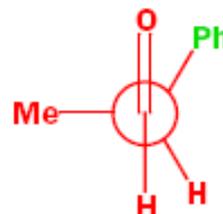
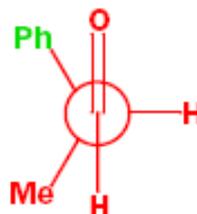
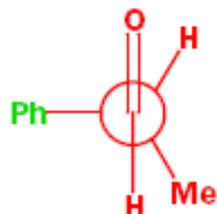
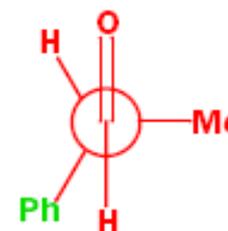
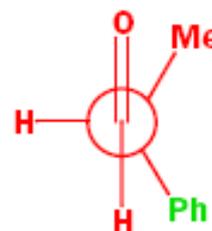
no eclipsing interactions



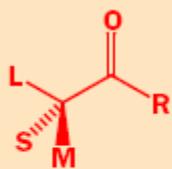
Newman projection of one possible conformation



largest group, Ph, is furthest from O and H

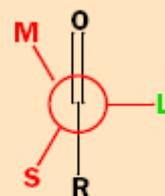


largest group, Ph, is furthest from O and H

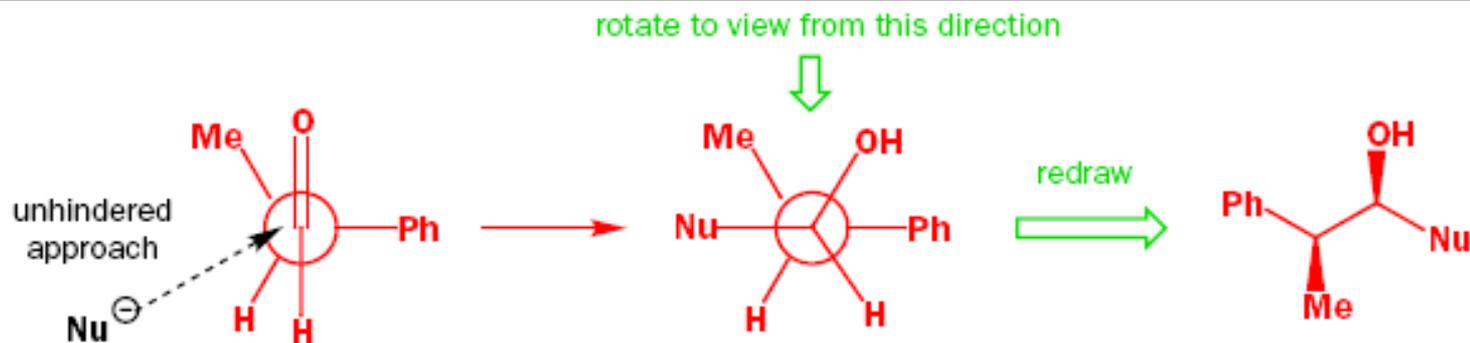
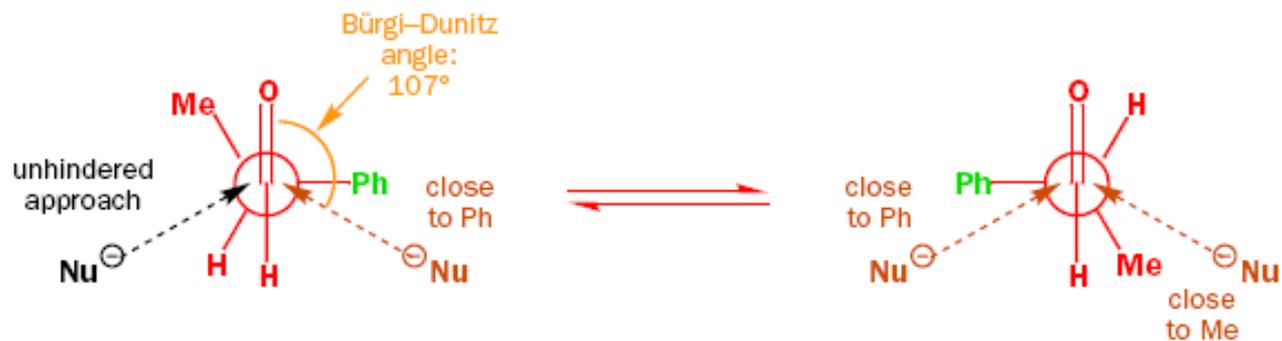
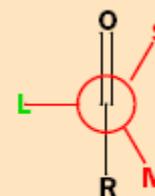


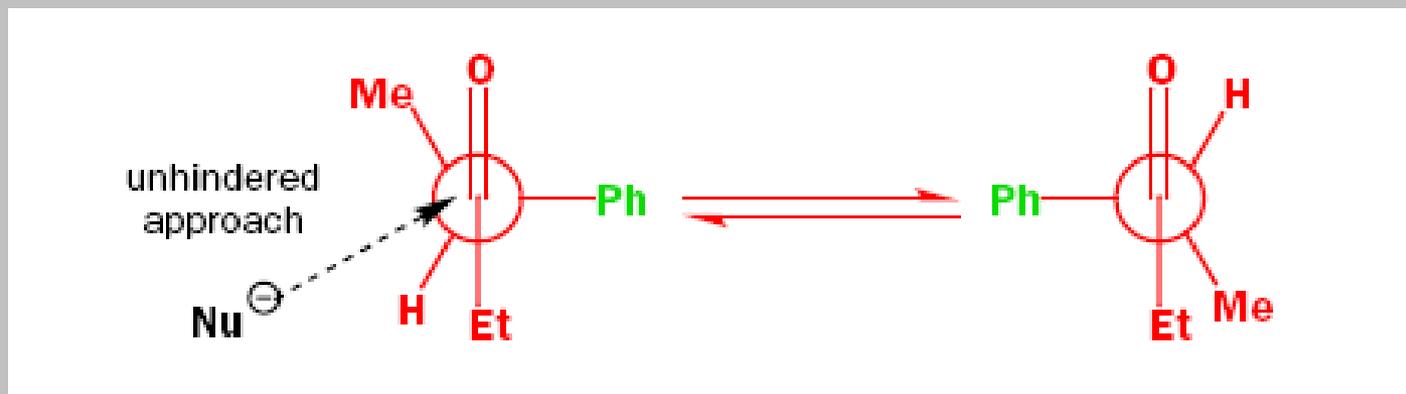
most important conformations are

L = large group, e.g. Ph
 M = medium-sized group, e.g. Me
 S = small group, e.g. H

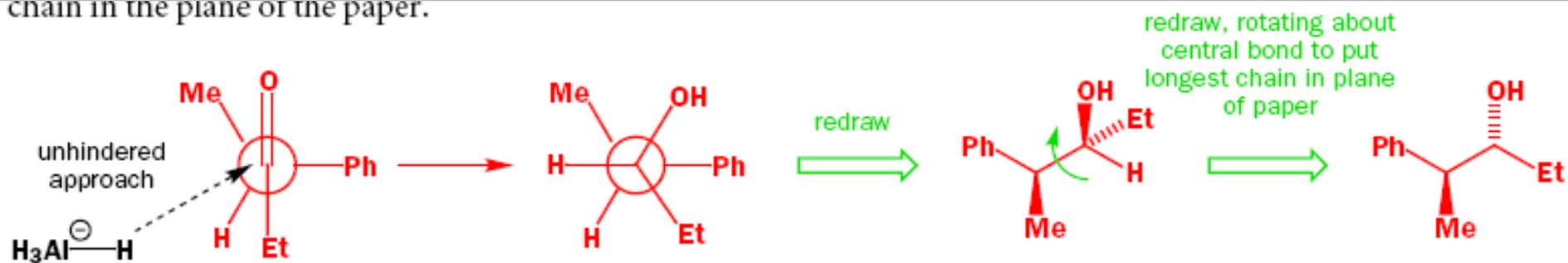


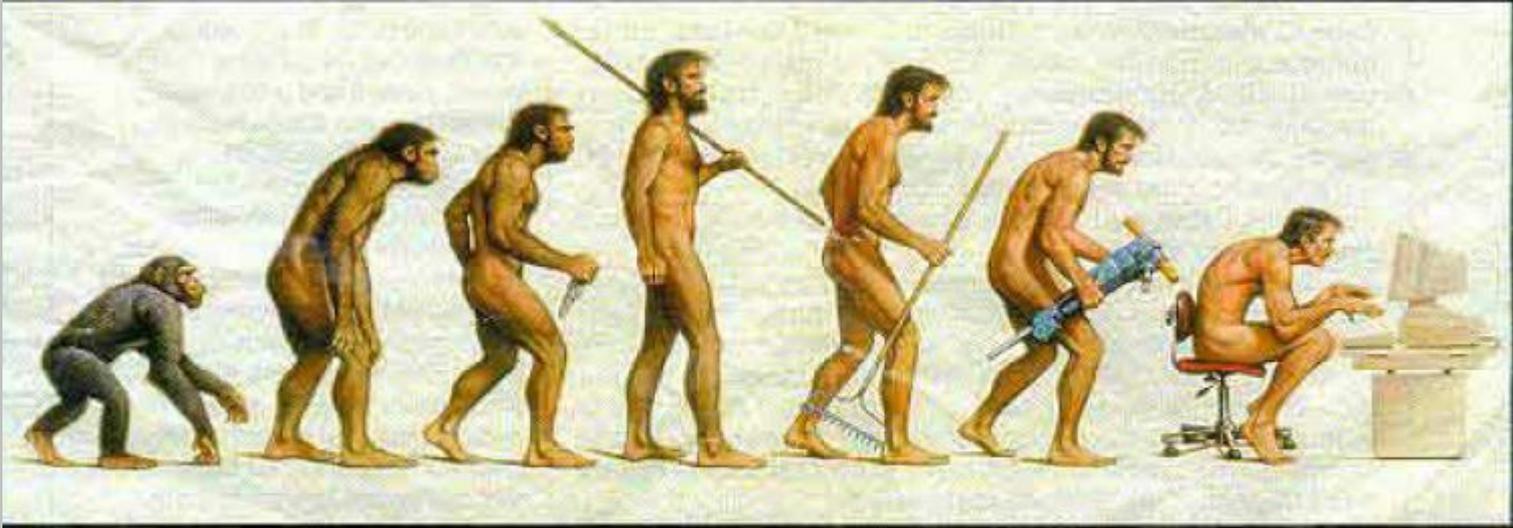
and





chain in the plane of the paper.





Fischer

Cram

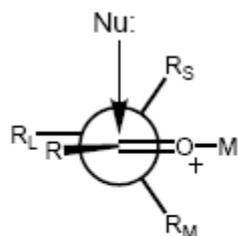
Cornforth

Felkin

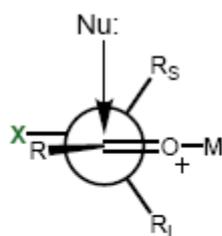
Anh/Eisenstein

Cieplak

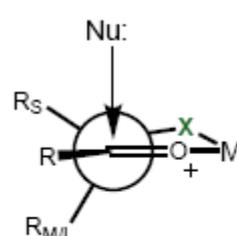
Tomoda



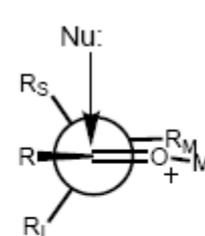
Cram acyclic model (1952)
steric



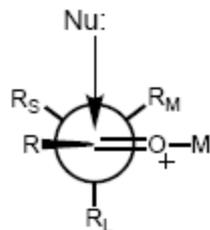
Cornforth model (1959)
electrostatic



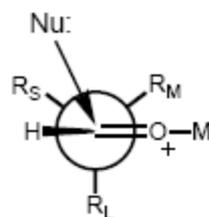
Cram rigid model (1959)
chelation



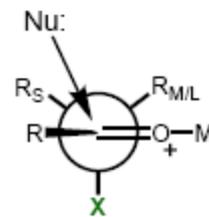
Karabatsos model (1967)
ground-state, steric



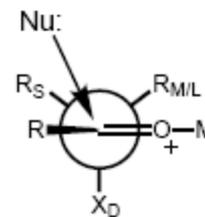
Felkin model (1968)
steric, torsional



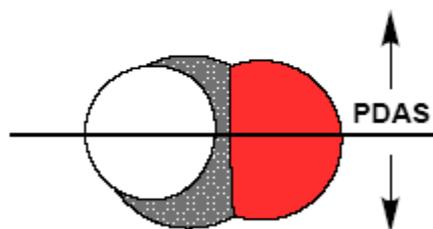
Felkin-Anh model (1977)
steric, torsional, Bürgi-Dunitz



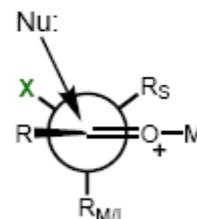
Felkin-Anh polar model (1977)
electronic, torsional,
Bürgi-Dunitz



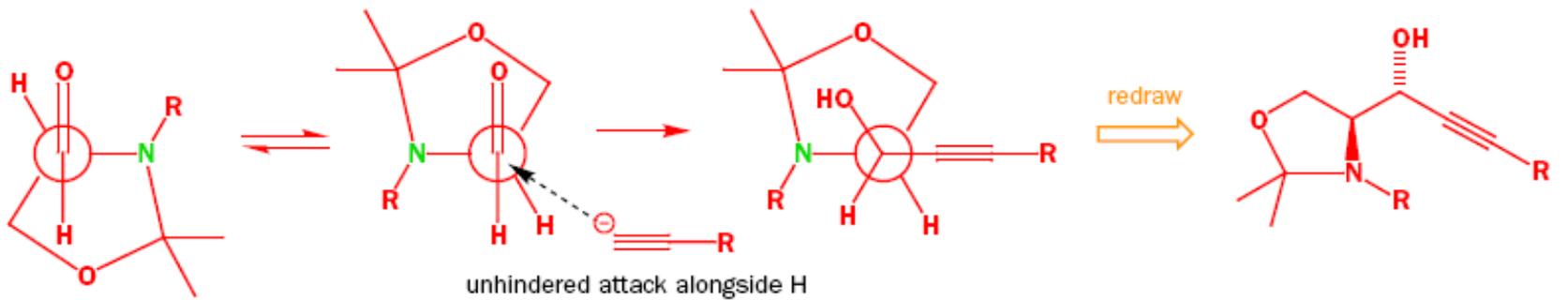
Cieplak model (1981)
electronic, torsional,
Bürgi-Dunitz



Tomoda EFOE model (1997)
ground-state, steric, electronic

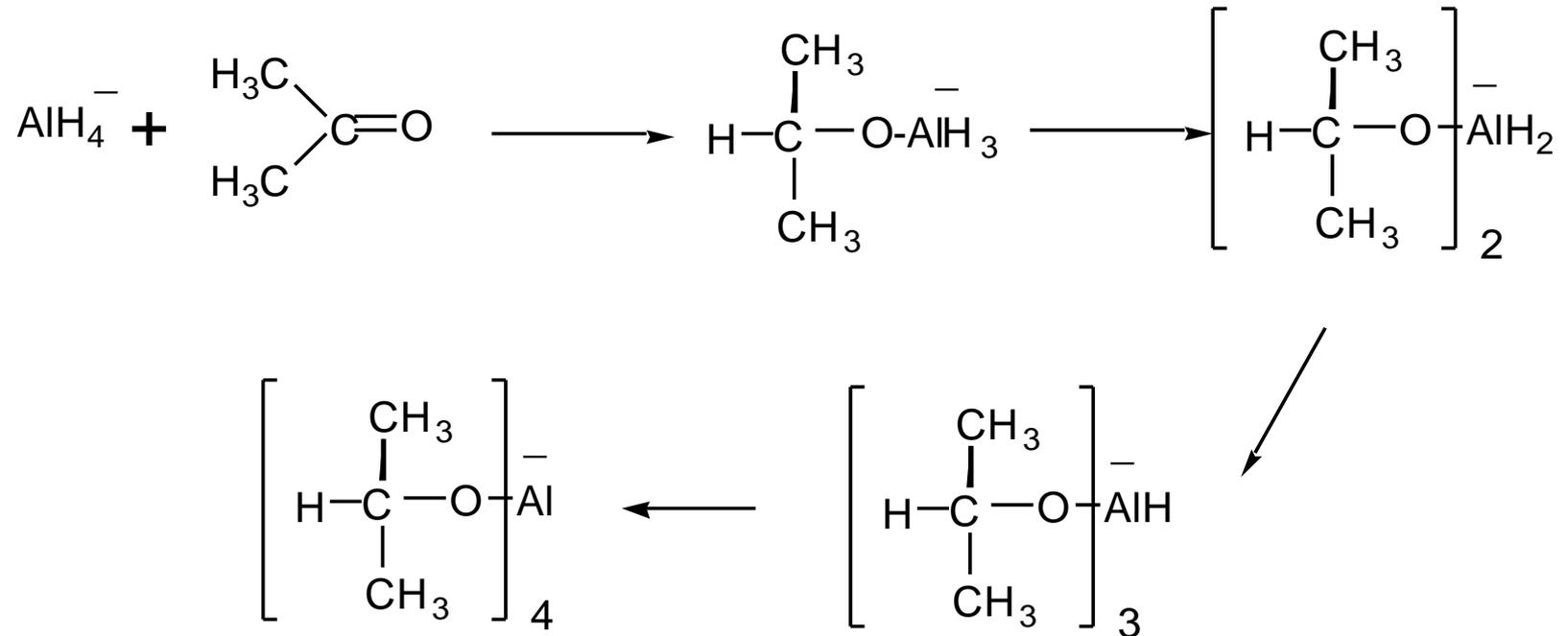


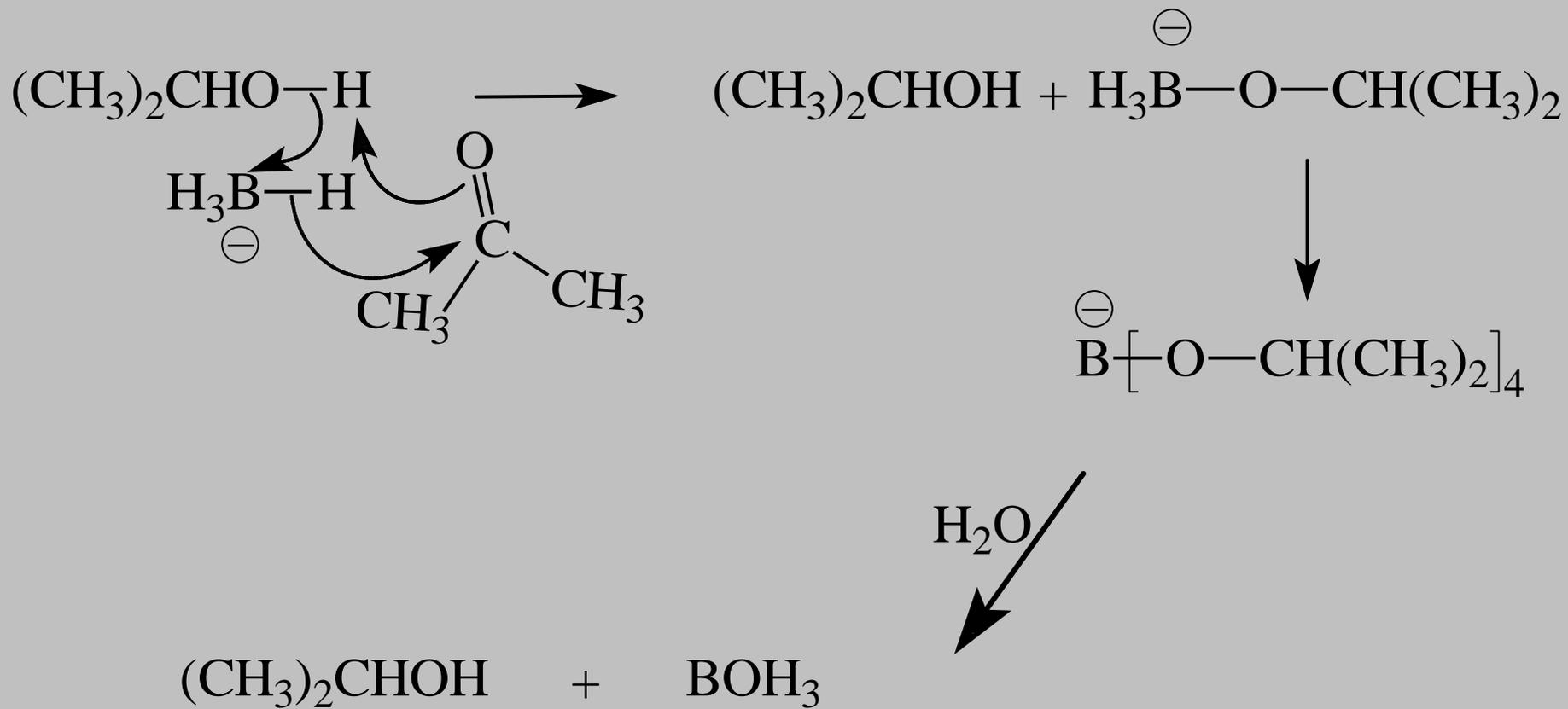
Evans electrostatic model (2001)
electrostatic, torsional, Bürgi-Dunitz

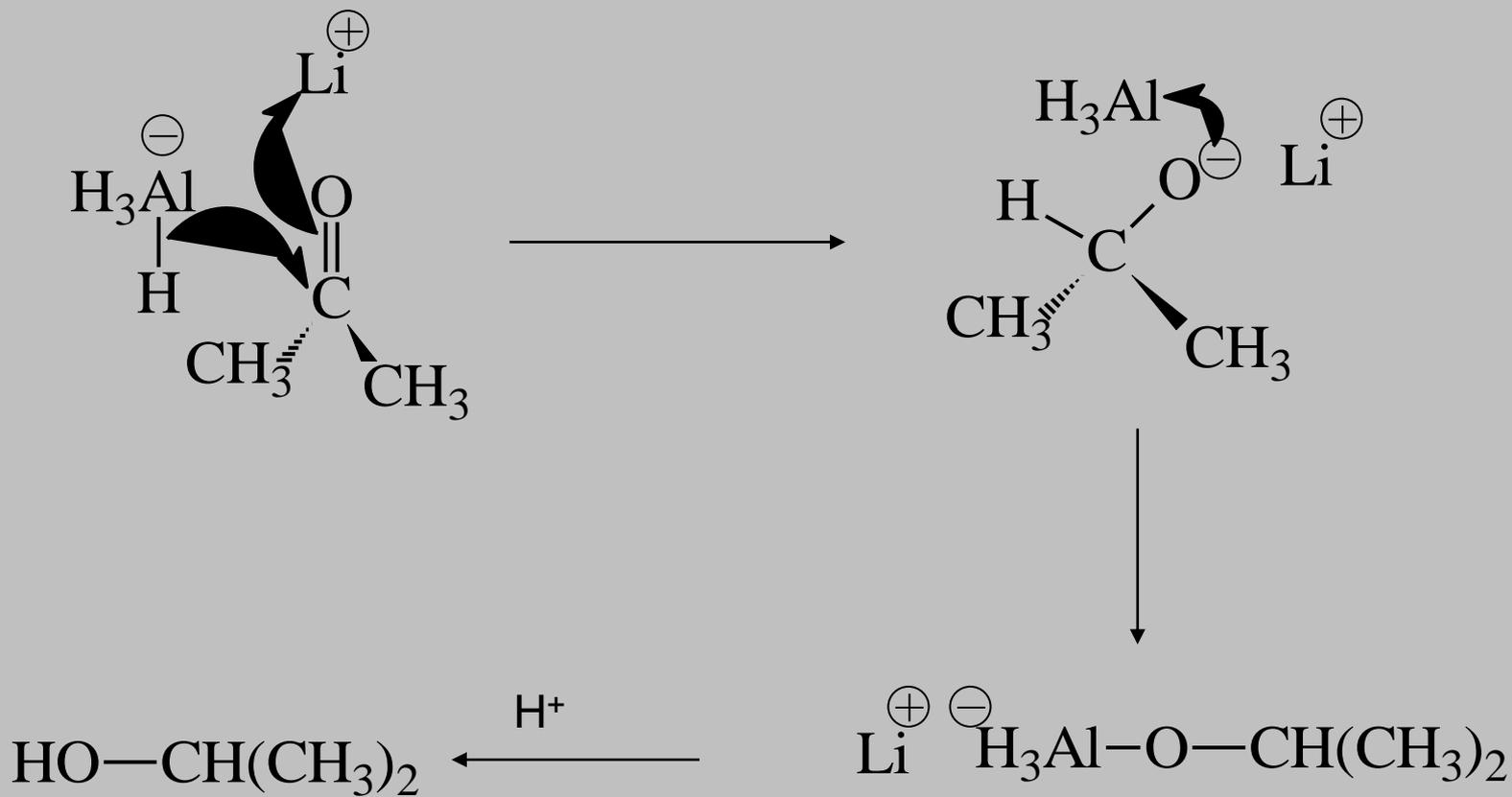


Reducción con transferencia de hidruro

Mecanismo de reducción de acetona









GRUPO FUNCIONAL

-CHO

C=O

CO₂R

CO₂H

PRODUCTO

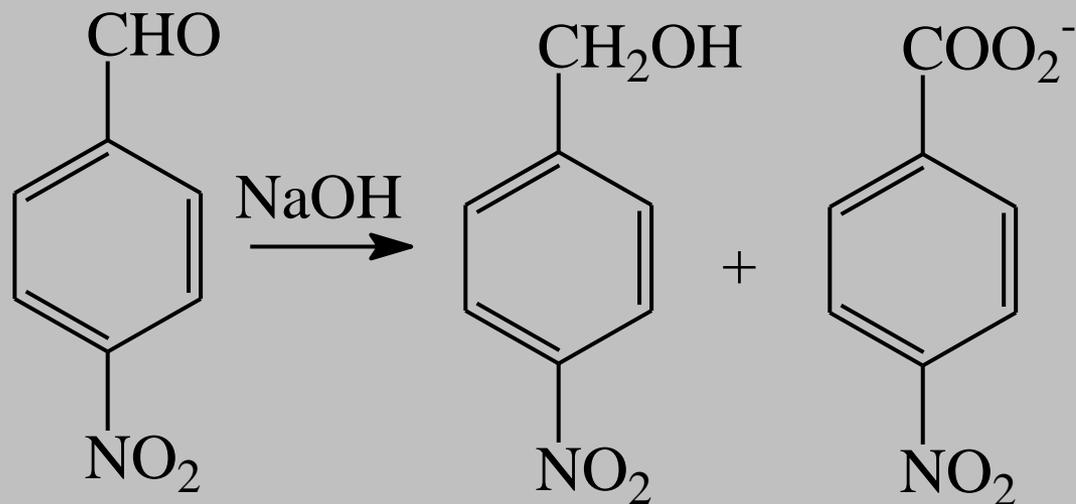
-CH₂OH

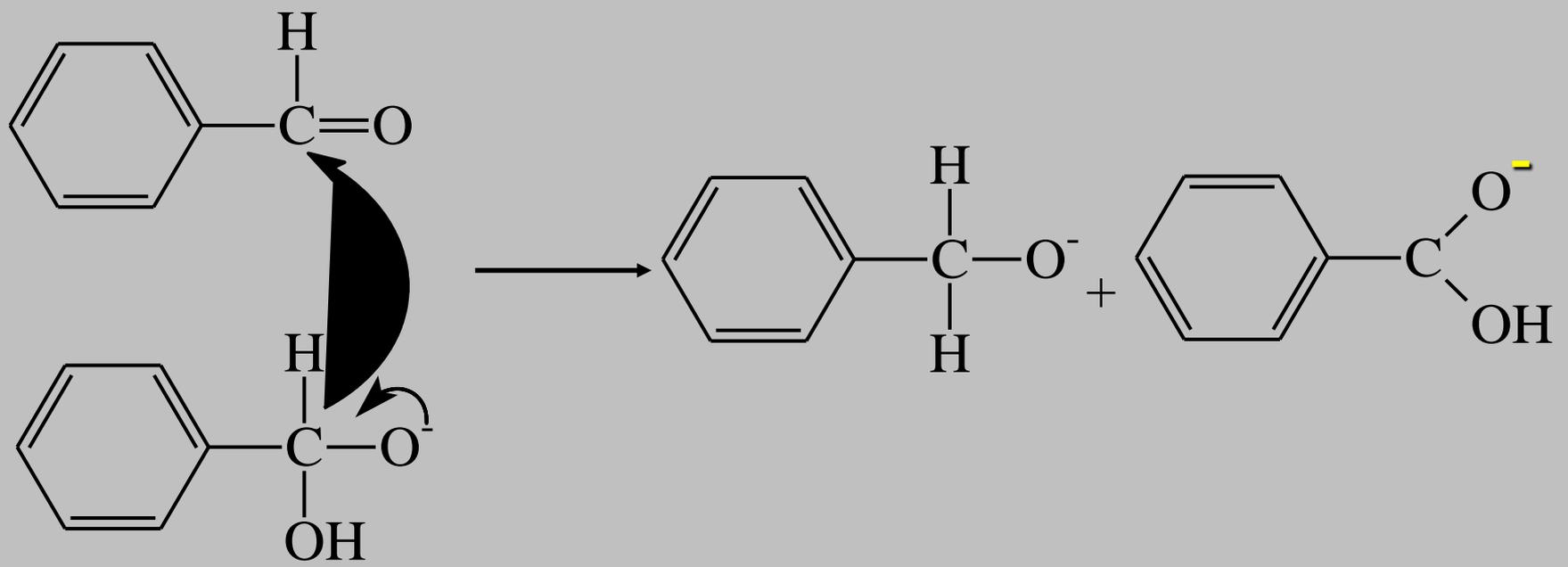
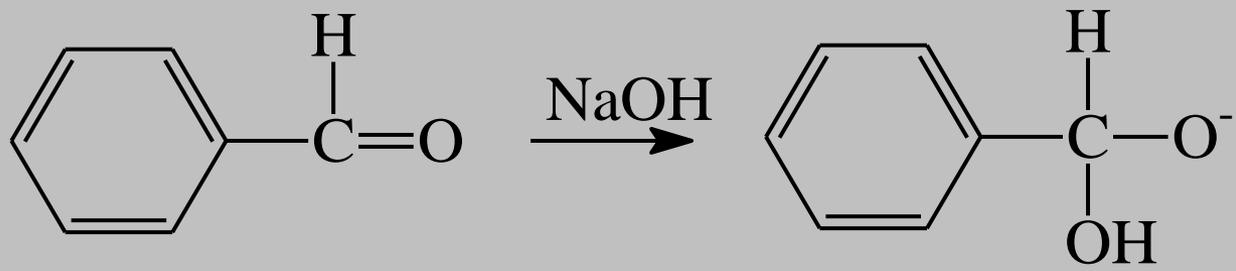
CHOH

CH₂OH + ROH

CH₂OH

REACCION DE CANNIZZARO

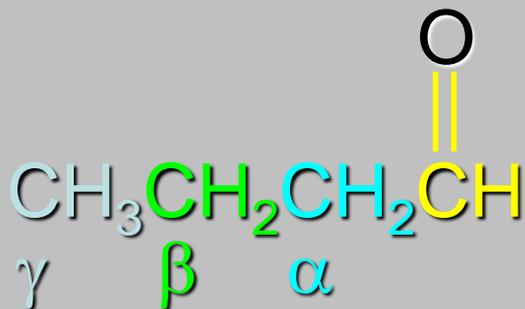




Enoles y Enolatos

CARBONO α Y SUS HIDROGENOS

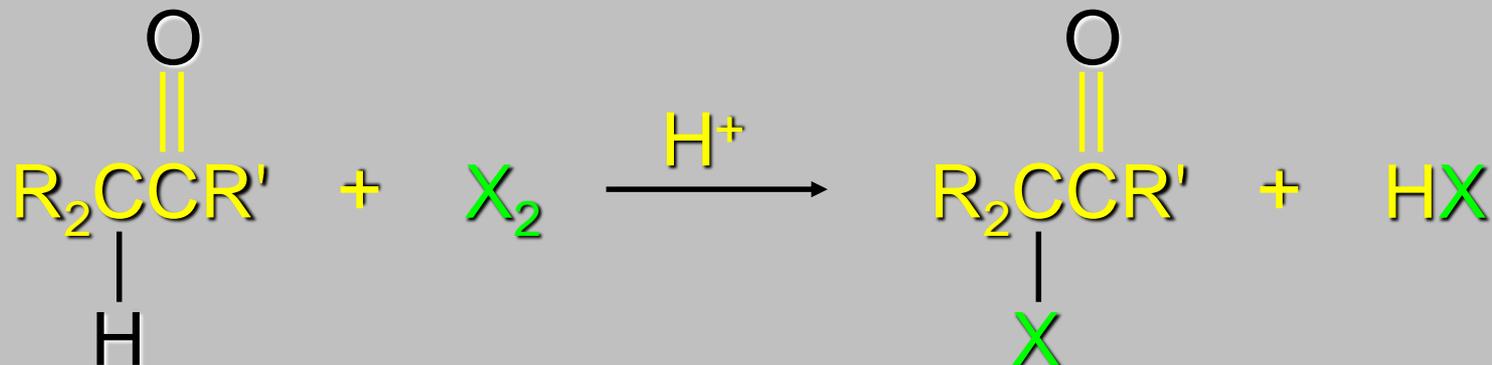
Terminología



- El átomo de referencia es el carbono carbonilo.
- Los otros carbonos son designados como α , β , γ , etc.
Basado en la posición con respecto al carbonilo.
- Los hidrógenos toman la misma nomenclatura

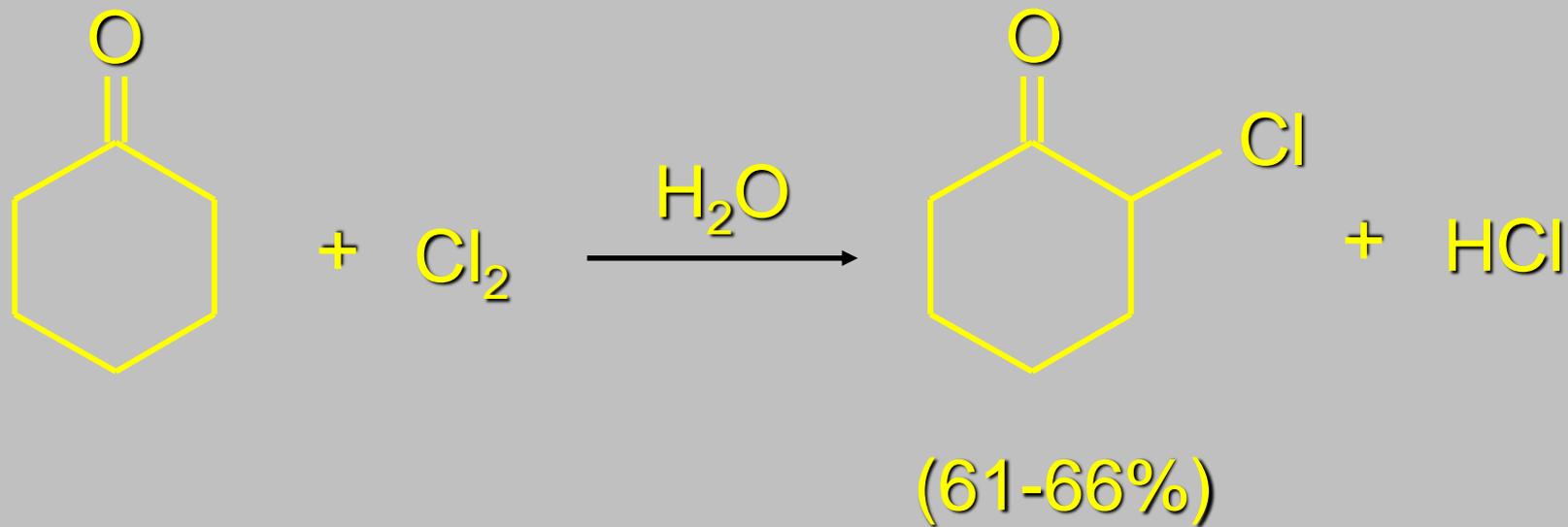
α Halogenación de
Aldehídos and cetonas

Reacción General

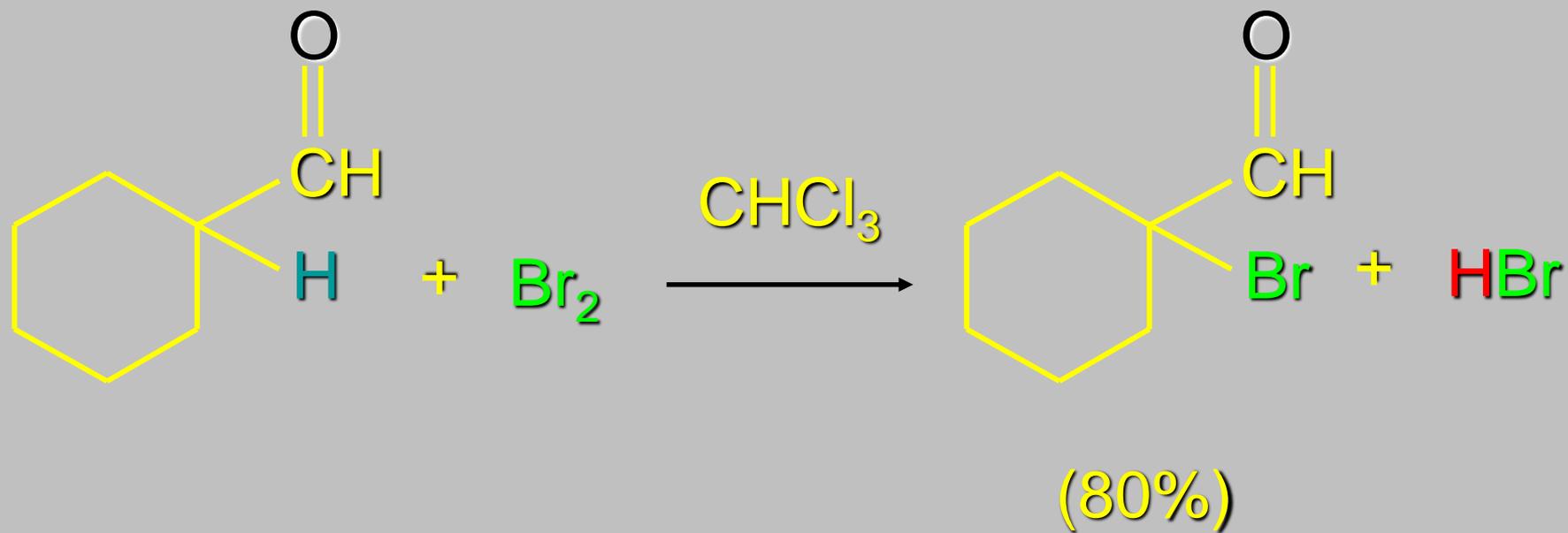


- X_2 es Cl_2 , Br_2 , o I_2 .
- Sustitución es específica para reemplazar al hidrógeno α .
- Catalizado por ácidos. Un de los productos es un ácido (HX).
- no hay reacción via radical libre.

Ejemplo



Ejemplo



Mecanismo de α Halogenación de Aldehídos y cetonas

Mecanismo

Factores experimentales

- específico para reemplazar el H α
- la velocidad para la cloración, bromación, y iodación es igual
- primer orden en la cetona; orden cero en el halogeno

Mecanismo

Factores experimentales

- específico para reemplazar el H α
- la velocidad para la cloración, bromación, y iodación es igual
- primer orden en la cetona; orden cero en el halogeno

Interpretación

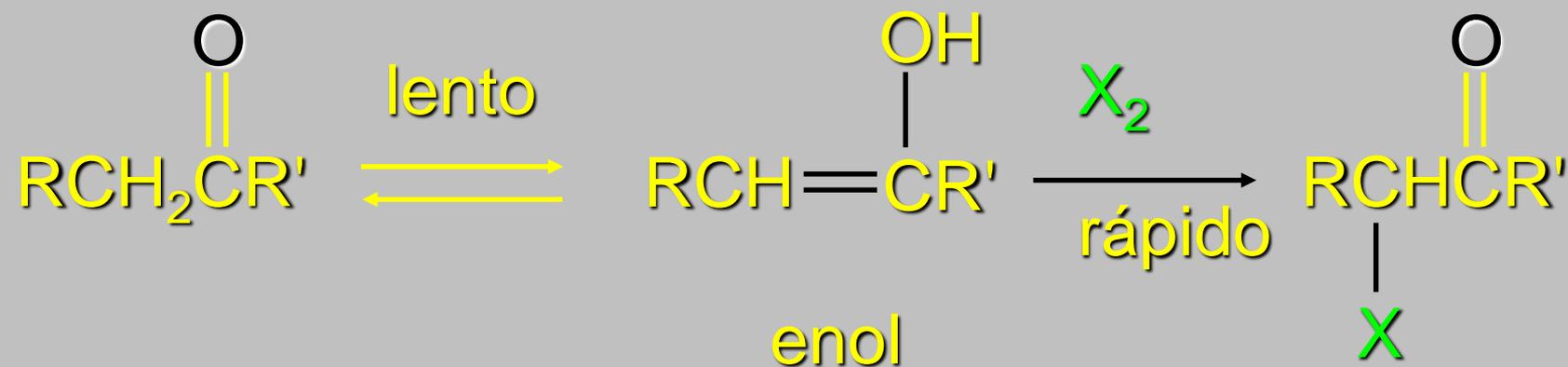
El paso determinante no involucra el ataque del halógeno

Mecanismo

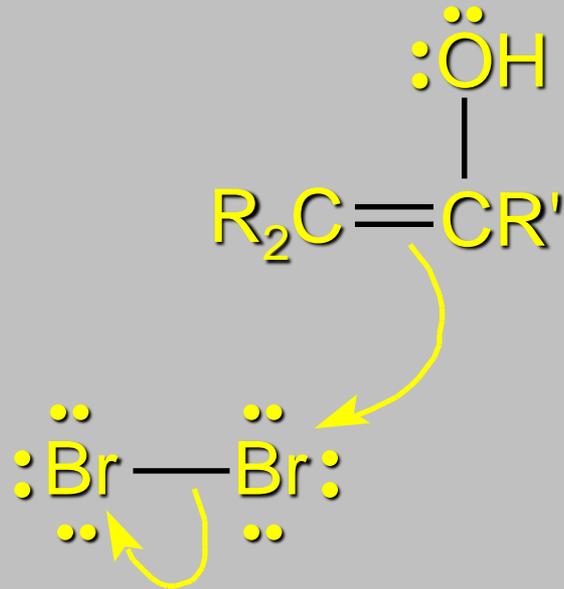
Dos pasos:

- convertir el aldehído o la cetona en el correspondiente enol, paso determinante
- reacción del enol con el halógeno, paso rápido

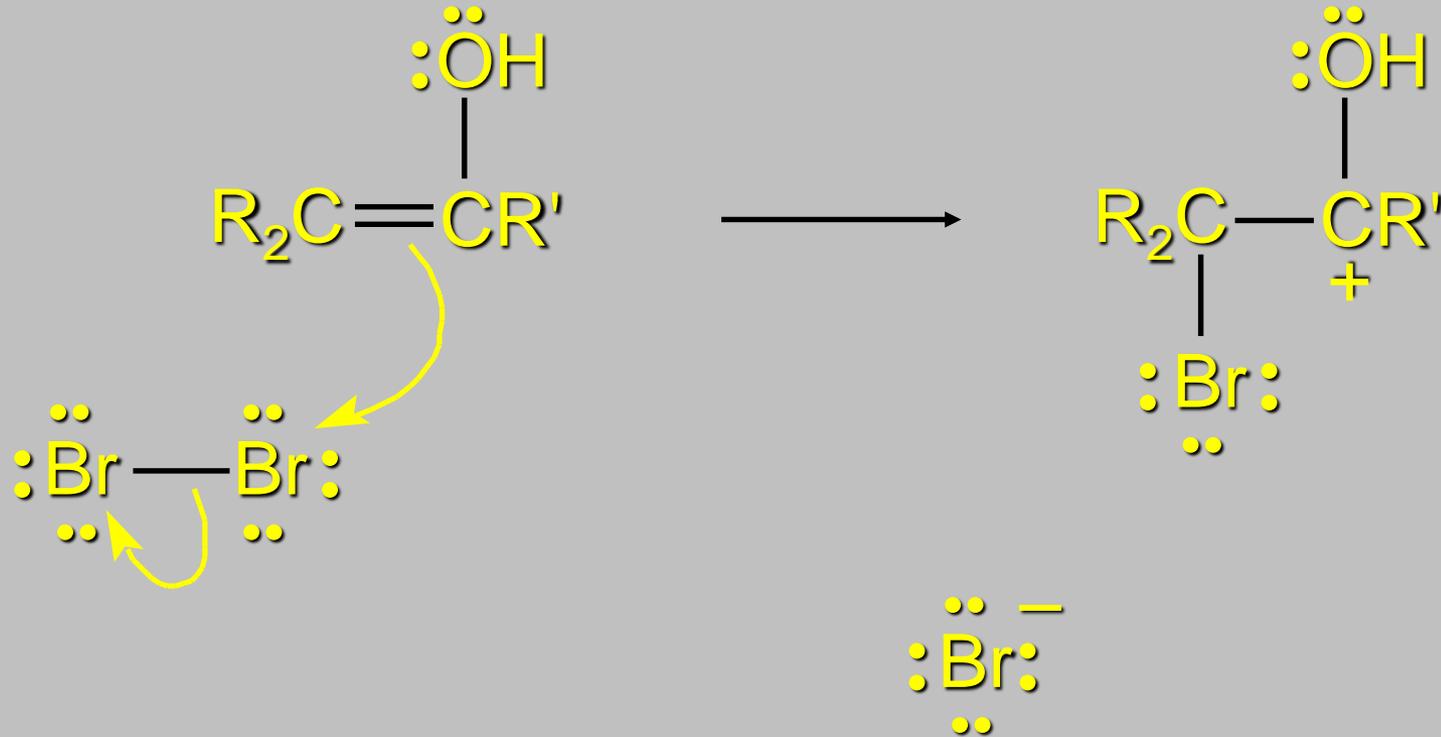
Mecanismo



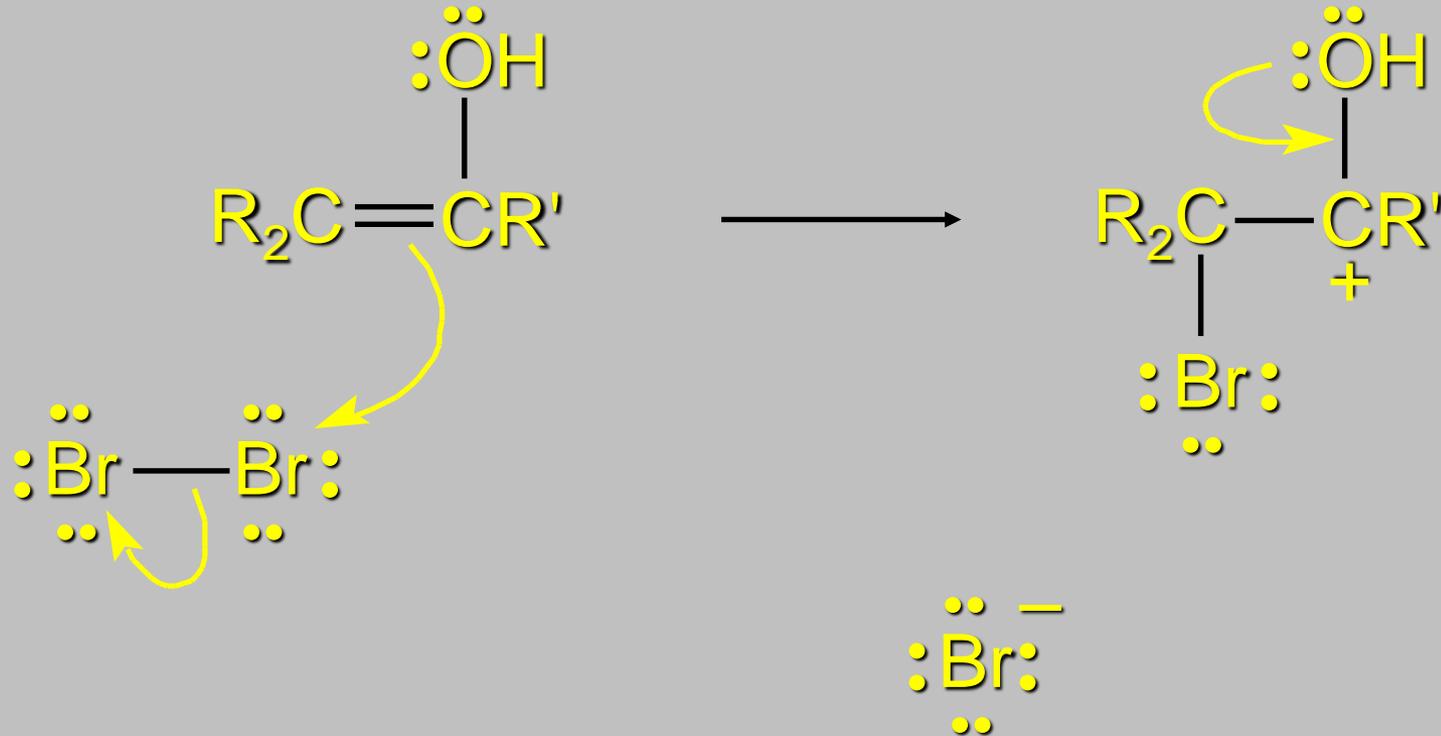
Reacción del enol con Br_2



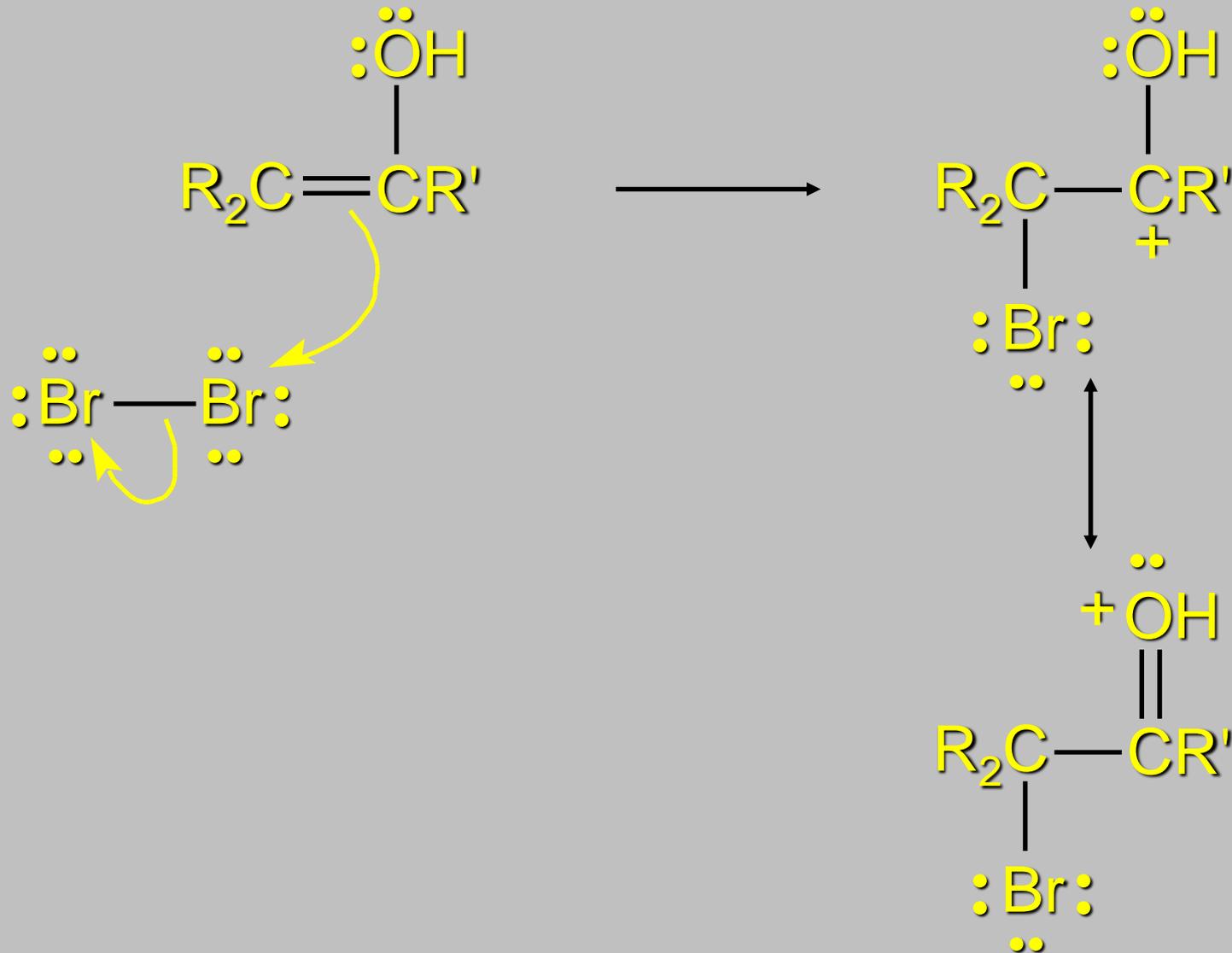
Reacción del enol con Br_2



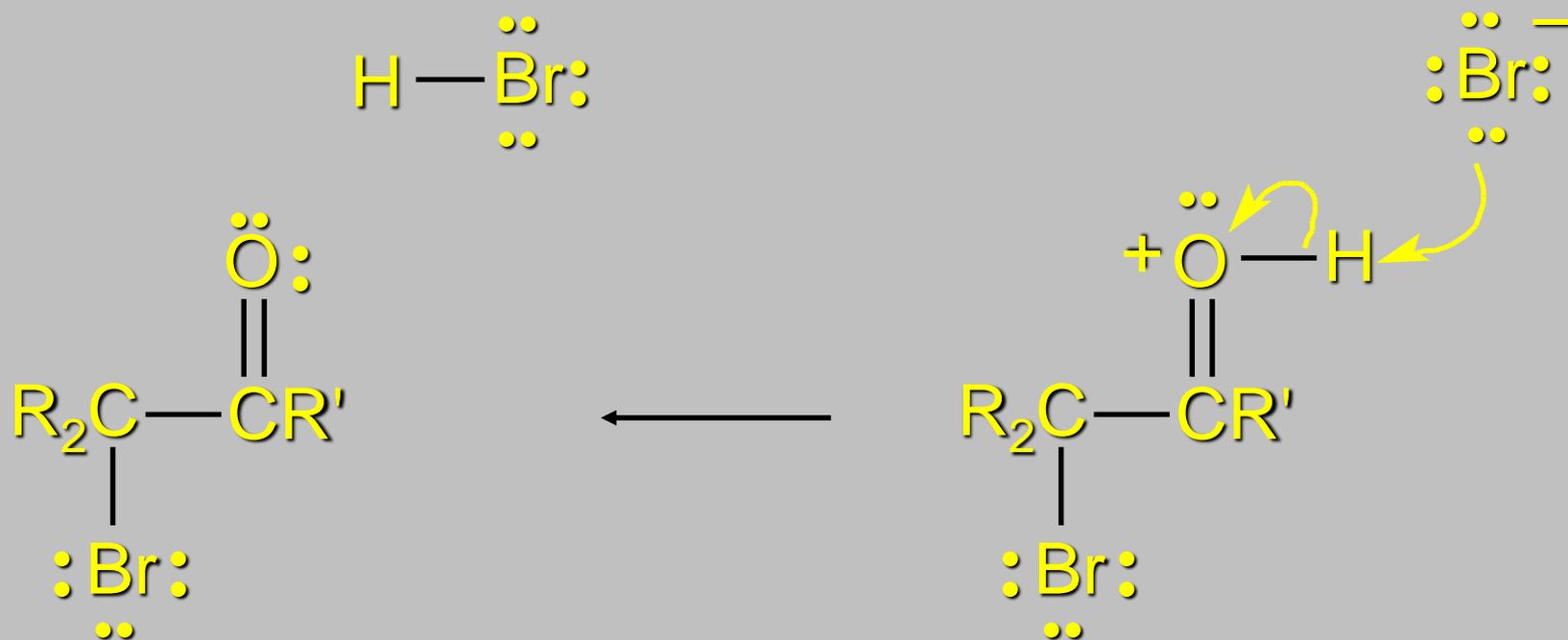
Reacción del enol con Br_2



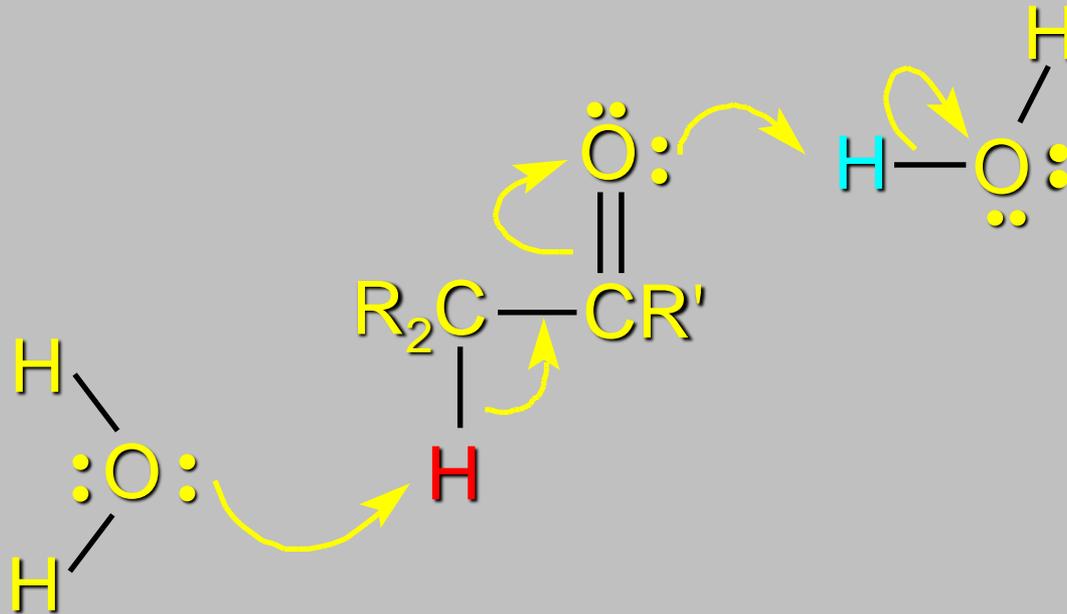
Reacción del enol con Br_2



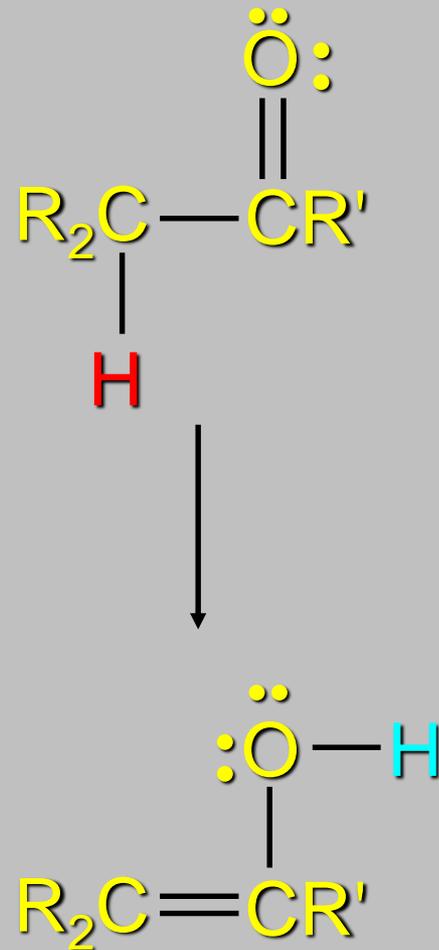
Pérdida del protón para completar el proceso



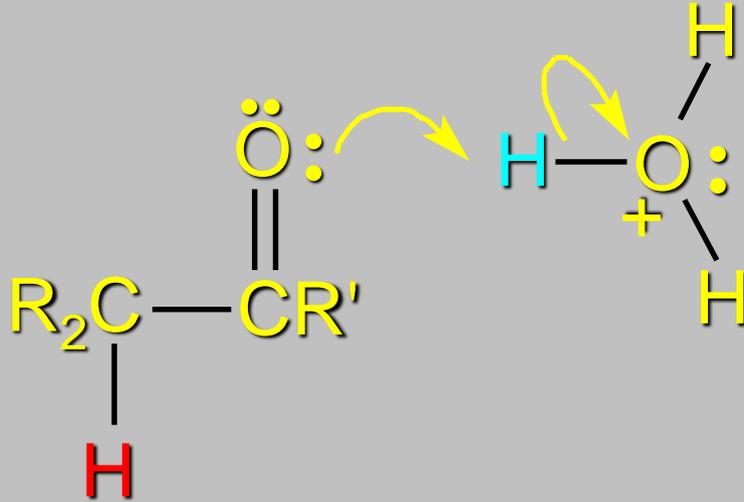
Mecanismo de Enolización (en general)



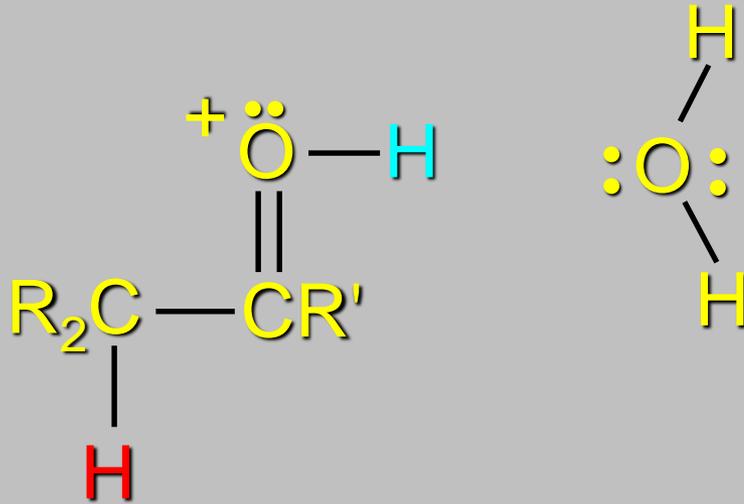
Mecanismo de Enolización (en general)



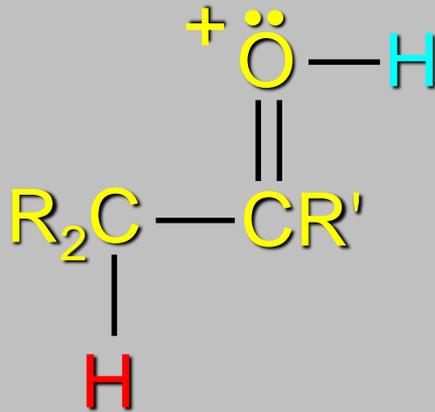
Mecanismo de la enolización (Acido-catalizada)



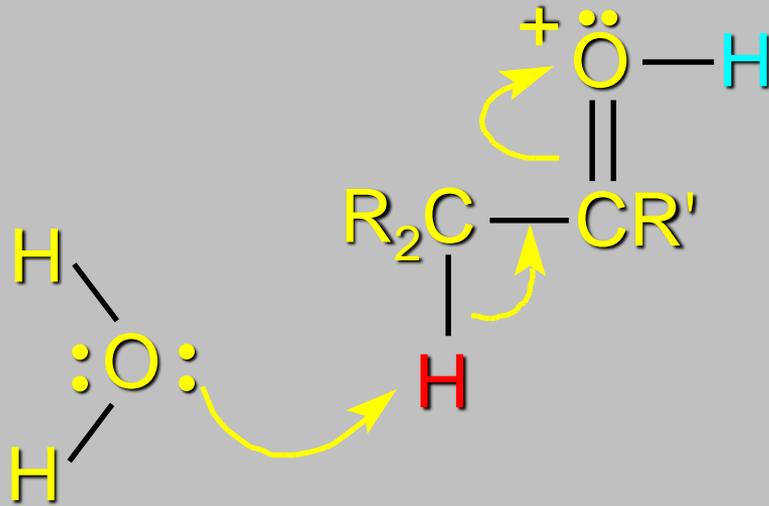
Mecanismo de la enolización (Acido-catalizada)



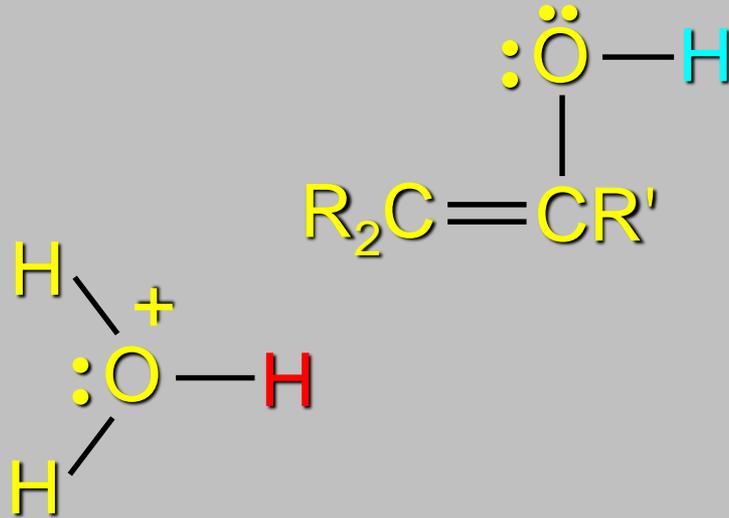
Mecanismo de la enolización (Acido-catalizada)



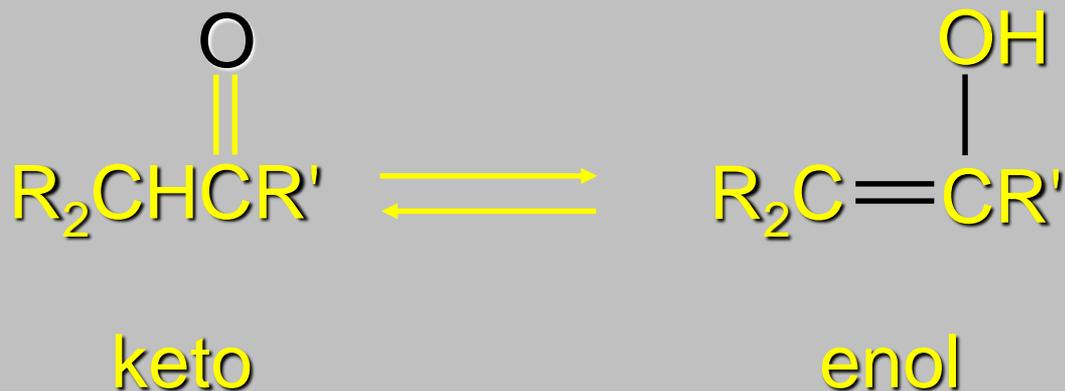
Mecanismo de la enolización (Acido-catalizada)



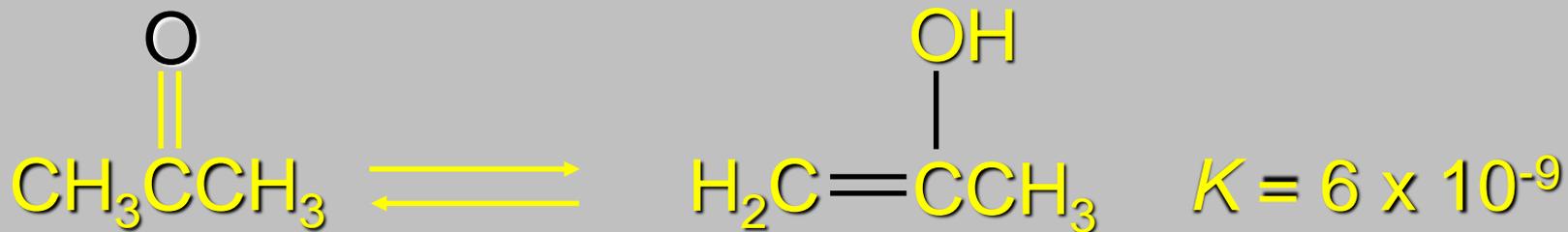
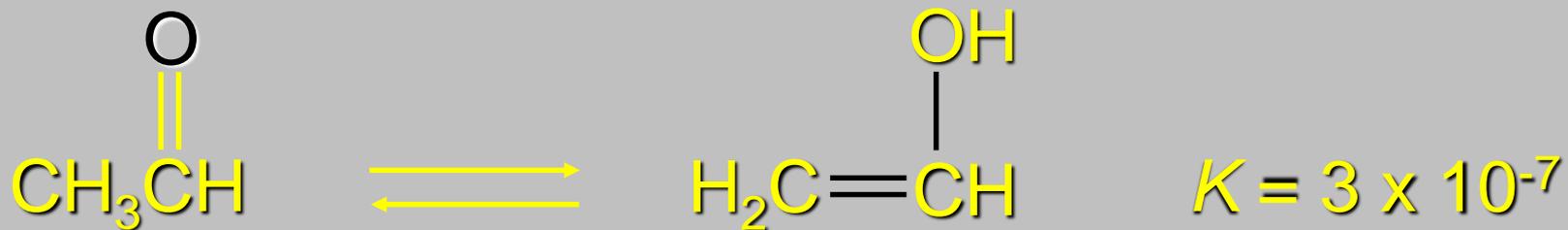
Mecanismo de la enolización (Acido-catalizada)



Contenido de Enol

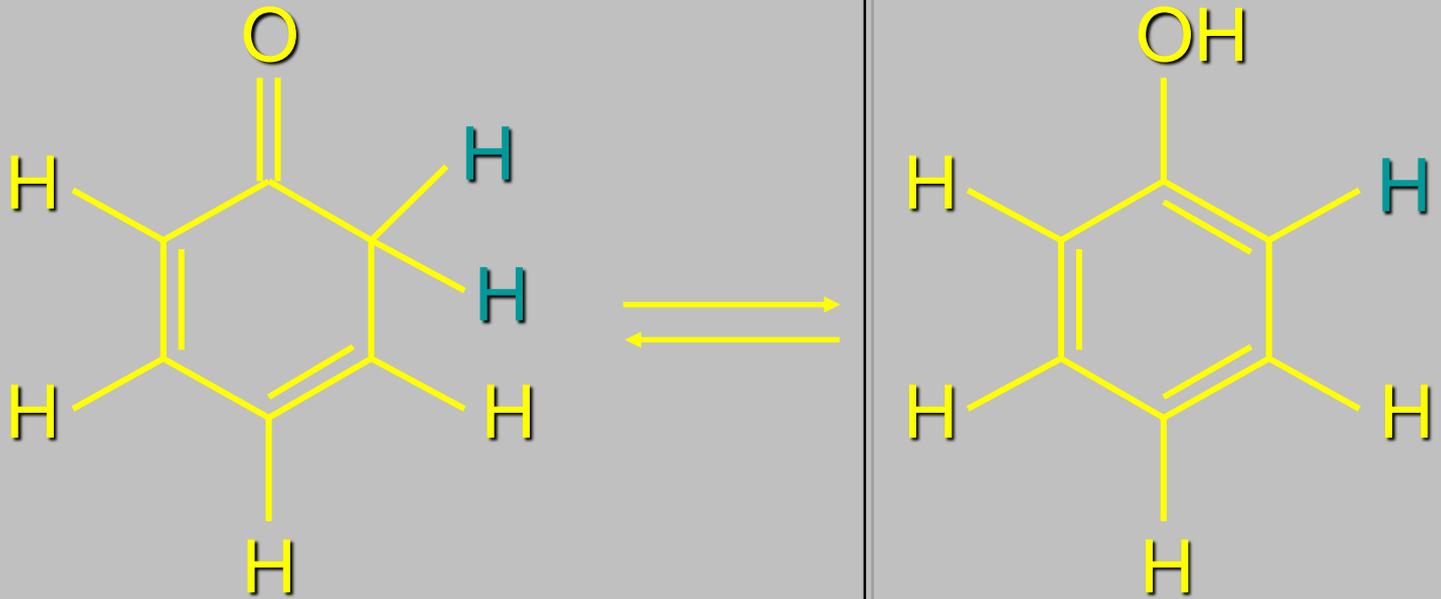


- Usualmente es pequeño
- La forma ceto es usualmente 45-60 kJ/mol
- Mas estable que el enol



Enoles estabilizados

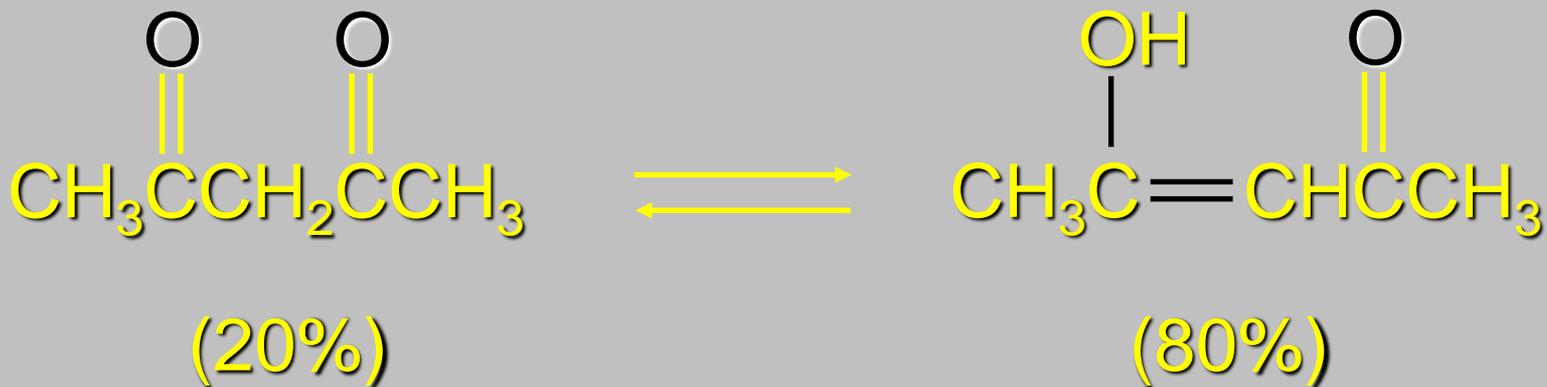
2,4-Ciclohexadienone



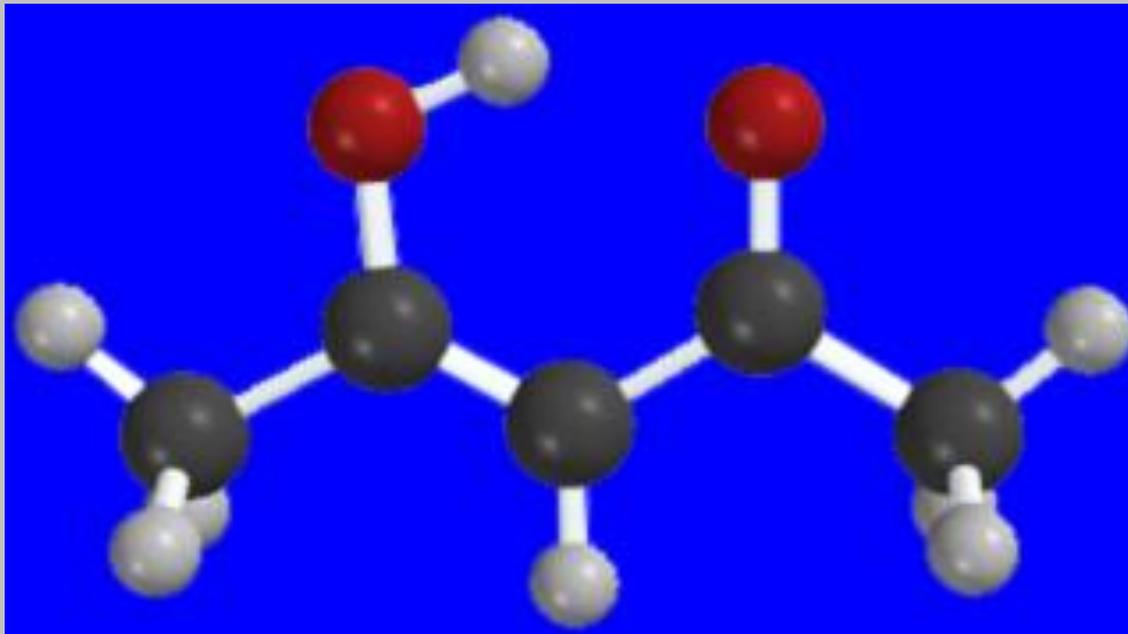
- la forma ceto es menos estable
- No es aromática

1,3-Dicetonas
(also called β -diketones)

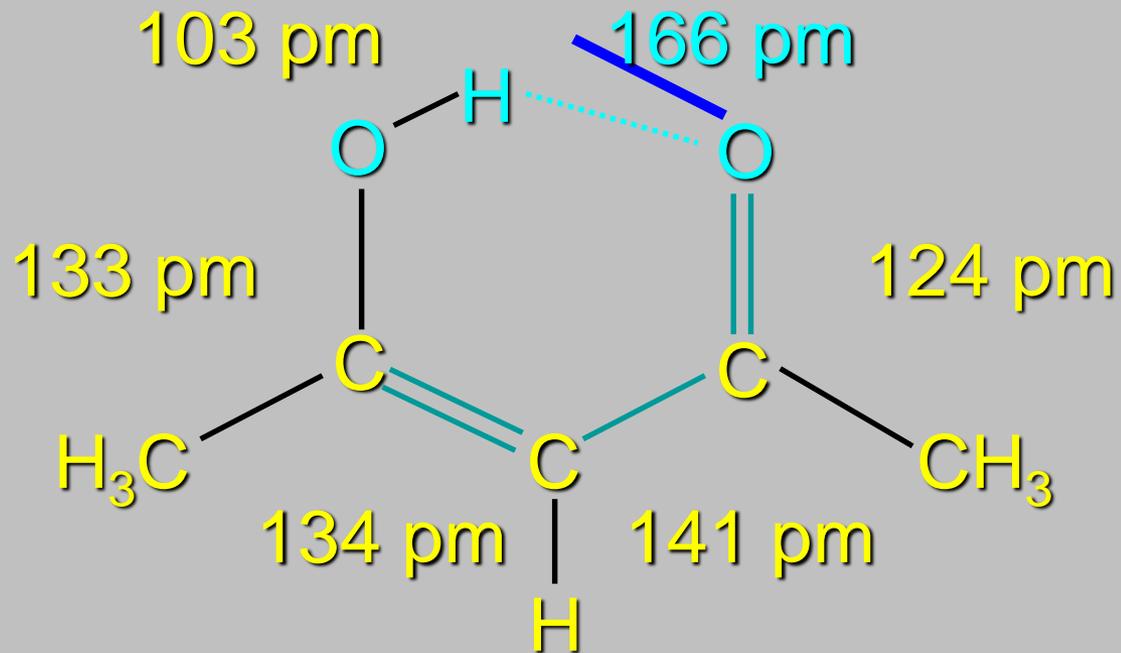
Ejemplo: 2,4-pentanodiona



enol de 2,4-pentanodiona



Enol de 2,4-pentanodiona

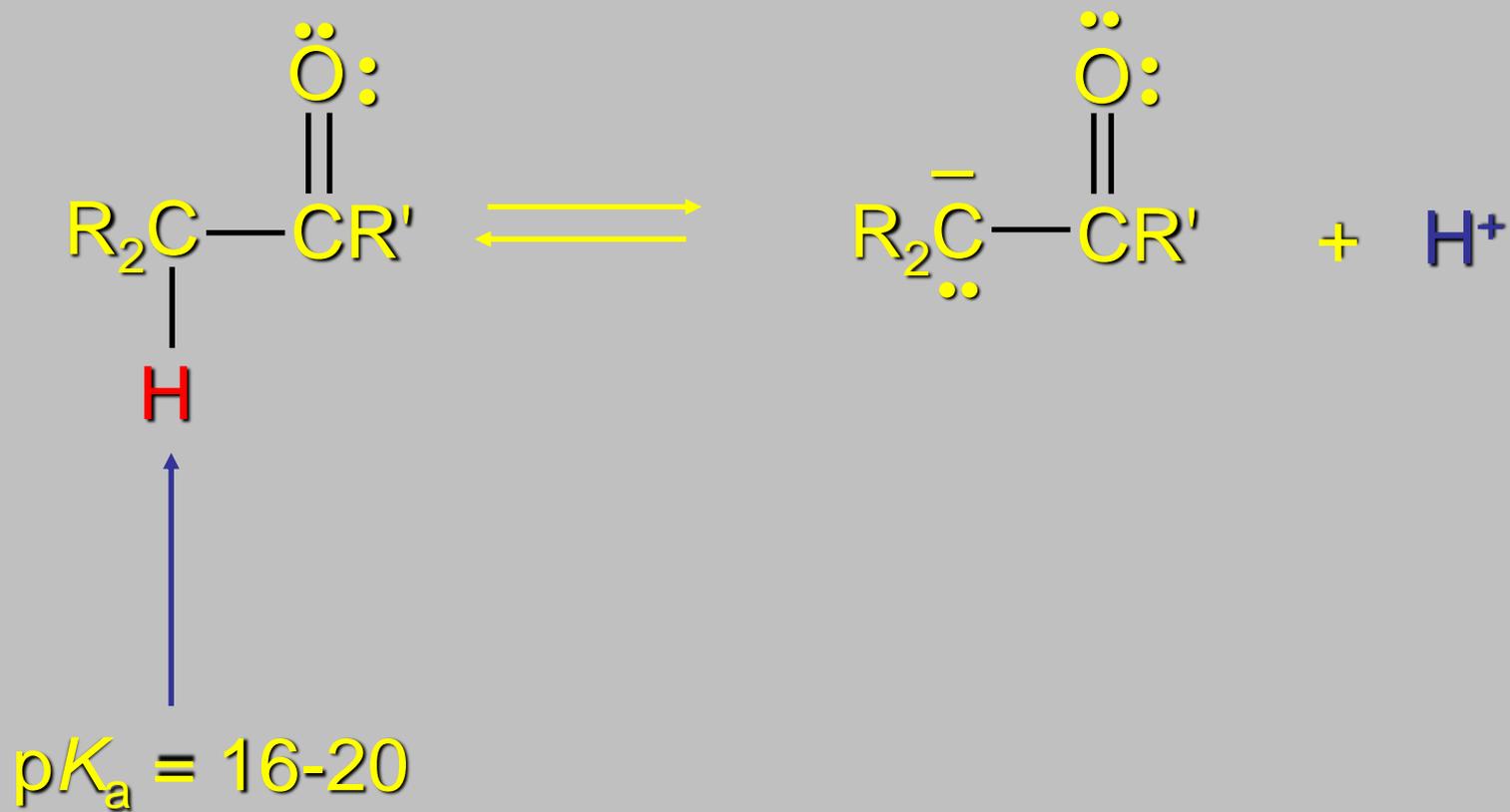


C=C y C=O es conjugado

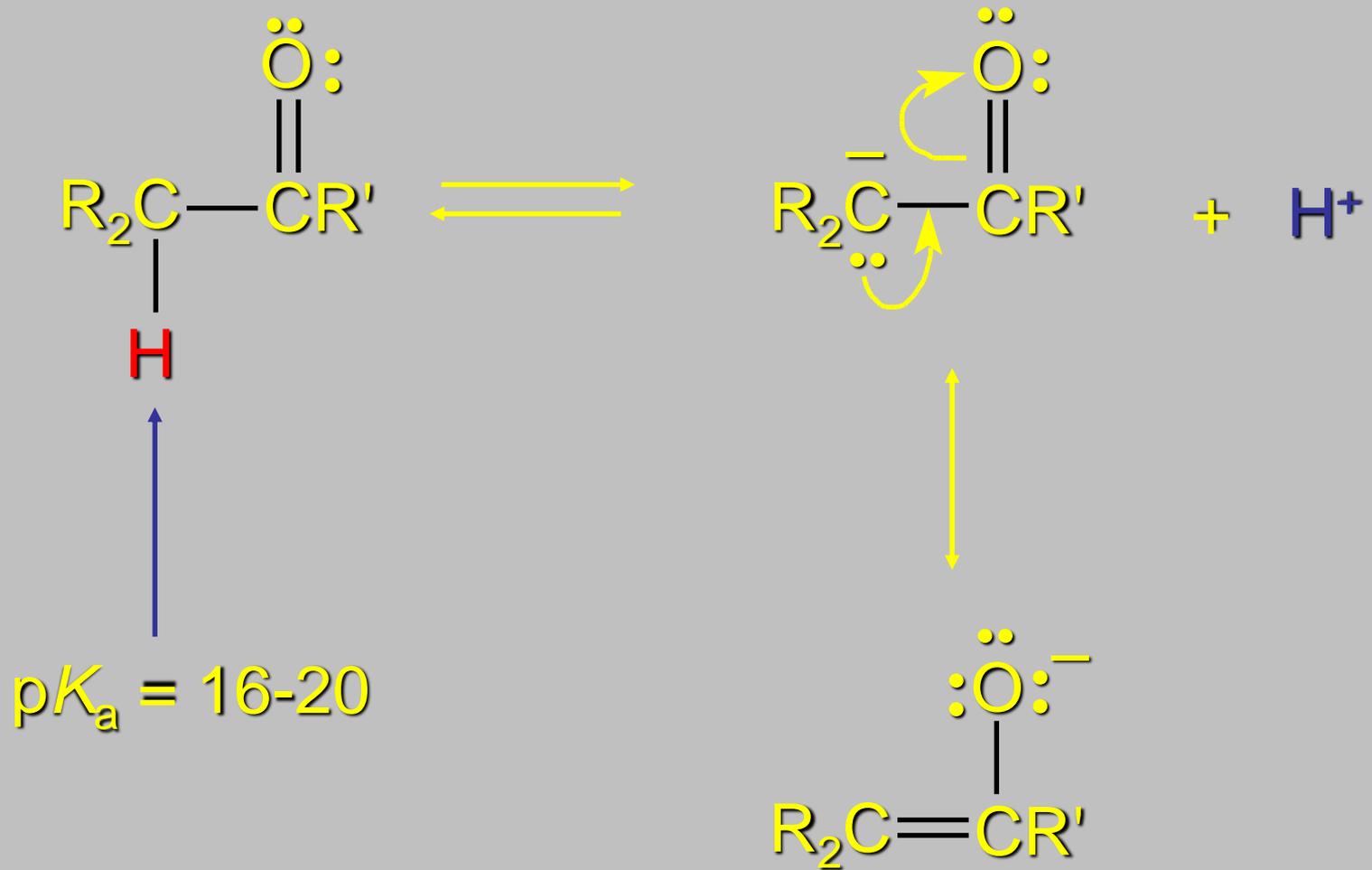
Enolización Base-Catalizada :

Anión Enolato

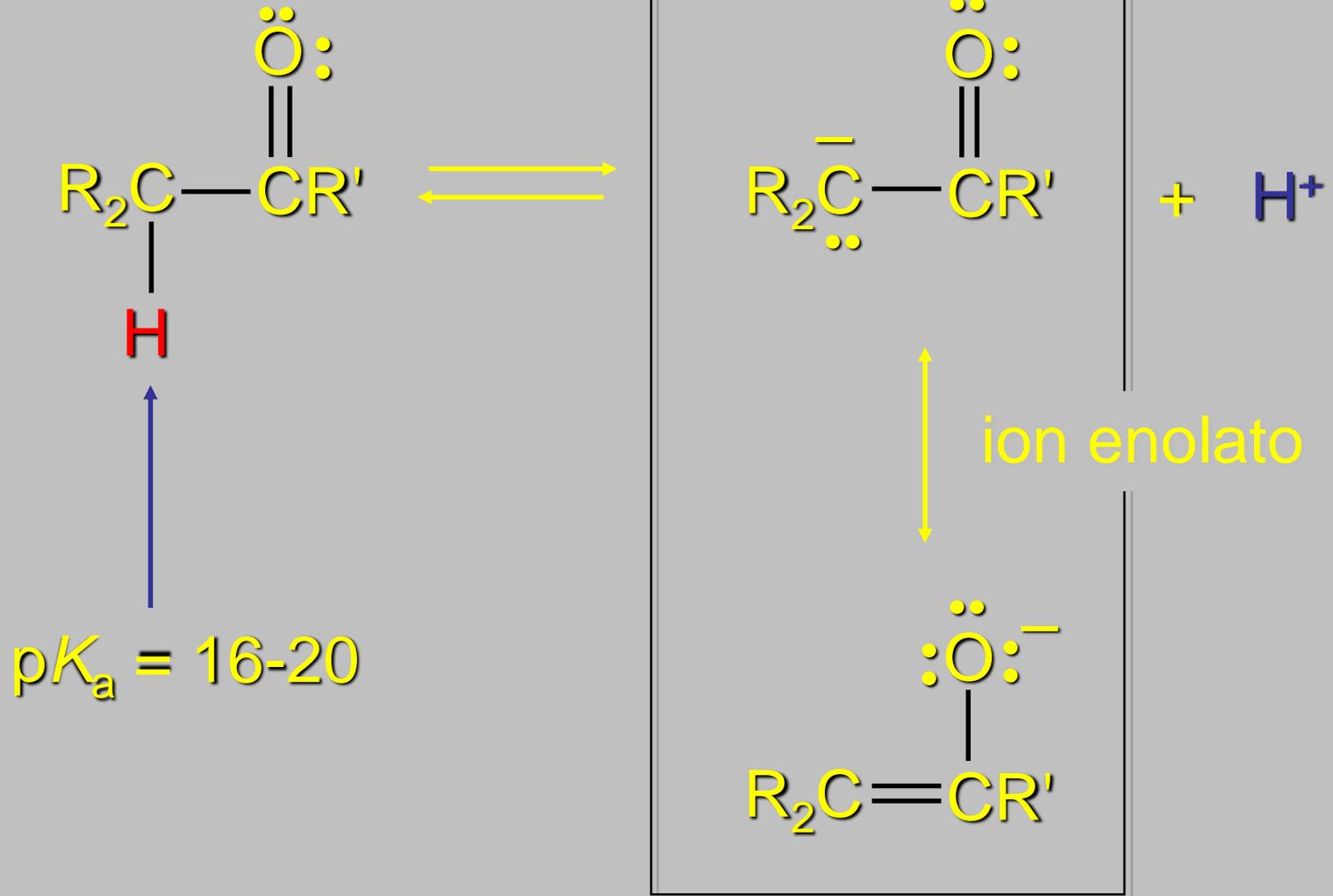
Acidez del α -Hidrógeno



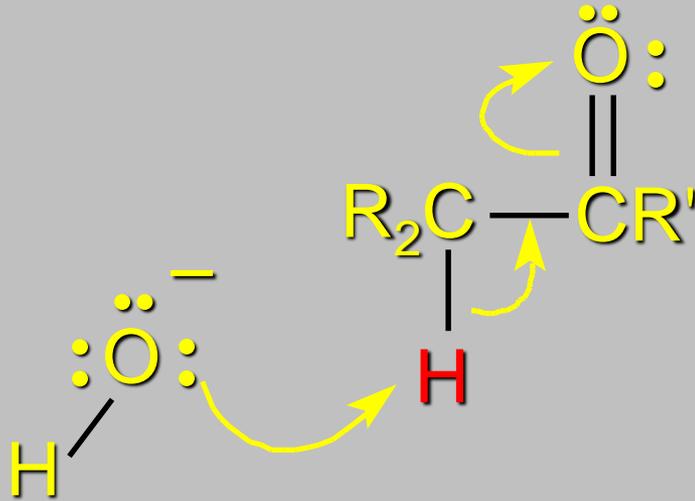
Acidez del α -Hidrógeno



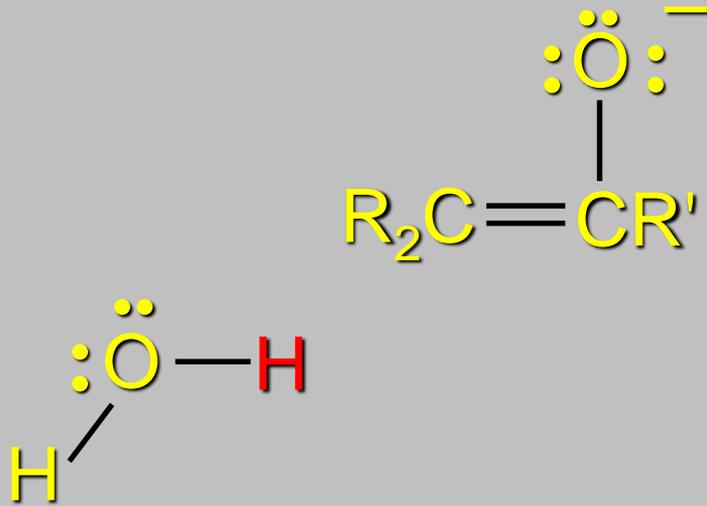
Acidez del α -Hidrógeno



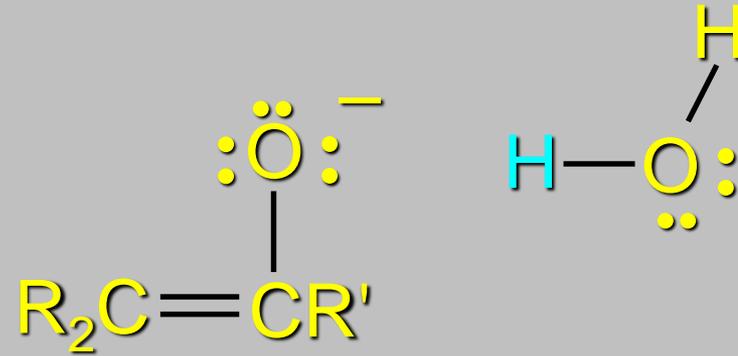
Mecanismo



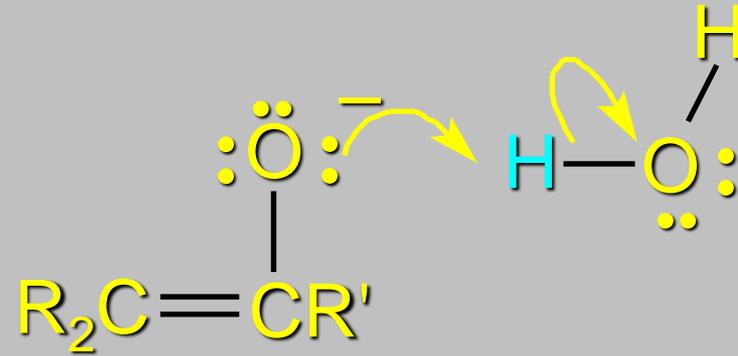
Mecanismo



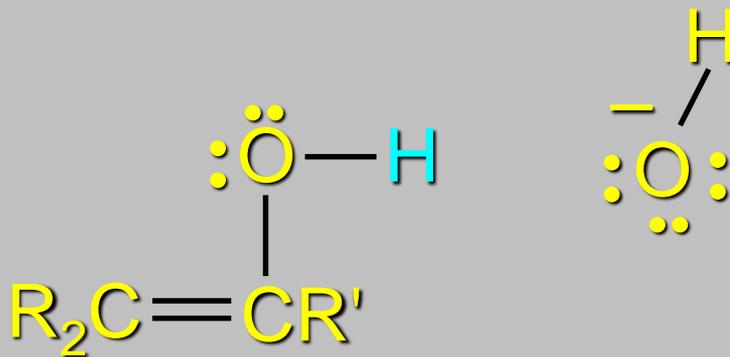
Mecanismo



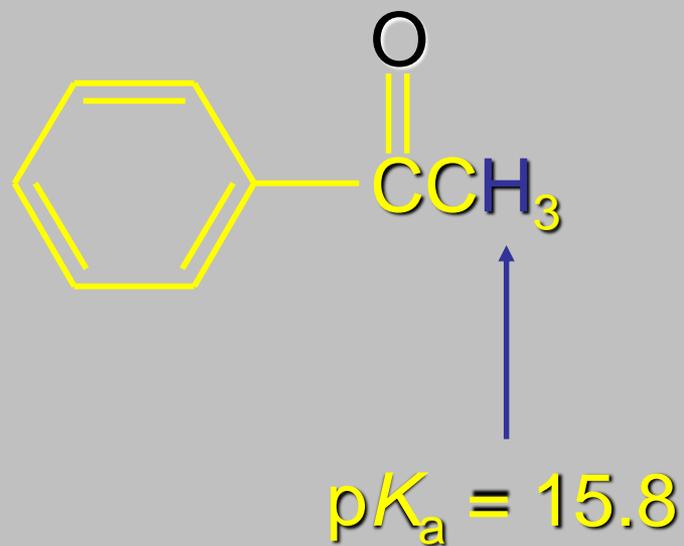
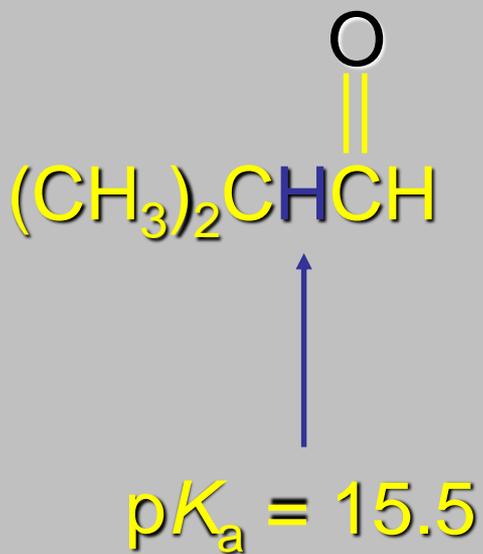
Mecanismo



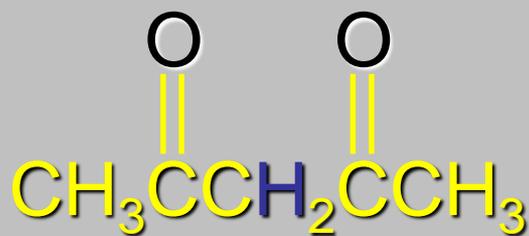
Mecanismo



Acidez del α -Hidr3geno

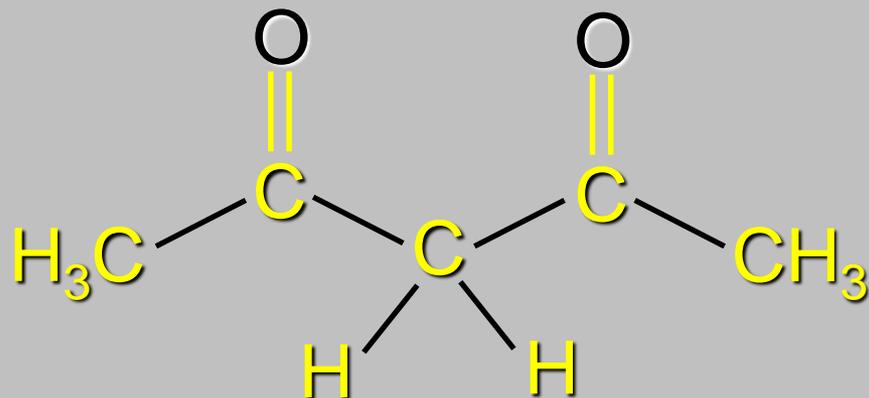


β -Dicetonas son mucho más acídicas

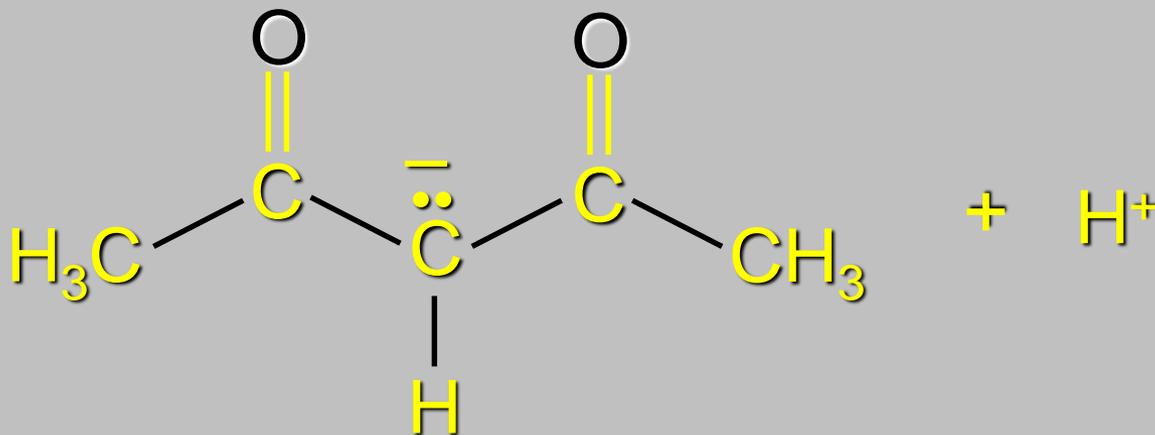


$\text{p}K_a \approx 9$

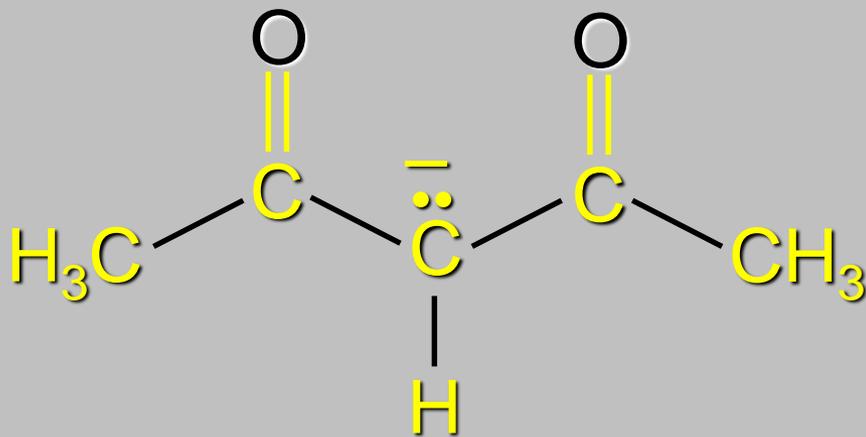
β -Dicetonas son mucho más ácidas



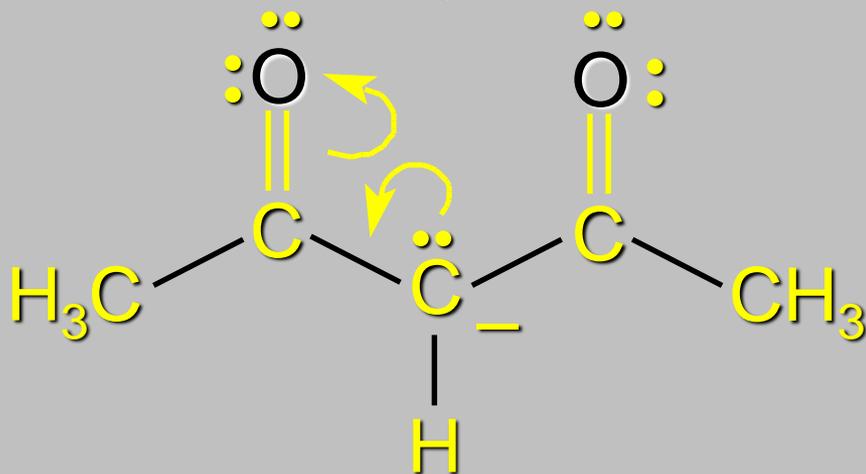
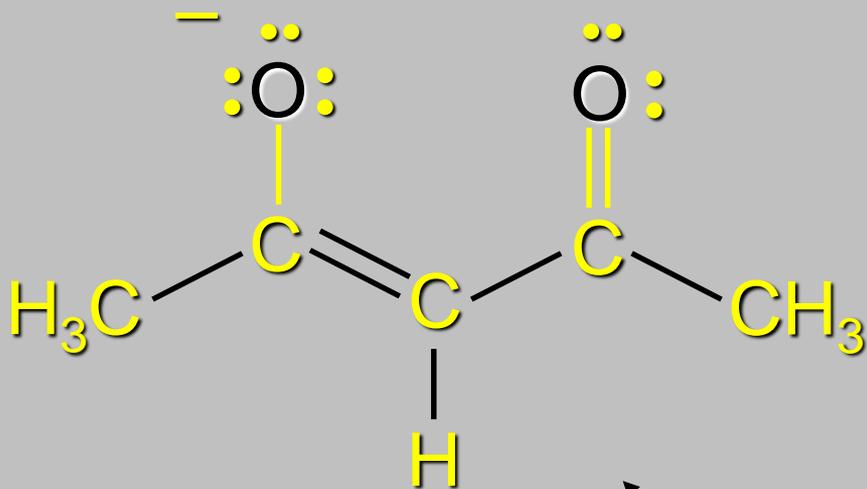
$$K_a = 10^{-9}$$



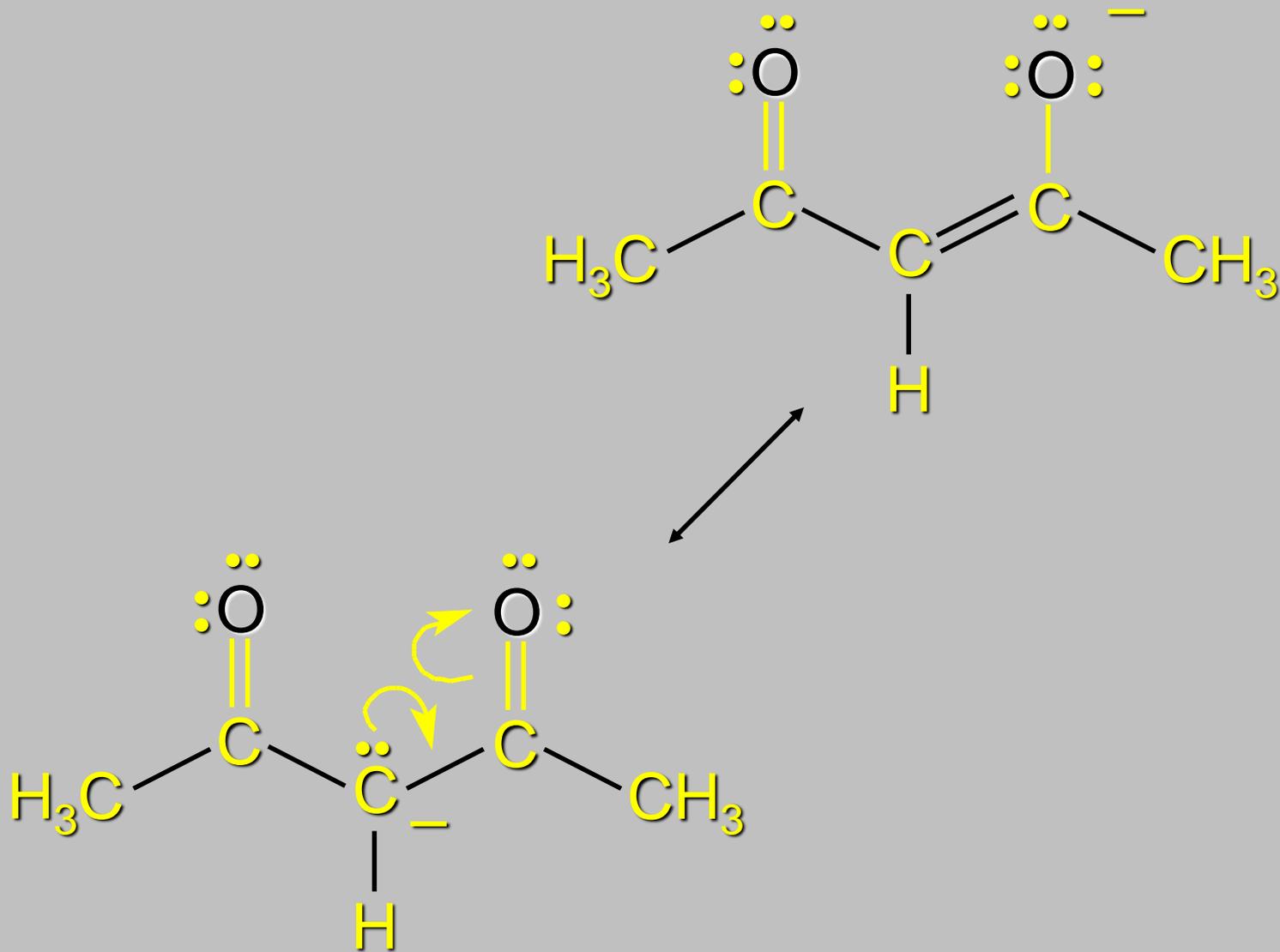
β -Dicetonas son mucho más acídicas



β -Dicetonas son mucho más acídicas



β -Dicetonas son mucho más acídicas

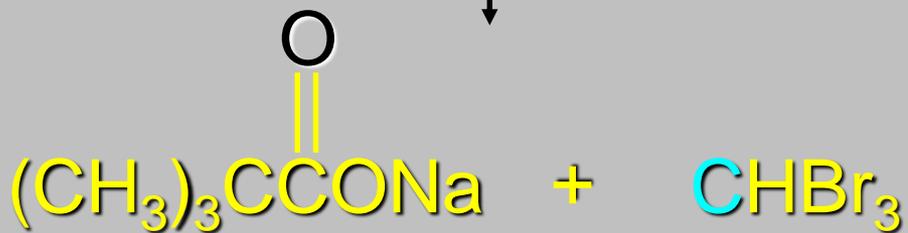
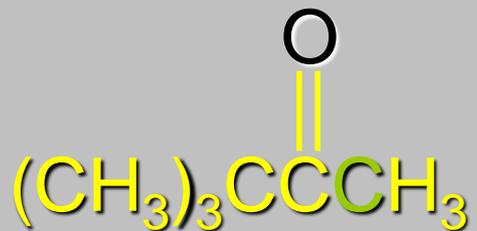


La Reacción de Haloformo

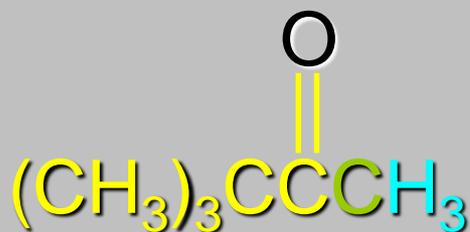
La Reacción de Haloformo

- En condiciones básicas, la halogenación de una metil cetona frecuentemente lleva a una ruptura del enlace carbono-carbono
- Esta reacción se llama Haloformo, ya que uno de los productos cloroformo, bromoformo, o iodoformo

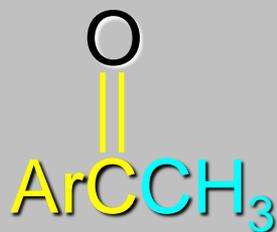
Ejemplo



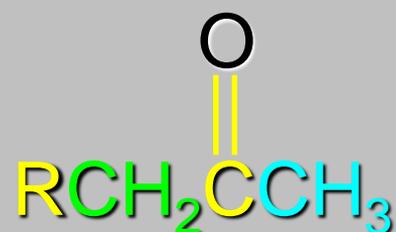
La Reacción de Haloformo



si

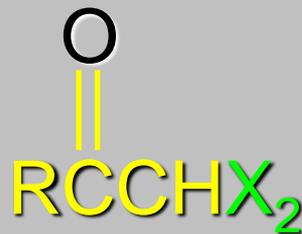
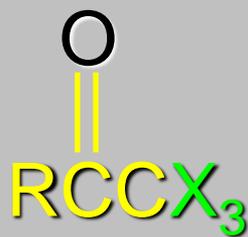
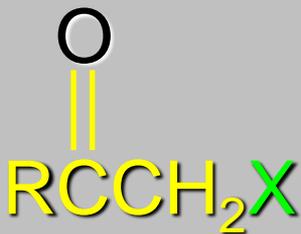
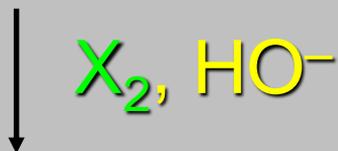
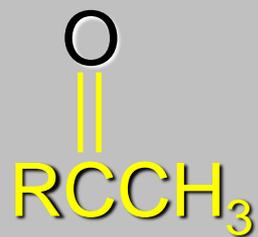


si



no

Mecanismo



Mecanismo

