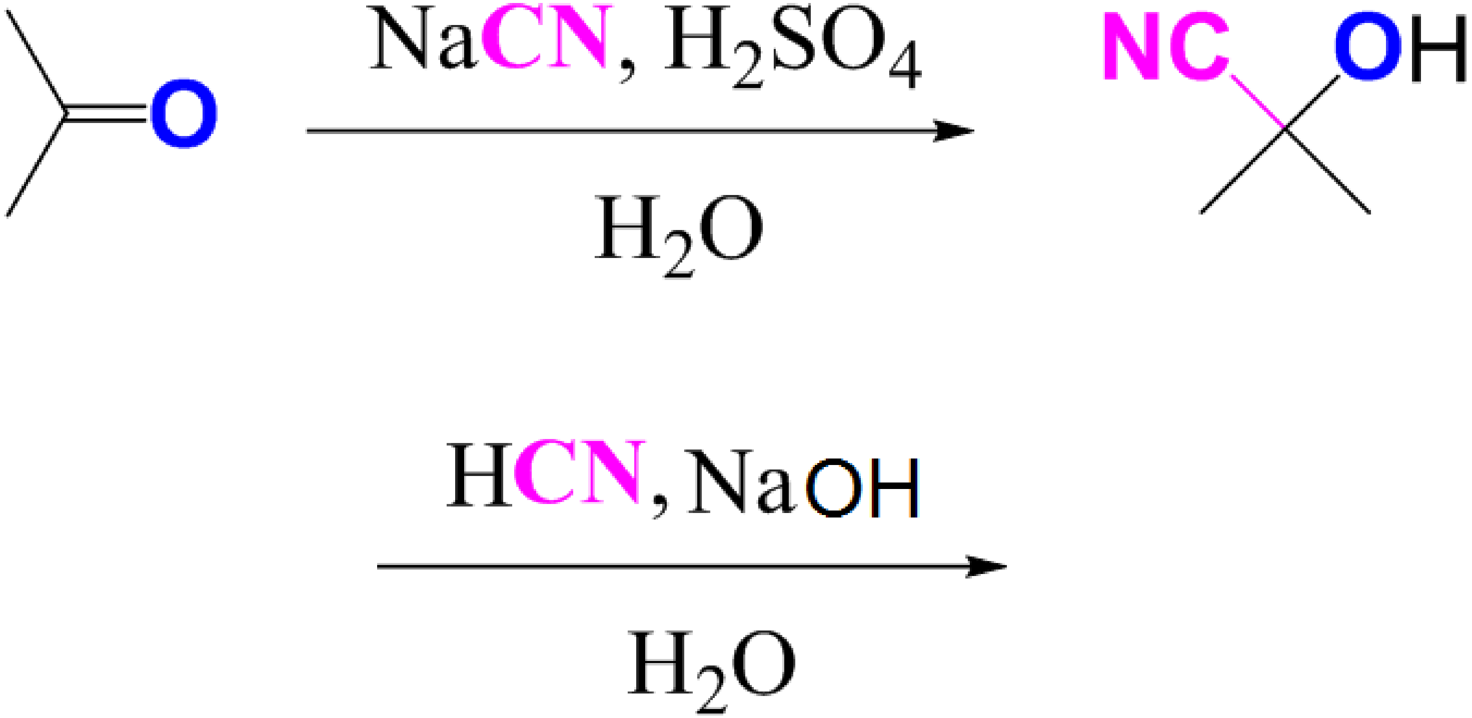
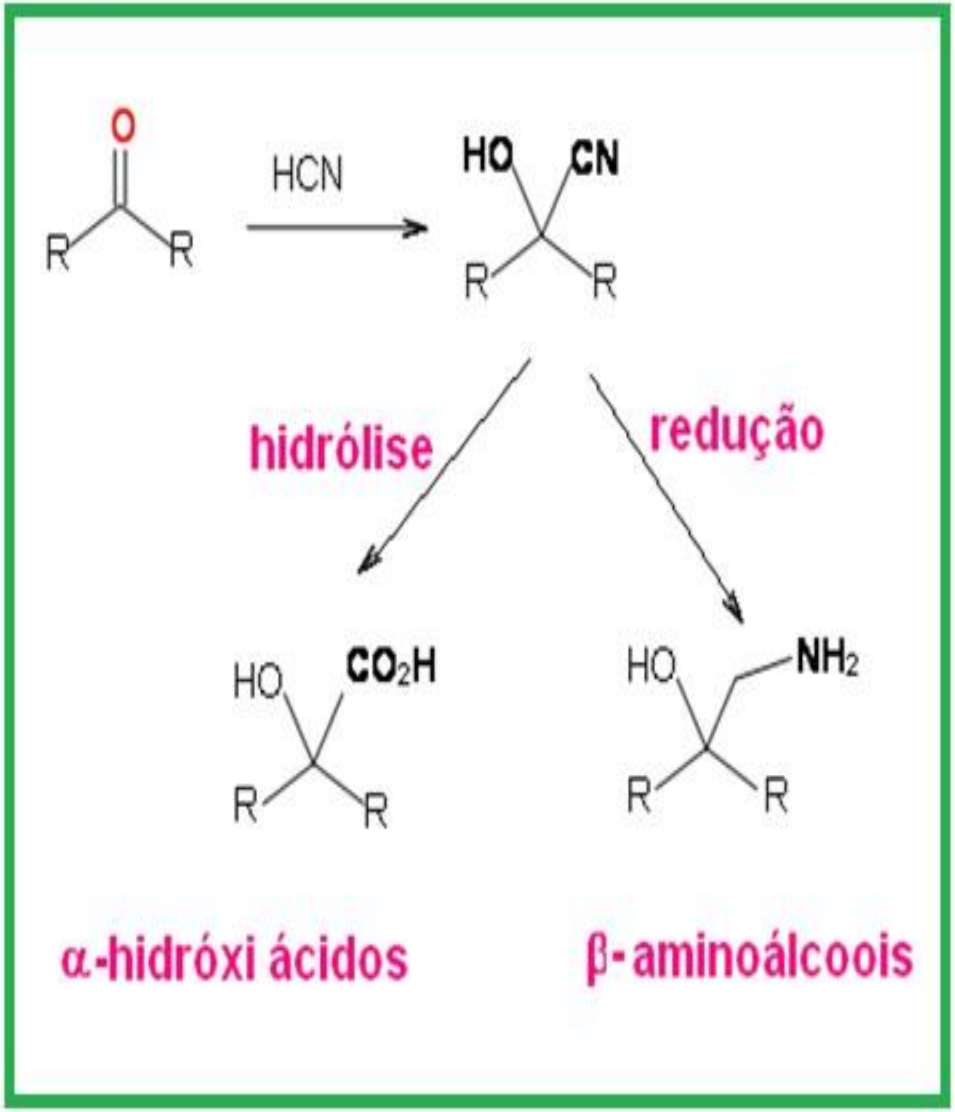
ADIÇÃO NUCLEOFÍLICA A COMPOSTOS CARBONÍLICOS


O
NaCN, H2SO4
H2O
NC
OH
HCN, NaOH
H2O

IMPORTÂNCIA SINTÉTICA DA ADIÇÃO DE CIANETO A CARBONÍLICOS

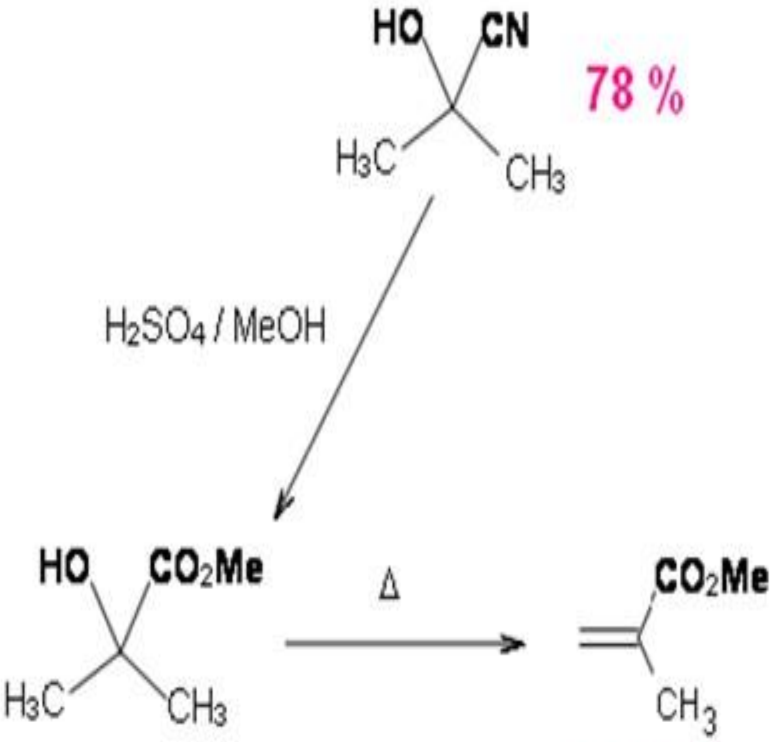


hidrólise

redução

α-hidróxi ácidos

β-aminoálcoois

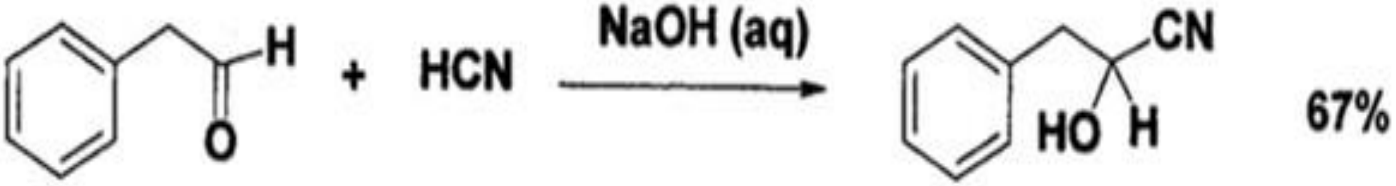


78 %

acrilato
de metila

90%

ADIÇÃO DE CIANETO



CIANOIDRINA

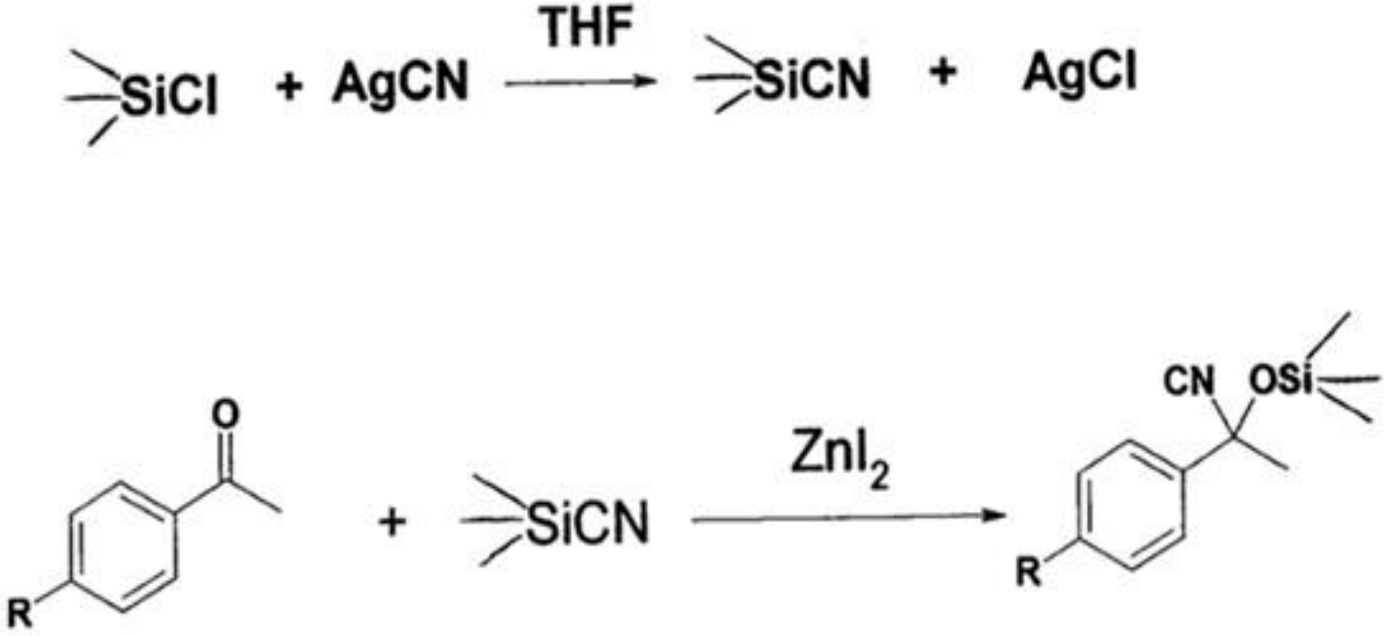
MECANISMO

$HCN + B^- \rightleftharpoons CN^- + HB$

GERAÇÃO DO NUCLEÓFILO

ATAQUE NUCLEOFÍLICO

OUTRA METODOLOGIA MAIS SEGURA

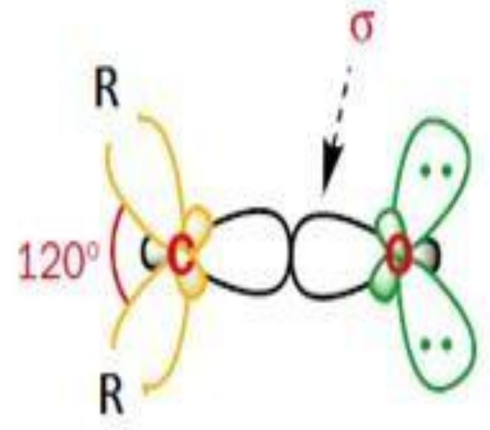


R = H (91%)
R = OMe (96%)
R = NO_2 (89%)

QUAL O MECANISMO DESTA REAÇÃO EM

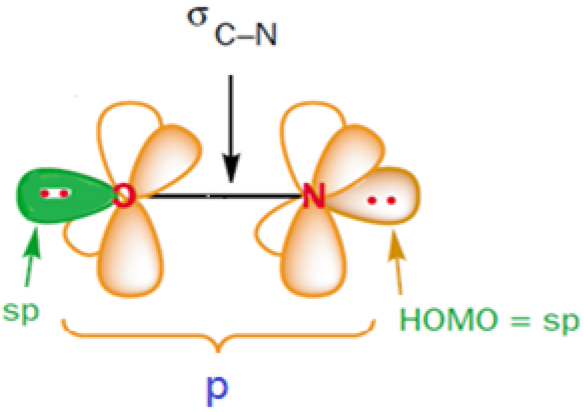
TERMOS DE ORBITAIS MOLECULARES ?

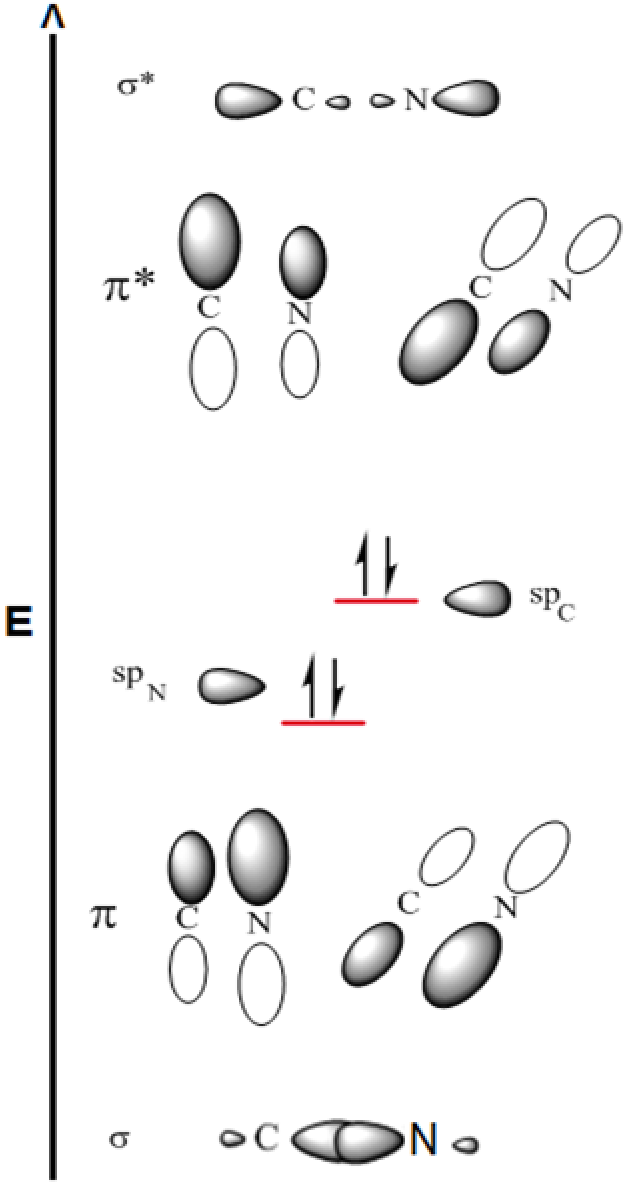
CONSIDEREMOS A ESTRUTURA ELETRÔNICA DO GRUPO CARBONILA

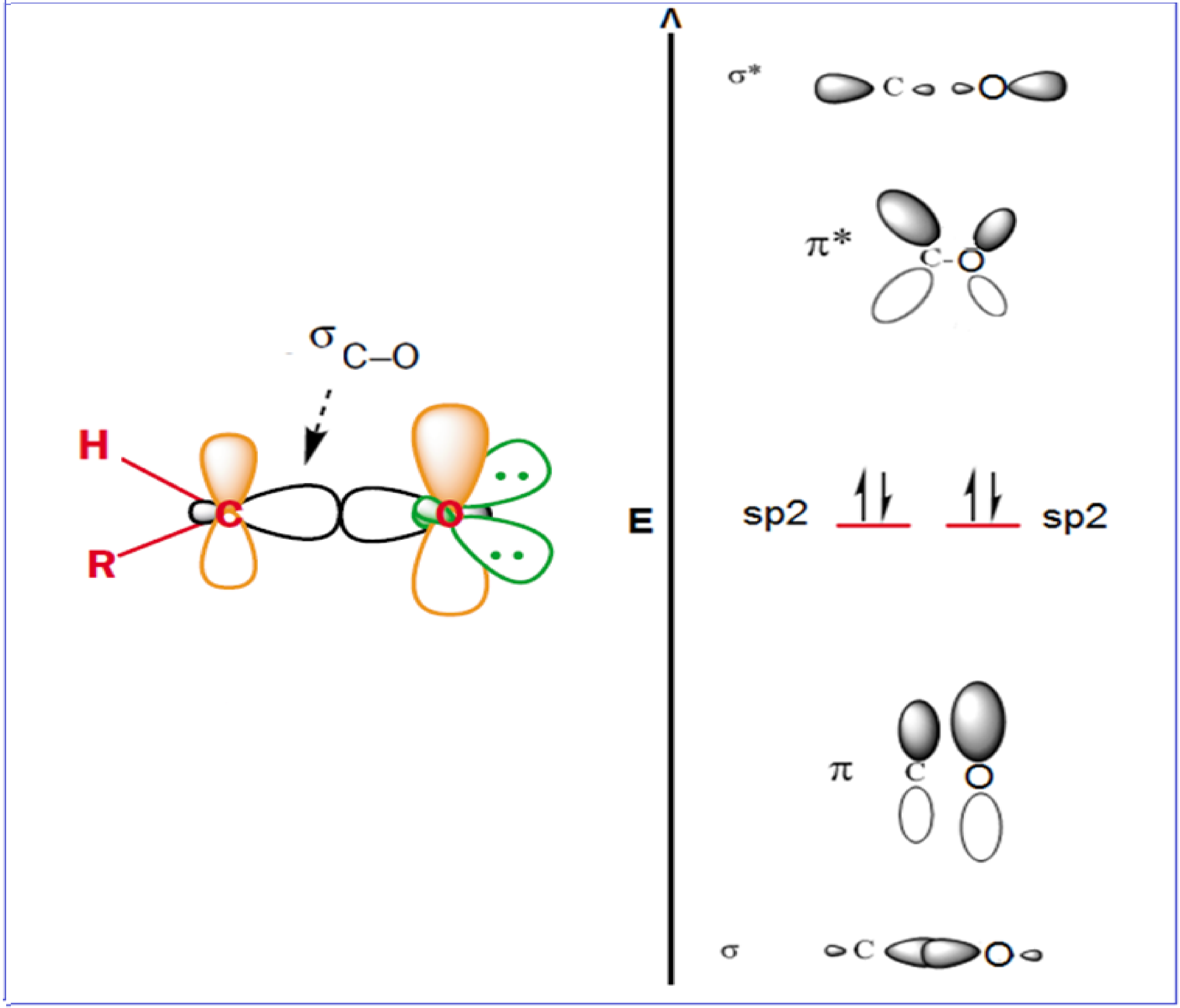


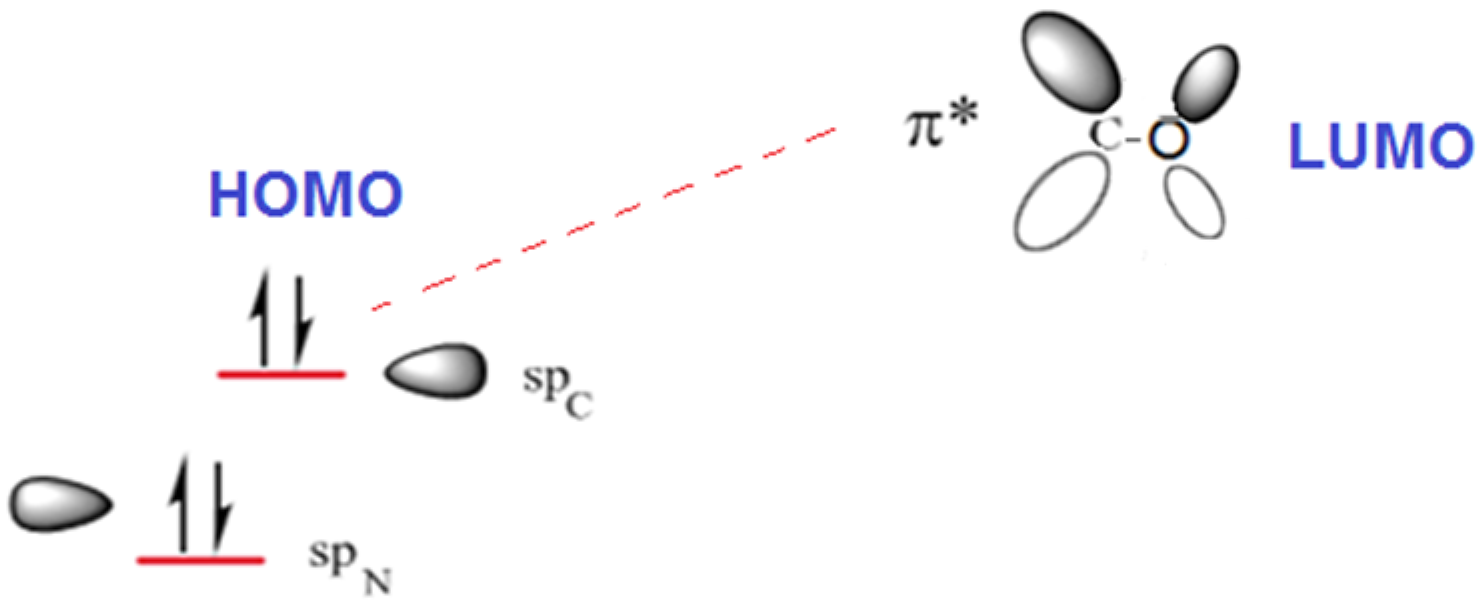
TLV

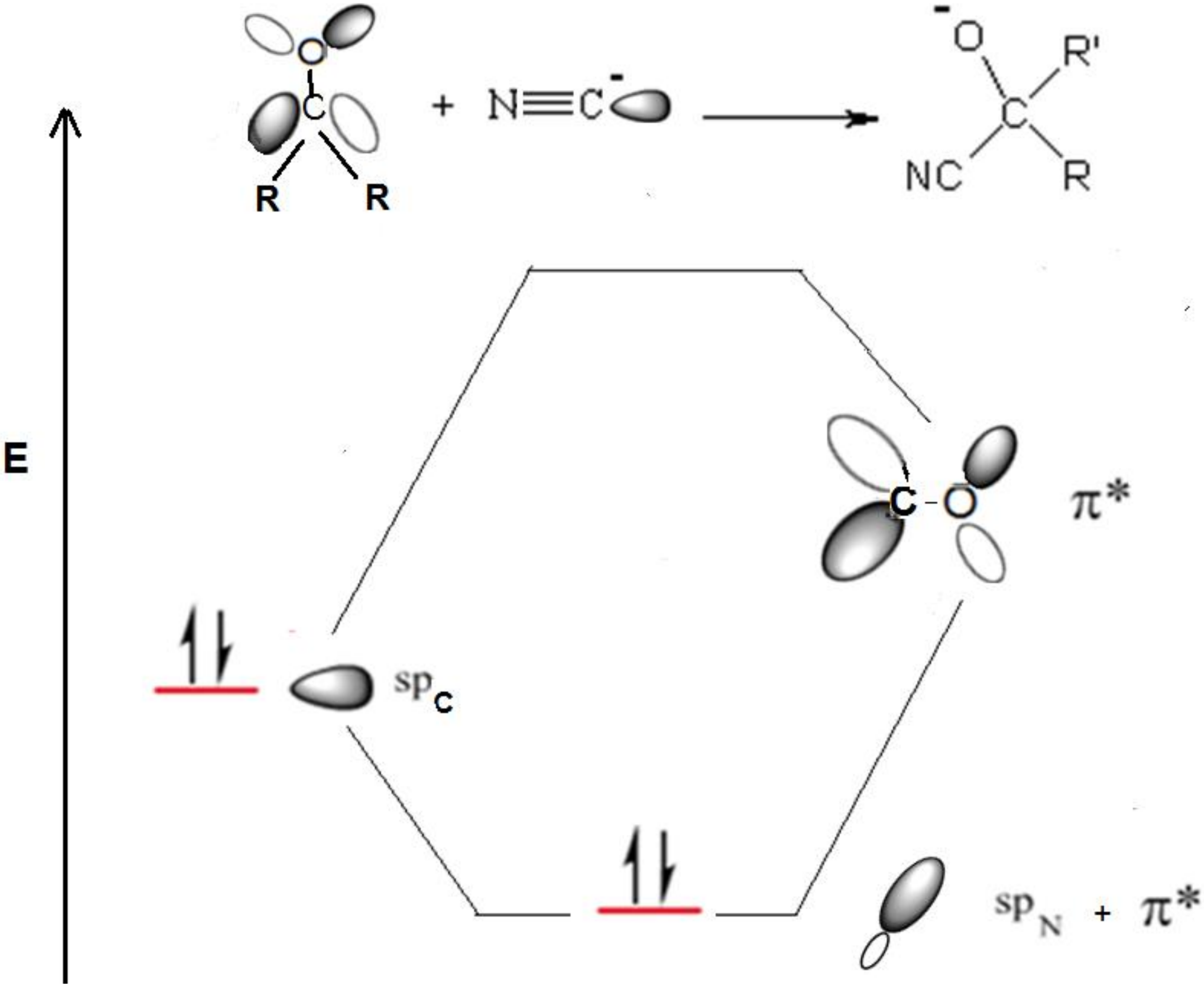
$:\mathrm{N}\equiv\mathrm{C}:^{\ominus}$



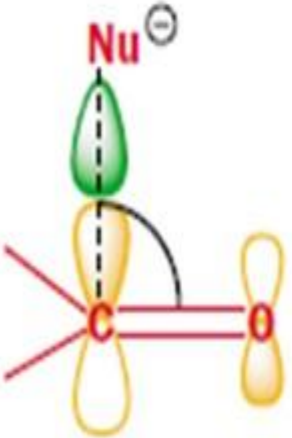



σ C–O
H
R
C
O
E
σ*
C
O
π*
C-O
sp2
sp2
π
C
O
σ
C
O

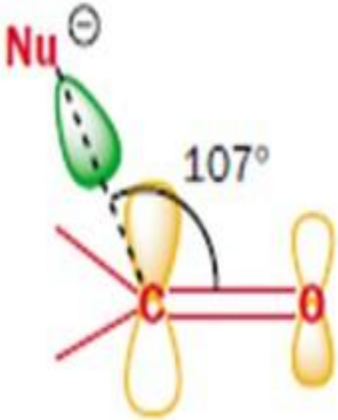

π*
C-O
LUMO
HOMO
sp_C
sp_N


O
C
R
R
+
N≡C⁻
⁻O
R'
C
NC
R
E
sp_C
C–O
π*
sp_N + π*

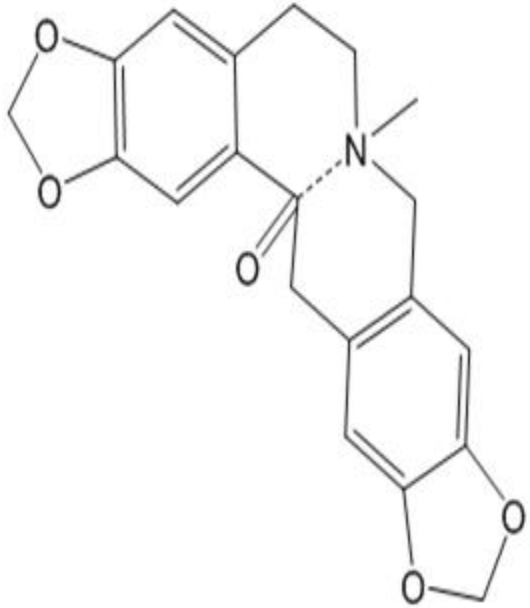
ORIENTAÇÃO

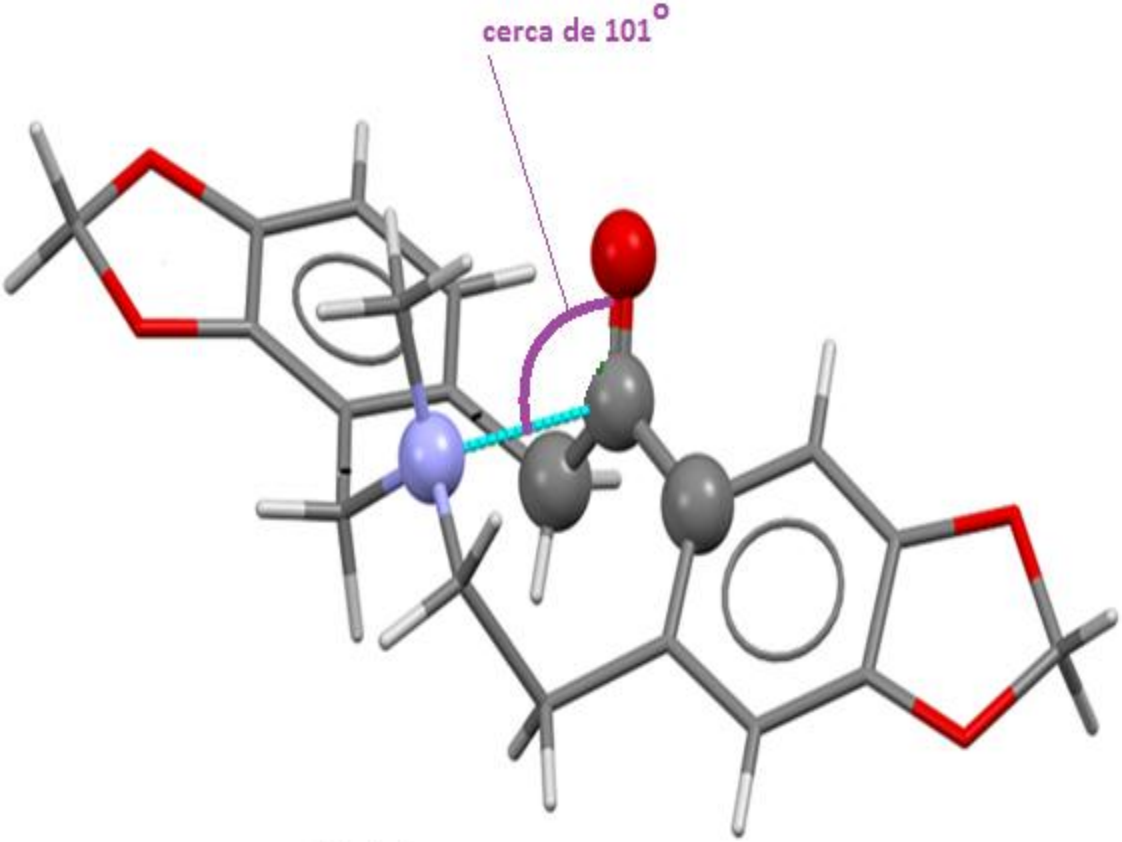


Nesta orientação há repulsão com a núvem π



trajetória de Burgi-Dunitz

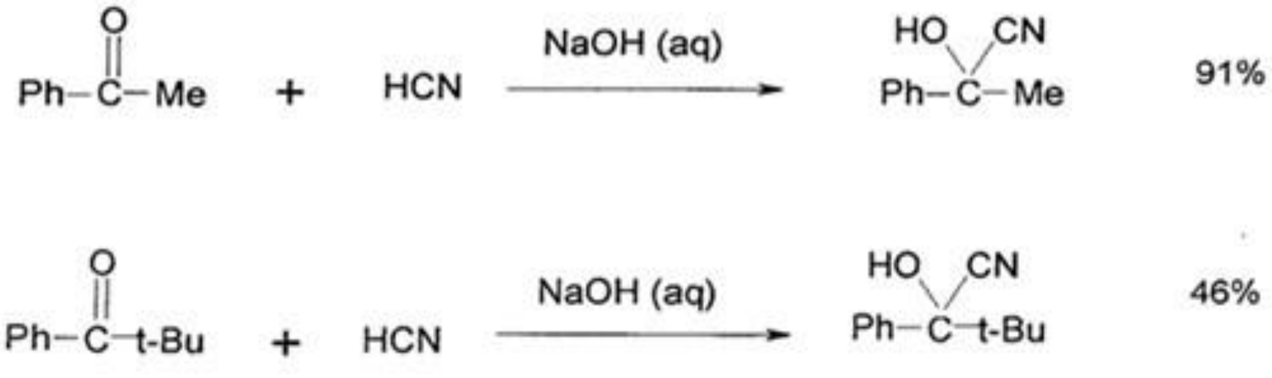




cristal de
Protopina

FATOS EXPERIMENTAIS

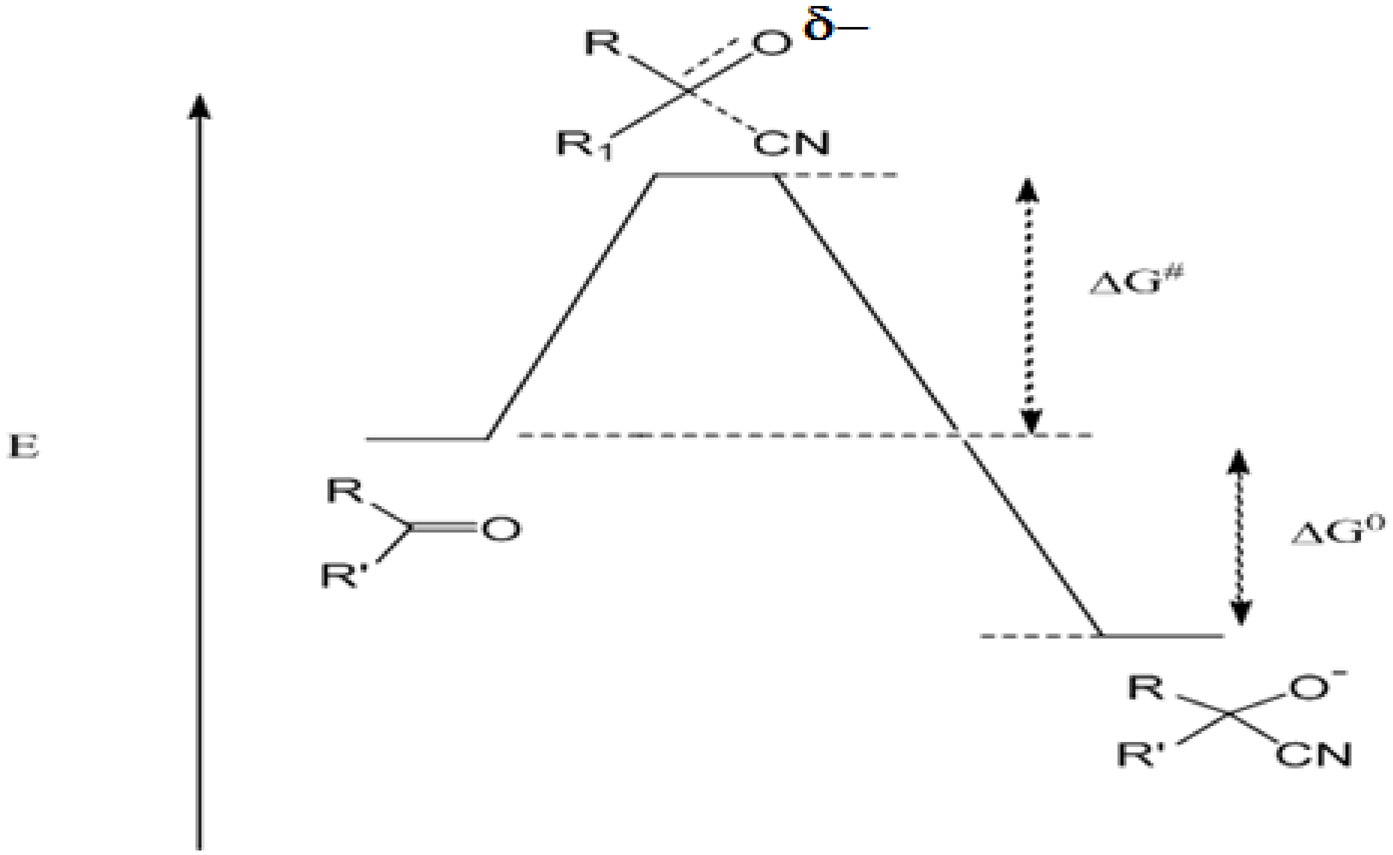
1)

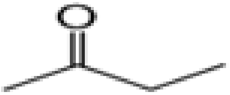


2) ALDEÍDOS SÃO MAIS REATIVOS DO QUE CETONAS

3) ACETALDEÍDO É MAIS REATIVO DO QUE BENZALDEÍDO

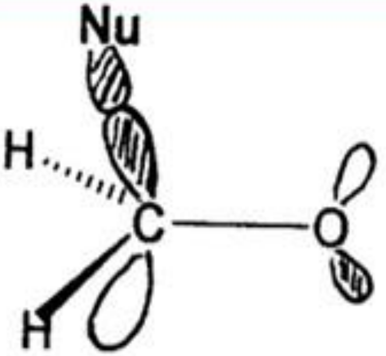
POR QUE ?

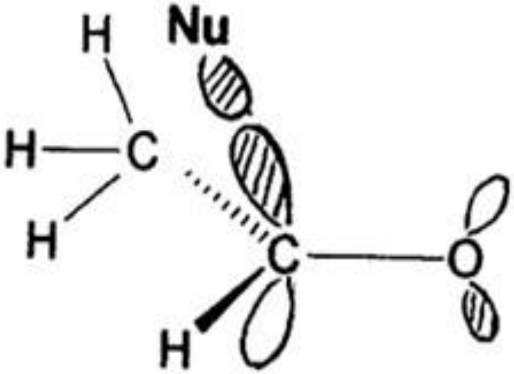


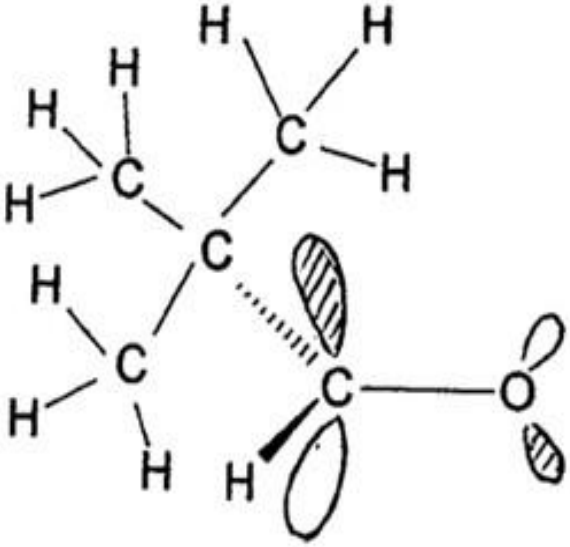
aldeído ou cetona	$K_{eq.}$
PhCHO	212
	28

velocidade = k [carbonílico] [cianeto]

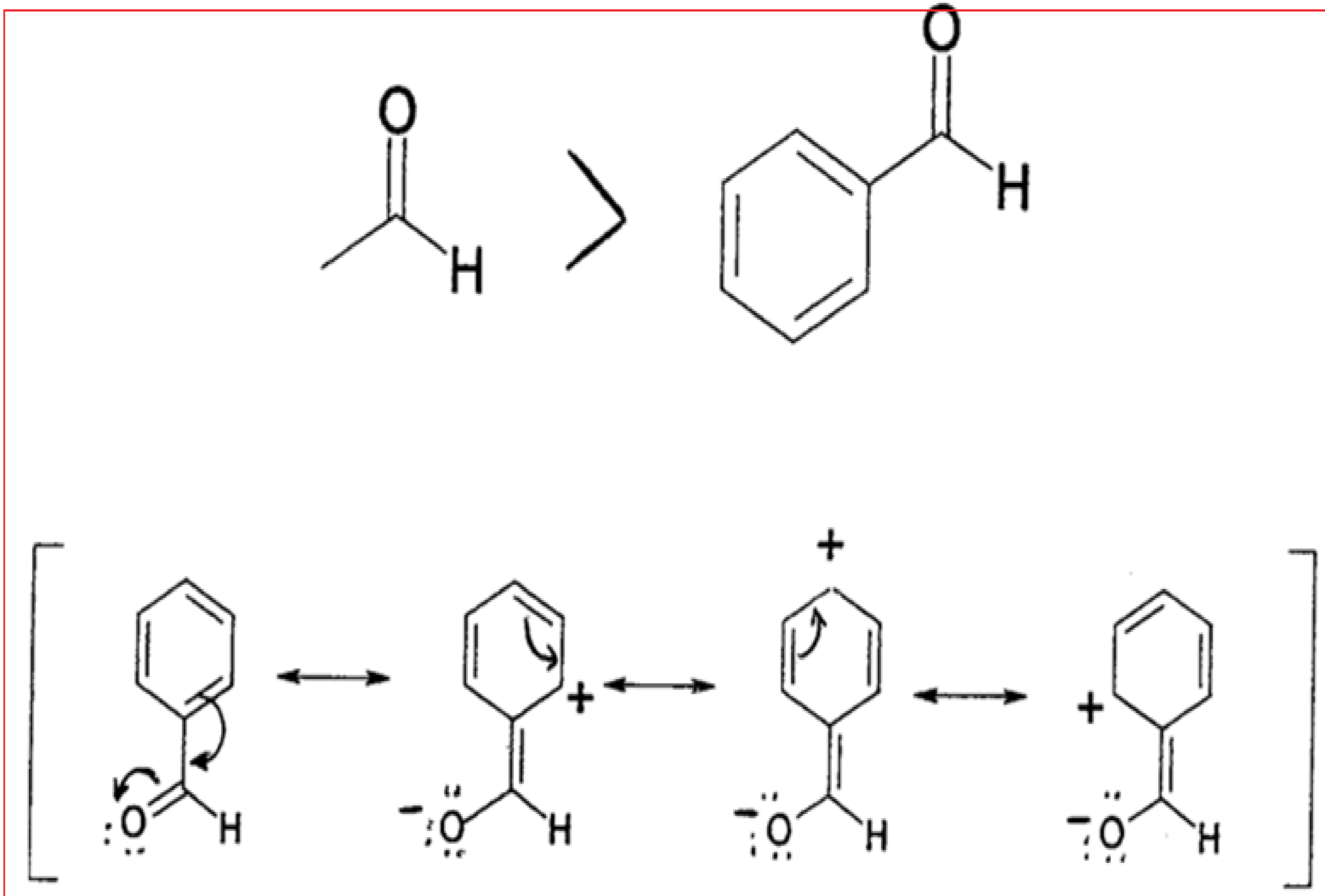
EFEITO ESTÉRICO







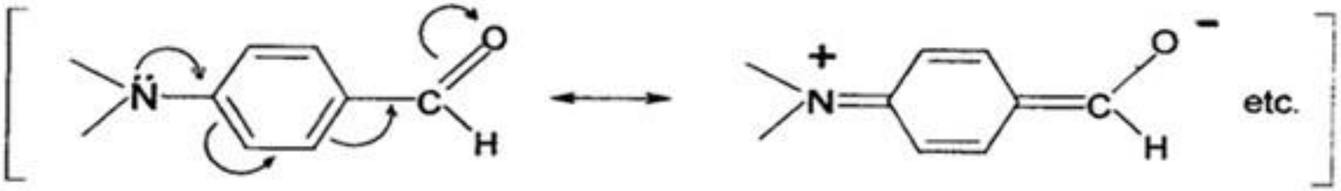
CONJUGAÇÃO : DIMINUIÇÃO DA REATIVIDADE

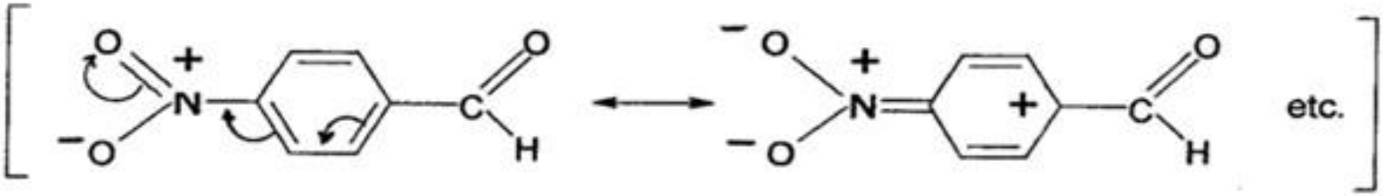


FATOS EXPERIMENTAIS

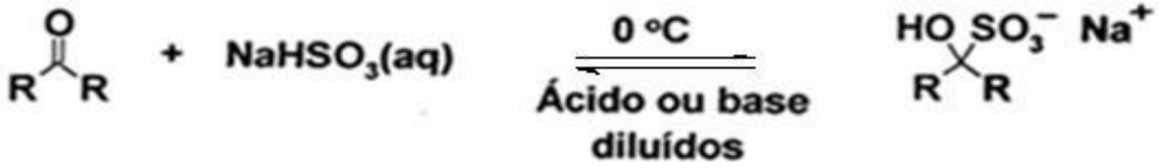
4-DIMETILAMINOBENZALDEÍDO → NÃO FORMA CIANOIDRINA

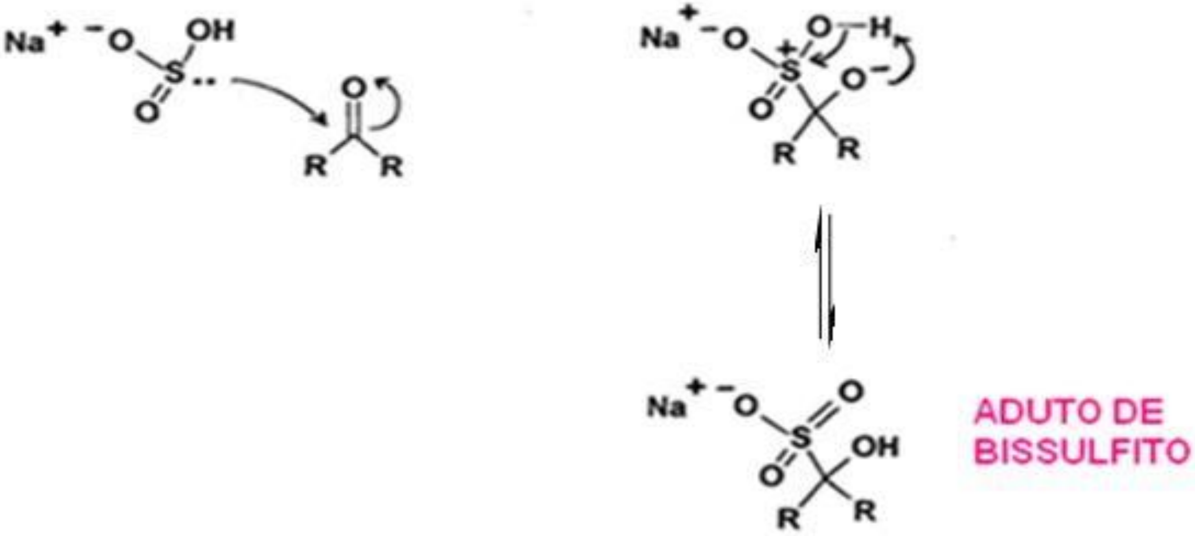
4-NITROBENZALDEÍDO → MAIS REATIVO DO QUE BENZALDEÍDO





ADIÇÃO DE BISSULFITO

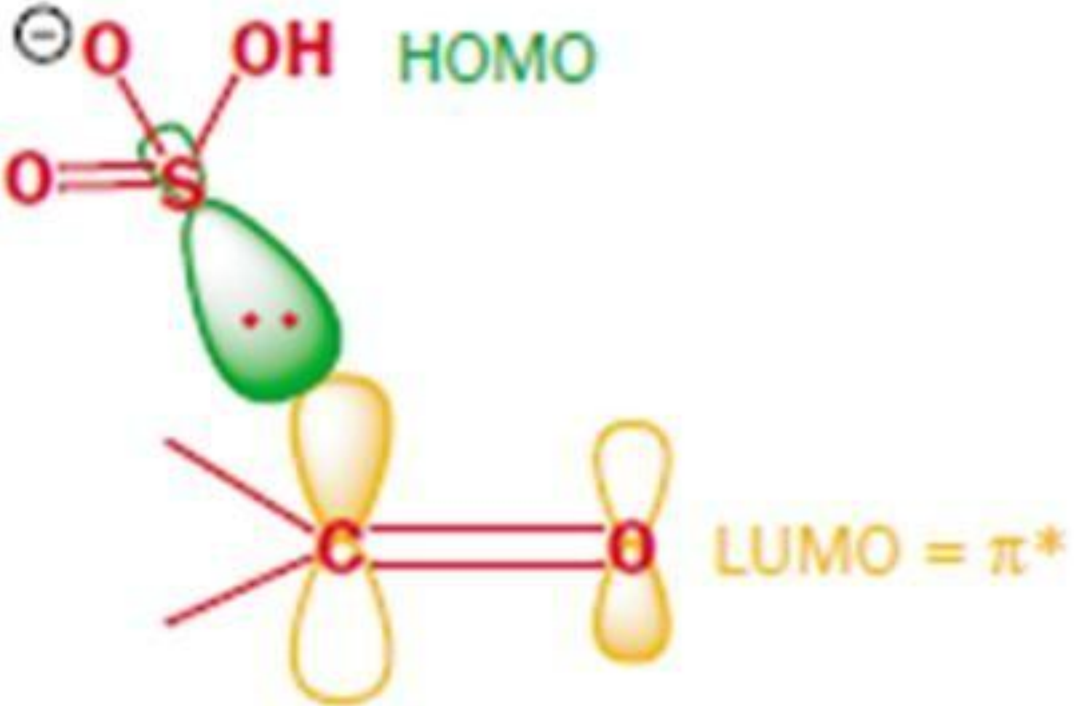




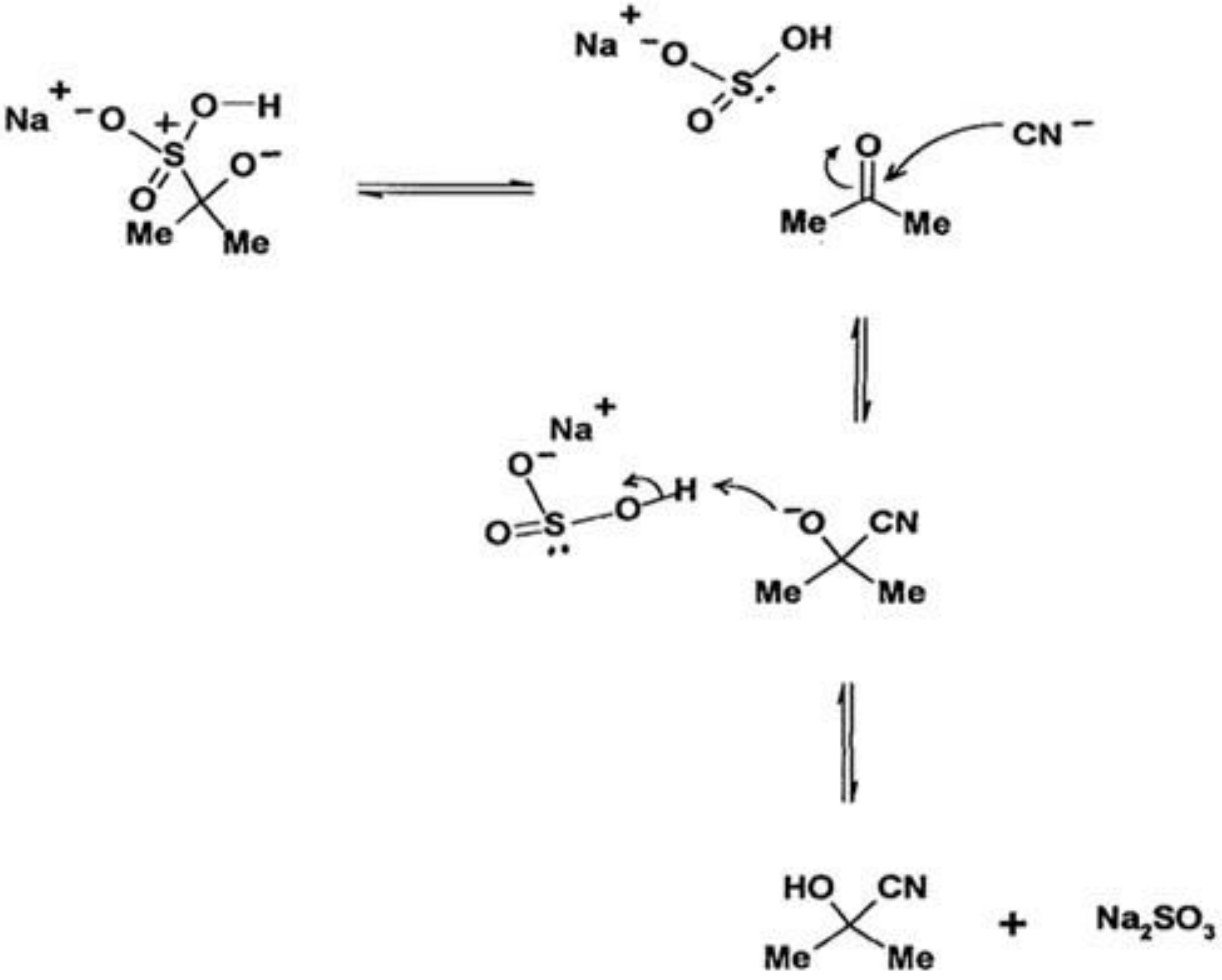
FREQUENTEMENTE ESTÁVEIS E CRISTALINOS

↘ UTILIZADOS PARA PURIFICAR ALDEÍDOS

INTERAÇÃO ENTRE O NUCLEÓFILO E O ELETRÓFILO



OUTRA UTILIDADE DE COMPOSTOS BISSULFÍTICOS



DISPENSA O USO DE ÁCIDO E, PORTANTO, SEM GERAÇÃO DE HCN

REDUÇÃO

NaH

HIDRETO DE SÓDIO

$NaBH_4$

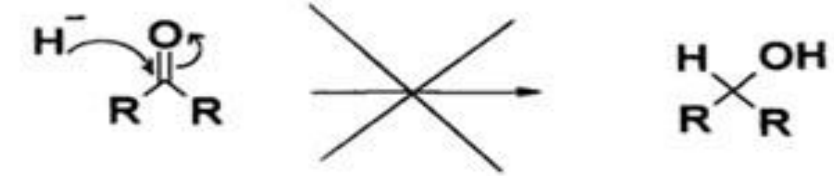
BOROIDRETO DE SÓDIO

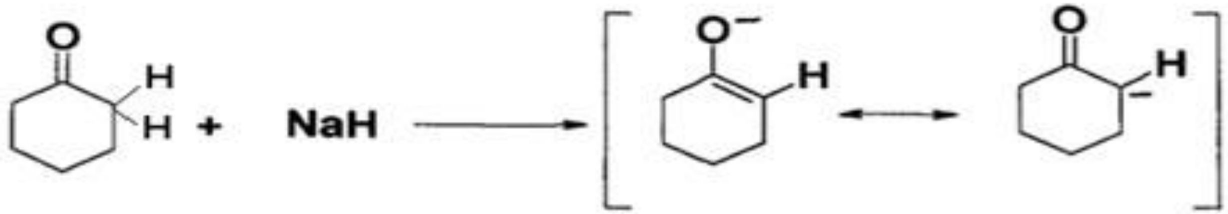
$LiAlH_4$

HIDRETO DE LÍTIO E ALUMÍNIO

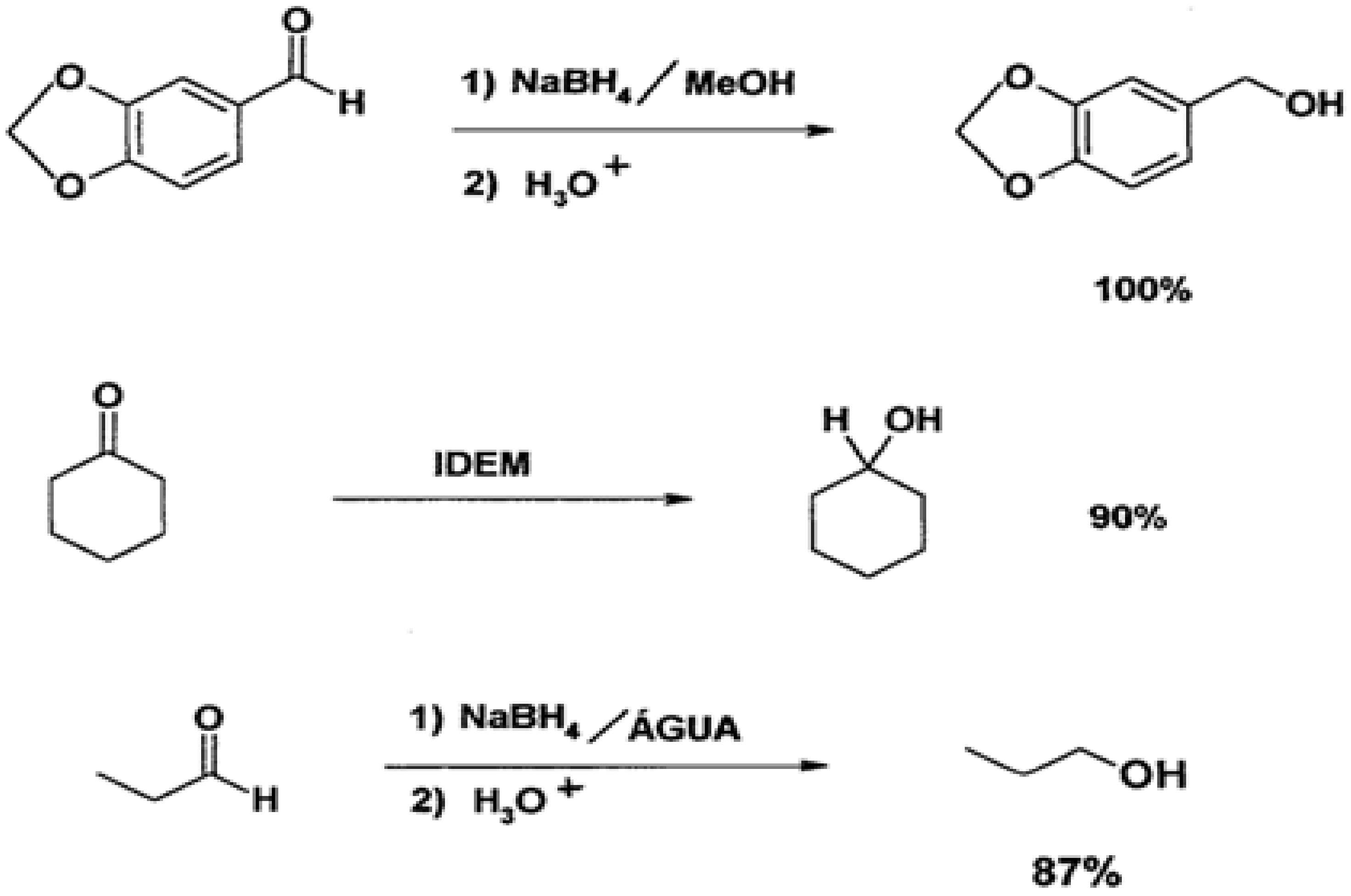
NaH → **ATUA COMO BASE**

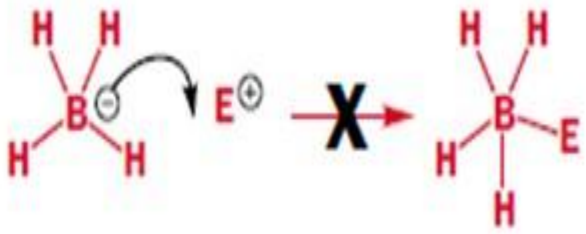
NÃO EFETUA REDUCÕES



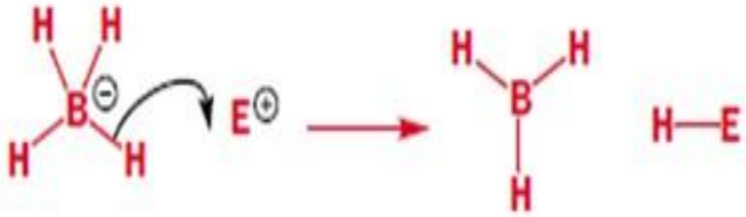


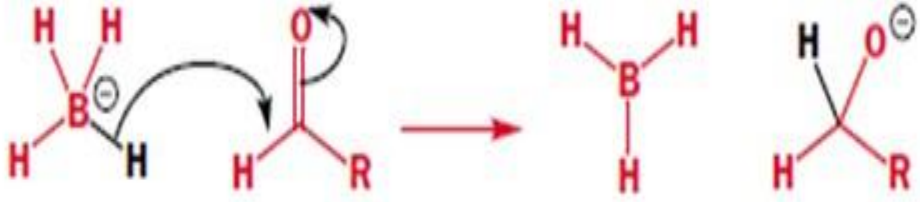
EXEMPLOS DE REDUÇÕES COM $NaBH_4$



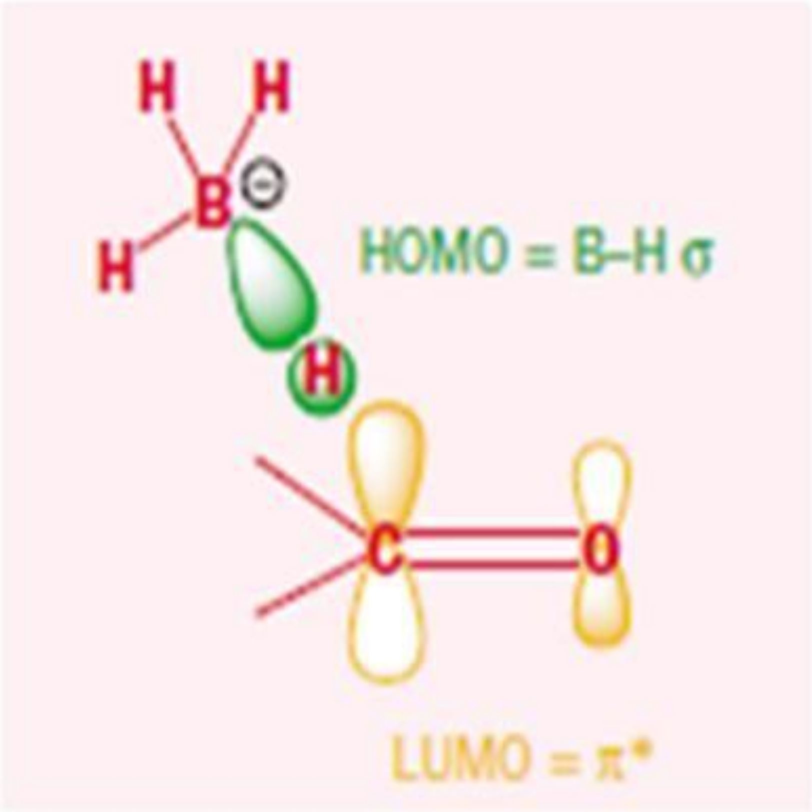


O CORRETO

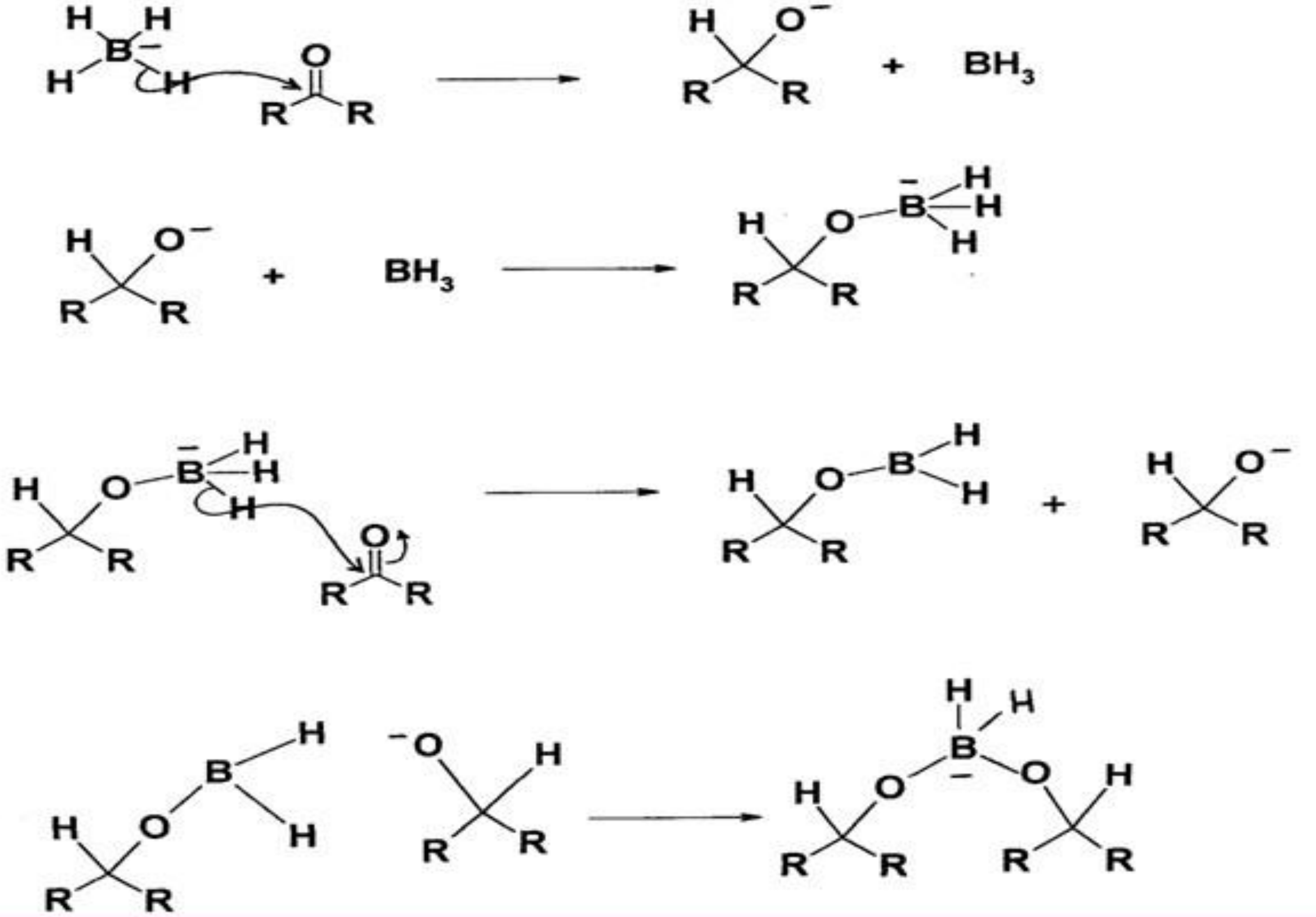




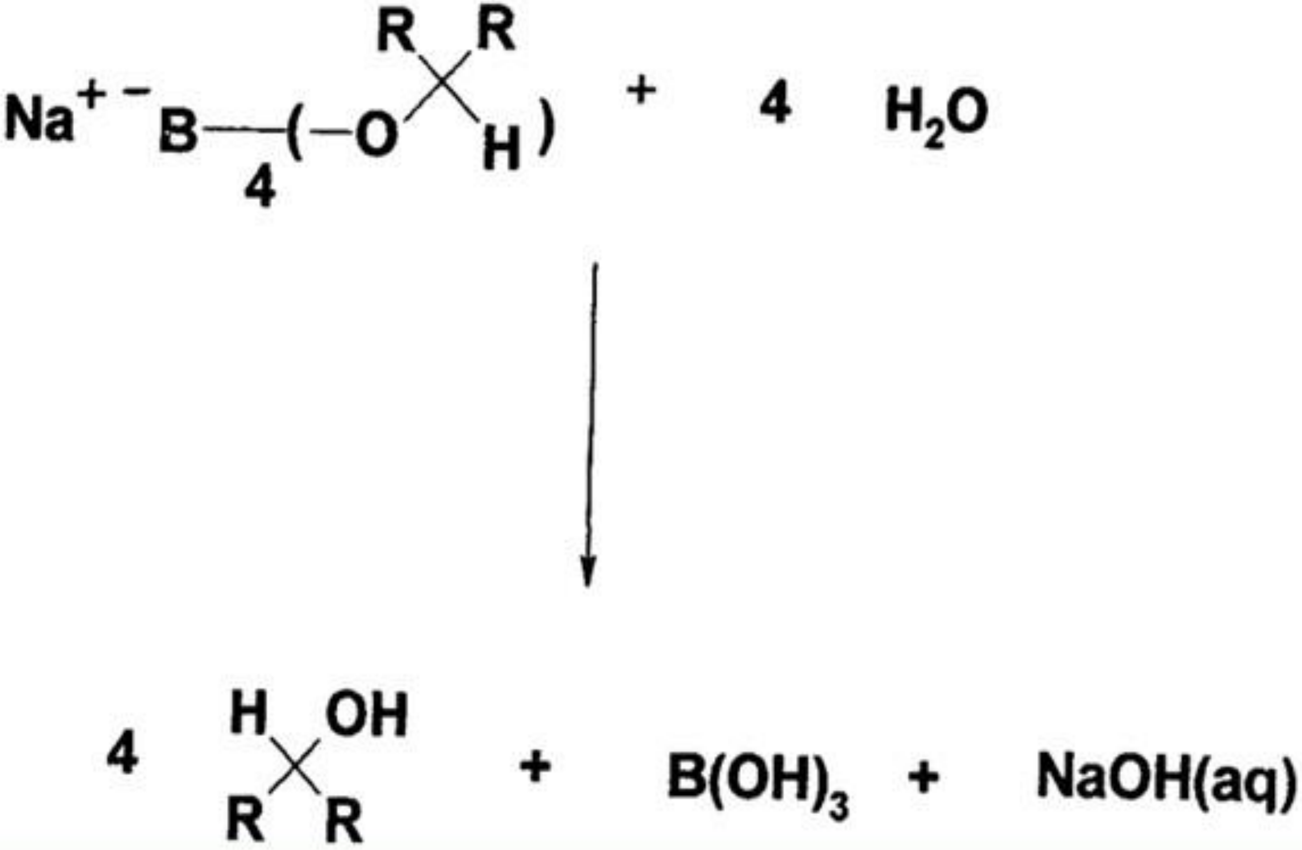
INTERAÇÃO ENTRE O NUCLEÓFILO E O ELETRÓFILO



MECANISMO

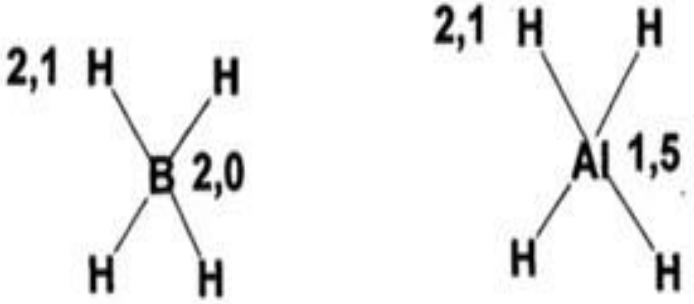


O QUE ACONTECE AO FINAL DA REAÇÃO



O USO DO HIDRETO DE LÍTIO E ALUMÍNIO

$LiAlH_4$ ⟶ USADO EM THF



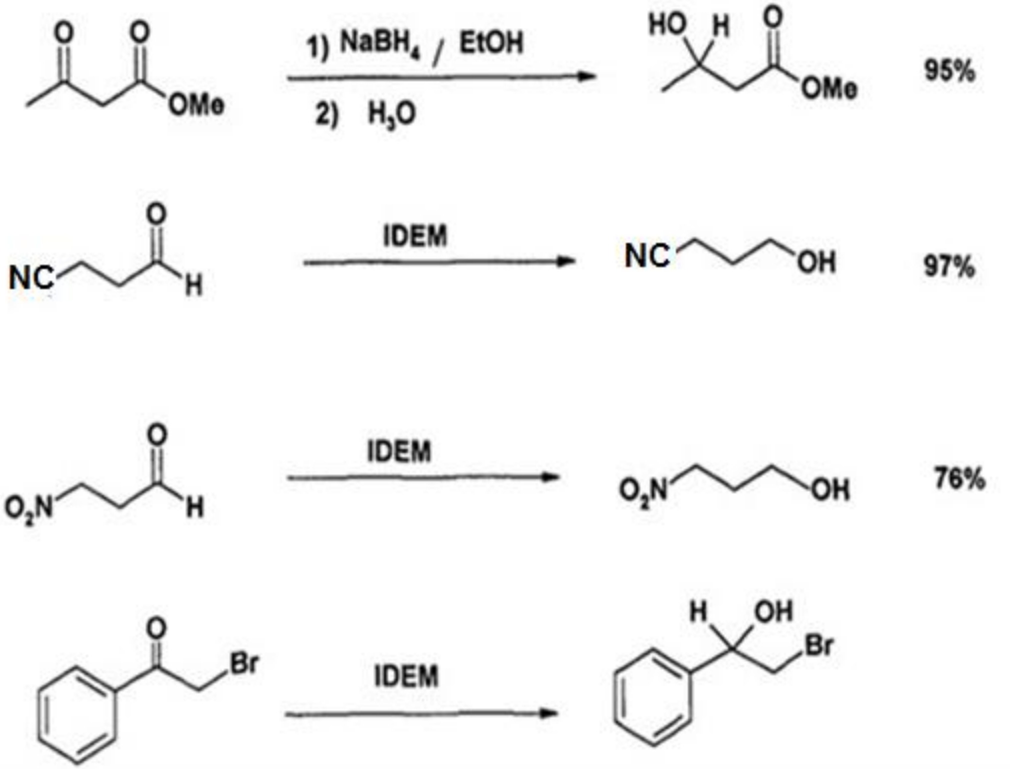
QUANTO MAIOR A DIFERENÇA DE ELETRONEGATIVIDADE

MAIOR A FACILIDADE DE TRANSFERÊNCIA DE HIDRETO

$LiAlH_4$ → MUITO MAIS REATIVO, REAGE VIOLENTAMENTE COM ÁGUA

$$LiAlH_4 + 4\,H_2O \longrightarrow 4\,H_2 + LiOH\,(aq) + Al(OH)_3$$

QUIMIOSSELETIVIDADE

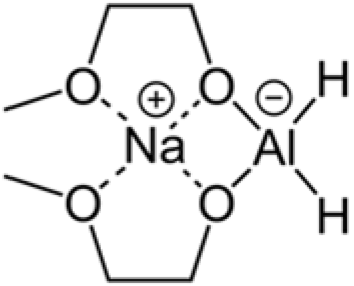


REDUZ CARBONÍLICOS SELETIVAMENTE

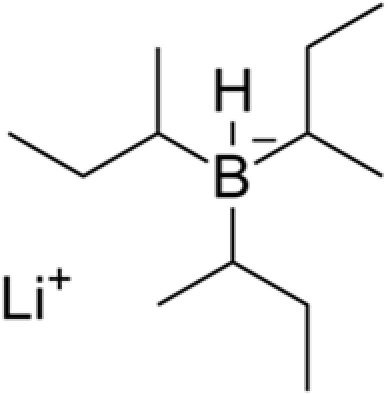
CO_2R, CN. NO_2, C-HALOGÊNIO PERMANECEM INTACTOS

Outros hidretos

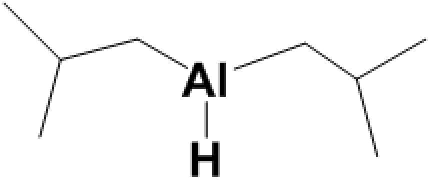
Red-Al ⇒



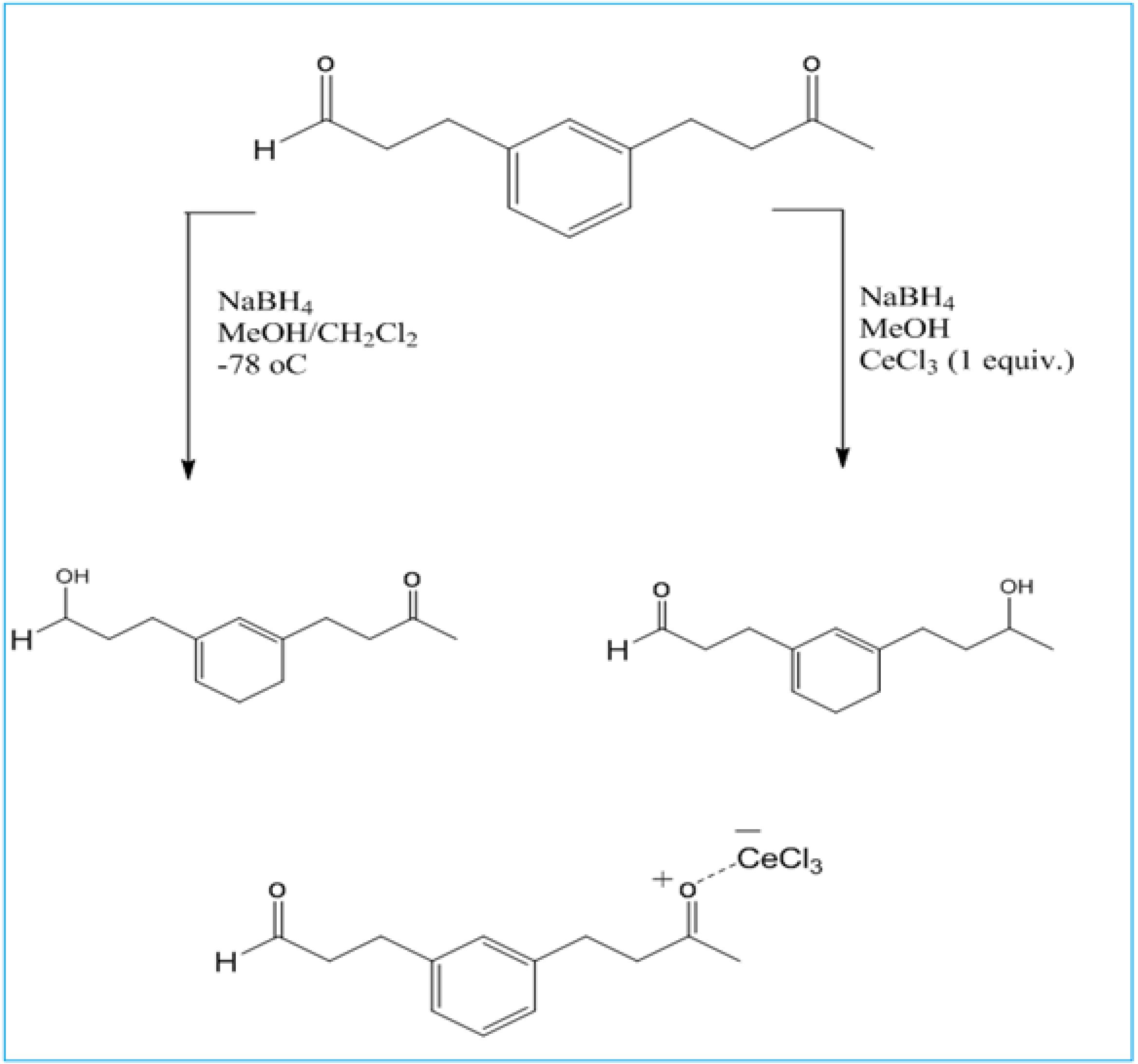
L- Selectride ⇒

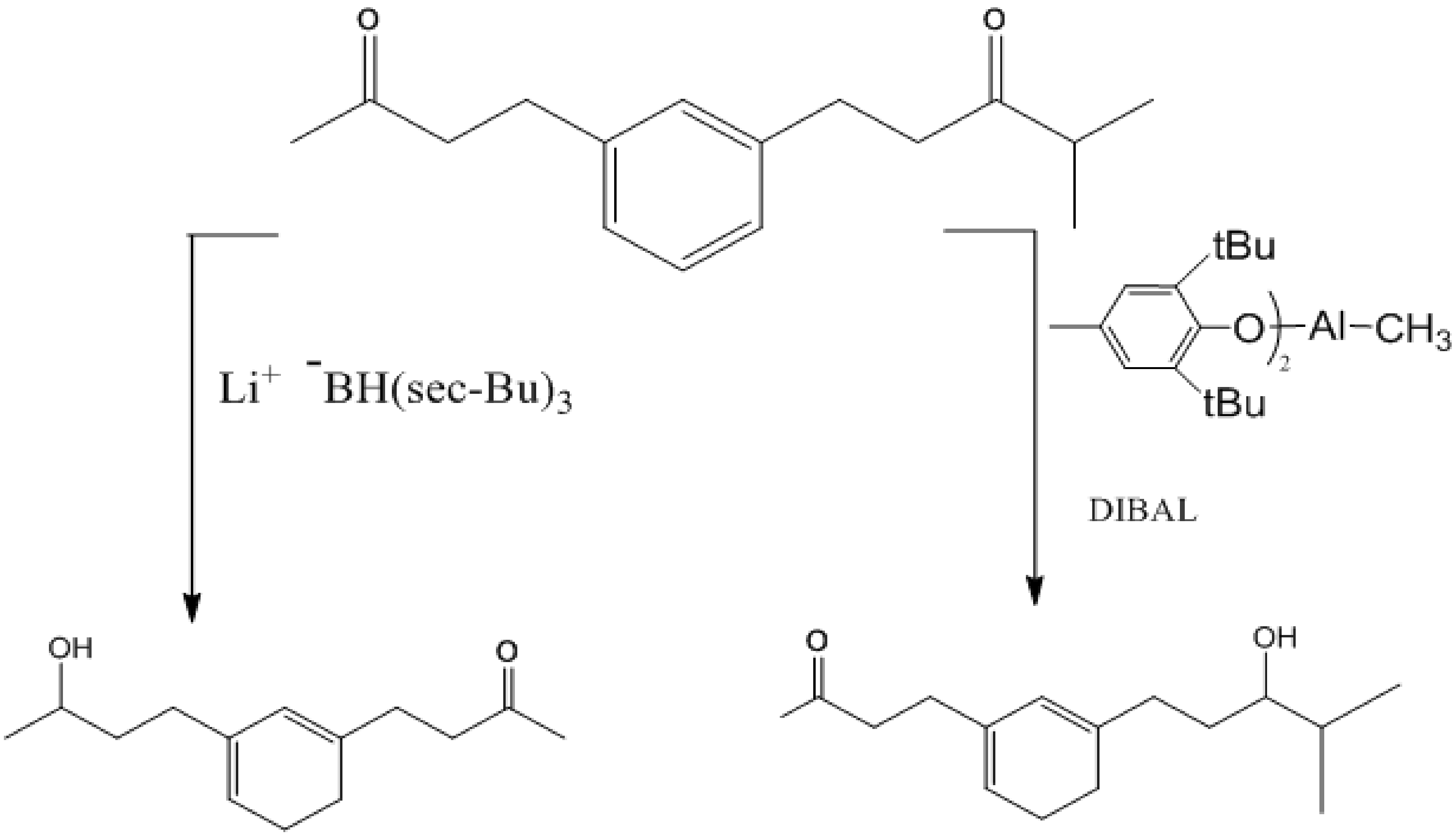


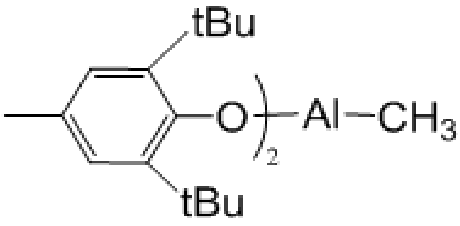
DIBAL ⇒



Redução de Luche



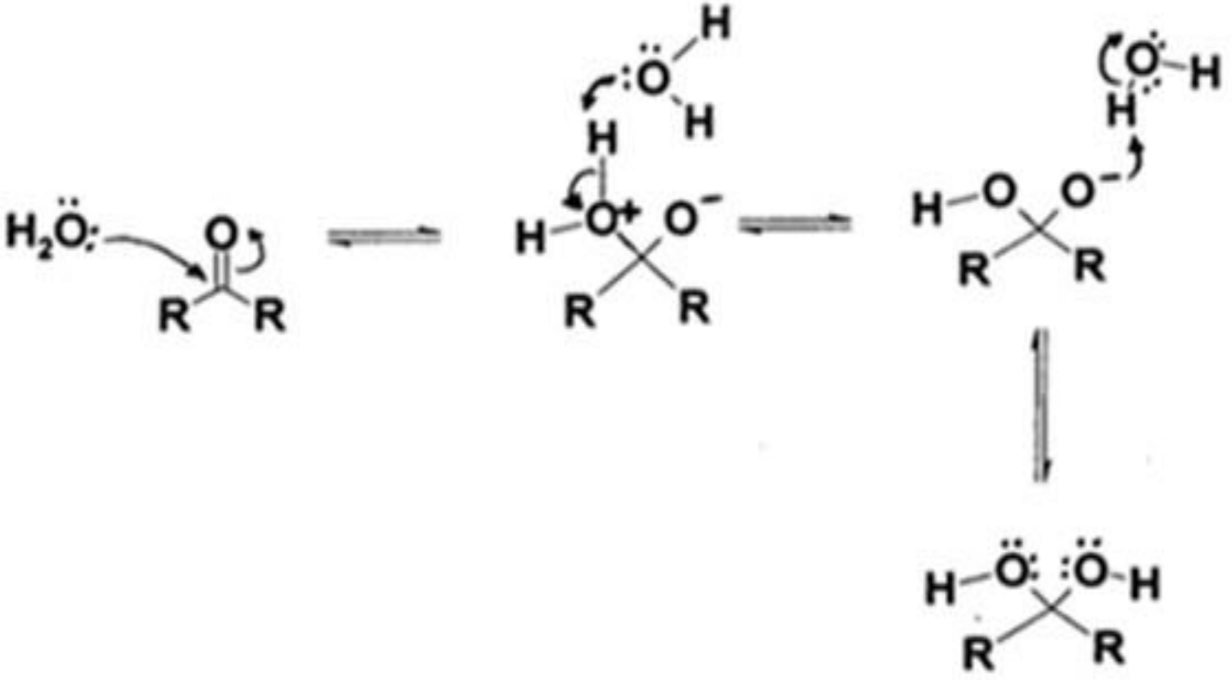




UM ALUMINOXANO

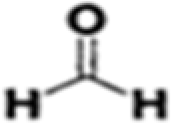
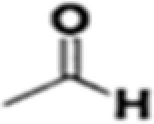
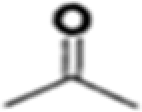
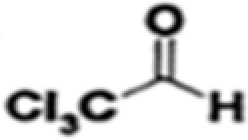
COMPLEXA COM A CARBONILA MAIS BÁSICA

ADIÇÃO DE ÁGUA

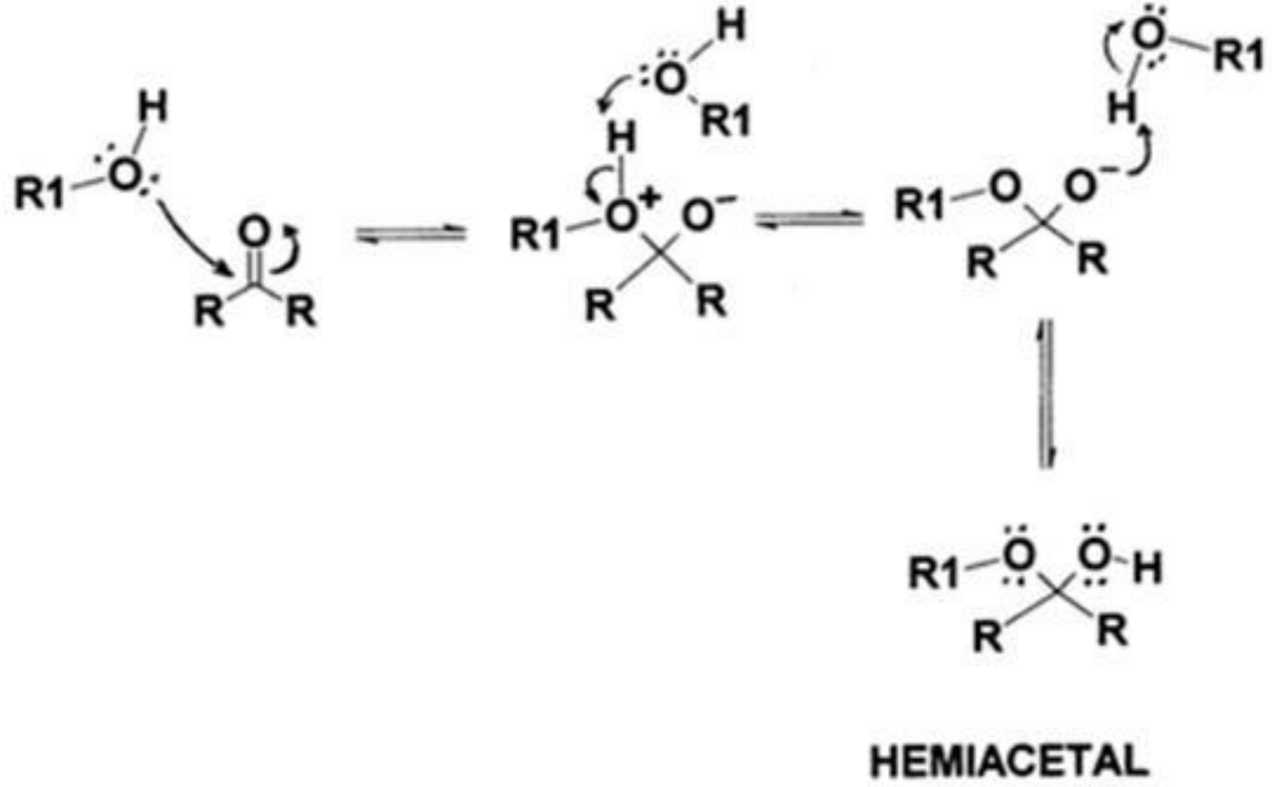


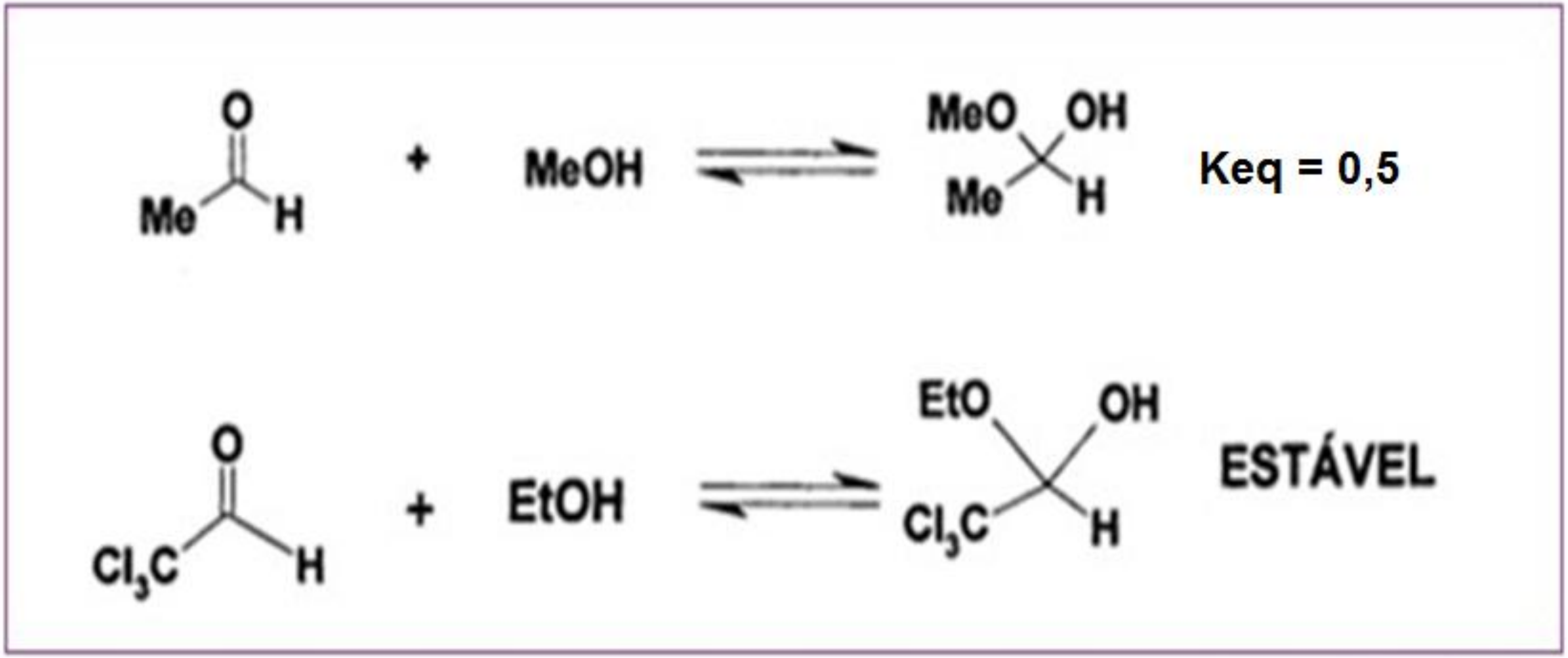
DIOL GEMINAL
HIDRATO

ADIÇÃO DE ÁGUA

COMPOSTO	% DE HIDRATO
	99,9
	58
	—
	100

ADIÇÃO DE ÁLCOOIS

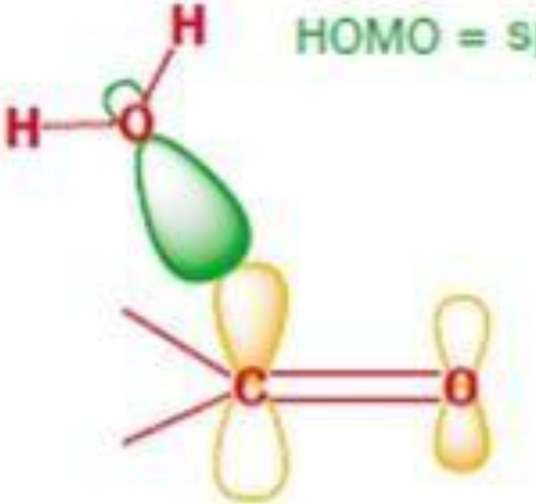




Keq = 0,5

ESTÁVEL

INTERAÇÃO ENTRE O NUCLEÓFILO E O ELETRÓFILO

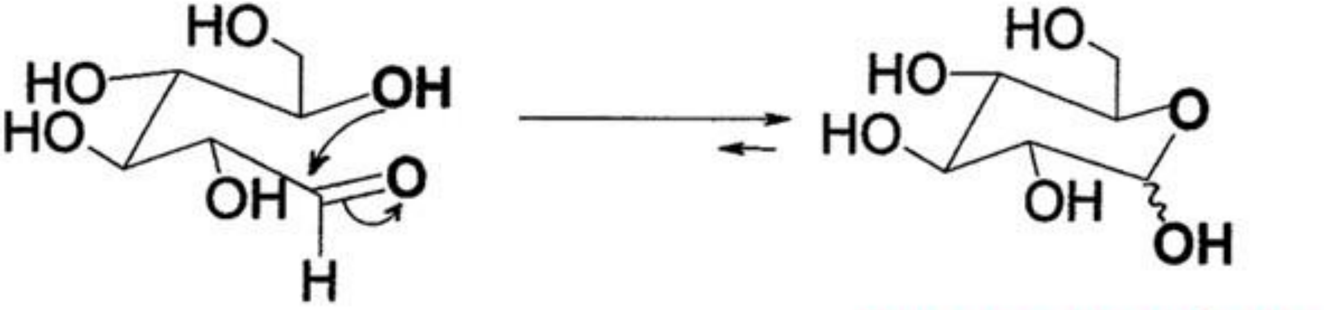


HOMO = sp^3 do oxigênio

LUMO = π^*

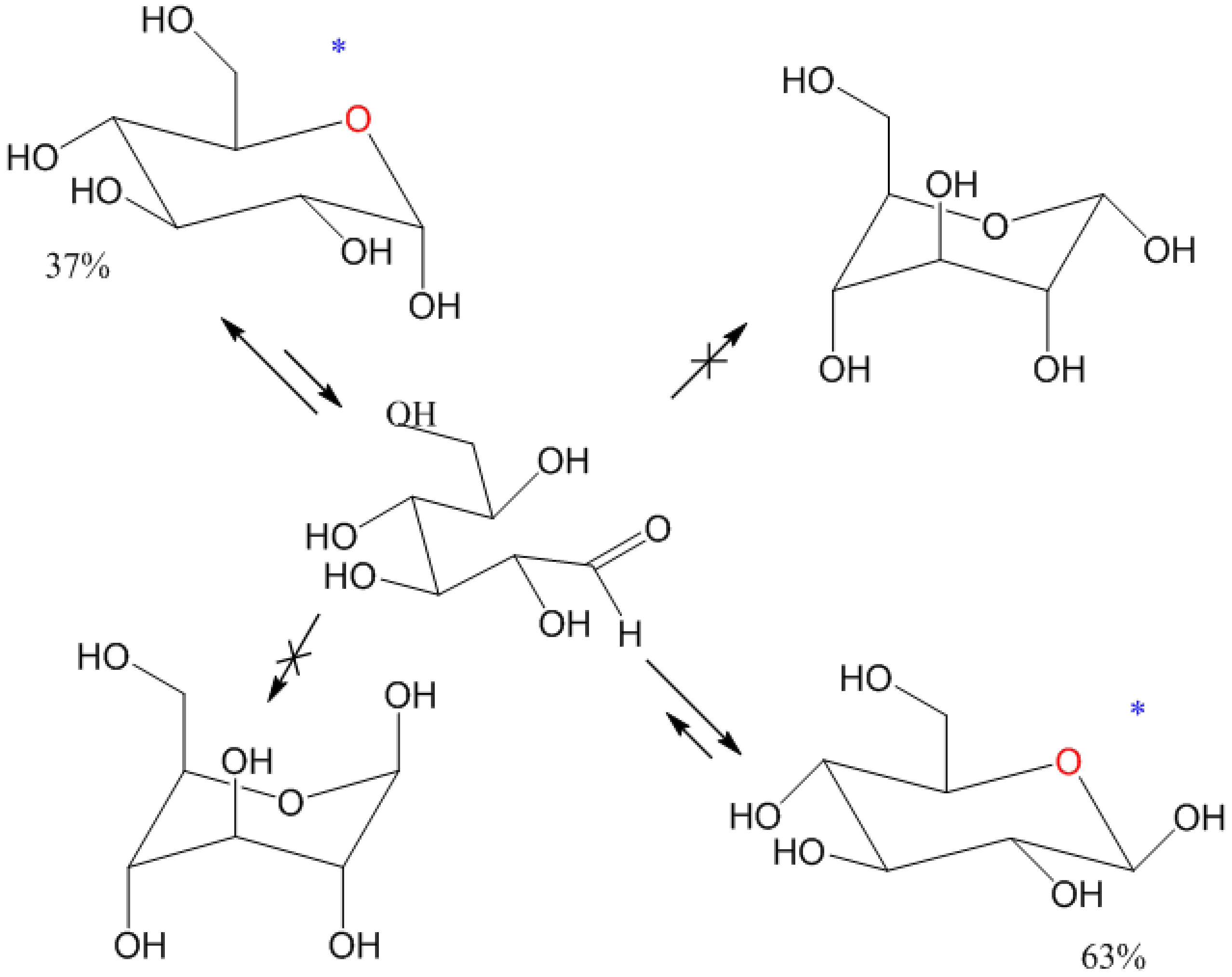
HEMICETAIS CÍCLICOS

ESTÁVEIS COM ANÉIS DE CINCO OU SEIS MEMBROS

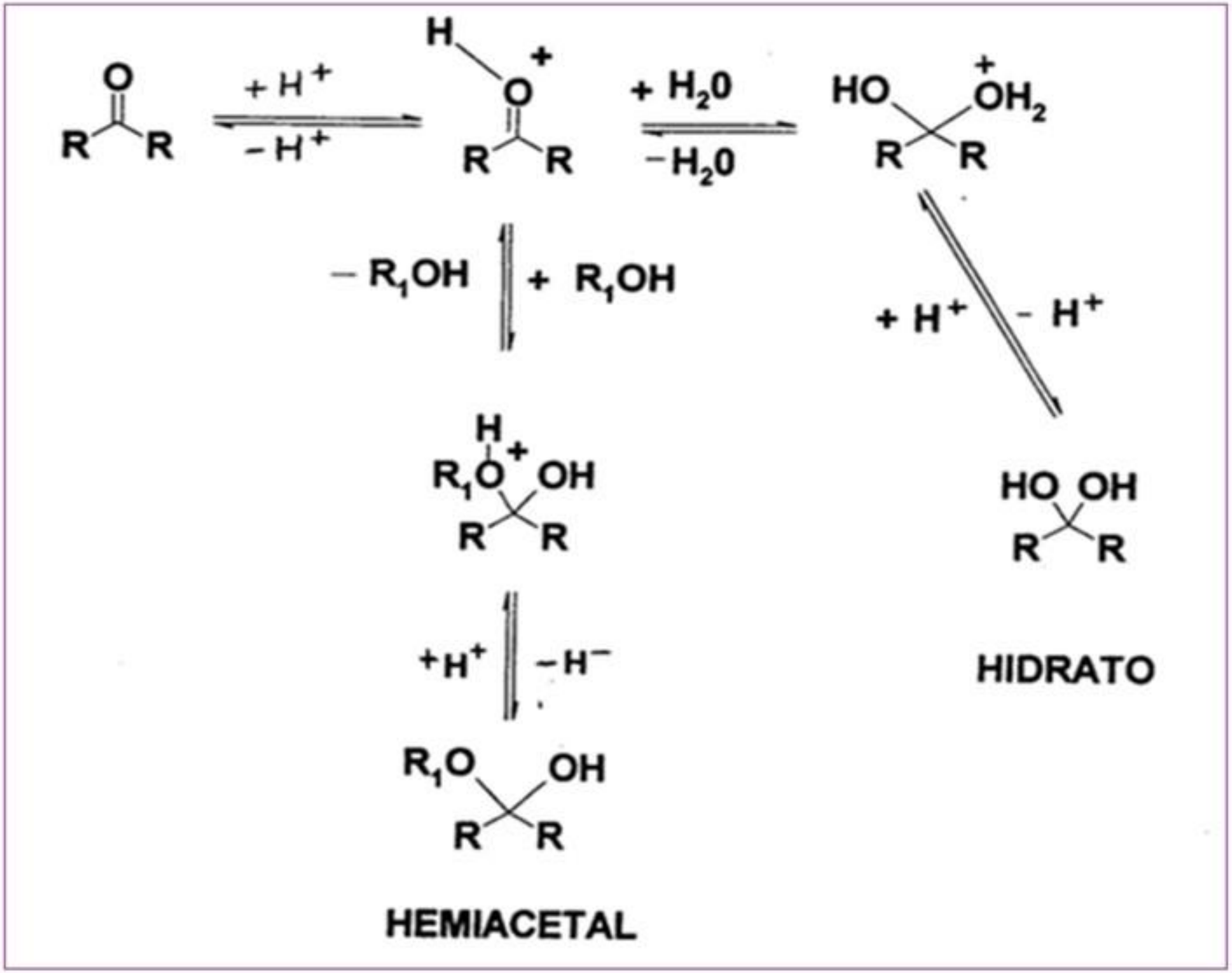


MISTURA DE EPÍMEROS

O fenômeno da mutarrotação

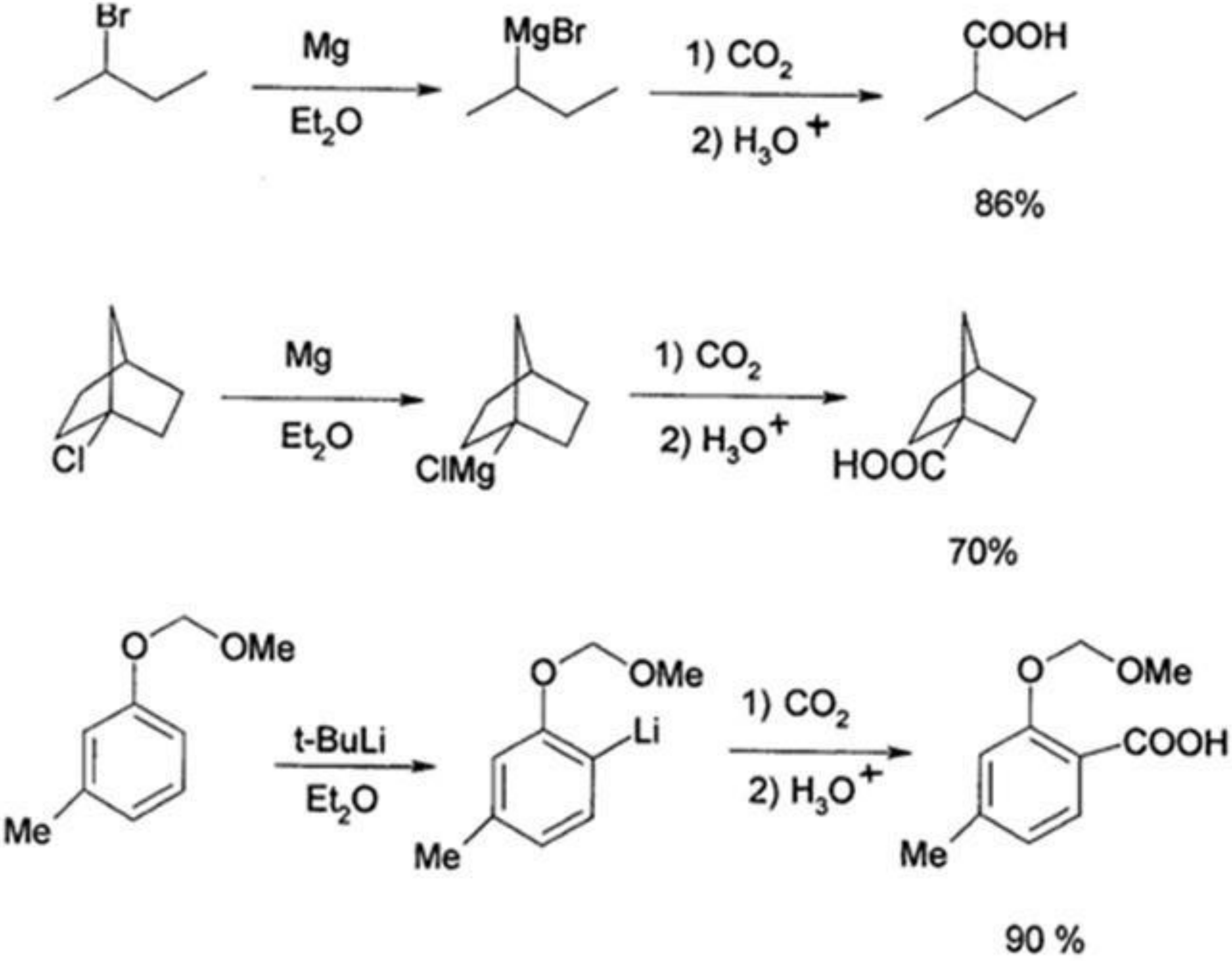


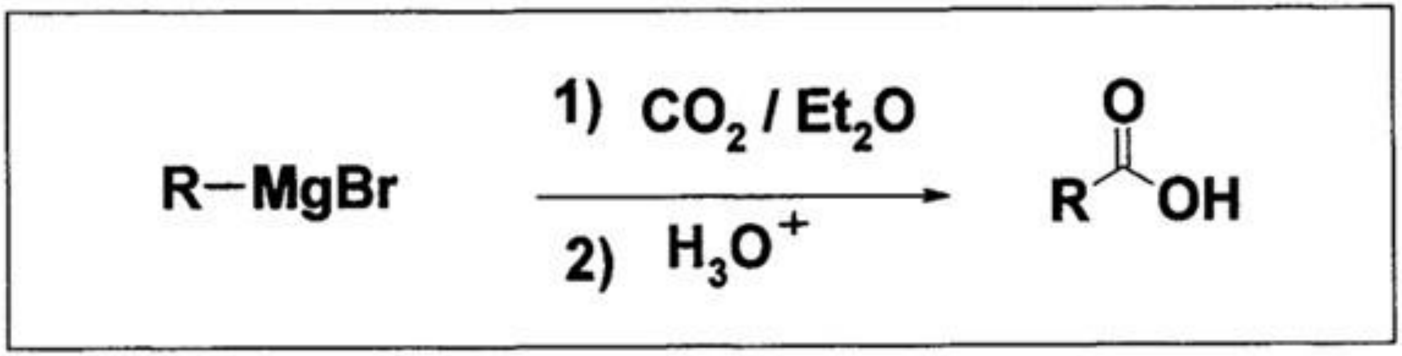
FORMAÇÃO DE HIDRATOS E HEMIACETAIS SOB CATÁLISE ÁCIDA



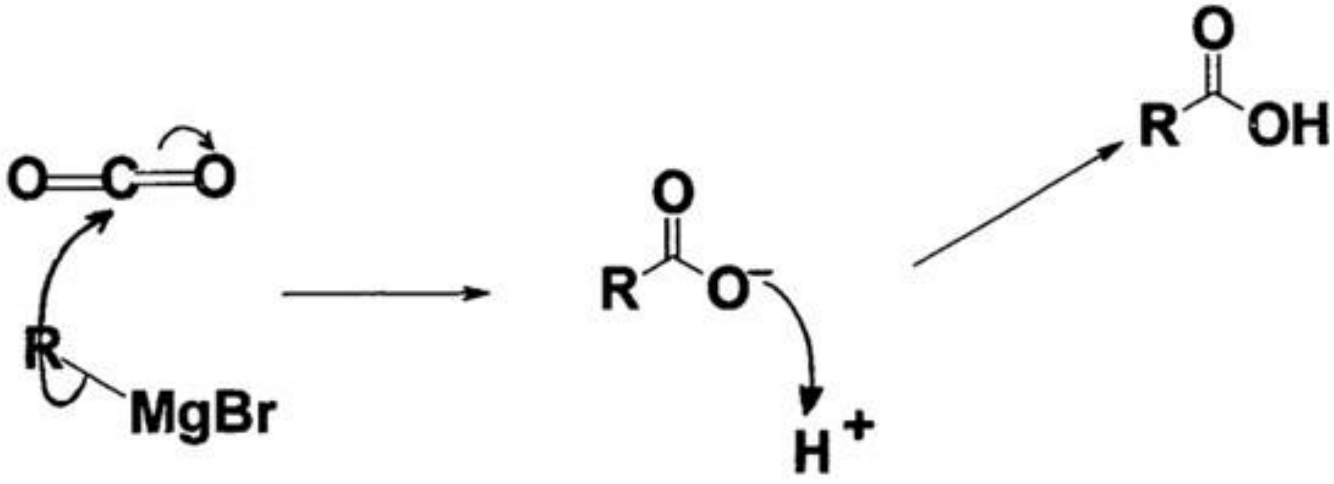
ADIÇÃO DE COMPOSTOS ORGANOMETÁLICOS

PREPARANDO ÁCIDOS CARBOXÍLICOS

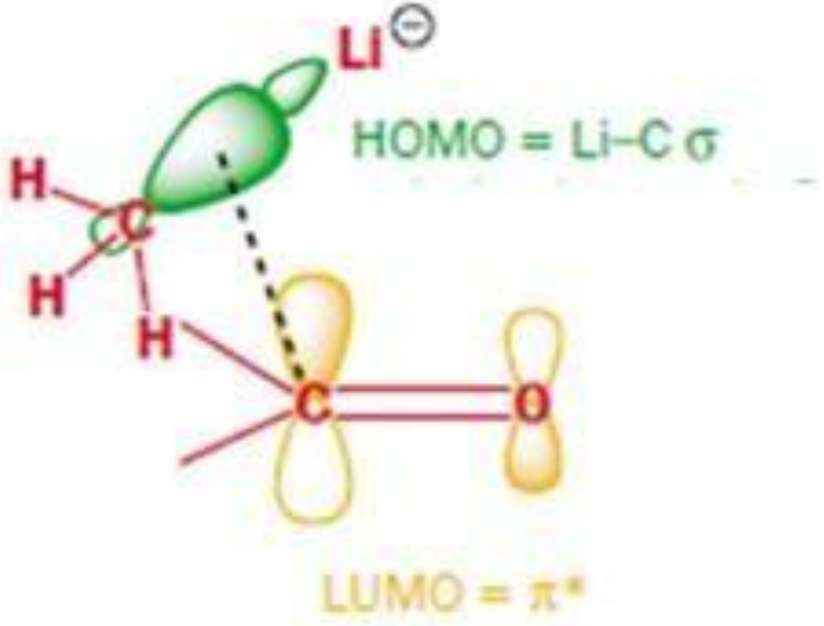




MECANISMO

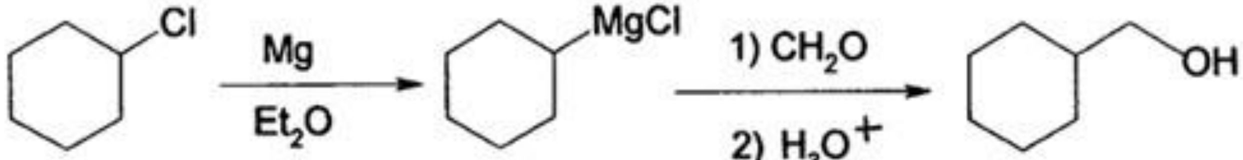


INTERAÇÃO ENTRE O NUCLEÓFILO E O ELETRÓFILO

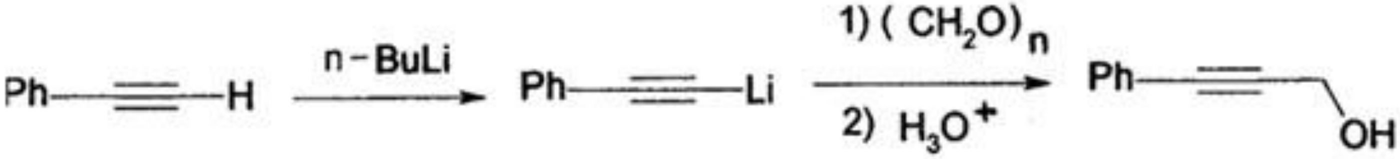


PREPARANDO ÁLCOOIS PRIMÁRIOS

REAÇÃO COM FORMALDEÍDO



69%

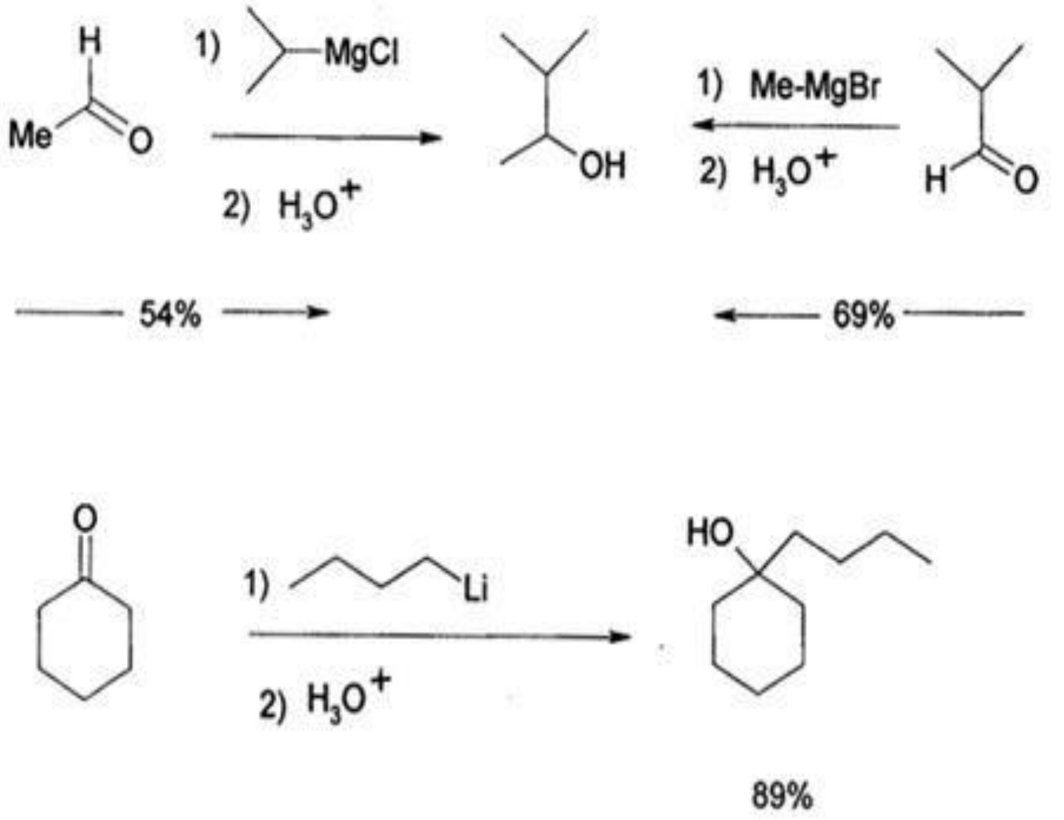


91%

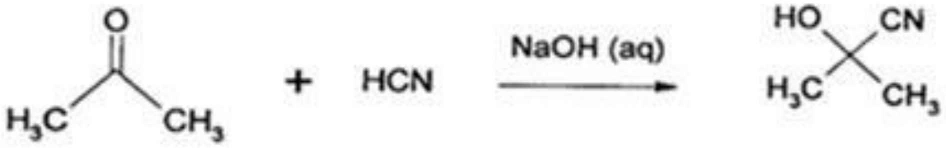
PREPARANDO ÁLCOOIS SECUNDÁRIOS E TERCIÁRIOS

ORGANOMÉTÁLICO + ACETALDEÍDO = ÁLCOOL SECUNDÁRIO

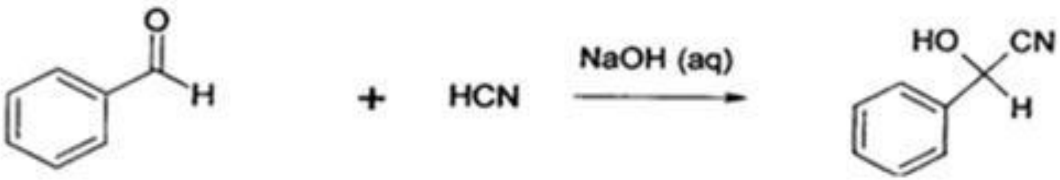
ORGANOMÉTÁLICO = CETONA = ÁLCOOL TERCIÁRIO



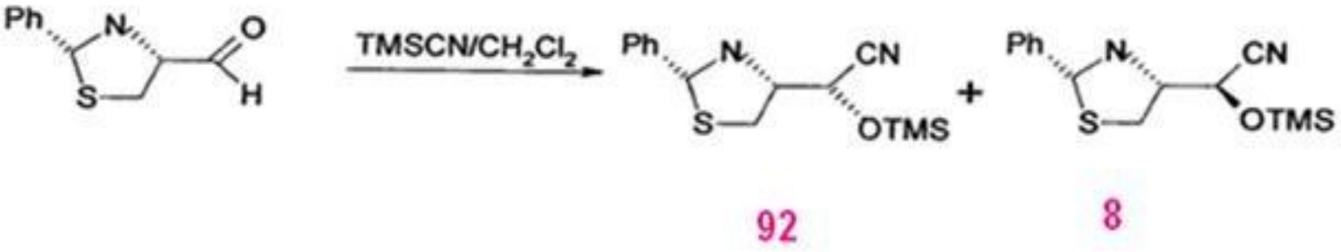
FATOS EXPERIMENTAIS



NÃO HÁ CENTRO ESTEREOGÊNICO

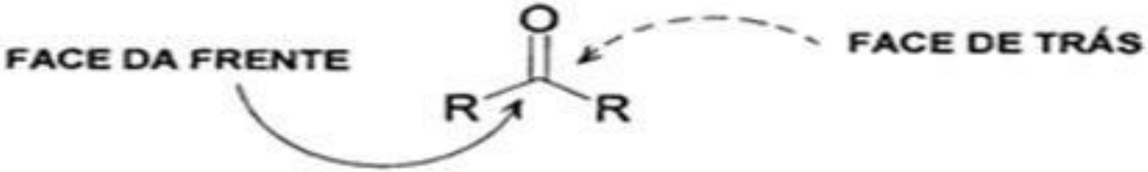


MISTURA RACÊMICA

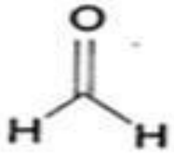


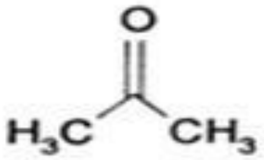
MISTURA DE DIASTEREOISÔMEROS

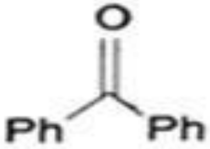
SÍNTESE ESTEREOSSELETIVA - PRINCÍPIOS



FACES HOMOTÓPICAS

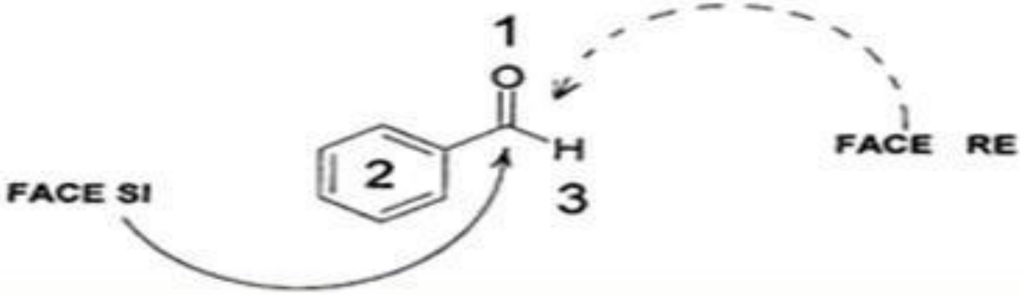


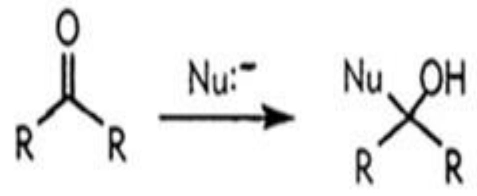




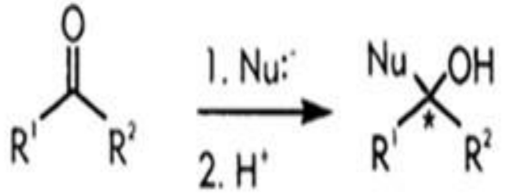
BENZOFENONA

FACES ENANTIOTÓPICAS

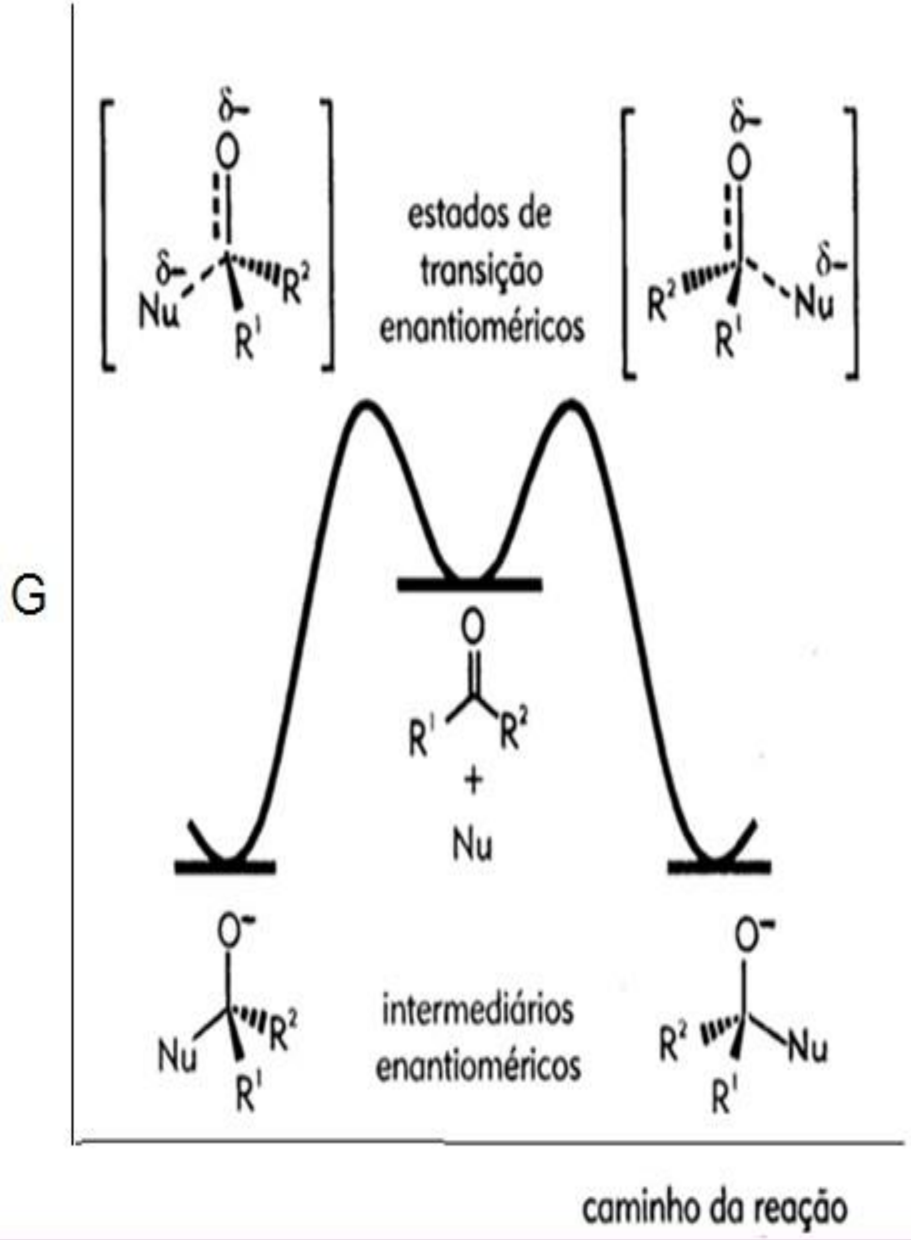


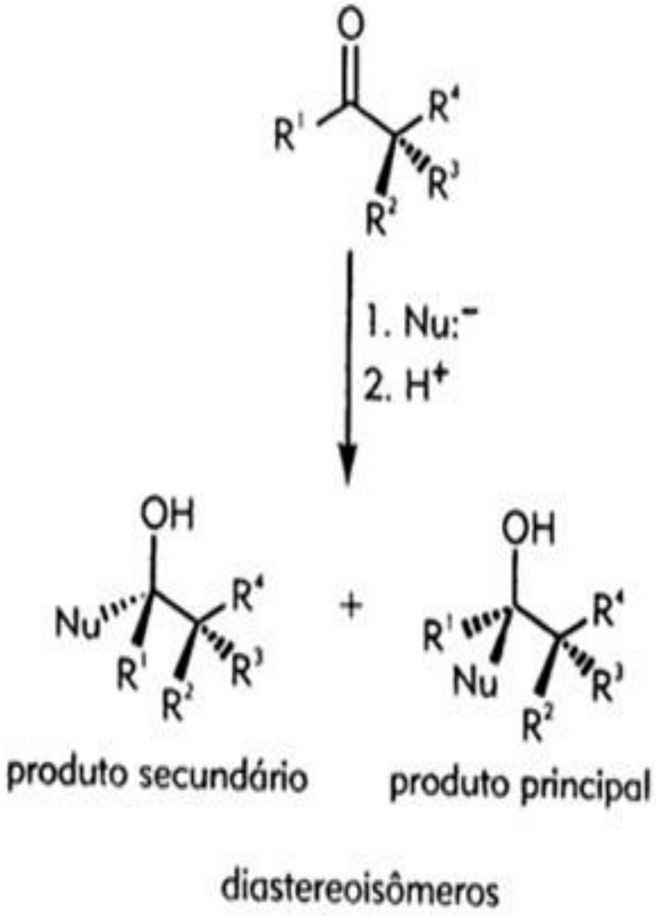


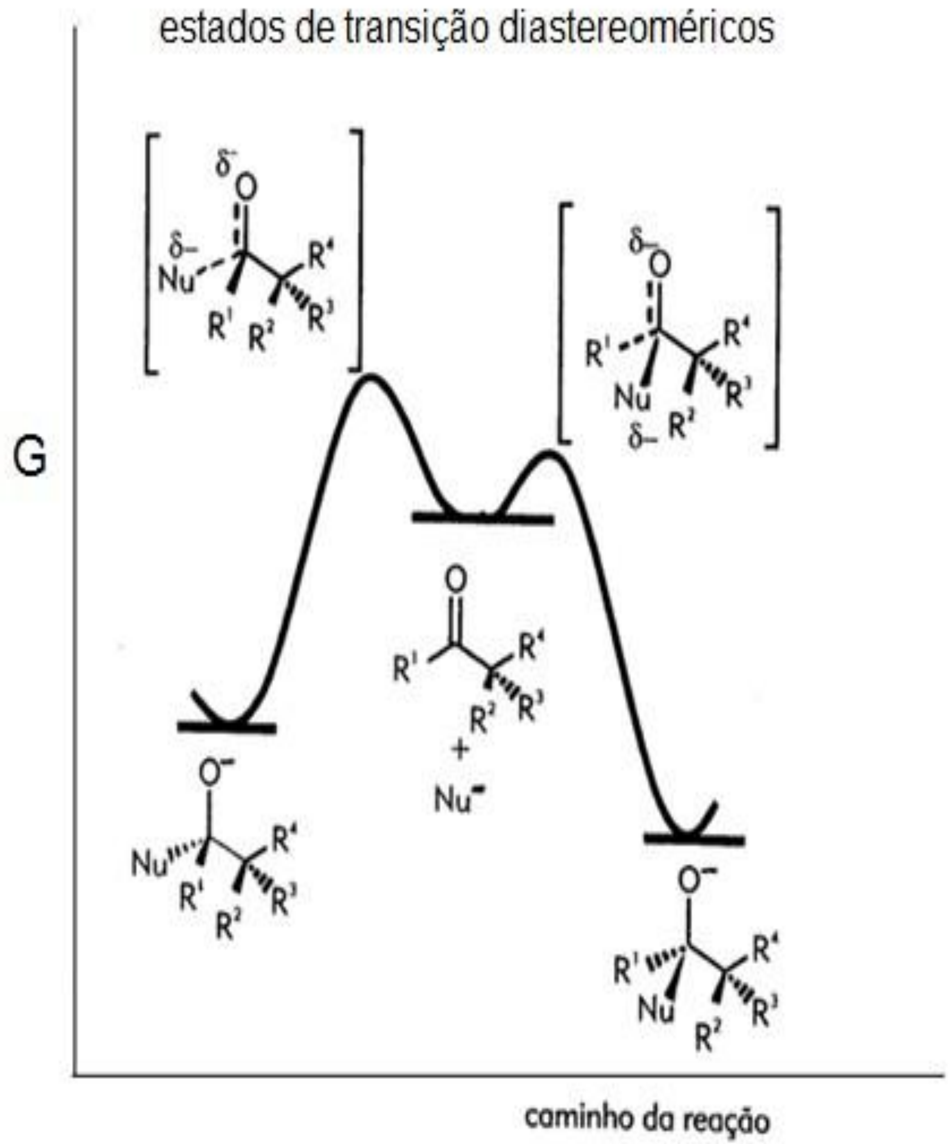
faces homotópicas
não há formação de centro estereogênico



faces proquirais enantiotópicas
há formação de uma mistura racêmica




O
R¹
R⁴
R³
R²
1. Nu:⁻
2. H⁺
OH
Nu
produto secundário
produto principal
diastereoisômeros


estados de transição diastereoméricos
G
δ⁻
O
Nu
R¹
R²
R³
R⁴
O⁻
+
Nu⁻
caminho da reação