esf european social fund in the czech republic
EUROPEAN UNION
MINISTRY OF EDUCATION, YOUTH AND SPORTS
OP Education for Competitiveness
INVESTMENTS IN EDUCATION DEVELOPMENT

Innovation and Development of Study Field Nanomaterials at the Technical University of Liberec

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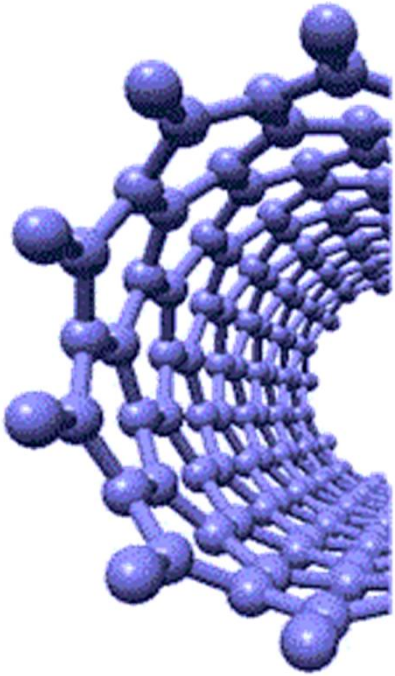

These materials have been developed within the ESF project: Innovation and development of study field Nanomaterials at the Technical University of Liberec

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Aldehydes, ketones

$CH_3CH_2CH_2CH_2CH_3$

pentane
b.p. 36,1 °C
m.p. -127,7 °C

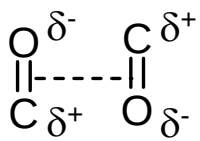
$CH_3CH_2CH_2{-}CH{=}O$

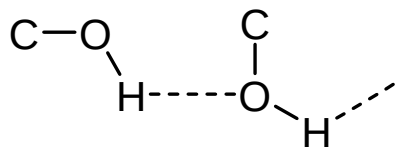
butanal
b.p. 75 °C
m.p. -96 °C

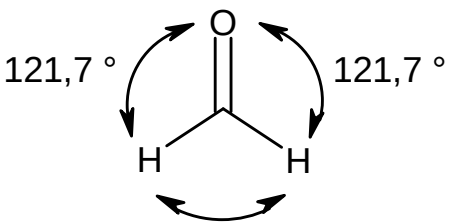
$CH_3CH_2CH_2{-}CH_2OH$

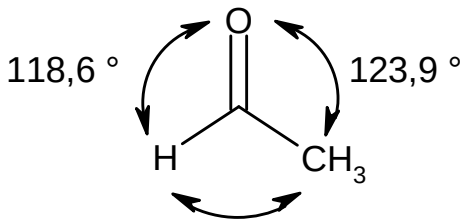
butanol
b.p. 118 °C
m.p. -88 °C

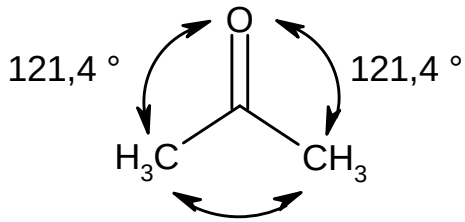
van der Waals interactions
(inducded dipole-induced dipole)

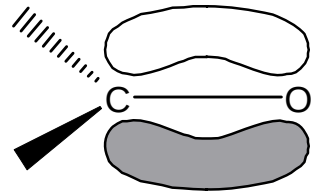




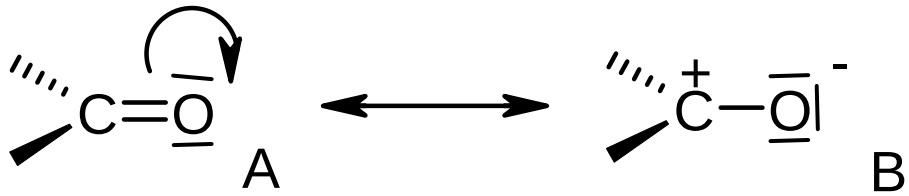


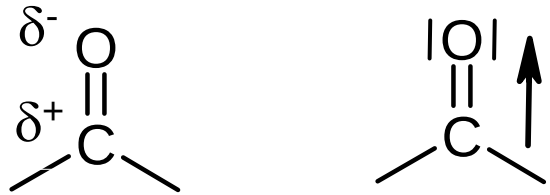




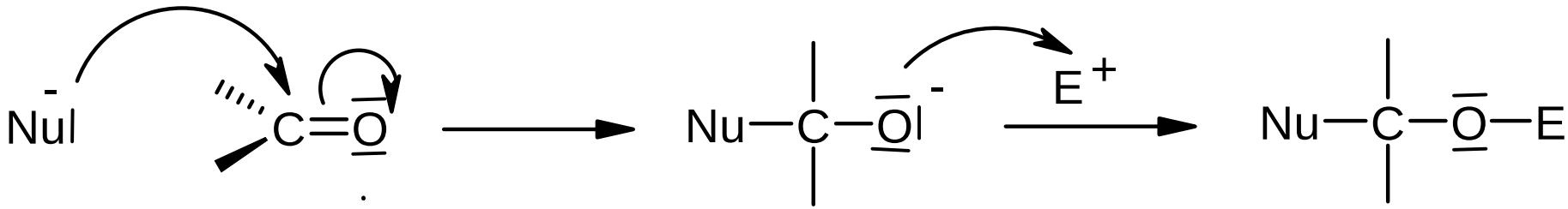


Aldehydes, ketones - nucleophillic addition



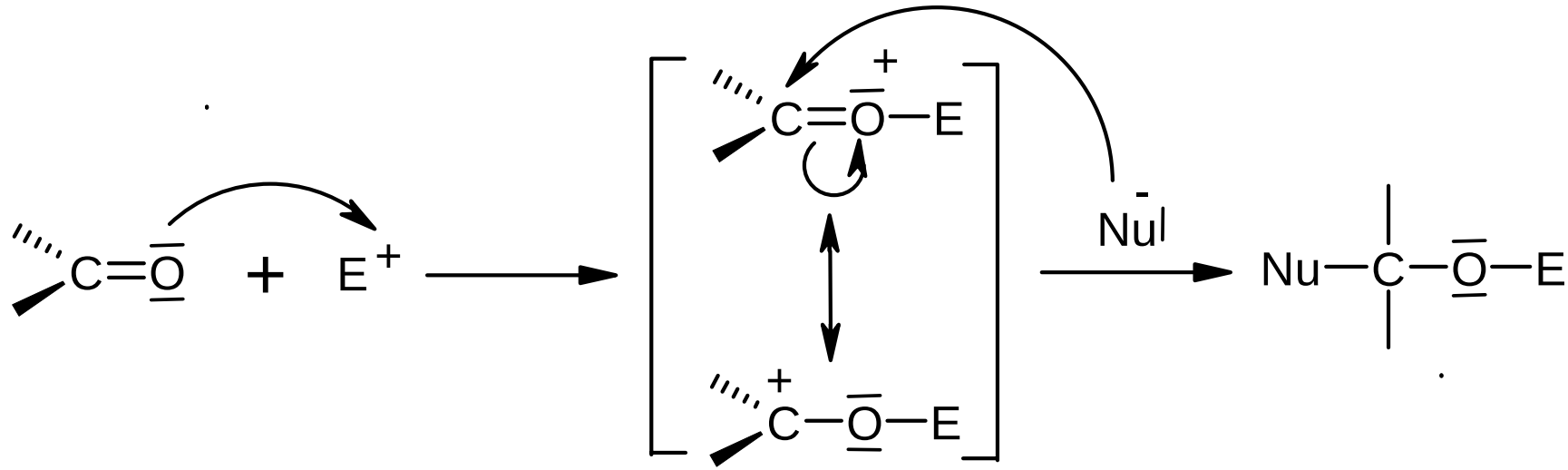


dipole moment: 2,5 D

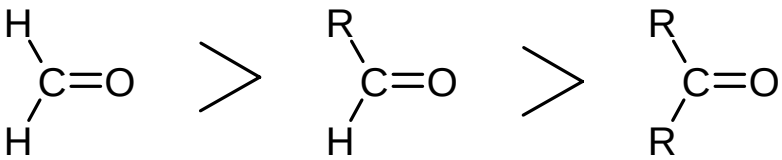


a)

Aldehydes, ketones - nucleophillic addition – reactivity order

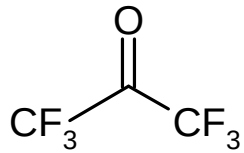


b)



$CCl_3—CH=O$

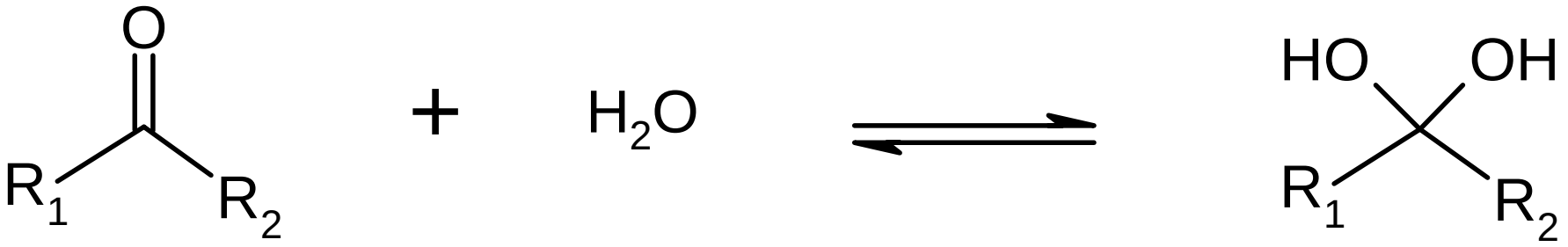
chloral
(trichloroacetaldehyde)



hexafluoroacetone

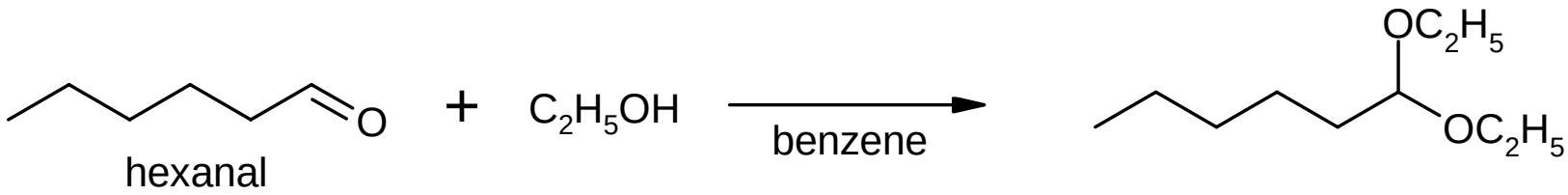
Organic Chemistry – functional groups

Aldehydes, ketones - nucleophillic addition - hydrates



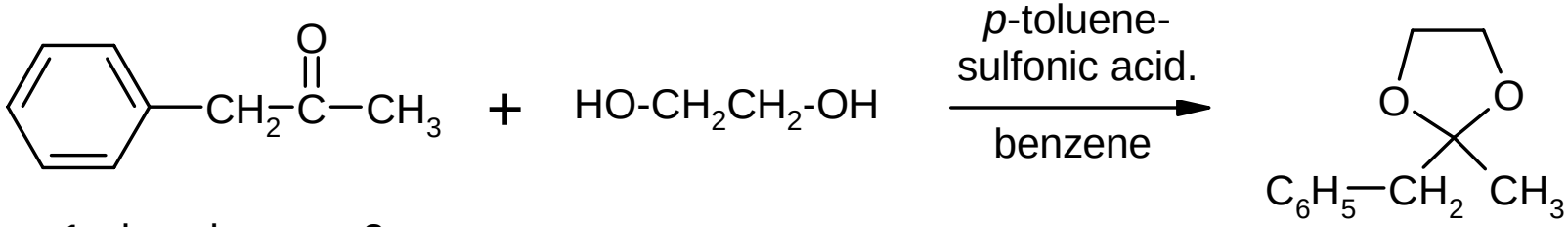
R_1	R_2	K_{hydr} [mol·l^{-1}]	% conversion
H	H	41	99,95
CH_3	H	$1,8 \times 10^{-2}$	50
$(CH_3)_3C$	H	$4,0 \times 10^{-3}$	20
CCl_3	H	3×10^{4}	100
CH_3	CH_3	$2,5 \times 10^{-5}$	0,14
$(CH_3)_3C$	$(CH_3)_3C$	$3,1 \times 10^{-8}$	$1,7 \times 10^{-4}$
CF_3	CF_3	$2,2 \times 10^{4}$	100

Aldehydes, ketones - nucleophillic addition - acetals



hexanal

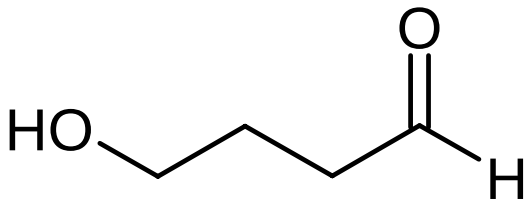
1,1-diethoxyhexane
(85 %)

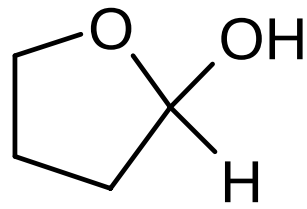


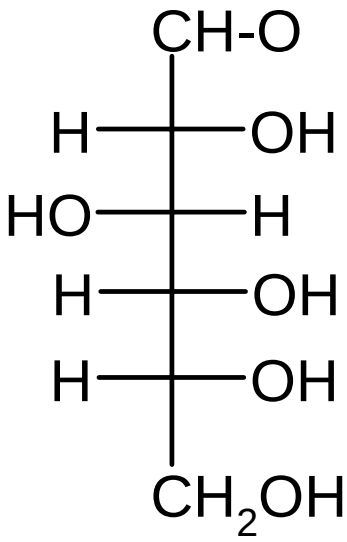
1-phenylpropan-2-one

2-benzyl-2-methyl-1,3-dioxolane
(78 %)

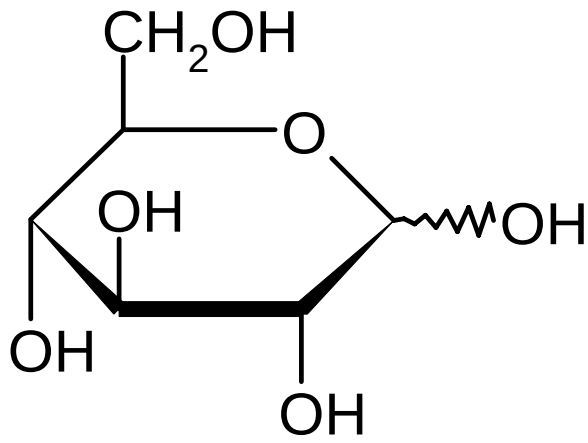
Aldehydes, ketones - hemiacetals formed by intramolecular A_N







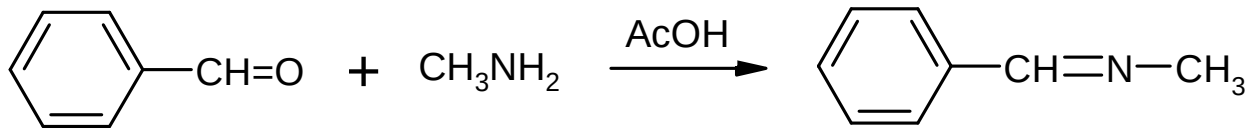
D-glucose



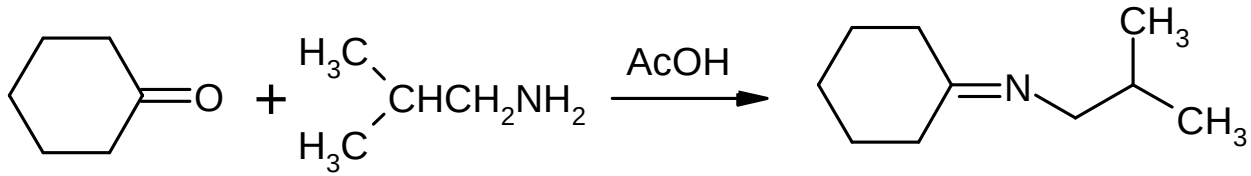
D-glucopyranose

Organic Chemistry – functional groups

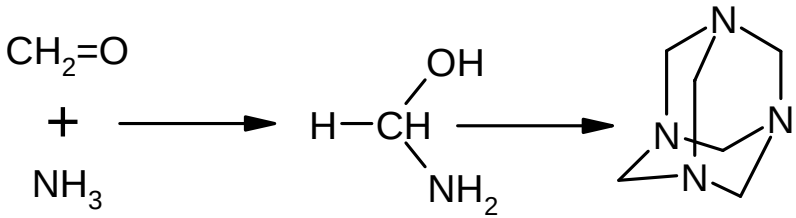
Aldehydes, ketones - „N“-nucleophiles – reaction with amines



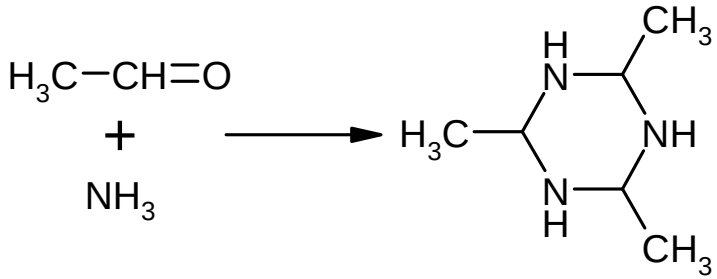
N-benzylidenemethylamine
(70 %)



N-cyclohexylideneisobutylamine
(79 %)

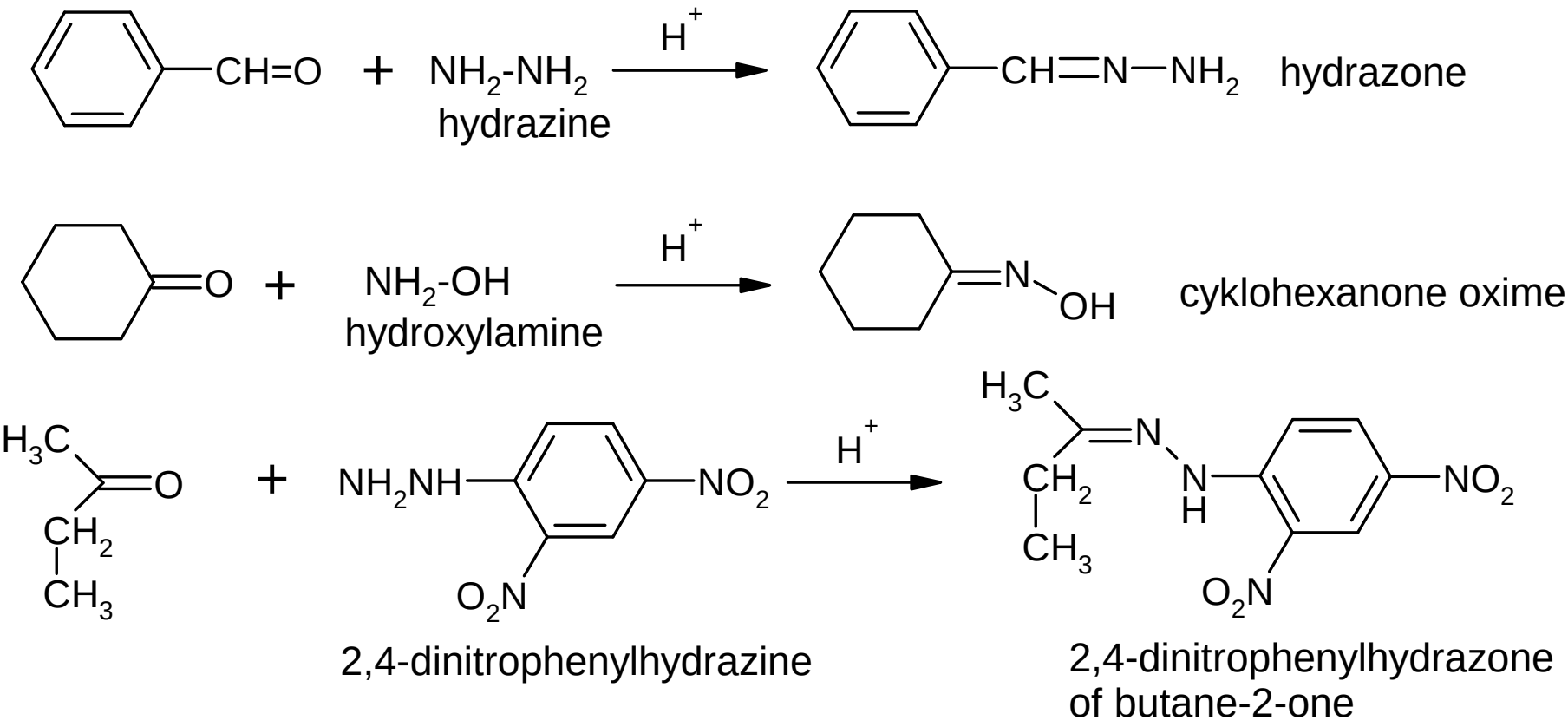


urotropine



Organic Chemistry – functional groups

Aldehydes, ketones -„N“-nucleophiles – hydrazines, hydroxylamines

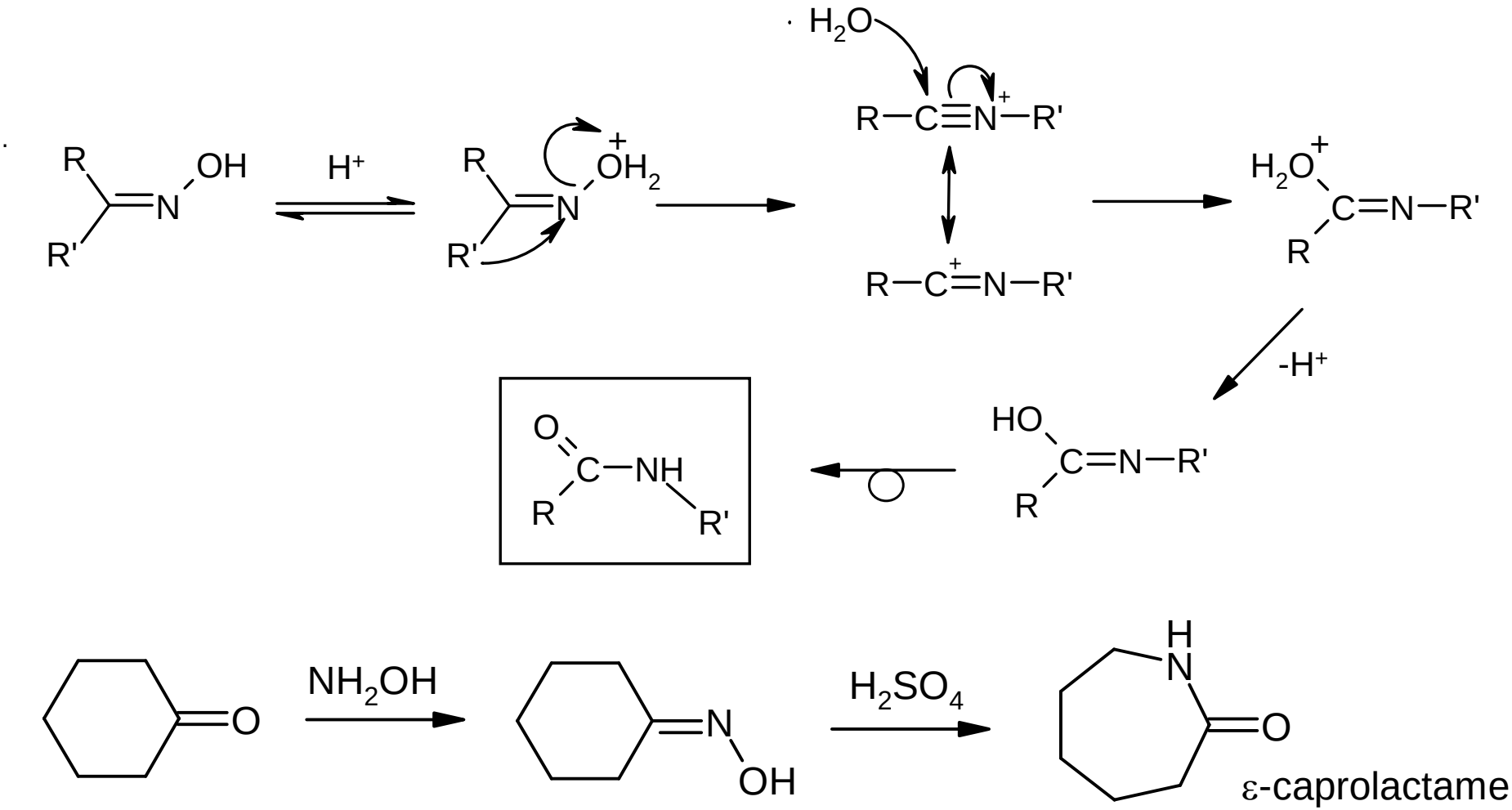


2,4-dinitrophenylhydrazine

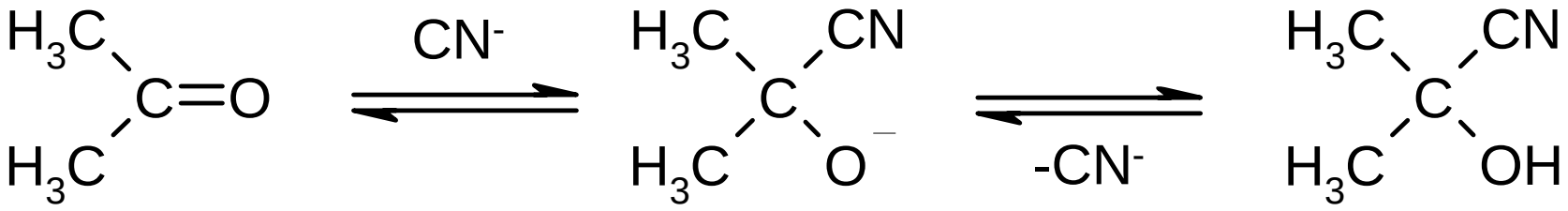
2,4-dinitrophenylhydrazone of butane-2-one

Organic Chemistry – functional groups

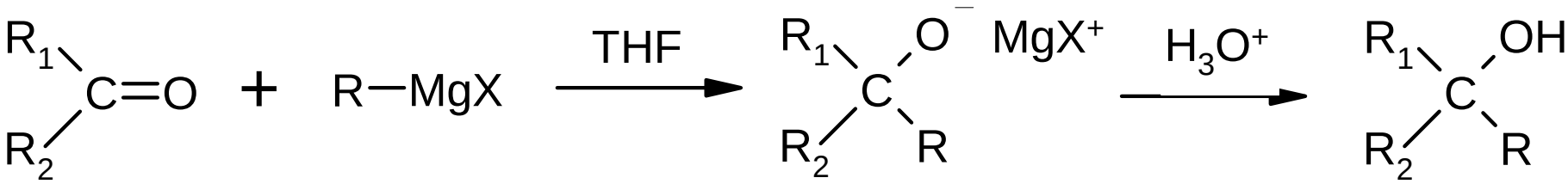
Aldehydes, ketones - oximes - Beckmann rearrangement



Aldehydes, ketones - nucleophillic addition – „C“ - nucleophiles

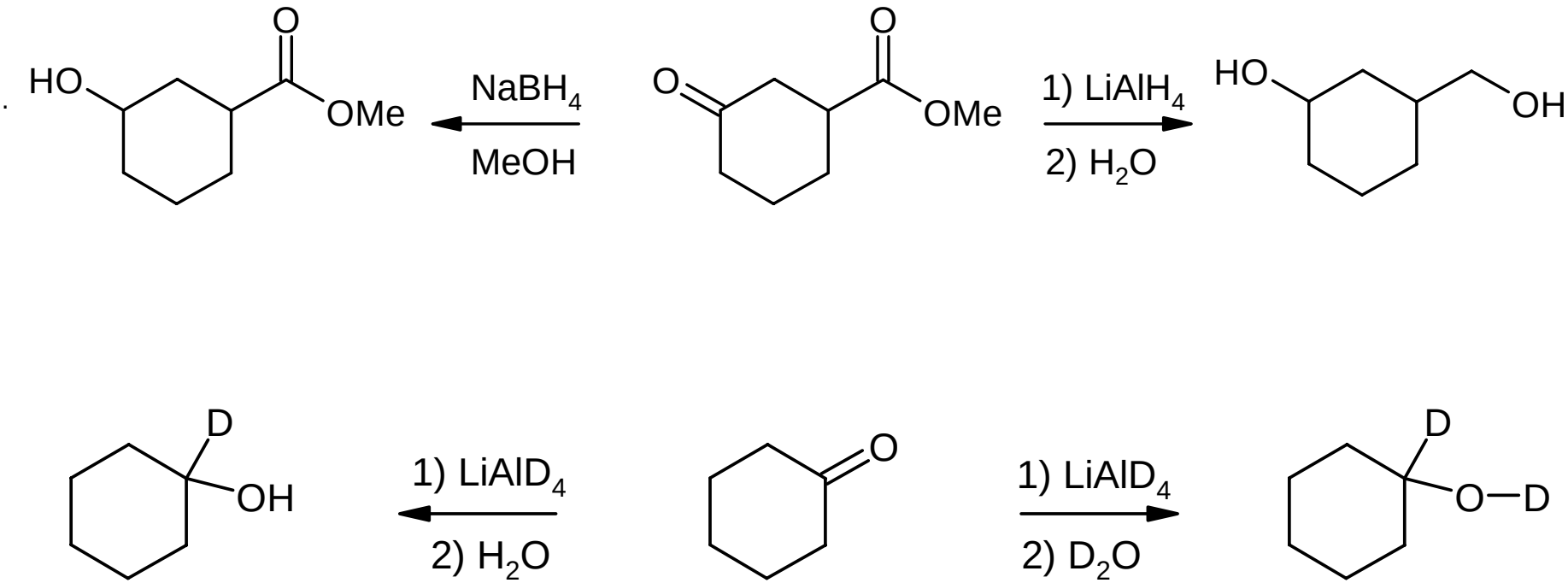


acetone cyanohydrine

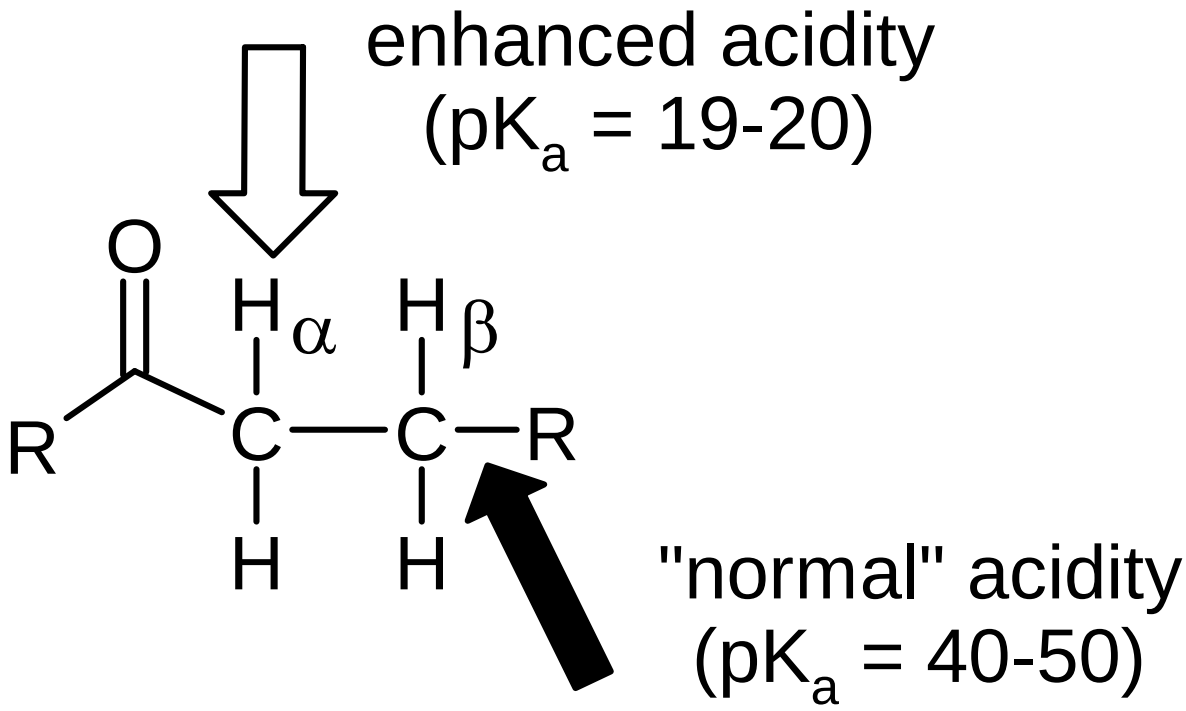


Organic Chemistry – functional groups

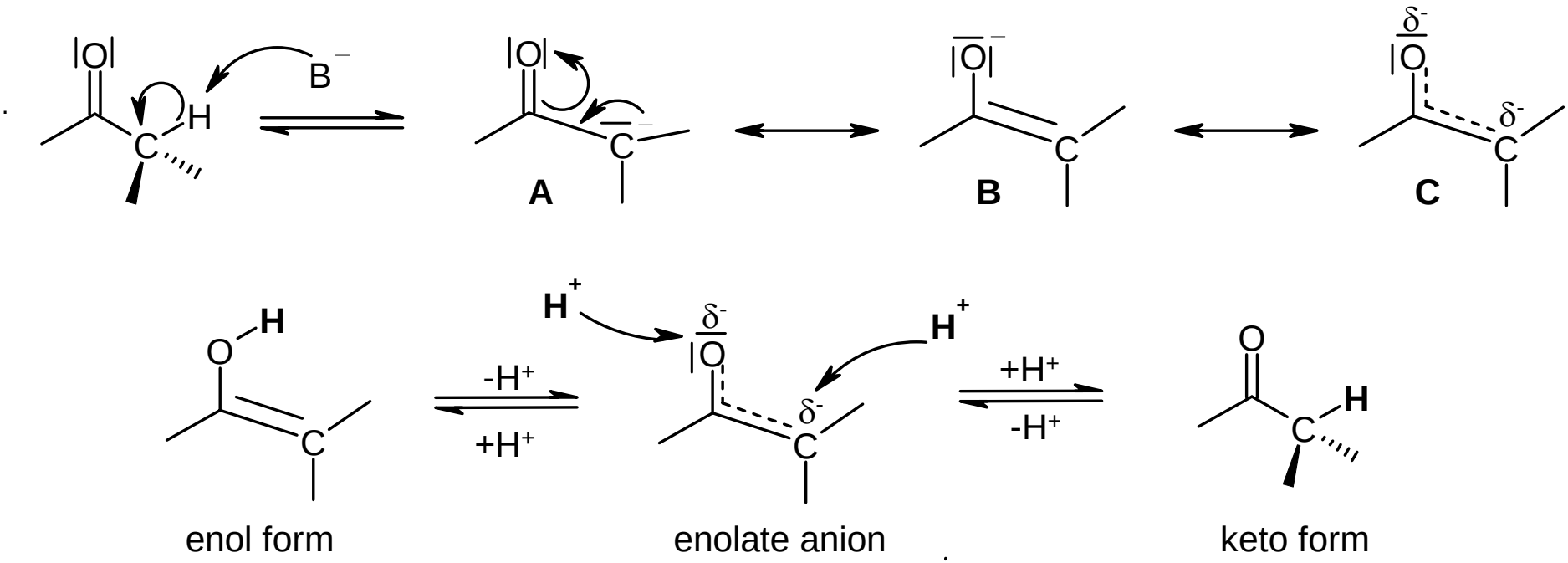
Aldehydes, ketones - nucleophillic addition – „H“ - nucleophiles



Aldehydes, ketones - acidity of C-H bond α - to carbonyl (C=O)



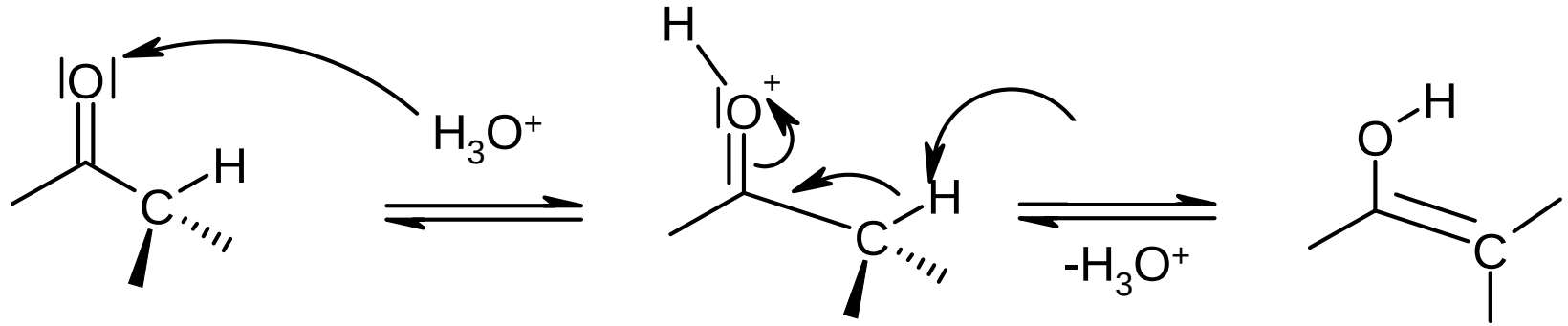
Aldehydes, ketones - enolate formation and use



Aldehydes, ketones - enolate formation and use

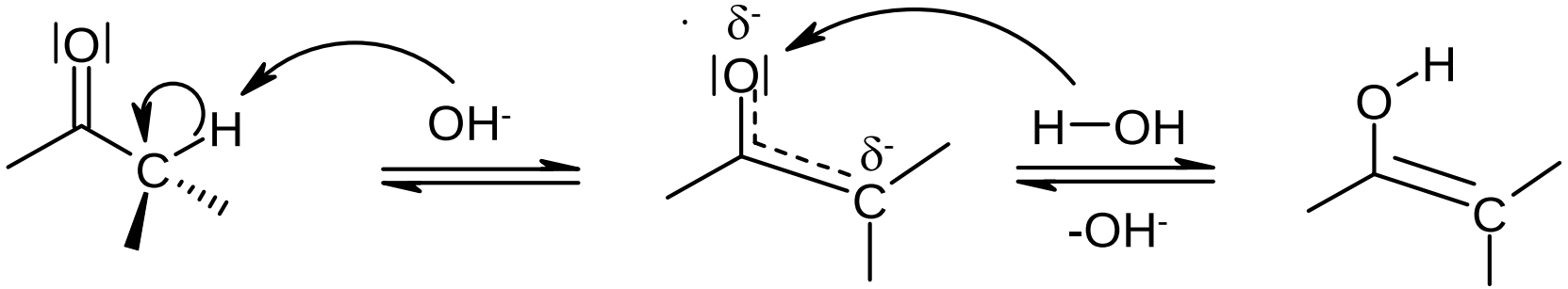
acid catalyzed enolisation

a)



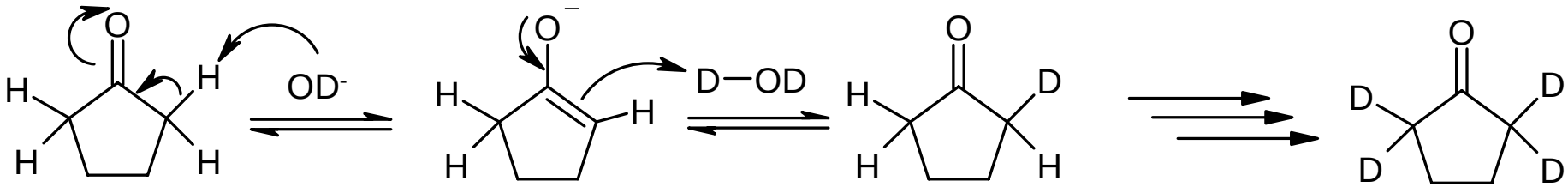
base catalyzed enolisation

b)

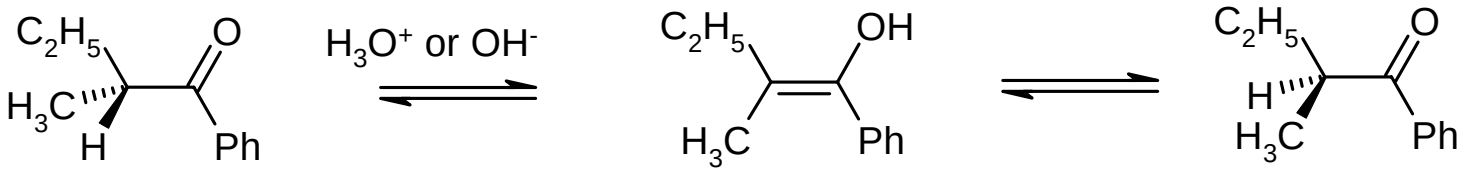


Aldehydes, ketones - enolate formation consequences

H – D exchange



racemisation

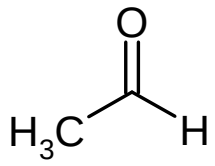


(+)-1-phenyl-2-methylbutane-1-one achiral enol form (-)-1-phenyl-2-methylbutane-1-one

Organic Chemistry – functional groups

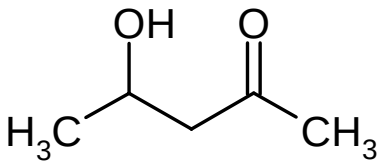
Aldehydes, ketones - enolate formation consequences

aldolisation

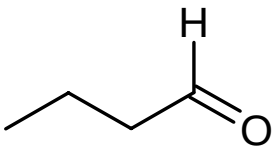


NaOH/water

5 °C

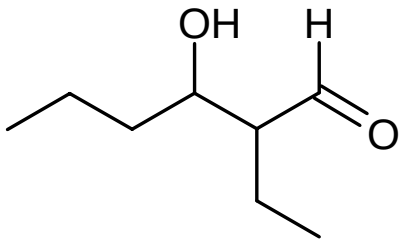


3-hydroxybutanal (50%)

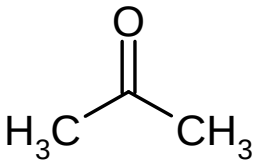


NaOH/water

5 °C

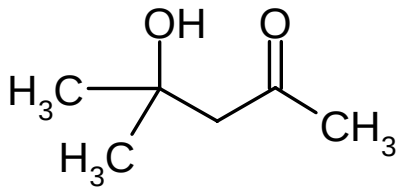


2-ethyl-3-hydroxyhexanal (75%)



$Ba(OH)_2$

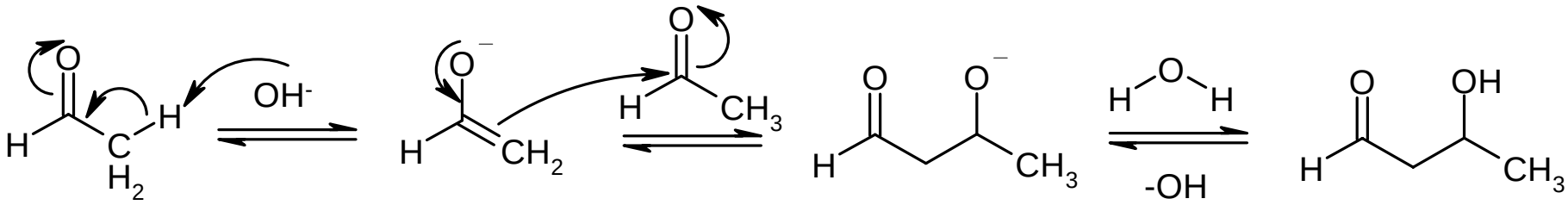
water



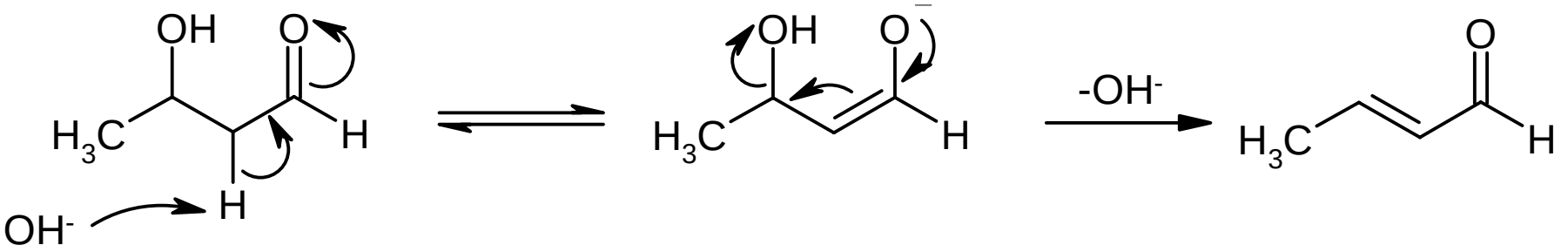
4-hydroxy-4-methylpentane-2-one

Aldehydes, ketones - enolate formation consequences

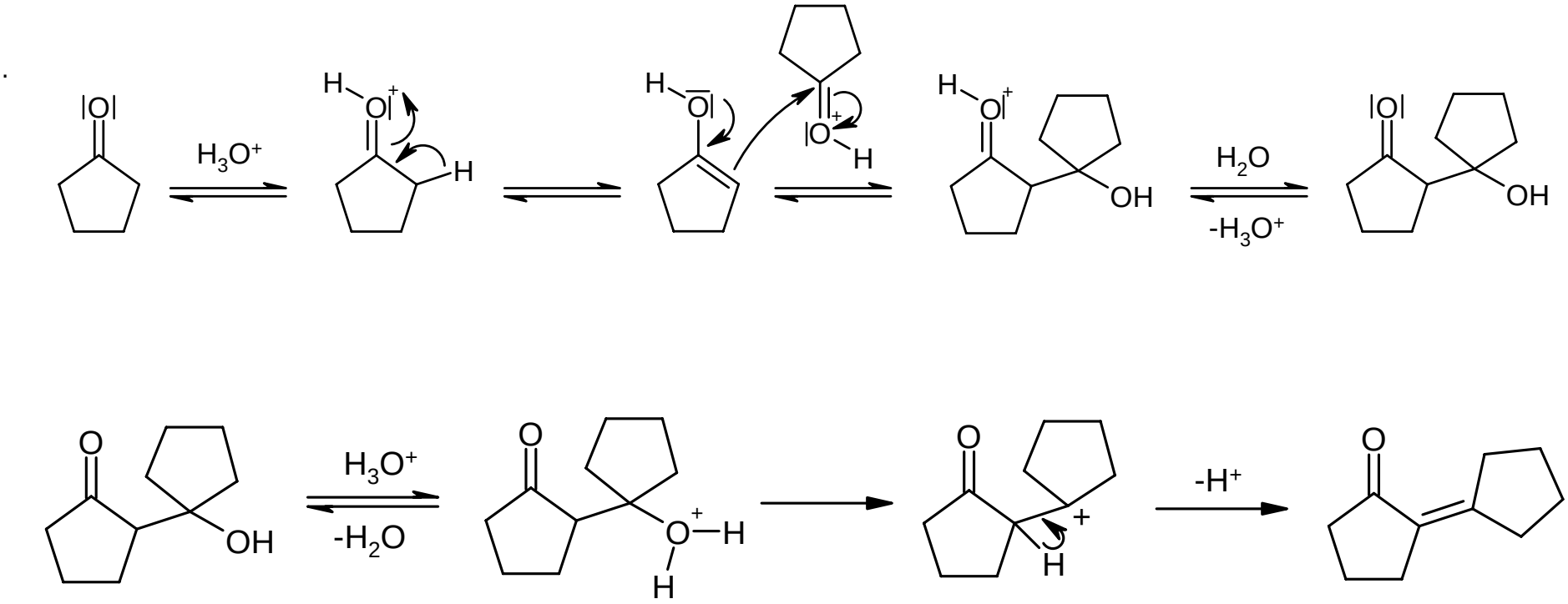
aldolisation



aldol condensation

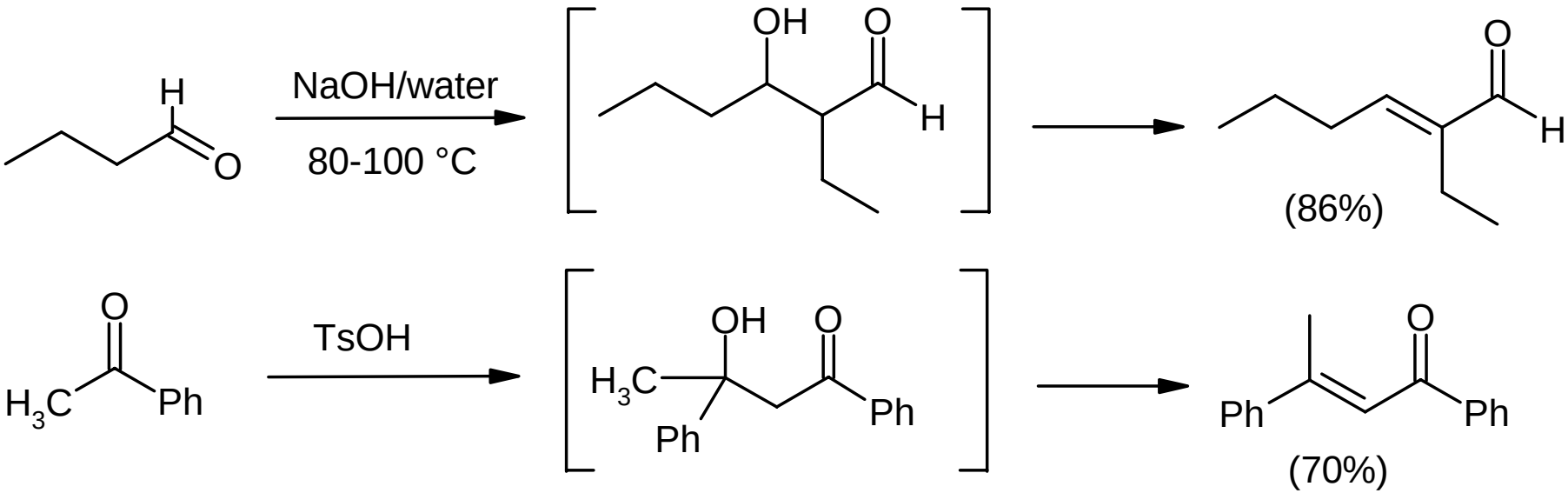


Aldehydes, ketones - enolate formation consequences



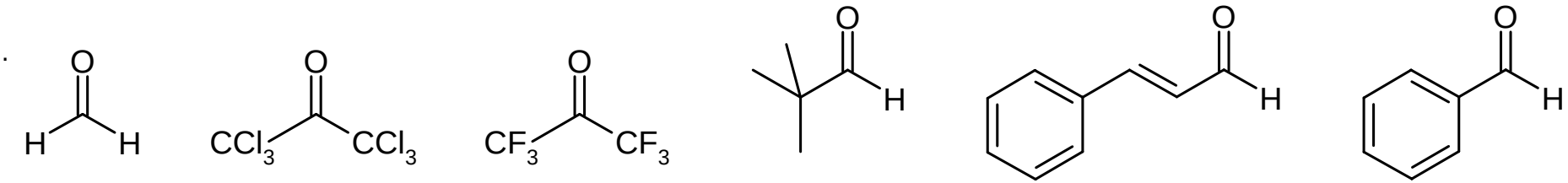
Aldehydes, ketones - enolate formation consequences

aldol condensation is promoted either by higher temperature (concentration of base) or by presence of acid



Aldehydes, ketones - enolate formation consequences

cross-aldolisation – with one non-enolizable compound only



„Semtex“ synthesis