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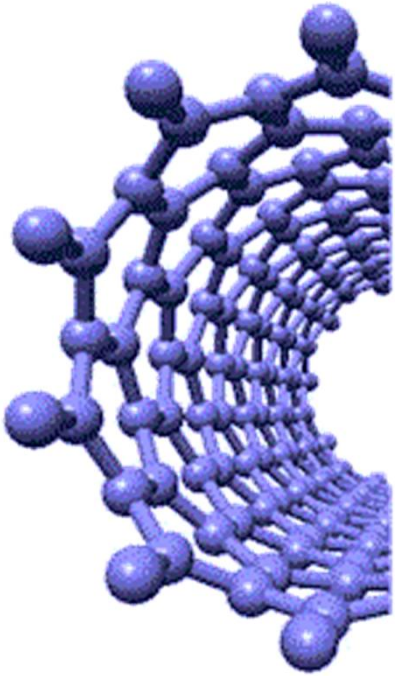
INVESTMENTS IN EDUCATION DEVELOPMENT

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

nano.tul.cz



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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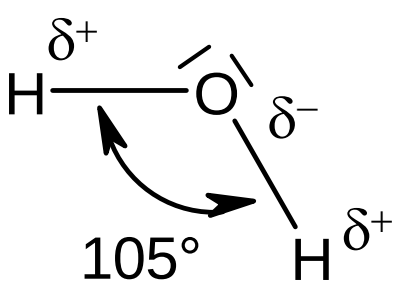
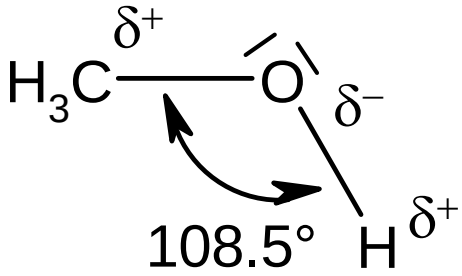
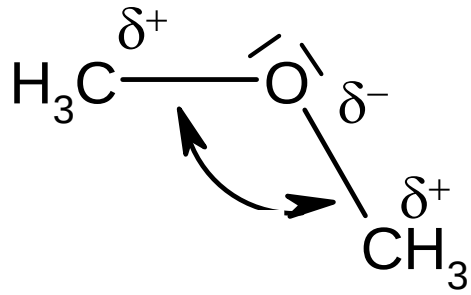
Alcohols – shape of the molecule



water



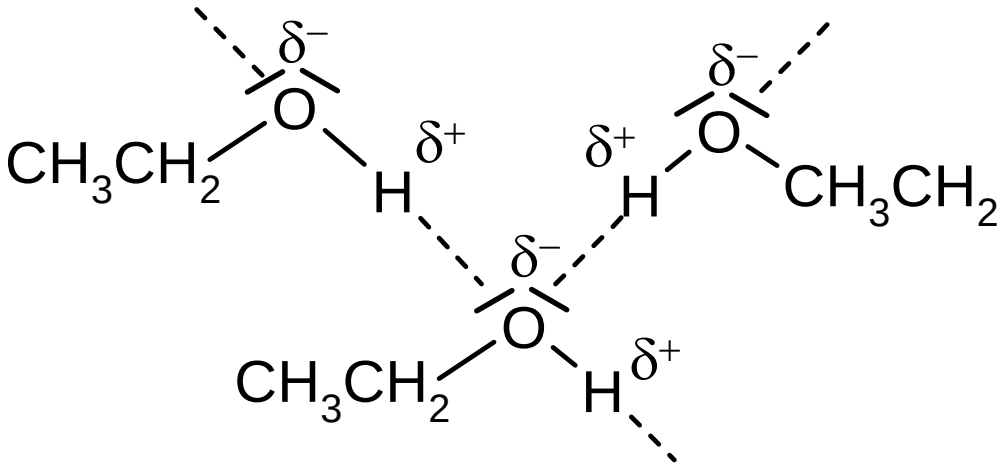
methanol



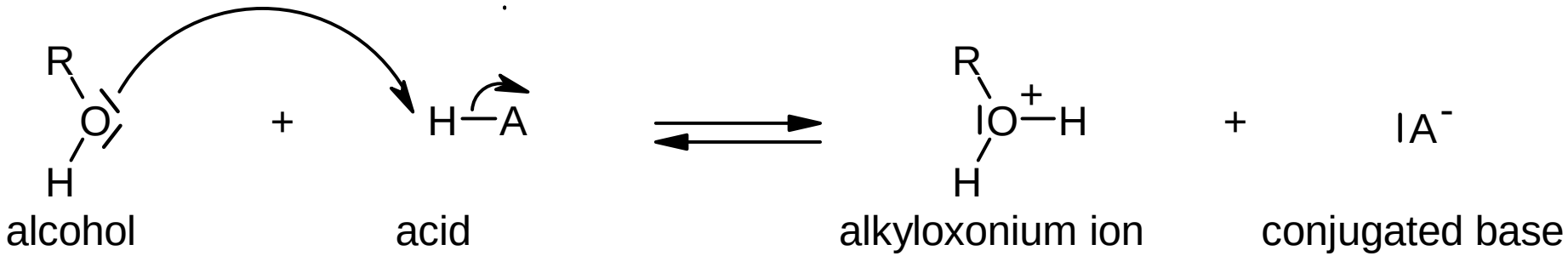
dimethylether

Alcohols – hydrogen bond

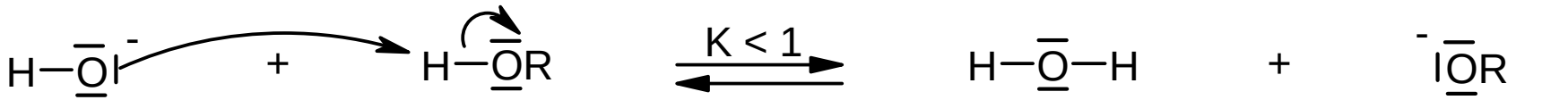
$CH_3CH_2CH_3$	CH_3CH_2OH	CH_3CH_2F
propane	ethanol	fluoroethane
b.v. -42 °C	b.v. 78 °C	b.v. -32 °C



Alcohols – as acid and base.



alcohol acid alkyloxonium ion conjugated base



hydroxide anion alcohol water alkoxide anion

Organic Chemistry – functional groups

Alcohols – reaction with hydrogenhalides

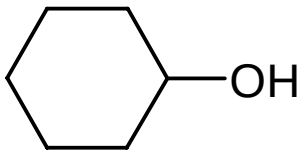
CH_3OH < RCH_2OH < R_2CHOH < R_3COH

methyl — primary — secondary — tertiary

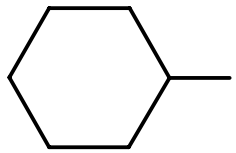
the least reactive — *the most reactive*

$(CH_3)_3COH + HCl \xrightarrow{25°C} (CH_3)_3CCl + H_2O$

tert-butylalcohol → *tert*-butylchloride (88%)



+ HBr $\xrightarrow{80\text{-}100°C}$



+ H_2O

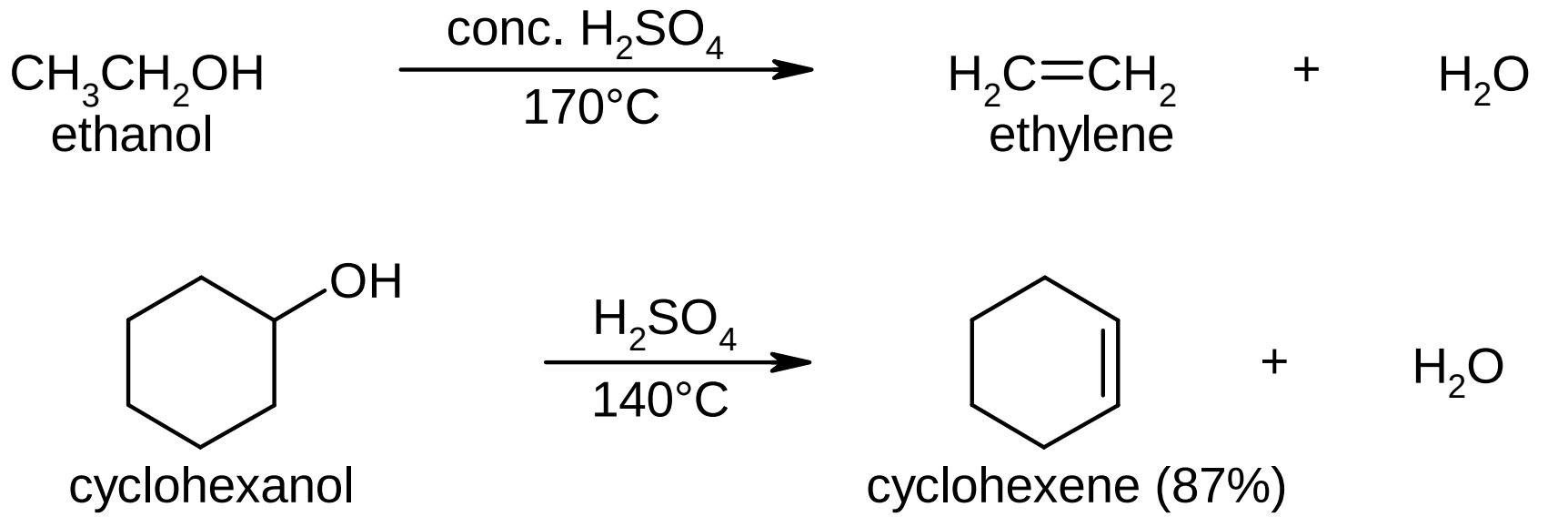
cyclohexanol → bromocyclohexane (73%)

$CH_3(CH_2)_3CH_2OH + HI \longrightarrow CH_3(CH_2)_3CH_2I + H_2O$

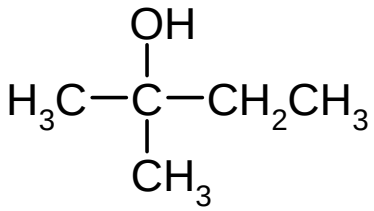
pentan-1-ol → 1-iodopentane

Organic Chemistry – functional groups

Alcohols – acid-catalyzed dehydration of ..

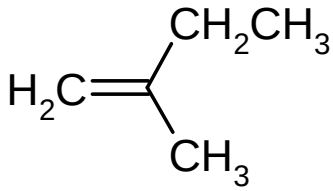


Alcohols – acid-catalyzed dehydration regioselectivity – Zaitsev rule



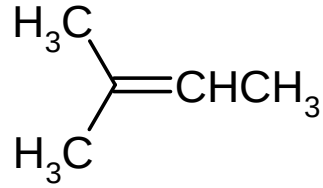
2-methylbutan-2-ol

$\xrightarrow[80°C]{H_2SO_4}$

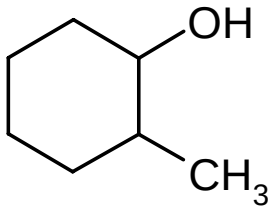


2-methylbut-1-ene (10%)

+

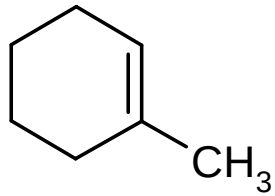


2-methylbut-2-ene (90%)



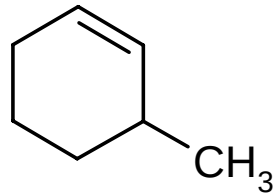
2-methylcyclohexanol

$\xrightarrow[100°C]{H_3PO_4}$



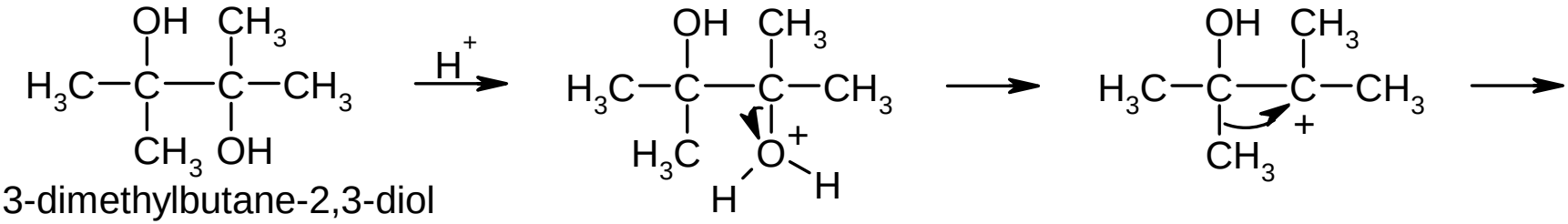
1-methylcyclohexene (84%)

+

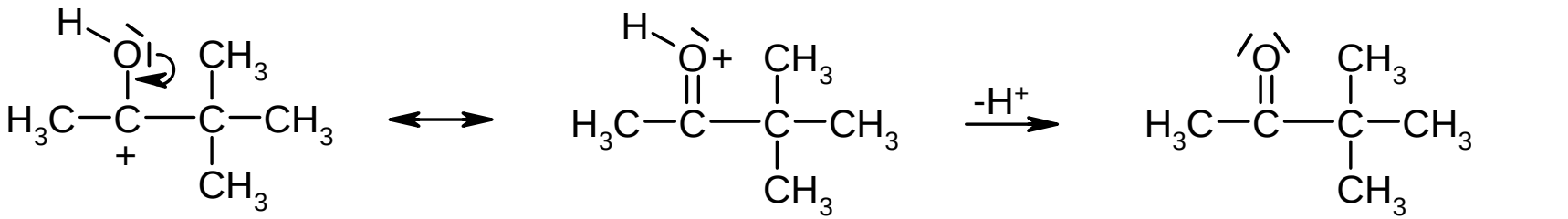


3-methylcyclohexene (16%)

Alcohols – acid-catalyzed dehydration - molecular rearrangements



2,3-dimethylbutane-2,3-diol
(pinacol)



3,3-dimethylbutane-2-one
(pinacolon)

Organic Chemistry – functional groups

Ethers – synthesis.

$$2\ RCH_2OH \xrightarrow[\Delta]{H^+} RCH_2OCH_2R + H_2O$$

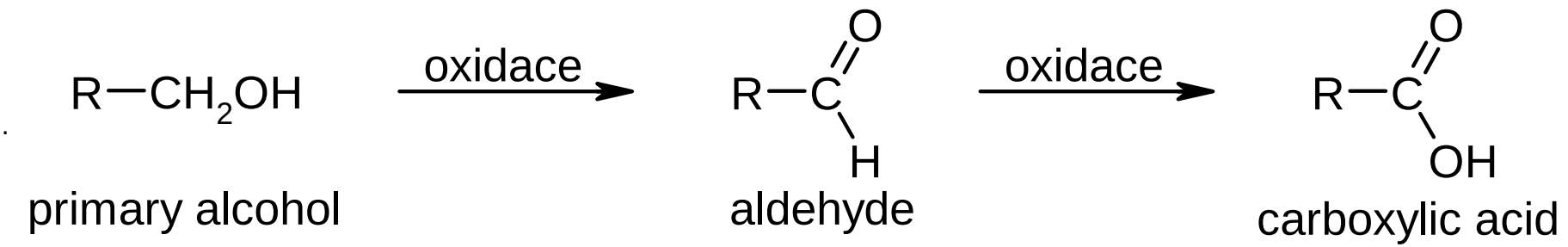
$$2\ CH_3CH_2CH_2CH_2OH \xrightarrow[130°C]{H_2SO_4} CH_3CH_2CH_2CH_2OCH_2CH_2CH_2CH_3 + H_2O$$

butane-1-ol — dibutylether (60%)

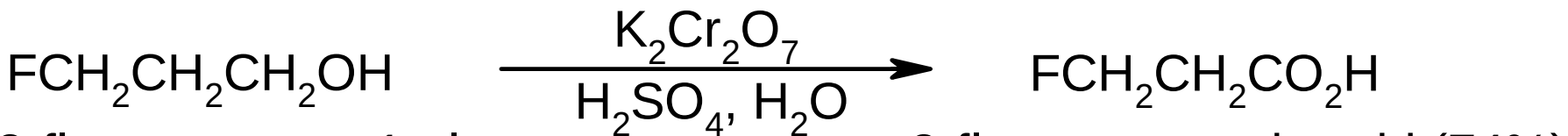
$$HOCH_2CH_2CH_2CH_2OH \xrightarrow[\Delta]{H_3PO_4} \text{O} + H_2O$$

butane-1,4-diol — tetrahydrofurane

Alcohols - oxidation.



primary alcohol — aldehyde — carboxylic acid

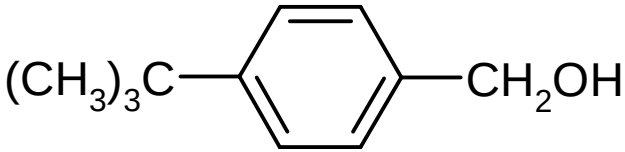


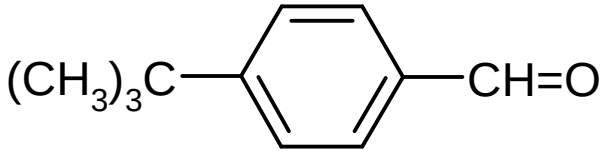
3-fluoropropane-1-ol — 3-fluoropropanoic acid (74%)

Alcohols - oxidation.

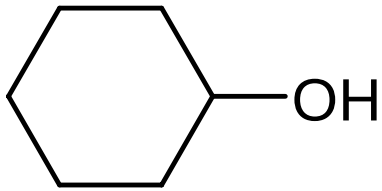
$CH_3CH_2CH_2CH_2CH_2CH_2CH_2OH$ —(PCC, CH_2Cl_2)→ $CH_3CH_2CH_2CH_2CH_2CH_2CH{=}O$

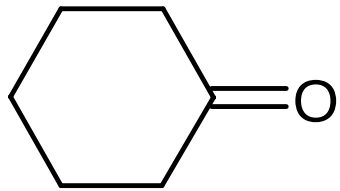
heptane-1-ol → heptanal (78%)



4-*terc*-butylbenzylalcohol —(PDC, CH_2Cl_2)→ 

4-*terc*-butylbenzaldehyde (94%)

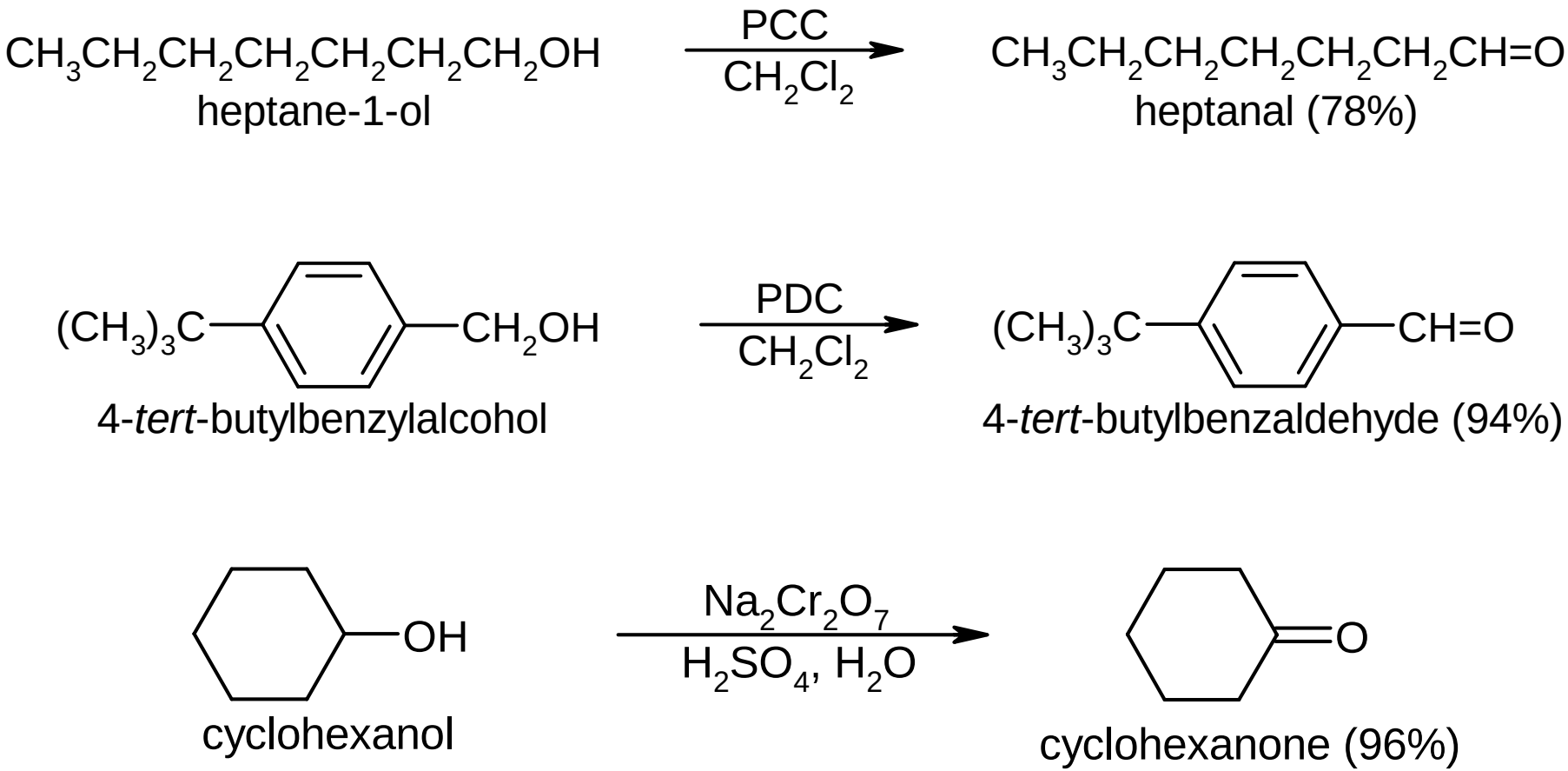


cyclohexanol —($Na_2Cr_2O_7$, H_2SO_4, H_2O)→ 

cyclohexanone (96%)

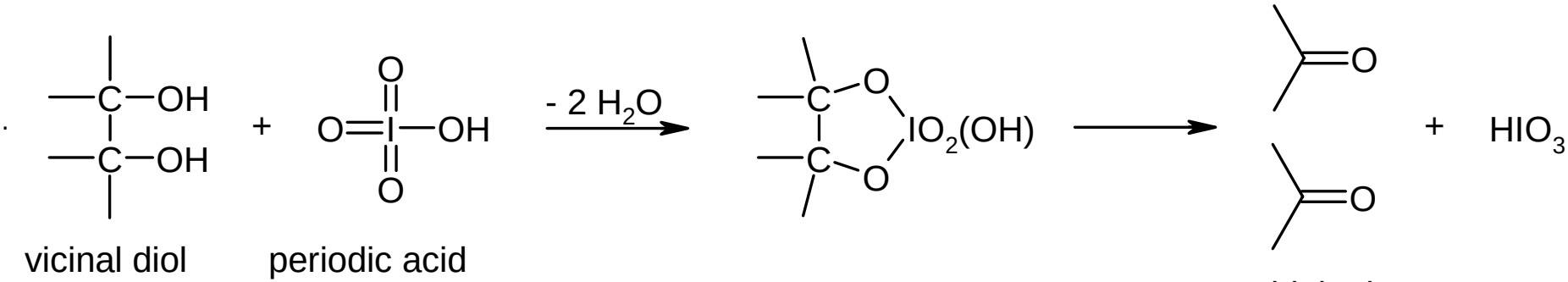
Organic Chemistry – functional groups

Alcohols - oxidation.

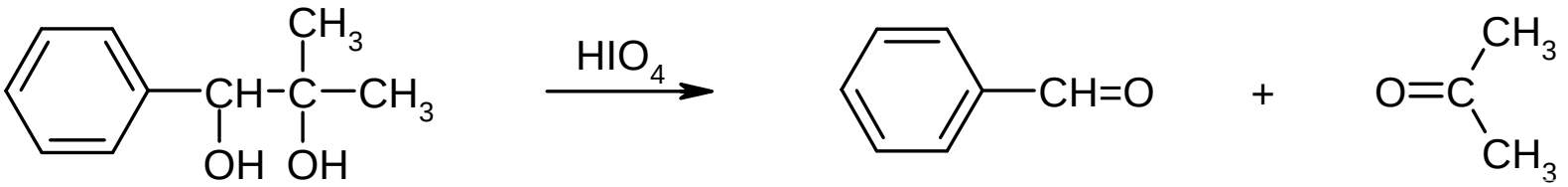


Organic Chemistry – functional groups

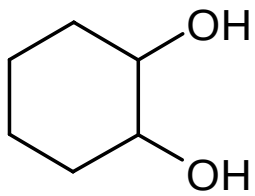
Alcohols – oxidative cleavage

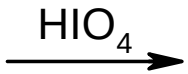


vicinal diol periodic acid aldehyde or ketone



1-phenyl-2-methylpropane-1,2-diol benzaldehyde (83%) acetone



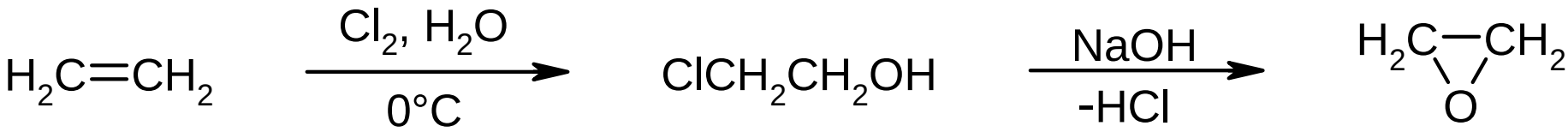


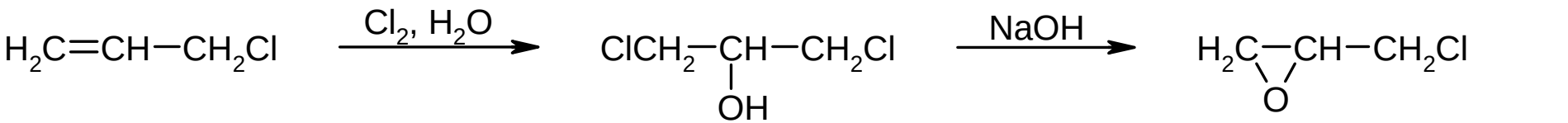
$O{=}CHCH_2CH_2CH_2CH_2CH{=}O$

cyclohexane-1.2-diol hexandial (77%)

Organic Chemistry – functional groups

Ethers – epoxides - synthesis





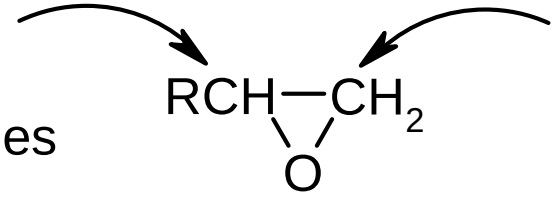
3-chloropropene
(allylchloride)

1,3-dichloropropane-2-ol

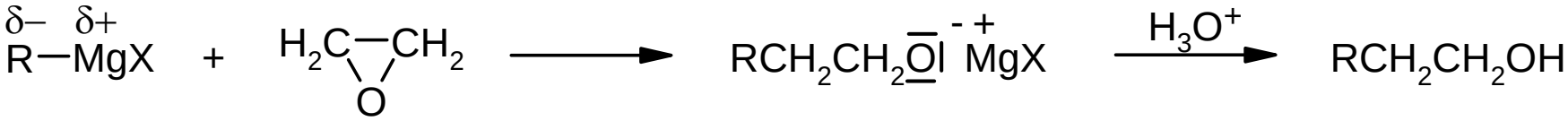
1-chloro-2,3-epoxypropane
(epichlorohydrine)

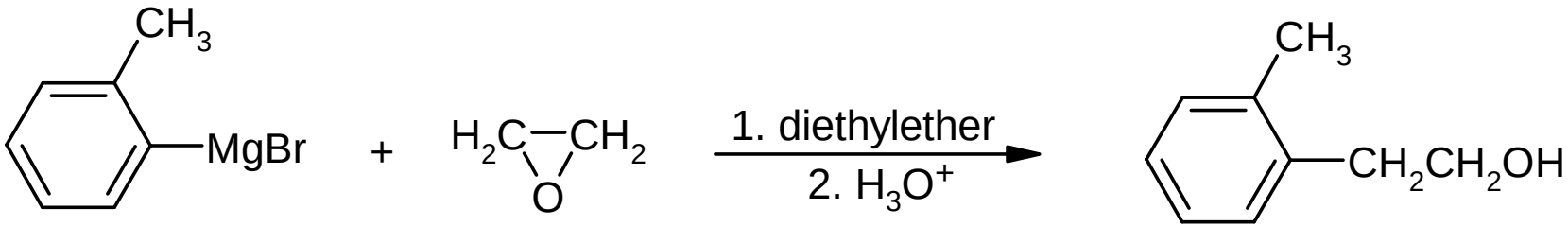
Ethers – epoxides - reactions

acid catalyzed
reaction with nucleophiles



reaction with nucleopghiles
in basic conditions

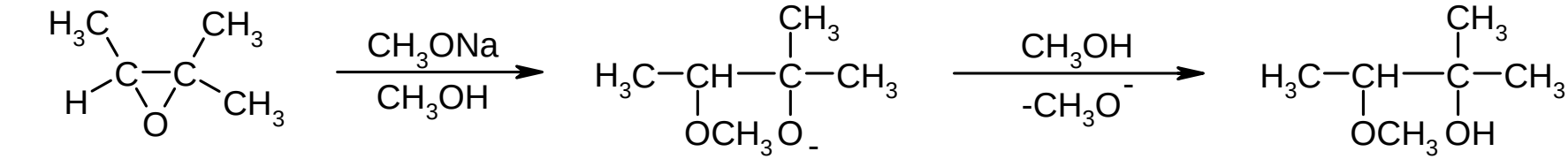




66%

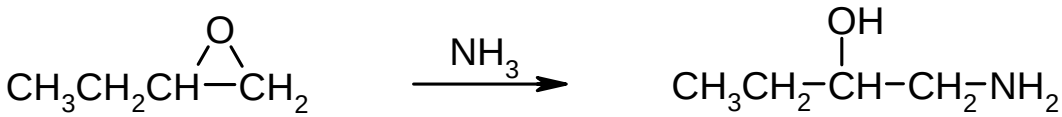
Organic Chemistry – functional groups

Ethers – epoxides - reactions



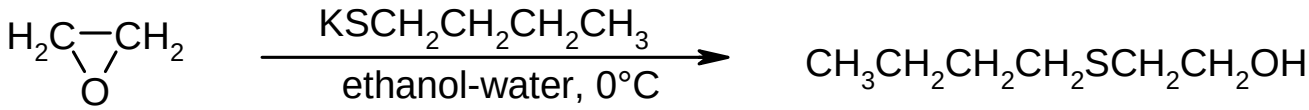
2,2,3-trimethyloxirane

3-methoxy-2-methylbutane-2-ol (53%)



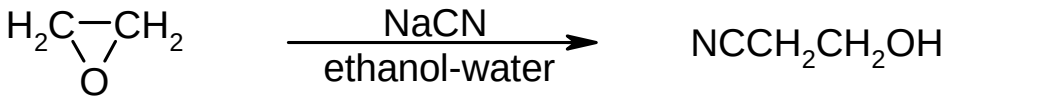
1,2-epoxybutan

1-aminobutane-2-ol



oxirane

2-(butylthio)ethanol (99%)



oxirane

3-hydroxypropannitrile

Ethers – epoxides-reactions