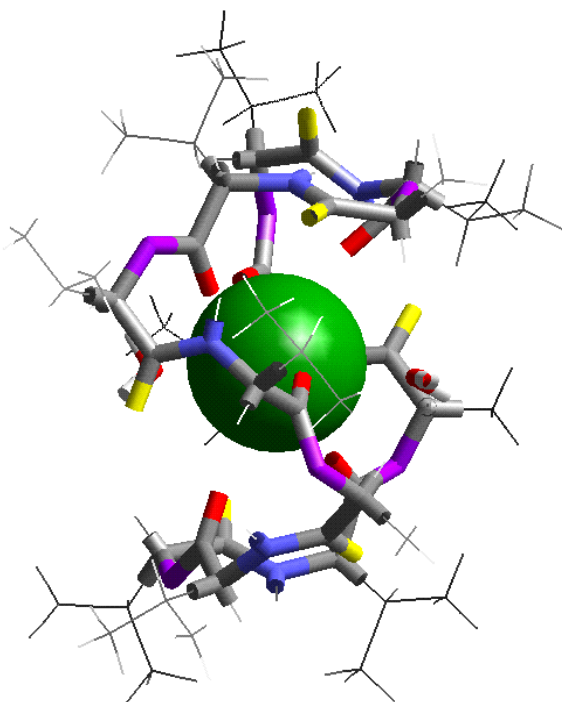


Organic compounds containing oxygen

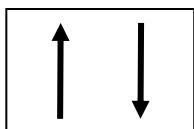


Matej Kohutiar

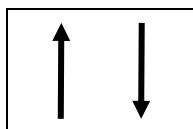
Organic compounds containing oxygen

- Alcohols and phenols
- Carbonyl compounds
- Carboxylic acids and derivatives
- Ethers

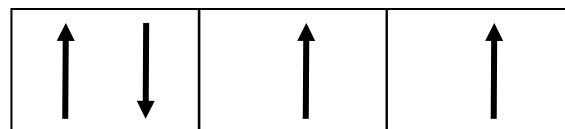
Electron configuration of oxygen



$1s^2$



$2s^2$



$2p^4$

In organic molecule oxygen is attached covalently



Electronic effects in molecules

Inductive effect



Hydroxy derivatives

- Alcohols ($C_{sp^3}\text{-OH}$)
- Phenols ($C_{ar}\text{-OH}$)
- Ethers ($R\text{-O-R}$)

Alcohols



Alcohols

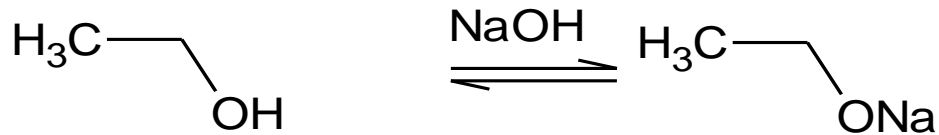
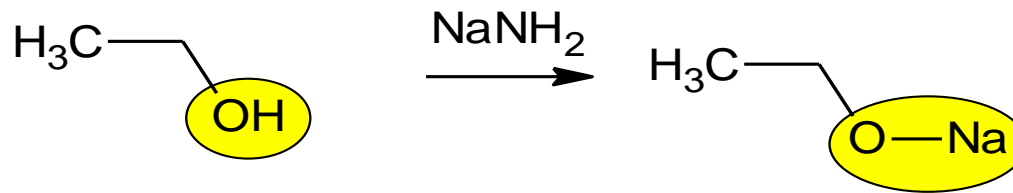
- In 1° alcohol, only one carbon atom is attached to the carbon carrying the -OH group (primary carbon)
- In 2° alcohol two carbon atoms are attached to the carbon carrying the -OH group (secondary carbon)
- In 3° alcohol three other carbon atoms are attached to the carbon atom carrying the -OH group (tertiary carbon)

Alcohols

The number of hydroxyl groups, there are:

- Monohydroxyderivatives
- Polyhydroxy alcohols
 - Diols (dihydroxyderivatives,)
 - Triols (trihydroxyderivatives)
 - Tetrols (tetrahydroxyderivatives)
- Phenols -OH attached primary to aromatic ring

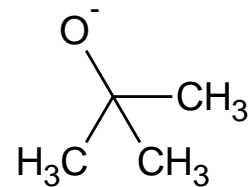
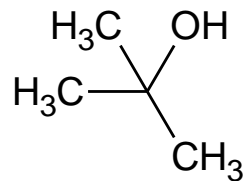
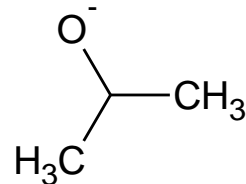
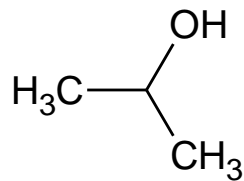
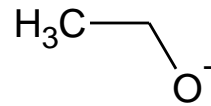
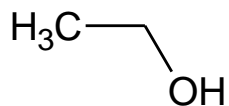
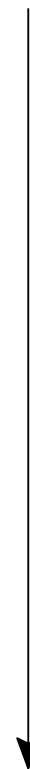
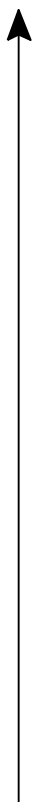
Acidity and alkalinity



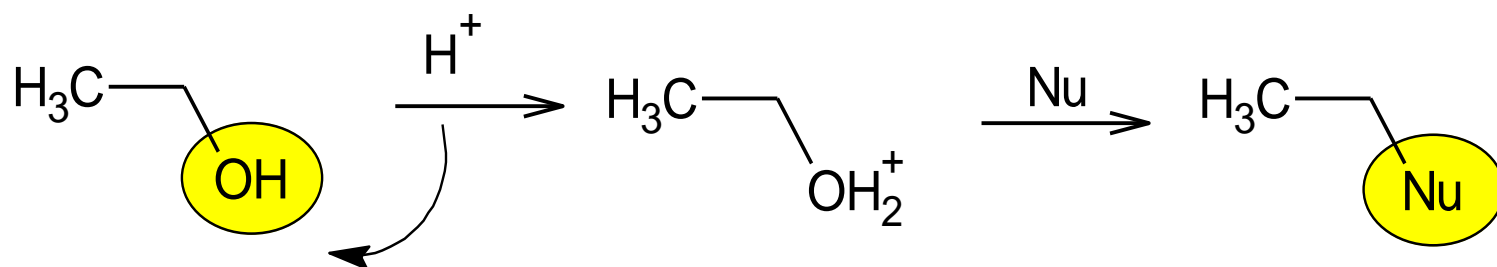
Acidity and alkalinity

acidity

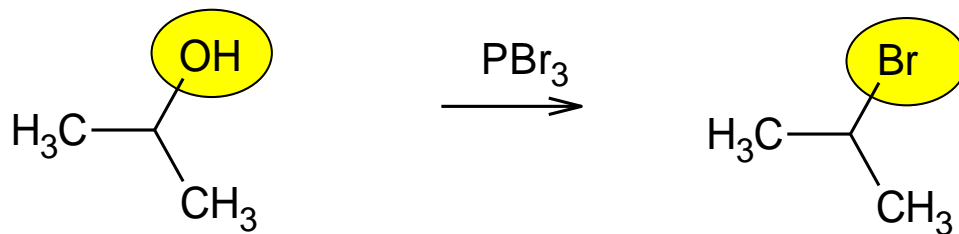
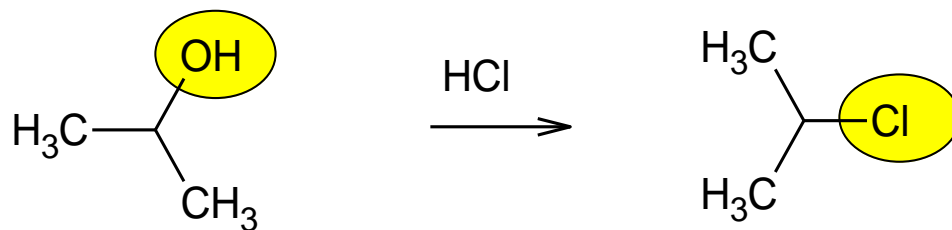
alkalinity



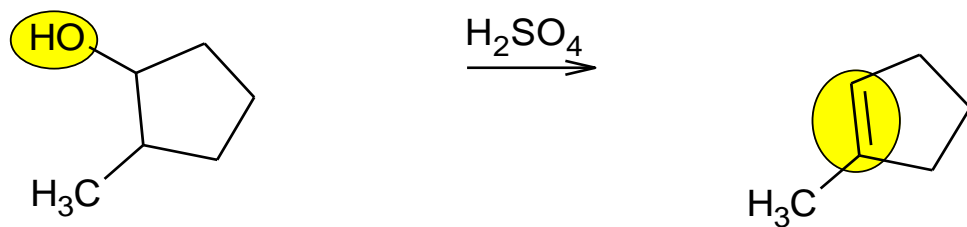
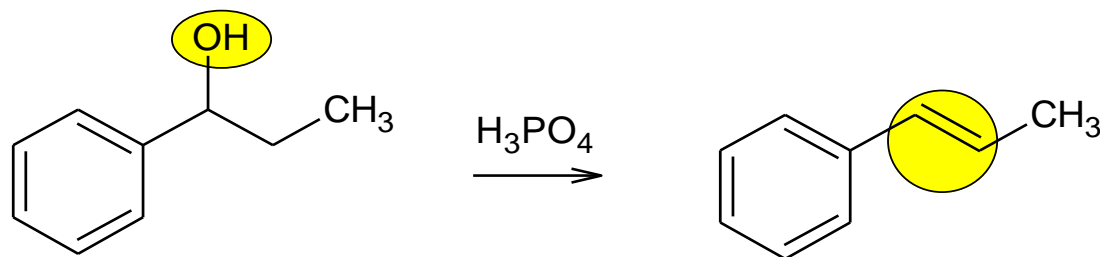
Nucleophilic substitution



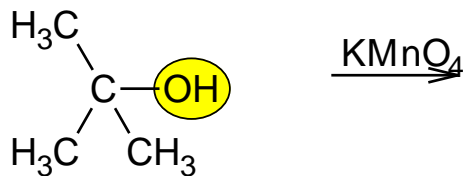
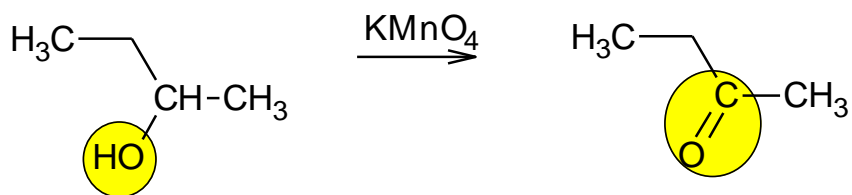
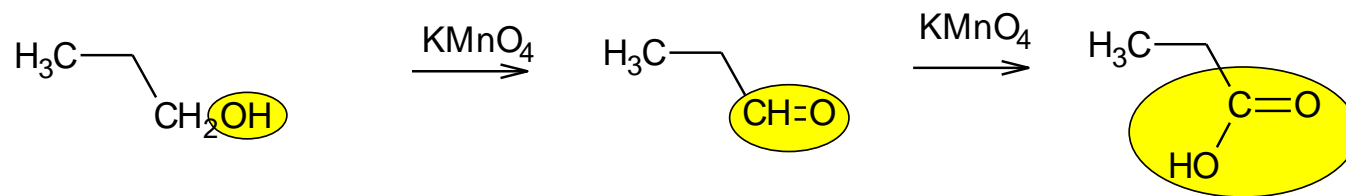
Nucleophilic substitution



Elimination



Oxidation of alcohols



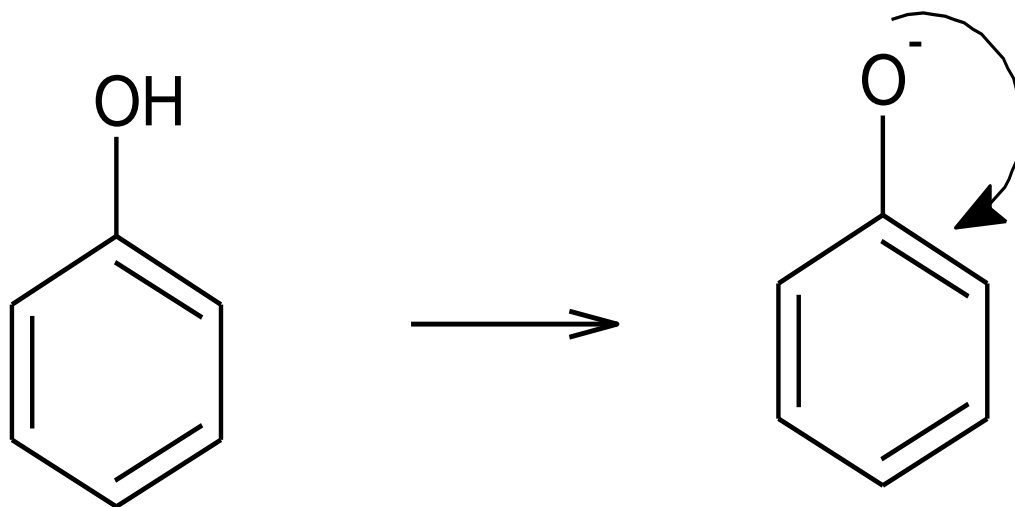
Biological effects of alcohols

- Drugs often contain OH group
- Increase of polarity and solubility in water
- Hypnotic activity decreases from tertiary to primary alcohol
- Natural structures - steroids, hormones etc.

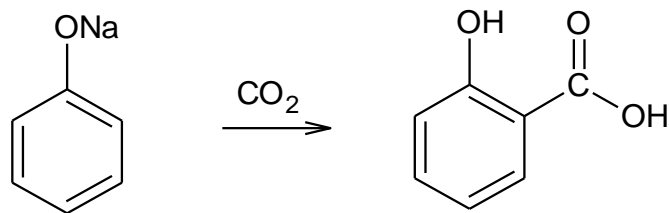
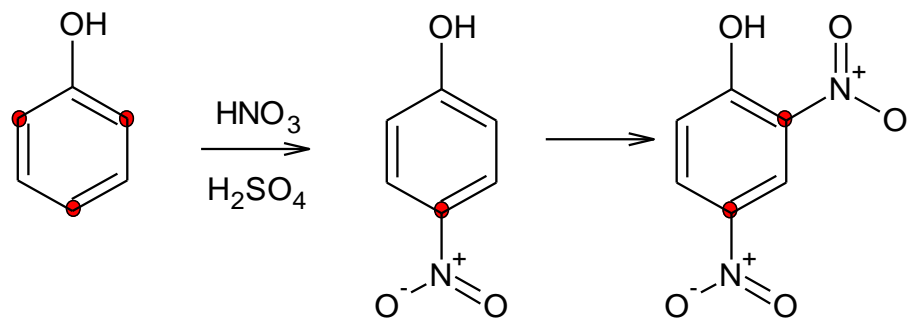
- Methanol
- Ethanol
- Glycerol

PHENOLS

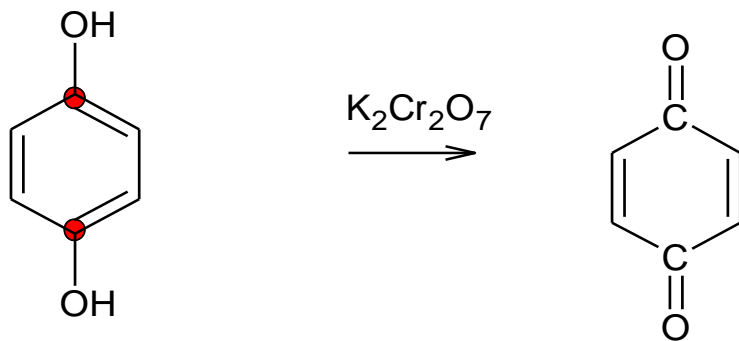
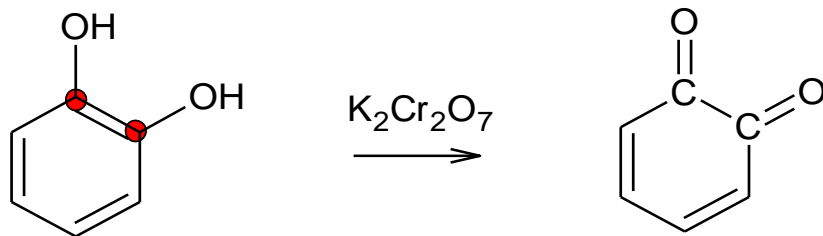
Phenols



Reactions of phenols



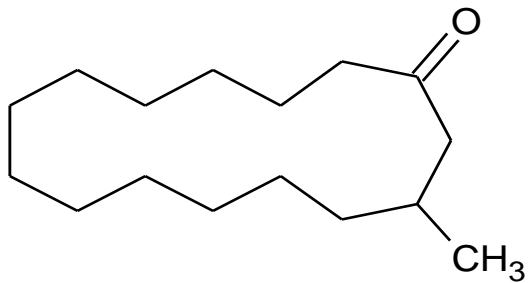
Reactions of phenols



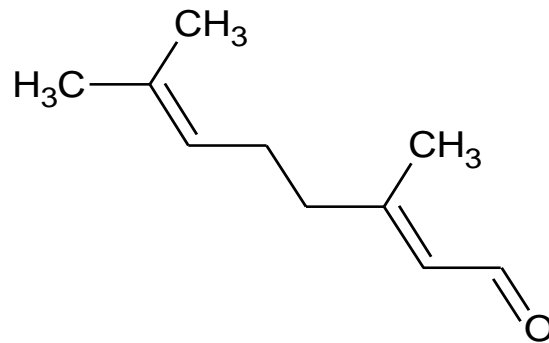
Biological effects of phenols

- Reactive group of acidic properties
- Phenol
- Resorcine
- Salicylic acid
- Acetylsalicylic acid

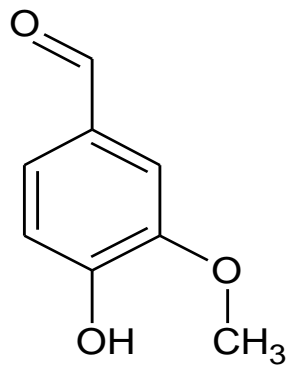
CARBONYL COMPOUNDS



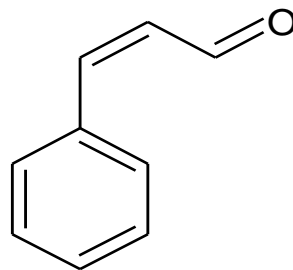
muscone



citral

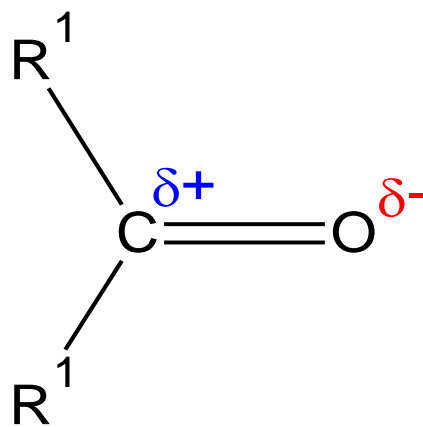


vanilin

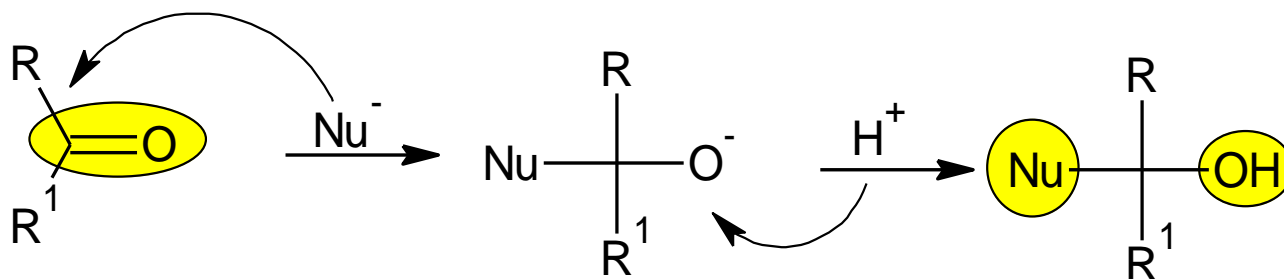


cinnamaldehyde

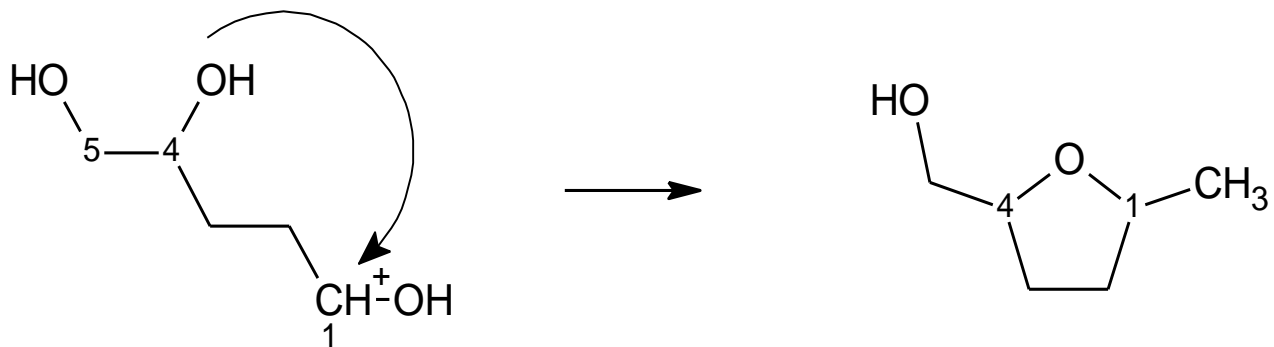
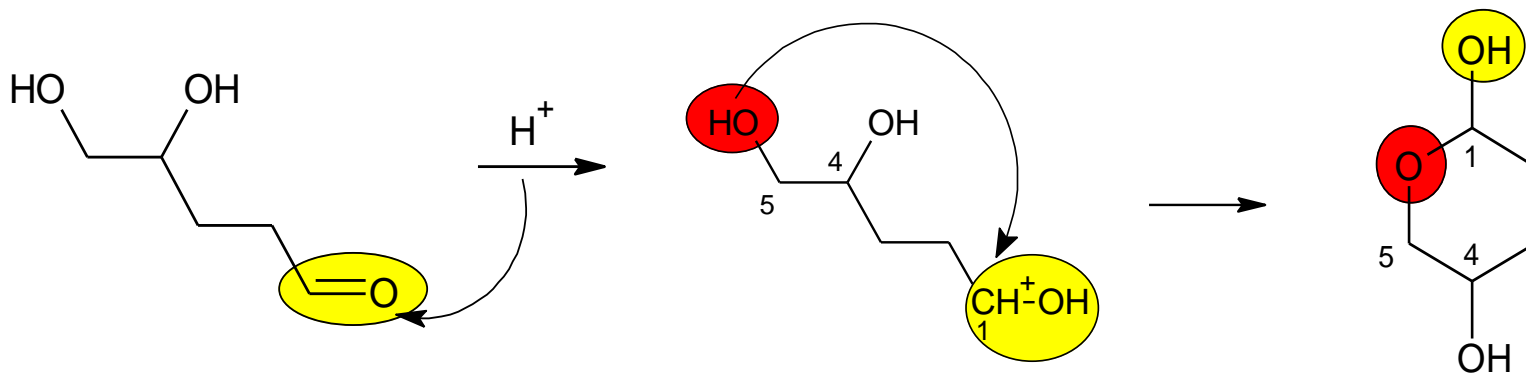
Reactivity



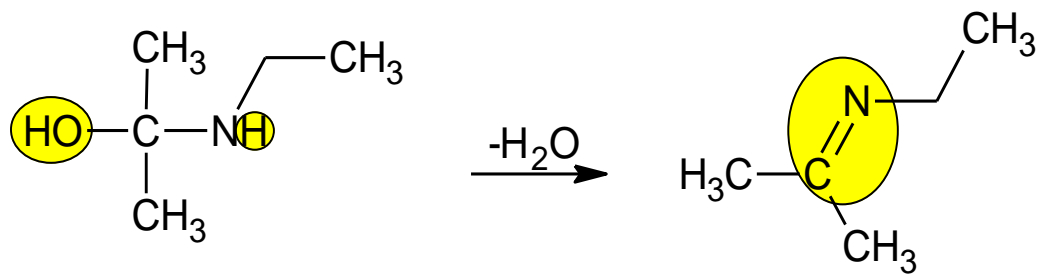
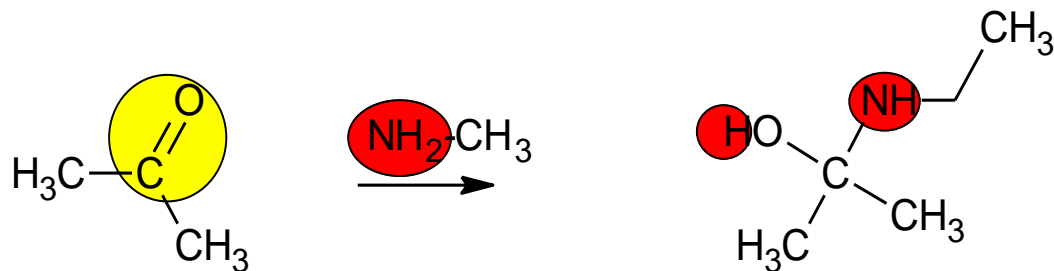
Nucleophilic addition



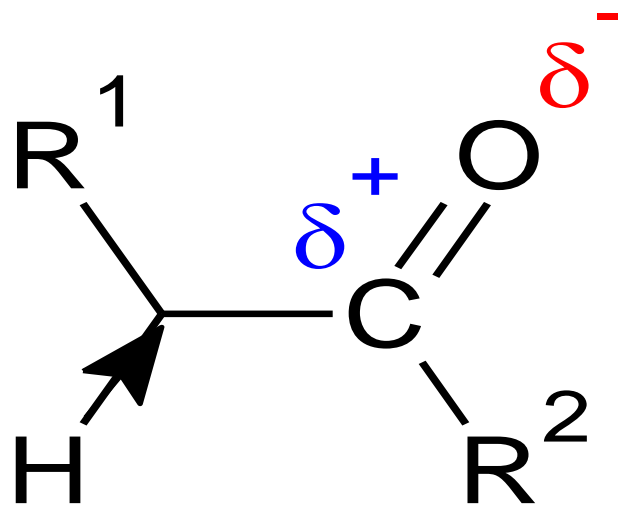
Nucleophilic addition



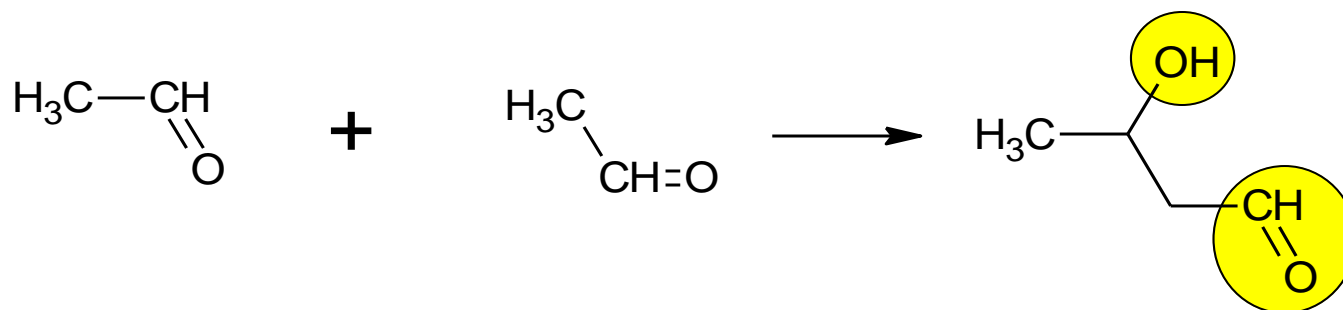
Nucleophilic addition



Aldol condensation

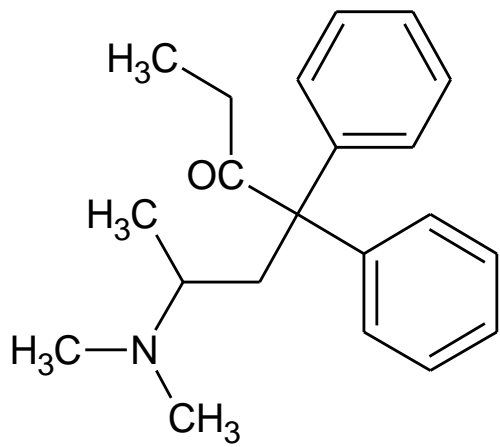


Aldol condensation

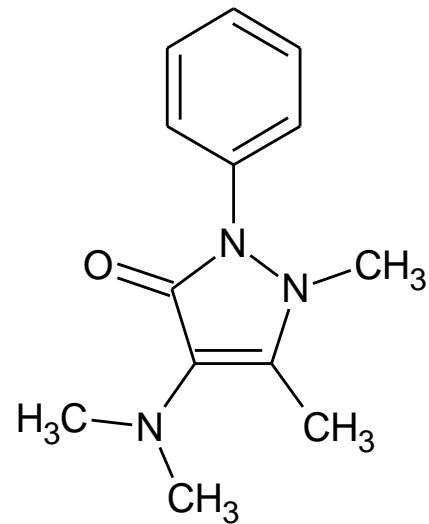


Biological effects of carbonyl containing molecules

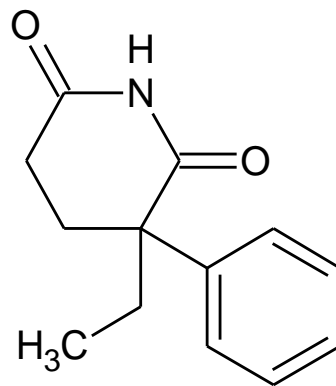
- Very reactive group
- Formaldehyde
- Benzaldehyde
- Acetone
- Steroid hormones



methadone



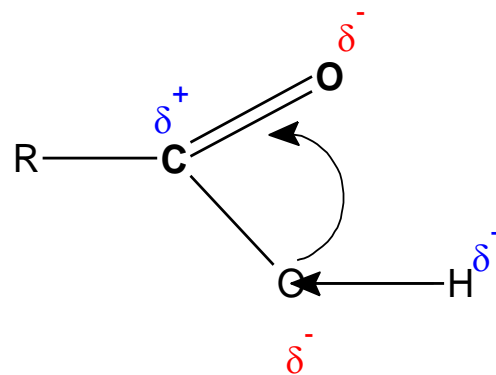
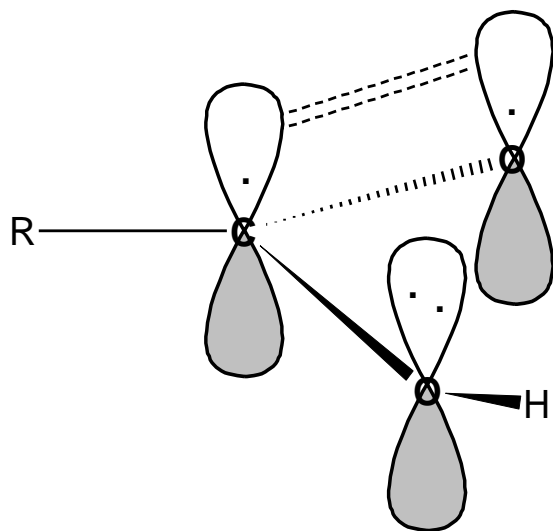
aminophenazon



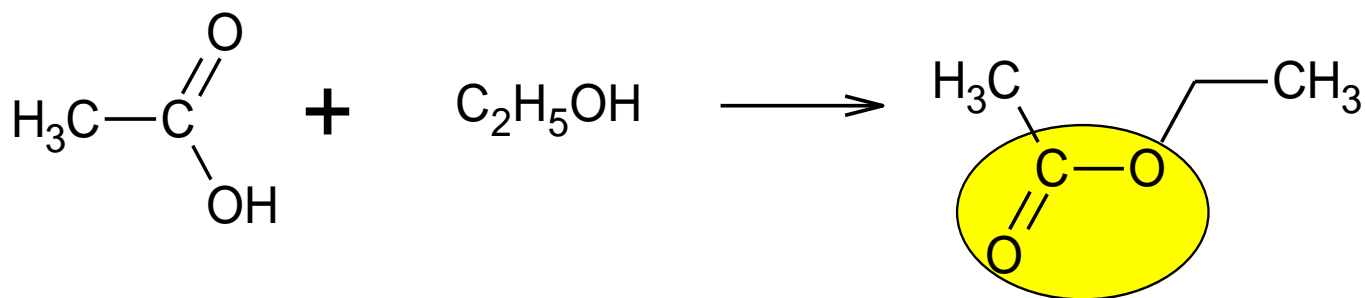
glutethimid

CARBOXYLIC ACIDS

Carboxylic acids

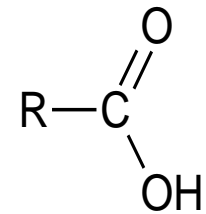
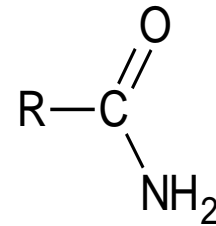
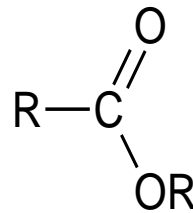
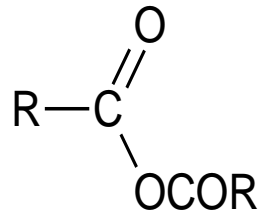
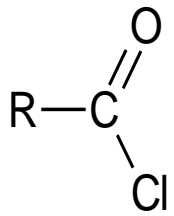
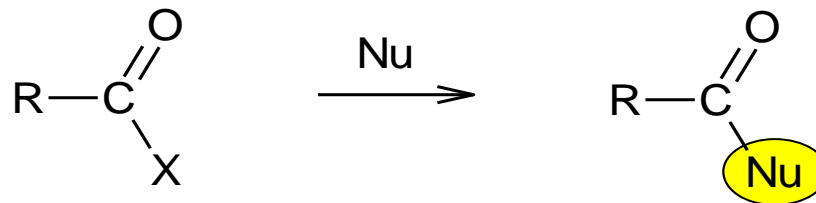


Nucleophilic substitution *esterification*

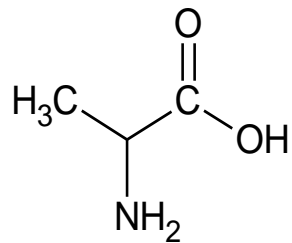
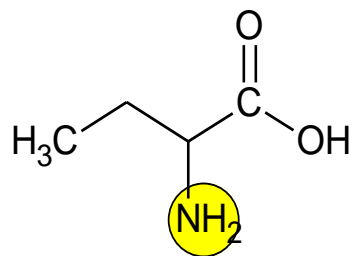
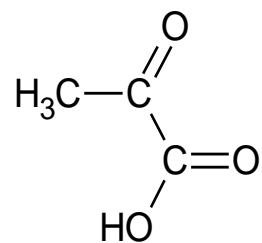
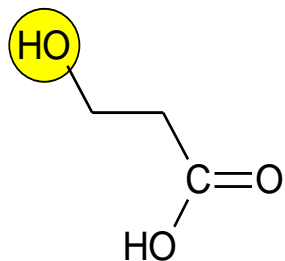
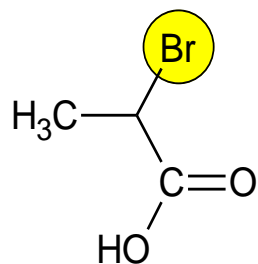


Carboxylic Acid Derivatives

Functional derivatives



Substitutional derivatives



Examples of Polyfunctional Carboxylic Acids

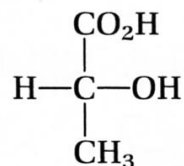
Dicarboxylic acids

HOOC-COOH – oxalic acid

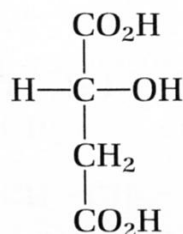
HOOC-CH₂-COOH – malonic acid

HOOC-CH₂-CH₂-COOH – succinic acid (citric cycle)

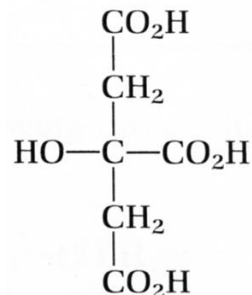
HCCO-CH₂-CH₂-CH₂-COOH – glutaric acid



lactic acid



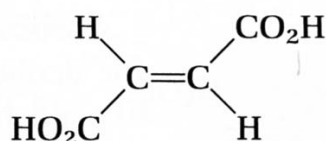
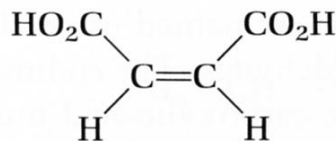
malic acid



citric acid

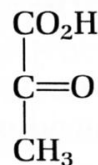
-OH group containing acids

Unsaturated acids

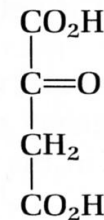


Maleic acid and fumaric acid are geometric isomers

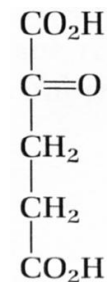
Ketoacids



pyruvic



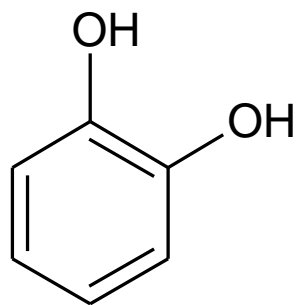
oxaloacetic acid



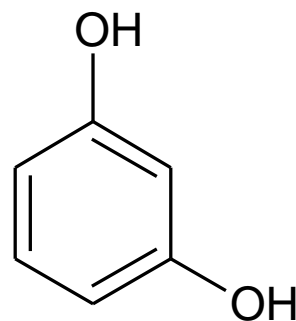
α-ketoglutaric acid

Errata

By mistake I wrote wrong formula for *resorcinol*. Please, find right formula for this structure below:



pyrocatechol



resorcinol

BR,
M.K.