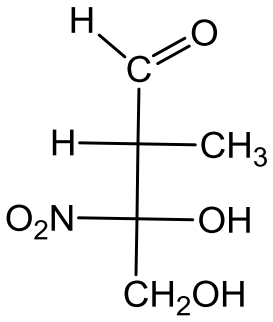
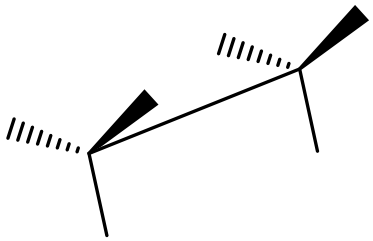
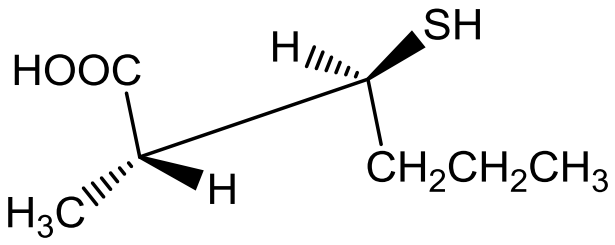
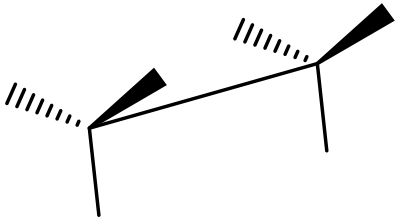
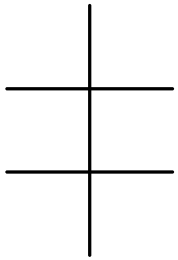
STEREOCHEMISTRY OF COMPOUNDS WITH Csp^3

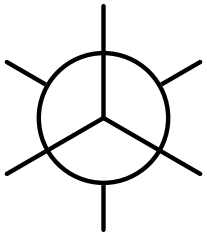


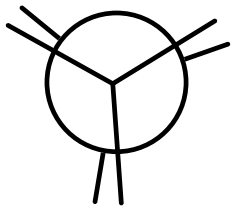




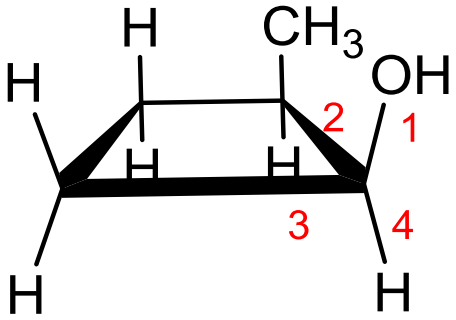


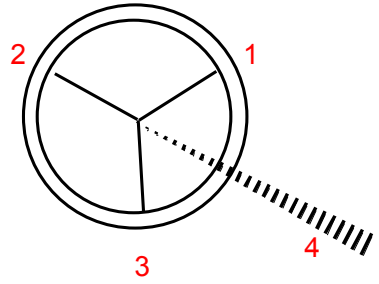


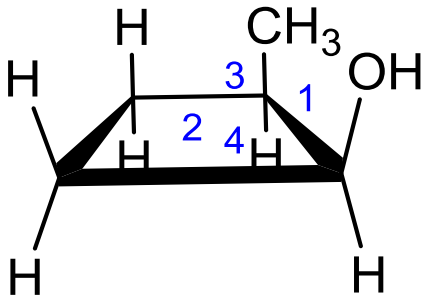


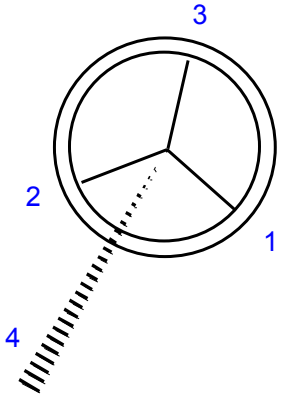


STEREOCHEMISTRY OF COMPOUNDS WITH Csp^3



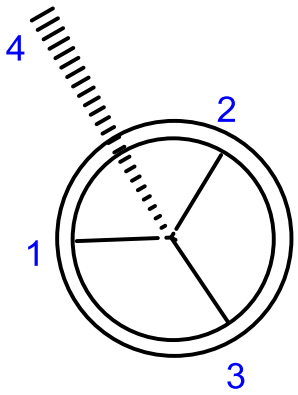




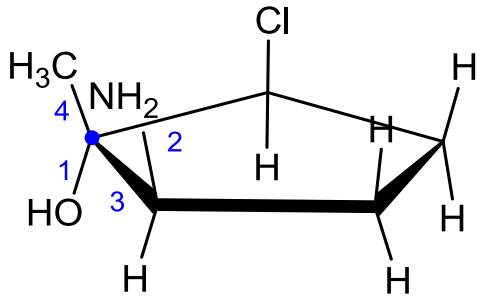


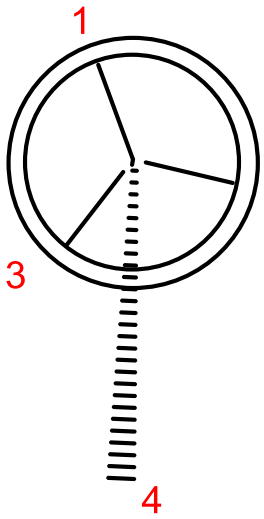
(1*S*,2*R*)- 2-Methylcyclobutanol

STEREOCHEMISTRY OF COMPOUNDS WITH Csp^3

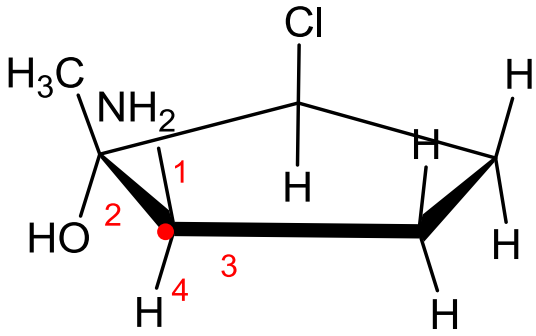


(*R*)



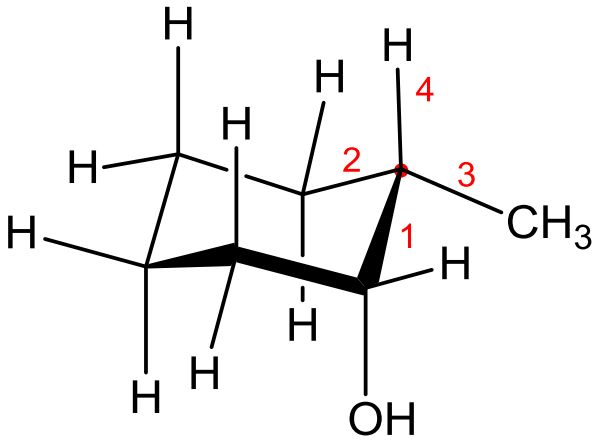


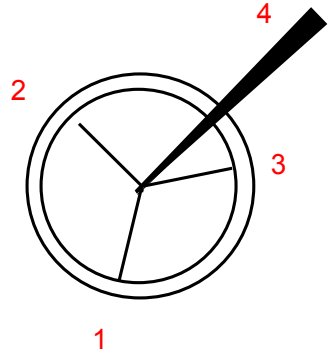
(*R*)



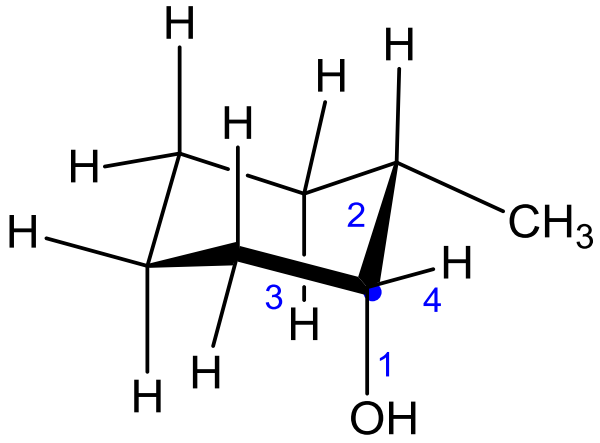
(1*R*,2*R*)-2-amino-5-chloro-1-methylcyclopentanol

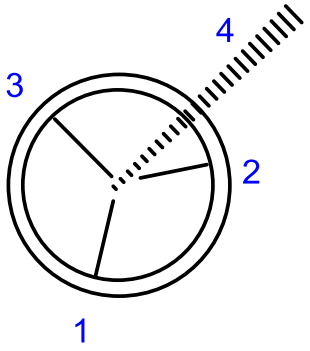
STEREOCHEMISTRY OF COMPOUNDS WITH Csp^3





(*S*)





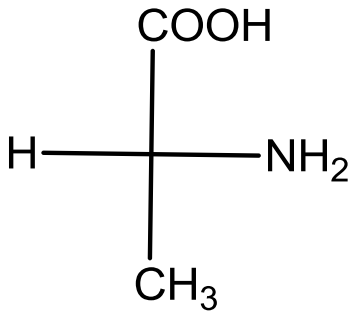
(*S*)

(1*S*,2*S*)-2-methylcyclohexanol

STEREOCHEMISTRY OF COMPOUNDS WITH Csp^3

Stereochemical nomenclature of compound according with older rules

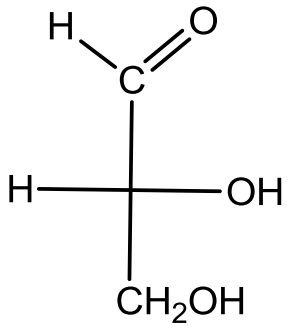
(used mostly in older literature and biology)



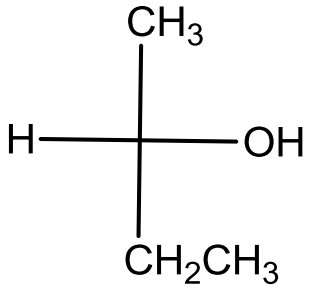
When the compound is placed in Fisher projection according with all the rules, that is the carbon atom in highest oxidation state at the top and the main carbon atoms chain perpendicular, then when the group with higher priority is located right , the compound is D- isomer; **when the group with higher priority is located left, the compound is L-**isomer.

Compound at this Fischer formula is D-alanin = (*R*) -2-aminopropanoic acid

All α-aminoacids forming protein structures have got configuration **L-**.



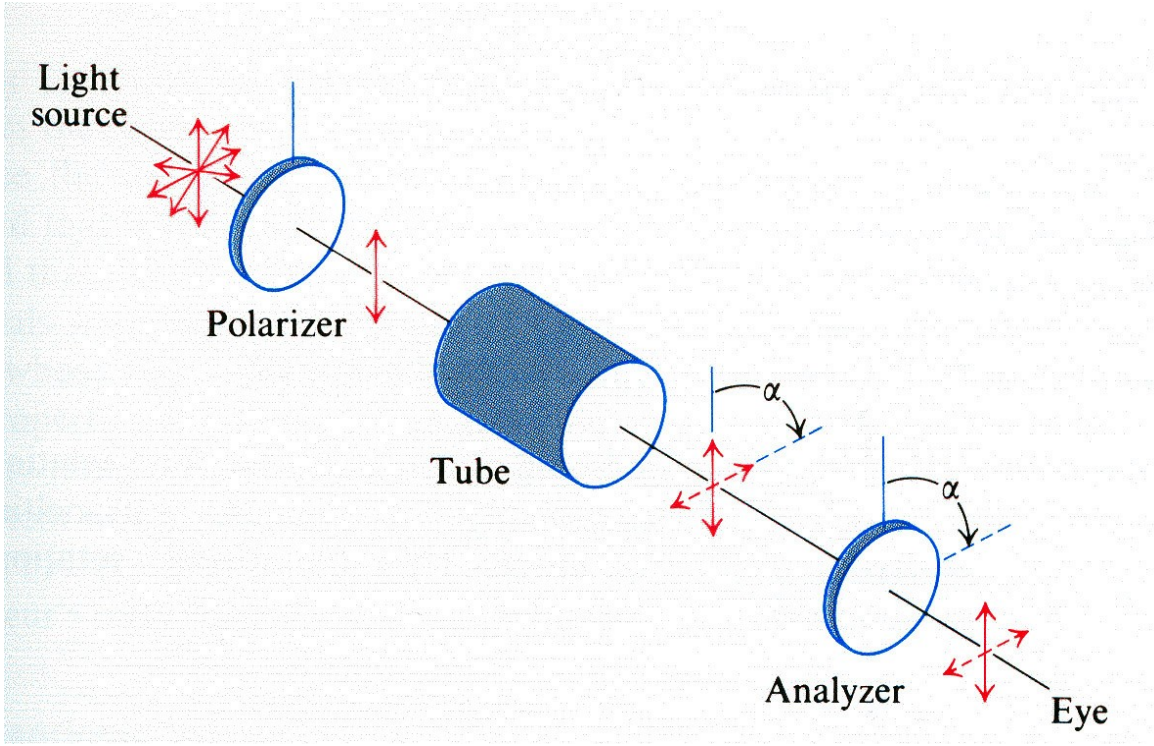
D-glyceraldehyde

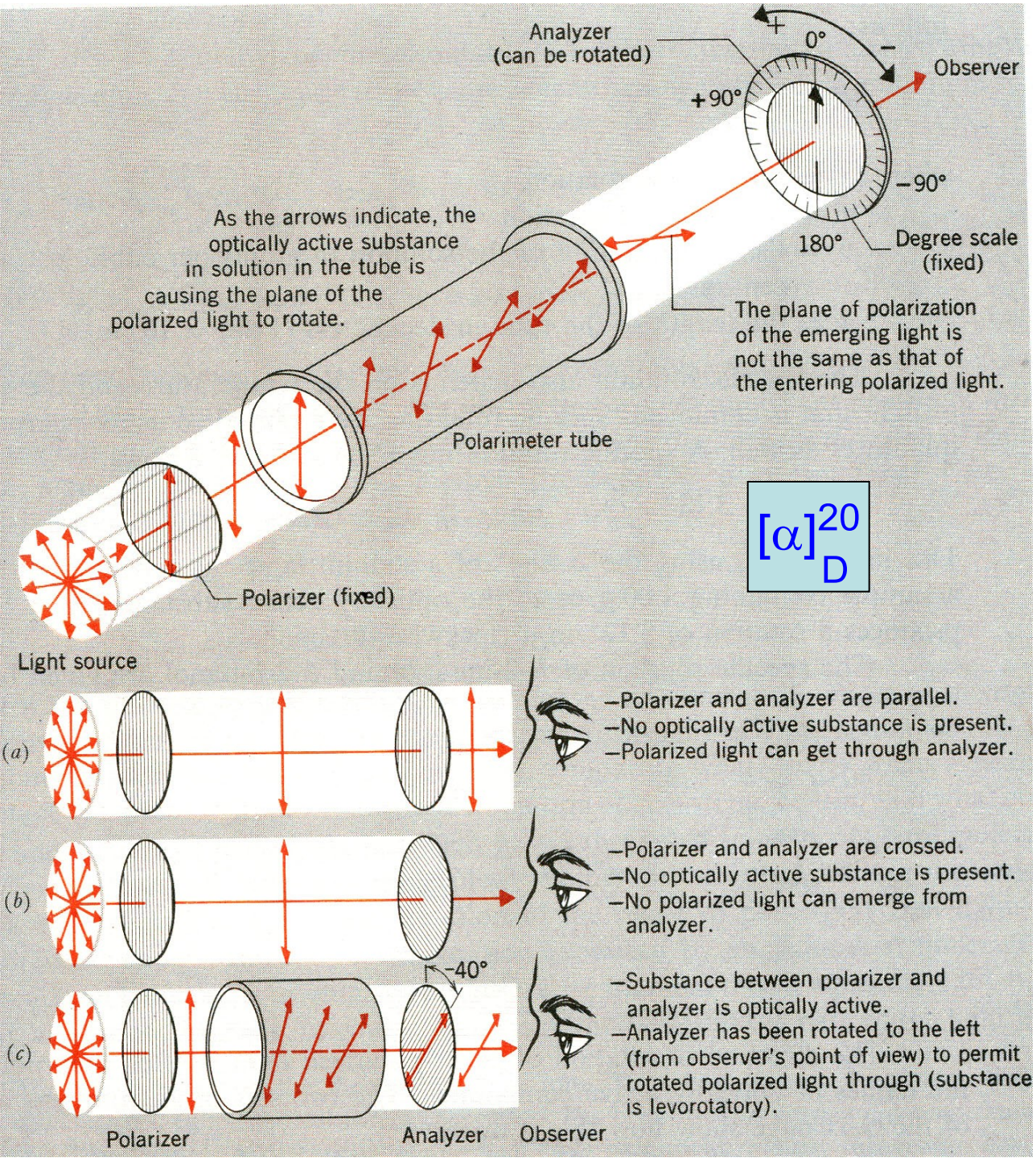


D-butane-2-ol

Physical properties molecules in connection with their stereochemistry

Enantiomers differ in the direction they rotate the polarized light only, other physical properties as melting point, boiling point, spectral properties, solubility etc. are the same.





$$[\alpha]_D^{20}$$

$$[\alpha] = \frac{\alpha}{l \cdot d} = \frac{\alpha \cdot 100}{l \cdot c}$$

α - measured value
l - lenght of the polarimetric tube [dm]
d - concentration [g/mL]
c - concentration [g/100mL]

D = D line of sodium lamp
λ = 589 nm

Values of specific rotation are dependent upon temperature and wave length of the light

enantiomers have the same value of the specific rotation, but they differ by the sense of rotation

$[\alpha]_D^{20}$ = + 13,5°

$[\alpha]_D^{20}$ = - 13,5°

Physical properties molecules in connection with their stereochemistry

Mixtures of enantiomers:

Racemic mixture is formed by 50% of both enantiomers – the measured specific rotation is zero.

Mixtures of enantiomers in another ratio than 1 : 1 are optical active

---

Optical purity gives us information about excess of one isomer over the other

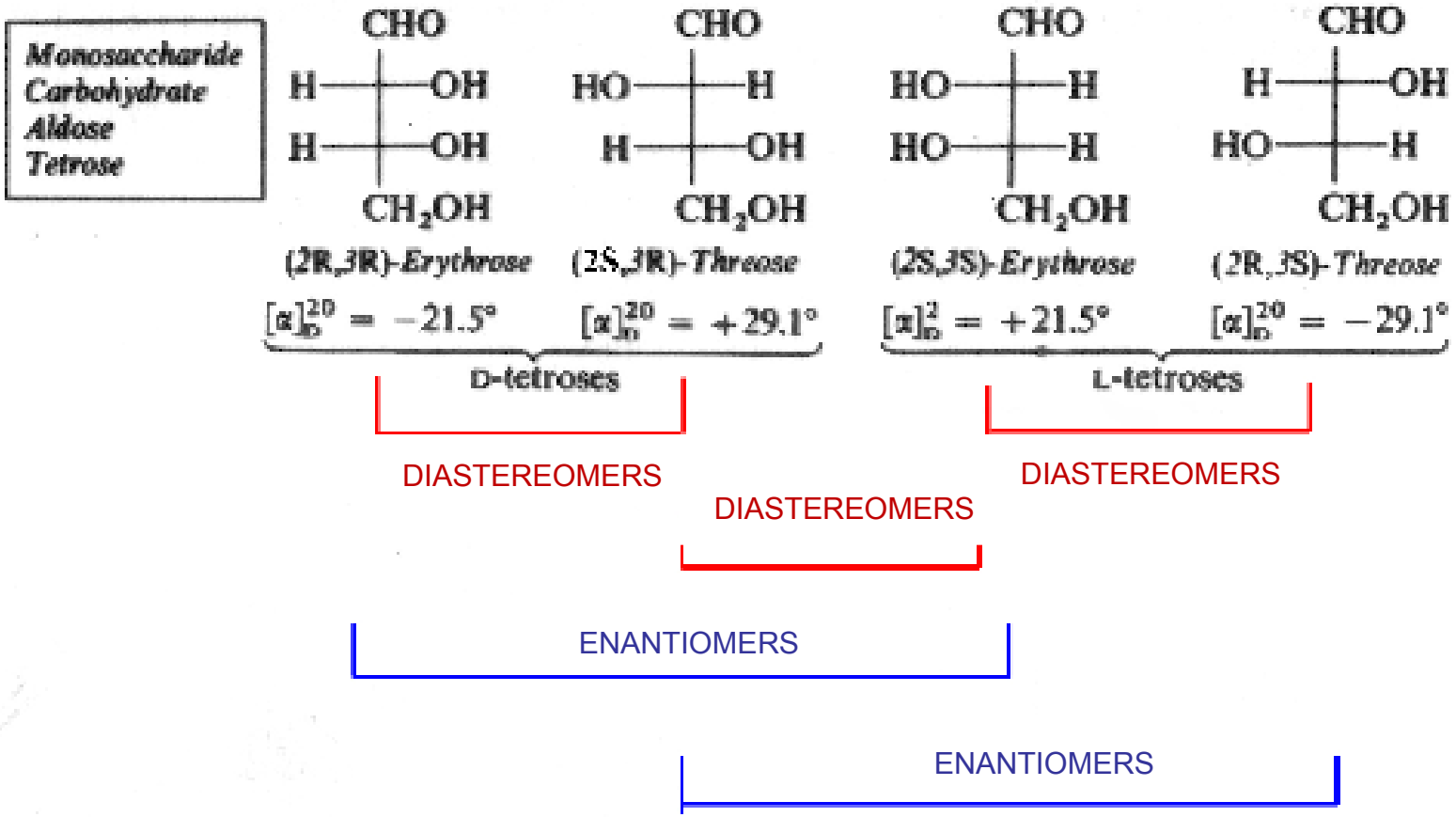
$$\textbf{\% optical purity} = \frac{\alpha}{[\alpha]_D^{20}} \cdot 100$$

Physical properties molecules in connection with their stereochemistry

Stereochemistry of compounds with more stereogenic centers

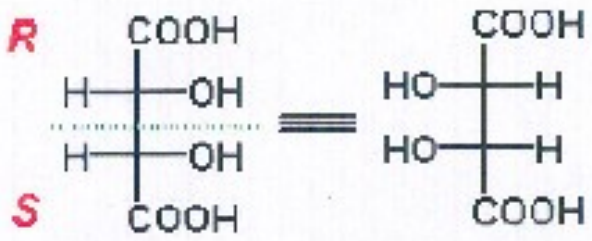
Number of stereoisomers with the number **n** of stereogenic centers is $\mathbf{2^n}$

One half of them are enantiomers

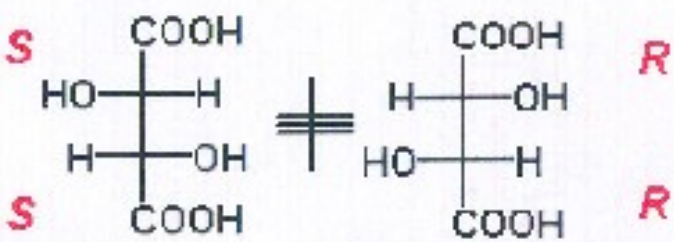


Physical properties molecules in connection with their stereochemistry

Stereochemistry of compounds with two similar stereogenic centers ***meso*compounds**



[2R, 3S] - tartaric acid
mesotartaric acid



[2*S*,3*S*] – tartaric acid

[2*R*,3*R*] – tartaric acid

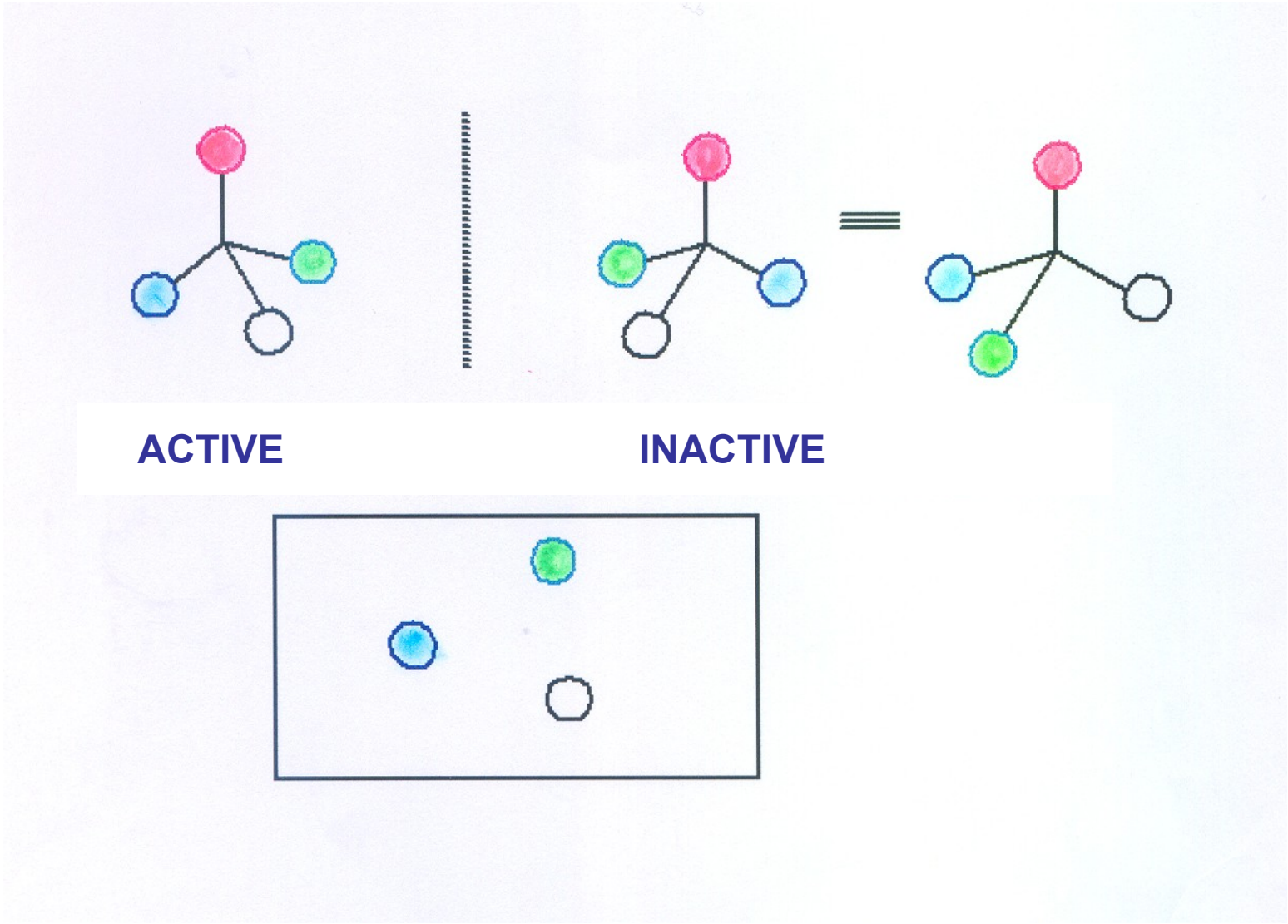
50% D-tartaric acid
50% L-tartaric acid

racemate

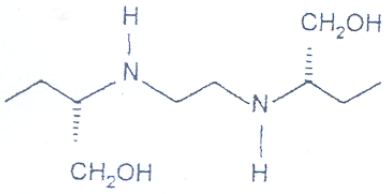
PROPERTIES:

m.p.	146 - 148 °C	168 - 170 °C	168 - 170 °C	206 °C
$[\alpha]_D$ (°)	0	- 12	+ 12	0
density [g/cm²]	1,6660	1,7598	1,7598	1,7880
solubility (g/100 ml H_2O)	125	139	139	20,6

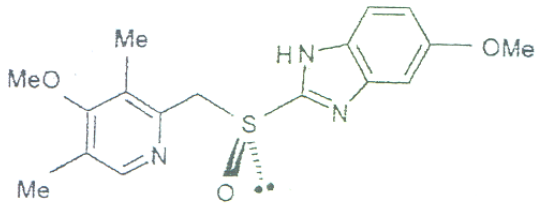
Interaction of chiral molecule with a active center (SCHEME)



Interaction chiral molecules with a substrate and their activity



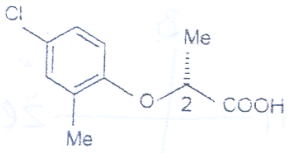
(S, S)-Ethambutol (**1**)



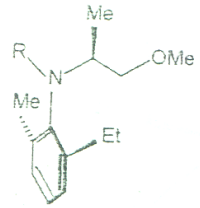
(S)-Omeprazole (**2**)

Drug	Enantiomer I Activity	Enantiomer II Activity	Racemate Activity	Actual application	Case[a]
Ethambutol (**1**)	*(S, S)*	*(R, R)*	*(S, S)* + *(R, R)*	*(S, S)*	C
	Antibacterial activity	No antibacterial activity	No data available		
Omeprazole (**2**)	*(S)*. Esomeprazole	*(R)*	*(RS)*	*(RS)*	A
	Reduces HCl concentration in stomach	Less active than *(S)*	Less active than *(S)*	*(S)*	

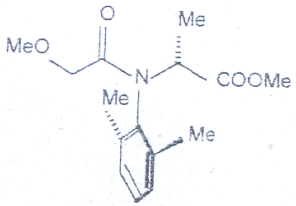
Interaction chiral molecules with a substrate and their activity



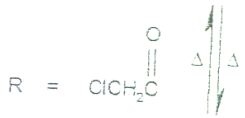
(R)-Mecoprop (5)

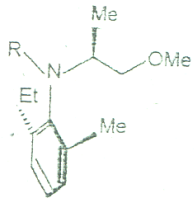


(S, M)-Metolachlor (6)



(R)-Metalaxyl (7)



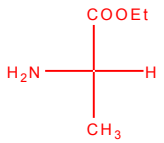


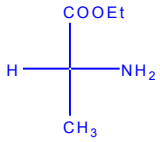
(S, P)-Metolachlor (6)

Pesticide	Enantiomer I Activity	Enantiomer II Activity	Racemate Activity	Actual application	Case[a]
Mecoprop (5)	*(R)*	*(S)*	*(RS)*	*(R)*	C
	Herbicide	No herbicide activity	About half of activity of *(R)*	*(RS)*	
Metolachlor (6)[b]	*(S, MP)*	*(R, MP)*	Mixture[c]	*(S, MP)*	A
	Herbicide	About half of activity of *(S, MP)*	Somewhat lower than activity of *(S, MP)*	Mixture[c]	

SCHEMA OF THE SEPARATION OF RACEMIC MIXTURE TO SINGLE ENANTIOMERS

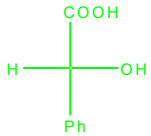
Racemická směs





[nedělitelná směs enantiomerů]

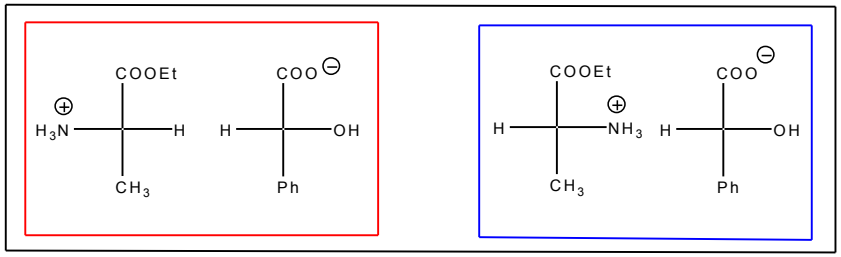
ethyl - (*L*) - 2- aminopropionát ethyl - (D) - 2- aminopropionát



(*D*) - (-) - kyselina mandlová

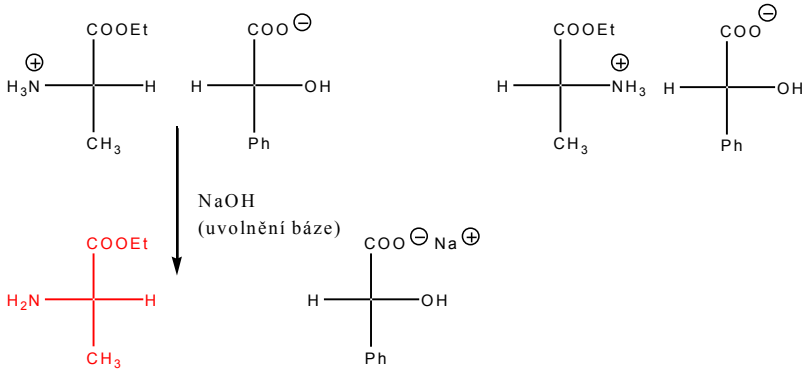
{ získává se z plodů mandlovníku (hořkých mandlí) extrakcí, kde je ve formě glykosidu (ten se lehce štěpí) }

[nastává acidobazická reakce]



směs diastereomerů

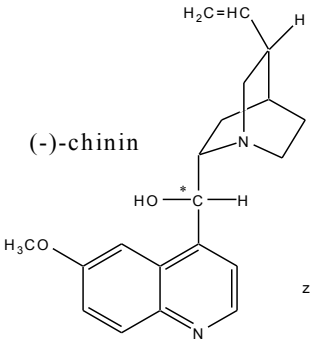
liší se fyzikálními vlastnostmi: jiná teplota tání, rozpustnost atp.



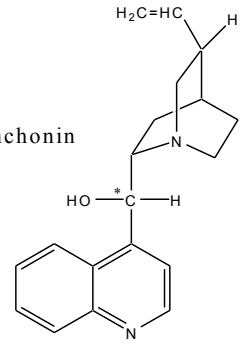
čistý enantiomer

ethyl – (*L*) - 2-aminopropionát

OVERVIEW OF PROPER ACIDS AND BASES FOR SEPARATION

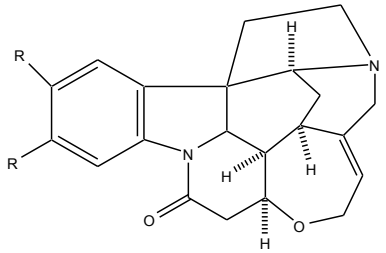


(-)-chinin



(-)-cinchonin

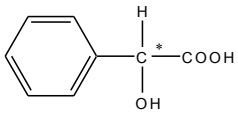
z kůry stromů



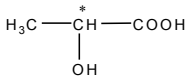
R = H (-)- strychnine

R = OCH_3 (-)-brucin

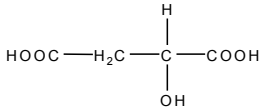
ze semen rostlin Strychnos nux vomica
Strychnos ignatii



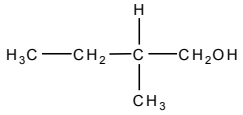
kyselina mandlová



(+)-kyselina mléčná
(-)-kyselina mléčná



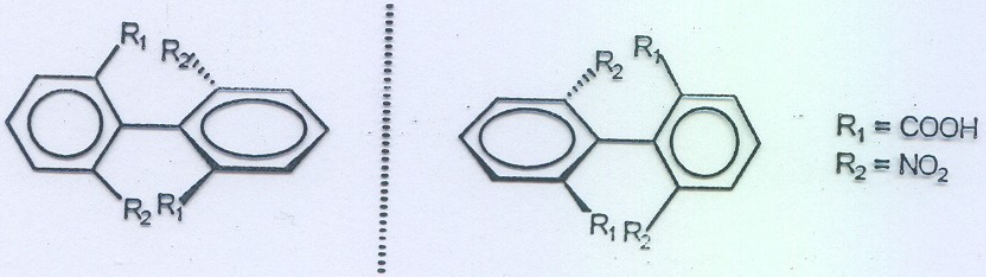
(-)-kyselina jablečná



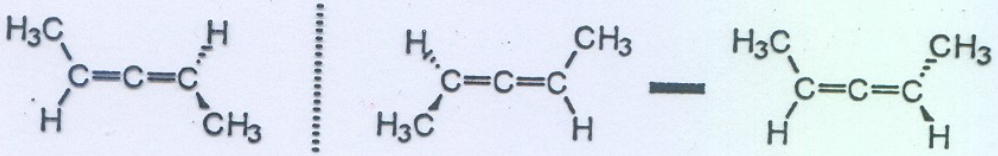
(-)-2-methylbutanol

OTHER SOURCES OF CHIRALITY

ATROPOISOMERIE



AXIAL CHIRALITY



HELICITY