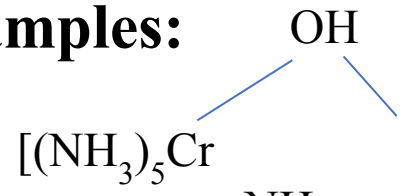
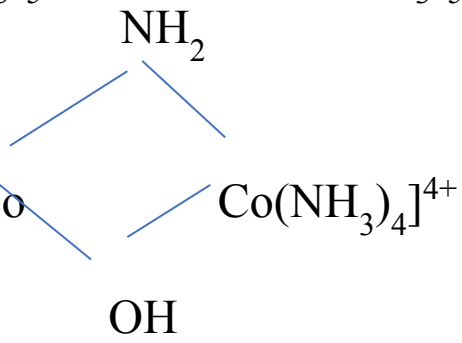
Nomenclature

Examples:

1. 

: μ-hydroxo-bis-pentaamine Chromium(III)

2. 

: μ-amido μ-hydroxo octaminedicobalt(III)

3. $[Zn\ (OH)_4]^{2-}$: Tetra hydroxo Zincate(II)

4. [Co(NO2)3(NH3)3] : Triammine trinitrocobalt(III)

5. [Co(NH3)6] [Cr(C2O4)3] : Hexamminecobalt(III) trioxalatochromate(III)

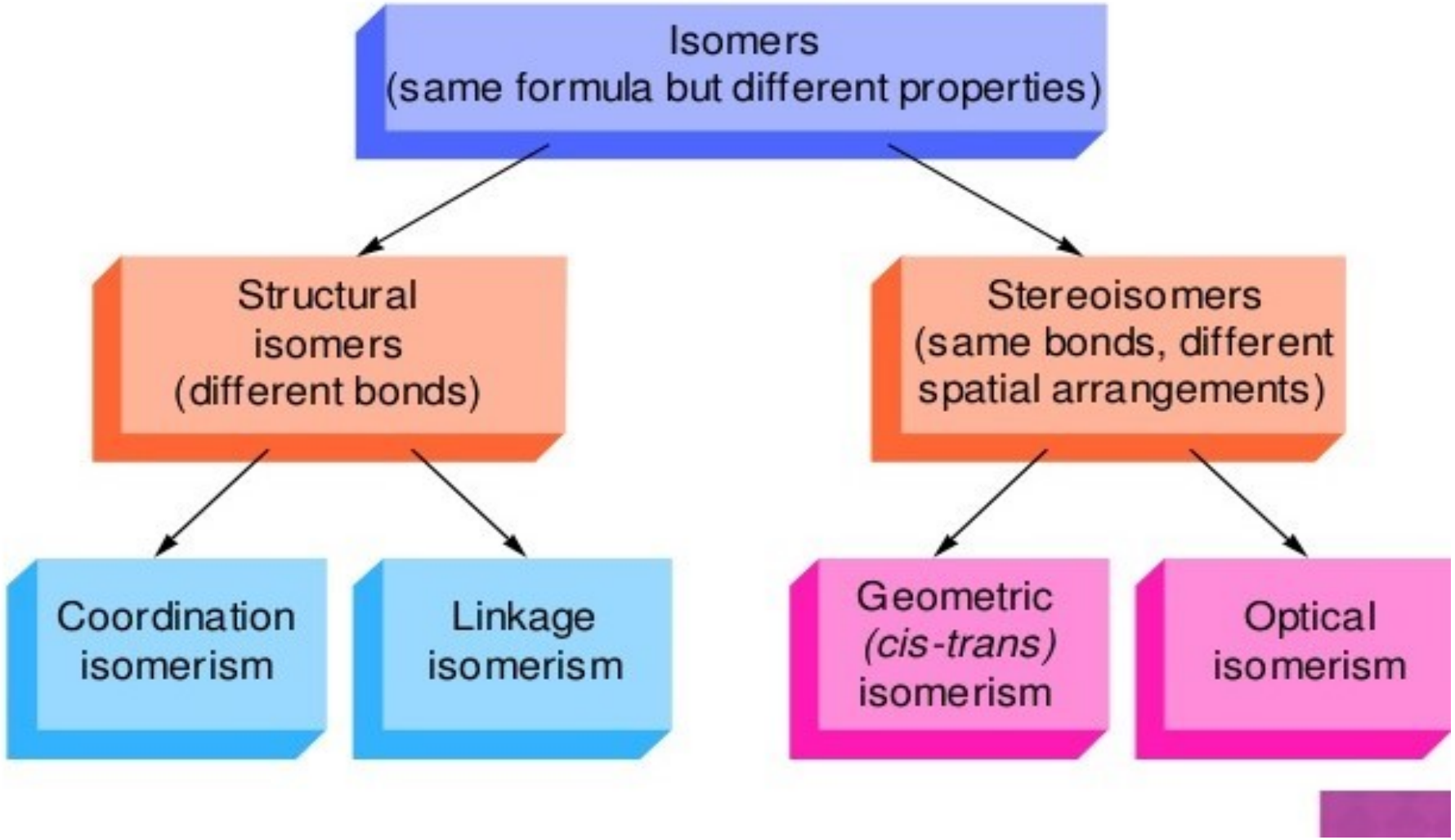
6. $NH_4\ [Cr(SCN)_4(NH_3)_2]$: Ammonium diamine tetrathiocyanato chromate(III)

Isomerism in Coordination Compounds

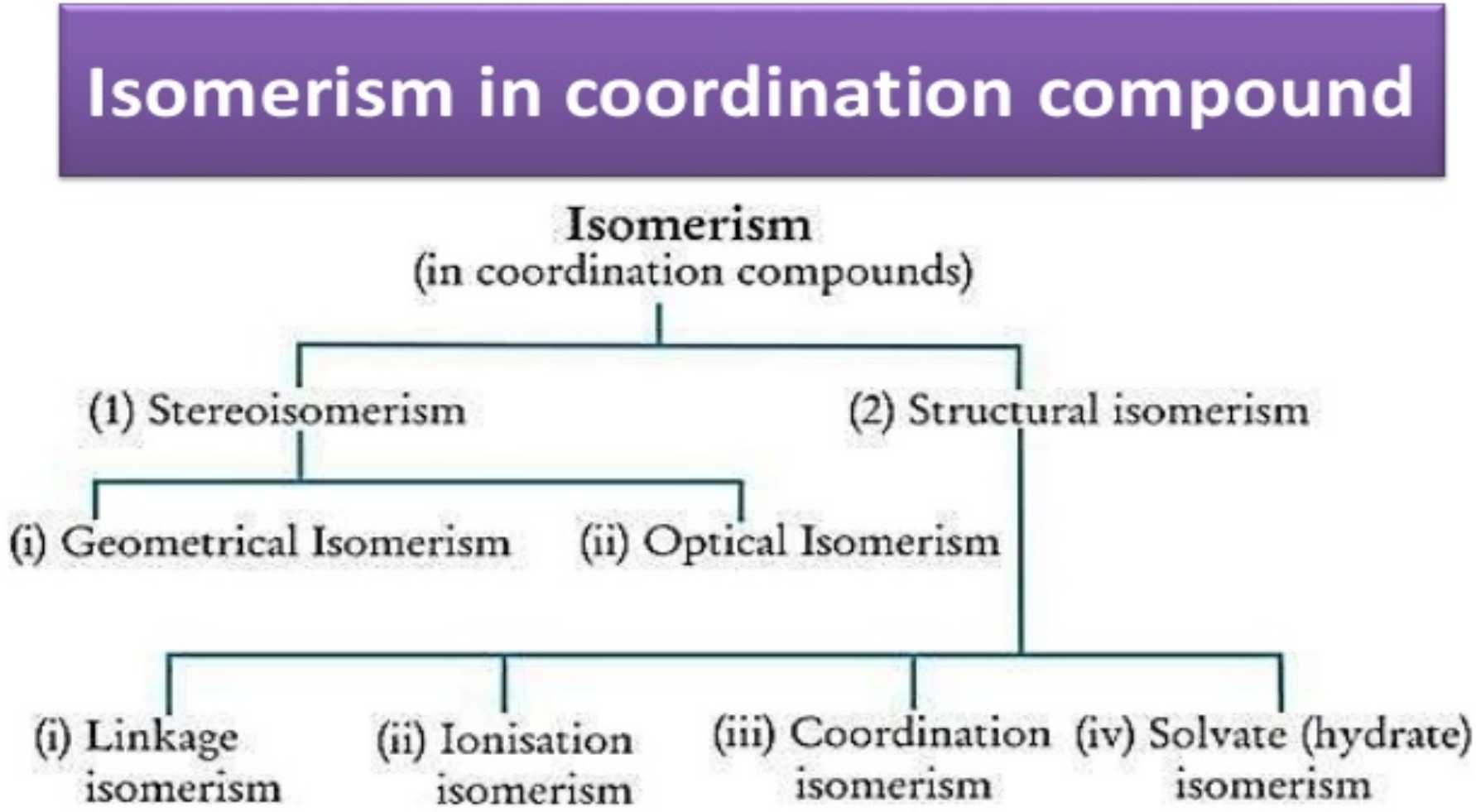
Dt. 26-11-2021

Isomerism

Compounds that have the same chemical formula, but different structural arrangements are called isomers.



More complete picture



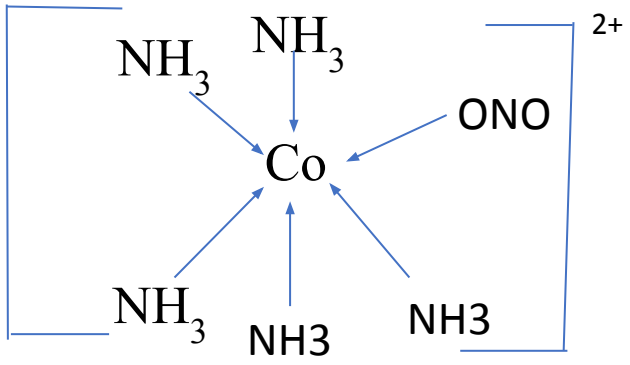
Coordination isomerism

When both the positive and negative ions are complex ions, isomerism may be caused by the interchange of ligands between the cation and the anion

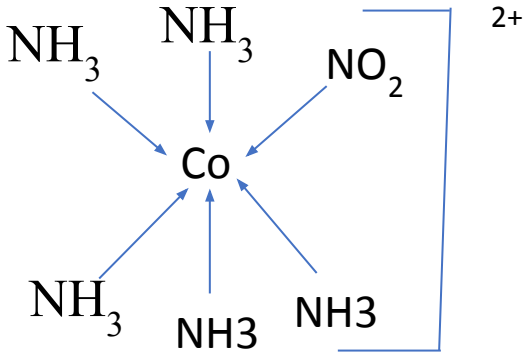
Ex: $[Co(NH_3)_6]\ [Cr(CN)_6]$ and $[Cr(NH_3)_6]\ [Co(CN)_6]$
Intermediate types between these extreme cases are also possible

Linkage isomerism

Certain ligands contain more than one atom which could donate an electron pair to the metal atom or ion
e.g., In the NO_2^- ion, either N or O atoms can act as the electron pair donor.



Nitritopentamminecobalt(III) ion (red)



Nitropentamminecobalt(III) ion (yellow)

Ionization isomerism

This type of isomerism is due to the exchange of groups between the complex ion and the ion outside it.

e.g., $[Co(NH_3)_5Br]SO_4$ and $[Co(NH_3)_5SO_4]Br$; $[Pt(NH_3)_4Cl_2]Br_2$ and $[Pt(NH_3)_4Br_2]Cl_2$

Hydrate isomerism

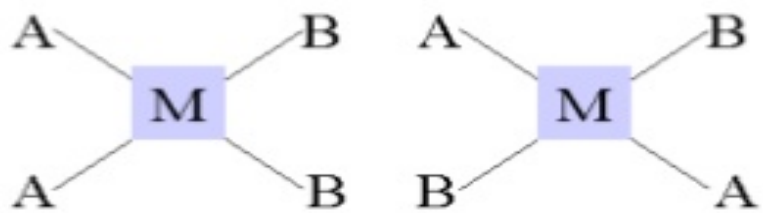
In these isomers, the number of H_2O molecules are different in the coordination sphere and outside it.

e.g., $[Cr(H_2O)_6]Cl_3$ (violet), $[Cr(H_2O)_5Cl]Cl_2.H_2O$ (green)

and $[Cr(H_2O)_4Cl_2]Cl.2H_2O$ (dark green)

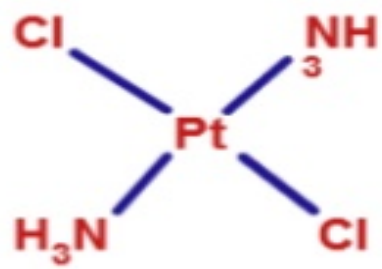
1. Geometrical isomerism

MA_2B_2

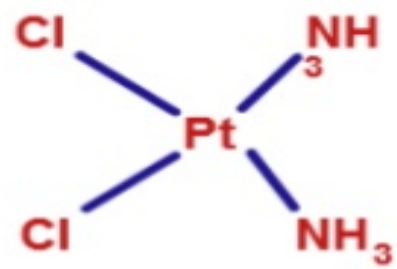


cis

trans



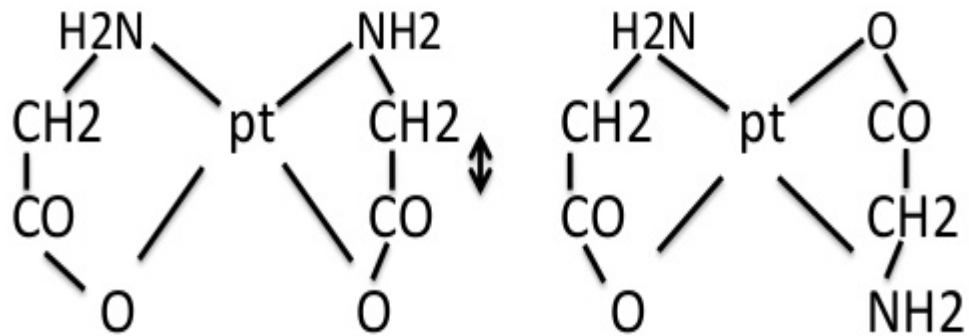
trans- $Pt(NH_3)_2Cl_2$



cis- $Pt(NH_3)_2Cl_2$

1. Geometrical isomerism

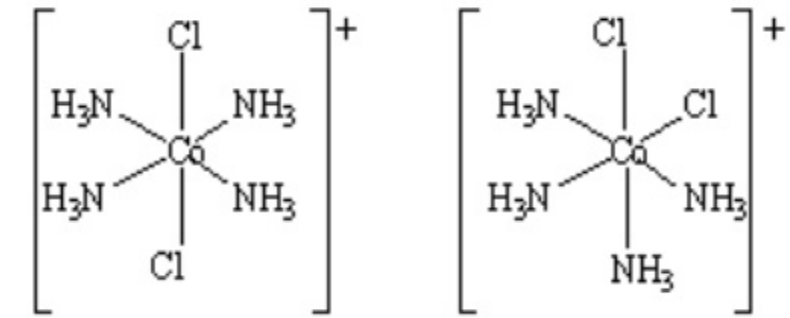
- $[Mabcd]^{n+}$ for eg. $[Pt(gly)_2]$ (glycino)



Cis Trans

six coordination compounds

- Complexes of the type $[Ma_4b_2]^{m+}$

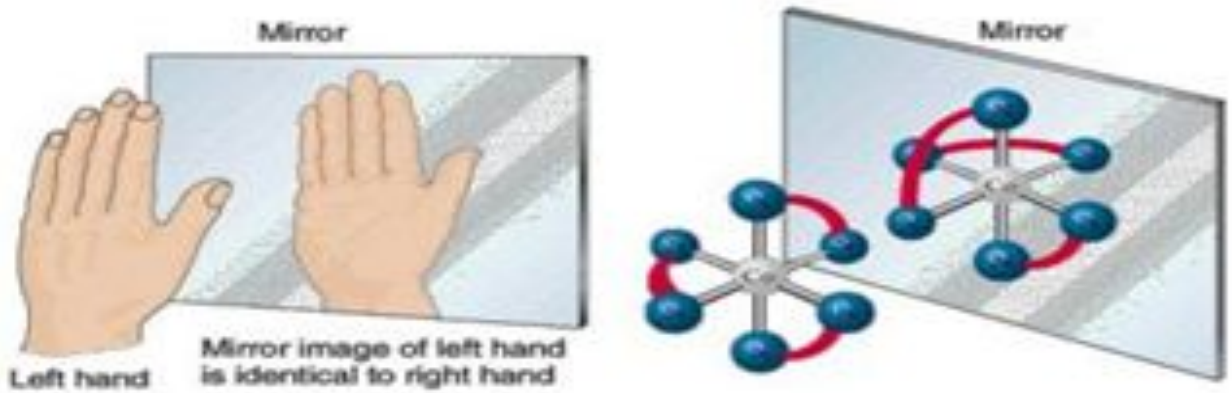


Trans - $[Co(NH_3)_4Cl_2]^+$ *Cis* - $[Co(NH_3)_4Cl_2]^+$

Isomerism

Stereoisomerism – Optical isomers

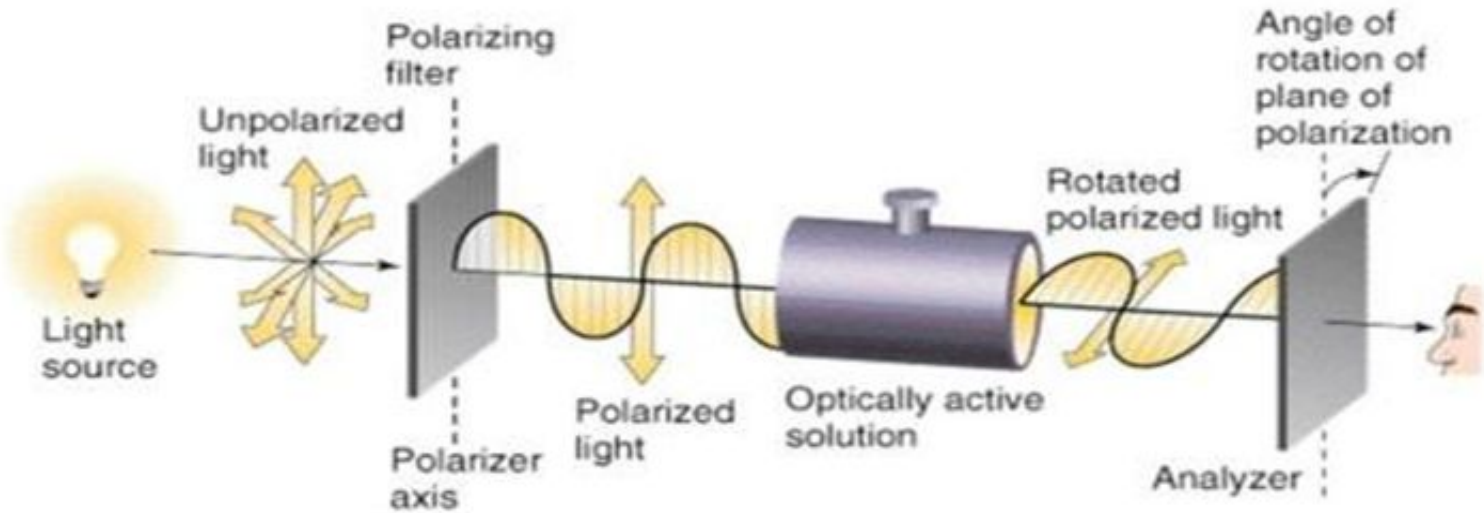
- **Optical isomers** are mirror images which cannot be superimposed on each other.
- Optical isomers are called enantiomers.
- Complexes which can form enantiomers are chiral.
- Most of the human body is chiral (the hands, for example).



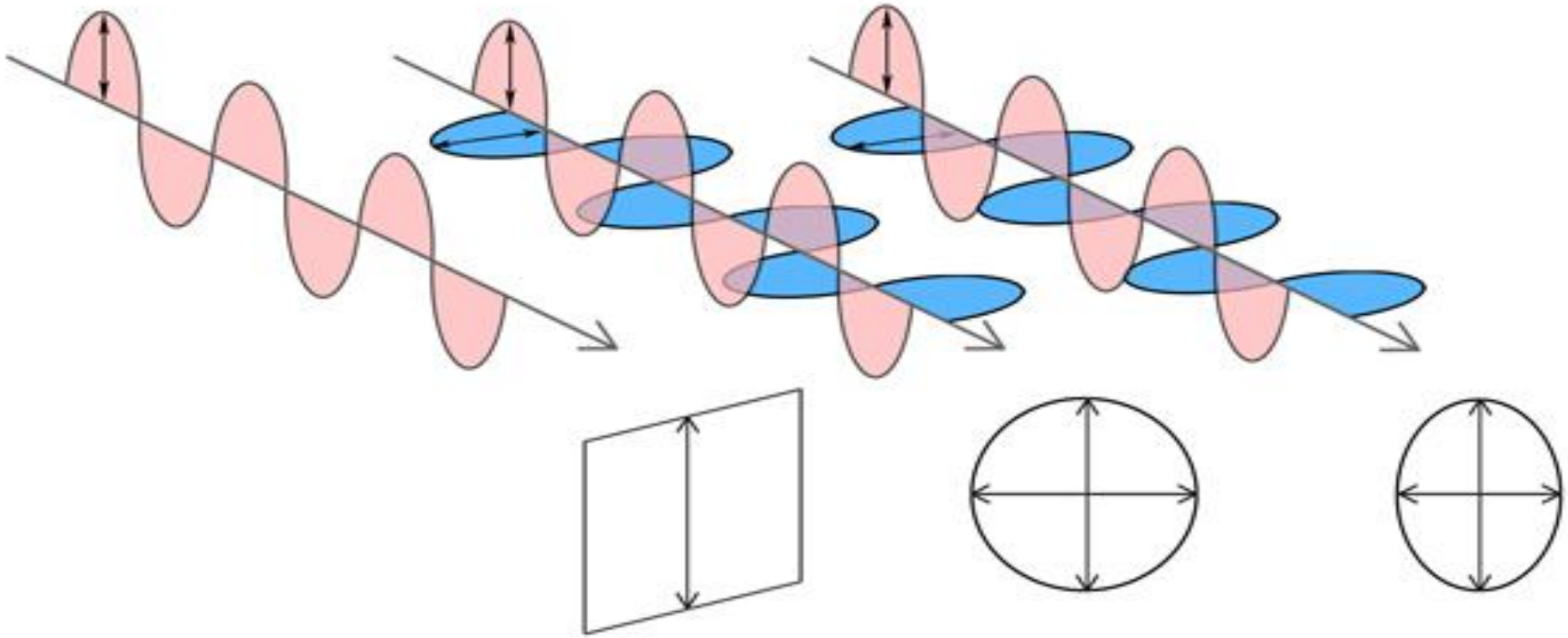
Isomerism

Stereoisomerism

- Most physical and chemical properties of enantiomers are identical.
- Enantiomers are different only in chiral environment. Very important in pharmaceuticals
- Enantiomers are capable of rotating the plane of polarized light, called optical isomers.



Types of Polarization of Light



Linearly polarized light

Circularly polarized light (equal amplitudes and phase difference = 90^0)

Elliptically polarized light (equal/unequal amplitudes and/or phase difference $\neq 90^0$ or $n\pi$)

Isomerism

Stereoisomerism

- Chiral molecules are optically active because of their effect on light.
- **Dextrorotatory** solutions rotate the plane of polarized light to the right. This isomer is called the *d*-isomer.
- **Levorotatory** solutions rotate the plane of polarized light to the left. This isomer is called the *l*-isomer.
- **Racemic** mixtures contain equal amounts of *l*- and *d*-isomers. They have no overall effect on the plane of polarized light.