M.Sc. Semester I
organic chemistry
Paper – CC-III
unit – II
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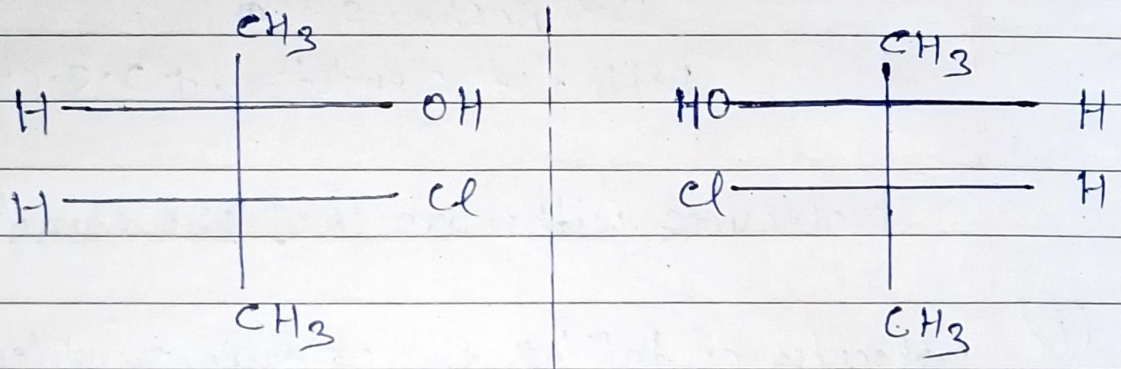
Molecules with more than one chiral centre :-

(i) Molecules containing two or more nonidentical (dissimilar) chiral carbon atoms. :-

In the case of an acyclic molecule n-nonidentical chiral carbon atoms, the number of stereoisomers will be 2^n (all optically active forms). Moreover, there will be 2^{n-1} pairs of enantiomers and the same number of racemic modifications. Any molecule with more than one chiral centre must have diastereomers.

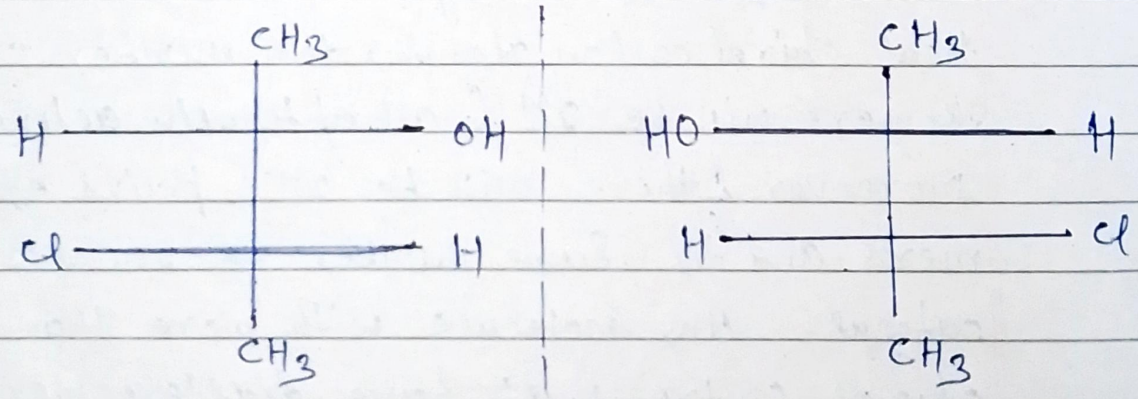
According to the general formula 2^n a compound having two different asymmetric carbon atoms (at least one substituent on both the carbon atoms is different like Cabd, Cabe) should occur in four optically active forms.

e.g. :- 3-chloro-2-butanol contains two chiral carbon atoms and as expected, exists as two pairs of enantiomers and $2^2 = 4$ stereoisomers as given below :-



I Mirror II

Two enantiomers



Mirror

III IV

Two enantiomers

The above configurations I and II are nonsuperimposable mirror images of each

other i.e. they are enantiomers, and similar in the case of structure III and IV. Moreover equimolar mixtures of enantiomers I and II, and III and IV constitute two different racemic modifications. Thus such compounds exist in six different forms two enantiomeric pairs and two racemic modifications.

Let us also examine the relationship between the structures I and III which are not identical because they resemble in configuration around one chiral carbon atom and at the same time differ around another. Such stereoisomers, which are not mirror images of each other are known as diastereomers. Other diastereomers are ~~Struct~~ structure I and IV, II and III and II and IV, diastereomers contain more than one chiral center.

Properties of diastereomers :—

(a) Diastereomers have different physical properties like boiling points, melting points, density, solubilities, refractive index, etc.

b. Diastereomers other than geometrical isomers may or may not be optically active.

c. Diastereomers have similar but not identical chemical properties. The rate of reactions differs with chiral as well as achiral reagents and solvents.

d. On account of differences in their chemical properties, diastereomers can be separated from one another through techniques like, fractional distillation, fractional crystallisations, chromatography, etc.