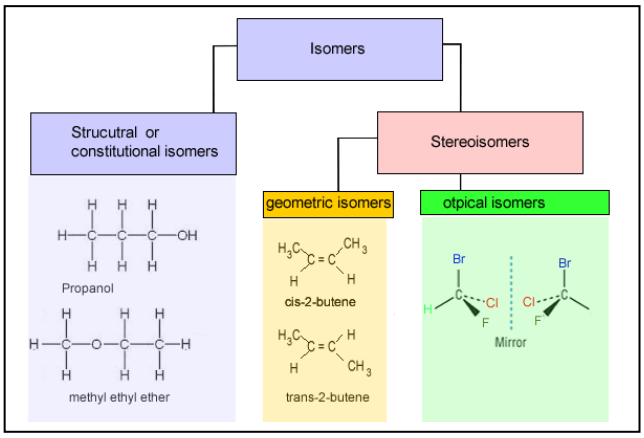
Lesson 5 Isomers optical and chiral centres

Click to revise chiral centres

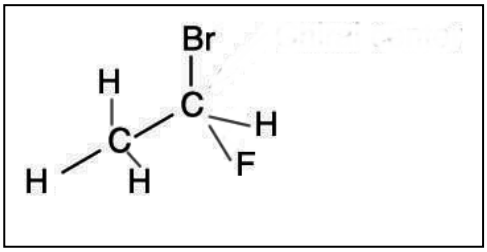


Isomers are molecules that have the same molecular formula, but have a different arrangement of the atoms in 3D space. The diagram on the right summarises the three different isomers we will be studying.

A pair of optical isomers are also known as ***enantiomers***. Enantiomers are chiral molecules that are mirror images of one another

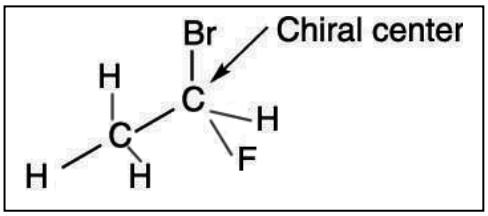
A molecule that has optical isomers is known as a ***chiral*** molecule. Such molecules have one or more chiral centres. A chiral centre is a carbon surrounded by four different groups of atoms. Click on the link above for a detailed explanation. Optical isomers have similar physical properties but totally different chemical properties. The link above explains this in more detail.

The number of possible optical isomers a molecule can have is determined by the number of chiral centres present according to the formula 2^y where y is the number of chiral centres in the molecule.



Example 1

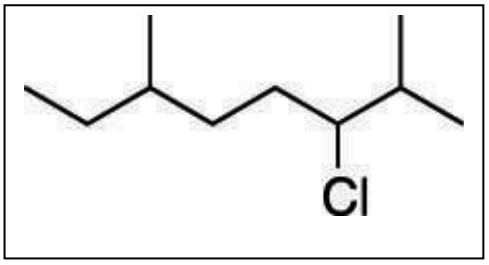
Identify the number of chiral centres present in 1-bromo-1-fluoroethane, pictured on the right.



Now there is only one carbon atom with four different groups of atoms surrounding it on the main carbon chain of the molecule. Carbon number 1 has a Br, F, H and a CH_3. So 1-bromo-1-fluoroethane has 2 optical isomers.

Example 2 . Only one optical isomer of 2,6-dimethyl-3-chlorooctane is active in a particular biological reaction all others cause dangerous side effects. Chemists must purify this isomer.

How many isomers are possible for this molecule, shown on the right?



Take each carbon on the main chain separately and workout if four different groups of atoms surround it.

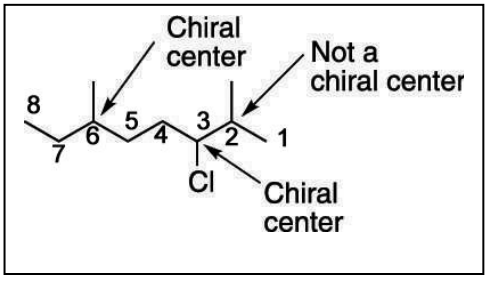
There are only 2 chiral centres present

C_1 and C_8 = CH_3

C_2 has two CH_3 goups coming of it

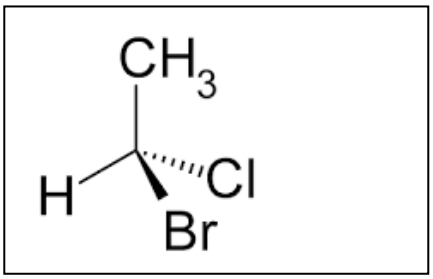
C_4, C_5 and C_7 = CH_2

The molecule has 2^2 = 4 optical isomers.



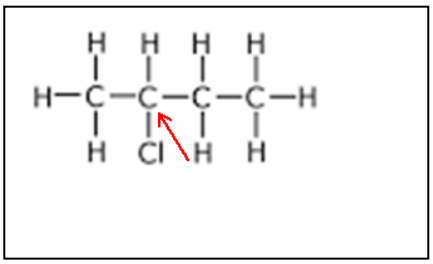
1) Name and draw the structural formulae of the following molecules and identify them as chiral or achiral. If chiral then give the number of optical isomers possible.

a) $CH_3CHBrCl$



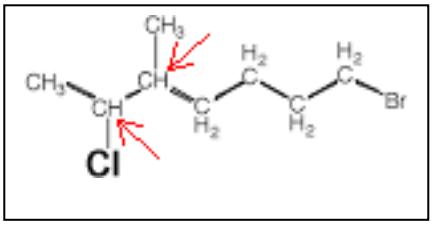
1-bromo-1-chloroethane
1 chiral centre
2 optical isomers

b) $CH_3CH_2CHClCH_3$



2-chlorobutane
1 chiral centre
2 optical isomers

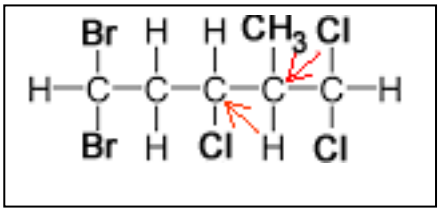
c) $CH_2Br\ CH_2CH_2CH_2CH(CH_3)\ CHClCH_3$



7-bromo-2-chloro—3-methylheptane

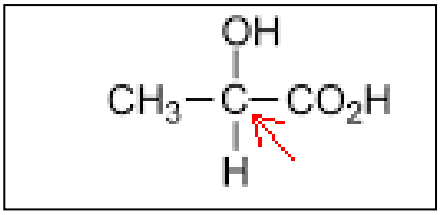
2 chiral centres
4 optical isomers

d) $CHBr_2CH_2CHClCH(CH_3)CHCl_2$



5,5-dibromo-1,1,3-trichloro-2-methylpentane
2 chiral centres
4 optical isomers

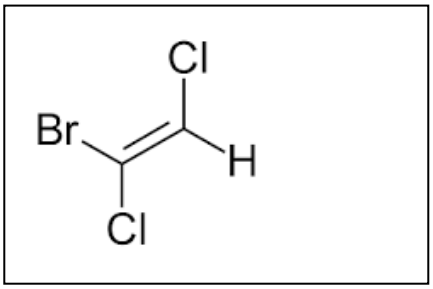
e) $CH_3CHOHCOOH$



2-hydroxypropanoic acid

1 chiral centre
2 optical isomers

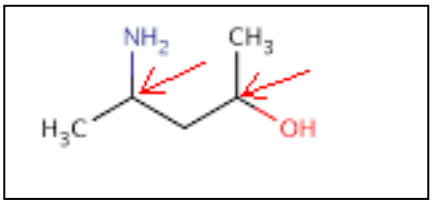
f) CHClCBrCl



1-bromo-1,2-dichloroethene

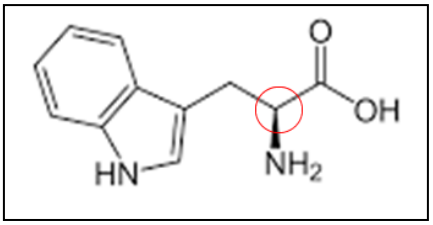
No optical isomers

g) $CH_3CH(NH_2)CH_2CHOHCH_3$



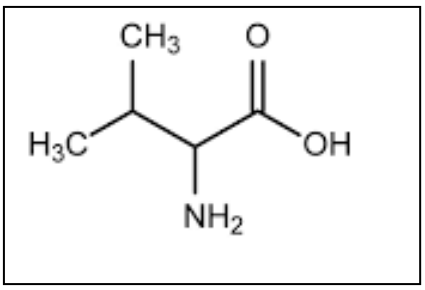
4-aminopentan-2-ol
2 chiral centres
4 optical isomers

h) Tryptophan is shown on the right.



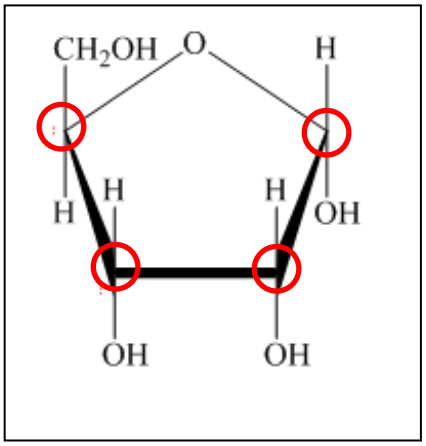
a) Circle all the chiral centres found in the molecule.
b) How many optical isomers are possible with this molecule.
two optical isomers

i) The amino acid valine is shown on the right.



a) Circle all the chiral centres found in the molecule.
b) How many optical isomers are possible with this molecule.
two optical isomers

j) The structure of D-ribose is shown on the right.
Circle all the chiral centres found in the molecule.



h) Retinal is formed from beta-carotene. Both molecules are shown on the right.
a) To what class of compounds does retinal belong to? *Aldehyde*

b) How many chiral centres are present in beta-carotene? *one*