

Hello everybody, my name is Doctor Richa Sardesai and I'm an assistant professor at the Saint Joseph's College, Cortalim. today's module is going to be for the first year BSc students in chemistry semester one. The paper code is CHC 101 and the title of the paper is inorganic and organic chemistry.

The title of the unit is Unit 2 stereo chemistry and the module name is enantiomerism and diastereomerism. The module is outlined in three significant parts. The first is the concept of chirality, enantiomerism and diastereomerism. At the end of this module, the student will gain knowledge, an understanding of the concept of chirality.

The student will understand the fundamentals of enantiomerism and diastereomerism. Also, the student will be able to understand the significance of clarity in nature and its applications. Before we begin, let us first understand what is isomers. Isomers are compounds which have the same molecular formula but different structural formula. If two isomers have same connectivity about the different atoms, then they form stereoisomers. If not, they form the constitutional isomers.

Within stereo isomers, if each isomer can be converted to the other by simply rotation about a single bond, then they form a conformation isomer pair. If not, then they form configurational isomers. The configurational isomers are further divided into 2 parts.

Depending upon whether they form mirror images of each other or not, if they are mirror images of each other which are not superimposable, then they are enantiomers and if they are not mirror images of each other then they are diastereomers. In today's module we're going to be focused mainly on diastereomers. And enantiomers.

Before learning about enantiomerism and diastereomerism, we must refresh our basics and knowledge about the chiral carbon, a chiral carbon. Or a moiety is a compound which has Or lacks plane of symmetry. A chiral object due to the lack of plane of symmetry will generate mirror image which is not superimposable on the original object.

Let us consider 2 letters, O & P. The letter O has many planes of symmetry and hence is achiral, whereas the letter P lacks a plane of symmetry and is thus chiral.

If we apply the same principle to organic chemistry. In the case of a simple molecule like methane, methane has a plane of symmetry and is thus achiral,

However, if you replace every Atom of hydrogen with a different Atom, like in this case, then the planes of symmetry are lost, generating an achiral molecule and the carbon is considered to be an achiral carbon.

The chiral carbon is a carbon with four different substituents that is a stereocenter, a chiral carbon or an asymmetric center. It is denoted as C^{*}.

Now let us go on doing organic chemistry. As we have already discussed, the molecule of methane has many planes of symmetry. What do we understand by a plane of symmetry, a plane of symmetry is a plane which can completely divide a molecule into equal parts. In the case of methane, you may have a plane of symmetry. Which is vertical, horizontal or diagonal. However, if you consider another molecule like glyceraldehyde where each Atom or group of atoms connected to the central carbon is different, it lacks a plane of symmetry. This type of a compound, when superimposed on its mirror image, does not form, does not overlap. Properly.

Hence they form non superimposable mirror images which are called as enantiomers. These enantiomers lack a plane of symmetry. Let us now try to apply the plane of symmetry to this molecule.

If we apply a vertical plane of symmetry, we realize that this molecule cannot be divided into equal parts.

Neither the application of a horizontal plane of symmetry. Or a diagonal plane of symmetry in either way. Will divide the molecule into equal parts. Hence enantiomers are basically molecules which lack a plane of symmetry and are non superimposable on each other.

The other fundamental concept of enantiomerism is based upon, The fact that the mirror images of the compound are not superimposable on the original molecule. If you consider a molecule which has a plane of symmetry like such which is shown. Then the mirror image of the molecule is superimposed on the original molecule simply by the rotation of a single bond. We can generate another molecule which is nothing but the original molecule. If you observe both the rotated molecule of the mirror image and the original molecule completely overlap and are almost similar.

Now let us consider another example like a non superimposable mirror images. In this case we are considering a molecule which has four different atoms or groups of atoms attached to the central carbon. If we consider the mirror image and we try to superimpose the mirror image on the original molecule.

We realize that. Though the molecules or the group of atoms which are highlighted in pink, they match.

However, the other items which are highlighted in red and green do not match. Now let us try to rotate the molecule about the vertical axis.

Once we rotate the mirror image about the vertical axis, we realize that. In this case The items highlighted in trade match, however. The atoms which are highlighted in pink in green will simply not match and will not be superimposable. Another rotation will generate. Another confirmation of the molecule, in which case. The molecule or the items highlighted in green are superimposable. There is the molecules or the atoms which are highlighted in red and pink are not superimposable. This shows us that enantiomers are non superimposable mirror images of each other. Now let us discuss the properties of enantiomers in animals always exist in pace. Enantiomers have same physical properties like boiling point, melting point,

solubility, density, viscosity, refractive index etc. and similar chemical properties in an achiral environment. Enantiomers have identical Spectra, like infrared, UV, NMR, etc. As long as they are measured in an achiral medium. Many of these properties are dependent upon the magnitude of the intermolecular forces operating between the molecules, and for molecules that are mirror images of each other. Obviously these forces are going to be identical. Each enantiomer shows the same chemical reactivity towards a Chiral relations. However, they showed different reactivity towards Chiralreagent. The fundamental identity of an enantiomeric pair is that they rotate the plane of polarized light on each side in opposite direction, but by the same magnitude light as you Reno. Is composed of particles which move in all different directions when a polarizer is. Taken and the light is passed through this polarizer. We get plane polarized light when we pass this plane polarized light in a chiral compound.

The plane of the polarized light may be rotated towards the right hand side or the left hand side and enantiomeric pair. Will rotate the plane of the polarized light in opposite direction, but with. Equal magnitude. If it rotates towards the right, it is called his Dexter Rotatry and if it rotates towards the left it is called as Liberty tree.

Why are we so curious about enantiomers? Significance of financial woes bears the fact that all living organisms are inherently Carolyn nature. For example, we have biological substrates like hormones. As well, which can react with only one type of enantiomer. If there is another type of financial more which approaches the biological substrate, it will not elicit the necessary response.

This leads to biological discrimination as observed in the case of limonene, and which exists is an initial merrickville of Leslie moaningand minus limonene, plus Limon is found in oranges. Ferrisminus limonene

is found in. Lemons are carvone and S carvone are. Another example of enantiomers which give two different orders of fragrances are carvone is found in

Spearmint. An eschar wound is found in caraway seeds.

The most important significance of financial more is in drug design. Approximately 50% of marketed drugs or Chiral living systems being themselves achiral, being themselves chiral. Each of the indentures of a carrot drug can behave in very different fashion. For example, the antidepressant amitriptyline. Can exist in two enantiomeric forms. It was observed that the R enantiomer had a 34 less potent effect than the S enantiomer which was in fact responsible for the activity. Many a times the effects of such drugs and they are enantiomers, not are not as benign. For example, in the case of Thalidomide, which was used as a cure for morning sickness, the orange enantiomer did function as a sedative. However, the S enantiomer functioned as a teratogen which led to birth defects and deformities in the children. The Diastereoisomers are basically stereoisomers that are not enantiomers. They are strictly not mirror images of each other and may have two or more stereocenters. Enantiomers have opposite configuration at each corresponding Chiral Center, for his tie streamers, have some matching and some opposite configuration. Let us consider the stereoisomers of lactic acids. Since it has only one Chiral Center, it exists as a pair of enantiomers. However, as soon as you increase the number of chiral centers, like in the case of tartaric acid, the arrangement may be such that the hydroxy groups are on the same side, or they may exist or lie on opposite sides. Each of these isomers generates its own mirror image, which are.

Enantiomers of each other. However. The relationship between one and three and one and four and two and three and two and four are such that they are diastereomeric in nature. Diastereoisomers have different physical properties like boiling point, melting points, density, solubility, viscosity and refractive indices. Diastereoisomers have different chemical properties like rates of reaction, reactivity, even in an A Chiral medium.

If you consider the same four stereoisomers of tartaric acid, we understand that the cause of the different arrangements of the hydroxy groups and the hydration's in each of the four stereoisomers diastereoisomers will. Demonstrate different physical and chemical properties which help in the separation of enantiomers. Finally. To summarize enantiomers differ in each with each other in the way that.

Diastereoisomers, I suppose that are non superimposable. Mirror images are called as enantiomers and the ones that are non superimposable isomers but are not mirror images are called as diastereoisomers. Enantiomers can have one or more stereocenters for his diastereoisomers. Mostly have two stereocenters.

Enantiomers are essentially identical in their physical properties except for rotation of plane, polarized light and enantiomers have completely different physical properties.

Enantiomers we have exactly opposite configuration at each of the Chiral center there is diastereomers have opposite configuration at one or more of their chiral centers. If you wish to study more about enantiomerism and diastereomerism, you may refer to these books. Thank you.