Introductory Organic Chemistry
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Lecture – 05
Learning Objectives for Week -2

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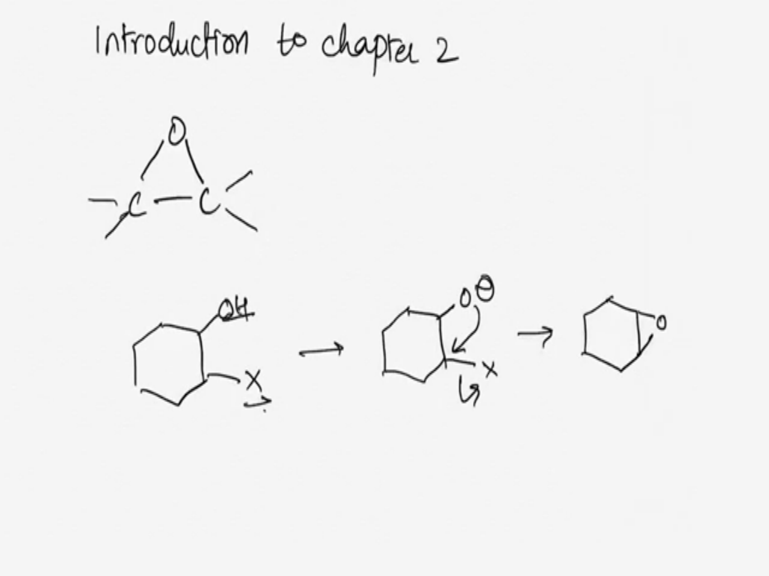

Welcome to Week 2. At the start of every week, I am going to go over the Introduction to the chapter, but I am most importantly going to go over the Learning Objectives for that week. So, while looking at the lectures, you can really focus on the concepts that I have said or the concepts that I have elaborated during this video which really talks about the learning objectives. You can pay close attention to those concepts while we are going over the week's videos.

So, this week we are going to start studying the structures of the organic molecules and we are going to begin our journey in conformational analysis. So, what is conformational analysis? The different spatial arrangements that a molecule can adopt due to rotation around the internal sigma bonds is called as conformations.

This rotation is possible about sigma bonds and not really possible about pi bonds as we have seen before. And this rotation really means that while the localized arrangement of atoms stays the same, the molecule as a whole can adopt a number of different shapes. The structures that only differ based on the shape of the molecule or based on the difference in the rotation around the sigma bonds are called as conformational isomers or even conformers.

So, this chapter focuses on various conformational isomers for different simple alkanes and their energetics. Why is the energy important? Because the understanding of the forces at work or the really the energy associated with these processes is important because the structure of the molecule can have significant influence on the molecular properties especially the reactivity of a molecule, okay. So, although we are going to just see simple alkanes or simplest functional groups really in this particular chapter. The same principles of conformational analysis can be expanded to other functional groups and can be applied to other functional groups as well.

So, we are also going to look at various kinds of isomers, we are going to start with constitutional isomers. Just a fun fact, you must have heard about 'queen bee and the worker bees' right, the way the queen bee and a worker bee kind of senses or signals are actually through two constitutional isomers. One of them is a secondary alcohol whereas, the other one is a primary alcohol.

We are also going to look at various other kind of isomerism such as stereoisomers, conformational isomers, configurational isomers and so on; cis-trans isomers which are really just diastereomers. Some of these we will elaborately study in the next chapter as well, but pay attention to the kind of isomers that we will talk about in this chapter.

So, I was saying conformation really affects reactivity right. I am going to give you one example and at this point this example may seem like not really easy to understand, but I am going to go over one reaction. This is a reaction which talks about epoxide formation. Epoxide is a functional group in which you have a triangular arrangement of two carbons and one oxygen, okay. Now one of the reactions that goes over this epoxide formation is if you have a halohydrin; halohydrin meaning if you have a halogen and a hydrin next to it. If I subject this to base, then you can have an epoxide formation using this mechanism and don't go over the mechanism right now, but you can just imagine that such a reaction takes place.

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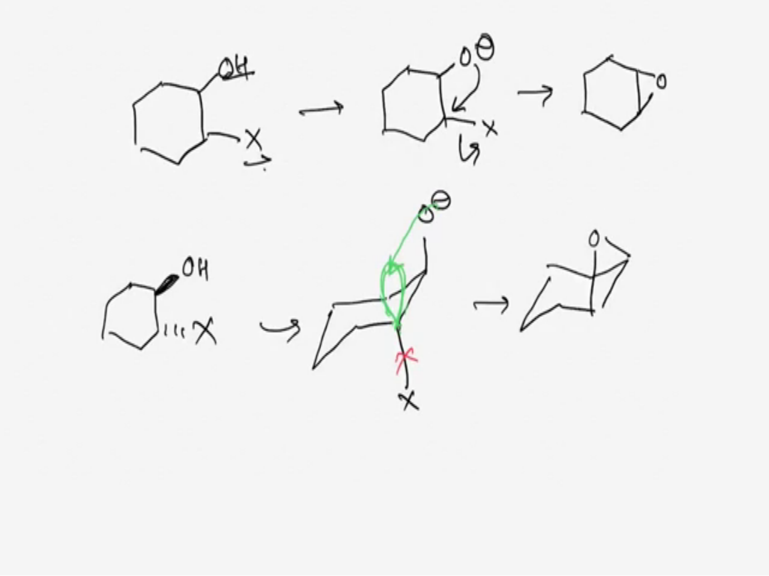

Now, the trick to this whole reaction is that you cannot just work with any halohydrin. A halohydrin should be such that it can have the OH and the halogen going in opposite direction. So, we should really work with trans halohydrins. Why do we work with trans halohydrins? Because again the conformation that this particular halohydrin can take in this case really matters.

So, you want a confirmation and this is how cyclohexenes are represented, we will see this in chapter. You want a conformation such that this oxide and the halogen are going exactly opposite to each other that is because in order to break this C-X bond, this oxide has to put electrons into the anti-bonding molecular orbital of this particular carbon halogen bond, okay.

Now, it cannot do that; if you cannot achieve this kind of conformation, it cannot do this kind of reaction. So, the reason why this is possible is because that oxygen can find the anti-bonding orbital right next to it and can easily put its electrons such that the carbon and the halogen bond breaks.

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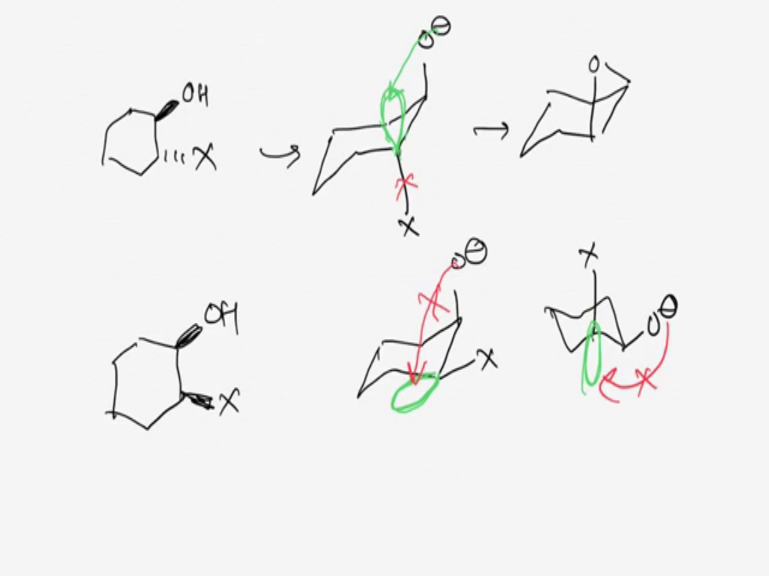

If I try doing this reaction with a cis halohydrin, something like this where both the oxygen as well as the halogen are going in the same place. I can never have a conformation like this. The two conformations that are possible are somewhat like this. So, this is one way. So, the anti-bonding of the carbon-halogen bond goes here. So, this is way too far for this oxygen to put its electrons, it is not able to do that.

The other conformation that it can adopt is this, okay. I am going to draw it here. Again the anti-bonding of the carbon-halogen bond is somewhere here and this oxygen really cannot put electrons in that particular anti-bonding orbital. So, as you can see depending on the kind of conformations, really these structures, I have drawn here, are conformations. In this chapter, we are going to do a thorough analysis of cyclohexane chair structures and you will be able to draw these structures after we are done with chapter.

My whole aim to show you this right now is that conformation really affects reactivity and we will go over these reactions later on in the corresponding chapters. But when we are going over those reactions remember that it is the conformation that plays a huge role in the way the molecule reacts.

So, the important learning objectives of this week are firstly, drawing Newman projections of simple alkanes and establishing their relative stabilities based on staggered and eclipsed interactions; drawing cyclohexane chair forms from their dash and wedge chair structures; drawing the cyclohexane chair flips effectively between the two chair forms; estimating the stability of each chair. So, also being able to recognize the more stable cyclohexane chair derivative; figuring out the percentage of molecules in each chair conformation at a particular temperature and identifying various types of isomers. So, these may include constitutional and conformational isomers.

So, hope we have a really good week of learning conformational analysis.