TRU Open Press

E2 Mechanism

Transcript

Instructor: Ainsley

00:00:00:00 - 00:00:26:79
Instructor: Hi, I'm Ainsley. And in this video, I'm going to show you how to predict the products of E two reactions by using the Hoffman and the Zaitsev rules. E two is a bimolecular elimination reaction. A strong base deprotonates an antihydrogen, a double bond forms, and the leaving group is kicked off all within one step. To form this product.

00:00:26:83 - 00:00:57:47
Instructor: The first part of determining the major products in a reaction is to first determine what type of reaction it is. So I found that this table was extremely helpful for tests and assignments. If you memorize it and write it out at the beginning of a test, you'll be prepared for a lot of different questions. The portion we are concerned with today is the E two section. The strong base unhindered column will be assigned to the Zaitsev rule.

00:00:58:14 - 00:01:43:26
Instructor: These bases will be small and unhindered like sodium hydroxide in water. Sodium methoxide in methanol or sodium amide in ammonia. The sodium could also be a different monovalent ion like potassium or lithium. The strong base hindered column can be assigned to the Hoffman rule. These bases will be bulky and hindered.

00:01:43:26 - 00:02:32:53
Instructor: You will mostly see lithium diisopropylamide or for short LDA in an aprotic solvent like THF. You may also see sodium tert butoxide, which looks like this in tert Butanol. Now we will try our first practice problem. First of all, we know that these are E two reactions because it involves a secondary haloalkane and strong bases. Remember that strong bases are oxygens and nitrogens with negative charges and without resonance.

00:02:32:53 - 00:02:57:49
Instructor: Let's start by identifying the anti hydrogens on the molecule. We can see one here. You can actually see three here, but only one matters, and then one here. Let's start with the green reaction. Sodium amide is a strong unhindered base, meaning it is a zaitsev.

00:03:00:57 - 00:03:39:16
Instructor: One way to think about it is that the zaitsev base will grab the hydrogen that is more sterically hindered. So you can see this one is more sterically hindered. So the sodium amide will take this hydrogen, the bond will eliminate to form a double bond, and the bromine will leave. This will give this product. This makes sense because since sodium amide is a small molecule, it can fit into the sterically hindered area to grab the hydrogen.

00:03:39:16 - 00:04:05:12
Instructor: Whereas LDA is bigger, so it can't fit into this area. So like I said, since LDA is a bulky, strong base, it's going to go Hoffman. The negative is going to grab the less hindered hydrogen. It's going to eliminate and kick off the bromine. To give us this product.

00:04:07:72 - 00:04:38:33
Instructor: Another way to look at this is that the alkene product of the zaitsev is more substituted. So there's two groups coming off of one side, one group coming off of the other side. Whereas for the Hoffman product, there's only two hydrogens off of one side and one group off of the other. So this one is less or less substituted alkene, whereas this one is more substituted. Let's go on to the next problem.

00:04:38:33 - 00:05:07:87
Instructor: In this molecule, there's no apparent antihydrogen, because you can see that this hydrogen is sticking back the same as chlorine. So what you need to do is rotate this bond. When you rotate a bond, you need to flip two groups. I'm going to draw the rotated version. We can keep this side of the molecule the same.

00:05:11:65 - 00:05:55:47
Instructor: But you're going to flip this part down and flip this methyl group backwards. You can see that now your hydrogen is in its antiposition. The oxygen from sodium hydroxide is going to come and grab the hydrogen, form a double bond, and kick the chlorine off. Now we can draw the resulting product. Make sure you remember to get rid of the stereochemistry here as it's now a planar bond.

00:05:55:47 - 00:06:25:35
Instructor: Let's do one more practice problem. In the first part of this question, there are two possible leaving groups, but only one equivalent of base. So we need to decide which leaving group is going to leave. Since sodium methoxide is a small, unhindered base, this part of the question is going to go zaitsev. So let's start by identifying the most hindered antihydrogens.

00:06:25:35 - 00:06:56:37
Instructor: So there's one here. And there's another anti hydrogen right here. It's also important to note that there are anti hydrogens on this methyl and right here. However, they are less hindered than these ones. Both of these anti hydrogens are tertiary, so we need to decide which one would create the more substituted alkene double bond.

00:06:56:37 - 00:07:32:57
Instructor: To do this, it might help to draw out both of the products that are possible. One of these, if we took this hydrogen would look like this. Whereas the other one would look like this. From this, you can see that this one is the more substituted double bond as there's two groups coming off of each side. Whereas for this one, there's one methyl and a hydrogen and two groups on the other side.

00:07:32:57 - 00:08:06:66
Instructor: This one is going to be the major product of this reaction. The second part of this question uses potassium tert butoxide, which is a bulky, strong base. This part will go Hoffman. We need to start by drawing in our unhindered hydrogen, which will be right here. The negative charge will come and grab the hydrogen, form a double bond, and kick off the iodine.

00:08:06:78 - 00:08:46:40
Instructor: The resulting product looks like this. My key tips are to first start by identifying if it's a Hoffman or a zaitsev base. Remember that Hoffman means hindered and zaitsev means small. Next, you need to identify which anti hydrogen is easiest to grab for that type of base, whether that's the more hindered hydrogen or the less hindered hydrogen. zaitsev will take the more hindered hydrogens, whereas Hoffman will take the less hindered hydrogens.

00:08:46:40 - 00:08:59:98
Instructor: Lastly, you need to make sure that the most substituted alkene is the product for zaitsev questions, and the least substituted alkene is the product for Hoffman questions.