Example of Electrophilic Addition

Transcript

Instructor: Brett McCollum

00:00:00:00 - 00:00:19:46
Instructor: In this video, we're going to look at nucleophilic substitution reactions. In particular, we're going to look at the SN2 reaction mechanism. Here's the reaction we're considering. When we look at nucleophilic substitution, there's a number of factors we have to consider. The first is identify your leaving group.

00:00:19:46 - 00:00:45:10
Instructor: We have our reagent and we can see that our leaving group is right here, the chlorine atom. It's going to leave, take the electron pair with it to form chloride, and that would end up generating a carbocation, if it leaves on its own. But in the SN2 mechanism, it gets pushed out by a nucleophile. Where's the nucleophile in our reaction? It's right here.

00:00:45:10 - 00:01:19:21
Instructor: We have a negatively charged species that will attack our electrophilic carbon, forming a new bond, pushing out our leaving group. Other things to consider is, what's the degree of that carbon? You can see that it has beyond the leaving group, it has two bonds to it plus an implicit hydrogen. This is a secondary carbon. If it was to form a carbocadan, a secondary carbocadan is reasonable and could proceed via a pathway of the leaving group going on its own.

00:01:19:21 - 00:01:57:08
Instructor: But because we have a good nucleophile, it's going to push in at a rate that drives the SN2 pathway. The last consideration for us to think about is our solvent. Here's our solvent, methanol. Notice that it is the conjugate acid of our nucleophile. Now, methanol is a polar protic solvent, and you'll look more about the designations of our solvents and the impact that they have on nucleophilic substitution reactions within this unit, as well as as we look at elimination reactions.

00:01:57:08 - 00:02:47:09
Instructor: While we would normally prefer a different type of solvent for an SN2 reaction mechanism, in this case, it's still going to work. Let's try drawing out the mechanism. We

will have a lone pair on our nucleophile, attack our side of reactivity, that carbon pushing the bonding pair to become a lone pair on the chlorine. If we draw what that reaction intermediate will look like, we have our six membered ring, going to our carbon, that will be in a transition state, that carbon has a methyl group attached to it. Let's draw that methyl group.

00:02:48:89 - 00:03:33:64
Instructor: And then there's also a hydrogen here. Now, in the transition state, we're going to have a backside attack, meaning that this oxygen is attacking from opposite position of the chlorine, positioning this methyl and hydrogen into a trigonal planar arrangement. We can represent that. Let's redraw it now as a trigonal planar arrangement with our methyl group. Our hydrogen, the nucleophile having a partial bond to the carbon as it comes in.

00:03:34:41 - 00:04:22:03
Instructor: And now it is partially negative charged as it's forming that bond. Then as the chlorine is being pushed out, it is also partially negatively charged as it's receiving electron density from this bond that is breaking. There's our transition state, and as this occurs, notice what is happening to the stereochemistry of this stereochemical center. In our original species, we have four different groups bonded to our carbon. We've got a phenyl, we have a chlorine, we have a methyl, and then we have an implicit hydrogen, and that hydrogen is going to be our lowest priority group.

00:04:22:43 - 00:04:56:59
Instructor: Chlorine will be priority one. Then this is a carbon with three hydrogens on it, whereas this is a carbon that has one, two, because of the double bond, and three carbons on it. This is higher priority than the methyl group. Priority two, priority three, and the hydrogen is priority four. As we draw a circle, we say that looks like it's clockwise, except remember, the hydrogen is coming forward, the methyl is going back, we want the lowest priority group to be going back.

00:04:56:59 - 00:05:59:17
Instructor: We're going to have to swap the methyl in the hydrogen. Generating the in enantiomer, which would be clockwise. In other words, our compound is the opposite. Instead of our compound, it looks R, but it's really the S in enantiomer. When we have this reaction proceed, because it goes through a transition state where now the methyl and the hydrogen are being pushed down relative to where they used to be, we're going to invert the stereochemistry in our product, and that will generate this species, which is R-enantiomer.

00:05:59:85 - 00:06:15:17
Instructor: We can see in this reaction, we transformed a halogenated hydrocarbon into an ether through SN2 reaction pathway.