Solving Multistep Carboxylic Acid Synthesis

Transcript

Instructor: Jessie Key

00:00:00:00 - 00:00:19:96
Instructor: Hello again, Doctor Jessie Key here to talk to you about synthetic strategies with carboxylic acids and derivatives by going through a few examples. In our first example, we're going to propose a multistep synthesis of benzaldehyde from the starting material, benzonitrile. Feel free to pause and try this problem on your own.

00:00:19:96 - 00:00:39:40
Instructor: Come on back when you're ready and we'll go through this together. To approach this problem, you should first determine what kind of changes have occurred between the starting material and the product. Has there been a change to the carbon skeleton?

00:00:39:40 - 00:00:47:02
Instructor: No. There are seven total carbons in both structures. Has there been a change in functional groups?

00:00:47:02 - 00:01:07:50
Instructor: Yes, the starting material has a nitrile. Well, the product has an aldehyde. Utilizing the strategy described earlier in the unit, you can focus your answer on getting to a more versatile carboxylic acid derivative to allow for the formation of the aldehyde.

00:01:10:30 - 00:01:35:30
Instructor: You can return to the carboxylic acid by hydrolysis under acidic aqueous conditions with heat. From this carboxylic acid, you can access the more versatile acid chloride by using thienyl chloride. The acid chloride can be reduced directly to an aldehyde using a more selective reducing agent like lithium tri-tert-butoxy aluminum hydride.

00:01:37:65 - 00:01:50:81
Instructor: This was one approach to solve this multi-step synthesis problem. There are additional correct methods. Pause the video now and generate an alternative approach for this problem if you haven't done so already.

00:01:50:81 - 00:02:14:05
Instructor: Hint, you could proceed through an ester. In our second example, we're going to propose a multi-step synthesis of methyl hexanoate from the starting material one Bromo pentane. Again, feel free to pause and work on this on your own first and come back to finish

the solution with me later.

00:02:18:71 - 00:02:33:71
Instructor: Welcome back. To approach this problem, you should first determine what changes have occurred between the starring material and the product. Has there been a change to the carbon skeleton?

00:02:34:63 - 00:02:57:59
Instructor: Yes, the parent gain is going from five carbons in one Bromo pentane to six carbons in methyl hexanoate, an increase of one carbon. Has there been a change in the functional groups? Yes, the starring material has a bromo group and the final product has a methyl aster.

00:02:59:03 - 00:03:21:75
Instructor: Seeing that there is a one carbon change to the carbon skeleton, you should consider what reactions accomplish this. Let's try out a strategy using a grignard with carbon dioxide. First, use magnesium to convert the one Bromo pentane starting material into a magnesium halide grignard reagent.

00:03:21:75 - 00:03:40:88
Instructor: Next, you can react the grignard reagent with CO two followed by acidic aqueous workup to generate hexanoic acid. You can convert acids directly into esters by a few different methods. One of my favorite methods is the Fischer esterification.

00:03:40:88 - 00:03:56:88
Instructor: Using methanol with an acid catalyst, methyl hexanoate can be formed by Fischer esterification. This was one approach to solve this multistep synthesis problem. There are additional correct methods.

00:03:56:88 - 00:04:04:28
Instructor: Can you think of another approach to solve this problem using the other common reaction that adds one carbon unit to the skeleton?