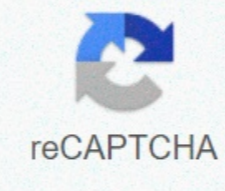




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Synthesis reaction examples organic chemistry

Organic chemistry can cover many concepts and themes, but it's all about reactions and mechanisms. At first it is not so scary, think about the simple deprotonation of acid / base, alkene reaction here, another there. Before you know it, you're drowning in dozens and dozens of reactions! You are asked to remember each one so that you know what each reactant and agent will do. And once you've got everything down, don't forget a dozen or so exceptions to the rule. Moaning! And once you have everything down, let's put them all together: when you get molecule A and asked to come up with all 20 steps to make product Z! Okay, maybe I'm overreacting a little bit... but really, just a little! The average organic chemistry 1 or 2 test synthesis question will range from two to five steps with intermediates. How do you keep everything you've learned straight? And more importantly, how to sussed hundreds of data points in the head to produce the exact steps needed to achieve the desired result? When I was a kid, I was proud to call myself a nerd. Maybe with a little OCD. I always looked for trends and found patterns where they didn't exist. Maybe that's why I'm enjoying Orgo so much. Secret to synthesis is simple: A) Look at the patterns as we explain below. B) When you get stuck, remember that it is likely that there is more than one way to achieve the desired product. Coming up with proper synthesis requires a combination of back and forth thinking! We will deal with the opposite thinking in retrosynthesis tutorial. In this course, we will focus on shorter and simpler synthesis. Let's start by looking for patterns. The following questions will help you understand what you need to pay close attention to. See the following: What function group is present on the reactant? What functional group is present on the product? What reactions do I know to transform from one to the other? Do I know of the reaction that creates an intermediate to the above product? For example: If you're starting with a 4-carbon alkene and the product asks for 4-carbon alcohol, ask yourself: What do I have in the reactant? Reactive pi binding! What's in my product? Alcohol. What reaction can help me convert from alken to alcohol? Well, there's a lot of them, if you think about it. Let's go in order from the most obvious to the less obvious: Acid catalyzed hydration Oxymmercuration-demercuration Hydroboration-oxidation These are direct obvious reactions with potentially different results. We use 3-methyl-1-buten to highlight this difference. But what if you weren't given an alken, or you didn't think of these alken reactions? What about putting a halogen group on alken hydrohalogenation? Or radical halogenation if you start with alkane? Then you can make an SN2 reaction NaOH in the polar protic solvent. What if it wasn't that easy? What if someone asks you to start with an alkyne? We can not go from alkyne to alcohol directly, because the enol product would immediately tautomerize ketone or aldehyde. This is where we present many options: -> If you reduce alkyne to alkene, you can use one of the following, as mentioned above: -> If you go from alkyne to carbonyl (ketone or aldehyde), you can follow up by reducing: Do you see where we are going with this? A) Identify patterns B) Ask yourself: What do I know? recognize these patterns C) Go from here Let's start with a simple example of the concept, then apply the same logic to something more complex. Let's say you're asked to synthesize 2-butanone from propyne. Review your questions: What functional group is present on the reactant? Reactive terminal alkyne What functional group is present on the product? Ketone on carbon #2 what reactions do I know to transform from one to the other? Acid catalyzed hydration of alkynes will bring ketone according to Markovnikov rule. However, in this example we start with a 3-carbon chain still ending with a 4-carbon chain. 4. Do I know of the reaction that creates the intermediate to the above product? Yes! Terminal alkynes easily pass through the chain extension via SN2. We begin with acid and base reactions to the deprotonation of terminal alkyne, which forms a good nucleophile. We need to extend the chain by just one carbon. Let's give this methyl group a good group that will facilitate the rapid reaction of SN2 - my go-to is bromine, but you can also use chlorine or iodine. Now that we have the carbon chain of the desired length, let's do the acid catalyzed hydration. But wait, the product is enol, not ketone!! The next step happens automatically. So even if you don't show the reagent simply draw 'KET' through the reaction arrow for Keto Enol Tautomerization. And here we go! Even scarier than synthesis itself is the following test question/request: Suggest a reasonable mechanism to perform the following synthesis. This is where you got one reactant, one product, and one or two sets of reagents. In other words, you get all the steps, but asked to show how different molecules work together. While the question is completely different, the concept is the same. We will slightly adjust the initial questions: What functional group is present on the reactant? What functional group is present on the product? WHERE IS THE REACTIVITY TO THE STARTING MOLECULE? As in, where do I start the mechanism? What reactions do I know to transform from one to the other? Do I know of the reaction that creates an intermediate to the above product? A student recently showed me this exam question for which not a single student in his class got a full Let me forew this by saying YES, that's a tough question. But if you think through it logically, you will realize that if you have studied individual steps and recognize them, you should be able to follow them together. In fact, I challenge you to give it a try and see how far you get before reading on. Propose an adequate mechanism for subsequent responses. View all intermediates and formal charges. Is this reaction SN1 SN2 E1 E2? What do you mean? Did you get it? Here's a video with a step by step solution: No matter how well you prepare, you'll still be caught off-guard in one tricky step or another. And if you get stuck? Chances are there is more than one way to infer your product! When I took my first weekly organic chemistry 2 quiz, I inadvertently set the trend of scoring top of the class, but that was a coincidence. I didn't realize we had weekly quizzes... We were asked to outline a step-by-step procedure to separate two similar molecules with different functional groups. This process involved a number of reactions to the preparation of a single molecule for extraction. I tried! I remembered that there were about six steps, but I could only answer four with certainty. I already bombed, then aced Orgo 1, and did not want to do it again! No matter what I did, I couldn't come up with the next steps. So instead, I crossed out my four and a half steps and wrote a step-by-step step-by-step procedure for performing fractional distillation. My TA very reluctantly gave me full credit with an amused warning. No one else came close. Am I asking you to outsmart that question? Not exactly. Just be aware that the more reactions you learn, the more options you have to create a single functional group. If you're stuck on a particular path or can't fully describe the steps, ask yourself: Is there another way to create the same functional group? Remember the many alcohol production reactions we discussed above. If you forgot one option, simply use another. Here are some interesting patterns and alternatives to consider. -> Go-To reactions to lengthen the chain Use alkynes in Orgo 1 Use Grignards or condensation in Orgo 2 -> Add carboxylic acids or carbonyls -> Movable reactivity to start/react to another part of the molecule compared to the current position of the active group. Active groups include leaving groups, pi bindings, nucleophilic centers prone to attack, and more. Here are some of my favorite 'moving reactive placement' tricks: These are just some of the tricks you can take advantage of. Maximizing partial credit for exam getting bonus points for exams is one thing, but here's the best part: The average synthesis question costs anywhere from 10-30 points. And the average professor will give partial credit. So, if you can only remember four of the five steps, it's empty to receive zero zero instead, type four steps and add as much relevant information as possible. Then very confidently pretend the fifth step. Don't write Magic! (Yes, I saw it for the student exam). It forms something that seems to be just a 'careless' mistake. Your professor will be impressed with your work and hopefully give you 80% of the question. This also applies to reagents! If you remember only the steps, but do not remember which reagents will get you there, start by drawing molecules: A - > B - > C This will help you think without distraction, so you can clearly see how the molecule and functional groups change / evolve from step to step. Now that you have a clear idea of where you are doing, you should be able to follow your steps and fill the required reagents! Of course, if reagents are going to give you trouble with this, here's a video on 'Remembering' Organic Chemistry Reagents. And if you don't remember them, think of something rather than leave it empty. Try using a reagent that has groups that you are adding. For example, if you forget that alkyne will react with HgSO4 in H2SO4 to bring ketone, but you know that you are trying to get oxygen to the molecule, put something else with oxygen. Example: O3 or KMnO4. Are they right? Not exactly! They're both going to split the alkyne. But I've seen enough students use it as a legitimate mistake that your professor can think the same thing and hopefully give you partial credit. Again, I'm not asking you to come up with an exam. But guessing logically on a multi-step issue where you've already earned enough points will help you get closer to full credit. I did it successfully on my orgo exams and come out to the top of the class, despite missing half a point back and forth on multiple issues. My Study Hall members and tutoring clients are doing the same squeeze in a few extra points, bringing them to the top. Bottom line, make sure you learn and understand all the desired reactions! But even the best of us forget some things under pressure. This is when you can take advantage of the above tips to help you try your best and you will have an advantage with most professors. Hopefully you favor doubt when the answers are questionable or not exactly what they were looking for. Are you ready to start thinking backwards? This is where the more difficult theme of Retrosynthetic Analysis or simply retrosynthesis comes into play. I would love to hear from you you feel better about synthesis and know what to do when you are stuck? Let me know in the comments below

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