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Grignard reactions practice problems with answers pdf

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The Grignard reaction stands out from other alcohol reactions by allowing the formation of new C-C bonds and extending the carbon chain of molecules. This approach is particularly useful when working with aldehydes, ketones, and esters to produce secondary and tertiary alcohols. One notable advantage of the Grignard reaction is its regioselectivity in producing ketones, whereas other methods can result in a mixture of products. The reaction's versatility allows it to be used interchangeably with alkylation of terminal alkynes for preparing carbonyl compounds. However, when compared to hydroboration-oxidation of internal alkynes, the Grignard reaction provides better regioselectivity and control over the formation of ketones. Let's consider an example of synthesizing a specific ketone using the Grignard reaction. We can start by deprotonating an alkyne and reacting it with ethyl iodide to extend the carbon chain through an SN2 reaction. The resulting alkyne can then be converted into the desired ketone via acid-catalyzed hydration or hydroboration-oxidation. However, this approach has limitations, as it may produce a mixture of products due to the lack of regioselectivity in hydrating internal alkynes. To overcome this issue, we can use the Grignard reaction with ethyl magnesium bromide and then oxidize the resulting secondary alcohol to produce the target ketone. In general, the Grignard reaction offers more control over the formation of ketones compared to other methods. This is particularly important when working with primary alcohols, as they can be selectively oxidized to the corresponding aldehyde using mild or strong oxidizing agents. 2. Efficient syntheses for each transformation using the Grignard reaction are proposed below: a) The product contains three more carbons than the starting aldehyde. To achieve this, one can employ propyl magnesium chloride to extend the carbon chain via the Grignard reaction, ultimately yielding a secondary alcohol that can be oxidized with any oxidizing agent. 1. Our Plan Involves Working Backwards To Analyze Grignards We'll first examine what we know about Grignards in the forward direction and then use that information to work backwards. For instance, if we know that 3 + 4 = 7, we can reverse it by finding the number subtracted from 7 to give us 3. 2. Three Key Reactions Of Grignard Reagents Grignard reagents undergo three key reactions: addition to aldehydes, addition to ketones, and addition to esters. Note that these reactions involve forming C-C and breaking C-O bonds as well as creating O-H bonds. In the case of esters, the Grignard reacts twice. 3. Problem 1 - Working "In Reverse" We'll examine the molecule 2-pentanol. Since it's a secondary alcohol, we can use the addition of Grignard reagents to aldehydes to create it. However, if we were to reverse this reaction using a magic wand, which bonds would form and break? We'd be breaking C-C and O-H bonds while forming C-O (π) bonds. 4. Problem 2 - Another Challenge We'll analyze the molecule B, which is a tertiary alcohol. Given its structure, it's likely that it was created through the reaction of a ketone with a Grignard reagent. However, there are three possible ways to make this molecule, as we can break one or both of the C-C bonds attached to the hydroxyl group. When breaking bonds A, B, or C in reverse direction with Grignard reagents, three combinations of ketone and Grignard are possible, each equally suitable. However, to achieve this, ester reactions aren't feasible because they require identical R groups on the tertiary alcohol, which is not the case here. This approach can be used later for syntheses involving different precursors like cyclohexyl Grignard with an ester or combinations of ketones and Grignards, offering multiple pathways to achieve the same result. The ability to see reactions in both forward and backward directions and applying reverse synthesis by identifying bonds that form and break is crucial for organic chemistry understanding. Join the MOC membership for exclusive access to numerous Grignard reaction quizzes, featuring: * Quiz#: 1474: Select reagents with protecting groups * Fill-in-the-gap quizzes: Quiz#: 581-584 and Quiz#: 14-82 * Synthesis problems: Quiz#: 582 and Quiz#: 14-56 * Additional quizzes: Quiz#: 24-02, Quiz#: 14-67-68, and Quiz#: 583-36 Unlock the secrets of Grignard reactions by becoming a MOC member today!