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Addition of Water to Alkenes (Hydration of Alkenes) An alkene does not react with pure water since water is not acidic enough to allow the hydrogen to act as an electrophile to start a reaction. However, with the presence of a small amount of an acid, the reaction does occur with a water molecule added to the double bond of alkene, and the product is an alcohol. This is the acid-catalyzed addition reaction of water to alkene (also called hydration), and this reaction has great utility in the large-scale industrial production of certain low-molecular-weight alcohols. Figure 10.3a Hydration Reaction The acid most commonly applied to catalyze this reaction is the dilute aqueous solution of sulfuric acid (H<sub>2</sub>SO<sub>4</sub>). Sulfuric acid dissociates completely in an aqueous solution and the hydronium ion (H<sub>3</sub>O<sup>+</sup>) generated participates in the reaction, a strong organic acid, tosyl acid (TsOH), is sometimes used as well. The mechanism for the acid-catalyzed hydration of alkene is essentially the same as the mechanism for the addition of hydrogen halide, HX, to alkenes, and the reaction therefore also follows Markovnikov's rule in terms of regioselectivity. The hydration of 1-methylcyclohexene and the reaction mechanism are shown below. Figure 10.3b Mechanism for acid-catalyzed hydration of alkene Since a water molecule can be regarded as H—OH, the regioselectivity of alcohol product that follows Markovnikov's rule means the hydrogen atom connects to the double bond carbon that has more hydrogen atoms, and the OH group adds to the carbon that has fewer hydrogen atoms. This can be explained again by the formation of a more stable carbocation in the first step of the mechanism. The acidic hydronium ion (H<sub>3</sub>O<sup>+</sup>) is regenerated in the last deprotonation step, so only a small amount of acid is required to initiate the reaction. The acid therefore is a catalyst. When comparing the hydration reaction of alkene to the dehydration reaction of alcohol in section 10.1.2, you will recognize that they are reverse reactions, as one is addition, and the other is elimination. To produce alcohol from an alkene via hydration, water should be in excess to ensure the reaction goes to completion. While preparing alkene from alcohol through dehydration, a high concentration of acid with an elevated temperature favors the elimination process, and the product can be removed by distillation as it is formed to push the equilibrium to the alkene side. Figure 10.3c Hydration reaction of alkene vs. dehydration reaction of alcohol Addition of Alcohol to Alkenes With the presence of acid, an alcohol can be added to the alkene in the same way that water can be, and ether is formed as a product. For example: Figure 10.3d Example of addition of Alcohol to Alkenes Show the mechanism for above addition reaction of methanol to 2-methyl-1-butene. Refer to the hydration mechanism. Solutions: Mechanism: addition of methanol to 2-methyl-1-butene Step 1: Electrophilic attack of H<sub>3</sub>O<sup>+</sup> to the alkene, carbocation intermediate formed Step 2: Methanol reacts with the carbocation Step 3: Deprotonation to get neutral product Please keep in mind that for the reaction that involves carbocation intermediate, the rearrangement of carbocation is always an option. Therefore the addition of water/alcohol to alkenes may involve carbocation rearrangement if possible. Show major product(s) for the following reactions. Answers to Chapter 10 Practice Questions Manufacturing other alcohols If you start from an unsymmetrical alkene like propene, you have to be careful to think about which way around the water adds across the carbon-carbon double bond. Markovnikov's Rule says that when you add a molecule HX across a carbon-carbon double bond, the hydrogen joins to the carbon atom which already has the more hydrogen atoms attached to it. Thinking of water as H-OH, the hydrogen will add to the carbon with the more hydrogens already attached. That means that in the propene case, you will get propan-2-ol rather than propan-1-ol. The conditions used during manufacture vary from alcohol to alcohol. The only conditions you will need for UK A level purposes are those for making ethanol. A Harvard Health article It is very possible to have a drinking problem that is not defined or described as "Alcoholic." Many people use alcohol to deal with stress but do not realize that it exacerbates the problems in their lives. There are techniques and therapies available to help you to lessen your dependence on alcohol and rediscover balance in your life.Are you Almost Alcoholic?Some people believe there are only two kinds of people in the world: alcoholics and non-alcoholics. Many also believe that we are either born alcoholics or we are not. This has been a prevailing view for a long time, and though this statement may seem dramatic to some, it does have some basis in reality. Those who hold these beliefs tend to be people who have experienced or witnessed the most severe symptoms and/or the most severe consequences of drinking, such as:Being unable to stop drinking, beginning from the first time he or she had a drinkRepeatedly having blackouts (i.e. can't remember the next day what happened) after having only a few drinksBeing arrested multiple times for driving while intoxicatedBecoming violent on more than one occasion when drinkingWe know from our own clinical experience that there are people who develop severe alcohol drinking patterns and behaviors such as the ones just described. These are true alcoholics. However, there are also a large number of people who don't meet the accepted criteria for diagnosing alcoholism, but fall into a grey area of problem drinking. These are the almost alcoholic.Get professional help from BetterHelp's network of licensed therapists.HelpGuide is reader supported. We may receive a commission if you sign up for BetterHelp through the provided link. Learn more.Need urgent help? Click here.True alcoholics vs. almost alcoholicsAnyone who drinks heavily is at risk for adverse health consequences, but some people appear to face a heightened risk for developing alcohol-related health problems. The reason appears to be largely biological, though environmental factors also likely play a role in this difference. Researchers have found, for example, that people differ in how their bodies metabolize alcohol. Since our biological make up is determined at birth, there is some truth in the idea that we have certain traits that make us more (or less) vulnerable to the effects of alcohol.Our discovery of the almost alcoholic came through our many years of working not only with people who had the kinds of drinking problems just described, but also with a much larger group of people with a variety of drinking patterns that didn't meet the criteria for alcoholism. As noted earlier, the majority of this larger group came to us not because they were concerned (or because others had expressed concern) about their drinking but for help with some other problem. The connection between the problems they sought help for and their drinking emerged later. Let's look at a couple of examples.Jennifer's storyJennifer, 41, was married with two children, an eleven-year-old son and a nine-year-old daughter. Jennifer was a typical, two-income contemporary family. She had a middle management job in a large real estate development and management company, while her husband, Dan, worked in the information technology department of a large university. As was true for most of the couples they knew, they struggled with balancing the demands of work with those of parenting, not to mention housekeeping. They enjoyed their life in a comfortable suburban community with good schools and access to recreation; at the same time, both Jennifer and Dan sometimes expressed that they found life on a "treadmill" difficult.Dan and Jen had met in college during their junior years and married a year after graduating. As college students, they'd enjoyed partying as much as most of their friends, but had never gone "over the top" with it. They'd each known the occasional hangover, especially as freshman, and both enjoyed meeting friends for tailgating parties at football games after graduation.Jen did not drink at all during her pregnancies. However, after her second child was born, and after she returned to work following a six-week maternity leave, she joined Dan in his routine of sipping a glass of wine while they "decompressed" after work. That meant unloading the kids, making dinner, supervising homework, getting ready for the next day, and so on. Then, after the kids were in bed, Jen would have a second glass of wine, and sometimes a third. She told us that for a number of years this was an effective way for her to release the stress that built up over the course of the day. She also felt that the third glass of wine helped her sleep better.When Jen sought therapy, it was not because of her drinking—which she still regarded as normal, and indeed helpful, given her high-pressure lifestyle. Jen was referred by her primary care physician, with whom she had shared her concerns about not sleeping well. Not sleeping well left her feeling "wired" the next day. That pattern then led her to feel increasingly depressed, which was reflected in a shortened temper (especially with the children), chronic feelings of fatigue, and a complaint from Dan that their sex life was "evaporating." She'd asked her doctor about sleeping medications, or perhaps an antidepressant. The doctor said she would consider that, but first she wanted Jen to talk with a counselor.Jen is a good example of this large group of people whom we have come to know well in our offices, people whose drinking emerges as a factor in their presenting problems. She did not make an appointment with a counselor because she was worried about her drinking.No. She would not have enough of the symptoms to meet the accepted criteria for any of the alcohol-related diagnoses. She was not someone for whom one drink was never enough. Nor did she drink frequently enough to maintain a certain level of alcohol in her body. She'd never experience a blackout. And so on.Yet she was clearly experiencing symptoms—such as disturbed sleep, chronic fatigue, depression and outbursts of anger—that true alcoholics often report. The answer, for Jen, was that at some point she had crossed over the line that separates normal social drinking from almost alcoholic drinking. The good news, for her, was that this discovery became an opportunity to reassess her drinking (along with the stress that seemed to be driving it) and make some decisions.In the end, she made some changes not only about her drinking, but also about how to cope with the stresses she faced and how to create some balance in her life. She'd had that balance once as a college student and as newlywed, but it had gotten uneven as her life became packed with more and more responsibilities.Marcus's storyMarcus, nineteen, had done well in high school despite struggling with attention deficit hyperactivity disorder (ADHD). He'd avoided alcohol during those years—he'd been warned that his ADHD medication didn't mix well with liquor—but once he got to college, he began drinking, usually in binges and in the company of friends.At first, the downside of Marcus's drinking was fairly subtle: his grades slipped a bit, and sometimes missed classes the morning after drinking. On the upside, he became more outgoing when he drank and was less shy than he'd been through his high school years. A complicating factor for Marcus's situation was his age: drinking in the college-age population typically involves a great deal of binge drinking, which is often organized around drinking games (Binge drinkings defined by the National Institute of Alcohol Abuse and Alcoholism as a drinking pattern corresponding to five or more drinks for a male and four or more for a female within about two hours, resulting in a blood alcohol level of .08 percent or more.) One such game is "beer pong" in which opponents try to bounce a Ping-Pong ball into one another's full glass of beer. When your opponent lands his (or her) ball in your beer you have to drink it all. Then another round begins.Marcus found games like beer pong fun. It was socially acceptable and an easy way for him to overcome his shyness. Being drunk also made it easier for him to talk to girls, which further reinforced his behavior.By the middle of his second semester at school, though, Marcus was in danger of flunking one course and was barely passing three others. To make matters worse, after drinking way too much one Friday night at a fraternity party, he got into a fight with a guy who thought Marcus was flirting with his girlfriend. Words were exchanged, but instead of it ending there, Marcus shoved the guy and then punches were thrown. Fearing it could lead to a brawl, someone dialed 911 for the campus police.In accordance with the college's zero tolerance policy toward violence on campus, Marcus was barred from living on campus the following semester. While he did manage to avoid flunking out, he finished that first year with a grade point average that jeopardized his chances of getting into the pharmacy school he'd always dreamed of attending.Marcus is another example of someone who has crossed the line and entered the grey area of almost alcoholic drinking. Did this young man see the connection between the negative consequences he was seeing and his drinking behavior? No. The only reason he sought counseling was because, in lieu of a suspension for the rest of that semester, Marcus was offered the option of enrolling in an anger management program at the student counseling center. This is a typical intervention, and not at all unique to Marcus.As we have learned, it is common for authorities (and even loved ones) to focus on a single incident—in Marcus's case, his aggressive behavior—and to identify it as the problem, while ignoring the context (binge drinking) in which it occurred. This is more evidence that almost alcoholics have until now remained a largely invisible segment of the population.Research consistently shows that people tend to drink the heaviest in their late teens and early-to-mid twenties. Young adults, both male and female, are especially likely to binge drink. For some of these youths, such drinking may lead to other serious problems. For example, some studies have shown that a region in the brain associated with learning and memory—the hippocampus—is smaller in people who began drinking as adolescents. And studies of teens who were treated for alcohol withdrawal showed that they were more likely to have memory problems than adolescents who did not drink.Unfortunately, what some college students consider social drinking may include various binge-drinking "games." Not every college student binge drinks, but this behavior tends to be fairly widespread and relatively tolerated by peers on college campuses. It is not uncommon for students to get drunk to the point of passing out. Because of that social context, and also because his drinking was mostly limited to weekends, Marcus viewed his own drinking as normal. He thought he was just doing what a lot of other students did, so how could he have a drinking problem? The reality is that most college students who binge on alcohol will pass through this phase and emerge in adulthood as normal social drinkers. Some of the heaviest drinkers may suffer some memory or learning problems connected to their earlier alcohol use, though they may never make this connection themselves. A few will go on to become full-blown alcoholics. And some, like Marcus, will become almost alcoholics.Marcus's experiences—getting into a fight and struggling with academics—were clearly consequences of his drinking. All by themselves, they would not have qualified him for diagnosis of alcoholism. In other words, he didn't fit into the accepted diagnostic "box." If Dr. Doyle had concluded that Marcus didn't have a drinking problem, that young man could have concluded that the negative things that were happening to him were just a matter of bad luck—being in the wrong place at the wrong time—and decided that there was no need to change his drinking behavior. Things could well have continued to go downhill from there. But by introducing Marcus to the concept of the almost alcoholic, Dr. Doyle was able help Marcus see the connection between his drinking and its consequences. From there they could discuss whether Marcus ought to consider doing something about his drinking, even if he was not an alcoholic.





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