What?

Alkenes are hydrocarbons whose molecules contain the carbon-carbon double bond. Open chain alkenes with one double bond have the general formula, \( C_nH_{2n} \), where \( n \) equals the number of carbon atoms and the hydrogen deficiency is 1. Hydrocarbons whose molecules contain the carbon-carbon triple bond are called alkynes. Open chain alkynes with one triple bond have the general formula, \( C_nH_{2n-2} \) and the hydrogen deficiency is 2.

![Ethene, Propene, Ethyne](image)

Like alkanes and other hydrocarbons, they are insoluble in water and are flammable. The most familiar alkenes are ethene and propene. Ethyne (acetylene) is an important alkyn.

Why?

Alkenes are very important in petrochemical industry because they can participate in a wide variety of reactions. Alkenes are relatively stable compounds, but are more reactive than alkanes due to the presence of a carbon-carbon \( \pi \)-bond. The majority of the reactions of alkenes involve the rupture of this \( \pi \) bond, forming new single bonds.

Alkynes are also involved in many organic reactions. Unlike alkanes, and to a lesser extent, alkenes, alkynes are unstable and reactive. Terminal alkynes and acetylene are fairly acidic and have \( pK_a \) values (25) between that of ammonia (35) and ethanol (16).

1. Treatment of 3,3-dimethyl-2-butanol with concentrated sulfuric acid and heat produces three isomeric alkenes (A, B and C) with the molecular formula \( C_6H_{12} \), in the ratios shown below.

![Reaction](image)

a. The mechanism has been started for you below. Continue the mechanism from the carbocation shown below, and see if you can come up with three compounds. HINT: think about a 1,2-rearrangement.

b. Based on the ratios for each of your three products, determine and assign compounds A, B and C.
2. The π electrons of an alkene can act as a base when treated with acid, as shown below in the simple example of hydrohalogenation of an alkene. Formation of the more stable secondary carbocation is what drives the proton to end up on the least substituted carbon. The second step of the mechanism is simply an $S_{N}1$ mechanism.

Using the concepts from this simple reaction above, predict the major products of the following reactions. For each reaction, draw a mechanism using the curved arrow formalism showing all the bond breaking and bond making steps.

3. Terminal alkynes are relatively acidic ($pK_{a} = 25$) and can be converted into acetylides by strong bases such as lithium diisopropylamide (LDA). Acetylides are good nucleophiles, and can react with primary alkyl halides by an $S_{N}2$ reaction to form new C-C bonds (an example is shown below).

Adding this reaction to your synthetic library of reactions (see below), propose a synthesis of 2-methylheptane using reactants containing four carbon atoms or less. **Hint:** recall that alkynes can be hydrogenated to alkanes.