

9.S: ALKYNES - AN INTRODUCTION TO ORGANIC SYNTHESIS (SUMMARY)

CONCEPTS & VOCABULARY

9.1 Naming Alkynes

- Follow IUPAC rules in naming alkynes.

9.2 Preparation of Alkynes - Elimination Reactions of Dihalides

- Vicinal** describes two groups on adjacent carbon atoms.
- Geminal** describes two groups on the same carbon atom.
- Alkynes can be prepared by two successive eliminations of HX from either **vicinal** or **geminal** dihalides.

9.3 Reactions of Alkynes - Addition of HX and X₂

- Alkynes** undergo addition reactions similarly to alkenes yielding Markovnikov products.

9.4 Hydration of Alkynes

- Enols have a hydroxyl group bonded to a sp² hybrid carbon (double-bonded carbon).
- Enols are usually not stable and undergo **keto-enol tautomerization** to form a ketone or aldehyde.
- Hydration of alkynes leads to an enol product which then rapidly tautomerizes into a ketone or aldehyde.

9.5 Reduction of Alkynes

- Alkynes can be hydrogenated with hydrogen gas and strong catalysts to yield alkanes.
- Alkynes can be hydrogenated with hydrogen gas and Lindlar's catalyst to yield Z alkenes.
- Alkynes can be hydrogenated with sodium metal and liquid ammonia to yield E alkenes.

9.6 Oxidative Cleavage of Alkynes

- Oxidative cleavage of internal alkynes forms two molecules of carboxylic acids.
- Oxidative cleavage of terminal alkynes forms one molecule of carbon dioxide and one carboxylic acid.

9.7 Alkyne Acidity - Formation of Acetylide Anions

- Terminal alkynes are relatively acidic compared to alkene and alkane carbon-hydrogen bonds.
- Deprotonation of a terminal alkyne forms an acetylide ion, which is a good nucleophile.

9.8 Alkylation of Acetylide Anions

- Acetylide ions can be alkylated by adding to alkyl halides and carbonyl compounds.

9.9 An Introduction to Organic Synthesis

- Desired products cannot always be made from available starting materials through one reaction. Formation of these materials may require multiple reactions completed in sequence. This type of reaction sequence is termed synthesis.

SKILLS TO MASTER

- Skill 9.1 Use IUPAC rules to accurately name alkynes.
- Skill 9.2 Draw elimination mechanisms to form alkynes.
- Skill 9.3 Draw addition mechanisms to alkynes incorporating carbocation intermediates.
- Skill 9.4 Draw addition mechanisms to alkynes incorporating halonium intermediates.
- Skill 9.5 Describe relative stability of enols to ketones and aldehydes.
- Skill 9.6 Draw keto-enol tautomerism mechanism.
- Skill 9.7 Draw products that differentiate between multiple reduction reactions of alkynes.
- Skill 9.8 Draw products of oxidative cleavage of alkynes.
- Skill 9.9 Draw mechanism for deprotonation of terminal alkynes.
- Skill 9.10 Compare acidity of terminal alkynes with other organic compounds.
- Skill 9.11 Draw reaction mechanisms using acetylide ions as nucleophiles.
- Skill 9.12 Describe schemes to accomplish synthesis of organic products given a starting material.

SUMMARY OF REACTIONS

Preparation of Alkynes

