Nomenclature of Alkynes

- Draw skeletal structures for:

  acetylene

  dimethylacetylene

  1-butyne

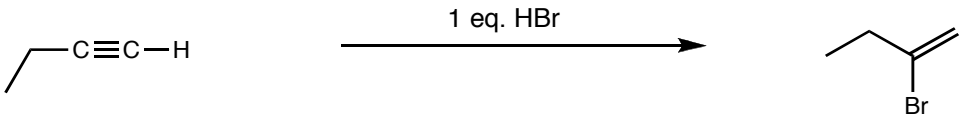
  2-butyne

  propargyl chloride

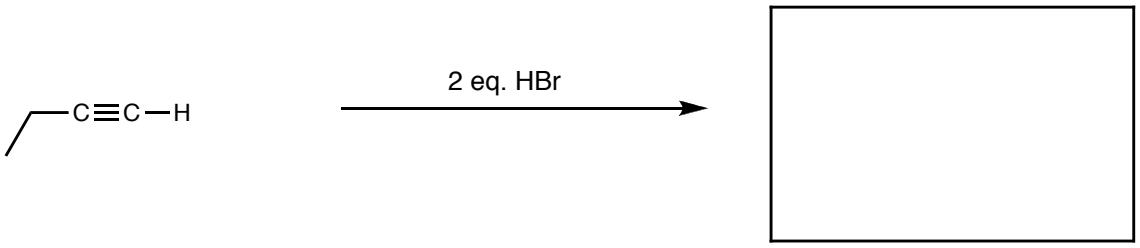
Reading: Section 14.1

Addition of HX to Alkynes

- Draw a complete curved-arrow mechanism for the following reaction:



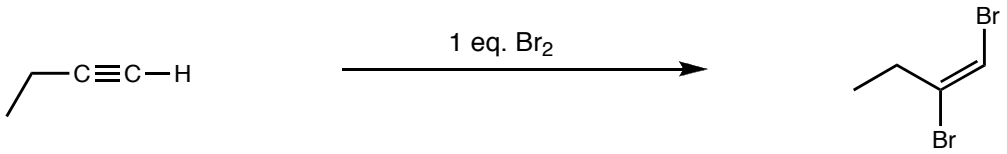
- Predict the product and draw a complete curved-arrow mechanism for the following reaction:



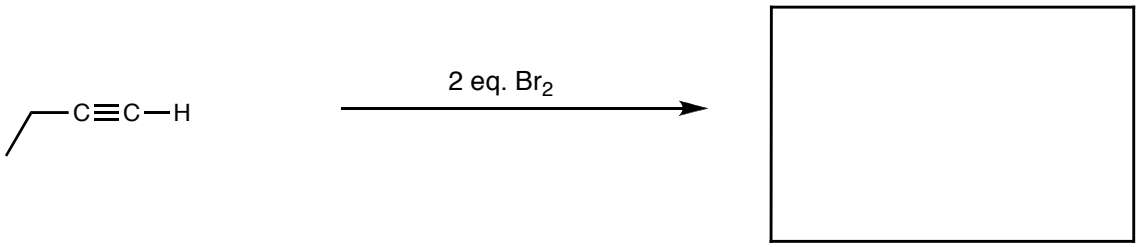
Reading: Section 14.4

Addition of Halogens (X_2) to Alkynes

- Draw a complete curved-arrow mechanism for the following reaction:



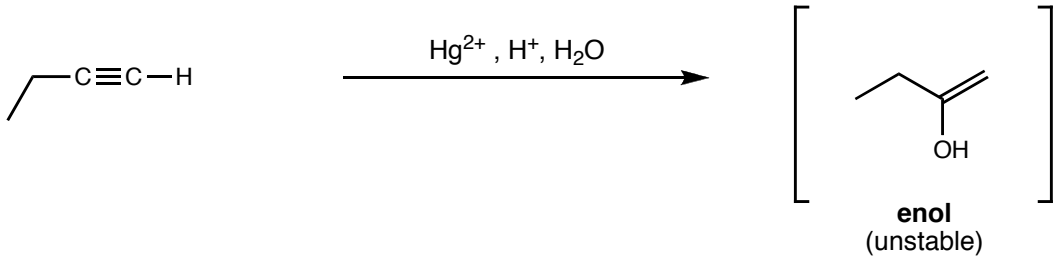
- Predict the product and draw a complete curved-arrow mechanism for the following reaction. Be sure to show the **stereochemistry** of the product!



Reading: Section 14.4

Addition of Water to Alkynes: Enol Formation

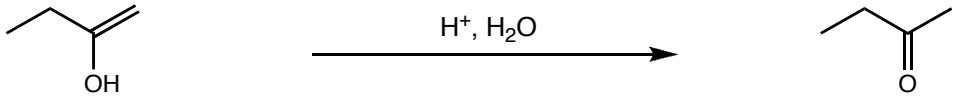
- The following reaction produces an **unstable** intermediate known as an **enol** (alk**ene** + alcoh**ol** = **enol)**. Draw a complete curved-arrow mechanism for this reaction up to the formation of the enol.



Reading: Section 14.5

Addition of Water to Alkynes: Enol Hydrolysis

- The enol is **not** the final product of the reaction of an alkyne with water. The enol reacts rapidly with the aqueous acid to form a carbonyl compound: in this case, a **ketone**. Provide a complete curved-arrow mechanism for the following reaction:



enol
(unstable)

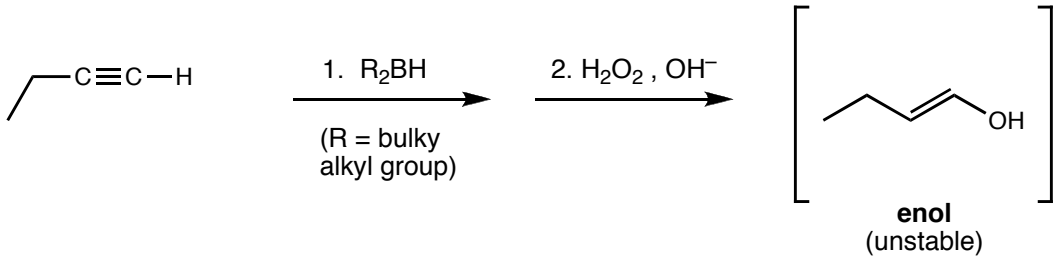
ketone

- Show the complete synthetic transformation from an **alkyne** to a **ketone**:

Reading: Section 14.5

Hydroboration/Oxidation of Alkynes: Enol Formation

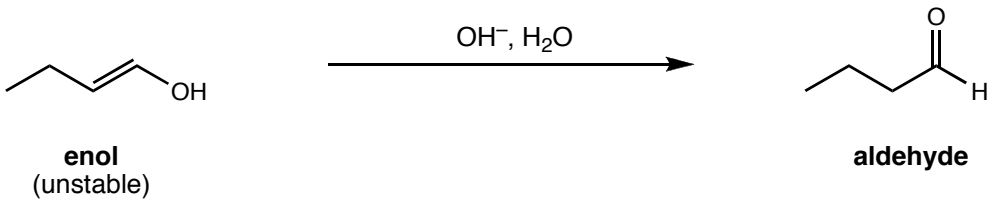
- The following reaction produces an **unstable** intermediate known as an **enol** (alk**ene** + alcoh**ol** = **enol)**. Draw a complete curved-arrow mechanism for this reaction up to the formation of the enol. You should also explain why the alkene geometry is *trans* (that is, you should explain the **stereochemistry**!)



Reading: Section 14.5

Hydroboration/Oxidation of Alkynes: Enol Hydrolysis

- The enol is **not** the final product of hydroboration/oxidation of an alkyne. The enol reacts rapidly with the aqueous base (in the oxidation step) to form a carbonyl compound: in this case, an **aldehyde**. Provide a complete curved-arrow mechanism for the following reaction:



enol
(unstable)

aldehyde

- Show the complete synthetic transformation from an **alkyne** to an **aldehyde**:

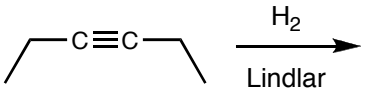
Reading: Section 14.5

Hydrogenation of Alkynes: Catalytic Hydrogenation

- Ordinarily, the reaction of an alkyne with H_2 / Pd adds *two* equivalents of hydrogen and yields an alkane. Show the intermediate and final product in the following transformation. Be sure to consider the **stereochemistry**!

an alkene an alkane

- However, we can use a **poisoned catalyst** (for example, a Lindlar catalyst) to halt the reaction at the alkene stage. This is one of the **best** ways of making a *cis*-alkene:



a *cis*-alkene

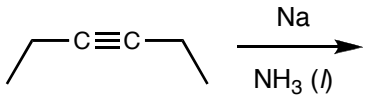
Reading: Section 14.6

Hydrogenation of Alkynes: Reduction with Na in NH_3

- We can convert an alkyne into a *trans*-alkene by using a unique reducing agent: sodium metal in liquid ammonia (!). Ammonia is a gas at room temperature; it boils at –33°C. When it is condensed into a liquid it is a tremendously interesting and useful solvent. It dissolves sodium metal to produce a deep blue solution that contains *solvated electrons*:

- Write a balanced equation showing how Na dissolves in NH_3 to produce solvated electrons e^-

- These solvated electrons react with the alkyne via an interesting free-radical mechanism that yields a *trans*-alkene as the final product. (You can remember the steps of this mechanism if you note that it involves only 2 kinds of reactions: adding an electron to form an anion, and protonating the anion using NH_3.)



Reading: Section 14.6

Summary: Reactions of Alkynes

- Show how each of the following products could be synthesized from an alkyne: