Alkyne Reactions & Selective Reduction

INSTRUCTOR ANSWER KEY

Instructions: Select the best answer for questions 1–8 and briefly justify your choice using substrate, reagents, or reaction conditions. For 9–10, explain your reasoning in complete sentences.

1. **2-Butyne + H_2/Lindlar gives:**

   A. cis-2-Butene B. trans-2-Butene C. Butane D. 2-Butanone

   Answer: A. cis-2-Butene

   Explanation: Lindlar reduction gives syn addition, stopping at the cis alkene.

2. **2-Butyne + Na/NH_3(l) gives:**

   A. trans-2-Butene B. cis-2-Butene C. Butane D. 2-Butanone

   Answer: A. trans-2-Butene

   Explanation: Dissolving metal conditions yield the trans alkene.

3. **1-Butyne + $HgSO_4$/H_2SO_4/H_2O gives:**

   A. 2-Butanone B. Butanal C. 1-Butanol D. Butanoic acid

   Answer: A. 2-Butanone

   Explanation: Markovnikov hydration and tautomerization yields the methyl ketone.

4. **1-Butyne hydroboration–oxidation with bulky borane gives:**

   A. Butanal B. 2-Butanone C. Butane D. 1-Butene

   Answer: A. Butanal

   Explanation: Anti-Markovnikov addition gives an enol that tautomerizes to an aldehyde.

5. **An alkyne completely hydrogenated with excess H_2/Pd gives:**

   A. An alkane B. A cis alkene only C. A trans alkene only D. An alcohol

   Answer: A. An alkane

   Explanation: Unpoisoned Pd catalysis proceeds from alkyne through alkene to alkane.

6. **Which reagent stops at a cis alkene?**

   A. Lindlar catalyst + H_2 B. Pd/C + excess H_2 C. Na/NH_3(l) D. $HgSO_4$/H_2O

   Answer: A. Lindlar catalyst + H_2

   Explanation: Poisoned Lindlar catalyst favors partial syn reduction.

7. **What intermediate initially forms on alkyne hydration?**

   A. An enol B. A carboxylate C. A nitrile D. A nitrene

   Answer: A. An enol

   Explanation: Enols tautomerize to aldehydes/ketones under typical conditions.

8. **For a terminal alkyne, mercury-catalyzed hydration commonly gives:**

   A. A methyl ketone B. An aldehyde exclusively C. A carboxylic acid D. An ether

   Answer: A. A methyl ketone

   Explanation: Markovnikov water addition yields methyl ketone after tautomerization.

9. **Give two reagents that convert 2-butyne into different geometric alkene isomers.**

   Suggested response: Lindlar catalyst/H_2 gives cis-2-butene; Na/NH_3(l) gives trans-2-butene.

10. **What carbonyl product comes from hydroboration–oxidation of 1-butyne?**

    Suggested response: Butanal, $CH_3CH_2CH_2CHO$, following enol-to-aldehyde tautomerization.