Alcohol Reactions: Oxidation, Dehydration & Substitution

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. **PCC oxidation of 1-butanol usually gives which product?**

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

   Answer: A. Butanal

   Explanation: A primary alcohol under mild, anhydrous PCC oxidation gives an aldehyde.

2. **Aqueous Jones oxidation of 1-butanol usually gives:**

   A. Butanal only B. Butanoic acid C. 2-Butanone D. Butane

   Answer: B. Butanoic acid

   Explanation: Aqueous Cr(VI) reagents commonly oxidize a primary alcohol to carboxylic acid.

3. **Oxidation of cyclohexanol gives:**

   A. Cyclohexanone B. Cyclohexanal C. Cyclohexane D. Benzoic acid

   Answer: A. Cyclohexanone

   Explanation: A cyclic secondary alcohol oxidizes to the corresponding cyclic ketone.

4. **Which alcohol resists ordinary Cr(VI) oxidation without C–C cleavage?**

   A. Ethanol B. 1-Propanol C. 2-Propanol D. 2-Methyl-2-propanol

   Answer: D. 2-Methyl-2-propanol

   Explanation: A tertiary alcohol lacks a hydrogen on the carbon bearing OH.

5. **Acid-catalyzed dehydration of an alcohol generally forms:**

   A. An alkene B. An ester C. An amide D. An ether exclusively

   Answer: A. An alkene

   Explanation: Elimination of water produces alkene product(s), often under acid and heat.

6. **2-Propanol + PCC produces:**

   A. Acetaldehyde B. Propanone C. Propanoic acid D. Propane

   Answer: B. Propanone

   Explanation: A secondary alcohol forms a ketone, propanone.

7. **Primary alcohol oxidation to a carboxylic acid generally requires:**

   A. PCC in CH_2Cl_2 B. Aqueous strong oxidant C. $NaBH_4$ D. H_2/Lindlar

   Answer: B. Aqueous strong oxidant

   Explanation: Strong oxidizing, aqueous conditions can carry oxidation through the aldehyde stage.

8. **An alcohol leaving group is often improved by:**

   A. Converting OH to a sulfonate ester B. Adding more water only C. Adding NaCl only D. Heating alone

Answer: A. Converting OH to a sulfonate ester

Explanation: A sulfonate ester (such as a tosylate) is a better leaving group than OH^-.

9. **Compare the oxidation of 1-propanol under PCC and aqueous Jones conditions.**

Suggested response: PCC commonly produces propanal; Jones oxidation generally yields propanoic acid.

10. **Why is 2-methyl-2-propanol resistant to ordinary oxidation?**

Suggested response: The carbon bearing OH has no C–H bond; normal oxidation to a carbonyl would require C–C bond cleavage.