Hemiacetals & Acetals — Instructor Answer Key

Worked solutions and reasoning • For instructor review before publication

1. **A hemiacetal carbon has which substituents?**

   Answer: One OH and one OR

   Reasoning: A hemiacetal bears an OH and an OR group on the same carbon.

2. **An acetal carbon contains:**

   Answer: Two OR groups

   Reasoning: An acetal has two alkoxy substituents replacing the original carbonyl oxygen environment.

3. **Typical acid-catalyzed acetal formation requires:**

   Answer: Aldehyde/ketone, alcohol and acid

   Reasoning: Carbonyl + alcohol under acid catalysis forms acetals in reversible reactions.

4. **Which condition commonly hydrolyzes an acetal back to a carbonyl?**

   Answer: Aqueous acid

   Reasoning: Acetal cleavage is promoted by aqueous acid.

5. **Acetal formation is best described as:**

   Answer: An equilibrium process

   Reasoning: Water concentration and acid catalysis shift reversible acetal equilibrium.

6. **Why remove water during acetal protection?**

   Answer: It shifts equilibrium toward acetal

   Reasoning: Removing a product can shift the equilibrium toward acetal.

7. **Which structure represents acetaldehyde dimethyl acetal?**

   Answer: $CH_3CH(OCH_3)_2$

   Reasoning: Two methoxy groups indicate the fully formed acetal.

8. **Hemiacetal formation from many simple aldehydes and alcohols is:**

   Answer: Typically reversible

   Reasoning: Many simple hemiacetals exist in reversible equilibria, often favoring carbonyl.

9. **How many OR substituents are on a simple acetal carbon?**

   Answer: Two OR groups.

   Reasoning: Two OR groups.

10. **What conditions commonly remove an acetal protecting group?**

    Answer: Aqueous acid, which catalyzes hydrolysis back to the carbonyl.

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