

Ethers & Williamson Ether Synthesis

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. Williamson ether formation is normally which mechanism?

- A. SN1 B. SN2 C. E1 D. Radical substitution

Answer: B. SN2

Explanation: Alkoxide attacks an unhindered alkyl electrophile in a concerted SN2 step.

2. Most suitable electrophile with sodium phenoxide?

- A. Bromomethane B. tert-Butyl bromide C. 2-Bromo-2-methylpropane D. Neopentyl bromide

Answer: A. Bromomethane

Explanation: A methyl bromide is the least hindered SN2 electrophile.

3. Sodium methoxide + 1-bromopropane mainly gives:

- A. 1-Methoxypropane B. 2-Methoxypropane C. Propanone D. Propene exclusively

Answer: A. 1-Methoxypropane

Explanation: Methoxide displaces bromide on the primary carbon.

4. Using a tertiary bromide and a strong alkoxide usually favors:

- A. SN2 ether formation B. E2 elimination C. Aromatic substitution D. Hydrogenation

Answer: B. E2 elimination

Explanation: Tertiary halides are sterically blocked for SN2 and strong bases favor E2.

5. Which part is the SN2 nucleophile?

- A. Alkoxide anion B. Alkyl bromide C. Bromide ion before reaction D. Water exclusively

Answer: A. Alkoxide anion

Explanation: An alkoxide $R-O^-$ provides the attacking oxygen.

6. The bond created in a Williamson reaction is:

- A. C–O B. C=O C. O–O D. $C\equiv C$

Answer: A. C–O

Explanation: The new covalent bond joins oxygen to electrophilic carbon.

7. A useful way to prepare an alkoxide from an alcohol is:

- A. Appropriate strong base such as NaH B. PCC C. H_2/Pd D. HBr only

Answer: A. Appropriate strong base such as NaH

Explanation: Strong base removes the alcohol proton to form $R-O^-$.

8. For ethyl tert-butyl ether, the better electrophile is:

- A. Ethyl halide B. tert-Butyl halide C. Both equally ideal D. Neither can form any ether

Answer: A. Ethyl halide

Explanation: Use tert-butoxide as nucleophile and a primary ethyl halide as electrophile to avoid tertiary SN2.

9. Propose a Williamson route to methoxyethane using sodium ethoxide.

Suggested response: React sodium ethoxide with bromomethane or iodomethane: $\text{CH}_3\text{CH}_2\text{O}^- + \text{CH}_3\text{Br} \rightarrow \text{CH}_3\text{CH}_2\text{OCH}_3$.

10. Why is tert-butyl bromide a poor electrophile for this process?

Suggested response: SN2 attack at a tertiary carbon is strongly hindered and the strong alkoxide tends to cause E2 elimination.