

Epoxide Ring Opening: Acidic vs Basic Conditions

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. Basic nucleophile attack on propylene oxide usually occurs at:

- A. Less substituted carbon B. More substituted carbon C. Epoxide oxygen D. No carbon

Answer: A. Less substituted carbon

Explanation: Backside SN₂-like attack is sterically controlled under basic conditions.

2. When one epoxide carbon is tertiary, acid-catalyzed opening often favors attack at:

- A. More substituted carbon B. Less substituted carbon exclusively C. No carbon D. O atom only

Answer: A. More substituted carbon

Explanation: For an epoxide with a tertiary carbon, acid activation can favor that more substituted site; this is not a universal rule.

3. After hydrolysis/workup, the epoxide oxygen typically becomes:

- A. An alcohol OH B. A ketone O automatically C. CO₂ D. An ether absent any nucleophile

Answer: A. An alcohol OH

Explanation: Ring oxygen remains attached and is protonated to give an OH.

4. A basic epoxide opening is generally:

- A. SN₂-like and backside B. SN₁ with free long-lived carbocation C. E₂ always D. Radical chain

Answer: A. SN₂-like and backside

Explanation: The C–Nu bond forms with inversion at the attacked stereocenter.

5. Propylene oxide + NaOCH₃/MeOH predominantly gives:

- A. CH₃CH(OH)CH₂OCH₃ B. CH₃CH(OCH₃)CH₂OH C. CH₃COCH₃ D. CH₃CH₂CH₃

Answer: A. CH₃CH(OH)CH₂OCH₃

Explanation: Methoxide attacks the less-substituted CH₂ carbon.

6. 2-Methyl-1,2-epoxypropane + MeOH/H⁺ often gives:

- A. (CH₃)₂C(OCH₃)CH₂OH B. (CH₃)₂C(OH)CH₂OCH₃ C. 2-Methylpropene D. Acetone

Answer: A. (CH₃)₂C(OCH₃)CH₂OH

Explanation: When one epoxide carbon is tertiary, protonation can favor methanol attack there.

7. Epoxide ring opening is driven in part by:

- A. Relief of ring strain B. Creation of a more strained ring C. Loss of all oxygen D. An aromaticity gain

Answer: A. Relief of ring strain

Explanation: Opening the 3-membered ring relieves substantial angle strain.

8. Stereochemical attack at the reacting epoxide carbon tends to:

- A. Invert configuration B. Retain via front-side attack always C. Erase stereochemistry at all centers D. Give only radicals

Answer: A. Invert configuration

Explanation: The attacking nucleophile approaches opposite the breaking C–O bond.

9. Compare basic and acid-catalyzed methanol opening of 2-methyl-1,2-epoxypropane.

Suggested response: Basic methoxide attacks the primary CH₂ carbon, leading to (CH₃)₂C(OH)CH₂OCH₃. Under acidic conditions methanol can favor the tertiary carbon, leading to (CH₃)₂C(OCH₃)CH₂OH.

10. Does protonated epoxide opening always involve a freely rearranging carbocation?

Suggested response: No. Protonated epoxides are activated, but the C–O bond cleavage and nucleophile attack can remain concerted or asynchronous; ordinary carbocation rearrangements are not expected as a general rule.