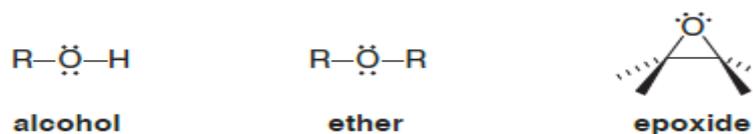


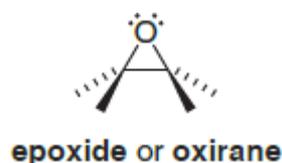
كلية التربية للعلوم الصرفة	الكلية
قسم الكيمياء	القسم
Organic chemistry	المادة باللغة الانجليزية
الكيمياء العضوية	المادة باللغة العربية
المرحلة الثانية	المرحلة الدراسية
د. عمر جمال مهدي العسافي	اسم التدريسي
Epoxides	عنوان المحاضرة باللغة الانجليزية
الايبوكسي	عنوان المحاضرة باللغة العربية
الرابعة	رقم المحاضرة
<i>Organic Chemistry</i> 6 ^{ed} , William H. Brown, Christopher S. Foote, Brent L. Iverson, Eric V. Anslyn, Bruce M. Novak, 2012	المصادر والمراجع
<i>Organic Chemistry</i> 3 ^{ed} , Janice Gorzynski Smith, 2011	
<i>Organic Chemistry</i> '' by Jonathan Clayden, Nick Greeves, and Stuart Warren	



Epoxides is a functional group that contain carbon–oxygen σ bonds.

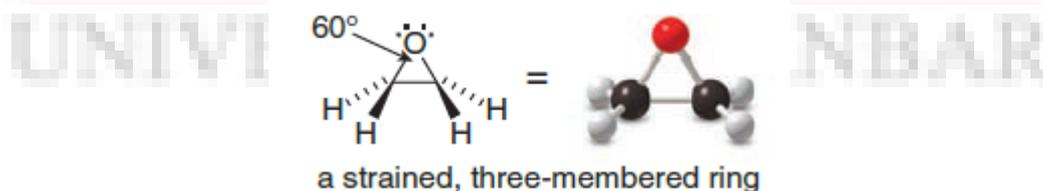


Epoxides are ethers having the oxygen atom in a three-membered ring. Epoxides are also called **oxiranes**.



2- Structure and Bonding

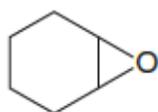
The bond angle around the O atom in an alcohol or ether is similar to the tetrahedral bond angle of 109.5° . In contrast, the C–O–C bond angle of an epoxide must be 60° , a considerable deviation from the tetrahedral bond angle. For this reason, epoxides have angle strain, making them much more reactive than other ethers.



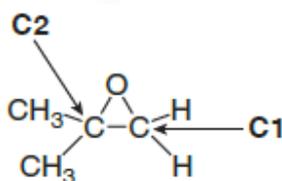
Because oxygen is much more electronegative than carbon or hydrogen, the C – O and O – H bonds are all polar, with the O atom electron rich and the C and H atoms electron poor.

3. Naming Epoxides

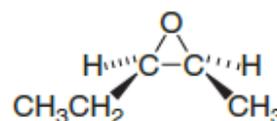
Epoxides are named in three different ways—**epoxyalkanes**, **oxiranes**, or **alkene oxides**. To name an epoxide as an **epoxyalkane**, first name the alkane chain or ring to which the oxygen is attached, and use the prefix **epoxy** to name the epoxide as a substituent. Use two numbers to designate the location of the atoms to which the O's are bonded.



1,2-epoxycyclohexane



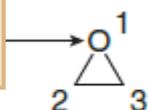
1,2-epoxy-2-methylpropane



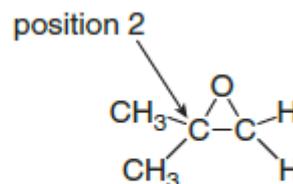
cis-2,3-epoxypentane

Epoxides bonded to a chain of carbon atoms can also be named as derivatives of **oxirane**, the simplest epoxide having two carbons and one oxygen atom in a ring. The oxirane ring is numbered to put the O atom at position “1,” and the first substituent at position “2.” No number is used for a substituent in a monosubstituted oxirane.

Number the ring beginning at the O atom.

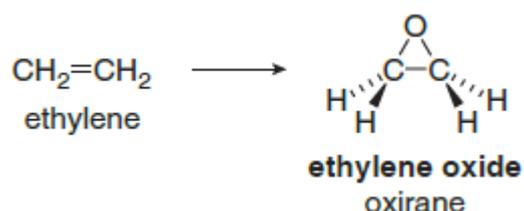


oxirane

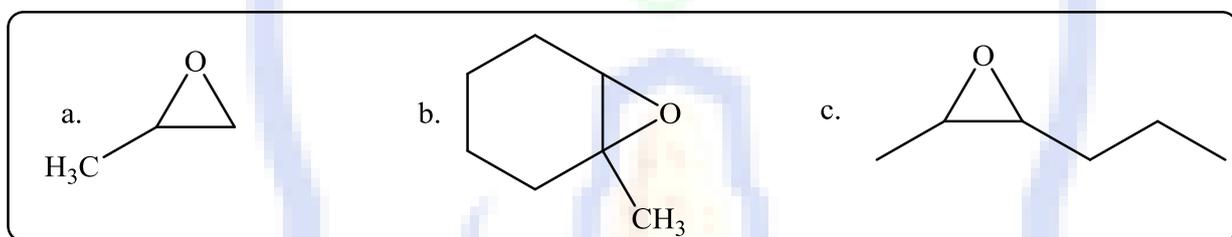


2,2-dimethyloxirane

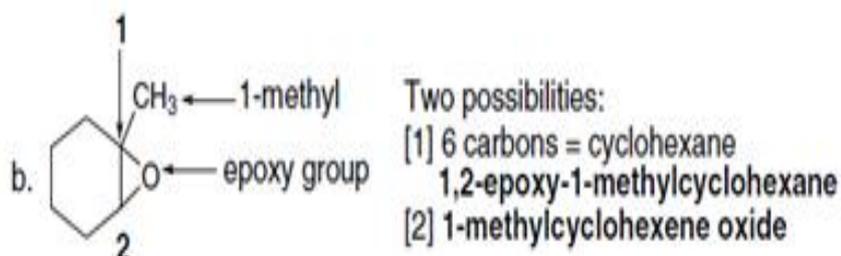
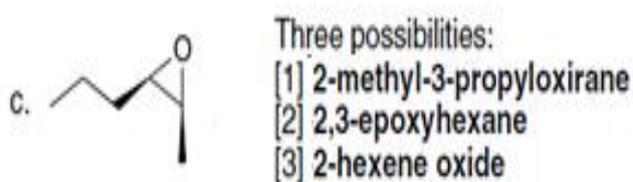
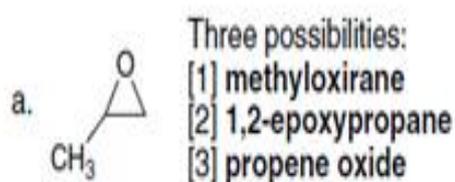
Epoxides are also named as alkene oxides, since they are often prepared by adding an O atom to an alkene. To name an epoxide this way, mentally replace the epoxide oxygen by a double bond, name the alkene, and then add the word oxide. For example, the common name for oxirane is ethylene oxide, since it is an epoxide derived from the alkene ethylene.



Problem Name each epoxide.



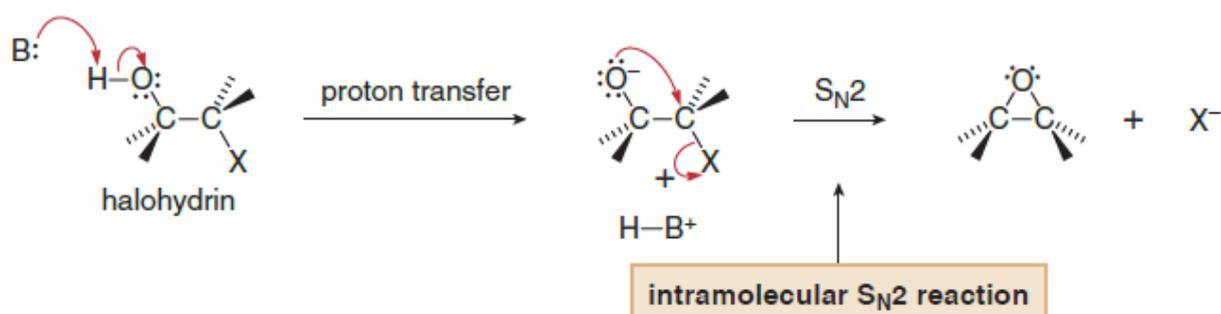
Solution:-



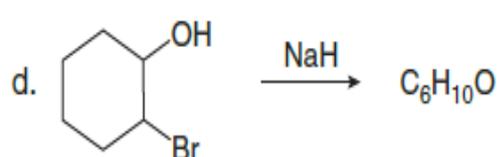
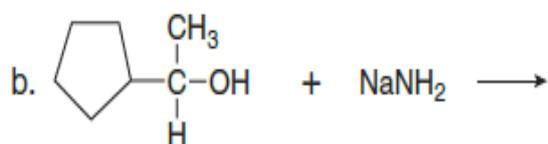
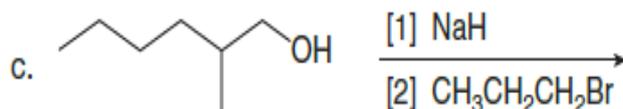
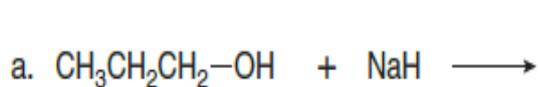
4. Preparation of Epoxides

When an organic compound contains both a hydroxy group and a halogen atom on adjacent carbon atoms, an *intramolecular* version of this reaction forms an epoxide. The starting material for this two-step sequence, a **halohydrin**, is prepared from an alkene,

Epoxide synthesis—A two-step procedure



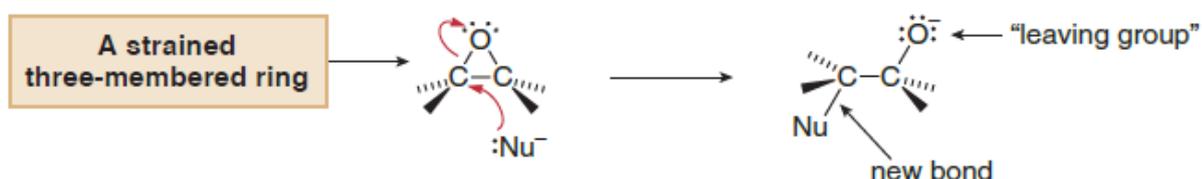
Problem Draw the products of each reaction.



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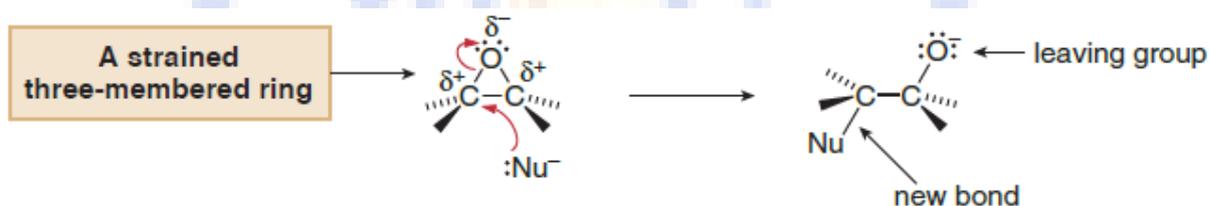
5. Reactions of Epoxides

Epoxides don't have a good leaving group either, but they have one characteristic that neither alcohols nor ethers have: the "leaving group" is contained in a strained three-membered ring. Nucleophilic attack opens the three-membered ring and relieves angle strain, making nucleophilic attack a favorable process that occurs even with the poor leaving group.

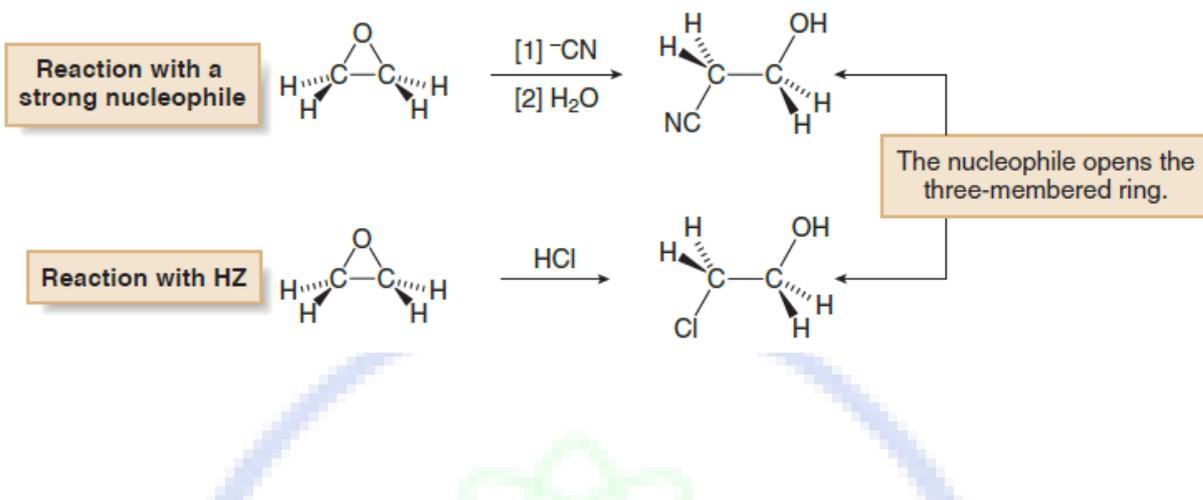


Reactions of Epoxides

Although epoxides do not contain a good leaving group, they contain a strained three-membered ring with two polar bonds. **Nucleophilic attack opens the strained three-membered ring**, making it a favorable process even with the poor leaving group.



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Preparation of Alcohols, Ethers, and Epoxides

[1] Preparation of alcohols

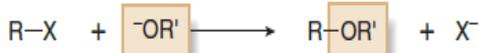


- The mechanism is $\text{S}_{\text{N}}2$.
- The reaction works best for CH_3X and 1°RX .

[2] Preparation of alkoxides—A Brønsted–Lowry acid–base reaction

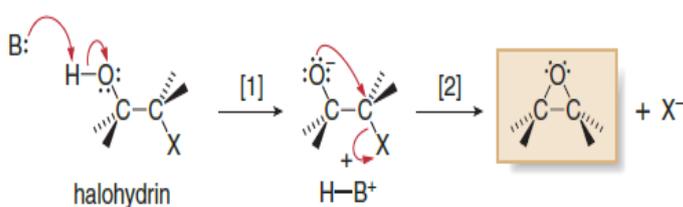


[3] Preparation of ethers (Williamson ether synthesis)



- The mechanism is $\text{S}_{\text{N}}2$.
- The reaction works best for CH_3X and 1°RX .

[4] Preparation of epoxides—Intramolecular $\text{S}_{\text{N}}2$ reaction

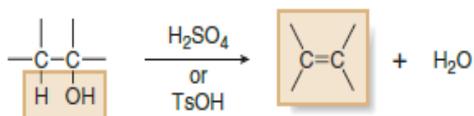


- A two-step reaction sequence:
 - [1] The removal of a proton with base forms an alkoxide.
 - [2] An intramolecular $\text{S}_{\text{N}}2$ reaction forms the epoxide.

Reactions of Alcohols

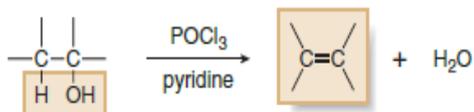
[1] Dehydration to form alkenes

a. Using strong acid



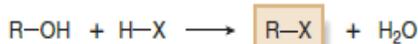
- Order of reactivity: $\text{R}_3\text{COH} > \text{R}_2\text{CHOH} > \text{RCH}_2\text{OH}$.
- The mechanism for 2° and 3° ROH is E1 —carbocations are intermediates and rearrangements occur.
- The mechanism for 1° ROH is E2 .
- The Zaitsev rule is followed.

b. Using POCl_3 and pyridine (9.10)



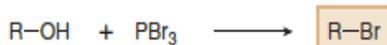
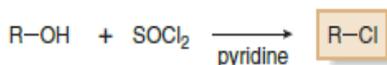
- The mechanism is E2 .
- No carbocation rearrangements occur.

[2] Reaction with HX to form RX



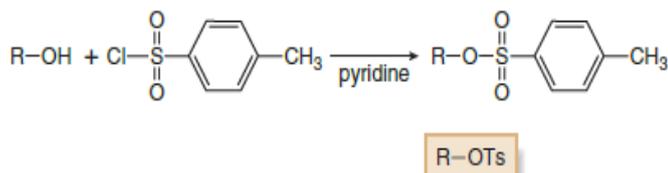
- Order of reactivity: $\text{R}_3\text{COH} > \text{R}_2\text{CHOH} > \text{RCH}_2\text{OH}$.
- The mechanism for 2° and 3° ROH is $\text{S}_{\text{N}}1$ —carbocations are intermediates and rearrangements occur.
- The mechanism for CH_3OH and 1° ROH is $\text{S}_{\text{N}}2$.

[3] Reaction with other reagents to form RX



- Reactions occur with CH_3OH and 1° and 2° ROH.
- The reactions follow an $\text{S}_{\text{N}}2$ mechanism.

[4] Reaction with tosyl chloride to form alkyl tosylates



- The C-O bond is not broken, so the configuration at a stereogenic center is retained.

