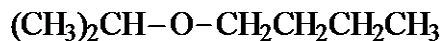
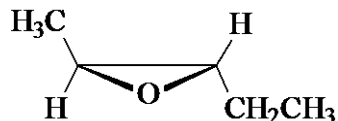


## Acs Review Ethers Epoxides and Sulfides

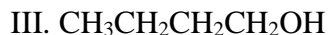
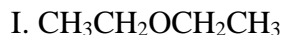
1. The name of the following ether is:



- A. butyl isopropyl ether.  
B. isobutyl propyl ether.  
C. *sec*-butyl isopropyl ether.  
D. butyl propyl ether.
2. The IUPAC name of the following epoxide is:



- A. *cis*-2-ethyl-3-methyloxirane.  
B. *trans*-2-ethyl-3-methyloxirane.  
C. *trans*-1ethyl-2-methyloxycyclopropane.  
D. *trans*-1-ethyl-2-methylethane epoxide.
3. The C-O-C bond angle in dimethyl ether is closest to:
- A. 90°  
B. 109°  
C. 120°  
D. 180°
4. Consider the three compounds below:



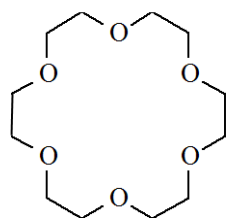
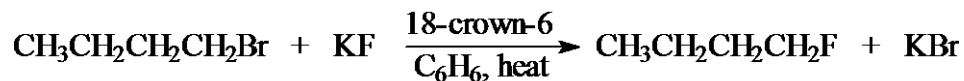
The two most similar in boiling point are \_\_\_\_\_ and the two most similar in solubility in water are \_\_\_\_\_.

- A. I and III, II and III  
B. I and II, I and III  
C. II and III, I and II  
D. I and III, I and III
5. Match the boiling points with the following three isomers of  $\text{C}_4\text{H}_{10}\text{O}_2$ .

	$\text{CH}_3\text{OCH}_2\text{CH}_2\text{OCH}_3$	$\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_2\text{OH}$	$\text{HOCH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
A)	85°C	230°C	135°C
B)	230°C	85°C	135°C
C)	85°C	135°C	230°C
D)	135°C	230°C	85°C

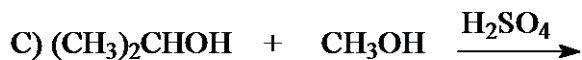
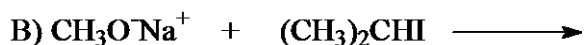
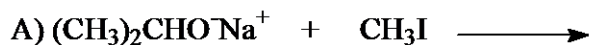
- A. A  
B. B  
C. C  
D. D

6. The role of 18-crown-6 in the reaction shown below is to:



18-crown-6

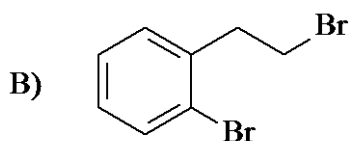
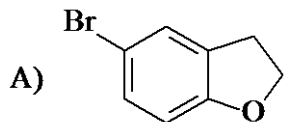
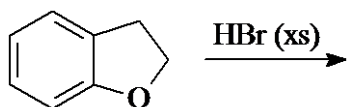
- A. complex  $\text{F}^-$  by ion-dipole attraction and make it more nucleophilic  
 B. remove  $\text{Br}^-$  by ion-dipole attraction and shift the equilibrium to the products  
 C. complex  $\text{K}^+$  by ion-dipole attraction increasing the solubility of KF and the nucleophilicity of  $\text{F}^-$   
 D. stabilize the carbocation in the substitution reaction
7. Of the following, which yields isopropyl methyl ether as the major product with little or no by-products?

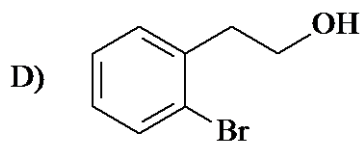
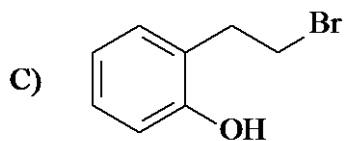


D) all three give isopropyl methyl ether as the major product

- A. A  
 B. B  
 C. C  
 D. D

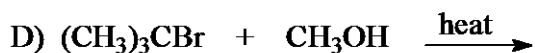
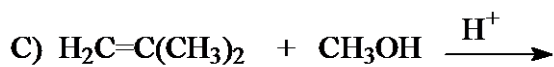
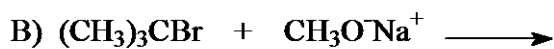
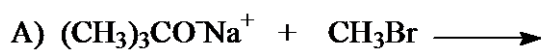
8. What is the product of the following reaction?





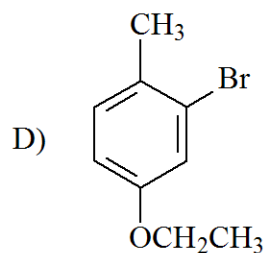
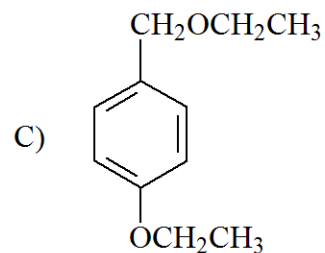
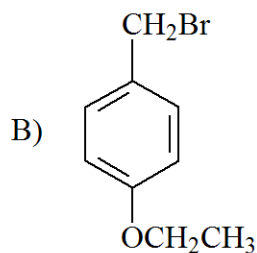
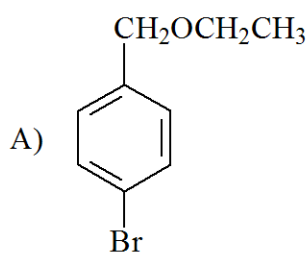
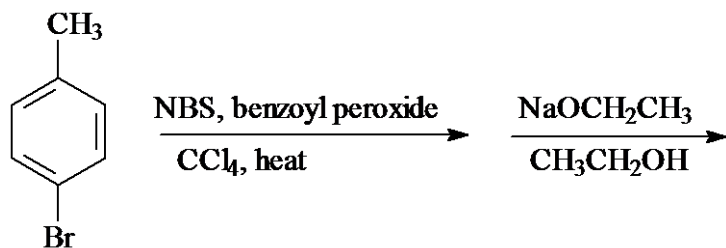
- A. A  
B. B  
C. C  
D. D

9. Which of the following is not a good method to make *tert*-butyl methyl ether?



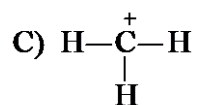
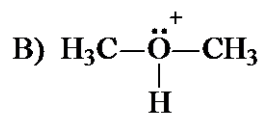
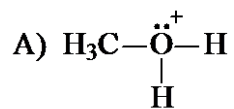
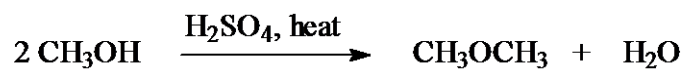
- A. A  
B. B  
C. C  
D. D

10. What is the major product of the following reaction?



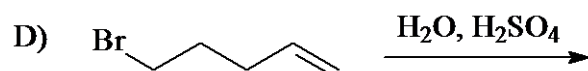
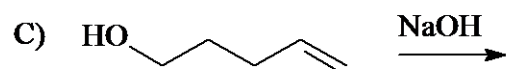
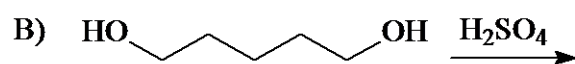
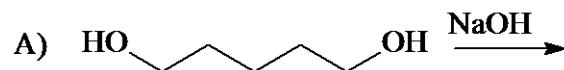
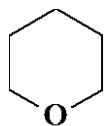
- A. A  
B. B  
C. C  
D. D

11. Which of the following is not an intermediate in the reaction below?



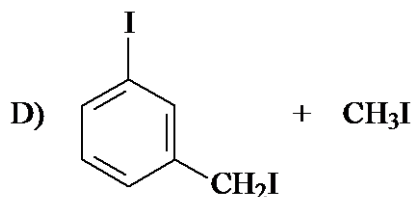
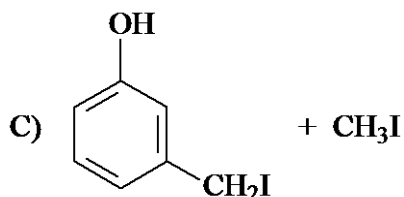
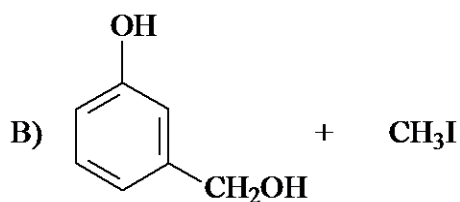
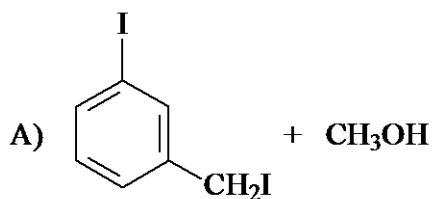
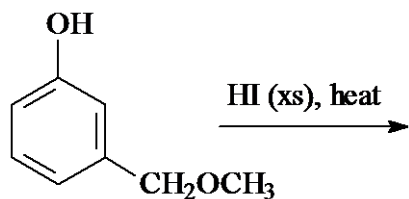
- A. A  
B. B  
C. C  
D. they are all intermediates

12. Which one of the following reactions makes the cyclic ether shown below?



- A. A  
B. B  
C. C  
D. D

13. What are the products of the reaction below?

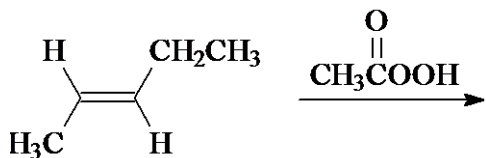


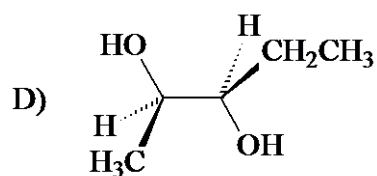
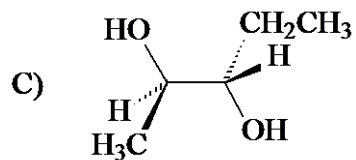
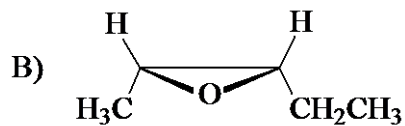
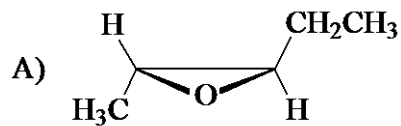
- A. A  
 B. B  
 C. C  
 D. D

14. How many constitutionally isomeric ethers are there with a formula of C<sub>4</sub>H<sub>10</sub>O?

- A. only one  
 B. two  
 C. three  
 D. four

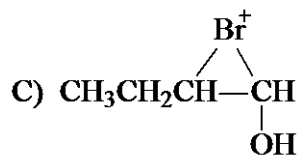
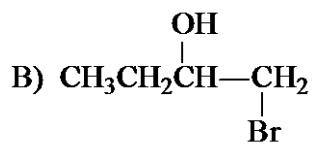
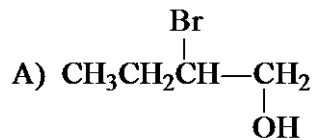
15. What is the product of the following reaction?

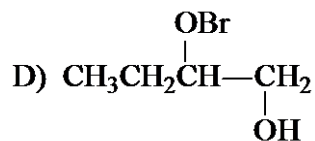




- A. A  
B. B  
C. C  
D. D

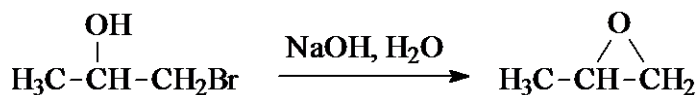
16. Which of the following is compound X of the synthesis shown below?





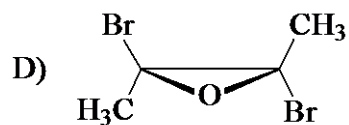
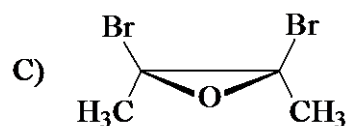
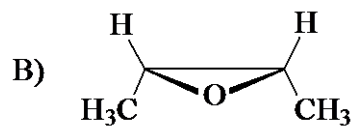
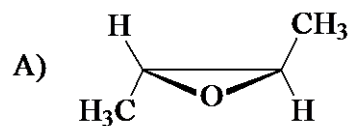
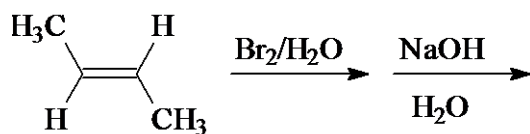
- A. A  
B. B  
C. C  
D. D

17. The reaction shown below can be described as an:



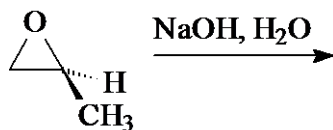
- A. acid-base reaction followed by an intramolecular Williamson ether synthesis.  
B. acid-base reaction followed by an intramolecular  $\text{S}_{\text{N}}1$  reaction.  
C. E2 reaction followed by an addition reaction to a double bond.  
D.  $\text{S}_{\text{N}}2$  reaction followed by an intramolecular Williamson ether synthesis.

18. What is the product of the following sequence of reactions?



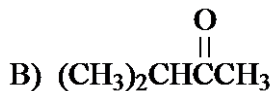
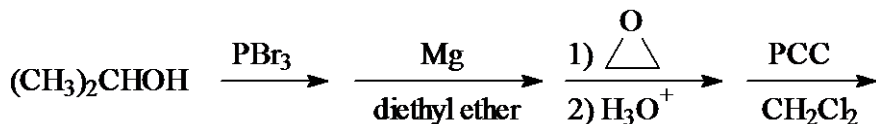
- A. A  
B. B  
C. C  
D. D

19. What is the product of the following reaction?



- A. (S)-1,2-propanediol  
 B. (R)-1,2-propanediol  
 C. racemic mixture of 1,2-propanediol  
 D. 1,3-propanediol

20. What is the final product of the following sequence of reactions?

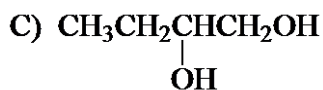
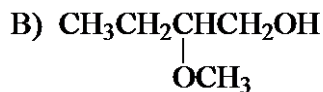
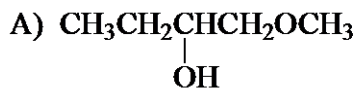
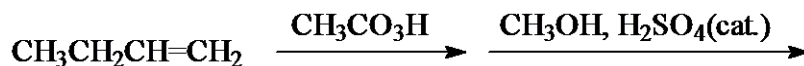


- A. A  
 B. B  
 C. C  
 D. D

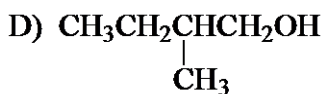
21. Which of the following reacts the fastest with NaOH, H<sub>2</sub>O?

- A. ethylene oxide (oxirane)  
 B. *cis*-2,3-dimethyloxirane  
 C. *trans*-2,3-dimethyloxirane  
 D. 2,2,3,3-tetramethyloxirane

22. What is the product of the reactions below?







- A. A  
 B. B  
 C. C  
 D. D

23. What reagents and/or reaction sequence below would convert *trans*-3-hexene to *meso*-3,4-hexanediol?

- A.  $\text{OsO}_4$ ,  $(\text{CH}_3)_3\text{COOH}$ ,  $(\text{CH}_3)_3\text{COH}$ ,  $\text{NaOH}$   
 B.  $\text{B}_2\text{H}_6$ /diglyme followed by  $\text{H}_2\text{O}_2/\text{NaOH}$   
 C.  $\text{O}_3$  followed by  $\text{Zn}/\text{H}_2\text{O}$   
 D.  $\text{CH}_3\text{CO}_3\text{H}$  followed by  $\text{NaOH}/\text{H}_2\text{O}$

24. What reagents and/or reaction sequence below would convert *cis*-3-hexene to *meso*-3,4-hexanediol?

- A.  $\text{OsO}_4$ ,  $(\text{CH}_3)_3\text{COOH}$ ,  $(\text{CH}_3)_3\text{COH}$ ,  $\text{NaOH}$   
 B.  $\text{B}_2\text{H}_6$ /diglyme followed by  $\text{H}_2\text{O}_2/\text{NaOH}$   
 C.  $\text{O}_3$  followed by  $\text{Zn}/\text{H}_2\text{O}$   
 D.  $\text{CH}_3\text{CO}_3\text{H}$  followed by  $\text{NaOH}/\text{H}_2\text{O}$

25. Which of the following yields an epoxide on treatment with  $\text{NaOH}$ ?

- A. *cis*-2-bromocyclohexanol  
 B. *trans*-2-bromocyclohexanol  
 C. *cis*-1,2-cyclohexanediol  
 D. 3-bromocyclohexene

26. Which reagent(s) below converts cyclohexene to *trans*-1,2-cyclohexanediol?

A)  $\text{OsO}_4$ ,  $(\text{CH}_3)_3\text{COOH}$ ,  $(\text{CH}_3)_3\text{COH}$ ,  $\text{NaOH}$

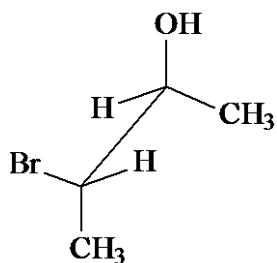
B)  $\text{O}_3$  followed by  $\text{Zn}/\text{H}_2\text{O}$

C)  $\text{CH}_3\overset{\text{O}}{\parallel}\text{COOH}$  followed by  $\text{NaOH}/\text{H}_2\text{O}$

D)  $\text{HIO}_4$

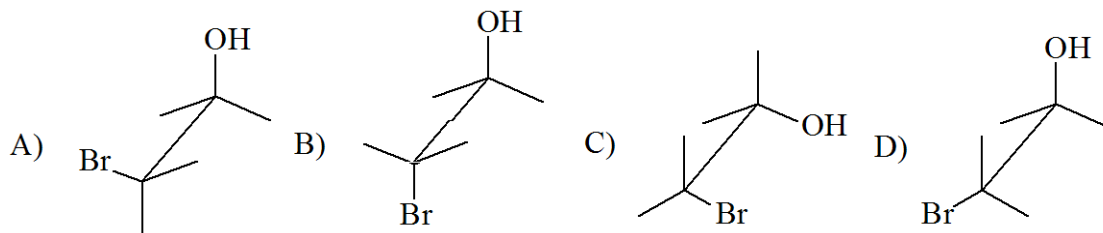
- A. A  
 B. B  
 C. C  
 D. D

27. Which of the following epoxides is formed when  $\text{KOH}$  is added to the optically active halohydrin shown below?



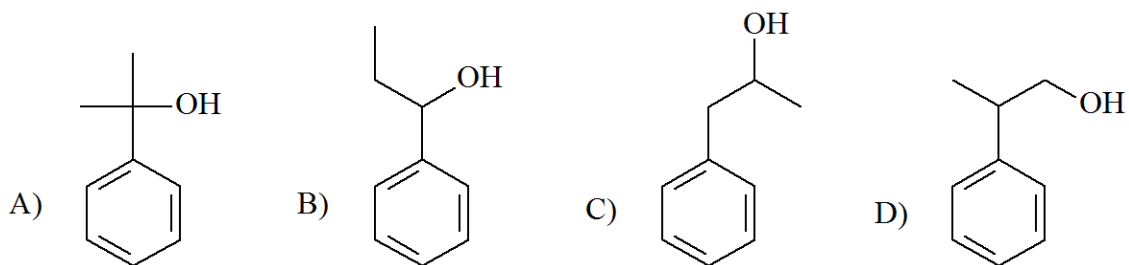
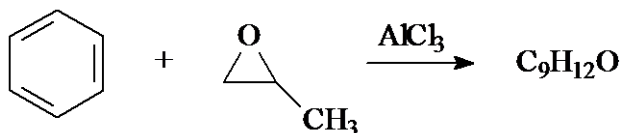
- A. *trans*-(2S,3S)-2,3-dimethyloxirane
- B. *trans*-(2R,3R)-2,3-dimethyloxirane
- C. 2,2-dimethyloxirane
- D. *meso*-2,3-dimethyloxirane

28. Which of the following is the preferred conformation for epoxide ring formation? (Assume a base is provided.)



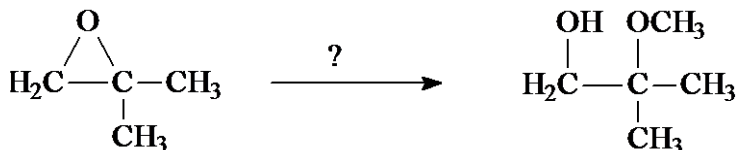
- A. A
- B. B
- C. C
- D. D

29. Benzene reacts with 2-methyloxirane in the presence of  $\text{AlCl}_3$  to give a product with a formula of  $\text{C}_9\text{H}_{12}\text{O}$ . Identify the product.



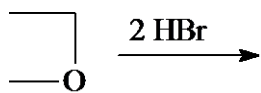
- A. A
- B. B
- C. C
- D. D

30. Which of the following reagents would be used to carry out the reaction shown below?



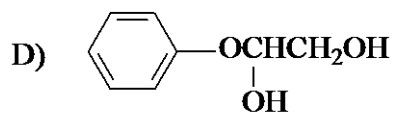
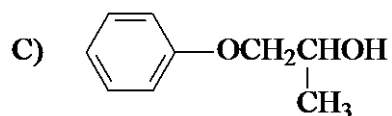
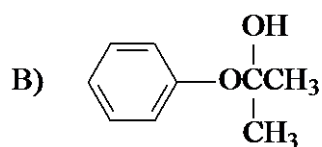
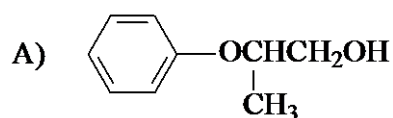
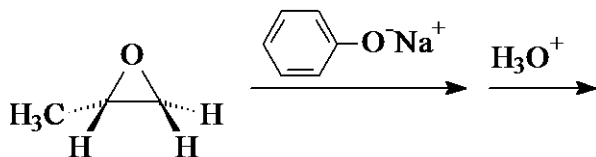
- A.  $\text{CH}_3\text{OH}, \text{CH}_3\text{O}^-\text{Na}^+$
- B.  $\text{CH}_3\text{OH}, \text{H}_2\text{SO}_4$
- C.  $\text{CH}_3\text{MgBr}$ /ether followed by  $\text{H}_3\text{O}^+$
- D.  $\text{H}_2\text{O}/\text{H}_2\text{SO}_4$  followed by  $\text{CH}_3\text{OH}$

31. What is the product of the following reaction?



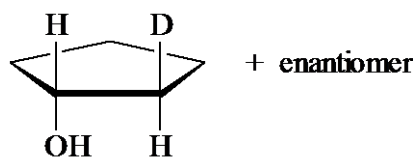
- A. 1,2-dibromobutane
- B. 1,3-dibromopropane
- C. 1,4-dibromobutane
- D. 1,2-dibromopropane

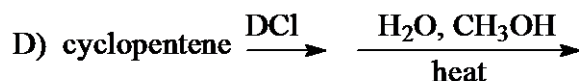
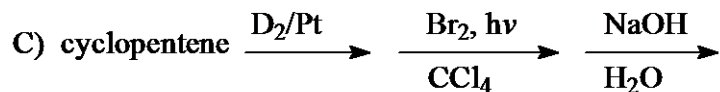
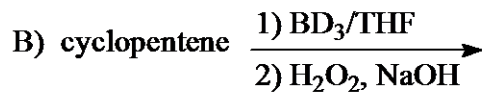
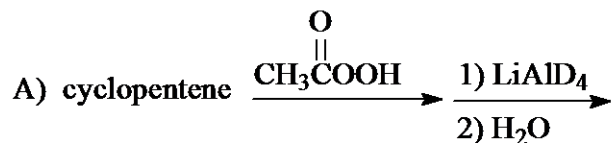
32. What is the major product of the following nucleophilic ring-opening reaction?



- A. A
- B. B
- C. C
- D. D

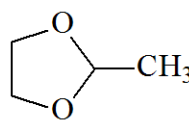
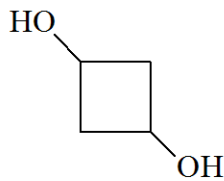
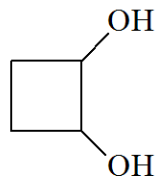
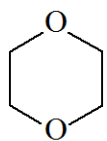
33. Which synthetic pathway below gives a racemic mixture of the following deuterated compound with little or no isomeric impurities?





- A. A  
B. B  
C. C  
D. D

34. Ethylene glycol reacts in acid to form a cyclic compound with the formula of  $\text{C}_4\text{H}_8\text{O}_2$ . Which one of the following is this cyclic compound?

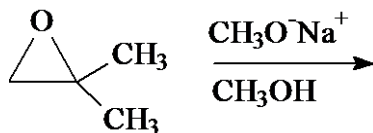


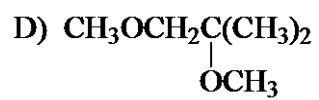
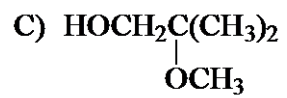
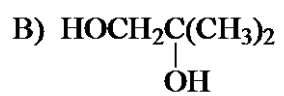
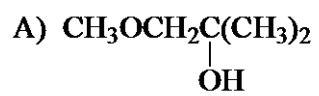
- A) A  
B) B  
C) C  
D) D

35. In general, ethers have a much lower boiling point than their isomeric alcohols. Why?

- A. The carbon-oxygen bond in ethers is nonpolar.  
B. Unlike alcohols, ethers cannot act as Lewis bases.  
C. Ethers are less reactive than alcohols.  
D. Unlike alcohols, ethers cannot hydrogen bond with each other.

36. What is the product of the reaction shown below?





- A. A
- B. B
- C. C
- D. D

## ACS Review Ethers Epoxides and Sulfides KEY

1. A
2. B
3. B
4. B
5. C
6. C
7. A
8. C
9. B
10. A
11. C
12. B
13. C
14. C
15. A
16. B
17. A
18. A
19. A
20. C
21. A
22. B
23. D
24. A
25. B
26. C
27. D
28. B
29. D
30. B
31. B
32. C
33. A
34. A
35. D
36. A