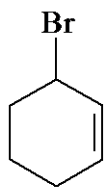
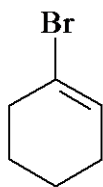


# ACS Review Conjugation in Alkadienes and Allylic Systems

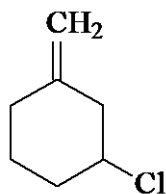
1. Identify the allylic halide(s).



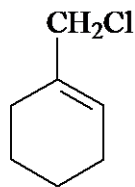
I



II



III



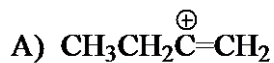
IV

- A. only II  
 B. I and II  
 C. I and IV  
 D. I, III, and IV

2. How many vinylic hydrogens are there in 1-ethylcyclohexene?

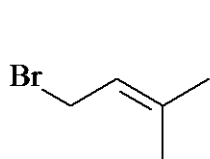
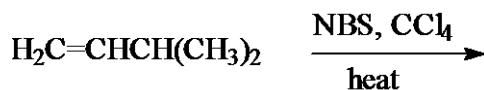
- A. one  
 B. two  
 C. three  
 D. four

3. Which of the following carbocations is the most stable?

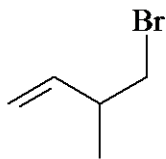


- A. A  
 B. B  
 C. C  
 D. D

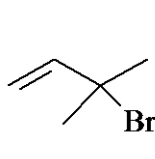
4. What is(are) the expected product(s) of the following reaction?



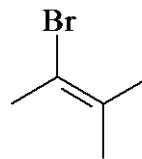
I



II



III

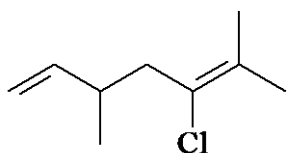


IV

- A. only II  
 B. only III

- C. I and III  
D. II and IV

5. What is the IUPAC name of the following diene?



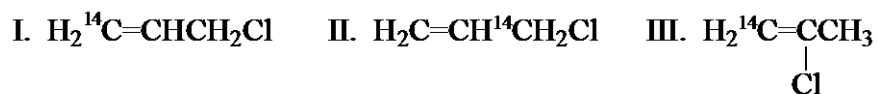
- A. 3-chloro-2,5-dimethyl-2,6-heptadiene  
B. 3-chloro-2,5-dimethyl-1,5-heptadiene  
C. 5-chloro-3,5-dimethyl-1,6-heptadiene  
D. 5-chloro-3,6-dimethyl-1,5-heptadiene

6. Which of the following are conjugated dienes?

- I. 1,2-octadiene      II. 1,3-octadiene      III. 2,5-octadiene      IV. 1,7-octadiene

- A. only I  
B. only II  
C. I and II  
D. II and III

7. Chlorination of  $^{14}\text{C}$ -labeled propene ( $\text{H}_2^{14}\text{C}=\text{CHCH}_3$ ) with  $\text{Cl}_2$  at high temperature would give which of the following chloropropenes?

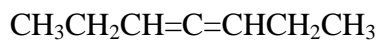


- A. only I  
B. only II  
C. I and II  
D. I and III

8. Which compound below has the lowest heat of hydrogenation?

- A. 1,5-hexadiene  
B. (*E*)-1,4-hexadiene  
C. 3,4-hexadiene  
D. (*E,E*)-2,4-hexadiene

9. What type or types of stereoisomers are possible for 3,4-heptadiene, shown below?



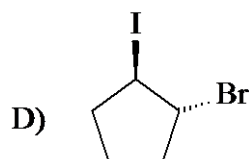
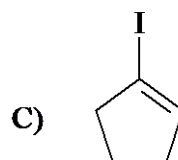
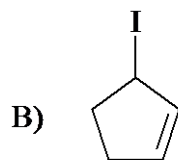
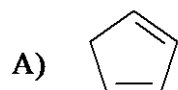
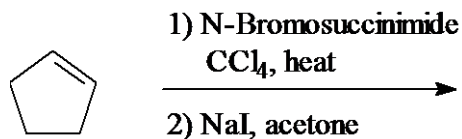
- A. a pair of enantiomers  
B. two diastereomers, *E* and *Z*  
C. three diastereomers, (*E,E*), (*E,Z*), and (*Z,Z*)  
D. no stereoisomers are possible

10. Which of the following compounds most readily undergoes solvolysis with methanol?

- A. (*E*)-1-bromo-1-butene  
B. 2-bromo-1-butene  
C. 3-bromo-1-butene

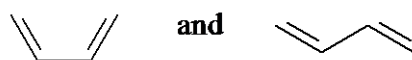
D. 4-bromo-1-butene

11. What is the product of the reaction sequence shown below?



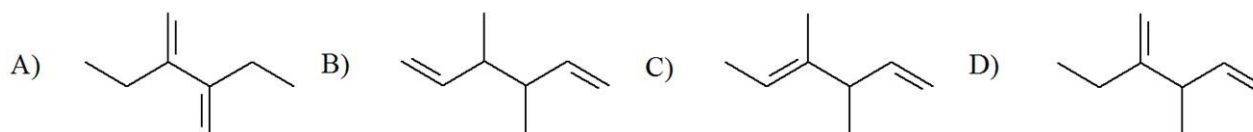
- A. A  
B. B  
C. C  
D. D

12. What is the relationship between the *s*-cis and *s*-trans forms of 1,3-butadiene?



- A. constitutional isomers  
B. different conformations of the same compound  
C. diastereomers  
D. resonance forms

13. Which compound undergoes 1,4-addition with Br<sub>2</sub>?



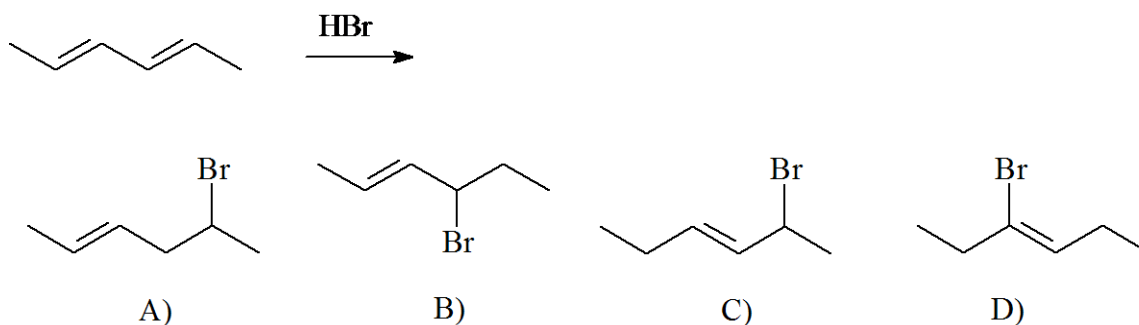
- A. A  
B. B

- C. C  
D. D

14. Addition of one equivalent of HBr to 1,3-cyclohexadiene gives:

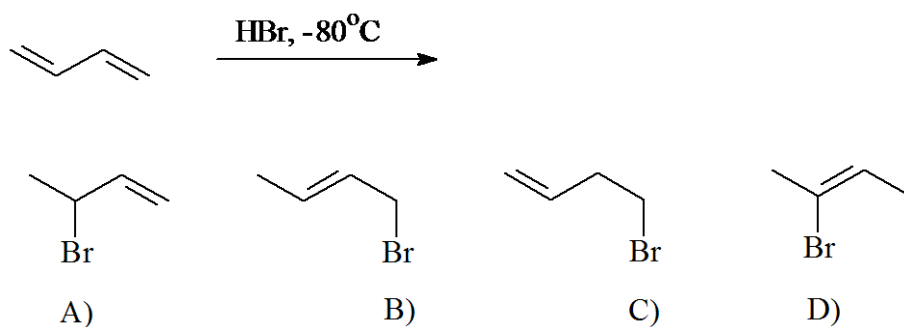
- A. bromocyclohexane  
B. 3-bromocyclohexene  
C. 4-bromocyclohexene  
D. 3-bromocyclohexene and 4-bromocyclohexene

15. Which of the following is the 1,4-addition product in the reaction shown below?



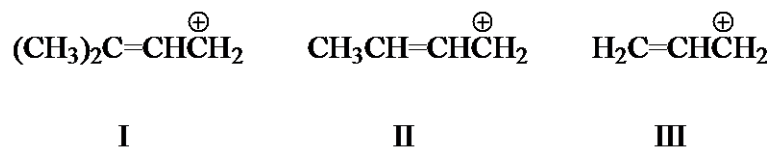
- A. A  
B. B  
C. C  
D. D

16. What is the kinetically controlled product in the following reaction?



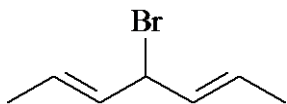
- A. A  
B. B  
C. C  
D. D

17. Rank the following carbocations in decreasing order of stability.

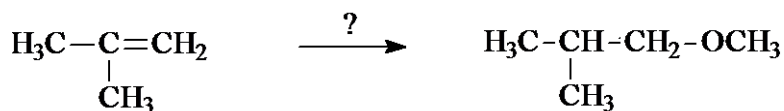


- A. I > II > III  
B. III > II > I  
C. II > I > III  
D. they are of equal stability

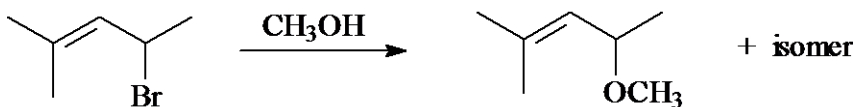
18. Give the total number of resonance forms of the carbocation which results from the  $S_N1$  ionization of the compound shown below.

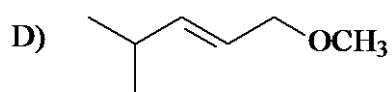
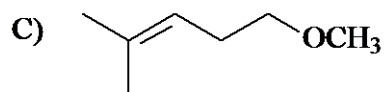
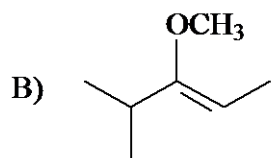
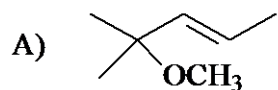


- A. no resonance forms - a single Lewis structure  
 B. two  
 C. three  
 D. four
19. Which reaction sequence below would work best (and with highest overall yield) in the following conversion?



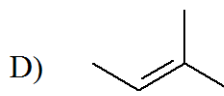
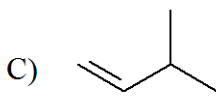
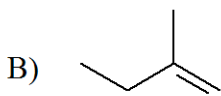
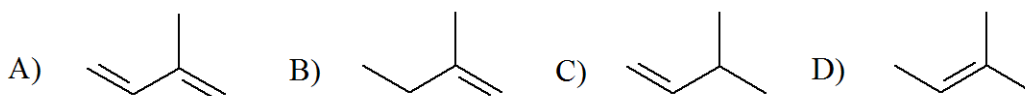
- A) (1)  $\text{H}_2/\text{Pt}$                       (2)  $\text{Br}_2$ , light                      (3)  $\text{CH}_3\text{O}^-\text{Na}^+$   
 B) (1) NBS,  $\text{CCl}_4$ , heat            (2)  $\text{CH}_3\text{O}^-\text{Na}^+$                       (3)  $\text{H}_2/\text{Pt}$   
 C) (1) NBS,  $\text{CCl}_4$ , heat            (2)  $\text{H}_2/\text{Pt}$                               (3)  $\text{CH}_3\text{O}^-\text{Na}^+$   
 D) (1) HBr, peroxides                (2)  $\text{CH}_3\text{OH}$ , heat
- A. A  
 B. B  
 C. C  
 D. D
20. Methanolysis of 4-bromo-2-methyl-2-pentene gives two isomeric substitution products, one of which is shown. What is the other substitution product?





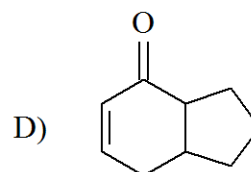
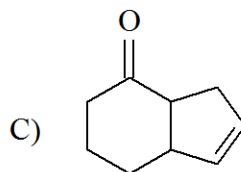
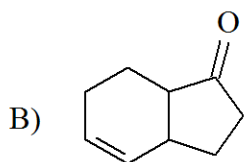
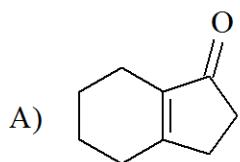
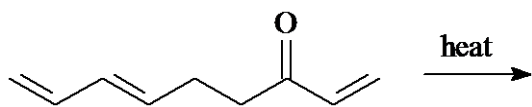
- A. A  
B. B  
C. C  
D. D

21. Which one of the following gives only a single allylic bromide on heating with NBS in carbon tetrachloride?



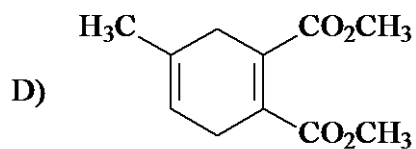
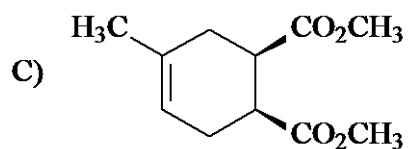
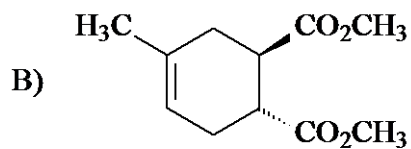
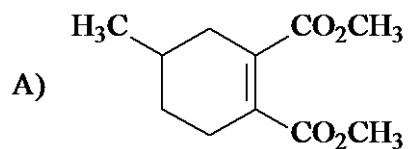
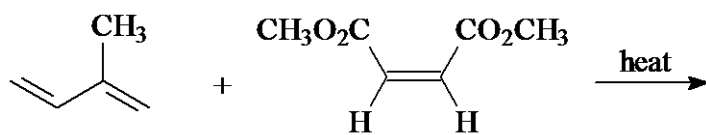
- A. A  
B. B  
C. C  
D. D

22. Which of the following is the product of the intramolecular Diels-Alder reaction shown below?



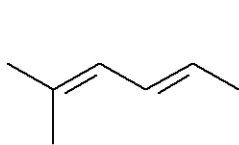
- A. A  
B. B  
C. C  
D. D

23. What is the product of the following Diels-Alder reaction?

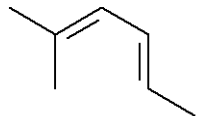


- A. A  
B. B  
C. C  
D. D

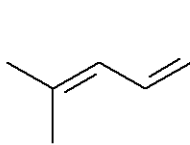
24. Which one of the following is the *s*-trans conformation of (*E*)-2-methyl-2,4-hexadiene?



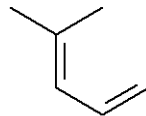
A)



B)



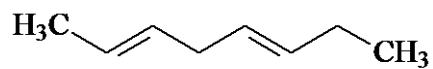
C)



D)

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

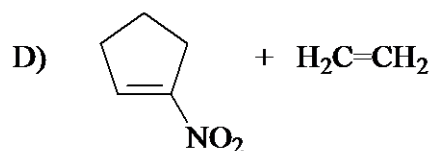
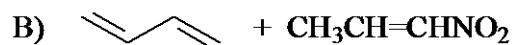
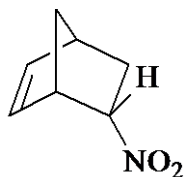
25. Identify the weakest carbon-hydrogen bond in the following diene.



1 2 3 4 5 6 7 8

- A. C-H on C(1)
- B. C-H on C(2)
- C. C-H on C(4)
- D. C-H on C(7)

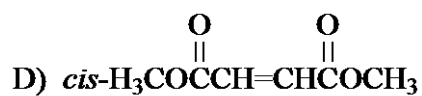
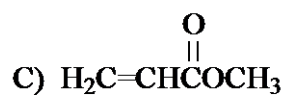
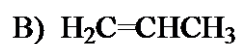
26. Identify the diene and dienophile which would give the following product.



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

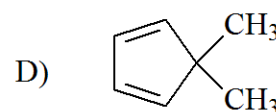
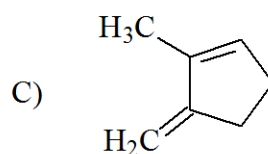
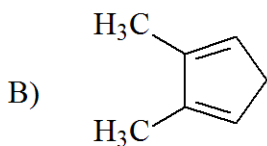
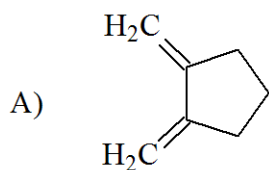
27. Which dienophile is most reactive with 1,3-butadiene?





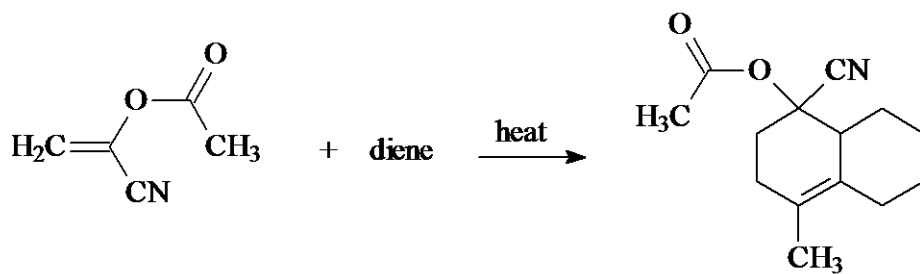
- A. A  
B. B  
C. C  
D. D

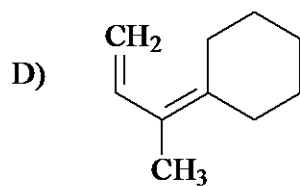
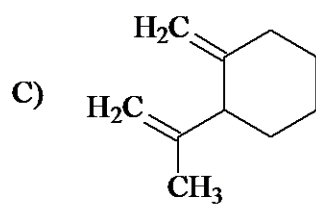
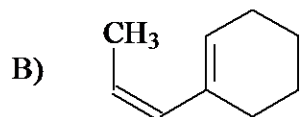
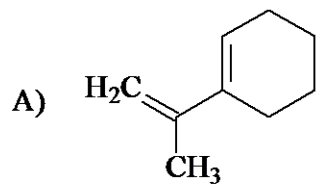
28. Which of the following compounds cannot react as a diene in a Diels-Alder reaction?



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

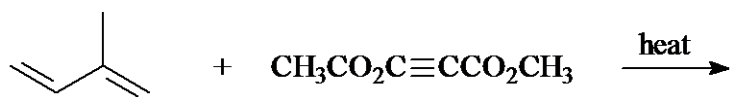
29. Identify the diene used in the reaction shown below.

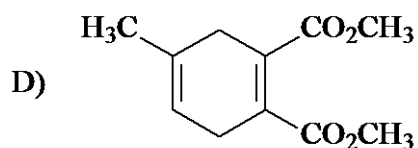
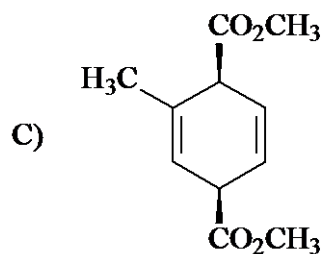
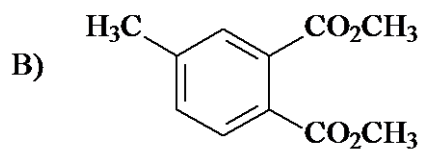
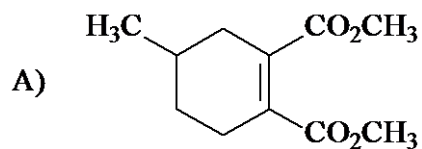




- A. A  
 B. B  
 C. C  
 D. D

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



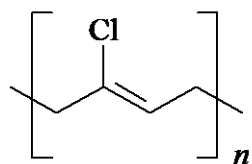


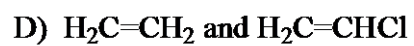
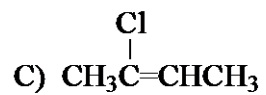
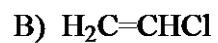
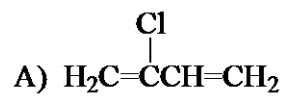
- A. A  
 B. B  
 C. C  
 D. D

31. Which of the following is not true concerning the addition of HCl to 1,3-butadiene?

- A. The intermediate is an allylic carbocation.  
 B. A carbocation rearrangement leads to the 1,4-addition product.  
 C. The 1,4-addition product is the thermodynamically controlled product.  
 D. The reaction mechanism has two steps.

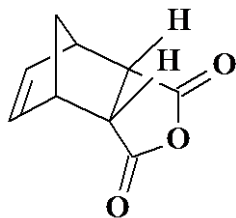
32. Which of the following is the monomer or monomers needed to make the polymer neoprene shown below?

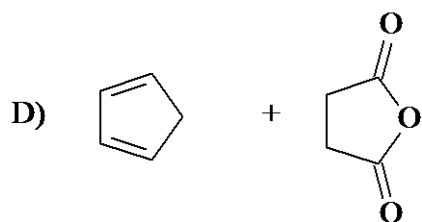
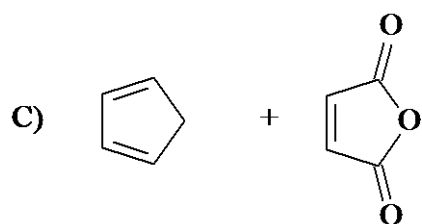
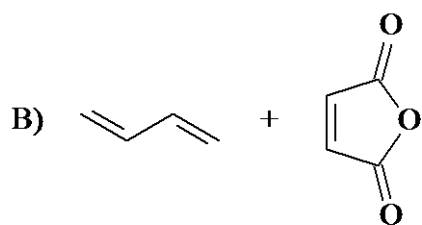
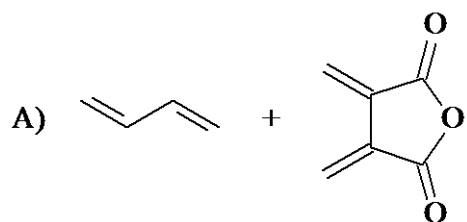




- A. A
- B. B
- C. C
- D. D

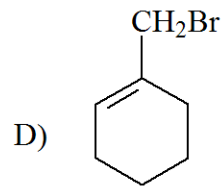
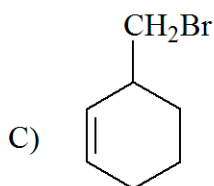
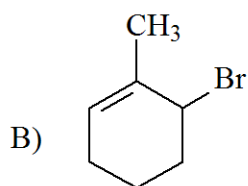
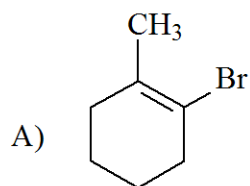
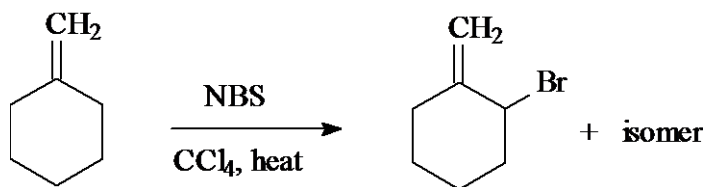
33. Identify the diene and dienophile needed to make the following Diels-Alder adduct.





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

34. Allylic bromination of methylenecyclohexane would be expected to give two isomeric monobromination products. Identify the other isomer.



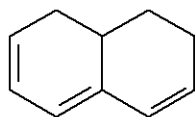
- A. A  
B. B  
C. C

D. D

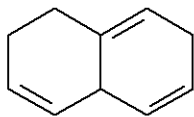
35. Which one of the following is not true concerning Diels-Alder reactions?

- A. The reaction is stereospecific.
- B. The reaction mechanism has only one step.
- C. The reaction mechanism involves a resonance stabilized carbocation.
- D. The diene must be a conjugated diene.

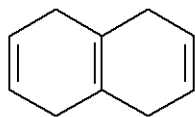
36. Which of the following isomers of  $C_{10}H_{12}$  has the greatest resonance energy (delocalization energy)?



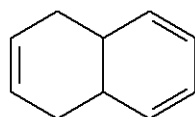
A)



B)



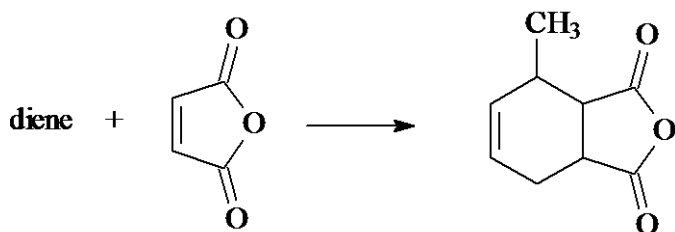
C)



D)

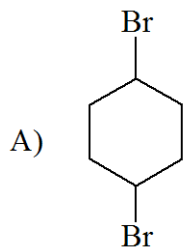
- A. A
- B. B
- C. C
- D. D

37. Identify the diene needed for the following reaction.

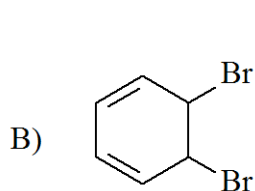


- A. 1,3-pentadiene
- B. 1,4-pentadiene
- C. 2-methyl-1,3-butadiene
- D. 1-methyl-1,3-cyclohexadiene

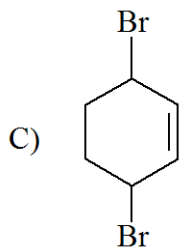
38. Which of the following is the 1,4-addition product of  $Br_2$  to 1,3-cyclohexadiene?



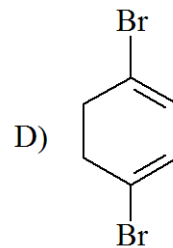
A)



B)



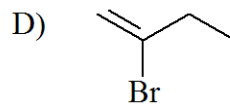
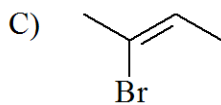
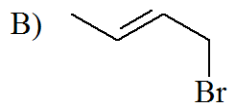
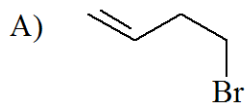
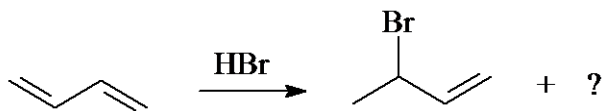
C)



D)

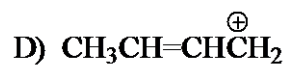
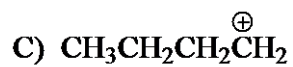
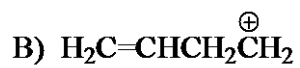
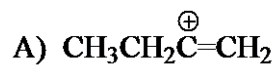
- A. A
- B. B
- C. C
- D. D

39. The addition of HBr to 1,3-butadiene gives two products. One of the products is shown. Identify the second product.



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

40. Which of the following is the most stable carbocation?



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

## ACS Review Conjugation in Alkadienes and Allylic Systems KEY

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