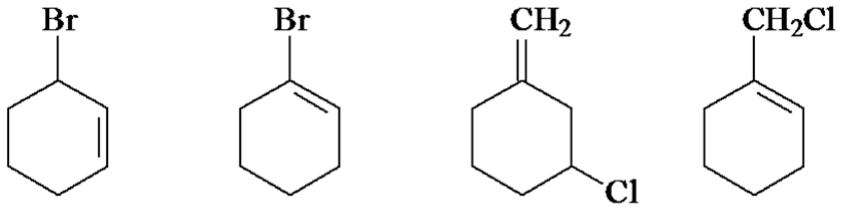
Chapter 10: Conjugation in Alkadienes and Allylic Systems

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
Ans: C

2. How many vinylic hydrogens are there in 1-ethylcyclohexene?
A) one B) two C) three D) four
Ans: A

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

A) $CH_3CH_2\overset{\oplus}{C}=CH_2$

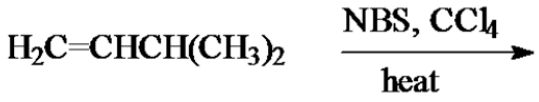
B) $H_2C=CHCH_2\overset{\oplus}{C}H_2$

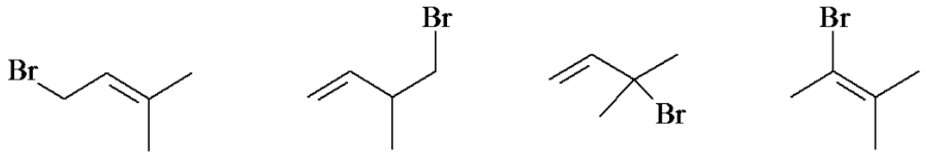
C) $CH_3CH_2CH_2\overset{\oplus}{C}H_2$

D) $CH_3CH=CH\overset{\oplus}{C}H_2$

A) A B) B C) C D) D
Ans: D

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

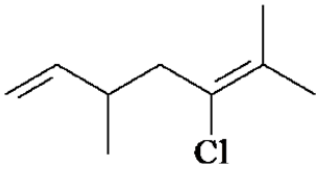




I II III IV

A) only II B) only III C) I and III D) II and IV
Ans: C

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
Ans: D

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
Ans: B

7. Chlorination of ^{14}C-labeled propene ($H_2{}^{14}C{=}CHCH_3$) with Cl_2 at high temperature would give which of the following chloropropenes?

I. $H_2{}^{14}C{=}CHCH_2Cl$ II. $H_2C{=}CH^{14}CH_2Cl$ III. $H_2{}^{14}C{=}C(Cl)CH_3$

A) only I B) only II C) I and II D) I and III
Ans: C

8. Which compound below has the lowest heat of hydrogenation?
A) 1,5-hexadiene C) 3,4-hexadiene
B) (*E*)-1,4-hexadiene D) (*E*,*E*)-2,4-hexadiene
Ans: D

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

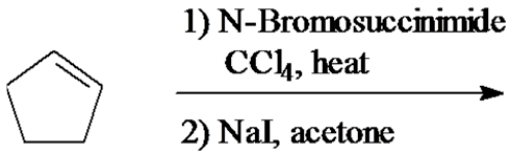
$CH_3CH_2CH=C=CHCH_2CH_3$

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
Ans: A

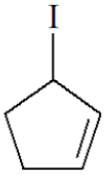
10. Which of the following compounds most readily undergoes solvolysis with methanol?

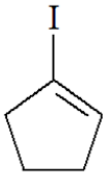
A) (*E*)-1-bromo-1-butene
B) 2-bromo-1-butene
C) 3-bromo-1-butene
D) 4-bromo-1-butene
Ans: C

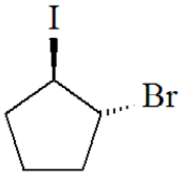
11. What is the product of the reaction sequence shown below?



A) 

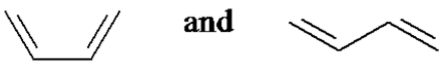
B) 

C) 

D) 

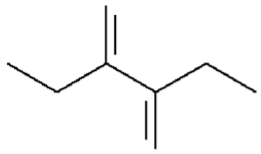
A) A B) B C) C D) D
Ans: B

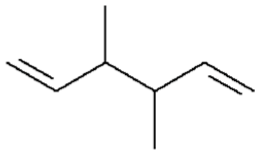
12. What is the relationship between the *s*-cis and *s*-trans forms of 1,3-butadiene?

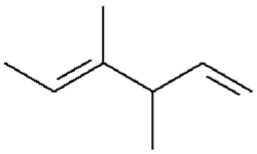


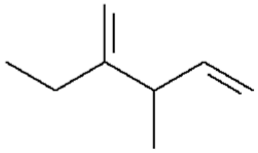
A) constitutional isomers
B) different conformations of the same compound
C) diastereomers
D) resonance forms
Ans: B

13. Which compound undergoes 1,4-addition with Br_2?

A) 

B) 

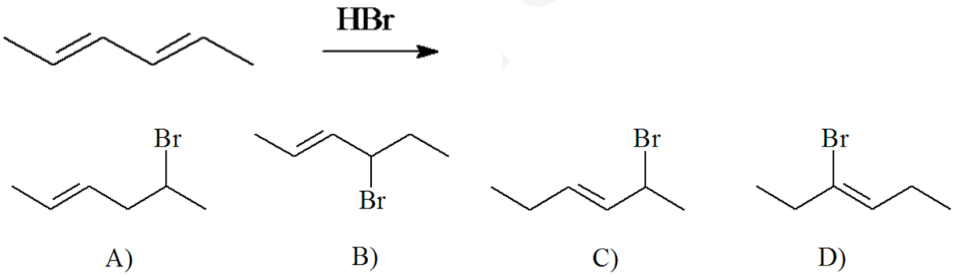
C) 

D) 

A) A B) B C) C D) D
Ans: A

14. Addition of one equivalent of HBr to 1,3-cyclohexadiene gives
A) bromocyclohexane.
B) 3-bromocyclohexene.
C) 4-bromocyclohexene.
D) 3-bromocyclhexene and 4-bromocyclohexene.
Ans: B

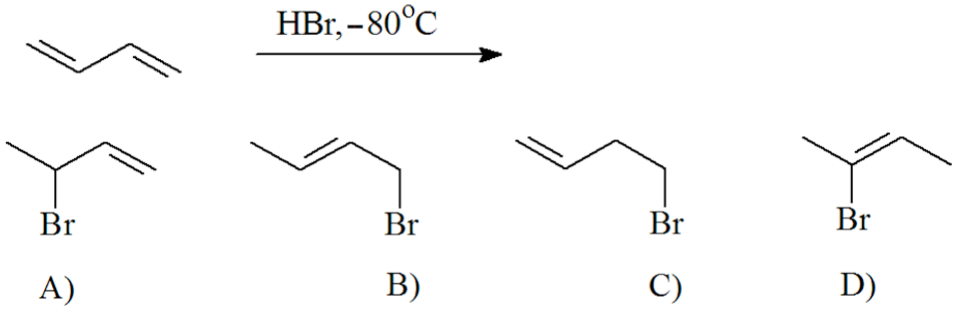
15. Which of the following is the 1,4-addition product in the reaction shown below?



A) B) C) D)

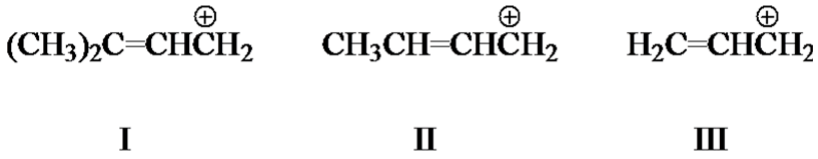
A) A B) B C) C D) D
Ans: C

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



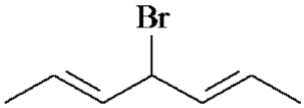
A) A B) B C) C D) D
Ans: A

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



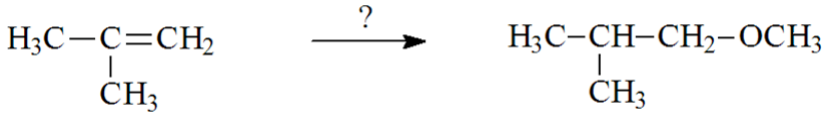
A) I > II > III B) III > II > I C) II > I > III D) They are of equal stability.
Ans: A

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
Ans: C

19. Which reaction sequence below would work best (and with highest overall yield) in the following conversion?



A) (1) H_2/Pt
(2) Br_2, light
(3) $CH_3O^-Na^+$

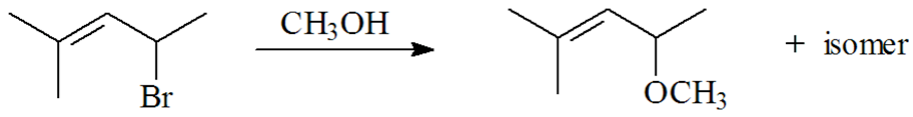
B) (1) NBS, CCl_4, heat
(2) $CH_3O^-Na^+$
(3) H_2/Pt

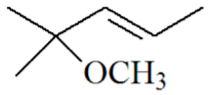
C) (1) NBS, CCl_4, heat
(2) H_2/Pt
(3) $CH_3O^-Na^+$

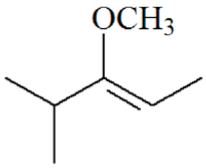
D) (1) HBr, peroxides
(2) CH_3OH, heat

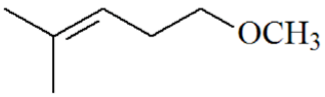
A) A B) B C) C D) D
Ans: B

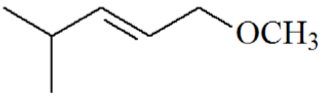
20. Methanolysis of 4-bromo-2-methyl-2-pentene gives two isomeric substitution products, one of which is shown. What is the other substitution product?



A) 

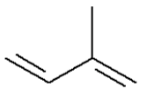
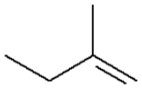
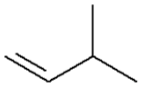
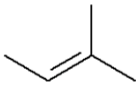
B) 

C) 

D) 

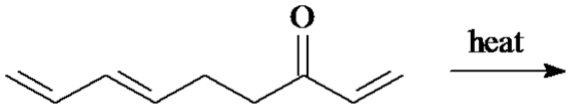
A) A B) B C) C D) D
Ans: A

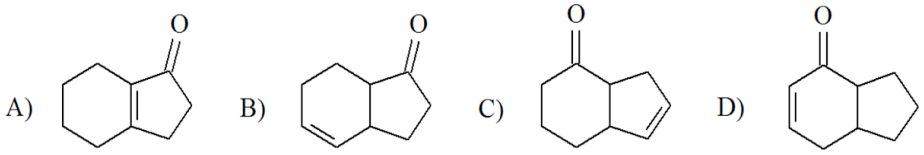
21. Which one of the following gives only a single allylic bromide on heating with NBS in carbon tetrachloride?

A) 
B) 
C) 
D) 

A) A B) B C) C D) D
Ans: A

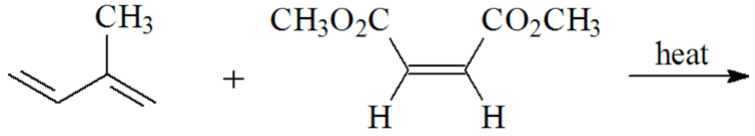
22. Which of the following is the product of the intramolecular Diels-Alder reaction shown below?

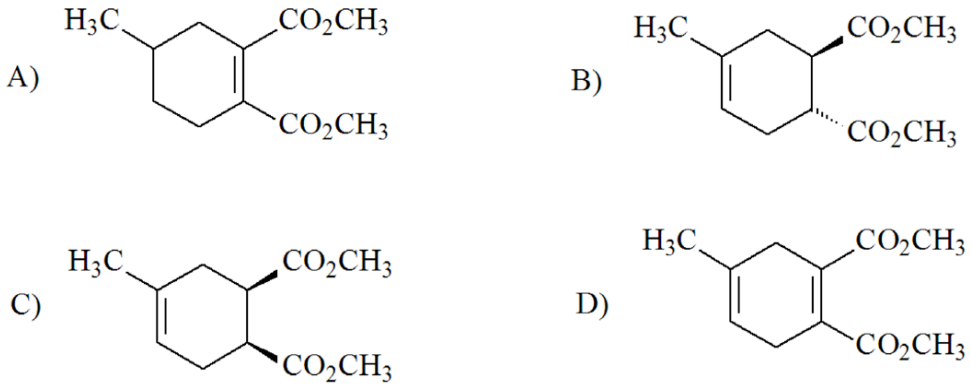




A) A B) B C) C D) D
Ans: B

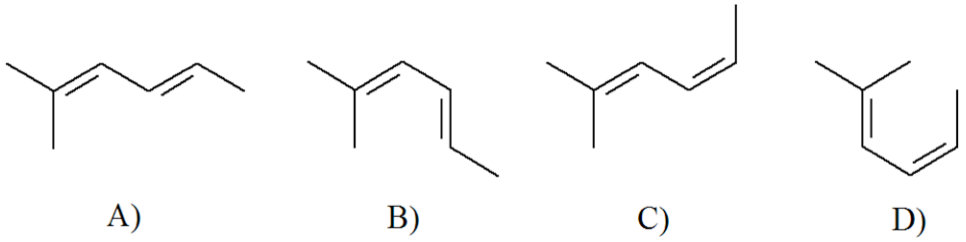
23. What is the product of the following Diels-Alder reaction?





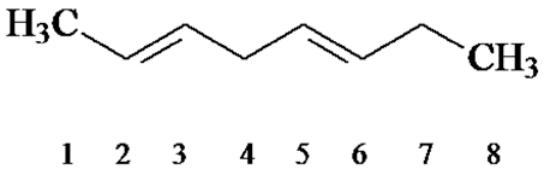
A) A B) B C) C D) D
Ans: C

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



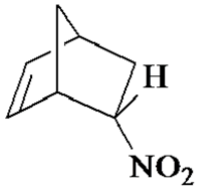
A) A B) B C) C D) D
Ans: A

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



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

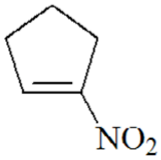
26. Identify the diene and dienophile which would give the following product.



A)  + $H_2C{=}CHNO_2$

B)  + $CH_3CH{=}CHNO_2$

C)  + $H_2C{-}CHNO_2$

D)  + $H_2C{-}CH_2$

A) A B) B C) C D) D
Ans: A

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

A) $H_2C{=}CH_2$

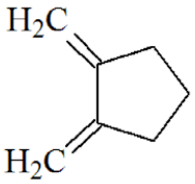
B) $H_2C{=}CHCH_3$

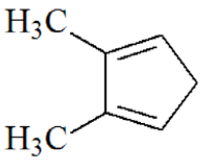
C) $H_2C{=}CHC(=O)OCH_3$

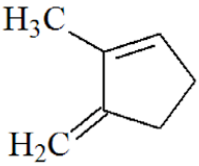
D) *cis*-$H_3COC(=O)CH{=}CHC(=O)OCH_3$

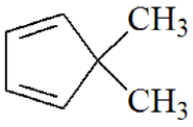
A) A B) B C) C D) D
Ans: D

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

A) 

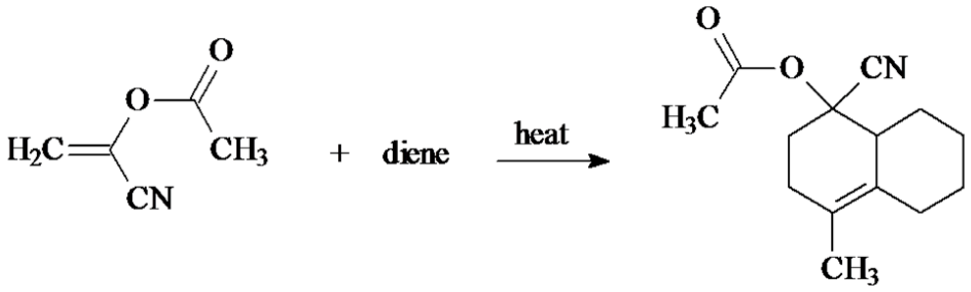
B) 

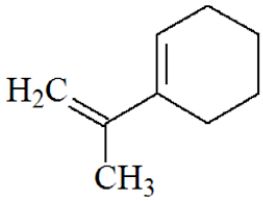
C) 

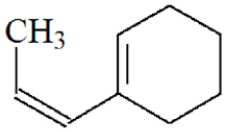
D) 

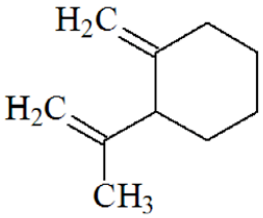
A) A B) B C) C D) D
Ans: C

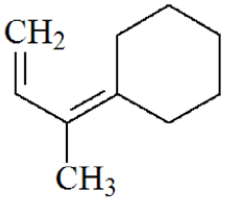
29. Identify the diene used in the reaction shown below.



A) 

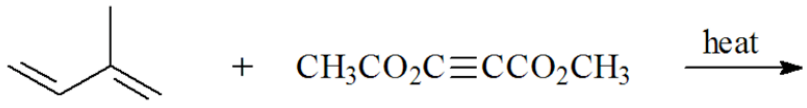
B) 

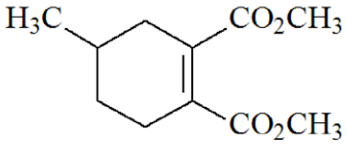
C) 

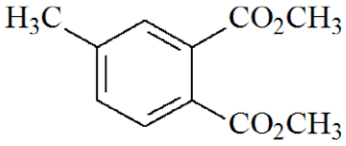
D) 

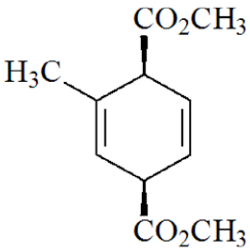
A) A B) B C) C D) D
Ans: A

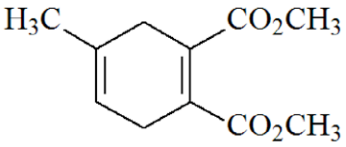
30. What is the product of the reaction shown below?



A) 

B) 

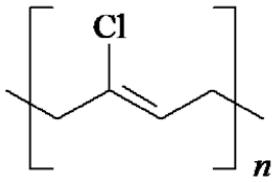
C) 

D) 

A) A B) B C) C D) D
Ans: D

31. Which of the following is <u>not</u> 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.
Ans: B

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



A) $H_2C{-}\overset{\overset{Cl}{|}}{C}CH{-}CH_2$

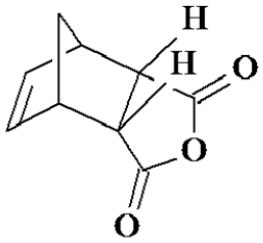
B) $H_2C{-}CHCl$

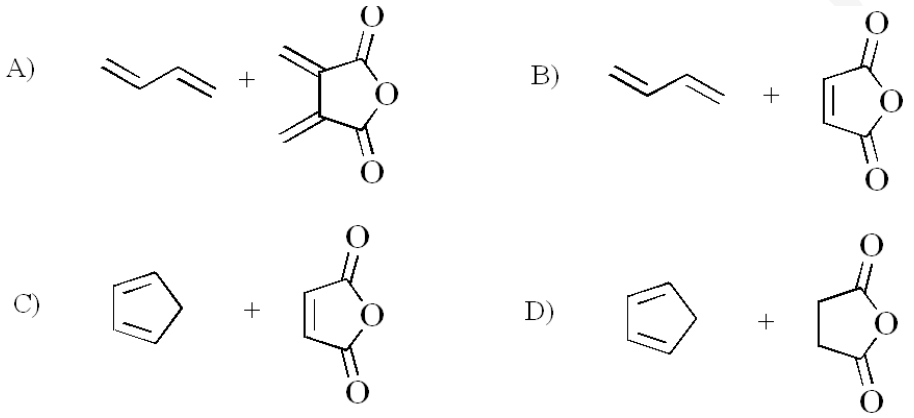
C) $CH_3\overset{\overset{Cl}{|}}{C}{=}CHCH_3$

D) $H_2C{=}CH_2$ and $H_2C{=}CHCl$

A) A B) B C) C D) D
Ans: A

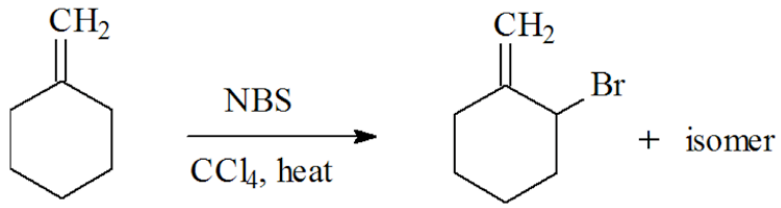
33. Identify the diene and dienophile needed to make the following Diels-Alder adduct.

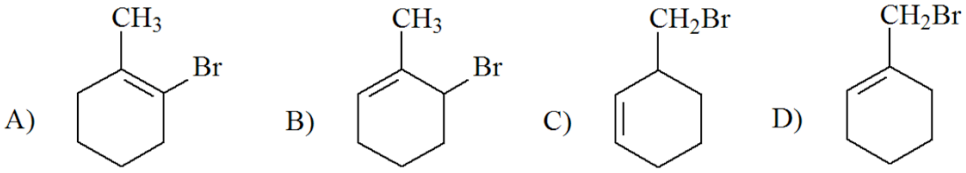




A) A B) B C) C D) D
Ans: C

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

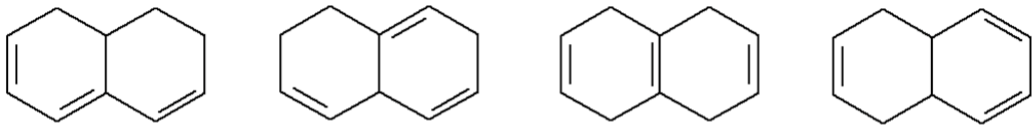




A) A B) B C) C D) D
Ans: D

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.
    Ans: C

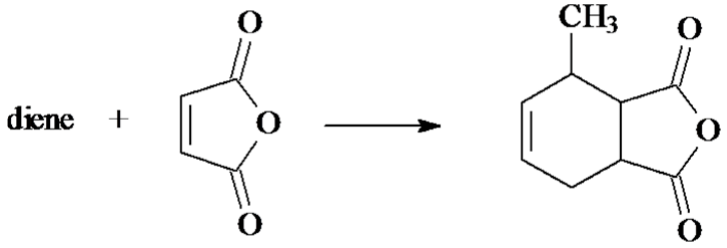
36. Which of the following isomers of $C_{10}H_{12}$ has the greatest resonance energy (delocalization energy)?



A) B) C) D)

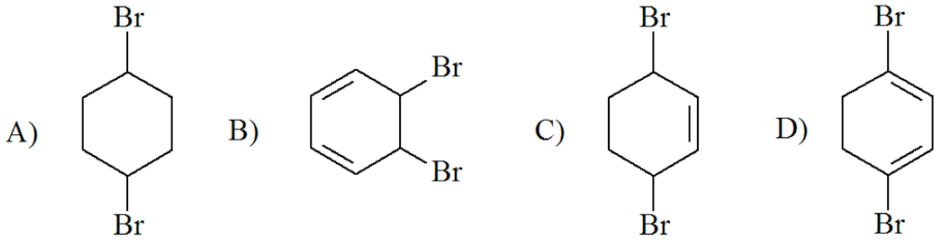
    A) A B) B C) C D) D
    Ans: A

37. Identify the diene needed for the following reaction.



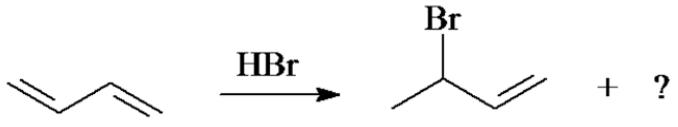
    A) 1,3-pentadiene
    B) 1,4-pentadiene
    C) 2-methyl-1,3-butadiene
    D) 1-methyl-1,3-cyclohexadiene
    Ans: A

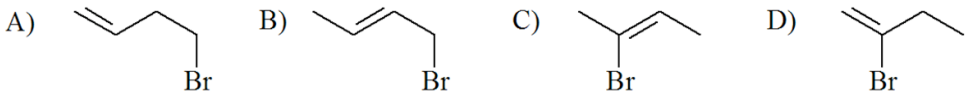
38. Which of the following is the 1,4-addition product of Br_2 to 1,3-cyclohexadiene?



    A) A B) B C) C D) D
    Ans: C

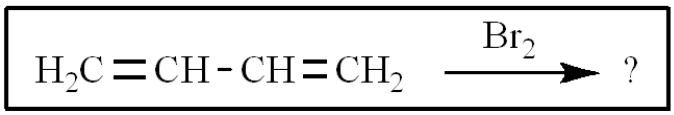
39. The addition of HBr to 1,3-butadiene gives two products. One of the products is shown. Identify the second product.

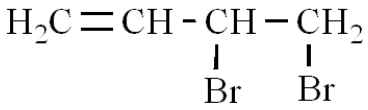


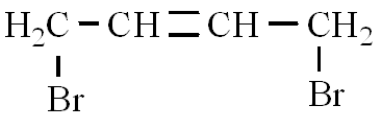


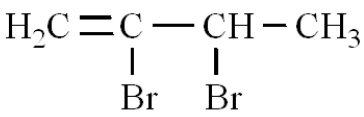
A) A B) B C) C D) D
Ans: B

40. What product do you **NOT** expect from this reaction?



A 

B 

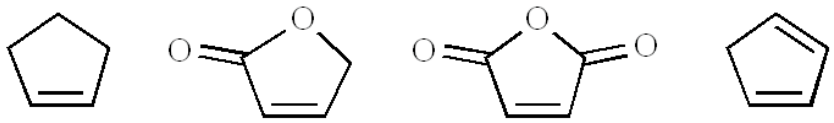
C 

D All of these are formed

A) A B) B C) C D) D
Ans: C

41. Why is 1,3-cyclopentadiene not sold by ANY chemical suppliers?
A) it cannot be made
B) it is too expensive
C) it reacts with itself
D) it is a gas, and gases are too dangerous to transport
Ans: C

42. Which would be the most reactive dienophile?



A B C D

A) A B) B C) C D) D
Ans: C

43. Which of the following would react fastest with 1,3-cyclopentadiene?

A. $H_2C=CH-CH_2-CH_2-CHO$

B. $H_2C=CH-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$

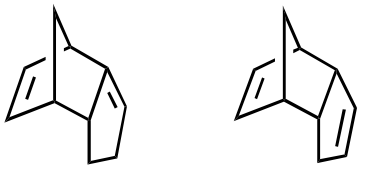
C. $H_2C=CH-\overset{\overset{O}{\|}}{C}-CH_2-CH_3$

D. $HC\equiv C-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$

A) A B) B C) C D) D
Ans: C

44. 1,3-cyclopentadiene is known for
A) its unusually high acidity ($pK_a \sim 16$)
B) slowly dimerizing at room temperature
C) being a good Diels-Alder diene
D) all of the above.
Ans: D

45. What material is cyclopentadiene made from?



A

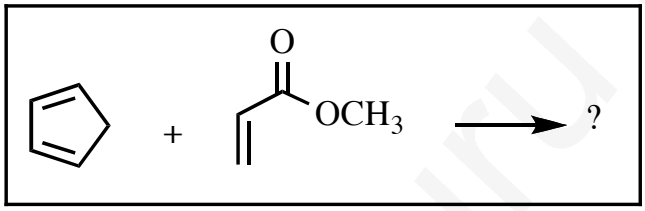
B

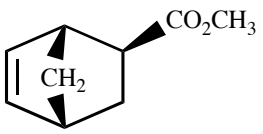
C

D

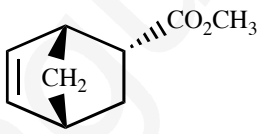
A) A B) B C) C D) D
Ans: B

46. What product will result from this reaction?

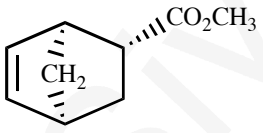




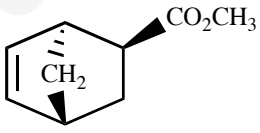
A



B



C



D

A) A B) B C) C D) D
Ans: B