Conjugated Systems

Conjugated systems are systems with alternating single and double bonds. The double bonds can interact with each other when they are separated by only one single bond.

Conjugated diene:

$CH_2=CH-CH=CH-CH_2$

Unconjugated diene:

$CH_2=CH-CH_2-CH=CH_2$

Conjugated systems are more stable than their non-conjugated counterparts.

Molecular Orbital Theory

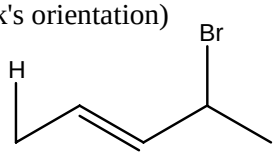
The most stable conformation of a conjugated diene will usually be the one that allows for the electrons in the double bonds to be delocalized over the entire molecule or as much of the molecule as possible.

General Reactions

1,2 and 1,4 addition to conjugated dienes:

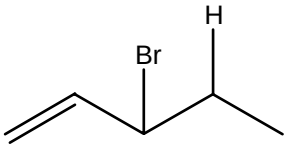
When numbering the carbons to identify the 1,2 and 1,4 positions remember that you may start from either double bond, shown above.

1,2 addition--H adds to the 1st carbon and the Br adds to the second (Mark's orientation)

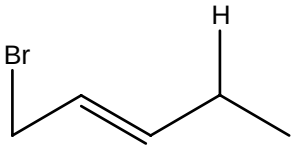


1,4 addition sends the Br to the fourth carbon.
Note also that the position of the double bond has changed.

1,2 addition--numbered the other way



1,4 addition--numbered the other way



Consult your textbook for a mechanism for this reaction. It is one you need to know!

Practice Problem

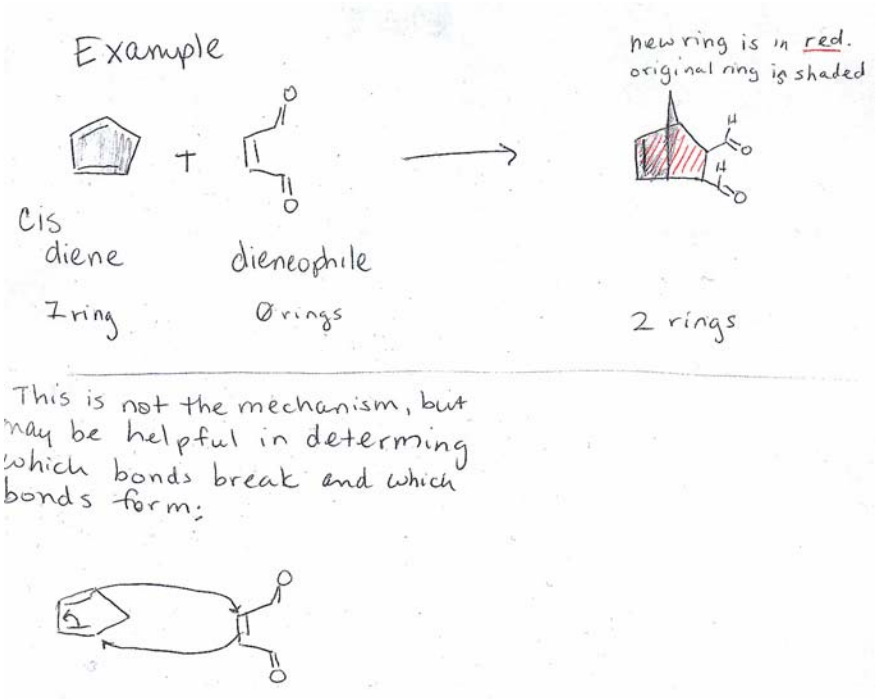
Predict the products of the following reaction:

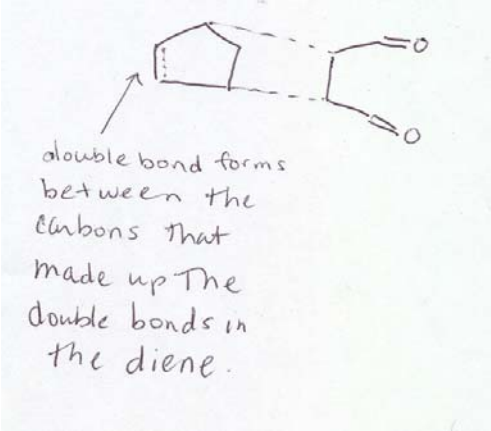
1) 1,3 hexadiene + hydrobromic acid

Answer

Diels Alder

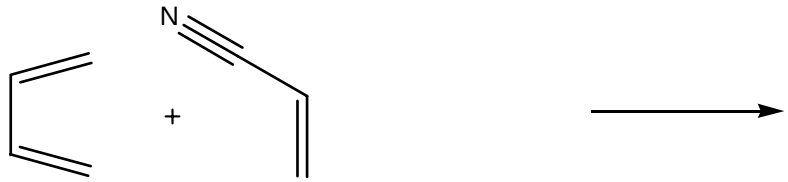
The Diels-Alder reaction is a concerted reaction involving a diene having a cis conformation with a dieneophile and results in a ring forming between the two. This means that the number of rings in the product will always be one more than the number of rings in the reactants. Syn stereochemistry is observed.

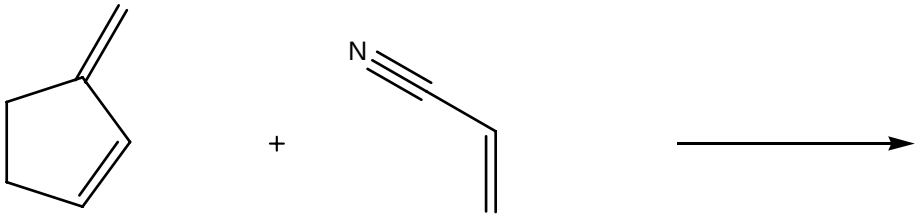




Note also that in the final product the electronegative group from the dienophile needs to be in the *endo* position rather than the *exo* position.

Practice Problem
Predict the products of the following reactions:
2)



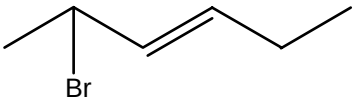


Answer

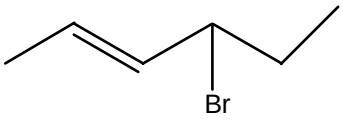
Answer to Practice Problem 1

1,2 addition

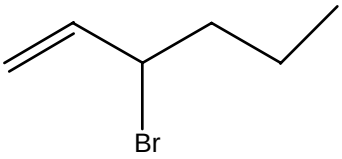
1 2 3 4

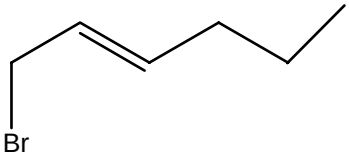


1,4 addition



4 3 2 1

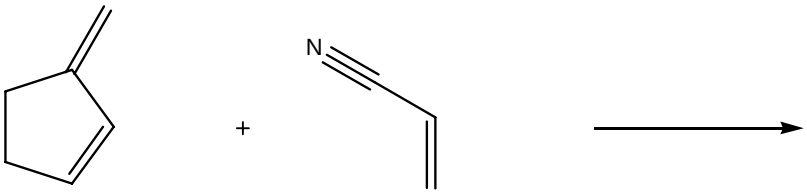




Back to Practice Problem

Answer to Practice Problem 2

Make sure to depict eno stereochemistry.



No Reaction.
Locked into Trans configuration.

Back to Practice Problem