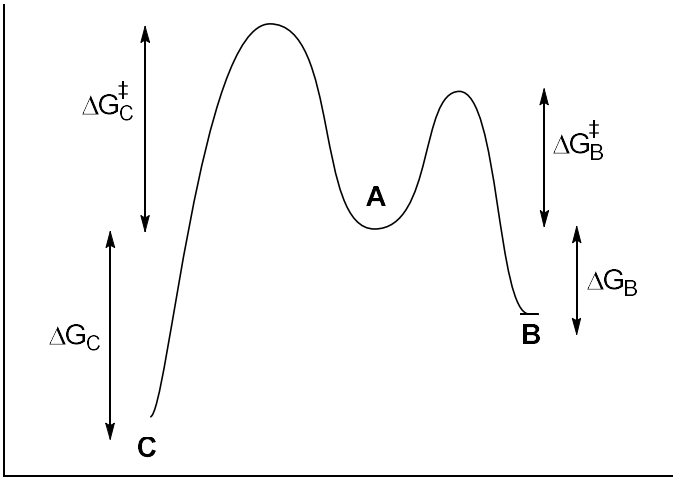
Experiment 15

The Diels-Alder Reaction: A Reaction with High Atom Economy

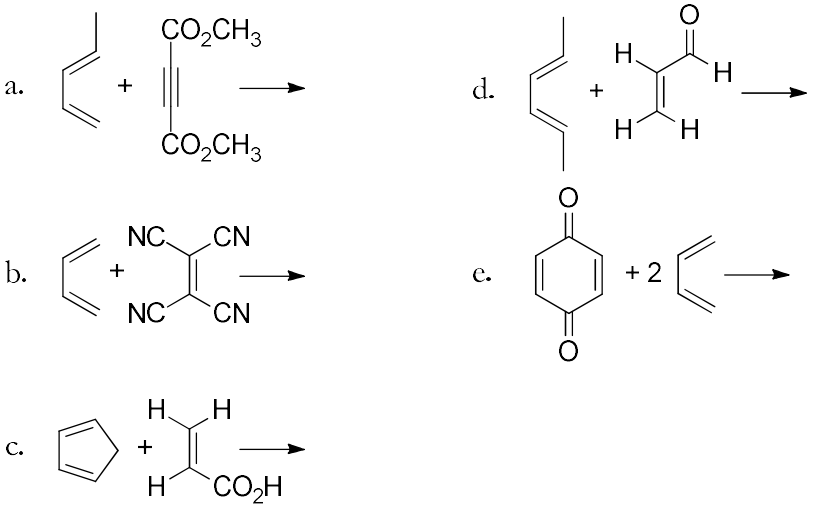
Study Questions

1) Given the following reaction sequence and information, draw an energy diagram (Energy *vs* Reaction Coordinate) illustrating the major energetic features of the following reaction.

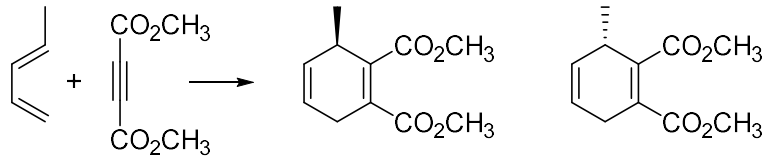
Answer:

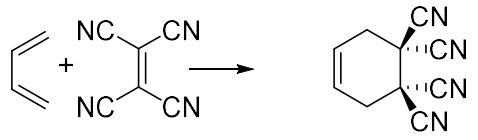


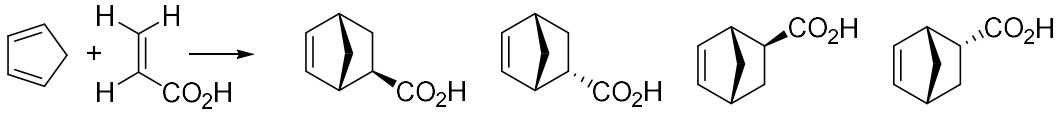
2) Provide the products for the following Diels-Alder reactions. Be sure to indicate the stereochemistry of the products where applicable.

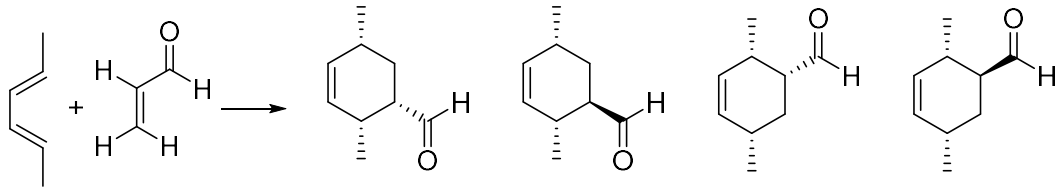


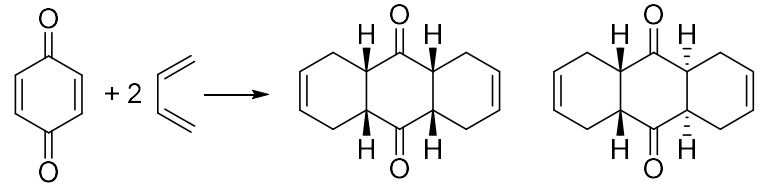
Answer:

a. 

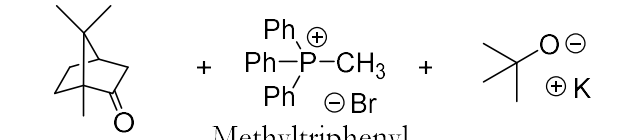
b. 

c. 

d. 

e. 

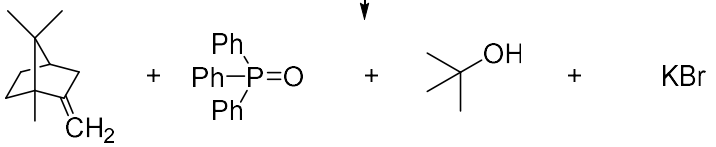
3) The reaction shown below is an example of the *Wittig reaction*, which you will learn about in Chapter 19 of Loudon. What is the atom economy for this particular reaction?



Camphor
MW = 152.24

Methyltriphenyl-phosphonium bromide
MW = 357.23

Potassium *tert*-butoxide
MW = 112.21



MW = 150.26
(Desired product)

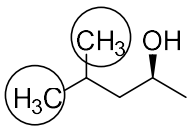
MW = 278.29

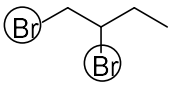
MW = 74.12

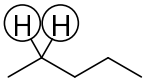
MW = 119.00

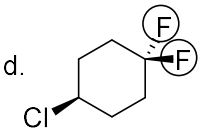
If a chemist performs this reaction using 0.152 g of camphor, 0.536 g of methyltriphenylphosphonium bromide, and 0.168 g of potassium *tert*-butoxide, and isolates 0.138 g of product, what is the percent yield? **Answer:** The atom economy is 24.17%, and the yield is 92.0%.

4) Describe each of the following pairs of groups as homotopic, enantiotopic, diastereotopic, or chemically inequivalent.

a. 

b. 

c. 

d. 

Answer: a. Diastereotopic, b. Chemically inequivalent, c. Enantiotopic, d. Diastereotopic