Organic Synthesis
Chem 144
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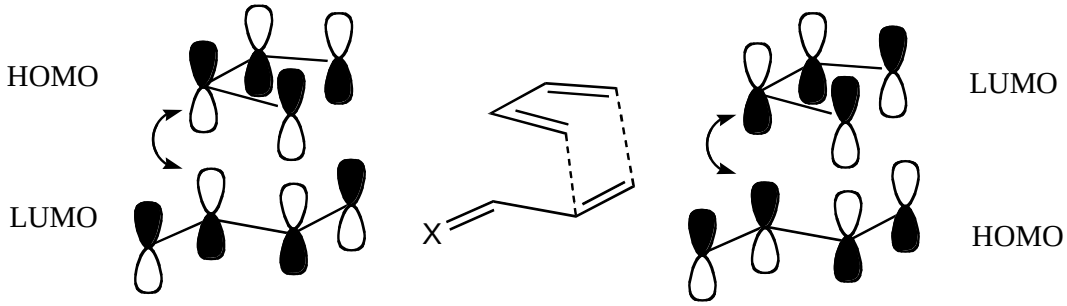
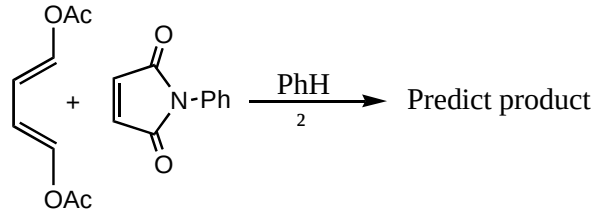
Stereochemistry of Diels-Alder Reaction

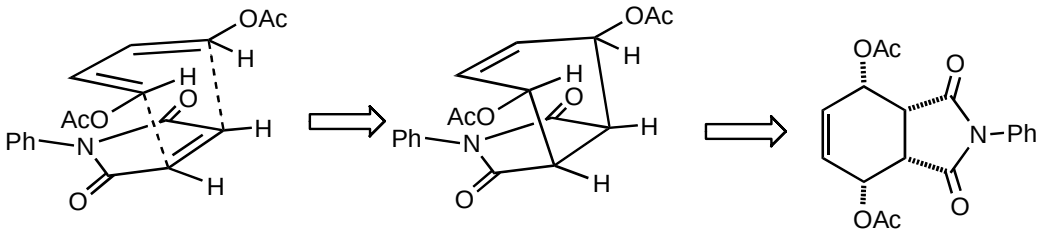
Alder endo transition state rules (explained by Woodward and Hoffmann as being due to secondary orbital overlap between the orbital at C2 of the diene and the orbital on C of the C=X group of the dienophile (in both HOMO/LUMO pairs)



How to apply these rules:



Draw the endo TS, namely the diene and dienophile in parallel planes so that the electron-withdrawing group on the dienophile lies underneath the diene so that secondary orbital overlap is possible and then connect the bonds. Whatever is pointing in the same dirtection (on the same side of the plane defined by the new sigma bonds) is cis in the cycloadduct.



Carbonyl groups of imide lie underneath the diene

H's are all cis

Note: Product is dl

Another example: