E2 reactions are typically seen with secondary and tertiary alkyl halides, but a hindered base is necessary with a primary halide. The mechanism by which it occurs is a single step concerted reaction with one transition state. The rate at which this mechanism occurs is second order kinetics, and depends on both the base and alkyl halide. A good leaving group is required because it is involved in the rate determining step. The leaving groups must be coplanar in order to form a pi bond; carbons go from sp\(^3\) to sp\(^2\) hybridization states.

**General Reaction**

In this reaction Ba represents the base and X represents a leaving group, typically a halogen. There is one transition state that shows the concerted reaction for the base attracting the hydrogen and the halogen taking the electrons from the bond. The product be both eclipse and staggered depending on the transition states. Eclipsed products have a *synperiplanar* transition states, while staggered products have *antiperiplanar* transition states. Staggered conformation is usually the major product because of its lower energy confirmation.

An E2 reaction has certain requirements to proceed:

- Secondary and tertiary alkyl halides will proceed with E2 in the presence of a base (OH-, RO-, R\(_2\)N-)
- Both leaving groups should be on the same plane, this allows the double bond to form in the reaction. In the reaction above you can see both leaving groups are in the plane of the carbons.
- Follows Zaitsev's rule, the most substituted alkene is usually the major product.
- Hoffman Rule, if a sterically hindered base will result in the least substituted product.
Problems

1.

E2-1.bmp

2. What is the major product and why?

3. What is the major product when 2-bromo-2-methylbutane reacts with sodium ethoxide?

4.