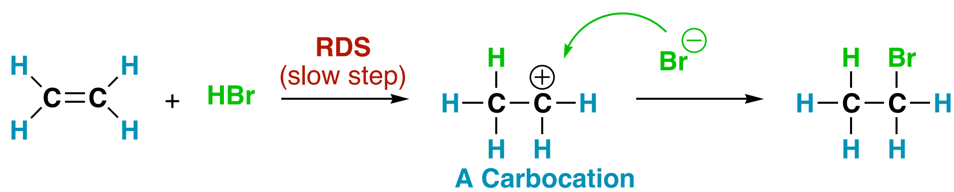
Chem 341

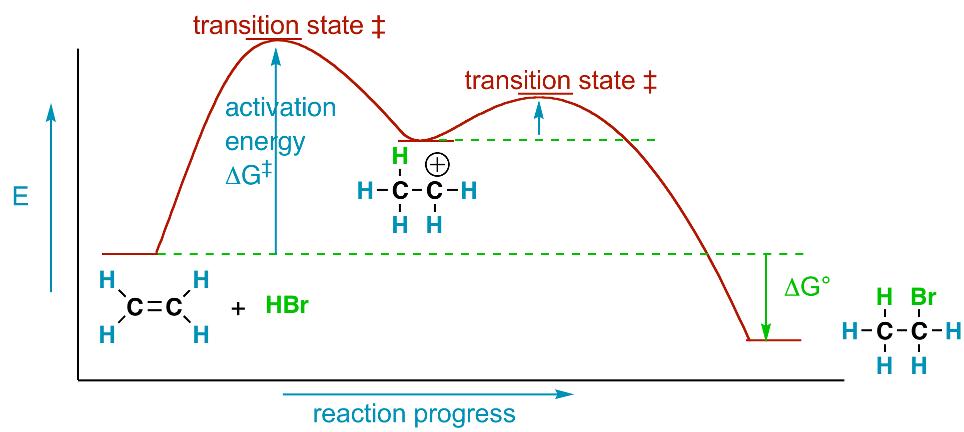
Lecture Summary 15
October 1, 2004

Chapter 5 - Overview of Organic Reactions

Kinetics

Recall the reaction coordinate diagram we discussed last time. The reaction diagram below shows the reaction of HBr addition to ethane. First a proton is transferred from HBr to the alkene forming a carbocation intermediate. The slowest step in the reaction is called the Rate Determining Step. This would be the highest energy barrier in the reaction as it progresses from starting materials to products. In any given step of a reaction, there is an Activation Energy required to get over the hill. Simply stated, this is how much energy it takes to go over the highest point.





Note that this particular reaction has the highest activation energy in the first step. Other reactions could have the highest energy barrier in the second step. Indeed, other reactions could be much more complicated having multiple steps and multiple intermediates or even different pathways to different products.

Chapter 6 - Alkenes: Structure and Reactivity

Alkenes

Alkenes are a compounds that contain double bonds. The general formula for an alkene with one double bond is: C_nH_{2n} because you would have to lose two H's from an alkane to form the pi-bond. This is the same general formula as found in cycloalkanes.

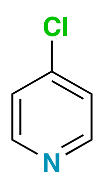
Small alkenes are industrially important. Ethene and Propene are multibillion dollar industries - mostly for the polymer/plastics industry. These small alkenes are produced by high temperature cracking of petroleum-derived alkanes.

Unsaturation

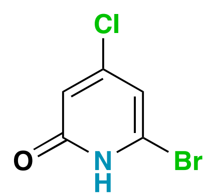
We use the term saturated to refer to an organic molecule that has all single bonds and as many H’s as can be attached. Thus, if there are less H’s, such as with pi-bonds or cyclic structures, we call these unsaturated molecules. It is useful to see how much unsaturation there is in a molecule - especially if you are trying to figure out the structure of an unknown compound. Simply stated, the Degrees of Unsaturation is the number of pi-bonds or rings present in a molecule. You can figure out the number of unsaturations there are by examining the number of H’s you would expect if the molecule were completely saturated and comparing that with the number of H’s that actually exist in your molecule. The formula is shown below. Note that we need to add to the number that actually exists for every halogen in the molecule because these monovalent atoms will replace an H in the molecular formula. Nitrogens, being trivalent, will add an additional H to the formula, so we need to substract one for every N. Oxygens do not affect the number of H’s in a formula, so they do not need to be considered at all.

$$DU = \frac{\left(\text{Number of H's if saturated}\right) - \left(\text{Number of H's that are present}\right)}{2}$$

$$DU = \frac{\left(2n+2\right) - \left(\#H - \#X + \#N\right)}{2}$$



$$DU = \frac{12 - (4 - 1 + 1)}{2} = 4$$



$$DU = \frac{12 - (3 - 2 + 1)}{2} = 4$$