

## Answer on Question#52194 - Chemistry - Organic Chemistry

What is hyperconjugation? Explain the relative stability of primary, secondary and tertiary carbocations on the basis of hyperconjugation.

In organic chemistry, hyperconjugation is the interaction of the electrons in a sigma bond (usually C–H or C–C) with an adjacent empty (or partially filled) non-bonding p-orbital, antibonding  $\sigma$  or  $\pi$  orbital, or filled  $\pi$  orbital, to give an extended molecular orbital that increases the stability of the system. Only electrons in bonds that are  $\beta$  to the positively charged carbon can stabilize a carbocation by hyperconjugation.

When thinking about carbocation stability is the number of carbons attached to the carbon carrying the positive charge. We look at the number of bonding electrons that are attached to the carbocation because those bonding electrons will help in alleviating the positive charge. Bonding electrons from adjacent  $\sigma$  bonds may overlap with the unoccupied p orbital of the carbocation. This phenomenon is termed hyperconjugation. Since the overlap supplies electron density to the electron-deficient carbocation carbon, we predict that increasing the number of hyperconjugative interactions increases carbocation stability. Extending this idea, we predict that increasing the number of bonds adjacent to the carbocation by increasing the number of alkyl groups attached to the carbocation carbon results in an increase in carbocation stability. For example, a tertiary carbocation should be more stable than a secondary carbocation. This prediction is accurate.