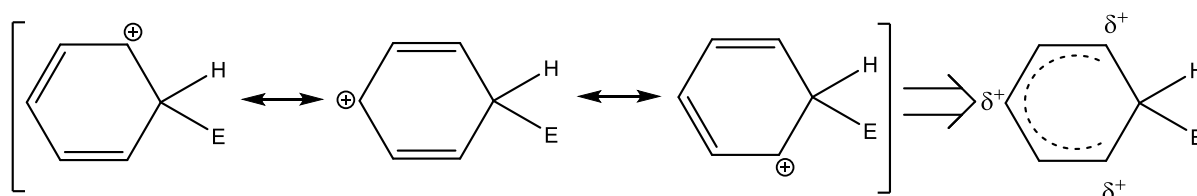


What is the sigma complex?

In electrophilic substitution reactions, a sigma (σ) complex is an intermediate species that is formed when an electrophile attacks an aromatic ring. The σ complex is a type of transition state in which the electrophile becomes temporarily bonded to the aromatic ring through the overlap of its atomic orbitals with the sigma (σ) bond of the aromatic ring. The σ complex is characterized by a distorted ring structure, in which the bonds between the carbon atoms are weakened and the electron density of the ring is redistributed.



In electrophilic aromatic substitution reactions, the σ complex is an important intermediate because it determines the regioselectivity of the reaction, i.e., which carbon atoms of the aromatic ring are substituted by the electrophile. The σ complex is typically less stable than the starting materials or the final products of the reaction, and it undergoes a rapid rearrangement to form the substitution product. The formation and rearrangement of the σ complex involve the transfer of electrons within the aromatic ring, and the nature of the substituent and the reaction conditions can influence the rate and selectivity of the reaction.