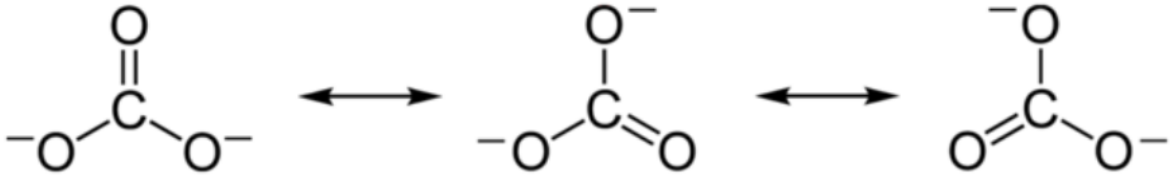
Answer on Question #75297, Chemistry / General Chemistry

In carbonate ion, all the three C-O bonds have identical bond lenght .explain

Answer

The carbonate ion has three resonance structures. The true structure of the carbonate is an average of these three resonance structures.



Two of the three Oxygen atoms in the carbonate ion has an extra electron that makes its overall charge -2. When electrons linger at atoms which don't compensate for its charge, they'd rather form a bond with another electron from another atom essentially staying in between the atoms so that its charge would be spread between the two. When these two electrons pair up in the centre of the Carbon and Oxygen atoms, their orbitals, one of the π-orbitals, overlap, thus forming a π -bond. But there is another Oxygen atom that wants to do the same. Yet, Carbon can only have 4 bonds around it. If the other Oxygen would form another π-bond with the Carbon, it would have 5! That is including the other single-bonded oxygen. Both of these single-bonded Oxygens have a charge of -1 due to the excess electron thus both would strive to get a spot in Carbon's π-orbital. Therefore, we can now say that at any given time, there is going to be a double-bonded Oxygen and 2 single bonded, negatively charged Oxygens. However, again, two of these Oxygens will fight to get that double bond. Thus, by mere random chance, one of the two Oxygens will get to get it with the Carbon at the same time knocking out the electron of the π-bond of the previously double bonded Oxygen and returning it to it. The location of the double bond has now changed. But the same thing will soon happen again, very, very quickly, millions of times a second to the extent that the changing of the bonds is practically undetectable or they are aligned.

The alignment of the bonds leads to the decreasing of the energy of formation of the real molecules or ions comparing to that ones of structures shown in the figure. That's way it is energetically favorable for C-O bonds to be equivalent. There no single or double bonds in the ion, the order of each bond is 1⅓.