

3.6: Resonance

In the previous section, we constructed a Lewis diagram for the carbonate anion. Our final structure showed two carbon-oxygen single bonds and one carbon-oxygen double bond. The structure that we drew is shown below, along with two other possible representations for the carbonate anion. These structures differ only in the position of the carbon-oxygen double bond.

So which of these is correct? Actually, they *all* are! These are all “proper” Lewis diagrams for a covalent structure having constant geometry, and the diagrams differ *only* in the manner that we have arbitrarily arranged the electrons. These Lewis diagrams are called **resonance forms**. For the carbonate anion, there are three equivalent resonance forms that can be drawn. It is important to note that the electrons are not “hopping” between the atoms, but that the electrons are spread *evenly* between the carbon and all three oxygens and that each carbon-oxygen bond has a bond-order of 1.33 (one and one-third covalent bonds). A structure such as this is called the **resonance hybrid**, and although it most clearly represents the actual bonding in the compound, it is often difficult to understand the nature of the bonding when structures are represented as resonance hybrids. A full discussion of resonance is beyond the scope of an introductory text and, for structures such as the carbonate anion, we will accept any of the proper resonance forms shown above.

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