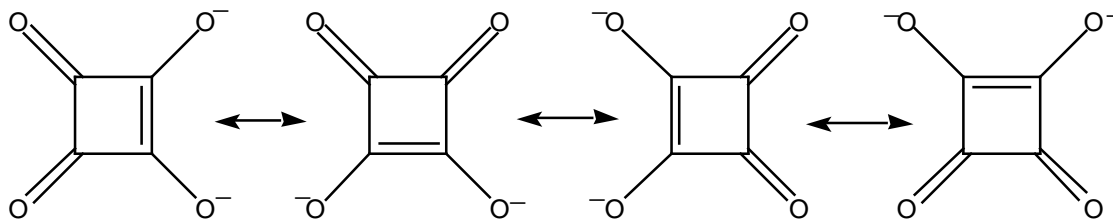


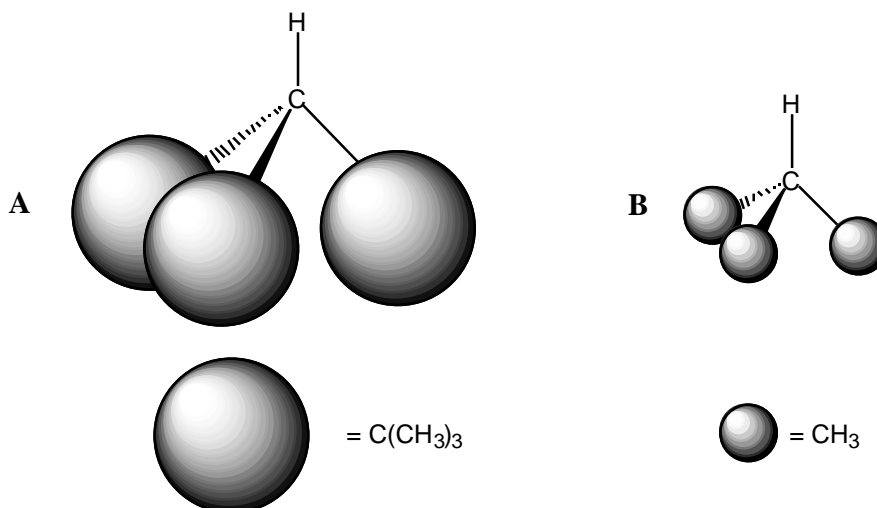
Answers to Problem Set #2
CH241-2001F

- [1] (a) The dianion of squaric acid is a resonance hybrid of the following structures. Please practice pushing arrows by showing how one structure can be converted into the next.

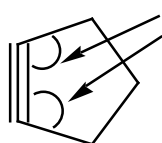


As indicated by the above structures, in the “real” hybrid, every carbon-carbon bond is one part double bond and three parts single bond. A similar analysis reveals that every carbon-oxygen bond is two parts single bond and two parts double bond.

- (b) Just look at the size of the three bulky $-\text{C}(\text{CH}_3)_3$ groups in **A**! These groups are *huge* compared to the smaller $-\text{CH}_3$ groups. Thus, in **A**, the bond lengths stretch and bond angles widen to relieve some of the crowding caused by the three big groups. These ideas are schematically shown below.

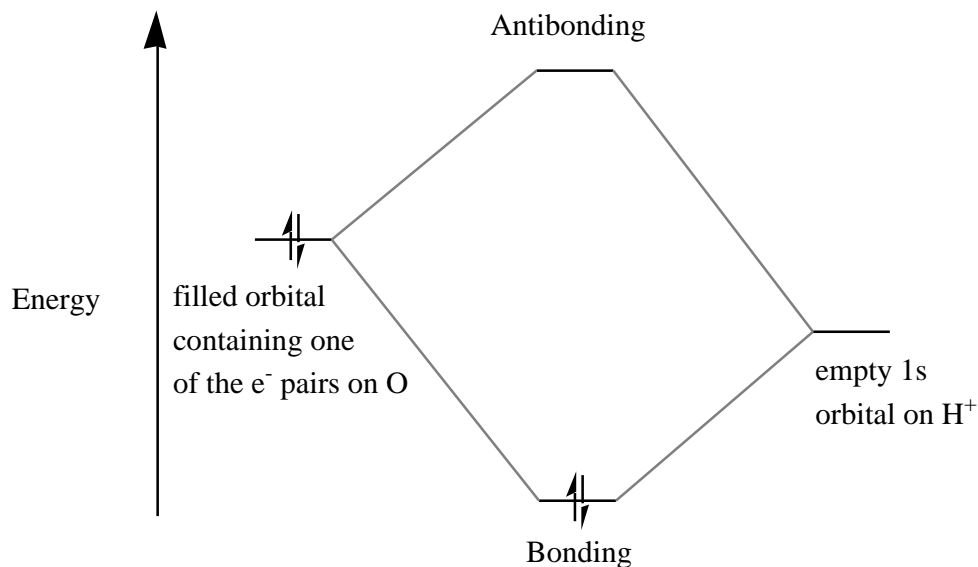


- (c) There is tremendous angle strain in the ring. The two sp hybridized carbon atoms involved in the triple bond prefer bond angles of 180° which are difficult to accommodate within the five membered ring.



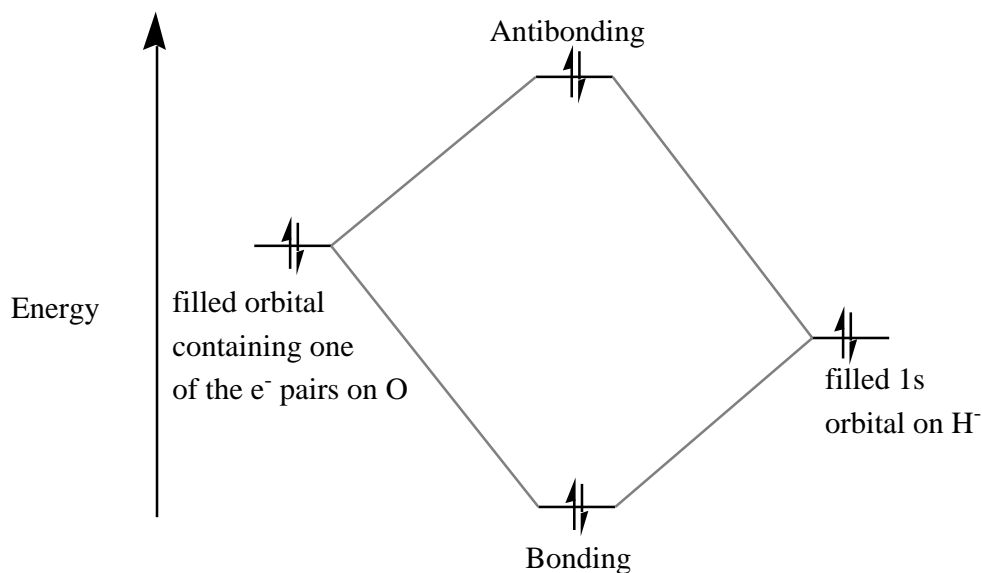
These two angles deviate enormously from the preferred 180° .

- [2] Water will react with H^+ rather than H^- . In the first reaction, the orbital containing one of the nonbonded pair of electrons on O can overlap with the empty 1s orbital on H^+ to give a favorable bonding interaction in which the two electrons wind up in the lower energy bonding orbital. Note that the antibonding level is empty.



Favorable interaction. Bonding orbital is filled but antibonding orbital is empty.

The second reaction, however, is not favorable because now there are four electrons involved (two from O and two from H^-), and two of them would have to go into the higher energy antibonding orbital.



Unfavorable interaction! Bonding *and* antibonding orbitals are fully occupied.

- [3] The answer is given below. Please convince yourself that there are six eclipsing interactions among the hydrogens in cyclopropane.

