

## Answer on Question #57194 - Chemistry - Organic Chemistry

### Question:

Name the three types of strain commonly encountered in cyclic molecules. With the aid of sketches, explain how the structures of cyclopropane and cyclopentane reflect the strain energy present in each of these molecules.

### Answer:

There are the three types of strain:

- 1) Angle strain concerns the case when the bond angle differs from  $109.5^\circ$ , which corresponds the optimum overlap of atomic orbitals for  $sp^3$ -hybridized carbon atoms.
- 2) Torsional strain is an energy barrier between conformations of the same organic molecule which are formed as result of rotation around C-C bond.
- 3) Van der Waals strain – the linear bond stretching or compression caused by the Van der Waals forces.

Cyclopropane has very small bond angle for C-C which is of  $60^\circ$ . This provides significant angle strain. The torsional strain is also represented due to the 1,2 repulsion between hydrogen atoms.

Cyclopentane shows two half-chair conformations and planar one. The planar conformation has torsional strain, when eclipsing C-H – bonds cause 1,2 and 1,3 nonbonded repulsions, however, there is a weak angle strain, because all bond angle are around of  $108^\circ$ , which is close to an ideal bond angle for  $sp^3$  –carbon atoms.

The half-chair conformations are unstable, which is conditioned by the strong angle strain. Namely, C-C-C angle is significantly deviated from  $109^\circ$ .