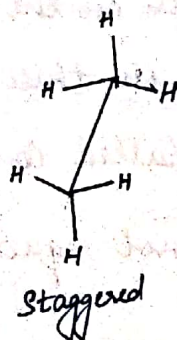
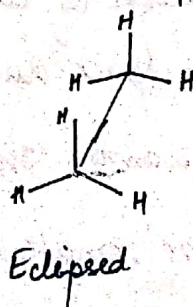


Conformation of alkanes

Alkanes can have an infinite number of conformations by rotation around Carbon-carbon single bonds.

In ethane two carbon atoms are linked by a single bond and each carbon atom is further linked with three hydrogen atoms. If one of the carbon atoms is allowed to rotate about Carbon single bond keeping the other carbon stationary an infinite number of arrangement of the hydrogens of one Carbon, with respect to those of other, are obtained. All these arrangements are called Conformations (Bond angles and bond lengths remain the same).

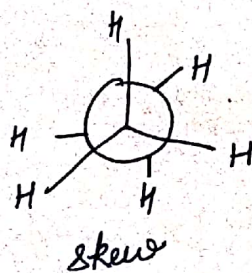
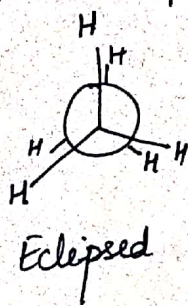
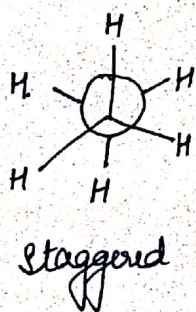
Out of the infinite number of possible conformations of ethane, only two extreme are important.



Sawhorse representation for conformation of ethane

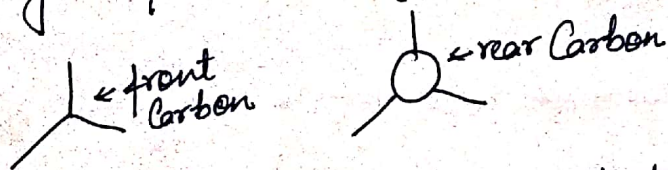
- 1) The eclipsed form in which rear methyl group is completely eclipsed only one nearer to eye is visible.
- 2) Staggered form in which rear methyl group is rotated upside down and all the six hydrogen atom of the two methyl groups are staggered symmetrically.
- 3) Evidently there could be several other arrangements or forms possible in between the eclipsed form and the staggered form an arrangement lying anywhere between two extreme forms is called skew form.

A Scientist Melvin Newman devised very useful method for representing three dimensional structures on paper and after his name these are called Newman projection.



As suggested by Newman in ethane the front carbon atom is represented by intersection of bonds from it, while rear carbon appears as a circle.

Bonds of the rear carbon in the eclipsed form are shown slightly displaced simply to make them visible.

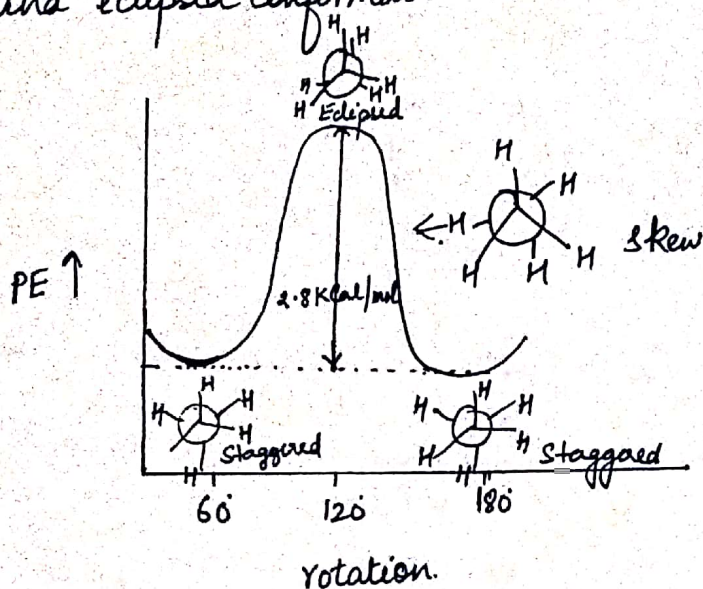


Different conformations of ethane are not of equal stability. The staggered form in which the ^{two} hydrogen atoms on adjacent carbon are far apart as possible. As a result, the repulsion between the e^- clouds of σ -bonds of two non-bonded hydrogen atoms is minimum. Staggered conformation of ethane permits max possible separation of electron pairs of six carbon-hydrogen bonds. Thus staggered conformation of ethane is most stable and has least potential energy.

In eclipsed conformation non-bonded hydrogen atoms attached to each carbon are direct opposite to each other (quite close). This permits min separation of electrons of six C-H bonds, as a result electron cloud of σ -bonds of two non-bonded hydrogen atom repel each other.

This interaction raises the energy of eclipsed Conformation. The eclipsed Conformation is therefore of highest energy & has lowest stability.

All skew Conformation of ethane will have stabilities in between staggered and eclipsed Conformation.



Relative stabilities of various Conformation of ethane are
 Staggered > skew > Eclipsed

At room temperature, however molecules have average energy of 15-20 Kcal/mol. Notice that difference in PE between staggered and eclipsed Conformation of ethane is 2.8 Kcal/mol. This energy is not large enough to prevent rotation. Two conformations are readily interconvertible. However at any moment if we consider a single molecule of ethane it would exist in staggered Conformation or we can say that they spend most of the time in staggered Conformation to its min energy and max stability. It will spend very less time in eclipsed Conformation.