Trigonal Bipyramidal electron configuration is part of the VSEPR model of an atom with 5 electron pairs.

**Introduction**

Trigonal Bipyramidal structures are electronic configurations of molecules. VSEPR gives us a handful of parent shapes. The one with 5 sets of bonded or non-bonded electrons.

**Molecular Geometry of the Trigonal Bipyramidal Structures**

<table>
<thead>
<tr>
<th>Number of Lone pairs</th>
<th>Geometry</th>
<th>Bond Angles</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Trigonal Bipyramidal</td>
<td>90 and 120</td>
</tr>
<tr>
<td>1</td>
<td>Seesaw</td>
<td>90 and 120</td>
</tr>
<tr>
<td>2</td>
<td>T-Shaped</td>
<td>90</td>
</tr>
<tr>
<td>3</td>
<td>Linear</td>
<td>180</td>
</tr>
</tbody>
</table>

The order of most repulsion to least repulsion among bonding and lone pair electrons are:

Lone pair-Lone pair > Lone pair-Bond pair > Bond pair-Bond pair

To decide where to place lone pairs on the parent Trigonal Bipyramidal structure, we must place lone pairs far away from each other and bond pairs. The seesaw shape maximizes the bond angles of the single lone pair and the other atoms in the molecule. The lone pair is in an equatorial position offering 120 and 90 degree bond angles, compared to only 90 degree bond angles if placed at the axial position.

The T shaped structure minimizes the remaining bond pair-bond pair angles at 90 degrees and maximizes the lone pair-lone pair bond angle at 120.

The linear structure does the same by making sure that the lone pairs are kept at a maximum of 120 degree bond angles. As a result, all are placed in the equatorial position, leaving room at the axial position for the atoms. Thus, the bond angles of the atoms are 180 degrees from each other.

**Stereoisomers**

Since there are two types of atoms on a Trigonal Bipyramidal structure, axial and equatorial, there are different Stereoisomers that could arise depending on the substituents attached. For example, if there is 4 X atoms and 1 Y atom attached to the central atom, Y could either be in an equatorial position or in an axial position. If there are 3 X atoms and 2 Y atoms, then one Y atom could be placed in a equatorial position and the other in an axial position, or both Y atoms could be placed in the same position.
References


Problems

1. How would you arrange SeCl$_4$?
2. How would you arrange ArCl$_2$?
3. How would you arrange ICl$_3$?

Contributors

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