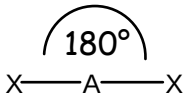
Valence-Shell Electron-Pair Repulsion (VSEPR) and the Geometry of Inorganic Compounds

Assumption

Covalent bonds to a central atom, which consist of pairs of electrons, and lone pairs of electrons located on the central atom will arrange themselves so that they minimize the effects of electron-electron repulsion. That is, bonding and non-bonding electrons will adopt a geometry around the central atom that minimizes their interaction.

Example

Consider the molecule AX_2, where A is the central atom and X is an atom covalently bound to A. There are no non-bonding pairs of electrons on A. To maximize the separation of the covalently bound electrons from each other, the molecule adopts a linear geometry with a bond angle of 180°. Any other geometry will bring the covalently bonded electrons into closer proximity and increase the effect of electron-electron repulsion. This is the bonding geometry of molecules such as CO_2.



Your Turn

Using the available supplies and working with one or more partners, create models showing the preferred geometry for the molecules AX_3, AX_4, AX_5, and AX_6. In each case X is an element covalently bound to A and there are no non-bonding pairs of electrons on A. Use the principle of minimizing electron-electron repulsion as your guide. When you are satisfied with a structure, try to draw its three-dimensional representation on a piece of paper and estimate all the X-A-X bond angles.