

Analysis of Linear Molecular Shapes

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Response: An analysis of both statements evaluates the assertion and reason in this G.C.E. A/L Chemistry multiple-choice question format:

First Statement (Left Column)

"Even though the number of valence shell electron pairs of the central atoms in ICl_2^- , N_3^- and BeCl_2 differ from each other, they have the same shape."

- ICl_2^- : Iodine has 7 valence electrons + 1 extra electron from charge + 2 electrons from two Cl single bonds = 10 valence electrons = **5 electron pairs** (2 bond pairs + 3 lone pairs).
 - Electron geometry: Trigonal bipyramidal.
 - Molecular shape: **Linear** (the 3 lone pairs occupy the equatorial positions at 120°).
- N_3^- (**Azide ion**): Central nitrogen has 5 valence electrons + 1 extra charge $\rightarrow$ forms two double bonds ($\text{N} = \text{N} = \text{N}$) $^-$.
 - Valence shell electron pair distribution (steric count): **2 σ -bond pairs + 0 lone pairs** on the central atom (total 2 bonding electron domains/pairs influencing geometry).
 - Molecular shape: **Linear**.
- BeCl_2 : Beryllium has 2 valence electrons + 2 electrons from two Cl single bonds = 4 valence electrons = **2 electron pairs** (2 bond pairs + 0 lone pairs).
 - Molecular shape: **Linear**.

Since all three species have a **linear shape** despite having different total numbers of valence shell electron pairs on their central atoms (5, 2, and 2 respectively), the **First Statement is TRUE**.

Second Statement (Right Column)

"In molecules and ions, lone pairs of electrons on the central atom are held as far as possible from each other to reduce repulsing each other."

According to VSEPR theory, electron pairs (both bond pairs and lone pairs) in the valence shell of a central atom adopt spatial arrangements that maximize the distance between them to minimize electron-electron repulsions. Specifically, lone pair–lone pair repulsions are the strongest, so lone pairs occupy positions that keep them as far apart as possible (such as equatorial positions in a trigonal bipyramidal geometry).

Therefore, the **Second Statement is TRUE**.

Relationship Between the Statements

While both statements are individually true, the second statement describes the general VSEPR principle regarding lone pair positioning. However, it does not fully explain why species without lone pairs on the central atom (like BeCl_2 and N_3^-) share the same linear shape as a species with three lone pairs (ICl_2^-). The common linear geometry arises because the bonding atoms are arranged 180° apart in all three cases (either due to having only 2 electron domains or having 3 equatorial lone pairs cancelling out symmetrically).

- **First Statement:** True
- **Second Statement:** True
- **Explanation:** Second statement is **not** the correct explanation for the first statement.

Correct Option: (2) (Both statements are true, but the second statement does not correctly explain the first statement).
