

SHAPES OF MOLECULES & IONS

Name Form



Molecules and ions possess two types of electron pairs:

- **Bonding pairs** (the two shared electrons in a covalent bond)
- **Lone pairs** (two electrons in a pair not involved in bonding – also known as non-bonding pairs).

These electron pairs will repel each other as far as possible. The shape of any molecule or ion is a consequence of these electron pairs repelling each other as far as possible.

Lone pairs are more compact than bonding pairs and provide more repulsion. Consequently, the greatest repulsion is between two lone pairs, followed by the repulsion between one lone pair and one bonding pair, with the weakest repulsion between two bonding pairs.

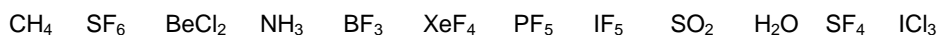
In a molecule or ion with only bonding pairs, the repulsions will therefore be equal.

Guidance to help to work out the shape of a molecule or ion:

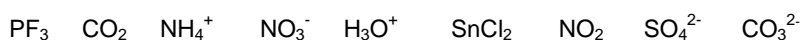
- 1) Draw a stick diagram.
- 2) Add in any lone pairs onto the stick diagram.
- 3) Count the total number of bonds (double and triple bonds count as singles for this) + lone pairs to work out the shape.

The chart over the page shows the common shapes.

TASK 1: Work out the shape of the following molecules and ions, and then fill them into the example column overleaf.



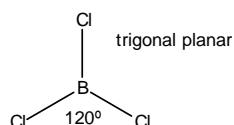
TASK 2: Work out the shape of the following molecules and ions, and drawing them in your book, showing bond angles and explaining the shape.



Approach to answering exam questions

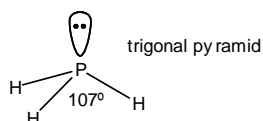
Give the shape and bond angles in the following molecules and ions, explaining how you worked out the shape.

BCl₃



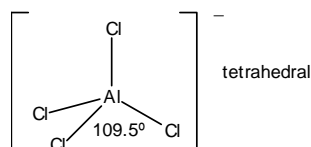
Electron pairs repel each other as far as possible.
3 bonding pairs repel each other equally.

PH₃

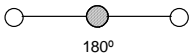
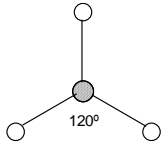
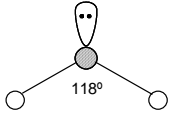
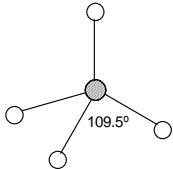
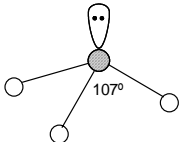
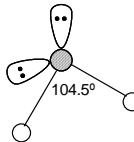
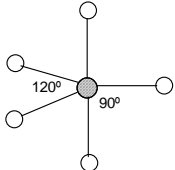
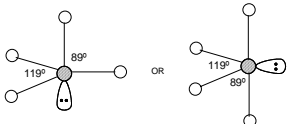
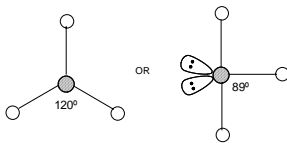
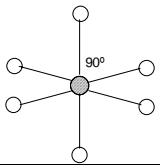
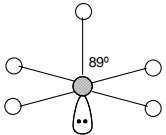
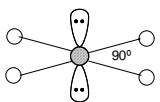


Electron pairs repel each other as far as possible.
3 bonding pairs and 1 lone pair.
Lone pair repels more than bonding pairs.

AlCl₄⁻



Electron pairs repel each other as far as possible.
4 bonding pairs repel each other equally.

total number of electron pairs	number of bonding pairs	number of lone pairs	shape	example
2	2	0		linear
3	3	0		trigonal planar
	2	1		bent
4	4	0		tetrahedral
	3	1		trigonal pyramid
	2	2		bent
5	5	0		trigonal bipyramid
	4	1		
	3	2		trigonal planar or T-shape
6	6	0		octahedral
	5	1		distorted square pyramid
	4	2		square planar