



tbp molecules
and
lone pairs

Answer the questions below then check your answers.

1. State one difference between a lone pair of electrons and a bonding pair of electrons.
2. For each of the molecules below identify the number of bonding pairs and lone pairs of electrons present in the molecule.
 - a. H_3O^+
 - b. H_2O
 - c. SF_4
 - d. SbCl_5^{2-}
 - e. XeF_4
 - f. I_3^-
3. Work out the shapes of the following molecules and sketch, clearly showing the 3d structure of the molecule.
 - a. AlH_4^-
 - b. PF_6^-
 - c. XeF_2
 - d. PCl_4^+
 - e. BrF_3
 - f. BF_4^-
 - g. TeF_5^-
 - h. NH_2^-
4. State whether the following statements are true or false. If false correct the statements so that it becomes true.
 - a. NH_3 is a tetrahedral molecule.
 - b. SF_4 has 4 fluorine atoms covalently bonded to the central sulfur atom so this molecule has a tetrahedral shape with bond angles of 109.5° .
 - c. BrF_5 has a trigonal bipyramidal structure.

Shapes of molecules

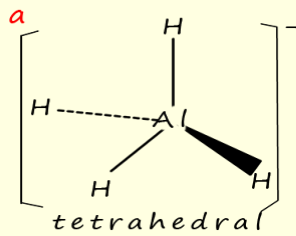
Answers

1. State one difference between a lone pair of electrons and a bonding pair of electrons. Lone pairs of electrons take up more space than bonding electron pairs/lone pairs are held in place by the attraction of only 1 positively charged nucleus, bonding pairs of electrons are held in place by the attraction to two nuclei.
2. For each of the molecules below identify the number of bonding pairs and lone pairs of electrons present in the molecule.
 - a. H_3O^+ central atom is oxygen, 6e. 3 electrons, 1 from each hydrogen, minus 1e since molecule has a positive charge. Total electrons = 8. 3 bonding pairs and 1 lone pair. Molecule has a pyramidal shape.
 - b. H_2O central atom is oxygen, 6e. 2 electrons, 1 from each hydrogen, Total electrons = 8. 2 bonding pairs and 2 lone pairs. Molecule has a V-shape or bent shape
 - c. SF_4 central atom is sulfur, 6e. 4 electrons, 1 from each fluorine, Total electrons = 10. 5 bonding pairs and no lone pairs. Molecule is tbp in shape
 - d. SbCl_5^{2-} central atom is antimony, 5e. 5 electrons, 1 from each chlorine, add 2e since molecule has a 2- charge. Total electrons = 12. 5 bonding pairs and 1 lone pair. Molecule has a square pyramidal shape.
 - e. XeF_4 central atom is xenon, 8e. 4 electrons, 1 from each fluorine, Total electrons = 12. 4 bonding pairs and 2 lone pairs. Molecule has a square planar shape.

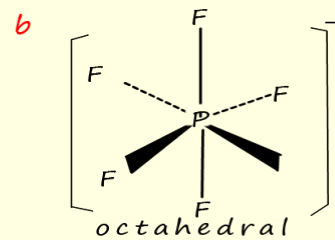
f. I_3^- central atom is iodine, 7e. 2 electrons, 1 from each iodine, add 1e since molecule has a negative charge. Total electrons = 10. 2 bonding pairs and 3 lone pairs. Molecule is linear. Molecule shape based on trigonal bipyramidal with all the lone pairs in the equatorial positions and two iodine atoms in the axial positions, so shape is linear.

3. Work out the shapes of the following molecules and sketch, clearly showing the 3d structure of the molecule.

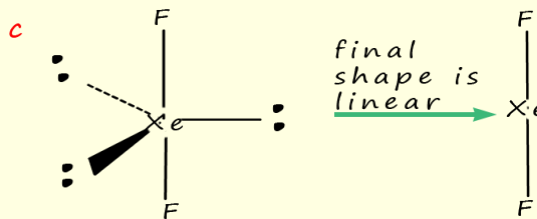
a. AlH_4^-



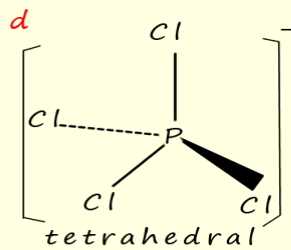
b. PF_6^-



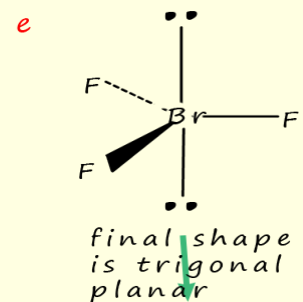
c. XeF_2



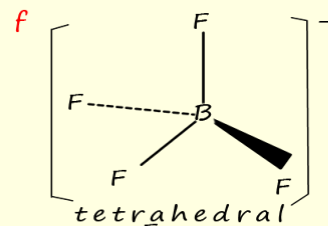
d. PCl_4^+



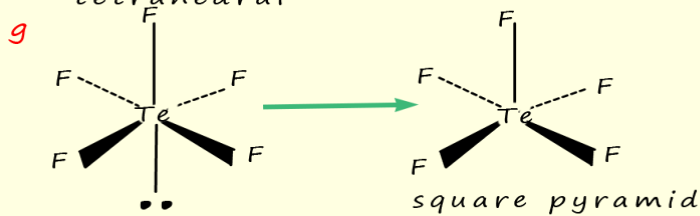
e. BrF_3



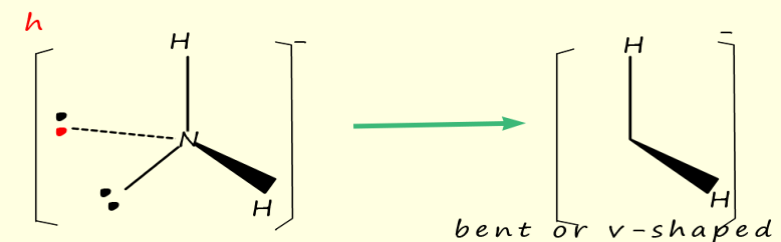
f. BF_4^-



g. TeF_5^-



h. NH_2^-



4. State whether the following statements are true or false. If false correct the statements so that it becomes true.

a. NH_3 is a tetrahedral molecule.

False, molecule has 3 bonding pairs and 1 lone pair. Shape is based on a tetrahedral structure with one lone pair, so final shape is pyramidal.

b. SF_4 has 4 fluorine atoms covalently bonded to the central sulfur atom so this molecule has a tetrahedral shape with bond angles of 109.5° .

False, molecule has a *tpb* structure with bond angles of 90° and 120° .

c. BrF_5 has a trigonal bipyramidal structure.

False, molecule has 5 bonding pairs of electrons and 1 lone pair. Structure based on octahedral structure with one lone pair, so final shape is square pyramidal.