EXPLAIN Why the HOH molecule is bent, whereas the HBeH molecule is linear.

**Answer**

The placement of the two sets of unpaired electrons in water forces the bonds to assume a tetrahedral arrangement, and the resulting HOH molecule is bent. The HBeH molecule (in which Be has only two electrons to bond with the two electrons from the hydrogens) must have the electron pairs as far from one another as possible and is therefore linear.

EXPLAIN Explain the difference between electron-pair geometry and molecular structure.

**Answer**

Space must be provided for each pair of electrons whether they are in a bond or are present as lone pairs. Electron-pair geometry considers the placement of all electrons. Molecular structure considers only the bonding-pair geometry.

EXPLAIN Why is the H–N–H angle in NH$_3$ smaller than the H–C–H bond angle in CH$_4$? Why is the H–N–H angle in NH$_4^+$ identical to the H–C–H bond angle in CH$_4$?

**Answer**

NH$_3$ has a lone pair of electrons, which forces the bonds closer together, lessening the bond angle compared to species with 4 bonds and no lone pairs.

EXPLAIN Predict the electron pair geometry and the molecular structure of each of the following molecules or ions:

a. BeH$_2$ (hint: Be does not have a complete octet)
b. CH$_3^+$ (hint: C does not have a complete octet)

**Answer a**

Both the electron geometry and the molecular structure are linear.

**Answer b**

Both the electron geometry and the molecular structure are trigonal planar.
PROBLEM \PageIndex{5}

Identify the electron pair geometry and the molecular structure of each of the following molecules or ions:

a. CF$_4$

b. BF$_3$

c. BeCl$_2$

**Answer a**

Both the electron geometry and the molecular structure are tetrahedral.

**Answer b**

Both the electron geometry and the molecular structure are trigonal planar.

**Answer c**

Both the electron geometry and the molecular structure are linear.

PROBLEM \PageIndex{6}

What are the electron-pair geometry and the molecular structure of each of the following molecules or ions?

a. ClO$_2^-$

b. PCl$_3$
c. $\text{\ce{PH2-}}$

**Answer a**

- electron-pair geometry: tetrahedral
- molecular structure: bent

**Answer b**

- electron-pair geometry: tetrahedral
- molecular structure: trigonal pyramidal

**Answer c**

- electron-pair geometry: tetrahedral
- molecular structure: bent (109°)

Click here to see a video of the solution

Media, iframe, embed and object tags are not supported inside of a PDF.

PROBLEM \(\PageIndex{7}\))

Identify the electron pair geometry and the molecular structure of each of the following molecules:
a. ClNO (N is the central atom)
b. CS₂
c. Cl₂CO (C is the central atom)
d. Cl₂SO (S is the central atom)
e. SO₂F₂ (S is the central atom)
f. (g) \(\text{ClOF}_2^+\) (Cl is the central atom)

Answer a
electron-pair geometry: trigonal planar, molecular structure: bent (120°)

Answer b
electron-pair geometry: linear, molecular structure: linear

Answer c
electron-pair geometry: trigonal planar, molecular structure: trigonal planar

Answer d
electron-pair geometry: tetrahedral, molecular structure: trigonal pyramidal

Answer e
electron-pair geometry: tetrahedral, molecular structure: tetrahedral

Answer f
electron-pair geometry: tetrahedral, molecular structure: trigonal pyramidal

PROBLEM \(\PageIndex{8}\)

Draw the Lewis structures and predict the shape of each compound or ion:

a. CO₂
b. \(\text{NO}_2^-\)
c. SO₃
d. \(\text{SO}_3^{2-}\)

Answer a

\[ \ce{O = C = O} \]

linear
Answer b

\[
\begin{array}{c}
\text{O} - \text{N} = \text{O} \\
\end{array}
\]

trigonal planar (bent 120)

Answer c

\[
\begin{array}{c}
\text{O} - \text{S} = \text{O} \\
\text{O} \\
\end{array}
\]

trigonal planar

Answer d

\[
\begin{array}{c}
\text{O} - \text{S} - \text{O} \\
\text{O} \\
\end{array}
\]

tetrahedral (trigonal pyramidal)
PROBLEM \(\PageIndex{9}\)

A molecule with the formula AB\(_2\), in which A and B represent different atoms, could have one of three different shapes. Sketch and name the three different shapes that this molecule might have. Give an example of a molecule or ion for each shape.

**Answer**

Three Lewis diagrams are shown. The first diagram shows the letter A single bonded to the left and right to the letter B. An example, “C O\(_{\text{subscript}}\) subcript 2,” and the term, “linear,” are written beside this diagram. The second diagram shows the letter A with two lone pairs of electrons, single bonded to the left and lower right to the letter B. An example, “H\(_{\text{subscript}}\) subcript 2 O,” and the term, “bent with an approximately 109 degree angle,” are written beside this diagram. The third diagram shows the letter A with one lone electron pair, single bonded to the left and lower right to the letter B. An example, “S O\(_{\text{subscript}}\) subcript 2,” and the term, “bent with an approximately 120 degree angle,” are written beside this diagram.

PROBLEM \(\PageIndex{10}\)
A molecule with the formula $\text{AB}_3$, in which $A$ and $B$ represent different atoms, could have one of two different shapes. Sketch and name the three different shapes that this molecule might have. Give an example of a molecule or ion that has each shape.

**Answer**

![Three different shapes of a molecule with the formula AB₃](image)

**Contributors**

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- Adelaide Clark, Oregon Institute of Technology

**Feedback**

Think one of the answers above is wrong? Let us know [here](http://cnx.org/).