

AP CHEMISTRY

TOPIC 5: BONDING, PART C

Day 51:

- VSEPR (Valence Shell Electron Pair Repulsion Theory)

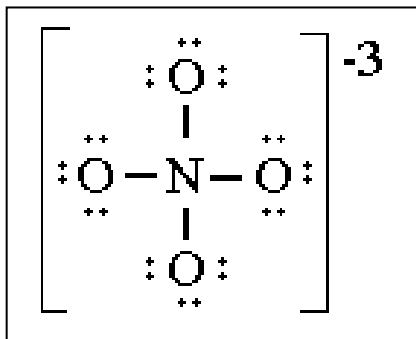
First draw the Lewis Structure, then name the shape (with lone pairs) and then indicate the name of the molecular shape (ignoring lone pairs, the shape the atoms form). Be sure to check formal charges as well.

1) NO_4^{-3}

$$\begin{aligned} \text{N}_{\text{assigned}} &: 0 + \frac{1}{2}(8) = 4 \\ \text{N}_{\text{F.C.}} &: 5 - 4 = +1 \end{aligned}$$

$$\begin{aligned} \text{O}_{\text{assigned}} (\text{single}) &: 6 + \frac{1}{2}(2) = 7 \\ \text{O}_{\text{F.C.}} (\text{single}) &: 6 - 7 = -1 \end{aligned}$$

$$\begin{aligned} \text{O}_{\text{assigned}} (\text{double}) &: 4 + \frac{1}{2}(4) = 6 \\ \text{O}_{\text{F.C.}} (\text{double}) &: 6 - 6 = 0 \end{aligned}$$



$$5 e^- + (4) 6 e^- = 29 e^- + 3 e^- = 32 e^-$$

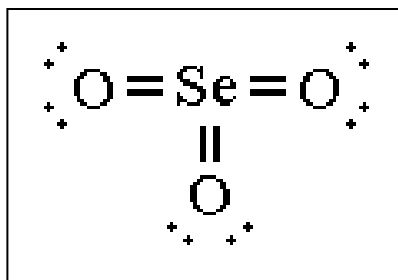
Tetrahedral (w / lone pairs)

Tetrahedral (molecular shape)

2) SeO_3

$$\begin{aligned} \text{Se}_{\text{assigned}} &: 0 + \frac{1}{2}(12) = 6 \\ \text{Se}_{\text{F.C.}} &: 6 - 6 = 0 \end{aligned}$$

$$\begin{aligned} \text{O}_{\text{assigned}} (\text{double}) &: 4 + \frac{1}{2}(4) = 6 \\ \text{O}_{\text{F.C.}} (\text{double}) &: 6 - 6 = 0 \end{aligned}$$



$$6 e^- + (3) 6 e^- = 24 e^-$$

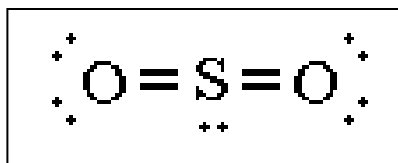
Trigonal planar (w / lone pairs)

Trigonal planar (molecular shape)

3) SO_2

$$\begin{aligned} \text{S}_{\text{assigned}} &: 2 + \frac{1}{2}(8) = 6 \\ \text{S}_{\text{F.C.}} &: 6 - 6 = 0 \end{aligned}$$

$$\begin{aligned} \text{O}_{\text{assigned}} (\text{double}) &: 4 + \frac{1}{2}(4) = 6 \\ \text{O}_{\text{F.C.}} (\text{double}) &: 6 - 6 = 0 \end{aligned}$$



$$6 e^- + (2) 6 e^- = 18 e^-$$

Trigonal planar (w / lone pairs)

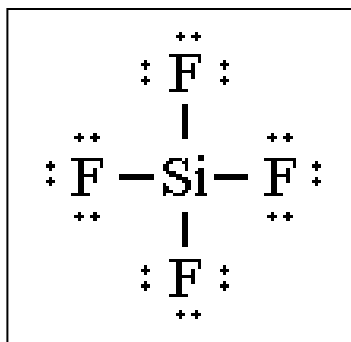
Bent (molecular shape)

NOTE: SO_2 actually only has ONE double bond. Formal Charge can lead to erroneous predictions. Tests made from experiments must be used to make final decisions toward the shape of the molecule.

4) SiF_4

$$\begin{aligned} \text{Si}_{\text{assigned}} &: 0 + \frac{1}{2}(8) = 4 \\ \text{Si}_{\text{F.C.}} &: 4 - 4 = 0 \end{aligned}$$

$$\begin{aligned} \text{F}_{\text{assigned}} (\text{single}) &: 6 + \frac{1}{2}(2) = 7 \\ \text{F}_{\text{F.C.}} (\text{single}) &: 7 - 7 = 0 \end{aligned}$$



$$4 e^- + (4) 7 e^- = 32 e^-$$

Tetrahedral (w / lone pairs)

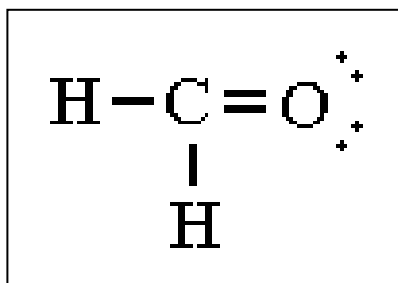
Tetrahedral (molecular shape)

5) H₂CO

$$\begin{aligned} \text{C}_{\text{assigned}} &: 0 + \frac{1}{2}(8) = 4 \\ \text{C}_{\text{F.C.}} &: 4 - 4 = 0 \end{aligned}$$

$$\begin{aligned} \text{H}_{\text{assigned}} \text{ (single)} &: 0 + \frac{1}{2}(2) = 1 \\ \text{H}_{\text{F.C.}} \text{ (single)} &: 1 - 1 = 0 \end{aligned}$$

$$\begin{aligned} \text{O}_{\text{assigned}} \text{ (double)} &: 4 + \frac{1}{2}(4) = 6 \\ \text{O}_{\text{F.C.}} \text{ (double)} &: 6 - 6 = 0 \end{aligned}$$



$$4 e^- + (2) 1 e^- + 6 e^- = 10 e^-$$

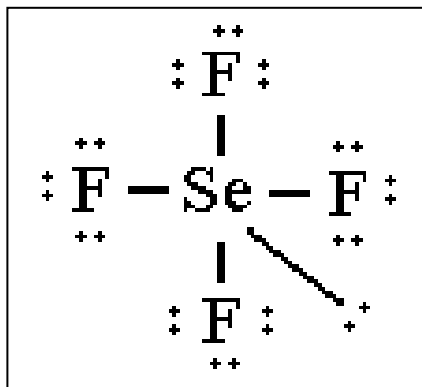
Trigonal Planar (w / lone pairs)

Trigonal Planar (molecular shape)

6) SeF₄

$$\begin{aligned} \text{Se}_{\text{assigned}} &: 2 + \frac{1}{2}(8) = 6 \\ \text{Se}_{\text{F.C.}} &: 6 - 6 = 0 \end{aligned}$$

$$\begin{aligned} \text{F}_{\text{assigned}} \text{ (single)} &: 6 + \frac{1}{2}(2) = 7 \\ \text{F}_{\text{F.C.}} \text{ (single)} &: 7 - 7 = 0 \end{aligned}$$



$$6 e^- + (4) 7 e^- = 34 e^-$$

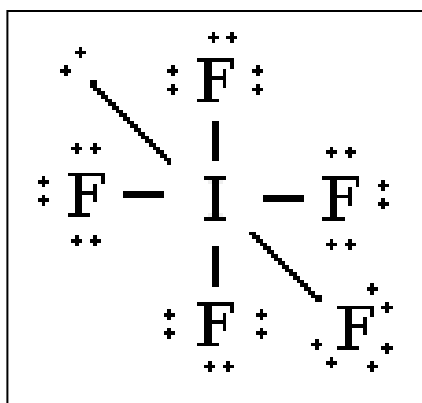
Trigonal bipyramidal (w / lone pairs)

See - Saw (molecular shape)

7) IF₅

$$\begin{aligned} \text{I}_{\text{assigned}} &: 2 + \frac{1}{2}(10) = 7 \\ \text{I}_{\text{F.C.}} &: 7 - 7 = 0 \end{aligned}$$

$$\begin{aligned} \text{F}_{\text{assigned}} \text{ (single)} &: 6 + \frac{1}{2}(2) = 7 \\ \text{F}_{\text{F.C.}} \text{ (single)} &: 7 - 7 = 0 \end{aligned}$$



$$7 e^- + (5) 7 e^- = 42 e^-$$

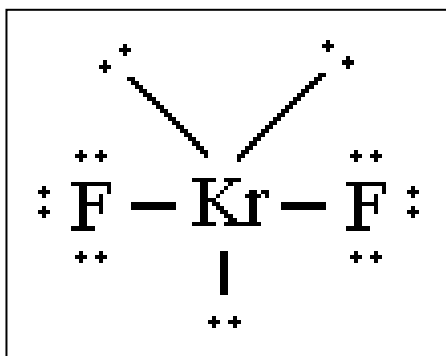
Octahedral (w / lone pairs)

Square pyramidal (molecular shape)

8) KrF₂

$$\begin{aligned} \text{Kr}_{\text{assigned}} &: 6 + \frac{1}{2}(4) = 8 \\ \text{Kr}_{\text{F.C.}} &: 8 - 8 = 0 \end{aligned}$$

$$\begin{aligned} \text{F}_{\text{assigned}} \text{ (single)} &: 6 + \frac{1}{2}(2) = 7 \\ \text{F}_{\text{F.C.}} \text{ (single)} &: 7 - 7 = 0 \end{aligned}$$



$$8 e^- + (2) 7 e^- = 22 e^-$$

Trigonal Bipyramidal (w / lone pairs)

Linear (molecular shape)

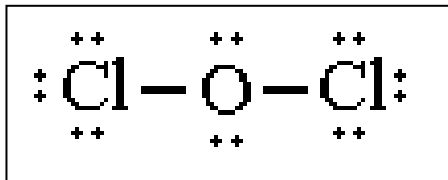
9) OCl_2

$$\text{O}_{\text{assigned}} : 4 + \frac{1}{2}(4) = 6$$

$$\text{O}_{\text{F.C.}} : 6 - 6 = 0$$

$$\text{Cl}_{\text{assigned}} (\text{single}) : 6 + \frac{1}{2}(2) = 7$$

$$\text{Cl}_{\text{F.C.}} (\text{single}) : 7 - 7 = 0$$



$$6 e^- + (2) 7 e^- = 20 e^-$$

Tetrahedral (w / lone pairs)

Bent (molecular shape)

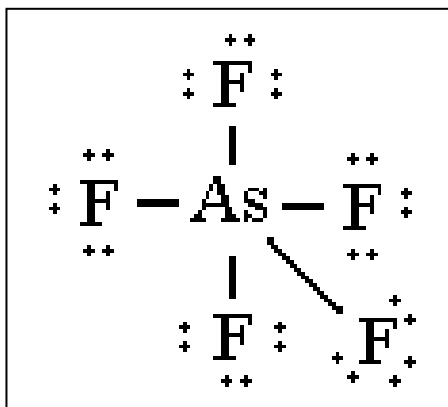
10) AsF_5

$$\text{As}_{\text{assigned}} : 5 + \frac{1}{2}(10) = 10$$

$$\text{As}_{\text{F.C.}} : 10 - 10 = 0$$

$$\text{F}_{\text{assigned}} (\text{single}) : 6 + \frac{1}{2}(2) = 7$$

$$\text{F}_{\text{F.C.}} (\text{single}) : 7 - 7 = 0$$



$$10 e^- + (5) 7 e^- = 45 e^-$$

Trigonal Bipyramidal (w / lone pairs)

Trigonal Bipyramidal (molecular shape)