

6.3 Molecular Structures

1. Review!

What is the name of P_2O_4 ?
diphosphorus tetroxide

What is the formula of
triboron pentafluoride?



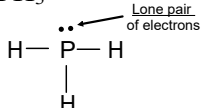
What is the formula
of sulfuric acid?



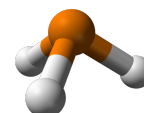
Five ways Show Structure:

Ex. = Phosphorous Trihydride

1. Molecular formula: PH_3

2. Lewis structure: 

3. Structural formula – no lone electrons (e^-):

4. Ball and stick model: 

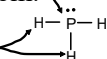
5. Space filling model: 

Lewis Structure – Process

1. From the formula, place atoms:

a. Central atom is a formula's single atom.

b. Hydrogen always terminal atom.



2. Add up all valence e^- , PLUS or MINUS charge e^- (Ex: NO_3^- has 1 more e^-).

3. Determine e^- pairs = Divide valence e^- number by two.

Lewis Structure – Process

4. Draw single bond b/w central and terminal atoms.

5. Count and place remaining e^- pairs:

a. Place on terminal atoms to satisfy octet rule.

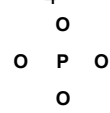
b. Place final pairs on central atom.

6. Does central atom obey octet rule?

If not, make double or triple bonds using lone pairs from terminal atoms (not hydrogen) to central atom.

2. Polyatomic Ion Guided Example

Phosphate Ion PO_4^{3-}

1. Phosphorus in middle. 

2. Valence Electrons:

$P \rightarrow 5 e^-$

$O \rightarrow 6 e^- / \text{atom} \times 4 \text{ atoms} = 24 e^-$

3 more e^- from charge

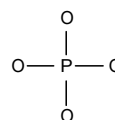
Sum of 32 e^-

2. Polyatomic Ion Guided Example

3. Electron pairs:

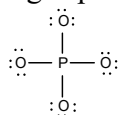
32 electrons / 2 = 16 pairs of e^-

4. Connect terminal atoms:



2. Polyatomic Ion Guided Example

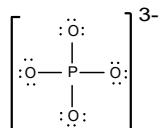
5. Place remaining e^- pairs around terminal atoms:



6. Does each atom have an octet?

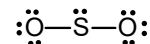
Yes! All done, BUT...

Note: Ionic Lewis Structures are bracketed, with charges in superscript.

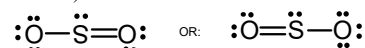


3. SO₂ Guided Example:

- Sulfur in middle. O S O
- How many valence electrons? = 18 (O = 6 X 2, S = 6).
- Total pairs = 9 (18/2 = 9).
- Placement: single bonds first. O---S---O
- Place remaining seven pairs first on terminal atoms, then the rest on the central atom.



6. Make double bonds so central atom obeys octet rule (oxygen shares with sulfur):

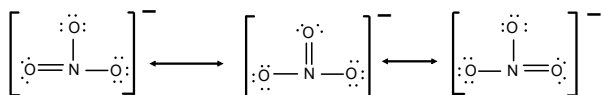


Resonance

In the previous example, more than one correct Lewis structure was possible.

Resonance can happen when a double bond is present.

4. Draw the Nitrate ion: NO_3^-

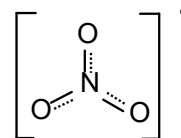


Resonance Short Hand

It is tedious to draw all a compound's resonance structures.

A quick way exists, using a dashed line to show possible configurations.

Nitrate Example:

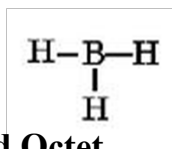


Note: no electrons are drawn around terminal atoms. It's implied that they will form an octet regardless of the number of bonds they have to the central atom.

Sub-Octets

Some compounds are stable with less than an octet.

5. Draw BH_3

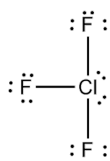


Expanded Octet

Some atoms can have more than eight electrons in their valence shell.

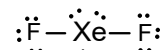
Happens in elements with available d orbitals (period three and higher).

6. Draw chlorine trifluoride, ClF_3



7. Xenon Example!

Draw the Lewis Structure of XeF_2 .



8. Carbon Monoxide Example!

Draw the Lewis Structure of CO.



Homework

Preview 6.4

6.3 Problems in your Booklet
Due: Next Class