

WKS
Determining Lewis Structures

NAME Answer Key
Period _____ Date _____

Process for Determining Lewis Structures

- Determine arrangement of atoms in molecule: Put *terminal* atoms (usually the element with 2 or more atoms) around *central* atom (usually the single atom, or the least electronegative, or the one with the highest bonding capacity) attached by a single covalent bond. Multiple C or N atoms can bond in a row.
- Count total valence electrons:
 - add total valence electrons from each atom
 - for polyatomic ions, each (–) charge adds one electron to the ion (it has gained an electron), each (+) charge removes one electron from the ion (it has lost an electron)
- Subtract two electrons for each bond from your total. This is the number of remaining non-bonding electrons (lone pairs).
- Distribute these as lone pairs of electrons evenly around terminal atoms to complete their octets (except H, which is complete with its single bond).
 - If there are any remaining electrons after all the terminal atoms are complete, they go on central atom (or atoms if you have C) as lone pairs.
- If the central atom does not have an octet, “borrow” electron pairs from outer C, N, O, P, or S for double or triple bonds. Borrow one pair at a time, checking each time for an octet.
 - H, F, Cl, Br, I *never* form double bonds.
 - Note: central atoms with fewer than 4 valence electrons (i.e. Be, B) may not obtain an octet.
- Put square brackets around polyatomic ions with the charge as a superscript

Determine the total valence electrons and draw the Lewis structures for these molecules and polyatomic ions:

Molecule	# v. e ⁻	Lewis Structure	#Single bonds, double bonds, triple bonds & lone pairs
1. CF ₄	C: 4 4F: 28 32		4 single bonds (8 e ⁻) 12 lone pairs (24 e ⁻)
2. N ₂	N: 10		1 triple bond (6 e ⁻) 2 lone pairs (4 e ⁻)
3. NO ₂ ⁺	N: 5 2O: 12 +: -1 16		2 double bonds (8 e ⁻) or 1 single (2) & 1 triple (6) 4 lone pairs (8 e ⁻)
4. NO ₂ ⁻	N 5 2O: 12 -: +1 18		1 single bond (2 e ⁻) 1 double bond (4 e ⁻) 6 lone pairs (12 e ⁻)
5. CO ₃ ²⁻	C: 4 3O: 18 2-: +2 24		2 single bonds (4 e ⁻) 1 double bond (4 e ⁻) 8 lone pairs (16 e ⁻)

Molecule	# v. e ⁻	Lewis Structure	#Single bonds, double bonds, triple bonds & lone pairs
6. NH ₃	$\begin{array}{r} \text{N: } 5 \\ \underline{3\text{H: } 3} \\ 8 \end{array}$	$\begin{array}{c} \text{H} - \overset{\cdot\cdot}{\underset{\cdot\cdot}{\text{N}}} - \text{H} \\ \\ \text{H} \end{array}$	3 single bonds (6 e ⁻) 1 lone pair (2 e ⁻)
7. OF ₂	$\begin{array}{r} \text{O: } 6 \\ \underline{2\text{F: } 14} \\ 20 \end{array}$	$\begin{array}{c} \cdot\cdot \\ \cdot\cdot \\ \text{F} - \text{O} \\ \cdot\cdot \\ \cdot\cdot \\ \\ \text{F} \\ \cdot\cdot \\ \cdot\cdot \end{array}$	2 single bonds (4 e ⁻) 8 lone pairs (16 e ⁻)
8. ClO ₄ ⁻	$\begin{array}{r} \text{Cl: } 7 \\ \underline{4\text{O: } 24} \\ \text{-: } +1 \\ \underline{\quad\quad} \\ 32 \end{array}$	$\left[\begin{array}{c} \cdot\cdot \\ \cdot\cdot \\ \text{O} \\ \cdot\cdot \\ \cdot\cdot \\ \\ \cdot\cdot \\ \cdot\cdot \\ \text{O} - \text{Cl} - \text{O} \\ \cdot\cdot \\ \cdot\cdot \\ \\ \cdot\cdot \\ \cdot\cdot \\ \text{O} \\ \cdot\cdot \\ \cdot\cdot \end{array} \right]^{-}$	4 single bonds (8 e ⁻) 12 lone pairs (24 e ⁻)
9. CS ₂	$\begin{array}{r} \text{C: } 4 \\ \underline{2\text{O: } 12} \\ 16 \end{array}$	$\begin{array}{c} \cdot\cdot \\ \cdot\cdot \\ \text{:S} = \text{C} = \text{S:} \\ \cdot\cdot \\ \cdot\cdot \end{array}$ or $\begin{array}{c} \cdot\cdot \\ \cdot\cdot \\ \text{:S} - \text{C} \equiv \text{S:} \\ \cdot\cdot \\ \cdot\cdot \end{array}$	2 double bonds (8 e ⁻) or 1 single (2) & 1 triple (6) 4 lone pairs (8 e ⁻)
10. CO	$\begin{array}{r} \text{C: } 4 \\ \underline{\text{O: } 6} \\ 10 \end{array}$	$\text{:C} \equiv \text{O:}$	1 triple bond (6 e ⁻) 2 lone pairs (4 e ⁻)
11. CN ⁻	$\begin{array}{r} \text{C: } 4 \\ \text{N: } 5 \\ \text{-: } +1 \\ \underline{\quad\quad} \\ 10 \end{array}$	$[\text{:C} \equiv \text{N:}]^{-}$	1 triple bond (6 e ⁻) 2 lone pairs (4 e ⁻)
12. C ₂ H ₆ (H ₃ CCH ₃)	$\begin{array}{r} 2\text{C: } 8 \\ \underline{6\text{H: } 6} \\ 14 \end{array}$	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H} - \text{C} - \text{C} - \text{H} \\ \quad \\ \text{H} \quad \text{H} \end{array}$	7 single bonds (14 e ⁻)
13. C ₂ H ₄ (H ₂ CCH ₂)	$\begin{array}{r} 2\text{C: } 8 \\ \underline{4\text{H: } 4} \\ 12 \end{array}$	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H} - \text{C} = \text{C} - \text{H} \end{array}$	4 single bonds (8 e ⁻) 1 double bond (4 e ⁻)
14. C ₂ H ₂ (HCCH)	$\begin{array}{r} 2\text{C: } 8 \\ \underline{2\text{H: } 2} \\ 10 \end{array}$	$\text{H} - \text{C} \equiv \text{C} - \text{H}$	2 single bonds (4 e ⁻) 1 triple bond (6 e ⁻)
15. N ₂ H ₄ (H ₂ NNH ₂)	$\begin{array}{r} 2\text{N: } 10 \\ \underline{4\text{H: } 4} \\ 14 \end{array}$	$\begin{array}{c} \text{H} \quad \text{H} \\ \quad \\ \text{H} - \overset{\cdot\cdot}{\text{N}} - \overset{\cdot\cdot}{\text{N}} - \text{H} \\ \cdot\cdot \quad \cdot\cdot \end{array}$	5 single bonds (10 e ⁻) 2 lone pairs (4 e ⁻)