



Formal Charge

Video Workbook with Dr. B

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Formal charge is a way to determine whether a Lewis structure for a molecule represents the most favorable or stable distribution of electrons.

Formal charges should be as close to zero as possible.

For ions formal charges should add up to the charge on the ion.

 [Determining Formal Charge](#)

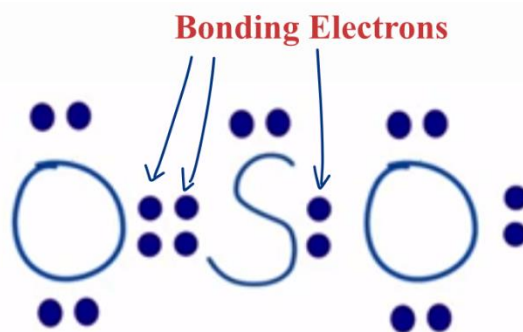
 [Practice with Formal Charge](#)

$$\text{Formal Charge} = \text{Valence Electrons} - \text{Non-Bonding Electrons} - \frac{\text{Bonding Electrons}}{2}$$

Your teacher may give you a slightly different formula. Both will yield the same results.

Example: SO₂

1. [Draw the Lewis Structure](#) for a molecule.
2. Determine the [number of valence electrons](#) using the Periodic Table. S has 6. O also has 6.
3. Find the non-bonding electrons (not between atoms) for each atom.
4. Find the number of bonding electrons (between atoms) for each atom.
5. Use formula to find formal charge for each atom.



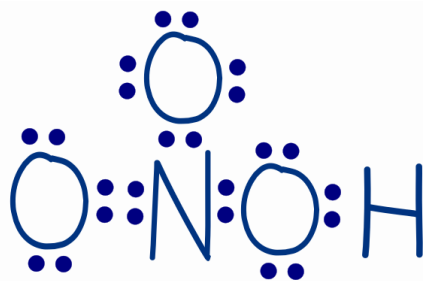
$$\begin{array}{l} \text{Formal Charge} = \text{Valence Electrons} - \text{Non-Bonding Electrons} - \frac{\text{Bonding Electrons}}{2} \\ \text{O with double bond} = 6 - 4 - \frac{4}{2} = 0 \\ \text{S} = 6 - 2 - \frac{6}{2} = +1 \\ \text{O with single bond} = 6 - 6 - \frac{2}{2} = -1 \end{array}$$

Because we have non-zero formal charges there may be a better way to draw the Lewis Structure for SO₂.

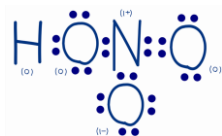
Note that S can have more than eight valence electrons (an [expanded octet](#)).



Practice: Calculate the formal charge for each atom in this Lewis Structure for HNO₃.



Answer:



Although the formal charges are not all zero, this is the best we can do still using all the valence electrons and drawing a plausible Lewis Structure.

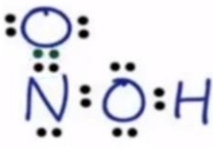
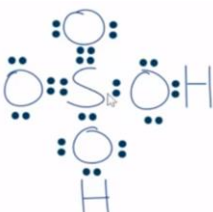
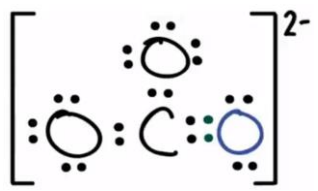




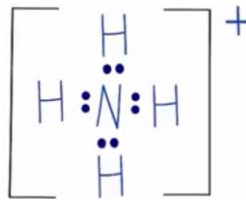
How to Quickly Find Formal Charge for Most Compounds

You can avoid doing the calculation for many compounds if you remember these patterns for H, C, O, and N. This knowledge can be *especially* useful in organic chemistry. The first four rows are the most important to remember.

Atom	Formal Charge	Example
Carbon with Four Bonds	Zero	CH ₄ C ₂ H ₂ CH ₄ OH
Hydrogen (only forms one bond)	Zero	H ₂ H ₂ O
Oxygen (2 bonds, 2 lone pairs)	Zero	O ₂ H ₂ O
Oxygen (1 bond, 3 lone pairs)	-1	OH ⁻ NO ₃ ⁻
Nitrogen (3 bond, 1 lone pairs)	Zero	NH ₃ NF ₃
Nitrogen (4 bonds, no lone pairs)	+1	HCN NH ₄ ⁺
F, Cl, Br, I (1 bond, 3 lone pairs)	Zero	HF HCl

For a detailed discussion and extended description [visit this page on ChemLibre](#).

Finding Formal Charge: Practice with Video Explanations

<p>HNO_2</p>  <p>Answer: https://youtu.be/6kAJAy4YipY</p>	<p>H_2SO_4</p>  <p>Answer: https://youtu.be/JVhnaHUsJuA</p>	<p>CO_3^{2-}</p>  <p>Answer: https://youtu.be/rUXVYyGfzIA</p>
<p>NH_3</p>  <p>Answer: https://youtu.be/BTEycFw2EkU</p>	<p>CH_2O</p>  <p>Answer: https://youtu.be/liTzvOOmw5E</p>	<p>CN^-</p>  <p>Answer: https://youtu.be/Ld8g2dg4qBA</p>
<p>OH^-</p>  <p>Answer: https://youtu.be/XBVX18xZ6oQ</p>	<p>NH_4^+</p>  <p>Answer: https://youtu.be/UInAu8WRkdM</p>	<p>N_2O</p> <p>Draw the Lewis Structure(s) and find the most favorable.</p> <p>Answer: https://youtu.be/5hyDeo1Sc1g</p>

If your time is extremely limited, watch these videos and do the practice problems:

- Counting Valence Electrons: <https://youtu.be/VBp7mKdcrDk>
- Lewis Structures Made Simple: <https://youtu.be/1ZlnzyHahvo>
- More Lewis Structures Practice: <https://youtu.be/DQclmBeIKTc>
- The Octet Rule: <https://youtu.be/6Ecr7m-0E0E>
- Exceptions to the Octet Rule: <https://youtu.be/Dkj-SMBLQzM>
- Calculating Formal Charge: https://youtu.be/vOFAPlq4y_k
- Practice Calculating Formal Charge: <https://youtu.be/-9f4H0puVzc>
- Lewis Structures for Ionic Compounds: <https://youtu.be/2urppjeSfgA>

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