

Core Revision Concept

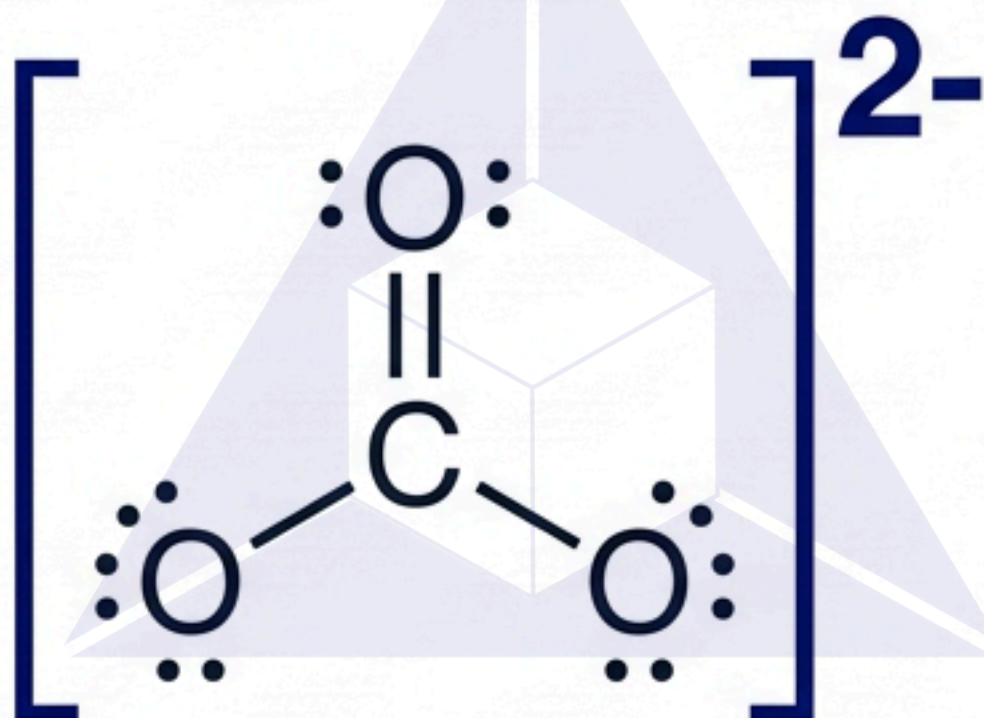
UNIT 4.1 • CHEMICAL BONDING & MOLECULAR STRUCTURE

4.1.4 Formal Charge

The Bookkeeping of Valence Electrons

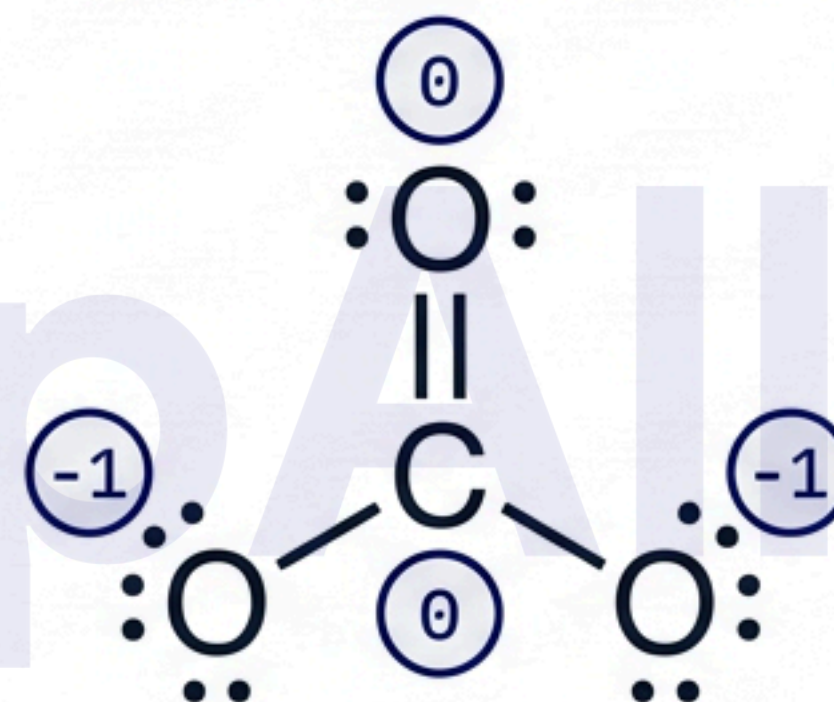
Why Formal Charge Is Needed

Ambiguous Ownership



Net charge applies to the entire ion as a whole.

Precise Bookkeeping



Formal charge localizes the electron tracking to individual atoms.

Lewis dot structures do not represent actual shapes or internal charge distribution. Formal charge is an accounting tool used to track valence electrons and assign localized charges, even when the net molecule is neutral.

Formal Charge Formula

$$FC = V - N - \frac{1}{2}B$$

V • Total Valence Electrons

The number of electrons the atom has in its isolated, free state.

N • Non-bonding Electrons

Total number of lone pair electrons assigned to the atom.

$\frac{1}{2}B$ • Bonding Electrons

Half the total number of shared electrons (since covalent bonds are shared equally).

Formal Charge = [Free Atom Electrons] minus [Electrons Assigned in Lewis Structure]



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$$E=mc^2$$



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Ozone (O3) Calculation Map

Atom 1 (Central)

$$6 - 2 - \frac{1}{2}(6) = +1$$

+1

1

Atom 2 (End, Double Bond)

$$6 - 4 - \frac{1}{2}(4) = 0$$

0

2

Atom 3 (End, Single Bond)

$$6 - 6 - \frac{1}{2}(2) = -1$$

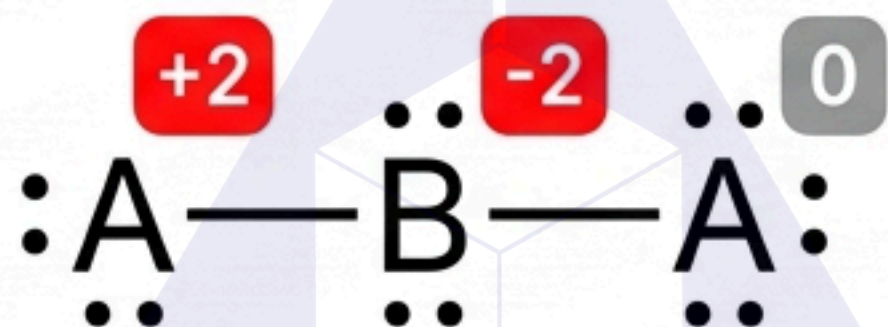
-1

3

The sum of formal charges (+1 + 0 - 1) equals the net charge of the neutral ozone molecule (0).

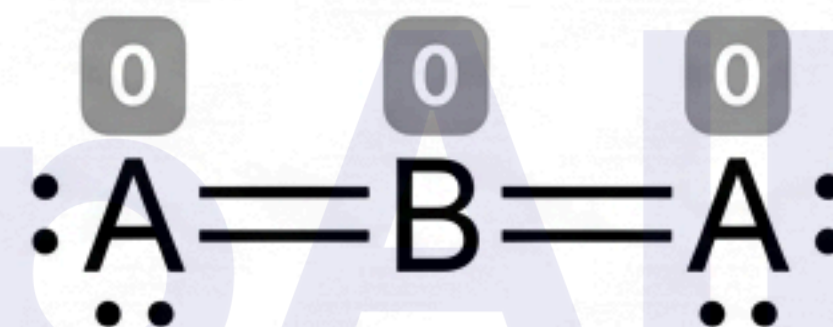
Lowest-Energy Structure Logic

Sub-Optimal



High charge separation implies a higher energy, less stable state.

Preferred Model

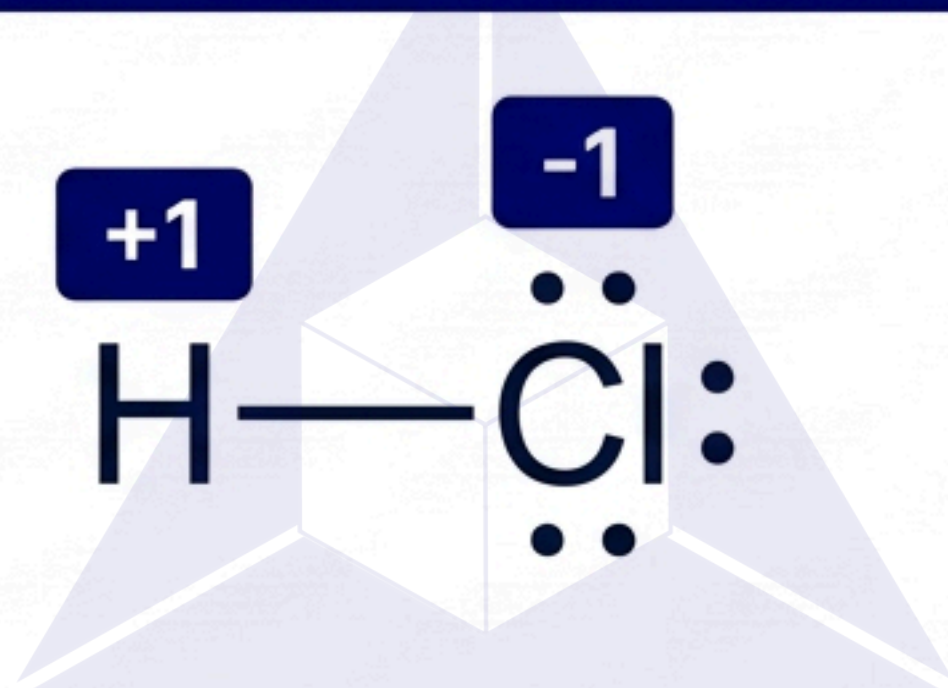


The lowest energy structure is the one with the smallest formal charges.

Diagnostic Rule: When evaluating multiple possible Lewis structures for a given species, prioritize the structure that keeps formal charges as close to zero as possible.

Bookkeeping vs. Physics

Formal Charge Model



- Assumes 100% pure covalent bonding.
- Assumes electron pairs are shared perfectly equally.

Theoretical Accounting Tool

vs

Actual Electron Density



- Real molecules have polar electron clouds.
- Unequal sharing based on electronegativity.

Physical Reality

Crucial Takeaway: Formal charges do NOT indicate real charge separation within the molecule. They are simply an accounting metric to help select the best Lewis structure.



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