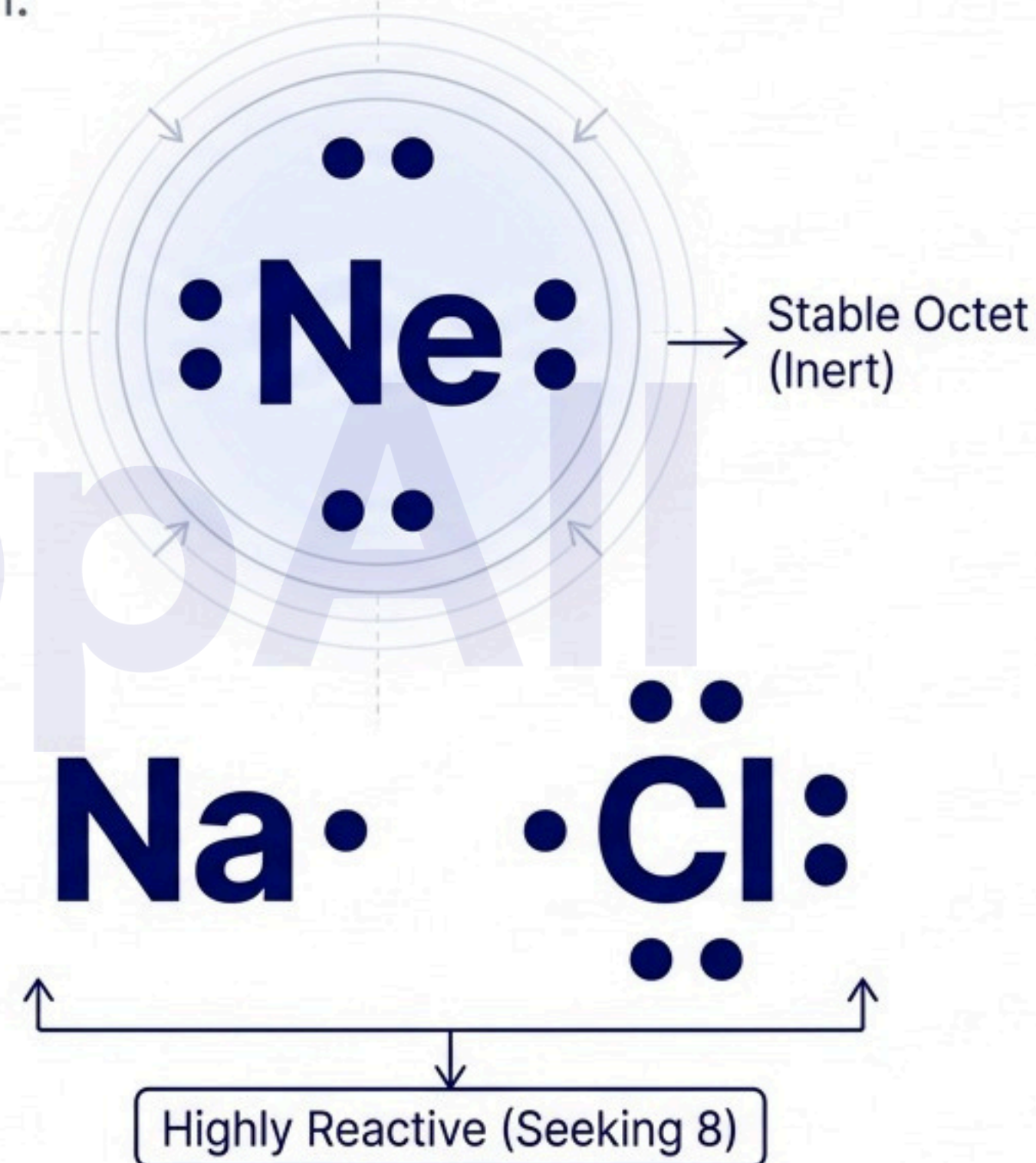


The Octet Idea: The Drive for Stability

Bonding is nature's way of lowering the energy of a system.

The Kössel-Lewis Approach (1916)

- ❖ **The Observation:** Noble gases are chemically inert because they possess a remarkably stable outer shell configuration of eight electrons (ns^2np^6).
- ❖ **The Postulate:** Atoms interact to achieve this identical stable octet.
- ❖ **The Mechanism:** Atoms link by chemical bonds—manipulating their outermost (valence) electrons—until they mimic the stability of a noble gas.
- ❖ **The Valence Shell:** Inner core electrons are protected; only outer-shell electrons dictate chemical combination.

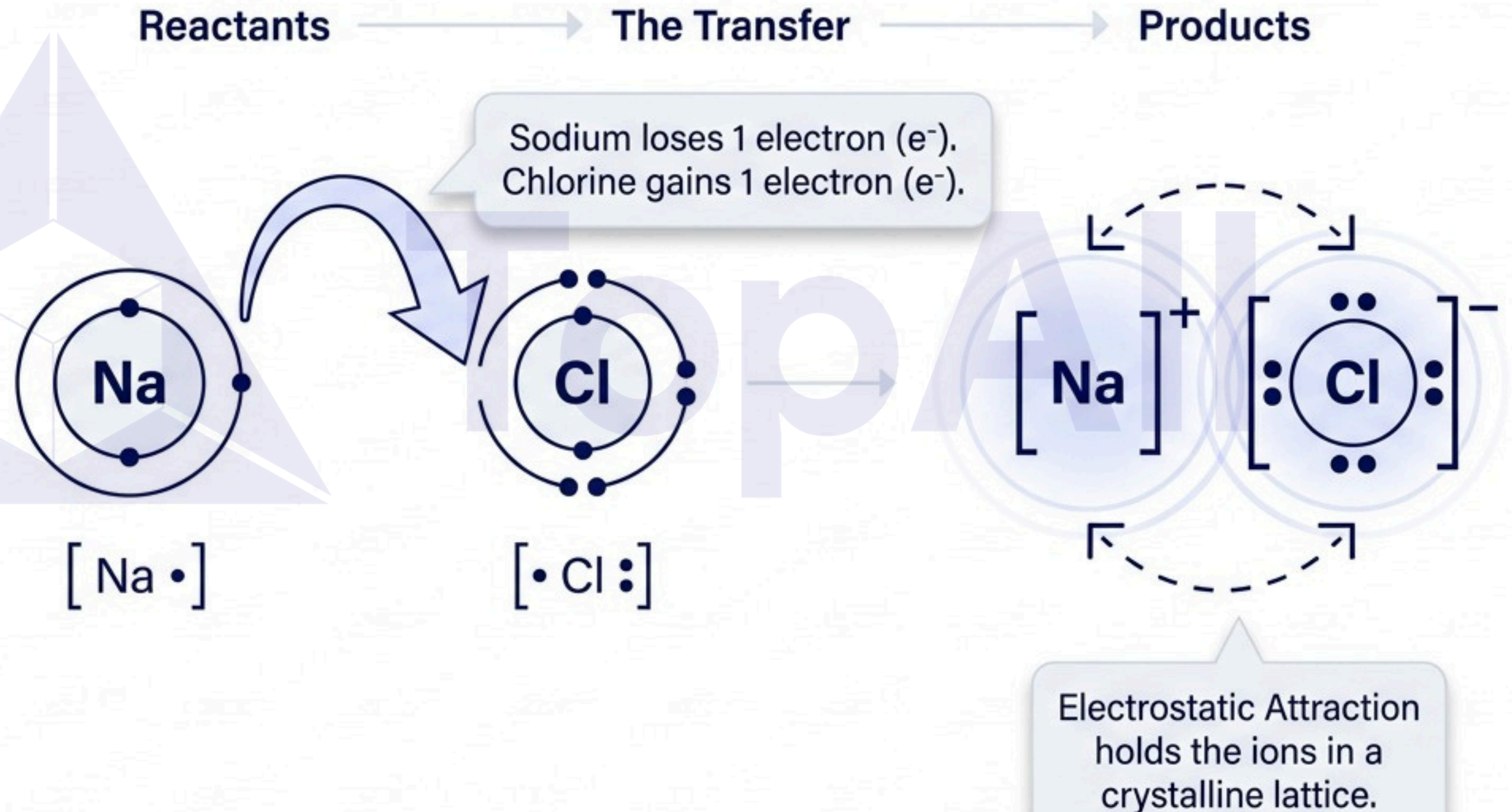


Route 1: The Transfer (Electrovalent Bond)

Attaining an octet through the complete gain or loss of electrons.

The Mechanism:

Occurs primarily between highly electropositive alkali metals (low ionization enthalpy) and highly electronegative halogens (high negative electron gain enthalpy).

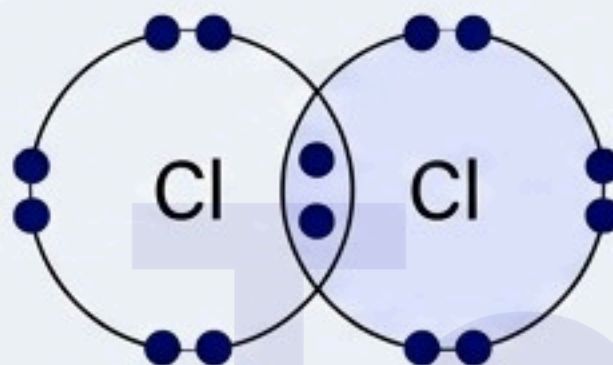
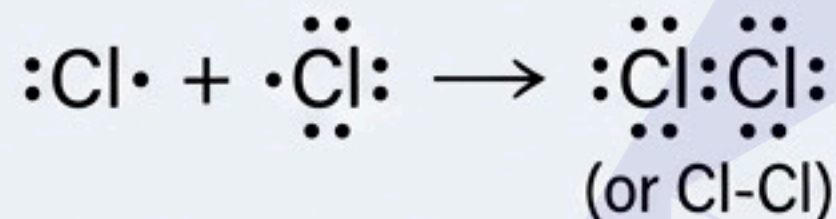


Route 2: The Sharing (Covalent Bond)

Attaining an octet through mutual contribution of electron pairs (Langmuir, 1919).

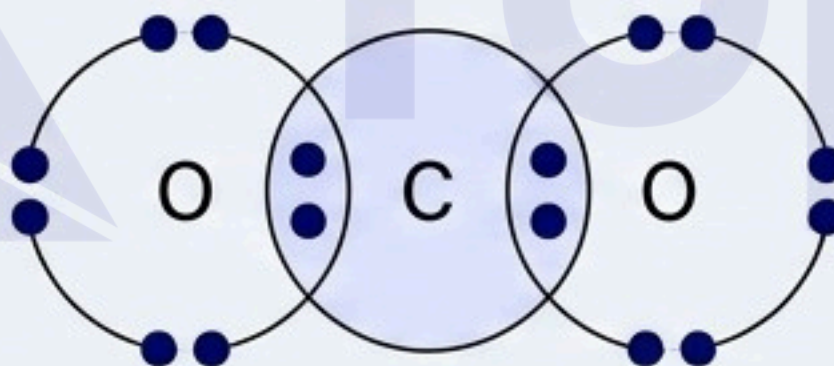
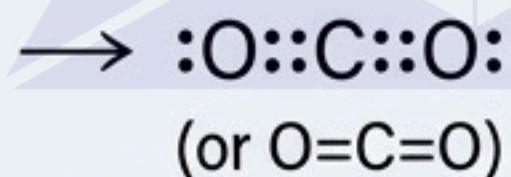
The Mechanism: When complete transfer is unfavorable, atoms contribute an equal number of electrons to a shared pool. Both atoms count the shared pair(s) toward their own octet.

Panel 1: Single Bond (1 Pair)



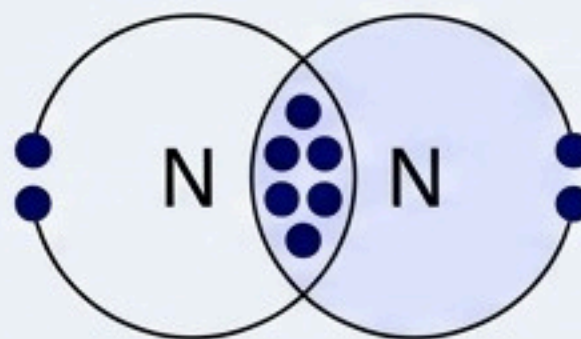
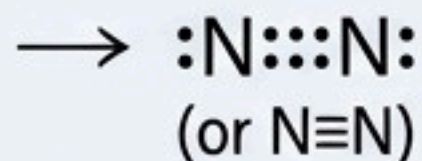
1 pair shared. Each Chlorine atom attains Argon's ns^2np^6 configuration.

Panel 2: Double Bond (2 Pairs)



Carbon dioxide. The central Carbon shares 2 pairs with each Oxygen to complete all three octets.

Panel 3: Triple Bond (3 Pairs)



Nitrogen molecule. 3 pairs shared. Features exceptionally high bond dissociation enthalpy.



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Key Highlights

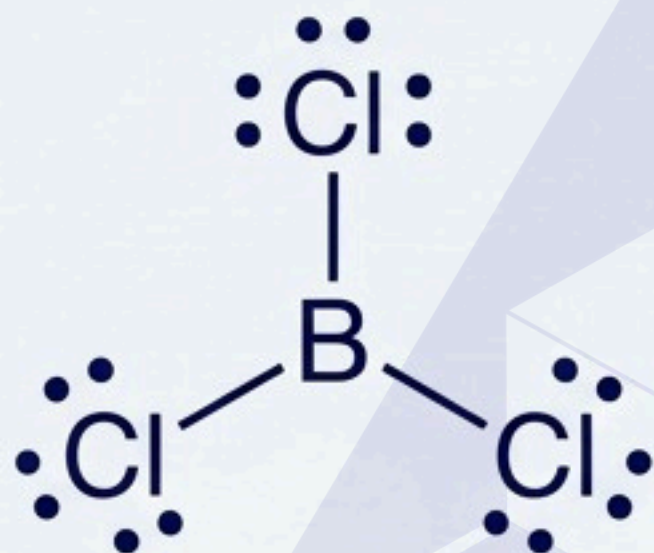
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Useful, But Not Universal

The Octet Rule is based on chemical inertness, but nature has distinct exceptions.

The Incomplete Octet

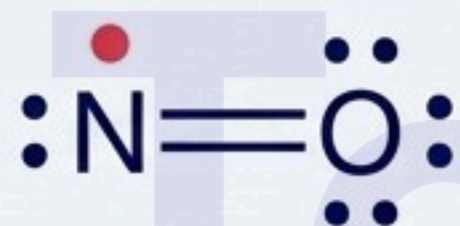


Elements with fewer than four valence electrons (like Li, Be, B) often form perfectly stable molecules without reaching eight.

Exception Profile

BCl₃ (Central Boron has only 6 e⁻).

Odd-Electron Molecules

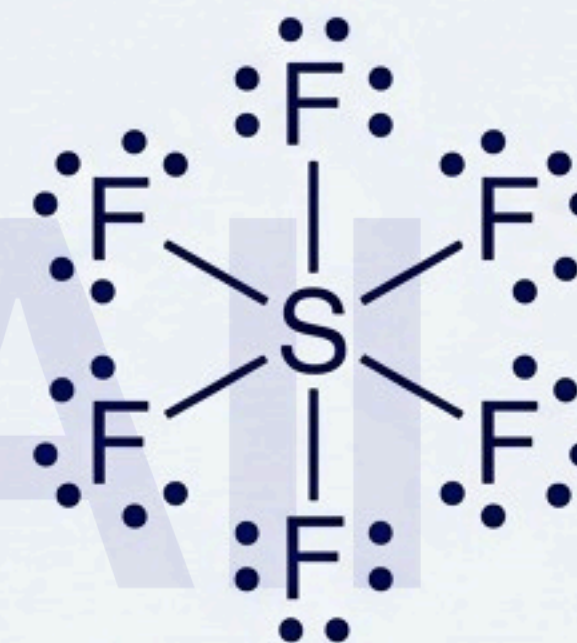


Molecules with an odd total number of electrons physically cannot pair them all. The octet rule cannot be satisfied for every atom in the system.

Exception Profile

NO, NO₂.

The Expanded Octet



Elements in the 3rd period and beyond have vacant 3d orbitals available for bonding, allowing the central atom to hold much more than 8 valence electrons.

Exception Profile

SF₆ (12 e⁻), PF₅ (10 e⁻), H₂SO₄.

Crucial Limitation: The Octet Theory strictly tracks electrons; it is entirely silent on predicting 3D molecular shapes or relative energy stability.

Revision Frame: The Octet Rule

Summary of chemical bonding via valence electron manipulation.

THE CORE PRINCIPLE

- **The Rule:** Atoms combine in ways that leave them with 8 valence electrons (mimicking a noble gas configuration).
- **The Goal:** Lowering the total energy of the system to maximize physical stability.

HOW IT HAPPENS

Route A: Ionic (Transfer)

- **Action:** Complete transfer of electrons.
- **Result:** Formation of positive cations and negative anions.
- **Force:** Electrostatic attraction in a lattice.
- **Example:** $\text{Na}^+ \text{Cl}^-$

Route B: Covalent (Sharing)

- **Action:** Mutual sharing of valence electron pairs.
- **Result:** Single ($2e^-$), double ($4e^-$), or triple ($6e^-$) bonds.
- **Force:** Shared electron density between nuclei.
- **Example:** $\text{O}=\text{C}=\text{O}$

WHERE IT FAILS (LIMITS)

- **Incomplete Octets:** Central atom holds $<8 e^-$ (e.g., BCl_3 , BeH_2).
- **Odd Electrons:** Total electrons are odd, leaving an unpaired e^- (e.g., NO).
- **Expanded Octets:** Central atom uses d-orbitals to hold $>8 e^-$ (e.g., SF_6 , PF_5).
- **Noble Gas Reactivity:** "Inert" gases can sometimes form compounds (e.g., XeF_2).
- **Structural Blindspot:** Theory cannot predict 3D geometry or bond energies.



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