

The octet rule



THE OCTET RULEThe Northwestern University's Holmgren Laboratory defines the octet rule as "Atoms will lose, gain or share electrons to achieve the electron configuration of the nearest noble gas." With the single exception of helium, which has only two electrons, the number is eight (an octet). Where it can exist, an octet of electrons imparts great stability and lower reactivity. There are instances, however, in which an octet cannot form, i. e. the octet rule is "violated."

"The Noble or Inert Gases"Most of the noble gases do not possess sufficient reactivity to form compounds, and those that do form them require especially powerful reactants and reaction conditions. Although elements that form octets do not achieve the degree of stability of noble gases, they do achieve maximum stability. Their further reactivity is limited. **Octet Violation One — the Two Electron Case**Hydrogen gas exists ordinarily as the diatomic (two atoms) gas, H₂. Since each hydrogen atom carries with it only one lone electron, each of the atoms in the diatomic gas "sees" only two electrons, not an octet.

If one of the two hydrogen atoms is replaced by a sodium or other alkali metal atom, it is only sodium that achieves an octet. The single hydrogen sees only two electrons. **Violation Two — Period Two Elements**Some of the period two elements cannot form an octet of electrons. Lithium, for example, has three electrons. It loses one when it forms compounds. Although other members of period two can add electrons to form a total of eight, some of those electrons are not valence electrons—i. e., they are not available to form chemical bonds, so there is no octet formed.

Violation Three — Geometrical Limitations Some chemical bonds have “directionality.” Directionality can decrease the ability to form bonds. For instance, p orbitals, of which there are three, face in what can be identified as an “x,” a “y,” and a “z” direction. Carbon ordinarily can form four bonds, yet it cannot do so with itself in the gas phase, as the geometry they would require is unachievable.

Violation Four — Special Exceptions There are molecules whose bonding is not yet clearly understood, such as that of chlorine dioxide. Chlorine dioxide may involve a three-electron bond, which clearly falls outside the realm of the predictable and the expected. It also nullifies the concept of the octet of electrons.