Chemical Bonding

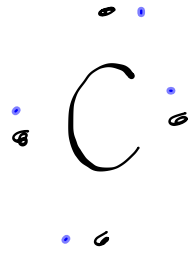
Valence electrons
electrons in the highest occupied energy level of an element's atoms.

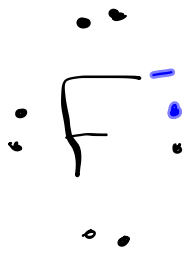
- determines the chemical properties of an element
- only electrons used in chemical bonds
- for a representative element, the number of valence electrons corresponds to the group number

Electron dot structure
diagrams showing the valence electrons as dots

Table 7.1

C(4)





C $1s^2 2s^2 2p^2$

Table 7.1

Electron Dot Structure of Some Group A Elements

Period	Group 1A	2A	3A	4A	5A	6A	7A	8A
1	H·							He:
2	Li·	·Be·	·B·	·C·	·N·	·O·	·F·	:Ne:
3	Na·	·Mg·	·Al·	·Si·	·P·	·S·	·Cl·	:Ar:
4	K·	·Ca·	·Ga·	·Ge·	·As·	·Se·	·Br·	:Kr:

Octet Rule

To form compounds, atoms usually achieve the electron configuration of a noble gas.

At the highest occupied energy level: ns^2np^6

Ne $1s^2 2s^2 2p^6$

Formation of Cations

Cations lose valence electrons to form positively charged ions

Na $1s^2 2s^2 2p^6 3s^1$ $\xrightarrow{-e^-}$ Na^+ $1s^2 2s^2 2p^6$

Ionization:

$Na \longrightarrow Na^+ + e^-$

$Mg \longrightarrow Mg^{2+} + 2e^-$

Transition Metals will attempt to form a pseudo noble-gas configuration.

Cu (I)

$Cu \rightarrow Cu^+ + e^-$

$1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^8$

Formation of Anions

Anions gain electrons to produce a negatively charged ion.

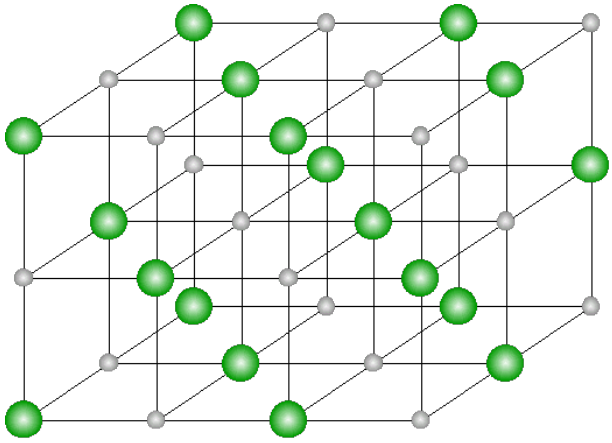
$Cl\ 1s^2 2s^2 2p^6 3s^2 3p^5 \xrightarrow{+\ e^-} Cl^-\ 1s^2 2s^2 2p^6 3s^2 3p^6$

Ionization:

$Cl + e^- \longrightarrow Cl^-$

$O + 2e^- \longrightarrow O^{2-}$

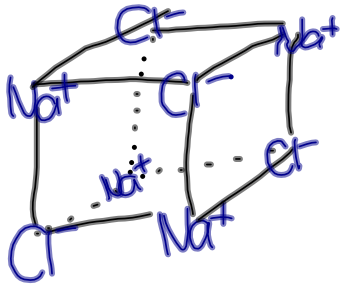
Crystal Structure of Ionic Solids



NaCl

$Na^+ Cl^-$

$Cl^- Na^+$



Metallic Bonds

Metals are made of closely packed cations rather than neutral atoms.

In metals, the valence electrons drift freely from one part of the metal to another.

Metallic bonds consist of the free-floating valence electrons for the positively charged metal ions.

Ductility and Malleability

Metals - cations insulated by 'sea' of electrons

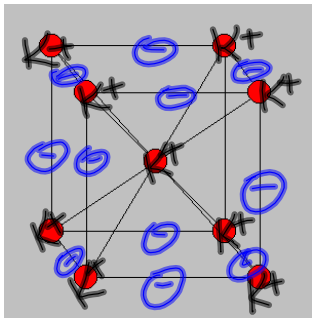
Ionic compounds - positive ions pushed together and repel, causing crystal to shatter.

Crystalline Structure of Metals

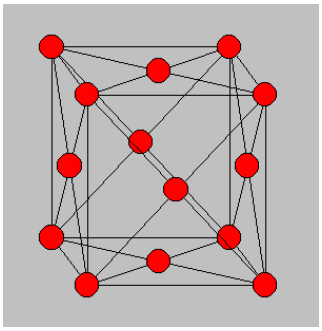
Metals are arranged in very compact and orderly patterns.

Closely-Packed Arrangements:

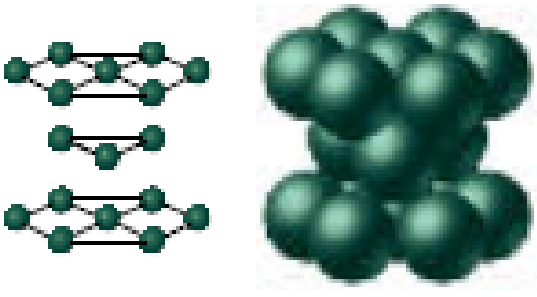
- Body-Centered Cubic



- Face-Centered Cubic



- Hexagonal Close-Packed



Hexagonal close-packed