Chemical Foundations: Elements, Atoms, and Ions

Ions and Their Compounds

Atoms are neutral entities.

–They have a zero net charge.

-The number of protons in its nucleus equals the number of electrons in the space around the nucleus.



–We can create an ion by taking a neutral atom and adding or removing one of more electrons.

 Ion → an atom or group of atoms that has a positive or negative charge.





Cations and Anions Losing electrons

- Cation \rightarrow a positively charged ion.
 - Produced when one or more electrons are *lost* from a neutral atom.
 - When electrons are removed from an atom it becomes much smaller.

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

magnesium ion

magnesium atom

(12+) + (10-) = 2+



–A cation is named using the name of the parent atom.

• Ex. above is the aluminum ion (or aluminum cation).



Gaining electrons

 Anion → a negatively charged ion.
– Produced when a neutral atom gains one or more electrons.

 $CI + e^{-} \rightarrow CI^{-}$

chlorine atom

(17+) + (17-) = 0

chloride ion

(17+) + (18-) = 1-

- When electrons are added to an atom it becomes much larger.
- An anion is named by taking the root name of the atom and changing the ending.



- Add the suffix -ide.
 - fluorine $F + e^- \rightarrow F^-$ fluoride ion
 - bromine $Br + e^- \rightarrow Br^-$ bromide ion
 - iodine I + $e^- \rightarrow I^-$ iodide ion

Forming ions

- Ions are always formed by removing electrons from an atom (forming cations) or adding electrons to an atom (forming anions).
- lons are never formed by changing the number of protons in an atom's nucleus.
- Most commonly, ions form when metallic elements (form cations) combine with nonmetallic elements (form anions).

- Ion Charges and the Periodic Table
- Group 1 metals all form 1⁺ ions.
- Group 2 metals all form 2⁺ ions.
- Group 3 metals all form 3⁺ ions.

Li+

Na⁺

K+

Rb*

Cs+

Cation charge
is the same
as the group
number.

- Most of the transition metals form cations with various positive charges.
 - There is no easy way to predict the charge.
 - Metals always form cations.



• The tendency to lose electrons is a characteristic of metals.

- Nonmetals form negative ions (anions) by gaining electrons.
- Group 7 atoms all form 1⁻ ions.
- Group 6 nonmetals all form 2⁻

ions.



 Write the relationship between the group number and the type of ion formed on your periodic table for future reference.



