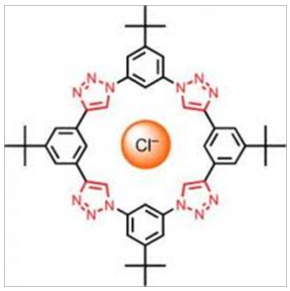
5.1 Ion Formation.



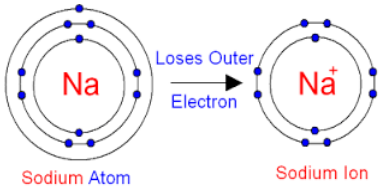
Oct 14-10:35 AM

Ion Definition

Ion: atom that has lost or gained one or more valence electrons by reacting with another atom.
In forming ions, elements become stable (unreactive).

Ions mimic nearest noble gas's electron configuration.

Noble gases already have a full outer shell, so are unlikely to form bonds with other elements.



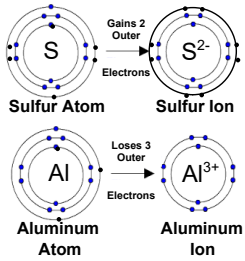
Oct 18-9:32 PM

Octet Rule

Ions with eight electrons in their valence shells are chemically stable - they won't react more.
Atoms end up with eight electrons by losing or gaining them (whichever is easiest).

Ex. 1: sulfur has 6 V. E.; by obtaining two more, it will have 8 (easier than losing 6).

Ex. 2: aluminum has 3 V. E.; by losing all three, the next energy level down will have 8 (easier than gaining 5).



Oct 24-7:33 AM

Octet Rule Exceptions

Helium is a noble gas with only two electrons.

H, Li, Be, and B will form ions that mimic helium's electron configuration: $\mathbf{1s^2}$, because they have too few electrons to end up with eight.

Carbon is also an exception, it can form a 4+ ion that mimics helium.

Oct 24-7:33 AM

1. Octet Rule Examples

How many electrons will these elements gain or lose to satisfy the octet rule?

Nitrogen = 3 electrons gained

Chlorine = 1 electron gained

Calcium = 2 electrons lost

Carbon = 4 electrons gained or lost

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2. Sodium Example

Sodium atom (Na) = $1s^2 2s^2 2p^6 3s^1$

Sodium loses one electron.

New electron configuration = $1s^2 2s^2 2p^6$

Same configuration as neon.

Note: it is still the element sodium. Electron movement doesn't make a new element (there are still 11 protons).

Nov 1-9:18 PM

3. Phosphorus Example

Phosphorus atom (P) = $1s^2 2s^2 2p^6 3s^2 3p^3$

Phosphorus gains three electrons.

New electron configuration = $1s^2 2s^2 2p^6 3s^2 3p^6$

Same configuration as argon.

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Details

Positive ions – called cations (cat-ions)

Negative ions – called anions (an-ions)

The **charges** of ions appear as **superscripted** numbers beside the symbol:

K^+ S^{2-} Al^{3+} Cl^-

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Cations

Metals lose electrons.

Group 1 metals form 1+ ions,
Group 2 metals form 2+ ions.

Transition metals lose s electrons, and may lose d electrons also, depending on what they react with.

Look at Resources 3 for metal ions with multiple charges: those are listed with Roman Numerals.

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Anions

Nonmetals gain electrons.

Group 5 elements gain 3 electrons: charge = 3-.
Group 6 elements gain 2: charge = 2-.

Group 7 (halogens) elements gain one: charge = 1-

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Singles vs. Groups

Look at your Ions Resource (Page 3).
Monatomic Ion – A single atom with a charge.
Ex: I^- (iodide ion),
Al^{3+} (aluminum ion),
O^{2-} (oxide ion).

Polyatomic Ion – A group of atoms with a charge.
Ex: NO_3^- (nitrate ion),
NH_4^+ (ammonium ion),
$C_2H_3O_2^-$ (acetate ion).

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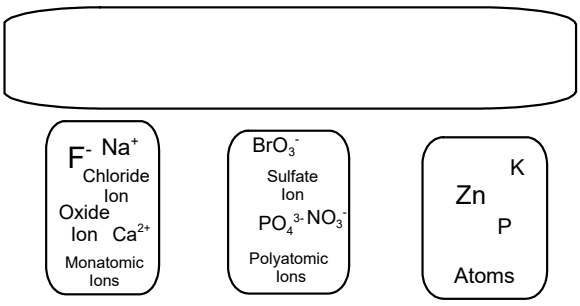
4. Sorting Example

Sort the following specimens into monatomic ions, polyatomic ions, and uncharged atoms!



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5. Chlorine Example

Chlorine (Cl) = $1s^2 2s^2 2p^6 3s^2 3p^5$

Gains one electron becoming chloride ion (Cl^-)

Configuration = $1s^2 2s^2 2p^6 3s^2 3p^6$ – (same as Argon).

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6. Naming Monatomic Anions

Monatomic anions end in ide:

Oxygen - Oxide Ion

Nitrogen - Nitride Ion

Phosphorus - Phosphide Ion

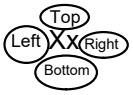
Iodine – Iodide Ion

Nov 1-9:22 PM

Electron-dot Structure

Graphic way of showing valence electrons.

1. Determine element's valence electrons.
2. Place them one at a time in any order in four regions around an element's symbol:

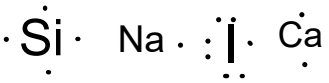


Also called "Lewis Structures", after American chemist Gilbert Lewis.

cesium Cs ·

sulfur ·S:

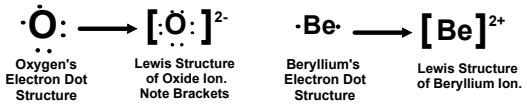
You Do!



Mar 5-12:33 PM

Electron-dot Structure of Ions

1. Determine ionic valence electrons.
Note: metal ions have none.
2. Put electrons around the element's symbol.
3. Add brackets.
4. Superscript the charge of the ion.



Oxygen's Electron Dot Structure

Lewis Structure of Oxide Ion. Note Brackets

Beryllium's Electron Dot Structure

Lewis Structure of Beryllium Ion.

Mar 5-12:33 PM

Homework

Preview 5.2

5.1 Problems in your Booklet
Due: Next Class

Nov 1-9:24 PM