Ionic Compounds

Forming Chemical Bonds
• Chemical bond - the force that holds two atoms together
• Ionic bonds - exist between oppositely charged ions
• Cation - positively charged ion
• Anion - negatively charged ion

Mini-review
• Electron configuration reveals Principle Energy Level where valence electrons are found
• Valence electrons are the electrons involved in bonding
• Represent valence electrons via electron dot structures

Formation of Positive Ions
Positive ions form when atoms lose electrons in order to attain 8 valence electrons (like a noble gas)
Examples:
Na $1s^22s^22p^63s^1 \rightarrow 1$ val. e-
When sodium loses that one electron it assumes a noble gas config. of $s^2p^6$
Once it ionizes it then has more protons than electrons and has a charge of +1. (CATIONS)

Formation of Negative Ions
• Again, atoms want to attain 8 val e-
• Example:
  Cl: $1s^22s^22p^63s^23p^5$ will gain 1 e- to attain a tot. of 8
• When chlorine gains that one electron it assumes a noble gas config. of $s^2p^6$
• Once it ionizes it then has more electrons than protons and has a charge of -1. (ANIONS)

Charge Chart
• Group 1A $\rightarrow$ all will form +1 charge
• Group 2A $\rightarrow$ all will form +2 charge
• Group 3A $\rightarrow$ all will form +3 charge
• Group 4A $\rightarrow$ +/- 4 charge
• Group 5A $\rightarrow$ all will form a -3 charge
• Group 6A $\rightarrow$ all will form a -2 charge
• Group 7A $\rightarrow$ all will form a -1 charge
• Group 8A $\rightarrow$ will not form a charge
Formation of Ionic Bond

Ionic bond - the electrostatic force that holds oppositely charged particles together.
Forms between positively charged metal cations and negatively charged non-metal anions.

Example:
Na\(^{+1}\) and Cl\(^{-1}\) becomes NaCl

Na \(1s^22s^22p^6\) becomes Na\(^{+1}\) \(1s^22s^2\)
Cl \(1s^22s^22p^5\) becomes Cl\(^{-1}\) \(1s^22s^22p^6\)

Also explained via Electron Dot Models

Na\(\cdot\)Cl

Ionic Vocab.

• If a metal combines with a non-metal it forms an ionic compound called a salt.

• Exception: A metal bonding with oxygen is called an oxide.

• Many ionic compounds are binary which mean they consist of two elements.

What happens if….

A compound forms from Calcium (Grp. 2A) and Fluorine (Grp. 7A).
Calcium will need to lose _2_ electrons to become stable.
Fluorine will need to gain _1_ electron to become stable.
SO, what happens?
One Ca\(^{+2}\) cation will attract two F\(^{-1}\) anions

CaF\(_2\)

What are the formulas for these combinations?

• Sodium and nitrogen
• Lithium and oxygen
• Strontium and fluorine
• Aluminum and sulfur
• Cesium and phosphorus
Names and Formulas for Ionic Compounds

- Formula units
- simplest ratio of the ions represented in an ionic compound
- Overall charge (net charge) is ZERO

Ex. KBr [one ion of potassium (K) and one ion of Bromine (Br)]

Determining Charge

- Monotomic ions: charge is equivalent to the group number (Group 1A-Group 8A)
- Charge is called its oxidation number
- Oxidation state equals the number of electrons transferred from an atom of the element to form the ion.
- Transition elements can have more than one oxidation state (see page 255, table 9.2)

Potassium and iodine
magnesium and chlorine
aluminum and bromine
cesium and nitrogen
barium and sulfur

Sodium and nitrate
Calcium and chlorate
Aluminum and carbonate
Potassium and chromate
Magnesium and carbonate

Opener Quiz - on a piece of paper
Write the formulas for these:
1. Calcium bromide
2. Strontium sulfite
3. ammonium oxide
4. Boron oxide

Practice!!!
Naming Compounds

- With monotomic ions, cations stay the same; however, anions change their ending to –ide
- Polyatomic ions:
  - Most are oxyanions (has oxygen)
  - Some are composed of exact same ions but in different amounts
- Ex. $NO_3^-$ nitrate $NO_2^-$ nitrite

Chlorine (forms 4 oxyanions)

- $ClO_4^-$: perchlorate
- $ClO_3^-$: chlorate
- $ClO_2^-$: chlorite
- $ClO^-$: hypochlorite

Rules in a Nutshell

1. Name cation before anion
2. Monotomic cations use the name
3. Monotomic anions use the root of the name and add –ide
4. Groups 1-2 metals have one oxidation number while transition metals have more than one
5. Polyatomic ions → name them.

Properties of Ionic Compounds

- Crystalline structure
- Large amt. of energy required to break bonds
- Formation of ionic bonds is always exothermic
- Solid state → non-conductors
- In aqueous solution → great conductors (aka electrolytes)

Metallic bonding

holds atoms of metals together and explains the behavior of metals.

**Electron Sea Model** – all metal atoms in a metallic solid contribute their valence e- to form a sea of electrons

> e- not held by a specific atom → they move freely = delocalized e-
> Metallic bond – attraction of metallic cations for delocalized e-
Properties of metals

- High m.p. & b.p. (attraction b/t cations & e-)
- Malleable, ductile, lustrous
- Good conductors (delocalized e- move heat/ electricity through rapidly)
- Alloy – mixture of elements that has metallic properties
  eg: steel

\[
\begin{align*}
\text{FeO} & \quad \text{Iron(II) oxide} \\
\text{Fe}_2\text{O}_3 & \quad \text{Iron(III) oxide} \\
\text{Pb}_2\text{O}_4 & \quad \text{Lead(IV) oxide}
\end{align*}
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