Ionic Compounds
Chapter 9

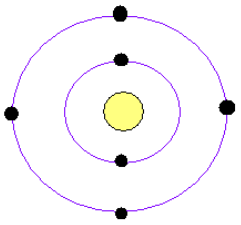
Chapter 6: Ionic Compounds

A. Octet Rule
B. Ionic Bonding
C. Formulas
D. Naming Ionic compounds

Octet rule

- **Octet rule:** Atoms in a compound will lose, gain or share electrons in order to achieve a stable noble gas configuration.
- It is the electrons in the outer shell that participate in these changes to create bonds

Valence electrons

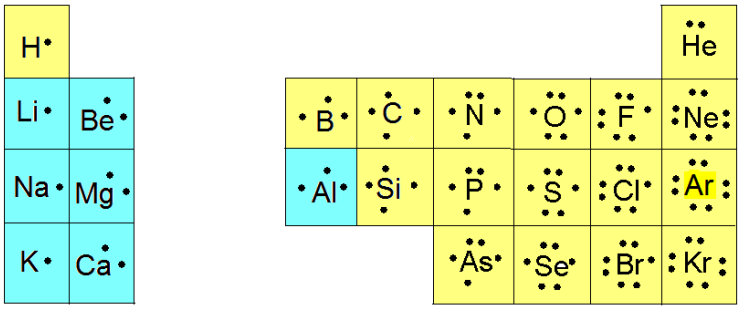


- The valence electrons of an atom are defined as the electrons in the outermost shell of the uncharged atom.
- The number of valence electrons of an uncharged atom is equal to the group number for main group elements.

Dot structures

- In Lewis dot structures, the valence electrons are represented by dots.
- Lewis dot structures play a more important role in covalent bonding than ionic bonding.
- Sodium, in group I has 1 valence electron
- Carbon in group IV has 4 valence electrons.

Dots for common elements

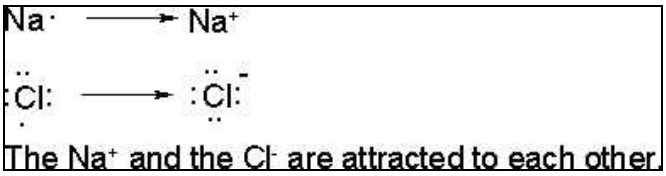


Types of bonding

- metal + non-metal leads to ionic bonding.
  - the metal will lose electrons to become positively charged.
  - the non-metal will gain electrons to become negatively charged.
  - the ionic compound is held together by the electrostatic attraction between the positive and negative charges.

Salt and Lewis Structures

- The sodium and chlorine combine in a 1:1 ratio.



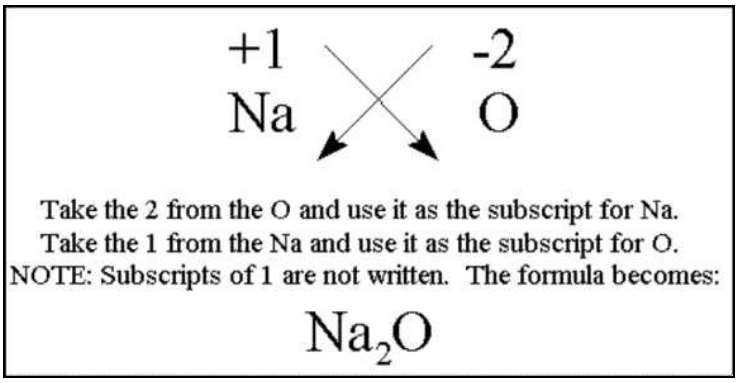
Charges of some Common Monatomic ions

H 1+ 1-																	
Li 1+	Be 2+													N 3-	O 2-	F 1-	
Na 1+	Mg 2+											Al 3+		P 3-	S 2-	Cl 1-	
K 1+	Ca 2+	Sc 3+	Ti 3+ 4+	V 3+ 4+	Cr 2+ 3+	Mn 2+ 3+	Fe 2+ 3+	Co 2+ 3+	Ni 2+ 4+	Cu 1+ 2+	Zn 2+					Br 1-	
Rb 1+	Sr 2+								Pd 2+ 4+	Ag 1+	Cd 2+		Sn 2+ 4+			I 1-	
Cs 1+	Ba 2+								Pt 2+ 4+	Au 1+ 3+	Hg 2+ *		Pb 2+ 4+				
Fr 1+	Ra 2+																

Does it have to be a 1:1 ratio? No!

- All ionic compounds must have no overall charge so positive charges must equal negative charges.
- Example sodium oxide: Na_2O

The Switcheroo Rule



Note that the cation is written first and the anion second.

A Caveat to the Switcheroo rule

- If you can divide by an integer greater than one, you must do so.
- Mg^{2+} and O^{2-} form MgO not Mg_2O_2

Polyatomic ions

- Polyatomic ions are groups of covalently bound atoms that act like a single ion.
- Example: nitrate NO_3^- combines with Mg^{2+} to form $Mg(NO_3)_2$.
- Note the use of ( ) to identify that it is 2 nitrates.
- Pb^{3+} and OH^- form: $Pb(OH)_3$

Ten polyatomic ions

Formula	Name
NH_4^+	Ammonium
OH^-	Hydroxide
NO_3^-	Nitrate

$CH_3CO_2^-$	Acetate
CN^-	Cyanide
ClO_3^-	Chlorate
CO_3^{2-}	Carbonate
HCO_3^-	Bicarbonate
SO_4^{2-}	Sulfate
PO_4^{3-}	Phosphate

Rules for naming simple ionic compounds.

1. Name the metal by its elemental name.
2. Name the nonmetal by its elemental name and an -ide ending.
3. Name metals that can have different oxidation states using roman numerals to indicate positive charge. Example Fe^{2+} is Iron(II)

(See table "Charges of some Common Monatomic ions" to determine which metals can have more than one positive charge.)

4. Name polyatomic ions by their names.

Ionic Nomenclature Practice

The Rule: Name the cation Name the anion

- $CoCl_2$ **Cobalt(II) chloride**
- $Sn(ClO_3)_2$ **Tin(II) chlorate**
- K_2S **Potassium sulfide**
- $NH_4C_2H_3O_2$ **Ammonium acetate**
- $Mg(NO_3)_2$ **Magnesium nitrate**
- AgI **Silver iodide**

More Practice On the Web

- Nomenclature Activity
- game
- Worksheet
- More Worksheets

Homework

1) An element that can form an ionic compound with oxygen is
   a) hydrogen
   b) carbon
   c) sulfur
   d) iron

2) The formula for magnesium hydroxide is
   a) MgOH
   b) Mg_2OH
   c) $MgOH_2$
   d) $Mg(OH)_2$

3) The name of the compound Ca_3N_2 is
   a) calcium nitride
   b) calcium nitrate
   c) calcium nitrite
   d) tricalcium nitrite

4) The number of atoms in $(NH_4)_3PO_4$ is
   a) 10
   b) 14
   c) 18
   d) 20

5) What is the name of the compound $Ni(NO_3)_2$?
6) What is the formula for Iron(III)oxide?

Answers: 1) d 2) d 3) a 4) d 5) nickel(II)nitrate 6) Fe_2O_3 or Fe2O3 on the test