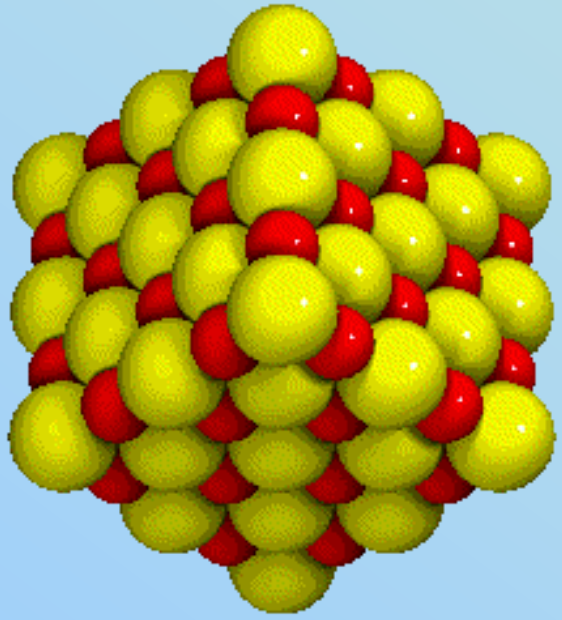
Names and Formulas of Compounds



Chemistry 2 Honors
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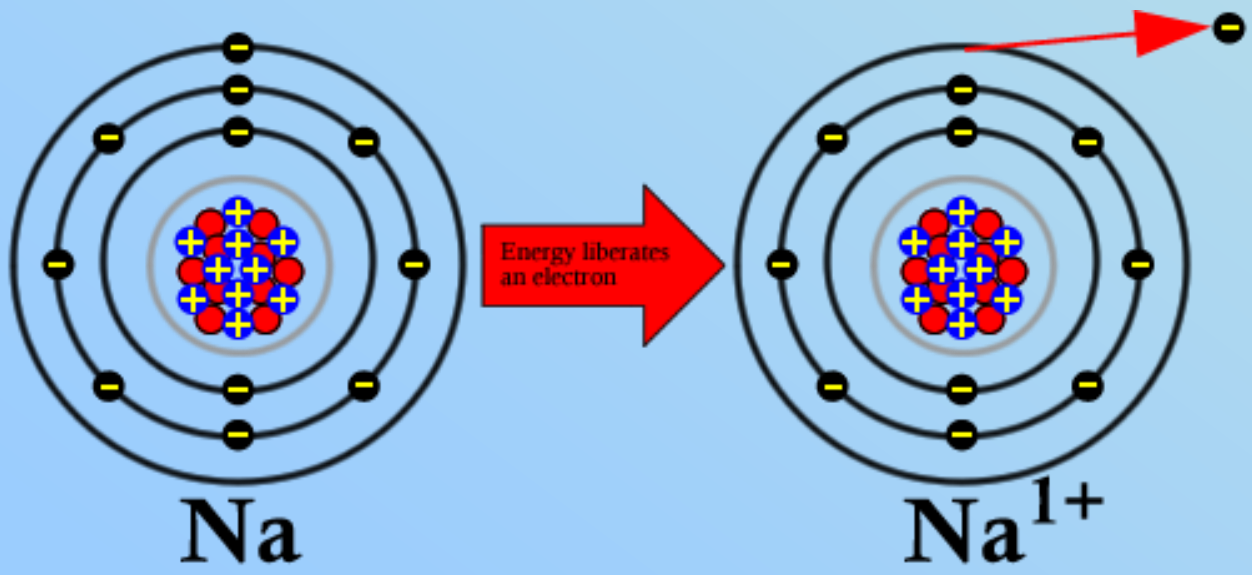
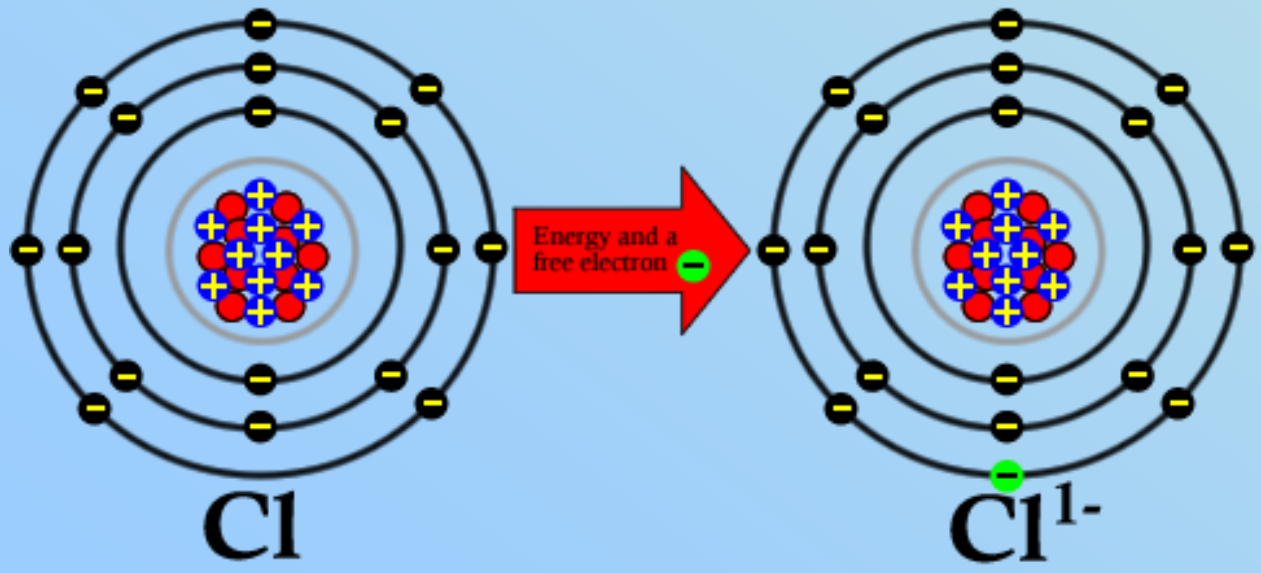
Formation of Compounds

- When an atom or molecule loses electrons, it becomes positively charged.
  - For example, when Na loses an electron it becomes Na^+.
- Positively charged ions are called *cations*.



- When an atom or molecule gains electrons, it becomes negatively charged.
  - For example when Cl gains an electron it becomes Cl^{-}.
- Negatively charged ions are called *anions*.
- An atom or molecule can lose more than one electron.



Formation of Compounds

- *In general: metal atoms tend to lose electrons to become cations; nonmetal atoms tend to gain electrons to form anions*.

Formation of Ionic Bonds

- Opposite ions attract one another. A crystalline lattice forms.

Predicting Ionic Charge

- The number of electrons an atom loses is related to its position on the periodic table.

Predicting Ionic Charge

1A	2A											3A	4A	5A	6A	7A	8A
H^+																H^-	NOBLE GASES
Li^+	Be^{2+}													N^{3-}	O^{2-}	F^-	
Na^+	Mg^{2+}	Transition metals										Al^{3+}			S^{2-}	Cl^-	
K^+	Ca^{2+}										Zn^{2+}				Se^{2-}	Br^-	
Rb^+	Sr^{2+}									Ag^+	Cd^{2+}				Te^{2-}	I^-	
Cs^+	Ba^{2+}																

Examples: Determine the most likely charge formed by each:

1. Mg
2. Li
3. Cl
4. N
5. Ca
6. S

Examples: Determine the most likely charge formed by each:

1. Mg +2
2. Li +1
3. Cl -1
4. N -3
5. Ca +2
6. S -2

Ionic Compounds

- The majority of chemistry involves the transfer of electrons between species.

Example:

- To form NaCl, the neutral sodium atom, Na, must lose an electron to become a cation: Na^+.
- The electron cannot be lost entirely, so it is transferred to a chlorine atom, Cl, which then becomes an anion: Cl^-.
- The Na^+ and Cl^- ions are attracted to form an ionic NaCl lattice which crystallizes.

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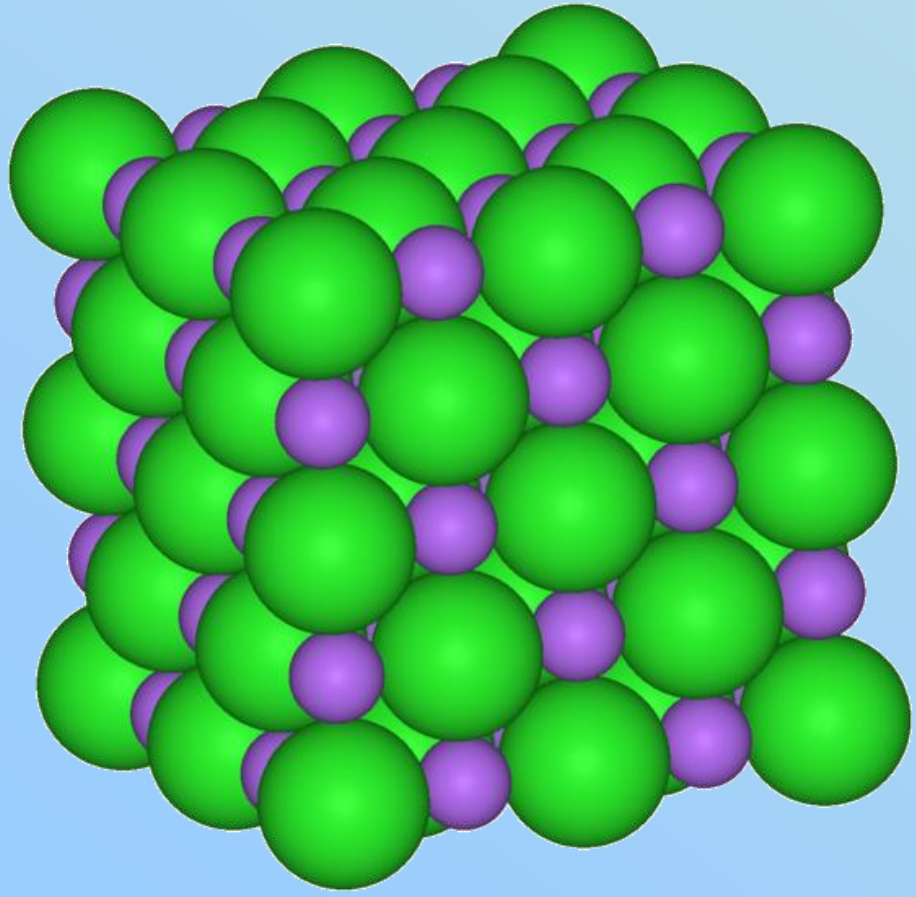
Ionic Compounds



Ionic Compounds

- Important: note that there are no easily identified NaCl molecules in the ionic lattice. Therefore, we cannot use molecular formulas to describe ionic substances.
- Consider the formation of Mg_3N_2:
- Mg loses two electrons to become Mg^{2+};
- Nitrogen gains three electrons to become N^{3-}.
- For a neutral species, the number of electrons lost and gained must be equal.

Ionic Compounds

- However, Mg can only lose electrons in twos and N can only accept electrons in threes.
- Therefore, Mg needs to lose 6 electrons (2×3) and N gain those 6 electrons (3×2).
- I.e., 3Mg atoms need to form $3Mg^{2+}$ ions (total $3 \times 2+$ charges) and 2 N atoms need to form $2N^{3-}$ ions (total $2 \times 3-$ charges).
- Therefore, the formula is Mg_3N_2.

Examples: Determine the formula of the compound formed by each:

1. Na and N
2. Ca and Br
3. Al and Cl
4. Al and S
5. K and O
6. Li and F

Examples: Determine the formula of the compound formed by each:

1. Na and N Na_3N
2. Ca and Br $CaBr_2$
3. Al and Cl $AlCl_3$
4. Al and S Al_2S_3
5. K and O K_2O
6. Li and F LiF

Naming Compounds

- Naming of compounds, nomenclature, is divided into organic compounds (those containing C) and inorganic compounds (the rest of the periodic table).
- Cations formed from a metal have the same name as the metal.

  Example: Na^+ = sodium ion.
- If the metal can form more than one cation, then the charge is indicated in parentheses in the name.

  Examples: Cu^+ = copper(I); Cu^{2+} = copper(II).

- Cations formed from non-metals end in -*ium*.

  Example: NH_4^+ ammonium ion.

Negative Ions

- Monatomic anions (with only one atom) are called –ide.

Example: Cl^- is _____.

Exceptions: hydroxide (OH^-), cyanide (CN^-), peroxide (O_2^{2-}).

Polyatomic anions (with many atoms) containing oxygen end in -*ate* or -*ite*. (The one with more oxygen is called –ate.) – see sheet.

Examples: NO_3^- is nitrate, NO_2^- is _____.

- Chemical nomenclature is a systematic way of naming compounds.
  - Name the cation followed by the anion.
  - For monatomic cations use the element name.
  - For monatomic anions, use the root element name and the suffix –*ide*.
  - To distinguish between different oxidation states of the same element, the oxidation state is written in parentheses after the name of the cation. (no roman numerals for group 1, group 2, Al, Zn, Cd, Ag)
  - When the compound contains a polyatomic ion, name the cation followed by the name of the polyatomic ion.

Naming Ionic Compounds

- Name the cation then anion for the ionic compound.

  Example: $BaBr_2$ = barium bromide.

  Examples – Name each:

  1. $Ca(HSO_3)_2$
  2. $Ba(ClO_3)_2$
  3. Na_3N
  4. $Al(CN)_3$
  5. $(NH_4)_3PO_4$
  6. $LiNO_3$
  7. $Cu(NO_2)_2$

Naming Ionic Compounds

- Name the cation then anion for the ionic compound.

  Example: $BaBr_2$ = barium bromide.

  Examples – Name each:

  1. $Ca(HSO_3)_2$ calcium hydrogen sulfite
  2. $Ba(ClO_3)_2$ barium chlorate
  3. Na_3N sodium nitride
  4. $Al(CN)_3$ aluminum cyanide
  5. $(NH_4)_3PO_4$ ammonium phosphate
  6. $LiNO_3$ lithium nitrate
  7. $Cu(NO_2)_2$ copper (II) nitrite