Part A Ionic Compounds

Nomenclature of Metal & Non-Metal Ions

1. Write the names of the following ions using the Stock system of notation.
   a) Cu^2+ b) CrO_4^{2-} c) WO_4^{2-}

2. Write the formulas of the following ions to show their charges.
   a) calcium ion b) chromium (III) ion c) vanadium (V) ion

3. Name the elements in the following formulas.
   a) CaO b) CrCl_3 c) VO_2+ d) WO_4^{2-}

Names and Formulae of Inorganic Compounds

Practice: Challenge how much do you remember?

Ions are charged atoms or charged groups of atoms. Ions always occur bound together in the ratio that results in their charges cancelling to form neutral compounds. Complete the table by avoiding the formulas of the compounds formed by the ions specified.

<table>
<thead>
<tr>
<th>Element</th>
<th>Monatomic ion name</th>
<th>Ion symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na</td>
<td>Sodium</td>
<td>Na^+</td>
</tr>
<tr>
<td>Ca</td>
<td>Calcium</td>
<td>Ca^2+</td>
</tr>
<tr>
<td>Cl</td>
<td>Chloride</td>
<td>Cl^-</td>
</tr>
<tr>
<td>Br</td>
<td>Bromide</td>
<td>Br^-</td>
</tr>
<tr>
<td>O</td>
<td>Oxygen</td>
<td>O^2-</td>
</tr>
<tr>
<td>N</td>
<td>Nitride</td>
<td>N^3-</td>
</tr>
<tr>
<td>S</td>
<td>Sulfide</td>
<td>S^2-</td>
</tr>
<tr>
<td>P</td>
<td>Phosphate</td>
<td>P^5-</td>
</tr>
</tbody>
</table>

Binary Ionic Compounds

The name of any ionic compound is... name of metal + name of the non-metal ion

NaCl: Sodium chloride

For example, a compound containing sodium and chlorine ions is called sodium chloride.

The ratio of ions formed when a particular metal and non-metal react can be predicted through the charges of their common ions, which can be found in the tables of common ions in your DATULE.

Positively charged ions are called... CATIONs

Negatively charged ions are called... ANIONs

Note that the sign of the ion charge is + or - as written in the formula. For example, aluminum ion is denoted as Al^3+ rather than as Al^-.

The different types of electrical charge are called... Opposite charges together (apply the rules of sign change) => balance charges

When particles with opposite charges bond together, the charged ions produce a neutral compound with a net change of zero.

Formula for ionic compound: +...+...+...+...+...+...=

The formula Al_2(SO_4)_3 means that there are 2Al^3+ ions for every 3SO_4^{2-} ions.

Chemists know the charges because... Chemical compounds are neutral... only ions have charges... ionic compounds... neutral... even though...
Constructing an IONIC COMPOUND from the NAME of the compound

Definition: An IONIC COMPOUND is a compound made up of ions.

1. Write the formula for the positive ion first and write the formula for the negative ion second. In a chemical name, the POSITIVE ion is always written before and the NEGATIVE ion is always written after. TIP: Do not transpose the words in the chemical name into ions in the order they are given.

2. Cross out the numbers in front of the charges on the ions.

For example:

**Sn**^4+ + **S**^2-  --> **Sn**S

3. Tidy up the formula in a three-step process.
   - If both subscripts can be evenly divided by "2" or "3" (occasionally), do so. Get the superscripted charges. Get any subscripts which is a "1".

For example:

**Na** + **S**^2-  --> **Na**2**S**

Sample Problem — Determining the Name of a Binary Ionic Compound from its Formula

What is the name of the compound?

What to Think about
1. Write the names of the two constituent ions.
2. Write the formulas of the possible compounds to see which one has the correct formula.

How to Do It

Write the name of the compound.

Iron(II) Sulfide

\[ \text{Fe}_2\text{S}_3 \]

Determining the Names and Formulas of Binary Ionic Compounds

1. Write the formula of each of the following binary ionic compounds:
   - a. sodium sulfite
   - b. aluminum chloride
   - c. copper(II) oxide
   - d. lead(I) iodide
   - e. strontium sulfide
   - f. iron(III) oxide

2. Name each of the following binary ionic compounds:
   - a. Zn(NO3)2
   - b. MnCl2
   - c. Cu(NO3)2
   - d. CaCO3
   - e. PbSO4

Polyatomic Ions

Recall that a polyatomic ion is a neutral group of covalently bonded atoms that carries a charge.

Examples:
- **CO3**^2- (carbonate)
- **NO3**^- (nitrate)
- **OH**^- (hydroxide)

Diatomic Molecules

Recall that a diatomic molecule is a molecule containing only two atoms that are held together by a covalent bond.

Examples:
- **H2** (hydrogen)
- **Cl2** (chlorine)
- **Br2** (bromine)

**Keep the polyatomic ion charged!**

**Answer:**

1. a. (**Na**2**S**)
   b. (**Al**2**Cl**3)
   c. (**Cu**2**O**)
   d. (**Pb**2**I**2)
   e. (**Sr**2**S**)

2. a. (**Zn**2**N**03)
   b. (**Mn**2**Cl**2)
   c. (**Cu**2**N**03)
   d. (**Ca**2**C**03)
   e. (**Pb**2**S**04)

**Note:** Always check the charges to ensure the formula is balanced. In a chemical name, the POSITIVE ion is always written first and the NEGATIVE ion is always written second. TIP: Do not transpose the words in the chemical name into ions in the order they are given.
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**Data Booklet**

Because they are charged, ionic compounds associate with oppositely charged ions to form.

**Ionic compounds**

1. Write the symbols of the ions named.
2. Combine the ions in the simplest ratio that results in their charges cancelling.

**Sample Problem — Determining the Formula of any Ionic Compound from Its Name**

**What to Think about**

1. Write the symbols of the ions named.
2. Combine the ions in the simplest ratio that results in their charges cancelling.

**Sample Problem — Determining the Name of any Ionic Compound from Its Formula**

**What to Think about**

1. Write the names of the two constituent ions.
2. Write the formulas of the possible compounds to see which one has the correct formula.

**Practice Problems — Determining the Names and Formulas of Ionic Compounds**

1. Write the formulas of each of the following ionic compounds:
   - (a) Barium sulphate
   - (b) Silver nitrate
   - (c) Magnesium bromide

2. Name each of the following ionic compounds:
   - (a) Zn(NO₃)₂
   - (b) SnO
   - (c) Cu(NO₃)₂

**Answers**

1. (a) BaSO₄  d. Sn(NO₃)₂  
   (b) AgNO₃  e. Al₂(C₂O₄)₃ 
   (c) MgBr₂  f. K₂SO₄ 

2. (a) zinc hydroxide  
   (b) tin(II) oxide  
   (c) copper(II) hydroxide 
   (d) sodium ethanoate or sodium acetate 
   (e) magnesium iodide 
   (f) iron(II) dichromate
Writing Compound Names

Ionic Bonds
(a bond between a metal and a nonmetal)

Naming a Binary Ionic Compound
(two elements with no transition metals)

NaCl
sodium
chloride
sodium chloride
K₂O
potassium
 oxide
potassium oxide

Element or Polyatomic Ion?
Elements are found on the periodic table.

Elements look like this:
H K O Ca Ag
one capital letter
one capital letter
one lower case letter
one lower case letter

Polyatomic ions are groups of two or more elements.
ClO₃⁻ NH₄⁺ OH⁻
They stick together.

Naming a Compound with a Transition Metal

FeCl₂
iron (II)
chloride
iron (II) chloride
Ag₂S
silver (I)
sulfide
silver (I) sulfide

Naming a Compound with a Polyatomic Ion

(NH₄)₂S
ammonium
sulfur
ammonium sulfide
Ca(ClO₃)₂
calcium
chlorate
calcium chlorate

notice that we don't change the ending of polyatomic ions