SODIUM OXIDE AND RIHANNA HAVE A #1 HIT

O NA NA
WHAT'S MY NAME

Name:______________  Block:_______
Test yourself....ionic & covalent

<table>
<thead>
<tr>
<th>Formula</th>
<th>Ionic or Covalent?</th>
<th>Name of Compound</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Cl₂O</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) CO₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) CoO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) CO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e) PbO₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(f) MgCl₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(g) PtCl₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(h) SCl₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(i) NaCH₃COO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(j) NH₄CH₃COO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This unit deals with the naming of compounds made from ____________________ and non-___________________.

Indicate the sections on the periodic table below that contain:
- METALS
- NON-METALS
- METALLOIDS
- TRANSITION METALS

The compounds used in the examples and exercises which follow are selected from the metals in white boxes (below) and the nonmetals in shaded boxes. The elements in outlined boxes are not used in any of the examples or exercises which follow (although you should know the names and symbols for later purposes).

Review: Ions & Charges

Going across the periodic table, there are trends in the charges of the ions formed by the elements in the columns.

Label the charges -->
You should become VERY familiar with the following ion charges, as they are the most common...and you will use them often

**Key Terms:**

An ____________ is an ion with a ____________ charge.

**Example:** $\text{Cl}^-$, $\text{NO}_3^-$

A ______________ is an ion with a ____________ charge.

**Example:** $\text{Al}^{3+}$, $\text{NH}_4^+$

**MEMORY AID:**

A **MONATOMIC** species is made up of only __________ atom.

**Example:** $\text{Ne}$, $\text{He}$, $\text{Li}^+$, $\text{Cl}^-$

A **DIATOMIC** species is made up of ___ atoms (which may be the same or different types).

**Example:** $\text{O}_2$, $\text{IBr}$, $\text{NO}$, $\text{Br}_2$, $\text{ClO}^-$, $\text{Hg}_2^{2+}$

A _________________ species is made up of three atoms.

**Example:** $\text{O}_3$, $\text{NO}_2$, $\text{NOCl}$, $\text{H}_2\text{O}_2$, $\text{I}^-$

A _______________ species is made up of many atoms ("poly" means "more than ONE").

**Note:** This is a general term and applies to any species having more than one atom.

**Example:**

**PRACTICE**

1. In the space after each of the following species, indicate which of the terms below apply to each species. There is more than one term which applies to each species.

   $\text{N}$ (neutral), $\text{C}$ (cation), $\text{A}$ (anion)
   $\text{M}$ (monatomic), $\text{D}$ (diatomic), $\text{T}$ (triatomic), $\text{P}$ (polyatomic)

   (a) $\text{SO}_4^{2-}$ ____________
   (c) $\text{Sr}^{2+}$ ____________
   (e) $\text{NH}_4^+$ ____________

   (b) $\text{H}_2\text{O}$ ____________
   (d) $\text{OH}^-$ ____________
   (f) $\text{Ar}$ ____________
Part A Ionic Compounds: Naming Monatomic Metal & Non-Metal Ions

### Naming monatomic metal ions:
Use the name of the metal and add the word ________

**Example:** Sodium metal (Na) forms the ________________

### The Stock System of naming metal ions:
If a metal ion has more than one possible charge, the charge is indicated by a ________________, immediately following the name.

**Example:** Fe$^{3+}$ = iron______, Fe$^{2+}$ = iron______, U$^{6+}$ = uranium______, U$^{3+}$ = uranium______

### Multivalent Ions:
Most transition metals are multivalent, meaning they have more than 1 stable state.

---

**Challenge (how much do you remember?)**

2. Write the names of the following ions using the Stock system of notation.
   (a) Cu$^+$  
   (b) Cr$^{3+}$  
   (c) W$^{6+}$  

3. Write the formula of the following ions to show their charges.
   (a) cobalt(III) ion  
   (b) nickel(II) ion  
   (c) vanadium(V) ion

---

### Naming monatomic non–metal ions:
Take off the original ending of the element’s name and put on an ________

(The ending ide means the ion has a negative charge and has no attached atoms such as oxygen included with the ion.)

<table>
<thead>
<tr>
<th>Element name</th>
<th>Element symbol</th>
<th>Ion name</th>
<th>Ion symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>fluorine</td>
<td>F</td>
<td>fluor</td>
<td></td>
</tr>
<tr>
<td>chlorine</td>
<td>Cl</td>
<td>chlor</td>
<td></td>
</tr>
<tr>
<td>bromine</td>
<td>Br</td>
<td>brom</td>
<td></td>
</tr>
<tr>
<td>iodine</td>
<td>I</td>
<td>iod</td>
<td></td>
</tr>
<tr>
<td>oxygen</td>
<td>O</td>
<td>ox</td>
<td></td>
</tr>
<tr>
<td>sulphur</td>
<td>S</td>
<td>sulph</td>
<td></td>
</tr>
<tr>
<td>nitrogen</td>
<td>N</td>
<td>nitr</td>
<td></td>
</tr>
<tr>
<td>phosphorus</td>
<td>P</td>
<td>phosph</td>
<td></td>
</tr>
</tbody>
</table>

---

Names and Formulae of Inorganic Compounds

**Challenge (how much do you remember?)**

Ions are charged atoms or charged groups of atoms. Ions always associate (bond) together in the ratio that results in their charges cancelling to form neutral compounds. Complete the table by providing the formulas of the compounds formed by the ions specified.

<table>
<thead>
<tr>
<th></th>
<th>Br$^{-}$</th>
<th>O$^{2-}$</th>
<th>N$^{3-}$</th>
<th>OH$^{-}$</th>
<th>SO$_{4}^{2-}$</th>
<th>PO$_{4}^{3-}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na$^{+}$</td>
<td>NaBr</td>
<td>Na$_{3}$N</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ca$^{2+}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ca$<em>{3}$(PO$</em>{4}$)$_{2}$</td>
<td></td>
</tr>
<tr>
<td>Al$^{3+}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Al(OH)$_{3}$</td>
<td></td>
</tr>
<tr>
<td>NH$_{4}^{+}$</td>
<td>(NH$<em>{4}$)$</em>{2}$O</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sn$^{4+}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Sn(SO$<em>{4}$)$</em>{2}$</td>
</tr>
</tbody>
</table>
Recall that non-metals form __________________________ compounds with other non-metals but they form __________________________ compounds with metals. The names and formulas of these two types of compounds are handled differently.
A __________ compound contains the atoms of only two elements, and binary ionic compounds contain only two types of monatomic ions (charged individual atoms).

The name of any ionic compound is ...

For example, a compound containing sodium ions and chloride ions is called sodium chloride.
The __________________________ formed when a particular metal and non-metal react can be predicted through the __________________________ of their common ions, which can be found in the table of common ions in your DATA BOOKLET.

**Positively charged ions** are called __________________________ (think of the letter ‘t’ as a + sign)

**Negatively charged ions** are called __________________________.
Note that the sign of the ion charge (+ or –) is written after the numeral.
For example, the aluminum ion is denoted as Al\(^{3+}\) rather than as Al\(^{+3}\).
The different types of electrical charge are called opposite charges because they have opposing effects.

When particles with __________________________ charges bond together, the charges cancel to yield a product with a net charge of zero.

Ions always associate together in a ratio that results in their charges cancelling to form neutral compounds

\[
\begin{align*}
\text{separate} & \quad \text{combined} \\
2\text{Al}^{3+}(aq) & + 3\text{S}^{2-}(aq) \rightarrow \text{Al}_2\text{S}_3(s) \\
6^+ & + 6^- = 0
\end{align*}
\]

*The formula Al\(_2\)S\(_3\) means that there are 2Al\(^{3+}\) ions for every 3S\(^{2-}\) ions.*

Chemists know the charges but __________________________ in the formulas of ionic compounds.

The formula of an ionic compound shows that the compound as a whole is __________________________ even though it contains both positively and negatively charged ions.

Look at the formula of *aluminum sulphide* shown below on the left. The number of aluminum ions equals the numerical value of the sulphide ion’s charge and vice versa.

This simple shortcut for __________________________ of ionic compounds is sometimes called the __________________________ (or ‘swap and drop’).

This method matches up the opposite charges so that they cancel and **will always work if you reduce the formula** to its __________________________.

**EXAMPLES:**
Constructing an IONIC COMPOUND from the NAME of the compound

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

**IMPORTANT:** Compounds are NEUTRAL MOLECULES. Therefore (the sum of the "+" ion charges in the molecule) = (the sum of the "−" ion charges in the molecule)

The translation of a chemical name into a chemical formula is a simple process with three rules.

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 FIRST and the NEGATIVE ion is always SECOND. All you do is translate the words in the chemical name into ions in the order they are given.)
   
   For example: Tin(IV) oxide is translated as

2. “Criss–cross” the numbers in front of the charges on the ions.
   
   For example:

3. Tidy up the formula in a three–part process.
   - If both subscripts can be evenly divided by “2” (or “3”, occasionally), do so.
   - Omit the superscripted charges.
   - Omit any subscript which is a “1”.

   For example:

**PRACTICE**

a) sodium chloride:

b) potassium oxide:

c) calcium phosphide:

d) tin(IV) sulphate: $\text{tin(IV)}$ ion = $\text{SO}_4^{2−}$

---

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

What is the name of $\text{Fe}_2\text{S}_3$?

**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**
### Polyatomic Ions

<table>
<thead>
<tr>
<th>Polyatomic Ion</th>
<th>Formula</th>
</tr>
</thead>
<tbody>
<tr>
<td>nitrite</td>
<td>NO₂⁻</td>
</tr>
<tr>
<td>sulphite</td>
<td>SO₃²⁻</td>
</tr>
<tr>
<td>nitrate</td>
<td>NO₃⁻</td>
</tr>
<tr>
<td>sulphate</td>
<td>SO₄²⁻</td>
</tr>
</tbody>
</table>

A **polyatomic ion** is a neutral group of covalently bonded atoms so it’s like a molecule except that it has a charge.

They are relatively stable species that often remain intact in chemical reactions.

Many polyatomic ions are **charged**, consisting of an atom of a given element and some number of **oxygen** atoms.

Typically the element forms polyatomic ions with different numbers of oxygen atoms.

The prefix **prefix** before the name of a polyatomic ion adds an **acid** to it.

*For example:*

- carbonate CO₃²⁻
- sulphate SO₄²⁻
- hydrogen carbonate or bicarbonate HCO₃⁻ (H⁺ + CO₃²⁻)
- hydrogen sulphate or bisulphate HSO₄⁻ (H⁺ + SO₄²⁻)

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

**Polyatomic ions are** charged in formulas.

*For example, the formula of calcium nitrate is Ca(NO₃)₂*.

This means that the atoms within the brackets are bonded to each other and as a group they are bonded to the atom or atoms outside the brackets.

The brackets are necessary to show that the applies to the entire polyatomic ion, not just to its last atom.

For example, the formula of calcium hydroxide is Ca(OH)₂ meaning that there are hydroxide (OH⁻) ions for each calcium ion.

By convention, chemists **omit the brackets if no subscript is required**.

*For example, Na(OH) is written as just NaOH.*
Sample Problem — Determining the Formula of any Ionic Compound from Its Name
What is the formula of potassium sulphite?

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.

How to Do It

Sample Problem — Determining the Name of any Ionic Compound from Its Formula
What is the name of Cr(HSO₄)₂?

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 formula of each of the following ionic compounds:
   (a) barium sulphate  
   (b) silver nitrate  
   (c) mercury(II) bromide  
   (d) tin(IV) oxalate  
   (e) aluminum dichromate  
   (f) potassium fluoride

2. Name each of the following ionic compounds:
   (a) Zn(OH)₂  
   (b) SnO  
   (c) Cu(ClO)₂  
   (d) NaCH₃COO  
   (e) MgI₂  
   (f) FeCr₂O₇

Assignment #8-Hebden pg 71-72 Questions #4-5(odd)
All assignments are to be completed on a separate page with the assignment number & heading. Be sure to show FULL WORKING OUT for all homework.
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
- chlorine
- sodium chloride

O
- potassium
- oxide
- potassium oxide

2O
- oxygen

**Naming a Compound with a Transition Metal**

FeCl₂
- iron
- chlorine
- iron (II)
- iron (II) chloride

Ag₂S
- silver
- sulfur
- silver (I)
- silver (I) sulfide

**Naming a Compound with a Polyatomic Ion**

(NH₄)₂S
- ammonium
- sulfur
- ammonium sulfide

CaClO₃)₂
- calcium
- chlorate
- calcium chlorate

Element or Polyatomic Ion?

Elements are found on the periodic table.

Elements look like this:
- one capital letter
- one capital letter and one lowercase letter

Polyatomic ions are groups of two or more elements.

ClO₃⁻ NH₄⁺ OH⁻

They stick together.
Part B Covalent Compounds: Names and Formulas of Binary Molecular Compounds

(Covalent Compounds)

Any cation and anion combine in a single ratio that is easily predictable from their charges. This is why ionic compounds’ names do not need to explicitly contain their formulas.

On the other hand, two atoms may _______ electrons and combine in several ratios. Therefore, the name of the molecular compound must reveal its formula to distinguish it from the other compounds of the same two elements. The name of a molecular compound uses a _______________ to provide its formula. The prefixes used are shown in Table 2.4.1.

The names of all binary compounds have an __________ suffix.

_______ is therefore _____nitrogen _______oxide.

Note that the __________________________ comes before the name of the element but after the symbol of the element. The prefix mono- is understood for the first element named if no prefix is stated.

For example, carbon ______oxide is ___________, NOT monocarbon dioxide.

---

Determining the FORMULA of a Molecular Compound from Its Name

What is the formula of xenon tetrafluoride?

What to Think about

1. Write the symbols of each element and the number of atoms of each.
2. Rewrite this information as a formula.

How to Do It

---

Determining the NAME of a Molecular Compound from Its Formula

What is the name of $P_4S_{10}$?

What to Think about

1. Write the names of each element and the number of atoms of each.
2. Rewrite this information using the prefix code.

How to Do It

---

Practice

Determining the Names and Formulas of Molecular Compound

1. Write the formula of each of the following molecular compounds:
   (a) ) nitrogen monoxide
   (b) ) nitrogen dioxide
   (c) ) dinitrogen tetroxide
   (d) ) dinitrogen trioxide
2. Name each of the following molecular compounds:
   (a) $PCl_5$ ___________________________
   (b) $SO_2$ ___________________________
   (c) CO _____________________________
   (d) $P_2O_5$ _________________________

---

chemistry homework

Assignment #9- Hebden pg 74 Questions #8-9
All assignments are to be completed on a separate page with the assignment number & heading. Be sure to show FULL WORKING OUT for all homework.
Covalent Bonds
(a bond between two nonmetals)

Writing Compound Names

<table>
<thead>
<tr>
<th>prefix</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>mono-</td>
<td>1</td>
</tr>
<tr>
<td>di-</td>
<td>2</td>
</tr>
<tr>
<td>tri-</td>
<td>3</td>
</tr>
<tr>
<td>tetra-</td>
<td>4</td>
</tr>
<tr>
<td>penta-</td>
<td>5</td>
</tr>
<tr>
<td>hexa-</td>
<td>6</td>
</tr>
<tr>
<td>septa-</td>
<td>7</td>
</tr>
<tr>
<td>octa-</td>
<td>8</td>
</tr>
<tr>
<td>nona-</td>
<td>9</td>
</tr>
<tr>
<td>deca-</td>
<td>10</td>
</tr>
</tbody>
</table>

N\textsubscript{2}O\textsubscript{5}

\begin{align*}
\text{N}_2\text{O}_5 & \quad \text{nitrogen} \quad \text{oxygen} \\
\downarrow & \quad \downarrow \\
\text{nitrogen} & \quad \text{oxide} \\
\downarrow & \quad \downarrow \\
\text{dinitrogen} & \quad \text{pentoxide}
\end{align*}

dinitrogen pentoxide

carbon monoxide

CO

\begin{align*}
\text{C} & \quad \text{oxygen} \\
\downarrow & \quad \downarrow \\
\text{carbon} & \quad \text{oxide} \\
\downarrow & \quad \downarrow \\
\text{carbon} & \quad \text{monoxide}
\end{align*}

SiF\textsubscript{4}

\begin{align*}
\text{Si} & \quad \text{fluorine} \\
\downarrow & \quad \downarrow \\
\text{silicon} & \quad \text{fluoride} \\
\downarrow & \quad \downarrow \\
\text{silicon} & \quad \text{tetrafluoride}
\end{align*}

silicon tetrafluoride

SiF\textsubscript{4}

\begin{align*}
\text{Si} & \quad \text{fluorine} \\
\downarrow & \quad \downarrow \\
\text{silicon} & \quad \text{fluoride} \\
\downarrow & \quad \downarrow \\
\text{silicon} & \quad \text{tetrafluoride}
\end{align*}

silicon tetrafluoride

Notice that we don’t use the prefix \textit{mono-} here. That’s because it’s the first element in the compound.

If the element starts with a vowel, you may need to drop the \textit{o-} or \textit{a-} at the end of your prefix.

\begin{align*}
penta- & \rightarrow \text{pentoxide} \\
di- & \rightarrow \text{dioxide} \\
tetra- & \rightarrow \text{tetroxide} \\
hexa- & \rightarrow \text{hexoxide}
\end{align*}
When many salts crystallize out of aqueous solution they incorporate _______ in a fixed ratio and pattern into their ionic crystal lattice. These salts are called _______. Many salts are supplied as hydrates and are destined for aqueous solutions (dissolved in water) anyway. Water is an integral part of hydrates and thus must be accounted for in both their names and their formulas. The same prefixes used for naming _______ go before the term _______ to denote the _______ in the formula. This tells you the _______ of water molecules to ions.

When a crystal of an ionic compound is grown by evaporation from aqueous solution, frequently it is found that the _______ will include water molecules.

**EXAMPLE:** When copper(II) sulphate is crystallized from water, the resulting crystals have the formula _______.

This formula shows that _______ water molecules are included with (or attached to) every CuSO₄. In other words, CuSO₄·5H₂O can be thought of as “CuSO₄+5H₂O”.

The naming is straightforward and relies on using a prefix to tell how many water molecules are attached. Memorize the following prefixes and the numbers they represent.

<table>
<thead>
<tr>
<th>Prefix used</th>
<th># of water molecules</th>
<th>Prefix used</th>
<th># of water molecules</th>
</tr>
</thead>
<tbody>
<tr>
<td>mono</td>
<td>1</td>
<td>hexa</td>
<td>6</td>
</tr>
<tr>
<td>di</td>
<td>2</td>
<td>hepta</td>
<td>7</td>
</tr>
<tr>
<td>tri</td>
<td>3</td>
<td>octa</td>
<td>8</td>
</tr>
<tr>
<td>tetra</td>
<td>4</td>
<td>nona</td>
<td>9</td>
</tr>
<tr>
<td>penta</td>
<td>5</td>
<td>deca</td>
<td>10</td>
</tr>
</tbody>
</table>

### Determining the Formula of a Hydrate from Its Name

What is the formula of copper(II) sulphate heptahydrate?

**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.
3. Tack on the appropriate number of water molecules to complete the formula.

**How to Do It**

### Determining the Name of a Hydrate from its Formula

What is the name of NaCH₃COO·3H₂O?

**What to Think about**
1. Write the names of the two constituent ions.
2. Tack on the appropriate number of water molecules using the prefix code (–hydrate).
Determining the Names and Formulas of Hydrates

1. Write the formula of each of the following hydrates:
   (a) barium chloride dihydrate
   (b) sodium carbonate monohydrate
   (c) iron(III) nitrate nonahydrate
   (d) barium hydroxide octahydrate

2. Name each of the following hydrates:
   (a) CoCl$_2$•6H$_2$O __________________________
   b) FeCl$_3$•4H$_2$O __________________________
   (c) Na$_2$Cr$_2$O$_7$•2H$_2$O __________________________
   (d) MgSO$_4$•7H$_2$O __________________________
Part D Naming Acids:

Acids

An acid can be thought of as one or more ___________________ bonded to an anion. Remember that in ionic compounds the ___________________ (negate each other) without being cancelled (eliminated). In acids however, these ion charges are actually cancelled as the ions convert into ___________________ and the group of atoms into a ___________________.

___________________ are a special type of ___________________compound that can be induced to form ions.

The names of acids are based on the name of the ___________________formed.

The rules for naming acids depend on whether the anion contains ___________________. If the anion doesn’t contain oxygen, the prefix _________________ precedes the name of the anion and the suffix ________________ replaces the –ide in the anion’s name.

Hydrogen fluoride (HF) is ___________________.

hydrogen chloride (HCl) is ___________________.

hydrogen cyanide (HCN) ___________________.

There are of course some exceptions. S2– is the sulphide ion, not the sulphuride ion yet hydrogen sulphide (H2S) is hydrosulphuric acid.

Determining the Formula of an Acid from Its Name

What is the formula of hydrobromic acid?

<table>
<thead>
<tr>
<th>What to Think about</th>
<th>How to Do It</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Decode the suffix to determine possible anions: bromic denotes bromide or bromate.</td>
<td></td>
</tr>
<tr>
<td>2. Decode the prefix (if any) to select the anion: hydro- indicates that the anion doesn’t contain oxygen.</td>
<td></td>
</tr>
<tr>
<td>3. Determine the formula from the ion charges.</td>
<td></td>
</tr>
</tbody>
</table>

If the anion does contain oxygen then the suffix _________________ replaces ________________ in the anion’s name or the suffix ________________ replaces ________________ in the anion’s name.

Hydrogen sulphate (H2SO4) is ___________________.

Hydrogen sulphite (H2SO3) is ___________________.

If an acid contains a polyatomic ion that ends in “-ate”, the acid name will end in ”-ic”.

"I ate an acid and it was Icky!"

H2SO4 = sulfATE ion = sulfurIC acid

If an acid contains a polyatomic ion that ends in “-ite”, the acid name will end in ”-ous”.

"I only bite into things that are delicious."

H2SO3 = sulfITE ion = sulfurOUS acid
Determining the Names and Formulas of Acids

1. Write the formula of each of the following acids:
   (a) hydrofluoric acid
   (b) hypochlorous acid
   (c) phosphoric acid
   (d) hydrosulphuric acid

2. Name each of the following (as) acids:
   (a) HCH₃COO _________________________
   (b) H₂SO₃_________________________________________
   (c) H₂CO₃ __________________________
   (d) HI ______________________________

Determining the Name of an Acid from Its Formula

What acid has the formula HNO₂?

What to Think about
1. Write the names of the two constituent ions.
2. Use the code for naming acids. The anion contains oxygen so the suffix –ous replaces –ite in the anion’s name.

How to Do It

Determining the Names and Formulas of Acids

1. Write the formula of each of the following acids:
   (a) hydrofluoric acid
   (b) hypochlorous acid
   (c) phosphoric acid
   (d) hydrosulphuric acid

2. Name each of the following (as) acids:
   (a) HCH₃COO _________________________
   (b) H₂SO₃_________________________________________
   (c) H₂CO₃ __________________________
   (d) HI ______________________________

SOME COMMON ACIDS

A compound is called an "acid" if the compound has a chemical formula starting with "H". All of the following acids are assumed to be dissolved in water; that is, they are "aqueous solutions".

HF = hydrofluoric acid
HCl = hydrochloric acid
HBr = hydrobromic acid
HI = hydroiodic acid
H₂SO₄ = sulphuric acid
H₂SO₃ = sulphurous acid
H₃PO₄ = phosphoric acid
H₂SO₃ is one of the principle components of acid rain,
H₂SO₄ is the acid used in automobile batteries,
HCl is present in "stomach acid" and is also called "muriatic acid",
HF is used to "etch" or "frost" glass,
HNO₂ = nitrous acid
HNO₃ = nitric acid
HC₂H₃O₂ or CH₃COOH = acetic acid

Some additional facts about these acids:

SUMMARY: HOW TO PICK THE CORRECT METHOD FOR NAMING A COMPOUND

The first element or ion in a formula is used to decide on the method.

<table>
<thead>
<tr>
<th>If the first element or ion in the formula is:</th>
<th>Then:</th>
</tr>
</thead>
<tbody>
<tr>
<td>hydrogen</td>
<td>write the name of the acid if the substance is listed under “SOME COMMON ACIDS”. use “hydrogen” as the first name and add the name of the anion which follows the “H” if the acid is NOT in the list.</td>
</tr>
<tr>
<td>a non–metal (and the formula doesn’t contain NH₄)</td>
<td>use the prefix–naming system</td>
</tr>
<tr>
<td>a species listed in the table Names, Formulae, and Charges of Some Common Ions</td>
<td>use the name of the cation listed, followed by the name of the anion.</td>
</tr>
<tr>
<td>a metal not listed in the table Names, Formulae, and Charges of Some Common Ions</td>
<td>use the Stock system (Roman numerals) for the cation, followed by the name of the anion.</td>
</tr>
</tbody>
</table>
Review Questions

1. In each case below, write out the chemical equation for the association of the ions that form the given binary ionic compound.
   Example: magnesium phosphide
   $$3 \text{Mg}^{2+} + 2 \text{P}^{3-} \rightarrow \text{Mg}_3\text{P}_2$$
   (a) sodium fluoride
   (b) iron(II) bromide
   (c) tin(IV) chloride
   (d) chromium(III) sulphide

2. Write the formulas of the following binary ionic compounds:
   (a) chromium(III) chloride
   (b) aluminum fluoride
   (c) magnesium iodide
   (d) tin(IV) oxide

3. Write the names of the following binary ionic compounds:
   (a) $\text{K}_2\text{O}$
   (b) $\text{ZnBr}_2$
   (c) $\text{PbO}_2$
   (d) $\text{HgCl}_2$

4. Write the name and formula of the binary ionic compound formed by:
   (a) potassium and chlorine
   (b) manganese(IV) and oxygen
   (c) iron(III) and sulphur
   (d) copper(II) and iodine

5. In each case below, write out the chemical equation for the association of the ions that form the given ionic compound.
   Example: magnesium nitrate
   $$\text{Mg}^{2+} + 2 \text{NO}_3^{-} \rightarrow \text{Mg(NO}_3)_2$$
   (a) sodium nitrite
   (b) silver phosphate
   (c) lithium ethanoate (lithium acetate)
   (d) chromium(III) oxalate

6. Write the formulas of the following ionic compounds:
   (a) copper(I) perchlorate
   (b) calcium bisulphide
   (c) aluminum monohydrogen phosphate
   (d) magnesium hydroxide

7. Write the names of the following ionic compounds:
   (a) $\text{Ba}_3(\text{PO}_4)_2$
   (b) $\text{Fe(HSO}_3)_2$
   (c) $\text{Pb(HC}_2\text{O}_4)_4$
   (d) $\text{CuH}_2\text{PO}_4$

8. Many minerals contain three types of ions. In BC, we mine several minerals of copper including two forms of copper(II) carbonate hydroxide.
   malachite
   $$2 \text{Cu}^{2+} + \text{CO}_3^{2-} + 2 \text{OH}^- \rightarrow \text{Cu}_2(\text{CO}_3)(\text{OH})_2$$
   $$4^+ + 2^- + 2^- = 0$$
   azurite
   $$3 \text{Cu}^{2+} + 2 \text{CO}_3^{2-} + 2 \text{OH}^- \rightarrow \text{Cu}_3(\text{CO}_3)_2(\text{OH})_2$$
   $$6^+ + 4^- + 2^- = 0$$
   Notice that more than one ratio of the ions results in their charges cancelling. Thus there is more than one possible compound of three ion combinations.
   Write a possible formula for:
   (a) iron(III) sodium chromate
   (b) zinc sulphate nitrate
9. Write the formulas of the following molecular compounds:
(a) chlorine monoxide
(b) tetraphosphorus hexaoxide
(c) arsenic pentafluoride
(d) nitrogen tri-iodide

10. Write the names of the following molecular compounds:
(a) $\text{P}_3\text{Br}_5$
(b) $\text{B}_2\text{H}_6$
(c) $\text{SO}_3$
(d) $\text{CF}_4$

11. Write the formulas of the following hydrated salts:
(a) sodium sulphate decahydrate
(b) calcium chloride dihydrate
(c) copper(II) acetate monohydrate
(d) chromium(III) chloride hexahydrate

12. Write the names of the following hydrated salts:
(a) $\text{Cd(NO}_3\text{)}_2 \cdot 4\text{H}_2\text{O}$
(b) $\text{Na}_2\text{HPO}_4 \cdot 7\text{H}_2\text{O}$
(c) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
(d) $\text{Fe(NO}_3\text{)}_3 \cdot 9\text{H}_2\text{O}$

13. Why is a hydrate not a mixture of salt and water?

14. Suggest why hydrate formulas are written in the manner they are, rather than bracketing the number of water molecules in the formula (e.g., $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ rather than $\text{SrCl}_2(\text{H}_2\text{O})_6$).

15. Write the formulas of the following acids:
(a) hydrobromic acid
(b) chromic acid
(c) chloric acid
(d) hypochlorous acid

16. Write the names of the following acids:
(a) $\text{H}_2\text{S}$
(b) $\text{HClO}_4$
(c) $\text{HNO}_2$
(d) $\text{HSCN}$

17. Write the formulas of the following variety of compounds:
(a) potassium oxide
(b) permanganic acid
(c) sulphur dioxide
(d) ammonium carbonate
(e) iron(II) sulphate heptahydrate
(f) hydrocyanic acid
(g) sulphur hexafluoride
(h) calcium acetate monohydrate
(i) chromium(III) bisulphite
(j) magnesium hydroxide
**OPTIONAL EXTRA NAMING PRACTICE**
You most certainly DO NOT have to complete all of these....I would recommend that you use this as test practice.

**COMBINED EXERCISES FOR INORGANIC NAMING**

Write the correct name for each of the following.

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<tr>
<th>Number</th>
<th>Formula</th>
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<tr>
<td>14</td>
<td>MgO</td>
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<tr>
<td>15</td>
<td>CuSO₄</td>
</tr>
<tr>
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<td>NaCH₂COO</td>
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<td>17</td>
<td>NH₄NO₂</td>
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<tr>
<td>18</td>
<td>MoCl₅</td>
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<td>LiOH·H₂O</td>
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<tr>
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<td>PtCl₄</td>
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<td>21</td>
<td>NH₄ClO₄</td>
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<tr>
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<td>KMnO₄</td>
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<tr>
<td>24</td>
<td>Cu₂SO₄</td>
</tr>
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<td>25</td>
<td>H₂SO₄</td>
</tr>
<tr>
<td>26</td>
<td>Na₂CO₃·10H₂O</td>
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<tr>
<td>66</td>
<td>N₃</td>
</tr>
<tr>
<td>67</td>
<td>CrBr₂</td>
</tr>
<tr>
<td>68</td>
<td>Mg₃P₂</td>
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<tr>
<td>69</td>
<td>FeSO₄·5H₂O</td>
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<td>Ca(OH)₂</td>
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<td>H₃PO₄</td>
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<td>Be(H₂S)₂·4H₂O</td>
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</tr>
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<td>H₂O₅</td>
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<td>Hg(NO₃)₂</td>
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<td>Hg(SCN)_2</td>
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<td>76</td>
<td>NiSO₄·7H₂O</td>
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<tr>
<td>77</td>
<td>Mn(SCN)₂</td>
</tr>
<tr>
<td>78</td>
<td>Sb₂S₃</td>
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<tr>
<td>79</td>
<td>Sn(CrO₄)₂</td>
</tr>
<tr>
<td>80</td>
<td>Cr₂(CO₄)₃·8H₂O</td>
</tr>
</tbody>
</table>

Write the chemical formula for each of the following.

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
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</thead>
<tbody>
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<td>90</td>
<td>silver chloride</td>
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<td>91</td>
<td>sulphur dioxide</td>
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<tr>
<td>92</td>
<td>iron(III) oxalate</td>
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<tr>
<td>93</td>
<td>beryllium oxide</td>
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<td>94</td>
<td>lead(II) acetate decahydrate</td>
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<tr>
<td>96</td>
<td>mercury(I) acetate</td>
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<td>molybdenum(III) chloride</td>
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<td>ammonia</td>
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<td>gold(III) sulphide</td>
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<td>100</td>
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<td>calcium acetate</td>
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<td>chromium(III) oxalate</td>
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<td>104</td>
<td>difluorine dioxide</td>
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<td>molybdenum(V) oxide</td>
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<td>106</td>
<td>silicon tetrafluoride</td>
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<td>107</td>
<td>cadmium(II) acetate</td>
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<td>108</td>
<td>mercury(II) chloride</td>
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<td>silver oxide</td>
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<td>163</td>
<td>manganese(IV) monohydrogen phosphate</td>
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