

Writing Formulas - Naming Compounds

This program demonstrates how to write chemical formulas as well as naming inorganic compounds and acids.

Please read each section carefully. You might wish to take notes.

Note that the oxidation state for atoms has the sign and then number, while the charge on a polyatomic ion has the number and then sign.

Writing Chemical Formulas

1) For 2 elements having different oxidation states:

a) write the symbols, listing the element with a positive oxidation state first (this will be a metal or something acting like a metal)

example: Ca F

b) above each symbol, place the oxidation state of that element

example: $\begin{array}{cc} +2 & -1 \\ \text{Ca} & \text{F} \end{array}$

c) subscripts must be written below and to the right of the symbols so that the sum of electrons lost will be equal to the number gained. These subscripts must be in the lowest whole number ratio.

In our example the calcium atom will lose 2 outershell (valence) electrons

---> CaF_2

2) For 2 elements having the same oxidation states:

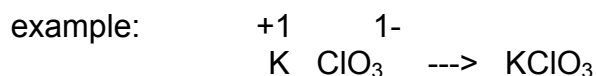
a) subscripts will not be needed for ionically bonded compounds

b) molecular weights are used to determine subscripts for covalently bonded compounds

c) remember never to use '1' as a subscript

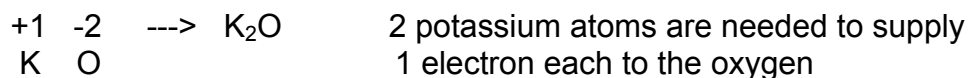
example: $\begin{array}{cc} +2 & -2 \\ \text{Ca} & \text{O} \end{array} \quad \text{--->} \quad \text{CaO}$

Here each atom of calcium lost two electrons and each oxygen atom gained two electrons

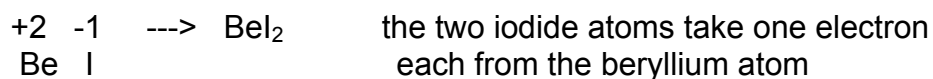


Now we need to look at lots of examples.

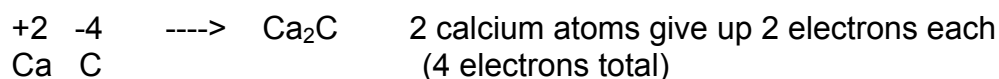
Problem # 1: potassium + oxygen



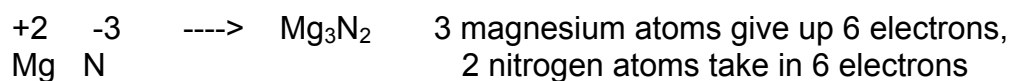
Problem # 2: beryllium + iodine



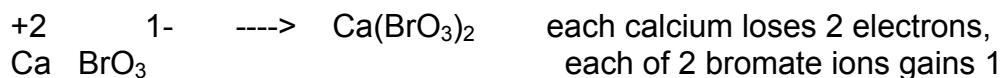
Problem # 3: calcium + carbon



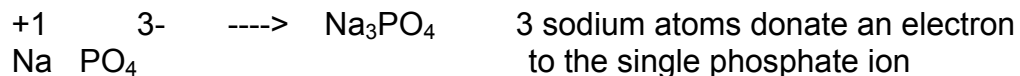
Problem # 4: magnesium + nitrogen



Problem # 5: calcium + bromate



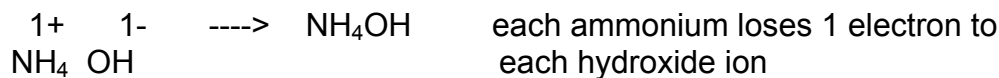
Problem # 6: sodium phosphate



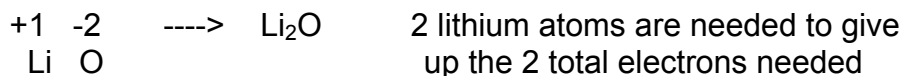
Problem # 7: aluminum sulfate



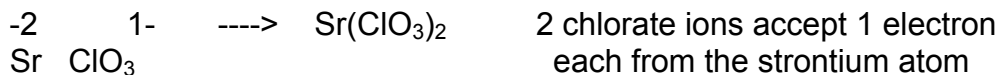
Problem # 8: ammonium hydroxide



Problem # 9: lithium oxide



Problem # 10: strontium chlorate



Naming Compounds

1) The nonmetal name of binary compounds (those consisting of only 2 type elements) must end in 'ide'.

NaCl = sodium chloride

CaO = calcium oxide

K₂S = potassium sulfide

AlCl₃ = aluminum chloride

Mg₃N₂ = magnesium nitride

BaBr₂ = barium bromide

2) For transition metals, metalloids, or other metals with multiple oxidation states, calculate what that state must be:

FeCl₂ = iron (II) chloride

FeCl₃ = iron (III) chloride

SnCl₂ = tin (II) chloride

SnCl₄ = tin (IV) chloride

Fe(OH)₃ = iron (III) hydroxide

Sn(NO₃)₂ = tin (II) nitrate

Several harder problems show that the oxidation state of the metal must equal that of the nonmetal.

CuSO_4 = copper (II) sulfate (since sulfate is 2- the copper must be +2)

$\text{Ni}_3(\text{PO}_4)_2$ = nickel (II) phosphate (phosphate is 3- but the two of them nickel atoms give up 2 electrons each)

Now we need to look at lots of examples. After you are given the formula figure out on paper what you think the final chemical name would look like.

Problem # 1: KmnO_4

potassium permanganate (potassium's only oxidation state is +1 so no Roman numerals needed)

Problem # 2: MgCO_3

magnesium carbonate

Problem # 3: Au_3PO_4

gold (I) phosphate (phosphate is 3- so each gold atom must be a +1)

Problem # 4: HgCO_3

mercury (II) carbonate (carbonate's charge is 2- so the one mercury must be +2)

Problem # 5: $\text{Cr}_3(\text{AsO}_4)_2$

chromium (II) arsenate (the two arsenates gain 6 electrons, so each chromium must lose 2 electrons)

Acid Nomenclature

When working with inorganic acids, always start with the 'ate' polyatomic ion.

example: CO_3 has a 2- charge so 2 hydrogens will be needed:

$\begin{matrix} +1 & & 2- \\ \text{H}_2 & \text{CO}_3 & \end{matrix}$ this would be named: carbonic acid

The six most common acids we use are given next. They all end in 'ic'

HBrO_3 bromic acid H_3PO_4 phosphoric acid

HClO_3 chloric acid H_2SO_4 sulfuric acid

HNO_3 nitric acid H_2CO_3 carbonic acid

Use these as starting points for the alternative acid (and their names)

Rules for Naming Acids/Writing their Formulas

Rule 1: all acids must contain hydrogen

Rule 2: acids with 'ic' suffix represent natural 'ate' polyatomic ions

HBrO_3 bromic acid

Rule 3: when all oxygen atoms are removed, add 'hydro' prefix to name

HBr hydrobromic acid HCl hydrochloric acid

Rule 4: when an extra oxygen is added, add a 'per' prefix to name

HBrO_4 perbromic acid HClO_4 perchloric acid

Rule 5: when 1 oxygen is taken away (from 'ate' ion number), change the 'ic' suffix to 'ous'

HBrO_2 bromous acid HClO_2 chlorous acid

Rule 6: when 2 oxygens are taken away (from 'ate' ion number), change the 'ic' suffix to 'ous' and add a 'hypo' prefix

HBrO hypobromous acid HClO hypochlorous acid

Many more examples are available in class. Please see Mr. Jones for these.

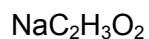
Writing Formulas and Naming Compounds. Check your answers in class to each of these



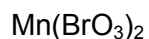
copper (I) nitrate



calcium bromate



copper (II) phosphite



potassium carbonate

sodium hypochlorite



magnesium fluoride



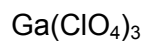
potassium silicate

sodium sulfate

ammonium chloride

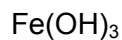


lithium carbide



beryllium iodide

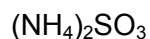
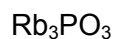
carbon (IV) oxide



ammonium nitride



tin (II) chromate



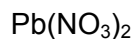
silicon (IV) oxide

sodium cyanide

copper (II) acetate



mercury (II) iodide

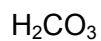
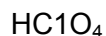


rubidium cyanide

zinc iodide

ACIDS:

bromic acid



pernitric acid

phosphoric acid

Side A -- Nomenclature

The names/formulas for these problems are found on webpage: [Side B](#)

- | | |
|---|--|
| 1) FeCl_3 | 31) Ag_3AsO_4 |
| 2) $\text{Ba}(\text{OH})_2$ | 32) aluminum iodide |
| 3) ammonium phosphate | 33) $(\text{NH}_4)_2\text{SO}_3$ |
| 4) nitric acid | 34) Hg_0 |
| 5) hydrogen sulfide | 35) $\text{Be}_3(\text{PO}_3)_2$ |
| 6) phosphoric acid | 36) potassium chromate |
| 7) Hg_2SO_4 | 37) $(\text{NH}_4)_3\text{AsO}_4$ |
| 8) sodium nitrate | 38) calcium silicate |
| 9) calcium acetate | 39) MgCO_3 |
| 10) H_3PO_4 | 40) $\text{Ni}(\text{OH})_2$ |
| 11) AuP | 41) tin (II) perchlorate |
| 12) K_2O | 42) lead (II) hydroxide |
| 13) HCl | 43) sodium sulfate |
| 14) tin (II) permanganate | 44) $\text{FrC}_2\text{H}_3\text{O}_2$ |
| 15) $\text{Pb}(\text{C}_2\text{H}_3\text{O}_2)_2$ | 45) zinc phosphate |
| 16) Hg_2P_3 | 46) tin (II) fluoride |
| 17) lithium hypochlorite | 47) $\text{Al}(\text{MnO}_4)_3$ |
| 18) lead (II) chromate | 48) $\text{Mg}(\text{C}_10)_2$ |
| 19) Zn_0 | 49) strontium silicate |
| 20) hypochlorous acid | 50) K_3AsO_4 |
| 21) nickel (II) chlorite | 51) lithium cyanide |
| 22) lead (II) sulfide | 52) $(\text{NH}_4)_2\text{SO}_4$ |
| 23) $\text{Cu}(\text{C}_1\text{O}_3)_2$ | 53) HC_1O |

24) RbBr

25) calcium bromate

26) ammonium sulfate

27) $\text{Mg}(\text{C}_2\text{O}_4)_2$

28) beryllium cyanide

29) $\text{Cu}(\text{OH})_2$

54) Mn_2O_7

55) K_2O

56) lead (II) chromate

57) Hg_3N_2

58) ZnCrO_4

59) Au_3P

Side B - Nomenclature

The companions to these nomenclature problems are found on webpage: [Side A](#)

1) iron (III) chloride

2) barium hydroxide

3) $(\text{NH}_4)_3\text{PO}_4$

4) HNO_3

5) H_2S

6) H_3PO_4

7) mercury (I) sulfate

8) NaNO_3

9) $\text{Ca}(\text{C}_2\text{H}_3\text{O}_2)_2$

10) phosphoric acid

11) gold (III) phosphide

12) potassium oxide

13) hydrochloric acid

14) $\text{Sn}(\text{MnO}_4)_2$

31) silver arsenate

32) AlI_3

33) ammonium sulfite

34) mercury (II) oxide

35) beryllium phosphite

36) K_2CrO_4

37) ammonium arsenate

38) CaSiO_3

39) magnesium carbonate

40) nickel (II) hydroxide

41) $\text{Sn}(\text{ClO}_4)_2$

42) $\text{Pb}(\text{OH})_2$

43) Na_2SO_4

44) francium acetate

- 15) lead (II) acetate
- 16) mercury (II) phosphide
- 17) LiClO
- 18) PbCrO_4
- 19) zinc oxide
- 20) HClO
- 21) $\text{Ni}(\text{ClO}_2)_2$
- 22) PbS
- 23) copper (II) chlorate
- 24) rubidium bromide
- 25) $\text{Ca}(\text{BrO}_3)_2$
- 45) $\text{Zn}_3(\text{PO}_4)_2$
- 46) SnF
- 47) aluminum permanganate
- 48) magnesium hypochlorite
- 49) SrSiO_3
- 50) potassium arsenate
- 51) LiCN
- 52) ammonium sulfate
- 53) chloric acid
- 54) manganese (VII) oxide
- 55) potassium oxide