NOMENCLATURE REVIEW

Writing Formulas For Binary Compounds -- "ide" compounds

For compounds containing 2 elements only. To write the formula of a binary compound (eg. aluminum oxide), use the following rules:
1. Write the symbols of the 2 elements, putting the one with the positive electrovalence first (eg. Al O)
2. Mentally mark in the valences above each element. (eg. $Al^{+3}O^{-2}$)
3. Use the "cross-over" rule. (eg. Al_2O_3)
4. Divide the subscripts by the highest common factor, if necessary.

Examples:

calcium nitride	Ca_3N_2	potassium bromide	KBr	potassium oxide	K_2O
aluminum carbide	Al_4C_3	zinc arsenide	Zn_3As_2	aluminum bromide	$AlBr_3$
sodium fluoride	NaF	barium iodide	BaI_2	calcium hydride	CaH_2
calcium oxide	CaO	magnesium chloride	$MgCl_2$	silicon hydride	SiH_4
silver sulfide	Ag_2S	hydrogen oxide	H_2O	hydrogen sulfide	H_2S
zinc silicide	Zn_2Si	silicon carbide	SiC	silver phosphide	Ag_3P

Use of "ous" and "ic"

When the electropositive element has 2 valences, "ous" denote the LOWER and "ic" denotes the HIGHER valence. For example, mercury has two valences, +1 and +2. Mercurous would indicate mercury with a valance of 1 whereas mercuric would indicate mercury with a valence of 2.

Examples:

ferrous oxide	FeO	antimonous sulfide	Sb_2S_3
ferric oxide	Fe_2O_3	arsenious chloride	$AsCl_3$
phosphorous oxide	P_2O_3	antimonic carbide	Sb_4C_5
phosphoric oxide	P_2O_5	arsenic phosphide	As_3P_5
cuprous sulfide	Cu_2S	ferrous nitride	Fe_3N_2
stannous fluoride	SnF_2	mercuric bromide	$HgBr_2$
stannic fluoride	SnF_4	cupric oxide	CuO

Use of the "Roman Numeral" System - IUPAC System

This is the preferred method for naming binary compounds. The Roman numeral represents the *valence* of the *first* element, that is the element with 2 positive electrovalences. The name of the first element is unchanged. DON'T MIX METHODS.

Examples:

iron (II) chloride	$FeCl_2$	antimony (V) sulfide	Sb_2S_5

tin (IV) oxide	SnO_2	arsenic (III) oxide	As_2O_3
phosphorous (III) iodide	PI_3	mercury (I) oxide	Hg_2O
copper (I) bromide	CuBr	lead (IV) nitride	Pb_3N_4
iron (III) chloride	$FeCl_3$	bismuth (V) phosphide	Bi_3P_5

Use of the Prefixes - "mono", "di", "tri", "tetra", "penta",...

This may be used as an alternative to the 2 preceding methods. The prefix indicates *the number of atoms* of the element *to which the prefix is attached*.
eg. phosphorous (III) chloride = phosphorous trichloride = PCl_3
The proper name is monophosphorous trichloride but the prefix for the first element is often omitted. Use only with carbon, sulfur and silicon.

Examples:

carbon monoxide	CO
carbon dioxide	CO_2
sulfur dioxide	SO_2
sulfur trioxide	SO_3
carbon disulfide	CS_2
silicon dioxide	SiO_2
carbon tetrachloride	CCl_4

Summary:
There are 3 ways of naming most binary compounds.

P_2O_3	phosphorous oxide phosphorous (III) oxide phosphorous trioxide	P_2O_5	phosphoric oxide phosphorous (V) oxide phosphorous pentoxide

Exceptions

Peroxides: To write the formula of a peroxide, simply write the formula for the normal oxide *then add one oxygen atom*.

Examples:

sodium oxide	Na_2O	sodium peroxide	Na_2O_2
hydrogen oxide	H_2O	hydrogen peroxide	H_2O_2
barium oxide	BaO	barium peroxide	BaO_2
lead (II) oxide	PbO	lead (II) peroxide	PbO_2

Finding the Valence From the Formula

eg. find the valence of lead in PbO_2

1. The valence of oxygen is -2.
2. The total valence oxygen is -4 (2*-2).
3. The sum of the total valences of a compound must be 0.
4. The valence of lead is +4.

Compounds Containing 3 Elements

Oxyacids and Their Salts

The 5 Main Oxyacids are:	sulphuric acid	H_2SO_4
	nitric acid	HNO_3
	carbonic acid	H_2CO_3
	chloric acid	$HClO_3$
	phosphoric acid	H_3PO_4

Note - 1. All contain oxygen, hence the name.
2. All contain hydrogen - they are acids.
3. All end in "ic".

Many of these acids have derivative names as follows:

*hypo*chlor*ous* acid	HClO - lost 2 oxygen
chlor*ous* acid	$HClO_2$ - lost 1 oxygen
chloric acid	**$HClO_3$**
*per*chloric acid	HClO4 - gained 1 oxygen

Complex Ions From the Oxyacids

A complex ion is a group of atoms that act as a unit. When the hydrogen (or part thereof) is removed from an acid, a complex ion remains.
Examples:

Acid	Complex Ion	Valence
H_2SO_4	SO_4	-2
HNO_3	NO_3	-1
H_3PO_3	PO_3	-3

Naming Complex ions

Acid Prefix and Suffix	Complex Ion Prefix and Suffix
hypo_____ous	hypo_____ite
_____ous	_____ite
_____ic	_____ate
per_____ic	per_____ate

Examples:

Acid	Formula	Complex Ion	Name of Complex Ion

sulfuric	H_2SO_4	SO_4	sulfate
perchloric	$HClO_4$	ClO_4	perchlorate
chloric	$HClO_3$	ClO_3	chlorate
chlorous	$HClO_2$	ClO_2	chlorite
nitric	HNO_3	NO_3	nitrate
hyponitrous	HNO	NO	hyponitrite
phosphorous	H_3PO_3	PO_3	phosphite

Salts of the Oxyacids

eg. calcium phosphate $Ca^{+2}PO_4^{-3}$ --> $Ca_3(PO_4)_2$

Examples:

calcium sulfite	$CaSO_3$	arsenic phosphate	$As_3(PO_4)_5$
sodium chlorite	$NaClO_2$	antimony (III) hypochlorite	$Sb(ClO)_3$
aluminum nitrate	$Al(NO_3)_3$	cupric nitrite	$Cu(NO_2)_2$
ferric sulfate	$Fe_2(SO_4)_3$	mercurous perchlorate	$HgClO_4$
zinc carbonate	$ZnCO_3$	potassium chlorate	$KClO_3$

Other Complex Ions

a) ammonium complex ion (NH_4 valence of +1)

ammonium chloride	NH_4Cl
ammonium sulphate	$(NH_4)_2SO_4$
ammonium phosphate	$(NH_4)_3PO_4$
ammonium nitrite	NH_4NO_2

b) hydroxide complex ion (OH valence of -1)

sodium hydroxide	NaOH
ammonium hydroxide	NH_4OH
ferrous hydroxide	$Fe(OH)_2$
copper (I) hydroxide	CuOH

c) acetate complex ion ($C_2H_3O_2$ valence of -1)

calcium acetate	$Ca(C_2H_3O_2)_2$
iron (III) acetate	$Fe(C_2H_3O_2)_3$
tin (IV) acetate	$Sn(C_2H_3O_2)_4$
ammonium acetate	$NH_4C_2H_3O_2$

Binary Acids

Certain gases dissolve in water to form acids having the same formula.

Name of Gas	Formula	Name of Acid	Formula
hydrogen chloride	HCl	hydrochloric	HCl
hydrogen bromide	HBr	hydrobromic	HBr
hydrogen iodide	HI	hydroiodic	HI
hydrogen fluoride	HF	hydrofluoric	HF
hydrogen sulfide	H_2S	hydrosulfuric	H_2S
hydrogen cyanide	HCN	hydrocyanic	HCN

Formation of salts from these acids has been covered under binary compounds.

Diatomic Gases

The molecules of these gaseous elements consist of pairs of identical atoms.

hydrogen gas	H_2
fluorine gas	F_2
chlorine gas	Cl_2
bromine vapour	Br_2
iodine vapour	I_2
nitrogen gas	N2
oxygen gas	O_2

Hydrates

Compounds containing water of hydration.

copper sulphate pentahydrate $CuSO_4*5H_2O$
sodium sulphate decahydrate $Na_2SO_4*10H_2O$
magnesium sulfate heptahydrate $MgSO_4*7H_2O$

Lesser Oxyacids

Treat these acids as chloric acid because bromine and iodine are related chemically.
bromic acid HBrO3 iodic acid HIO_3

Review

1. Give the name for each of the following:

a) Na_3PO_4

b) O_2
c) Na
d) $Mg(ClO_4)_2$
e) $HgCl_2$
f) CaH_2
g) SnS_2
h) $Al(OH)_3$
i) $ZnCO_3$
j) CF_4
k) H_2SO_4
l) FeSO3
m) $AsCl_5$
n) $Ca(BrO_3)_2$
o) HCl
p) ZnI_2
q) Na_2O_2

2. Give the formula for each of the following:

a) sodium carbonate
b) tin (IV) chloride
c) copper (I) oxide
d) ammonium phosphate
e) mercurous sulfate
f) phosphorous oxide
g) carbon dioxide
h) cuprous chloride
i) sulfuric oxide
j) silver sulfide
k) calcium nitride
l) barium nitrite
m) sodium nitrite
n) ammonium perchlorate
o) potassium hypobromite
p) hydrosulfuric acid
q) magnesium peroxide