Chemical Nomenclature: Naming Compounds

New Nomenclature: refers to names for compounds which do not have polyatomic ions.

A) Naming Binary Covalent Compounds (2 nonmetal atoms present)

Rule: Use Greek prefixes to indicate the number of each kind of atom in the compound. Add 'ide' to each ending.

Greek Prefixes

1. mono
2. di
3. tri
4. tetra
5. penta
6. hexa
7. hepta
8. octa
9. nona
10. deca

e.g. N_2O_4 = dinitrogen tetraoxide
NI_3 = mononitrogen triiodide or nitrogen triiodide ('mono' may be dropped)
CO = carbon monoxide (most common) or monocarbon monoxide or monocarbon oxide
P_4O_{10} = tetraphosphorous decaoxide

You name the following:

1. P_2O_5
2. CCl_4
3. PBr_5
4. N_2O_3
5. PO_3
6. S_2Cl_2
7. Cl_2O_6
8. CO_2
9. HI
10. N_2O

B) Naming Binary Ionic Compounds (a metal + a nonmetal)

How you will name this type of compound depends on whether the metal always has the same charge or not (if there is only one charge in the bottom of the element's 'box' on the periodic table then this is the only charged ion it can form. If there is more than one charge here, then the element forms each of these charged ions, depending on the circumstances – the charge written first is the more common one).

Naming Ionic Compounds When the Metal has Only One Charge
(Type 1 Ionic compounds)

Rule: Write the name of the metal, then the name of the nonmetal, then add ide.

e.g. Na_2O = sodium oxide
AlN = aluminum nitride
MoO_3 = molybdenum oxide

Now you try:

1. ZnF_2
2. Cs_3N
3. AgCl
4. Ca_3N_2
5. Rb_2S
6. CdO
7. BaI_2
8. KBr
9. $BeAt_2$
10. Zn_3N_2

Now try this question. There are binary covalent compounds and binary ionic compounds (Type1) mixed together:

e.g. SO_3 = sulfur trioxide
K_2O = potassium oxide

1. N_2S_4
2. SrO
3. Ba_3N_2
4. PI_5
5. CaS
6. Br_2S_6
7. $ZnCl_2$
8. P_2S_3
9. Ag_3N
10. SBr_6

Naming Ionic Compounds When the Metal is Capable of Forming Different Ion Charges
(Type 2 Ionic Compounds)

Rule: Since the metal atom can form different charges, you must indicate what charge the metal ion has in this particular compound. A roman numeral is used to indicate the charge of one atom of the metal. Write the name of the metal, then the roman numeral (in brackets), then the name of the nonmetal, and add 'ide'.

e.g. FeO = iron (II) oxide

1= I, 2=II, 3=III, 4=IV, 5=V, 6=VI, 7=VII

$CuBr_2$ = copper (II) bromide

Cu_2O = copper (I) oxide

Cu_3N_2 = copper (II) nitride

Au_3N = gold (I) nitride

AuN = gold (III) nitride

You try these:

1. PbO_2
2. MnO
3. PbS
4. FeN
5. CuO
6. PdO_2
7. Cr_3N_2
8. Hg_3N
9. HgS
10. Fe_2O_3
11. MnS_2
12. CuI
13. RuN
14. Nb_2O_5
15. Pt_3N_4
16. TiN
17. Cu_2S
18. Hg_3N_2
19. PtS_2
20. Au_2O

Now this next question has binary covalent compounds and binary ionic compounds (both kinds) mixed together. A suggestion... check to see 1.) if there are two nonmetals (then use Greek prefixes). Next, check to see if, in the remaining ionic compounds, 2.) the metal always has the same charge. If so then simply write the metal and nonmetal names and add 'ide'. When you are done these the remaining ionic compounds will need 3.) roman numerals...

1. AuN
2. B_2H_4
3. $CaBr_2$
4. SF_6
5. $PbBr_2$
6. AlN
7. RbI
8. N_2O_5
9. Cu_3N
10. HgBr
11. NO
12. Zn_3N_2
13. Ag_2S
14. Ni_3N_2
15. OF_2
16. WO_3
17. PtO_2
18. ClO_2
19. SrS
20. FeO

C) Naming Using Traditional Nomenclature (i.e. polyatomic ions present)

'poly' = many
'ion' = charged particle

polyatomic ion = a **group** of atoms which have an overall charge

Rules: 1) If the cation is NH_4^+, then just write the name of this cation and the name of the anion. (cation = a positively charged ion; anion = a negatively charged ion)

e.g. NH_4Cl = ammonium chloride

$(NH_4)_3N$ = ammonium nitride

NH_4NO_3 = ammonium nitrate

$(NH_4)_3PO_4$ = ammonium phosphate

2) If the cation is not NH_4^+, then it must be a metal. If it is a metal that always has the same charge then name by writing the name of the metal and the name of the polyatomic anion.

e.g. $AlPO_4$ = aluminum phosphate

$Al_2(SO_4)_3$ = aluminum sulphate

You try:

1. $Cs_2C_2O_4$
2. $Ca(HCO_3)_2$
3. Ag_3PO_4
4. $Cd_3(PO_4)_2$
5. KSCN
6. $(NH_4)_2CO_3$
7. $Ba(CH_3COO)_2$
8. LiOH
9. $SrSO_3$
10. $Mg_3(BO_3)_2$
11. ZnS_2O_3
12. NH_4Br

Rule 3) If the metal is one whose charge varies, use roman numerals like before:

e.g. $Fe(OH)_2$ = iron (II) hydroxide

Au_2SO_4 = gold (I) sulphate

$Cu_3(PO_4)_2$ = copper (II) phosphate

$NiPO_4$ = nickel (III) phosphate

You try these:

1. $Mn(ClO_3)_2$
2. $CuNO_3$
3. $PbCrO_4$
4. $Pt(C_2O_4)_2$
5. Hg_3BO_3
6. $Bi_2(CO_3)_5$
7. $FePO_4$
8. $Fe(OH)_3$
9. $Ni(C_2H_3O_2)_2$
10. $NiBO_3$

11. $Ni_3(PO_4)_2$
12. $NbPO_4$
13. $Pb(ClO)_2$
14. $Pb(S_2O_3)_2$
15. $Cr_2(Cr_2O_7)_3$
16. $Mn(MnO_4)_4$
17. $Hg_2S_2O_3$
18. $AuClO_2$
19. Au_3PO_4
20. $Mn(C_2O_4)_2$

Now try this question. All of the types of compounds that you have learned to name are mixed up here. If you get confused, here is a suggested approach...

1. Look through for all covalent compounds (2 nonmetals) and name these first using Greek prefixes.

2. Next, find all ionic compounds in which the metal only has one charge (regardless of whether there are polyatomic or monatomic anions). Name accordingly by writing the name of the metal, then the name of the nonmetal or polyatomic anion. NH_4^+, ammonium, may be treated the same as a metal with a constant charge.

3. Now, all that remain are ionic compounds in which the metal's charge varies. Use roman numerals to indicate the charge of one atom of the metal.

1. Au_3N
2. LiH_2PO_4
3. SiF_4
4. KCH_3COO
5. NH_4Br
6. $CuCl_2$
7. B_2Cl_4
8. $Co_3(BO_3)_2$
9. SO_3
10. $Al_2(CO_3)_3$
11. $Sc_2(CO_3)_3$
12. HCH_3COO
13. P_2S
14. $Pt(CrO_4)_2$
15. $NaOH$
16. MoN_3
17. P_2S_3
18. H_2SO_4
19. $(NH_4)_2Cr_2O_7$
20. F_2S_6

21. NS_3
22. Hg_2SO_4
23. SiI_4
24. Cs_2O
25. $Pb(SO_3)_2$
26. ZnN
27. $Mn(NO_3)_2$
28. NO_2
29. $Ca(NO_2)_2$
30. $Al(OH)_3$

Writing Formulas for Compounds

A) Writing Formulas for Covalent Compounds (2 nonmetals)

Rule: The Greek prefixes tell you the number of each kind of atom.

e.g. tritellurium hexachloride = Te_3Cl_6
diphosphorus tetrasulphide = P_2S_4

You try:

1. dicarbon tetraoxide
2. carbon tetrachloride
3. oxygen hexabromide
4. sulphur trioxide
5. carbon dioxide
6. diboron tetrahydride
7. sulphur difluoride
8. diphosphorus pentaoxide
9. carbon monoxide
10. nitrogen dioxide

B) Writing Formulas for Ionic Compounds: Type 1 (metal with constant charge)

Rule: Find the charge of the metal on the periodic table. Write down the ion symbols for the metal and the nonmetal parts. Now put them together to balance the charges.

e.g.

Now try these:

1. sodium chloride
2. sodium oxide
3. cesium nitride
4. beryllium sulphide
5. zinc nitride
6. calcium fluoride
7. silver iodide
8. cadmium oxide
9. lithium nitride
10. molybdenum nitride

Now these are still Type 1 Ionic Compounds, but these have polyatomic ions:

e.g.

You try these:

1. silver phosphate
2. calcium chlorite
3. ammonium nitrate
4. ammonium borate
5. cesium oxalate
6. strontium acetate
7. zinc phosphate
8. aluminum sulphate
9. rubidium nitrite
10. magnesium thiocyanate

C) **Writing Formulas for Type II Ionic Compounds (metal with charge that varies)**

Rule: Same idea, except instead of finding the charge of the metal on the periodic table, look at the roman numeral. The roman numeral ***is the charge*** of the metal.

e.g.

Now try:

1. manganese (II) oxide
2. chromium (III) sulfide
3. cobalt (II) phosphate
4. copper (I) sulphate
5. gold (III) chromate
6. mercury (II) chlorite
7. iron (III) oxide
8. lead (II) sulphide
9. nickel (III) sulphate
10. titanium (IV) sulfite
11. chromium (II) nitride
12. gold (I) nitrate
13. mercury (I) nitrite
14. platinum (IV) dihydrogen phosphate
15. nickel (II) bicarbonate
16. lead (IV) carbonate
17. copper (II) acetate
18. ruthenium (IV) borate
19. vanadium (V) chlorite
20. titanium (III) chlorate

Now these are all mixed together:

1. cobalt (II) carbonate
2. silver permanganate
3. ammonium chloride
4. nitrogen trioxide
5. lead (IV) oxide
6. barium borate
7. cobalt (III) bromide
8. phosphorus pentabromide
9. platinum (IV) oxalate
10. calcium hydroxide
11. strontium chromate
12. chromium (II) dichromate
13. nitrogen monoxide
14. gold (III) sulfide
15. lithium oxide
16. diarsenic pentasulphide
17. molybdenum oxide
18. lead (II) nitride
19. cadmium acetate
20. dicarbon dichloride

21. silicon disulphide
22. aluminum thiocyanate
23. vanadium (V) nitride
24. diphosphorus tetraoxide
25. gold (I) phosphate
26. ammonium hydroxide
27. zinc dihydrogen phosphate
28. selenium hexaiodide
29. potassium chlorate
30. chromium (III) bicarbonate

The Grand Finale!

Directions: If the name is given, then write the formula. If the formula is given, then write the name.

1. P_2S_5
2. strontium chloride
3. oxygen hexachloride
4. cesium dichromate
5. SiF_4
6. iron (III) oxide
7. manganese (IV) iodide
8. AgI
9. NiN
10. radium phosphate
11. dicarbon tetrachloride
12. $Pd(S_2O_3)_2$
13. CdF_2
14. $Pd(CrO_4)_2$
15. copper (I) nitrate
16. $Mn(H_2PO_4)_2$
17. calcium hydroxide
18. ammonium phosphate
19. NO_2
20. Cu_2O
21. tin (IV) carbonate
22. aluminum oxide
23. Mg_3N_2
24. gold (III) nitride
25. sodium nitride
26. mercury (II) borate
27. Fe_2O_3
28. $Zn(NO_3)_2$
29. sulphur dioxide
30. $Os(HCO_3)_4$