

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

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|----------|----------|
| 1. mono | 6. hexa |
| 2. di | 7. hepta |
| 3. tri | 8. octa |
| 4. tetra | 9. nona |
| 5. penta | 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:

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|---------------------------|----------------------------|
| 1. P_2O_5 | 6. S_2Cl_2 |
| 2. CCl_4 | 7. Cl_2O_6 |
| 3. PBr_5 | 8. CO_2 |
| 4. N_2O_3 | 9. HI |
| 5. PO_3 | 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:

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

Now try this question. There are binary covalent compounds and binary ionic compounds (Type 1) mixed together:

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

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|----------------------------|----------------------------|
| 1. N_2S_4 | 6. Br_2S_6 |
| 2. SrO | 7. ZnCl_2 |
| 3. Ba_3N_2 | 8. P_2S_3 |
| 4. PI_5 | 9. Ag_3N |
| 5. CaS | 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:

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

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|----------------------------------|------------------------------------|
| 1. AuN | 11. NO |
| 2. B ₂ H ₄ | 12. Zn ₃ N ₂ |
| 3. CaBr ₂ | 13. Ag ₂ S |
| 4. SF ₆ | 14. Ni ₃ N ₂ |
| 5. PbBr ₂ | 15. OF ₂ |
| 6. AlN | 16. WO ₃ |
| 7. RbI | 17. PtO ₂ |
| 8. N ₂ O ₅ | 18. ClO ₂ |
| 9. Cu ₃ N | 19. SrS |
| 10. HgBr | 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 NH₄⁺, then just write the name of this cation and the name of the anion. (cation = a positively charged ion; anion = a negatively charged ion)

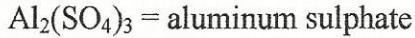
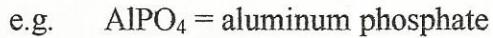
e.g. NH₄Cl = ammonium chloride

(NH₄)₃N = ammonium nitride

NH₄NO₃ = ammonium nitrate

(NH₄)₃PO₄ = ammonium phosphate

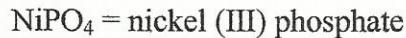
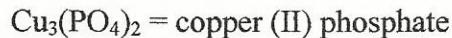
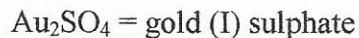
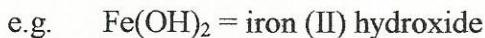
- 2) If the cation is not NH_4^+ , then it must be a metal. If it is a metal that always has the same charge then name by writing the name of the metal and the name of the polyatomic anion.



You try:

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|--------------------------------------|---|
| 1. $\text{Cs}_2\text{C}_2\text{O}_4$ | 7. $\text{Ba}(\text{CH}_3\text{COO})_2$ |
| 2. $\text{Ca}(\text{HCO}_3)_2$ | 8. LiOH |
| 3. Ag_3PO_4 | 9. SrSO_3 |
| 4. $\text{Cd}_3(\text{PO}_4)_2$ | 10. $\text{Mg}_3(\text{BO}_3)_2$ |
| 5. KSCN | 11. ZnS_2O_3 |
| 6. $(\text{NH}_4)_2\text{CO}_3$ | 12. NH_4Br |

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



You try these:

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| 1. $\text{Mn}(\text{ClO}_3)_2$ | 6. $\text{Bi}_2(\text{CO}_3)_5$ |
| 2. CuNO_3 | 7. FePO_4 |
| 3. PbCrO_4 | 8. Fe(OH)_3 |
| 4. $\text{Pt}(\text{C}_2\text{O}_4)_2$ | 9. $\text{Ni}(\text{C}_2\text{H}_3\text{O}_2)_2$ |
| 5. Hg_3BO_3 | 10. NiBO_3 |

- | | |
|--|---|
| 11. $\text{Ni}_3(\text{PO}_4)_2$ | 16. $\text{Mn}(\text{MnO}_4)_4$ |
| 12. NbPO_4 | 17. $\text{Hg}_2\text{S}_2\text{O}_3$ |
| 13. $\text{Pb}(\text{ClO})_2$ | 18. AuClO_2 |
| 14. $\text{Pb}(\text{S}_2\text{O}_3)_2$ | 19. Au_3PO_4 |
| 15. $\text{Cr}_2(\text{Cr}_2\text{O}_7)_3$ | 20. $\text{Mn}(\text{C}_2\text{O}_4)_2$ |

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.

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| 1. Au_3N | 11. $\text{Sc}_2(\text{CO}_3)_3$ |
| 2. LiH_2PO_4 | 12. HCH_3COO |
| 3. SiF_4 | 13. P_2S |
| 4. KCH_3COO | 14. $\text{Pt}(\text{CrO}_4)_2$ |
| 5. NH_4Br | 15. NaOH |
| 6. CuCl_2 | 16. MoN_3 |
| 7. B_2Cl_4 | 17. P_2S_3 |
| 8. $\text{Co}_3(\text{BO}_3)_2$ | 18. H_2SO_4 |
| 9. SO_3 | 19. $(\text{NH}_4)_2\text{Cr}_2\text{O}_7$ |
| 10. $\text{Al}_2(\text{CO}_3)_3$ | 20. F_2S_6 |

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|--------------------------------|--------------------------------|
| 21. NS_3 | 26. ZnN |
| 22. Hg_2SO_4 | 27. $\text{Mn}(\text{NO}_3)_2$ |
| 23. SiI_4 | 28. NO_2 |
| 24. Cs_2O | 29. $\text{Ca}(\text{NO}_2)_2$ |
| 25. $\text{Pb}(\text{SO}_3)_2$ | 30. $\text{Al}(\text{OH})_3$ |

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:

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|-------------------------|----------------------------|
| 1. dicarbon tetraoxide | 6. diboron tetrahydride |
| 2. carbon tetrachloride | 7. sulphur difluoride |
| 3. oxygen hexabromide | 8. diphosphorus pentaoxide |
| 4. sulphur trioxide | 9. carbon monoxide |
| 5. carbon dioxide | 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 *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 | 26. ammonium hydroxide |
| 22. aluminum thiocyanate | 27. zinc dihydrogen phosphate |
| 23. vanadium (V) nitride | 28. selenium hexaiodide |
| 24. diphosphorus tetraoxide | 29. potassium chlorate |
| 25. gold (I) phosphate | 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.

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|---|--|
| 1. P_2S_5 | 16. $\text{Mn}(\text{H}_2\text{PO}_4)_2$ |
| 2. strontium chloride | 17. calcium hydroxide |
| 3. oxygen hexachloride | 18. ammonium phosphate |
| 4. cesium dichromate | 19. NO_2 |
| 5. SiF_4 | 20. Cu_2O |
| 6. iron (III) oxide | 21. tin (IV) carbonate |
| 7. manganese (IV) iodide | 22. aluminum oxide |
| 8. AgI | 23. Mg_3N_2 |
| 9. NiN | 24. gold (III) nitride |
| 10. radium phosphate | 25. sodium nitride |
| 11. dicarbon tetrachloride | 26. mercury (II) borate |
| 12. $\text{Pd}(\text{S}_2\text{O}_3)_2$ | 27. Fe_2O_3 |
| 13. CdF_2 | 28. $\text{Zn}(\text{NO}_3)_2$ |
| 14. $\text{Pd}(\text{CrO}_4)_2$ | 29. sulphur dioxide |
| 15. copper (I) nitrate | 30. $\text{Os}(\text{HCO}_3)_4$ |